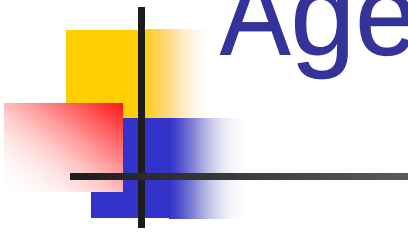
# IS 2150 / TEL 2810
# Risk Management, Legal Issues, Physical Security, CC Evaluation

October 31, 2007

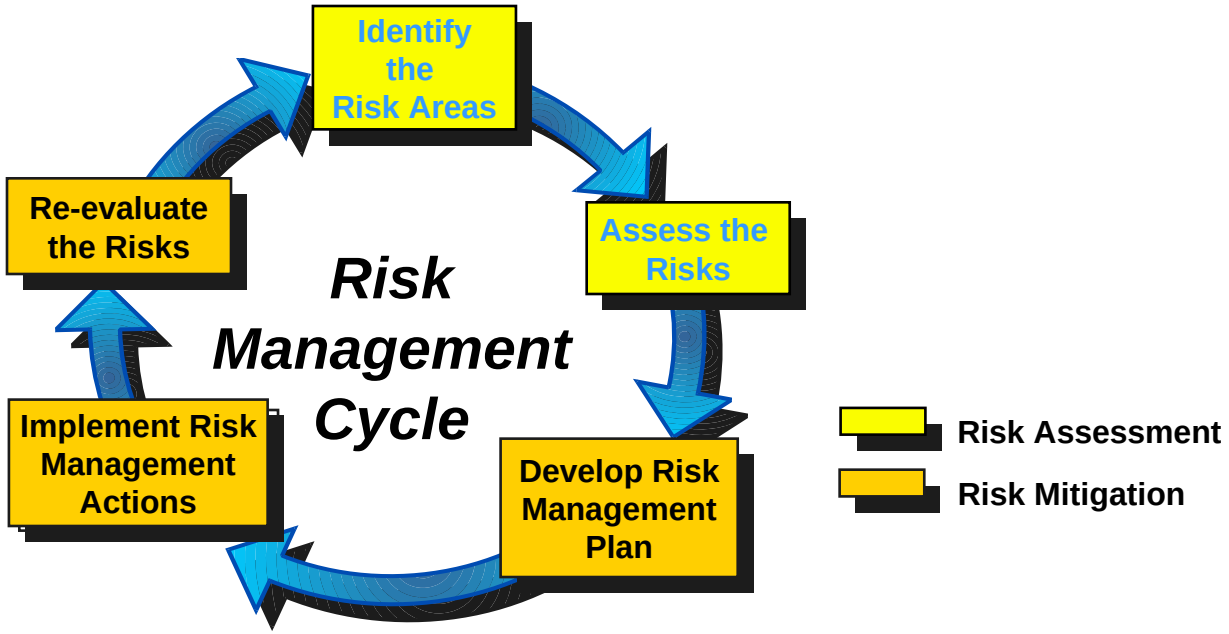
# Agenda

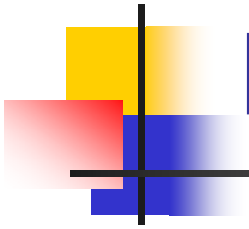


- Risk Management Examples
- Legal & Ethical issues
- Physical Security
- Common Criteria

# Risk Management

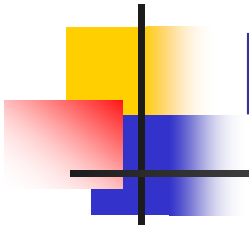
- The process concerned with identification, measurement, control and minimization of security risks in information systems to a level commensurate with the value of the assets protected (NIST)





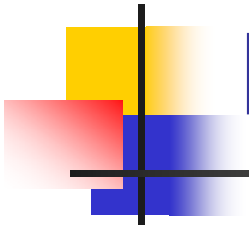
# Risk

- The *likelihood* that a particular *threat* using a specific *attack*, will exploit a particular *vulnerability* of a system that results in an undesirable *consequence* (NIST)
  - *likelihood* of the threat occurring is the estimation of the probability that a threat will succeed in achieving an undesirable event



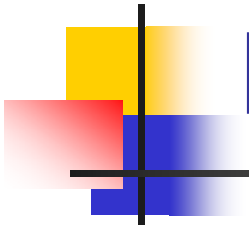
# Risk Assessment/Analysis

- A process of analyzing *threats* to and *vulnerabilities* of an information system and the *potential impact* the loss of information or capabilities of a system would have
  - List the threats and vulnerabilities
  - List possible control and their cost
  - Do cost-benefit analysis
    - Is cost of control more than the expected cost of loss?
- The resulting analysis is used as a basis for identifying appropriate and cost-effective counter-measures
  - Leads to proper security plan



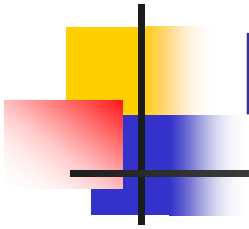
# Risk Assessment steps

- Identify assets
  - Hardware, software, data, people, supplies
- Determine vulnerabilities
  - Intentional errors, malicious attacks, natural disasters
- Estimate likelihood of exploitation
  - Considerations include
    - Presence of threats
    - Tenacity/strength of threats
    - Effectiveness of safeguards
  - Delphi approach
    - Raters provide estimates that are distributed and re-estimated



# Risk Assessment steps (2)

- Compute expected annual loss
  - Physical assets can be estimated
  - Data protection for legal reasons
- Survey applicable (new) controls
  - If the risks of unauthorized access is too high, access control hardware, software and procedures need to be re-evaluated
- Project annual savings of control



# Example 1

- Risks:
  - disclosure of company confidential information,
  - computation based on incorrect data
- Cost to correct data: $1,000,000
  - @10%liklihood per year: $100,000
  - Effectiveness of access control sw:60%: -$60,000
  - Cost of access control software: +$25,000
  - Expected annual costs due to loss and controls:
    - $100,000 - $60,000 + $25,000 = $65,000
  - Savings:
    - $100,000 - $65,000 = $35,000

# Example 2

- Risk:
  - Access to unauthorized data and programs
    - 100,000 @ 2% likelihood per year: $2,000
  - Unauthorized use of computing facility
    - 100,000 @ 40% likelihood per year: $4,000
- Expected annual loss:

  $6,000
- Effectiveness of network control: 100%

  -$6,000

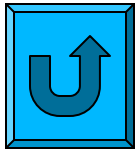
# Example 2 (2)

- Control cost
  - Hardware +$10,000
  - Software +$4,000
  - Support personnel +$40,000
- Annual cost

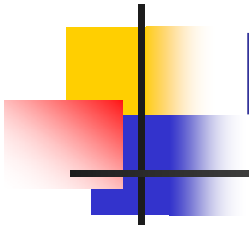
  $54,000
- Expected annual cost (6000-6000+54000) $54,000
- Savings (6000 – 54,000)

  -$48,000

# Some Arguments against Risk Analysis

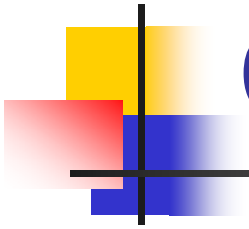


- Not precise
  - Likelihood of occurrence
  - Cost per occurrence
- False sense of precision
  - Quantification of cost provides false sense of security
- Immutability
  - Filed and forgotten!
  - Needs annual updates
- No scientific foundation (not true)
  - Probability and statistics



# Laws and Security

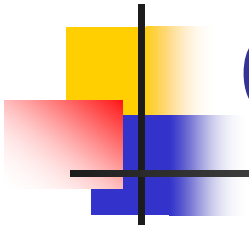
- Federal and state laws affect privacy and secrecy
  - Rights of individuals to keep information private
- Laws regulate the use, development and ownership of data and programs
  - Patent laws, trade secrets
- Laws affect actions that can be taken to protect secrecy, integrity and availability



# Copyrights

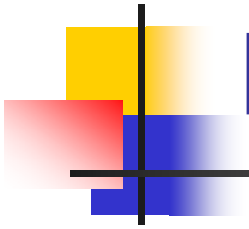
- Designed to protect *expression* of ideas
- Gives an author exclusive rights to make copies of the *expression* and sell them to public

- Intellectual property (copyright law of 1978)
  - Copyright must apply to an original work
  - It must be done in a tangible medium of expression
- Originality of work
  - Ideas may be public domain
- Copyrighted object is subjected to fair use



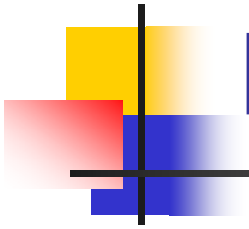
# Copyright infringement

- Involves copying
- Not independent work
  - Two people can have copyright for identically the same thing
- Copyrights for computer programs
  - Copyright law was amended in 1980 to include explicit definition of software
  - Program code is protected not the algorithm
  - Controls rights to copy and distribute



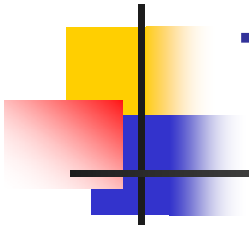
# Patent

- Protects innovations
  - Applies to results of science, technology and engineering
  - Protects new innovations
    - Device or process to carry out an idea, not idea itself
  - Excludes newly discovered laws of nature
    - 2+2 = 4



# Patent

- Requirements of novelty
  - If two build the same innovations, patent is granted to the first inventor, regardless of who filed first
  - Invention should be truly novel and unique
  - Object patented must be non-obvious
- Patent Office registers patents
  - Even if someone independently invents the same thing, without knowledge of the existing patent
- Patent on computer objects
  - PO has not encouraged patents for software – as they are seen as representation of an algorithm

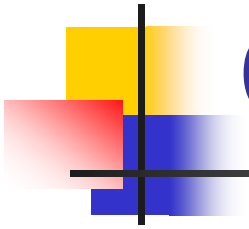


# Trade Secret

- Information must be kept secret
  - If someone discovers the secret independently, then there is no infringement – trade secret rights are gone
  - Reverse-engineering can be used to attack trade secrets
- Computer trade secret
  - Design idea kept secret
  - Executable distributed but program design remain hidden

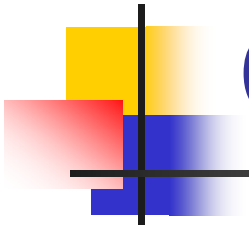
# Comparison

| | Copyright | Patent | Trade secret |
|---|---|---|---|
| Protects | Expression of idea | Invention | Secret information |
| Object made public | Yes: intention is to promote | Design filed at patent office | No |
| Requirement to distribute | Yes | No | No |
| Ease of filing | Very easy, do-it-yourself | Very complicated; specialist lawyer suggested | No filing |
| Duration | Life of human originator or 75 years of company | 19 years | Indefinite |
| Legal protection | Sue if copy sold | Sue if invention copied | Sue if secret improperly obtained |
| Examples | Object code, documentation | Hardware | Source code |



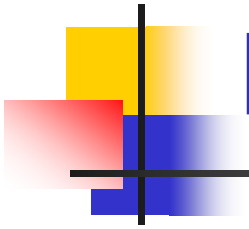
# Computer crime

- Hard to predict for the following reason
  - Low computer literacy among lawyers, police agents, jurors, etc.
  - Tangible evidence like fingerprints and physical clues may not exist
  - Forms of asset different
    - Is computer time an asset?
  - Juveniles
    - Many involve juveniles



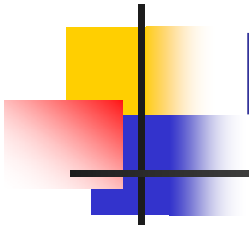
# Computer Crime related laws

- Freedom of information act
  - Provides public access to information collected by the executive branch of the federal government
- Privacy act of 1974
  - Personal data collected by government is protected
- Fair credit reporting act
  - Applies to private industries – e.g., credit bureaus
- Cryptography and law
  - France: no encryption allowed (to control terrorism)
  - US, UK, Canada, Germany:
    - Control on export of cryptography; but they are published!



# Ethics

- An objectively defined standard of right and wrong
- Often idealistic principles
- In a given situation several ethical issues may be present
- Different from law



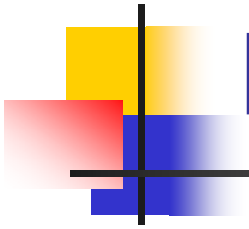
# Law vs Ethics

## Law

- Described by formal written documents
- Interpreted by courts
- Established by legislatures representing all people
- Applicable to everyone
- Priority determined by laws if two laws conflict
- Court is final arbiter for right
- Enforceable by police and courts

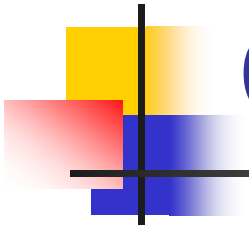
## Ethics

- Described by unwritten principles
- Interpreted by each individual
- Presented by philosophers, religions, professional groups
- Personal choice
- Priority determined by an individual if two principles conflict
- No external arbiter
- Limited enforcement



# Ethics Example

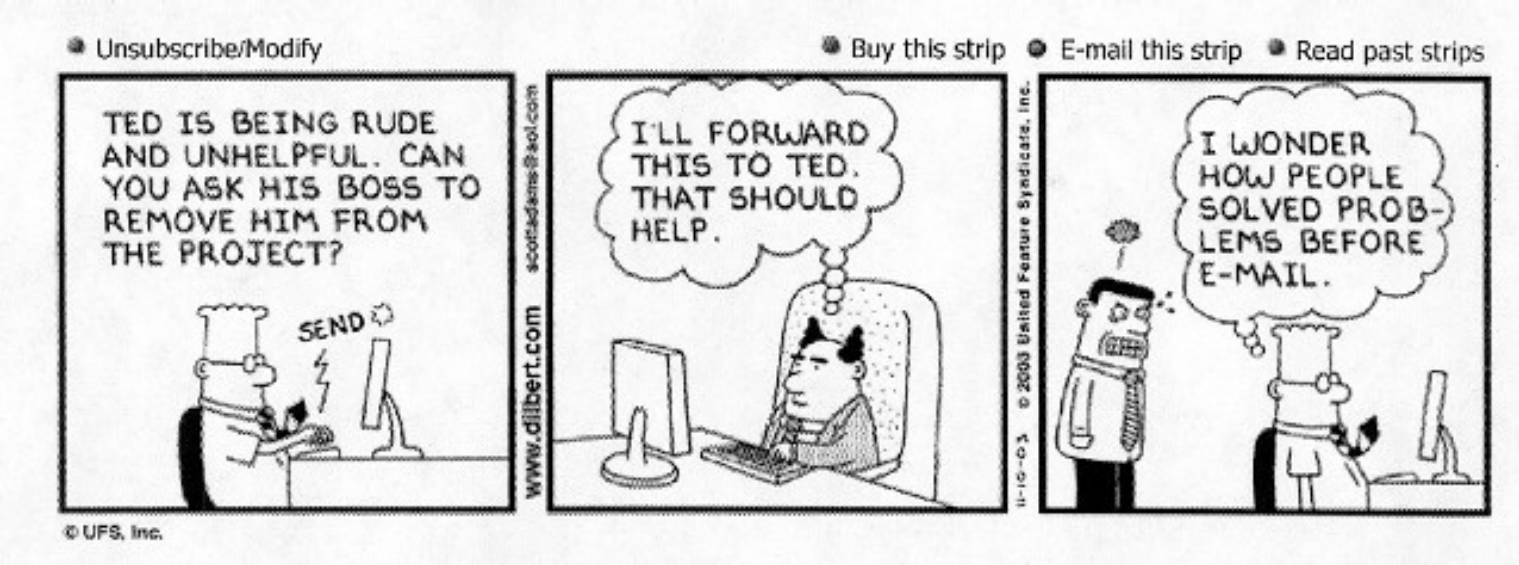
- Privacy of electronic data
  - “gentlemen do not read others’ mail” - but not everyone is a gentleman!
  - Ethical question: when is it justifiable to access data not belonging to you
    - One approach: Protection is user’s responsibility
    - Another: supervisors have access to those supervised
    - Another: justifiably compelling situation

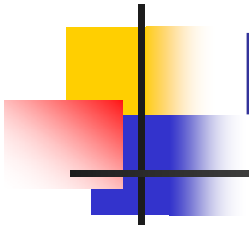


# Codes of ethics

- IEEE professional codes of ethic
  - To avoid real or perceived conflict of interest whenever possible, and to disclose them to affected parties when they do exist
  - To be honest and realistic in stating claims or estimates based on available data
- ACM professional codes of ethics
  - Be honest and trustworthy
  - Give proper credit for intellectual property

- Email humor
  - Persistence of the written word

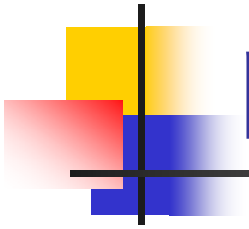




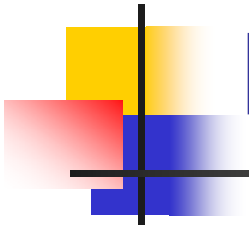
# Physical Security

- Often ignored or considered as of little or no concern
  - If someone working late steals a laptop – the fancy firewall defenses won't help!
- A NY investment bank spent tens of thousands of dollars on comsec to prevent break-in during the day, only to find that its cleaning staff opened the doors at night!
- A company in SFO had more than $100,000 worth of computers stolen over a holiday; an employee had used his electronic key card to unlock the building and disarm the alarm system

# Physical security in security plan

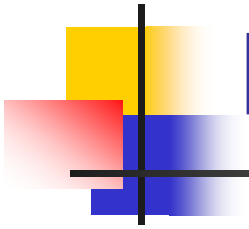


- Organizational security plan should include
  - Description of physical assets to be protected
  - Description of physical areas where the assets are located
  - Description of security perimeter
  - Threats (attacks, accidents, natural disasters)
  - Physical security defense and cost-analysis against the value of information asset being protected



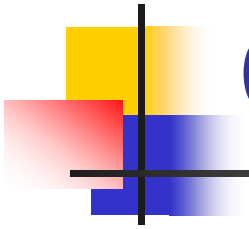
# Disaster Recovery

- Natural disasters
  - Flood/Falling water
  - Fire
  - Earthquake
  - Other environmental conditions
    - Dust, explosion (terrorist act), heat/humidity, electrical noise, lighting
- Power loss
  - Uninterruptible power supply
  - Surge protectors
- Accidents: food & drink



# Physical security plan

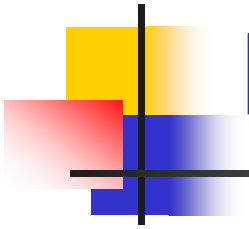
- Should answer (at least) the following
  - Can anybody other than designated personnel physically access the computer resources?
  - What if someone has an outburst and wants to smash the system resources?
  - What if an employee from your competitor were to come to the building unnoticed?
  - What are the consequences in case of fire?
  - How to react in case of some disaster?



# Contingency planning

"key to successful recovery is adequate planning"

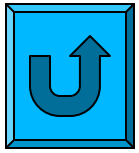
- Backup/off-site backup
- Cold-site/hot-site
  - Cold site: facility with power/cooling where computing system can be installed to begin immediate operation
  - Hot-site: facility with installed and ready to use computing system.
- Theft prevention
  - Prevent access: guards; locks; cards
  - prevent portability: locks, lockable cabinets
  - detect exit: like in library



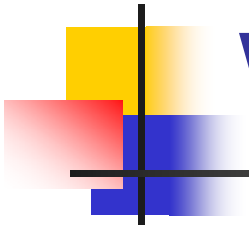
# Disposal of Sensitive Media

- Shredders
  - Mainly for paper; also used for diskettes, paper ribbons and some tapes
- Sanitizing media before disposal
  - Completely erase data
  - ERASE and DELETE may not be enough
  - Overwrite data several times
- Degaussers
  - Destroys magnetic fields
  - Fast way to neutralize a disk or tape

# TEMPEST: Emanations protections

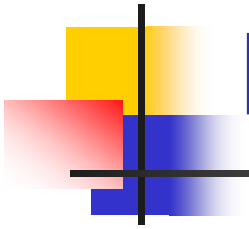


- All electronic and electromechanical info. processing equipment can produce unintentional data-related or intelligence-bearing emanations which, if intercepted and analyzed, disclose the info. transmitted, received, handled or otherwise processed (NSTISSAM 1-00)
- PASSIVE attack !!
- TEMPEST program certifies an equipment as not emitting detectable signals
  - Enclosure
    - Completely cover a tempest device
      - Shielded cable
      - Copper shielding a computer?
  - Emanation modification
    - Similar to generating noise



# What is Formal Evaluation?

- Method to achieve *Trust*
  - Not a guarantee of security
- Evaluation methodology includes:
  - Security requirements
  - Assurance requirements showing how to establish security requirements met
  - Procedures to demonstrate system meets requirements
  - Metrics for results (level of trust)
- Examples: TCSEC (Orange Book), ITSEC, CC



# Formal Evaluation: Why?

- Organizations require assurance
  - Defense
  - Telephone / Utilities
  - “Mission Critical” systems
- Formal verification of entire systems not feasible
- Instead, organizations develop formal evaluation methodologies
  - Products passing evaluation are trusted
  - Required to do business with the organization

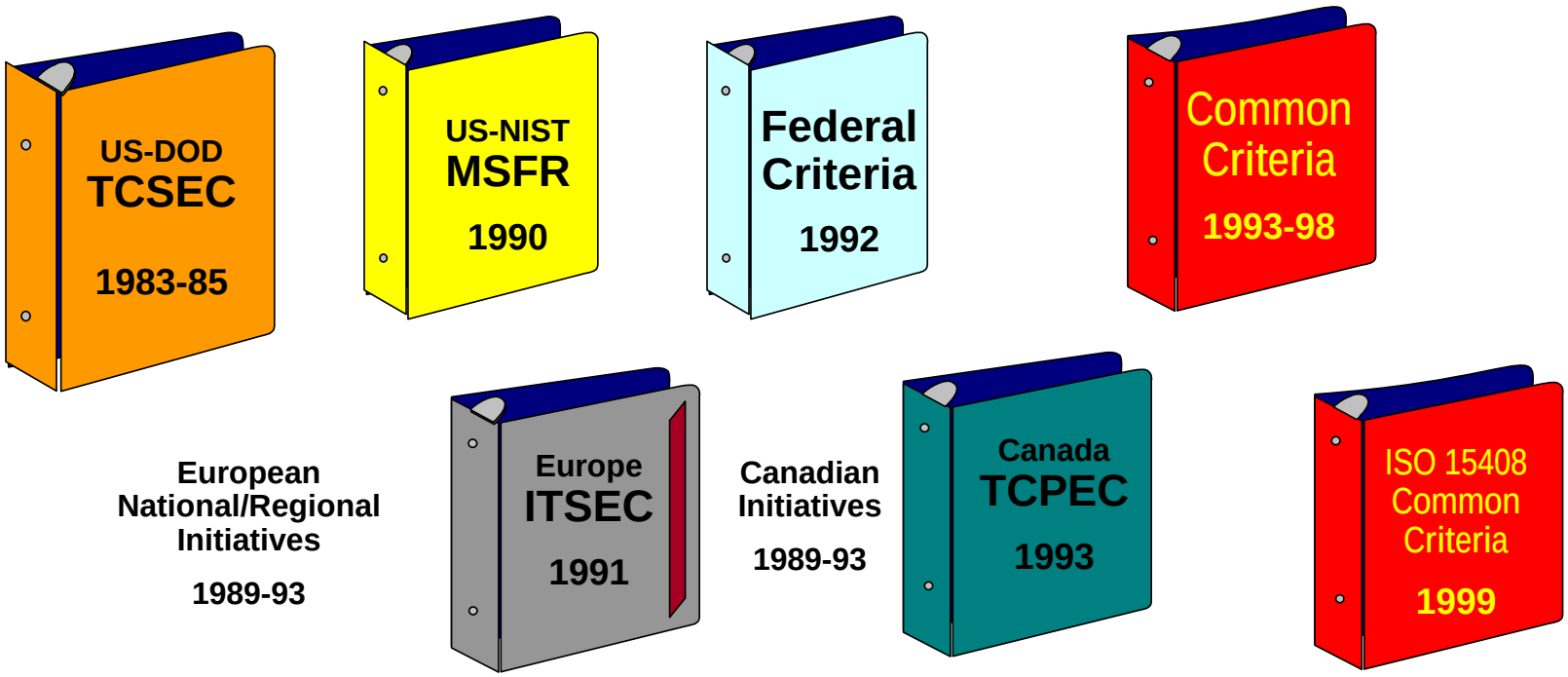
# Mutual Recognition Arrangement

National Information Assurance partnership (NIAP), in conjunction with the U.S. State Department,
negotiated a Recognition Arrangement that:

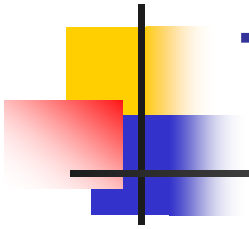
- Provides recognition of Common Criteria certificates by 24 nations (was 19 in 2005)
- Eliminates need for costly security evaluations in more than one country
- Offers excellent global market opportunities for U.S. IT industry

# An Evolutionary Process

Two decades of research and development...

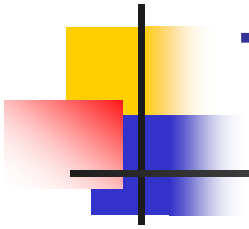


# Common Criteria: Origin



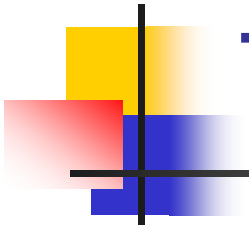
# TCSEC

- Known as Orange Book, DoD 5200.28-STD
- Four trust rating divisions (classes)
  - D: Minimal protection
  - C (C1,C2): Discretionary protection
  - B (B1, B2, B3): Mandatory protection
  - A (A1): Highly-secure



# TCSEC: The Original

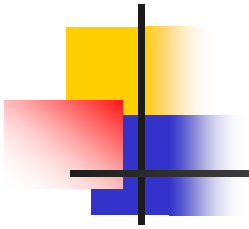
- Trusted Computer System Evaluation Criteria
  - U.S. Government security evaluation criteria
  - Used for evaluating commercial products
- Policy model based on Bell-LaPadula
- Enforcement: Reference Validation Mechanism
  - Every reference checked by compact, analyzable body of code
- Emphasis on Confidentiality
- Metric: Seven trust levels:
  - D, C1, C2, B1, B2, B3, A1
  - D is “tried but failed”



# TCSEC Class Assurances

- C1: Discretionary Protection
  - Identification
  - Authentication
  - Discretionary access control
- C2: Controlled Access Protection
  - Object reuse and auditing
- B1: Labeled security protection
  - Mandatory access control on limited set of objects
  - Informal model of the security policy

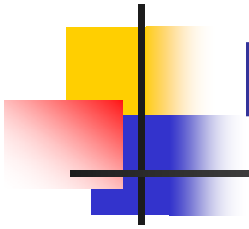
# TCSEC Class Assurances *(continued)*



- B2: Structured Protections
  - Trusted path for login
  - Principle of Least Privilege
  - Formal model of Security Policy
  - Covert channel analysis
  - Configuration management
- B3: Security Domains
  - Full reference validation mechanism
  - Constraints on code development process
  - Documentation, testing requirements
- A1: Verified Protection
  - Formal methods for analysis, verification
  - Trusted distribution

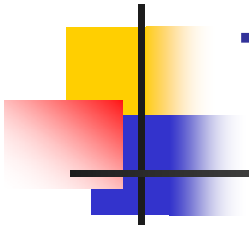
# How is Evaluation Done?

- Government-sponsored independent evaluators
  - Application:  Determine if government cares
  - Preliminary Technical Review
    - Discussion of process, schedules
    - Development Process
    - Technical Content, Requirements
  - Evaluation Phase



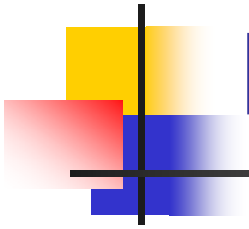
# TCSEC: Evaluation Phase

- Three phases
  - Design analysis
    - Review of design based on documentation
  - Test analysis
  - Final Review
- Trained independent evaluation
  - Results presented to Technical Review Board
  - Must approve before next phase starts
- Ratings Maintenance Program
  - Determines when updates trigger new evaluation



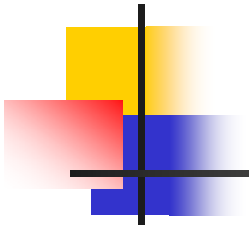
# TCSEC: Problems

- Based heavily on confidentiality
  - Did not address integrity, availability
- Tied security and functionality
- Base TCSEC geared to operating systems
  - TNI: Trusted Network Interpretation
  - TDI: Trusted Database management System Interpretation



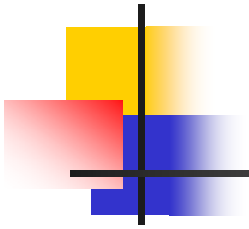
# Later Standards

- CTCPEC – Canada
- ITSEC – European Standard
  - Did not define criteria
  - Levels correspond to strength of evaluation
  - Includes code evaluation, development methodology requirements
  - Known vulnerability analysis
- CISR: Commercial outgrowth of TCSEC
- FC: Modernization of TCSEC
- FIPS 140: Cryptographic module validation
- Common Criteria: International Standard
- SSE-CMM: Evaluates developer, not product



# ITSEC: Levels

- E1: Security target defined, tested
  - Must have informal architecture description
- E2: Informal description of design
  - Configuration control, distribution control
- E3: Correspondence between code and security target
- E4: Formal model of security policy
  - Structured approach to design
  - Design level vulnerability analysis
- E5: Correspondence between design and code
  - Source code vulnerability analysis
- E6: Formal methods for architecture
  - Formal mapping of design to security policy
  - Mapping of executable to source code

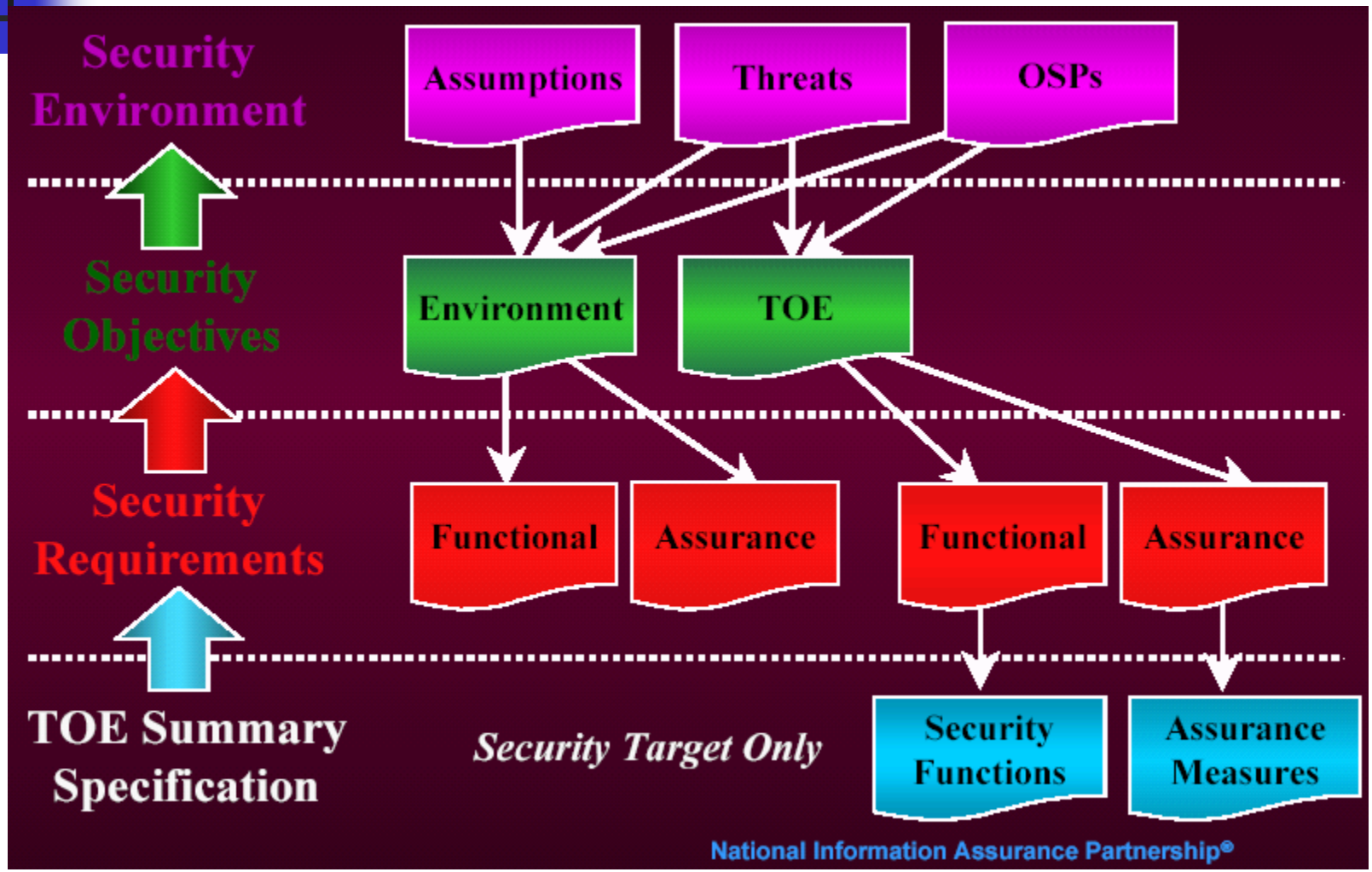


# ITSEC Problems:

- No validation that security requirements made sense
  - Product meets goals
  - But does this meet user expectations?
- Inconsistency in evaluations
  - Not as formally defined as TCSEC


- Replaced TCSEC, ITSEC
- 7 Evaluation Levels (functionally tested to formally designed and tested)
- Functional requirements, assurance requirements and evaluation methodology
- Functional and assurance requirements are organized hierarchically into: *class*, *family*, *component*, and, *element*. The components may have *dependencies*.

# PP/ST Framework



# IT Security Requirements

***The Common Criteria defines two types of IT security requirements--***

**Functional Requirements**

**- for defining security behavior of the IT product or system:**

**• implemented requirements become security functions**

**Examples:**

- ***Identification & Authentication***
- ***Audit***
- ***User Data Protection***
- ***Cryptographic Support***

**Assurance Requirements**

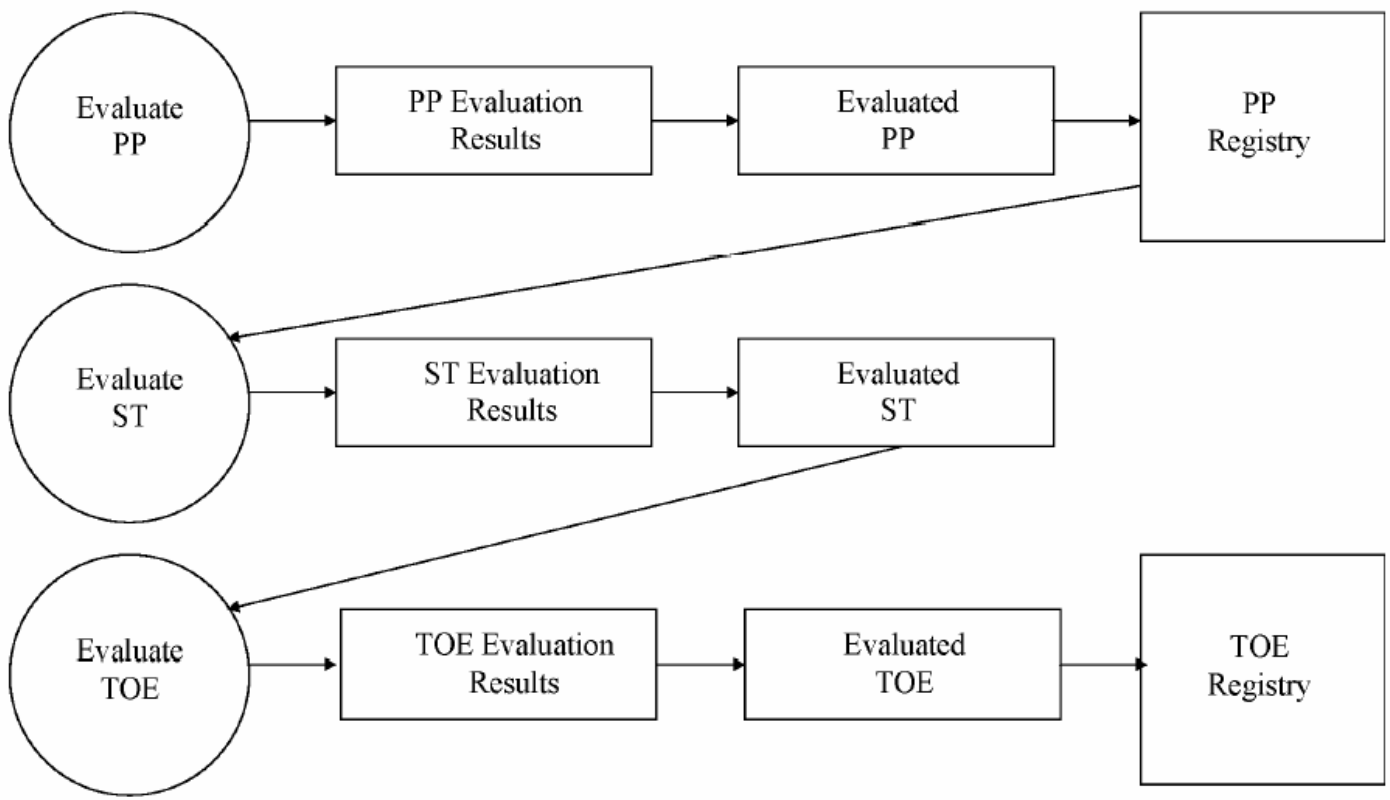
**- for establishing confidence in security functions:**

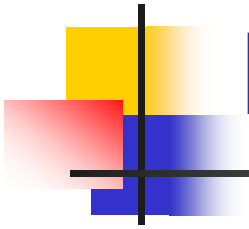
**• correctness of implementation**

**• effectiveness in satisfying security objectives**

**Examples:**

- ***Development***
- ***Configuration Management***
- ***Life Cycle Support***
- ***Testing***
- ***Vulnerability Analysis***


Evaluate PP
PP Evaluation Results
Evaluated PP
PP Registry
Evaluate ST
ST Evaluation Results
Evaluated ST
Evaluate TOE
TOE Evaluation Results
Evaluated TOE
TOE Registry



# Documentation

- Part 1: Introduction and General Model
- Part 2: Security Functional Requirements
- Part 3: Security Assurance Requirements
- CEM

- Latest version: 3.1 (variations exist)
- http://www.commoncriteriaportal.org/public/expert/index.php?menu=2

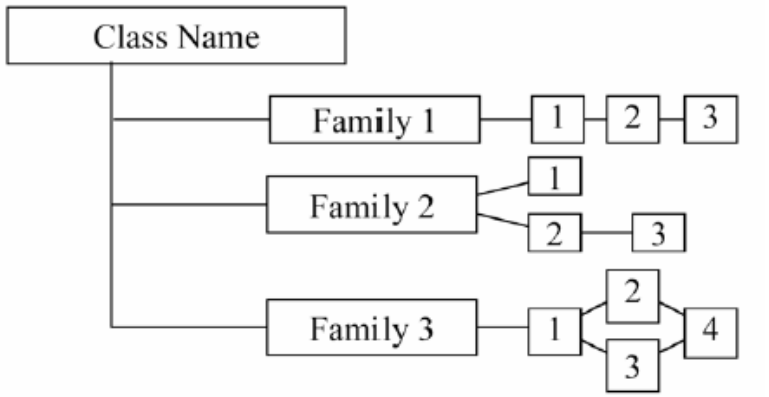
# Class Decomposition

**Class**

**Family**

**Components**

**Elements**

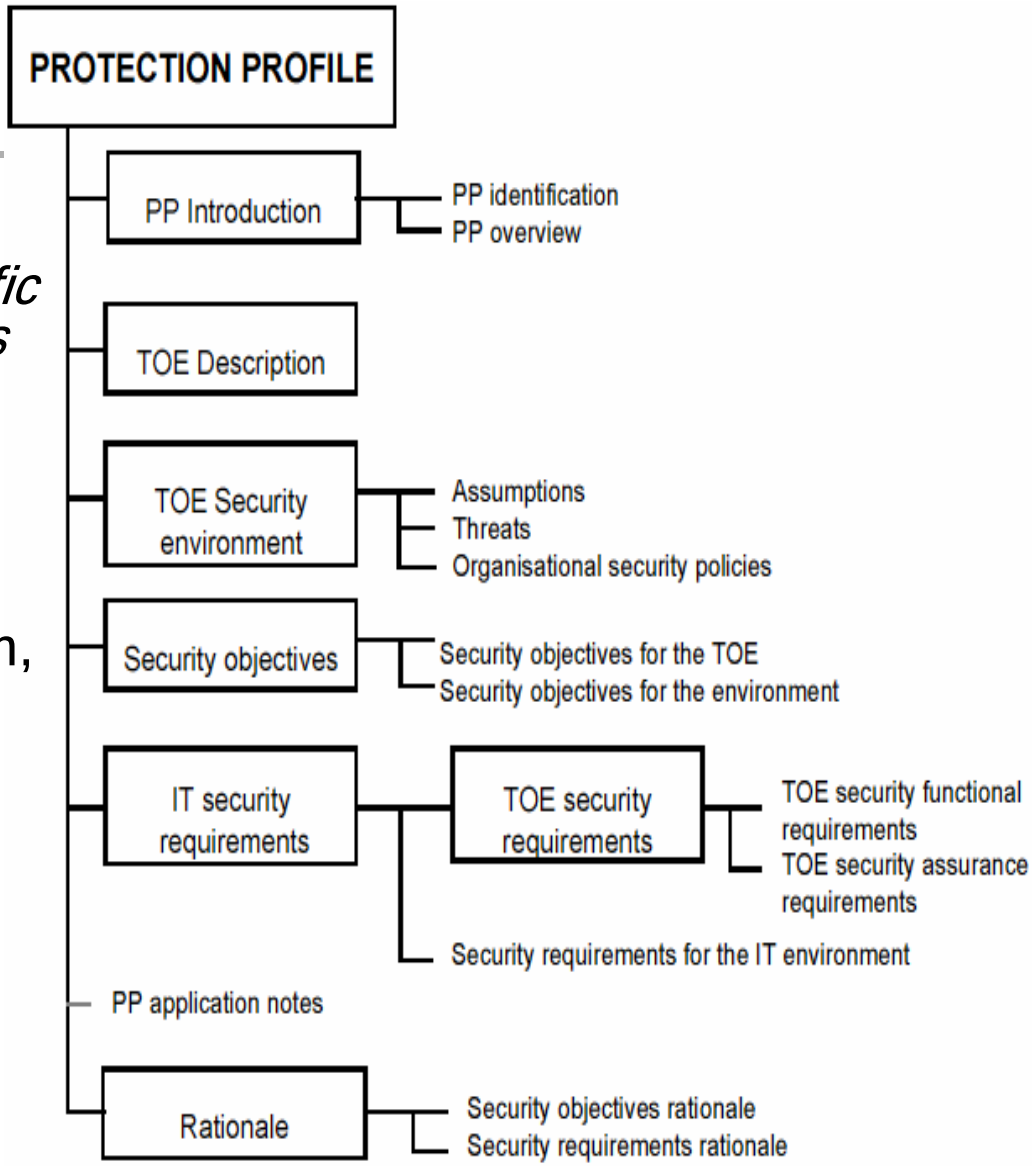



Note:
Applicable to both functional and assurance documents

# CC Evaluation 1: Protection Profile

*Implementation independent, domain-specific set of security requirements*

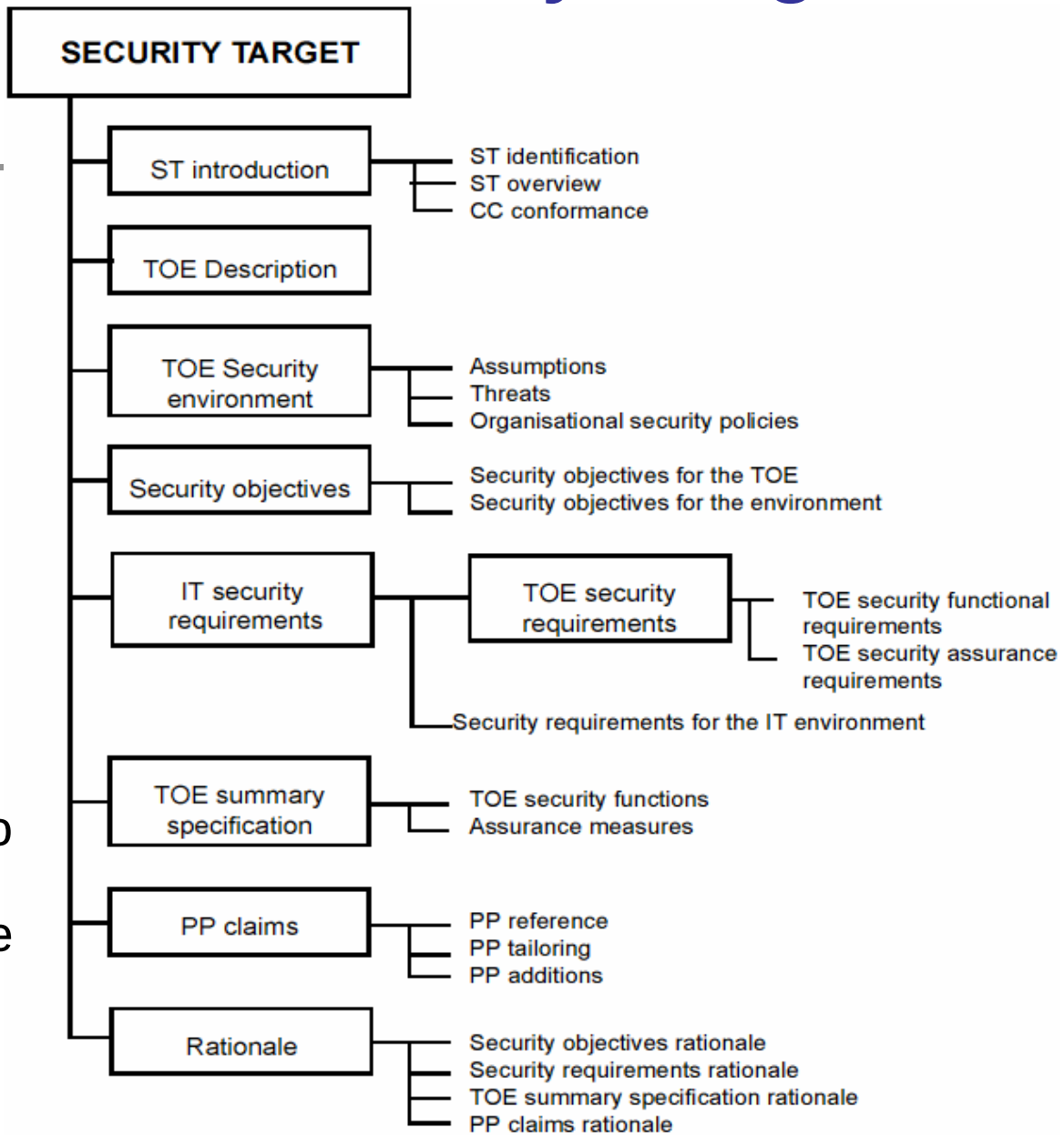
- Narrative Overview
- Product/System description
- Security Environment (threats, overall policies)
- Security Objectives: System, Environment
- IT Security Requirements
  - Functional requirements drawn from CC set
  - Assurance level
- Rationale for objectives and requirements



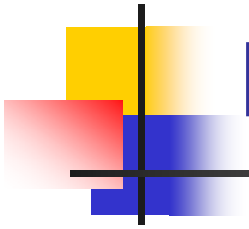
# CC Evaluation 2: Security Target

*Specific requirements used to evaluate system*

- Narrative introduction
- Environment
- Security Objectives
  - How met
- Security Requirements
  - Environment and system
  - Drawn from CC set
- Mapping of Function to Requirements
- Claims of Conformance to Protection Profile

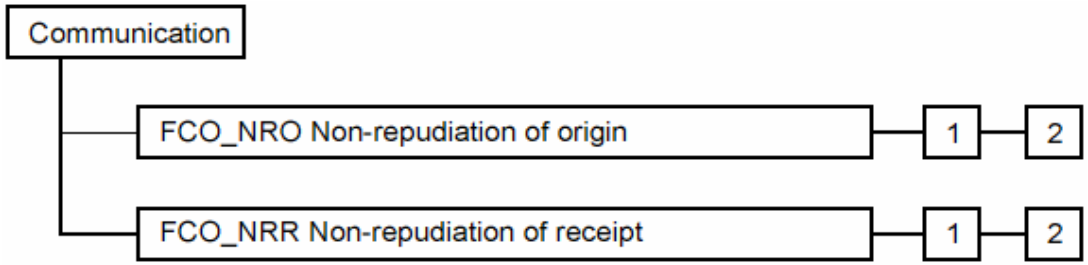


# Common Criteria: Functional Requirements



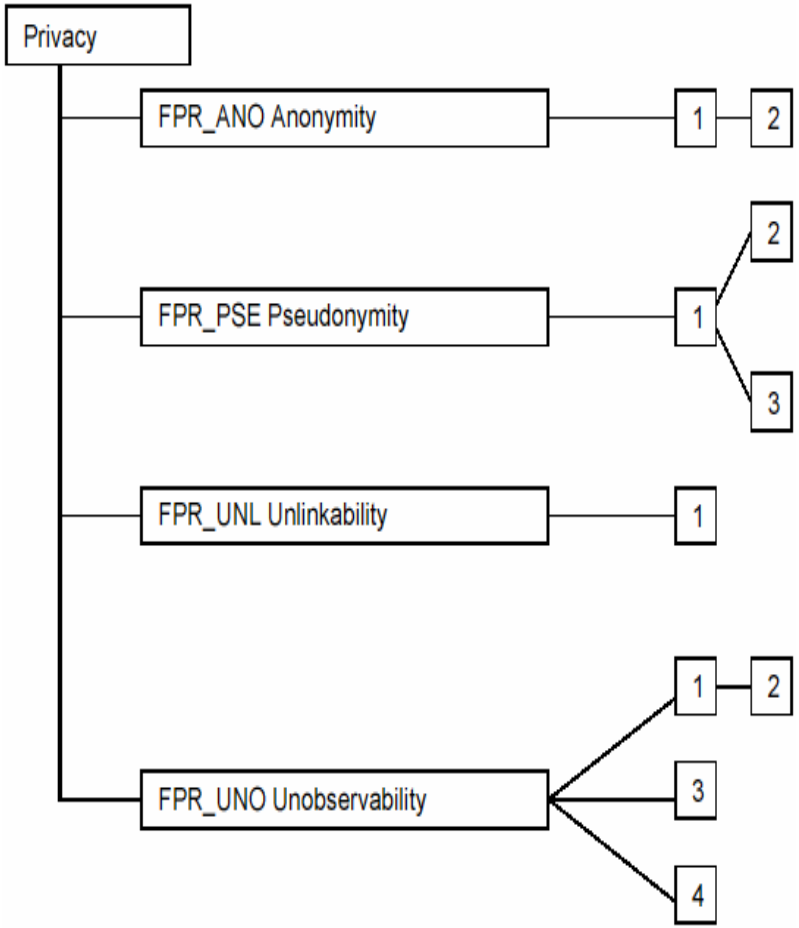
- 314 page document
- 11 Classes
  - Security Audit, Communication, Cryptography, User data protection, ID/authentication, Security Management, Privacy, Protection of Security Functions, Resource Utilization, Access, Trusted paths
- Several families per class
- Lattice of components in a family

# Class Example: Communication



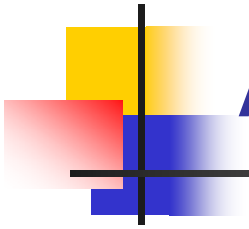

- Non-repudiation of origin
  1. Selective Proof. Capability to request verification of origin
  2. Enforced Proof. All communication includes verifiable origin

# Class Example: Privacy



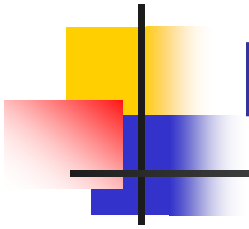

1. Pseudonymity
   - The TSF shall ensure that [assignment: *set of users and/or subjects*] are unable to determine the real user name bound to [assignment: *list of subjects and/or operations and/or objects*]
   - The TSF shall be able to provide [assignment: *number of aliases*] aliases of the real user name to [assignment: *list of subjects*]
   - The TSF shall [selection: *determine an alias for a user, accept the alias from the user*] and verify that it conforms to the [assignment: *alias metric*]
2. Reversible Pseudonimity
   - ...
3. Alias Pseudonimity
   1. ...

# Common Criteria: Assurance Requirements

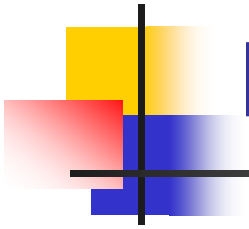


- 231 page document
- 10 Classes
  - Protection Profile Evaluation, Security Target Evaluation, Configuration management, Delivery and operation, Development, Guidance, Life cycle, Tests, Vulnerability assessment, Maintenance
- Several families per class
- Lattice of components in family

# Common Criteria: Evaluation Assurance Levels



1. Functionally tested
2. Structurally tested
3. Methodically tested and checked
4. Methodically designed, tested, and reviewed
5. Semi-formally designed and tested
6. Semi-formally verified design and tested
7. Formally verified design and tested



# Common Criteria: Evaluation Process

- National Authority authorizes evaluators
  - U.S.: NIST accredits commercial organizations
  - Fee charged for evaluation
- Team of four to six evaluators
  - Develop work plan and clear with NIST
  - Evaluate Protection Profile first
  - If successful, can evaluate Security Target

# Defining Requirements

ISO/IEC Standard 15408


***A flexible, robust catalogue of standardized IT security requirements (features and assurances)***

Protection Profiles

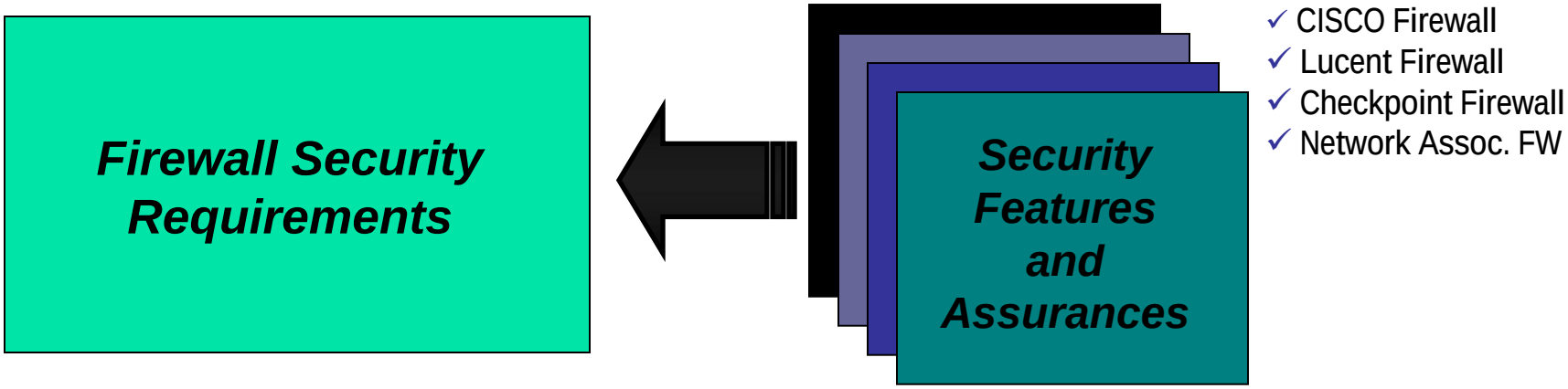

- ✓ Operating Systems
- ✓ Database Systems
- ✓ Firewalls
- ✓ Smart Cards
- ✓ Applications
- ✓ Biometrics
- ✓ Routers
- ✓ VPNs

***Consumer-driven security requirements in specific information technology areas***

# Industry Responds

Protection Profile

Security Targets

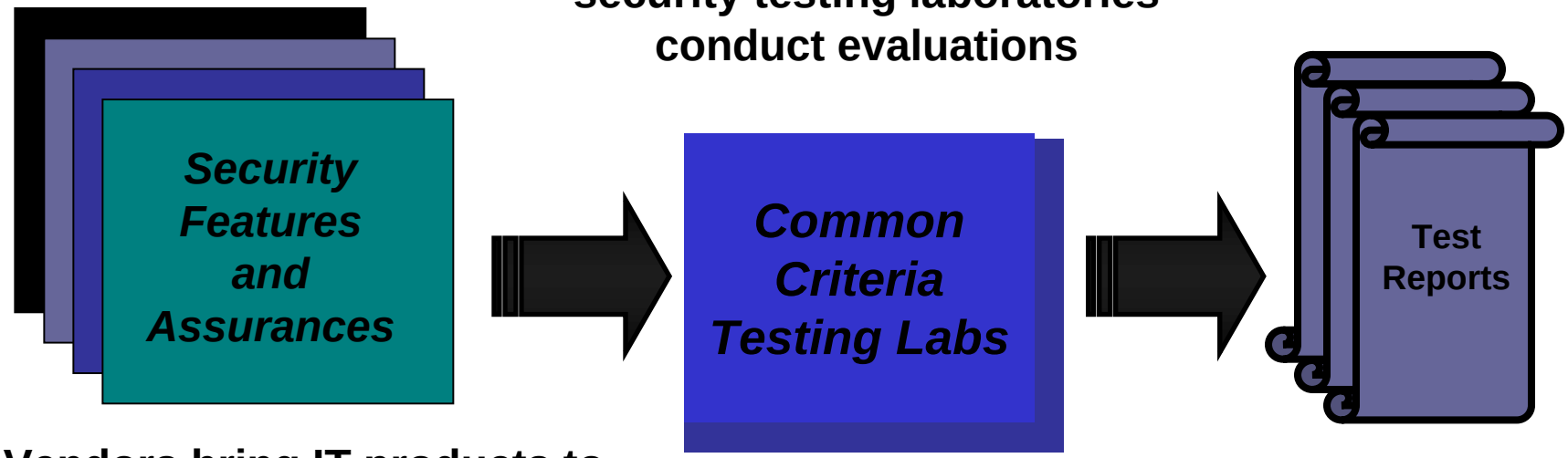



***Consumer statement of IT security requirements to industry in a specific information technology area***

***Vendor statements of security claims for their IT products***

# Demonstrating Conformance

**Private sector, accredited security testing laboratories conduct evaluations**

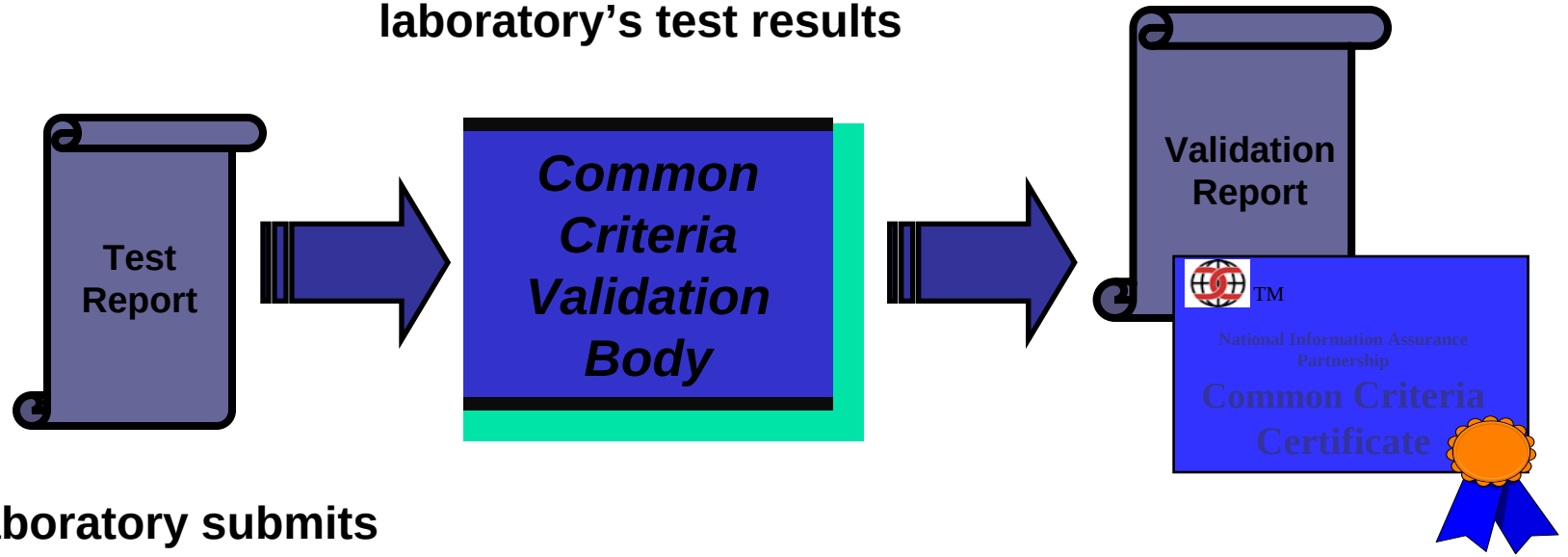



**Vendors bring IT products to independent, impartial testing facilities for security evaluation**

**Test results submitted to the National Information Assurance Partnership (NIAP) for post-evaluation validation**

# Validating Test Results

**Validation Body validates laboratory's test results**




**Laboratory submits test report to Validation Body**

**NIAP issues Validation Report and Common Criteria Certificate**

# Common Criteria: Status

- About 80 registered products (2005)
  - Only one at level 5 (Java Smart Card)
  - Several OS at 4
  - Likely many more not registered
- 223 Validated products (Oct, 2007)
  - Tenix Interactive Link Data Diode Device Version 2.1 at EAL 7+