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Information Technology as an Integrating Force in Manufacturing

Security

Despite all that…
security breaches are on the rise

.. and require far less technical expertise

What is computer security?

- Securing access to resources
  - Two steps:
    - Authenticate = establish identity of the requestor
    - Authorize = grant or deny access
- Securing communications
  - Three steps:
    - Secrecy = prevent understanding of intercepted communication
    - Authentication = establish identity of sender
    - Integrity = establish that communication has not been tampered with

General Access Control Techniques

- Something you have
- Something you know
- Something you are

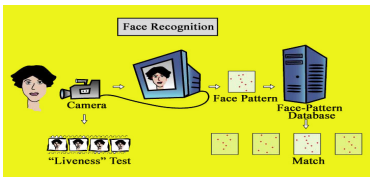
Smart Cards
"Something you have"

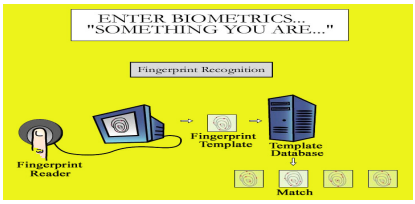
- Several subcategories
- One of interest here are cryptographic smart cards:
  - Store user's digital certificate and/or private key
  - Used to prevent private keys from being "hacked" from user's computer
  - What happens if a smart card is stolen?

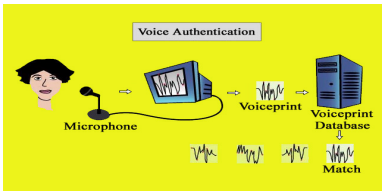
System Access Controls "Something you know…"

- Login procedures
  - Usually something you know
- Password leaks
  - Commonly used password
  - Explicitly told
    - Voluntarily
    - Trojan horse
  - Trial and error
  - Intercepted communication
    - paper, camera, wiretap, file on disk, emanations
    - password sniffing on networks
- Passwords are inconvenient
  - In client/server environment, user doesn't want to enter password for every service she connects to

Enter Biometrics… "Something you are…"

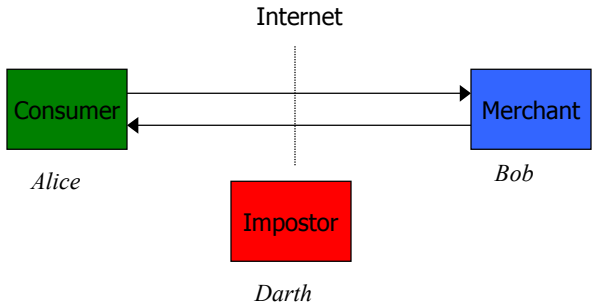






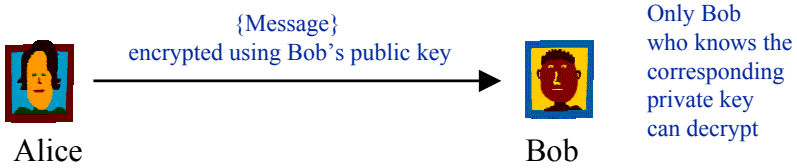
Communication security issues

- Encryption
  - how do I ensure the secrecy of my transactions?
- Authentication
  - how do I verify the true identity of my counterparts?



Public key cryptography

- Secret key cryptography: Based on a secret key
  - Same secret key used for encryption and decryption
  - Problem: How to transmit key securely on the Internet???
- Public key cryptography: Two keys used
  - Public key known to everybody. Used for encryption.
  - Private key known only to owner. Used for decryption.



Public key cryptography works if…

- Private key remains secret
  - Never leaves the owner's computer
  - Typically encrypted and password-protected
- Difficult to guess private key from knowledge of public key
  - Boils down to trying all different key combinations
  - Difficulty of "breaking" the code rises exponentially with the bit length of the key
  - 1024-bit keys require more time than the life of the universe in order to be "broken"
- Reliable public key distributed
  - This is the most difficult problem!

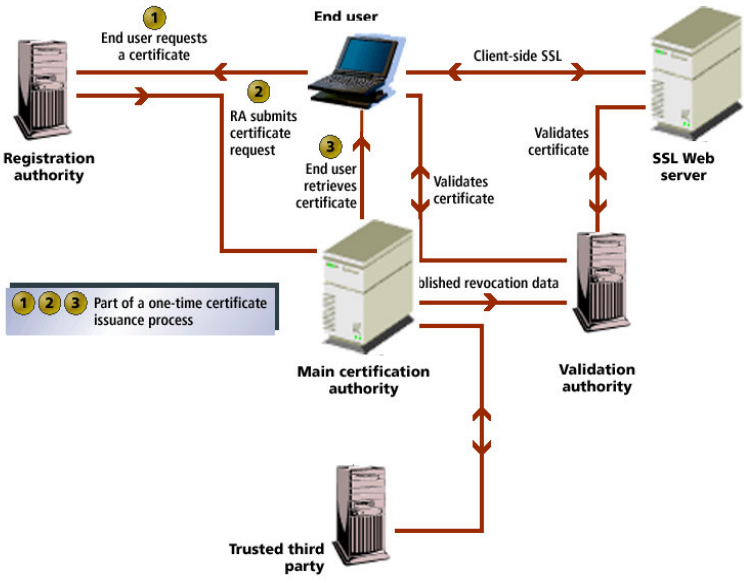
Encryption is not enough: Spoofs

- Pretending to be someone else
- Hard to login without someone's password
- But can send out communications with someone else's name on it
  - email
    - 1993: Dartmouth sent a message saying midterm exam was cancelled
    - Message appeared to come from the Professor!
  - netnews
  - world wide web

Digital Signatures

- Key property: Public and private keys can be applied in either order
- Alice has message M
  - She applies her private key to it
  - She sends encrypted message to Bob
- Bob decrypts it with Alice's public key
  - gets back original message
  - infers that Alice is indeed the sender (since only Alice has the private key that corresponds to her public key)
- In that way, encrypting a message with one's private key acts as a digital signature!

Overview of PKI



PKI Industry

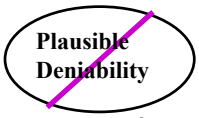
- Main players: trusted third party CAs
  - Verisign
  - Entrust
  - Cybertrust
  - RSA
- Revenue from
  - products (PKI servers for intranets and extranets)
  - services (certificate services for individuals and organizations)
- Revenue predictions (Datamonitor)
  - $330 million for products $347 million for services
  - Figures will grow to $1.2b and $1.4b resp. in 2006
- Mobile devices a big boost

SSL Certificates

- Used to certify a user's identity to another user
  - The certificate issuer's name
  - Who the certificate is being issued for (a.k.a the subject)
  - The public key of the subject
  - Some time stamps
- Digitally signed by issuer
- Issuer must be a trusted entity
- All users must have a reliable public key of the issuer
  - in order to verify signed certificate

Needed: Message Authentication

- Make sure Bob gets the message unaltered
- Don't let Alice deny sending the message



- Don't care about eavesdropper Darth, unless Darth changes the message
- How can cryptography help?

Public Key Management

- Public key cryptography works as long as
  - ✓ d is really kept secret
  - ✓ Hard to compute d from e
  - – Get the correct e from some trusted source
- Bob can send public key over insecure communication channel
- But how do you know Darth didn't send you his key instead?

A central key distributor

- Alice asks the distributor for Bob's public key
- The distributor sends it to Alice and "digitally signs" it
- Alice knows the key came from the distributor
  - Now just have to be sure that the distributor is honest and got Bob's key from Bob, not Darth
- Requires one secure communication per user
  - Bob sends public key to distributor when he joins the system
- Secret keys require secure communication between every pair of users

Public Key Infrastructure (PKI)

- Certificate Authorities are Trusted Third Parties charged with the responsibility to generate trusted certificates for requesting individuals organizations
  - Certificates contain the requestors public key and are digitally signed by the CA
  - Before a certificate is issued, CA must verify the identity of the requestor
- These certificates can then facilitate automatic authentication of two parties without the need for out-of-band communication