A549 cells or using calf thymus DNA, they found that cells provide about 100-fold protection to their DNA. They also applied the method to demonstrate that eukaryotic cells turn on inducible DNA repair in response to low-level irradiation. A549 cells treated with 0.25 Gy 4 hours before a 2-Gy irradiation showed an enhanced rate of initial thymine glycol removal compared to A549 cells that were not pretreated.

Armed with such a specific and sensitive assay, one can only begin to imagine some of the possibilities. For instance, scientists should more easily detect the type and frequency of DNA lesions in living tissues after exposure to environmental radiation or chemical carcinogens. Monoclonal antibodies targeted at other base lesions could be used to look at a series of DNA or RNA lesions. The system could also be used to monitor protein adducts or drug metabolites, as long as monoclonal antibodies are raised to specific moieties. There is little doubt that, over the forseeable future, we will see an explosion in the number of reports making use of this seminal technique in the various fields of life sciences, from toxicology to molecular biology.

–Richard Peters and Robert Sikorski

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Internet Connectivity

NET TIPS

Over the past few months, we have looked into the details behind a variety of Internet topics, ranging from opening files transferred via the Internet to finding sites on specific topics. Although it is obvious that the Net will find an ever increasing role in the day-to-day activities of scientists, it is not obvious today how any given scientist will actually connect to the Net in the future, particularly when the scientist accesses the Net from home.

For discussion purposes, all of the hardware and software involved in a typical user's access to the Internet can be grouped into a client (your PC), a connection (hardware and software for access), and a server. This month, we look into competing connection technologies that are likely to dramatically speed the way information is piped to your desktop. We organized the technologies in order of increasing speed, which is measured in Kbps (1000 bits per second).

1. *POTS*. The standard "plain old telephone service" connection to the Internet is the slowest, but most ubiquitous. When you dial up to an Internet service provider (ISP) or your university, you are using POTS. Currently, modems that run at 28.8 Kbps are the most common POTS gateways to the Internet. The top speed of modems today is 56 Kbps, but they will only work at that speed if your ISP has special hardware on their end, so you should check into this before you make the investment. 56K modems cost between $100 to 250 and work on a regular phone line. Several include ISPs include 56K modem support in their basic pricing; others will charge about $10 more per month to provide 56K access.

2. *ISDN*. An integrated services digital network (ISDN) connection to the Internet can usually be obtained from a local telephone company. ISDN coverage varies greatly around the country and you should contact your local phone company to check for availability and pricing. Once in service, an ISDN connection can be treated like an additional phone line and used for making ordinary calls. For the Internet, the use of a special modem connects a computer to an ISDN line and the Internet at maximum speeds of 128 Kbps. A nice feature of ISDN is that you can split it into different channels, allowing you to access the Net and make a telephone call at the same time. ISDN modems can be difficult to set up and configure, and the monthly service fees can be expensive. An ISDN adapter costs between $400 to $800. The set-up fee that your local phone company will charge is about $100, then you will have to pay them $10 to $20 per month. Your ISP also has to support ISDN and will charge you between $20 to $40 above their basic service rate.

3. *Satellite*. Next on our list of connection options is the use of a small, 21-inch satellite dish. Although this may sound high-tech, the service does exist as a commercial product and is accessible throughout most of the United States. The advantage of satellite-based Internet connections (400 Kbps maximum speed) is that there are few geographic limitations to their use. You simply point the dish at a defined angle and direction in order to target the service provider's orbiting satellite. Then, you install a card in your PC that connects the dish to the computer. Satellite Internet connections won't be cheap, since you need a POTS connection as well. A phone connection is also needed because the outgoing request is actually sent via a POTS line. In fact, all outgoing messages—including file transfers—must be done through the slower phone connection. Depending on quality of access, service can cost from $100 to $200 per month.

4. *Cable*. The same cable that delivers TV channels to your home can also deliver high-speed Internet connectivity. Speeds obtained by a cable modem connection are impressive and can theoretically reach 10 Mbps. Cable modems use co-axial cables to transmit data. The effective download speed is between 1.5 to 3 Mbps, rivaling the speed form T1 lines. The speed for uploading documents is usually less than that. The major drawback of cable modems is their lack of availability. Many areas are not yet wired with the fiberoptic network required to run cable modems. While your speed will be less depending on how many multiple users are configured in your neighborhood, cable modems provide the fastest access in the home setting. A cable modem may even be faster than the access a scientist has in their university lab. Another bonus is that you don't have to dial up to connect a cable modem to the net. It is always on. Given their rather inexpensive price, less than $50 per month (with the cable TV channels), this method is hard to beat.

5. *DSL*. The digital subscriber line is a service that is provided by your telephone company. With maximum speeds at about 8 Mbps, a DSL line is similar to a cable modem. DSL uses conventional copper phone lines. There are several DSL varariations: high-bit-rate DSL (HDSL), symmetric or single-line high-bit-rate DSL (SDSL), very high-bit-rate DSL (VDSL), dedicated ISDL DSL (IDSL), and asymmetric DSL (ADSL). Set-up fees and modem charges can total $1000 and monthly charges are about $200 per month at the moment. Like cable connections, a DSL line is always live on the Net. DSL service is limited and can be expensive to set up, but this technology has the potential for widespread use.

6. *Internet2*. The Internet is being redesigned by a group of more than 120 U.S. universities with the goal of providing high bandwidth connections that can be used for research purposes. Internet2 will not replace the current Internet, but it will serve as a platform to achieve communications speeds that are 100 times faster than currently possible. For more information, check out the Internet2 Web site at www.Internet2.edu. Here you can find out about current demonstration projects that have applied Internet2 technology to topics such as three-dimensional brain mapping, molecular modeling, microscopy, and virtual reality anatomy.

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