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MEDICINE

Fertility clinics plan to disclose results

Acknowledging some centers made

BY RICHARD SALTUS
GLOBE STAFF



AN FRANCISCO - Conceding that some centers have advertised inflated success rates, *in vitro* fertilization spe-

Success rates with IVF and GIFT
National survey of 146 clinics, showing 1988 births and pregnancies continuing into 1989. Rate represents the chance that a single treatment cycle (beginning with drug stimulation of ovulation) will result in a live birth or continuing pregnancy.

TECHNOLOGY

Phone systems going digital to gain speed

ISDN transmission is slowly modernizing 'the last mile' of the subscriber's line

By Simson L. Garfinkel
SPECIAL TO THE GLOBE

When John Rochlis' new phone rings at Massachusetts Institute of Technology, Rochlis knows the caller's number before he even picks up the receiver: He just looks at the little computer screen above the key pad.

Knowing the phone number of a caller is just one small feature of the telephone switching system installed last fall to bring MIT into the rapidly expanding new world of digital telephone communication.

Special buttons on the telephone let Rochlis transfer calls to other phone numbers, initiate three-way conference calls, or put up to eight people on hold - all from a single telephone line. And a plug in the back of the telephone allows Rochlis, who is assistant network manager of MIT's Telecommunications systems, to connect a desktop computer directly to the phone system and transmit data 50 times faster than through most existing systems.

More important than any one feature, however, is the fundamental difference between the way traditional telephones relay sound and information and the way that's done by MIT's new system (an Electronic Switching System No. 5 manufactured by AT&T) and systems like it being installed around the country.

Whereas traditional telephones transmit voice by converting it to a continuously fluctuating electrical voltage - a so-called analog system - the new phones convert voice into a stream of discrete digital pulses - 1's and 0's - and send the signal along a computerized, high-speed digital channel.

Indeed, it is computer users who are likely to benefit most from the system. Computers, which are also digital, can be connected directly to that channel, making it possible to send information faster by telephone than ever before.

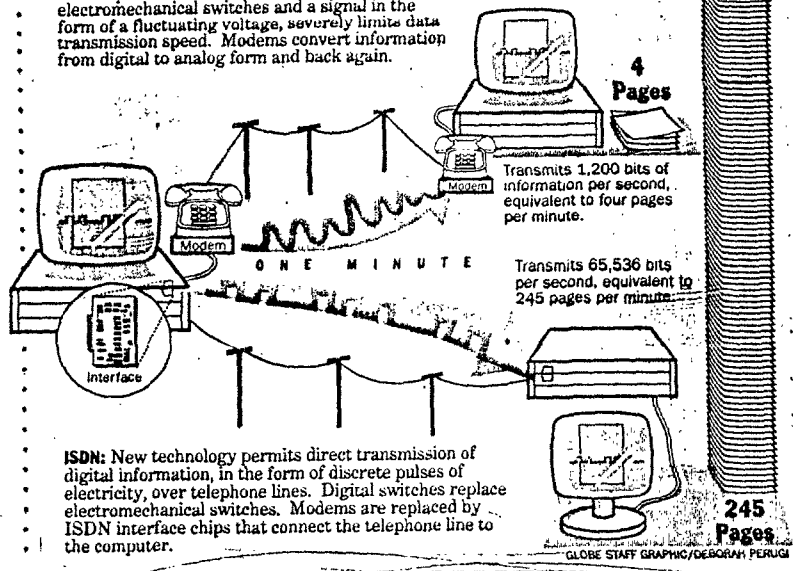
It's done with a system called Integrated Digital Services Network, or ISDN.

"The analog network is like a dirt road. The digital network is like a super-

ISDN, Page 26

ISDN: A telephone super-highway

ANALOG: Traditional technology, relying on electromechanical switches and a signal in the form of a fluctuating voltage, severely limits data transmission speed. Modems convert information from digital to analog form and back again.



4 Pages

Transmits 1,200 bits of information per second, equivalent to four pages per minute.

Transmits 65,536 bits per second, equivalent to 245 pages per minute.

ISDN: New technology permits direct transmission of digital information, in the form of discrete pulses of electricity, over telephone lines. Digital switches replace electromechanical switches. Modems are replaced by ISDN interface chips that connect the telephone line to the computer.

245 Pages

GLOBE STAFF GRAPHIC/DEBORAH PERUGI

Telephone systems going digital

■ ISDN

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per highway," says Nick Morley, a Newton-based writer who covers ISDN for trade journals.

Comparing the speed of ISDN to conventional systems is like comparing the speed of jet aircraft to railroad cars. And faster data transmission translates into more capacity for the communication networks that tie the nation together.

Traditional telephone technology relies on electromechanical switches, like household light switches, to physically make and break electrical circuits to complete calls. Digital switches move a digitized voice signal, essentially a stream of numbers, coming in from one subscriber's line, through an interface with a central computer, to another's subscriber's line.

Computers communicating with ISDN can send data equivalent to a 200-page document in less than a minute. Transmitting the same document with modems via analog typically takes 45 minutes.

Piece by piece over the last decade, the telephone system has been converting to digital systems. Today, data and voice are often transmitted between cities by a computer, without the need to physically make and break connections between circuits. Digital switches are generally faster and more reliable than mechanical systems, and therefore cheaper to operate.

Most long distance phone calls already go over digital facilities, usually through fiber optic cables, says Daisy Ottmann, an AT&T spokesperson. Local telephone companies have also been replacing older, electromechanical central office switches with digital ones; more than 40 percent of the telephone lines in Massachusetts are now served by digital switches, says Jerry Johnson, New England Telephone's managing director of network planning.

It is only the so-called "last mile" of the phone system — the pair of copper wires that connect the telephone company's switching equipment to homes and offices — that has remained basically the same for more than a hundred years.

"It's digital in the middle," says Don Lane, director of ISDN market research and planning for NYNEX. "The problem has always been at the local loop, that the subscriber line [is] analog."

Although the analog system works fine for voice, it is terrible for data-transmitting machines such as computers and faxes. To work with today's telephone system, these machines must convert their digital data into audible tones, a process that slows the transmission rate and can introduce errors.

Electrical impulses

The irony is that once those tones reach the phone company's central office, they are frequently turned back into digital signals and transmitted across town or across the country by fiber optics, only to be converted back into tones for the "last mile" of copper. If the signal is from one fax machine to another, it gets converted one last time from analog to digital form.

ISDN uses that same last mile of copper, but instead of sending a fluctuating analog voltage it sends the electrical pulses — 1's and 0's — that are converted by the telephone back into voice in a process similar to the way a compact disk player turns flashes of light reflected from the disk into music. A new generation of computers and fax machines will be



MIT's new phone switching system speeds up communicating for John Rochlis.

GLOBE STAFF PHOTO/JANET RIVOTT

able to use this digital stream directly without conversion.

The basic ISDN telephone service is divided into two high-speed digital channels for sending voice or data and a low-speed channel used to transmit signaling information. The high speed channels operate at 65,536 bits per second — compared to the 1,200 bits per second of most computers today. Higher speed ISDN interfaces are available to carry even more data.

The signaling channel allows the computer in the central office switch to communicate with the tiny computer in the telephone. When a number key on the ISDN telephone is pressed, that number is transmitted down the signaling channel. Likewise, the central switch can transmit a message to the telephone instructing it to ring the bell or display a telephone number.

Part of the signaling channel can be shared among a variety of low-speed applications, says Richard Lush, director of ISDN product marketing at Codex Corp., a New England telecommunications vendor. For example, a single ISDN line could be used by an alarm company to monitor a residential alarm system and by a utility company to read gas and electric meters.

ISDN has been a long time coming. "ISDN standardization started in the early 1970s and it's still going on," says Lush. Standards organizations representing equipment manufacturers and communication utilities from all over the world have been involved in the effort. Standardization is critical so that equipment from competing vendors and different countries will be compatible.

Until recently, ISDN was only available to companies that own their digital telephone switching equipment, to companies that have made special arrangements with telephone utilities, and to those participating in one of several ISDN trials around the country.

Trial runs

Earlier this year, the Lockheed Missiles & Space Co. in California completed a six-month trial using ISDN to transmit voice, computer data and even video from closed-circuit cameras.

Next year the University of

Michigan will participate in a trial with Michigan Bell in which students throughout Ann Arbor will connect their home computers with the university's network, taking advantage of ISDN's speed and eliminating the need to lease additional telephone lines for their computers.

Some telephone companies are already offering ISDN as a regular service. More than 300 of AT&T's toll-free 800 number customers are connected to the AT&T network with ISDN or plan to join, says Ottmann. "If you call an 800 number to order something from a catalog, or inquire on your credit card balance ... it is quite possible the company you are calling subscribes [to] ISDN," she says.

The main attraction is the feature that automatically displays the caller's telephone number. Companies can use a caller's area code and phone number to determine instantly the name of the dealer closest to a prospective customer. Credit companies can tie their computers into the telephone system so that a customer's records are displayed automatically on a clerk's terminal when the caller inquires about a bill.

Because it knows the caller's telephone number, a computer connected to an ISDN telephone line can be programmed to reject calls that do not originate from an approved list. MIT uses this feature to prevent students and unauthorized staff from placing calls to computers used for administrative functions such as grades and billing, says Morton Berlan, the institute's director of telecommunications.

But some companies, cautions Robert Smith, editor of the Privacy Journal, might use ISDN's caller identification system to capture phone numbers for later resale to telemarketing firms. "Right now, operators of 800 numbers are capturing numbers for their own use," but, he added, there is nothing to prevent them from reselling them.

Individuals will benefit

Those likely to benefit most from ISDN, says Codex's Lush, are small businesses and individuals with offices in their homes. "With ISDN, they will be able to have things a large company has," such as a high-speed data network and telephone features usually available only to firms with their own corporate tele-

phone systems.

In the home office, says author Morley, incoming calls could be automatically directed among a personal computer, fax machine, answering machine and telephone, depending on the kind of information sent down the ISDN signaling channel.

With special devices, some of ISDN's capabilities are possible with today's telephone system, says Paul Parker-Johnson, a senior consultant at Cambridge-based BBN Communications Corp., but "in the long run, you will be paying more for what you get on an application-by-application basis than if you consolidate" and use ISDN.

Nevertheless, he says, "to be really useful in the long run, ISDN has to become something that means uses and applications to businesses and residential customers. Unless more sophisticated applications can be developed based on ISDN, it won't go anywhere."

Another thing needed is to tie together the various ISDN installations, which are nicknamed "islands" in the telecommunications industry. Today, when a call is placed outside an island, none of the special ISDN features works. At MIT, for example, when an incoming telephone call originates outside the university, the ISDN telephone's screen displays the message "Incoming" instead of the caller's telephone number. A new generation of digital switch software is required to connect the islands; installation should begin by the end of the year.

Still, ISDN will be available only to telephone subscribers who are served by digital switches. By 1991, however, this will include more than 61 percent of the business and residential lines in New England, says New England Telephone's Johnson.

Of course, the customer will still need to purchase a telephone, or computer interface that can "speak" the electronic ISDN language.

Today these devices cost between \$400 and \$1,000, although prices are expected to plummet as production volumes increase, and computer chips that implement the ISDN protocols become available. NYNEX hopes that ISDN service will cost a little less than two analog telephone lines.

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