OASIS Security Requirements

Developed by: OASIS Standards Collaborative (OSC)

Version 1.0

INTENTIONALLY
BLANK

Table of Contents

1 Introduction

1.1 Scope

This document describes the security requirements for OASIS Phase 2, Electronic Tagging, and for any other industry systems that require strong security and authentication.

1.2 Overview

No formal method of securing communications among OASIS nodes, E-Tag nodes, or authenticating market participants has been available. The general consensus among OASIS administrators, market participants, and E-Tag participants is that if these systems were to be compromised, it would have a significant impact of system reliability and energy markets. The following security services were identified as the most critical:

1. Privacy: Messages are private among communicating parties.
2. Authentication: Determining whom you are communicating with.
3. Message Integrity: Ensuring that messages are not tampered with during transit.

Since both OASIS and E-Tag use HTTP 1.0/1.1, a technology capable of securing HTTP or the message content is necessary. Additionally, the technology chosen must be easily implemented and cost effective while still achieving the stated objectives (see section 2). The following security architecture is believed to meet these requirements and objectives:

1. Secure Sockets Layer, version 3.0.
2. Mutual Authentication (both Client and Server must have certificates and be authenticated)
3. 1024 bit X.509V3 certificates from approved commercial Certificate Authorities capable of supporting 128-bit SSLv3.0 encryption.

Additional details will be provided in the remainder of this document. **If unfamiliar with cryptographic concept or SSL, it is highly recommended that section 4 be reviewed first.**

1.3 Notation Convention

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC-2119.

A “CLIENT” shall be considered to be any system that initiates an SSL or HTTP connection/session. A “SERVER” shall be considered to be any system that accepts an SSL or HTTP connection/session and/or processes E-Tag methods.

2 Requirements

The requirements for OASIS security expand on the SSL/TLS security options provided under SMXP1.0, section 7.0. Review the SMXP1.0 specification for additional information regarding SSLv3.0 as it applies to the SMXP1.0.

2.1 SSLv3.0

ETag1.7 nodes (clients and servers) must use SSLv3.0 on IP port 443. Both client and server authentication (mutual) must be enabled. TLS1.0 may optionally be supported but must not be required by servers or clients.

2.1.1 Encryption

Secure Sockets Layer employs symmetric cryptography for the bulk encryption of session messages sent between the client and server. The session key for the bulk encryption of data shall be 128-bits long and the X.509v3 certificate used by a server must be capable of supporting a 128-bit key exchange. Conversely, the SSLv3.0 implementations (i.e., toolkits, operating system and libraries) utilized by both the client and server must be capable of supporting 128-bit encryption.

2.1.2 Performance

Depending on the cryptographic protocols being used and SSL parameters chosen, SSL connections can be anywhere between 2 and 100 times slower than ordinary TCP connections. To minimize the impact this may have on systems, there are several basic SSL performance rules that should be observed by clients and servers:

Asymetric Algorithm of choice: RSA

Symmetric Algorithm of choice: RC4 (128-bit). 3DES is more secure but has a significant performance penalty associated with it.

Digest Algorithm of choice: SHA-1. MD5 is slightly faster, but SHA-1 is more secure and MD5 is being phased out.

Session Resumption: Clients should always attempt to use session resumption. Servers should allow it if clients tend to reconnect within 5 to 10 minutes.

Record Size: Send data in the largest chunks possible.

Not all SSL/TLS toolkits and implementations may allow direct control over cryptographic settings and operating parameters. However, to the extent a client or server does have control over these operating parameters they should be set accordingly. The use of hardware or inline SSL accelerators may also be used to improve performance (see section 3.3). **See section 4 for more information on cryptography and SSL.**

2.1.3 Non-repudiation

SSL and TLS are not able to provide non-repudiation of data. While SSL/TLS ensures that communicating parties are certain of who they are talking to and provides for the highly secure and tamper proof transfer of data, the data itself is not signed with either of the communicating parties private keys. Consequently, outside of an SSL/TLS session, the data cannot stand-alone as non-repudiatable. Sufficient logging and vigilance on the part of both sender and receiver are necessary to adequately defend against possible claims repudiating data.

2.2 Certificates

Standard 1024-bit X.509v3 certificates (RFC 2459) shall be used by clients and servers.

2.2.1 Server Certificates

A server's certificate subject (i.e., distinguished name) shall have:

1. The "CN" field (Common Name) set to the fully qualified host name of the server.
2. The "OU" field (Organizational Unit) of the certificate's subject shall be set to the NERC registered code of the PSE/CA/TP associated with the server or that of a service provider acting on behalf of the PSE/CA/TP.
3. The "O" field (Organization) of the certificate's subject shall be the legal name of the entity represented by the NERC code located in the certificate's "OU" field.

The "CN", "OU" and "O" fields MUST be consistent with the NERC registry.

2.2.2 Client Certificates

A client certificate must be associated with a NERC registered PSE/CA/TP via the certificate's subject "OU" and "O" fields. The "CN" field of the certificate may either be the fully qualified host name of the client system communicating with the server or the name of an employee/individual authorized as a business representative by the NERC registered PSE/CA/TP.

2.2.3 Certificate Authorities

Client and server certificates may be acquired from any NERC approved Certificate Authority (see section 4.6 for description). The currently approved Certificate Authorities include [note: bogus list – need to evaluate several CA's yet]:

Certificate Authority	Product Name	Client	Server
ABC Certificates	ABC	Yes	No
Certificates "R" Us	DEF	Yes	No

Certificates “R” Us	GHI	No	Yes
Secure IT	JKL	No	Yes

2.3 Client Authentication

Servers must authenticate a client using the clients X.509v3 certificate. When establishing an SSLv3.0 session, the server shall request the clients certificate by issuing an SSLv3.0 `CertificateRequest` message to the client, per the SSLv3.0 specification (see Appendix B). In the event that a client attempts to establish a non-secure (i.e., port 80) HTTP session with the server (accept for “server.htm” file – section 2.6), the server must respond with an HTTP 403.4 error indicating that SSL is required.

The server must also perform the following certificate validation:

1. The certificate provided by the client must have had its subject and issuing Certificate Authority registered in the NERC Registry as detailed in section 2.8
2. In the event the client’s certificate subject “CN” field is an IP address or host name, the server must verify that the client has initiated communications from the specified IP address or host.
3. The server must validate all certificates it receives by verifying the Certificate Authorities signature within them.
4. The server must check the validity period for all certificate, including the “not before” and “not after” times.

If any of these checks fail, the client shall not be permitted access and the server must return an HTTP 403 Forbidden.

The server shall also make a reasonable effort to check the current revocation status of any certificates before accepting them. This may be accomplished using a published Certificate Revocation List (CRL) and/or the Online Certificate Status Protocol (OCSP), provided by the Certificate Authority that signed the client certificate. If the certificate is determined to be revoked, suspended, or invalid, the server must cease communications with the client and return an HTTP 403 Forbidden. If a valid CRL cannot be obtained or an OCSP server contacted for more than 36 hours, the server must also cease communications with the client and return an HTTP 403 Forbidden, unless officially directed otherwise by NERC.

Until the authentication failure is resolved, If the client attempts to continue to establish SSLv3.0 sessions, the server shall block the client from attempting further connections and notify NERC and the associated Security Officer (SO) of the PSE/CA/TP, via the phone number(s) or e-mail address contained in the NERC registry (see section 2.8).

2.4 Server Authentication

Clients shall only attempt to establish SSLv3.0 sessions and exchange production data with servers identified in the NERC Registry (see section 2.8). Clients may establish SSLv3.0 sessions for testing purposes with other servers provided that only non-sensitive data is exchanged and the intent is made clear. The client must also perform the following certificate validation:

1. The host that communications has been established with must match the IP address or host name identified in the "CN" field of the certificate's subject.
2. The client must validate Certificate Authorities signature within the server's certificate.
3. The client must check the validity period of the server's certificate, including the "not before" and "not after" times.

Failing any of these checks, the client must cease communications and notify NERC.

The client shall also make a reasonable effort to check the current revocation status of the server's certificate. This may be accomplished using a published Certificate Revocation List (CRL) and/or the Online Certificate Status Protocol (OCSP), provided by the Certificate Authority that signed the client certificate. If the certificate is determined to be revoked, suspended or invalid, the client must cease communications. If a valid CRL cannot be obtained or an OCSP server contacted for more than 36 hours, the client must also cease communications with the server, unless officially directed otherwise by NERC.

2.5 Authorization

Assuming a client has been authenticated as described in section 2.3, the server shall authorize the client to perform only those operations allowed by the type of entity (PSE/CA/TP) they have been authenticated as and the security categories that the Security Officer (SO) has authorized the certificate to perform (see section 2.8). The type of client shall be determined by cross-referencing the client's certificate subject with the NERC Registry. See the appropriate application specification (OASIS, E-Tag, etc.) for further information.

It is still reasonable and acceptable, depending on the application and environment, that the client's company may not be recognized as a customer or valid entity by an organization. If so, the client may not be authorized to perform certain functions. Which companies and organizations a market participant chooses to recognize as a customer is under their control and discretion.

2.6 Firewalls, IP Security, and Server.htm

All Servers shall be placed behind a firewall. The firewall shall allow clients to access the server on port 443, the standard SSLv3.0 port. Client access to the server on IP ports other than 443 shall be restricted, except for a single HTML file on port 80. This HTML file shall be located at the root of the server and have a file name of "server.htm." This file shall allow anonymous access and contain the following information:

1. Server's host name
2. One or more administrative contacts including a 24 hour administrative contact (phone, fax, e-mail, pager)
3. Date/Time of the NERC Registry currently loaded.

Any unsecured links from "server.htm" shall only reference other sections of the file (server.htm) or files/resources on other servers. If images (gif and/or jpg) are included in this file, they should be served from a different server. Other html files and resources may be served from the server, and consequently reference in the "server.htm" file, as long as they are accessed via IP port 443 using SSLv3.0 and the client is authenticated using their certificate.

Since the firewall shall allow only IP ports 443 and 80, ICMP messages shall not be supported inbound, such as ping and trace-route. Outbound ICMP messages may still be performed. The html file located at "http://hostname:80/server.htm" , where "hostname" is the host name of the server in the NERC Registry, may be used to verify connectivity. As a substitute for ping, an HTTP TRACE on port 80 may also be performed to verify connectivity. Attempts to access the server on ports other than 443 and 80 shall be logged and include the date/time and IP address of the system attempting access. Firewall logs shall be kept for a minimum of 30 days after which they may be purged.

2.7 Logging

In addition to logs generated by the Firewall, the server shall log the following information for all messages/requests exchanged between the client and server (server may log additional information at its discretion):

1. Date and time to the millisecond that the server received the message/request.
2. Client's certificate full subject.
3. IP address of the client.
4. Success/Failure of the operation (http status codes)
5. Target URL of the client's message/request.
6. Content of the client's message/request for any action that involves the creation of modification of data on the server. This is not necessary for query only operations.

This data must be maintained for a minimum of three (3) months and available upon request by NERC.

2.8 NERC Registry and Access Control

Each valid and NERC authenticated market participant (PSE/CA/TP/Vendor) must establish a primary and backup Security Office (SO). Each SO must provide one or more phone numbers, one of which must be reachable 24x7, and at least one e-mail address. The SO shall be responsible for all modifications to data contained in the NERC registry for their company, including which client certificates and servers are authorized to perform specific market functions.

2.8.1 Physical, Procedural, and Personnel Security Controls

Given the critical nature of the registry and access control information that it contains, NERC must ensure a high degree of physical, procedural, and personnel security controls are in place for all systems and individuals involved in the maintenance and operations of the registry. In order for the industry to trust and rely the validity and accuracy of the registry, these types of control are necessary.

It is expected that NERC or a separate Registry Task Force will formalize and finalize the requirements and implementation details of the registry and that it will comply with the general set of requirements defined in this document.

2.8.1.1 Physical

NERC shall implement appropriate physical security controls to restrict access to the hardware and software (including servers, workstations, databases and any external cryptographic hardware modules, certificates, and tokens) used in conjunctions with the registry and access control information. Access to such hardware and software shall be limited to those personnel performing in a Trusted Role as described in Section 2.8.1.2.

2.8.1.2 Procedural and Personnel

NERC must ensure the following procedural and personnel controls are implemented and followed:

1. A separation of duties for critical registry functions to prevent one person from maliciously using the system without detection
2. Reasonable procedures and practices are in place to ensure that one person acting alone cannot circumvent safeguards.
3. All personnel involved in the maintenance or operation of the registry have their identity verified.
4. When accessing the system across a shared network, communications must be secured and authenticated.

5. Formulate and follow personnel and management policies sufficient to provide reasonable assurance of the trustworthiness and competence of their employees and of the satisfactory performance of their duties.

These procedure and personnel controls shall apply to NERC employees and all contractors and subcontracts that may be involved in the maintenance or operation of the registry.

2.8.2 Access Control Modifications

Requests by a Security Officer (SO) to modify the registry shall ONLY be communicated to NERC by an authorized SO via out-of-band methods or by submittal of an authenticated message (secure e-mail or SSL). Acceptable out-of-band methods include:

1. Phone. NERC must call the SO back at their registered phone number and challenge the SO with a previously established pass-phrase.
2. In person. SO must provide two authenticating credentials such as a valid drivers license and a company ID.

2.8.3 Access Control List

The registry shall contain the following security categories for each market participant:

1. **Tag:** Produce, process, or approve tags.
2. **Schedule:** Produce, process, or approve schedules for energy or transmission.
3. **Transmission**: Reserve Transmission Capacity and participate in secondary markets.
4. **Energy**: Participation in other energy markets.
5. **Admin**: Administer other non-security and access control related attributes within the NERC Registry, such as POR/POD registrations and the like.
6. **Other:** As required or defined by NERC

In addition to other data currently required in the NERC Registry, all market participants and nodes, via their Security Officer, must register with NERC the following information:

1. For each server function being performed in the security categories above, one or more fully qualified server host names and the CA providing the server's certificate. If a service provider is being used, it must also be identified.
2. One or more client certificate subjects, their associated Certificate Authorities, and for which security categories they are authorized for (Tag,

Schedule, Transmission, etc.). This is only appropriate or necessary when acting as a client. The certificate subject's "OU" and "O" fields must also match those of the market participant.

For any single certificate, the Security Officer (SO) must also be able to globally perform the following functions:

1. Enable and disable it across all security categories and roles - as in the case when an employee is transferred, takes vacation, leaves the organization, or a certificate has been compromised - by setting an EXECUTE attribute to either "Y" or "N".
2. Provide an effective period during which the certificate may be used by supplying an effective from and to date.

Both a client certificate and a server may be associated with more than one security category or server function. In the case of a service provider, it is acceptable for the same server to provide services for more than one PSE/CA/TP or market participant. In this case, the same fully qualified host name and the CA providing the server's certificate will be provided by each PSE/CA/TP and the server may utilize the same server certificate.

In combination with the type of market participant the company or organization happens to be (TP, CA, PSE, etc.), which is also contained in the registry, certain functions and roles may be unavailable.

2.8.4 Publication

NERC shall publish the full registry as a coordinated set of three files:

1. The registry itself - preferably formatted as an XML document.
2. An SHA-1/RSA digital signature (see section 4) of the registry, signed using a valid client certificate obtained by NERC from one of the approved Certificate Authorities.
3. The NERC certificate used to create the SHA-1/RSA digital signature.

The registry, signature, and signing certificate shall be published in an SSL secured HTTP or LDAP server. Before relying on the registry obtained from NERC, both clients and servers must verify the signature on the signed registry file and the validity of the certificate used to sign the registry. In the case of an SSL secured LDAP or HTTP server, the same checks as described in section 2.4 shall be used.

In the event the signature on the file or the certificate is found to be invalid or the authentication check of the LDAP or HTTP server fails, NERC shall be notified immediately and the last known valid registry shall continue to be used.

3 Appendix A: Resources

3.1 Specifications and RFC

Secure Sockets Layer (version 3.0)	http://www.netscape.com/eng/ssl3/
Transport Layer Security (RFC 2246)	http://www.ietf.org/rfc/rfc2246.txt
Key words use (RFC 2119)	http://www.ietf.org/rfc/rfc2119.txt
X.509v3 Certificate and CRL Profile (RFC 2459)	http://www.ietf.org/rfc/rfc2459.txt

3.2 SSL/TLS Toolkits

COMPANY	DESCRIPTION	URL
RSA Security	SSL/TLS/PKI toolkits - Java and C++	http://www.rsasecurity.com/products/bsafe/index.html
Baltimore	SSL/TLS/PKI toolkits - Java and C++	http://keytools.baltimore.com/ssl/index. html
DART	SSL/TLS toolkit – ActiveX/COM	http://www.dart.com/powertcp/
PHAOS Technology	SSL/TLS toolkit – Java	http://www.phaos.com/e_security/prod_ssl.html
Sun Microsystems	SSL/TLS toolkit – Java	http://java.sun.com/products/jsse/
OpenSSL	Open Source SSL/TLS toolkit – C++	http://www.openssl.org/
PureTLS	Open Source SSL/TLS toolkit – Java	http://www.rtfm.com/puretls/
Certicom	SSL/TLS tookit – Java and C	http://www.certicom.com/
IBM	PKIX Reference Implementatio n	http://www-3.ibm.com/security/library/wp_pkix.shtml
Mozilla.org	Cryptographic libraries	http://www.mozilla.org/projects/security/pki/psm/

3.3 Hardware and Inline Accelerators

COMPANY	DESCRIPTION	URL
Rainbow	CryptoSwift: PCI and Inline Accelerators	http://www.rainbow.com/
nCipher	nFast: PCI Accelerator	http://www.ncipher.com/

Intel	NetStructure: Inline Accelerator	http://www.intel.com/netstructure/ecommerce_equipment.htm
F5	E-Commerce Controller: Inline Accelerator	http://www.f5.com/

3.4 General Links and Books

LINKS	
PKI related links and resources	http://www.pki-page.org/
Encryption and Security-related Resources	http://www.cs.auckland.ac.nz/~pgut001/links.html
Introduction to SSL	http://developer.netscape.com/docs/manuals/security/sslin/contents.htm
PKI Forum	http://www.pkiforum.org/
PKI Guru	http://www.pkiguru.com/

BOOKS		
Title	Author	ISBN
SSL and TLS Essentials	Stephen Thomas	0-471-38354-6
SSL and TLS, Designing and Building Secure Systems	Eric Rescorla	0-201-61598-3
Internet Cryptography	Richard E. Smith	0-201-92480-3
Digital Certificates, Applied Internet Security	Jalal Feghhi, Jalil Feghhi, Peter Williams	0-201-30980-7

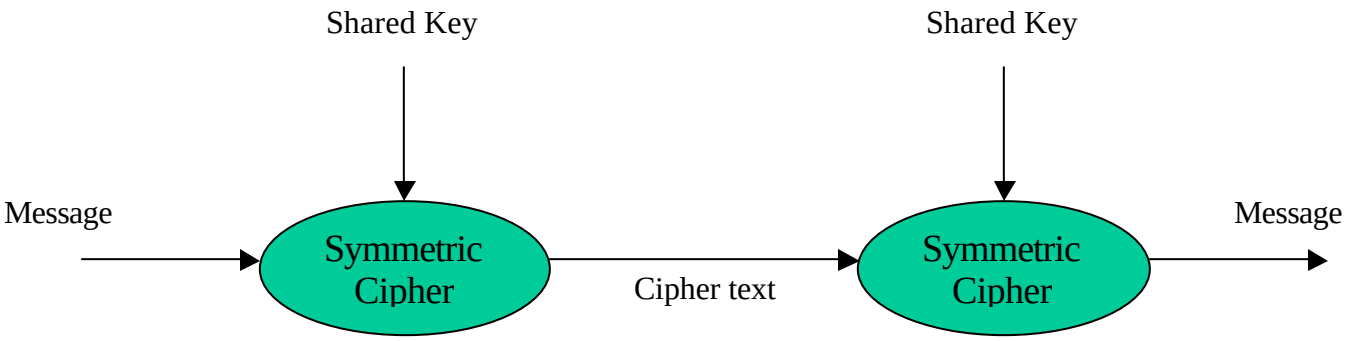
4 Appendix B: Cryptography and SSLv3.0 Overview

The books referenced in section 3 provide a complete description of public key infrastructures and the implementation of SSL and TLS. Below is a quick overview of how cryptographic algorithms, X.509v3 certificates and SSL/TLS work together.

4.1 Cryptographic Algorithms

4.1.1 Symetric Encryption

Secret Key Cryptography is commonly referred to as "**symmetric encryption.**" When utilizing symmetric cipher, both sender and receiver have the "shared key" and it is used for both encryption and decryption.



Common symmetric key ciphers:

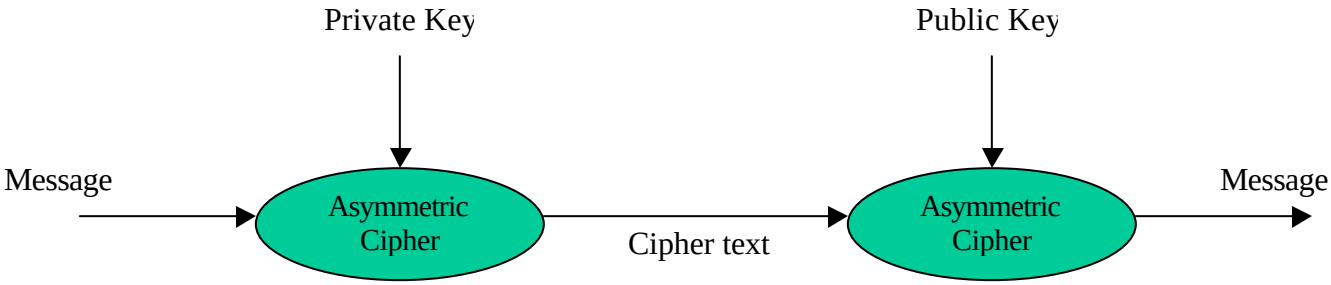
•**DES**: Data Encryption Standard (56 bit block cipher)
•**3DES**: Triple-Strengths Data Encryption Standard (112 bit block cipher)
•**RC2**: Rivest Cipher 2 (variable key length block cipher)
•**RC4**: Rivest Cipher 4 (variable key length stream cipher)

Note1: **RC4** is extremely fast; a Pentium II/400 can achieve speeds on the order of 45 MB/s. **RC2** and **3DES**, however, are many times slower.

Note2: The US National Institute of Standards and Technology (NIST) has selected the Advanced Encryption Standard (AES) to replace DES as the US government's standard encryption algorithm.

4.1.2 Asymetric Encryption

Public Key Cryptography is commonly referred to as "**asymmetric cryptography**." The two primary uses of public key cryptography are **key establishment** (section 4.4) and **digital signatures** (section 4.3). When utilizing an asymmetric cipher, messages are encrypted by one of the key pairs and decrypted with the other.



In the example above, the private key is closely guarded by the sender and never shared. The receiver only knows the public key that corresponds to the private key used to encrypt the message. Alternatively, a message may be encrypted using a public key and may then only be decrypted by the private key.

Common Asymmetric key ciphers/algorithms:

- **DSA/DSS**: Digital Signature Algorithm (type: Digital Signature)
- **El Gamal**: (type: Digital Signature)
- **RSA**: Rivest, Shamir, Adleman (type: Signature, encryptions, key exchange)
- **Diffie-Hellman**: (type: Key exchange)

4.2 Hashing and Digesting

A **Message-digest algorithm** take a variable-length message as input and produces a fixed-length digest as output. The fixed length output is called the "**message-digest**", "the **digest**" or a "**hash**." The algorithms are also referred to as a "**one-way hash algorithm**" or simply a "**hash algorithm**." A message digest algorithm must satisfy four properties:

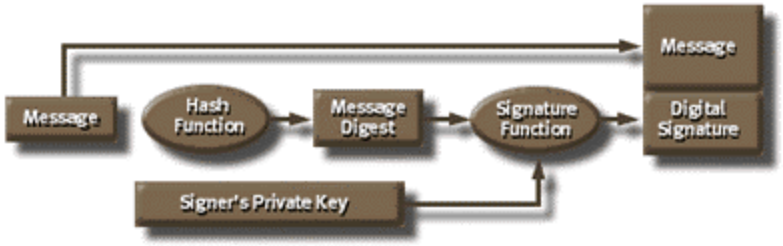
1. In must not be feasible to determine the input message based on its digest.
2. In must not be possible to find an arbitrary message that has a particular, desired digest.
3. Should be computationally infeasible to find two messages that have the same digest.
4. Mappings from a message to a digest should appear random and flipping even one bit of the message results in an entirely new and uncorrelated digest.

Message-Digest Algorithm	Digest Length (bits)
MD2	128
MD4	128
MD5	128
SHA	160
SHA-1	160

Note: MD5 and SHA-1 are newer algorithms and generally used by SSL and TLS. MD5 has an approximate 2 to 1 speed advantage over SHA-1, but MD5 is slowly being phased out.

4.3 Digital Signatures

In order to sign a message, the message originator creates a message digest and signs (encrypts) the digest with their private key. The original message and the signed hash are then sent to the recipient(s).



Recipient(s) uses the same hash function on the message as the signer. Recipient(s) then uses the signer's public key to decrypt the message digest the originator signed. If the message digests are identical, the signature will verify and one can safely assume the message came from the signer and has not been altered or counterfeited.

Note: Currently **RSA** and **DSS** are commonly used to create digital signatures. DSS was invented by the NSA (FIPS-186) and uses the SHA-1 digest algorithm. RSA, however, may use any digest, such as MD5.

4.4 Key Establishment

Two types of key establishment exist, *key exchange (*also known as a *key transport)* and *key agreement*. In the case of key exchange, one side generates a symmetric key, encrypts it using a public key of the other side, and then sends it to the other side. In *key agreement*, both sides cooperate to generate a shared key.

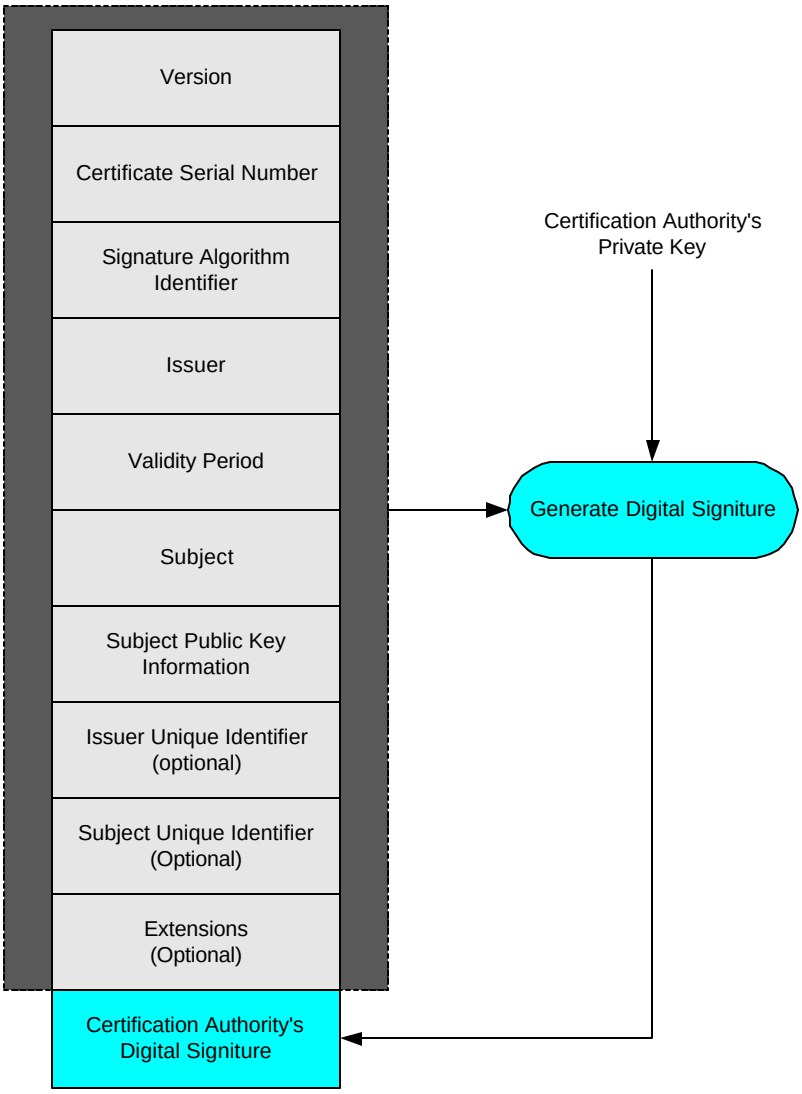
Cryptographic Algorithms supporting Key Establishment:

- **RSA**: (Rivest, Shamir, Adelman) Supports *key exchange*.
- **DH**: (Diffie-Hellman) Supports *key agreement*.

4.5 Digital Certificates

Certificates are electronic documents that correlate (called binding) a public key with a specific entity. Commonly this entity is a person but may be a computer, software, document, etc. Certificates may be used to authenticate persons in a SSL session, to encrypt messages or digitally sign messages. Digital Certificates contain, among other things, the following information:

- **Version:** Contains the version number of the encoded certificate (currently 1, 2, or 3).
- **Serial Number:** A unique number assigned by the CA
- **Signature Algorithm:** Algorithm used by the CA to digitally sign the certificate (RSA or DSA)
- **Issuer Name:** The CA who has signed the certificate
- **Validity Period:** Time interval during which the certificate is valid.
- **Subject Name:** This is the identity of the entity whose public key is certified in the public key. Sometime called a Distinguished Name (DN).
- **Subject Public Key Information:** Contains public key and parameters.
- **Issuer unique identifier:** Optional field to allow the reuse of issuer names over time.
- **Subject unique identifier:** Optional field to allow the reuse of the subject name over time.
- **Extensions:** Way to associate additional information for subjects, public keys, etc.



X.509 v3 Certificate Format

By signing a certificate, a Certificate Authority if acting as a trusted third-party and certifying that the contents of the certificate are verifiably correct.

4.6 Certificate Authorities (CA)

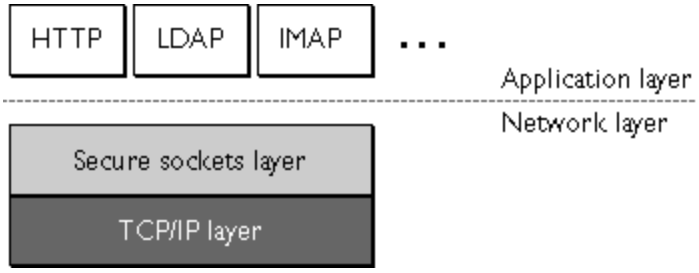
Typically a CA verifies the credentials of entities seeking certificates, issue them, and then make these certificates available in some common database (usually a directory.) CAs must be trusted in order for their certificates to be meaningful. A very large PKI may also include an RA, or Registration Authority, or even a LRA or Local Registration Authority that does actual physical verification.

A CRL is a Certificate Revocation List. CRLs are regularly created, signed, and published by CAs in order to list certificates that have been compromised or revoked prior to the certificates expiration date. A CA may also provide a server

or system that may be queried using the Online Certificate Status Protocol (OCSP). This type of service provides for real-time certificate status checking. Most CRLs are published only once or twice a day.

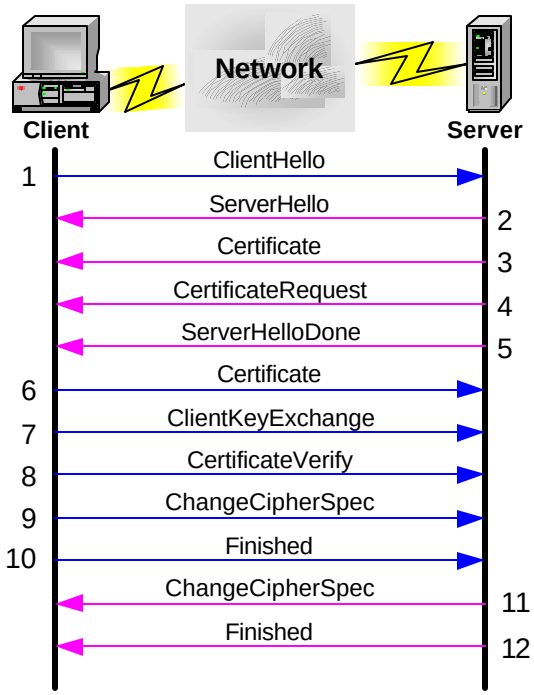
4.7 Secure Sockets Layer (SSL/TLS)

SSLv3 (version 3) is functionally a security protocol that fits between the application layer and TCP. As such, it can secure many different application layer protocols such as HTTP, FTP, Telnet, etc.



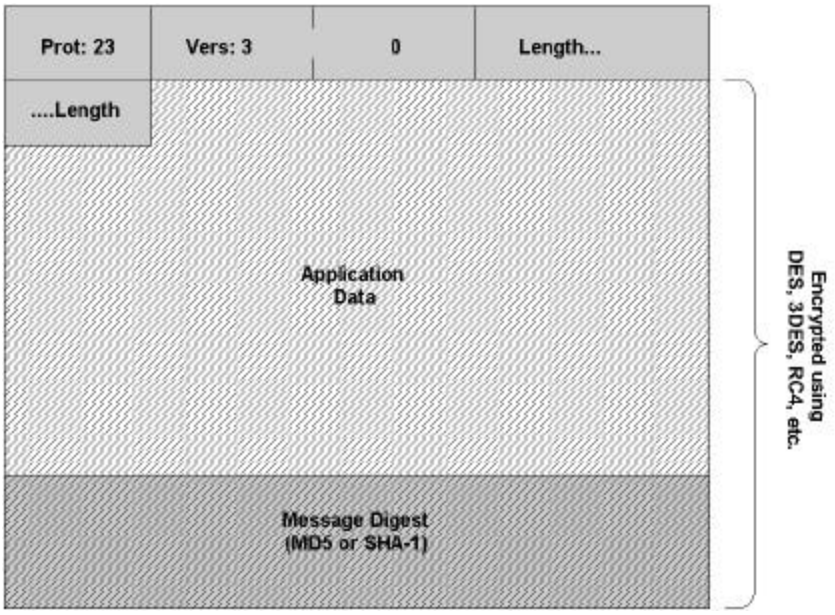
Originally developed by Netscape, the protocol was eventually turned over to the Internet Engineering Task Force (IETF). In January 1999, the Transport Layer Security (TLS) protocol was published by the IETF (RFC 2246). The Transport Layer Security protocol (TLS) is the successor to SSLv3. It should be considered the next version of SSL and is currently at version 1.0. Inside the TLS/SSL hello message, an SSLv3 session is identified as version 3.0 and a TLS session is identified as version 3.1.

In SSL and TLS, there is always a “client” role and a “server” role. The message protocol when both client and server authentication are enforced is as follows:



- **Step 1**: Client sends **ClientHello** message proposing SSL options such as version and cipher algorithms supported.
- **Step 2**: Server responds with a **ServerHello** message selecting the SSL options to use.
- **Step 3**: Server sends its public key certificate in the **Certificate** Message
- **Step 4**: Server sends a **CertificateRequest** message to indicate that it wants to authenticate the client.
- **Step 5**: Server concludes its part of the negotiation with a **ServerHelloDone** message.
- **Step 6**: Client sends its public key certificate in a **Certificate** message.
- **Step 7**: Client sends session key information (encrypted with the servers public key) in a **ClientKeyExchange** message.
- **Step 8**: Client sends **CertificateVerify** message, which signs important information about the session using the client's private key; the server uses the public key from the client's certificate to verify the client's identity.
- **Step 9**: Client sends a **ChangeCipherSpec** message to activate the negotiated options for all future message it (the client) will send.
- **Step 10**: Client sends a **Finished** message to let the server check the newly activated options.
- **Step 11**: Server sends a **ChangeCipherSpec** message to activate the negotiated options for all future messages it (the server) will send.
- **Step 12**: Server sends a **Finished** message to let the client check the newly activated options.
- SSL is now ready for the application to use as an authenticated, high integrity, secure and private communications channel.

An SSL message:



Certificate Policy

for

Energy Market Access and Reliability Certificates

(e-MARC)

Version 2.0
Accepting changes per PKISC Meeting
(30 July 2003)

North American Electric Regulatory Council
(NERC)

August 2003

TABLE OF CONTENTS

SECTION **PAGE**

SECTION 1

INTRODUCTION

1.1 OVERVIEW

In support of deregulated energy markets and system reliability functions, many computer-based systems, applications, and market participants have a significant requirement for the secure operations of these networked computer-based systems, electronic messages, and transactions. One mechanism to fulfill that requirement uses digital certificates to ensure availability of the following security services:

- Confidentiality: The assurance to an entity that no one can read a particular piece of data except the receiver(s) explicitly intended
- Authentication: The assurance to one entity that another entity is who he/she/it claims to be
- Integrity: The assurance to an entity that data has not been altered (intentionally or unintentionally) between "there" and "here," or between "then" and "now"
- Non-Repudiation: A party cannot deny having engaged in the transaction or having sent the electronic message

This mechanism requires the use of public key cryptography which uses public key certificates to bind a person's or computer system's public key to his/her/its identity and to support symmetric encryption key exchange. In support of this goal, the North America Electric Reliability Council (NERC) will provide for commercial public key certificate services to United States (U.S.) deregulated energy markets and the associated system reliability functions (referred to as "Energy Market Access and Reliability Certificates" or "e-MARC"). NERC will provide this mechanism by certifying Registry Domains, Registry Administrations, and service provider(s) to furnish the services presented in this Policy.

The e-MARC security services will meet the following requirements for supporting Public Key Infrastructure (PKI) activities:

- Subscriber identification and authentication verification
- Control of computer and cryptographic systems
- Operation of computer and cryptographic systems
- Use of keys and public- key certificates by subscribers and relying parties
- Definition of rules to limit liability and provide a high degree of certainty that the stipulations of this Policy are being met

The reliability of the public-key cryptography portion of the security mechanism is a direct result of the secure and trustworthy operations of an established PKI, including equipment, facilities, personnel, and procedures.

This Policy describes (1) roles, responsibilities, and relationships among the Registry Domains, Registry Administrators, Certification Authorities (CAs), Registration Authorities (RAs), Certificate Manufacturing Authorities (CMAs), Repositories, Subscribers, Qualified Relying Parties, and Policy Authority (referred to collectively as "Program Participants") authorized to participate in the public key infrastructure described by this Policy; (2) the primary obligations and operational responsibilities of the Program Participants; and (3) the rules and requirements for the issuance, acquisition, management, and use of an e-MARCs.

The Policy also provides a high level description of the policies and operation of the e-MARC Program and follows the *X.509 Public Key Infrastructure Certificate Policy and Certificate Practices Framework* as detailed in Request for Comment (RFC) 2527 of the Internet Engineering Task Force (IETF). Specific detailed implementations of this Policy appear in the Certificate Practice Statement (CPS) of any CA certified to issue certificates bound by this Policy.

The key words "must", "must not", "required", "shall", "shall not", "should", "should not", "recommended", "may", and "optional" in this document should be interpreted as described in RFC 2119. This interpretation is shown below.

- Must: This word, or the terms "required" or "shall", means that the definition is an absolute requirement of the specification.

- Must Not: This phrase, or the words "shall not", means that the definition is an absolute prohibition of the specification.

- Should: This word, or the word" recommended", means that there may exist valid reasons in particular circumstances to ignore a specific item, but the full implications must be understood and carefully weighed before choosing a different course.

- Should Not: This phrase, or the words "not recommended" means that there may exist valid reasons in particular circumstances when the specific behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.

- May: This word, or the word "optional", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation that does not include a particular option must be prepared to interoperate with another implementation which include the options, although with reduced functionality. Similarly,

an implementation that includes a particular option must be able to interoperate with another implementation which does not include the option (except for the feature that the option provides.)

1.2 CERTIFICATE POLICY IDENTIFICATION

This Policy is registered with the _____ and all object identifiers (OIDs) are registered under the _____- OID:

e-MARC OID:_____
The following OIDs for the e-MARCs defined in this Policy have been defined:

- **Unaffiliated Individual e-MARCs: { _____ }**
  Business Representative e-MARCs: { _____ }
- **Business Representative acting on behalf of**
  Sponsoring Organization e-MARCs: { _____ }
- **Role-based e-MARCs: { _____ }**
  Server/QRP e-MARCs: { _____ }
-

Additionally, there are two levels of assurance specified in this Policy and defined in Section 1.3.9: one is based on software tokens and the other is based on hardware tokens. Each level of assurance shall have an OID, to be asserted in certificates issued by CAs who comply with the Policy stipulations herein, as follows:

- Level 3 OID: _____
- Level 4 OID: _____

All e-MARCs issued under this Policy shall reference this Policy by including the appropriate OIDs for this Policy in the *Certificate Policies* field of the e-MARC. The foregoing OIDs may not be used except as specifically authorized by this Policy.

1.3 COMMUNITY AND APPLICABILITY

This Policy describes a bounded PKI. That is, it describes the rights and obligations of persons and entities authorized under this Policy to fulfill any of the following roles: Registry Service Provider roles, Certificate Service Provider roles, End-Entity roles, and Policy Authority role. Registry Service Provider roles refer to Registry Administrators. Certificate Service Provider roles are the Certification Authority, Registration Authority, Certificate Manufacturing Authority, and Repository. End-Entity roles are Subscriber and Relying Parties. This section describes the requirements for persons and entities

authorized to fulfill any of these roles. Section 2 contains general descriptions of these roles and their responsibilities.

1.3.1 Registry Domains

A Registry Domain may support the requirements cited in this Policy only if it is qualified and authorized to do so by the Policy Authority. To qualify as an authorized Registry Domain, the Registry must have the following capabilities:

- Serve as a registry of organizations participating in an energy market.
- Include an organization's Data Universal Numbering System (DUNS) numbers or other industry-recognized, third-party assigned business identifiers as one of their attributes.
- Associate a unique alphanumeric code (Entity Code) to each registered organization.
- Identify each CA qualified as an Authorized CA.

1.3.2 Registry Administrators

A Registry Administrator may support this Policy and administer a qualified and authorized Registry Domain only if such Registry Administrator first qualified as an authorized Registry Administrator by performing the following actions:

- Enter into an appropriate e-MARC Contract.
- Document the specific practices and procedures that the e-MARC Contract will implement to satisfy the requirements of this Policy and of the Registry Domain that the Registry Administrator wishes to administer.

1.3.3 Authorized Certification Authorities

A CA may issue certificates ("e-MARC certificates") that identify this Policy only if such CA first qualifies as an "Authorized CA" by performing the following functions:

- Enter into an appropriate e-MARC Contract.
- Document the specific practices and procedures the e-MARC Contract will implement to satisfy the requirements of this Policy in a Certificate Practice Statement ("e-MARC CPS").
- Receive e-MARC security certification and accreditation.

For the purposes of this document, a "Certification Authority**"** is an entity that is responsible for authorizing and causing the issuance of a certificate. The term "Authorized CA**"** refers to a Certification Authority who has been authorized by the Policy Authority to issue e-MARCs and provide Authorized CA services under the Policy.

1.3.4 Local Registration Authorities

Each Authorized CA shall perform the role and functions of the LRA or may subcontract LRA functions to third-party LRAs who agree to be bound by this Policy, provided that such arrangements are entered into by the parties in accordance with provisions stated in the CA's e-MARC CPS and are acceptable to the Policy Authority. However, the Authorized CA will remain responsible for the performance of those services in accordance with this Policy and its requirements under the Policy Authority's e-MARC Contract. The only exception would occur when the Policy Authority, pursuant to agreement among the Policy Authority, Qualified Relying Parties, and the Authorized CAs defined portions of the LRA role and functions.

1.3.5 Certificate Manufacturing Authorities

Each Authorized CA shall perform the role and functions of the CMA. An Authorized CA may subcontract CMA functions to third-party CMAs who agree to be bound by this Policy, provided that such arrangements are entered into by the parties in accordance with provisions stated in the CA's e-MARC CPS and are acceptable to the Policy Authority. However, the Authorized CA shall remain responsible for the performance of those services in accordance with this Policy and its requirements under the Policy Authority's e-MARC Contract.

1.3.6 Repositories

Each Authorized CA shall perform the role and functions of the Repository. An Authorized CA may subcontract performance of the Repository functions to a third-party Repository who agrees to be bound by this Policy, provided that such subcontractor is approved in advance by the NERC. The Authorized CA shall remain responsible for the performance of those services in accordance with this Policy and the requirements of its NERC e-MARC Contract.

1.3.7 End Entities

An individual or organization and their agents may be Subscribers or Qualified Relying Parties. As described in Section 1.3.7.1, Subscribers may be issued e-MARCs for assignment to devices, groups, organizational roles, or applications provided that responsibility and accountability are attributable to an individual or an organization as defined in Section 7.

e-MARCs will only be issued after receiving requests or authorization for issuance from one or more Sponsors. They may be issued to employees, citizens, organizations, and others with whom the Sponsor has a relationship.

Eligibility for a certificate is at the sole discretion of the Authorized CA, and the Authorized CA may administer any number of Subscribers.

1.3.7.1 Subscribers

An Authorized CA may issue e-MARCs to the following classes of Subscribers:

- Members of the general public ("Unaffiliated Individuals")
- Individuals authorized to act on behalf of business entities (i.e., Sponsoring Organizations registered in an authorized Registry) recognized by the Authorized CA, such as employees, officers, and agents of a Sponsoring Organization ("Business Representatives")
- An authorized representative of a sponsoring organization responsible for the request, renewal, key generation and proper storage of a role-based certificate. Role-based certificates are designed to support multiple individuals and a business need, where the actions attributable to that certificate shall be non-repudiable to the sponsoring organization.
- Servers, devices, and/or computer applications that may take action on behalf of a business entity (i.e., Sponsoring Organizations registered in an authorized Registry) recognized by the Authorized CA, such as, but not limited to, Web servers, application servers, and custom client applications ("Devices")
- Qualified Relying Parties ("Qualified Relying Party Applications") that choose to use an e-MARC

1.3.7.2 Qualified Relying Parties (QRP)

Persons and entities authorized to accept and rely upon e-MARCs to ensure privacy, authentication, integrity, and non-repudiation of electronic records and messages are those eligible entities that enter into an e-MARC Agreement (i.e., Memorandum of Understanding) to accept e-MARCs and agree to be bound by the terms of this Policy shall be referred to as "Qualified Relying Parties." Eligible entities include registered energy market participants entered into an authorized Registry to include; Canadian, Mexican, and U.S. Federal agencies; Provincial, State and local agencies; authorized contractors and sponsored universities and laboratories of the Policy Authority. Other organizations may be added as deemed appropriate under this Policy and by the Policy Authority. The Policy Authority reserves the right to add authorized users in these categories at any time during the term of this Policy.

1.3.8 Policy Authority (PA)

NERC serves as the PA and is responsible for organizing and administering the Policy and e-MARC Contract (s).

1.3.9 Applicability and Applications

There are two levels of certificate assurance within the e-MARC PKI. Each level of certificate assurance provides a different level of operational assurance, which shall be factored into the operational security requirements where e-MARCs are used to support operational missions, as follows:

- **e-MARC PKI Software Token – level 3:** This level is the baseline for the e-MARC PKI and is intended for use with applications used by typical end users. This level of assurance can be achieved with implementations that store private key(s) on software tokens (e.g., computer disks) and perform all cryptographic functions in software on the computer.
- **e-MARC PKI Hardware Token - level 4:** This is the e-MARC PKI baseline for all Privileged User operations (i.e., PKI component operators and system administrators). This level of assurance differs from the software-based token level 3 in that storage of private key(s) is on a hardware token (e.g., smart card). All private key operations (e.g., signing, key exchange) are performed on this hardware token and all cryptographic functions may be performed on this hardware device.

1.3.9.1 Purpose

Subscribers and Authorized CAs may use e-MARCs to authenticate Subscribers to Qualified Relying Party applications for individual and/or business purposes, and for authentication of Qualified Relying Party applications. The following table summarizes the functional uses of e-MARCs:

Certificate Type	Category	Key Usage	Description of Use of Certificate
CA Certificates	Certification Authorities (Root, Subordinate, e-Marc)	Digital Signature (0), Non Repudiation (1), Certificate Signing (5), CRL Signing (6)	To enables CA's to issue subordinate CA certificates, end-entity Certificates, and Certificate Revocation Lists (CRLs)
Encryption Certificates	Unaffiliated Individual	Key Encipherment (2), Data Encipherment (3), Key Agreement (4), Encipher Only (7), Decipher Only (8)	To enable an Unaffiliated Individual to, establish secure symmetrical key exchanges, and encrypt or decrypt data.
	Business Representative	Key Encipherment (2), Data Encipherment (3), Key Agreement (4), Encipher Only (7), Decipher Only (8)	To enable a Business Representative to establish secure symmetrical key exchanges, and encrypt or decrypt data.

Certificate Type	Category	Key Usage	Description of Use of Certificate
	Business Representative authorized to act on behalf of a Sponsoring Organization	Key Encipherment (2), Data Encipherment (3), Key Agreement (4), Encipher Only (7), Decipher Only (8)	To enable a business representative authorized to act on behalf of a sponsoring organization to establish secure symmetrical key exchanges, and encrypt or decrypt data**.**
	Role	Key Encipherment (2), Data Encipherment (3), Key Agreement (4), Encipher Only (7), Decipher Only (8)	To enable a role-based user or group or users to establish secure symmetrical key exchanges, and encrypt or decrypt data..
Digital Signing Certificates	Unaffiliated Individual	Digital Signature (0), Non Repudiation (1), Key Encipherment (2), Data Encipherment (3), Key Agreement (4), Encipher Only (7), Decipher Only (8)	To enable an unaffiliated individual to authenticate itself to qualified relying parties, establish secure symmetrical key exchanges, verify digitally signed documents and transactions, and participate in non-repudiatable transactions.
	Business Representative	Digital Signature (0), Non Repudiation (1), Key Encipherment (2), Data Encipherment (3), Key Agreement (4), Encipher Only (7), Decipher Only (8)	To enable a business representative to authenticate itself to qualified relying parties, establish secure symmetrical key exchanges, verify digitally signed documents and transactions, and participate in non-repudiatable transactions.

1.3.9.2 Suitable Applications

e-MARCs , under the assertion of the Policy OIDs, may be, but are not limited to, use in the following suitable applications:

- Energy market transactions
- Energy or transmission scheduling
- Filings with government agencies
- Filings with law enforcement agencies
- Application filing processes, such as applying for or requesting access to physical facilities
- Financial transactions within the energy markets' communities
- Billing, metering, and invoicing

- Conveyance and transfer or operational data
- Conveyance and transfer or system reliability data

1.3.9.3 Restricted and Prohibited Applications

e-MARCs, under the assertion of the Policy OIDs, shall **never** be used for performing any of the following functions:

- Any transaction or data transfer that, if compromised or falsified, may directly cause physical injury or loss of life
- Any transaction or data transfer that, if compromised or falsified, may result in imprisonment
- Any transaction or data transfer deemed illegal under federal law
- The bulk encryption (large contiguous amounts) of data or documents using the certificate's public or private key. (Bulk encryption may be accomplished using symmetric key cipher algorithms with the e-MARC used for secure key exchange only. Public key cryptography is inefficient for encryption of large data files while symmetric (secret) key cryptography provides a more efficient algorithm. The exchange of the symmetric or secret key can be securely achieved using public key cryptographic mechanism to encrypt the secretkey.)

1.4 CONTACT DETAILS

1.4.1 Policy Administration Organization

The NERC, as the Policy Authority and Contract Authority, administers this Policy; the address follows:

North American Electric Reliability Council
116-390 Village Boulevard
Princeton, New Jersey 08540-5731

1.4.2 Point of Contact

Attn.: e-MARC Administrator
Phone: (609) 452-8060
e-mail address: emarc.policy@nerc.com

1.4.3 Person Determining e-MARC CPS Suitability for the Policy

Attn.: e-MARC Administrator
Phone: (609) 452-8060
e-mail address: emarc.policy@nerc.com

SECTION 2

GENERAL PROVISIONS

2.1 OBLIGATIONS

This Section provides a general description of the roles and responsibilities of the e-MARC Program Participants operating under this Policy: Authorized Registration Domains, Registry Administrators, Authorized CAs, Registration Authorities, Certificate Manufacturing Authorities, Repositories, Subscribers, Qualified Relying Parties, and the Policy Authority. Additional obligations are set forth in other provisions of this Policy, the Policy Authority's e-MARC Contracts, the e-MARC Agreements with Qualified Relying Parties, and the Subscriber Agreements.

2.1.1 Registry Domains Obligations

A Registry Domain is responsible for containing a list of organizations that are authorized to participate in a particular energy market or reliability function and recognized by other participants in that market. It is the obligation of a Registry Domain to:

(a) have documented and enforceable requirements for market participants;
(b) obtain and maintain a registered Internet domain name to uniquely identify the registry;
(c) include organizations' DUNS numbers or other industry recognized, third-party assigned business identifier as one of their attributes;
(d) associate a unique alphanumeric code (Entity Code) to each registered organization;
(e) identify each Certification Authority qualified as an "Authorized CA"; and
(f) make all entries electronically and reliably available to all e-MARC Program Participants.

2.1.2 Registry Administrator Obligations

It is the responsibility and obligation of a Registry Administrator to ensure that the Registry Domain that it has been authorized to administer and maintain by the Policy Authority meets its obligations under this Policy and:

(a) Registering market participants in the registry and managing the application/enrollment process;
(b) Implementing an identification and verification process to ensure that market participants are eligible in accordance with the Registry Domain's policies;
(c) Promptly reflecting all registration changes or modifications that affect the status of e-MARCs issued to registered organizations, in accordance with the Certificate Revocation requirements of this Policy.

2.1.3 Authorized CA Obligations

This Policy describes the responsibilities of each Authorized CA that issues e-MARCs (and all of its subcontractor RAs, CMAs, and Repositories) by virtue of its e-MARC Contract with the Policy Authority, and governs its performance with respect to all e-MARCs it issues.

Each Authorized CA is responsible for all aspects of the issuance and management of e-MARCs, including the disclosure of required terms of uses as required in this Policy to all end entities, the application/enrollment process; the identification verification and authentication process; the certificate manufacturing process; dissemination and activation of the certificate; publication of the certificate (if required); renewal, suspension, revocation, and replacement of the certificate; verification of certificate status upon request; and ensuring that all aspects of the Authorized CA Services and Authorized CA operations and infrastructure related to e-MARC Certificates issued under this Policy are performed in accordance with the requirements, representations, and warranties of this Policy. The only exception is when the Policy Authority, pursuant to agreement between the Policy Authority, Qualified Relying Parties, and the Authorized CAs provides defined portions of the RA role and function.

Each Authorized CA is responsible for providing a disclaimer page during end-entity registration that requires e-MARC users to accept all rules and stipulations set forth in this Policy.

2.1.4 Local Registration Authority (LRA) Obligations

A Local Registration Authority (LRA) is responsible for the applicant registration, certificate application, and authentication of identity functions for Unaffiliated Individuals, Business Representatives, and Qualified Relying Parties. An LRA may also be responsible for handling suspension and revocation requests, and for aspects of Subscriber education.

2.1.5 CMA Obligations

A Certificate Manufacturing Authority (CMA) is responsible for the functions of manufacture, issuance, suspension, and revocation of e-MARCs.

2.1.6 Repository Obligations

A Repository is responsible for maintaining a secure system for storing and retrieving e-MARCs, a current copy of this Policy, and other information relevant to e-MARCs, and for providing information regarding the status of e-MARCs as valid or invalid that can be determined by a Qualified Relying Party.

2.1.7 Subscriber Obligations

The responsibilities of each applicant for an e-MARC are to:

- Provide complete and accurate responses to all requests for information made by the Authorized CA or RA during the applicant registration, certificate application, and authentication of identity processes.

- Generate a key pair using a reasonably trustworthy system, and take reasonable precautions to prevent any compromise, modification, loss, disclosure, or unauthorized use of the private key.

- Upon issuance of an e-MARC naming the applicant as the Subscriber, review the e-MARC to ensure that all Subscriber information included in it is accurate, and to expressly indicate acceptance or rejection of the e-MARC, consistent with Section 4.3.

- Use the e-MARC and the corresponding private key exclusively for purposes authorized by this Policy and only in a manner consistent with this Policy.

- Employ all reasonable diligence to securely store and protect the certificate's private key from loss, theft, misuse, unauthorized use, misappropriation or any other circumstance that brings the authenticated use of the certificate into question.

- Instruct the issuing Authorized CA or RA to revoke the e-MARC promptly upon any actual or suspected loss, disclosure, or other compromise of the private key, or, in the case of a Device or Business Representative e-MARC, whenever the Subscriber or Device is no longer affiliated with the Sponsoring Organization or the Device is no longer active.

- Instruct the issuing Authorized CA or RA to revoke the e-MARC immediately upon Sponsoring organization's cessation of functions requiring use of the certificate or within 60 days upon change of Sponsoring organization's identity (such as merger or acquisition).

- Permit the backup of the private keys of certificates issued for digital signature only by means of 1) a backup copy under the sole control of the Subscriber, or 2) a key backup program approved by the Authorized CA and administered by the Subscriber's Sponsoring Organization.

- Under no circumstances allow the private key of a certificate issued for the sole purpose of digitally signing documents under this Policy to be backed up or escrowed except by such means that is under the sole control of the Subscriber.

2.1.8 Qualified Relying Party Obligations

This Policy is binding on each Qualified Relying Party by virtue of its e-MARC Agreement, and governs its performance with respect to its application for, use of, and reliance on e-MARCs.

(a) Acceptance of Certificates. Each Qualified Relying Party will validate e-MARCs issued by all

Authorized CAs.

(b) Certificate Validation. Each Qualified Relying Party will validate every e-MARC it requests and receives with the Authorized CA that issued the certificate.

(c) Reliance. A Qualified Relying Party may rely on a valid e-MARC for purposes of verifying the digital signature and symmetric key exchange only if:

- The e-MARC was used and relied upon to authenticate a Subscriber's digital signature for an application bound by this Policy;
- Prior to reliance, the Qualified Relying Party (1) verified the digital signature by reference to the public key in the e-MARC, and (2) verified that the status of the e-MARC was valid by checking a current Certificate Revocation List (CRL);
- The reliance was reasonable and in good faith in light of all the circumstances known to the Qualified Relying Party at the time of reliance; and,
- For the purpose of non-repudiation, the Qualified Relying Party shall only rely on digital signatures created using an e-MARC with the non-repudiation bit set in the key usage extension.

2.1.9 Policy Authority Obligations

The Policy Authority is responsible for the terms of this Policy, contract administration, and the authorization and approval of Registry Domains, Registry Administrators, Certification Authorities, Registration Authorities, Certificate Manufacturing Authorities, and Repositories to participate in this Policy.

2.2 LIMITATIONS ON LIABILITIES

Nothing in this Policy shall alter, or eliminate any other obligation, responsibility, or liability that may be imposed on any Program Participant by virtue of any contract or obligation that is otherwise applicable under relevant law.

Issues of liability must be expressly set forth in contracts between individual parties.
[NOTE: To be addressed by NERC.]

2.3 RESPONSIBILITIES AND RELATIONSHIPS

2.3.1 Financial Responsibilities

A potential CA must make a reasonable, good faith showing that it has sufficient financial strength to be relied upon as an Authorized CA, including having adequate insurance coverage (e.g., Errors and Omissions coverage, liability insurance, etc.).

2.3.2 Fiduciary Relationships

A subcontracted Repository has a fiduciary relationship with its contracting Authorized CA for all information or data held by that Repository.

2.3.3 Administrative Processes

No stipulation.

2.4 INTERPRETATION AND ENFORCEMENT

2.4.1 Governing Law

The law of New Jersey shall govern the enforceability, construction, interpretation, and validity of this Policy.

2.4.2 Severability, Survival, Merger, Notice

Should it be determined pursuant to judicial process that one section of this Policy is invalid or otherwise unenforceable; all other sections shall remain in effect until the Policy is revised. Requirements for revising this Policy and providing notice thereof are described in Section 8. All unchanged responsibilities, requirements, and privileges of this Policy are merged into the revised Policy upon release thereof.

2.4.3 Dispute Resolution Procedures

In the event of any dispute or disagreement between or among two or more of the Program Participants ("Disputing Parties") arising out of or relating to this Policy or e-MARC Contracts, CPS, or Agreements, the Disputing Parties shall use their best efforts to settle the dispute or disagreement through negotiations in good faith following notice from one Disputing Party to the other(s). Such negotiations may be mediated or arbitrated at the discretion of the Disputing Parties. If the Disputing Parties cannot reach a mutually agreeable resolution of the dispute or disagreement within sixty (60) days following the date of such notice, then the Disputing Parties may present the dispute to the e-MARC Contract Officer for resolution.

Any contract dispute between Authorized CAs and e-MARC Contract Officers shall be handled under the terms and conditions of the e-MARC contract.

2.5 FEES

2.5.1 Certificate Issuance, Renewal, Suspension, and Revocation Fees

The Authorized CA may impose a reasonable fee to issue or renew e-MARCs. The Authorized CA shall not impose a fee to suspend or revoke e-MARCs.

2.5.2 Certificate Access Fees

The Authorized CA shall not impose any certificate access fees on Subscribers with respect to use of their own e-MARCs or the status of such e-MARCs.

2.5.3 Revocation Status Information Access Fees (Certificate Validation Services)

No fees shall be assessed for access to an Authorized CA's published CRL.

2.5.4 Fees for Policy Information

The Authorized CA shall not impose fees for access to Policy information.

2.5.5 Fees for Other Services

Reasonable fees, as set forth in contracts between individual parties, may be charged for other services (e.g., key escrow, key replacement, etc).

2.5.6 Refund Policy

There shall be no refunds of any fees from the Policy Authority under any circumstances.

2.6 PUBLICATION AND REPOSITORY

2.6.1 Publication of Authorized CA Information

Each Authorized CA shall operate a secure online Repository available to Subscribers and Qualified Relying Parties that shall contain: (1) all e-MARCs issued by the Authorized CA that have been accepted by the Subscriber, typically available via Lightweight Directory Access Protocol (LDAP); (2) a CRL ; (3) the Authorized CA's e-MARC for its signing key; (4) past and current versions of the Authorized CA's e-MARC CPS; (5) a copy of this Policy; and (6) other relevant information about e-MARCs. Submittal of such information to said Repository, with the subsequent availability of such

information to Subscribers and Qualified Relying Parties, constitutes "publication" for purposes of this Policy.

2.6.2 Frequency of Publication

All information to be published in the Repository shall be published promptly after such information is available to the Authorized CA. The Subscriber will publish e-MARCs issued by the Authorized CA promptly upon acceptance of such e-MARCs. Information relating to the status of an e-MARC will be published in accordance with the Policy Authority's e-MARC Contract, if applicable.

2.6.3 Access Controls

The Authorized CA shall not impose any access controls on this Policy, the Authorized CA's e-MARC for its signing key, CRLs, and past and current versions of the Authorized CA's e-MARC CPS. The Authorized CA may impose access controls on e-MARCs, in accordance with provisions of the Authorized CA's e-MARC Contract, if applicable.

2.6.4 Repository Access and Security

For purposes of this Policy, the requirement of availability will be satisfied if the information can be accessed through or by means of a "site" or "page" via the Internet by means of a "browser" implementing the HTTP protocol. Such access to Subscribers and Qualified Relying Parties must be secure – provided in accordance with all of the security requirements reflected in this Policy and the CA Requirements document.

2.7 QUALITY ASSURANCE INSPECTION AND REVIEW

The Authorized CA, shall undergo e-MARC Security Certification and Accreditation (C&A) reviews as a condition of obtaining and retaining approval to operate as an Authorized CA under this Policy and e-MARC Contract. The purpose of the C&A process shall be to verify that the Authorized CA has in place and follows a system that assures that the quality of its Authorized CA Services conforms to the requirements of this Policy and the e-MARC Contract.

2.7.1 Frequency of Certification Authority C&A Compliance Review

Certification authorities shall undergo C&A under the direction of the Policy Authority prior to initial approval as Authorized CA, to demonstrate 1) compliance with this Policy, 2) their e-MARC CPS, and 3) their e-MARC contracts. Re-certification shall be required every 12 months or at any time that a significant change in their operations is made, whichever occurs first, to demonstrate continuing compliance.

2.7.2 Identity/Qualifications of C&A Reviewer

An independent security audit firm acceptable to the Policy Authority that is qualified to perform a security audit on a CA shall conduct the C&A process.

2.7.3 C&A Auditor's Relationship to Audited Party

The auditor shall be an independent, unbiased party that is in no way, beyond the audit itself, associated with the party to be audited.

2.7.4 Topics Covered by C&A Quality Assurance Inspection and Review

The C&A quality assurance inspection shall be conducted based in part on the guidance provided in the American Institute of Certified Public Accountants' / Canadian Institute of Chartered Accountants (AICPA/CICA's) WebTrust Principles and Criteria for Certification Authorities. The topics covered by the C&A Quality Assurance Inspection and Review will be sufficient to ensure the Policy Authority thath the perspective CA is capable of issuing certificates under this Policy.

2.7.5 Actions Taken as a Result of Deficiency

When the compliance auditor finds a deficiency in a CA/CMA's operation and the stipulations of its CPS, the following actions must occur:

(a) The compliance auditor shall note the deficiency;
(b) The compliance auditor shall notify the parties identified in Section 2.7.6 of the deficiency;
(c) The CA will propose a remedy, including expected time for remediation, to the Policy Authority.

The Policy Authority will determine the appropriate remedy, up to and including revocation of the Authorized CA certificate.

The Policy Authority will address any identified deficiencies with the potential or Authorized CA. An authorized CA whose certificate has been revoked may reapply for e-MARC certification, upon correction of the deficiencies.

2.7.6 Communication of Results

The Certification Authority shall make the results of the C&A review available to the Policy Authority for determining the CA's suitability for initial and continued performance as an Authorized CA. The Policy Authority will use the results of the C&A Review, along with any other test evidence the CA offers, for determinig the CA's suitability for initial and continued performance as an Authorized e-

MARC CA. At no time will this information provided by a perspective CA be made public nor disclosed by the Policy Authority without the prior consent of the subject CA.

2.8 CONFIDENTIALITY

2.8.1 Types of Information to Be Kept Confidential

Subscriber Information. The Authorized CA shall protect the confidentiality of personal information regarding Subscribers that is collected during the applicant registration, e-MARC Certificate application, authentication, and certificate status checking processes in accordance with the *Privacy Act of 1974 and Amendments*[1]. Such information shall be used only for the purpose of providing Authorized CA Services and carrying out the provisions of this Policy and the e-MARC Contract, and shall not be disclosed in any manner to any person without the prior consent of the Subscriber, unless otherwise required by law, except as may be necessary for the performance of the Authorized CA Services in accordance with the e-MARC Contract. In addition, personal information submitted by Subscribers:

(a) must be made available by the Authorized CA to the Subscriber involved following an appropriate request by such Subscriber;

(b) must be subject to correction and/or reasonable and appropriate revision by such Subscriber;

(c) must be protected by the Authorized CA in a manner designed to ensure the data's integrity and confidentiality; and

(d) cannot be used or disclosed by the Authorized CA for purposes other than the direct operational support of e-MARC unless such use is authorized by the Subscriber involved or is required by law, including judicial process.

Under no circumstances shall the Authorized CA (or any authorized RA, CMA, or Repository) have access to the private keys of any Subscriber to whom it issues an e-MARC to be used solely for the purpose of generating digital signatures when the non-repudiation bit is expressed. Subscriber private key backup or key escrow programs are permitted for the purposes of recovering the private keys of e-MARCs issued for encryption. See Section 7, for a complete certificate profile.

Other Subscriber Information. The Authorized CA shall take reasonable steps to protect the confidentiality of Qualified Relying Party or other Subscriber information provided to the Authorized

[1] Privacy Act of 1974 and Amendments (as of Jan 2, 1991), 5 USC Sec. 552.a, Title 5, Part 1, Chap. 5, Subchapter II.

CA. Such information shall be used only for the purpose of providing Authorized CA Services and carrying out the provisions of this Policy and the e-MARC Contract, and shall not be disclosed in any manner to any person except as may be necessary for the performance of the Authorized CA Services in accordance with the e-MARC contract, or as otherwise required by law, including judicial process.

2.8.2 Types of Information Not Considered Confidential

Information contained within a single e-MARC or related status information shall not be considered confidential when the information is necessary for providing Authorized CA Services and carrying out the provisions of this Policy and the e-MARC contract.

2.8.3 Disclosure of Certificate Revocation/Suspension Information

No stipulation.

2.8.4 Release to Law Enforment Officials

No stipulation.

2.8.5 Release as Part of Civil Discovery

No stipulation.

2.8.6 Disclosure Upon Owners Request

No stipulation.

2.8.7 Other Information Release Circumstances

No stipulation.

2.9 INTELLECTUAL PROPERTY RIGHTS

Private keys shall be treated as the sole property of the legitimate holder of the corresponding public key identified in an e-MARC. This Policy is the property of the Policy Authority. "Energy Market Access and Reliability Certificates," otherwise referred to as "e-MARCs" or "e-MARCd," and the e-MARC OIDs are the property of the Policy Authority and may be used only by Authorized CAs in accordance with the provisions of this Policy and the Authorized CA's e-MARC Contract. Any other use of the above without the express written permission of the Policy Authority is expressly prohibited.

SECTION 3

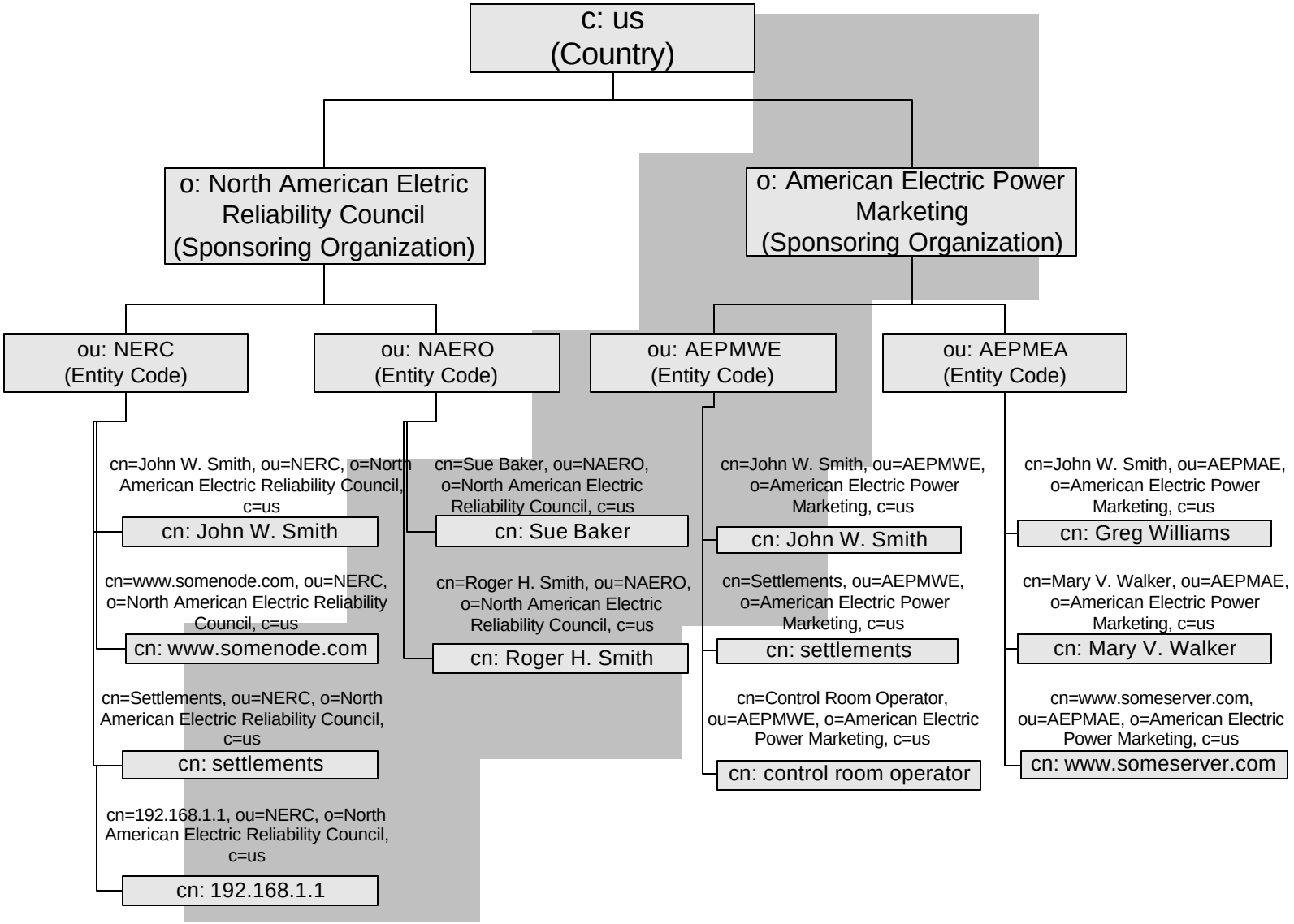
IDENTIFICATION AND AUTHENTICATION

3.1 INITIAL REGISTRATION

Subject to the requirements noted below, applications for e-MARCs may be communicated from the applicant to an Authorized CA or an authorized RA, and authorizations to issue e-MARCs may be communicated from an authorized RA to an Authorized CA, (1) electronically, provided that all communication is encrypted and/or digitally signed, (2) by first class mail, or (3) in person. The applicant must also specify in their application, which Registry Domain they are requesting a certificate under and include both their unique "Entity Code" assigned to them by the Registry and the official company name of the sponsoring organization. Unaffiliated individuals, however, do not have to provide an "Entity Code" or the company name of a sponsoring organization. Unaffiliated individuals must demonstrate a need in order to obtain an E-MARC.

3.1.1 Types of Names

All e-MARCs subjects shall contain a unique X.500 Distinguished Name (DN) that must be a printable string, must contain some string of characters (not be blank), and in the case of a Qualified Relying Party, Business Representative, must clearly and uniquely identify the official company name of the sponsoring organization and the Entity Code of the sponsoring organization as they appear in the Registry Domain. Unaffiliated individuals must go through a verification process prior to obtaining an e-MARC. Shown in Table 3-1 below is an ***example*** DN hierarchy:



(**NOTE**: C = Country, O = Organization, OU = Organizational Unit, CN = Common Name)

Figure 3-1. Example DN Hierarchy

3.1.2 Name Meanings

In the case of Unaffiliated Individuals, the authenticated common name (labeled "CN" in the above diagram) should be a combination of first name, surname and an optional middle initial. In the case of Business Representatives, the authenticated common name should be the combination of first name, surname and an optional middle initial. In the case of Qualified Relying Parties, the authenticated common name should be the combination of first name, surname and an optional middle initial unless the Qualified Relying Party represents a device or application (e.g., Web servers) in which case the common name should be the fully qualified domain name of the device/application.

A certificate issued for a device or application must include the Point-of-Contact email address or person who is responsible for that device or application in the SubjectAltName field of the certificate.

For Business Representatives, Qualified Relying Parties, and Devices, the DN within the certificate subject must also contain the Entity Code of the sponsoring organization in the OU field and the official company name of the sponsoring organization being represented in the O field.

3.1.3 Rules for Interpreting Various Name Forms

Rules for interpreting name forms are contained in the applicable certificate profile (see Section 7.1.2), and are established by a naming authority if one exists, or by the Authorized CA itself. The naming authority shall be identified contractually or in an authorized CA's CPS.

3.1.4 Name Uniqueness

Name uniqueness across all e-MARCs must be enforced and each Authorized CA shall enforce name uniqueness within the X.500 name space that it has been authorized. When other name forms are used, they too must be allocated such that name uniqueness across all active e-MARCs is ensured. An Authorized CA shall document in its CPS what name forms will be used and how they will allocate names within the subscriber community to guarantee name uniqueness among current and past subscribers (e.g., if "Joe Smith" leaves an Authorized CA's community of subscribers, and a new, different "Joe Smith" enters the community of subscribers, these two individuals must be provided unique names). The Entity Codes and sponsoring organizations contained with an e-MARC's DN shall be provided and maintained by the Registry Administrator.

3.1.5 Name Claim Dispute Resolution Procedures

The Authorized CA shall investigate and correct if necessary any non-unique names (or "name collisions") brought to its attention. If appropriate, the Authorized CA shall coordinate with and defer to the appropriate naming authority or Registry Administrator but the Authorized CA reserves the right to make all final decisions.

3.1.6 Recognition, Authentication, and Role of Trademarks

The use of trademarks will be reserved to registered trademark holders.

3.1.7 Verification of Possession of Key Pair

The Authorized CA shall verify that the applicant (to include a role-based certificate applicant acting as an authorized representative of the sponsoring organization) possesses the private key corresponding to the public key submitted with the application by utilizing a key transfer protocol or equivalent method, and that these keys form a functioning pair.

3.1.8 Authentication of Sponsoring Organization or Qualified Relying Party Identity

If the applicant is requesting a Business Representative e-MARC or Qualified Relying Party Certificate, in addition to verifying the applicant's individual identity, as outlined in section 3.1.9, and authorization to represent the Sponsoring Organization, the Authorized CA shall also verify that the entity exists, is registered with a unique Entity Code in an approved Registry Domain, and conducts business at the address listed in the e-MARC application. In conducting its review and investigation, the Authorized CA shall validate information concerning the entity to establish its authenticity, including legal company or business name, type of entity place of incorporation or principle registration, , principle business address (including number and street, city, postal code), and principle business telephone number. The Authorized CA may rely on the Registry to verify the business credentials (e.g., entity code, business code, etc.) of the Sponsoring Organization.

If the Sponsoring Organization had previously established the identity of the entity organization using a process that satisfies the CA and this Policy, and there have been no changes in the information presented, then the Authorized CA or RA and the prospective Subscriber may utilize private shared information in order to verify the identity of the Sponsoring Organization.

3.1.9 Authentication of Individual Identity

3.1.9.1 Unaffiliated Individual

Unaffiliated Individuals may be authenticated through an electronically submitted application or by personal presence. In accordance with the e-MARC Contract requirements the Authorized CA shall verify all of the following identification information supplied by the applicant: first name, middle initial, and last name, current address (number and street, city, ZIP code), and principle telephone number. Subscriber identification must be confirmed via a Policy Authority-approved identity-proofing process that incorporates the following factors:

Submission by the applicant of at least three individual identity items, which must be verified through reference to multiple independent data sources along with cross-checks for consistency, for example:

- Currently valid credit card number;
- United States Alien Registration Number, or similar Canadian or Mexican identification;
- Passport number and country;
- Current employer name, address (number and street, city, postal code), and principle telephone number;
- Currently valid state-issued driver's license number or state-issued identification card number;
- Social Security Number, or similar Canadian or other national identification;
- Date of birth; and
- Place of birth.

At least one of the above data sources must be based on an antecedent in-person, or the equivalent, identity-verification process;

The use of an alternative notification process that is linked to the requesting individual's physical postal mail address; or equivalent, and verification that the information contained in the Certificate Application is correct.

3.1.9.2 Business Representative and Device e-MARCs

If the applicant is requesting a certificate for a Business Representative, device, or role-based certificate, the authorized CA shall verify:

(a) that the applicant is a duly authorized representative of the Sponsoring Organization as an employee, partner, member, agent, or other association; and
(b) the Sponsoring Organization's identity as specified in section 3.1.8.

3.1.9.3 Qualified Relying Party e-MARCs

If the applicant is requesting a Qualified Relying Party e-MARC, the Authorized CA shall verify:

(a) that the applicant is authorized to act on behalf of the Qualified Relying Party;
(b) the affiliation of the e-MARC applicant with the Qualified Relying Party; and
(c) The Sponsoring Organization's identity as specified in section 3.1.8

3.2 ROUTINE REKEY (CERTIFICATE RENEWAL)

The longer and more often a key is used, the more susceptible it is to loss or discovery. This weakens the assurance provided to a Relying Party that the unique binding between a key and its named Subscriber is valid. Therefore, it is important that a Subscriber periodically obtain new keys and re-

establish its identity. Re-keying a certificate means that a new certificate is created that is identical to the old one, except that the new certificate has a new, different public key (corresponding to a new, different private key); a different serial number; and may be assigned a different validity period. Therefore e-MARCs shall also be rekeyed when they are renewed.

In accordance with the e-MARC contract the Authorized CA shall accept e-MARC renewal requests from their Subscribers within 90 days from the scheduled end of the operational period (expiration date) of the e-MARC, provided the e-MARC is not currently under revocation or suspension or expired. The e-MARCs shall be renewed in 1-year increments.

Since the key pair is required to change, the Authorized CA shall require the Subscriber to request a new e-MARC with an associated new public/private key pair each year. For the first two years a renewal request may take place based on the presentation of the existing valid certificate. Every third year the certificate Subscriber must identify itself as for a new request, in accordance with section 3.1. This process is not designed to place undue burden on the Subscriber or Authorized e-MARC CA, but rather to verify that the Subscriber still has a valid need for an E-MARC. The Authorized CA shall renew e-MARCs issued to Qualified Relying Parties only after completing successful identity proofing verification in accordance with the requirements for individual identity authentication specified in Section 3.1.9.

3.3 REKEY (CERTIFICATE RENEWAL) AFTER REVOCATION

In accordance with the e-MARC Contract, suspended, revoked, or expired e-MARCs shall not be renewed. Applicants without a valid e-MARC shall be re-authenticated by the Authorized CA or an authorized RA through a new e-MARC application, just as with an initial applicant registration, and shall be issued a new e-MARC.

3.4 REVOCATION REQUEST

In accordance with the e-MARC contract and section 4.4.1, an e-MARC revocation request that is submitted electronically may be authenticated on the basis of a digital signature using the e-MARC's associated key pair. The identity of the person submitting a revocation request in any other manner shall be authenticated in accordance with Section 3. Revocation requests authenticated on the basis of the e-MARC's associated key pair shall always be accepted as valid. Other revocation request authentication mechanisms may be used as well, including a request in writing signed by the Subscriber and sent via first class mail, or by any means with equivalent assurances of security. These authentication mechanisms must balance the need to prevent unauthorized revocation requests against the need to quickly revoke certificates.

SECTION 4

OPERATIONAL REQUIREMENTS

4.1 CERTIFICATE APPLICATION

Application Initiation. The following persons may initiate the e-MARC application process:

Applicant or Potential Subscriber	Authorized Initiator
Unaffiliated Individual	Potential Subscriber only
Business Representative, device, or application	Sponsoring Organization; or potential Subscriber
Qualified Relying Party	Duly authorized representative of the Qualified Relying Party

(a) Application Form. An applicant for an e-MARC shall complete an e-MARC application and provide requested information in a form prescribed by the Authorized CA and this Policy.

(b) Applicant Education and Disclosure. At the time of e-MARC application, the Authorized CA shall inform applicants of the advantages and potential risks associated with using e-MARCs to access Qualified Relying Parties electronically and provide information to Subscribers regarding the use of private keys and digital signatures created with such keys, and Subscriber obligations.

4.1.1 Application

It is the intent of this Policy to identify the minimum requirements and procedures that are necessary to support trust in use of a PKI system for e-MARCs, and to minimize imposition of specific implementation requirements on CMAs, applicants, and all other relying parties.

The applicant and/or the CMA must perform the following steps when an applicant applies for a certificate:

- establish and record identity of an applicant (per Section 3.1);
- obtain a public/private key pair for each certificate required;
- establish that the public key forms a functioning key pair with the private key held by the applicant (per Section 3.1.7);
- provide a point of contact for verification of any roles or authorizations requested;
- acknowledge the terms and conditions of acceptance and use of the certificate by the applicant.

These steps may be performed in any order that is convenient for the CMA and applicant, and that does not defeat security; but all must be completed prior to certificate issuance. All communications among CMAs supporting the certificate application and issuance process shall be authenticated and protected from modification. Any electronic transmission of shared secrets shall be protected (e.g., encrypted) using means commensurate with the requirements of the data to be protected by the certificates being issued.

Authorized CAs implementing this Policy shall certify other CAs (to include cross-certification) only as authorized by the Policy Authority and then may only do so within the constraints embodied within said authorizations.

Requests by CAs for Authorized CA certificates shall be submitted to the Policy Authority using the contact provided in Section 1.4, and shall be accompanied by a CPS written to the format of the *Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework* [RFC2527].

The Policy Authority will evaluate the submitted CPS for acceptability. The Policy Authority may require an initial compliance audit, performed by parties of the Policy Authority's choosing, to ensure that the CMA is prepared to implement all aspects of the submitted CPS, prior to the Policy Authority authorizing the CMA to issue and manage certificates asserting this Policy.

Authorized CAs shall only issue certificates asserting the Policy upon receipt of written authorization signed by a duly authorized representative of the Policy Authority, and then may only do so within the constraints embodied within said authorization.

4.1.2 Delivery of Subscriber's public key to certificate issuer

Public keys shall be delivered to the certificate issuer in a way that binds the applicant's verified identification to the public key being certified. This binding shall be accomplished using means that are as secure as the security offered by the keys being certified. The binding shall be accomplished using cryptographic, physical, procedural, and other appropriate methods. The methods used for public key delivery shall be stipulated in the CPS.

4.2 CERTIFICATE ISSUANCE

Upon successful completion of the Subscriber identification and authentication process in accordance with the e-MARC contract, the Authorized CA shall create the requested e-MARC, notify the applicant thereof, and make the e-MARC available to the applicant. The Authorized CA shall use a secondary notification process linked to the e-MARC applicant's physical postal mail address, or its physical equivalent to provide notification of the e-MARC issuance only to the Subscriber or the authorized representative of the Sponsor. Authorized e-MARC CAs may use e-mail as a certificate issuance notification method provided that no sensitive information such as passphrases, unlock codes,

etc., are transmitted in those e-mails.

Upon issuance of an e-MARC, the Authorized CA warrants to all Program Participants that:

(a) the Authorized CA has issued, and will manage, the e-MARC in accordance with the requirements in this Policy;
(b) the Authorized CA has complied with all requirements in this Policy when identifying the Subscriber and issuing the e-MARC;
(c) there are no misrepresentations of fact in the e-MARC actually known to or reasonably knowable by the Authorized CA and the Authorized CA has verified the information in the e-MARC pursuant to this Policy;
(d) information provided by the Subscriber for inclusion in the e-MARC has been accurately transcribed to the e-MARC; and
(e) the e-MARC meets the material requirements of this Policy.

4.2.1 Delivery of Subscriber's Private Key to Subscriber

Private keys shall be delivered to the Subscriber or authorized representative, based on the following table:

Certificate Key Usage	**Category**	**Minimum Private Key Delivery Requirement**
CA certificates	Certificate Authorities	FIPS 140-2 Level 3 hardware device (token)
Encryption certificates	Unaffiliated Individual	Must remain within the cryptographic boundary of a cryptographic module where it was created or delivered via secured PKCS 12 file or equivalent.
	Business Representative	Must remain within the cryptographic boundary of a cryptographic module where it was created or delivered via secured PKCS 12 file or equivalent.
	Business Representative authorized to act on behalf of a Sponsoring Organization	Must remain within the cryptographic boundary of a cryptographic module where it was created or delivered via secured PKCS 12 file or equivalent.
	Role	FIPS 140-2 Level 2 hardware device (token)
Digital Signing certificates – Individual	Unaffiliated Individual	Must remain within the cryptographic boundary of a cryptographic module where it was created.
	Business Representative	Must remain within the cryptographic boundary of a cryptographic module where it was created.

4.2.2 Role-based Certificates (Tokens)

Certificates shall be issued to persons whenever possible. For cases where there are several persons acting in one capacity (role), a certificate may be issued that corresponds to a private key that is shared by multiple Subscribers. Certificates corresponding to private keys held by multiple Subscribers shall not be used for contracting or e-commerce applications. In the case of a shared certificate:

- An authorized representative of the Sponsoring Organization shall be responsible for ensuring control of the private key, including maintaining a list of Subscribers who have access to use of the private key, and accounting for which Subscriber had control of the key at what time.
- That list of those holding the shared private key must be provided to, and retained by, the Authorized CA and/or LRA.

For reasons of security, role-based certificates must be issued in FIPS-140 compliant hardware tokens only. Currently for e-MARC, FIPS-140 compliant hardware tokens must meet the standards for a FIPS 104-2, level 2. The procedures for issuing tokens for use in shared key applications must comply with all other stipulations of this Policy (e.g., key generation, private key protection, and Subscriber obligations, etc.).

Certificates issued to a role-based entity shall be non-repudiable to the organization and not to an individual. The sponsoring organization shall be held responsible for all non-repudiable transactions issued by the sponsoring organizations role-based certificates.

4.3 CERTIFICATE ACCEPTANCE

As described in the e-MARC contract, as a condition to issuing the e-MARC, the Subscriber shall indicate acceptance or rejection of the e-MARC to the Authorized CA and acknowledge the Subscriber obligations under Section 2.1.7. During this acceptance process, the Subscriber must indicate through whatever mechanism the Authorized CA provides, that they have read and agreed to the e-MARC Policy as stated in the E-MARC CP. By accepting the e-MARC, the Subscriber is warranting that all information and representations made by the Subscriber that are included in, and relied upon in issuing, the e-MARC are true and accurate.

4.4 CERTIFICATE SUSPENSION AND REVOCATION

4.4.1 Who Can Request Revocation

The only persons permitted to request revocation of an e-MARC issued pursuant to this Policy are the Subscriber, an authorized representative of the Sponsoring Organization, the RA, or the issuing Authorized CA.

4.4.2 Circumstances for Revocation

4.4.2.1 Permissive Revocation

As described in the e-MARC contract a Subscriber may request revocation of their own e-MARC at any time for any reason. A Sponsoring Organization may request revocation of an e-MARC issued to its Business Representative (device or individual) at any time for any reason.

4.4.2.2 Required Revocation

An authorized CA, Subscriber, Sponsoring Organization (where applicable), or Registry Administrator is responsible for promptly requesting revocation of an e-MARC under at least the following circumstances:

(a) When any of the identifying information on the e-MARC changes or otherwise becomes obsolete.

(b) When the private key, or the media holding the private key, associated with the e-MARC (the Subscriber's private key) is, or is suspected of having been, compromised.

(c) When the individual named as a Business Representative no longer represents, or is no longer affiliated with, the Sponsoring Organization.

(d) When a device or server is no longer active or no longer affiliated with a Sponsoring Organization.

(e) Upon a change of an Individual or Sponsoring Organization's registration in the Registry Domain (where applicable). Changes in registration information, including DUNS number or Entity Code or any other attribute that the appropriate Registry Administrator deems to warrant revocation within the intent of this Policy. During the transition to e-MARCs, existing Subscriber certificates will be accepted, by Qualified Relying Parties up to one year.

(f) If an Authorized CA learns, or reasonably suspects, that the Subscriber's private key has been compromised; or

(g) If the issuing Authorized CA determines that the e-MARC was not properly issued in accordance with this Policy and/or the Authorized CA's e-MARC CPS.

(h) The authorized CA or sponsoring organization shall revoke the subscriber certificate if they determine that the certificate has been used in a manner that violates this Policy.

Failure to do so shall subject the subscriber to assume liabilities under this Policy.

4.4.3 Revocation

4.4.3.1 Procedure for Revocation Request

As described in the e-MARC Contract an e-MARC revocation request should be promptly communicated to the issuing Authorized CA, either directly or through the RA authorized to accept such notices on behalf of the Authorized CA. An e-MARC revocation request may be communicated electronically if it is digitally signed with the private key of the requesting entity. Alternatively, the requester may request revocation by contacting the issuing Authorized CA or its RA in person and providing adequate proof of identification in accordance with this Policy.

4.4.3.2 Revocation Request Grace Period

Revocation is immediate if the certificate has been compromised. In all other situations, certificates should be revoked as soon as practical; however, a 2-week (10 business days) grace period may be given at the Authorized CA's discretion.

4.4.4 Suspension

4.4.4.1 Who Can Request Suspension

The only persons permitted to request suspension of an e-MARC issued pursuant to this Policy are the Subscriber, the Sponsoring Organization (where applicable), the RA, and the issuing Authorized CA. Although not required, a certificate **may** be placed in suspended status following an unsigned request for certificate revocation, pending authentication of the revocation request.

4.4.4.2 Procedure for Suspension Request

As described in the e-MARC Contract an e-MARC suspension request should be promptly communicated to the issuing Authorized CA, either directly or through the RA authorized to accept such notices on behalf of the Authorized CA. An e-MARC suspension request may be communicated electronically if it is digitally signed with the private key of the Subscriber' identity certificate, or the Sponsoring Organization (where applicable). Alternatively, the Subscriber, or Sponsoring Organization (where applicable) may request suspension by contacting the issuing Authorized CA or its RA in person and providing adequate proof of identification in accordance with this Policy.

4.4.4.3 Limits on Suspension Period

A certificate may maintain a suspended state up to 2 weeks (10 business days). After that time, if no action has been taken, the Authorized CA shall change the certificate status to a revoked and inform the Subscriber of the action taken.

4.4.5 CRL Issuance Frequency

An Authorized CA must ensure that it issues an up to date CRL at least every twelve (12) hours. Additionally, the validity period of a CRL shall not exceed 12 hours. An Authorized CA must ensure that its CRL issuance is synchronized with any directory synchronization to ensure the accessibility of the most recent CRL to e-MARC holders and Qualified Relying Parties. When a certificate is revoked an updated CRL must be issued within four (4) hours of the event.

4.4.6 Revocation/Status Checking

4.4.6.1 CRL Checking Requirements

A Qualified Relying Party must check the status of all certificates in the certificate validation chain against the current CRL prior to their use. The Qualified Relying Party must also verify the authenticity and integrity of CRLs using the digital signature attached to the CRL. The application shall refresh the CRL at least every 12 hours.

4.4.6.2 Online Revocation Checking Requirements

Each Qualified Relying Party will validate via CRL every e-MARC it receives for every transaction. A transaction includes but are not limited to, web-based authentications, digital signature of documents, digital signature of email, ssl session establishment.

4.4.7 Other Revocation Advertisements

4.4.7.1 Other Forms Available

An Authorized CA may also use other methods to publicize the certificates it has revoked. Any alternative method must meet the following requirements:

- The alternative method must be described in the Authorized CA's approved CPS; and
- The alternative method must provide authentication and integrity services commensurate with the assurance level of the certificate being verified.

4.4.7.2 Checking Requirements

A Qualified Relying Party may also use other methods to verify the status of certificates it has revoked. Any alternative method must meet the following requirements:

- The alternative method must be described in the Authorized CA's approved CPS;
- The alternative method must provide authentication and integrity services commensurate with the assurance level of the certificate being revoked.

4.4.8 Special Requirements for Key Compromise

In the event of the compromise, or suspected compromise, of a Authorized CA signing key, the Authorized CA must immediately notify the Policy Authority and all Authorized CAs to whom it has issued cross-certificates.

In the event of the compromise, or suspected compromise, of any other Entity's signing key, an Entity must notify the issuing Authorized CA immediately.

An Authorized CA must ensure that its CPS or publicly available documents and appropriate agreements contain provisions outlining the means it will use to provide notice of compromise or suspected compromise.

4.5 COMPUTER SECURITY AUDIT PROCEDURES

All significant security events, including at least those specified in Section 4.6.1, on each Authorized CA's system must be logged. These logs shall be maintained in sufficient detail for the Authorized CA to use them as an aid in troubleshooting and as an aid in diagnosing system security breaches. Audit trail files are to be maintained in a secure manner in accordance with section 4.6, and shall not be provided to any entity external to the Authorized CA for any use other than those mentioned in Section 2.7 of this Policy.

4.6 RECORDS ARCHIVAL

4.6.1 Types of Events Recorded

The data and files archived by or on behalf of each Authorized CA must include:

- e-MARC applications, including all application information;
- certificate issuances and transactions;
- system start-up and shutdown;
- authorized CA application start-up and shutdown;
- attempts to create, remove, set passwords or change the system privileges of the PKI Master Office, PKI Office, or PKI Administrator;
- changes to Authorized CA details and/or keys;
- changes to certificate creation policies e.g., validity period;
- login and logoff attempts;
- unauthorized attempts at network access to the Authorized CA system;
- unauthorized attempts to access system files;
- generation of own and subordinate Entity keys;

- revocation of certificates;
- attempts to initialize, remove, enable, and disable Subscribers, and update and recover their keys;
- failed read-and-write operations on the certificate and CRL directory; and
- discrepancy and compromise reports.

All logs, whether electronic or manual, should contain the date and time of the event, and the identity of the entity which caused the event.

An Authorized CA should also collect and consolidate, either electronically or manually, security information, whether or not system or automatically generated, such as:

- physical access logs;
- system configuration changes and maintenance;
- personnel changes;
- discrepancies and compromise reports;
- record of the destruction of media containing key material, activation data, or personal Subscriber information.

An Authorized CA must ensure that all logged events are explained in an audit log summary and that audit logs are actively reviewed either manually or automatically on a regular basis. Any responsive or remedial actions taken following these reviews must be documented.

4.6.2 Retention Period for Archive

Archives of the recorded events in Section 4.6.1 shall be retained and protected against modification, loss, or destruction for a period as specified in the Authorized CA's CPS, but in any event not less than seven years without any loss of data. Applications necessary to read these archives must be maintained for the identical period.

4.6.3 Protection of Archive

The archive media must be protected at least at the level required to maintain and protect all Subscriber information and data from disclosure, modification, or destruction. The media that the archive is stored on must be protected from modification and destruction either by physical security alone, or by a combination of both physical security and cryptographic protection, and must also be provided adequate protection from environmental threats such as temperature, humidity, and magnetism.

4.6.4 Archive Backup Procedures

Adequate backup procedures must be in place so that in the event of the loss or destruction of the primary archives, a complete set of backup copies will be readily available within a 48 hour time period.

4.6.5 Requirements for Time-Stamping of Records

Archived, data, files, and similar records need not be time-stamped as of their creation or modification, but all logs must contain data indicating the time each logged event occurred.

4.6.6 Archive Collection System (Internal or External)

Archive data shall be recorded in any expedient manner.

4.6.7 Procedures to Obtain and Verify Archive Information

Procedures detailing how to create, collect, verify, package, transmit, and store Authorized CA archives shall be published in the Authorized CA's CPS. Only authorized persons shall be permitted to access the archive.

4.7 CA Key Lifetime

The lifetime of a CA certificate is defined as the time under which that CA may issue certificates. The validity period is defined as the time under which that CA certificate is considered valid for the purposes of validity checking. The maximum lifetime of the Root CA certificate will be 20 years. The maximum lifetime of any intermediary CAs will be 10 years, while the lifetime of CA issuing end-entity e-MARCs will be a maximum of 5 years. The validity period of each of these CAs will be longer to account for changeover..

4.8 COMPROMISE AND DISASTER RECOVERY

4.8.1 Computing Resources, Software, and/or Data are corrupted

The Authorized CA must establish business procedures that outline the steps to be taken in the event of the corruption or loss of computing resources, software and/or data. Where a Repository is not under the control of the Authorized CA, a Authorized CA must ensure any agreement with the Repository provides that business continuity procedures be established and documented by the Repository, and must independently verify, or obtain independent verification, that such procedures are followed.

4.8.2 Authorized CA Public Key Is Revoked

In the event of the need for revocation of an Authorized CA's Digital Signature certificate, the Authorized CA must immediately notify:

- The Policy Authority;
- All Authorized CAs to whom it has issued cross-certificates;

- All of its RAs;
- All Subscribers; and
- All individuals or organizations who are responsible for a certificate used by a device or application.

The Authorized CA must also:

- Publish the certificate serial number on an appropriate CRL; and
- Revoke all cross-certificates signed with the revoked Digital Signature certificate.

After addressing the factors that led to revocation, the Authorized CA may:

- Generate a new Authorized CA signing key pair; and/or
- If a new pair is generated, re-issue certificates to all Subscribers and ensure that all CRLs are signed using the new private key (see Section 6.3.3)

4.8.3 Authorized CA Private Key Is Compromised (Key Compromise Plan)

As required by the e-MARC contract each Authorized CA must have in place an appropriate key compromise plan that addresses the procedures that will be followed in the event of a compromise of the private signing key used by an Authorized CA to issue e-MARCs. Such plan shall include procedures for revoking all affected e-MARCs and promptly notifying all Subscribers and all Qualified Relying Parties substantially similar to the procedures under Section 4.8.2.

4.8.4 Secure Facility after a Natural or Other Disaster (Disaster Recovery Plan)

An Authorized CA must have in place an appropriate disaster recovery/business resumption plan. Such plan shall be detailed within the Authorized CA's e-MARC CPS or other appropriate documentation made available to and approved by the Policy Authority.

4.9 AUTHORIZED CA CESSATION OF SERVICES

In the event that an Authorized CA ceases operation or its participation as an Authorized CA in e-MARC or is otherwise terminated:

(a) All Subscribers, sponsoring organizations, and Qualified Relying Parties must be promptly notified of the cessation.
(b) All e-MARCs issued by an Authorized CA shall be revoked no later than the time of cessation.
(c) All current and archived e-MARC identity proofing, certificate, validation, revocation/suspension, renewal, policy and practices, billing, and audit data shall be transferred to the Policy Authority or arrangements shall be made to provide the information upon request made at any time during a period of not less than 3 years. Transferred data shall not include non-e-MARC data.

If the Authorized CA has arranged for the transfer and retention of the Authorized CA's keys and information to another Authorized CA that meets the requirements of this Policy and the Policy Authority, service may be continued under the new Authorized CA and certificates need not be revoked.

4.10 CUSTOMER SERVICE CENTER

As described in the e-MARC contract each Authorized CA shall implement and maintain an e-MARC Customer Service Center to provide assistance and services to Subscribers and Qualified Relying Parties, and a system for receiving, recording, responding to, and reporting e-MARC problems within its own organization and for reporting such problems to the Policy Authority.

SECTION 5

PHYSICAL, PROCEDURAL, AND PERSONNEL SECURITY CONTROLS

5.1 PHYSICAL SECURITY CONTROLS

Each Authorized CA, and all associated RAs, CMAs, and Repositories, shall implement appropriate physical security controls to restrict access to the hardware and software (including the server, workstations, and any external cryptographic hardware modules or tokens) used in connection with providing Authorized CA Services. Access to such hardware and software shall be limited to those personnel performing in a Trusted Role as described in Section 5.2.1.

5.1.1 Site Location and Construction

Physical security controls shall be implemented that protect the Authorized CA hardware and software from unauthorized access and damage. Authorized CA cryptographic modules shall be protected against theft, loss, and unauthorized use. The Authorized CA shall implement appropriate physical security controls to restrict access to and protect the hardware and software used in connection with providing Authorized CA services. Proper physical barriers shall be in place. For instance, surrounding walls shall extend from real ceiling to real floor, not raised floor or suspended ceiling. The facility will be locked and intruder detection systems will be activated while the facility is unoccupied. Fire prevention and protection controls will be in place including a fire extinguisher system. CA facilities must be constructed so as to prevent exposure of systems to water. All electronic physical security devices will be tested daily.

The Authorized CA equipment shall consist of equipment dedicated to the e-MARC Authorized CA function; it shall not perform non- Authorized CA related functions. The Authorized CA's facility shall also store backup and distribution media in a manner sufficient to prevent loss, tampering, or unauthorized use of the stored information.

5.1.2 Asset Classification and Management

Inventory records must be generated and maintained for all equipment used to support Authorized CA operations. Classification of this equipment according to its function and media is required. Assignment of responsibility for each piece of equipment to individuals is also required, maintaining a chain of custody.

5.1.3 Physical Access Controls

Physical access to the Authorized CA's systems will be limited to authorized individuals with a valid purpose to enter. Authentication controls will be used to access areas containing the Authorized CA's systems. Those persons not authorized to enter the facility but who require access for business purposes

can enter the facility only if escorted by authorized personnel. All access to the Authorized CA facility must be logged.

5.1.4 Power and Air Conditioning

The Authorized CA facility shall be supplied with power and air conditioning sufficient to create a reliable operating environment. Personnel areas within the facility shall be equipped with sufficient facilities to satisfy operational needs and comply with all applicable health and safety requirements.

5.1.5 Cabling and Network Devices

Cabling and network devices supporting Authorized CA services shall be protected from interception and damage.

5.1.6 Media Storage, Handling, Destruction, and Reuse

Authorized CA storage media and devices containing storage media shall be checked to ascertain if they contain sensitive data prior to disposal or reuse. Items found to contain sensitive information will be physically destroyed or securely overwritten. All storage media associated with Authorized CA services shall be protected from environmental threats of temperature, humidity and magnetism.

5.1.7 Physical Security Controls for End Entities

A subscriber shall physically protect any password or Personal Identification Number (PIN) that allows entry into the subscriber's digital certificate. Passwords or PINs should be memorized and not written down. If a password or PIN needs to be written down, it shall be stored in a locked file cabinet or container accessible only to authorized personnel.

5.2 PROCEDURAL CONTROLS

5.2.1 Trusted Roles

An Authorized CA must ensure a separation of duties for critical Authorized CA functions to prevent one person from maliciously using the Authorized CA system without detection.

An Authorized CA should provide for a minimum of two distinct PKI personnel roles, distinguishing between day-to-day operation of the Authorized CA system and the management and audit of those operations. The selection and distinction of trusted roles must provide resistance to insider attack.

5.2.2 Number of Persons Required Per Task

An Authorized CA shall utilize commercially reasonable practices to ensure that one person acting alone cannot circumvent security safeguards or otherwise compromise the integrity of the e-MARC system.

5.2.3 Identification and Authentication for Each Role

All Authorized CA personnel must have their identity and authorization verified under procedures substantially similar to those stipulated in Sections 3.1.9 and 5.3.2 before they are:

- included in the access list for the Authorized CA site;
- included in the access list for physical access to the Authorized CA system;
- given a certificate for the performance of their Authorized CA role;
- given an account on the PKI system.

Each of these certificates and accounts must be:

- directly attributable to a single individual (not shared);
- securely stored; and
- restricted to actions authorized for that role through the use of Authorized CA software, operating system and procedural controls.

Authorized CA operations must be secured, using mechanisms such as token-based strong authentication and encryption, when accessed across a shared network.

5.3 PERSONNEL SECURITY CONTROLS

Each Authorized CA and its RA, CMA, and Repository subcontractors shall formulate and follow personnel and management policies sufficient to provide reasonable assurance of the trustworthiness and competence of their employees and of the satisfactory performance of their duties in a manner consistent with this Policy.

5.3.1 Personnel Security Controls for Certification Authorities

The individual(s) assuming the role of the Authorized CA Administrator should exhibit loyalty, trustworthiness and integrity, and should demonstrate a high degree of security consciousness.

All Authorized CA personnel shall:

- Not be assigned duties that would interfere with their other responsibilities;
- Not knowingly have been previously relieved of a past assignment for reason of negligence or non-performance duties;
- Be appointed in writing by an approving authority;
- Have received proper training in the performance of their duties.

5.3.2 Clearance Procedures

Clearance procedures, such as background checks consistent with all legally binding obligations, are required for personnel filling positions where a high degree of trust is required. Clearance procedures must be an on-going process.

5.3.3 Training

Authorized CA employees must receive training in the organizational policies and procedures to ensure the Authorized CA's policies are adhered to. Training must be an ongoing and documented process.

5.3.4 Sanctions for Unauthorized Actions

In the event of actual or suspected unauthorized action by a person performing duties with respect to the operation of the Authorized CA, their access to the system must be revoked or suspended. Breach of this Policy whether through negligence or with malicious intent, is subject to privilege revocation, administrative discipline, and/or civil and/or criminal prosecution.

5.3.5 Employee Termination Controls

Once an employee holding a position of trust or any level of system access leaves the organization, their physical access and system access must be revoked immediately.

5.3.6 Contracting Personnel

Contractor personnel employed to operate any part of the Authorized CA are subject to the same clearance procedures specified in section 5.3.2.

5.3.7 Documentation Supplied to Personnel

The Policy and relevant parts of the CPS shall be made available to the Authorized CA personnel and subscribers. Operation manuals shall be made available to Authorized CA personnel to facilitate the operation and maintenance of the Authorized CA, but must not be copied by them or given to a non-authorized person, and must be returned upon suspension or termination of access rights.

5.3.8 Personnel Security Controls for End Entities

Subscribers shall be provided with information on the use and protection of the software used within the e-MARC domain. The Authorized CA shall provide a support line for all subscribers.

SECTION 6

TECHNICAL SECURITY CONTROLS

6.1 KEY PAIR GENERATION AND INSTALLATION

6.1.1 Key Pair Generation

(a) General. Key pairs for all Program Participants must be generated in such a way that the private key is not known by other than the authorized user of the key pair except as noted for key backup and/or escrow. Authorized CA, RA, and CMA keys may be generated in either hardware or software, although hardware based key generations is preferred. Key pairs for Subscribers and Qualified Relying Party applications can be generated in either hardware or software. Minimum requirements for key pair generation are shown in Table 6-1 below.

Table 6-1. Minimum Key Pair Generation Requirements

Certificate Key Usage	Category	Minimum Key Generation Requirement
CA certificates	Certificate Authorities	FIPS 140-2 Level 3 hardware device
Encryption certificates	Unaffiliated Individual	FIPS 140-2 Level 1 hardware or software
	Business Representative	FIPS 140-2 Level 1 hardware or software
	Business Representative authorized to act on behalf of a Sponsoring Organization	FIPS 140-2 Level 1 hardware or software
	Device	FIPS 140-2 Level 1 hardware or software
	Role	FIPS 140-2 Level 1 hardware or software
Digital Signing certificates – Individual	Unaffiliated Individual	FIPS 140-2 Level 1 hardware or software and non exportable except by the subscriber
	Business Representative	FIPS 140-2 Level 1 hardware or software and non exportable except by the subscriber

(b) If key pair generation is performed in hardware, the private key must be non-exportable from the hardware device that created it. If key pair generation is performed in software, the system used to generate the key-pair must be accessible to the Program Participant and initiated by the authorized user of the key pair (subscriber and/or Program Participant).

(c) If key pair generation is performed in a manner inconsistent with the policies described in this section, the public key is not a candidate for signing or certificate issuance by an Authorized CA. If it is discovered by any Program Participants that a certificate was issued in violation of 6.1.1a or 6.1.1b, the certificate must be revoked.

(d) Exact FIPS level requirements are documented and explained in National Institute of Standards and Technology (NIST). *FIPS Publication 140-2: Security Requirements for Cryptographic Modules)* which includes all change documents.

6.1.2 Private Key Delivery to Entity

Private keys shall not be delivered as specified in Section 4.2.1

6.1.3 Subscriber Public Key Delivery to Authorized CA

As part of the e-MARC Certificate application process, the Subscriber's public key must be transferred to the Registration Authority or Authorized CA in a way that ensures that (1) it has not been changed during transit; (2) the sender possesses the private key that corresponds to the transferred public key; and (3) the sender of the public key is the legitimate user claimed in the certificate application. If done on-line, the delivery mechanism should be in accordance with the Public Key Infrastructure X.509V3 (PKIX-3) Certificate Management Protocol (See RFC 2510), or via an equally secure manner.

6.1.4 Authorized CA Public Key Delivery to Users

In accordance to an Authorized CA's CPS.

6.1.5 Key Sizes

Key sizes and algorithms shall be a minimum of 1024 bits and preferably 2048 bits for all e-MARC end-entities (Subscribers, Business Partners, Devices, and Qualified Relying Parties). All Authorized CAs in the e-MARC trust hierarchy shall use a minimum of 2048 bits for all keys. All certificates will display the Public Key length and a minimum length of:

Certificate Key Usage	Min. Public Key Length
CA certificates	2048
Encryption certificates	1024
Digital Signing certificates – Individual	1024

Detailed information describing each certificate is contained in section 7.

6.1.6 Public key parameters generation

Public key parameters shall always be generated and checked in accordance with the standard that defines the crypto-algorithm in which the parameters are to be used. For example, public key parameters for use with algorithms defined in the *Digital Signature Standard* [FIPS 186-2] shall be generated and tested in accordance with FIPS 186-2. Public key parameters for use with the RSA algorithm defined in PKCS-1 shall be generated and checked in accordance with PKCS-1, and so on.

Whenever a crypto-algorithm is described FIPS 186-2, the parameter generation and checking requirements and recommendations of FIPS 186-2 shall be required of all entities generating key pairs whose public components are to be certified by the e-MARC PKI.

6.1.7 Key usage purposes (as per X.509 v3 key usage field)

e-MARC keys shall be certified for use in signing or encrypting, but not both. The use of a specific key is determined by the key usage extension in the X.509 certificate. This restriction is not intended to prohibit use of protocols that provide authenticated connections using key management certificates.

e-MARC Software certificates include a single key for use with either encryption or digital signature. Such certificates shall be generated and managed in accordance with their respective signature certificate requirements, except where otherwise noted in this policy. Certificate issued for encryption purposes shall never assert non-repudiation and shall not be used for authenticating data. Certificates issued for digital signature must assert non-repudiation and may be used for authenticating data.

e-MARC Hardware Token certificates may include a single key for use by a single individual or multiple individuals (role-based) in support of legacy applications. Such "role-based" certificates shall be generated and managed in accordance with their respective signature certificate requirements. "Role-based" certificates shall assert non-repudiation; however, the actions taken by that certificate shall be non-repudiable to the sponsoring organization and not the individuals using the token.

Public keys that are bound into certificates which assert the e-MARC assurance policies shall be certified for use solely for the purposes expressed in the key usage field. The use of a specific key is determined by the key usage extension in the X.509 certificate. This restriction is not intended to prohibit use of protocols (like the Secure Sockets Layer) that provide authenticated connections using key management certificates. See section 7 for a description of the specific key usages expressed in each e-MARC.

6.2 AUTHORIZED CA PRIVATE KEY PROTECTION

Each Authorized CA, RA, and CMA shall each protect its private key(s) in accordance with the provisions of their e-MARC contract, this Policy, and best industry practice.

The relevant standard for cryptographic modules is *Security Requirements for Cryptographic Modules* [current version of FIPS140]. The Policy Authority may determine that other comparable validation, certification, or verification standards are sufficient. These standards will be published by the Policy Authority. Cryptographic modules shall be validated to meet or exceed the FIPS 140 level identified in this section, or validated, certified, or verified via one of the standards published by the Policy Authority. A PKI should provide the option of using any acceptable cryptographic module, to facilitate the management of Subscriber certificates.

All cryptographic modules shall be operated such that the private asymmetric cryptographic keys shall never be output in plaintext. No private key shall appear unencrypted outside the Authorized CA equipment.

No one shall have access to a private signing key but the Authorized CA. Any private key management keys held by an authorized CA shall be held in strictest confidence.

Note that Section 6.1.1 stipulates minimum cryptographic module requirements for key generation.

	Subscriber	Authorized **RA**	Authorized **CA**
FIPS 140 validation	Level 1 or 2	Level 2	Level 3
Operational requirement	Shall not output private asymmetric key in plaintext		

6.3 OTHER ASPECTS OF KEY PAIR MANAGEMENT

6.3.1 Public Key Archival

The issuing Authorized CA must retain all verification public keys. In no circumstances shall an attempt be made to archive or create a repository for private signing keys except as described as one or more of the following methods:

Backup: The End Entity named in the certificates subject makes a duplicate copy of the certificate including the private key. The duplicate is secured in such a way that only the End Entity can restore the certificate and private key.

Archive: The authorized representative of the End Entity's organization makes a duplicate copy of the certificate including the private key. The duplicate is secured in such a way that only the authorized representative of the End Entity's organization can restore the certificate and private key.

Also see section *6.1.1 Key Pair Generation*). Table 6.2-1 below, provides the approved mechanism for for each type of e-MARC.

Table 6.2-1. Key Backup/Archive Allowances

Certificate Key Usage	Category	Backup Allowed	Archive Allowed
CA certificates	Certificate Authorities	Per FIPS Level 3 requirements.	Per FIPS Level 3 requirements.
Encryption certificates	Unaffiliated Individual	Yes	Yes
	Business Representative	Yes	Yes
	Business Representative authorized to act on behalf of a Sponsoring Organization	Yes	Yes
	Device	No	Yes
	Role	No	Yes
Digital Signing certificates – Individual	Unaffiliated Individual	No[1]	No
	Business Representative	No[1]	No

1 Digital Signing certificates for individuals have exportable private keys which will allow the End Entity to backup the certificate. Only an individual shall export & backup their Digital Signature keys.

6.3.2 Usage Periods for the Public and Private Keys (Key Replacement)

Subscriber key pair must be replaced in accordance with the validity periods specified in the applicable certificate profile. (see Section 7.1 Certificate and CRL Profiles).

6.3.3 Restrictions on Authorized CA's Private Key Use

The private key used by Authorized CAs for issuing e-MARCs shall be used only for signing such Certificates and, optionally, CRLs or other validation services responses pursuant to Section 4.8.2.

A private key held by a CMA, if any, and used for purposes of manufacturing e-MARCs, is considered the Authorized CA's signing key, is held by the CMA as a fiduciary, and shall not be used by the CMA for any other purposes, except as agreed to by the Policy Authority and the Authorized CA. Any other private key used by a CMA for purposes associated with its CMA function shall not be used for any other purpose without the express permission of the Authorized CA.

The private key used by each RA employed by an Authorized CA in connection with the issuance of e-MARCs shall be used only for communications relating to the approval or revocation of such certificates.

6.4 ACTIVATION DATA

No stipulation.

6.5 COMPUTER SECURITY CONTROLS

No stipulation.

6.6 Life Cycle Technical Controls

New equipment and software, including patches and updates, must be thoroughly tested on a separate platform prior to release on operational systems.

A Security Policy document must exist. This document must provide guidance facilitating the secure operation of the Authorized CA and ensuring the integrity of its operating environment.

6.7 NETWORK SECURITY CONTROLS

Access to unused ports and services must be denied. Users shall be provided access only to services that they are specifically authorized to use. Remote access and connections from remote computers must be limited to those who absolutely necessary, and must be properly authenticated. External threats shall be mitigated by controls such as firewalls, network intrusion detection systems and router access control lists to protect the internal network. The Authorized CA shall document security attributes of all network services.

6.8 CRYPTOGRAPHIC MODULE ENGINEERING CONTROLS

Requirements for cryptographic modules are as stated above in Sections 6.1.1 and 6.2.

SECTION 7

CERTIFICATE AND CRL PROFILES

7.1 CERTIFICATE PROFILE

e-MARCs shall contain public keys used for authenticating the sender of an electronic message and verifying the integrity of such messages, i.e., public keys used for digital signature verification and symmetric key exchange.

The Authorized CA shall create and maintain e-MARCs that conform to the International Telecommunications Union – Telecommunications Sector (ITU-T) Recommendation X.509, "The Directory: Authentication Framework," June 1997.

All e-MARCs must include a reference to an OID for this Policy within the appropriate field, and contain the required certificate fields according to the Authorized CA's CPS and the e-MARC Contract.

The Authorized CA certificate shall be issued in the X.509 format, and it will include a reference to the OID for this Policy (or equivalent OID) within the Certificate Policies field. Supported certificate extensions shall be identified in the e-MARC CPS.

7.1.1 Certification Authority Certificates

e-MARC will employ certificates that follow the X.509 Version 3 (v3) standard. This section describes the certificate fields and standard extensions that the e-MARC PKI uses. The e-MARC PKI will provide several standard certificates. Standard certificates have a specific profile and support large communities of users. IETF RFC 2549 provides additional details on the specific format and content of certificates. X.509v3 and RFC 2549 provide guidance that must be supplemented with choices identified in this profile. Interoperability testing with the Authorized CAs is designed to help ensure interoperability.

In the profiles that follow (represented in tabular form) there are portions from a basic certificate and other portions that are extensions. An extension may be critical or non-critical. If an extension is critical and an application does not recognize or cannot process that extension, the application must reject any transaction that depends on such a certificate. In the following tables, "c=yes" or "c=no" is used to represent "critical" and "non-critical" respectively. In addition, the terms "must be present" or "may be present" dictate whether a CA *must* include the extension as a matter of policy or if a certificate without that extension is acceptable. This may be a matter of Policy (for the e-MARC profile column) or a requirement from the IETF or FPKI depending on where the phrases appear in the table.

7.1.1.1 Root Certificates

There are three types of CA certificates. The Root CA will issue two types. The first type is for the Root CA itself, and the second type is for the Energy Sector Specific (Electric, Gas, Petroleum) subordinate CAs that exists at the second level of the certificate hierarchy. The third type is for the e-MARC signing Authorized CAs that exists at the third level of the certificate hierarchy. The following sections describe these certificates. The Root CA is a basic certificate with the least number of certificate extensions. The Root CA's certificate is self-signed, (i.e., Root CA is both the certificate issuer and subject). The Root CA issues the certificates for the Energy Sector Subordinate CAs. The Subordinate CAs includes the extensions found in the Root CA and some additional extensions. This Policy will only discuss the Electric Sector Subordinate CA. The Electric Sector Subordinate CAs issues the certificates for the e-MARC Authorized CAs. The e-MARC Authorized CAs includes the extensions found in the Subordinate CA, the Root CA and some additional extensions. e-MARC Authorized CAs issues the certificates for the e-MARC end-entities which include Subscribers and Qualified Relying Parties. Subscribers will receive Identity Certificates and Encryption Certificates, while Qualified Relying Parties will only receive and Identity Certificate.

Table 7-1. Root Certification Authority Certificate Profile

FIELD	e-MARC Root CA Certificate
Basic Certificate	
Version	V3 (2)
Serial Number	Unique Integer
Issuer Signature Algorithm	SHA1 with RSA or DSA with SH1
Issuer Distinguished Name	X.500 DN: cn=Energy CLASS 3 Root CA, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)[3]
Validity Period	20 years from date of issue (UTCTime, Zulu); The notBefore component will be the certificate's issue date. The notAfter component will be midnight on the day ending the duration given in the table.
Subject Distinguished Name	X.500 DN: cn= Energy CLASS 3 Root CA, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is each RDN is printableString3) will be unique
Subject Public Key Information	2048 bit RSA key modulus, rsaEncryption
Issuer Unique Identifier	Not used
Subject Unique Identifier	Not used
Issuer's Signature	SHA1 with RSA or DSA with SH1
Standard Extensions	
authority key identifier	Not used (since same as subject key identifier for self signed certificate)

[3] e-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

FIELD	e-MARC Root CA Certificate
subject key identifier	c=no; 20 byteSHA-1 hash of the binary DER encoding of the Root CA's public key information
key usage	Not used
Extended key usage	Not used
Private key usage period	Not used
Certificate policies	Not used
Policy Mapping	Not used (since cross certification is not supported)
subject Alternative Name	Not used
Issuer Alternative Name	Not used
Subject Directory Attributes	Not used

Basic Constraints	c=no[4];
	cA=True;
	no path length constraint

Name Constraints	Not used
Policy Constraints	Not used
CRL Distribution Points	Not used since Root's CRL will be short.
Private Internet Extensions	
Authority Information Access	Not used

7.1.1.2 Energy Sector Subordinate CA Certificates

Table 7-2. Energy Sector Subordinate Certification Authority Certificate Profile

FIELD	Energy Sector Subordinate CA Certificate
Basic Certificate	
Version	V3 (2)
Serial Number	Unique integer
Issuer Signature Algorithm[5]	SHA1 with RSA or DSA with SH1
Issuer Distinguished Name	X.500 DN: cn=Energy] CLASS 3 Root CA, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)[6]
Validity Period	6 years from date of issue (UTCTime, Zulu); The notBefore component will be the certificate's issue date. The notAfter component will be midnight on the day ending the duration given in the table.

[4] The decision to make Basic Constraints non-critical for the Root CA was based on a desire to ensure that applications would not reject the root if they could not process Basic Constraints.

[5] e-MARC will use the PKIX algorithm, but will monitor trends to determine if it should migrate to the X9.31 standard, based on commercial acceptance.

[6] E-MAR will monitor commercial practice and migrate to UTF8 format when appropriate

FIELD	Energy Sector Subordinate CA Certificate
Subject Distinguished Name[7]	X.500 DN: For identity certificates: cn=[Electric, Gas, Petroleum] CLASS 3 CA-<n>, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)[8] For email certificates: cn= [Electric, Gas, Petroleum] E-MARC CLASS 3 EMAIL CA-<n>, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)
Subject Public Key Information	2048 bit RSA key modulus, rsaEncryption
Issuer Unique Identifier	Not used
Subject Unique Identifier	Not used
Issuer's Signature	SHA1 with RSA or DSA with SH1
Standard Extensions	
authority key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the Root CA's public key information
subject key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the subject's public key information
key usage	c=yes; digitalSignature[9], keyCertSign, cRLSign
Extended key usage	Not used
Private key usage period	Not used
Certificate policies	c=no[10]; id-US-e-MARC-class3 id-US-e-MARC-class3hardware reserved[11] No Policy qualifiers[12]
Policy Mapping	Not used
subject Alternative Name	Not used
Issuer Alternative Name	c=no, URI of directory entry of Root
Subject Directory Attributes	Not used

Basic Constraints	c=yes;
	cA=True;
	no path length constraint

Name Constraints	Not used[13]

[8] e-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

[9] The digital signature is included for cases where the CA must authenticate to other entities, e.g., a directory.

[10] Certificate Policies is non-critical to permit broadest client support.

[11] A policy OID has been reserved for future use.

[12] No value seen in pointing to display text.

[13] The e-MARC does not require names of entities to match the names of the CAs

FIELD	Energy Sector Subordinate CA Certificate
Policy Constraints	c=no[14]; requireExplicitPolicy set with skipCerts set to zero, inhibitPolicyMapping.
CRL Distribution Points	c=no; distribution point = URI of directory entry of CA; all reason codes, CRL issuer is CA:[15] e.g., ldap://tbd/ cn=e-MARC CLASS 3 Root CA, ou=PKI, ou=NERC, ou=U.S. Government, c=US?certificateRevocationList;binary[16]
Private Internet Extensions	
Authority Information Access	Not used

7.1.1.3 E-MARC CA Certificates

Table 7-3. E-MARC Certification Authority Certificate Profile

FIELD	E-MARC CA Certificate
Basic Certificate	
Version	V3 (2)
Serial Number	Unique integer
Issuer Signature Algorithm[17]	SHA1 with RSA or DSA with SH1
Issuer Distinguished Name	X.500 DN: cn=[Electric, Gas, Petroleum] CLASS 3 Root CA, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)[18]
Validity Period	6 years from date of issue (UTCTime, Zulu); The notBefore component will be the certificate's issue date. The notAfter component will be midnight on the day ending the duration given in the table.
Subject Distinguished Name[19]	X.500 DN: For identity certificates: cn=[E-MARC#] CLASS 3 CA-<n>, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)[20] For email certificates: cn= [E-MARC#] E-MARC CLASS 3 EMAIL CA-<n>, ou=PKI, ou=e-MARC, o=FERC, c=US, (each RDN is printableString)
Subject Public Key Information	2048 bit RSA key modulus, rsaEncryption
Issuer Unique Identifier	Not used

[14] Policy constraints is non-critical to permit broadest client support

[15] Use of a single distribution point for all reasons is intended as a transitional implementation. Future implementations may partition the CRL by reason and store the at separate distribution points.

[16] Actual encoding would be: TBD

[17] e-MARC will use the PKIX algorithm, but will monitor trends to determine if it should migrate to the X9.31 standard, based on commercial acceptance.

[18] E-MAR will monitor commercial practice and migrate to UTF8 format when appropriate

[20] e-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

FIELD	E-MARC CA Certificate
Subject Unique Identifier	Not used
Issuer's Signature	SHA1 with RSA or DSA with SH1
Standard Extensions	
authority key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the Root CA's public key information
subject key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the subject's public key information
key usage	c=yes; digitalSignature[21], keyCertSign, cRLSign
Extended key usage	Not used
Private key usage period	Not used
Certificate policies	c=no[22]; id-US-e-MARC-class3 id-US-e-MARC-class3hardware reserved[23] No Policy qualifiers[24]
Policy Mapping	Not used
subject Alternative Name	Not used
Issuer Alternative Name	c=no, URI of directory entry of Root
Subject Directory Attributes	Not used

Basic Constraints	c=yes;
	cA=True;
	no path length constraint

Name Constraints	Not used[25]
Policy Constraints	c=no[26]; requireExplicitPolicy set with skipCerts set to zero, inhibitPolicyMapping.
CRL Distribution Points	c=no; distribution point = URI of directory entry of CA; all reason codes, CRL issuer is CA:[27] e.g., ldap://tbd/ cn=e-MARC CLASS 3 Root CA, ou=PKI, ou=NERC, c=US?certificateRevocationList;binary[28]

[21] The digital signature is included for cases where the CA must authenticate to other entities, e.g., a directory.

[22] Certificate Policies is non-critical to permit broadest client support.

[23] A policy OID has been reserved for future use.

[24] No value seen in pointing to display text.

[25] The e-MARC does not require names of entities to match the names of the CAs

[26] Policy constraints is non-critical to permit broadest client support

[27] Use of a single distribution point for all reasons is intended as a transitional implementation. Future implementations may partition the CRL by reason and store the at separate distribution points.

FIELD	E-MARC CA Certificate
Private Internet Extensions	
Authority Information Access	Not used

7.1.2 e-MARC Server Certificates

Server certificates primarily support the use of secure Web applications using SSL. SSL relies on the server key to exchange a symmetric session key. Servers initiating SSL sessions with other servers may also need to authenticate using a digital signature key.

Table 7-4. e-MARC Standard Server Certificate Profiles

FIELD	E-MARC Server Certificate
Basic Certificate	
Version	V3 (**2**)
Serial Number	Unique integer
Issuer Signature Algorithm[29]	SHA1 with RSA or DSA with SH1
Issuer Distinguished Name	X.500 DN: cn=e-MARC CLASS 3 CA-<n>, ou=PKI, ou=E-MARC, o=FERC, c=US (each RDN is printableString)[30]
Validity Period	3 years from date of issue: (UTCTime, Zulu); The notBefore component will be the certificate's issue date. The notAfter component will be midnight on the day ending the duration given in the table.
Subject Distinguished Name	X.500 DN: cn=<host address>, ou=<C/S/A>, ou=PKI, ou=E-MARC, o=FERC, c=US (each RDN is printableString)[31]
Subject Public Key Information	1024 bit RSA key modulus, rsaEncryption
Issuer Unique Identifier	Not used
Subject Unique Identifier	Not used
Issuer's Signature	SHA1 with RSA or DSA with SH1
Extensions	
authority key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the signing CA's public key information
subject key identifier	c=**no**; must be present, 20 byte SHA-1 hash of the binary DER encoding of the subject's public key information

[28] Actual encoding would be: TBD

[29] E-MARC will use the PKIX algorithm, but will monitor trends to determine if it should migrate to the X9.31 standard, based on commercial acceptance.

[30] E-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

[31] E-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

FIELD	E-MARC Server Certificate
key usage	c=yes; keyEncipherment, digitalSignature[32]
Extended key usage	Not used[33]
Private key usage period	Not used
Certificate policies	c=no[34]; id-US-e-MARC-class3 No Policy qualifiers[35]
Policy Mapping	Not used
subject Alternative Name	Not used
Issuer Alternative Name	URI of CA's directory entry
Subject Directory Attributes	Not used
Basic Constraints	Not used in EE certificates
Name Constraints	Not used[36]
Policy Constraints	Not used
CRL Distribution Points	c=**no**; distribution point = URI of directory entry of CA that issued this certificate; all reason codes, CRL issuer is CA [37]
Private Internet Extensions	
Authority Information Access	Not used

7.1.3 User Certificates

The identity certificate is normally for people and is the electronic equivalent of an ID card. This certificate contains limited, relatively static information. It does not include more dynamic information such as detailed organizational affiliation and e-mail address. The subject name in the certificate is the DN for a corresponding entry in the directory.

[32] Since many products do not currently support separate signing and key exchange keys, use of the same key for both is being permitted. There are no current requirements for non-repudiation in servers, which is helpful since the same certificate could not support both non-repudiation and key exchange.

[33] Exteneded key usage may be supported in the future for end entity certificates

[34] Certificate Policies is non-critical to permit broadest client support.

[35] No value seen in pointing to display text.

[36] The E-MARC does not require names of entities to match the names of the CAs

[37] Actual encoding would be:
TBD

7.1.3.1 Identity Certificates

Table 7-5. Standard User Identity Certificate Profile

FIELD	E-MARC Identity Certificate
Basic Certificate	
Version	V3 (2)
Serial Number	Unique integer
Issuer Signature Algorithm[38]	SHA1 with RSA or DSA with SH1
Issuer Distinguished Name	X.500 DN: cn=E-MARC CLASS 3 CA-<n>, ou=PKI, ou=E-MARC, o=FERC, c=US (each RDN is printableString)[39]
Validity Period	1 years from date of issue (UTCTime, Zulu); The notBefore component will be the certificate's issue date. The notAfter component will be midnight on the day ending the duration given in the table.
Subject Distinguished Name	X.500 DN: cn=<name>[40], ou=<C/S/A>, ou=PKI, ou=E-MARC, o=FERC, c=US [41]
Subject Public Key Information	1024 bit RSA key modulus, rsaEncryption
Issuer Unique Identifier	Not used
Subject Unique Identifier	Not used
Issuer's Signature	SHA1 with RSA or DSA with SH1
Standard Extensions	
authority key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the signing CA's public key information
subject key identifier	c=no; must be present, 20 byte SHA-1 hash of the binary DER encoding of the subject's public key information
key usage	c=yes; digitalSignature, nonRepudiation
Extended key usage	Not used[42]
Private key usage period	Not used

[38] E-MARC will use the PKIX algorithm, but will monitor trends to determine if it should migrate to the X9.31 standard, based on commercial acceptance.

[39] E-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

[40] In user certificates issued by the E-MARC, the entire common name will not exceed 64 characters and will be unique. Applications should not assume a particular format for the common name. The current thought is, the common name consists of last name, generational qualifier, first name or initial, and a middle name or initial, separated by periods; e.g., Smith.Jr.John.A. Future releases may make other changes to the format.

[41] E-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

[42] Exteneded key usage may be supported in the future for end entity certificates

FIELD	E-MARC Identity Certificate
Certificate policies	c=no[43]; id-US-e-MARC-class3 or id-US-e-MARC-class3hardware No Policy qualifiers[44]
Policy Mapping	Not used
subject Alternative Name	Not used
Issuer Alternative Name	C=no; URI of CA's directory entry in IA5String format e.g., TBD[45]
Subject Directory Attributes	Not currently used
Basic Constraints	Not used
Name Constraints	Not used
Policy Constraints	Not used
CRL Distribution Points	c=**no**; distribution point = URI of directory entry of CA; all reason codes, CRL issuer is CA:[46] e.g., TBD[47]
Private Internet Extensions	
Authority Information Access	Not used

7.1.3.2 Encryption (E-Mail) Certificate

The purpose of e-mail certificates is to enable the associated subscriber to use S/MIME email. S/MIME e-mail provides capability to send either or both signed and encrypted e-mail. There will be two versions of e-mail certificate. One version is for the verification of signed messages that the subscriber sends, and the other is for the encryption of symmetric message keys for messages the subscriber receives. S/MIME e-mail certificates must include the certificate owner's e-mail address. A user's email address is contained in the subject alternative name extension. Note that this is a change from the E-MARC PKI version 1.0 which placed the email address in an "E=" attribute in the subject distinguished name.

---

[43] Certificate Policies is non-critical to permit broadest client support.

[44] No value seen in pointing to display text.

[45] Actual encoding:
TBD; the purpose is to aid in obtaining a certificate chain by pointing to the directory entry where the certificate is stored.

[46] Use of a single distribution point for all reasons is intended as a transitional implementation. Future implementations may partition the CRL by reason and store the at separate distribution points.

[47] Actual encoding would be:
TBD

Table 7-6. Standard Encryption Certificate Profile

FIELD	E-MARC Encryption (E-mail) Certificate
Basic Certificate	
Version	V3 (2)
Serial Number	Unique integer
Issuer Signature Algorithm	SHA1 with RSA or DSA with SH1
Issuer Distinguished Name	X.500 DN: cn=E-MARC CLASS 3 EMAIL CA-<n>, ou=PKI, ou=E-MARC, o=FERC, c=US (each RDN is printableString)[48]
Validity Period	1 years from date of issue (UTCTime, Zulu); The notBefore component will be the certificate's issue date. The notAfter component will be midnight on the day ending the duration given in the table.
Subject Distinguished Name	X.500 DN: <name>,[49] ou=<C/S/A>, ou=PKI, ou=E-MARC, o=FERC, c=US[50]
Subject Public Key Information	1024 bit RSA key modulus, rsaEncryption
Issuer Unique Identifier	Not used
Subject Unique Identifier	Not used
Issuer's Signature	SHA1 with RSA or DSA with SH1
Standard Extensions	
authority key identifier	c=no; 20 byte SHA-1 hash of the binary DER encoding of the signing CA's public key information
subject key identifier	c=no; 20 byte SHA-1 hash of the binary DER encoding of the subject's public key information
key usage	c=yes; email signing certificate[51]: digitalSignature and non-repudiation email key exchange certificate: keyEncipherment
Extended key usage	Not used[52]
Private key usage period	Not used

[48] E-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

[49] In user certificates issued by the E-MARC, the entire common name will not exceed 64 characters and will be unique. Applications should not assume a particular format for the common name. In current certificates, the common name consists of last name, generational qualifier, first name or initial, and a middle name or initial; e.g., Smith.Jr.John.A. Future releases may make other changes to the format.

[50] E-MARC will monitor commercial practice and migrate to UTF8 format when appropriate

[51] Because many S/MIME clients do not enforce functional separation both the digitalSignature and keyEncipherment flags may be set in older certificates. However, since S/MIME clients that enforce functional separation the PKI are beginning to become available, the E-MARC PKI will issue one S/MIME certificate with the digital signature and non-repudiation bits set and a second certificate with the key encipherment bit set.

[52] Extended key usage may be supported in the future for end entity certificates

FIELD	E-MARC Encryption (E-mail) Certificate
Certificate policies	c=no[53]; id-US-e-MARC-class3 or id-US-e-MARC-class3hardware No Policy qualifiers[54]
Policy Mapping	Not used
subject Alternative Name	C=no; RFC822 Name
Issuer Alternative Name	C=no; URI of CA's directory entry
Subject Directory Attributes	Not currently used
Basic Constraints	Not used
Name Constraints	Not used
Policy Constraints	Not used
CRL Distribution Points	c=**no**; distribution point = URI of directory entry of CA; all reason codes, CRL issuer is CA [55]
Private Internet Extensions	
Authority Information Access	Not used

7.1.4 Version Number

All certificates shall be X.509 "Version 3" certificates.

7.1.5 Signature Algorithm

All certificates will use SHA1 with RSA or DSA with SH1.

7.1.6 Certificate Validity Periods

Certificate Key Usage	Validity Period
Root CA certificates	20
Energy Sector CA certificates	10
e-MARC CA certificates	5
End Entity Encryption certificates	1 year
End Entity Digital Signing certificates – Individual	1 year
End Entity Digital Signing certificates – Organization	1 year

[53] Certificate Policies is non-critical to permit broadest client support.

[54] No value seen in pointing to display text.

[55] Actual encoding would be:
TBD

7.1.7 Public Algorithm Identifiers

Certificates under this Policy will use the following OIDs for signatures:

signature algorithm	OID
id-dsa-with-sha1	{iso(1) member-body(2) us(840) x9-57(10040) x9cm(4) 3}
sha-1WithRSAEncryption	{iso(1) member-body(2) us(840) rsadsi(113549) pkcs(1) pkcs-1(1) 5}
ecdsa-with-SHA1	{iso(1) member-body(2) us(840) ansi-x9-62 (10045) signatures (4) 1 }

Certificates under this Policy will use the following OIDs for identifying the algorithm for which the subject key was generated:

algorithm	OID
id-dsa	{iso(1) member-body(2) us(840) x9-57(10040) x9cm(4) 1}
Id-ecPublicKey	{iso(1) member-body(2) us(840) ansi-x9-62(10045) public-key-type (2) 1}
rsaEncryption	{iso(1) member-body(2) us(840) rsadsi(113549) pkcs(1) pkcs-1(1) 1}
dhpublicnumber	{iso(1) member-body(2) us(840) ansi-x942(10046) number-type(2) 1}

The e-MARC PKI shall certify only public keys associated with the crypto-algorithms identified above, and shall only use the signature crypto-algorithms described above to sign certificates, certificate revocation lists and any other PKI product.

7.1.8 Public Key Length

All certificates will display the Public Key length and a minimum length of:

Certificate Key Usage	Min. Public Key Length
Root CA certificates	2048
Energy Market CA certificates	2048
e-MARC CA certificates	2048
Encryption certificates	1024
Digital Signing certificates – Individual	1024

7.1.9 Key Usage and Enhanced Key Usage

All certificates will have the Key Usage (marked as critical) extension. This extension, along with the Enhanced Key Usage extension, will be used to determine what the certificate can be used for (i.e. the Certificate Key Usage).

All certificates will display the Key Usage extension and use one or more of these available values.

Digital Signature (0),
Non Repudiation (1),
Key Encipherment (2)
Data Encipherment (3)
Key Agreement (4),
Certificate Signing (5),
CRL Signing (6),
Encipher Only (7),
Decipher Only (8)

The Enhanced Key Usage extension indicates one or more purposes for which the public key may be used, in addition to, or in place of the basic purposes indicated in the Key Usage extension. This extension will appear only in end entity certificates and use one or more of these available purposes.

Server Authentication (9)
Client Authentication (10)
Code Signing (11)
Secure Email (12)

Certificate Key Usage	**Category**	**Key Usage(s)**	**Enhanced Key Usage**	**Must NOT Set**
CA certificates	Certificate Authorities	0,1,5,6	None	11,12
Encryption certificates	Unaffiliated Individual	2,3,4,7,8	None	0,1,5,6,9,10,11,12
	Business Representative	2,3,4,7,8	None	0,1,5,6,9,10,11,12
	Business Representative authorized to act on behalf of a Sponsoring Organization	2,3,4,7,8	None	0,1,5,6,9,10,11,12
	Role	2,3,4,7,8	None	0,1,5,6,9,10,11,12
Digital Signing certificates – Individual	Unaffiliated Individual	0,1,2,3,4,7,8	10,11,12	5,6,9
	Business Representative	0,1,2,3,4,7,8	10,11,12	5,6,9

If the Enhanced Key Usage extension is present, then the certificate MUST only be used for one of the purposes indicated. If multiple purposes are indicated the application need not recognize all purposes indicated, as long as the intended purpose is present. Applications MAY require that a particular purpose be indicated in order for the certificate to be acceptable to that application.

If a certificate contains both a Key Usage extension and an Enhanced Key Usage extension, then both extensions MUST be processed independently and the certificate MUST only be used for a purpose consistent with both extensions. If there is no purpose consistent with both extensions, then the certificate MUST NOT be used for any purpose.

7.1.10 Basic Constraints

This extension must be present in all Certificate Authority certificates (marked as critical) with Subject Type = CA. It is recommended, but not required, to set the Path Length Constraint.

7.1.11 Subject Key Identifier

The Subject Key Identifier extension must be present in all certificates as it facilitates certification path construction. For Certificate Authority certificates, the value of the Subject Key Identifier MUST is the same as the Authority Key Identifier extension of certificates issued by the subject of this certificate.

7.1.12 Authority Key Identifier

The Authority Key Identifier extension must be present in all certificates as it facilitates certificate path construction in instances where a Certificate Authority has multiple signing keys (either due to multiple concurrent key pairs or due to changeover). The identification MUST be based on the key identifier (the subject key identifier in the issuer's certificate) but in addition MAY also use the issuer name and/or serial number.

7.1.13 Subject Alternative Name

This is an optional extension based on RFC822 which MAY be used to further clarify the owner of the certificate or to strengthen name uniqueness.

7.1.14 Name Forms

In a certificate, the issuer DN and subject DN fields shall contain the full X.500 Distinguished Name of the Authorized CA and the subject to which the certificate was issued, respectively.

7.1.15 Name Constraints

Subject and Issuer DNs must comply with Policy Authority standards and be present in all certificates.

7.1.16 Certificate Policy Object Identifier

All certificates MUST include a Certificate Policy Identifier equal to the EMARC Policy Object Id and MUST include a Policy Qualifier which points to the Certificate Authority's CPS. Other Policy Qualifiers MAY be used to point to legal, privacy, or restricted use notices.

There will be a transition period in which the e-MARC Policy OID will not be contained in all Authorized CA issued certificates, however, at a reasonable time to be determined by the Policy Authority, Authorized CAs must ensure that the e-MARC Policy OID is contained within the certificates they issue.

7.1.15 Authority Information Access

All certificates MAY include at least one Authority Information Access extension. This extension is used to download the Issuers signing Certificate Authority certificate. Add more to definition

7.1.16 CRL Distribution Point

All certificates MUST include at least one CRL Distribution Point and may use any of the currently available protocols including HTTP, FTP, LDAP, or File.

7.1.17 Usage of Policy Constraints Extension

No stipulation.

7.1.18 Policy Qualifiers Syntax and Semantics

The Authorized CA must populate the policyQualifiers extension with the URI of its Policy.

7.1.19 Processing Semantics for the Critical Certificate Policy Extension

No stipulation.**7.1.20 Certificate Profile and Certificate Profile Extensions**

Certificates issued by an Authorized CA may conform to the profile recommendations in the Federal PKI X.509 Certificate and CRL Extensions Profile (http://csrc.nist.gov/pki/twg/y2000/papers/twg-00-

18.xls). Any variance from the above profile recommendations shall be approved by the Policy Authority, and documented in the Authorized CA CPS

7.2 CRL PROFILE

7.2.1 Version Number(s)

CRLs issued under this Policy shall assert a version number as described in the X.509 standard [ISO9594-8]. CRLs shall assert X.509 "Version 2".

7.2.2 CRL and CRL Entry Extensions

Certificates issued by an Authorized CA may conform to the profile recommendations in the Federal PKI X.509 Certificate and CRL Extensions Profile (http://csrc.nist.gov/pki/twg/y2000/papers/twg-00-18.xls), or may issue CRLs asserting no extensions. Any variance from the above profile recommendations shall be approved by the Policy Authority, and documented in the Authorized CA CPS.

SECTION 8

POLICY ADMINISTRATION

8.1 POLICY CHANGE PROCEDURES

8.1.1 Notice

Notice of all proposed changes to this Policy under consideration by the Policy Authority that may materially affect users of this Policy (other than editorial or typographical corrections, minor changes to the contact details, or other minor changes) will be provided to Authorized CAs, subscribers, and Qualified Relying Parties, and will be posted on the Policy Authority's Website. The Authorized CA shall publish notice of such proposed changes to the appropriate Repository and shall advise their Subscribers of such proposed changes by means of a specific email or postal notice.

8.1.2 Comment Period

Any interested person may submit written comments with the Policy Authority dispatched within 45 days of the original notice. If the proposed change is modified as a result of such comments, a new notice of the modified proposed change shall be given.

8.1.3 Process for Adoption

Proposed changes to this Policy will be brought forth to the Senior PKI Steering Committee members. The proposed change(s) will be reviewed and members of the committee will vote whether to accept or reject it. If accepted, the Policy change will be published on the Policy Authority's Website. Subscribers are responsible for periodically checking to ensure no Policy changes have been issued. Entities relying on the e-MARCs will be given a reasonable amount of time to transition to the updated Policy.

8.2 PUBLICATION AND NOTIFICATION PROCEDURES

A copy of this Policy shall be made available in electronic form on the Policy Authority's Website, and may also be obtained via e-mail upon request from the Policy Authority. The Authorized CA shall also make available copies of this Policy both online and in writing.

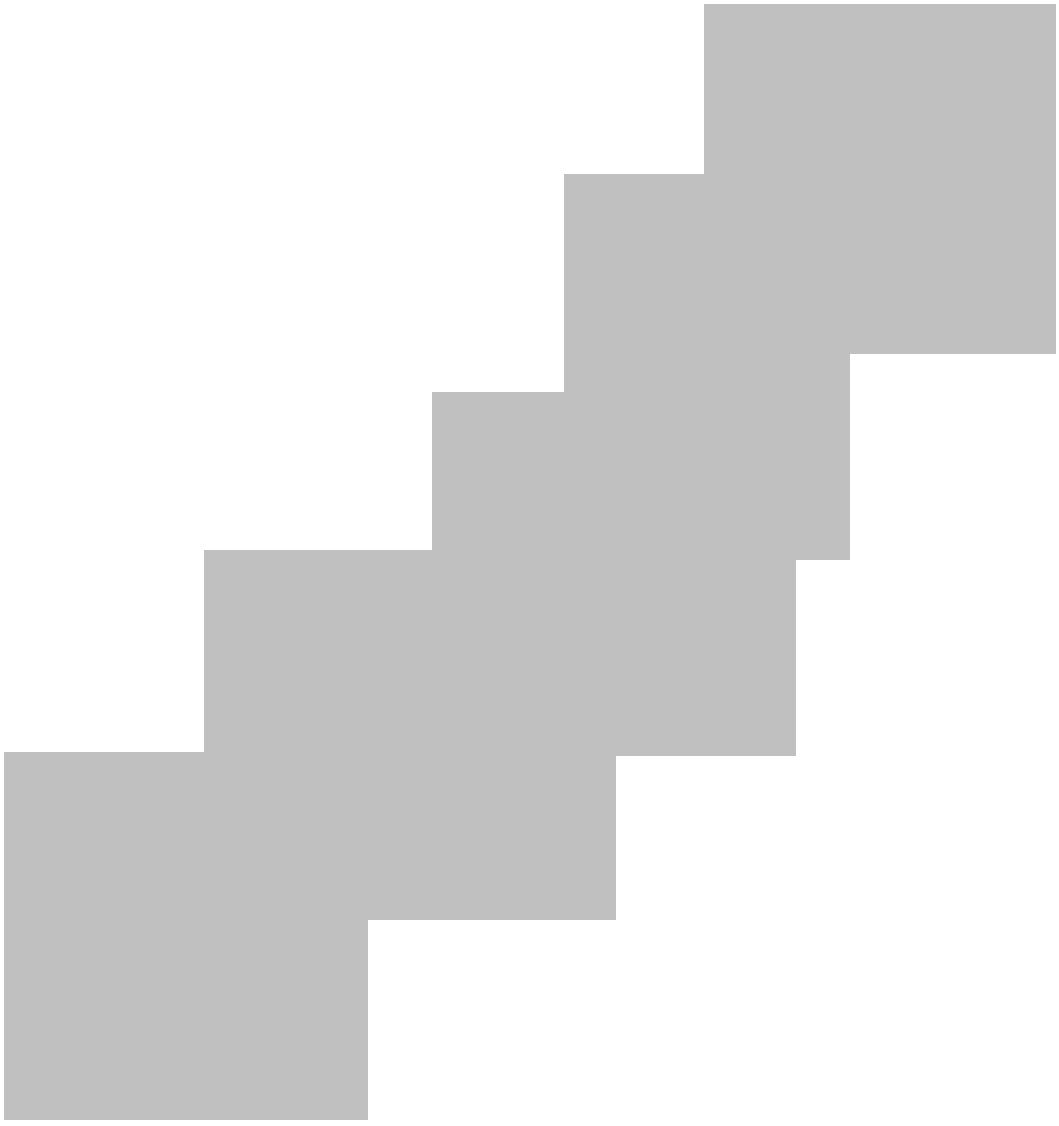
8.3 CPS APPROVAL PROCEDURES

The Policy Authority, or its duly authorized agent, must approve an Authorized CA's e-MARC CPS prior to its incorporation into the Authorized CA's operational procedures. The approval process will include a subset of the below criteria:

(1) Compliance with RFC 2527

(2) Compliance with the e-MARC Certificate Policy

(3) Completion of the C & A process
(4) Fulfilling the e-MARC Requirement's document.



GLOSSARY

e-MARC. Energy Market Access and Reliability Certificates. Aimed at providing commercial public key certificate services to the those participating in energy markets and identified in authorized Registry Domains.

e-MARC certificates. Certificates issued by an Authorized CA in accordance with this Policy, which certificates reference, this Policy by inclusion of the e-MARC OID.

e-MARC CPS. An e-MARC CPS is a certification practice statement of the practices that an Authorized CA employs in issuing, suspending, and revoking e-MARC certificates and providing access to the same.

Agency. A term used to identify all federal agencies, authorized federal contractors, agency-sponsored universities and laboratories, and, when authorized by law or regulation, state, local, and tribal Governments.

Agency Applications. See "Qualified Relying Party."

Applicant. A term used to describe an individual or authorized representative that is beginning or in the process or obtaining an e-MARC. Once an e-MARC is issued the applicant becomes a Subscriber.

Authenticate. Relates to a situation where one party has presented an identity and claims to be that identity. Authentication enables another party to gain confidence that the claim is legitimate.

Authorized CA. A certification authority that has been authorized by the Policy Authority to issue e-MARC certificates and provide Authorized CA Services under the Policy.

Authorized CA Services. The services relating to e-MARC certificates to be provided by Authorized CAs under this Policy (See section 2.1.1).

CA. See "Certification Authority."

Certificate. A data record that, at a minimum: (a) identifies the Authorized CA issuing it; (b) names or otherwise identifies its Subscriber; (c) contains a public key that corresponds to a private key under the control of the Subscriber; (d) identifies its operational period; and (e) contains an e-MARC Certificate serial number and is digitally signed by the Authorized CA issuing it. As used in this Policy, the term of "Certificate" refers to certificates that expressly reference the OID of this Policy in the "*CertificatePolicies*" field of an X.509 v.3 certificate.

Certificate Manufacturing Authority (CMA). An entity that is responsible for the manufacturing and delivery of e-MARC certificates signed by an Authorized CA, but is not responsible for

identification and authentication of certificate subjects (i.e., a CMA is an entity that is delegated or outsourced the task of actually manufacturing the Certificate on behalf of an Authorized CA).

Certification Authority. A certification authority is an entity that is responsible for authorizing and causing the issuance of a Certificate. See "Authorized CA."

Certification Practice Statement. A "certification practice statement" is a statement of the practices that a certification authority employs in issuing, suspending, revoking, and renewing certificates and providing access to same, in accordance with specific requirements (i.e., requirements specified in this Policy, requirements specified in a contract for services).

CMA. See "Certificate Manufacturing Authority".

CPS. See "Certification Practice Statement".

CRL. Certificate Revocation List

CSOR. Computer Security Objects Register operated by the National Institute of Standards and Technology (NIST).

Digital Signature. A digital signature is a string of bits associated with a collection of data (e.g., a file, document, message, transaction); this string of bits can only be generated by the holder of a private key, but can be verified by anyone with access to the corresponding public key. Note that some algorithms include additional steps (e.g., one-way hashes, timestamps) in this basic process.

DSA. Digital Signature Algorithm

DSS. Digital Signature Standard

DUNS. Data Universal Numbering System

Entity Code. A unique alphanumeric code assigned to a registered organization in a Registry Domain by the Registry Administrator.

FAR. Federal Acquisition Regulation

FED-STD. Federal Standard

FIPS. Federal Information Processing Standards. These are Federal standards that prescribe specific performance requirements, practices, formats, communications protocols, etc. for hardware, software, data, telecommunications operation, etc. Federal agencies are expected to apply these standards as specified unless a waiver has been granted in accordance to agency waiver procedures.

FIPS PUB. Federal Information Processing Standards Publication

Government. Federal Government and authorized agencies and entities.

NERC. North America Electric Reliability Council

e-MARC Contract.

e-MARC Operating Agreement.

IETF. See "Internet Engineering Task Force."

Internet Engineering Task Force (IETF). The Internet Engineering Task Force is a large open international community of network designers, operators, vendors, and researches concerned with the evolution of the Internet architecture and the smooth operation of the Internet.

ISO. International Standards Organization

ITU. International Telecommunications Union

ITU-T. International Telecommunications Union – Telecommunications Sector

ITU-TSS. International Telecommunications Union – Telecommunications Systems Sector

Key Changeover (CA). The procedure used by a Authorities to replace its own private key (e.g., due to compromise) and replace current valid certificates issued with old key.

Key pair. Means two mathematically related keys, having the properties that (i) one key can be used to encrypt a message that can only be decrypted using the other key, and (ii) even knowing one key, it is computationally infeasible to discover the other key.

Mutual Authentication. Parties at both ends of a communication activity authenticate each other (see authentication).

NIST. National Institute of Standards and Technology.

Object Identifier. An object identifier is a specially formatted number that is registered with an internationally-recognized standards organization.

OID. See "Object Identifier".

Operating Rules. See "e-MARC Operating Rules".

Operational Period of an e-MARC Certificate. The operational period of an e-MARC Certificate is the period of its validity. It would typically begin on the date the certificate is issued (or such later date as specified in the certificate), and ends on the date and time it expires as noted in the certificate or is earlier revoked or suspended.

Out-of-band. Communication between parties utilizing a means or method that differs from the current method of communication (e.g., one party using U.S. Postal mail to communicate with another party where current communication is online communication).

PKI. Public Key Infrastructure

PKIX. Public Key Infrastructure (X.509)

PIN. Personal Identification Number

Policy. Means this Certificate Policy.

Policy Authority. The entity specified in Section 1.4

Private Key. The key of a key pair used to create a digital signature. This key must be kept a secret.

Program Participants. Collectively, the Registry Administrators, Authorized CAs, Registration Authorities, Certificate Manufacturing Authorities, Repositories, Subscribers, Qualified Relying Parties, and Policy Authority authorized to participate in the public key infrastructure defined by this Policy.

Public Key. The key of a key pair used to verify a digital signature. The public key is made freely available to anyone who will receive digitally signed messages from the holder of the key pair. The public key is usually provided via an e-MARC Certificate issued by an Authorized CA and is often obtained by accessing a repository. A public key is used to verify the digital signature of a message purportedly sent by the holder of the corresponding private key.

Qualified Relying Party. A recipient of a communication event protected by a certificate-based security service that is authorized by this Policy to rely on an e-MARC Certificate to verify the digital signature on the message, including the revocation status of any presented certificate.

RA. See "Registration Authority."

Registration Authority. An entity that is responsible for identification and authentication of certificate subjects, but that does not sign or issue certificates (i.e., a Registration Authority is delegated certain tasks on behalf of an Authorized CA)

Registry Domain. A registry of market participant. A Registry Domain typically describes a bounded set of market participants within a particular energy segment, such as gas or electricity. The Registry and Registry Domain must comply with the policies set forth in this document and have a unique registered Internet domain name.

Registry Administrator. An entity or organization authorized to administer a Registry Domain in accordance with the policies set forth in this document.

Repository. A database containing information and data relating to certificates, and an Authorized CA, as specified in this Policy.

Responsible Individual. A trustworthy person designated by a Sponsoring Organization to authenticate individual applicants seeking certificates on the basis of their affiliation with the sponsor.

Revoke a Certificate. Means to prematurely end the operational period of a Certificate from a specified time forward.

Sponsoring Organization. A business entity, government agency, or other organization with which a Business Representative is affiliated (e.g., as an employee, agent, member, user of a service, business partner, customer, etc.).

Subject. A person whose public key is certified in an e-MARC Certificate. Also referred to as a "Subscriber".

Subscriber. A Subscriber is a person who (1) is the subject named or identified in an e-MARC Certificate issued to such person and (2) holds a private key that corresponds to a public key listed in that certificate, and (3) the person to whom digitally signed messages verified by reference to such certificate are to be attributed. See "Subject."

Suspend a Certificate. To temporarily suspend the operational period of a Certificate for a specified time period or from a specified time forward.

Transaction. Any financially binding action. As defined by the software application or process being secured or implemented.

Trustworthy System. Computer hardware, software, and procedures that: (a) are reasonably secure from intrusion and misuse; (b) provide a reasonable level of availability, reliability, and correct operation;

(c) are reasonably suited to performing their intended functions, and (d) adhere to generally accepted security procedures.

URI. Universal Resource Identifier**.**

U.S.C. United States Code

Valid Certificate. Means an e-MARC Certificate that (1) an Authorized CA has issued, (2) the Subscriber listed in it has accepted, (3) has not expired, and (4) has not been revoked. Thus, an e-MARC Certificate is not "valid" until it is both issued by an Authorized CA and has been accepted by the Subscriber.

Written. A written record, or any writing, includes email or other electronic communication legally binding in the jurisdiction where created or received.

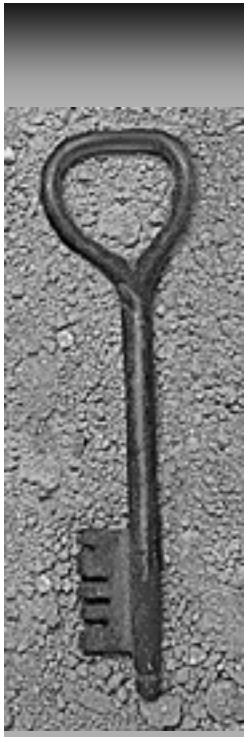
Web. "Web" refers to the World Wide Web, which is a popular subset of the Internet; it affords reader-friendly access to information by means of Hyper-Text Markup Language (HTML) and Extended Markup Language (XML) and other commands embedded in text displayed as "(Web)pages" on/at "(Web)sites."

BIBLIOGRAPHY

The following documents were used in part to develop this Policy:

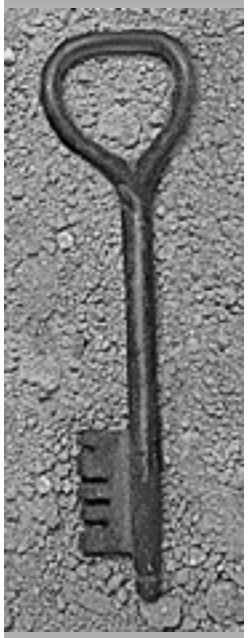
ABADSG	Digital Signature Guidelines, 1996-08-01. http://www.abanet.org/scitech/ec/isc/dsgfree.html.
FIPS 112	Password Usage, 1985-05-30 http://csrs.nist.gov/fips/
FIPS 140-1	Security Requirements for Cryptographic Modules, 1994-01 http://csrs.nist.gov/fips/fips1401.htm
FIPS 140-2	Security Requirements for Cryptographic Modules, 2001-05 http://csrs.nist.gov/fips/fips1402.htm
FIPS 186	Digital Signature Standard, 1994-05-19 http://csrs.nist.gov/fips/fips186.pdf
FOIACT	5 U.S.C. 552, Freedom of Information Act. Http://www4.law.cornell.edu/uscode/5/552.html
FPKI-Prof	Federal PKI X.509 Certificate and CRL Extensions Profile http://csrc.nist.gov/pki/twg/y2000/papers/twg-00-18.xls
ISO9594-8	Information Technology-Open Systems Interconnection-The Directory: Authentication Framework, 1997. ftp://ftp.bull.com/pub/OSIdirectory/ITU/97x509final.doc
ITMRA	40 U.S.C. 1452, Information Technology Management Reform Act of 1996. Http://www4.law.cornell.edu/uscode/40/1452.html
NAG69C	Information System Security Policy and Certification Practice Statement for Certification Authorities, rev C, November 1999.
NS4005	NSTISSI 4005, Safeguarding COMSEC Facilities and Material, August 1997.
NS4009	NSTISSI 4009, National Information Systems Security Glossary, January 1999.
PKCS#12	Personal Information Exchange Syntax Standard, April 1997. Http://www.rsa.com/rsalabs/pubs/PKCS/html/pkcs-12.html
RFC 2510	Certificate Management Protocol, Adams and Farrell, March 1999.
RFC 2527	Certificate Policy and Certificate Practices Framework, Chokhani and Ford, March 1999.
RFC 3280	Certificate and Certificate Revoxcation List (CRL) Profile ftp://ftp.rfc-editor.org/in-notes/rfc3280.txt Obsoletes RFC 2459
	Security Requirements for Certificate Issuing and Management Components, 3 November 1999, Draft
	United States Department of Defense X.509 Certificate Policy, Version 6.0, 31 May 2002

Introduction to Public Key Infrastructure (PKI) and Certification



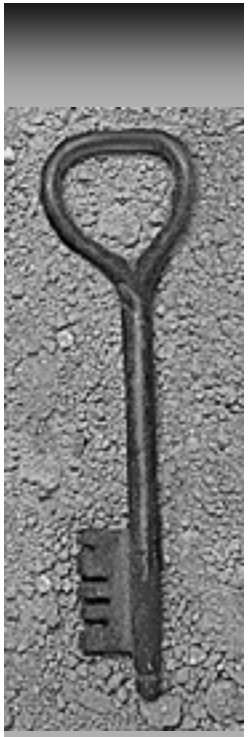
Introduction to PKI

- How do you achieve secure communications in a public network
  - ✓ What is a digital certificate?
  - ✓ What is a Public Key Infrastructure (PKI)?
  - ✓ Why do you need a digital certificate?
  - ✓ What can I use a digital certificate for?

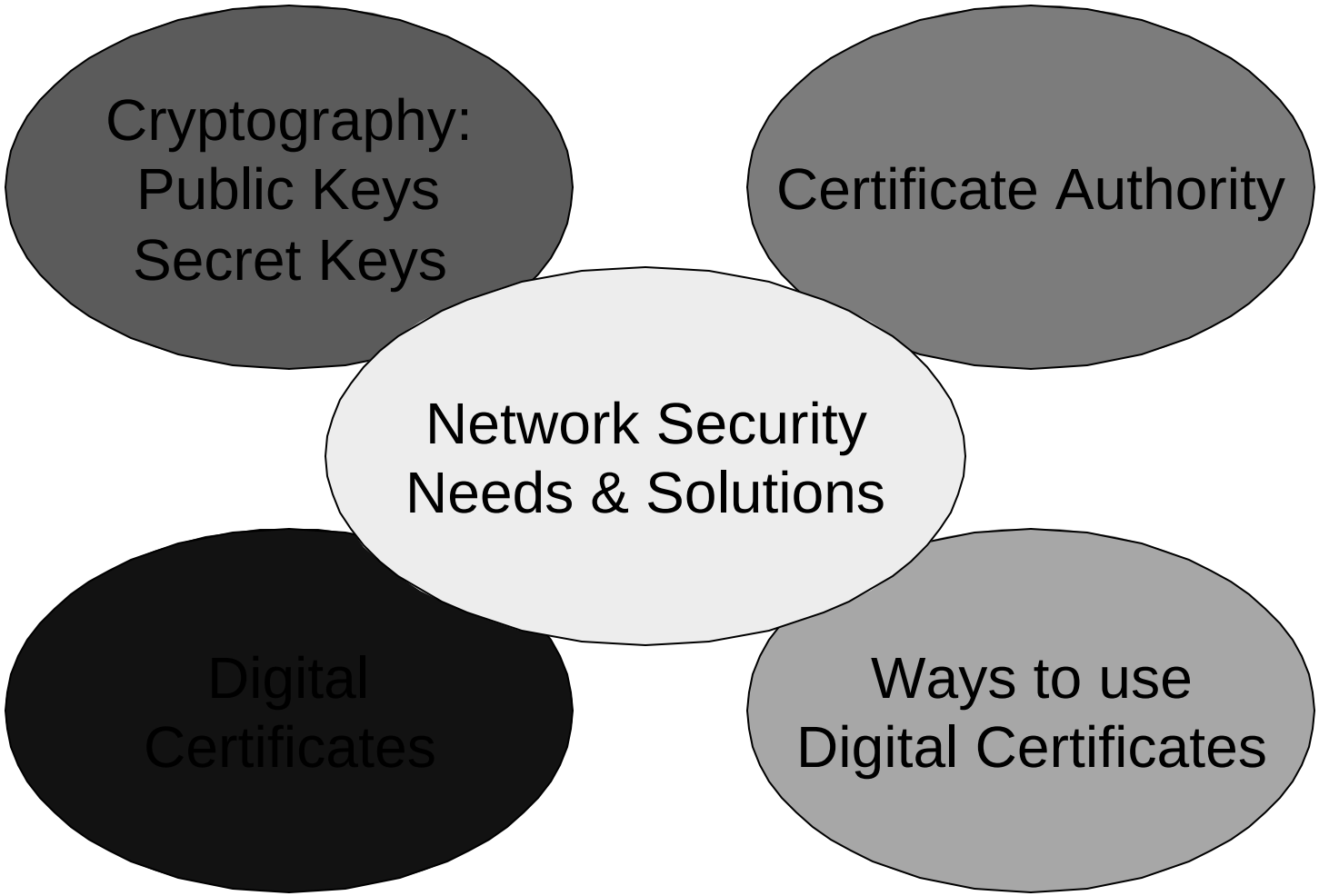


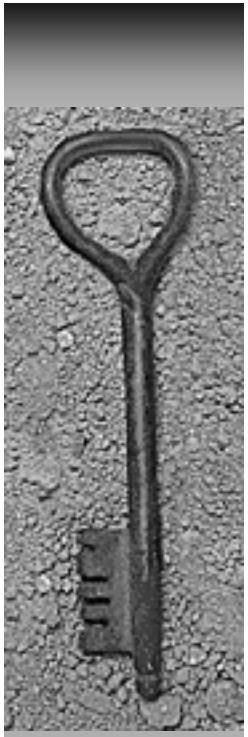
How do I achieve secure communications in a public network?

- I want to use the Internet to…
  - Send email
  - Make purchase
  - Distribute software
  - Inventory control & order entry
- But I have some concerns – How do I…
  - Know a person is who they claim to be?
  - Know I'm connected to an authentic vendor?
  - Protect the privacy of my communications?
  - Know if information has been tampered with
  - Prove later that someone sent me the message?



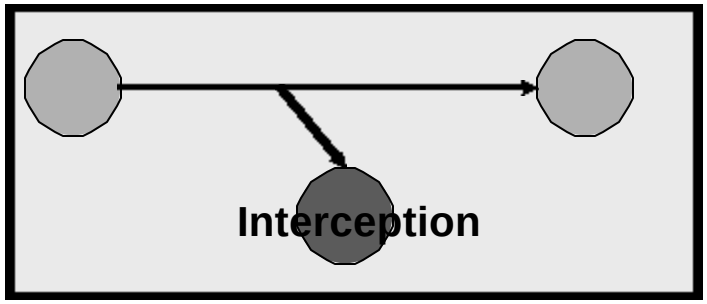
We can find the answers in:





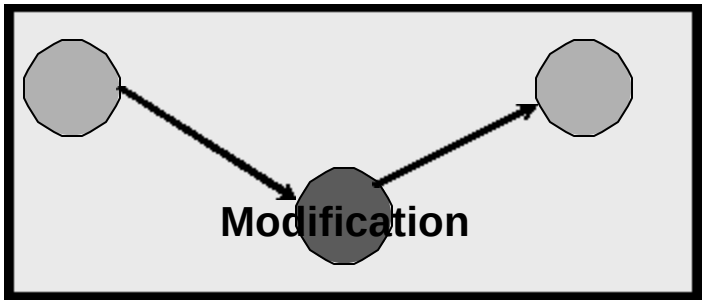
4 Security Needs for Network Communications

Confidentiality



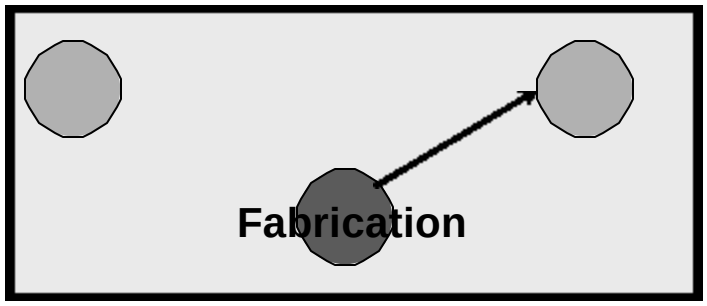
Is my communication private?

Integrity



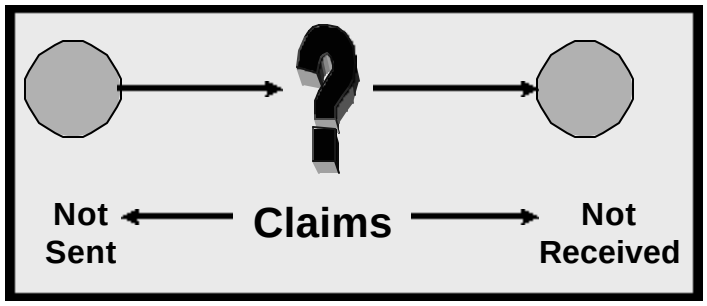
Has my communication been altered?

Authentication

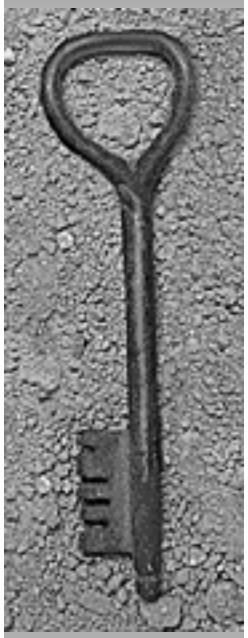


Who am I dealing with?

Non-repudiation

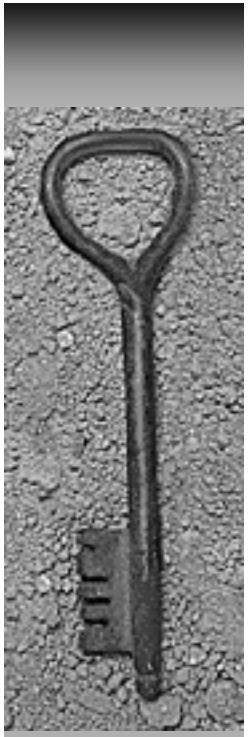


Who sent/received it and when?



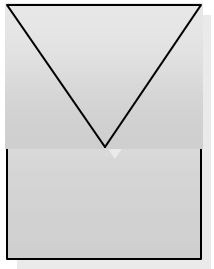
Access Control

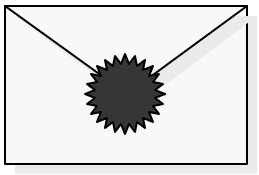
- The ‘fifth security need’ – while not directly a communication security need, it is related
- Applies after the network part of a communication has been secured
- Can be confused with Authentication
  - An employee badge may authenticate you, but not allow you access into the engineering lab
- Considered an application of digital certificates

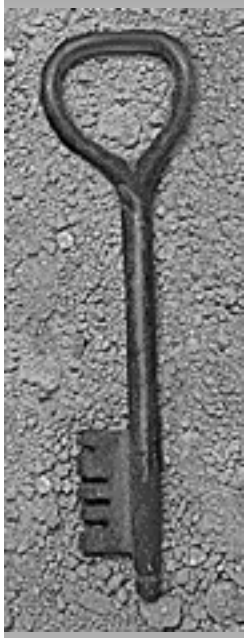


Physical Solutions to Solve Communications Security Needs

- Authentication:
  Passport,
  drivers license
- Confidentiality:
  Sealed envelopes
- Integrity:
  Tamper-evident seal
- Non-repudiation:
  Signature and date

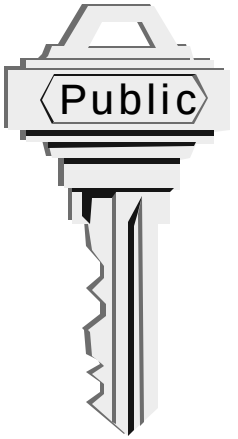




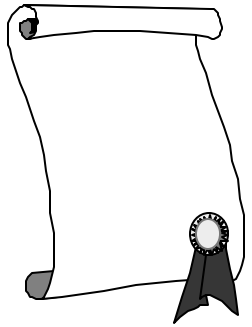


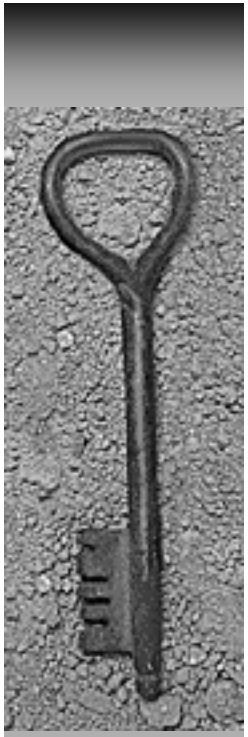
Electronic Solutions to Solve Communications Security Needs

- Cryptography
  - Secret Key
  - Public Key



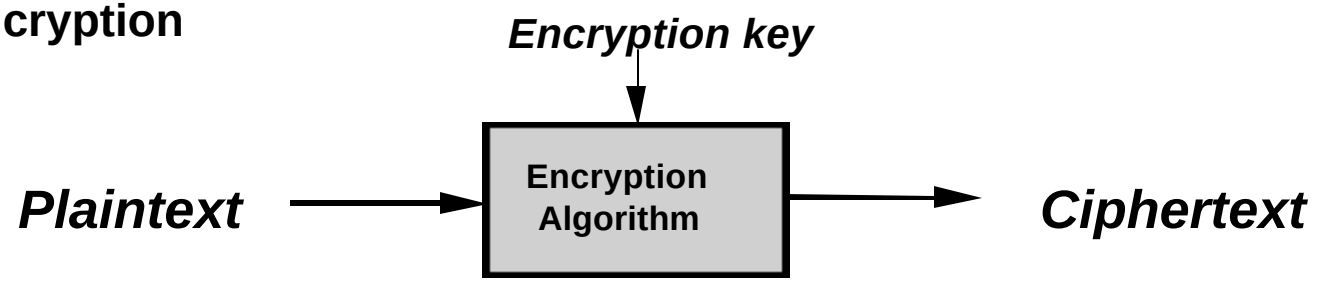
- Specialized Uses of Cryptography:
  - Digital Signature
  - Digital Certificates



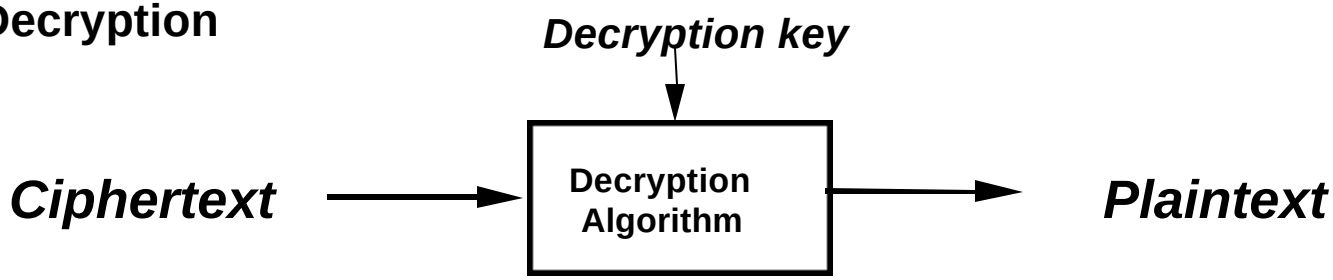


Cryptographic System

- **Encryption**

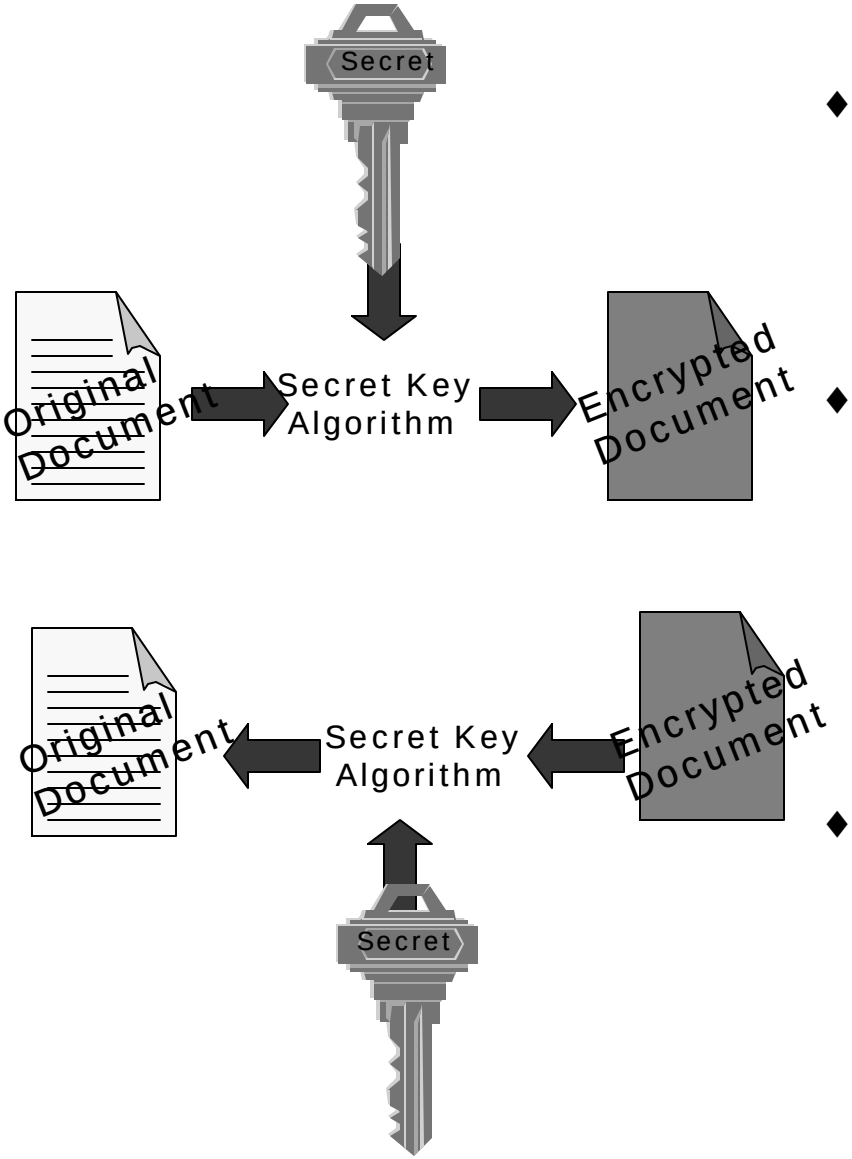


- **Decryption**



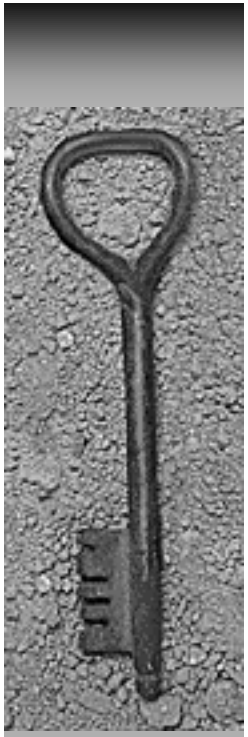
- **For each encryption key there is a corresponding decryption key that assures that the final plaintext is the same as the original.**

Secret Key Cryptography



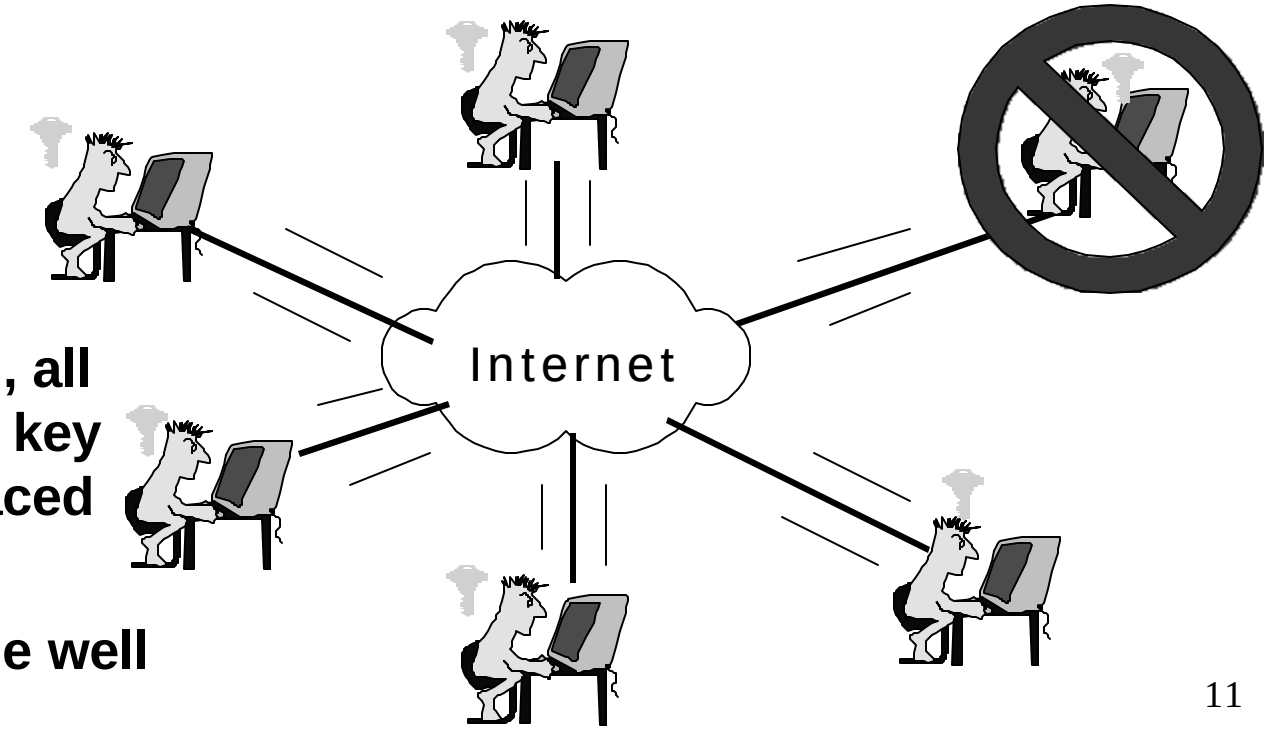
- Cryptography Involves:
  - encryption
  - decryption
- Secret Key cryptography:
  - Data is *encrypted & decrypted* using the same *Secret Key*
  - a.k.a. *"Symmetric Key"*
- DES[1] is an example of a secret key algorithm

[1]data encryption standard

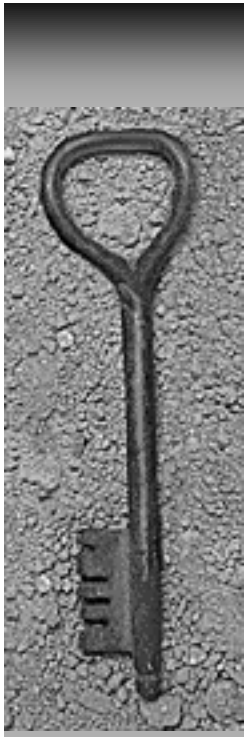


Secret Key Cryptography

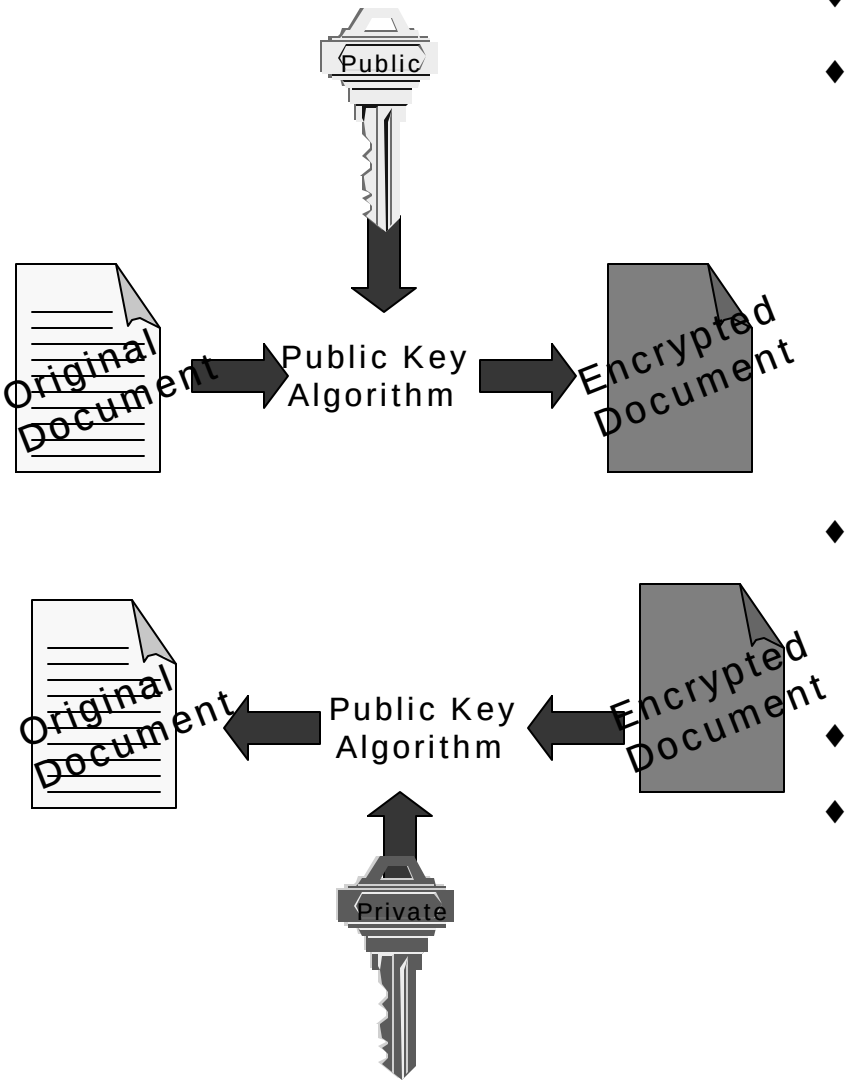
- It's fast, but…
  - How do I get my secret key to my recipient?
  - Do I have a different secret key for everyone with whom I communicate?



- **If one key is compromised, all copies of that key must be replaced**
- **Does not scale well**

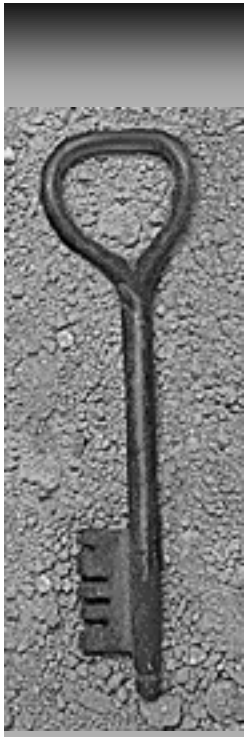


Public Key Cryptography



- **Two keys = key pair**
- **Mathematically related, but not identical, *public & private key pairs***
  - ***Public Keys* are widely distributed**
  - ***Private Keys* are held securely by the owner**
- **Data encrypted with one key can be decrypted only with the other key of the pair**
- **a.k.a. *"Symmetric Key"***
- **RSA is an example of a public key algorithm**

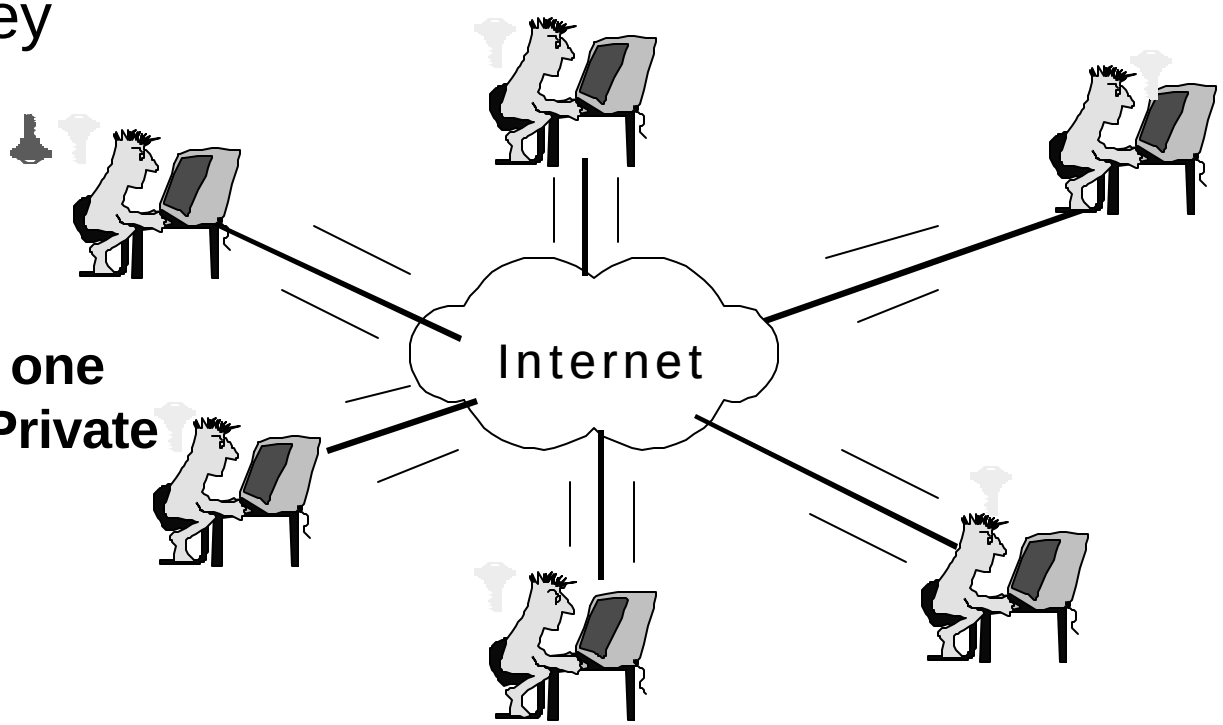
[1]data encryption standard



Public Key Cryptography

It's slow, but…

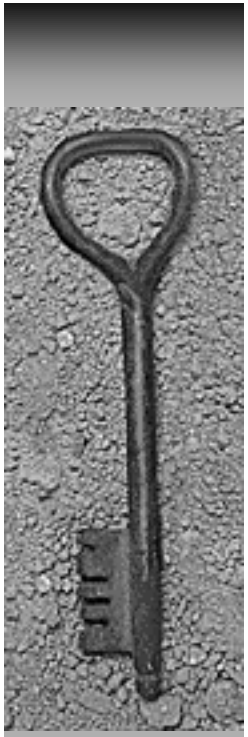
- I don't have to distribute a secret key because I have my Private Key
- Everyone with whom I communicate can know my Public Key



– **There's only one copy of the Private Key**

– **Scale well**

And there's another advantage…



Public Key Cryptography is…

❶ Public Key Encryption

Public Key encrypts data

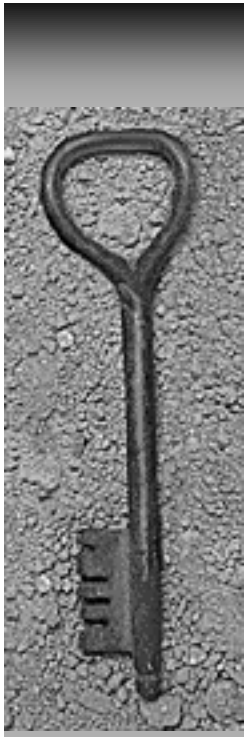
Private Key decrypts data

asymmetric

Private Key signs (encrypts) data

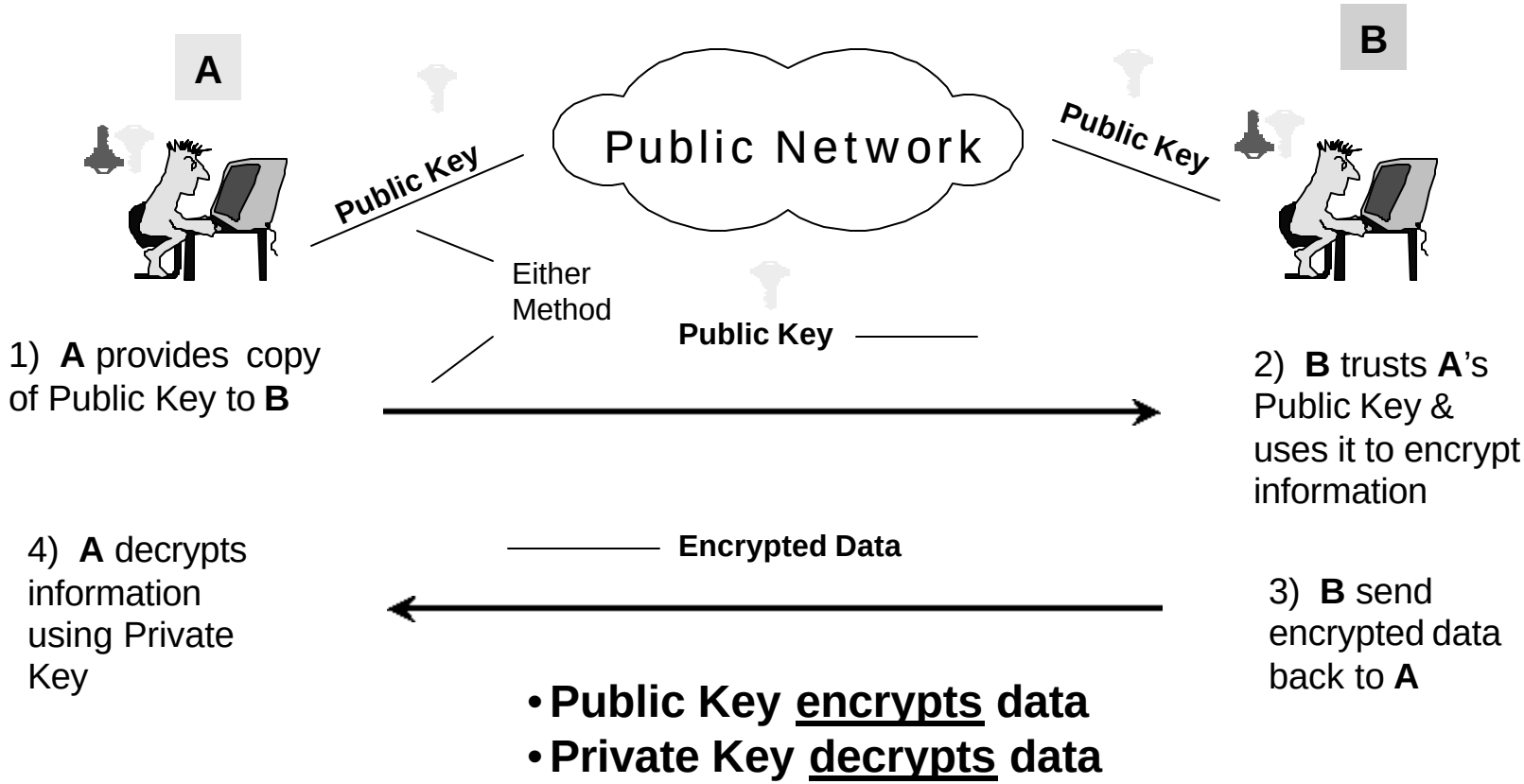
Public Key verifies (decrypts) data

❷ Digital Signature

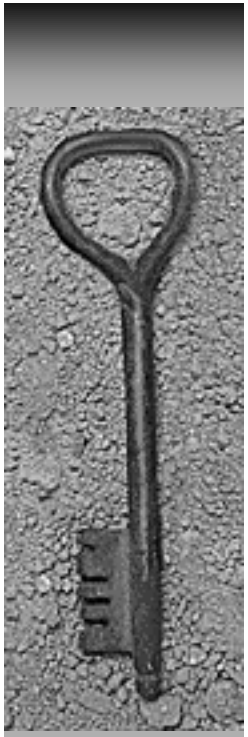


❶ Public Key Encryption

Everyone has a Key Pair: Public Key & Private Key



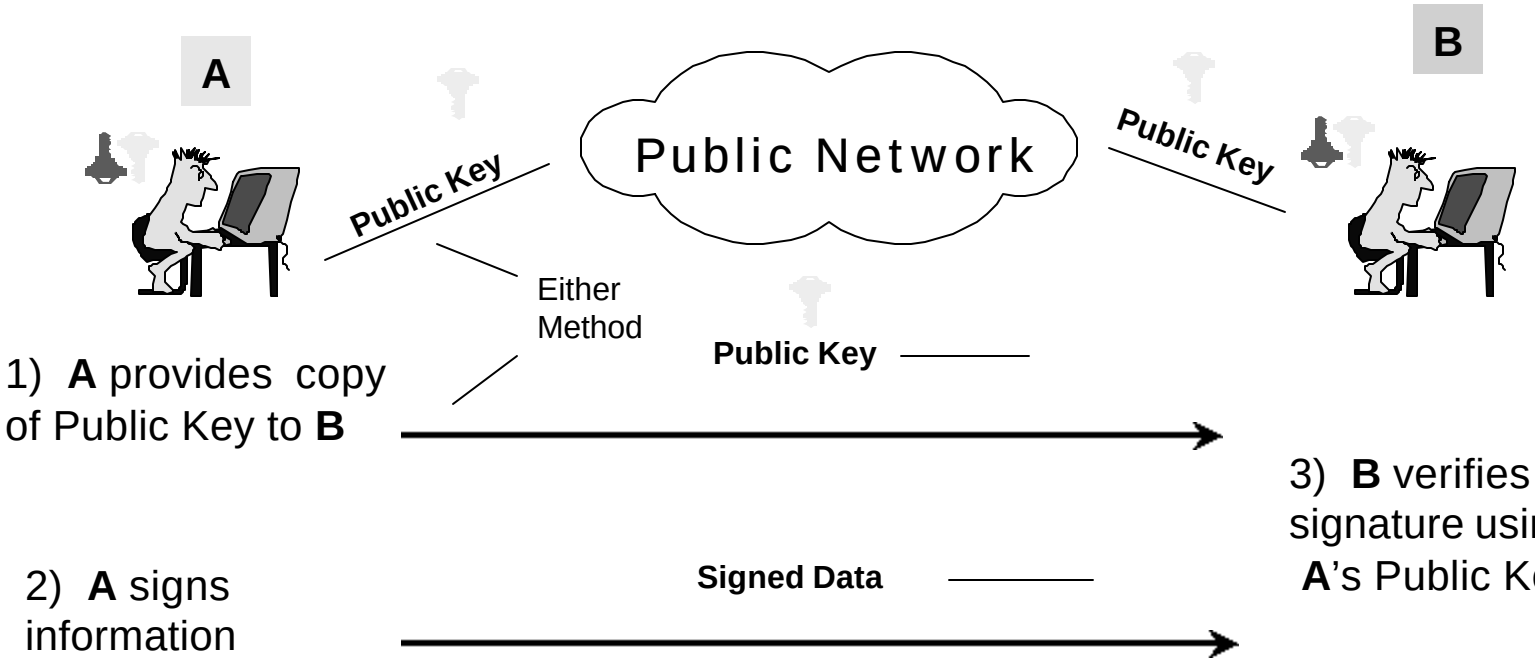
- **Public Key <u>encrypts</u> data**
- **Private Key <u>decrypts</u> data**



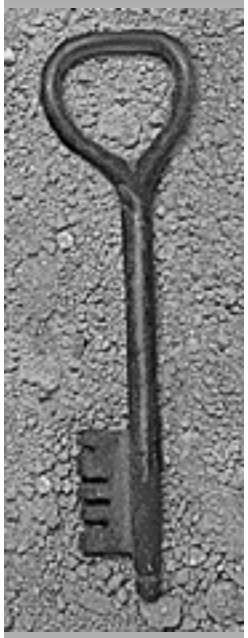
❷ Digital Signature

Everyone has a Signature *Key Pair*

- **Normally not the same as the *Encryption Key Pair***

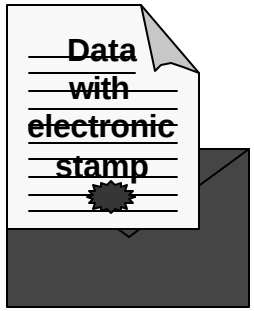


- **Private Key <u>signs</u> (encrypts) data**
- **Public Key <u>verifies</u> (decrypts) signature on data**
  - **Public Key may be sent with the signed data**



A Closer Look at Digital Signature

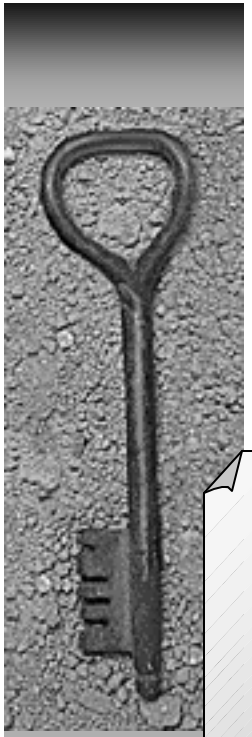
- Digital Signature
  - Electronic (digital) stamp appended to data before sending
  - The result of encrypting the *Hash* of the data to be sent on the network

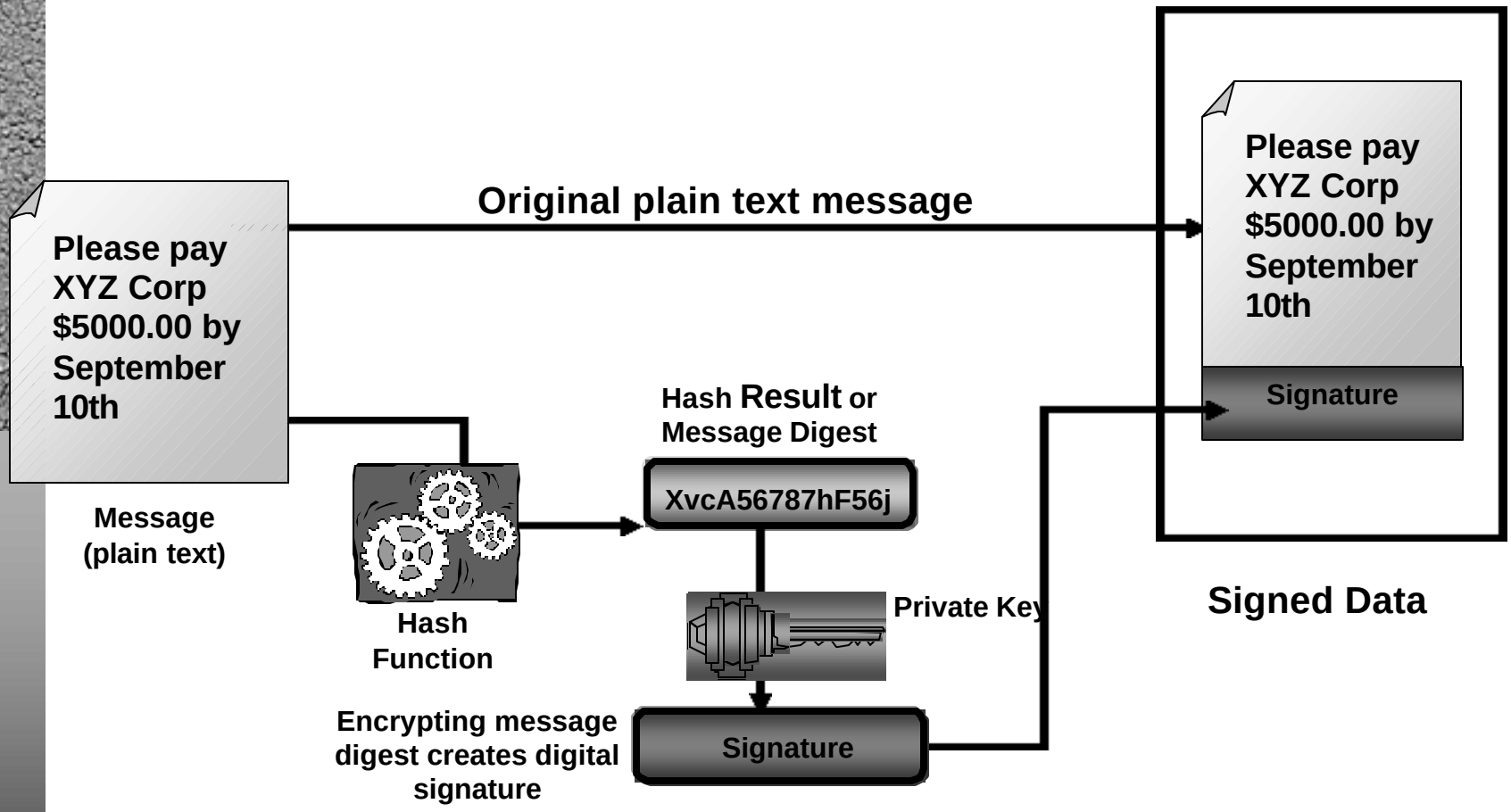


- Hash – or Digest
  - Mathematical reduction of data down to a fixed length field
  - One way conversion of the data
  - Uniquely represents the original data

So, using a diagram…

Digital Signing of the Data

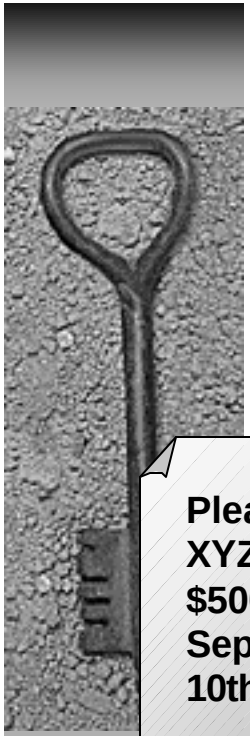


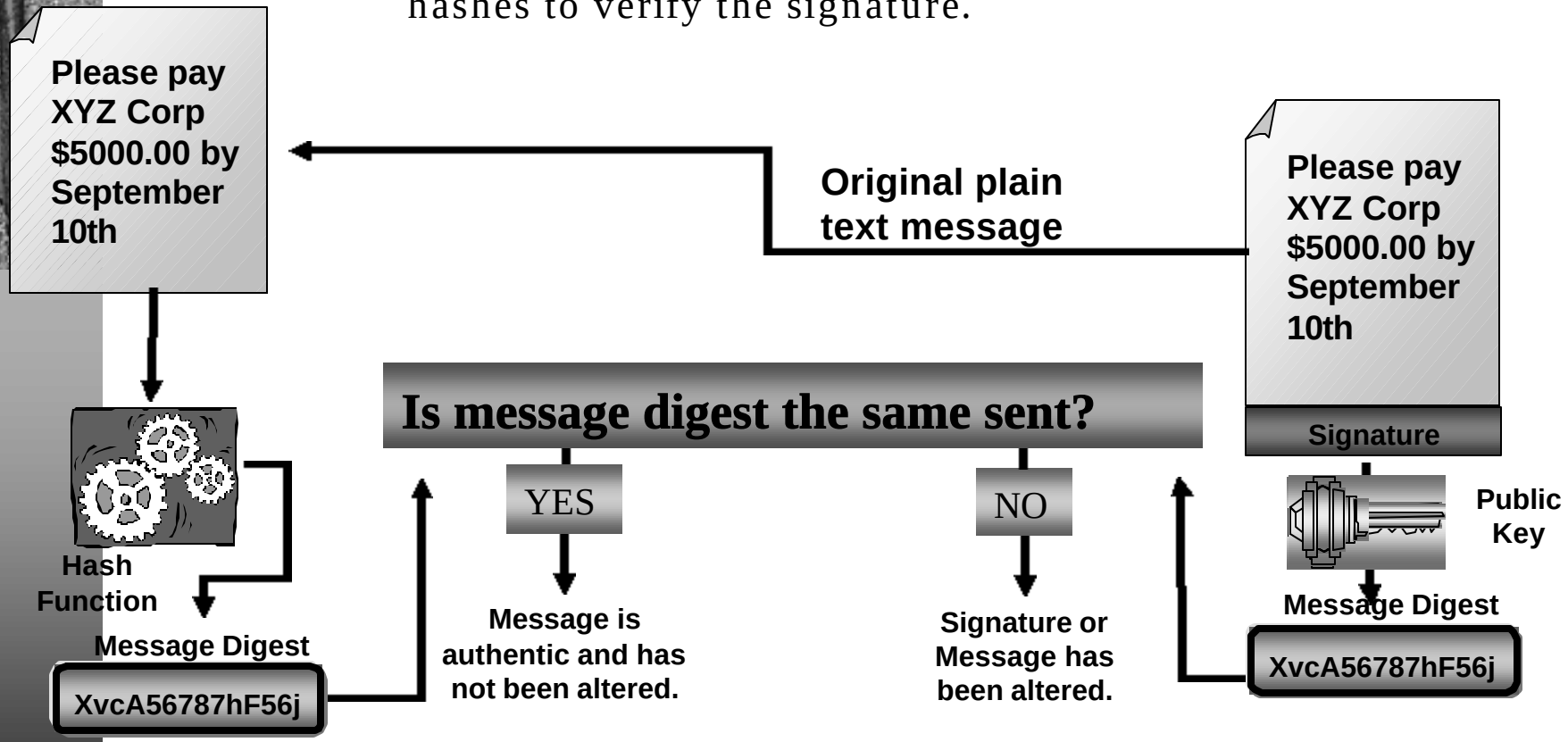


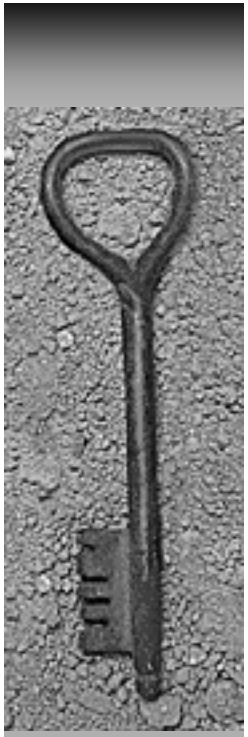
Why do the hash?

Digital Signature Verification

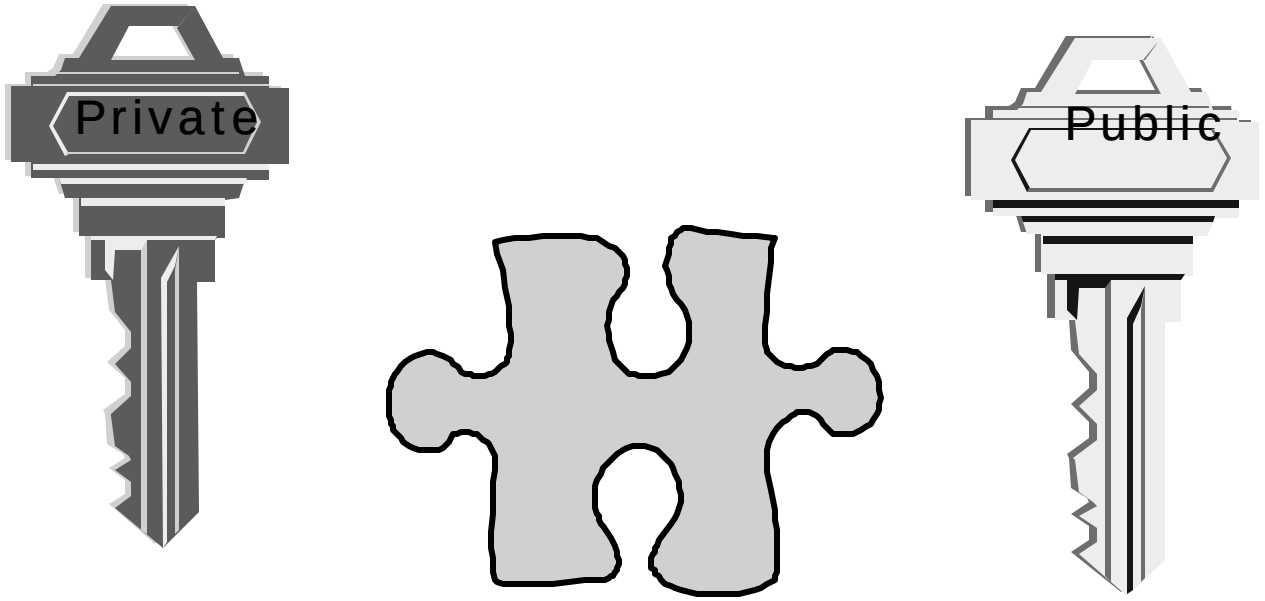
So the receiver can compare hashes to verify the signature.



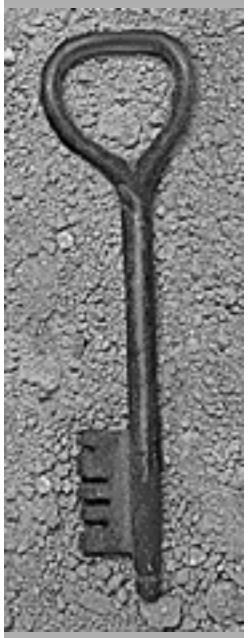




Public Key Cryptography

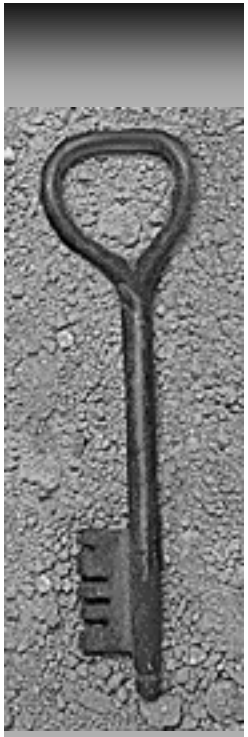


Digital Signature		Public Key Encryption
Private Key Public Key	→ encrypts ← → decrypts ←	Public Key Private Key



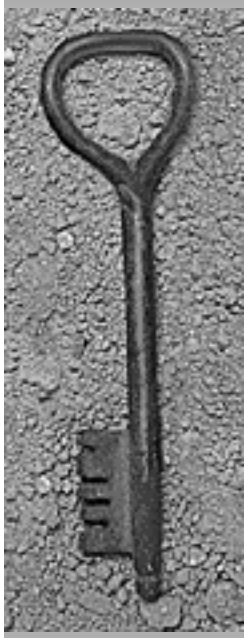
Security Solutions

- You've learned some security mechanisms:
  - Secret Key encryption
  - Public Key encryption
  - Digital Signature
    - Hashing
- How can these security mechanism solve the 4 communications security needs?
  - Confidentiality
  - Integrity
  - Authentication
  - Non-Repudiation



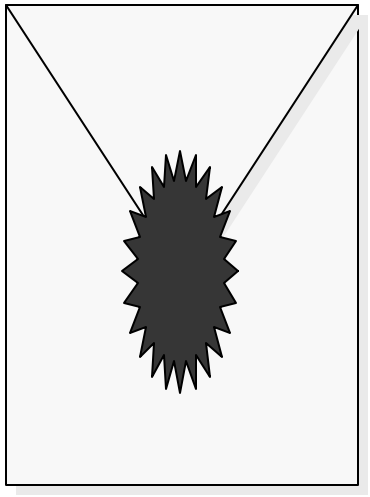
Confidentiality

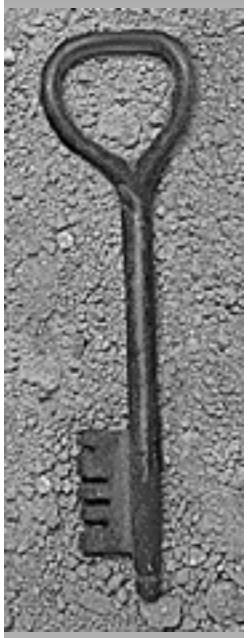
- Encryption
  - Secret Key
  - Public Key



Integrity

- Digital Signature
  - If signature verification fails, the integrity of the data has been compromised

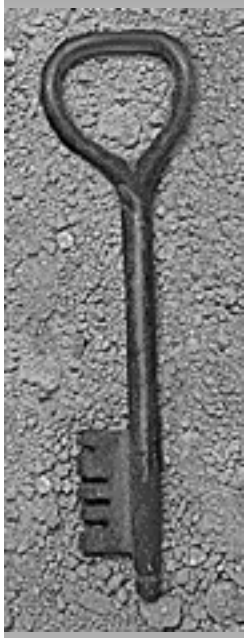




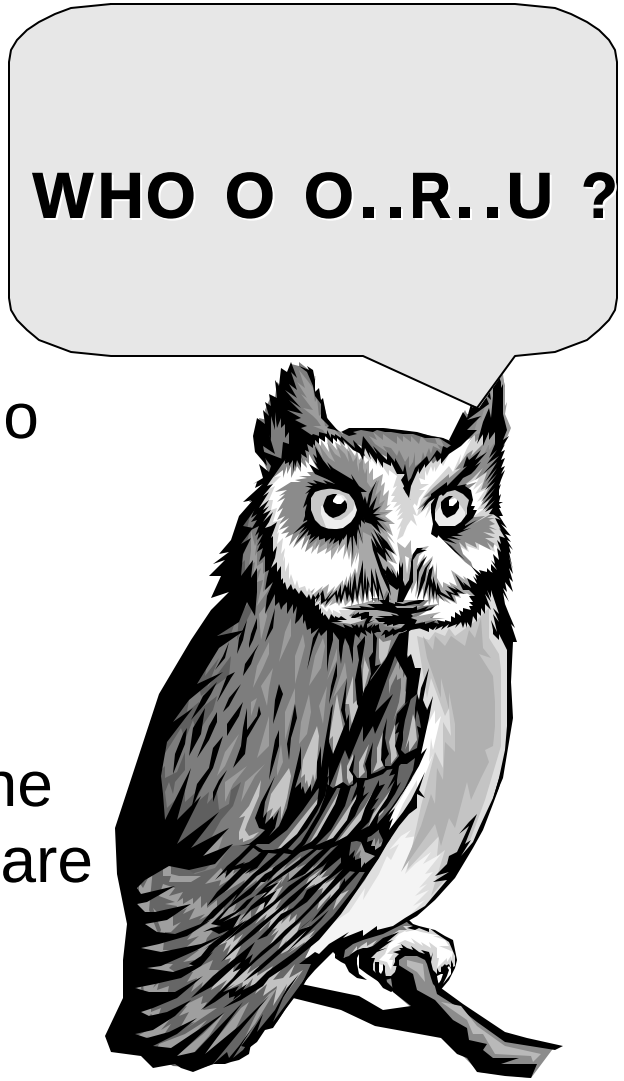
Non-Repudiation

- Digital signature proves a message has been sent & received:
  - Sender cannot deny sending the message
    - Digital signature uses sender's private key which only he/she possesses
  - Recipient can not deny receiving the message
    - Recipient non-repudiation may require signed acknowledgement messages, and trusted third party timestamps

Digital Signature, Date and Time



Authentication

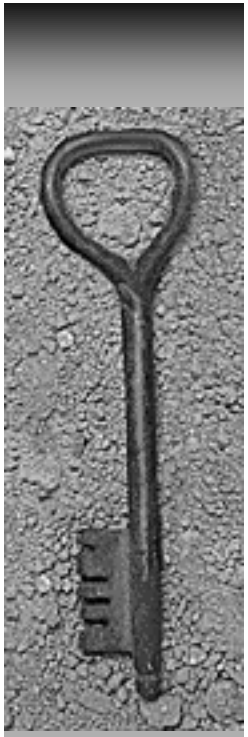


- Identification:

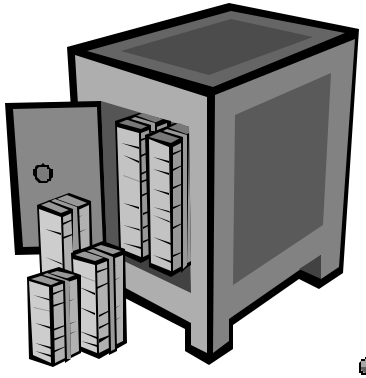
  How you tell someone who you are

- Authentication:

  How you prove to someone you are who you say you are



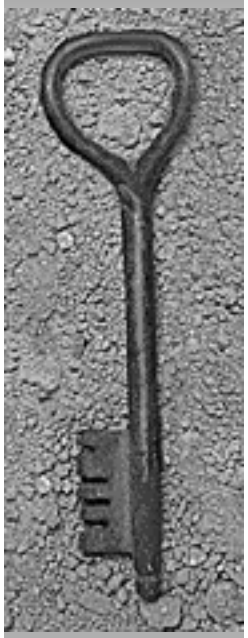
How do I solve Authentication?



- Physical Solutions:
  - Something you know
    - Password, combination to safe
  - Something you have
    - Key, token, badge
  - Something you are
    - Signature, iris pattern, fingerprint

- Electronic Solution:

So, why does B trust A's Public Key?

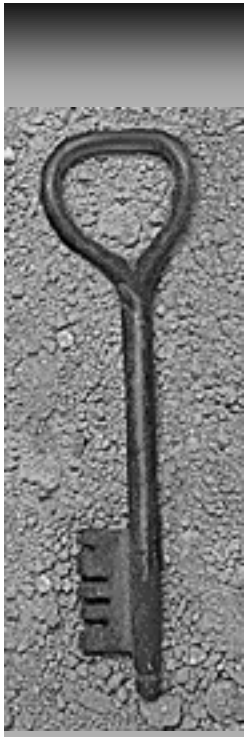


Digital Certificates

…Because a *trusted third party* has authenticated that the Public Key belongs to **A :**

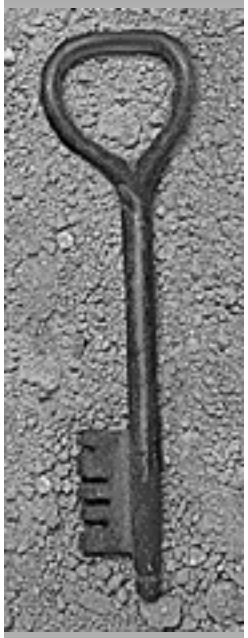
Certification Authority (CA)

- When **A** provides proof of identity, the Certification Authority creates a *signed message* containing **A**'s name and public key:
  - A "Digital Certificate"



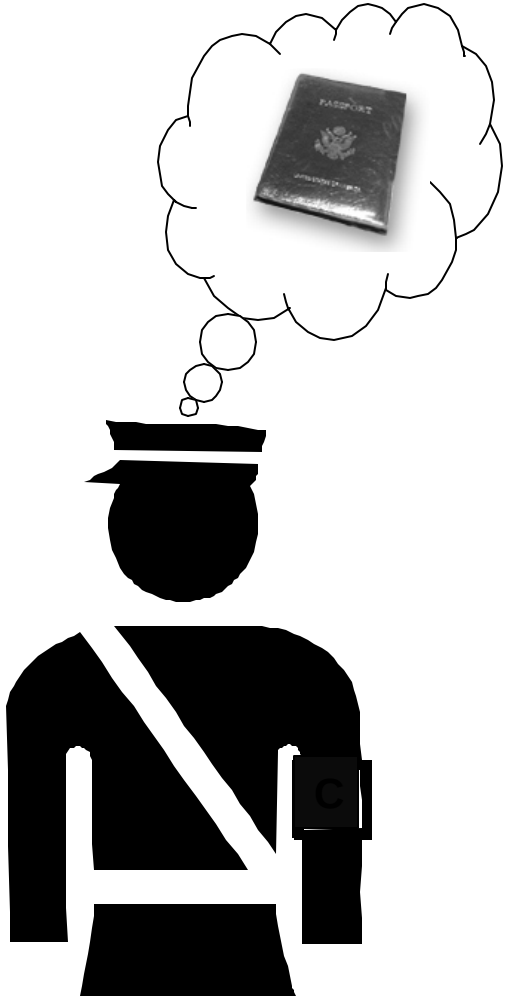
Why trust a Digital Certificate

- A digital Certificate becomes a passport that proves you identity and authenticates you
  - A US passport is issued by a trusted Government – when another Government sees it, they trust it
- A digital Certificate issued by a trusted CA can also be trusted



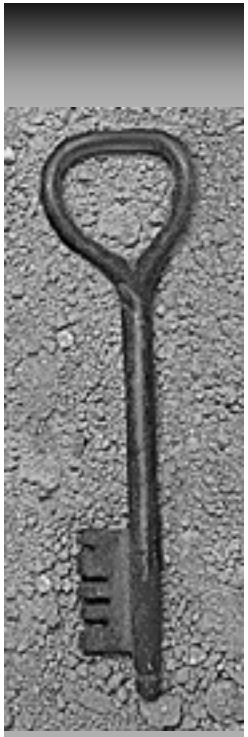
Certificate Authority

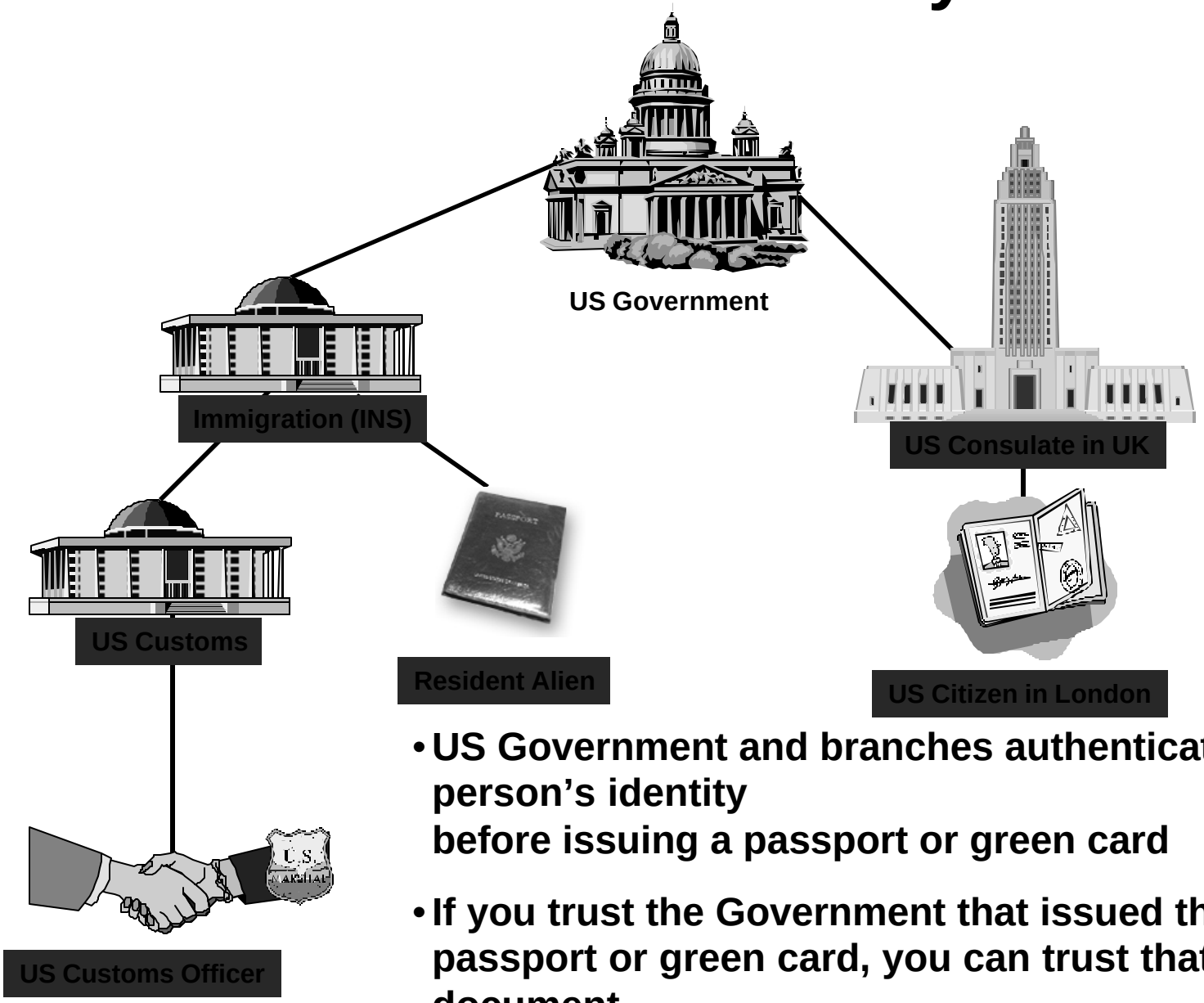
- Certificate Authority assumes the responsibility of authenticating Certificate identity information
  - Like a Government for passports
- CA authentication techniques
  - Check against existing records
    - Employee database
  - Examine typical identification
    - Passport, license
  - Background check
    - Government Databases



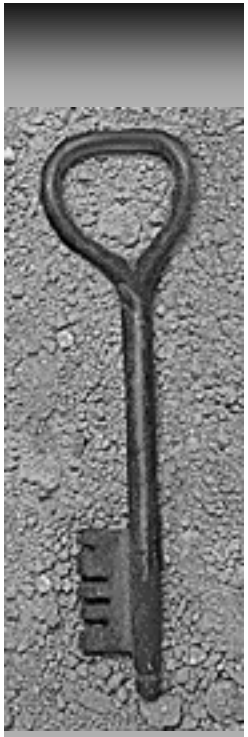
CA authenticates, issues & manages Certificates

Government Trust Hierarchy

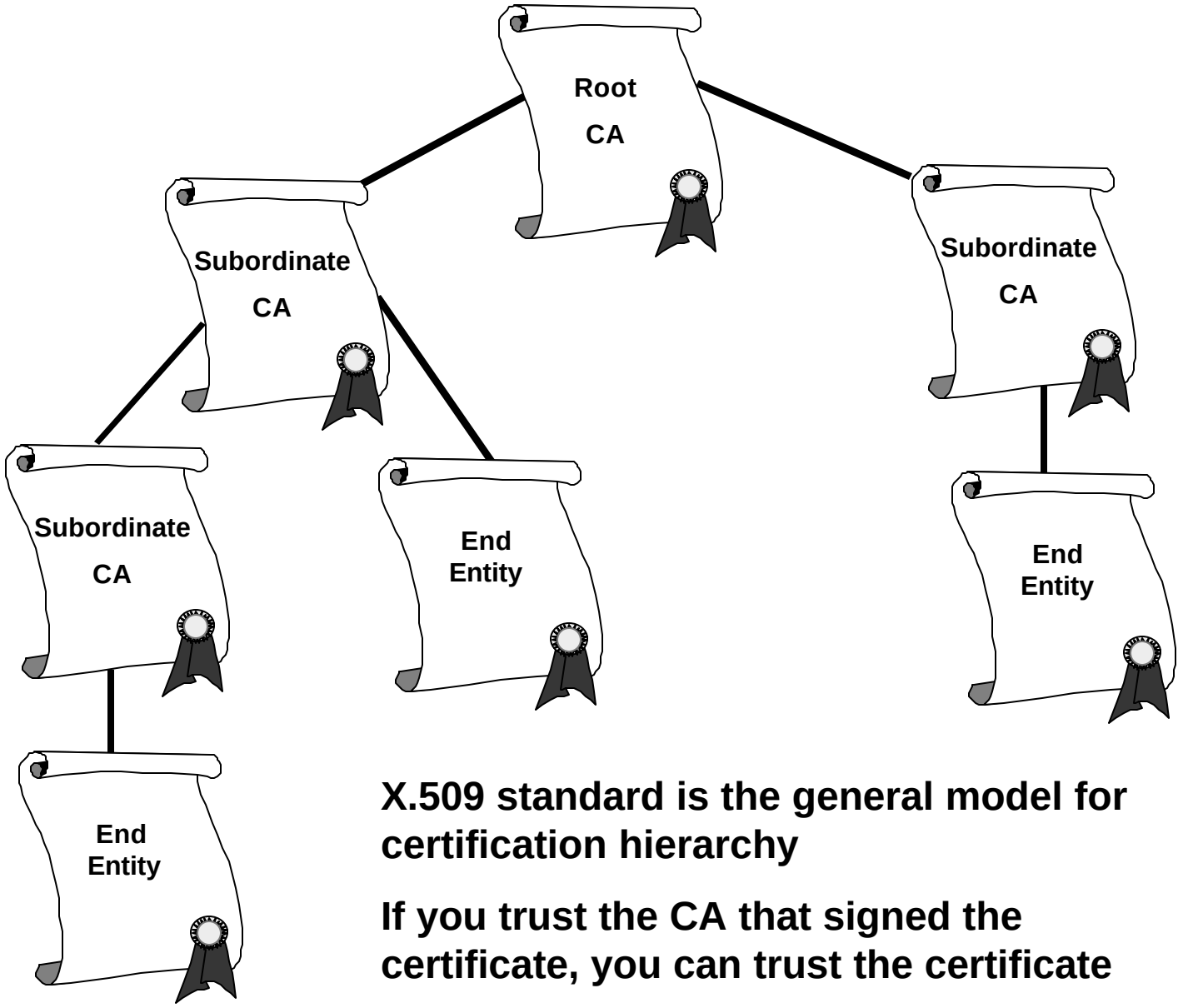




- **US Government and branches authenticate a person's identity before issuing a passport or green card**
- **If you trust the Government that issued the passport or green card, you can trust that document**

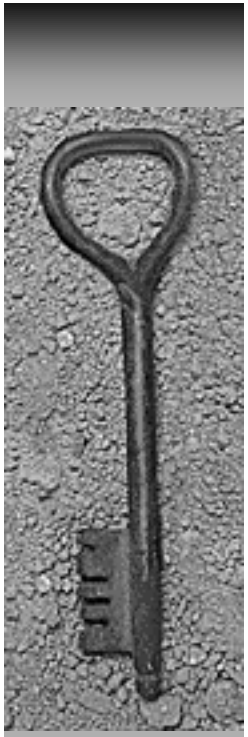


Certification Hierarchy

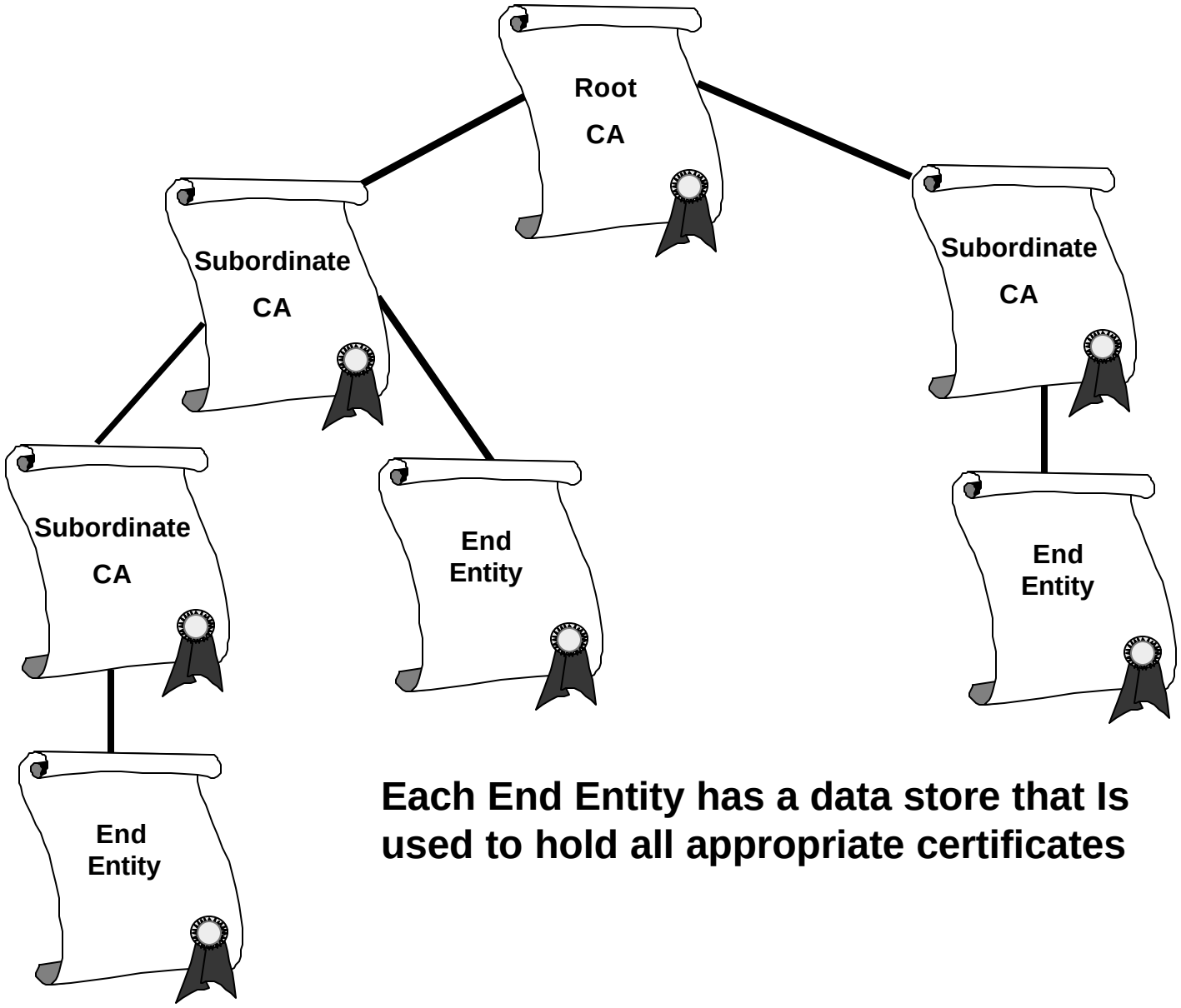


X.509 standard is the general model for certification hierarchy

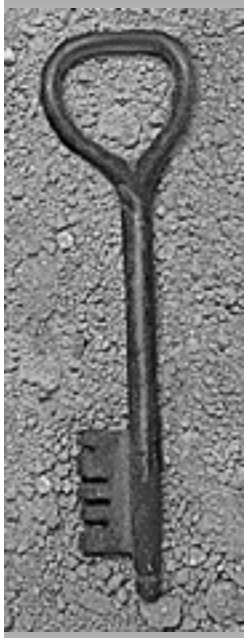
If you trust the CA that signed the certificate, you can trust the certificate



Certification Hierarchy

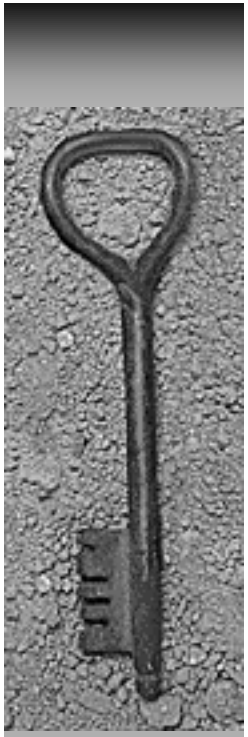


Each End Entity has a data store that Is used to hold all appropriate certificates



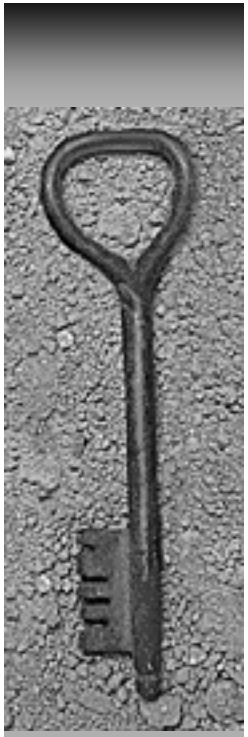
✓ Information Checkpoint

- What do you use Public Key Cryptography for?
- What is Secret Key Cryptography usually used for?
- What are the 2 important parts of a Digital Certificate?
- What does the Certificate Authority do?



✓ Information Checkpoint

- What do you use Public Key Cryptography for?
  Digital Signature & Public Key Encryption, but it's slow
- What is Secret Key Cryptography usually used for?
  Encryption of exchanged data because it's fast
- What are the 2 important parts of a Digital Certificate?
  The subject's identity & public key
- What does the Certificate Authority do?
  – CA authenticates, issues & manages certificates



✓ Information Checkpoint

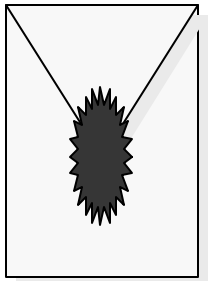
- How do we solve the 4 security needs?

Confidentiality

???

Integrity

???

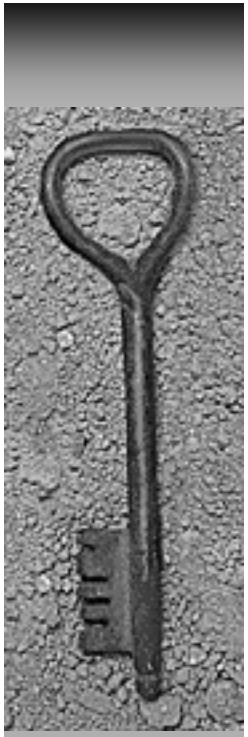


Non-Repudiation

???

Authentication

???



✓ Information Checkpoint

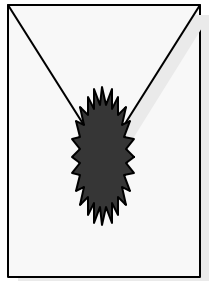
- How do we solve the 4 security needs?

Confidentiality

- **Secret Key**
- **Public Key**

Integrity

Digital Signature

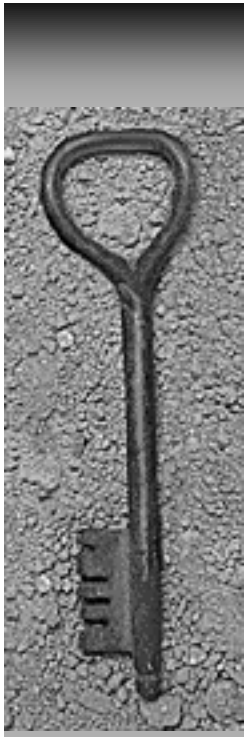


Non-Repudiation

Digital Signature

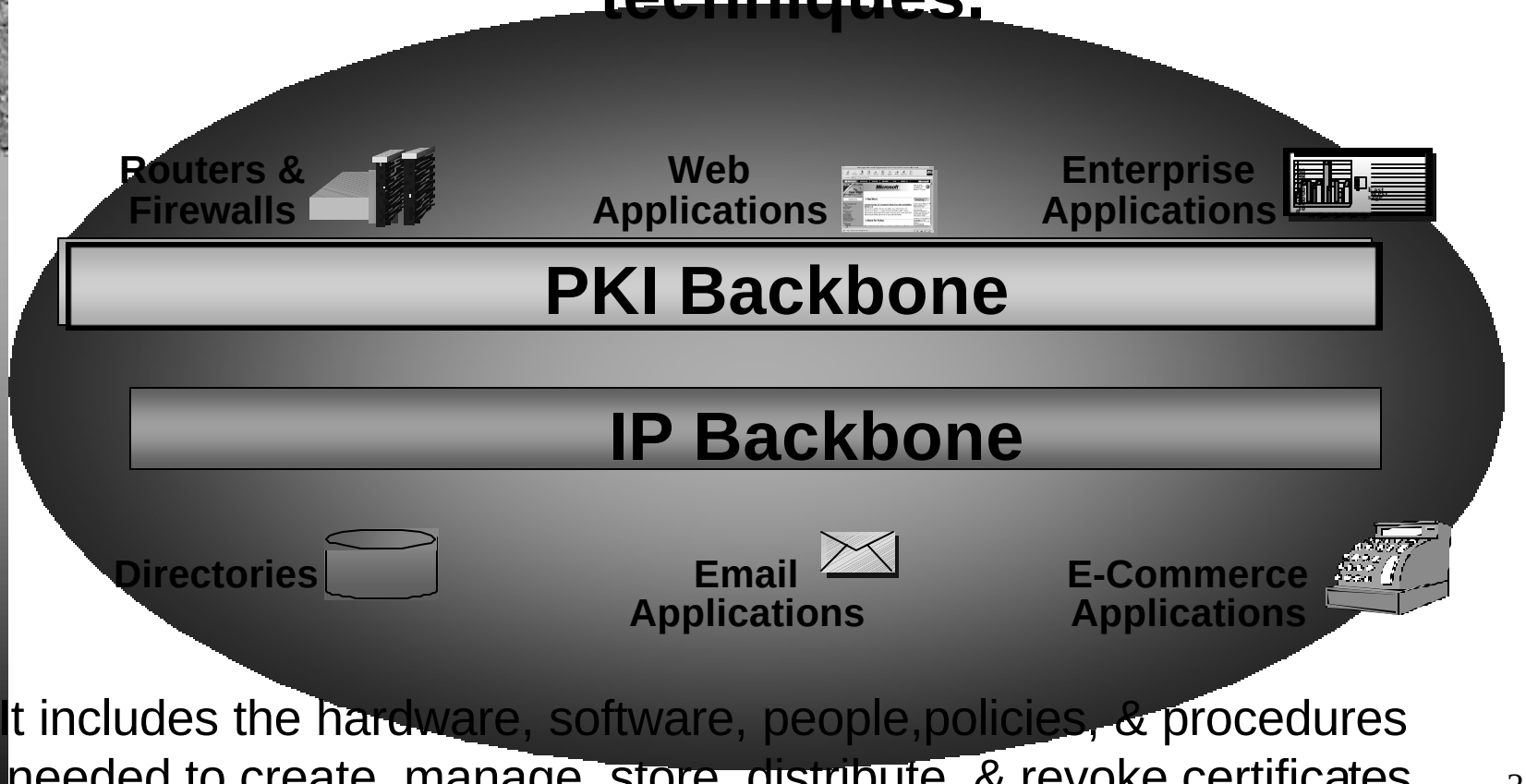
Authentication

Digital Certificates

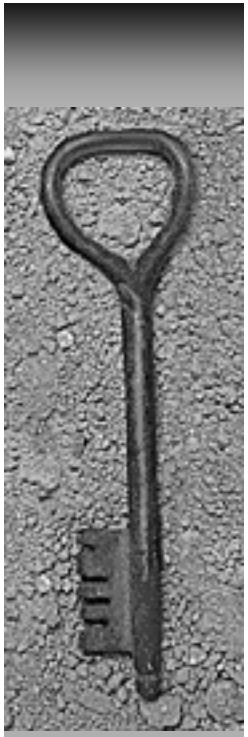


So,what is PKI?

PKI is a pervasive security infrastructure whose services are implemented and delivered using public-key concepts and techniques.



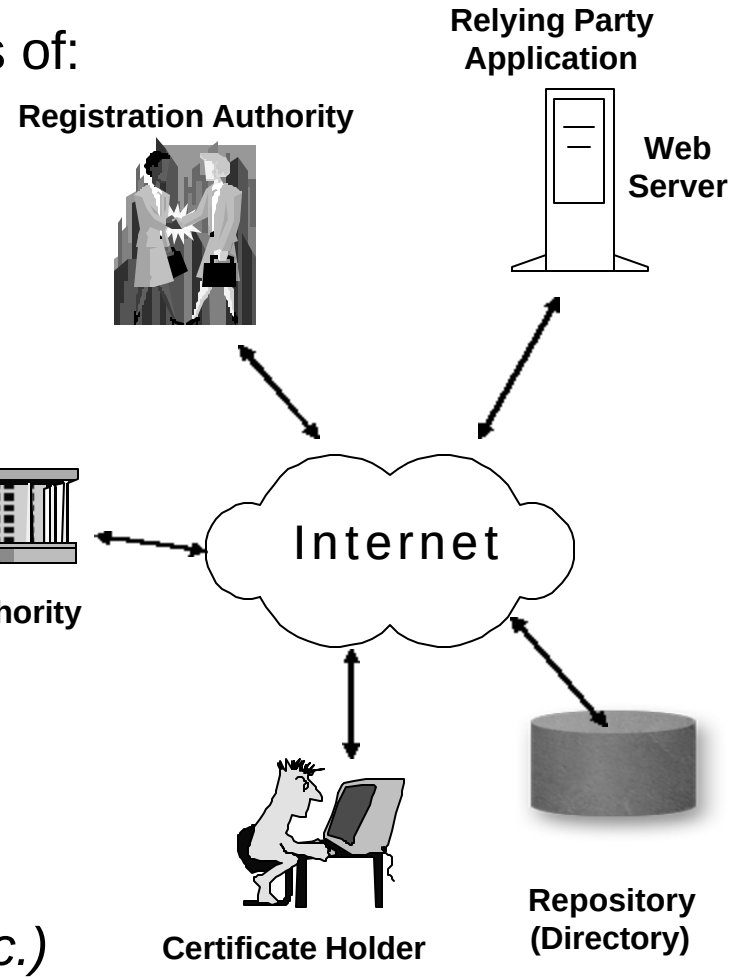
It includes the hardware, software, people,policies, & procedures needed to create, manage, store, distribute, & revoke certificates

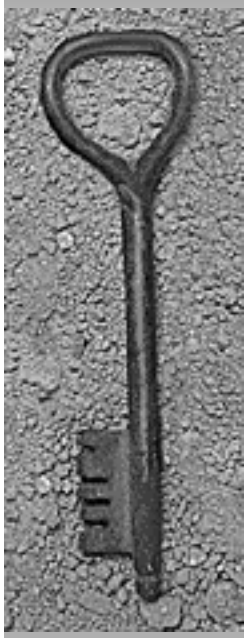


PKI Components & Model

A Public Key Infrastructure Consists of:

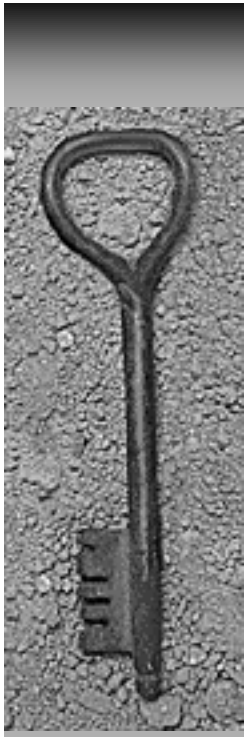
- Certification Authorities (CAs) *(Issuers)*
- Registration Authorities (RAs) *(Authorize the binding between Public Key & Certificate Holder)*
- *Certificate Holders (Subjects)*
- *Relying Parties (Validate signatures & certificate paths)*
- *Repositories (Store & distribute certificates & status: expirancy, revocations etc.)*





PKI Components = Functions

- The Five components of a PKI are functional roles:
  - Certification Authority
  - Certificate Holder
  - Registration Authority
  - Relying Party
  - Repository
- A single entity can perform one or more of these roles

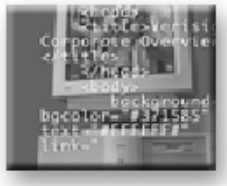


Physical to Digital Translations

Physical World

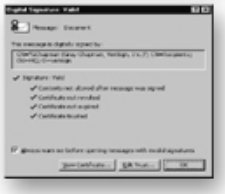
Digital World

Encryption



Digital Certificate

Digital Signature



Digital Receipt

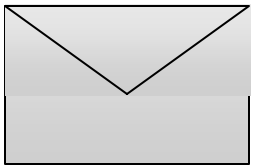
Directories

Applications Embedded with PKI

Web Browsers

Microsoft IE
Netscape Communicator

E-Mail

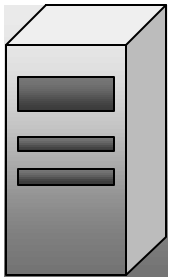


Outlook
Netscape
Eudora
Lotus

E-FORMS

PureEdge
ELock
Jetform
UWI.Com

Web Servers



Microsoft
Netscape/iPlanet
Apache
Lotus

ENTERPRISE

SAP R/3 (Secude)
Lotus Notes

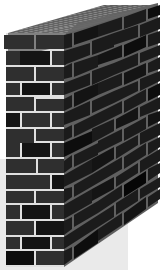
EDI

Actra
AT&T
Sterling
Premenos

Sign-on

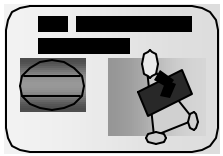
EnCommerce
Gradient

Network Mgmt



Checkpoint
Cisco
ISS
Lucent
Network Assoc.

SMART Card



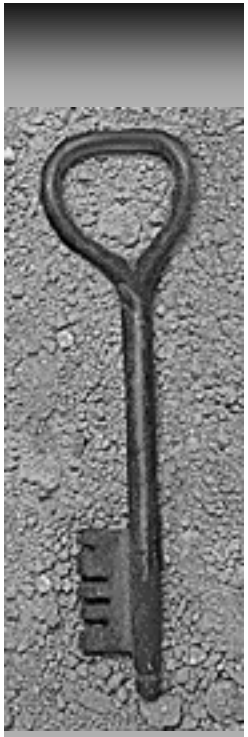
GemPlus
Litronic
Schlumberger

Tool Kits

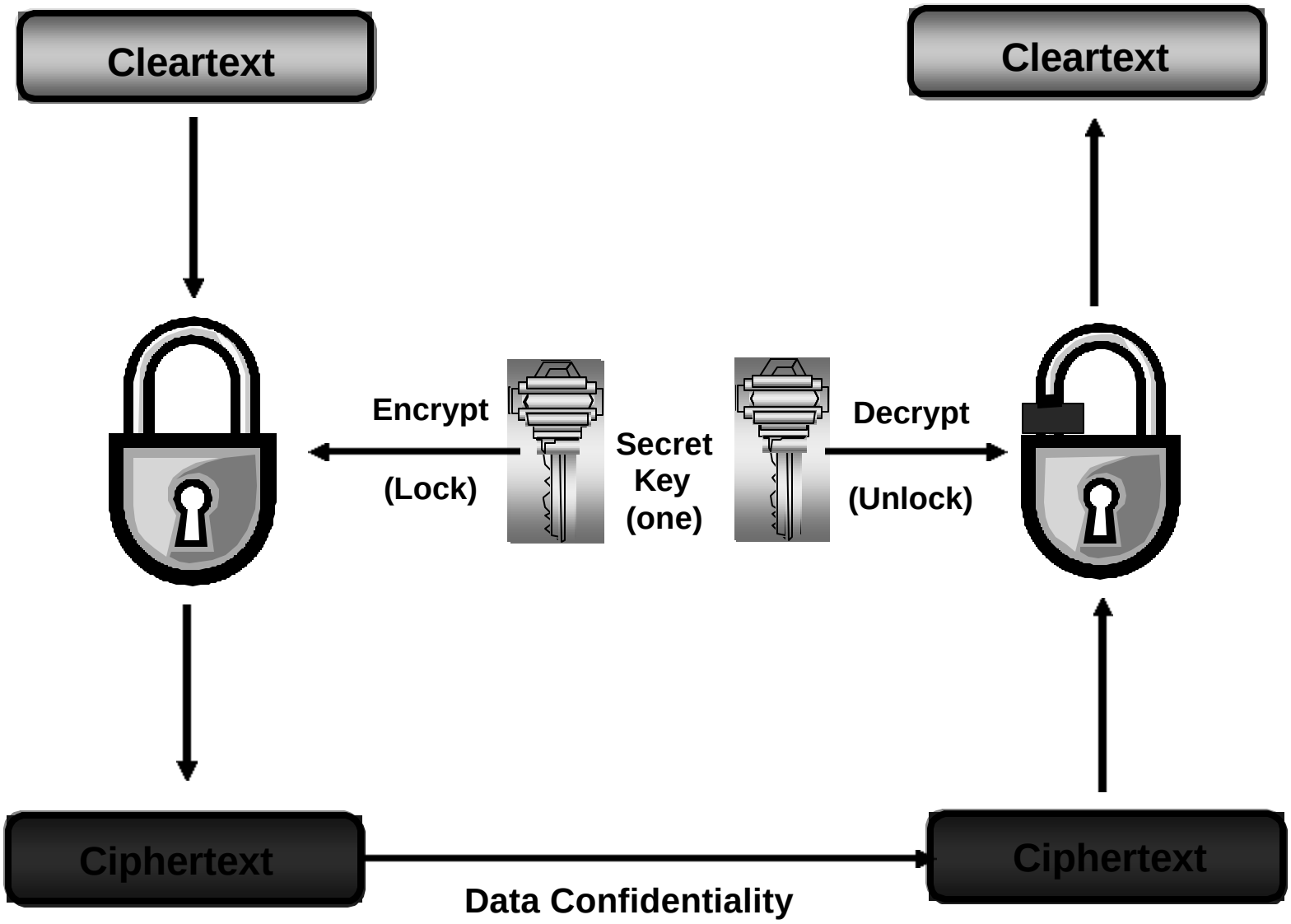
Baltimore
Entegrity
Xeti
RSA
VeriSign

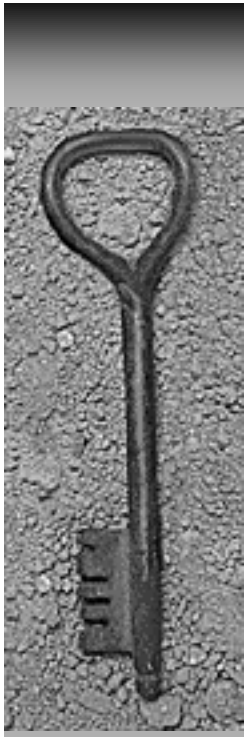
QUESTIONS?

BACKUP Picture

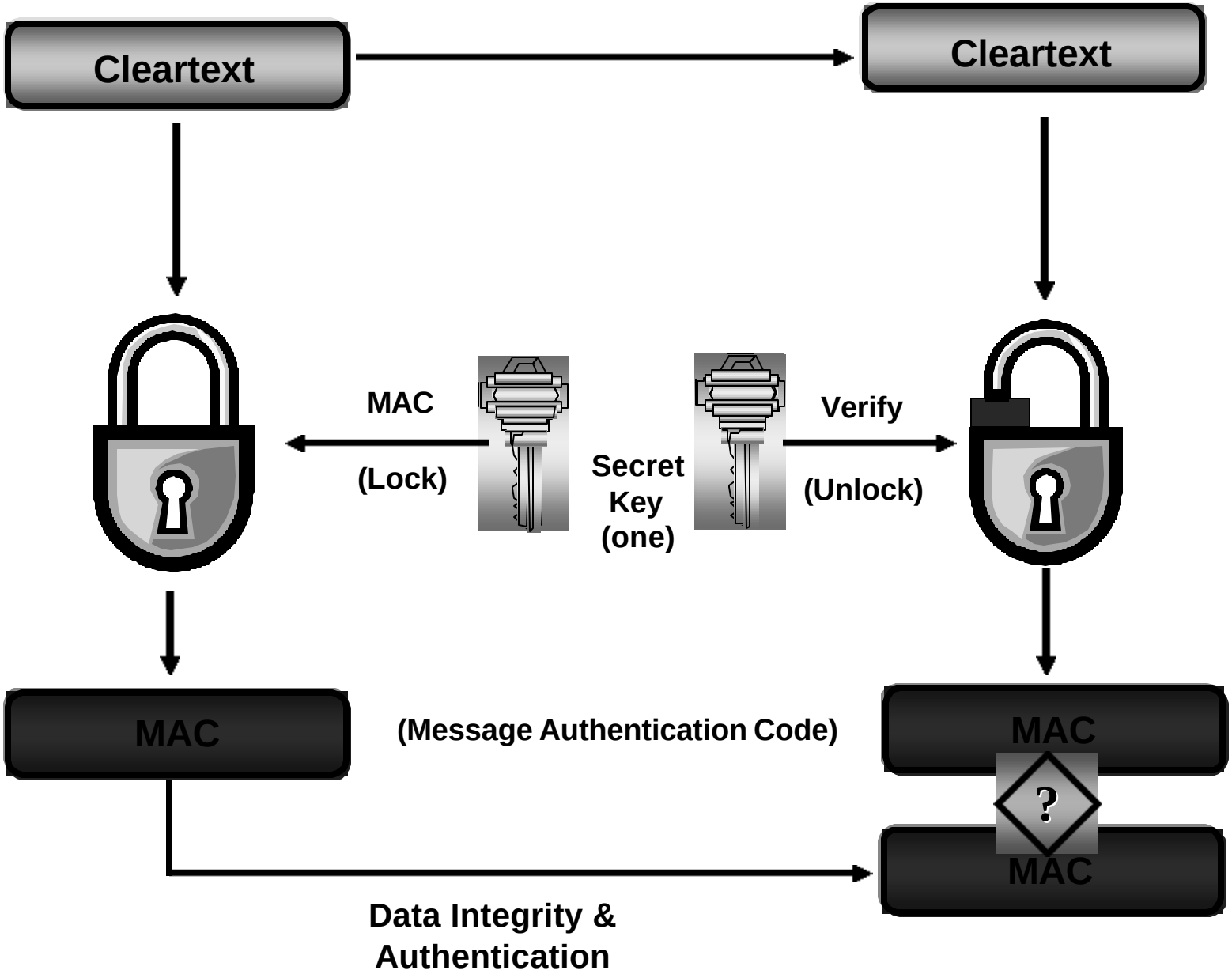


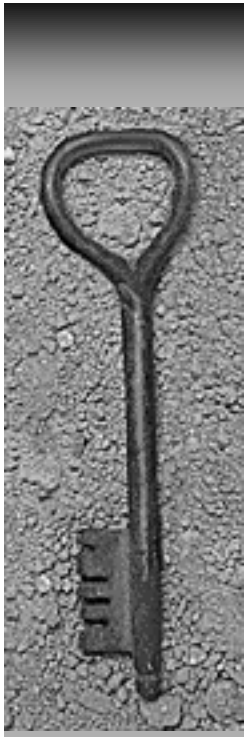
Symmetric Encryption



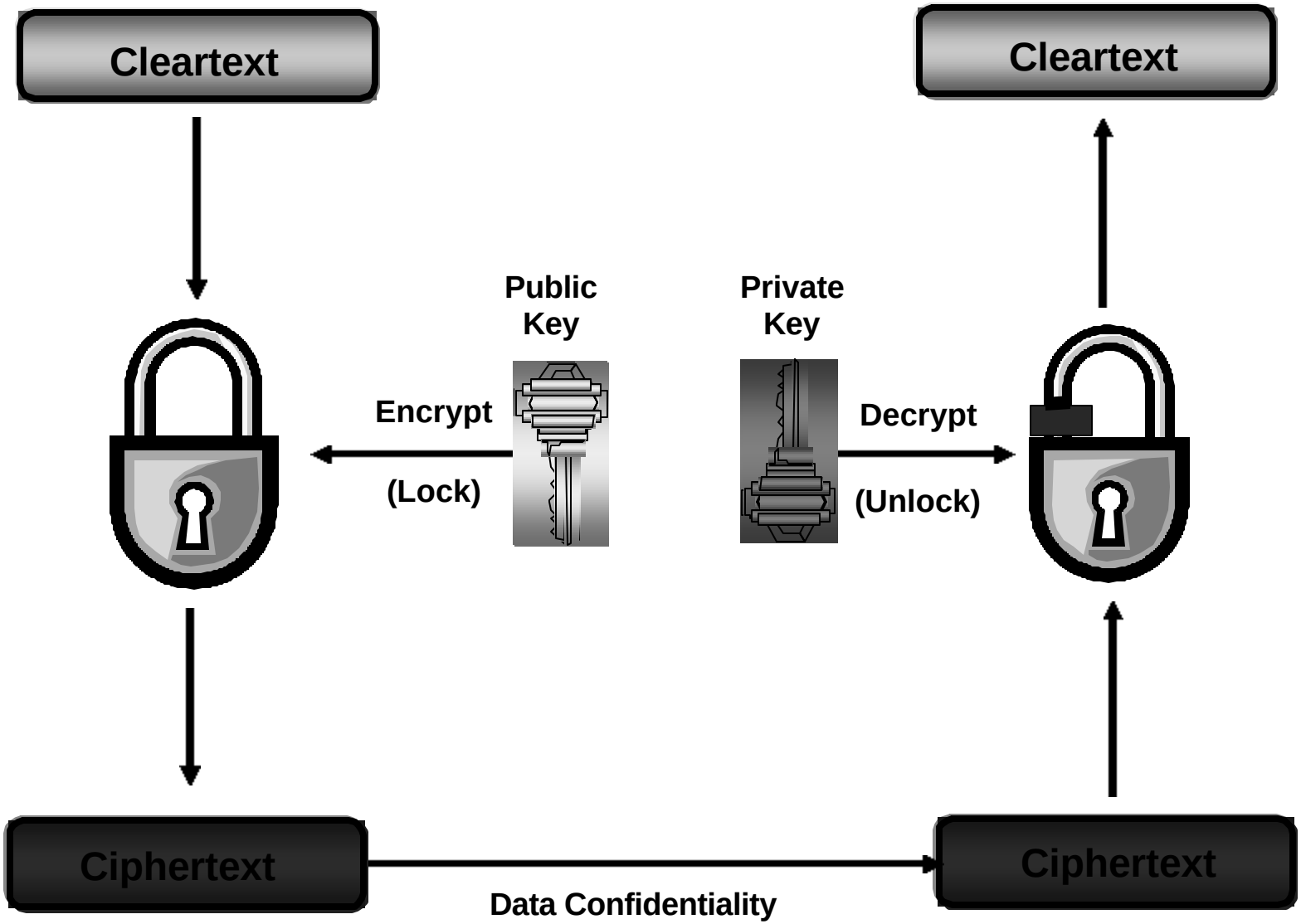


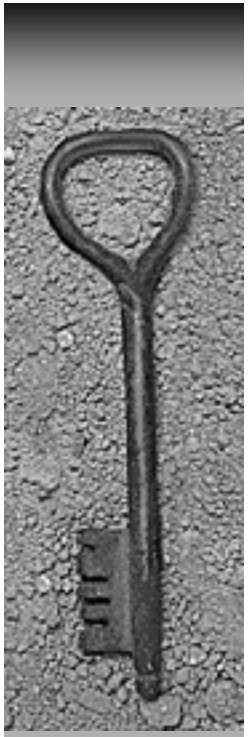
Message Authentication Code (Hash)



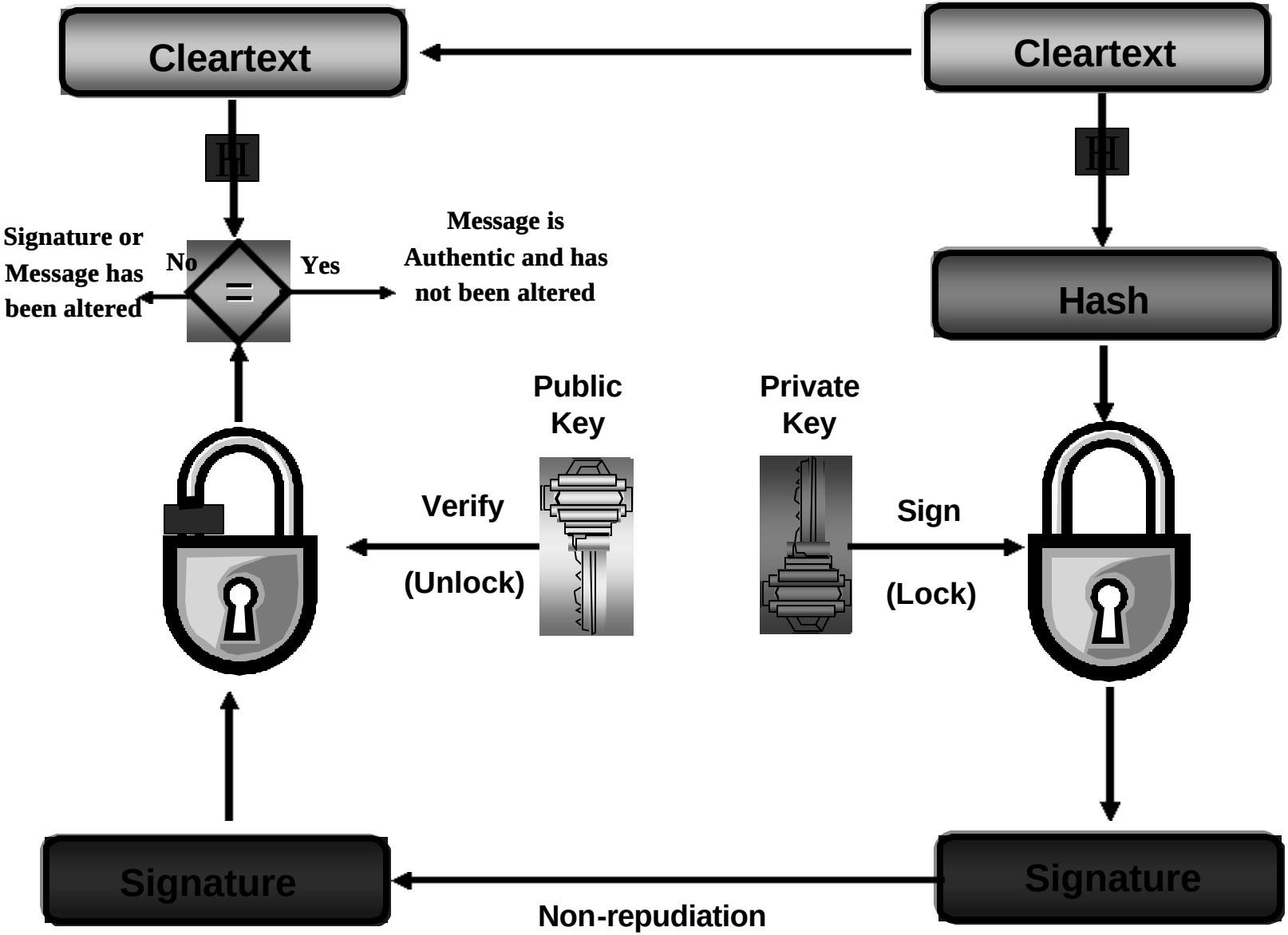


Asymmetric Encryption





Digital Signature

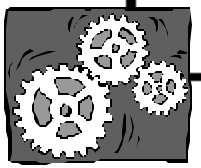


Digital Signature Example

Please pay XYZ Corp $5000.00 by September 10th

Bob's message (plain text)

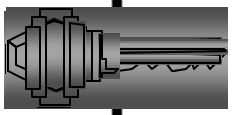
Original plain text message



Hash Function

Message Digest

XvcA56787hF56j



Bob's Private Key

Encrypting message digest creates digital signature

Signature

Please pay XYZ Corp $5000.00 by September 10th

Signature

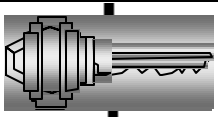
Sent to Alice

Please pay XYZ Corp $5000.00 by September 10th

Original plain text message

Please pay XYZ Corp $5000.00 by September 10th

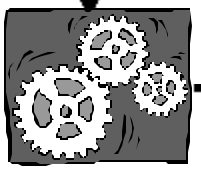
Signature



Bob's Public Key

Message Digest

XvcA56787hF56j



Hash Function

Alice's Message Digest

XvcA56787hF56j

Is message digest the same sent?

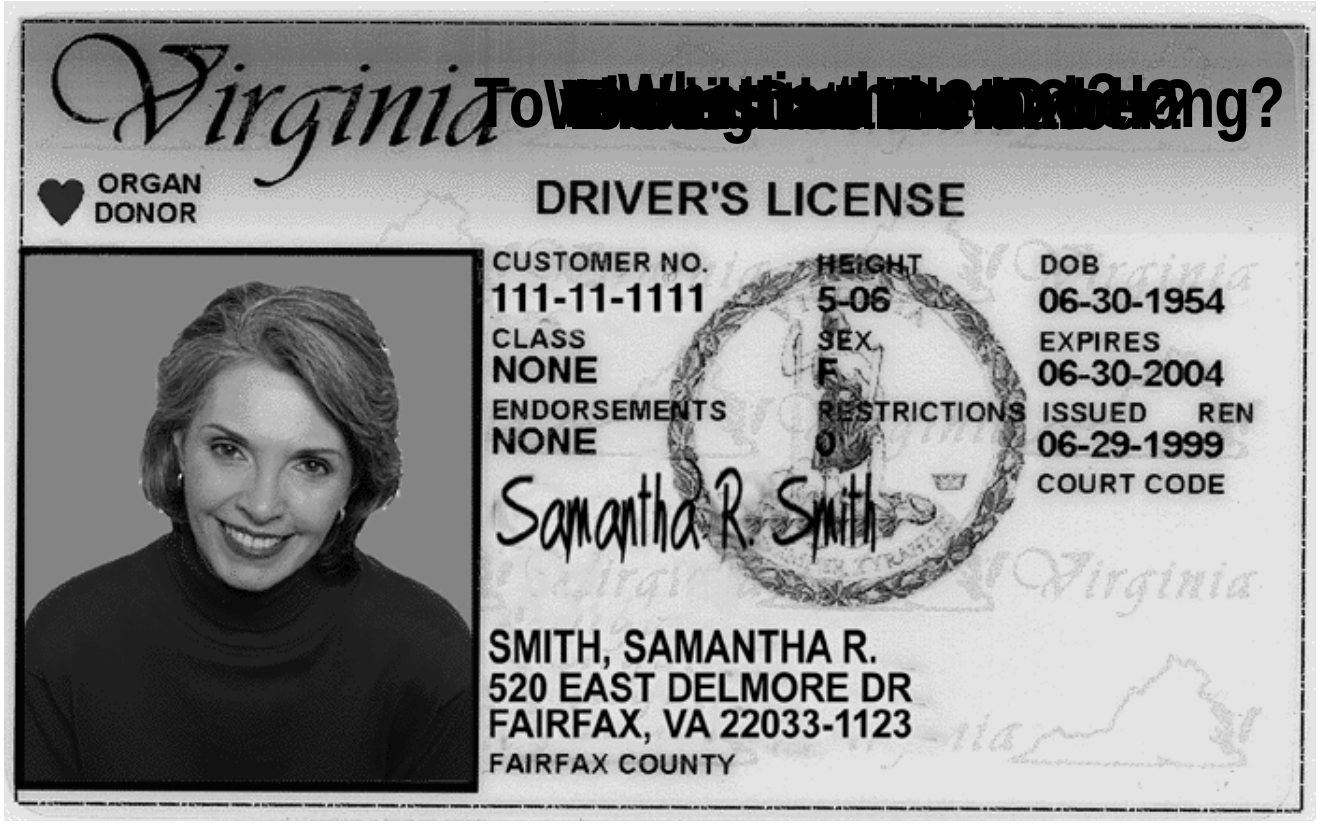
YES

Message is authentic and has not been altered.

NO

Signature or Message has been altered.

What is a Certificate?



Digital Certificate