Overview

Unit 13 is organized into four sections, the first being this overview, the introduction, and the objectives. The second section introduces the Internet. The third section discusses the strategic use of Internet/intranets in organizations. The fourth section covers the technical implications of Internet/intranet system design over traditional architectures. The fifth section contains a summary of Unit 13, references, a glossary of terms, and the Orient-Pacific Insurance Corporation case study.
Introduction

Discussion on systems design is not complete without at least touching on the evolutionary trend of Internet and intranet applications development. Thus, this unit will highlight the characteristics of Internet and intranet systems designs and considerations. Furthermore, the role of a systems analyst is also to keep up with new information technology and understand innovations along with the risks and benefits they bring.

In particular, the Internet and the corresponding World Wide Web (WWW) has introduced new solutions to existing systems development problems and has paved the way for new opportunities for organizations. Consider the following benefits over traditional operating environments for business applications.

1. Facilitates universal information sharing for a wide variety of platforms
2. Support for multimedia
3. Non-proprietary architecture and solutions
4. Reduced maintenance of applications
5. Ability for true global network computing
6. Fast location of distributed information on web-pages through text-based (and national language-based) search engines.
Objectives

By the end of Unit 13, you should be able to:

1. *Explain* the strategic use of Internet/intranet technology within an organization’s IS architecture.

2. *Explain* the benefits and drawbacks to Internet/intranet-based designs.

3. *Identify* the standards associated with Internet-designs.

4. *Explain* the systems design consideration for Internet-based and intranet-based applications design (architecture, development tools, databases, user-interfaces, and maintenance considerations).
Internet and the World Wide Web

From a historical perspective, the Internet has existed for a long time, actually over 30 years. Since the time of its creation, it has grown from a US military supported academic network to the indispensable international infrastructure of information and applications known as the World Wide Web.

For detail development of the Internet, an authoritative history of the major technical and personal milestones in the Internet's development, called ‘Hobbes’ Internet Timeline’ is located at URL:http://info.isoc.org/guest/zakon/Internet/History/HIT.html

The World Wide Web (WWW or web) is the universal published collection of multimedia documents (or content) of all categories which are hyper-linked to one another. The WWW essentially represents a higher functional level over the pure (non-graphical) Internet on which it was built. Now, the WWW is seldom discussed distinctly from the Internet as the WWW is considered an evolution of the Internet itself, although they are truly distinct concepts. In this unit, we will accept the term Internet to refer to the WWW.

Access to the WWW is through software called a browser which allows any user to access any of millions of sites (servers) around the globe for information (business, news, entertainment, personal, etc.). Browsers are available from at least two major vendors (Microsoft and Netscape) and function on a number of operating systems (Windows, Unix, Macintosh, and others).

In terms of the hardware and software requirements for access to the web, a standard PC, modem, browser software, and a network connection through an Internet Service Provider (ISP) is all that is needed. For a typical organization, establishing a lease-line connection from a Local Area Network (LAN) to an ISP is typically all that is needed for establishing a link. Organizations can then develop their web server applications accordingly. The web server itself is typically a dedicated machine where an organization or groups’ web pages (information) and web applications are located. Essentially, it can be any hardware or software platform, as long as it supports the standards of content and applications for the Internet.
Strategic use of Internet/intranet technology

Modern business computing is today inextricably linked to the Internet. In very simple terms, all significant businesses today have a presence on the Internet. It can range from a simple marketing site with product/service information all the way to direct retailing (e.g. on-line ordering of computers) and delivery of services (e.g. stock trading systems). Many successful business applications and cases abound.

Consider the case of Dell Computers (http://www.dell.com), operating in both the US and Hong Kong, which has achieved a level of sales in the order of HK$25 million per day in sales in 1997 from only a mere fraction of that one year previously. Another successful company is E*Trade Securities (http://www.etrade.com) an electronic brokerage house that allows customers to directly initiate stock transactions directly from a browser. Being the first on-line brokerage has allowed it not only to establish a strong base of customers, but more importantly, the necessary experience to keep it ahead of new competitors. Hong Kong being an international port city is quickly establishing itself in many areas (such as import/export goods, banking, and other services) on the web.

Businesses are incorporating intranets (or private networks based on Internet standards) to take advantage of the benefits in its design. Specifically, organizations realize the amount of information that needs to be shared and communicated across workgroup boundaries. Thus by putting policies, manuals, statistics, and other useful information on the intranet, communication efficiencies are improved and paper-based document distribution eliminated. Further, the concept of storing information in a single location accessible by everyone needing it ensures that it is consistent and up-to-date.

Benefits of Internet/intranets

- Lower cost of set-up and can run on relatively thin clients-bases.
- Non-proprietary, open, and inherently cross platform, utilising TCP/IP.
- Intuitive and common user interface, using hypertext on browser.
- Good multimedia support allowing objects such as sound, video, and others.
- Huge investment and rapid developments currently taking place in intranet technology.
Drawbacks of Internet/intranets

- Just purchasing the required technology does not immediately provide any usable applications — applications development work has to be carried out in order to add the required business functions.

- Many aspects of intranet technology and standards — particularly HyperText Mark-up Language (HTML) authoring and generation systems are constantly changing — which makes it hard to keep up to date and choose a ‘standard’ that will remain a standard. (This is usually the downside of rapid technological progress!)

- Poor support for mobile users, although advances are being made.

Although Internet/intranet standards and mechanisms are now quite sophisticated they are not automatically invoked and have to be designed into Internet/intranet applications.

Self-test 13.1

What are the driving forces that are encouraging organizations worldwide to invest in Internet/intranet systems development?
Internet application considerations

There are some applications development considerations particular to the Internet/intranet environments. What follows are discussions on specific aspects relating to these considerations. Here is a list of the aspects discussed.

- Standards
- Architecture
- Development Process
- Databases
- User-Interfaces
- Development Tools
- Security Design
- Maintenance

Standards

Open standards is one of the reasons why the WWW/Internet has been accepted and implemented so quickly. The desire for open systems in which standards that allow any combination of hardware and software to interoperate alleviate the concern of businesses and organizations of being overdependent on a specific technology or vendor.

In terms of inter-operability, where heterogeneous distributed systems can interact and communicate with each other, standards has provided value in this respect. It is also these standards that will help Internet/intranet-based systems become more flexible in terms of systems development and maintenance. This allows the designer and developer to be more selective in choosing hardware platforms that are decoupled with applications development aspects. This gives the organization greater flexibility, and further provides the systems analyst transferable skills across such open and standardized environments.

A first step for the systems analyst is to understand the terminology of the standards and what it means for the analyst. Specifically, the following terms need to be understood:

**URL:** Universal Resource Locator is a standard reference for documents on the WWW (Internet). It serves to provide a unique address for the location of each document. For example, the OUHK homepage URL is http://www.ouhk.edu.hk, while the homepage of B329 is http://www.ouhk.edu.hk/ole.
HTTP: HyperText Transfer Protocol is a network protocol that essentially defines the ‘address’ referencing capability of documents and information on the World Wide Web. Specifically, a web-page and its multimedia items can cross reference other information through logical address links (URL references within the document). Thus, HTTP allows for the ability to hyperlink pages to one another.

HTML: Hypertext Mark-up Language is the page definition language that defines how the content for a web-page should appear. It is also the language that all WWW browsers can understand and henceforth process the file for presentation. Documents produced with HTML are typically called homepages or web-pages.

CGI: Common Gateway Interface is a standard for the development of Web-enable applications using existing (external to Internet) programming environments. Thus, your database on Unix which may have a C language program interface can be made accessible using CGI scripting. This allows for real interactive applications to function through a browser. Additionally, existing applications/databases can be made accessible through the Internet/WWW through CGI thus saving on redevelopment costs using SunSoft’s Java programming language, Microsoft’s Active-X model, or other means.

Through careful consideration in systems planning, leveraging designs on the open systems standards and modular development capability of the Internet has been a strong incentive for organizations’ adoption of Internet/intranet solutions. HTML and Java are continually going through evolutionary standards change, thus a good analyst needs to be in touch with all such information technology.

Self-test 13.2

Why are standards important for organizations and for the systems analyst?

Architectures

Internet/intranet are distinctly distributed and networked architectures. They can employ any combination of the client-server approaches (2-tier and 3-tier) as discussed in Unit 10. Similarly, the same set of issues of data, network, application, and interface distribution applies here. The basic architecture of an Internet application is depicted in Figure 13.1.
All users accessing content and applications on the Internet or on an intranet are called clients. They interface into the WWW or intranet through a browser (e.g., MS-Internet Explorer and Netscape Communicator). Connection from the client to the server is over a network. The web-server, its web-pages, and applications are addressable using the addressing scheme of URL and the HTTP protocol. The design of the web-pages and applications are presented through the HTML defined web-pages. In the case of an application, a CGI application (executable) can be referenced by the client to perform some application function on the server. CGI is but one of the ways to develop Internet/intranet applications, albeit the most popular one. It is a server-side application (e.g., executes on the server). If using some Internet-oriented development tools and languages, the application logic can be designed to be executed at the client-side, server-side, or on a dedicated application server depending on the architectural requirements (e.g., performance needed and the number of simultaneous clients).

There are some issues relating to the architecture an organization needs to assess when considering an Internet/intranet architecture. Specifically the following:

1. **support for and interface to existing legacy systems**
   
   Many well-established organizations have major and long-term investments in information systems. Making such legacy systems available for access on the Internet and intranet requires considerable efforts as middle-ware tools and development experience are likely to be limited.

2. **high performance systems**
   
   Internet-based systems have been acknowledged as generally slower performing when compared with established hardware/software platforms (WinNT, Unix, etc.). Thus consideration in architecture design has to factor in this aspect, especially for mission-critical systems. In essence, Internet-based systems are not for every project.
3 speed of development

One of the benefits of Internet/intranet designs is the ability to quickly publish information. In particular, the ability of end-users to participate in the development of homepages of mixed text and multimedia content. The speed of development has been facilitated by advanced tools and languages discussed in the next section.

Self-test 13.3

How are Internet/intranet architectures different over traditional systems architectures?

Development processes

For typical systems developed for public Internet, speed of development is important. This can be observed by electronic commerce systems such as http://www.amazon.com (on-line bookstore) or http://www.etrade.com (on-line brokerage house) where being first on-line makes the competitive difference. The introduction of new categories of systems, features, capability, and service has captured a following of loyal customers.

With speed of applications deployment a concern, the choice of development method correspondingly needs to support this development requirement. Thus joint applicant development (JAD), prototyping, and rapid applications development (RAD) are ideal and popular choices for the development methodology. In JAD, for example, all people involved, managers, marketing people, systems analysts, and developers can get together to determine the requirements completely thereby shortening the communications process between them. In prototyping, a design can be generated and evaluated quickly by a field of users. A benefit to prototyping is that all users can have access to the prototype with just a browser, and can be simultaneously accessible with just a different URL. RAD is another popular choice, in part due to more robust and visual tools available for development.

Due to the document-based presentation of information and the hyperlinked design of web-pages, distributed development efforts over centralised control for intranet design is the trend. This is because it is simple for end-users to learn HTML so they can share information across an organization. Thus this distributed or delegated development process will continue to support end-user computing.
Self-test 13.4

Are there any fundamental differences between the development process for Internet/intranet over traditional systems development methods?

Development tools

A variety of tools are available to develop applications. These tools range from simple Internet extensions for existing non-Internet application to HTML to complete programming languages such as SunSoft’s Java and Virtual Reality Modelling Language (VRML). These and other development tools are described below.

Java: Programming language designed specifically for developing applications on the web. Originally developed by Sun Microsystems, a maker of Unix workstations, it has established itself as an ‘open’ systems programming language. Unique to its ability is that applications written in Java can be directly downloaded and operable from any system with a Java-enabled browser; something no other programming language can claim.

Java Beans: Toolkit including user-interface controls that facilitates development of Java language applications. Eliminates the ‘reinventing the wheel’ for popularly used modules and controls in applications programming. Additionally, the modules are likely to be more robust.

Active-X: This is Microsoft’s Corporations component tools approach to development of Internet applications. Formerly known as OLE or OCX in the MS-Windows environment they have been enhanced to function in Internet applications. Since large libraries of Active-X components exist, they can make complex applications easy to build, though applications are presently limited to operating under the MS-Internet Explorer browser.

VRML: Virtual Reality Modelling Language is a language that supports interactive 3D applications. Though presently used for marketing and entertainment purposes, it is likely to have some presence in business applications as 3D user-interfaces become more popular.

Activity 13.1

Search the Internet for three major suppliers of Internet/intranet development tools. Look at their product offering with respect to the tools and technologies described above.
For some organizations, it may not be so practical to rebuild every legacy application for access into the Internet/intranet. In such cases, organizations can build the link through Common Gateway Interface (CGI) programming. CGI allows for the linking of existing applications written in traditional languages (C/C++/Visual-Basic/FORTRAN/etc.) Using this approach, the developer can leverage on existing functioning applications and databases.

Databases

The WWW was not originally designed to support databases directly, but the need has prompted to some solutions. Specifically, linking databases and database applications to the Internet can be done in a number of ways. Essentially, most of the solutions require some middleware layer to provide connection (or database gateway) to the database. Figure 13.2 shows a typical database architecture using the CGI approach.

![Database Architecture using the Common Gateway Interface](image)

*Figure 13.2* The Database Architecture using the Common Gateway Interface

The other approaches to connecting a database to the Internet include the following methods:

**CGI executable:** This approach depicted in Figure 13.2 essentially links the database to the CGI executable that is accessible from a browser. The benefit to this design is that it does not require any proprietary approach and all client platforms are supported. A major drawback however is its performance which is generally slow due to the creation of discrete processes for each database request. Thus this approach is well suited for 2-tier architectures.

**CGI application server:** In this approach, the CGI program instead of being linked directly to the database is instead a database server application that will dispatch requests and results. Performance is increased as only one connection need to be established and multiple requests can be processed through this one connection. The cost for this is additional complexity in the design.

**Server API:** By extending the function of the web-server to have an application program interface (API) to the database, applications can be written that simply call the API. The advantage is that it is likely to be higher performing. The cost is that it is likely to give a proprietary approach. Examples include Netscape, NSAPI and Microsoft’s ISAPI.
**Proprietary server:** A database server can be extended to become a web-server. In this approach, a proprietary database server can be turned into a web-site server. The result of this approach is that performance is likely to be high, but at a cost of being proprietary in nature and may risk being extendible to other applications/databases.

There are likely to be more solution approaches to come as development tools for Internet/intranet designs mature that will address the performance and/or proprietary issues.

**User-interfaces**

The metaphor of the user interface for the WWW is the ‘document’ interface with selectable text and images. This is the hypertext, hypermedia model of user-interface. This document model is further enhanced with the addition of standard GUI controls discussed in the previous Unit 12. The Internet itself is not accessed ‘directly’, but rather through one of the two dominant browsers (Netscape Communicator/Navigator, and Microsoft Internet Explorer). These browsers provide the ability to navigate through the many web-pages (or home-pages) of information published on the Internet.

The document/browser model as an interface has become extremely successful due to its ease of use and intuitive design of selectable content and multimedia support. A wide range of users who are not computer literate have found the interface easier to use than a typical windows/GUI operating system. This accessibility has driven businesses and organizations to adopt the model for its customers as well as internal operations (hence the popularity for implementing intranets).

With global Internet/intranet systems being considered for a wider audience of end-users, more graphics can be employed to reduce the dependence on national language for navigation through applications. Thus, the designer can reduce the overheads for communicating to a wider audience.

**Self-test 13.5**

Compare in general terms the difference of an application running through an Internet browser versus a traditional application in say Win95/NT?

**Security design**

The Internet, by nature, is free and unbounded which causes much concern about the security of web-servers and transactions. Fortunately, security elements are in place that allow for privileged access and secure connections. This is an important requirement for electronic commerce to be conducted. The following are security elements that can be incorporated into the Internet/intranet architecture:
User login authentication: This is the sub-system that allows a user to connect to a web-server and access its homepages and its applications. This is the approach used by many of the subscriber services available on the Internet today. These are member-based sites that are accessible by logging in with a user account name and a password.

Encryption: For communication of messages between a client and the server, this approach codes the message to be indecipherable (should the information fall into the wrong hands) and deciphers it at the other end. This is important for electronic commerce where passwords, credit-card numbers, and other sensitive information needs to be communicated.

Firewalls: This is a hardware and/or software strategy where an intermediary system is introduced between the clients and the web-server. The firewall is designed to resist attacks from hacking and unauthorised access preventing any direct access from outside clients to the server. Firewall solutions can typically be purchased for most major operating systems that can host web-servers.

Though an intranet is a private and internal network operating within an organization, security may also need to be considered for different classification of users. So in any Internet/intranet architecture, identifying outside client points-of-entry is important to securing corporate data and communications.

Activity 13.2

Identify within the Internet browser that you use the security options that are built-in and the capacity to support other security measures (e.g., secured connection, Email encryption, etc.)

Maintenance

One of the compelling benefits of Internet/intranet design is the concept of ‘develop once and run everywhere.’ This has an advantage for systems developers who can update applications in a single location (e.g., web-server) so that all clients will have the latest version available for use. Traditional network applications required individual re-installation and testing of every PC/workstation in an organization which needed to use the application; a tremendous effort if the organization has hundreds or thousands of clients.

As for maintenance, the only requirement is that it be tested thoroughly, as the same benefits of running the latest version of a web-application can be undone if the application is flawed. One popular solution has been to run new versions of systems concurrently. This is extremely convenient as the user can use both a new version or an older version through the same browser by only referencing a different URL. The cycle of maintenance request, system update, and execution are significantly shortened.
Summary

Knowledge of Internet/intranet design has become an important necessity today for the systems analyst and systems developer. The systems analyst and systems designer need to be aware of the capabilities and limitations of the new technologies for Internet/intranet designs. The major aspects of standards, architecture, development process, databases, user-interfaces, development tools, security design and maintenance have been introduced topically to provide you with some perspectives on the Internet technology from the design perspective. Internet/intranet design is likely to become more significant in the future, thus design skills learned now are likely to be transferable.
References

Business Systems for Internet


Intranet Design


Electronic Commerce


Glossary

This glossary provides brief definitions of the main technical terms you encountered in Unit 13. The definitions given here are offered in addition to, or in place of those found in your textbook.

**Active-X**: This is Microsoft’s Corporations component tools approach to development of Internet applications. Formerly known as OLE or OCX in the MS-Windows environment they have been enhanced to function in Internet applications and are presently limited to operating under the MS-Internet Explorer browser.

**Browser**: This is the software needed to access, use, and traverse the WWW/Internet.

**CGI application server**: This is an approach for linking a database to the Internet. It is a middleware application that is likely to be higher performing than using a CGI executable.

**CGI executable**: A CGI program file. It can be used to link a database.

**Common Gateway Interface (CGI)**: A standard for publishing graphical World Wide Web components, constructs, and links.

**Database Gateway**: Middleware layer to provide connection to the database from the Internet through a CGI program.

**Electronic commerce**: Global trading and consumer transaction of goods and services over a network such as the Internet.

**Encryption**: This is the coding of messages to be communicated for security reasons. Recovering the original messages is only possible with the correct unlocking key code.

**Firewalls**: This is a security measure that places an intermediary piece of hardware and software between outside access and a computer (server). The firewall is designed to resist attacks from hacking and unauthorised access.

**Homepages**: A World Wide Web document. It can also be the first document for a specific web-server site.

**HTML (HyperText Mark-up Language)**: The language used to construct World Wide Web pages and links.

**HTTP**: HyperText Transfer Protocol is a network protocol that essentially provides the ‘address’ referencing capability of documents and information on the World Wide Web. Each site (node) and each web-page needs to be addressable across the internet. Thus, HTTP allows for the ability to hyperlink pages to one another.

**Hyper-linked**: Document and information that is context linked to other documents/information in a user-interface by selecting the text/graphic of interest.
Internet Service Provider (ISP): This is a telecommunications company that sells access to the Internet.

Internet: The global information superhighway that permits computers of all types and sizes all over the world to exchange data and information using standard languages and protocols.

Interoperate: The ability for which connected computers can cooperate with one another in a manner that is transparent to their users (the clients).

Intranet: A secure network, usually corporate, that uses Internet technology to integrate desktop, work group, and enterprise computing into a single cohesive framework.

Java Beans: Toolkit including user-interface controls that facilitates development of Java language applications.

Java: A general-purpose programming language for creating platform-independent programs or applets that can execute across the World Wide Web.

LAN: It is the Local Area Network that connects computers within a small geographical range (< 4km in distance).

Lease-line: A specialised communications link (usually a telephone line) that provides a high-speed full-time network connection to individual companies. Access is usually through established local telecommunications companies.

Open systems: The concept of non-proprietary hardware and software standards that will allow numerous vendors products to work with one another.

Proprietary server: A web-server that is proprietary in nature. Typically referring to a database server that has been extended to allow for Internet access.

Server API: This is an extension of the web-server so as to have an application program interface (API) to a database. Applications can be written that simply call the API.

URL: Universal Resource Locator is a standard reference for documents on the WWW (Internet). It serves to provide a unique address for the location of each document.

User login authentication: This is the sub-system that allows a user access to a password-protected system.

VRML: Virtual Reality Modelling Language is a language that supports interactive 3D applications on the Internet.

Web-page: A World Wide Web document that can be composed of text and multimedia information.

World Wide Web (WWW): It is the universal published collection of multimedia documents (or content) of all categories which are hyper-linked to one another on the Internet.
Answer key for self-test questions

Self-test 13.1

Organizations are seeking to have a presence on the Internet as a means of marketing to potential customers and to provide services for customers. Such efforts, which used to be seen as a competitive advantage, have now become standard business practice. In addition, intranet development has become an ideal approach towards linking and serving information services within an organization. In particular, the advantage of fast systems maintenance and the ease in learning to use a browser by a wide range of users makes the Internet a future trend in information systems applications.

Self-test 13.2

Standards are important as historically organizations have suffered from the inability to easily integrate or even relate different information systems together. Using the standards of the Internet technologies, organizations can use a wide range of applications development efforts and information delivery that are operable from any hardware/software environment supporting an Internet browser.

Self-test 13.3

Internet and intranet designs provide greater flexibility in terms of architecture than existing approaches. Specifically, it can be designed using 2- or 3-tier client-server architectures. The program logic can be executed at any location (client or application server) depending on performance requirements and other factors. In addition, with information modelled as documents, a standardised search-engine can be set up for use with an intranet to facilitate the search for relevant information.

Self-test 13.4

In theory, there is little difference in the development process for Internet/intranet designs over traditional systems designs. There is, however, greater encouragement for shorter systems delivery cycles. This has been driven by the competitive nature of global electronic commerce across the Internet. The methodologies of JAD, RAD, and prototyping has been a popular approach to systems development.
Self-test 13.5

One of the benefits of the user-interface aspect of Internet/intranet design has to do with the interface of the browser. The concept of hyper-linked documents and applications, bookmarks, and returning back to a previous link has simplified the navigation and use of the graphical user-interface. For most business/organizational users, the browser model of interface is the simplest to understand particularly compared to esoteric or custom user-interfaces for each different application. The immediate support of multimedia elements and content is also a compelling advantage in the user-interface.
Unit 13

Internet applications design
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