Network Security

Double Tap to Add Subtitle

What is network security?

Confidentiality: only sender, intended receiver should "understand" message contents

- sender encrypts message
- receiver decrypts message

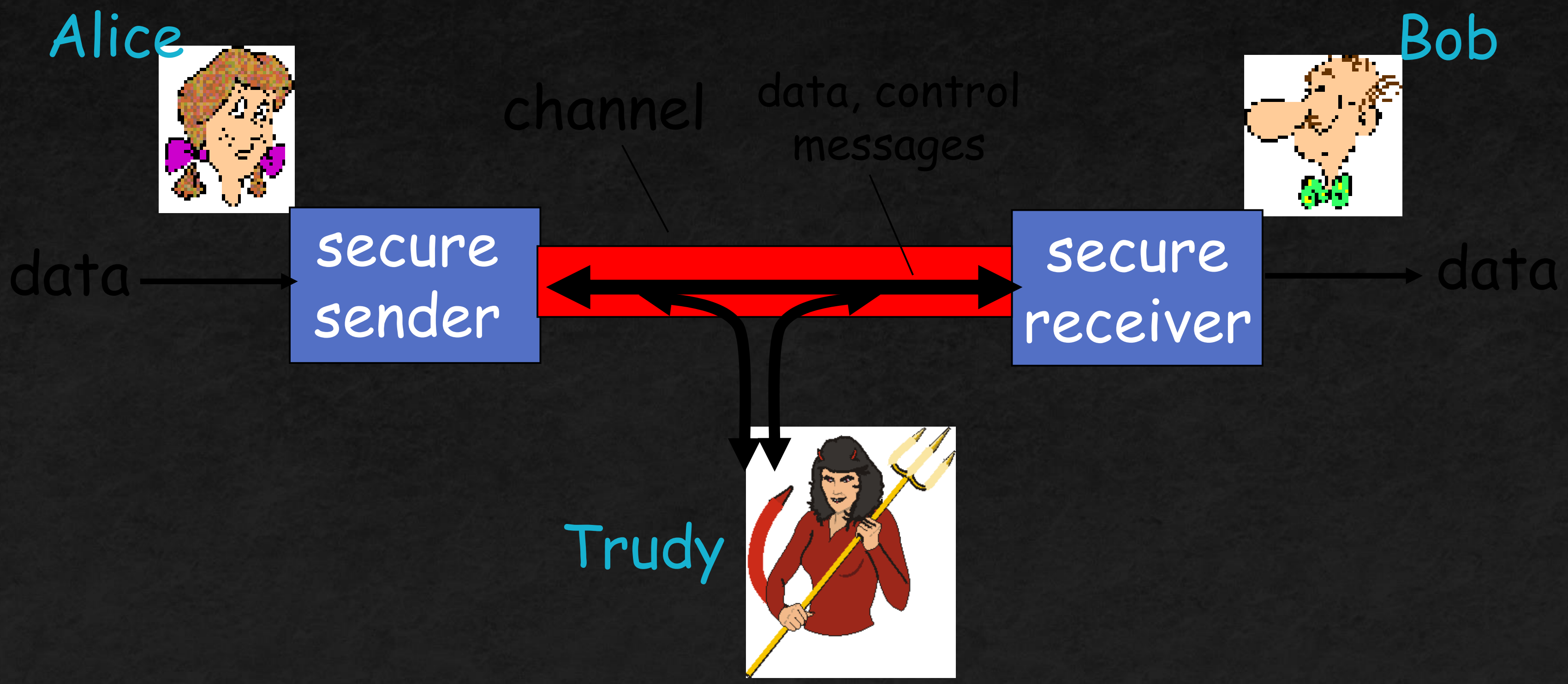
Authentication: sender, receiver want to confirm identity of each other

Message integrity: sender, receiver want to ensure message not altered (in transit, or afterwards) without detection

Access and availability: services must be accessible and available to users

Friends and enemies: Alice, Bob, Trudy

- well-known in network security world
- Bob, Alice (lovers!) want to communicate “securely”
- Trudy (intruder) may intercept, delete, add messages



Who might Bob, Alice be?

- … well, *real-life* Bobs and Alices!
- Web browser/server for electronic transactions (e.g., on-line purchases)
- on-line banking client/server
- DNS servers
- routers exchanging routing table updates
- other examples?

There are bad guys (and girls) out there!

Q: What can a "bad guy" do?

A: a lot!

- *eavesdrop:* intercept messages
- actively *insert* messages into connection
- *impersonation:* can fake (spoof) source address in packet (or any field in packet)
- *hijacking:* "take over" ongoing connection by removing sender or receiver, inserting himself in place
- *denial of service*: prevent service from being used by others (e.g., by overloading resources)

more on this later ……

What is “Security”

- Dictionary.com says:
  - 1. Freedom from risk or danger; safety.
  - 2. Freedom from doubt, anxiety, or fear; confidence.
  - 3. Something that gives or assures safety, as:
    - 1. A group or department of private guards: Call building security if a visitor acts suspicious.
    - 2. Measures adopted by a government to prevent espionage, sabotage, or attack.
    - 3. Measures adopted, as by a business or homeowner, to prevent a crime such as burglary or assault: Security was lax at the firm's smaller plant.

…etc.

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Why do we need security?

- Protect vital information while still allowing access to those who need it
  - Trade secrets, medical records, etc.
- Provide authentication and access control for resources
  - Ex: AFS
- Guarantee availability of resources
  - Ex: 5 9’s (99.999% reliability)

Who is vulnerable?

- Financial institutions and banks
- Internet service providers
- Pharmaceutical companies
- Government and defense agencies
- Contractors to various government agencies
- Multinational corporations
- **ANYONE ON THE NETWORK**

Common security attacks and their countermeasures

- Finding a way into the network
  - Firewalls
- Exploiting software bugs, buffer overflows
  - Intrusion Detection Systems
- Denial of Service
  - Ingress filtering, IDS
- TCP hijacking
  - IPSec
- Packet sniffing
  - Encryption (SSH, SSL, HTTPS)
- Social problems
  - Education

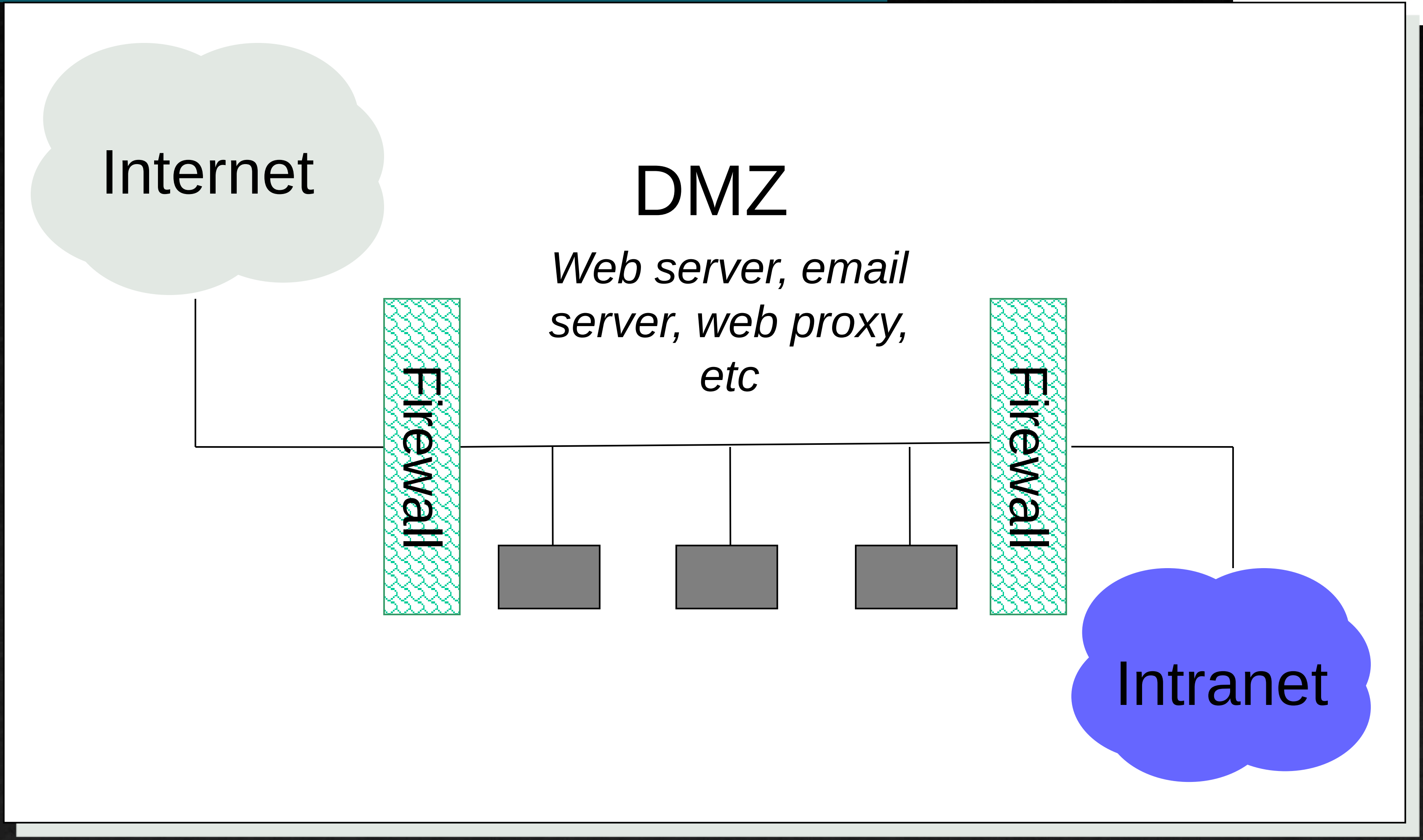
Firewalls

- Basic problem – many network applications and protocols have security problems that are fixed over time
    - Difficult for users to keep up with changes and keep host secure
    - Solution
        - Administrators limit access to end hosts by using a firewall
        - Firewall is kept up-to-date by administrators

Firewalls

- A firewall is like a castle with a drawbridge
  - Only one point of access into the network
  - This can be good or bad
- Can be hardware or software
  - Ex. Some routers come with firewall functionality
  - ipfw, ipchains, pf on Unix systems, Windows XP and Mac OS X have built in firewalls

Firewalls



Web server, email server, web proxy, etc

Firewalls

- Used to filter packets based on a combination of features
  - These are called packet filtering firewalls
    - There are other types too, but they will not be discussed
  - Ex. Drop packets with destination port of 23 (Telnet)
  - Can use any combination of IP/UDP/TCP header information
  - `man ipfw` on unix47 for much more detail
- But why don’t we just turn Telnet off?

Firewalls

- Here is what a computer with a default Windows XP install looks like:
  - 135/tcp open loc-srv
  - 139/tcp open netbios-ssn
  - 445/tcp open microsoft-ds
  - 1025/tcp open NFS-or-IIS
  - 3389/tcp open ms-term-serv
  - 5000/tcp open UPnP
- Might need some of these services, or might not be able to control all the machines on the network

Firewalls

- What does a firewall rule look like?
  - Depends on the firewall used
- Example: ipfw

  -
    ```
    /sbin/ipfw add deny tcp from
    cracker.evil.org to wolf.tambov.su
    telnet
    ```
- Other examples: WinXP & Mac OS X have built in and third party firewalls
  - Different graphical user interfaces
  - Varying amounts of complexity and power