Module 2.1
Crypto Essentials

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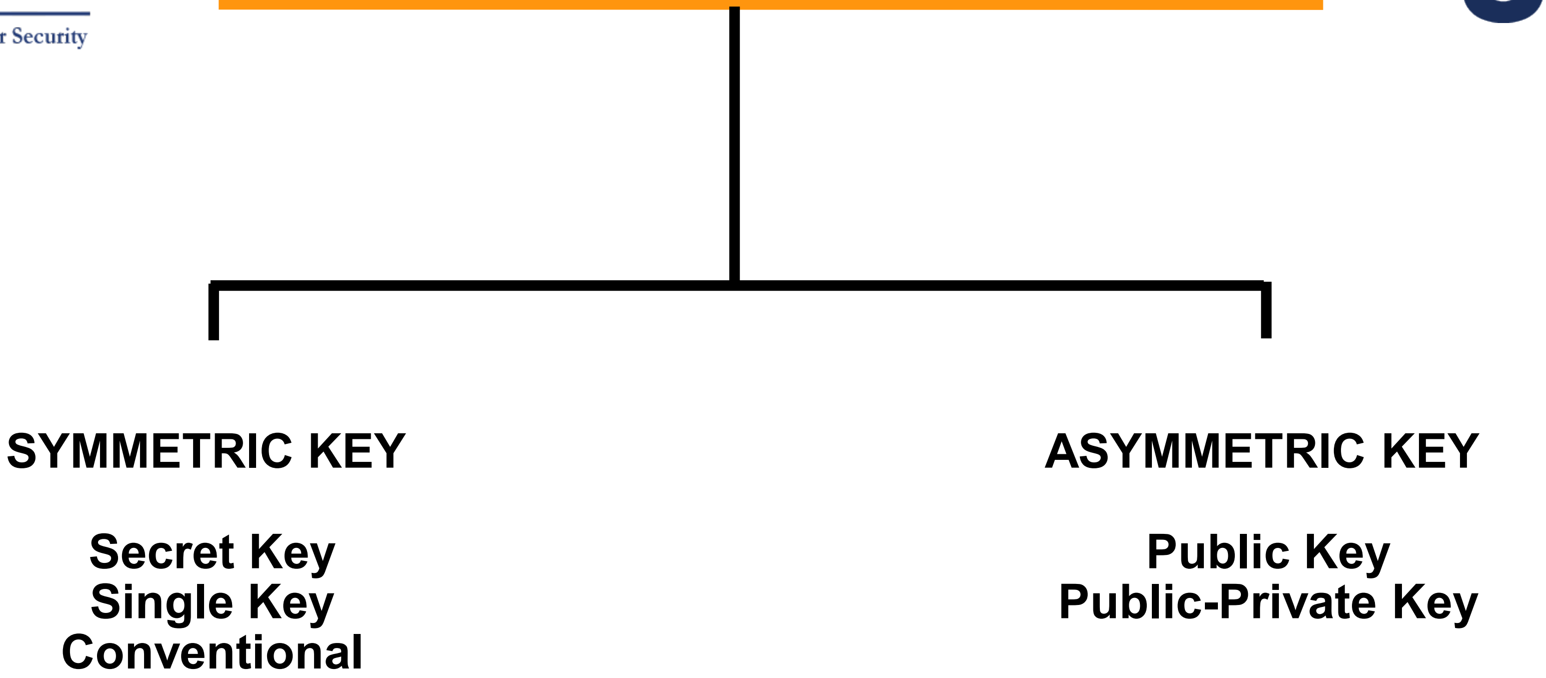
Spring 2021

Cryptographic Technology



SYMMETRIC KEY

Secret Key
Single Key
Conventional

ASYMMETRIC KEY

Public Key
Public-Private Key

Cryptographic Technology

- Symmetric-key encryption
- Symmetric-key message authentication codes (MAC)
- Public-key encryption
- Public-key digital signatures
- Message digests (hash functions)

SSL uses all of these

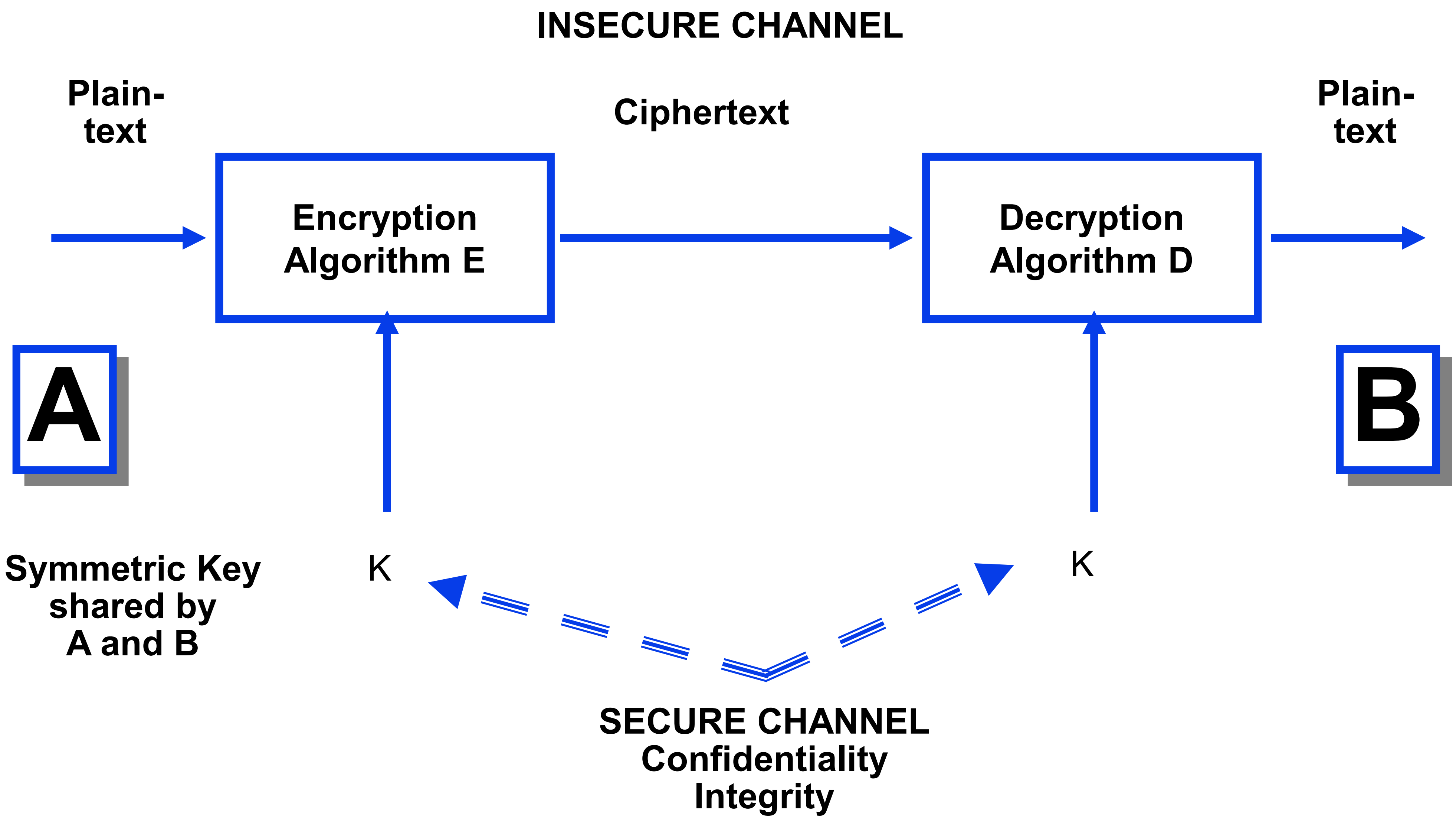
- Public-key certificates
- Public-key key agreement
- Challenge-response authentication
- Replay protection

ATMs run on symmetric-key technology

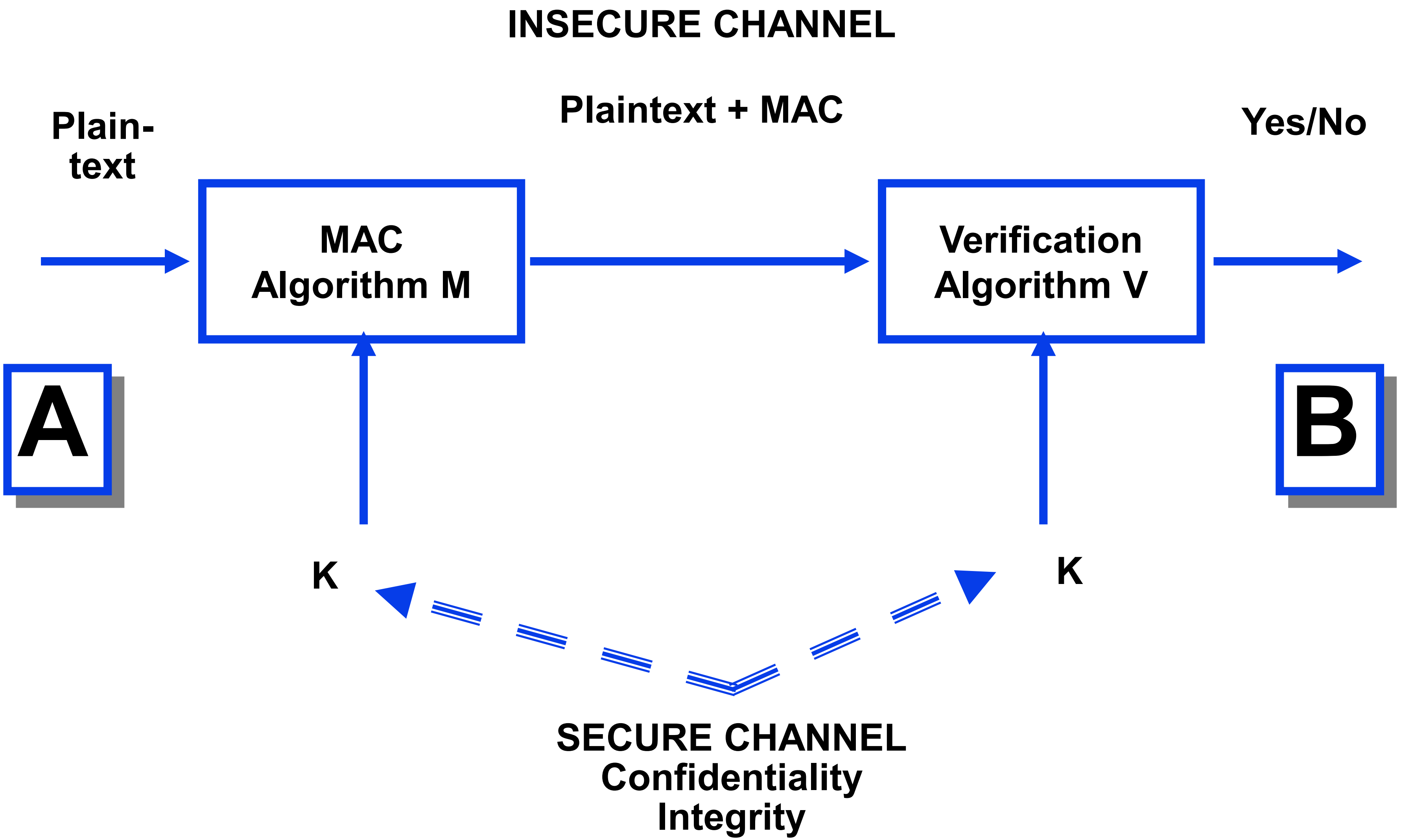
Cryptographic Services

- confidentiality
  - crypto keys leak profusely via side channels
- integrity + authentication
  - no point having one without the other
- non-repudiation
  - requires asymmetric cryptography
  - stronger form of integrity + authentication

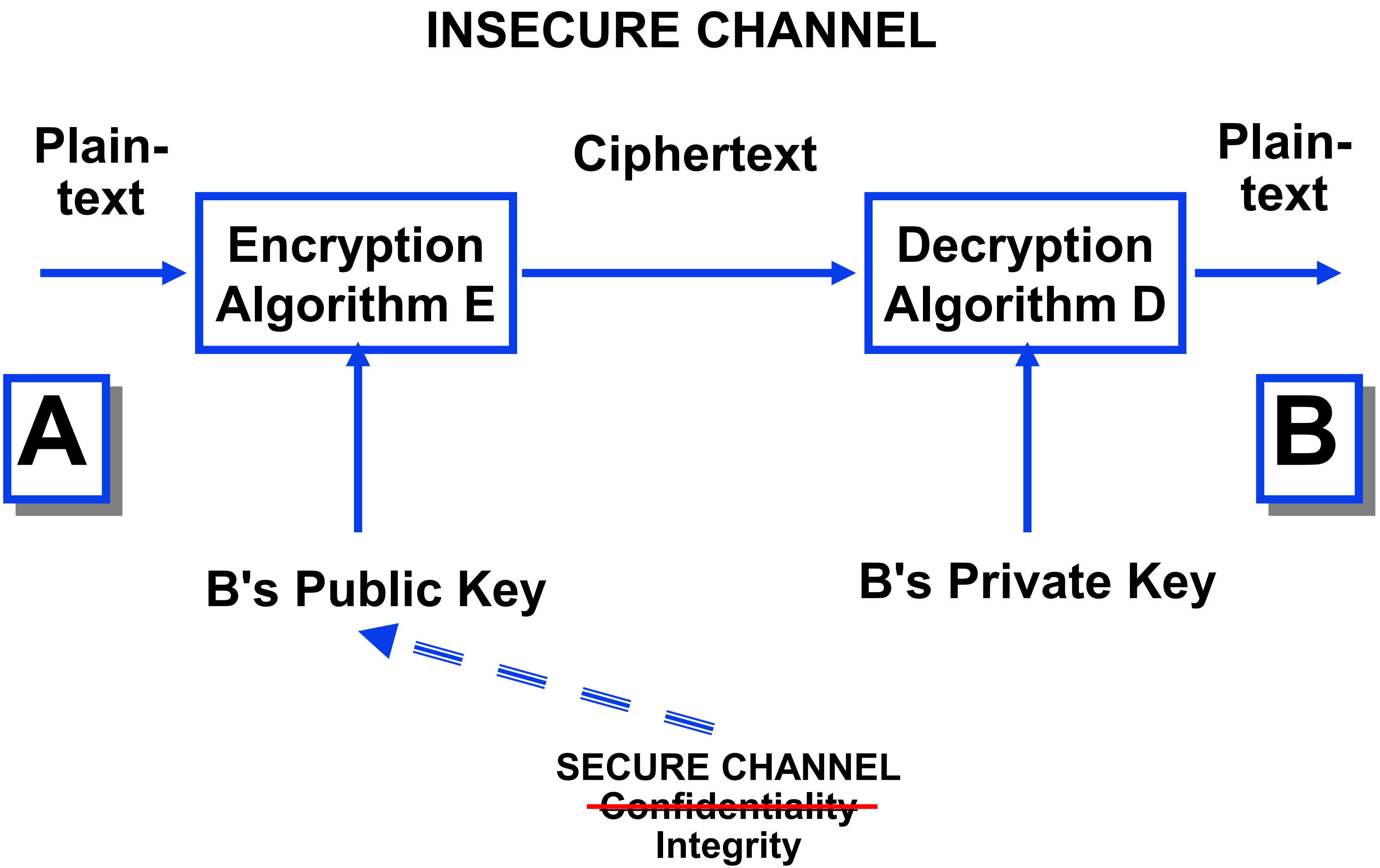
Symmetric-Key Encryption



Symmetric Key
Message Authentication Code



Public-Key Encryption


INSECURE CHANNEL

Plain-text

Encryption Algorithm E

Ciphertext

Decryption Algorithm D

Plain-text

A

B

B's Public Key

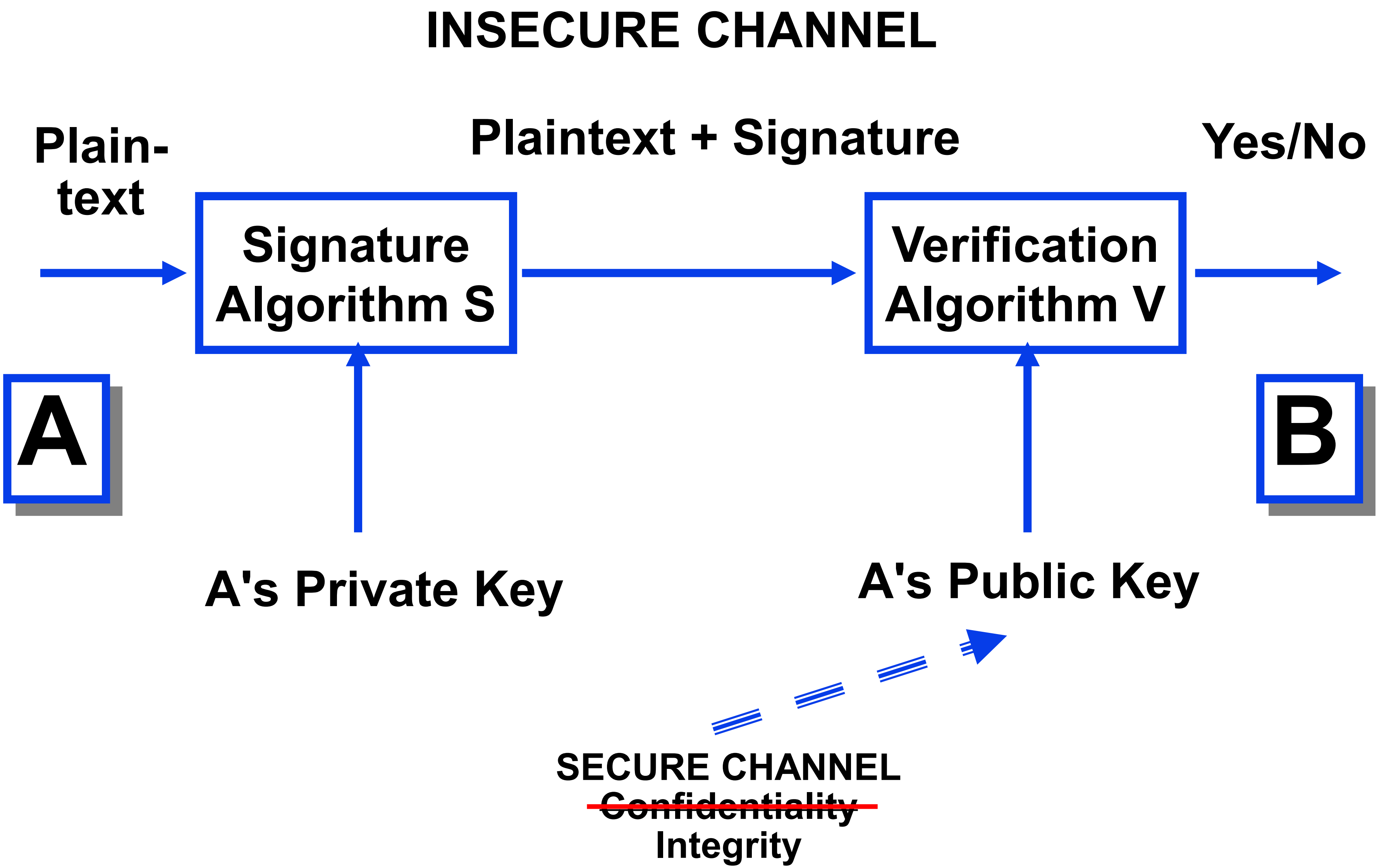
B's Private Key

SECURE CHANNEL

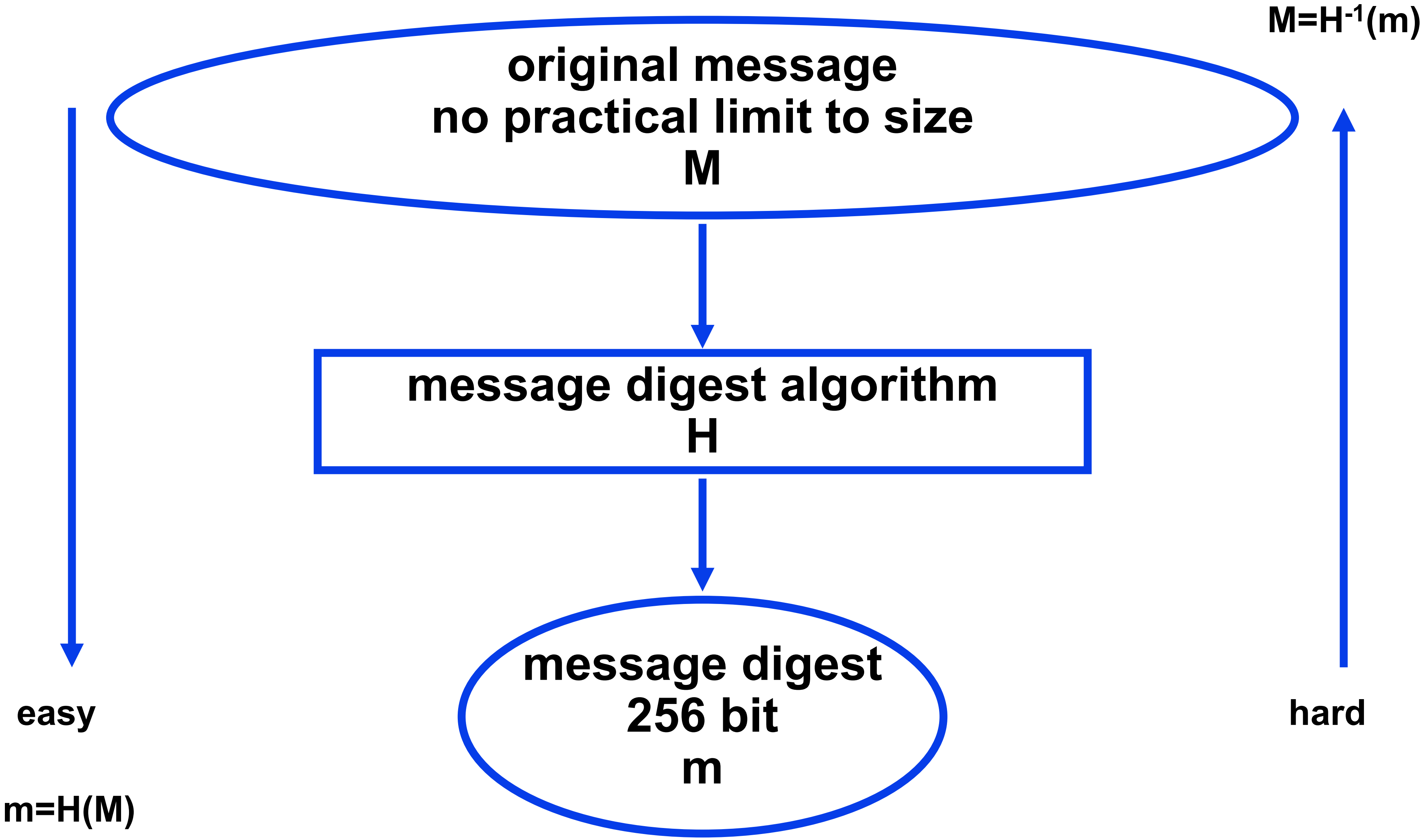
~~Confidentiality~~

Integrity

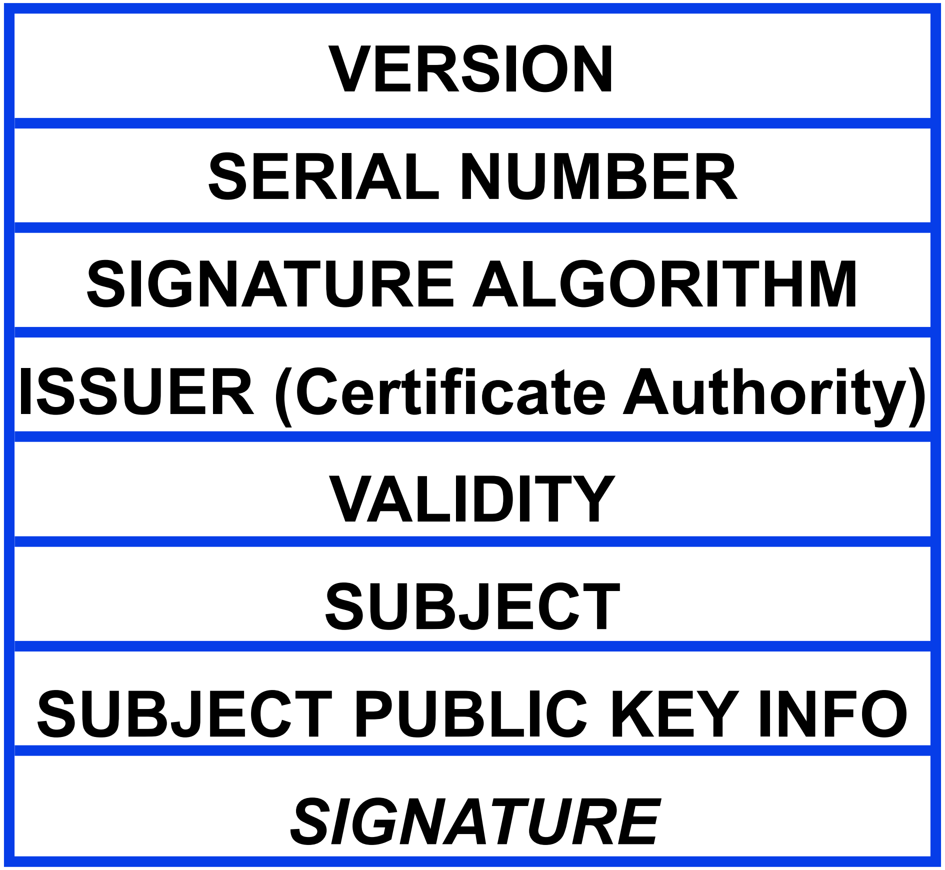
Public-Key Digital Signature



Message Digest (Hash)



X.509v1 Certificate



VERSION

SERIAL NUMBER

SIGNATURE ALGORITHM

ISSUER (Certificate Authority)

VALIDITY

SUBJECT

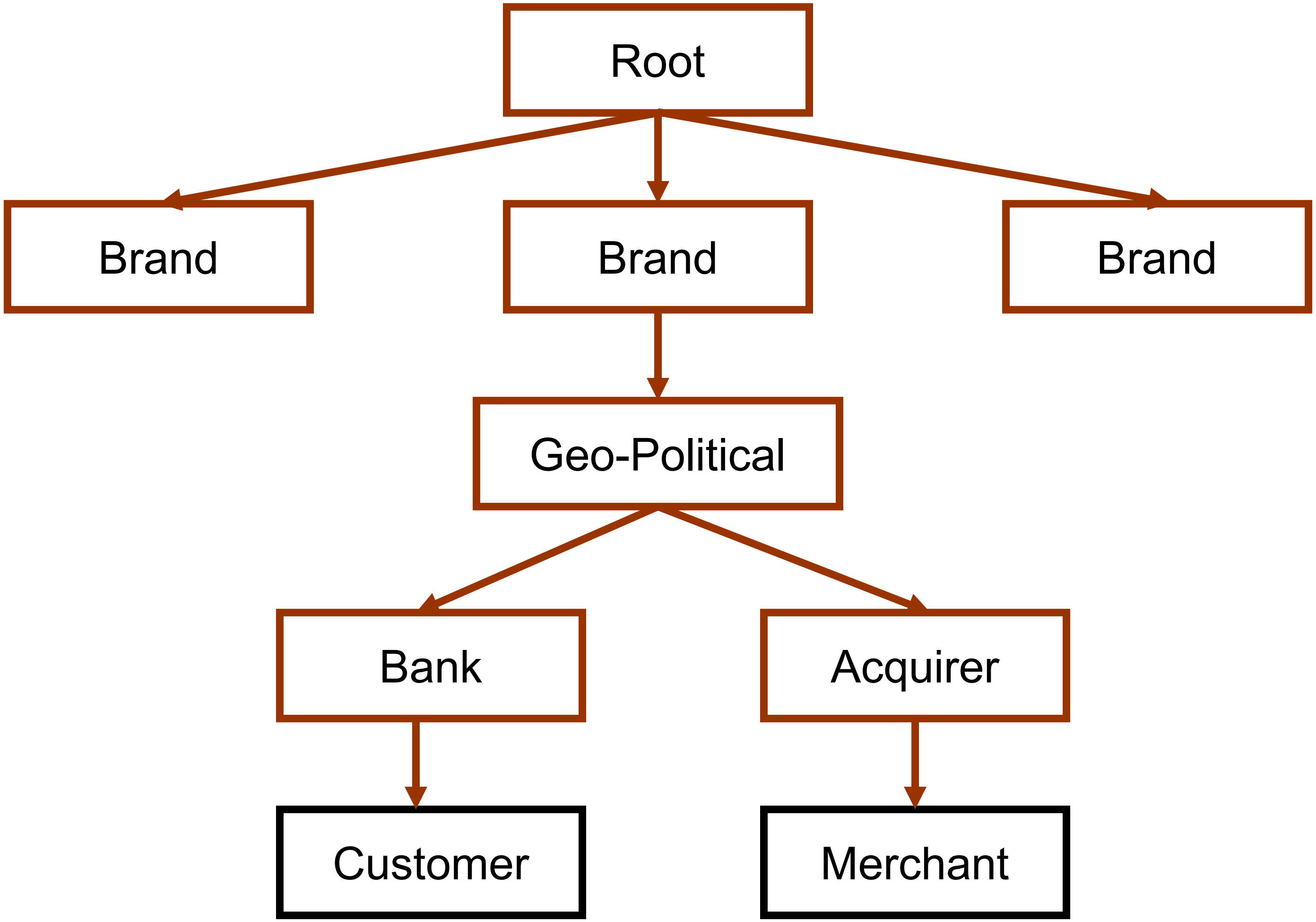
SUBJECT PUBLIC KEY INFO

SIGNATURE

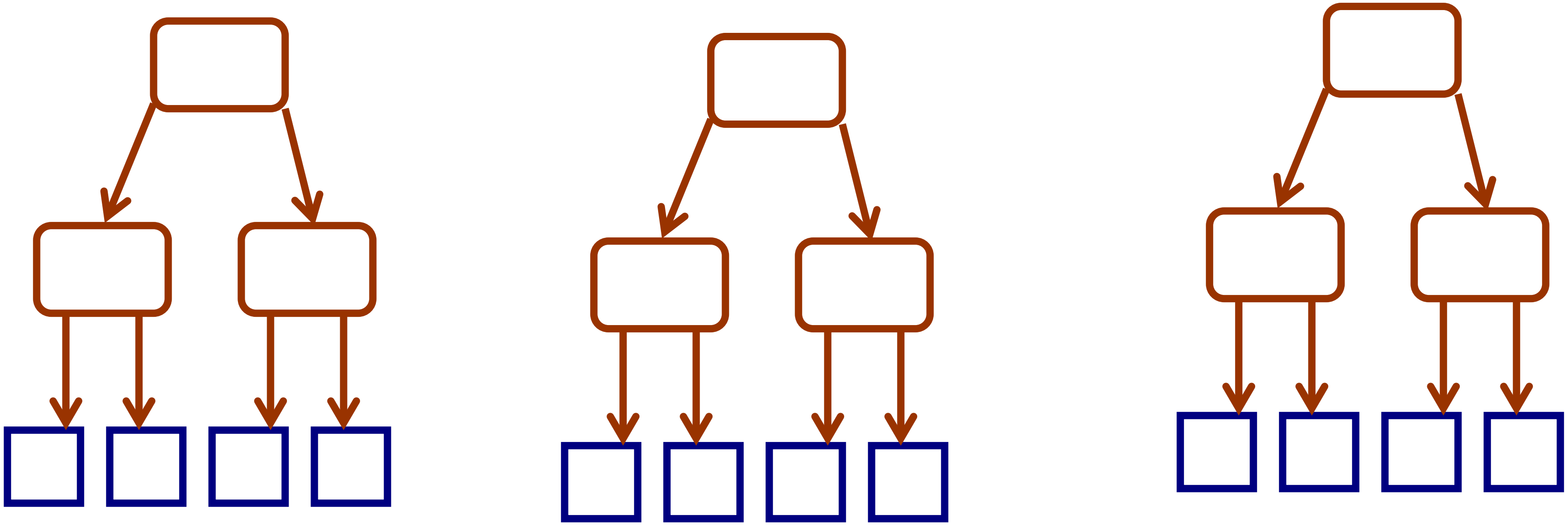
X.509v1 Certificate

1
1234567891011121314
RSA+SHA-3, 2048
C=US, S=TX, O=UTSA, OU=CS
1/1/19-12/31/20
C=US, S=TX, O=UTSA, OU=CS, CN=Ravi Sandhu
RSA, 2048, xxxxxxxxxxxxxxxxxxxxxxxxx
SIGNATURE

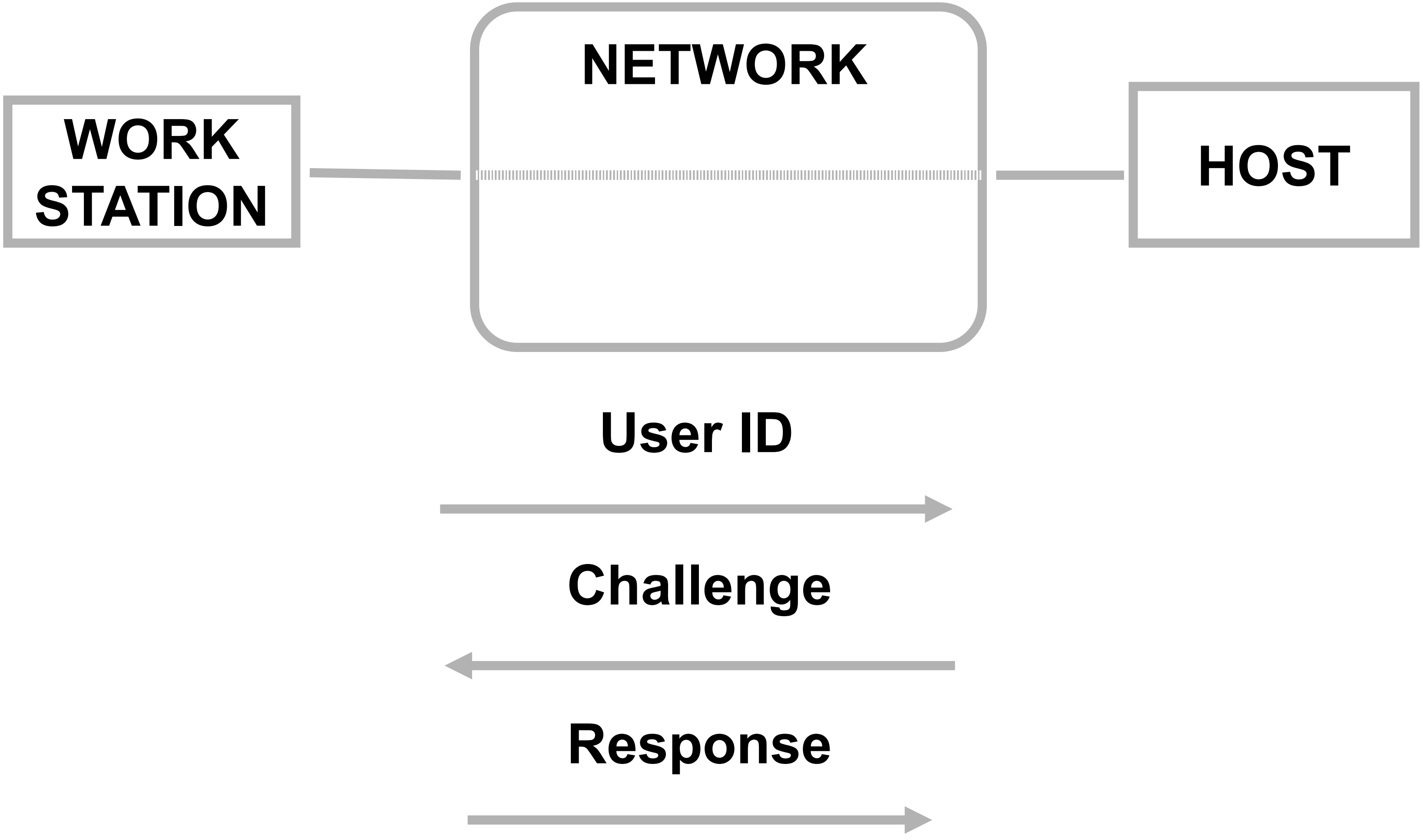
SET CA Hierarchy



Multiple Trusted Roots



Challenge-Response Authentication


WORK STATION
NETWORK
HOST
User ID
Challenge
Response