MAFTIA:
a European project for dependable Internet applications despite intrusions and accidental faults

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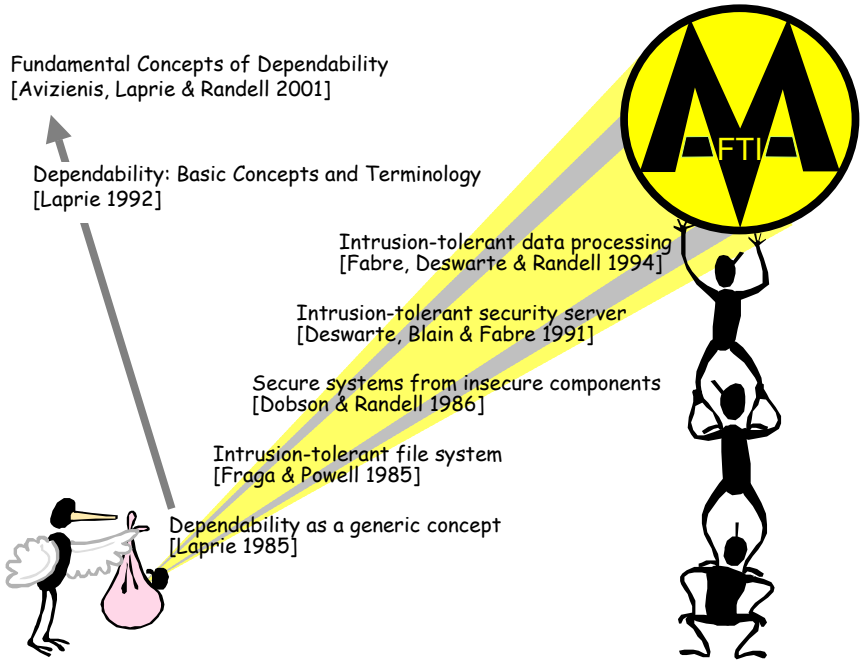

MAFTIA

IST Dependability Initiative
Cross Program Action 2
Dependability in services and technologies

- Malicious- and Accidental-Fault Tolerance for Internet Applications

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DERA, Malvern (UK)	Tom McCutcheon, Colin O'Halloran
University of Saarland (D)	Birgit Pfitzmann
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IBM Research, Zurich (CH)	Marc Dacier, Michael Waidner

c. 55 man-years, EU funding c. 2.5M€
Jan. 2000 -> Dec. 2002

Industrial Advisory Board

- Andrew Izon (North Durham NHS Trust, GB)
- Jean-Claude Lebraud (Rockwell-Collins, F)
- Derek Long (CISA Ltd., GB)
- Joachim Posegga (SAP Systems, D)
- Carlos Quintas (Easyphone, P)
- Gilles Trouessin (Ernst & Young Audit, F)
- Gritta Wolf (Credit Suisse, CH)

Objectives

- Architectural framework and conceptual model (WP1)
- Mechanisms and protocols:
  - dependable middleware (WP2)
  - large scale intrusion detection systems (WP3)
  - dependable trusted third parties (WP4)
  - distributed authorization mechanisms (WP5)
- Validation and assessment techniques (WP6)

Authorisaton

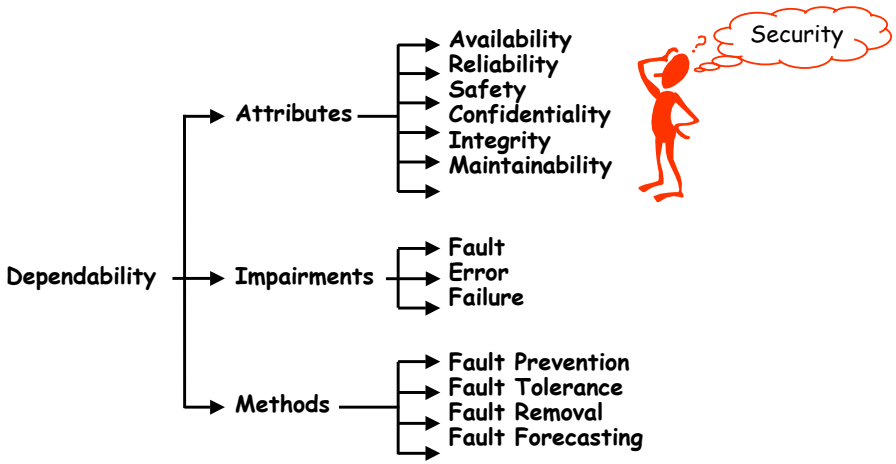
- Contributes to protection:
  - Error detection/confinement
  - Intrusion prevention/confinement
- For Internet applications:
  - More flexible than "client-server" paradigm
  - Contributes to privacy:
    personal information is disclosed only on a "need-to-know" basis

Dependability

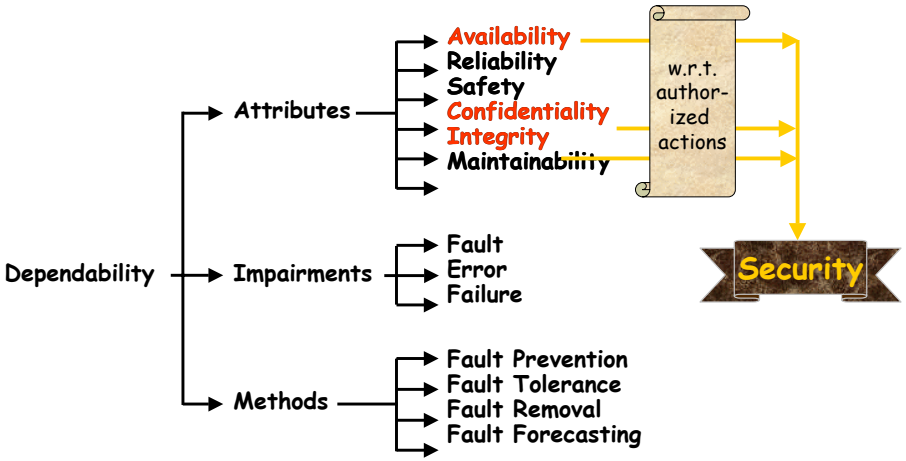
- Trustworthiness of a computer system such that reliance can justifiably be placed on the service it delivers

J.-C. Laprie *(Ed.)*, *Dependability: Basic Concepts and Terminology in English, French, German, Italian and Japanese*, 265p., ISBN 3-211-82296-8, Springer-Verlag, 1992.

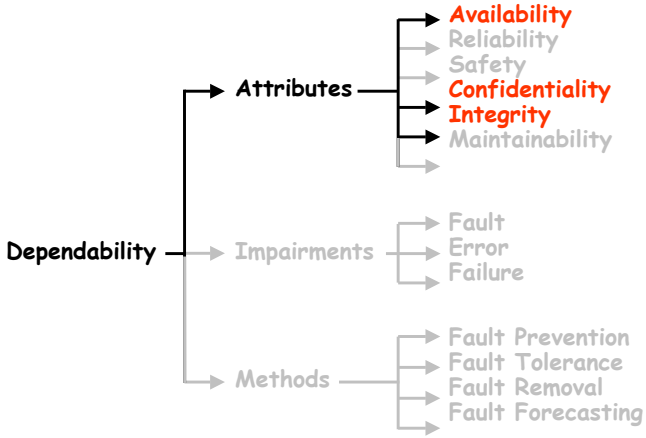
The Dependability Tree



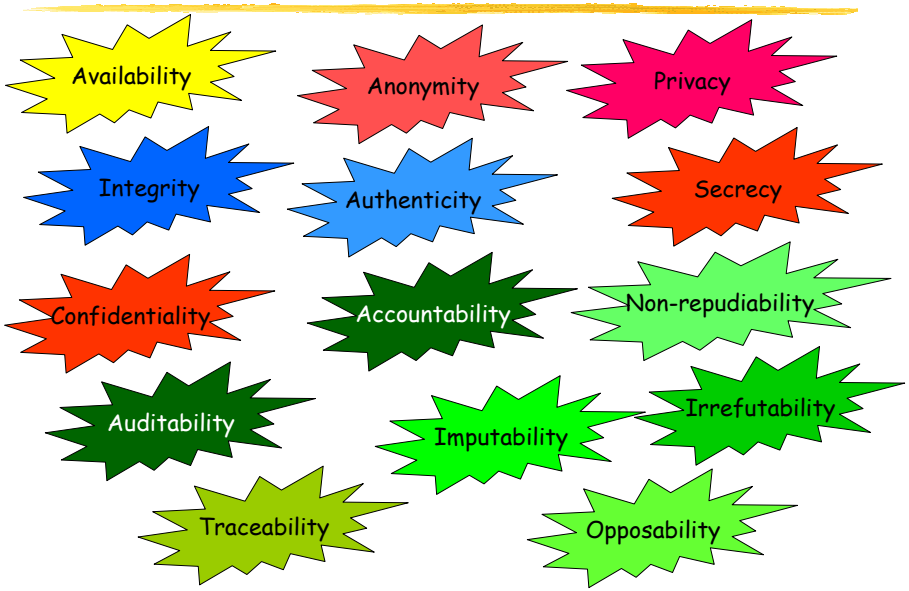
The Dependability Tree



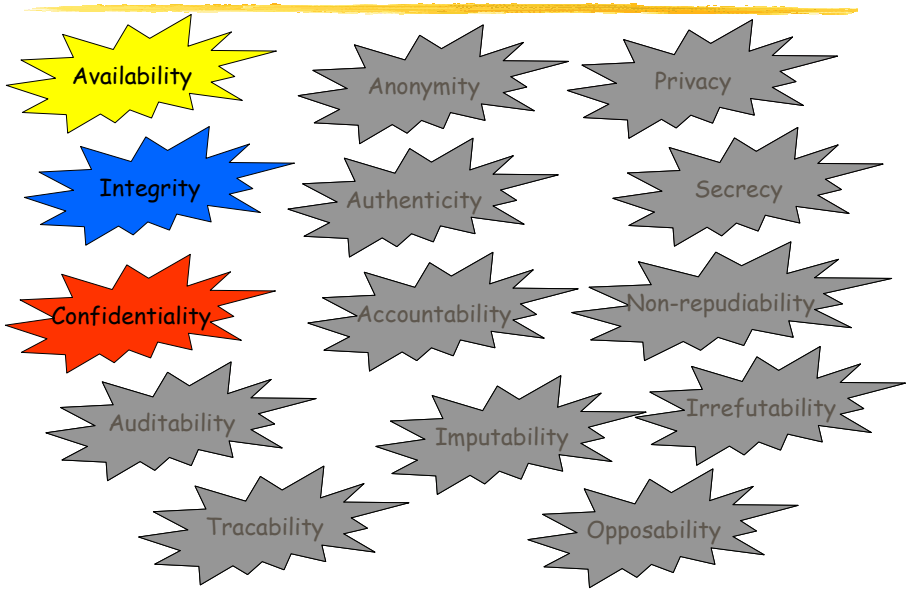
Are these attributes sufficient?



Security Properties



Security Properties



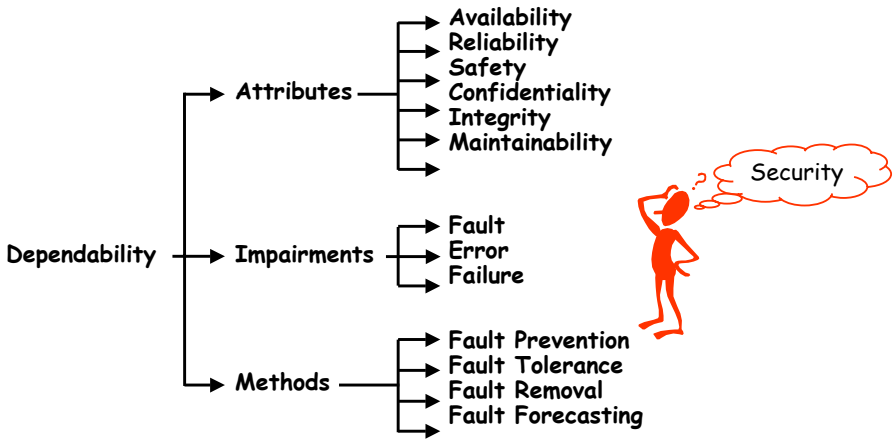
Security Properties

- Confidentiality
- Integrity
- Availability

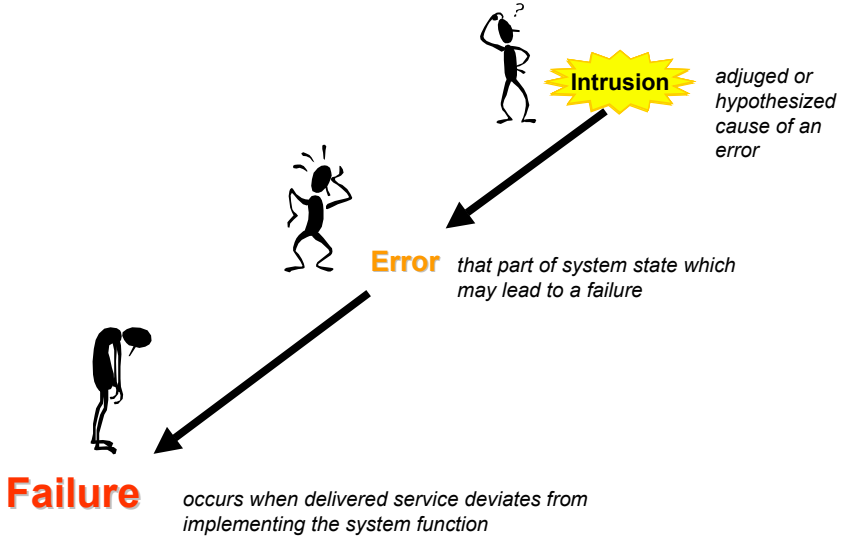
} of { Information, Meta-information

Accountability	*A+I*	• existence of operation
Anonymity	*C*	• identity of person
Privacy	*C*	• personal data
Authenticity	*I*	• message content
Non-repudiation	*A+I*	• message origin
		• sender, receiver identity

The Dependability Tree

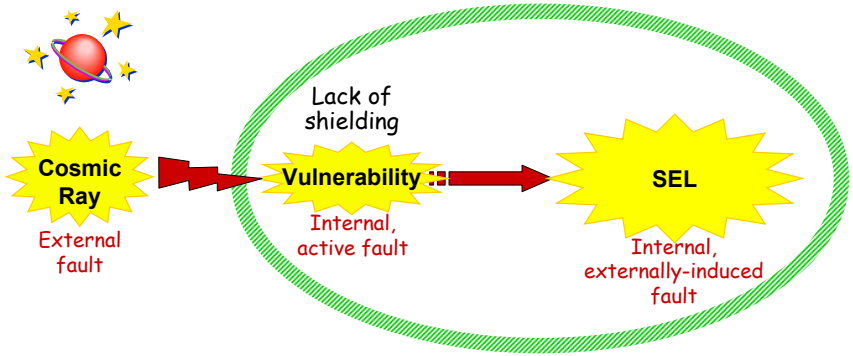


Fault, Error & Failure



Example: Single Event Latchup

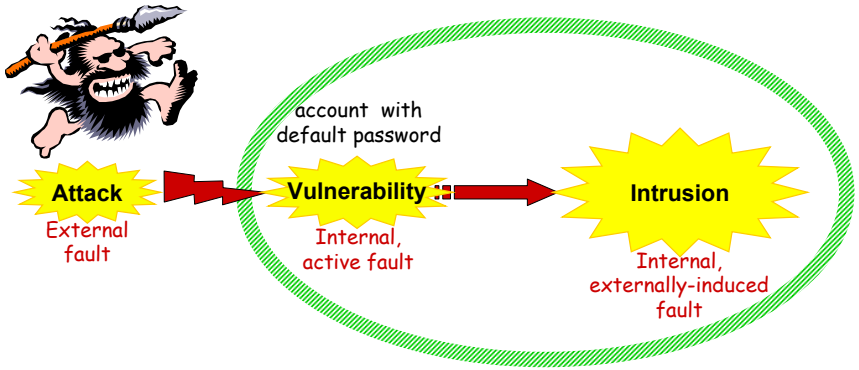
SELs (reversible stuck-at faults) may occur because of radiation (e.g., cosmic ray, high energy ions)



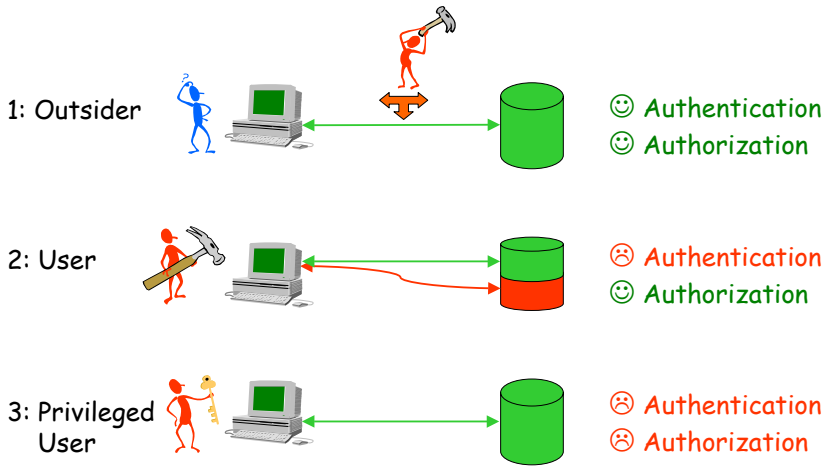
Satellite on-board computer

Intrusions

Intrusions result from
(at least partially) successful attacks:



Who are the intruders?

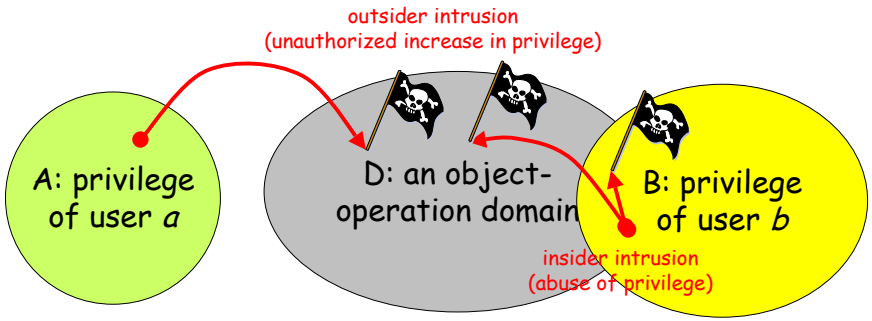


Insiders or Outsiders ?

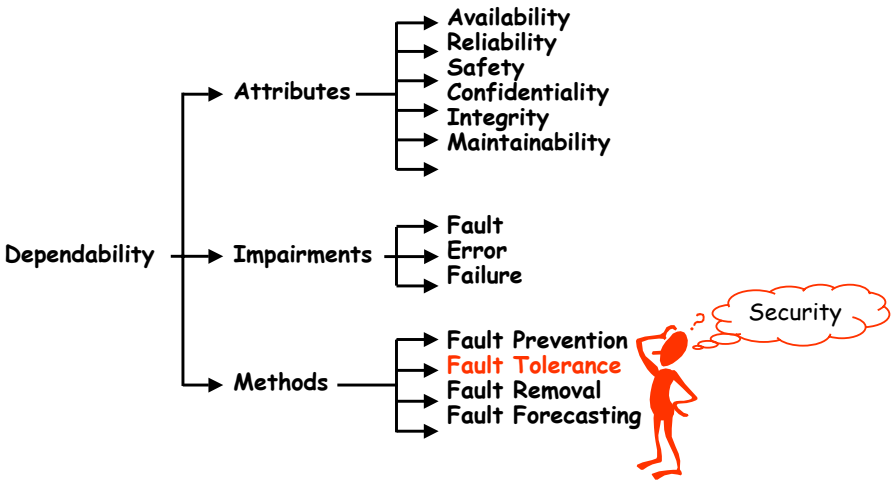
- 01 Informatique 1998
  - 1200 companies in 32 countries
  - 66% experienced fraud in last 12 months
    - 85% by company employees
- Computer Crime and Security Survey 2001
  (Computer Security Institute and the FBI)
  http://www.gocsi.com/prelea_000321.htm
  - 91% of respondent reported employee abuse of Internet (79% in 2000)
  - but decreasing proportion of disgruntled employees: 76% (82% in 2000)
  - 70% cite Internet as a frequent point of attack (59%)

Outsiders vs Insiders

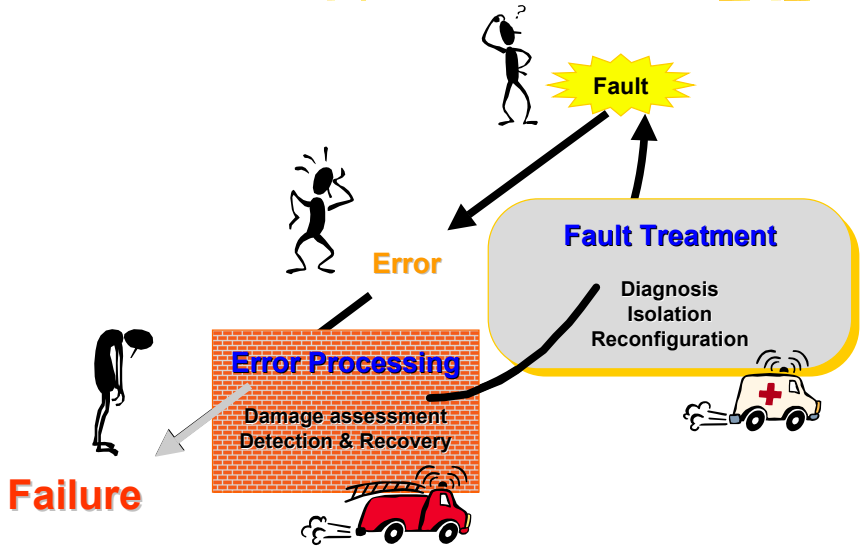
- Outsider: not authorized to perform any of specified object-operations
- Insider: authorized to perform some of specified object-operations



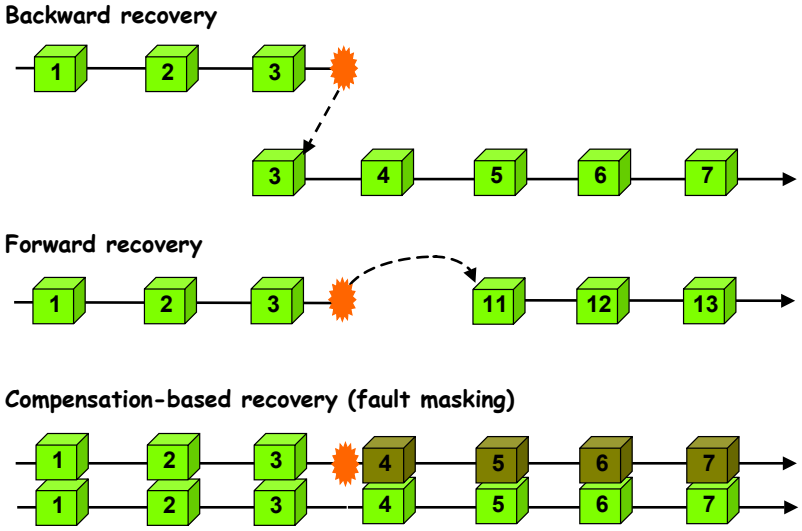
The Dependability Tree



Fault Tolerance



Error Processing



Error Processing (wrt intrusions)

- Error (security policy violation) detection
  - + Backward recovery (availability, integrity)
  - + Forward recovery (availability, confidentiality)
- Intrusion masking
  - Fragmentation (confidentiality)
  - Redundancy (availability, integrity)
  - Scattering

Intrusion Masking

Intrusion into a part of the system should give access only to non-significant information

FRS: Fragmentation-Redundancy-Scattering

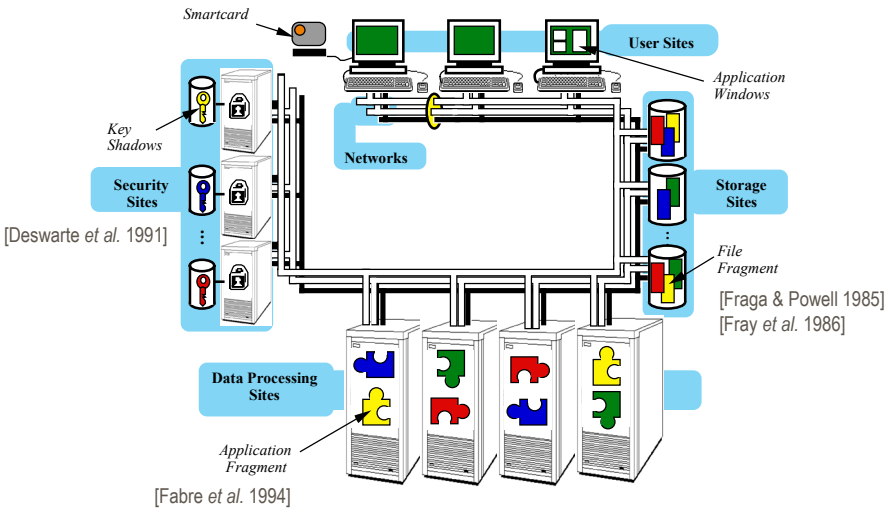
- Fragmentation: split the data into fragments so that isolated fragments contain no significant information: *confidentiality*
- Redundancy: add redundancy so that fragment modification or destruction would not impede legitimate access: *integrity + availability*
- Scattering: isolate individual fragments

Different kinds of scattering

- Space: use different transmission links and different storage sites
- Time: mix fragments (from the same source, from different sources, with jamming)
- Frequency: use different carrier frequencies (spread-spectrum)
- Privilege: require the co-operation of differently privileged entities to realise an operation (separation of duty, secret sharing)

Prototype

[Blain & Deswarte 1994]

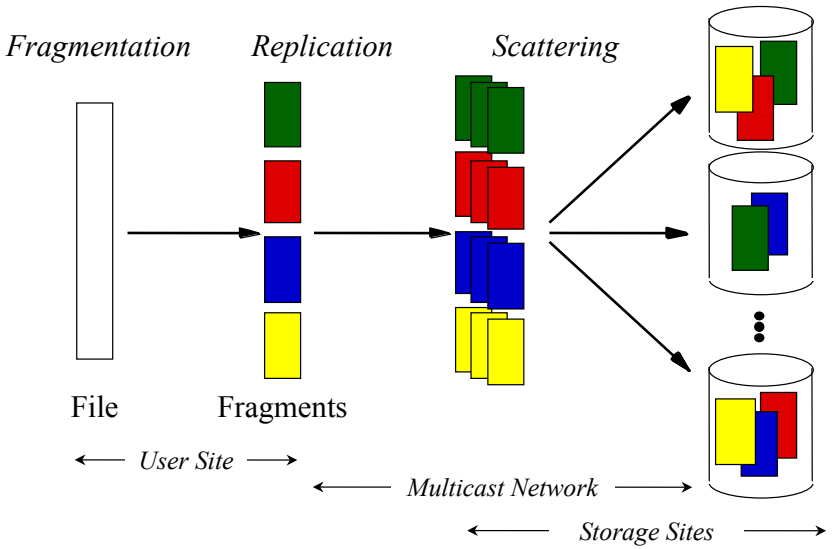


[Deswarte *et al.* 1991]

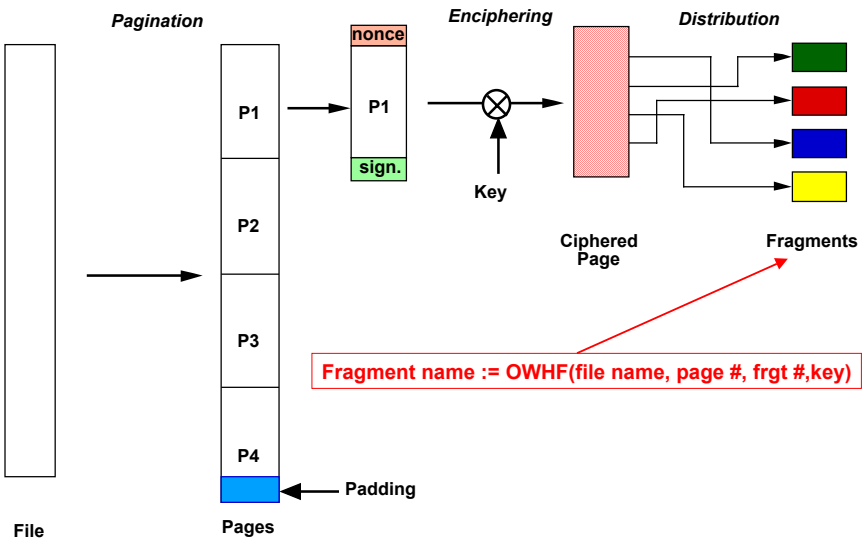
[Fraga & Powell 1985]
[Fray *et al.* 1986]

[Fabre *et al.* 1994]

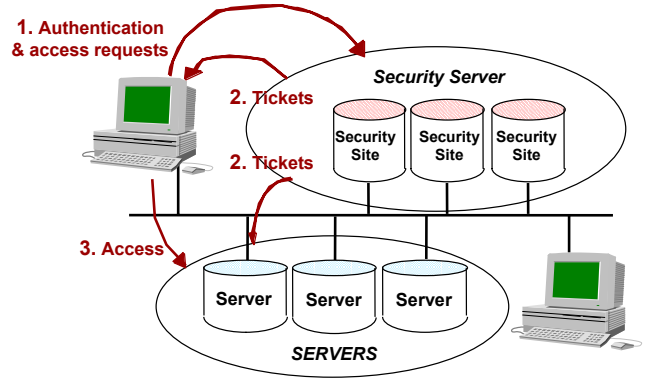
FRSed File Server



File Fragmentation

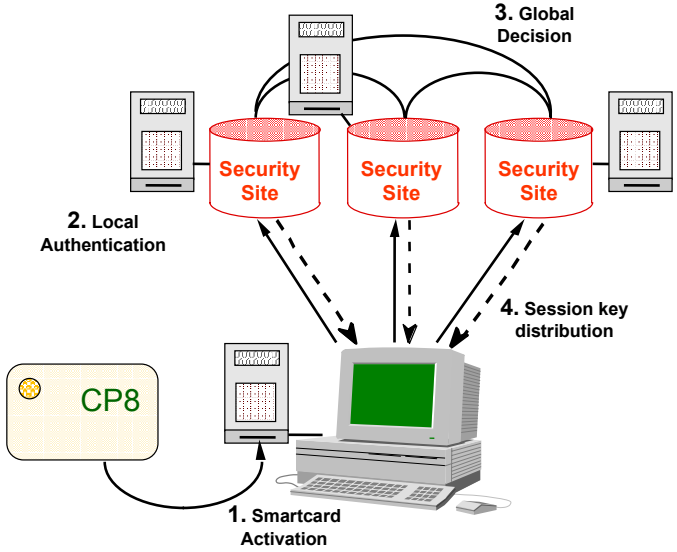


FRSed Security Management

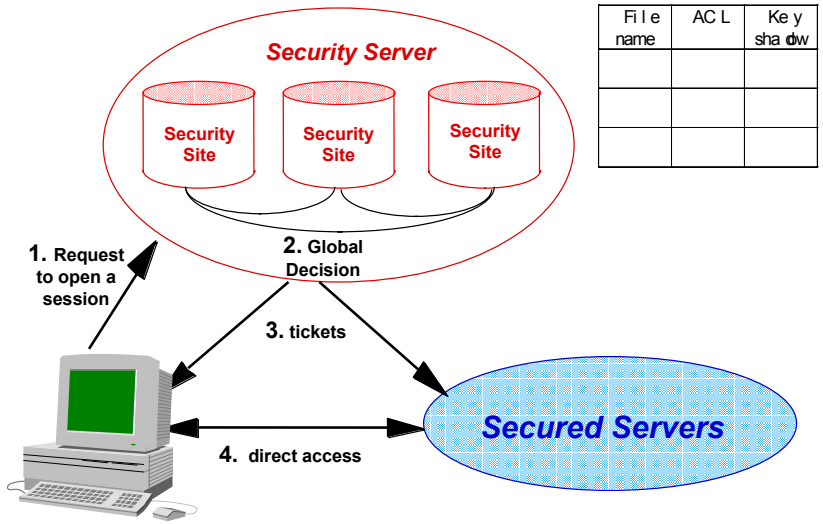


- No single trusted site or administrator
- Global trust in a majority of security sites (and administrators)

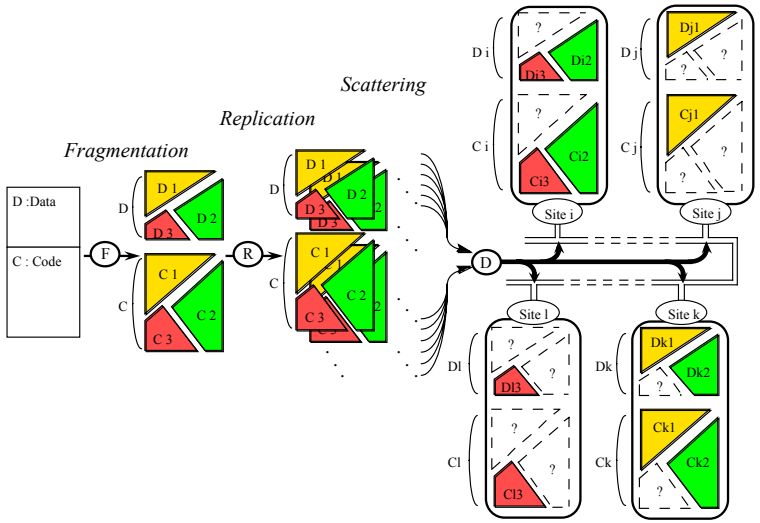
Authentication



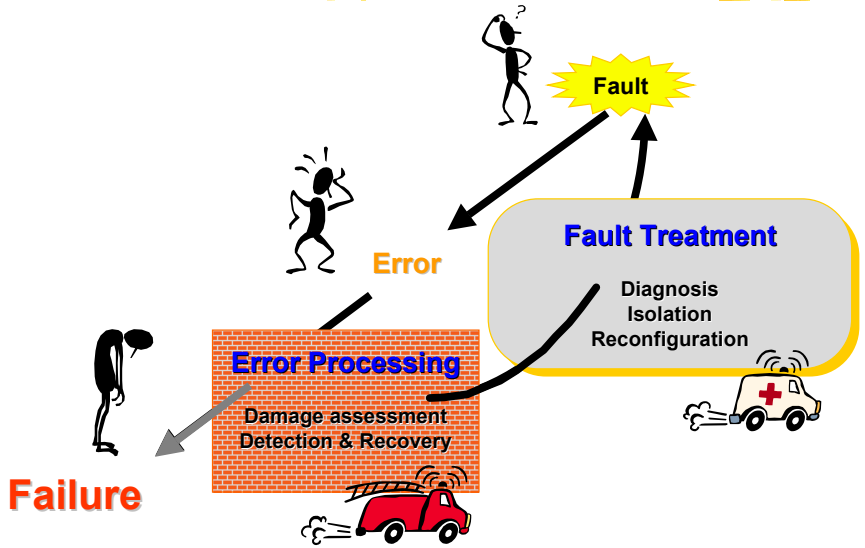
Authorization



Fragemented Data Processing



Fault Tolerance

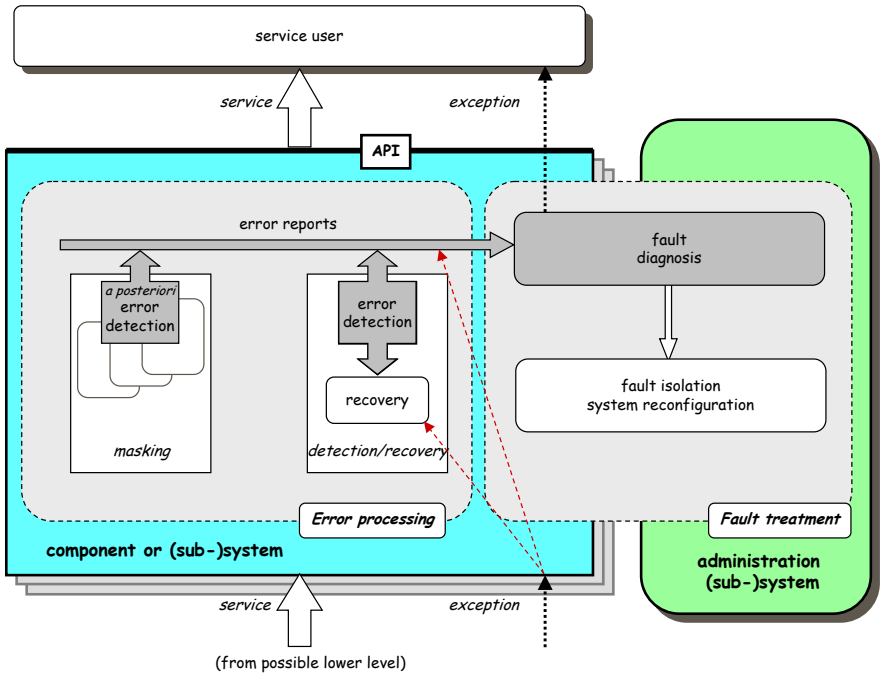


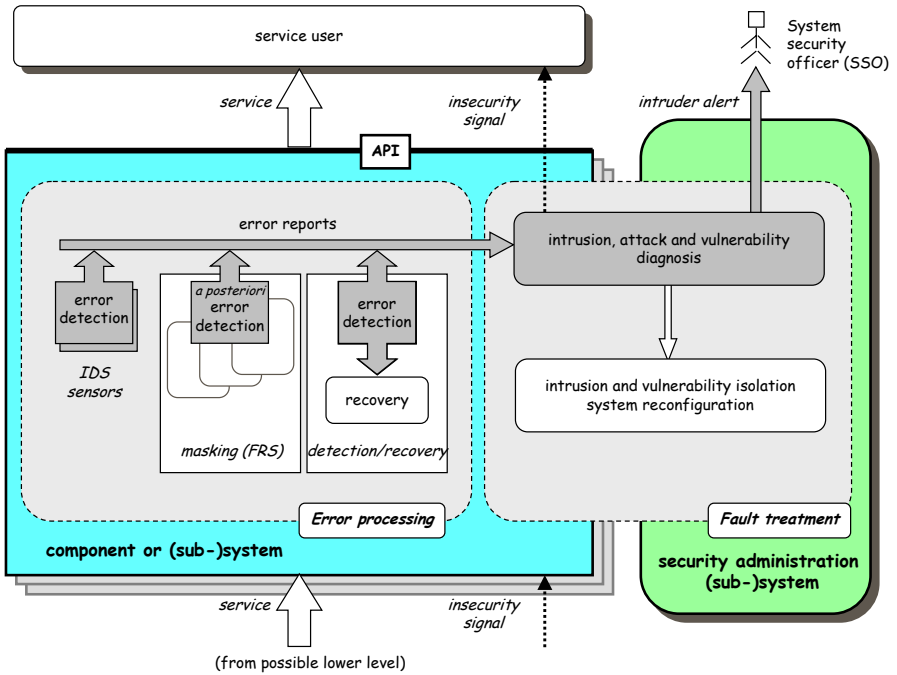
Fault Treatment

- Diagnosis
  - determine cause of error, i.e., the fault(s)
    - localization
    - nature
- Isolation
  - prevent new activation
- Reconfiguration
  - so that fault-free components can provide an adequate, although degraded, service

Fault Treatment (wrt intrusions)

- Diagnosis
  - Non-malicious or malicious (intrusion)
  - Attack (to allow retaliation)
  - Vulnerability (to allow removal)
- Isolation
  - Intrusion (to prevent further penetration)
  - Vulnerability (to prevent further intrusion)
- Reconfiguration
  - Contingency plan to degrade/restore service
    - inc. attack retaliation, vulnerability removal





http://www.research.ec.org/maftia/

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