CSE413 – Security of Information Systems 2020

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https://github.com/FurkanGozukara/Security-of-Information-Systems-CSE413-2020

Lecture 1

Basic concepts in Information Security

Composed from Prof. Audun Jøsang, University of Oslo, Information Security 2018 Lectures

Source: https://www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

Why study information security ?

- Being an IT expert requires knowledge about IT security
  - Analogy: Building architects must have knowledge about fire safety
- Developing IT systems without considering security will lead to vulnerable IT systems
- IT experts without security skills are part of the problem
- Learn about IT security to become part of the solution !
- Security by Design is a prerequisite for privacy by design which is a legal requirement for processing personal data
- Information security is a political issue
  - Often seen as a cost, but saves costs in the long term
  - Often given low priority in IT industry and IT education

Certifications for IS Professionals

- Many different types of certifications available
  - vendor neutral or vendor specific
  - from non-profit organisations or commercial for-profit organisations
- Certification gives assurance of knowledge and skills,
  - needed in job functions
  - gives credibility for consultants, applying for jobs, for promotion
- Sometimes required
  - US Government IT Security jobs
- Knowledge domains reflect current topics in IT Security
  - Generally kept up-to-date

ISACA Certifications
(Information Systems Audit and Control Association)

- ISACA provides certification for IT professionals
  - CISM - Certified Information Security Manager
  - CISA - Certified Information System Auditor
  - CGIT - Certified in the Governance of Enterprise IT
  - CRSIC - Certified in Risk and Information Systems Control

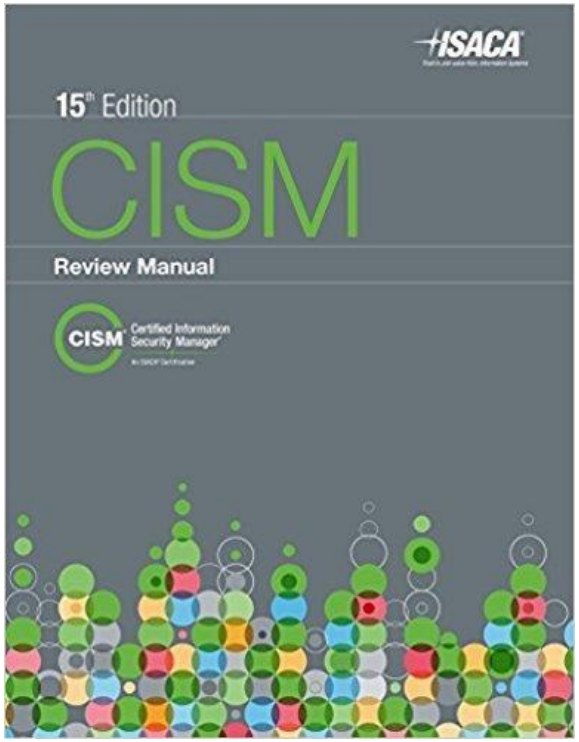
- CISM is the most popular ISACA security certification
- IT auditors and consultants commonly have ISACA certifications
- ISACA promotes IT governance framework COBIT
  (Control Objectives for Information and Related Technologies)

CISM: Certified Information Security Manager

- Focuses on 4 domains of IS management
  1. Information Security Governance
  2. Information Risk Management
  3. Information Security Program Development and Management
  4. Information Security Incident Management

- Official prep manual published by ISACA
  - https://www.isaca.org/bookstore/

    Price: US $115 ($85 for ISACA members)



CISM Exam

- Exams normally twice per year worldwide
- 2018 exam information to give you an idea
  - Next exam in Oslo (and worldwide): June 2018
    - Deadline for registering: April 2018
    - Register for exam at www.isaca.org
    - Exam fee approx. US $500
    - Multiple choice exam
    - Requires 5 years professional experience

    - Yearly CISM maintenance fee approx. US $100
    - Requires 120 hours “practice time” per 3 years

$(ISC)^2$ Certifications

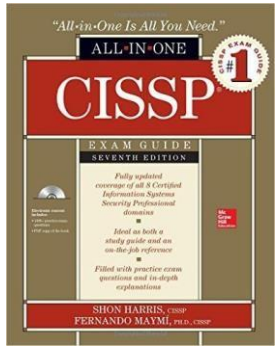
International Information Systems Security Certification Consortium

- $(ISC)^2$ provides certification for information security professionals
  - CISSP - Certified Information Systems Security Professional
  - ISSAP - Information Systems Security Architecture Professional
  - ISSMP - Information Systems Security Management Professional
  - ISSEP - Information Systems Security Engineering Professional
  - CAP - Certification and Accreditation Professional
  - SSCP - Systems Security Certified Practitioner
  - CSSLP - Certified Secure Software Lifecycle Professional
- CISSP is the most common IT security certification
  - Most IT Security Consultants are CISSP

CISSP Exam:
Certified Information System Security Professional

- Many different books to prepare for CISSP exam
- e.g. text book used for INF3510 course

  CISSP All-in-One Exam Guide
  7th Edition, 2016
  Author: Shon Harris and Fernando Maymí



- € 560 fee to sit CISSP exam
- Exam through http://www.pearsonvue.com/isc2/
- Test Centre in Oslo: http://www.glasspaper.no/

  Brynsveien 12, Bryn, Oslo
- Most of the of the material presented in the INF3510 course is taken from the syllabus of the CISSP CBK (Common Body of Knowledge).

CISSP CBK (Common Body of Knowledge)
8 domains

1. **Security and Risk Management** (Security, Risk, Compliance, Law, Regulations, and Business Continuity)
2. **Asset Security** (Protecting Security of Assets)
3. **Security Engineering** (Engineering and Management of Security)
4. **Communication and Network Security** (Designing and Protecting Network Security)
5. **Identity and Access Management** (Controlling Access and Managing Identity)
6. **Security Assessment and Testing** (Designing, Performing, and Analyzing Security Testing)
7. **Security Operations** (Foundational Concepts, Investigations, Incident Management, and Disaster Recovery)
8. **Software Development Security** (Understanding, Applying, and Enforcing Software Security)

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

Security Surveys

Useful for knowing the trend and current state of information security threats and attacks

- Verizon Data Breach Report:

  http://www.verizonenterprise.com/DBIR/

- PWC security survey:

  http://www.pwc.com/gx/en/issues/cyber-security/information-security-survey.html

- Mnemonic Security Report

  https://www.mnemonic.no/security-report/

- Mørketallsundersøkelsen;

  http://www.nsr-org.no/moerketall/

  – New report in December every 2 years (even years).

+ many others

Security Advisories

- Useful for managing threats and vulnerabilities
  - NorCERT: For government sector: https://www.nsm.stat.no/
  - NorSIS: For private sector: http://www.norsis.no/
  - FinansCERT: http://www.finanscert.no/
  - KraftCERT: https://www.kraftcert.no/
  - HelseCERT: https://www.nhn.no/tema/sikkerhet/HelseCERT/Sider/default.aspx
  - UNINETT-CERT: https://www.uninett.no/cert
  - UiO-CERT: http://www.uio.no/english/services/it/security/cert/
  - US CERT: http://www.cert.org/
  - Australia AusCERT: http://www.auscert.org.au/

  + many others

Academic Forum on Security

- Monthly seminar on information security
- https://wiki.uio.no/mn/ifi/AFSecurity/
- Guest expert speakers

- Next AF*Security* seminar:
  - **Topic:** *History of Cryptology in Norway*
  - **Speaker:** *Sondre Rønjom, NSM*
  - **Time:** January 2018
  - **Place:** Kristen Nygaards sal, 5th floor, OJD

- All interested are welcome !

- Organised by SecurityLab

UiO : University of Oslo

SecurityLab

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

Information Security
Basic Concepts

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

What is security in general

- Security is about protecting assets from damage or harm
- Focuses on all types of assets
  - Example: your body, possessions, the environment, the nation
- Security and related concepts
  - National security (political stability)
  - Safety (health)
  - Environmental security (clean environment)
  - Information security
  - etc.

What is *Information* Security

- *Information* Security focuses on protecting *information assets* from damage or harm
- What are the assets to be protected?
  - Example: data files, software, IT equipment and infrastructure
- Covers both intentional and accidental events
  - Threat agents can be people or acts of nature
  - People can cause harm by accident or by intent
- Information Security defined:
  - The preservation of confidentiality, integrity and availability of information; in addition, other properties such as authenticity, accountability, non-repudiation and reliability can also be involved. (ISO27000 Information Security Management Systems - Overview and Vocabulary)

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

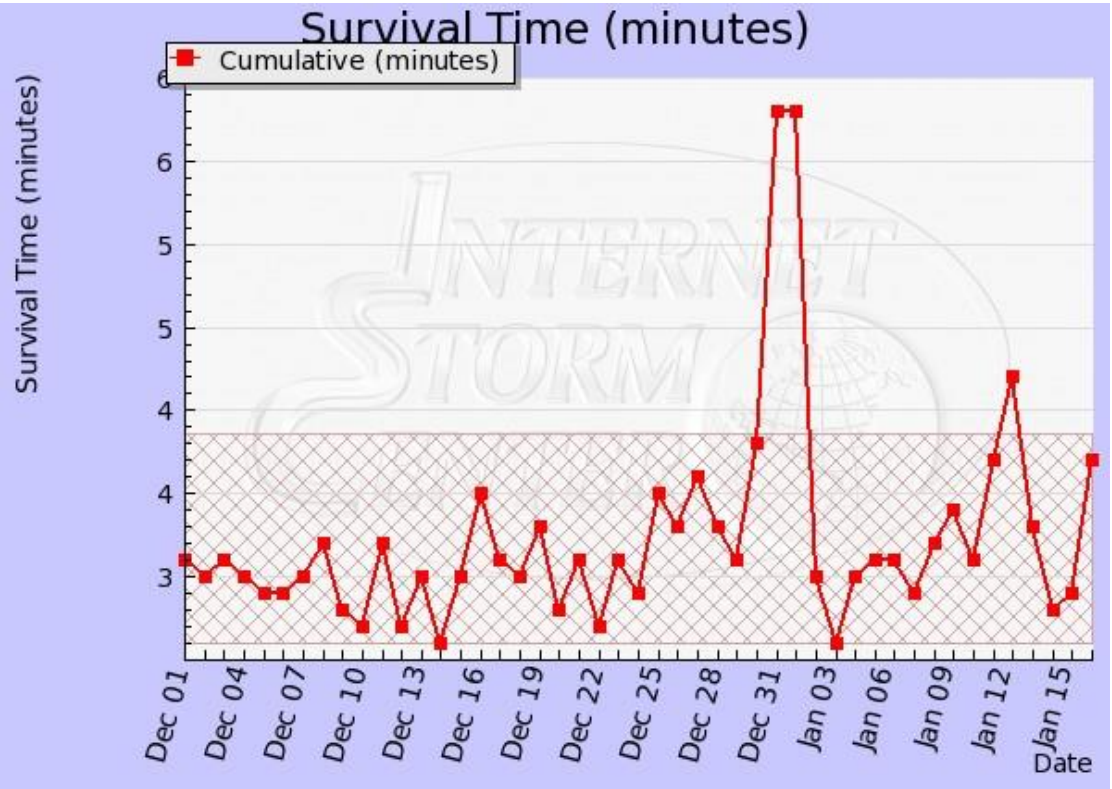
Scope of information security

- IS management has as goal to avoid damage and to control risk of damage to information assets
- IS management focuses on:
  - Understanding threats and vulnerabilities
  - Managing threats by reducing vulnerabilities or threat exposures
  - Detection of attacks and recovery from attacks
  - Investigate and collect evidence about incidents (forensics)

The Need for Information Security

- Why not simply solve all security problems once for all?
- Reasons why that's impossible:
  - Rapid innovation constantly generates new technology with new vulnerabilities
  - More activities go online
  - Crime follows the money
  - Information security is a second thought when developing IT
  - New and changing threats
  - More effective and efficient attack technique and tools are being developed
- Conclusion: Information security doesn't have a final goal, it's a continuing process

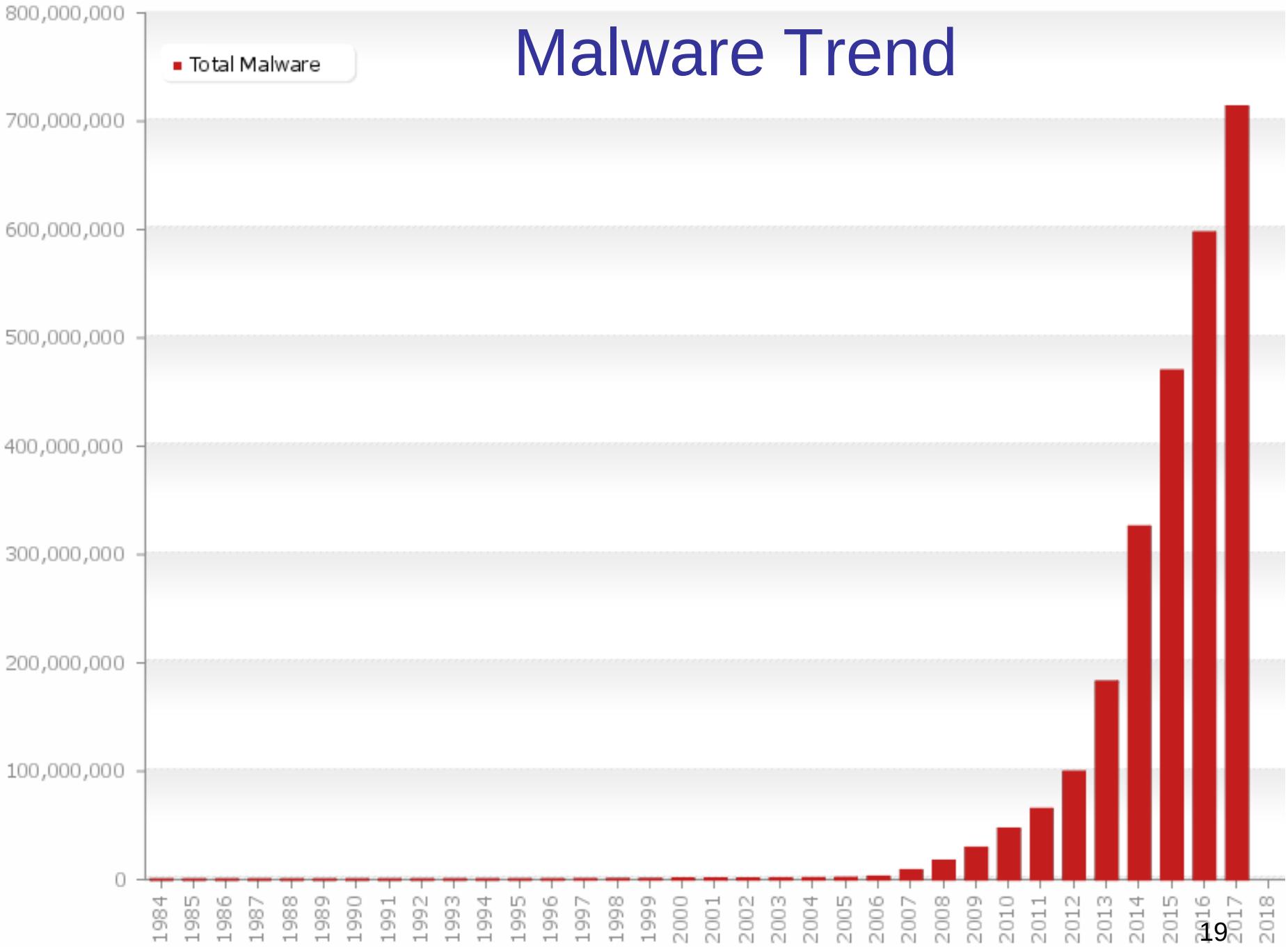
Internet Storm Survival Time Measure



The survival time is calculated as the average time between attacks against average target IP address.
http://isc.sans.org/survivaltime.html

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

Malware Trend



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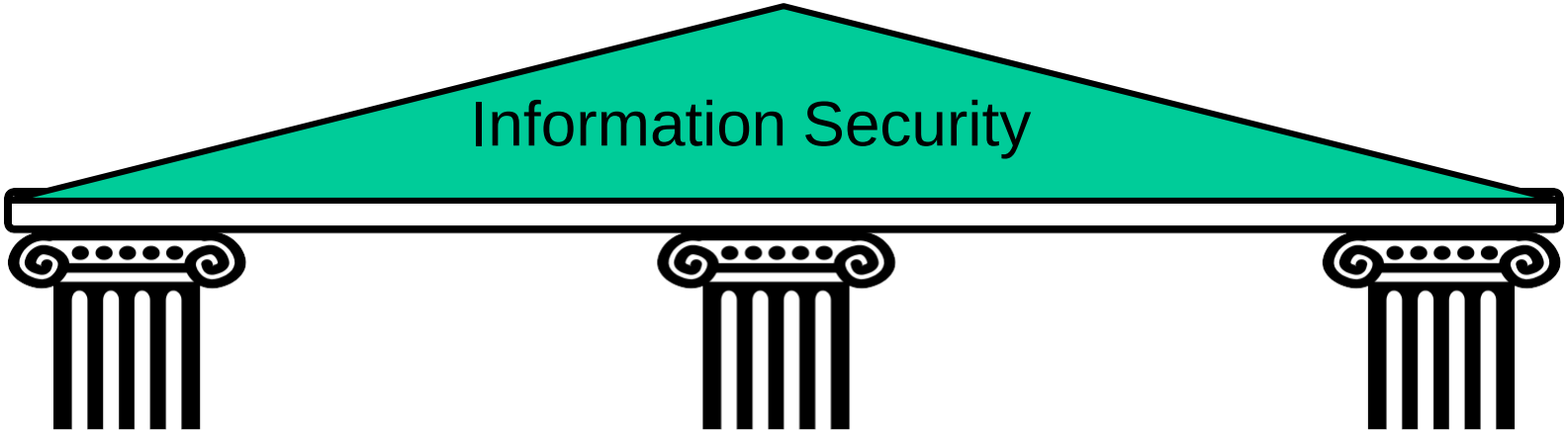
Security control categories



Physical controls
- Facility protection
- Security guards
- Locks
- Monitoring
- Environmental controls
- Intrusion detection

Technical controls
- Logical access control
- Cryptographic controls
- Security devices
- User authentication
- Intrusion detection
- Forensics

Administrative controls
- Policies & standards
- Procedures & practice
- Personnel screening
- Awareness training
- Secure System Dev.
- Incident Response

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

Security control functional types

- Preventive controls:
  - prevent attempts to exploit vulnerabilities
    - Example: encryption of files

- Detective controls:
  - warn of attempts to exploit vulnerabilities
    - Example: Intrusion detection systems (IDS)
- Corrective controls:
  - correct errors or irregularities that have been detected.
    - Example: Restoring all applications from the last known good image to bring a corrupted system back online

- Use a combination of controls to help ensure that the organisational processes, people, and technology operate within prescribed bounds.

Controls by Information States

- Information security involves protecting information assets from harm or damage.
- Information is considered in one of three possible states:
  - During storage
    - Information storage containers
    - Electronic, physical, human

  - During transmission
    - Physical or electronic

  - During processing (use)
    - Physical or electronic

- Security controls for all information states are needed

Security Services and Properties

- A security service provides a high level security property
- The traditional definition of information security is to preserve the three CIA properties for data and services:
  - **Confidentiality**:
  - **Integrity**
  - **Availability**:

- CIA are the three main security properties/services
- Data privacy is an additional property which assumes CIA

Data Privacy

Security services and controls

- Security services (aka. goals or properties)
  - implementation independent
  - supported by specific controls
- Security controls (aka. mechanisms)
  - Practical mechanisms, actions, tools or procedures that are used to provide security services

Security services:

e.g. Confidentiality – Integrity – Availability

support

Security controls:

e.g. Encryption – Firewalls – Awareness

Confidentiality

- The property that information is not made available or disclosed to unauthorized individuals, entities, or processes. (ISO 27000)
- Can be divided into:
  - Secrecy: Protecting business data
  - Privacy: Protecting personal data
  - Anonymity: Hide who is engaging in what actions
- Main threat: Information theft, unintentional disclosure
- Controls: *Encryption, Access Control, Perimeter defence*

  As general controls, also include:

  Secure Systems Development, Incident Response

Integrity

- **Data Integrity:** The property that data has not been altered or destroyed in an unauthorized manner.

  (X.800: Security Architecture for OSI)
- **System Integrity:** The property of accuracy and completeness (ISO 27000).

  Can include the accountability of actions.
- Threats: Data and system corruption, loss of accountability
- Controls:
  - *Hashing, cryptographic integrity check and encryption*
  - *Authentication, access control and logging*
  - *Software digital signing*
  - *Configuration management and change control (system integrity)*

  As general controls, also include:

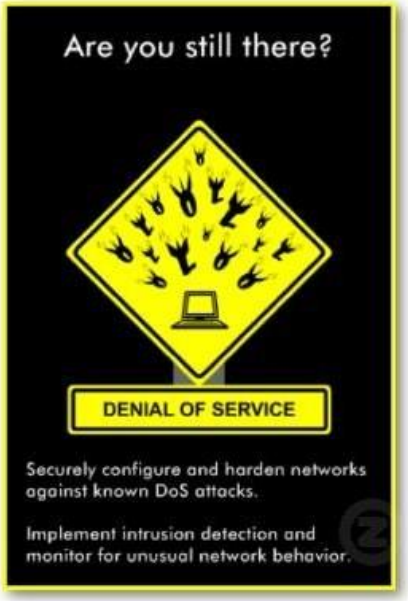
  Secure System Development, Incident Response

Availability

- The property of being accessible and usable upon demand by an authorized entity. (ISO 27000)
- Main threat: Denial of Service (DoS)
  - The prevention of authorized access to resources or the delaying of time critical operations
- Controls:
  - *Redundancy of resources,*
  - *Load balancing,*
  - *Software and data backups*

As general controls, also include:

Secure System Development and Incident Response



Data Privacy

To protect specific aspects of information that may be related to natural persons (personal information).

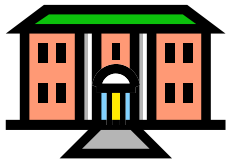
- Prevent unauthorized collection and storage of personal information
- Prevent unauthorized use of collected personal information
- Make sure your personal information is correct
- Ensure transparency and access for data subjects
- Provide adequate information security (CIA) around personal information
- Define clear responsibilities around personal information
- GDPR becomes EU law on 25 May 2018
  (General Data Protection Regulation)

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

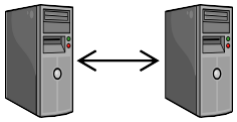
Authenticity (Security Service)

The CIA properties are quite general security services.
Other security services are often mentioned.
Authentication is very important, with various types:

- User authentication:
  - The process of verifying a claimed identity of a (legal) user when accessing a system or an application.



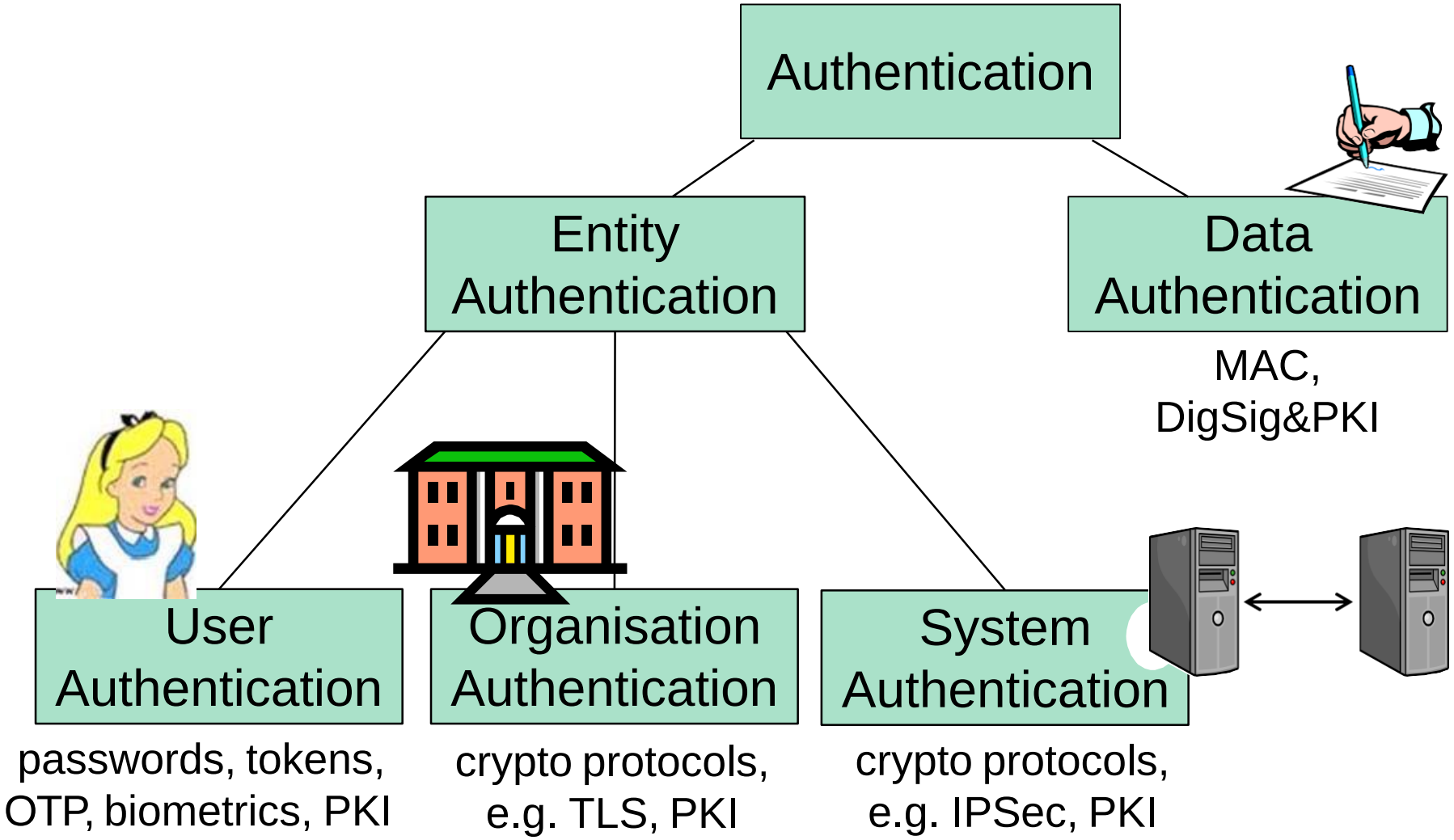
- Organisation authentication:
  - The process of verifying a claimed identity of a (legal) organisation in an online interaction/session



- System authentication (peer entity authentication):
  - The corroboration (verification) that a peer entity (system) in an association (connection, session) is the one claimed (X.800).

- Data origin authentication (message authentication):
  - The corroboration (verification) that the source of data received is as claimed (X.800).

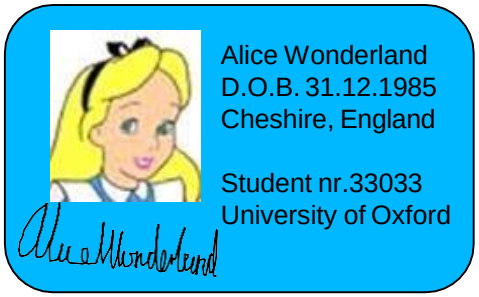
Taxonomy of Authentication



Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

User Identification and Authentication

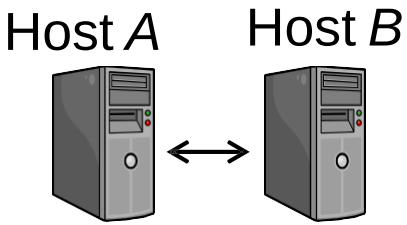
- Identification
  - Who you claim to be
  - Method: (user)name, biometrics
- User authentication
  - Prove that you are the one you claim to be
- Main threat: Unauthorized access
- Controls:
  - *Passwords,*
  - *Personal cryptographic tokens*,
    - OTP generators, etc.
  - *Biometrics*
    - Id cards
  - *Cryptographic security/authentication protocols*



Authentication token

Organisation/System Authentication

- Goal
  - Establish the correct identity of organisations/remote hosts
- Main threat:
  - Network intrusion
  - Masquerading attacks,
  - Replay attacks
  - (D)DOS attacks



- Controls:
  - *Cryptographic authentication protocols based on hashing and encryption algorithms*
  - *Examples: TLS, VPN, IPSEC*

Data Origin Authentication (Message authentication)

- Goal: Recipient of a message (i.e. data) can verify the correctness of claimed sender identity
  - But 3rd party may not be able to verify it
- Main threats:
  - False transactions
  - False messages and data
- Controls:
  - *Encryption with shared secret key*
  - *MAC (Message Authentication Code)*
  - *Security protocols*
  - *Digital signature with private key*
  - *Electronic signature,*
    - i.e. any digital evidence

Non-Repudiation
(Strong form of Data Authentication)

- Goal: Making sending and receiving messages undeniable through unforgible evidence.
  - Non-repudiation of origin: proof that data was sent.
  - Non-repudiation of delivery: proof that data was received.
  - NB: imprecise interpretation: Has a message been received and read just because it has been delivered to your mailbox?
- Main threats:
  - Sender falsely denying having sent message
  - Recipient falsely denying having received message
- Control: *digital signature*
  - Cryptographic evidence that can be confirmed by a third party
- Data origin authentication and non-repudiation are similar
  - Data origin authentication only provides proof to recipient party
  - Non-repudiation also provides proof to third parties

Accountability
(Can be considered as a part of System integrity)

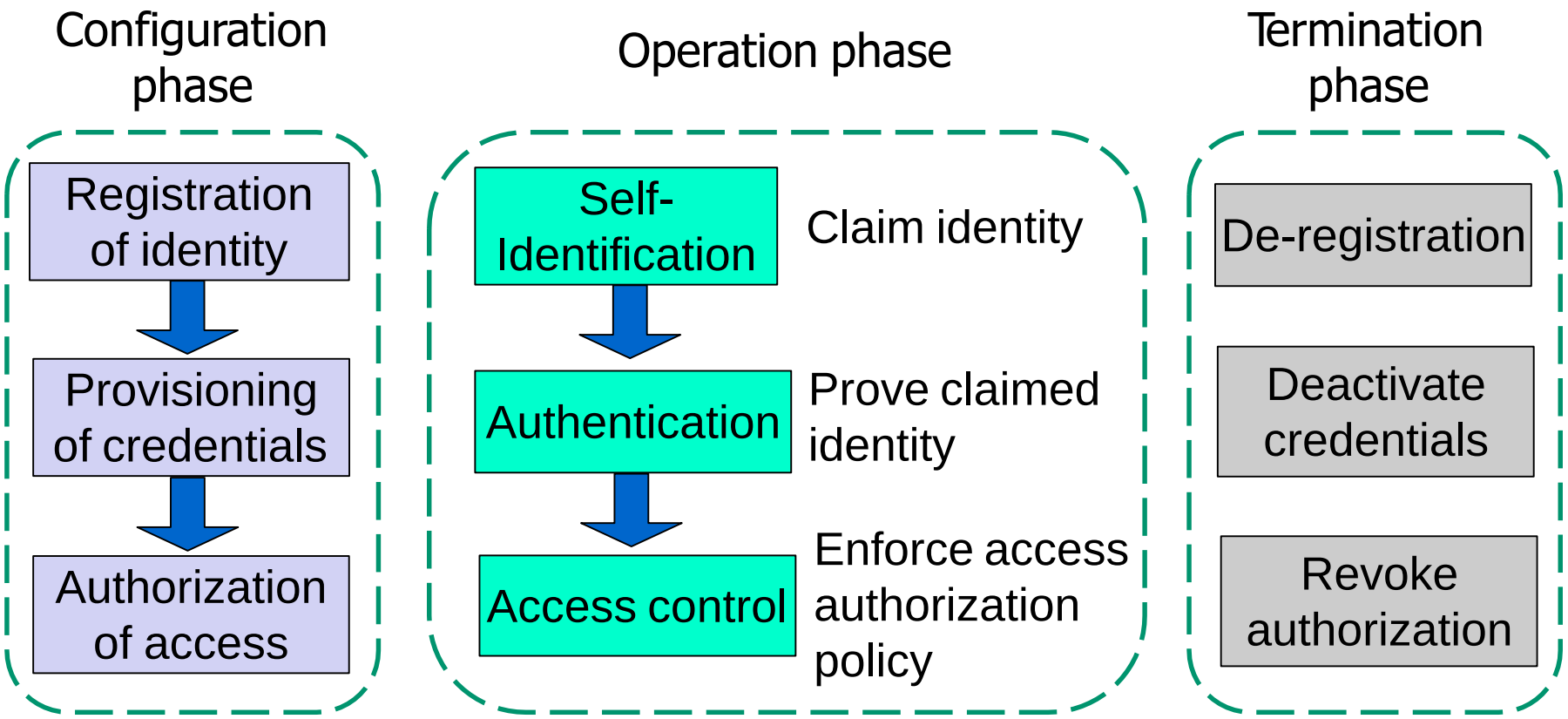
- Goal: Trace action to a specific user and hold them responsible
  - *Audit information must be selectively kept and protected so that actions affecting security can be traced to the responsible party*

    (TCSEC/Orange Book)
- Main threats:
  - Inability to identify source of incident
  - Inability to make attacker responsible
- Controls:
  - *Identify and authenticate users*
  - *Log all system events (audit)*
  - *Electronic signature*
  - *Non-repudiation based on digital signature*
  - *Forensics*

Authorization

- Authorization is to specify access and usage permissions for entities, roles or processes
  - Authorization policy normally defined by humans
  - Issued by an authority within the domain/organisation
- Authorities authorize, systems don’t
- Authority can be delegated
  - Management → Sys.Admin
  - Implemented in IT systems as configuration/policy

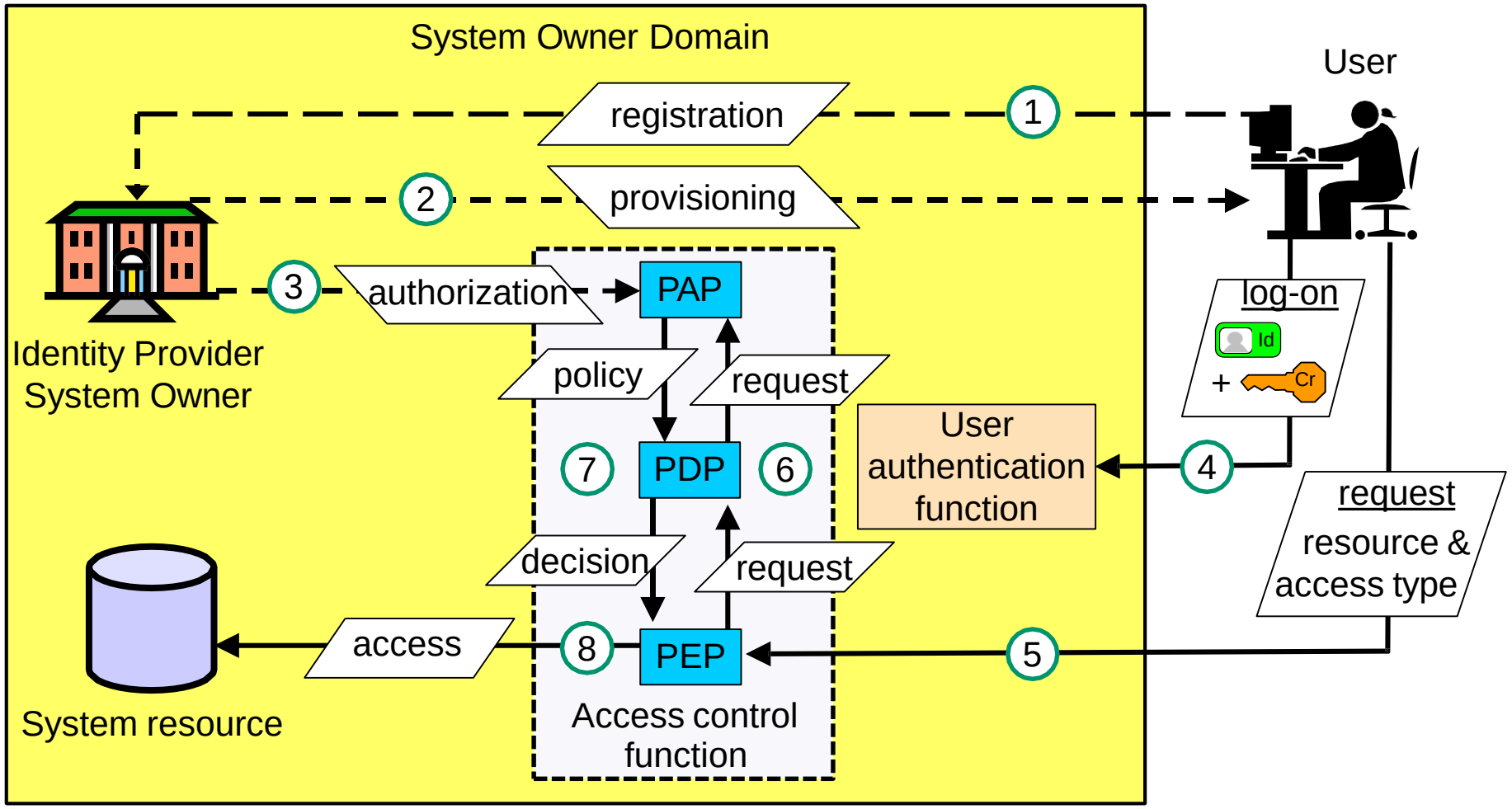
Identity and Access Management (IAM) Phases



Confusion about Authorization

- The term “authorization” is often wrongly used in the sense of “access control”
  - e.g. misleading figure on p.725 in Harris 7th ed.
  - Common in text books and technical specifications (RFC 2196 …)
  - Cisco AAA Server (Authentication, Authorization and Accounting)
- Wrong usage of “authorization” leads to absurd scenario:
  1. You get somebody’s password, and uses it to access account.
  2. Login screen gives warning: *“Only authorized users may access this system”.*
  3. You get caught and taken to the police
  4. You argue: *“Text books in security state that a system authorizes the user when typing the right password, hence I was authorized because I typed the right password”.*
  5. Case dismissed, you go free.

Identity and Access Management Concepts



PAP: Policy Administration Point

PDP: Policy Decision Point

PEP: Policy Enforcement Point

IdP: Identity Provider

Registration

Operations

Source: www.uio.no/studier/emner/matnat/ifi/INF3510/v18/lectures/

End of lecture