Announcements

- HW 4 due Thursday – 11:00 AM

- If you have any questions regarding HW3, Project Proposal and Midterm, please drop by during the office hour (or by appt)

Outline

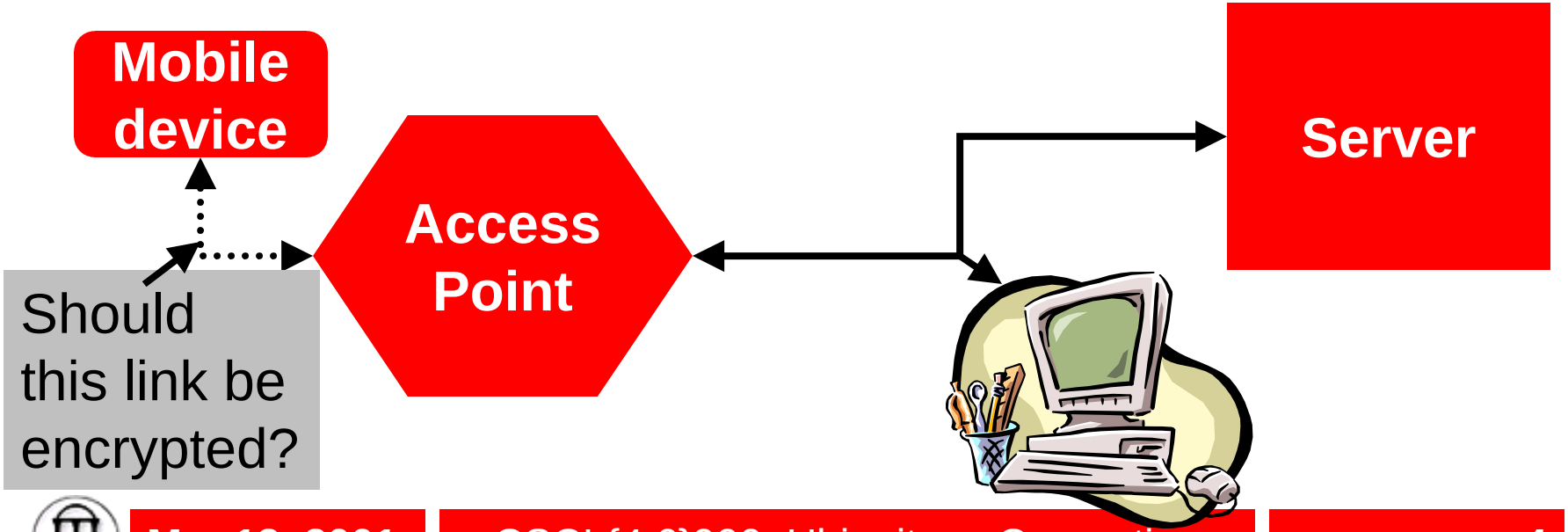
- *Introduction to cryptography*
  - Technology aspects
    - Encryption: asymmetric key, symmetric key
    - Authentication and access control
  - Social aspects

Risk analysis

- Important to understand threat and perform risk analysis
  - No system is “secure”, systems usually trade security for performance, ease of use etc.
  - If information is worth **x** and it costs **y** to break into system and if (**x** < **y**), then not worth encryption
  - Wasteful to build a system that is more secure than is necessary
    - Ssh in CS dept – good
    - Denying news server access from outside UGA - bad
  - Palm pilots may not require powerful encryption systems if they are expected to be physically secure

End-to-end argument

- End-to-end argument is appropriate for building a secure system
  - Perform security at lower levels if simple and does not impact performance
  - Higher levels usually know best regarding data integrity requirements



Security Attacks

- Social engineering attacks
  - Preys on people gullibility (good nature), hardest to defend
    - E.g. I once got an unlisted number from a telephone operator because I sounded desperate (I was, but that was not the point)
    - E.g. If I walk in with coupla heavy looking boxes into the elevator to go to Boyd 5th floor (at night) would you let me in? You can go into “secure” companies by looking like you “belong” there
- Denial of service attacks
  - Network flooding, Distributed DOS, holding resources, viruses

Common technology - firewalls

- Firewalls are used to restrict the kinds of network traffic in/out of companies
  - Application level proxies
  - Packet level firewalls

- Does not prevent end-to-end security violations
  - People sometimes email list of internal computer users outside firewall to scrupulous “researchers”
  - Emails viruses exploit certain vulnerabilities in VBS to get around firewalls

Encryption methods

- Symmetric cryptography
  - Sender and receiver know the secret key (apriori)
    - Fast encryption, but key exchange should happen outside the system

- Asymmetric cryptography
  - Each person maintains two keys, public and private
    - M ≡ PrivateKey(PublicKey(M))
    - M ≡ PublicKey (PrivateKey(M))
  - Public part is available to anyone, private part is only known to the sender
  - E.g. Pretty Good Privacy (PGP), RSA

My Public Key

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: PGPfreeware 7.0.3 for non-commercial use <http://www.pgp.com>

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9Xgv4qxKEA==
=Pv5O
-----END PGP PUBLIC KEY BLOCK-----
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RSA

- Named after Rivest, Shamir and Adleman (‘morrow)
  - Only receiver receives message:
    - Encode message using receivers public key
  - Only sender could’ve sent the message
    - Encode message using sender’s private key
  - Only sender could’ve sent the message and only receiver can read the message
    - Encode message using receivers public key and then encode using our private key

Strength

- Strength of crypto system depends on the strengths of the keys
- Computers get faster – keys have to become harder to keep up
- If it takes more effort to break a code than is worth, it is okay
  - Transferring money from my bank to my credit card and Citibank transferring billions of dollars with another bank should not have the same key strength

Public Key Infrastructure (PKI)

- Process of issuing, delivering, managing and revoking public keys
- E.g. Secure Sockey Layer (SSL)
  - Client C connects to Server S
    1. C requests server certificate from S
    2. S sends server certificate with Spublic to C
    3. C verifies validity of Spublic
    4. C generate symmetric key for session
    5. C encrypts Csymmetric using Spublic
    6. C transmits Csymmetric(data) and Spublic(Csymmetric) to S

Authentication

- Identification verification process
  - E.g. kerberos certificates, digital certificates, smart cards

- Used to grant resources to authorized users

Discussion