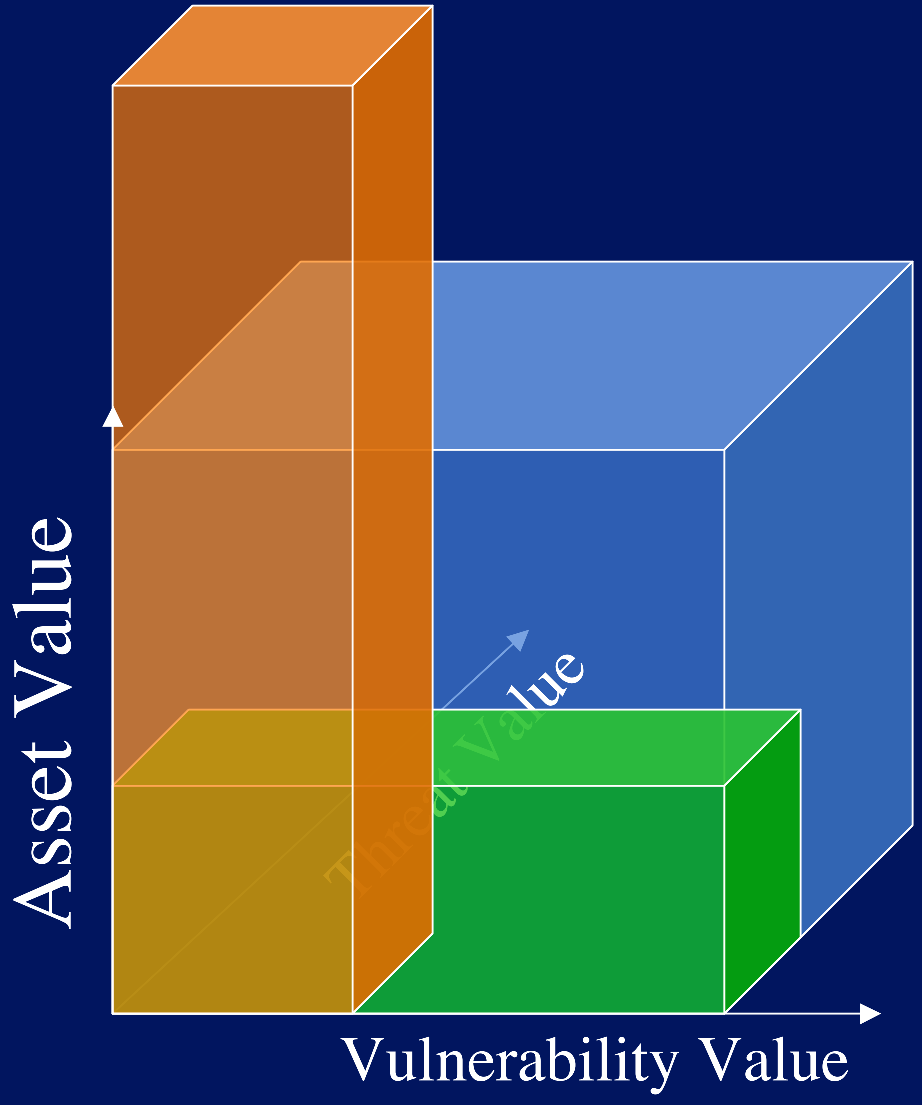
Introduction into Computer Security

EECE 412

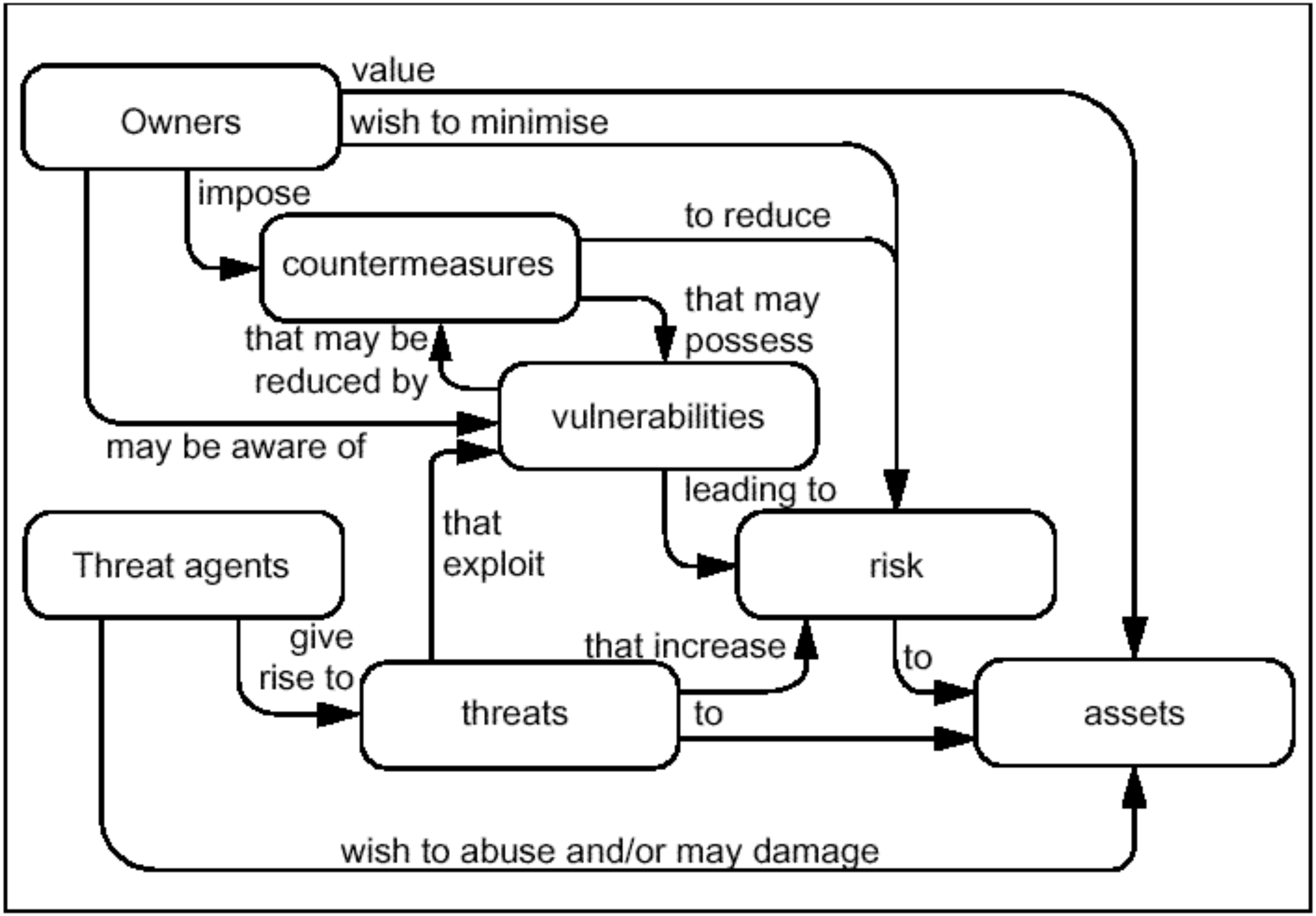
What is Security?

- security -- “safety, or freedom from worry”
- How can it be achieved?
  - Make computers too heavy to steal
  - Buy insurance
  - Create redundancy (disaster recovery services)

It’s all about risk



Risk = Asset * Vulnerability * Threat



Source: Common Criteria for Information Technology Security Evaluation. 1999

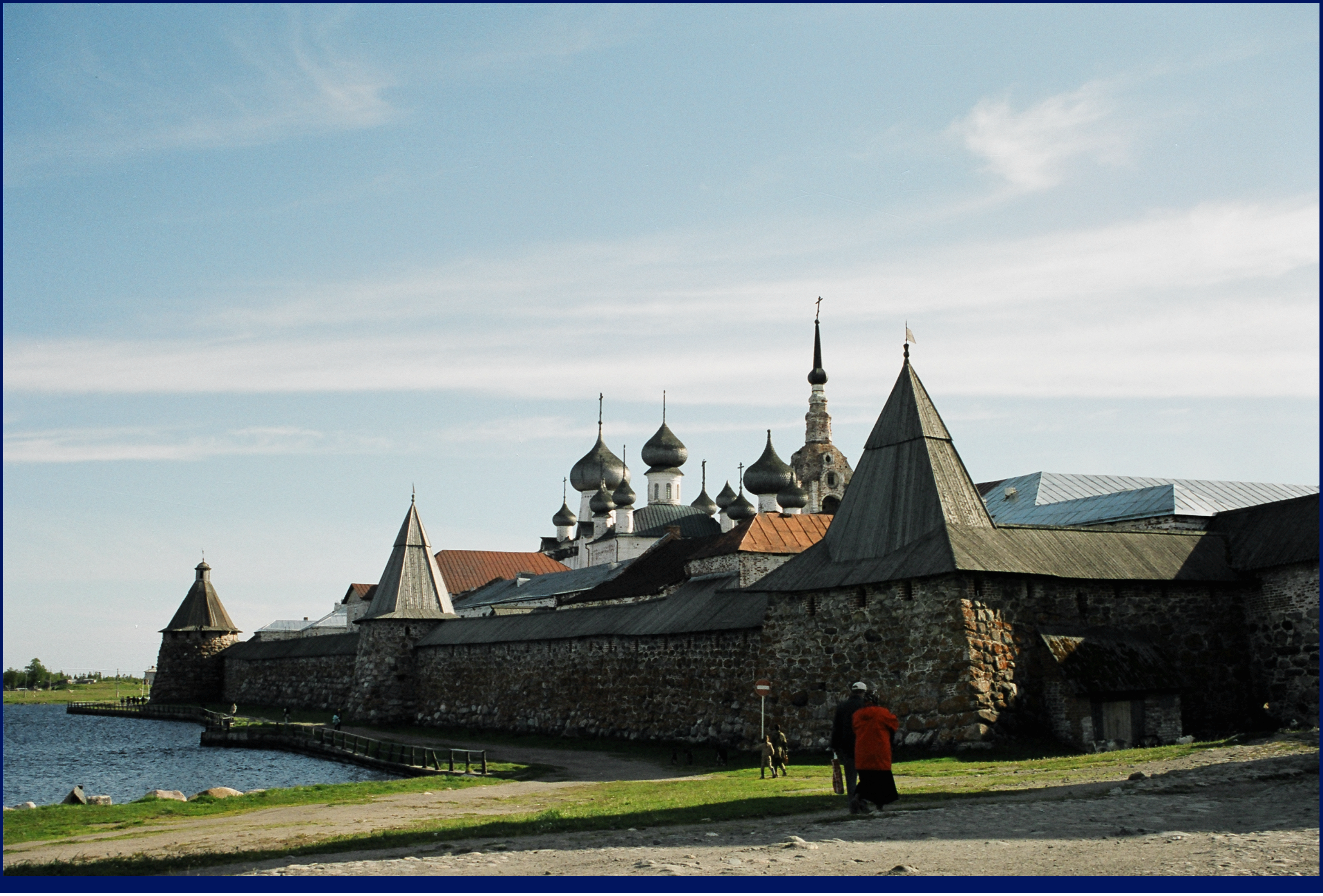
Classes of Threats

- Disclosure
  - snooping
- Deception
  - modification
  - spoofing
  - repudiation of origin
  - denial of receipt
- Disruption
  - modification
  - denial of service
- Usurpation
  - modification
  - spoofing
  - delay
  - denial of service

Goals of Security

- Deterrence
  - Deter attacks
- Prevention
  - Prevent attackers from violating security policy
- Detection
  - Detect attackers’ violation of security policy
- Recovery
  - Stop attack, assess and repair damage
  - Continue to function correctly even if attack succeeds
- Investigation
  - Find out how the attack was executed: forensics
  - Decide what to change in the future to minimize the risk

Solovki Monastery, White Sea, Russia



Conventional, fortress-based, security

Goal:

Prevent people from violating system’s security policy

Means:

Fortification

- provides safety
- involves layering
- expensive
- requires maintenance
- eventually compromised

Some points about fortresses

- No absolute safety
- One weakness/error sufficient
- Extra layers ➔ extra cost
- Important to understand threats
- Limited defender’s resources
- Adjust to attacks
- Resource suppliers
- Distinguishing noncombatants from attackers
- Containment

Fortress Analogy Limitations

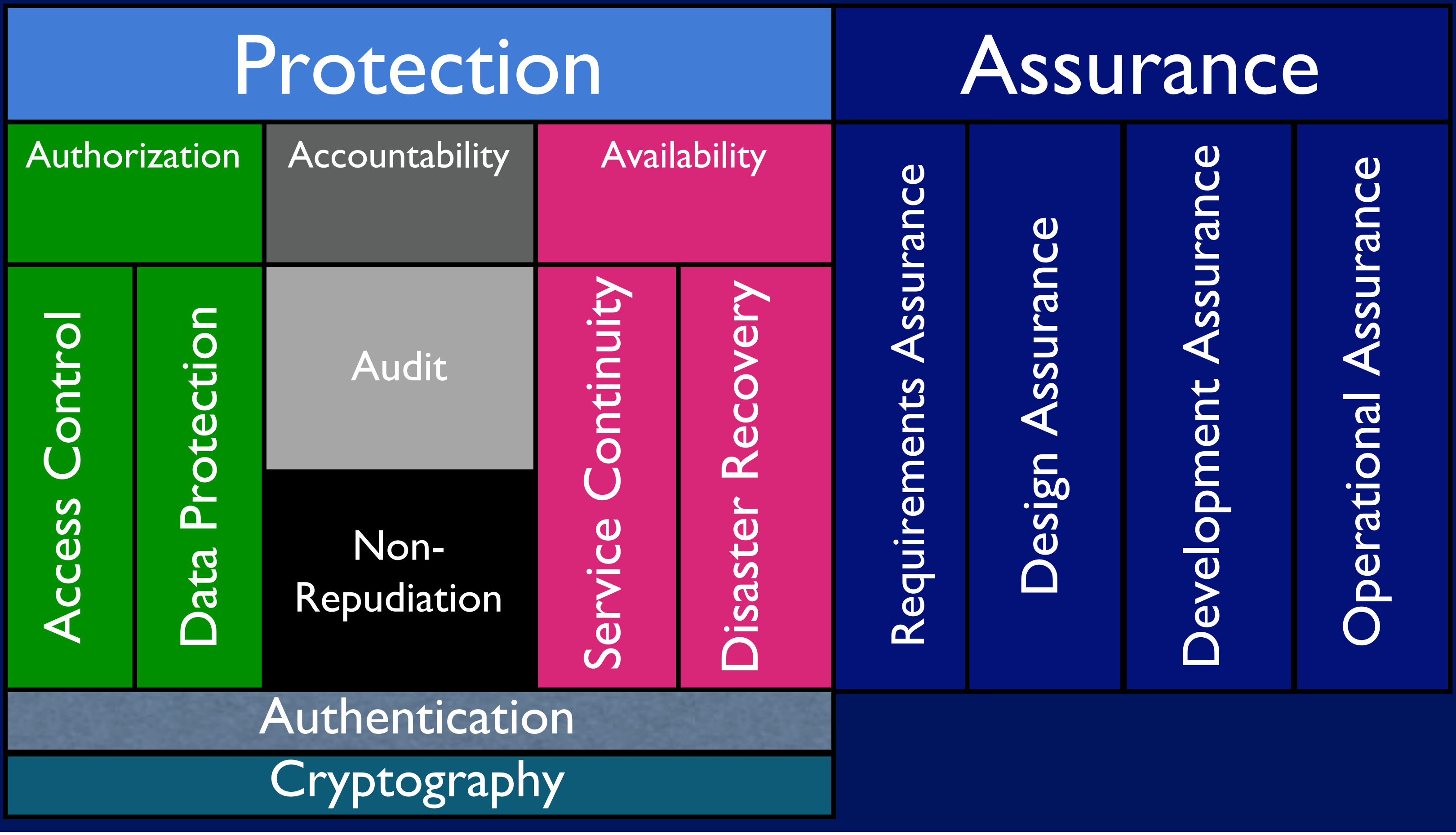
Fortress	Computer security
Against external attackers	Control of insiders
Protects only insiders	Has to keep system usable
Defenses cannot change	Has to protect from new types of attacks

What Computer Security Policies are Concerned with?

- Confidentiality
  - Keeping data and resources hidden
- Integrity
  - Data integrity (integrity)
  - Origin integrity (authentication)
- Availability
  - Enabling access to data and resources

CIA

Conventional Approach to Security



Protection

Authorization

Access Control

Data Protection

Accountability

Audit

Non-Repudiation

Availability

Service Continuity

Disaster Recovery

Authentication

Cryptography

Assurance

Requirements Assurance

Design Assurance

Development Assurance

Operational Assurance

Protection

provided by a set of mechanisms (countermeasures) to prevent bad things (threats) from happening

Authorization

protection against breaking rules

Rule examples:

- Only registered students should be able to take exam or fill out surveys
- Only the bank account owner can debit an account
- Only hospital's medical personnel should have access to the patient's medical records
- Your example…

Authorization Mechanisms: Data Protection

- No way to check the rules
  - e.g. telephone wire or wireless networks
- No trust to enforce the rules
  - e.g. MS-DOS

Accountability

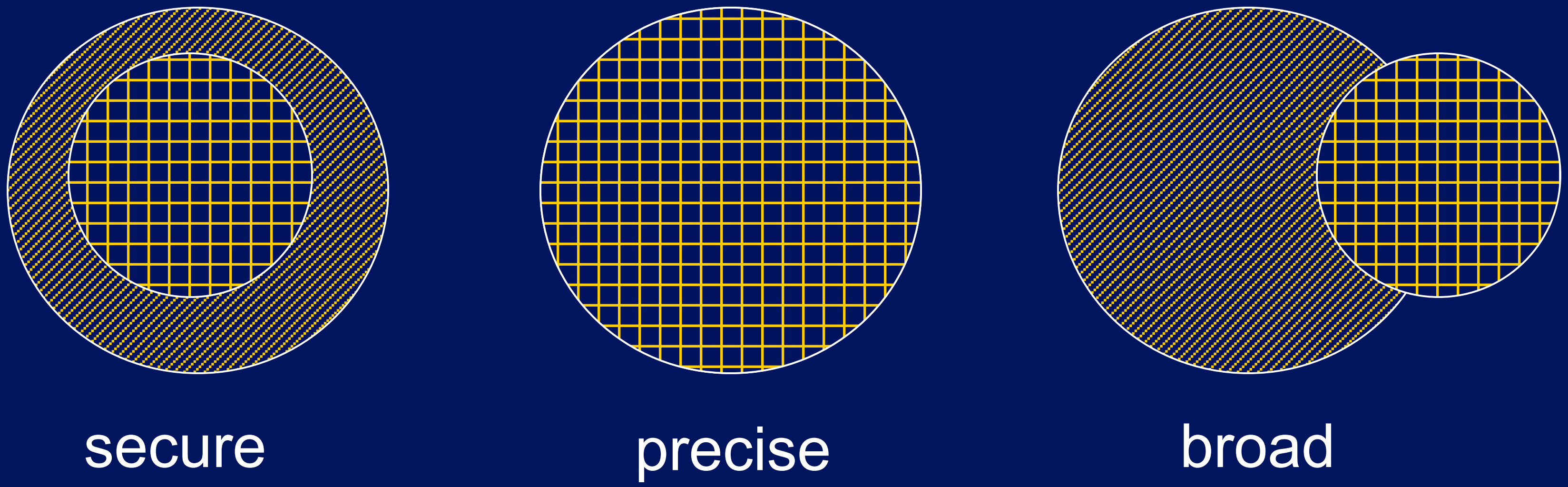
You can tell who did what when

- (security) audit -- actions are recorded in audit log
- Non-Repudiation -- evidence of actions is generated and stored

Availability

- Service continuity -- you can always get to your resources
- Disaster recovery -- you can always get back to your work after the interruption

Types of Mechanisms



▦ set of reachable states

▨ set of secure states

Assurance

Set of things the system builder and the operator of the system do to convince you that it is really safe to use.

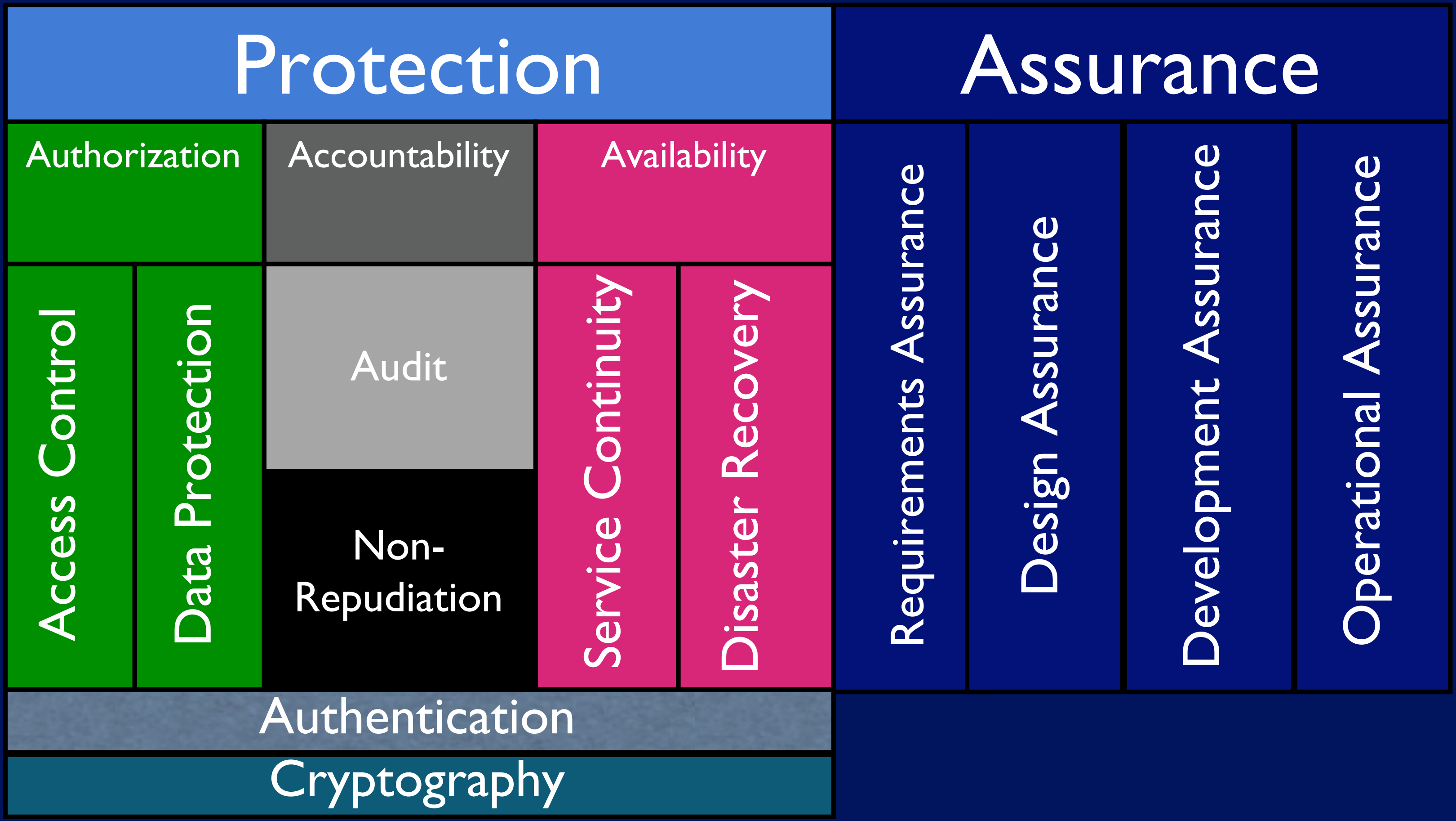
- the system can enforce the policy you are interested in, and
- the system works as intended

Securing Systems

Steps of Improving Security

1. analyze risks
   - asset values
   - threat degrees
   - vulnerabilities
2. develop/change policies
3. choose & develop countermeasures
4. assure
5. go back to the beginning

Key Points



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Key Points (cont-ed)

- *Secure*, *precise*, and *broad* mechanisms
- Risk = Asset * Vulnerability * Threat
- Steps of improving security
- Classes of threats
  - Disclosure
  - Deception
  - Disruption
  - Usurpation