

## Chapter 2 Using Networks

A network is for sharing information using computers. Each computer is important, but sharing information over inter-connected computers has a different value.

In order to use a network, you need special hardware to connect to it. However, many recently released computers include wireless networking capability as well as the capability to connect to wired networks. Probably more people use computer with a network connection at present than without one.

A network is a convenient tool: it expands the information space of computers and users by leaps and bounds. However, at the same time the risk of getting into various kinds of trouble also increases. You may end up a victim of illegal activity, or on the other hand, you could cause trouble to others. Or an inappropriate email you have written may offend your teacher and causing you to lose credits as a result.

All of these troubles are caused by the careless use of networks and the services provided on them. You do not have to understand the technical background in detail, but you need to learn its fundamental principles. Coping with existing individual problems is important, but understanding the fundamental principles will help you deal with various problems generally.

### 2.1 Networks and the Internet

Information can be shared by connecting computers together. Specific applications of information sharing include file and printer sharing.

By sharing files over a network, you no longer need to physically transfer files to other computers by using a FD or other media. The absence of the physical transfer of data also means there are no time or space restrictions, thus opening up various possibilities. Email and the Web are also file sharing in a broad sense. Moreover, networking also allows multiple computers to share expensive equipment like printers.

As we have seen, networks were originally developed for use within an organization, in a geographically limited area. Such a network is called a Local Area Network (LAN). A network which inter-connects geographically distant LANs is called a Wide Area Network (WAN).

Among WANs, the worldwide WAN which anyone can access and that uses packet switching to exchange data according to Internet Protocol (IP) standards is called the Internet<sup>1</sup>. Various services, such as email, Web, file transfer and chat, are provided on the Internet.

Let us explain some of the technical terms used above.

A protocol is a communication procedure (rule). Calling a protocol used on the Internet a “standard” means it is widely published and anyone can use it. You do not need to conform to the protocol, but if you do not, you cannot communicate with anybody.

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<sup>1</sup> Note that the definite article “the” is used here.

To use IP, something similar to a unique telephone number needs to be assigned to each computer. This number is called an IP address. In the Internet, information is grouped in the form of packets. A packet may be likened to a parcel. It is just like sending 100 apples from Aomori Prefecture to Tokyo by putting 25 apples in each box and sending four boxes. And just like a parcel delivery service's package slip that has the sender's address and the delivery address, every packet has sender and receiver information added to it.

Packet switching is a system where disparate information in the form of packets is exchanged on a shared line. Packet switching is easier to understand when it is compared to circuit switching. See Figure 2.1 “Packet-switching System (left) and Circuit-switching System (right).”

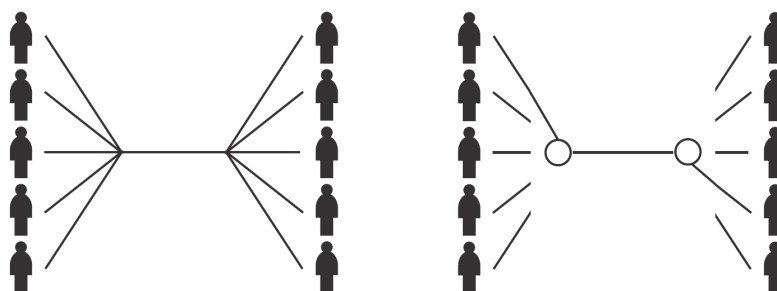


Figure 2.1: Packet-switching System (left) and Circuit-switching System (right)

One of the big differences between packet and circuit switching is that circuit switching takes up a whole circuit so that others cannot use that circuit while it is in use; while packet switching shares circuits that can be used by everyone. In Figure 2.1 (right), the top person on the left and the second person from the bottom on the right have monopolized the circuit so other people cannot use it.

Meanwhile, packet switching divides up data into chunks (packets), adds identification information to each chunk and sends them out over the circuit. By doing so, each circuit can be used efficiently.

On the other hand, there is a problem of sharing a circuit between many users: security. No one wants to use packet switching for sending highly confidential information. The sending or receiving of banking transaction or medical information unencrypted over the Internet is unthinkable. We are not saying that the Internet is a dangerous means of communication which is continuously being monitored<sup>2</sup>, but it is certainly a network that we cannot assume is safe.

In order to cope with such problems, we use encryption. Encryption is not only useful, but sometimes it is even convenient. Encryption comes in many different forms. This textbook explains different encryption methods which can be used in different scenes.

## 2.2 Services You Can Use on the Internet

Experiments leading to the Internet started in the United States in the 1970s and the Internet has continued to evolve since then. It was made available to the public commercially in 1991, allowing its use for general and commercial purposes.

The Internet started to attract attention in around 1995, mainly due to the spread of the World Wide Web. Because of the background, some people still view the Internet and the Web as being the same thing, but this is a misunderstanding<sup>3</sup>.

<sup>2</sup> There are also persistent rumors that the Internet is under constant surveillance.

<sup>3</sup> In fact, because the popularization of the Web attracts the convergence of a wide variety of services, the concept “Internet = Web” has gradually begun to form. But still, the Web is only one of the services provided on the Internet.

The Internet is only one means of communication and there are various ways of providing different services on the Internet. This chapter highlights only commonly used services. Try to understand their general characteristics.

The main basic models for service provision on the Internet are the client-server model and P2P (peer to peer).

The participants in the client-server model consist of a server, which provides a service and a client, which receives the service. A client requests the server for a service and in response the server provides the service. All the Internet services described in this book are in this form.

On the other hand, P2P establishes a service where terminal computers directly negotiate with each other. Typical P2P applications include file-sharing software, such as BitTorrent and Winny<sup>4</sup> and the Internet telephone application, Skype.

## 2.3 Email

Email is one of the most commonly used services on the Internet. Just like Waseda-net, you can read and write email using a Web browser, but ultimately, information is exchanged using the email framework. When using Multimedia Messaging Service (MMS) to send email from a cell phone to another carrier or an Internet email address, you also use this email service framework.

There are two main types of email program: MUA and MTA.

MUA is the abbreviation for Mail User Agent, an email client. These programs enables users to read, write and send email. Products such as Outlook Express and Thunderbird are well-known MUAs. There are a number of MUAs available, from commercial programs to free programs.

MTA is the abbreviation for Message Transfer Agent. It acts as a post office. MTA receives email from many users and delivers email between hosts. MTAs come in different forms, too, but since MTAs are generally managed by the system administrators of organizations or Internet Service Providers (ISPs), they will not be discussed here.

An MUA delivers email to an MTA, a post office, and requests that the MTA carry out subsequent delivery. Also since email is delivered to a place like a post office box, an MUA accesses the post office box to obtain the email.

The communication procedure which is used for sending email is the Simple Mail Transfer Protocol (SMTP) and the one used for acquiring email from a post office box is Post Office Protocol Version 3 (POP3). However, a web email system like Waseda-net, which uses a Web browser, uses a slightly different scheme.

Figure 2.2 “Structure of Email” shows a simplified version of actually received email.

	Delivered-To: waseda-hanako@waseda.jp Received: from smtp.email.s-idc.net ([58.89.214.202]) by vcheck.list.waseda.jp with ESMTTP; 14 Mar 2007 21:22:28 +0900
ヘッダ	Date: Tue, 14 Mar 2007 21:22:26 +0900 (JST) From: Your Name <yourself@ns.user01.camp.ila.or.jp> Message-Id: <200703141712.g6FHCTJY068565@w1234567.waseda.jp> To: waseda-hanako@waseda.jp
空行	
本文	This is a simple test for email.

Figure 2.2: Structure of Email

<sup>4</sup> Regardless of where you are, whether at home or on campus, you should never use Winny.

Email consists of a header and a main body. The top portion which is separated from the main body by a blank line is the header of this email. It will be longer if the entire header is displayed.

This entire header is attached to the body by an email delivery program, an MTA. Most of the lines of an email header begin with a word followed by a colon. Sometimes lines are too long, so they are wrapped over several lines and indented for easier reading. Let us briefly explain the meaning of the contents of the header.

“Received:” is added by an email server which is involved in the delivery. This part of the header is like the delivery history of the email. Going through one email server counts as 1 “hop” and an extremely large number of hops will result in an error.

“Date:” indicates the date and time when the email was first sent. “+0900” means that the time is 9 hours ahead of Coordinated Universal Time (UTC). JST is the abbreviation for Japan Standard Time. “From:” indicates the sender of the email. Sometimes the sender is displayed using a full name as in the above example. “Message-ID:” is identification data which can uniquely identify the email. Finally, “To:” is the email address of the recipient.

Out of the header information, a user can set the following<sup>5</sup>.

Destination: To:, Cc :, etc.

Subject:

To put it another way, these items must be set carefully.

“To,” “Cc,” and “Bcc” each specifies email addressees to which the email is delivered to. “To” indicates the respective address is the main destination. “Cc” is an abbreviation for Carbon Copy, indicating that the cc’ed addresses are not the main destination but the email is being sent to the addresses for reference. These two have the same function in the sense that an identical email is sent to the indicated addresses, but the sender’s intention is different. “To” sends the email to the exact recipients the sender wants to send it and “Cc” sends the email just for reference.

If these email addresses are wrong, the email will not reach the destination. The email may even be received by the wrong person. That may not good for either the sender or the recipient who has received the email by mistake.

What the “Subject” is called varies depending on the email software used, but whatever it is called, it means the same thing. The sender needs to summarize the purpose of the email briefly and enter it there. For the Subject, the sender should not use meaningless titles like “Request” or “Hello.” See Figure 2.3 “Waseda-net Mail Email List.” This shows a list of received emails, using Waseda-net mail as an example.

メッセージ3 通中 1 通目から 3 通目を表示

	送信者	件名	日付
<input type="checkbox"/>	system@list.waseda.jp	<a href="#">Waseda-netメールのシステム変更について</a>	03/10 09:36
<input type="checkbox"/>	BBS返信	<a href="#">【Oic】BBS投稿【特になし】への返信</a>	03/10 11:54
<input type="checkbox"/>	BBS返信	<a href="#">【Oic】BBS投稿【ありがとう☆☆】への返信</a>	03/10 14:56

Figure 2.3: Waseda-net Mail Email List

This picture shows only three email messages, but imagine you have several dozens or even several hundred-email messages. Messages whose Subject lines say things like “Request” or “Hello” are unhelpful and very likely to be given a low priority by their recipient. A blank subject is out of the question.

The main body follows the header. In emails, the main body starts from the first blank line and ends at the last line of the file. Only text (in Japanese, ISO-2022-JP) is contained in the main body. Using Multipurpose Internet

<sup>5</sup> In general a user edits these two items, though other elements can be configured, too.

Mail Extensions, or MIME, you can attach image, audio and video files to email (although the actual work is handled by your MUA). Although by using HTML, you can also send email messages which take advantage of the expressiveness of HTML, you should not use HTML email<sup>6</sup>.

Regardless of whether you use SMTP, POP3 or even web mail, as a rule email communication is not encrypted. Therefore, email is vulnerable to interception.

In case of Waseda-net mail, email is encrypted when you access your email from a Web browser. Figure 2.4 “Address Bar When Accessing Waseda-net Mail” shows the location bar of a Web browser when Waseda-net mail is accessed via Waseda-net portal. This example uses a Web browser called Firefox, but Internet Explorer displays a lock icon in a similar way. The URL shown on this address bar is an example. As of February 2009, Waseda University is considering whether to change its email system. So this URL may change.

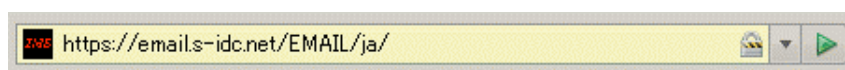


Figure 2.4: Address Bar When Accessing Waseda-net Mail

This encryption uses a system called Secure Sockets Layer or SSL. SSL ensures two things: (1) secure communication with other party and (2) the other party is the intended party.

You can access Waseda-net mail without using a Web browser by using an email client such as Thunderbird, and send and receive email via SMTP and POP3 respectively using SSL. Figure 2.5 “Example Settings to Allow POP3 Access to Waseda-net Mail Using SSL” and Figure 2.6 “Example Settings to Allow SMTP Access to Waseda-net Mail Using SSL” (p. 38) show example settings for Thunderbird. The user name and the server name in these figures are example names. Replace these sample names with the user name and server name given by the university, respectively while referring to the figure.

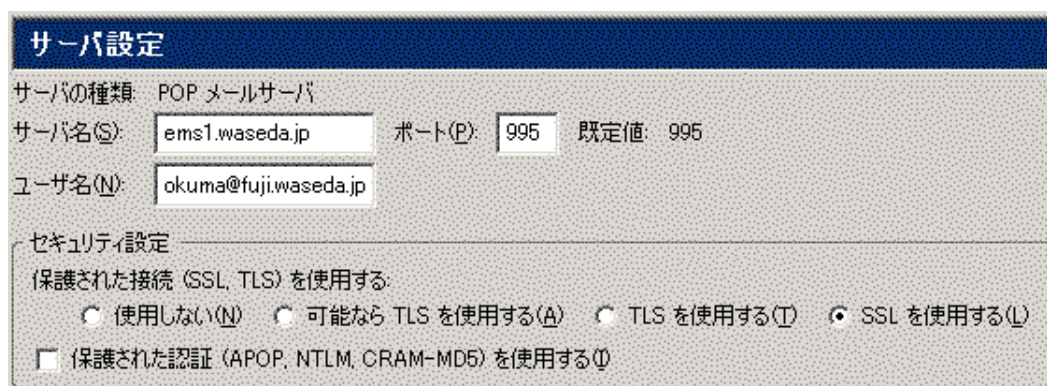


Figure 2.5: Example Settings to Allow POP3 Access to Waseda-net Mail Using SSL

These settings will not particularly inconvenience you in any way. So, set your email client to use encryption unless you have a special reason not to.

Refer to Chapter 3 “Information Ethics” (p. 41) for more about email.

<sup>6</sup> Since malware, such as computer viruses, can be distributed via such attachments, HTML email is often a subject of controversy. Detailed explanation has not been included due to lack of space, but for various security reasons you should not use HTML mail.

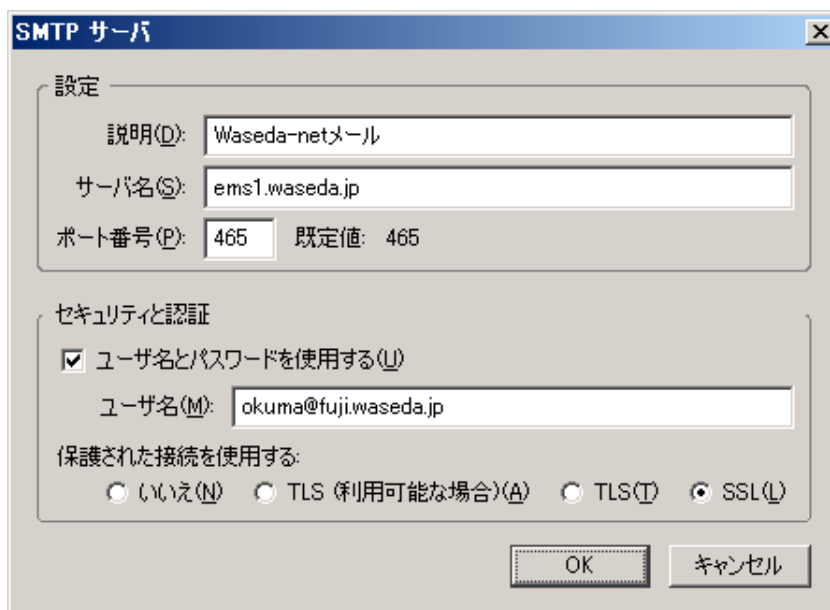


Figure 2.6: Example Settings to Allow SMTP Access to Waseda-net Mail Using SSL

## 2.4 World Wide Web

The word “web” in the term “World Wide Web” (Web) refers to a spider’s web. This word signifies a network of information spreading out on a global scale.

The Web is a communication service of the client-server model and uses Hyper Text Transfer Protocol (HTTP) as its communication protocol, and Hyper Text Markup Language (HTML) as the data format used for data transmission. Refer to Chapter 8 “Introduction to Web Publishing” (p. 115) for more information about HTML. It does not matter whether you use Internet Explorer, Firefox or another Web browser, but you do need a Web browser to view Web pages<sup>7</sup>. A Web browser requests information from a computer called a web server and in response that web server provides communication. Requests from a client are made in the standard format URL<sup>8</sup> or URI<sup>9</sup>. An example URL is “http://www.waseda.jp/index.html.” This string means: “get a file called index.html from the web server called www.waseda.jp via HTTP.”

http://	www.	ila.or.jp/	index.html
プロトコル	サーバ	ディレクトリ	ファイル名

ftp://	ftp.	ring.gr.jp/pub/GNU/	README
プロトコル	サーバ	ディレクトリ	ファイル名

Figure 2.7: Example HTTP and FTP URLs

Figure 2.7 “Example HTTP and FTP URLs” shows URL examples<sup>10</sup>.

<sup>7</sup> In Japan these are sometimes called “home pages,” but this book calls them Web pages.

<sup>8</sup> Abbreviation of Uniform Resource Locator.

<sup>9</sup> Abbreviation of Uniform Resource Identifier. URI is a broader concept than URL and includes Uniform Resource Name (URN).

<sup>10</sup> This chapter uses different terms from those used in Chapter 8 “Introduction to Web Publishing” (p. 115) to facilitate reader understanding. Refer to Chapter 8 if you want more exact information.

These requests are used for various purposes besides Web. Examples include email, TELNET and File Transfer Protocol (FTP). A mechanism, ports, is used to distinguish simultaneous communications over these services at the same time. Usually ports 20 and 21 are assigned to FTP and port 80 is assigned to HTTP as used by Web. For example, in the case of the Web, program called web servers wait (listen) for requests to be sent from clients over port 80.

To be more accurate, you can assign a port other than port 80 to HTTP. Some people purposefully choose an HTTP port that is not port 80. Since most Web browsers try to access only port 80 unless instructed otherwise, if a different port is used for HTTP, the URL is written as follows: a domain name followed by a colon followed by the port number, for example as “http://www.waseda.jp:8080/”.