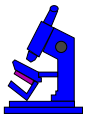
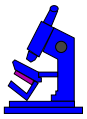



Chapter 11

Lecture 11 - Security


Last session

- Buffer overflow attacks
- PkZip attack
- DVDs and the CSS
- SSH and SSL
- PGPfone



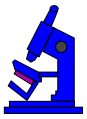
This session

- Design principles
- Biometrics
- IPSec
- Formal methods
- Formal evaluation
- Exam

Design principles

Ppaper by Saltzer and Schroeder, summarized below:

- **Economy of mechanism:** Keep the design as simple and small as possible. (identd assumption)
- **Fail-safe defaults:** Base access decisions on permission rather than exclusion. This is conservative design. (mail server - mail only access)
- **Complete mediation:** Every access to every object must be checked for authority. (DNS cache poisoning)



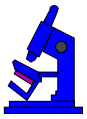
Design principles

- **Open design:** The design should not be secret. (DVDs, Microsoft SAM hashes...)
- **Separation of privilege:** Two keys are better than one. No single event can compromise the system. (su - password and *wheel* group)
- **Least privilege:** Every program and every user of the system should operate using the least set of privileges necessary to complete the job. (Military need-to-know)

Design principles

- **Least common mechanism:** Minimize the amount of mechanism common to more than one user and depended on by all users. (supervisor or library).
- **Psychological acceptability:** Human interface easy to use.

In the textbook there are examples of the use of each of these design principles.



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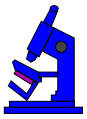
Biometrics

Biometrics is the use of **human** physical **characteristics** to support **authentication**.

FPC1010 Area Sensor

FEATURES
- Internal A/D
- SPI interface
- 3.3 Volt operation
- Robust surface coating
- >1 000 000 wear cycles
- >15kV ESD protection

APPLICATION EXAMPLES
- Mobile phones, PDAs
- PC peripherals
- Security systems
- Smart cards

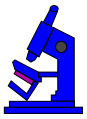


Biometrics - eyes

Minimal hardware biometrics

- ✔ **Voices** - Record and process voice leading to either speaker verification or recognition.
- ✔ **Faces** - Capture either a static or moving image of a face.
- ✔ **Keystrokes** - capture a sequence of keystrokes, recording timing.

Combinations of characteristics may be used, but in general biometric techniques are **not reliable** on their own. Good second key for ***separation of privilege***.



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IPSec

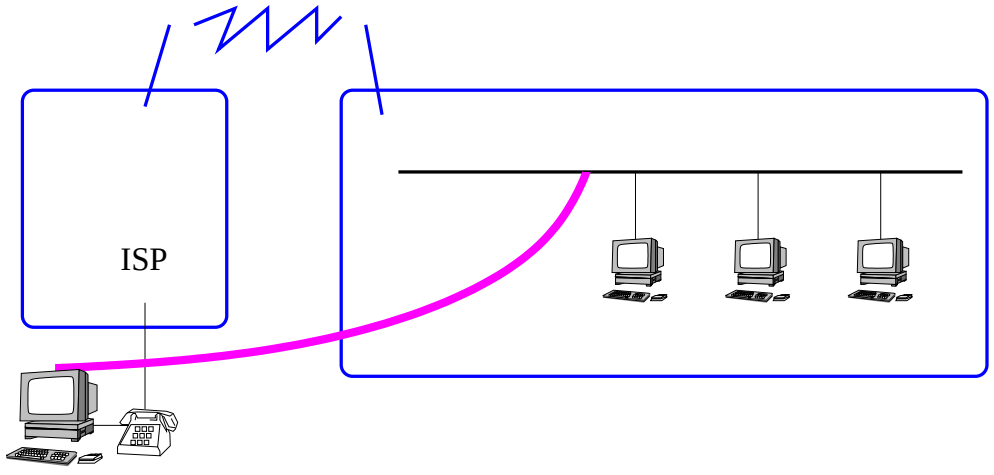
✔ IPSec is a **set of standards** intended to support communication security between networked computers, particularly in the newer IPv6 (IP Next-Generation) network.

✔ IPSec software is available in Windows2000, Linux, and on routers on the Internet.

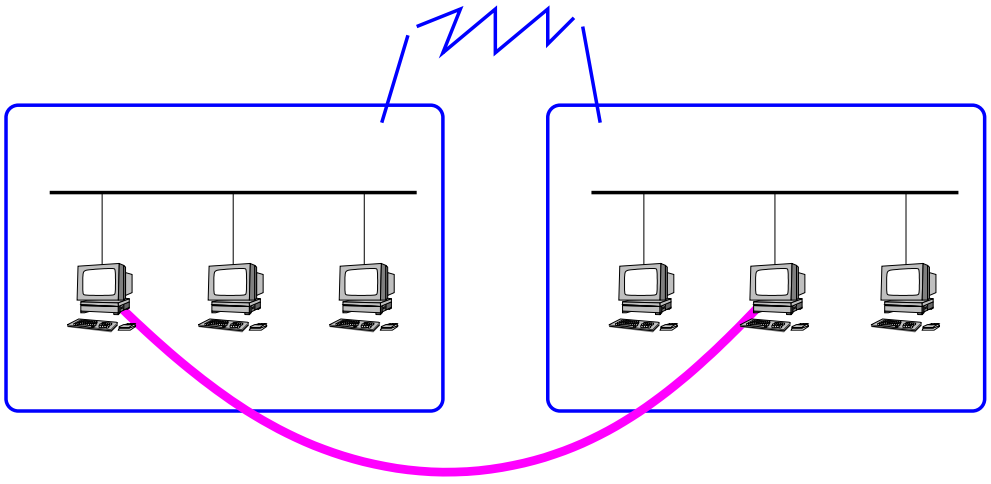
http://www.faqs.org/rfcs/rfc2401.html

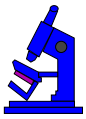
✔ IPSec may be used in a range of ways.

IPSec VPN

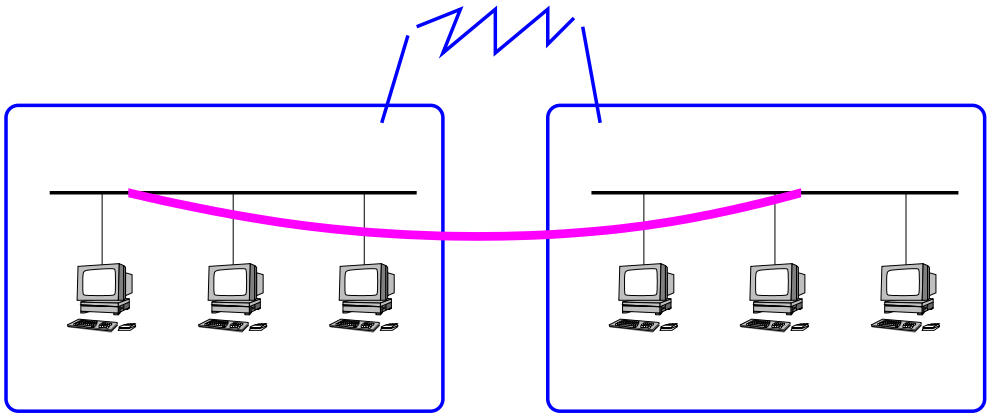


IPSec point-to-point





IPSec network-to-network



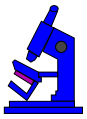
IPSec headers

There are two types of header, one used for **authentication**, and the other used for **encryption**:

1. **AH** - the **Authentication Header** for data integrity, anti-replay and authentication

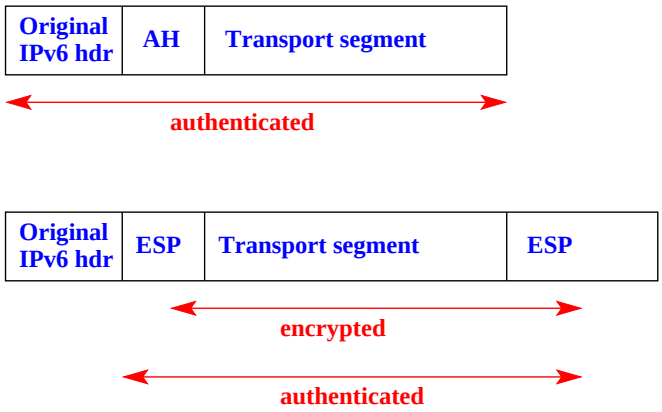
2. **ESP** - the **Encapsulating Security Payload** header, for confidentiality. ESP can also provide AH services.

Communicating parties agree on a **Security Association** (SA), one SA for each direction, and one SA for each type of communication.



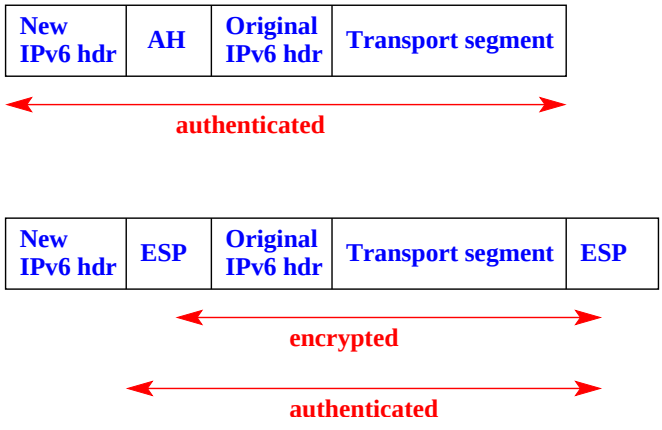
Modes of operation

- An end-to-end SA - Transport mode

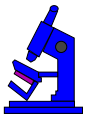


Modes of operation

- An SA between security gateways - Tunnel mode



SAs form a kind of distributed database.



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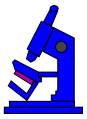
Formal methods

- ✔ **FM** encompasses a **wide range** of techniques...
- ✔ Model checking:
  - ✔ constructing formal ***models***, with
  - ✔ appropriate formal ***specifications***.
- ✔ Example is **Promela** and **Spin**.



Promela and spin

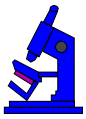
- ✔ The **language** Promela is 'C' like, with an initialization procedure. It can model asynchronous or synchronous, deterministic or non-deterministic systems
- ✔ Spin is the **checker** for Promela models
- ✔ Assertions to test correctness of model:

```
assert(some_boolean_condition);
```

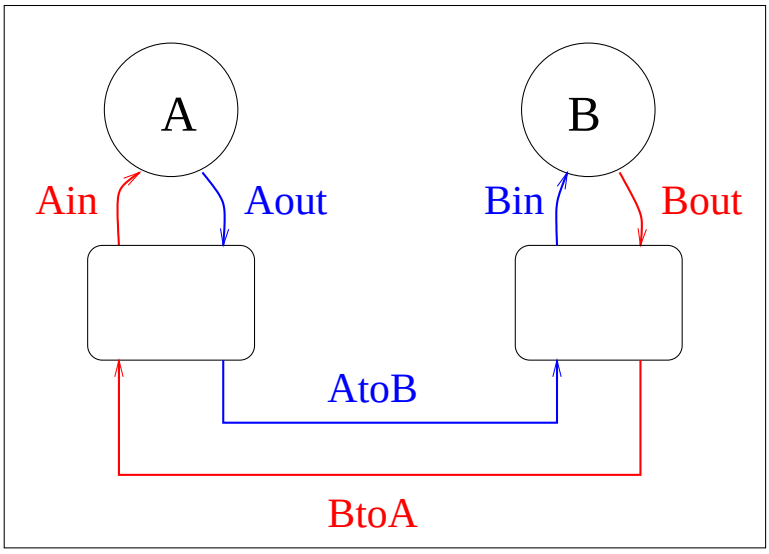
- ✔ If condition not TRUE then assertion violated.

Temporal claims

- ✔ ***We got here again without making any progress!***
- ✔ The support for temporal claims takes the form of:
  - ✔ **Endstate** labels - for determining valid endstates
  - ✔ **Progress** labels - claim no non-progress cycles
  - ✔ **Never** claims - impossible temporal assertions

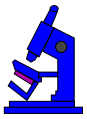


Simple example



Promela example

```
init
{
    chan AtoB = [1] of { mtype,byte };
    chan BtoA = [1] of { mtype,byte };
    chan Ain  = [2] of { mtype,byte };
    chan Bin  = [2] of { mtype,byte };
    chan Aout = [2] of { mtype,byte };
    chan Bout = [2] of { mtype,byte };
    atomic {
       run application( Ain,Aout );
       run transfer( Aout,Ain,BtoA,AtoB );
       run transfer( Bout,Bin,AtoB,BtoA );
       run application( Bin,Bout )
    };
    AtoB!err(0)
}
```



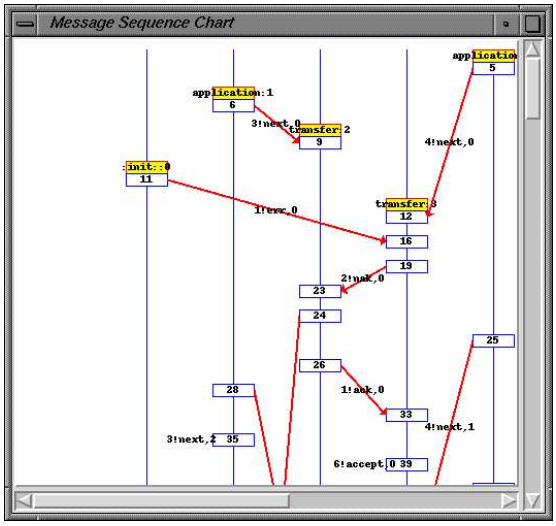
Promela example

```
#define MAX 10
mtype = { ack, nak, err, next, accept }
proctype transfer( chan in, out, chin, chout )
{
    byte o,i;
    in?next(o);
    do
      :: chin?nak(i) -> out!accept(i); chout!ack(o)
      :: chin?ack(i) -> out!accept(i); in?next(o); chout!ack(o)
      :: chin?err(i) -> chout!nak(o)
    od
}
```


Promela example

```
proctype application( chan in, out )
{
    int i=0, j=0, last_i=0;
    do
      :: in?accept(i) ->
            assert( i==last_i );
            if
              :: (last_i!=MAX) -> last_i = last_i+1
              :: (last_i==MAX)
            fi
      :: out!next(j) ->
            if
              :: (j!=MAX) -> j=j+1
              :: (j==MAX)
            fi
    od
}
```

Spin simulation



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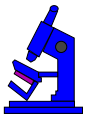


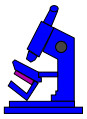
Formal evaluation - TCSEC

TCSEC (The Orange book) was the first rating system for the security of products. It defined six different evaluation classes. The classes are:

- **C1** - For **same-level** security access. Not currently used.
- **C2** - **Controlled access protection** - users are individually accountable for their actions. Most OS manufacturers have C2 versions of the OS.
- **B1** - **Mandatory BLP policies** - for more secure systems handling classified data.

Formal evaluation - TCSEC

- **B2** - **structured protection** - mandatory access control for all objects in the system. Formal models.
- **B3** - **security domains** - more controls, minimal complexity, provable consistency of model.
- **A1** - **Verified design** - consistency proofs between model and specification.

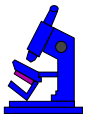


Formal evaluation - ITSEC

- ✔ From Dutch, English, French and German **national** security evaluation **criteria**.
- ✔ **Adaptable**.
- ✔ Sponsor determines operational requirements, threats and security objectives.
- ✔ ITSEC specifies the **interactions** and documents between the sponsor and the evaluator.

ITSEC

- ✔ Again there are various levels of evaluation: **E0..E6**, with **E6** giving the highest level of assurance - it requires two independant formal verifications.
- ✔ First certification of a smart-card system under **E6**.
  - ✔ The smart-cards are electronic purses - that is they carry value,
  - ✔ Forgery must be impossible.
  - ✔ The certification encompassed the communication with the card, as well as the software within the card, and at the bank.



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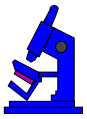
Exam

You can expect **12 pages** - write on paper. Marks/50.

✔ **10 short answer questions** worth 1 mark each

✔ Longer questions on...

- ✔ **Encryption**
- ✔ **Information**
- ✔ **Models**
- ✔ **Key systems**



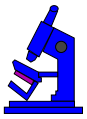
Exam

- ✔ **Modulo, primes, Fermat, Euler:** general & specific
- ✔ **Symmetric cryptosystems:** IC, DES, general & specific
- ✔ **Physical limits:** general
- ✔ **Information theory:** general & security-specific
- ✔ **Models:** BLP, Biba - general & specific
- ✔ **Key systems:** RSA, Kerberos, specific

Dr Robert Deng

Real World Applications of Network/Computer Security

Abstract: The lecture is on practical applications of network and computer security technology. Examples include virtual private networks, security solutions for e-banking, fair exchange of digital valuables over the Internet (e.g., electronic contract signing over a network and certified e-mail delivery) and techniques for user privacy protection in cyberspace.



Finally

This is my last lecture, so...

- ✔ **Good luck** with the exam, and
- ✔ **Thanks** for your attention

Good luck!