various pieces of the information infrastructure. But this massive construction project lacks a chief architect and a basic blueprint.

The NRC report represents an attempt to describe in some technical detail what the overarching framework should look like. It calls for the federal government to play a role in guiding this endeavor, in part to ensure that the interests of the library, research, and educational communities don't get overlooked in the rush to commercialize the system.

"We are at a critical juncture," Kleinrock says. "The technology decisions we make today ... will shape the future of the [National Information Infrastructure]. If we do a proper job . . . there will be lots of room for growth and a consistent, long-term benefit to society in general."

The open data network proposed by the panel incorporates a sharp division between those who supply various services — such as electronic mail, home shopping, or videoconferencing — on the network and those who provide the pathways — the wires, cables, microwave links, and associated equipment — over which these services ride.

Such an interface, or boundary, allows the two parts to evolve independently, says panel member David D. Clark of the Massachusetts Institute of Technology.

He likens this division to what a driver faces in a car. Whatever lies under the hood is hidden away from the driver, who sees just the steering wheel and the brake and accelerator pedals. The manufacturer is free to change the engine and make other improvements to the car, yet the vehicle can still be driven by anyone.

Modeled on the openness of Internet, the open data network "should be able to carry any kind of service developed by any kind of source to any kind of customer in an easy, accessible fashion," Kleinrock says.

"The Internet is a [worked-out] example of precisely how to do this," Clark says. Instead of targeting a particular service, it provides an environment available to a broad spectrum of users.

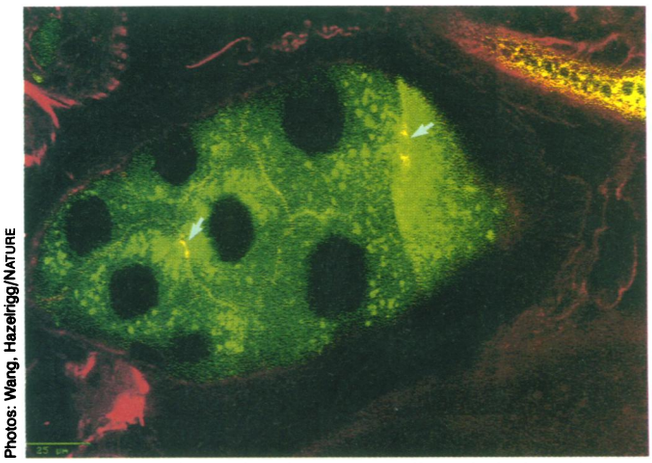
This openness contrasts with the specialized infrastructure currently provided by cable and telephone companies, which is geared to specific services, such as providing video signals or voice communication. Clark's hope is that these companies can be persuaded to reengineer their systems to carry the digital signals of an open data network in addition to their normal services.

"This is one of those places where market forces alone are not necessarily going to get us to the right place," Clark says. Although the government can't build the information superhighway or dictate its architecture, "it is reasonable for the government to articulate a vision of what this infrastructure should do and to find ways to try to bring that vision into existence." *—I. Peterson*

Jellyfish's glow reveals head's beginnings

Four months ago, a fluorescent green worm appeared on the cover of SCIENCE. Columbia University's Martin Chalfie and Douglas C. Prasher, now at the U.S. Department of Agriculture at Otis Air National Guard Base in Massachusetts, had succeeded in turning a fluorescing jellyfish protein into a new kind of biological tracer. With it, they had lit up parts of the nervous system of *Caenorhabditis elegans*.

That report also lit up Columbia's switchboard. The university and Chalfie have received some 1,000 requests for the gene that codes for this marker, called green fluorescent protein (GFP).



Photos: Wang, Hazelrigg/NATURE

Within this oval egg chamber, nurse cells with dark nuclei have sent hybrid GFP-exu protein (light green) through ring canals (yellow, arrows) to the maturing egg at right.

This week, a second Columbia team used GFP to illuminate the movements of molecules that help eggs transform into complex organisms. "Everyone can see this technique is going to be amazingly useful," comments Edwin Stephenson, a developmental geneticist at the University of Alabama in Tuscaloosa.

In cells, DNA passes instructions for making proteins to RNA, a messenger molecule that travels from the nucleus to where the cell eventually manufactures the proteins. In the egg chambers of fruit flies, that RNA also moves from nourishing cells called nurse cells to the maturing egg, traveling through cytoplasmic pathways called ring canals, says Columbia's Tulle Hazelrigg.

The egg concentrates certain RNA molecules in specific places. There they wait until the embryo begins to develop. Then, those RNA messages call for the production of a protein called bicoid. A high concentration of bicoid in one part of the embryo activates the genes needed for development of the head and thorax, says Hazelrigg.

To get where they're supposed to go, the RNA molecules encoding the bicoid message seem to need the help of a protein called exuperantia (exu). Without exu, RNA disperses evenly throughout the egg rather than gathering near the anterior region, says Hazelrigg.

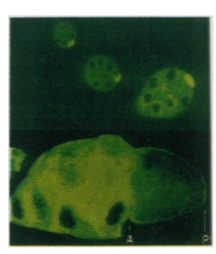
For their experiments, Columbia's Shengxian Wang and Hazelrigg joined the gene for GFP to the fruit fly gene that codes for the exu protein. They then inserted this hybrid gene into mutant fruit fly germ cells that lacked the exu gene. With the new gene, the germ cells developed eggs and nurse cells. As the nurse cells made exu, they also made fluorescing protein, lighting up this exu, the researchers report in the June 2 NATURE.

"Every molecule of exu is tagged," Hazelrigg says. Usually, scientists use tags attached to antibodies, molecules that home in on particular molecular targets. But antibodies miss some targets and may show up in places where no target exists, Hazelrigg says. Also, to use labeled antibodies, scientists must kill the cells. "We can see [GFP] in fixed and live cells," she adds.

In some experiments, Wang and Hazelrigg added a drug that disrupts microtubules, part of the cell's internal transport system. In those cells, exu failed to localize. The addition of a different drug led to the formation of new microtubules — and subsequently an accumulation of glowing exu — at those sites, they report. They suggest that microtubules are important to exu's movement to particular spots.

"It's really nice work because it gives a more detailed and higher-resolution picture of RNA localization mechanisms," says Stephenson. "The technique is going to allow people to look at processes in real time, in living organisms."

Scientists want to use this jellyfish protein in many organisms because it needs no helper enzymes to get it to glow, just blue light, says Chalfie. *—E. Pennisi*



Top: Very early in the development of the egg in these three chambers, GFP-exu (light green) has concentrated in the egg. Bottom: In this chamber, the GFP-exu has localized to the anterior section (A), with some small amounts in the posterior area (P) of the egg.