Building the Next Generation Enterprises

PISA

(Planning, Integration, Security & Administration)

An Intelligent Decision Support Environment for IT Managers and Planners

Pattern Repository for PISA

June 15, 2007

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1. Introduction

The PISA environment relies heavily on patterns to rapidly develop IT plans. The objective of this document is to give a quick overview of the patterns that are used by the PISA environment with some examples. These patterns are stored in the PISA Pattern Repository as XML documents and are fetched by the PISA advisors to develop quick solution sketches that are further customized through user interviews. The basic algorithm used by the PISA advisors in each stage j is the following:

- Fetch the pattern needed in stage j from the pattern repository (e..g., read the network pattern for the network stage)
- Present the pattern to the user as an initial sketch
- Allow the user to modify the pattern if needed

Patterns, introduced by Christopher Alexander [Alexander 1977, Alexander 1979], are a well-known format for capturing engineering knowledge. For the purpose of this document, a pattern *T* is a tuple *T(p, s, e)* where *p* is the problem to be solved, *s* is the solution (what works in practice*),* and *e* is an example. Additional information such as diagrams, context, benefits, consequences, and limitations can also be added to a pattern to help the designer. In addition, each pattern is assigned a name. The next section shows two examples of patterns. The main value of a pattern is the solution *s* that represents the best practice and what works in real life situations. The solution *s* is provided to a designer as a generic solution -- a sketch -- that can be refined and specialized based on the situation, additional inputs, or inferences from other patterns. Solutions in a pattern can depend on previous choices represented by other patterns. The patterns discussed in this document are based on extensive literature reviews and the knowledge of an IT consulting team.

The PISA pattern repository contains more than 100 patterns. Each pattern has several sub-patterns that show specializations of the patterns and the conditions when these specializations apply. For example, an

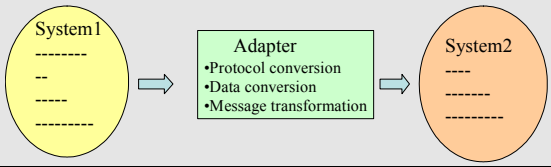
802.11 pattern is created with sub-patterns that show 802.11a, 802.11b, 802.11g and 802.11n networks. Sub-patterns inherit properties from higher level patterns (e.g., all 802.11 subpatterns conform to the 802.11 standard) and thus can be used to develop an elegant and highly reusable class hierarchy of patterns. As more and better solutions become available, we will update the pattern repository. The following discussion highlights the main patterns in the pattern repository. Because of space limitations, we will capture the main essence of each pattern as table rows (actual patterns may take several pages to describe).

2. Example of a Pattern

Exhibit 1 shows a simplified view of a commonly used pattern (adapter) in systems design. These patterns are stored in a pattern repository as XHTML documents that are interlinked by using RDF (Resource Description Facility). Diagrams are stored as Gif images. Some diagrams are translated into XML for machine processing.

Exhibit 1: Pattern Example

Name: Adapter
Problem: How to interconnect and integrate two different systems
Solution: Develop or buy a new component that does the translation between the two systems. Imbed all the methods that do the translation in this new component and make it general so that it can be reused over and over again.
Example: Adapter for SAP applications that connects SAP applications to non-SAP applications.
Diagram:



3. Enterprise Design Patterns for Enterprise Modeling

Enterprise design patterns (EDPs) capture the essence of proven solutions to recurring problems in enterprise design. Numerous patterns can fall into this category. The main criteria for selecting EDPs in this research is their ability to influence the stages of ITP: application planning, platform planning, network planning, security planning, and project planning. Table 1 shows a few EDPs that we have found most useful in the context of ITPs. The EDP-BP (business processes) pattern, also known as BPP (Business Process Pattern), identifies business processes (BPs) for different industry segments. As we will see later, this pattern greatly impacts all aspects of ITP. The EDP-WG pattern suggests that workgroups can be formed around BPs. For example, human resource BPs are conducted by human resources personnel.

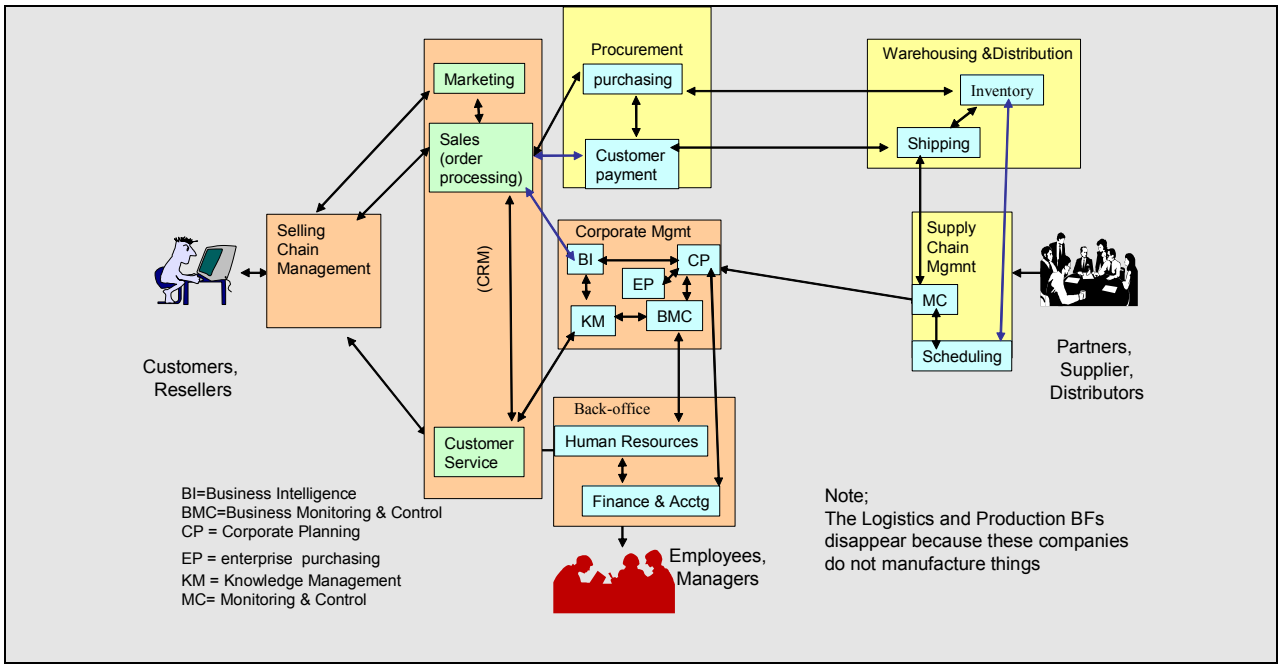
Exhibit 2 shows an Enterprise Design Pattern – Business Processes for a retail company. The diagrams of the BPPs are translated into XML for machine processing.

Table 1: Sample Enterprise Design Patterns (EDPs)

PATTERN NAME	PROBLEM	SOLUTION	EXAMPLE	SUB-PATTERNS
EDP-BP (also known as BPP)	What BPs need to be supported in an enterprise and how to build a BP model	Use a taxonomy of BPs, business ontologies, and business choreography	SAP's Business Maps (www.sap.com) is an example of EDP-BPs.	Manufacturing industry BPs, healthcare industry BPs
EDP-WG	How to assign Work Group (WG) and staffing profiles	Use cluster of related BPs to define a WG.	Human resource department is a WG,	Manufacturing personnel & knowledge workers WG

Exhibit 2: Business Process Pattern (BPP) Example

Name: Business Process Pattern (BPP), also known as Enterprise Design Pattern – Business Process (EDP-BP)
Problem: What BPs need to be supported in an enterprise and how to build a BP model
Solution: Use a taxonomy of BPs, business ontologies, and business choreography to identify what are the key business processes and how do they interact-interrelate with each other.
Example: SAP's Business Maps (www.sap.com) is an example of BPPs.
Diagram: BPP for a retail enterprise



4. Application Patterns for Application Planning

Application planning in the 21st century is quite different as compared to the previous century where planning concentrated primarily on in-house software development. This is largely due to the availability of highly configurable commercial-off-the-shelf (COTS) packages, rentals through application service providers (ASPs), outsourcing of software development, and increasing appeal of software re-use through service-oriented offerings based on Web-Services. Due to this, we focus on capturing those patterns that help in choosing between the buy, rent, outsource, develop, and extend/re-use (BRODE) strategies (see Table 2). The APP-STRATEGY pattern helps in choosing BRODE strategies and consists of five sub-patterns, one for each of the strategies. The APP-SOLUTIONS pattern suggests a detailed solution approach based on the selected APP-STRATEGY. For example, to support the buy strategy for CRM, this pattern suggests the commonly used COTS CRM packages.

We have developed a large repository of over 1000 application patterns that describe the applications in 12 different industry segments. Each application pattern consists of the following parts:

- Overview of the application with a conceptual diagram

- More information on this topic
- Main requirements to consider
- Information models (e.g., use cases, class diagrams and sequence diagrams)

Exhibit 3 shows a sample application pattern for human resource applications.

Table 2: Sample Application Patterns

PATTERN NAME	PROBLEM	SOLUTION	EXAMPLE	SUB-PATTERNS
APP-STRATEGY	What application strategy (buy/rent/build/outsource/re-use) to use for automation of a BP.	-Automate critical BPs -Buy COTS or rent for the back-office BPs (e.g., finance and accounting, human resources) -Re-use existing if the existing systems have high business value	-Manual inventory tracking in a small shop -Using SAP, Oracle, or Peoplesoft ERP systems -Using Web Hosters and ASPs for renting and outsourcing	Five subpatterns (buy, rent, outsource, develop, extend) each giving details (e.g., tradeoffs, limitations) about a particular strategy
APP-SOLUTIONS	How to select a detailed solution approach for applications based on the selected APP-STRATEGY	Use a development approach (e.g., concurrent programming for in-house development), recommend a commercial package based on cost, etc.	Links to COTS database. For example, if someone chooses CRM, then links to COTS DB to search for most suitable commercial packages	APP--SOLUTIONS for SMBs and large companies. For example SAP is used in large companies, Great Plains software in SMBs

Exhibit 3: Sample Application Pattern – HR Applications

Pattern Name: BP-HR-Main

Overview

HR systems concentrate on employees, the main asset of an organization. These systems manage employee career development, recruitment processes, personnel records, salary planning, compensation packages, and government regulations. Human resources information systems support activities such as identifying potential employees, maintaining complete records on existing employees, and creating programs to develop employees' talents and skills. HR systems exist at several levels in organizations (see figure). At the operational level, these systems process payrolls and track the recruitment and placement of the firm's employees. At the management level, HR systems help managers monitor and analyze the recruitment, training, allocation, and compensation of employees. Strategic-level HR systems identify the manpower requirements (skills, educational level, types of positions, number of positions, and cost) for meeting the company's long-term business plans.

Additional Information

Many HR application packages are commercially available from companies such as PeopleSoft, JD Edwards and Microsoft Great Plains. In addition, several 'Workforce Analytics" application packages are available from companies such as Cognos and 'Professional Services Automation' tools (see www.aberdeen.com for details). However, many HR systems are available for rentals through ASPs (Application Service Providers). The clients of ASPs pay a monthly fee based on the number of employees. The fee typically includes templates and network connections. The following table shows examples of HR systems.

Examples of Human Resources Information Systems

System	Description	Organizational Level
Human resources planning	Plan the long-term labor force needs of the organization	Strategic
Compensation analysis	Monitor the range and distribution of employee wages, salaries, and benefits	Management
Training and development	Track employee training, skills, and performance appraisals	Operational

Functional Requirements

The human resources function is responsible for attracting, developing, and maintaining the firm's work force. The specific functions performed by HR systems are:

- Hiring and retaining employees
- Payroll processing
- Employee training and career development
- Staff benefits (e.g., health, vacation, and pension benefits).
- Process new hire payroll information
- Employee tax handling (withholdings ad reporting)
- Time sheet processing and project charging

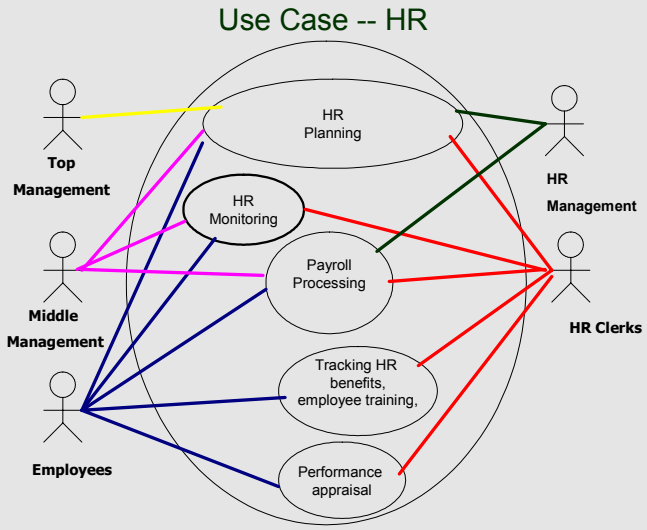
- Turnover and attrition analysis
- Compensation analysis
- Human capital optimization and alignment
- HR performance management (e.g. employee performance reviews, promotion and termination procedures)
- Analysis of staff turnover, terminations, voluntary and involuntary separations, and transfers
- Analysis of paycheck data, earnings, and deductions
- Analysis of employee benefit expenses, employer benefit expenses, and taxation
- Analysis of employee reviews and performance, sick leave, family leave, and vacation status
- Integrate and simplify deployment, maintenance, and day-to-day operations of HR department
- Provide extensive pre-fabricated reports and capabilities to quickly generate adhoc and customized reports from HR data
- Allow the users to easily navigate through the HR data interactively to compare and contrast different groups of employees—by location, by role, by manager, by salary, by age, etc.

Information Models

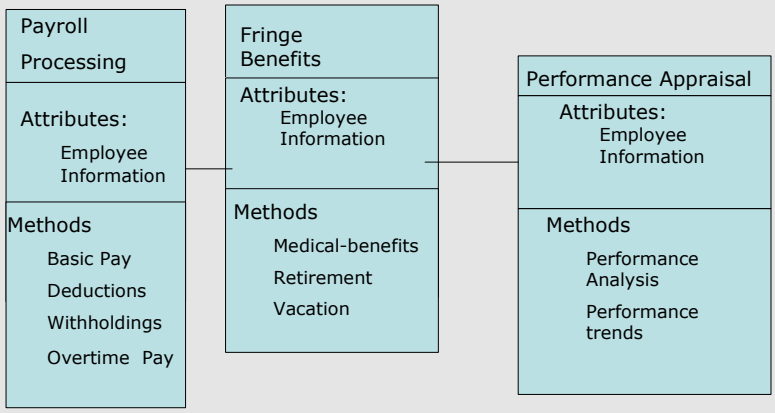
HR applications typically do the following:

- Pay employees on a regular basis
- Plan the long-term labor force needs of the organization
- Monitor the range and distribution of employee wages, salaries, and benefits
- Track employee training, skills, and performance appraisals

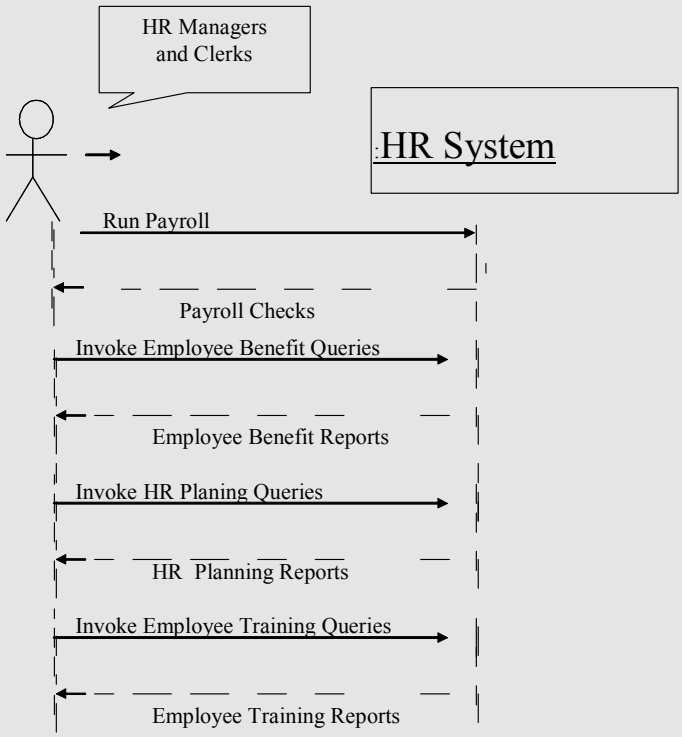
The following information models represent different aspects of HR applications for SMBs. These can be extended if needed



HR Class Diagram



System Sequence Diagram:



5. Computing Platform Patterns for Platform Planning

Computing platforms represent the computing hardware/software needed to support the application plans. Table 3 captures the commonly occurring computing platforms (laptops, PDAs, desktops) and the system software (OS. middleware services) in contemporary environments. The CPP-DESKTOP describes typical desktops for office use and the CPP-SERVER pattern shows a typical server platform with sub-patterns for application servers, mobile computing servers and ecommerce servers.

Table 3: Sample Computing Platform Patterns

PATTERN NAME	PROBLEM	SOLUTION	EXAMPLE	SUB-PATTERNS
CPP-WORKSTATION	What type of workstation platforms are needed with hardware, software, and middleware for different types of users	Typically desktops/laptops MS Windows Office Environment for regular business users, Linux and Macs for engineers and specialists	Dell Dimension 4400 with Microsoft Windows 2000. MS Office XP, MS Outlook Express, MS IE 6.0, .NET Framework	Desktop-Regular for managers and business employees in HR, sales, marketing Desktop-Pro for software developers and CAD designers.
CPP-SERVER:	What type of server platforms to use with hardware, software, and middleware	Powerful machine with system software to handle 100+ applications, licenses for middlware with network connectivity	IBM xSeries 226 (86481au) Server, Microsoft Windows Server 2003, Peoplesoft HR and CRM	Application servers, eCommerce servers, and mobile computing servers, Voice over IP server, multimedia server

6. Network Patterns for Network Planning

Network plans support the enterprise, application, and computing platform plans. Table 4 captures the commonly used network (wired/wireless) solutions. These patterns are influenced by the application, computing platforms and enterprise design patterns. The NET-WORKLOAD pattern suggests that a workload model can be developed from workgroups and the applications that run in the workgroup. For example, for a human-resources WG, the workload can be estimated based on the common activities performed in human resources (e.g., payroll). The NET-LAN and NET-EXTERNAL patterns represent common practices in modern networks.

So far, we have created around 50 network patterns. These patterns will be refined and additional patterns will be created in the future. The following section describes a sample pattern: (Net-LAN Small). .

Table 4: Sample Network Patterns

PATTERN NAME	PROBLEM	SOLUTION	EXAMPLE	SUB-PATTERNS
NET-WORKLOAD	How to estimate a workload model	Infer workload from the EDP-WG pattern	HR personnel use HR applications and email services	Workload models for clerks, managers, knowledge workers
NET-LAN	How to develop Wireless/Wired LAN design for a site	802.11b/g for wireless and 802.3U (Fast Ethernet) for wired.	An 802.11b business LAN in a small office	802.11 LANs, Bluetooth LANs, Ethernet LANs
NET-EXTERNAL	How to design external network for C2B and B2B activities	Connect to an ISP through DSL, Cable, T1, T3, or OC1 lines. Use Public Internet with VPN for B2B.	ANX (Automotive Network Exchange) is a large scale extranet for B2B trade. (see www.ANX.com)	External network for a campus (wireless local loop), a region (fiber network) or a global group (satellites).

Exhibit 4: Sample Network Pattern: Small (Single Room, SOHO) LANs

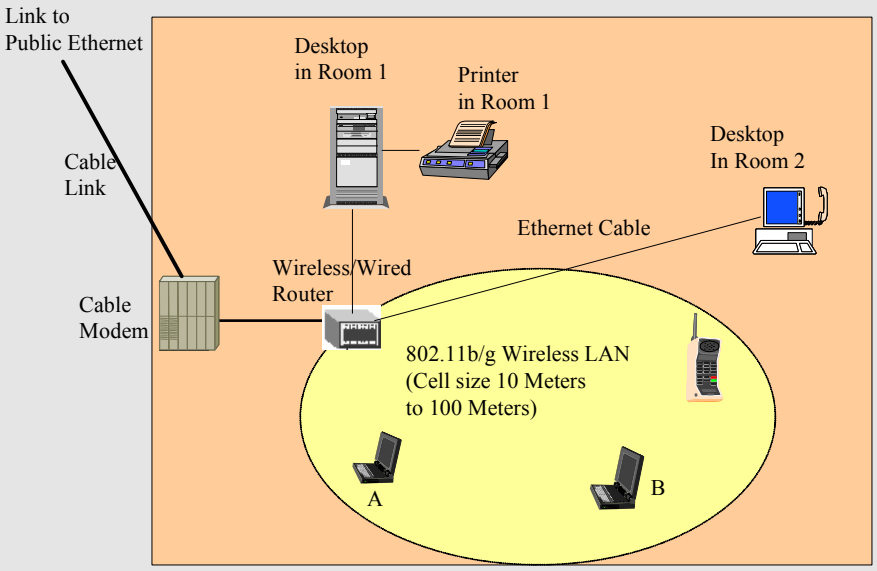
Pattern Name: Net-LAN-Small

Problem:
How to design a small LAN for a single room or a SOHO (small office, home office).

Typical Solution:
Most small LANs at present are based on the IEEE 802 standards committee that developed the very popular wired Ethernet (IEEE 802.3) and wireless Ethernet (IEEE802.11) Local Area Networks Standards. The older wired Ethernet LANs operate at 10 Million Bits Per Second (Mbps) over copper wires while the newer Ethernet (iEEE 802.11u) operate at 100 Mbps over fiber cables. Increasingly, wireless Ethernet (IEE 802.11) LANs are being used. These LANs operate at 11 Mbps (802.11b) and 54 Mbps (802.11g) and can support distances between 100 feet and 500 feet. Detailed information about these LANs can be found at the Wireless LAN Association Website (www.WLANA.org).

Although 802.11 LANs are very popular, Wireless Personal Area Networks (WPANs) for short-range (10 meter or less operating at 1 Mbps) personal, home, and other special uses are also popular. Within the WPAN family, several specifications such as Bluetooth, wireless sensor networks, and UWB (Ultra Wideband) have emerged.

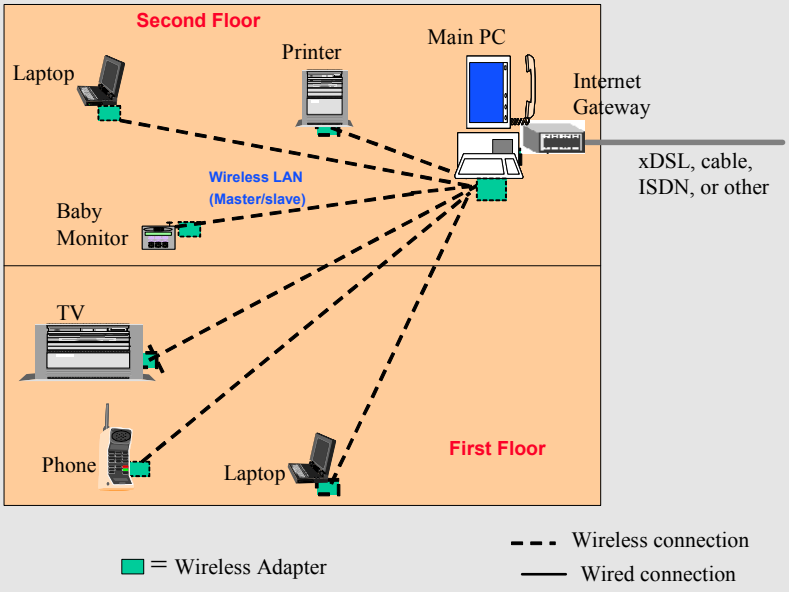
Example:
The following diagram shows a sample small LAN for a SOHO that uses wireless as well as wired Ethernet LANs. The workers can access the desktop in Room 1 (a server) plus access the public Internet through a cable modem. In this configuration, the wireless as well as wired devices are connected to a wireless/wired router. This router provides wireless access point as well as routing capabilities. The wireless LAN can be replaced with a Bluetooth LAN for small rooms.



Special Considerations: Home Networks

Home networks are an area of explosive growth due to several laptops, desktops, and other computing devices in a typical home. Of course 802 based wired and wireless LANs can be used at home, but many different types of networks, especially wireless networks, are becoming available at home. The following diagram shows a conceptual view of a predominantly wireless home network that connects laptops, desktops, printers, phones and other devices though a wireless network. The main contenders for home networks are:

- Wireless and wired Ethernet (802) networks
- Bluetooth: 10 meters, 1 Mbps
- UWB (Ultra Wideband): very short-range (about a meter) but very high data rate (over 100 Mbps) applications such as connecting TV to VCR wirelessly.
- Wireless sensor networks (WSNs) for very small, low-powered sensor devices mainly for monitoring and data collection purposes (e.g., baby monitoring, etc). .



7. Security Patterns for Security Planning

Security plans are needed to support the enterprise, application, computing platform, and network plans. Table 5 shows a few sample security patterns that suggest security solutions to common security problems. SEC-WLAN and SEC-WEB patterns capture the most commonly used solutions for wireless LANs and Web security. The SEC-AUDIT patterns suggest the commonly used approaches for security audits.

Table 5: Sample Security Patterns

PATTERN NAME	PROBLEM	SOLUTION	EXAMPLE	SUB-PATTERNS
SEC-WLAN	How to secure a wireless LAN (WLAN) and the resources connected to it.	a) Use local security (e.g., WEP) with full capabilities, b) place Wireless LANs outside the corporate firewall, and c) use higher level encryption (SSL) if needed	802.11 (WiFi) LAN in a financial institution is placed outside the firewall for authentication, and is heavily encrypted through WEP and SSL	Security for 802.11, security for Bluetooth, and security for wireless sensor networks
SEC-WEB	How to provide secure access over the Web and secure Websites to deter attacks on Websites	Use SSL with large key sizes for secure access over the Web (http). Use the Web security patterns identified by Kenzel and Elder (Kenzel 2001) for Website security.	Web access for online purchasing from Amazon.com site uses SSL. Amazon employs strong security measures to protect its websites.	Web-access security, Website security, business continuity planning for Websites due to attacks and disasters.
SEC-AUDIT	How to develop a good security audit and control program	Customize and use the comprehensive security audit checklists such as found in (Umar 2004).	Security audit checklist for a publicly owned financial institution exceeds 1100 questions.	Security audit checklist for SMBs, for SOX (Sarbenes-Oxley) compliance

8. Patterns for Project Planning

Project planning is an essential aspect of IT planning. In particular, project plans represent the work breakdown structure (WBS) and staffing needed to support the decisions made in application, computing platform, network, and security planning. Project patterns (PPs) suggest typical WBS for different types of activities. The PP-DEV pattern represents the WBS needed for software development. This pattern has a pre-fabricated WBS because we know the typical activities in software development (e.g., requirements, design, coding, unit testing, system testing, etc) and their interrelationships (e.g., testing follows coding).

Similarly, PP-BUY, PP-RENT, and PP-OUTSOURCE patterns represent the most commonly used WBSs in application buying, renting, and outsourcing, respectively. Project planning patterns are not shown here.

Main References on Patterns

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