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Module II. Internet Security

Chapter 4
Introduction to Internet Security

Web Security: Theory & Applications

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Outline

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1. Network Security

❑ International Standards Organizations

- International Organization for Standardization (ISO)
- International Electrotechnical Commission (IEC)
- International Telecommunication Union/Telecommunication Standardization Sector (ITU-T)
- Internet Society (ISOC)
- The Internet Engineering Task Force (IETF)
- National Institute of Standards & Technology (NIST)
- RSA Labs (de facto, 事实标准)
- ISO/IEC JTC1 SC27
  - ISO/IEC Joint Technical Committee 1
  - ISO/IEC 联合技术委员会, SC27 安全技术标准制定小组
- ANSI

1. Network Security

❑ Five Layers of Network Security Architectures

- Physical Security
  - ✧ Physical Security describes measures that are designed to deny access to unauthorized personnel (including attackers or even accidental intruders) from physically accessing a building, facility, resource, or stored information; and guidance on how to design structures to resist potentially hostile acts (抵抗潜在的敌意行为).
- System Security
- Network Security
- Applications Security
- Management Security

1. Network Security

❑ Five Layers of Network Security Architectures

- 网络安全体系的分层结构
  - ✧ 网络安全防范体系可以划分为物理安全、系统 (操作系统) 安全、网络安全、应用安全和安全管理5个层次，不同层次反映不同的安全问题。
- 物理环境安全性 (物理安全层面)
  - ✧ 物理安全包括通信线路、物理设备、机房的安全等。
  - ✧ 物理安全主要体现在
    - ○ 通信线路的可靠性 (线路备份、网管软件、传输介质)
    - ○ 软硬件设备安全性 (替换设备、拆卸设备、增加设备)
    - ○ 设备的备份容灾能力、抗干扰能力
    - ○ 设备的运行环境 (温度、湿度、烟尘)
    - ○ 不间断电源保障
    - ○ … …

1. Network Security

❑ Five Layers of Network Security Architectures

- 操作系统安全性 (系统安全层面)
    - 操作系统本身的缺陷带来的不安全因素
        - 身份认证
        - 访问控制
        - 系统漏洞
        - ……
    - 操作系统的安全配置
    - 病毒和木马对操作系统的威胁

1. Network Security

❑ Five Layers of Network Security Architectures

- 网络安全性 (网络安全层面)
  - 网络方面的安全性包括
    - 网络身份认证
    - 网络资源访问控制
    - 数据传输的保密性与完整性
    - 远程安全接入
    - 域名系统的安全
    - 路由系统的安全
    - 入侵检测手段
    - 防病毒设施
    - ……

1. Network Security

❑ Five Layers of Network Security Architectures

- 应用安全性 (应用安全层面)
  - ✧ 应用层的安全问题主要由提供服务所采用的应用软件和数据的安全性产生，包括 Web 服务、电子邮件系统、DNS 等。此外，还要考虑病毒对系统的威胁。
- 管理安全性 (管理安全层面)
  - ✧ 安全管理包括安全技术和设备的管理、安全管理制度、部门与人员的组织规则等。管理的制度化极大程度地影响着整个网络的安全，严格的安全管理制度、明确的部门安全职责划分、合理的人员角色配置都可以在很大程度上降低其它层次的安全威胁。

2. Information Security Models

- ❑ 信息安全模型和安全体系
  - ◆ 信息安全模型
    - ✧ 访问控制模型
    - ✧ 其他模型
  - ◆ 信息安全体系
    - ✧ 信息安全保障框架
    - ✧ OSI 7498-2
    - ✧ 信息技术安全性评估
    - ✧ 信息安全保障评估

2. Information Security Models

❑ 信息安全模型的概念

- 信息安全模型用于精确和形式地描述信息系统的安全特征，以及用于解释系统安全的相关行为。合适的安全模型对关键安全需求分析有重要意义，有助于建立有效的安全性评估准则。
- 信息安全模型的分类
  - ✧ 按机制分类：访问控制模型、信息流模型等。
    - ◌ 访问控制模型：从访问控制的角度描述安全系统，主要针对系统中主体对客体的访问及其安全控制。
    - ◌ 信息流模型：研究客体之间的信息传输过程的控制。目前尚处于理论阶段。
  - ✧ 按服务分类：机密性模型、完整性模型、可用性模型等。

2. Information Security Models

❑ 信息安全模型与安全操作系统的发展

- MIT 于1961年在 IBM 7094 型机器上实现了首个分时系统 CTSS (Compatible Time-Sharing System，相容分时系统)。1963年 MIT 启动 MAC 计划，由 IBM 大型机连接分布在校园的160台终端，允许30名用户同时使用。1965年 MIT 启动 MULTICS (多路信息与计算系统，MULTiplexed Information and Computing System) 计划，项目研发基于 CTSS 系统和 IBM PL/I 语言，建立在通用公司的 GE645 主机上，预计连接1000台终端，支持300名用户同时使用。新系统的研发由 AT&T 贝尔实验室、MIT 和 GE 合作。1969年，经历四年研发的 MULTICS 还是达不到计划中的性能，贝尔实验室退出项目。次年 GE 将电脑业务出售，Honeywell 公司接手后将 MULTICS 改造成为商业化的操作系统产品并大量销售。
- MULTICS 潮解：Many Unnecessarily Large Table In Core Simultaneously

2. Information Security Models

❑ 信息安全模型与安全操作系统的发展

- 1969年，贝尔实验室的 *Ken Thompson* 和 *Dennis Ritchie* 把原本为 MULTICS 设计的 Space Travel 游戏移植到一台空闲的 PDP-7 小型机上，后来又在程序中加入了文件管理、进程管理的功能和一组实用工具，并在1973年改由 C 语言实现。受到 MULTICS 的影响，*Brian Kernighan* 给系统取名为 UNiplexed Information and Computing System (UNICS，单路信息与计算系统)，取谐音便是 UNIX。
- MULTICS 虽然未能达到预期目标，但为后来的安全操作系统的研究积累了大量经验。

2. Information Security Models

❑ 信息安全模型与安全操作系统的发展

- BLP 模型 (1973)。由 Mitre 公司的 *D. E. Bell* 和 *L. J. La Padula* 模拟军事安全策略创建，改进后于1976年用于 Multics 操作系统。BLP 是大部分安全操作系统的基础安全模型。
- Biba 模型 (1977)。由 *K. J. Biba* 提出，增加了对信息完整性的支持。
- BMA 模型 (1995)。由英国医学会 (BMA) 提出，由客体授权主体使用用客体信息，保证客体信息的完整性和可用性。
- Adept-50 (1969)。基于 IBM/360 的第一个分时安全操作系统。
- PSOS (Provably Secure Operating System, 1975)。层次结构化的基于权能 (capability-based) 的安全操作系统。
- KSOS (Kernelized Secure Operating System, 1977)。美国国防部研究计划局主持的安全操作系统研究项目，通过形式化说明与验证的方法提供高可信度的安全性。

2. Information Security Models

❑ 信息安全模型与安全操作系统的发展

- UCLA Secure UNIX (1978)。美国国防部研究计划局主持，与 KSOS 类似的安全操作系统研究项目。
- LINVS IV (1984)。基于 BSD UNIX 4.1 的安全操作系统。
- Secure Xenix (1986)。由 IBM 研发，基于 IBM PC/AT 机器实现。
- OSF/1 (1990)。由 Open Software Foundation (OSF) 提供支持的 UNIX 版本。
- UNIX SVR 4.1 EE (1991)。由 UI 支持的 UNIX 版本。
- SELinux (Security Enhanced Linux, 2001)。由 NSA 支持的 Linux 版本。

2. Information Security Models

❑ 信息安全评估标准 (部分)

- TCSEC (Trusted Computer System Evaluation Criteria, 1985)。即橘皮书 (Orange Book)， 将计算机系统的安全划分为4个类别、7个等级，按安全程度从最低到最高的排序是 D，C1，C2，B1，B2，B3，A1。
- ITSEC (IT Security Evaluation Criteria, 信息技术安全评定标准, 1991)。英、法、德、荷共同标准。
- BS 7799 (信息安全管理体系, British Standards Institute, BSI, 1995)。
  - 英国标准协会 (BSI) 制定的关于信息安全管理方面的标准。
  - ISO 27000 的前身。
- CC (Common Criteria for IT Security Evaluation, 1996)。
  - 1996, CC 1.2 英、法、德、荷、美、加
  - 1997, CC 2.0
  - 1999, ISO/IEC 15408

2. Information Security Models

❑ 信息安全评估标准 (部分)

- BS 7799 信息安全管理体系
  - ✧ 英国标准协会 (British Standards Institute, BSI) 制定的关于信息安全管理方面的标准，它包含两个部分：第一部分是被采纳为 ISO/IEC 17799:2000 标准的信息安全管理实施细则 (Code of Practice for Information Security Management)， 它在10个标题框架下列举定义127项作为安全控制的惯例，供信息安全实践者选择使用；BS 7799 的第二部分是建立信息安全管理体系 (ISMS) 的一套规范 (Specification for Information Security Management Systems)，详细说明了建立、实施和维护信息安全管理体系的要求，指出实施机构应该遵循的风险评估标准。作为一套管理标准，BS7799-2 指导相关人员怎样去应用 ISO/IEC 17799，其最终目的还在于建立适合企业需要的 ISMS。
  - ✧ ISO 27000 源于 BS 7799。

2. Information Security Models

信息安全模型的分类

- 访问控制模型
  - 自主访问控制模型 (DAC, Discretionary Access Control)
    - 访问矩阵模型
      - 访问控制列表 (ACL)
      - 权能列表 (Capacity List)
  - 强制访问控制模型 (MAC, Mandatory Access Control)
    - 多级环境模型 (静态)
      - Bell-Lapadula 模型 (1973)
      - Biba 模型 (1977)
      - Clark-Wilson 模型 (1987)
    - 多边环境模型 (动态)
      - Chinese Wall 模型
      - BMA 模型 (1995)

2. Information Security Models

- ❑ 信息安全模型的分类
  - ◆ 访问控制模型
    - ✧ 基于角色控制模型 (RBAC)
    - ✧ 基于属性控制模型 (ABAC)

2. Information Security Models

❑ 信息安全模型的分类

- 信息流模型
  - ✧ 信息流安全模型主要关注对客体之间的信息传输过程的控制。信息流模型需要遵守的安全规则是：在系统状态转换时，信息流只能从访问级别低的状态流向访问级别高的状态。
  - ✧ 信息流模型实现的关键在于对系统的描述，即对模型进行彻底的信息流分析，找出所有的信息流，并根据信息流安全规则判断其是否为异常流，据此反复修改系统的描述或模型，直到所有的信息流都不是异常流为止。
  - ✧ 信息流模型的缺点：需要制定输入输出的安全性规范；对具体的实现只能提供少量的帮助和指导。

2. Information Security Models

❑ ISO 7498-2 安全体系结构

- ISO 7498-2 即 OSI 开放系统互联安全体系结构。
- ISO 于1989年对 OSI 开放系统互联环境的安全性进行了深入研究，在此基础上提出了 OSI 安全体系结构，即：ISO 7498-2:1989。
- ISO 7498-2 被我国等同采用，即《信息处理系统一开放系统互连一基本参考模型一第二部分：安全体系结构 GB/T 9387.2-1995》。
- ISO 7498-2 安全体系结构由5类安全服务 (认证、访问控制、数据保密性，数据完整性和抗抵赖性) 及用来支持安全服务的8种安全机制 (加密、数字签名、访问控制，数据完整性，认证交换、业务流填充、路由控制和公证) 构成。

2. Information Security Models

❑ ISO 7498-2 安全体系结构

- ISO 7498-2 安全体系结构针对的是基于 OSI 参考模型的网络通信系统，它所定义的安全服务也只是解决网络通信安全性的技术措施，其他信息安全相关领域，包括系统安全、物理安全、人员安全等方面都未涉及。
- ISO 7498-2 安全体系关注的是静态防护技术，它并没有考虑到信息安全动态性和生命周期性的发展特点，缺乏检测、响应和恢复这些重要的环节，因而无法满足更复杂更全面的信息保障的要求。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- PDR 安全模型
  - PDR 模型是由美国互联网安全系统公司 (ISS, 1999?) 提出的入侵检测模型。PDR 命名取自 Protection, Detection 和 Response 的首字母。
    - 防护
      - 安全规则的制定；系统安全的配置；安全措施的采用。
    - 检测
      - 异常监视；模式发现。
    - 响应
      - 在发现了攻击企图或者攻击之后，需要系统及时地进行反应。响应包括报告、记录、反应、恢复。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- PDR 安全模型
  - PDR 模型建立了一个基于时间的可证明的安全模型，定义了：
    - 防护时间 P_t
      - 黑客发起攻击时，保护系统不被攻破的时间。
    - 检测时间 D_t
      - 从黑客发起攻击到系统检测到攻击的时间。
    - 响应时间 R_t
      - 从系统发现攻击到系统作出有效响应的时间。
  - 当 $P_t > D_t + R_t$ 时，也即在黑客攻破系统之前安全体系发现并阻止了黑客的行为，那么系统就是安全的。
  - PDR 安全模型是一个理想模型，系统的 P_t、D_t、R_t 在实际中难以准确定义，这些时间可能随着不同的黑客和不同种类的攻击而发生变化。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- P2DR 安全模型
  - ✧ P2DR 模型源自 ISS 提出的自适应网络安全模型 ANSM (Adaptive Network Security Model)。P2DR 命名取自 Policy, Protection, Detection 和 Response 的首字母。
  - ✧ P2DR 认为一个良好、完整的动态安全体系，不仅需要恰当的防护 (如操作系统访问控制，防火墙、加密等)，而且需要动态的检测机制 (如入侵检测、漏洞扫描等)，在发现问题时还需要及时做出响应，这样的一个体系需要在统一的安全策略指导下进行实施，由此形成一个完备的、闭环的动态自适应安全体系。
  - ✧ P2DR 模型建立在基于时间的安全理论基础之上。该理论的基本思想是信息安全相关的所有活动，无论是攻击行为、防护行为、检测行为还是响应行为，都需要消耗时间，因而可以用时间尺度来衡量一个体系的能力和安全性。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- P2DR 安全模型
  - ✧ 策略
    - 策略是模型的核心，所有防护、检测和响应都是依据安全策略实施的。网络安全策略一般包括总体安全策略和具体安全策略两个部分组成。
  - ✧ 防护
    - 防护是根据系统可能出现的安全问题而采取的预防措施，这些措施通过传统的静态安全技术实现。采用的防护技术通常包括数据加密、身份认证、访问控制、授权、VPN、防火墙、安全扫描和数据备份等。
  - ✧ 检测
    - 当攻击者穿透防护系统时，检测功能发挥作用，与防护系统形成互补。检测是动态响应的依据。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- P2DR 安全模型
  - ✧ 响应
    - ◌ 系统一旦检测到入侵，响应系统就开始工作，进行事件处理。响应包括紧急响应和恢复处理，恢复处理又包括系统恢复和信息恢复。
  - ✧ P2DR 模型在整体的安全策略的控制和指导下，综合运用防护工具 (如防火墙、操作系统身份认证、加密等) 的同时，利用检测工具 (如漏洞评估、入侵检测等) 了解和评估系统的安全状态，通过适当的响应将系统调整到“最安全”和“风险最低”的状态。
  - ✧ 防护、检测和响应组成了一个完整的、动态的安全循环，在安全策略的指导下保证信息系统的安全。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- P2DR 安全模型
  - ✧ P2DR 模型的安全规则：
    - ○ 公式 (1)： $P_t > D_t + R_t$.
    - ○ 公式 (2)： $E_t = D_t + R_t$, if $P_t = 0$.
  - ✧ 公式 (1) 和 PDR 模型相同，表示防护时间大于检测时间加上响应时间，也就是在入侵者危害安全目标之前就能被检测到并及时处理。
  - ✧ 公式 (2) 假设防护时间为 0，D_t 与 R_t 的和就是该安全目标系统的暴露时间 E_t。针对于需要保护的安全目标，E_t 越小系统就越安全。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- P2DR 安全模型
  - ✧ P2DR 给信息系统安全一个全新的定义：“及时的检测和响应就是安全”，“及时的检测和恢复就是安全”。这样的定义为安全问题的解决给出了明确的方向：提高系统的防护时间 P_t，降低检测时间 D_t 和响应时间 R_t。
  - ✧ P2DR 的问题在于与策略相关的内在的变化因素难以界定，如人员的流动、人员的素质和策略贯彻的稳定性等。

2. Information Security Models

❑ PDR, P2DR 和 PDRR 安全模型

- PDRR 安全模型
  - ✧ PDRR 模型，或者叫 PPDRR (或者P2DR2)，与 P2DR 非常相似，区别在于把恢复环节 (Restore) 提到了和防护、检测、响应等环节同等的高度。在 PDRR 模型中，策略、防护、检测、响应和恢复共同构成了完整的安全体系。

3. Information Assurance

❑ 信息保障

- 随着网络攻击技术的发展，人们发现任何信息安全技术和手段都存在弱点，传统的“防火墙+补丁”这样的纯技术方案无法完全抵御来自各方的威胁，必须寻找一种可持续的保护机制，对信息和信息系统进行全方位的、动态的保护。因此，除了信息安全保护外，还应该重视提高安全预警能力、系统的入侵检测能力、系统的事件反应能力和系统遭到入侵引起破坏的快速恢复能力。区别于传统的加密、身份认证、访问控制、防火墙、安全路由等技术，需要强调信息系统整个生命周期的防御和恢复。同时安全问题的出现和解决方案也超越了纯技术范畴。
- 1989年卡内基·梅隆大学 CERT 部门开始研究如何从静态信息安全防护向动态防护转变。之后，美国防部在其信息安全及网络战防御理论探索中吸收了这一思想，并于1995年提出了“信息保障”概念。

3. Information Assurance

❑ 信息保障

- 信息保障 (information assurance, IA) 概念提出以后，经过多次修改、完善，到世界范围的广泛认可。
  - ✧ 信息保障是一种保证信息和信息系统能够安全运行的防护性行为；信息保障的对象是信息以及处理、管理、存储、传输信息的信息系统；信息保障的目的是采取技术、管理等综合性手段，使信息和信息系统具备机密性、完整性、可用性、可认证性、不可否认性，以及在遭受攻击后的可恢复性。
- 随着技术的不断发展和认识的不断深入，美军“信息保障”概念的内涵和外延也在实践中不断扩充和延伸，从最初的一套简单的纯技术防护措施，发展到由“人”、“技术”和“操作”三个范畴共同构成的一个综合体系，包括了政策管理、组织实施、运行使用、基础设施建设等方方面面的内容，形成指导美军构建信息安全体系的重要战略思想。

3. Information Assurance

❑ 信息保障

- 信息保障体系
  - 信息保障的目的是为保障对象 (信息和信息系统) 提供可用性、机密性、完整性、不可抵赖性、可授权性的安全服务。信息保障最终实现对保障对象提供持续安全性的保证，它需要的不仅仅是安全防护措施，更重要的是安全循环体系和完整的实施体系的支持，也即需要建立信息保障体系，
  - 信息保障体系包括风险分析、安全防护、安全检测、安全测试与评估、应急响应、系统恢复、信息保障实施体系。
  - 因此，信息保障是针对信息安全的一个多层次的体系结构，通过信息保障体系可以实现信息关键基础设施、信息、信息系统的安全持续性提升，在一个风险、检测、评估、响应的循环体系和完备的实施体系中保证良好的安全性。

3. Information Assurance

❑ 信息保障

- 信息保障体系
  - ✧ 风险分析 (Risk Analyze)
    - ○ 确定系统资源清单，进行脆弱性评估，分析系统风险级别。风险分析是了解信息系统各方面状态的关键步骤。
  - ✧ 安全防护 (Protect)
    - ○ 采用相关安全技术、安全机制、安全产品，实现安全防护方案。安全防护是保障信息安全性的重要静态措施。
  - ✧ 安全检测 (Detect)：
    - ○ 使用实时监控、入侵检测、漏洞扫描等技术，对系统进行安全检测，形成资源数据库。
  - ✧ 安全测试与评估 (Test and Evaluate)：
    - ○ 定期对系统的安全机制、安全产品、安全状态进行测试和评估，及时发现存在的安全脆弱性。安全检测和安全测试与评估是保障信息安全性的关键动态措施。

3. Information Assurance

❑ 信息保障

- 信息保障体系
  - ✧ 应急响应 (React)
    - ○ 对突发事件进行快速反应，尽可能减少突发事件对系统的影响，保证系统安全的最小资源集合可用。
  - ✧ 系统恢复 (Restore)
    - ○ 当系统遭受毁坏时，评估系统损失情况，在最短时间内恢复系统数据和系统服务，使系统迅速恢复基本的服务并重建。应急响应能力和恢复能力是信息系统生存性、抗毁性的重要衡量标准。
  - ✧ 信息保障实施体系 (Implement)
    - ○ 信息保障实施体系是信息保障有效实施的保障和基础，它包括相关组织机构体系构建、相关政策颁布、相关标准制订、资金支持、信息安全专家及相关人员的培养计划、人员信息安全意识的提高、信息保障的实施与管理等。

3. Information Assurance

❑ 信息保障技术框架 IATF

- **IATF** (Information Assurance Technical Framework 信息保障技术框架) 由 NSA 制定，目的是为美国政府和工业界的信息与信息技术设施的保护提供技术指南。
- IATF 从整体、过程的角度看待信息安全问题，其代表理论为“深度防御战略”(Defense-in-Depth, 也称纵深防御策略)。IATF 强调人、技术、操作三个核心原则，关注四个信息安全保障领域：保护网络和基础设施、保护边界、保护计算环境、支撑基础设施。
- IATF 首次提出了信息保障依赖于人、技术和操作三个要素来共同实现组织职能/业务运作的思想，对技术/信息基础设施的管理也离不开这三个要素。IATF 认为，稳健的信息保障状态意味着信息保障的策略、过程、技术和机制在整个组织的信息基础设施所有层面上都能得以实施。
- IATF 划分了4个密级的保护：无密级、保密、机密、绝密。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的安全目标
  - ✧ 可用性
    - ○ 合法用户的正常请求能及时、 正确、 安全地得到服务或回应。
  - ✧ 完整性
    - ○ 信息在存储和传输时不被篡改、 破坏， 或避免信息包的丢失、 乱序等不破坏信息的正确性和完整性。
  - ✧ 保密性
    - ○ 防止对信息的非授权访问和窃听、解密。
  - ✧ 可靠性
    - ○ 指信息的可信度， 包括信息完整性、 准确性和发送人的身份的可信度。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的保护对象是四个信息安全保障领域
  - 网络和基础设施的防御
    - 网络和基础设施是各种信息系统和业务系统的中枢，为用户数据流和用户信息获取提供传输机制，其安全是整个信息系统安全的基础。网络和基础设施防御包括维护信息服务，防止拒绝服务攻击 (DoS)；保护在整个广域网上进行交换的公共的、私人的或保密的信息，避免这些信息在无意中泄漏给未授权访问者或发生更改、延时或发送失败；保护数据流分析等。
      - 骨干网可用性
      - 无线网安全框架
      - VPN 和紧耦合连接

3. Information Assurance

信息保障技术框架 IATF

- IATF 的保护对象是四个信息安全保障领域
  - 区域边界防御
    - 根据业务的重要性、管理等级和安全等级的不同，一个信息系统通常可以划分多个区域，每个区域是在单一统辖权控制下的物理环境，具有逻辑和物理安全措施。这些区域大多具有和其他区域或网络相连接的外部连接。区域边界防御关注的是如何对进出这些区域边界的数据流进行有效的控制与监视，对区域边界的基础设施实施保护。
      - 网络访问控制
      - 远程访问安全
      - 多级别安全 (不同密级之间的连接)

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的保护对象是四个信息安全保障领域
  - 计算环境防御
    - 在计算环境中的安全防护对象包括用户应用环境中的服务器、客户机以及其上安装的操作系统和应用系统，这些应用能够提供包括信息访问、存储、传输、录入等在内的服务。计算环境防御利用识别与认证 (I&A)、访问控制等技术确保进出内部系统数据的保密性、完整性和不可否认性。这是信息系统安全保护的最后一道防线。
      - 客户端环境安全
      - 服务器端 (应用系统) 安全

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的保护对象是四个信息安全保障领域 (续)
  - ✧ 支撑性基础设施
    - ○ 支撑基础设施是一套相关联的活动与能够提供安全服务的基础设施相结合的综合体。深度防御策略定义了两种支撑基础设施：密钥管理基础设施 (KMI, Key Management Infrastructure)/公钥基础设施 (PKI, Public Key Infrastructure) 以及检测与响应基础设施。
    - ○ KMI/PKI 涉及网络环境的各个环节，是密码服务的基础；本地 KMI/PKI 提供本地授权，广域网范围的 KMI/PKI 提供证书、目录以及密钥产生和发布功能。
    - ○ 检测与响应基础设施中的组成部分则提供用户预警、检测、识别可能的网络攻击，作出有效响应以及对攻击行为进行调查分析等功能。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 信息保障体系三个要素
  - ✧ 人 People
    - ○ 人是信息体系的主体，是信息系统的拥有者、管理者和使用者，是信息保障体系的核心，是第一位的要素，同时也是最脆弱的要素。基于这样的认识，安全管理在安全保障体系中就愈显重要。信息安全保障体系实质上就是一个安全管理的体系，其中包括意识培训、组织管理、技术管理和操作管理等多个方面。
  - ✧ 技术 Technology
    - ○ 技术是实现信息保障的重要手段，信息保障体系所应具备的各项安全服务都需要通过技术机制实现。技术已经不单是以防护为主的静态技术体系，而是防护、检测、响应、恢复并重的动态的技术体系。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 信息保障体系三个要素 (续)
  - ✧ 操作/运行 Operation
    - ○ 操作或运营构成了安全保障的主动防御体系。如果说技术的构成是被动的，那操作和流程就是将各方面技术紧密结合在一起的主动过程，其中包括风险评估、安全监控、安全审计、跟踪告警、入侵检测、响应恢复等内容。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的核心思想
  - ✧ IATF 的核心思想是深度防御，采用一个层次化的、多样性的安全措施来保障用户信息及信息系统的安全。
  - ✧ 在深度防御战略中，人、技术和操作是三个主要核心因素，要保障信息及信息系统的安全，三者不可或缺；在技术层面上，纵深防御战略体现为在包括主机、网络、系统边界和支撑性基础设施等多个网络环节之中实现预警、保护、检测、反应和恢复 (WPDRR) 五个安全内容。
  - ✧ 深度防御战略的含义是多方面的，它试图全面覆盖一个层次化的、多样性的安全保障框架。纵深防御战略的核心目标就是在攻击者成功地破坏了某个保护机制的情况下，其它保护机制依然能够提供附加的保护。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的其他信息保障原则
  - ✧ 除了深度防御核心思想之外，IATF 还提出了其他一些信息保障原则，这些原则对指导我们建立信息安全保障体系都具有非常重要的意义。
  - ✧ 保护多个位置
    - ◌ 包括保护网络和基础设施、区域边界、计算环境。这一原则提醒我们，仅仅在信息系统的重要敏感设置保护装置是不够的，任意一个系统漏洞都有可能导致严重的攻击和破坏后果，所以在信息系统的各个方位需要布置全面的防御机制，这样才能将风险减至最低。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的其他信息保障原则 (续)
  - ✧ 分层防御
    - 如果说保护多个位置原则是横向防御，那么分层防御原则就是纵向防御，这也是纵深防御思想的一个具体体现。分层防御指的是在攻击者和和保护目标之间部署多层防御机制，每一个这样的机制必须对攻击者形成一道屏障。而且每一个这样的机制还应包括保护和检测措施，以使攻击者不得不面对被检测到的风险，迫使攻击者由于高昂的攻击代价而放弃攻击行为。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 的其他信息保障原则 (续)
  - ✧ 安全强健性
    - ◌ 不同的信息对于组织有不同的价值，该信息丢失或破坏所产生的后果对组织也有不同的影响。所以对信息系统内每一个信息安全组件的安全强健性 (即强度和保障) 的设置，取决于被保护信息的价值以及所遭受的威胁程度。在设计信息安全保障体系时，必须要考虑到信息价值和安全管理成本的平衡。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 小结
  - ✧ 阐述功能服务和技术机制的 ISO 7498-2 体系和动态安全模型 PDR 表现的都是信息安全最终的存在形态，是一种目标体系和模型。这种体系模型并不关注信息安全建设的工程过程，也未阐述实现目标体系的途径和方法。此外，已往的安全体系和模型无不侧重于安全技术，但它们并没有将信息安全建设过程中的非技术因素体现到各个功能环节当中。
  - ✧ 信息安全发展到信息保障阶段之后，人们认识到，构建信息安全保障体系必须从安全的各个方面进行综合考虑，只有将技术、管理、策略、工程过程等方面紧密结合，安全保障体系才能真正成为指导安全方案设计和建设的有力依据。IATF 就是在这种背景下诞生的。

3. Information Assurance

❑ 信息保障技术框架 IATF

- IATF 小结
  - ✧ IATF 认为，信息安全并不是纯粹的技术问题，而是一项复杂的系统工程，表现为具体实施的一系列过程，这就是信息系统安全工程 (ISSE)。通过完整实施的 ISSE 过程，组织应该能够建立起有效的信息安全体系。
  - ✧ IATF 的四个技术焦点区域是一个逐层递进的关系，从而形成一种纵深防御系统。因此，以上四个方面的应用充分贯彻了纵深防御的思想，对整个信息系统的各个区域、各个层次，甚至在每一个层次内部都部署了信息安全设备和安全机制，保证访问者对每一个系统组件进行访问时都受到保障机制的监视和检测，以实现系统全方位的充分防御，将系统遭受攻击的风险降至最低，确保信息的安全和可靠。

3. Information Assurance

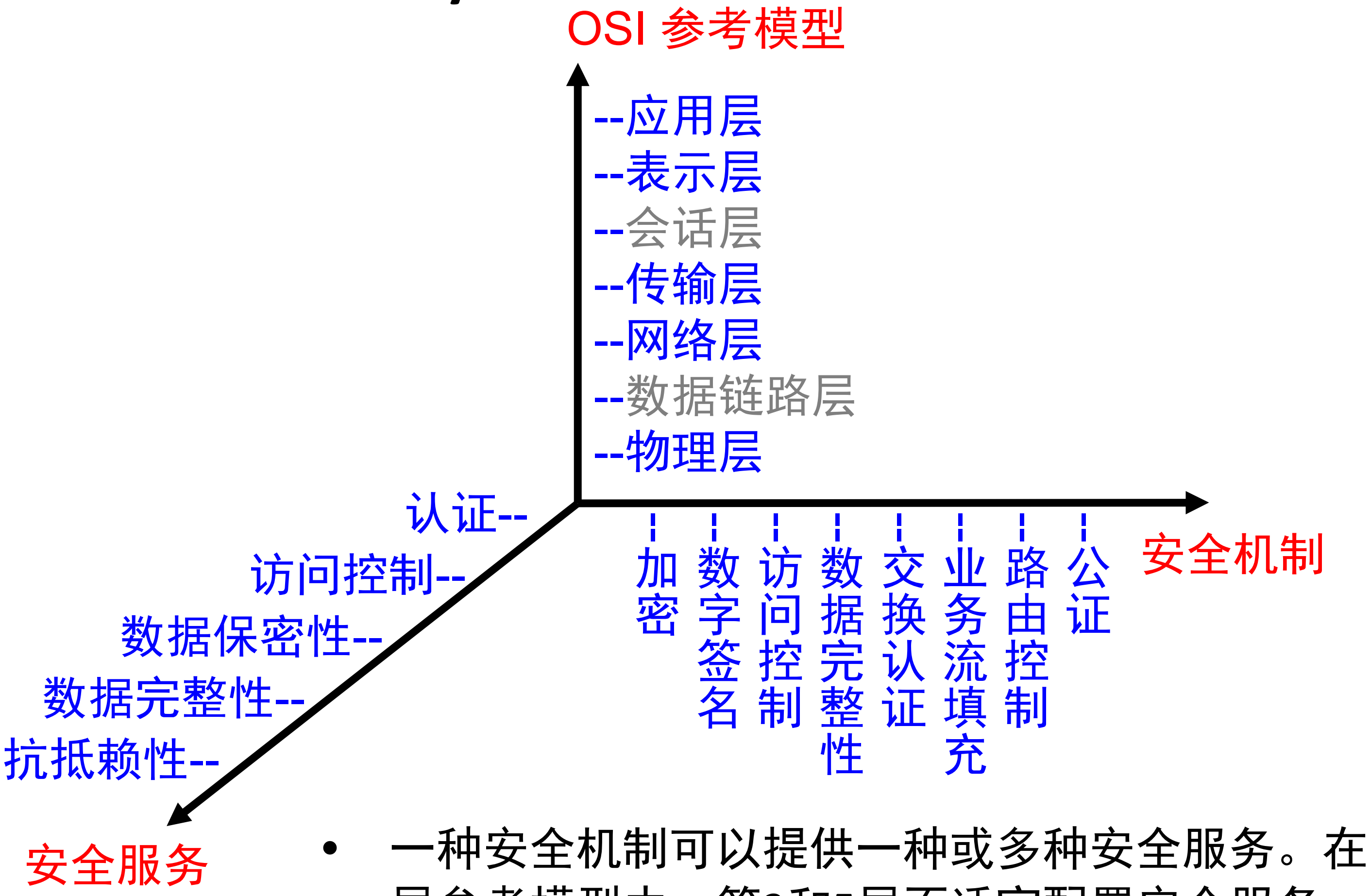
❑ 信息保障技术框架 IATF

- IATF 小结
  - ✧ IATF 提出了三个主要核心要素：人、技术和操作。尽管 IATF 重点讨论的是技术因素，但是它也提出了“人”这一要素的重要性。人即管理，安全管理在信息安全保障体系建设中同样起到十分关键的作用。
  - ✧ 尽管 IATF 强调了人的核心因素，但整个体系的阐述还是侧重于技术，很少涉及安全管理的内容。IATF 的主要贡献在于指出了设计、构建和实施信息安全解决方案的一个技术框架：信息安全体系建设与服务过程，为我们概括了信息安全应该关注的领域和范围、途径和方法，以及可选的技术性措施。
  - ✧ 注意到 IATF 并没有明确给出信息安全最终的表现形态，这和 PDR 等模型有很大区别。

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

- ❑ **ISO 7498-2:1989 Security Architecture**



- 一种安全机制可以提供一种或多种安全服务。在7层参考模型中，第2和5层不适宜配置安全服务。

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ ISO 7498

- ISO 7498，即 OSI RM，是 ISO 为解决异构计算机互联而制定的开放式计算机网络层次结构参考模型，其最大贡献是明确区分了服务、接口和协议三个概念。
  - ✧ 服务说明某一层提供的功能；
  - ✧ 接口说明如何使用下一层的服务；
  - ✧ 协议涉及如何实现该层的服务。
- 各层使用的协议没有限制，只要保持向上提供的服务和层间接口不变。服务完成的细节封装在层内，各层之间具有很强的独立性。
- OSI RM 出现在它的协议栈之前，不依赖于任何具体协议，适合用来描述一般的网络。 OSI RM 只是规定了网络的层次划分，以及每一层上实现的功能，并未规定服务和协议，因此不是一个网络体系结构。ISO 为每一层制定的技术标准不属于 OSI RM 的组成部分。

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ **ISO 7498**

- ISO 7498 系列
  - ISO 7498-1 基本模型
  - ISO 7498-2 安全体系结构 (GB/T 9387.2-1995)
  - ISO 7498-3 命名和寻址
  - ISO 7498-4 管理框架

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ ISO 7498-2

- ISO 7498-2 is intended to serve as a security-specific addition to ISO 7498, the OSI Reference Model.
  - It defines many security-related terms and ideas which are of importance to a variety of application areas, including many not covered by the OSI model. Of particular importance is the terminology it introduces for the description of security services and mechanisms.
    - provides standard definitions of security terminology
    - provides standard descriptions for security services and mechanisms
    - defines where in OSI reference model security services may be provided
    - introduces security management concepts

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Security Life-Cycle

- The underlying model, implicit to the discussion in ISO 7498-2, is that there is a generic ***security life-cycle***, containing the following steps:
  - ✧ definition of a security policy, containing a rather abstract series of security requirements for the system
  - ✧ a security requirements analysis, including a risk analysis, possibly using a tool such as CRAMM (CCTA Risk Analysis and Management Method), and an analysis of governmental, legal and standards requirements
    - ◌ CCTA: British Central Computer and Telecommunications Agency, 现属英国商务部 Office of Government Commerce
  - ✧ definition of the security services necessary to meet the identified security requirements
  - ✧ system design and implementation, including selection of security mechanisms to provide the chosen security services
  - ✧ On-going security management (持续的安全管理).

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Threats, Services and Mechanisms

- A security *threat* is a possible means by which a security policy may be breached.
  - ✧ 一个安全威胁是一种可能的手段，它可以破坏某种安全策略。
  - ✧ e.g. loss of integrity or confidentiality
- A security *service* is a measure which can be put in place to address a threat.
  - ✧ 一个安全服务是一种措施，它被设置用于处理某种安全威胁。
  - ✧ e.g. provision of confidentiality (提供数据保密性)
- A security *mechanism* is a means to provide a security service.
  - ✧ 安全机制是实现某种安全服务的技术手段。
  - ✧ e.g. encryption, digital signature

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Threats, Services and Mechanisms

- Note.
  - A security service is provided for a system, and a security mechanism is the means by which a security service is provided.
  - Hence ***confidentiality*** is a service, whereas ***encryption*** is a mechanism which can be used to provide confidentiality.
    - In fact encryption can be used to provide other services, and data confidentiality can also be provided by means other than encryption (e.g. by physical protection of data).

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Security Domains and Security Policies

- When designing a secure system, the ***scope*** of the system and the ***set of rules*** governing the security behavior of the system are of fundamental importance; these are the *security domain* (安全域) and the *security policy* (安全策略) respectively.
- A security policy is defined in ISO 7498-2 as “the set of criteria for the provision of security services” (提供安全服务的一些准则的集合).
- A security domain can be regarded as the scope of a single security policy.
- It is possible to have nested or overlapping security domains, and thus nested or overlapping scopes for security policies.

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Security Domains and Security Policies

- ISO 7498-2 gives the following statement as an example of a possible generic security policy statement regarding ***authorization***:
  - ✧ Information may not be given to, accessed by, or permitted to be inferred by, nor may any resource be used by, those not appropriately authorized.
- An initial generic policy of this type can then be refined, in conjunction with the results of a requirements analysis, into a detailed set of rules governing the operation and management of the system.
- This generic policy only deals with preventing unauthorized access, i.e. it does not make any statement about guaranteeing access to legitimate users. Thus it does not deal with *Availability*, and hence does not address denial of service threats.

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Types of Security Policies

- ISO 7498-2 distinguishes between two types of security policy.
  - ✧ *Identity-based policies* authorize system access on the basis of the identity of the client and the identity of the resource which the client wishes to make use of.
  - ✧ *Rule-based policies* rely on global rules imposed on all users, with access decisions typically made using a comparison of the sensitivity of the resources with the user attributes (e.g. the ‘clearance’ of the user).

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Threat, vulnerability and risk analysis

- A *threat* is a person, thing, event, or idea which poses some danger to an asset, in terms of that asset’s *Confidentiality*, *Integrity*, *Availability* or *Legitimate use* (CIA+). An *attack* is an actual realization of a threat.
- *Safeguards* (安全措施) are measures to protect assets against threats, including: physical controls, mechanisms, policies and procedures.
- *Vulnerabilities* (脆弱性) are weaknesses in a safeguard, or the absence of a safeguard.
- *Risk* is a measure of the cost of vulnerability, which takes into account the probability of a successful attack. The risk is *high* if the value of a vulnerable asset is high and the probability of a successful attack is also high.
- *Risk analysis* can provide a quantitative means of determining whether expenditure on safeguards is warranted. 风险分析提供一种量化手段，用于确认在安全措施上的投入是否得当。

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Classification of Threats

- *Accidental* (偶发的)
  - e.g. a secret message being sent to the wrong address
- *Deliberate* (蓄意的)
  - e.g. hacker penetration
  - Deliberate threats can be further sub-divided into *passive* or *active*.
    - *Passive threats* involve monitoring but not alteration of information, e.g. wire-tapping.
    - *Active threats* involve deliberate alteration of information, e.g. changing the value of a financial transaction.
  - In general passive threats are easier to mount than active ones.

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Fundamental Threats

- There is no universally agreed way to identify or classify security threats. Or we can identify four *fundamental threats*, which directly relate to the four ‘standard’ security goals of ‘CIA’ together with the goal of Legitimate use (i.e. ensuring that resources are not used by unauthorized persons or in unauthorized ways).
  - ✧ *Information leakage*. Information is disclosed or revealed to unauthorized parties. (信息泄露)
  - ✧ *Integrity violation*. Data consistency is compromised. (破坏完整性)
  - ✧ *Denial of service*. Legitimate access to resources (e.g. information or processing power) is deliberately impeded. (拒绝服务)
  - ✧ *Illegitimate use*. A resource is used by an unauthorized person or in an unauthorized way. (非法使用)

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ Primary Enabling Threats

- The following five *primary enabling threats* are significant because a realization of any of these threats can lead directly to a realization of one of the four fundamental threats. They can be sub-divided into three *penetration* and two *planting* threats
- The Three Penetration Threats (渗透)
  - *Masquerade*, where an entity pretends to be a different entity. (假冒)
  - *Bypassing controls*, where an attacker exploits system flaws or security weaknesses, in order to acquire unauthorized rights. (回避控制)
  - *Authorized violation*, where an entity authorized to use a system for one purpose uses it for another, unauthorized purpose. (违反授权)

4. OSI Security Architecture

A. ISO 7498-2:1989/OSI Security Architecture

❑ **Primary Enabling Threats**

- The Two Planting Threats (植入)
  - ✧ *Trojan horse*, where software contains an invisible part which, when executed, compromises the security of the system. (特洛伊木马)
  - ✧ *Trapdoor*, which is a feature built into a system such that the provision of specific input data allows the security policy to be violated. (陷门)

4. OSI Security Architecture

B. OSI Security Services

❑ Categories of Safeguard

- There are several categories of safeguard of communications security.
- Other categories of safeguards than communications include:
  - *Computer security*
    - e.g. operating system and database system security facilities.
  - *Physical security*
    - e.g. locks or other physical controls, equipment tamper-proofing.
  - *Personnel security*
    - e.g. employee screening (审查) for sensitive posts, security training and awareness.
  - *Administrative security*
    - e.g. controlling the importation of software, procedures for investigating security breaches, audit trail analysis.

4. OSI Security Architecture

B. OSI Security Services

❑ Categories of Safeguard

- Other categories of safeguards than communications include:
  - ✧ *Media security* (介质安全)
    - ○ e.g. protecting stored data, secure destruction of computer storage media, media scanning for viruses.
  - ✧ *Emanations security* (电磁安全)
    - ○ e.g. radio frequency emanation controls (TEMPEST protection.
      - TEMPEST, Transient Electromagnetic Pulse Emanation Surveillance Technology. 电磁脉冲瞬态发射 (辐射) 特性监视技术
  - ✧ *Life cycle controls*
    - ○ e.g. trusted system design, implementation, evaluation and certification, programming standards and controls, documentation controls.

4. OSI Security Architecture

B. OSI Security Services

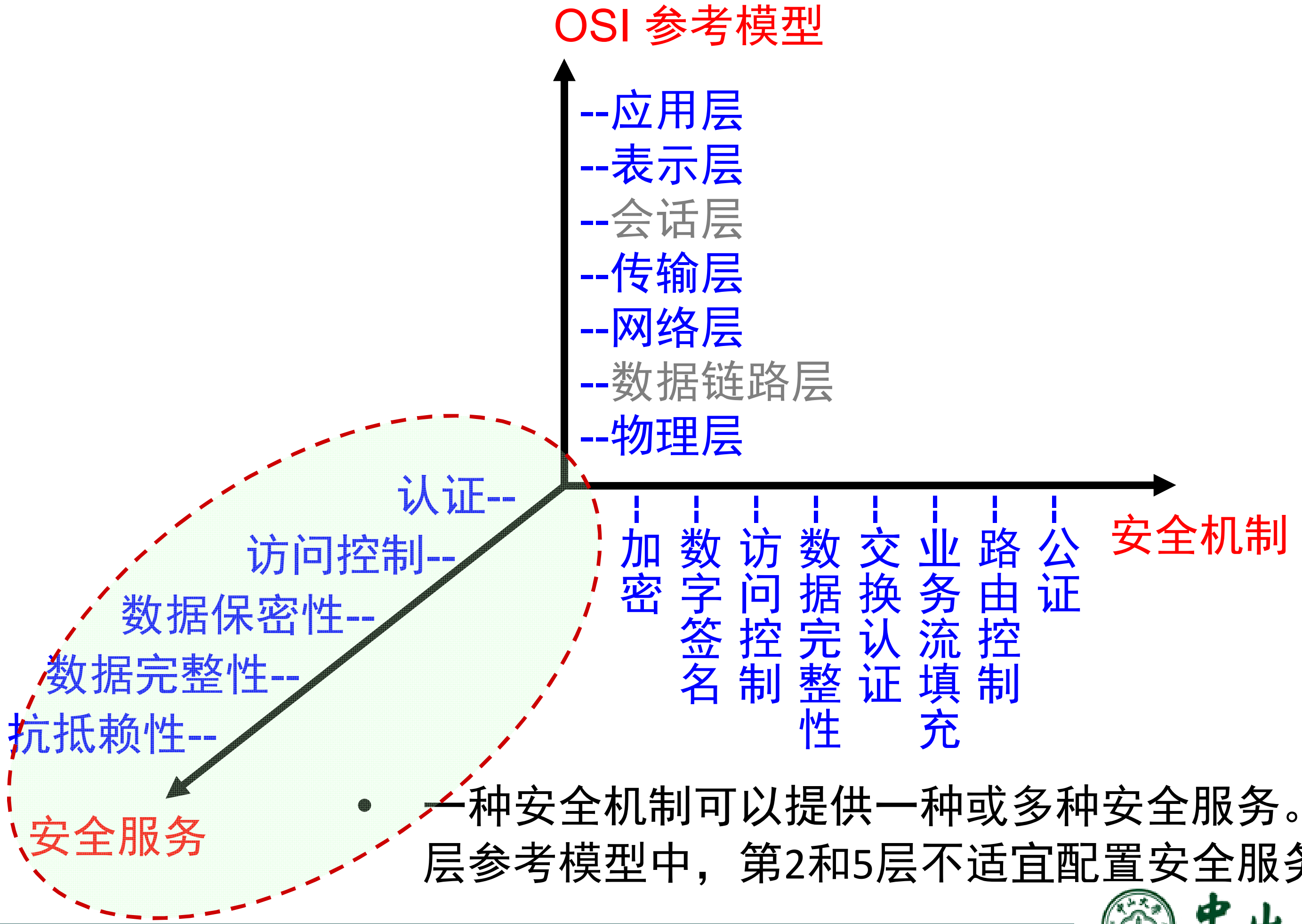
❑ Categories of Security Service

- Five main categories of security service
  - *Authentication*
    - including entity authentication and origin authentication
  - *Access control*
  - *Data confidentiality*
  - *Data integrity*
  - *Non-repudiation*
- ISO/IEC 10181
  - ISO/IEC 10181 (1988-2000) gives specific *Security framework* standards corresponding to each of these five categories of service, a much more detailed discussion of the general ways in which these services can be provided.
  - One additional topic covered in the frameworks is *security audit*.

4. OSI Security Architecture

B. OSI Security Services

❑ Categories of Security Service



- 一种安全机制可以提供一种或多种安全服务。在7层参考模型中，第2和5层不适宜配置安全服务。

4. OSI Security Architecture

B. OSI Security Services

❑ Authentication

- Two types of *Authentication* services
  - ✧ *Entity authentication* provides corroboration (证据) to one entity that another entity is as claimed.
    - This service may be used at the establishment of (or during) a connection, to confirm the identities of one or more of the connected entities.
    - This service provides confidence, *at the time of usage only*, that an entity is not attempting a masquerade or an unauthorized replay of a previous connection.
  - ✧ *Origin authentication* provides corroboration to an entity that the source of received data is as claimed.
    - However, the service does *not*, in itself, provide protection against duplication or modification of data units.

4. OSI Security Architecture

B. OSI Security Services

❑ Access Control

- *Access Control* service provides protection against unauthorized use of resources, including:
  - ✧ use of a communications resource,
  - ✧ reading, writing or deletion of an information resource,
  - ✧ execution of a processing resource.

4. OSI Security Architecture

B. OSI Security Services

❑ Data Confidentiality

- Four types of *Data Confidentiality* services provide for the protection of data against unauthorized disclosure.
  - ✧ *Connection confidentiality* for the confidentiality of all user data transferred using a connection.
  - ✧ *Connectionless confidentiality* for the confidentiality of all user data transferred in a single connectionless data unit (i.e. a packet).
  - ✧ *Selective field confidentiality* (特定数据字段保密) for the confidentiality of selected fields within user data transferred in either a connection or a single connectionless data unit.
  - ✧ *Traffic flow confidentiality* for the confidentiality of information which might be derived from observation of traffic flows.

4. OSI Security Architecture

B. OSI Security Services

❑ Data Confidentiality

- Note:
  - *Connection communication*
    - Connection-oriented communication is a network communication mode in telecommunications and computer networking, where a communication session or a semi-permanent connection is established before any useful data can be transferred, and where a stream of data is delivered in the same order as it was sent.
    - DL Layer: HDLC, PPP;
    - Network Layer: X.25;
    - Trans. Layer: TCP.

4. OSI Security Architecture

B. OSI Security Services

❑ Data Confidentiality

- Note:
  - *Connectionless communication*
    - CL-mode communication is a data transmission method used in packet switching by which each data unit is individually addressed and routed based on information carried in each unit, rather than in the setup information of a prearranged, fixed data channel as in connection-oriented communication.
    - DL Layer: 802.3 CSMA/CD;
    - Network Layer: IP;
    - Trans. Layer: UDP.

4. OSI Security Architecture

B. OSI Security Services

❑ **Data Integrity**

- Five types of *Data Integrity* services that counter active threats to the validity of transferred data:
  - ✧ *Connection integrity with recovery* for the integrity of all user data on a connection, and detects any modification, insertion, deletion or replay of data within an entire data unit sequence (with recovery attempted).
  - ✧ *Connection integrity without recovery* as previously but with no recovery attempted.
  - ✧ *Selective field connection integrity* for the integrity of selected fields within the user data of a data unit transferred over a connection.

4. OSI Security Architecture

B. OSI Security Services

❑ Data Integrity

- Five types of *Data Integrity* services:
  - ✧ *Connectionless integrity* providing integrity assurance to the recipient of a data unit. More specifically, it enables the recipient of a connectionless data unit to determine whether that data unit has been modified. Additionally, a limited form of replay detection may be provided.
  - ✧ *Selective field connectionless integrity* for the integrity of selective fields within a single connectionless data unit.

4. OSI Security Architecture

B. OSI Security Services

❑ Non-repudiation

- Two types of *Non-repudiation* services:
  - ✧ *Non-repudiation with proof of origin*. The recipient of data is provided with proof of the origin of data. This will protect against any subsequent attempt by the sender to falsely deny sending the data.
  - ✧ *Non-repudiation with proof of delivery*. The sender of data is provided with proof of delivery of data. This will protect against any subsequent attempt by the recipient to falsely deny receiving the data.

4. OSI Security Architecture

B. OSI Security Services

❑ Services vs. Layers

- ISO 7498-2 lays down which security services may be provided in what parts of the OSI model.
  - Layers 1 and 2 are restricted to providing certain types of confidentiality services.
  - Layers 3 and 4 can provide authentication, access control, confidentiality (Layer 3 only) and integrity services.
  - No security services can be provided in Layer 5 or Layer 6, although Layer 6 may contain facilities to support the provision of services at Layer 7.
  - All security services may be provided at Layer 7.

4. OSI Security Architecture

B. OSI Security Services

❑ Services vs. Layers

- Note:
  - ✧ There are good reasons for varying the position of security functionality within the OSI layer hierarchy depending on the type of network in use. For the maximum degree of traffic flow confidentiality, data encryption needs to be placed at the lowest possible layer (to hide the protocol addresses). Low level placement also offers common security support for all the different applications running across the network. If end-to-end security is required, then the security services must be placed in Layer 3 or above. If application-specific security services are required, then the security must be placed in Layer 7.

4. OSI Security Architecture

Service/Layer	Layer1	Layer2	Layer3	Layer4	Layer5/6	Layer7
Entity Authentication	○	○	✓	✓	○	✓
Origin Authentication	○	○	✓	✓	○	✓
Access Control	○	○	✓	✓	○	✓
Connection Confidentiality	✓	✓	✓	✓	○	✓
Connectionless Confidentiality	○	✓	✓	✓	○	✓
Selective Field Confidentiality	○	○	○	○	○	✓
Traffic Flow Confidentiality	✓	○	✓	○	○	✓
Connection Integrity with Recovery	○	○	○	✓	○	✓
Connection Integrity without Recovery	○	○	✓	✓	○	✓
Selective Field Connection Integrity	○	○	○	○	○	✓
Connectionless Integrity	○	○	✓	✓	○	✓
Selective Field Connectionless Integrity	○	○	○	○	○	✓
Non-repudiation of Origin	○	○	○	○	○	✓
Non-repudiation of Delivery	○	○	○	○	○	✓

4. OSI Security Architecture

C. OSI Security Mechanisms

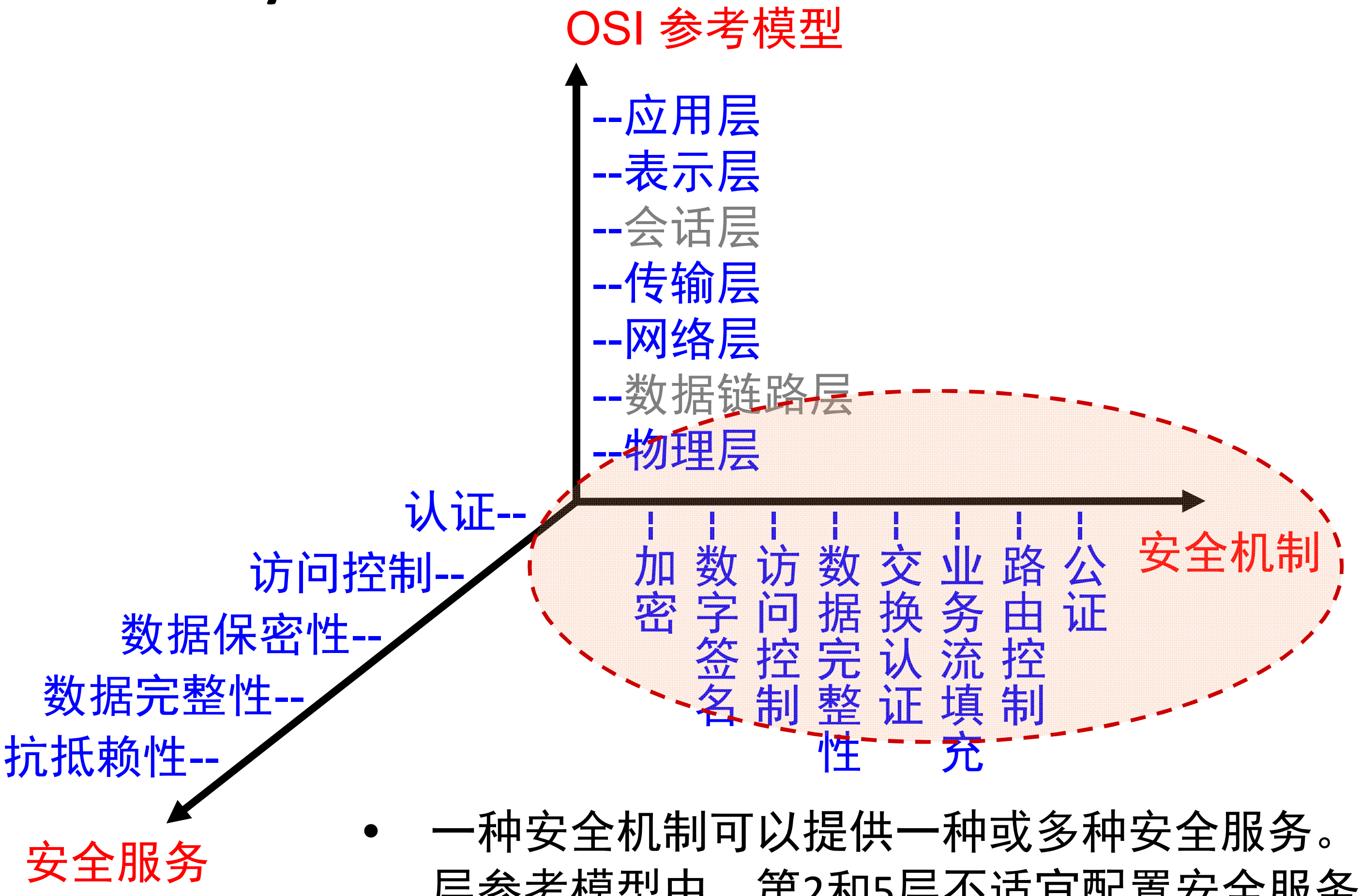
❑ Specific Security Mechanism 特定的安全机制

- Eight types of specific security mechanisms:
  - ✧ *Encryption mechanisms*
  - ✧ *Digital signature mechanisms*
  - ✧ *Access control mechanisms*
  - ✧ *Data integrity mechanisms*
  - ✧ *Authentication exchange mechanisms*
  - ✧ *Traffic padding mechanisms*
  - ✧ *Routing control mechanisms*
  - ✧ *Notarization mechanisms* (公证)
- ISO/IEC JTC 1/SC 27
  - ✧ Specific standards have been developed within ISO/IEC JTC 1/SC 27 (ISO 信息安全分技术委员会) to provide examples of most of these different classes of mechanism.

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ Specific Security Mechanism



- 一种安全机制可以提供一种或多种安全服务。在7层参考模型中，第2和5层不适宜配置安全服务。

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ Specific Security Mechanism

- *Encryption*
  - ✧ Commonly known as encryption or cipher algorithms.
  - ✧ Can provide data and traffic flow confidentiality.
  - ✧ Also provide the basis for some authentication and key management techniques.
- *Digital Signature*
  - ✧ Including signing procedure (private),
  - ✧ And verification procedure (public).
  - ✧ Can provide non-repudiation, origin authentication and data integrity services.
  - ✧ They can be basis of some authentication exchange mechanisms.

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ Specific Security Mechanism

- *Access Control*
  - A server using client information to decide whether to grant access to resources.
    - e.g. access control lists, capabilities, security labels.
- *Data Integrity*
  - Protection against modification of data.
    - Provide data integrity and origin authentication services. Also basis of some authentication exchange mechanisms.
- *Authentication Exchange*
  - Provide entity authentication service.
  - They can be thought of as a means for using information associated with a client entity and a server entity to decide whether access to the server's resource is granted to the client.

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ Specific Security Mechanism

- *Traffic Padding* (流量填充机制)
  - ✧ The addition of ‘pretend’ data to conceal real volumes of data traffic.
  - ✧ Provides traffic flow confidentiality.
- *Routing Control*
  - ✧ Used to prevent sensitive data using insecure channels.
    - ◌ e.g. route might be chosen to use only physically secure network components.
- *Notarization* (公证机制)
  - ✧ Integrity, origin and/or destination of data can be guaranteed by using a third party trusted notary.
  - ✧ Notary typically applies a cryptographic transformation to the data.

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ **Pervasive Security Mechanism 普适的安全机制**

- Five types of *Pervasive Security* mechanism are listed in ISO 7498-2:
  - ✧ *Trusted functionality*
  - ✧ *Security labels*
  - ✧ *Event detection*
  - ✧ *Security audit trail*
  - ✧ *Security recovery*

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ **Pervasive Security Mechanism**

- *Trusted functionality* (可信赖性)
  - ✧ Any functionality providing or accessing security mechanisms should be trustworthy (值得信赖).
  - ✧ May involve combination of software and hardware.
- *Security Labels* (安全标签)
  - ✧ Any resource (e.g. stored data, processing power, communications bandwidth) may have security label associated with it to indicate security sensitivity.
  - ✧ Similarly labels may be associated with users. Labels may need to be securely bound to transferred data.

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ Pervasive Security Mechanism

- *Event Detection*
  - ✧ Includes detection of
    - ○ attempted security violations (and whether they succeeded).
    - ○ legitimate security-related activity.
  - ✧ Can be used to trigger event reporting (alarms), event logging, automated recovery.
- *Security Audit Trail*
  - ✧ Log of past security-related events.
  - ✧ Permits detection and investigation of past security breaches.
- *Security Recovery*
  - ✧ Includes mechanisms to handle requests to recover from security failures.
  - ✧ May include immediate abort of operations, temporary invalidation of an entity, addition of entity to a blacklist.

4. OSI Security Architecture

C. OSI Security Mechanisms

❑ Services vs. Mechanisms

- ISO 7498-2 indicates which mechanisms can be used to provide which services.
  - It is illustrative and NOT definitive.
- Obvious omissions include:
  - The possible use of data integrity mechanisms to help provide peer entity authentication and data origin authentication services.
  - The possible use of encryption to help provide non-repudiation service (as part of notarization).

4. OSI Security Architecture

Service/Mechanism	Encryption	Digital Signature	Access Control	Data Integrity
Entity Authentication	✓	✓	○	●
Origin Authentication	✓	✓	○	●
Access Control	○	○	✓	○
Connection Confidentiality	✓	○	○	○
Connectionless Confidentiality	✓	○	○	○
Selective Field Confidentiality	✓	○	○	○
Traffic Flow Confidentiality	✓	○	○	○
Connection Integrity with Recovery	✓	○	○	✓
Connection Integrity without Recovery	✓	○	○	✓
Selective Field Connection Integrity	✓	○	○	✓
Connectionless Integrity	✓	✓	○	✓
Selective Field Connectionless Integrity	✓	✓	○	✓
Non-repudiation of Origin	●	✓	○	✓
Non-repudiation of Delivery	●	✓	○	✓

4. OSI Security Architecture

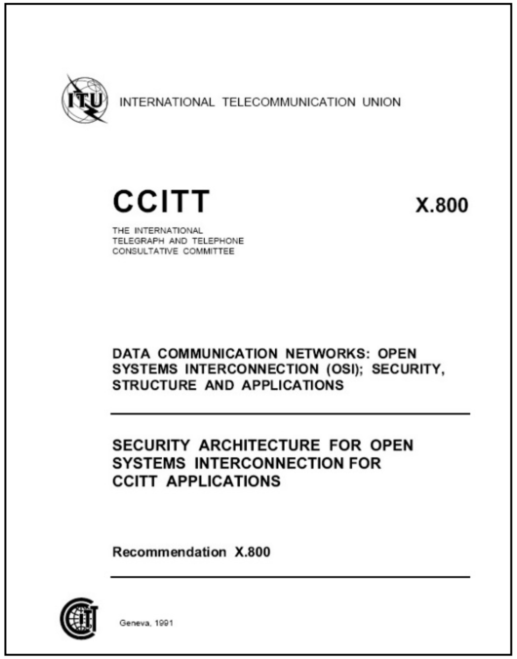
Service/Mechanism	Authorization Exchange	Traffic Padding	Routing Control	Notarization
Entity Authentication	✓	○	○	○
Origin Authentication	○	○	○	○
Access Control	○	○	○	○
Connection Confidentiality	○	○	✓	○
Connectionless Confidentiality	○	○	✓	○
Selective Field Confidentiality	○	○	○	○
Traffic Flow Confidentiality	○	✓	✓	○
Connection Integrity with Recovery	○	○	○	○
Connection Integrity without Recovery	○	○	○	○
Selective Field Connection Integrity	○	○	○	○
Connectionless Integrity	○	○	○	○
Selective Field Connectionless Integrity	○	○	○	○
Non-repudiation of Origin	○	○	○	✓
Non-repudiation of Delivery	○	○	○	✓

5. ITU-T X.800 and Others

A. X.800

❑ OSI Security Architecture

- ITU-T X.800 “Security Architecture for OSI” (1991-1996)
  - ✧ defines a systematic way of defining and providing security requirements.
  - ✧ provides a useful, if abstract, overview of concepts we will study.



INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

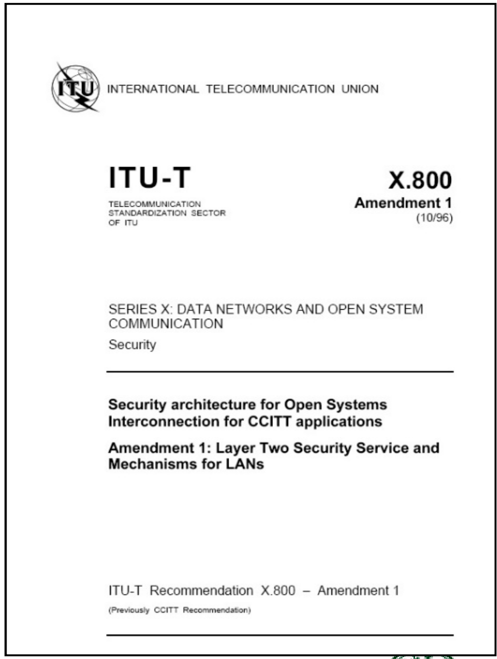
X.800

DATA COMMUNICATION NETWORKS: OPEN SYSTEMS INTERCONNECTION (OSI); SECURITY, STRUCTURE AND APPLICATIONS

SECURITY ARCHITECTURE FOR OPEN SYSTEMS INTERCONNECTION FOR CCITT APPLICATIONS

Recommendation X.800

Geneva, 1991



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.800
Amendment 1
(10/96)

SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Security

Security architecture for Open Systems Interconnection for CCITT applications

Amendment 1: Layer Two Security Service and Mechanisms for LANs

ITU-T Recommendation X.800 – Amendment 1

(Previously CCITT Recommendation)

5. ITU-T X.800 and Others

A. X.800

❑ OSI Security Architecture

- Series X: Data Networks and Open System Communication
  - ✧ **X.800** Security architecture for Open Systems Interconnection for CCITT applications
  - ✧ **X.802** Information technology - Lower layers security model
  - ✧ **X.803** Information technology - Open Systems Interconnection - Upper layers security model
  - ✧ **X.805** Security architecture for systems providing end-to-end communications

- International Telephone and Telegraph Consultative Committee (CCITT, from French: Comité Consultatif International Téléphonique et Télégraphique 国际电话与电报顾问委员会) was created in 1956, and was renamed ITU-T (The ITU Telecommunication Standardization Sector) in 1993.

5. ITU-T X.800 and Others

A. X.800

❑ OSI Security Architecture

- Series X: Data Networks and Open System Communication
  - Information technology - Open Systems Interconnection - Security frameworks for open systems
    - **X.810** Overview
    - **X.811** Authentication framework
    - **X.812** Access control framework
    - **X.813** Non-repudiation framework
    - **X.814** Confidentiality framework
    - **X.815** Integrity framework
    - **X.816** Security audit and alarms framework

5. ITU-T X.800 and Others

A. X.800

❑ OSI Security Architecture

- Series X: Data Networks and Open System Communication
  - Information technology - Open Systems Interconnection - Generic upper layers security:
    - **X.830** Overview, models and notation
    - **X.831** Security Exchange Service Element (SESE) service definition
    - **X.832** Security Exchange Service Element (SESE) protocol specification
    - **X.833** Protecting transfer syntax specification
    - **X.834** Security Exchange Service Element (SESE) Protocol Implementation Conformance Statement (PICS) proforma
    - **X.835** Protecting transfer syntax Protocol Implementation Conformance Statement (PICS) proforma

5. ITU-T X.800 and Others

A. X.800

❑ OSI Security Architecture

- Series X: Data Networks and Open System Communication
  - Information technology - Security techniques
    - **X.841** Security information objects for access control
    - **X.842** Guidelines for the use and management of trusted third party services
    - **X.843** Specification of TTP (Trusted Third Party) services to support the application of digital signatures

- Ref. to ITU-T
  Data networks, open system communications and security:
  http://www.itu.int/rec/T-REC-X/en

5. ITU-T X.800 and Others

A. X.800

❑ Security Service

- To enhance security of data processing systems and information transfers of an organization.
- Intended to counter (对抗) security attacks.
- Using one or more security mechanisms.
- Often replicates functions normally associated with physical documents
  - ✧ which, for example, have signatures, dates; need protection from disclosure, tampering, or destruction; be notarized or witnessed; be recorded or licensed.
  - ✧ 通常用于重现一些与物理文档有关的属性，例如拥有签名和日期；防止泄露、窜改或毁坏；可用于公证或取证；可记录或授权。

5. ITU-T X.800 and Others

A. X.800

❑ **Security Service** - X.800

- Authentication
  - ✧ assurance that communicating entity is the one claimed
  - ✧ have both peer-entity & data origin authentication.
- Access Control
  - ✧ prevention of the unauthorized use of a resource.
- Data Confidentiality
  - ✧ protection of data from unauthorized disclosure.
- Data Integrity
  - ✧ assurance that data received is as sent by an authorized entity.
- Non-repudiation
  - ✧ protection against denial by one of the parties in a communication.
- Availability
  - ✧ resource accessible/usable.

5. ITU-T X.800 and Others

A. X.800

❑ Security Mechanism

- aka **Control.**
- feature designed to detect, prevent, or recover from a security attack.
- no single mechanism that will support all services required.
- however one particular element underlies many of the security mechanisms in use: *cryptographic techniques.*

5. ITU-T X.800 and Others

A. X.800

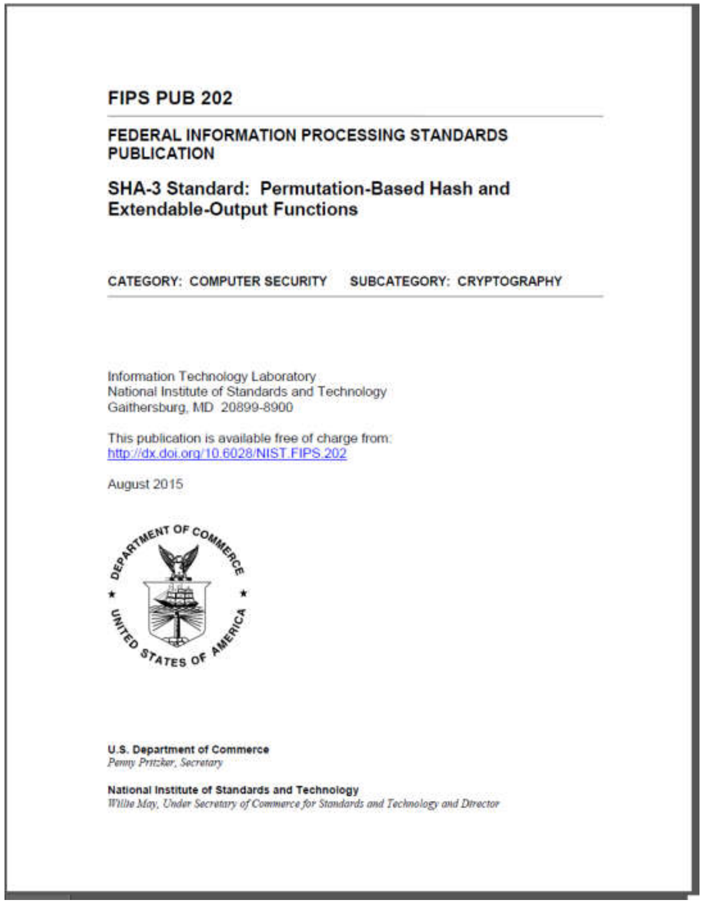
❑ **Security Mechanism -** X.800

- Specific security mechanisms
  - encipherment, digital signatures, access controls, data integrity, authentication exchange, traffic padding, routing control, notarization (公证机制).
- Pervasive (普适的) security mechanisms:
  - trusted functionality, security labels, event detection, security audit trails (追踪) , security recovery.

5. ITU-T X.800 and Others

B. Security Functional Requirements

- **Security Functional Requirements** (NIST FIPS 202)
  - Federal Information Processing Standards, NIST 2015



FIPS PUB 202

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATION

SHA-3 Standard: Permutation-Based Hash and Extendable-Output Functions

CATEGORY: COMPUTER SECURITY SUBCATEGORY: CRYPTOGRAPHY

Information Technology Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899-8900

This publication is available free of charge from:
http://dx.doi.org/10.6028/NIST.FIPS.202

August 2015

U.S. Department of Commerce
Penny Pritzker, Secretary

National Institute of Standards and Technology
Willie May, Under Secretary of Commerce for Standards and Technology and Director

5. ITU-T X.800 and Others

B. Security Functional Requirements

❑ **Security Functional Requirements** (NIST FIPS 202)

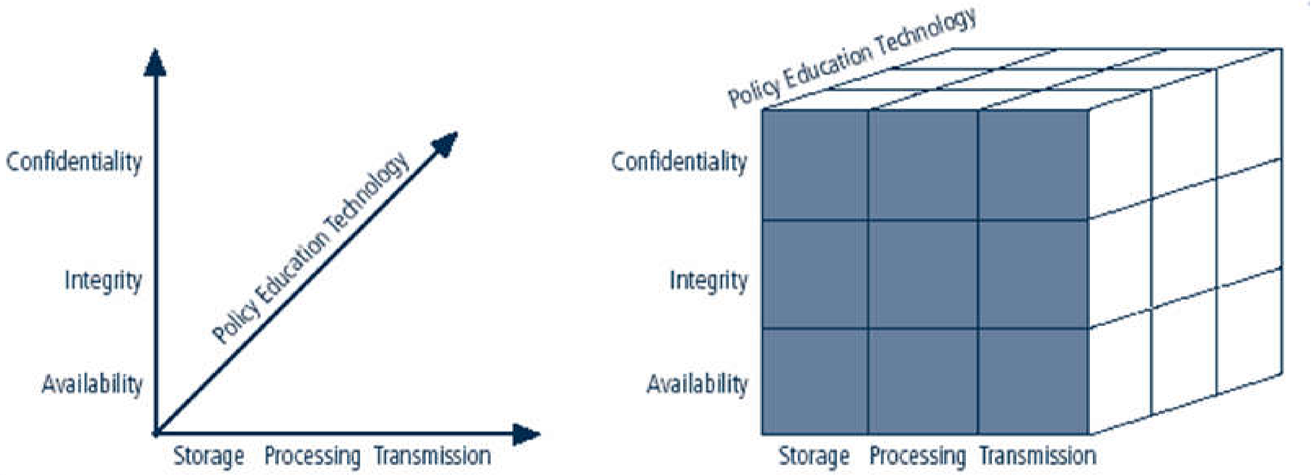
- Technical measures
  - ✧ Access control; identification & authentication; system & communication protection; system & information integrity.
- Management controls and procedures
  - ✧ Awareness & training; audit & accountability; certification, accreditation, & security assessments; contingency planning; maintenance; physical & environmental protection; planning; personnel security; risk assessment; systems & services acquisition.
- Overlapping technical and management
  - ✧ Configuration management; incident response; media protection.

- NIST, National Institute of Standards and Technology, 美国国家标准与技术研究院
- NBS (国家标准局), 1901 – NIST, 1988

5. ITU-T X.800 and Others

C. NSTISSC Security Model

❑ **NSTISSC Security Model**



- NSTISSC: National Security Telecommunications and Information Systems Security Committee 美国国家安全通信与信息系统安全委员会

6. Technology and Principles

❑ Network Security: Technology and Principles

- Cryptographic Tools
- User Authentication
- Access Control - Authentication, Authorization & Accounting
- Intrusion Detection
- DoS, Worms and Trojans
- Firewall, IDS and IPS
- UTM/SOC -Unified Threat Management/System on A Chip
- Malicious Software (恶意软件)
- Buffer Overflow
- Trusted Computing - TCM & TPM (in China)
- Trusted OS

7. Protocols and Standards

安全标准

- 安全管理框架
  - ISO/IEC 7498-2/10181, *OSI Security Architecture*
    - GB/T 9387.2-1995
  - ITU-T X.800
  - BS 7799, ISO/IEC 17799:2005, *Code of Practice for Information Security Management*
    - 1993: British Standards Institution (BSI)
    - 1995: Department of Trade and Industry, UK
    - 1995: BS 7799 Part-1 (British Standard 7799)
    - 1999: BS 7799 Part-2 ISMS, ISO/IEC 27001:2005
    - 2000: ISO/IEC 17799:2000-2005, ISO/IEC 27002:2007
  - ISO/IEC 13335, GMITS (*Guideline for the Management of IT Security*)
    - 指导性文件而非认证标准，但具备更好的可实施性。

7. Protocols and Standards

❑ 安全标准

- 安全技术标准
  - Application Protocols
    - SSL
  - Network Protocols
    - IPSec
  - Cryptography
    - RSA, DSA (*Digital Signature Algorithm*, based on discrete logarithms computation), ECC (*Elliptic Curves Cryptography*)
    - DES, AES
    - SHA-1,2,3 (FIPS 202)
    - PKCS (*The Public-Key Cryptography Standards*, RSA Security Llc.)
  - Vulnerability
    - CVE (*Common Vulnerabilities and Exposures*)

7. Protocols and Standards

❑ 安全标准

- 安全技术标准
  - Authentication
    - Kerberos (MIT Project Athena in 1980s; RFC 4120:2005)
    - RADIUS (*Remote Authentication Dial-In User Service*, 1991)
    - SAML (*Security Assertion Markup Language*, 2001-2008)
  - Messaging
    - S/MIME, OpenPGP (RFC4880), PEM (*Privacy-Enhanced Mail*, RFC 7468.)
    - XMLDSIG (*XML Digital Signatures*), XMLENC (*XML Encryption*, W3C)
  - Application Security
    - CORBA (*Common Object Request Broker Architecture*) Security
    - WS-Security (*Web Services Security*, OASIS 2004)
      - OASIS, the Organization for the Advancement of Structured Information Standards 结构化信息标准促进组织

7. Protocols and Standards

❑ 安全标准

- WS-Security
  - The WS-* architecture is a set of standards-based protocols designed to secure Web service communication. The WS-* security standards include:
    - WS-Policy. WS-Policy allows Web services to define policy requirements for endpoints. These requirements include privacy rules, encryption rules, and security tokens.
    - WS-Security. WS-Security allows Web services to apply security to Simple Object Access Protocol (SOAP) messages through encryption and integrity checks on all or part of the message.
    - WS-Trust. WS-Trust allows Web services to use security tokens to establish trust in a brokered security environment.
    - WS-SecureConversation. WS-SecureConversation builds on top of WS-Policy, WS-Security, and WS-Trust to enable secure communications between client and service.

7. Protocols and Standards

❑ 安全标准

- WS-Security
  - The WS-* architecture is a set of standards-based protocols designed to secure Web service communication. The WS-* security standards include:
    - WS-ReliableMessaging. WS-ReliableMessaging allows Web services and clients to trust that when a message is sent, it will be delivered to the intended party.
    - WS-AtomicTransactions. WS-AtomicTransactions allows transaction-based Web services in which transactions can be rolled back in the event of a failure.

7. Protocols and Standards

- 安全标准
  - 安全产品标准
    - TESEC
    - CC, ISO 15408
    - FIPS 140-2 (*Security Requirements for Cryptographic Modules*)
  - 安全工程标准
    - SSE-CMM (*System Security Engineering Capability Maturity Model*)
      - 1995-1996: SSE-CMM v1
      - 1999: SSE-CMM v2
      - 2002: ISO/IEC 21827
      - 2003: SSE-CMM v3
      - Note: Another CMM for software engineering development
        - SW-CMM (*Capability Maturity Model For Software, CMU*)

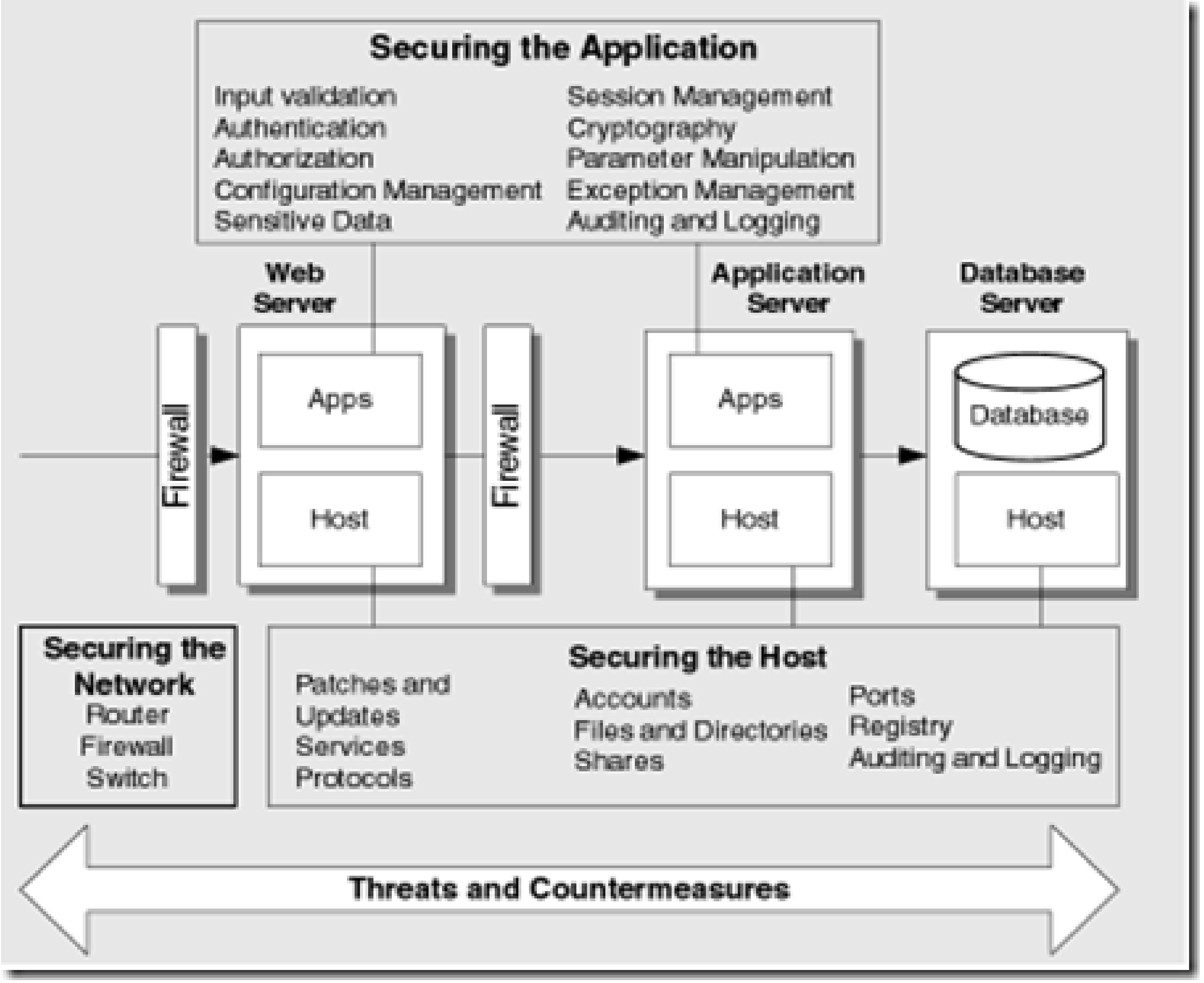
7. Protocols and Standards

❑ 安全标准

- 安全方法论
  - NIST SP 800-30 (*Risk Management Guide for IT System*)
    - NIST SP 800- Serials
  - AS/NZS 4360
  - OCTAVE (*Operationally Critical Threats, Asset and Vulnerability Evaluation*, CMU/SEI)
- 安全资格认证
  - CISSP (*Certified Information Systems Security Professional*)
    - By (ISC)2, *Information Systems Security Certifications Consortium*.
  - CISA (*Certified Information Systems Auditor*)
    - By ISACA, *Information Systems Audi and Control Association*.

8. Web Security

A. A Secure Architecture for Web Applications



8. Web Security

A. A Secure Architecture for Web Applications

❑ Securing the Application

- Input Validation
- Authentication
- Authorization
- Configuration Management
- Sensitive Data
- Session Management
- Cryptography
- Parameter Manipulation
- Exception Management
- Auditing and Logging

8. Web Security

A. A Secure Architecture for Web Applications

❑ Securing the Network

- Router
- Firewall
- Switch

8. Web Security

A. A Secure Architecture for Web Applications

❑ Securing the Host

- Patches and Updates
- Services
- Protocols
- Accounts
- Files and Directories
- Shares
- Ports
- Registry
- Auditing and logging

8. Web Security

B. Apache, IIS and Other Web Servers

❑ Apache HTTP Server

- Apache Software Foundation: Open Source on
  - Unix-Like System: UNIX, GNU, FreeBSD, Linux, Solaris
  - Novell NetWare, Amiga OS, Mac OS, Microsoft Windows
  - IBM: OS/2, TPF

❑ IIS Web Server

- Microsoft: on Windows
- Supports HTTP, HTTPS, FTP, FTPS, SMTP and NNTP

8. Web Security

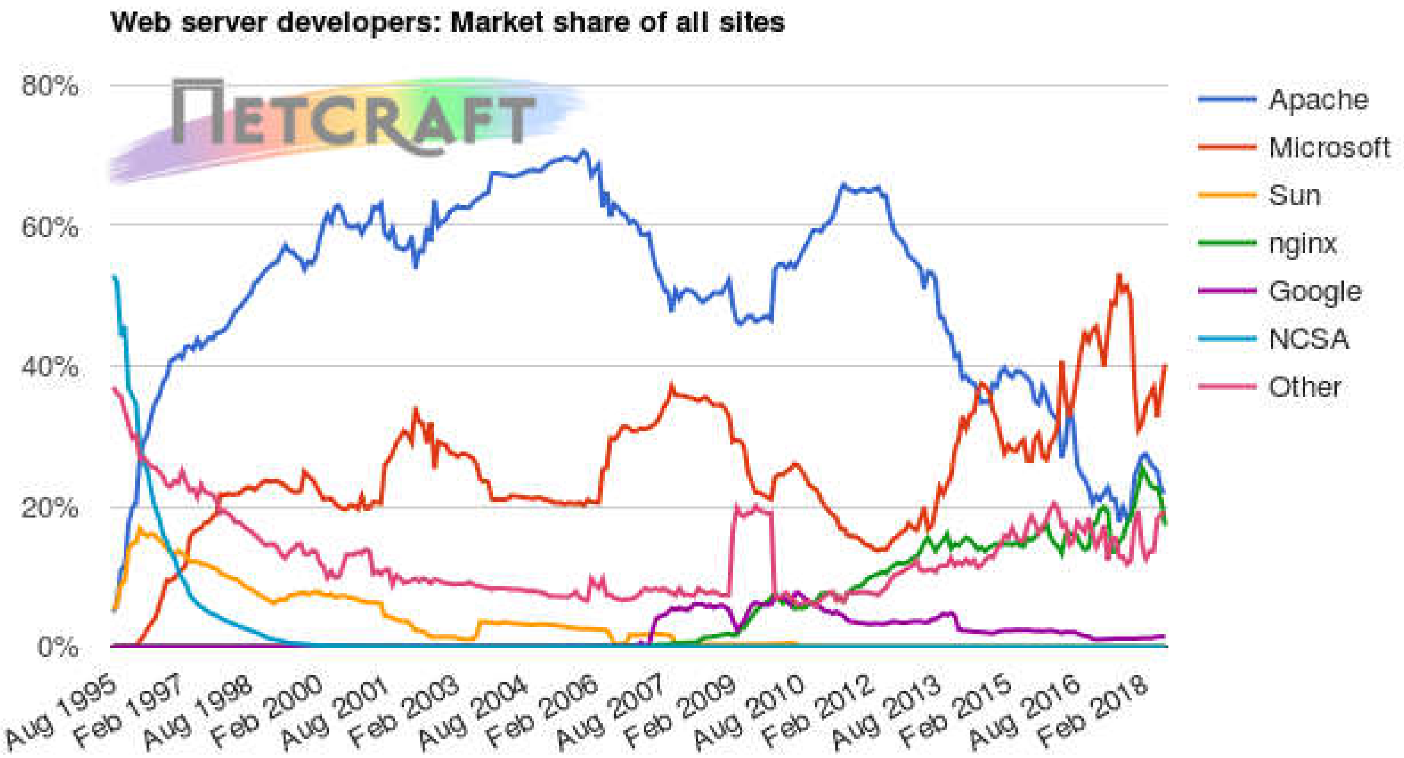
B. Apache, IIS and Other Web Servers

- ❑ **Nginx ("engine-x")**
  - ◆ Lightweight, high-performance Web server/reverse proxy and e-mail (IMAP/POP3) proxy, licensed under a BSD-like license
  - ◆ Unix, Linux, BSD variants, Mac OS X, Solaris, and Microsoft Windows
- ❑ **GWS**
  - ◆ Supported by Google.
  - ◆ Python emphasised.
- ❑ **lighttpd ("lighty")**
  - ◆ Open-source
  - ◆ For speed-critical environments

8. Web Security

B. Apache, IIS and Other Web Servers

- ❑ **Netcraft Web Server Survey 2018**



8. Web Security

B. Apache, IIS and Other Web Servers

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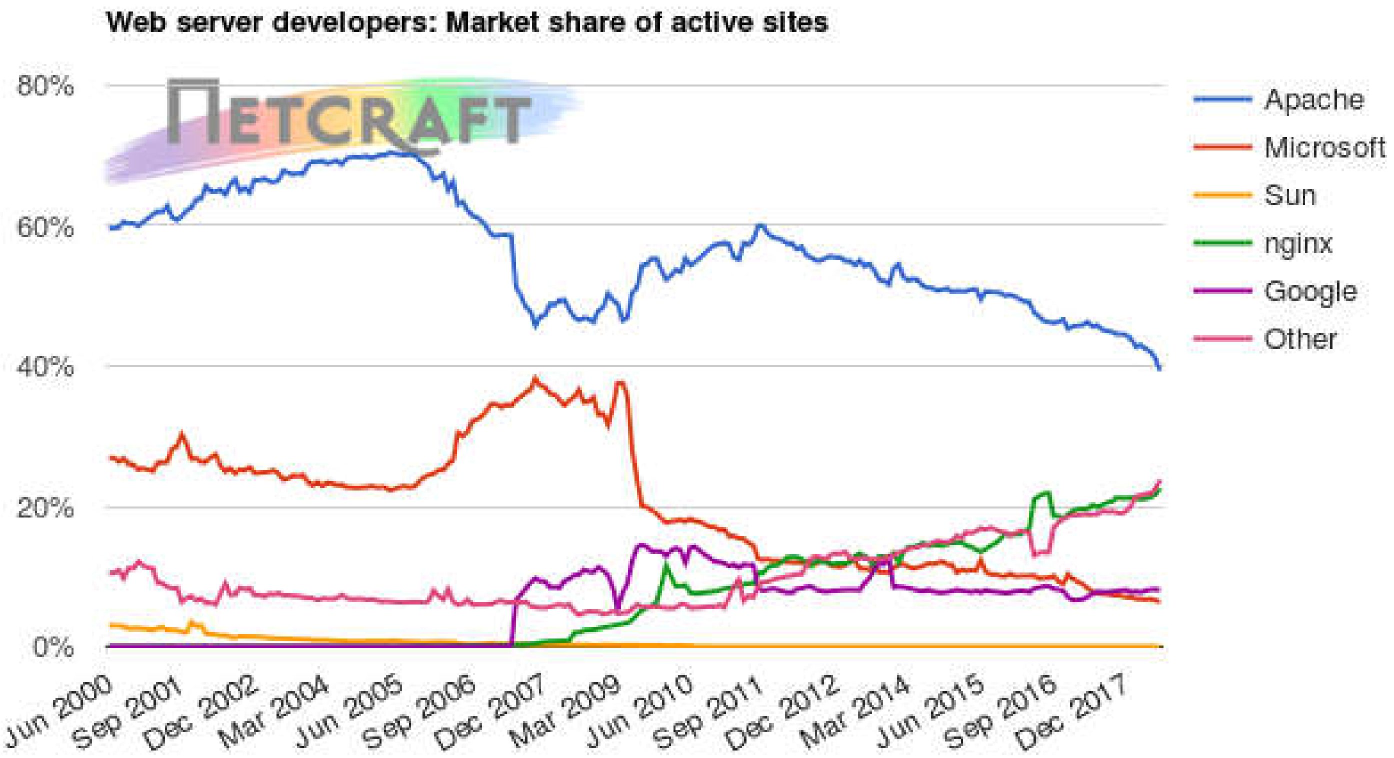

8. Web Security

B. Apache, IIS and Other Web Servers

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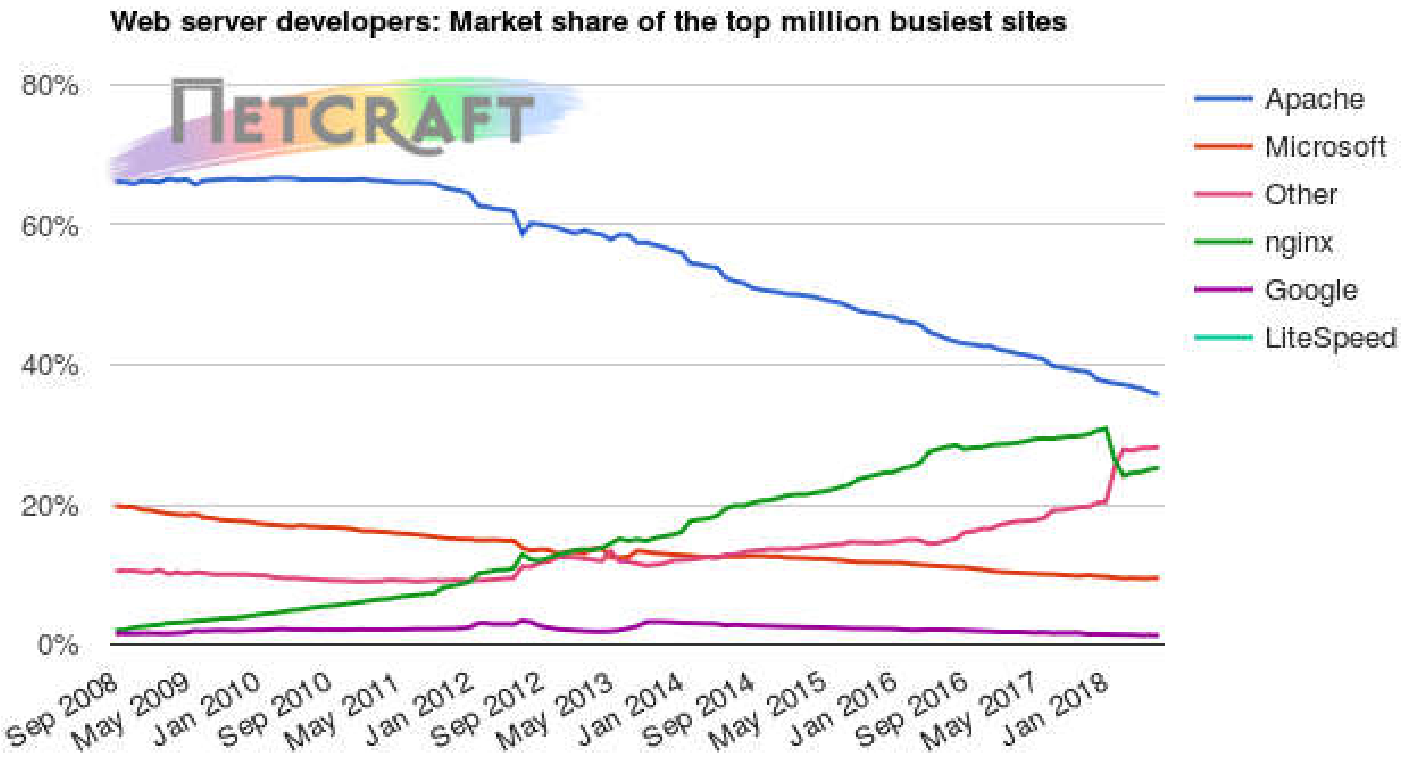
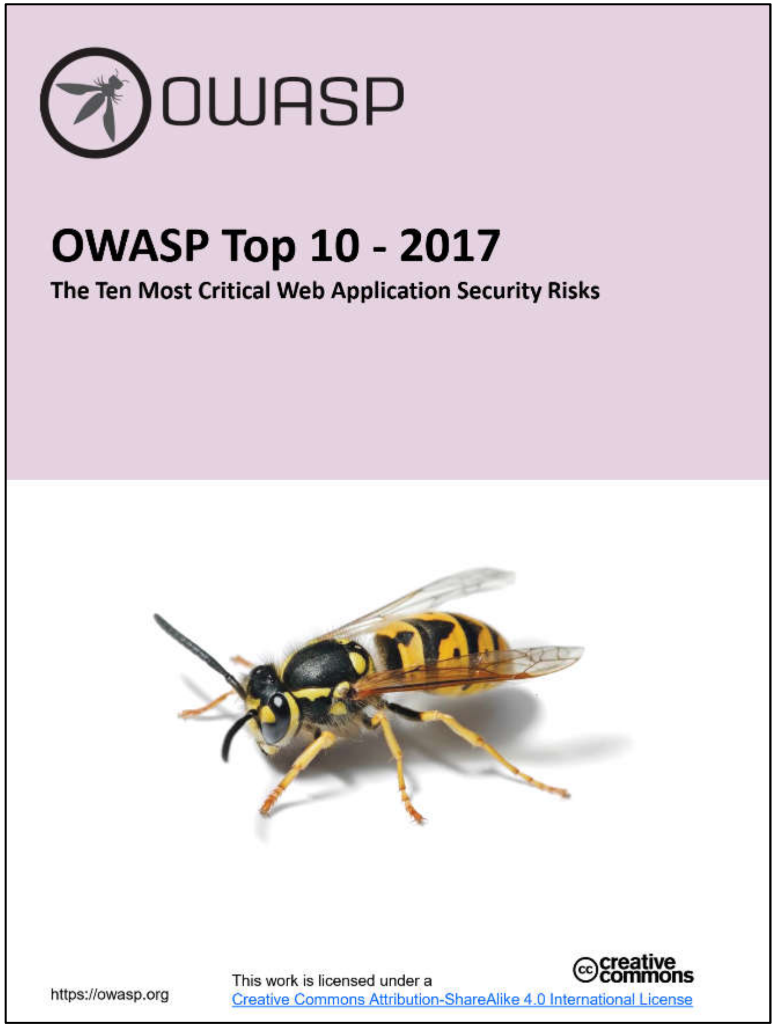


8. Web Security

C. OWASP Top 10 2017



OWASP

OWASP Top 10 - 2017

The Ten Most Critical Web Application Security Risks

https://owasp.org

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creative commons

8. Web Security

C. OWASP Top 10 2017

- ❑ **The Ten Most Critical Web Application Security Risks**
  - ◆ A1:2017-Injection 注入
  - ◆ A2:2017-Broken Authentication 失效的身份认证
  - ◆ A3:2017-Sensitive Data Exposure 敏感信息泄漏
  - ◆ A4:2017-XML External Entities (XXE) XML外部实体
  - ◆ A5:2017-Broken Access Control 失效的访问控制
  - ◆ A6:2017-Security Misconfiguration 安全配置错误
  - ◆ A7:2017-Cross-Site Scripting (XSS) 跨站脚本
  - ◆ A8:2017-Insecure Deserialization 不安全的反序列化
  - ◆ A9:2017-Using Components with Known Vulnerabilities 使用含有已知漏洞的组件
  - ◆ A10:2017-Insufficient Logging & Monitoring 不足的日志记录和监控
- ❑ Assignment 4.
  - ◆ 打印并通读 OWASP Top 10 (2017)。

8. Web Security

D. Web Services Security Frame

❑ **Microsoft – Patterns & Practices**

- Improving Web Services Security: Scenarios and Implementation Guidance for WCF (Windows Communication Foundation).
  - ✧ By *J.D. Meier, Carlos Farre, Jason Taylor, Prashant Bansode, Steve Gregersen, Madhu Sundararajan, Rob Boucher.* Microsoft Corporation 2009.
  - ✧ Summary: This guide shows you how to make the most of Microsoft® Windows Communication Foundation (WCF). WCF is Microsoft's solution for developing applications based on a service-oriented architecture (SOA) methodology. The guide contains proven practices, end-to-end applications scenarios, guidelines, a Q&A, and task-based "how-to" articles.
  - ✧ https://docs.microsoft.com/en-us/previous-versions/msp-n-p/ff650794(v%3dpandp.10)

8. Web Security

D. Web Services Security Frame

❑ Web Services Security frame

- Web Services Security frame helps to turn core security features such as authentication, authorization, auditing, confidentiality, integrity, and availability into action.
- **Auditing and Logging**
  - It refers to how security-related events are recorded, monitored, and audited.
- **Authentication**
  - It is the process in which an entity proves the identity of another entity, typically through credentials, such as a username and password.
- **Authorization**
  - It is how your service provides access controls for resources and operations.

8. Web Security

D. Web Services Security Frame

❑ Web Services Security frame

- **Configuration Management**
  - ✧ It refers to how your service handles database connections, administration, and other configuration.
- **Exception Management**
  - ✧ it refers to how you handle exceptions within your application, including fault contracts.
- **Impersonation/Delegation**
  - ✧ It refers to how your service impersonates users and passes identity information downstream for authorization purposes.
- **Message Encryption**
  - ✧ It refers to protecting a message by converting the contents to cipher text by using cryptographic methods.
- **Message Replay Detection**
  - ✧ It refers to identifying and rejecting messages that are resubmitted.

8. Web Security

D. Web Services Security Frame

❑ **Web Services Security frame**

- **Message Signing**
  - ✧ It refers to signing a message with a digital signature using cryptographic methods, to confirm the source of the message and detect if the contents have been tampered with (i.e., authentication and integrity of the message).
- **Message Validation**
  - ✧ it refers to how you verify the message payload against a schema, as well as message size, content, and character sets. This includes how your service filters, scrubs, and rejects input and output before additional processing. Input and output includes input from clients consuming the service as well as file-system input, in addition to input from network resources, such as databases. Output typically includes the return values from your service or disk/database writes, among others.

D. Web Services Security Frame

❑ Web Services Security frame

- **Sensitive Data**
  - ✧ It is user and application data whose integrity and confidentiality need to be protected. This includes how you protect sensitive data from being stolen from memory, from configuration files, or when transmitted over the network.
- **Session Management**
  - ✧ It refers to a series of related interactions between a client and your service.

8. Web Security

D. Web Services Security Frame

❑ Threats/Attacks

- Organized By the Web Services Security Frame
- **Auditing and Logging**
  - ✧ Tampering with log files (注册文件篡改)
  - ✧ Ineffectual or nonexistent audit processes (审计攻击)
    - Repudiation (抵赖)
    - Denial of service (DoS) (拒绝服务)
      - An attacker overwhelms logs with excessive entries or very large log entries.
    - Disclosure of confidential information (机密信息泄露)
      - An attacker gathers sensitive information from log files.

D. Web Services Security Frame

❑ Threats/Attacks

- **Authentication**
  - Network eavesdropping (窃听)
    - An attacker steals identity and/or credentials off the network by reading network traffic not intended for them.
  - Brute force attacks (暴力攻击)
    - An attacker guesses identity and/or credentials through the use of brute force.
  - Dictionary attacks (字典攻击)
    - An attacker guesses identity and/or credentials through the use of common terms in a dictionary designed for that purpose.
  - Cookie replay attacks (Cookie重用)
    - An attacker gains access to an authenticated session through the reuse of a stolen cookie containing session information.

8. Web Security

D. Web Services Security Frame

❑ **Threats/Attacks**

- ◆ **Authentication**
  - ✧ Credential theft (证书窃取)
    - ◌ An attacker gains access to credentials through data theft; for instance, phishing or social engineering.

8. Web Security

D. Web Services Security Frame

❑ Threats/Attacks

- **Authorization**
  - ✧ Elevation of privilege (提权)
    - An attacker enters a system as a lower-level user, but is able to obtain higher-level access.
  - ✧ Disclosure of confidential data (机密数据泄露)
    - An attacker accesses confidential information because of authorization failure on a resource or operation.
  - ✧ Data tampering (数据篡改)
    - An attacker modifies sensitive data because of authorization failure on a resource or operation.
  - ✧ Luring attacks (引诱攻击)
    - An attacker lures a higher-privileged user into taking an action on their behalf. This is not an authorization failure but rather a failure of the system to properly inform the user.

8. Web Security

D. Web Services Security Frame

- ❑ **Threats/Attacks**
  - ◆ **Authorization**
    - ✧ Token stealing (盗窃令牌)
      - ◌ An attacker steals the credentials or token of another user in order to gain authorization to resources or operations they would not otherwise be able to access.

8. Web Security

D. Web Services Security Frame

- ❑ **Threats/Attacks**
  - ◆ **Configuration Management**
    - ✧ Unauthorized access to administration interfaces
      - An attacker gains access to administration interfaces.
    - ✧ Unauthorized access to configuration stores
      - An attacker gains access to configuration files and is able to modify binding settings, etc.
    - ✧ Retrieval of clear text configuration secrets
      - An attacker gains access to configuration files and is able to retrieve sensitive information such as database connection strings.
    - ✧ No individual accountability

D. Web Services Security Frame

❑ **Threats/Attacks**

- **Exception Management**
  - ✧ Information disclosure
    - Sensitive system or application details are revealed through exception information.
  - ✧ Denial of Service (DoS)
    - An attacker uses error conditions to stop your service or place it in an unrecoverable error state.
  - ✧ Elevation of privilege
    - Your service encounters an error and fails to an insecure state; for instance, failing to revert impersonation.

8. Web Security

D. Web Services Security Frame

❑ Threats/Attacks

- **Impersonation/Delegation**
  - Elevation of privilege
    - An attacker is able to run in the context of a higher-privileged user.
  - Disclosure of confidential information
    - An attacker gains access to data that should only be available to another user.

8. Web Security

D. Web Services Security Frame

❑ **Threats/Attacks**

- **Message Encryption**
  - ✧ Failure to encrypt messages
    - ◌ An attacker is able to read message content off the network because it is not encrypted.
  - ✧ Theft of encryption keys
    - ◌ An attacker is able to decrypt sensitive data because he or she has the keys.
  - ✧ Man-in-the-middle attack
    - ◌ An attacker can read and then modify messages between the client and the service.

8. Web Security

D. Web Services Security Frame

❑ Threats/Attacks

- **Message Replay Detection**
  - ✧ Session replay (会话重放)
    - An attacker steals messages off the network and replays them in order to steal a user's session.

8. Web Security

D. Web Services Security Frame

❑ **Threats/Attacks**

- **Message Signing**
  - Data tampering (数据篡改)
    - An attacker modifies the data in a message in order to attack the client or the service.

D. Web Services Security Frame

❑ **Threats/Attacks**

- **Message Validation**
  - ✧ Canonicalization attacks
    - Canonicalization attacks - Unauthorized access of file and directories on the web server machine by tampering file/directory paths that a web site normally allows users to enter as part of its functionality (eg. making use of ../.. to cheat IIS, a directory traversal vulnerability). The attack is typically carried out by entering the path of the file in input field on a web page or by supplying it as part of the URL.
    - Canonicalization attacks can occur anytime validation is performed on a different form of the input than that which is used for later processing. For instance, a validation check may be performed on an encoded string, which is later decoded and used as a file path or URL.

8. Web Security

D. Web Services Security Frame

❑ Threats/Attacks

- **Message Validation**
  - ✧ Cross-site scripting
    - Cross-site scripting can occur if you fail to encode user input before echoing back to a client that will render it as HTML.
  - ✧ SQL injection
    - Failure to validate input can result in SQL injection if the input is used to construct a SQL statement, or if it will modify the construction of a SQL statement in some way.
  - ✧ XPath injection
    - XPath injection can result if the input sent to the Web service is used to influence or construct an XPath statement. The input can also introduce unintended results if the XPath statement is used by the Web service as part of some larger operation, such as applying an XQuery or an XSLT transformation to an XML document.

D. Web Services Security Frame

- **Threats/Attacks**
  - **Message Validation**
    - XML bomb
      - XML bomb attacks occur when specific, small XML messages are parsed by a service resulting in data that feeds on itself and grows exponentially. An attacker sends an XML bomb with the intent of overwhelming a Web service's XML parser, thus resulting in a denial of service (DoS) attack.

8. Web Security

D. Web Services Security Frame

❑ Threats/Attacks

- **Sensitive Data**
  - ✧ Memory dumping
    - ◌ An attacker is able to read sensitive data out of memory or from local files.
  - ✧ Network eavesdropping
    - ◌ An attacker listens to and intercepts unencrypted sensitive data off the network.
  - ✧ Configuration file sniffing
    - ◌ An attacker steals sensitive information, such as connection strings, out of configuration files.

D. Web Services Security Frame

❑ Threats/Attacks

- **Session Management**
  - ✧ Session hijacking
    - ○ An attacker steals the session ID of another user in order to gain access to resources or operations they would not otherwise be able to access.
  - ✧ Session replay
    - ○ An attacker steals messages off the network and replays them in order to steal a user's session.
  - ✧ Man-in-the-middle attack
    - ○ An attacker can read and then modify messages between the client and the service.
  - ✧ Inability to log out successfully
    - ○ An application leaves a communication channel open rather than completely closing the connection and destroying any server objects in memory relating to the session.

8. Web Security

D. Web Services Security Frame

❑ **Threats/Attacks**

- **Session Management**
  - ✧ Cross-site request forgery (跨站域请求伪造)
    - ◌ Cross-site request forgery (CSRF) is where an attacker tricks a user into performing an action on a site where the user actually has a legitimate authorized account.
  - ✧ Session fixation (固定会话)
    - ◌ An attacker uses CSRF to set another person's session identifier and thus hijack the session after the attacker tricks a user into initiating it.
  - ✧ Load balancing and session affinity (负载平衡和会话亲和性)
    - ◌ When sessions are transferred from one server to balance traffic among the various servers, an attacker can hijack the session during the handoff.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- Organized By the Web Services Security Frame
- **Auditing and Logging**
  - ✧ Identify malign or malicious behavior.
  - ✧ Know your baseline (e.g., what does good traffic look like?).
  - ✧ Use application instrumentation to expose behavior that can be monitored.
  - ✧ Throttle logging.
  - ✧ Strip sensitive data before logging.
  - ✧ Create a process to watch the logs and an escalation path for significant issues.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Authentication**
  - ✧ Use strong password policies.
  - ✧ Do not store credentials in an insecure manner.
    - ◌ Do not store credentials on the client side.
    - ◌ Do not store credentials in clear text on the server side.
  - ✧ Use authentication mechanisms that do not require clear text credentials to be passed over the network.
  - ✧ Encrypt communication channels to secure authentication tokens.
  - ✧ Use secure protocols such as Secure HTTP (HTTPS) to secure authentication tokens.
  - ✧ Separate anonymous from authenticated pages.
  - ✧ Use cryptographic random number generators to generate session IDs.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Authorization**
  - ✧ Use least-privileged accounts.
  - ✧ Tie authentication to authorization on the same tier.
  - ✧ Consider granularity of access. (存取粒度)
  - ✧ Enforce separation of privileges.
  - ✧ Use role-based access control.
  - ✧ Use multiple gatekeepers.
  - ✧ Secure system resources against system identities.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Configuration Management**
  - ✧ Use least-privileged service accounts.
  - ✧ Do not store credentials in plaintext format.
  - ✧ Use strong authentication and authorization on administrative interfaces.
  - ✧ Do not use the Local Security Authority (LSA).
  - ✧ Avoid storing sensitive information in the Web space or in configuration files, especially in clear text.
  - ✧ Use access control lists (ACLs).
  - ✧ Encrypt sensitive sections of configuration files.
  - ✧ Use secure settings for various operations of Web services using configuration files.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Exception Management**
  - ✧ Use structured exception handling (by using try/catch blocks).
  - ✧ Catch and wrap exceptions only if the operation adds value/information.
  - ✧ Do not reveal sensitive system or application information.
  - ✧ Implement a global exception handler.
  - ✧ Do not log private data such as passwords.
  - ✧ Use the finally block to perform cleanup.
  - ✧ Be cognizant of exception filters.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Impersonation/Delegation**
  - ✧ Use constrained delegation .
  - ✧ Do not hard-code credentials in your code and preferably not in the configuration files.
  - ✧ Use IIS application domains or Windows service accounts for the host.
  - ✧ Encrypt credentials; if you do, put them in configuration files.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Message Encryption**
  - ✧ Use strong algorithms with appropriate cipher modes, key management, key length, etc.
  - ✧ Use message security or transport security to encrypt your messages.
  - ✧ Use proven platform-provided cryptography.
  - ✧ Periodically change your keys.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Message Replay Detection**
  - ✧ Use any platform-provided replay detection features.
  - ✧ Consider creating custom code if the platform does not provide a detection mechanism.
  - ✧ Enable replay detection within WCF (Windows Communication Foundation).
  - ✧ Use nonces and unique tokens to detect replay or unauthorized requests.
    - ◌ Note: A cryptographic nonce (number once) is an arbitrary number that can be used just once.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Message Signing**
  - ✧ Use strong algorithms with appropriate padding modes, key management, key length, etc.
  - ✧ Avoid use of self-signed certificates.

8. Web Security

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Message Validation**
  - ✧ Use schema validation.
  - ✧ Offload schema validation to an XML accelerator if possible.
  - ✧ Use parameter validation.
  - ✧ Do not trust client input.
  - ✧ Validate input: length, range, format, and type.
  - ✧ Validate XML streams.
  - ✧ Constrain, reject, and sanitize input.
  - ✧ Encode output.
  - ✧ Restrict the size, length, and depth of parsed XML messages.

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Sensitive Data**
  - ✧ Encrypt sensitive data in configuration files.
  - ✧ Do not store secrets in software.
  - ✧ Enforce separation of privileges.
  - ✧ Encrypt sensitive data over the network.
  - ✧ Secure the channel.
  - ✧ Avoid key management.
  - ✧ Cycle your keys.

8. Web Security

E. Guidelines: Improving the Security of Web Services

❑ Improving the Security of Web Services

- **Session Management**
  - ✧ Partition services by anonymous, identified, and authenticated users.
  - ✧ Reduce session timeouts.
  - ✧ Avoid storing sensitive data in session stores.
  - ✧ Secure the channel to the session store.
  - ✧ Authenticate and authorize access to the session store.

9. Patterns & Practices Security Engineering

A. Activities

❑ Activities Descriptions

- Activities: **Planning**
  - ---------------------------------
- Activities: **Requirements and Analysis**
  - Core:
    - Functional Requirements
    - Non Functional Requirements
    - Technology Requirements
  - Security
    - Security Objectives

9. Patterns & Practices Security Engineering

A. Activities

❑ **Activities Descriptions**

- Activities: **Architecture and Design**
  - Core:
    - Design Guidelines
    - Architecture and Design Review
  - Security
    - Security Design Guidelines
    - Threat Modeling
    - Security Design Inspection

9. Patterns & Practices Security Engineering

A. Activities

❑ Activities Descriptions

- Activities: **Development**
  - Core:
    - Unit Tests
    - Code Review
    - Daily Builds
  - Security
    - Security Code Inspection

9. Patterns & Practices Security Engineering

A. Activities

❑ Activities Descriptions

- Activities: **Testing**
  - Core
    - Integration Testing
    - System Testing
  - Security
    - Security Testing

9. Patterns & Practices Security Engineering

A. Activities

❑ Activities Descriptions

- Activities: **Deployment**
  - Core
    - Deployment Review
  - Security
    - Security Deployment Inspection
- Activities: **Maintenance**

9. Patterns & Practices Security Engineering

B. Operations

❑ Operation Description

- Security objectives.
  - ✧ To helps to identify where to start, how to proceed, and when you are done.
- Threat modeling.
  - ✧ An engineering technique that can help to identify threats, attacks, vulnerabilities, and countermeasures that could affect your application. It can be used to shape your application’s design, meet your company’s security objectives, and reduce risk.
- Security design guidelines.
  - ✧ To guide development and share knowledge across the team. Effective design guidelines for security organize security principles, practices, and patterns by actionable categories.

9. Patterns & Practices Security Engineering

B. Operations

❑ Operation Description

- Security design inspection.
  - ✧ An effective way to identify problems in your application design. By using pattern-based categories and a question-driven approach, you simplify evaluating your design against root-cause security issues.
- Security code inspection.
  - ✧ Many security defects are found during code reviews. Analyzing code for security defects includes knowing what to look for and how to look for it. Security code inspections optimize inspecting code for common security issues.
- Security testing.
  - ✧ Use a risk-based approach and use the output from the threat modeling activity to help establish the scope of your testing activities and define your test plans.

9. Patterns & Practices Security Engineering

B. Operations

❑ Operation Description

- Security deployment inspection.
  - ✧ When you deploy your application during your build process or staging process, you have an opportunity to evaluate your application’s run-time characteristics in the context of your infrastructure. Deployment reviews for security focus on evaluating your security design and the configuration of your application, host, and network.

End of Chapter 4.1