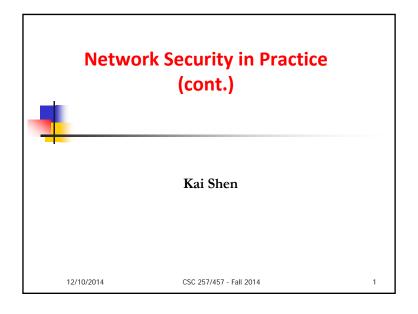
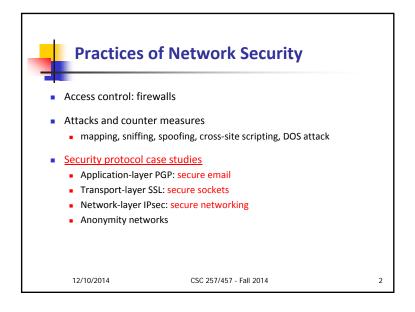
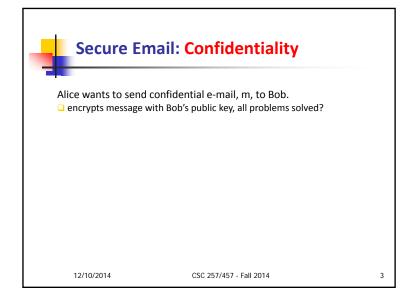
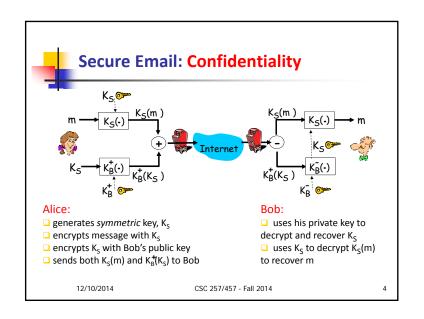
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Secure Email: Sender Authentication and Message Integrity

- Sender authentication and message integrity:
 - generates a digital signature of the message digest using his/her
- Put everything together
 - uses one-time session key and the receiver's public key to encrypt a digitally signed message
 - supports confidentiality, sender authentication, and message
 - PGP (pretty good privacy) for Internet email

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- SSL/TLS: transport layer security service to any TCP-based applications
 - used for remote terminal access (SSH).
 - used between Web browsers, servers for e-commerce (https).
 - used between IMAP clients and servers.
- Security services:
 - CA-certified public keys.
 - data confidentiality by encryption using a symmetric session key, key encrypted with server's public key.
 - source authentication & data integrity by signed message digests.

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Network Layer Security Protocol IPsec

- Two goals that secure socket layer cannot accomplish
 - secure everything (not just TCP traffic) on Internet
 - enable segmented protection protect a segment of the Internet path (e.g., public Internet but not internal company network)
- Like before:
 - data confidentiality by encryption using a symmetric session key
 - source authentication & data integrity by signed message digests
- Done in a way that is compatible with basic IP
 - IPsec packet is recognized as a supported protocol in IP
 - routers who don't support it can ignore it ⇒ allow incremental deployment with incremental benefits

IP header IPsec header Payload (potentially encrypted)

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More on IPsec

Transport mode (only host-to-host protection):

IP header IPsec header

Payload is data (TCP/UDP)

Tunnel mode (allow segmented protection):

IP header IPsec header

Payload is a full IP packet

- Tunnel mode allows intermediate segment of secure conn between two routers.
- (Virtual Private Network) VPN:



A rare example of success on enhancing the Internet!

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Tor Anonymity Network

- Standard encryption mechanisms protect the content of communication, but not the identities of the comm. parties
- Tor, The Onion Router, anonymity network
 - "Tor directs Internet traffic through a free, worldwide, volunteer network consisting of more than four thousand relays to conceal a user's location or usage from anyone conducting network surveillance or traffic analysis." --Wikipedia
 - "Edward Snowden used the Tor Network to send information about PRISM to the Washington Post and The Guardian in June 2013." --Wikipedia
 - http://en.wikipedia.org/wiki/File:Tor-onion-network.png

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Tor Anonymity Network

- NSA and GHCQ are interested in it
 - http://www.theguardian.com/world/2013/oct/04/nsa-gchq-attacktor-network-encryption
 - Compromise the source
 - Quotes from Guardian: But the documents [NSA leaks] suggest that the fundamental security of the Tor service remains intact. One top-secret presentation, titled 'Tor Stinks', states: "We will never be able to de-anonymize all Tor users all the time." It continues: "With manual analysis we can de-anonymize a very small fraction of Tor users," and says the agency has had "no success de-anonymizing a user in response" to a specific request.

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Network Security (summary)

Basic techniques.....

- cryptography (symmetric and public)
- authentication
- message integrity
- key distribution

.... network security in practice

- firewall
- attacks and countermeasures
- secure application (PGP for email)
- secure transport (SSL/TLS)
- secure network (IPsec)
- Tor anonymity network

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