

System Dynamics and The Internet

by

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System Dynamics in Education Project

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Abstract

As the 21st century approaches, the Internet will be an important resource for system dynamists. This paper will describe the new computer server where a suite of Internet tools are housed and maintained at MIT by the System Dynamics in Education Project under the supervision of Professor Jay Forrester. These tools will be available to anyone with an interest in systems thinking and system dynamics.

This introduction to the field of electronic networking will mention the various methods of connecting to the Internet and touch upon some of the most popular uses of the Internet. We will expand this discussion into how the Internet can be used for the rapid exchange of information.

One of the most intriguing capabilities of the server will be the sharing of computer models. These computer simulations can be downloaded, evaluated, modified, and sent back or on to other people. The use of technology will facilitate discussion, debate, and the exchange of ideas.

The MIT system dynamics server can be reached through the World Wide Web, FTP, Gopher, and e-mail. Specific detail will be given about how to access the server, and how to use each of its components. Since technology is changing rapidly, future plans for the expansion of the server will be discussed as well.

A summary of what papers, models, announcements, and resources are presently available on this system dynamics server will be presented. In addition, we will discuss other system dynamics resources available on the Internet, such as servers maintained by the System Dynamics Society and other institutions around the world.

The technology transfer that the Internet allows can benefit all those who are interested in the field of system dynamics including model building and sharing of experiences. The Internet is an efficient, often inexpensive means of communication, which can be important for the growth of system dynamics in the future.

System Dynamics in Education Project

The System Dynamics in Education Project (SDEP) was started in 1990 at MIT as a research group which would focus on the use of system dynamics approach to teach students in kindergarten through twelfth grades. As part of SDEP's current effort, a computer server offers information on who is doing work in the field and also contains a few complete research papers that can be transferred to your computer. The Project Director is Professor Jay W. Forrester.

What is the Internet?

The Internet is an international network that carries information between millions of computers. Most universities and major companies have their computers connected to the Internet. They use the Internet as a means of cost-effective information sharing. Large amounts of data can be sent relatively quickly. If an employee in a New York office wanted to send a spreadsheet that he/she was working on to an employee in a Los Angeles, he/she can send it over the Internet nearly instantaneously. The alternative would be for that person to put the file on disk and either mail it through the postal mail or courier.

The term Internet is abstract. There is nothing that you can physically put your finger on and call it the Internet. Perhaps the best way to envision the Internet is to start on a smaller scale. Most people who use computers in the workplace or school are familiar with local area networks

(LANs). They are small groups of computers, usually in the same room or building, that are connected to each other. Several LANs can be connected together to form a “network” of networks. These networks of networks can be connected, and so on. This idea is implemented on a much higher scale to form the Internet. Information travels from one computer on the Internet to another computer on the Internet by somehow traversing the mesh networks.

Exactly what kind of information is carried on the Internet then? It used to be that only scientific and defense research was allowed on the Internet, but now the Internet has shifted from government funding to private funding. As a result, there is now a distinct commercial presence on the Internet. With that commercial presence came the presence of the general public. Now the Internet is a household word.

There are several forms in which information is shared on the Internet. The three most important are electronic mail (e-mail), file transfer protocol (FTP), and the World Wide Web (WWW). E-mail is what the name implies. Messages consisting of text can be sent from one person to another very quickly. An e-mail sent from New Jersey arrives in Boston within seconds. An e-mail sent from Sweden arrives in Boston within minutes.

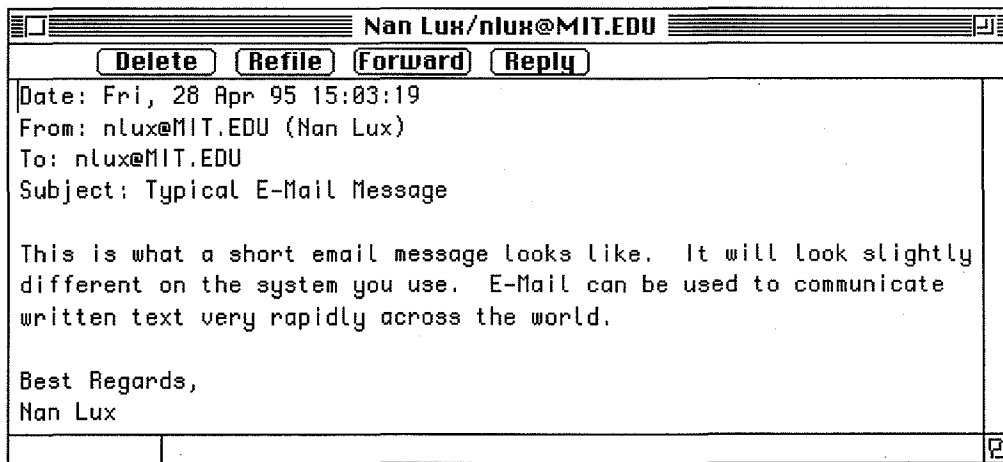


Figure 1 - A typical e-mail message

File transfer protocol (FTP) is the standard method of transferring computer files from one computer on the Internet to another. Files of almost any type and size can be transferred. FTP is not limited to text like e-mail is.

The World Wide Web (WWW) is a program that tries to make the Internet easier to use. The Web consists of documents that are located on many machines all over the Internet. Certain portions of the text of these documents can be "links" to another document which may reside on another computer. When a user is reading a document, he can click on a link and the document that the link points to will automatically appear on the screen.

What is SDEPNet?

SDEPNet (System Dynamics in Education Project Network) makes use of these three Internet resources. The information that one can find on SDEPNet will be useful for the educator, modeler, and student alike. SDEPNet takes advantage of e-mail lists, FTP, and WWW. Our e-mail list, "k-12sd," is home to discussion of a range of system dynamics/systems thinking ideas as applied to K through 12 education. Our FTP site contains many files, including papers, models, and utilities. Our WWW page contains more papers, as well as links to other system dynamics/systems thinking pages on the web.

How to Get To the Internet

In order to see the SDEPNet, you need to first access the Internet. There are a number of ways to access the Internet from your computer. Perhaps the most common form of Internet access is "dial-up" access. In this type of connection, the user has an account on a large system at a university or corporation, and accesses it by dialing into the system via a modem or through the local area network. The session is text based. With this type of connection, you can take advantage of the e-mail list and FTP site. However, while you will be able to read certain parts of the WWW page, you will not be able to see the graphics associated with them.

Many Internet service providers are supplying what are called SLIP or PPP accounts. This technology lets users with personal computers dial into the service provider and get full Internet connectivity without going through another system. Users with these types of accounts can take advantage of all the Internet resources.

Another popular means of Internet connection is through one of the commercial on-line services, such as America On-Line, CompuServe, Delphi, or Prodigy. As of this writing, all of these on-line services have the ability to exchange e-mail with the Internet. However, only America On-Line and Delphi offer the ability to FTP, and none offer the ability to browse the WWW. All of these services are planning on upgrading their Internet services in the future, but for now, they are limited.

The ideal but least common form of Internet connectivity is what is called a "fast" connection. This is where a user's computer is part of a LAN that has its own connection to the Internet. Workstations on a campus or student's or faculty member's computers that are networked usually have this type of connection. This type of connection is extremely fast.

To find out about what connectivity options are available to you, you can contact the Information Systems personnel at your institution. If you are not part of an institution that has such services, you can find private Internet service providers that will help you get connected to the Internet.

Hardware

As long as your computer has an Internet connection of some sort, then you can use SDEPNet regardless of what computer you have. However, many of the models that are found on SDEPNet will require you to have the software program it was modeled in (i.e.: STELLA, Vensim, etc.). As a result, the most common user will have an IBM compatible or Apple Macintosh computer. However, SDEPNet can be used to exchange Dynamo and other models that were designed for mainframe/workstation applications as well.

Software

Once you have an Internet connection, you need to have certain software to be able to access SDEPNet. For UNIX and mainframe users, this software is already built into the operating system. For personal computer users, you will have to obtain the software from the Information Systems personnel at your institution, or on your own. You can e-mail Eric Choi (echoi@mit.edu) for assistance.

The one piece of software that is absolutely necessary for all computers connected to the Internet (other than through dial-up access) is the TCP/IP stack. TCP/IP is the language that all computers speak on the Internet. There are many TCP/IP software packages on the market, and the one you use will depend on your computer, and what the administrators of the network you are using prefer. TCP/IP is built into all UNIX machines. The TCP/IP software for the Macintosh is known as MacTCP, and comes standard with System 7.5 and later. If you run System 7.1.2P or earlier, you can obtain MacTCP from most Macintosh software vendors. There are many choices of TCP/IP software for IBM compatible users, but perhaps the most common is Novell's LAN Workplace for Windows.

You will need an application for each of the three resources of SDEPNet. For e-mail, we highly recommend using Eudora for IBM compatibles and Macintosh. Eudora is a commercial software package, but shareware versions are available through on-line services and other FTP servers. UNIX/mainframe users would use whatever mail facilities they would normally use.

For FTP on a Macintosh, Fetch software is a public domain shareware. There are many FTP applications for IBM compatibles. On this platform, the TCP/IP software usually includes an FTP application. On UNIX/mainframe computers, there is an "ftp" command that can be entered at the prompt.

For WWW, you need a program called a "web browser." Netscape Navigator is one of the easiest to use. Netscape Navigator is available for almost any platform. Netscape Navigator is a commercial product published by Netscape Communications Corporation, but free evaluation copies are available over FTP. Dial-up users cannot run this program because their connections are not true TCP/IP connections, but they can use a browser called Lynx. Lynx lets you read pages on the web, but it is text based, and does not provide the graphics support that Navigator provides. There are many different applications available for each of the three resources. If you have difficulty acquiring software, please e-mail Eric Choi at echoi@mit.edu.

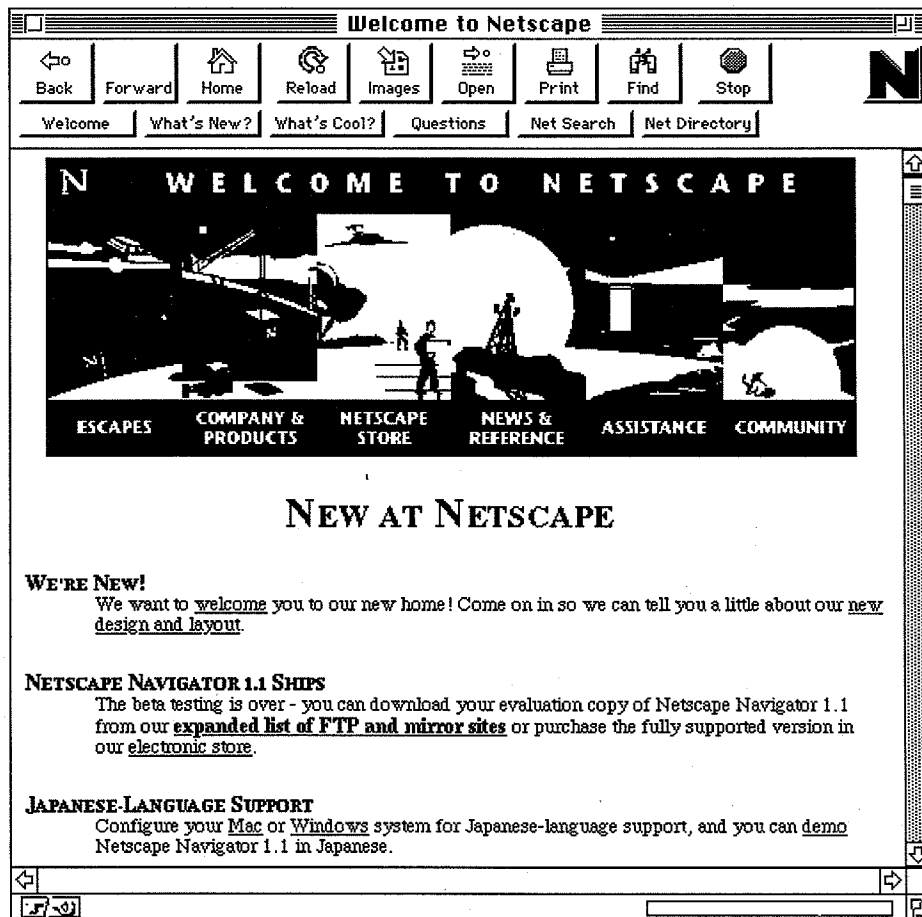


Figure 2 - Sample from Netscape Navigator

System dynamics and e-mail

There are a several interesting discussion groups that connect using e-mail. One such e-mail "list" is especially for people interested in using system dynamics in pre-college education. To be put on this list, e-mail your name and address to the list administrator, Nan Lux (nlux@mit.edu). Once

Parallel Program

your name is put on the list, you will start to receive e-mail from the list. If you want to send a message to the whole list, address it to **k-12sd@sysdyn.mit.edu**. At the time of this writing there are about 200 members on the list.

Keep in mind that the messages you receive from the list are not directed towards you specifically. They are being sent to the list as a whole. The purpose of the list is to have discussion. If you would like to send a message to the list and contribute to the discussion, simply compose a message and address it to **k-12sd@sysdyn.mit.edu**. Your message will automatically be forwarded to everyone on the list.

With all e-mail lists, please be careful to whom you address your e-mail messages. If you want to reply to only the author of a message, make sure that your reply is addressed to only the author, and not the list. Also, when sending messages to the list, take into consideration that many people will be seeing it. You do not want to annoy others or embarrass yourself by having private discussions on the list.

Another useful e-mail discussion group (around 300 members) for the field of system dynamics is administered by Bob Eberlein (vensim@world.std.com) in Massachusetts. The purpose of this list is to promote discussion around issues in building and using system dynamics models. To join the mailing list, send an e-mail message to:

majordomo@world.std.com

containing the following text in the body (the subject line is ignored):

subscribe system-dynamics
end

A third e-mail discussion group is moderated by Richard Karash (rkarash@world.std.com) and focuses on organizational learning and systems thinking. With 1200 subscribers, this active newsgroup is easy to join. Simply e-mail:

majordomo@world.std.com

Ignore the subject line and begin the message with

info learning-org
end

FTP Servers

There are several computers called FTP servers around the world that offer system dynamics papers which you can transfer to your computer, and then read on your screen or print. This is an important area, offering instant access to both the newest manuscripts and also some classic articles from the past. Here is a description of how to connect to the server at MIT.

Start your FTP application, and open a connection to **sysdyn.mit.edu**. Once connected, you will be asked for a Name and Password. When prompted for your Name, enter "anonymous." When prompted for a Password, enter in your e-mail address. This is for our information only.

Figure 3 shows what an interaction with our FTP server would look like over a dial-up or UNIX connection. If you are using an FTP application which has a graphical user interface such as Fetch on the Macintosh or Rapid Filer from LAN Workplace for Windows, it will look different than this, but the idea is the same. Instead of using change directory (cd) and list (ls) commands, all of that is done by pointing and clicking.

```
echoi@elysium% ftp sysdyn.mit.edu
Connected to sysdyn.mit.edu.
220 Peter's Macintosh FTP daemon v2.3.0 (Unregistered) awaits your
command.
Name (sysdyn:echoi): anonymous
Password (sysdyn:anonymous):
331 Guest log in, send Email address (user@host) as password.
230-You are being logged in as anonymous.
```

```

Please use your e-mail address as a password so we can get an
idea of who uses the system! Thanks!
Welcome to the System Dynamics in Education FTP server!
Documents being distributed by SDEP can be found in the "sdep"
folder.
Documents being distributed by the System Dynamics Society
can be found in the "sds" folder.
Documents pertaining to the Creative Learning Exchange can be
found in the "cle" folder.
Utilities that you may need to view the files found on this server
can be found in the "util" directory.
We are still under construction. If you have any questions or
suggestions, please e-mail echoi@mit.edu
230 Anonymous login to 1 volumes. Access restrictions apply.  "/pub".
Remote system type is MACOS.
ftp> ls
200 PORT command successful.
150 ASCII transfer started.
-----r--          332      526      858 Jan 18 23:48 !Folder Info
drwxrwxr-x          folder      2 Mar 20 14:18 cle
drwxrwxr-x          folder      1 Feb  8 14:59 help
drwxrwxr-x          folder      8 Apr 20 12:46 sdep
drwxrwxr-x          folder      4 Feb 10 05:36 schmailing
drwxrwxr-x          folder      6 Apr 20 12:43 util
226 Transfer complete.
ftp> cd sdep
250-This directory contains material made available by the
System Dynamics in Education Project.
Contact Nan Lux (nlux@mit.edu) with any questions.
250 "/pub/sdep" cd successful.
ftp> ls
200 PORT command successful.
150 ASCII transfer started.
-----r--          332      144      476 Apr 20 12:47 !Folder Info
drwxrwxr-x          folder      11 Apr 20 12:39 hqx
drwxrwxr-x          folder      1 Feb  8 14:59 html
drwxrwxr-x          folder      4 Feb 10 16:49 k-12all
drwxrwxr-x          folder      2 Apr 20 12:53 reviewed
drwxrwxr-x          folder      6 Feb  8 14:59 roadmaps
drwxrwxr-x          folder      1 Feb  8 14:59 stella
drwxrwxr-x          folder      10 Feb 8 14:59 word
226 Transfer complete.
ftp>

```

Figure 3 - A sample FTP interaction over dial-up

As you can see from the above (Figure 3), the FTP server **sysdyn.mit.edu** houses material for three groups: the System Dynamics in Education Project (RoadMaps), the System Dynamics Society, and the Creative Learning Exchange. The SDEP portion of the server is maintained by Eric Choi (echoi@mit.edu). The System Dynamics Society portion of the server is maintained by Bob Eberlein (vensim@world.std.com). The CLE portion of the server is maintained by Lees Stuntz (stuntzln@tiac.net).

World Wide Web page

One area of the Internet is called the World Wide Web (WWW) where each "homepage" has an address, just like each person has an e-mail address. Web page addresses are referred to as URL's (Universal Resource Locator). An important feature of these "home pages" is the ability to "click"

on links—any text you see in a different color and underlined. If you click on a link, another page will show up. From the initial page, there are links to other pages maintained by the SDEP, as well as pages maintained by other people around the world.

Here are some examples of home pages that relate to system dynamics.

- SDEPNet WWW Page (Eric Choi, echoi@mit.edu, Administrator)
<http://sysdyn.mit.edu/>

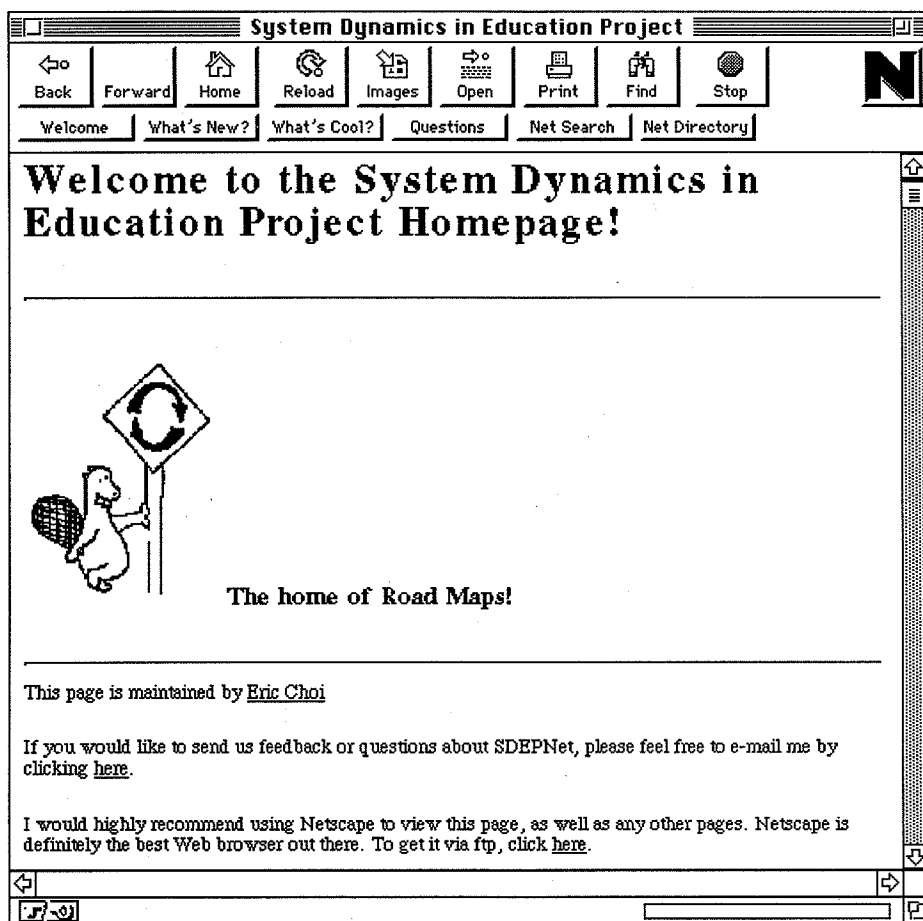


Figure 4 - An example of viewing our WWW home page.

Users will find information about RoadMaps and other systems thinking/system dynamics resources. Among these resources are other WWW pages maintained around the world. These include:

- STELLA Homepage (Robert Gotwals, gotwals@mcnc.org, Administrator)
<http://tfnet.ils.unc.edu/~gotwals/stella/stella.html/>

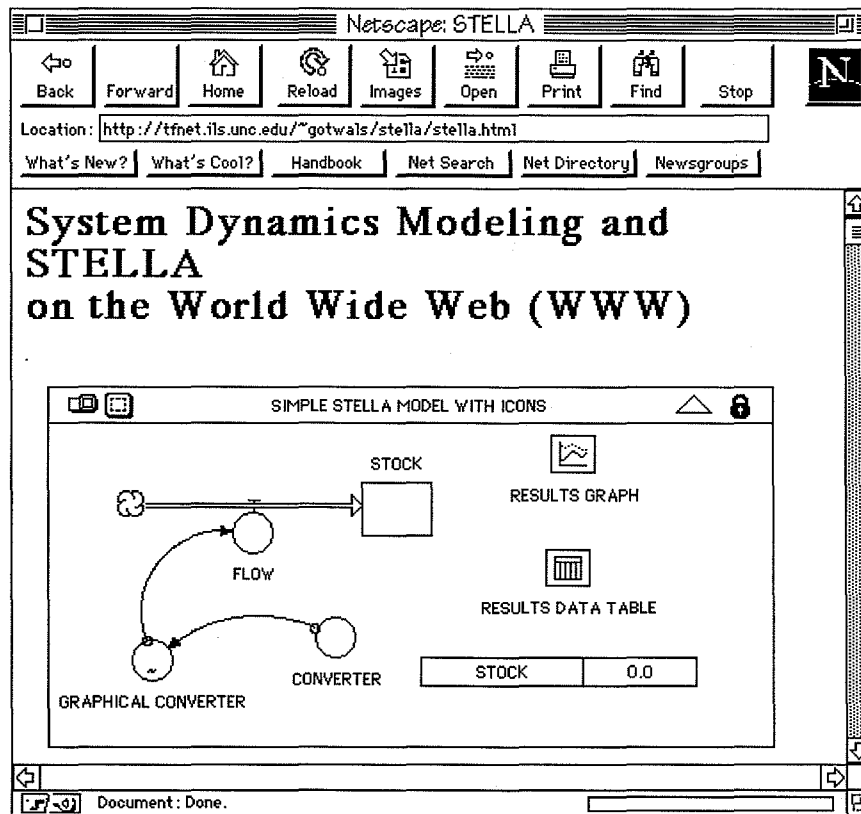


Figure 5 - the STELLA Homepage

- Serendip Homepage (Paul Grobstein, pgrobste@brynmawr.edu, Administrator)
<http://serendip.brynmawr.edu/>
- CC-STADUS Project WWW Page (Scott Guthrie, sguthrie@teleport.com, Administrator)
<http://www.teleport.com/~sguthrie/ccstadius.html>

Summary

This is a brief introduction to the fascinating world of electronic communication. We feel that the field of system dynamics can profit by the immediate exchange of ideas using e-mail services. Another important feature is the ability to access and exchange working simulation models around the world almost instantly.

How to get in touch with SDEPNet

Please send suggestions, comments, questions about SDEPNet to Eric Choi (echoi@mit.edu) or Nan Lux (nlux@mit.edu).