Chapter 18: Introduction to Assurance

- Overview
- Why assurance?
- Trust and assurance
- Life cycle and assurance
Overview

- Trust
- Problems from lack of assurance
- Types of assurance
- Life cycle and assurance
- Waterfall life cycle model
- Other life cycle models
Trust

• *Trustworthy* entity has sufficient credible evidence leading one to believe that the system will meet a set of requirements

• *Trust* is a measure of trustworthiness relying on the evidence

• *Assurance* is confidence that an entity meets its security requirements based on evidence provided by applying assurance techniques
Relationships

Policy

Statement of requirements that explicitly defines the security expectations of the mechanism(s)

Assurance

Provides justification that the mechanism meets policy through assurance evidence and approvals based on evidence

Mechanisms

Executable entities that are designed and implemented to meet the requirements of the policy
Problem Sources

1. Requirements definitions, omissions, and mistakes
2. System design flaws
3. Hardware implementation flaws, such as wiring and chip flaws
4. Software implementation errors, program bugs, and compiler bugs
5. System use and operation errors and inadvertent mistakes
6. Willful system misuse
7. Hardware, communication, or other equipment malfunction
8. Environmental problems, natural causes, and acts of God
9. Evolution, maintenance, faulty upgrades, and decommissions
Examples

• **Challenger explosion**
  – Sensors removed from booster rockets to meet accelerated launch schedule

• **Deaths from faulty radiation therapy system**
  – Hardware safety interlock removed
  – Flaws in software design

• **Bell V22 Osprey crashes**
  – Failure to correct for malfunctioning components; two faulty ones could outvote a third

• **Intel 486 chip**
  – Bug in trigonometric functions
Role of Requirements

- **Requirements** are statements of goals that must be met
  - Vary from high-level, generic issues to low-level, concrete issues
- **Security objectives** are high-level security issues
- **Security requirements** are specific, concrete issues
Types of Assurance

• Policy assurance is evidence establishing security requirements in policy is complete, consistent, technically sound

• Design assurance is evidence establishing design sufficient to meet requirements of security policy

• Implementation assurance is evidence establishing implementation consistent with security requirements of security policy
Types of Assurance

• *Operational assurance* is evidence establishing system sustains the security policy requirements during installation, configuration, and day-to-day operation
  – Also called *administrative assurance*
Life Cycle

1. Security requirements
2. Design
3. Implementation
4. Assurance justification

Design and implementation refinement
Life Cycle

- Conception
- Manufacture
- Deployment
- Fielded Product Life
Conception

• Idea
  – Decisions to pursue it

• Proof of concept
  – See if idea has merit

• High-level requirements analysis
  – What does “secure” mean for this concept?
  – Is it possible for this concept to meet this meaning of security?
  – Is the organization willing to support the additional resources required to make this concept meet this meaning of security?
Manufacture

- Develop detailed plans for each group involved
  - May depend on use; internal product requires no sales
- Implement the plans to create entity
  - Includes decisions whether to proceed, for example due to market needs
Deployment

• Delivery
  – Assure that correct masters are delivered to production and protected
  – Distribute to customers, sales organizations

• Installation and configuration
  – Ensure product works appropriately for specific environment into which it is installed
  – Service people know security procedures
Fielded Product Life

• Routine maintenance, patching
  – Responsibility of engineering in small organizations
  – Responsibility may be in different group than one that manufactures product

• Customer service, support organizations

• Retirement or decommission of product
Waterfall Life Cycle Model

- Requirements definition and analysis
  - Functional and non-functional
  - General (for customer), specifications
- System and software design
- Implementation and unit testing
- Integration and system testing
- Operation and maintenance
Relationship of Stages

Requirements definition and analysis
System and software design
Implementation and unit testing
Integration and system testing
Operation and maintenance
Models

• Exploratory programming
  – Develop working system quickly
  – Used when detailed requirements specification cannot
    be formulated in advance, and adequacy is goal
  – No requirements or design specification, so low
    assurance

• Prototyping
  – Objective is to establish system requirements
  – Future iterations (after first) allow assurance techniques
Models

- Formal transformation
  - Create formal specification
  - Translate it into program using correctness-preserving transformations
  - Very conducive to assurance methods

- System assembly from reusable components
  - Depends on whether components are trusted
  - Must assure connections, composition as well
  - Very complex, difficult to assure
Models

• Extreme programming
  – Rapid prototyping and “best practices”
  – Project driven by business decisions
  – Requirements open until project complete
  – Programmers work in teams
  – Components tested, integrated several times a day
  – Objective is to get system into production as quickly as possible, then enhance it
  – Evidence adduced after development needed for assurance
Key Points

• Assurance critical for determining trustworthiness of systems
• Different levels of assurance, from informal evidence to rigorous mathematical evidence
• Assurance needed at all stages of system life cycle