Computer Networks

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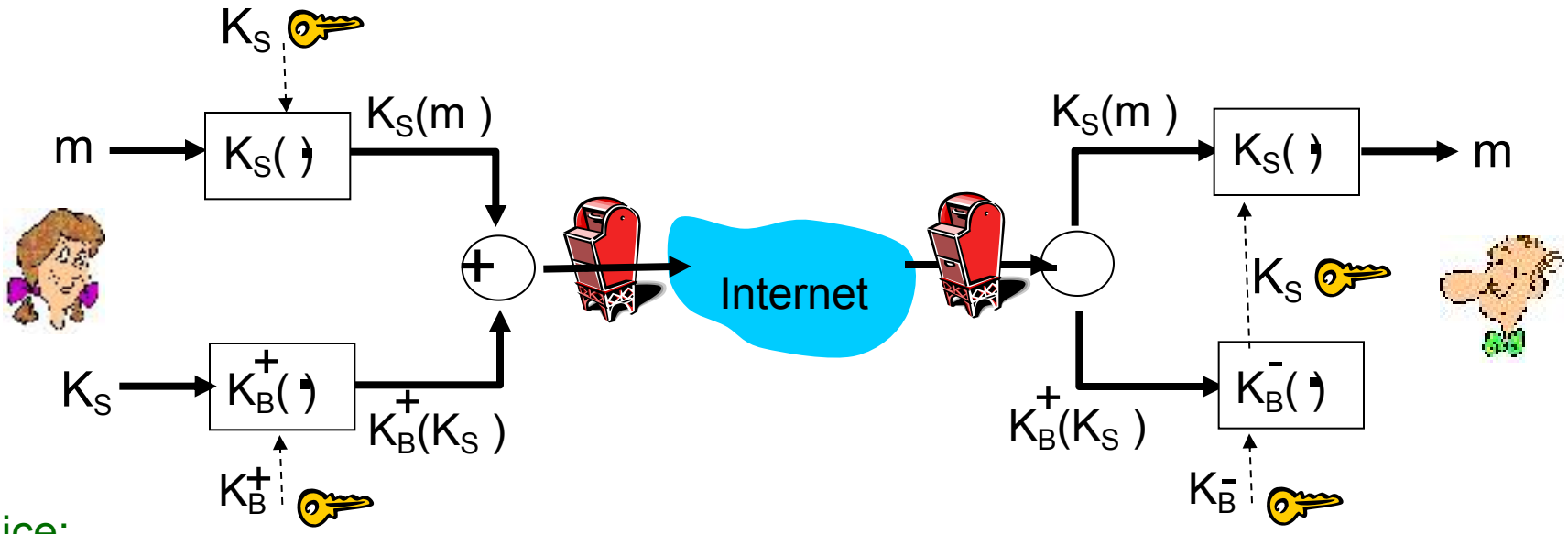
Q1

- Illustrate how Alice can send a confidential email to Bob using public/private keying.

Secure E-Mail



Alice:

- generates random *symmetric* private key, K_S.
- encrypts message with K_S (for efficiency)
- also encrypts K_S with Bob's public key.
- sends both $K_S(m)$ and $K_B(K_S)$ to Bob.

Bob: uses his private key to decrypt and recover K_S

- uses K_S to decrypt $K_S(m)$ to recover m

Q2

- Why is a symmetric key used in most protocols to encrypt a data payload (the message etc.), even if a public/private key infrastructure exists?

Why symmetric keys?

- Public/Private keying more costly
- Minimal use of public/private key minimizes the key exposure
  - Symmetric key can be generated each time on the fly and is therefore always fresh
  - Public/Private key is always the same. Encrypting large amounts of data could compromise the key... (although no efficient algorithm is known yet)

Q3

- Please explain in your own words the structure of the following PGP signed message (especially: how does the signature work?)

```
---BEGIN PGP SIGNED MESSAGE---
Hash: SHA1
Bob: My husband is out of town tonight. Passionately yours, Alice
---BEGIN PGP SIGNATURE---
Version: PGP 5.0
Charset: noconv
yhHJRHhGJGhgg/12EpJ+lo8gE4vB3mqJhFEvZP9t6n7G6m5Gw2
---END PGP SIGNATURE---
```

PGP E-Mail signature

Verification: Bob decrypts the PGP signature and obtains H(m). Additionally he computes H(m) for the message himself and compares it with the H(m) Alice computed.

Q4 and Q5

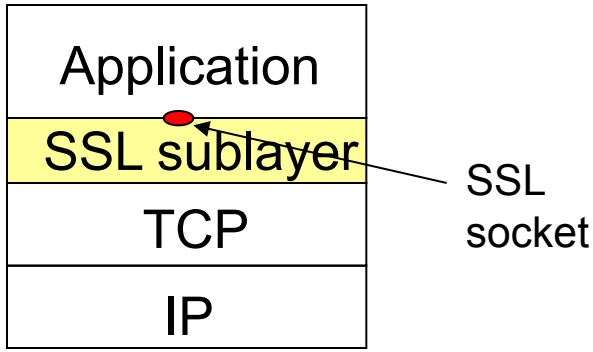
- What are the three main phases of SSL?
- On what layer does SSL reside and why is that advantageous?

SSL

- What are the three main phases of SSL?
  - 1. Handshake (TCP connection, authentication + master secret generation)
  - 2. Key derivation
  - 3. Data transfer

SSL

- On what layer does SSL reside and why is that advantageous?
  - provides transport layer security to any TCP-based application using SSL services.



TCP enhanced with SSL

Q6

- 6. Please sketch one typical scenario, where IPsec is used today.

IPsec

- Please sketch one typical scenario, where IPsec is used today.
  - VPN gateway at company or university. E.g. 134.76.22.1 is the VPN Gateway for the GWDG

Q7

- What are the two main protocols used in IPsec and what is their primary difference with respect to security properties?

Q7.a

- What are the two main protocols used in Ipsec?
  - Authentication Header (AH): Ensures authentication and data integrity. No encryption!
  - Encapsulated Security Payload (ESP): Ensures authentication, data integrity and encryption.

Q7.b

What is their primary difference with respect to security properties?

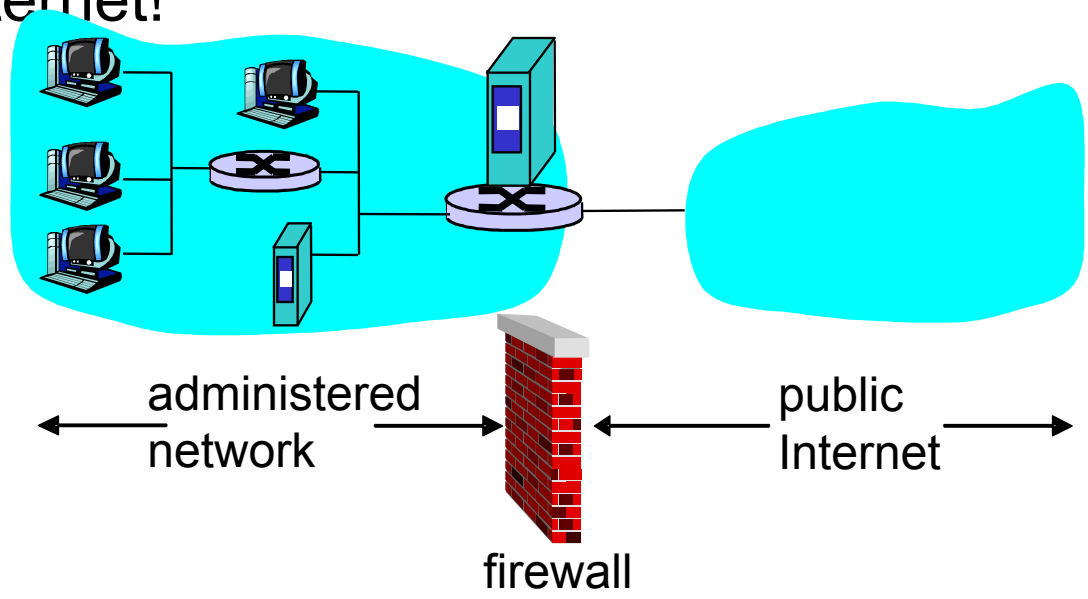
- AH incompatible with NAT-traversal
- ESP compatible with NAT-traversal

802.11i

- Who is handling the authentication information in an 802.11i scenario?
  - Using TLS-EAP (Extensible Authentication Protocol over Transport Layer Security) to contact an AAA (Authentication, Authorization, Accounting) Server

Firewalls

- What is the purpose of a firewall and what are filter rules?
  - Isolation of organization's internal network from internet!



Filter rules

- The firewall can be configured to only let certain packets pass. An administrator might be interested in setting up rules like:
  - No telnet connections to hosts behind the FW
  - Prevent outside machines to connect to inside machines, but still inside machines can connect to outsiders
  - Prevent web radios
  - Many more…

9 – Stateless & Stateful Firewalls

- Def A: a stateless firewall filters packets on a per-packet basis; the decision does not depend on previous packets and no state is saved on past packets
  - Pro: Simple rules, Low CPU requirements, Low cost
  - Cons: cannot check TCP flows

- *Def B: a stateful firewall* filters packets on a per-flow basis. It tracks status of every TCP connection
  - Pro: check TCP flows, Offer more precise statistic data
  - Cons: Do not examine the application-layer content, high cost

10 – Application Gateways

- Def: an *Application Gateway* can perform packet filtering on IP/TCP/UDP fields such as a firewall. Additionally, it can perform packet filtering based on application data.
  - Pro: more granular control compared to firewalls
  - Cons: an application gateway for each application, whereas firewalls are shared among applications

Exam in general

- Deadline in FlexNow!
- 90 minutes, no notes allowed
- No calculator needed, just a blue or black ball pen, paper will be provided
- We start at 10:15, be there at around 10:00
- Check out old exams on website

Exam hints

- No need to learn exact structure of packet (IP, TCP, UDP, …) headers
- No need to perform RSA (hard without calculator anyway ;)
- Be prepared to execute a routing algorithm
- Exercise questions often similar to exam questions

The networking lab

- Put what you've learned in theory now into practice.
- 5 ECTS practical course with dedicated lab hardware
- Teamwork (teams of 2 students)
- Check our wiki for more details

Thank you

Any questions?