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third quarter. They will contribute to the furtherance of our program of diversification into commercial and international markets, while strengthening our position in the defense market. And they will result in improved productivity in the microwave operations which will, I believe, be reflected in improved financial performance."

#### LXE VISIBILITY

The company's LXE subsidiary, which currently accounts for a majority of the company's commercial and international business, provides a variety of wireless digital data communications products for use in the area of materials handling and inventory control. Pippin said: "During the past two years, LXE's R&D effort has added new capability to its systems, providing terminals with integrated radios meeting international standards, intelligent network controls with non-stop, fault-tolerant processing, and the capability for RF coverage of large areas. This has allowed us to enter additional markets in factory automation and intermodal transport industries. In the third quarter of 1990, a new record of LXE orders was achieved.

"We believe that our long-term objective should be to increase LXE's visibility and to change its status from that of a wholly owned subsidiary. Therefore, when conditions in the market appear to be appropriate, we expect to make a public offering of LXE stock as a subsidiary of our company."

#### REPURCHASE OF COMMON SHARES

In connection with the repurchase of common stock, Pippin stated: "We remain confident of our company's fundamental strengths and of its ability to succeed in our marketplace. Our current expectations are that in 1991 our profitability will be significantly improved over that reported in 1989. Yet it does not appear to us that the company's fundamental strengths are reflected in the market price of its stock, which has become deeply depressed over the last two years. We believe that a share-repurchase program, while providing greater liquidity to those shareholders who wish to sell their shares, will benefit remaining shareholders with higher earnings per share, if, as we expect, the company returns to higher levels of profitability in the future.

"The company thus will seek to repurchase up to 1 million shares of common stock. Purchases within the 1-million share limit may be made from time to time as deemed advisable by management, based on the availability and market price of the shares. The board's authorization, under which the company is acting, does not specify maximum prices that may be paid or any time limit for completing the purchases."

CONTACT: Don T. Scartz of Electromagnetic Sciences, 404-263-9200

ORGANIZATION: Electromagnetic Sciences, Inc.

TICKER-SYMBOL: ELMG

SUBJECT: Offerings

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GEOGRAPHIC: Georgia

LEVEL 1 - 20 OF 53 STORIES

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October, 1990

SECTION: Vol. 237; No. 4; Pg. 41

LENGTH: 2350 words

HEADLINE: PCs come home again; New IBM and Tandy home computers

BYLINE: Hawkins, William J.

BODY:

PCs come home again With introductions from two of the biggest computer makers--IBM and Tandy--we may be on the verge of a jump-start for the erstwhile era of home computers.

A "home" computer? That's been tried before . . . and failed miserably. Remember the PCjr and Coleco's Adam? But something is different. To aim squarely at the home user, both companies are playing down technology, hyping ease of use.

All the programs that come with these machines are ready to run instantly: Software on diskettes is already programmed to use all the computer's hardware, and if you buy a model that contains a hard disk, all the programs are loaded and ready to go. The idea: If you can set up a toaster, you can use these "appliance" computers.

For example, open the box of IBM's new Ps/1, and the instruction manual is on top, opened to the page that tells you what to do next: Plug the monitor into a wall outlet, the system box into the monitor, and turn on the power. The machine is instantly taken over by the built-in operating system (DOS 4.01) and the User Interface Program. There are no commands to type or special characters to remember to get things done. Instead, the display shows a graphic quadrant of selections from which to choose with a mouse:

- \* "Information" about the system, tutorials, and on-line help.
- \* "Microsoft Works" containing spread sheets, data bases, word processing, and communications.
- \* "Your software" for choosing programs you've added to the computer.
- \* "IBM DOS" for menu-driven commands that use the operating system for such things as copying files or formatting disks.

Pick one of the four areas, click the mouse, and the PS/1 becomes a clever combination of graphics and on-screen easy-to-follow instructions. But if you still get confused?

"Call us," says Robert Amezcua, product manager for IBM. He's not kidding. IBM has a toll-free hot line for assistance, and once you become accustomed to using the computer, you can use its built-in modem to get general information about the PS/1 over the Prodigy and Promenade computer networks.

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While IBM won't tout technology in the PS/1 (Amezcuca calls it the "T" word), it's a powerful machine, and even the basic \$ 999 model includes everything you need to get started: a 10-megahertz 80286 processor, 512 kilobytes of RAM (expandable to one megabyte), a 1.44-megabyte 3.5-inch diskette drive, a 12-inch VGA monochrome monitor, a full-size keyboard, a mouse, a 2,400-bps modem, and software. A highend \$ 1,999 model has a color monitor, a 30-megabyte hard drive, and one megabyte of memory. And a \$ 169 Adapter Card Unit, which mounts between the console and monitor, is available for adding additional circuit boards--fax or scanner, for example--to the system.

If you're looking for an even less expensive machine, Tandy's 1000 RL starts at \$ 750. It includes a monochrome CGA monitor, 512 kilobytes of memory (expandable to 768 kilobytes), a 3.5-inch diskette drive, two joy sticks, software, and a mouse. A 16-color CGA model with a 20-megabyte hard drive is \$ 1,299. While the computer runs any PC-compatible software, the 80286-based machine concentrates on new, truly home-oriented applications.

For example, the Home Information Center program is an electronic bulletin board: Leave and retrieve messages for others in the family on the computer. "It's designed to be on all day," explains Tandy spokesman Ed Juge. "The screen blanks out and the hard disk stops after five minutes of no activity." That saves power (Juge claims that when the computer is in standby mode it draws only as much current as a clock radio), but it also means the computer is available instantly for . Touch a key, and the message reappears.

Also, there's a Home Organizer program, which is divided into three different categories: personal, kitchen, and financial. Under those areas you can organize lists, balance your checkbook, and plan meals based on recipes from an electronic version of The Good Housekeeping Cookbook. "It will adjust the recipes depending on how many guests you're having," claims Juge, "and even make up a shopping list of ingredients you'll need."

## Phony alarms

Kansas policemen reportedly receive several calls a month from cordless phones that dial the 911 emergency number when their batteries deteriorate. Apparently, the dying phones emit spurious signals that include a call for help.

## Factor to consider

Factoring a number requires finding the prime numbers that divide it (prime numbers are only evenly divisible by one and by themselves). For example, the number 105 is factored into 3x5x7. As the number to be factored gets larger, determining its prime numbers becomes much more difficult. That's why present digital encryption systems, used to code secretly everything from government messages to bank transactions, rely on a 155-digit number. Factoring that number, called the ninth Fermat, has been considered impossible by present techniques, making the data it scrambles secure from unauthorized eyes.

Now, warn researchers Arjen Lenstra, from Bellcore, and Mark Manasse, at Digital Equipment Corp., better make that a 200-digit number. The two scientists have factored the 155-digit number using a network of almost 1,000 computers that stretched through the United States, Europe, Australia, and Japan. Using the network at night, during off hours, it took a few months to determine the answer: The factors are three numbers that are 7, 49, and 99

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digits long. Lenstra calculates that if you tried doing the same calculations full time, on a medium-powered computer performing one million operations a second, it would take about 275 years.

#### Erasable CDs

Slide a compact disc into an unusual play at a Thomson Consumer Electronics' showroom and "CD" appears on its green alphanumeric display. Put a similar 4.7-inch disc with a glossy brown coating into the machine and the letters "MOD" appear. The MOD--magneto-optical disc--lets you record up to five hours of digital audio on Thomson's DR 1000. Only five similar machines exist, but developer Deutsche Thomson-Brandt of Villingen, West Germany, hopes that millions of similar disc recorders will appear in homes during the 1990s.

The DR 1000 is an intriguing gadget. Put an ordinary music CD into the machine and you'll hear superb audio. Plug a separate CD player into the DR 1000 and you can make exact disc copies--every digital one or zero stored on the originals--onto MODs. You can also erase and rerecord MODs endlessly. One drawback is that your disc recordings won't play back on today's CD players. But with a few modifications, future CD players could play MODs.

The latest DR 1000 prototype simplifies recording by using audio signals to vary the magnetic field from a dime-size coil above the MOD (see photo) with the audio signal. A laser beam beneath the disc that was formerly modulated with audio now heats and erases the magnetic coating. The previous technique, pulsing the laser with audio, required a separate pass to erase audio tracks.

Thomson isn't sure when MOD machines will be in stores. "What will slow down the introduction of this machine are the copyright issues and our ability to get other manufacturers--both hardware and software--on board with this system as a standard," says Daniel Collishaw, manager of audio product development at Thomson in Syracuse, N.Y.

#### Coming: no-miss VCRs

It's galling when you carefully program the VCR to record your favorite TV show, then return home to find that the broadcast ran late. Result: The VCR started early--and stopped early--so you never find out if the butler really did do it. Britain's TV Channel 4 aims to eliminate this annoyance by transmitting unseen coded teletext signals that would automatically start and stop waiting VCRs at exactly the right time despite any change in schedule. The system, being tested early next year, requires a new generation of VCRs incorporating the necessary teletext decoder, and Channel 4 is spearheading the idea as a means of gaining viewers for its own programs.

Similar schemes are being tried in Europe, and in the United States the Electronic Industries Association is trying to create standards for the variety of way information can be sent via broadcast or cable systems used in the home. Future VCRs could be set to record, say, all mysteries--then you'll know all the butlers that did it.

#### Digital sound at the movies

Cinema Digital Sound (CDS) is the latest in motion picture audio technology. Developed jointly by Eastman Kodak Co. in Rochester, N.Y., and Optical

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Radiation Corp. in Azusa, Calif., CDS is a six-channel digital sound-track that provides a dynamic range equal to compact discs. And unlike the best analog soundtracks, rated at 30 to 14,500 hertz, CDS has a wider frequency range too, from 20 to 20,000 hertz.

CDS relies on Kodak's new sound recording film to store digitally the information in the optical soundtrack. Although theaters need a new sound processor, the device mounts on existing projectors. Already two New York theaters and five Los Angeles theaters are equipped to play CDS, and one movie, Dick Tracy, has the digital soundtrack.

The inventors say the exceptional audio should lure people away from their VCRs and back to the theaters. As one Kodak official explained, "What you hear is much more like what the creator intended."

#### Dealers take a RISC

Sun Microsystems is the first desktop work station manufacturer to offer a RISC-based (Reduced Instruction Set Computing) machine through local computer dealers. The RISC microprocessor design, which accepts only a few software instructions, concentrates on speed: The new \$ 9,995 color work station, called the IPC SPARCstation, operates at 15.8 mips (millions of instructions per second). That's significantly faster than topend personal computes such as Apple's \$ 15,000 Macintosh IIfx (eight mips); slightly faster than Intel-based personal work stations like Compaq's 15-mips DeskPro 486/25 that would sell, similarly configured, for almost \$ 10,000 more. The system includes a 207-megabyte hard disk and a 16-inch color high-resolution monitor (1,152 by 900 pixels). While 16 mips is about 10 more than the average personal computer user ever needs, professionals using computes for publicaiton layout and graphics design should be able to find instant work for the speedy, yet relatively inexpensive, RISC-based system.

#### Heal thyself

Sometimes, during the manufacturing of circuit boards, electrical paths between integrated circuits become too thin, making the connections unreliable. The "near-open" wiring, called constrictions, are difficult to find and time-consuming to fix. One technique is to use pulses of high current to open any constrictions--like blowing a fuse--making them easier to locate and repair with solder.

But C. Julian Chen of the IBM T.J. Watson Research Center has invented a form a electroplating that lets constrictions repair themselves. To do it, a carefully controlled AC current is passed through the metal path, which is placed in a plating solution (see drawing). Because a thinner electrical path will have greater resistance, any constrictions will begin to heat causing a deposition process--the constricton is plated with metal that is transferred from cooler areas of the path in the plating solution.

The technique repairs multiple constrictions at once and even stops automatically--once a constrictions is plated sufficiently, its resistance drops, which reduces the heat and stops deposition.

Go-anywhere cellular phone

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Motorola is developing a satellite-based system that will allow callers in remote areas of the world to communicate by telephone. "You will be able to dial one number to reach someone, even if you don't know where they are on Earth," declared John F. Mitchell, vice chairman of the company, at a recent news conference.

Mitchell says the proposed system will use "a constellation of seventy-seven lightweight satellites in low-Earth orbit." The system is called Iridium, after the element iridium, in which 77 electrons orbit the atomic nucleus. The Iridium satellites will travel in polar orbits 413 nautical miles above Earth, low enough to transmit signals to phones equipped with small antennas. Because of the large number of satellites, at least one will always be in view.

Iridium is "really a cellular system turned upside-down," says Durrell W. Hillis, corporate vice president and general manager for satellite communications at Motorola. "Each satellite projects a set of cells onto the Earth. The Earth-based users seem to be stationary, while the cells move rapidly through space."

In the Iridium system (see drawing), a caller would transmit both his phone number and serial number from a handset (1) to a "smart" satellite (2) capable of relaying the call to another satellite (3) orbiting over the caller's service center (4). After the center checks the billing information and authorizes the call, it would beam a reply via the really satellite to the original satellite, which would send the call to a satellite orbiting over the called party (5). The signal would be beamed to that party's handset (6) or to an Earth station (7) that would send the call through the local phone network.

By the time the Iridium system is ready for operation in 1996, most people in the United States and Canada will have access to land-based cellular service. But the Iridium system, which will provide service in remote areas, will not compete with cellular systems, according to Mitchell. Potential users include international business travelers, disaster relief workers, and passengers aboard planes and ships.

Motorola, which will manufacture the satellites, handsets, and switching equipment for Iridium, is willing to put up 20 percent of the system's estimated \$ 2.3 billion cost, Mitchell says. The company estimates that handsets will be \$ 3,500, and calls will cost \$ 1 to \$ 3 per minute.

GRAPHIC: photograph

SUBJECT:  
Microcomputers, product introduction

PRODUCT-NAME:  
IBM PS/1 (Microcomputer), product introduction; Tandy 1000 RL (Microcomputer), product introduction

COMPANY:  
International Business Machines Corp., product introduction; Tandy Corp., product introduction

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LOAD-DATE-MDC: December 06, 1990

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LEVEL 1 - 21 OF 53 STORIES

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The New York Times

September 30, 1990, Sunday, Late Edition - Final  
Correction Appended

SECTION: Section 3; Page 9, Column 1; Financial Desk

LENGTH: 1124 words

HEADLINE: Technology;  
The Lure of Small Satellites

BYLINE: By LAWRENCE M. FISHER

DATELINE: SAN FRANCISCO

BODY:

INCREASED demand from the telecommunications industry, the military and meteorologists is fueling a rebirth of the small satellite. Less costly and quicker from drawing board to orbit than large satellites, 'lightsats' are scheduled to be launched in record numbers over the next ten years.

Lightsats typically weigh less than 500 pounds, compared with 5,000 pounds for a large satellite. Typical costs are an order of magnitude lower as well, about \$20 million against \$200 million. The trade-off is capability: lightsats simply cannot do as many things as large satellites can. But lightsats are gaining in capability all the time, and for many applications they offer increased flexibility and lower cost, scientists say.

In the early days of space exploration all satellites were lightsats. Sputnik 1, launched by the Soviet Union on Oct. 4, 1957, weighed 184 pounds; the United States' first satellite, Explorer 1, launched on Jan. 31, 1958, weighed just 10 pounds. But, given the high cost of any launching, the temptation was always to include as many functions in one satellite as possible; launch vehicles got bigger and so did satellites.

Launching small satellites with large rockets is not financially practical, unless each rocket carries several at once, which presents its own set of problems. Until the birth of the commercial space-launch industry and the development of new, smaller launch rockets, small satellite developers had only limited access to space.

'There's always been a latent desire to get some small things into space,' said Robert B. Pincus, head of the systems development office at the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Md. 'The problem was there weren't any viable vehicles to do the job at a reasonable rate,' he said. 'The successful launching of the Pegasus in April jump-started the rebirth of the small sats and the lightsats,' he said.

Pegasus, which was jointly developed by the Orbital Sciences Corporation of Fairfax, Va., and the Hercules Aerospace Company of Magma, Utah, is a winged rocket which is launched from an airplane. At \$7 million to \$8 million per launching, compared with \$60 million to \$70 million for a Delta rocket launching, Pegasus provides 'a relatively low-cost vehicle to launch

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relatively low-cost satellites," Mr. Pincus said. If Pegasus provided the means, science and industry rapidly found the motivation for putting small objects in space. Perhaps the greatest boost to the burgeoning lightsat field has come from Motorola Inc., which has proposed putting a constellation of 77 lightsats in orbit to relay telephone calls to and from mobile phone users.

Motorola plans to produce the satellites for this network, dubbed Iridium, on what it calls the "world's first high-volume satellite production line."

Most of the manufacturers of lightsats are small entrepreneurial companies, which are more geared to producing low-cost devices than are the traditional aerospace concerns. Even if these companies do not realize any revenue from Iridium, they expect it to lend their efforts new of credibility.

Iridium "is the first big evidence of faith in small spacecraft. It will drive the field," said R. Gilbert Moore, an adjunct professor of physics at the University of Utah and program chairman of the 4th Annual Conference on Small Satellites, held late last month in Logan. "The small spacecraft today has enormous capabilities compared with similar size birds of 20 years ago," primarily because of improvements in electronics, he said.

One drawback to small satellites is that they must typically be used in low earth orbit - about 400 miles up, compared with 22,000 for a large satellite - because their size limits the broadcast power they can carry. So unlike a large satellite that remains in place on an orbit synchronized with the earth's rotation, small satellites travel from horizon to horizon in about 10 minutes.

"They come and go like streetcars, and you have to track each one," said Mr. Moore. "That's a whole lot more complex than having a bird up in geosynch where you can have one big antenna keeping track," he said. But he added that the lower cost and the spreading of risk across multiple satellites compensate for the increased complexity.

Another advantage is the reduced time from design to orbit. Whereas a large satellite can take 10 to 15 years to reach completion, lightsats make the journey from initial concept to outer space in three to four years. The military likes the reduced time to space too, and, through the Defense Advanced Research Projects Agency has been a major proponent of light satellites. DARPA officials say that the tactical use of very small satellites during ground-based conflicts in places like Panama or the Middle East, could be possible within three or four years. DARPA will launch seven 47-pound "microsats," made by Defense Systems Inc. of McLean, Va., on the next Pegasus, scheduled for January.

"Our perspective is that small satellites have a role in our overall space architecture," said Air Force Lt. Col. Edward D. Nicastrì, the director of DARPA's Advanced Space Technology Program. "But we need to really get the technology moving to make that role a significant one," he said.

While microprocessors and custom integrated circuits have dramatically reduced the size and power consumption of satellite components, further advances are necessary, he said. "I need to put a Cray in a soup can," he said, referring to the most powerful of supercomputers.

In DARPA's concept, small tactical satellites could provide reconnaissance to individual commanders in the field, sending images and information via portable computers.

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But the most significant boost to the small satellite business could come from Brilliant Pebbles, a proposal of the Strategic Defense Initiative which would place thousands of small satellites in orbit to act as interceptors of enemy missile fire. In addition, the Los Alamos National Laboratory is studying the use of a network of small satellites carrying sensors to verify arms control agreements.

While most small satellites have been low orbit devices, some scientists are now considering their use for planetary missions, perhaps even as delivery vehicles for 'mini-rovers' to explore the surface of Mars or other planets. One NASA project will send mice into a high orbit to study long-term effects of radiation and weightlessness.

'It is now possible to think about doing some really intriguing science with very small projects,' said David Thompson, president and chief executive of Orbital Sciences. 'Small satellites can go any place a big satellite can go.'

CORRECTION-DATE: October 14, 1990, Sunday, Late Edition - Final

CORRECTION:

An article on the Technology page on Sept. 30 about small satellites misstated the affiliation of R. Gilbert Moore. He is an adjunct professor of physics at Utah State University, not the University of Utah.

GRAPHIC: Drawing: The Iridium 77 system from Motorola Inc. will consist of 77 small satellites - lightsats - which will be boosted into low earth orbit. ( Motorola Inc.)

SUBJECT: ASTRONAUTICS

NAME: FISHER, LAWRENCE M

LEVEL 1 - 22 OF 53 STORIES

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September 24, 1990

SECTION: Vol. 13; No. 38; Pg. 5

LENGTH: 829 words

HEADLINE: Motorola says 77 smallsat Iridium project will fly; Satellite communications project

BODY:

MOTOROLA SAYS 77 SMALLSAT IRIDIUM PROJECT WILL FLY

Despite ongoing skepticism about the Iridium project, Durrell Hillis, corporate vice president and general manager of satellite communications at Schaumburg, Ill.-based Motorola, said that Motorola continues to drive toward an aggressive schedule of satellite construction, launch and service implementation.

Hillis, speaking here last week before The Washington Space Business Roundtable, said the 77 smallsat communications constellation will begin demonstrations in 1992 and should be operational by 1996.

Iridium, which will cost up to \$ 2 billion, will provide global communications directly from a hand-held telephone to the satellite system and then to a designated phone system, using intersatellite links when necessary to provide full network interconnectivity (SN, June 11, p. 3).

"The satellites are self navigating--they look for a person to see where he [the Iridium user] is and then send the call to him anywhere," said Hillis. Hillis said a user's phone must be turned on for the system to find the individual.

Because the system can operate from handset to handset independently of national Postal Telegraph & Telephone Administrations (PTTs) or existing international satellite systems, the Iridium project may face opposition from organizations such as Intelsat, Inmarsat and national telecommunication monopolies. Hillis said Motorola currently is in negotiations with a number of countries and organizations to secure necessary operating agreements.

Describing development work currently under way at Motorola, Hillis said there are "no show stoppers" impeding the creation of an infrastructure that would permit national PTTs to track and tariff incoming or outgoing Iridium calls. He also said the network could be configured to interface with national telecommunications infrastructures if necessary.

. . . Hillis: Iridium Project is Not Competitive with Motorola's Cellular Business

Hillis said the Iridium project is "a cellular system turned upside down." With Iridium, the 77 smallsats beam cells onto the Earth. As a result, the users appear fixed and the cells move through the users. A cellular system, on the other hand, has users moving through the cells.

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Iridium can be used as a primer for terrestrial mobile communications in addition to providing comprehensive service by itself, primarily in rural areas. Hillis told SATELLITE NEWS that the system would not provide competition to Motorola's existing cellular phone business--which has been hot, growing at a clip of more than 50% a year.

"The Iridium satellite covers an area of about 350 miles and about 16,000 users--cellular covers a lot smaller area and a lot more users," Hillis told us.

Hillis told attendees of the Roundtable meeting he felt Motorola would have no problem obtaining users for the system. "We need less than 1 million users worldwide to be viable--which isn't much," said Hillis. Instead, Hillis said he expects to encounter problems with obtaining spectrum for the project and getting operating licenses with countries.

"We totally underestimated the cellular industry," he said. "We already have 7 million cellular users and projections for the year 2000 predict 100-150 million for the industry," he added.

. . . Iridium Offers Varied Uses for Consumers

The driving factor of the Iridium project, said Hillis, is the hand-held phone which can be taken anywhere. He said Motorola has been working with countries that have poor communication systems and little money for advanced telecommunications to provide telephone alternatives.

For instance, a government may choose to subsidize an Iridium hand-held phone for a village, put it in a phone booth-type format in the middle of the town, and as a result, provide the people with advanced, global communications, he said.

Hillis said the system has emergency-use implications because it can be taken anywhere. In addition, the recreational user may want an Iridium phone because it has a navigation device with longitude and latitude information as well as providing Greenwich Mean Time.

Hillis told us that the military could use the Iridium system because it is a digital switched technology that therefore can be used in a secure mode. However, he said Motorola envisions Iridium primarily as a "truly commercial program."

. . . Motorola Timetable Is Feasible, Said Industry Source

Motorola has requested base-lined L-band frequencies that fall below those requested by Washington, D.C.-based American Mobile Satellite Corp. (SN, June 25, pp. 1-3).

"The [launch] timetable is realistic," a source told us. "All of the satellite's smarts are the same as [NASA's] advanced communications technology satellite (ACTS). Motorola is the prime payload contractor on ACTS." Hillis said Motorola still needs to choose a partner to provide the spacecraft equipment. He expects the choice to be made by end of this year.

SUBJECT:  
Artificial satellites in telecommunication, planning

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COMPANY:  
Motorola Inc., planning; SIC: 4899; 3663

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LEVEL 1 - 23 OF 53 STORIES

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Communications Daily

September 17, 1990, Monday

SECTION: Vol. 10, No. 180; Pg. 11

LENGTH: 473 words

## BODY:

Japan's recently launched BS-3A broadcast satellite has suffered partial power loss following failure of solar units. Ground staff in Japan has been trying to solve problem since last week. Following launch from Tanegashima Space Center Aug. 28 with H-1 rocket, bird was boosted toward geosynchronous orbit slot of 110 degrees E on Aug. 30. Investigation showed that 3 of satellite's 4 solar systems were generating power. Part of system was manufactured by GE Astrospace, which wasn't available for comment. Tokyo-based NEC is satellite's prime contractor. Technical problem could create capacity shortage in Japanese satellite broadcasting because BS-2 is nearing end of design life. If it fails, it will leave BS-3 without backup, and next-generation bird isn't scheduled for launch until next summer.

U.K.-based Sky TV last week scrapped national newspaper advertising campaign against competitor British Satellite Bcstg. after several national newspapers declined to carry ads, which warned against paying for BSB service. Sky TV quoted from report by Technology Advisory Services, London consulting group, that said BSB would be forced out of business in 1991 because of financial troubles (CD Sept 10 p6). BSB launched 5-channel service earlier this year.

Corroon & Black Corp., N.Y.-based insurance company that agreed to merge with London-based Willis Faber, said last week that it had received another offer, this time for \$840 million (\$40 per share) from Chicago-based Aon Corp., insurance conglomerate. Offer from Willis Faber is worth about \$715 million (\$34). Corroon & Black is major insurer of satellites. Industry source said more recent bid would make Corroon & Black one of major players in world, but wouldn't provide company with access to foreign markets that Willis Faber offers.

Agricultural Satellite Network (Agsat), national satellite network that shares agricultural information and instruction, received \$735,795 grant from Commerce Dept.'s Public Telecommunications Facilities Program. Agsat, whose members include 31 land grant universities, will share credit courses among agricultural colleges, develop exchange programs, hold teleconferences. Organization, chartered in Neb., coordinates programs at satellite operations center, Neb. Educational Telecommunications Center, U. of Neb.-Lincoln.

John Major, gen. mgr. of Motorola Communications Systems Group, is to discuss company's Iridium satellite system Sept. 26 at Washington session of Society of Satellite Professionals. Major, member of Iridium board, manages development of system that's to provide global personal telephone and data communications through network of 77 small satellites in low-earth orbit (CD Aug 13 p4). Presentation will be made at Techworld Auditorium, 800 K St., Level MR, 6:30 p.m. Details: 202-408-0080.

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LEVEL 1 - 24 OF 53 STORIES

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September 3, 1990

SECTION: COLUMNISTS; Computers/Communications; Computer Ventures, Commentary,  
Pg. 102

LENGTH: 717 words

HEADLINE: WHY MOTOROLA IS EXPENSIVE -- AND STILL A BARGAIN

BYLINE: by Richard A. Shaffer; Richard A. Shaffer is founder of Technologic Partners, a technology consulting company in New York City, and publisher of Technologic Computer Letter.

BODY:

Good technology companies tend to be very expensive, in the sense that their prices are high multiples of their earnings, and Motorola is no exception. The stock is already up 24% this year, putting it at 19 times trailing earnings. Over the next few years, however, Motorola and its shareholders may do even better because of its increasing importance in wireless communications.

Motorola makes semiconductors and computers, too. For investors, however, the future lies in communications and in the company's plans to use its expertise in digital technology to build what could become a vast worldwide service and equipment business.

In computers, Motorola is unprofitable. But in semiconductors, the company is edging ahead of Texas Instruments, which had been America's largest producer of circuits sold primarily to others. [A few large producers, like IBM, make chips only for themselves.] Motorola is far behind Intel in profitability of its chip production, but it is at least doing well at a time when TI, Advanced Micro Devices and National Semiconductor all are struggling. And, although Motorola has no microprocessor home run like the Intel 386, Motorola is proving in semiconductors a point IBM has made in computers: Product breadth, strong marketing and manufacturing, and customer diversity can overcome many shortcomings. Like IBM, Motorola often comes late to an opportunity -- reduced-instruction-set computing being a recent case in point. But, again like IBM, Motorola is all but impossible to dislodge once it has entered a market. As cost-conscious customers strive to reduce the number of suppliers they work with, a big portfolio helps Motorola to stay on their lists.

Also like IBM, Motorola has figured out how to make money overseas, where the best opportunities for growth now lie. In foreign markets -- except in Japan, where TI is entrenched -- Motorola is usually the leading nonlocal chip supplier.

Increasingly, however, Motorola's story is a sotry about communications, not semiconductors. The company is the leading supplier of cellular equipment. In this explosively growing industry, carriers like McCaw Cellular are still far from profitability, because they are so busy paying off loans used to buy franchises. But the hardware makers are making good money.

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1990 Forbes, September 3, 1990

Motorola is capturing headlines with its papers -- one of its latest can be worn like a wristwatch, and another is the first that can store voice messages. Its \$ 3,500 Microtac, the 10-ounce cellular telephone, has become a popular executive perk. The company's digital voice technology has been chosen by the Japanese government. For an American company to win a Japanese government contract, especially in communications, you just know the product has to be great.

On the basis of such products, Motorola's cellular systems business contributed around 40% of operating profits last year and doubled in sales to about \$ 1.5 billion. Around the world, more than 60% of the equipment that connects cellular telephones with ordinary telephone systems is sold by Motorola. For the next three years, the company expects its cellular business to grow about 40% annually. If that happens, cellular equipment will become Motorola's largest single business, reaching almost \$ 4 billion within another couple of years. Cellular systems also are becoming the company's most profitable business -- earning a pretax return on sales that is almost twice as large as Motorola's other communications products, and nearly three times as much as its semiconductor products.

Now Motorola is planning a \$ 2.1 billion communications network that would rely on dozens of small satellites to connect millions of pocket-telephone subscribers around the world. The network, called Iridium, could be in service by the middle of this decade, although very high financing and regulatory hurdles remain.

There is no shortage of competition. Already, Japan's NEC and Sweden's L. M. Ericsson are challenging its lead in pocket telephones. But there is also a lot of business to go around, with the number of cellular telephone customers likely to climb from 10 million today to 100 million before the decade is out. Even at its current price (73), the stock looks good long term.

1990 Forbes, September 3, 1990

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LEVEL 1 - 25 OF 53 STORIES

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August 27, 1990

SECTION: Vol 10; No 42; Sec 1; pg 12

LENGTH: 1198 words

HEADLINE: Durrell Hillis: High-Technology Exec Relishes Living Life on the  
Leading Edge

BYLINE: Cathy Luebke

DATELINE: Chandler; AZ; US

BODY:

Sailing along in stiff winds, Durrell Hillis likes to lean his boat right to the point of capsizing. "Risk exercise," he calls it, "where you can choose to be right on the edge of being out of control."

The thrill of being involved in something that borders on the impossible also has driven his 27-year career with Motorola Inc. And now, as corporate vice president and general manager of satellite communications, he says he faces his biggest challenge.

Hillis, 50, captains a project called Iridium, which Motorola officials herald as the next major milestone in global communications. The heart of Iridium will be a constellation of 77 small satellites to be in orbit by 1996.

Those satellites will allow voice and data communications anywhere on earth -- whether on land, at sea or in the air --via portable cellular phones.

Iridium is intended not to compete with traditional cellular systems, but to fill in the gaps among them to reach even the most remote corners of the world, says Hillis.

Still in the study phase, Iridium eventually will involve an international consortium and cost about \$ 2.3 billion.

Until February, Hillis headed Motorola's Strategic Electronics Division, which employs about 2,000 people in Chandler. "I felt I had the very best job in the entire corporation" -- working in the space industry, having a good boss, running a major campus and challenging projects, he says.

Iridium started several years ago as one of those projects. Anticipating a shift away from large, complex satellites, Hillis recruited a small group of highly talented systems engineers.

"Even though we didn't see large satellites going away, we felt that a lot of the things that they had historically done functionally could be performed by small satellites." In much the same way as the personal computer, the advent of small, less costly satellites will create a proliferation of new applications, he says.

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"I personally had a vision to bring Motorola into that arena because we have extensive capability in building (the) electronics of satellites," Hillis says. "Every picture you've ever seen from outer space, every piece of data, every voice communication from outer space has all been on our equipment."

The Motorola team first came up with the cellular idea for use in a military setting. "When they reviewed this with me . . . I said, We've got to take this thing and go explore making a commercial, worldwide communications hookup," he recalls.

So Iridium began to take shape. In November, Iridium received funding through 1992. In February, Hillis was asked to devote all of his energies to the project. Even though he felt he had the best job in the corporation, Hillis said he was ready.

"One of my biggest nightmares is that I would retire and be sitting in a sailboat in the Caribbean or somewhere and I'd want to call some other part of the world, and I'd pick up phone and I'd make the call and it goes over a Japanese network. And I say to myself, We could have done that."

Although Iridium taps resources from several Motorola business groups, its headquarters will remain in tandem with the Strategic Electronics Division in Chandler, Hillis says.

Right now, about 50 people in Chandler are working full time on Iridium. Hillis expects Motorola to build about half the spacecraft, which eventually will mean expansion at the 160-acre campus on Price Road.

Hillis' career always has leaned to leading-edge technology. In fact, he says, by the time he was a high-school sophomore in southeast Missouri he had his sights set on the engineering profession.

And apparently his classmates were confident in his abilities, voting him "most likely to succeed." He graduated valedictorian and turned down football and basketball scholarships to take a full academic scholarship at the University of Missouri.

But being a someone with a clear vision of his future, Hillis gave up that scholarship to work his way through school at University of Arizona. He had visited a brother and sister in Tucson several times, and decided Arizona was the place for him. And since that time, he's lived outside the state for only six months --during a brief stint for Motorola in Austin, Texas.

Hillis worked as an engineer and engineering manager while earning his master's in that field. "I discovered the part of the job I liked best was the people interface on technical issues," he says, so he went on to earn a master's degree in business as well.

"I've had a lot of outside offers, and there have been several times when the offers were very attractive," he says of his long tenure with Motorola.

But there have always been opportunities for Hillis within the company, too. "For about the first 20 years of my career, I was in a new job about every year and a half."

Says Hillis: "I started off in semiconductor memories before semiconductor memories existed." He gets a kick out of telling young engineers -- now designing chips with 16 million bits -- that he designed the first Motorola semiconductor memory, which had four bits.

When microprocessors and microcomputers came along in the mid-1970s, Hillis crossed into marketing and put together the team that lead to Motorola's first onboard microprocessors for automobiles.

In another assignment, he formed a new business unit that developed a secure telephone unit for the federal government. " Motorola went from not being in that business to being the No. 1 supplier," he says.

"The challenge that I like in the positions . . . are those when you have a very complex set of variables to deal with which involve technical judgment, business judgment and the synthesis of technical and business issues in a complex environment."

While that does mean long hours --and, in the case of Iridium, traveling around the globe -- the Motorola VP says he does take time out for himself and his family. Hillis has three children, all attending Arizona State University, and two stepchildren.

He and his wife, Karen, like to take a lot of short vacations, often tacking a few extra days onto business trips or just getting away for three or four days.

Hillis has found a challenge of another sort as a board member for the Phoenix Urban League. "This country is losing the technology race," he says. "As a nation, we're not developing the bright minds of the kids."

While a lot of good things are being done, many don't reach the vast majority of children, Hillis says.

Education is the key to keeping a strong middle class, he adds. It's becoming more and more difficult for someone to get a job without certain basic math and reading abilities.

"That's one of the reasons why I hold the Phoenix Urban League in such high regard: because it . . . provides a remedial educational capability and training to a segment of our community who otherwise would have poor prospects for the future," he says.

As for his own future, Hillis is not ready to make too many predictions beyond Iridium. "I'll still be with Motorola, and if I'm not still with this specific program, I would guess based upon history that I will still be involved in something that's just barely on the edge of being doable."

GRAPHIC: Personal portrait

SUBJECT: Electronics industry; Satellite communications; Corporate officers; Personal profiles; Mountain

NAME: Durrell Hillis

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Business Jnl-Phoenix & the Valley of the Sun (c) 1990 UMI/Data Courier

GEOGRAPHIC: Mountain Region; Phoenix; AZ; US

COMPANY: Motorola Inc; DUNS: 00-132-5463; SIC: 3662;3674;3651;3661; TICKER:  
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LEVEL 1 - 26 OF 53 STORIES

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Forbes

August 20, 1990

SECTION: COMPUTERS/COMMUNICATIONS; Pg. 86

LENGTH: 1168 words

HEADLINE: Look out for the taxi dispatchers

BYLINE: By Gary Slutsker

HIGHLIGHT:

Why is cellular centimillionaire Craig McCaw trying to stop Fleet Call from upgrading its two-way radio service? Could McCaw be worried about competition?

BODY:

THESE ARE tough times for investors in cellular stocks. They took a hit last year after Prime Minister Margaret Thatcher opened up the British cellular industry to competition from personal communications networks -- it hasn't happened here, but it might one day. The highfliers took another hit recently when Motorola announced its stunning plan to run a worldwide cellular system in the sky called Iridium.

Now comes another competitive threat -- not from a futuristic technology, but from something as unglamorous as the taxi dispatch business. A clever startup called Fleet Call Inc., in Bloomfield, N.J., is trying to turn its collection of dispatch operations around the country into something that is almost identical to a cellular phone system.

Fleet Call wants permission from the Federal Communications Commission to upgrade its dispatch business. If it gets permission, Fleet could set a dangerous precedent for the cellular business. Other mobile radio operators, including the likes of Motorola and other creative technologists, could eventually do a lot of damage to the comfortable duopoly of the cellular business. At present only two companies can operate cellular phone service in any given area.

No surprise, then, that several large cellular operators, including Craig McCaw's McCaw Cellular Communications, are quietly lobbying against Fleet's petition. The heavyweight lawyer fighting Fleet for McCaw is former FCC chairman and current FCC powerbroker Richard Wiley.

The brains behind Fleet are Morgan O'Brien, 45, a former FCC staff lawyer, and Brian McAuley, 49, a onetime executive at Millicom Inc., a cellular and paging outfit. The two men formed the company in 1987 and began buying up FCC licenses in the specialized mobile radio band. This mobile band business is worth about \$ 400 million a year in service fees and equipment sales. It provides wireless dispatch service to taxi fleets, plumbers and other small businesses. Mobile radio operators may also complete phone calls for their mobile customers, at an additional cost, though this is now a small part of their business. O'Brien and McAuley have asked the FCC for permission to use new technology and would dramatically expand the capacity of channels they already control.

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1990 Forbes, August 20, 1990

Fleet Call had \$ 30 million in revenues last year, small potatoes next to, say, McCaw Communications' \$ 504 million. But it has giant ambitions. Here's how Brian McAuley, Fleet's president, describes his outfit: "If you own 50 miles of beachfront in prime areas of Hawaii and all that's on there now are shacks, you certainly ought to be able to put up some nice hotels."

Right now, Fleet Call is limited to beach shacks by its restrictive FCC license. The FCC merely lets mobile band operators blast signals throughout a metropolitan region from several high-power antennas using exclusive frequencies. In New York, for example, Fleet Call gathers transmissions from around the metropolitan area for retransmission, using over 40 antennas and 200 repeaters placed at several sites, including the Empire State Building.

O'Brien and McAuley want to increase their calling capacity and quality simply by using some of the same tricks the cellular folks have adopted. First, they want to divvy up cities into shifting, amoebalike cells that permit their precious frequencies to be reused every few cells, a process the cellular industry has used to expand capacity. Next, they want to switch to new digital transmission equipment and trade their bulky radio sets in for the same portable phones used by cellular operators.

If the FCC grants its wish, Fleet Call will increase its capacity over fifteen-fold, enough to keep its existing dispatch customers and expand by attracting cellular customers.

Fleet Call has a lot of money riding on the FCC application. After talking venture capitalists at First Chicago and Chase Manhattan banks into providing \$ 80 million in equity and access to debt financing, O'Brien and McAuley paid about \$ 250 million to acquire 1,600 or so of these dispatch channels in New York, Los Angeles, Chicago, San Francisco, Dallas and Houston.

In Los Angeles, for example, Fleet Call controls almost 9 megahertz of the electromagnetic spectrum, about 1 1/2 times the space of a single television channel. For that space it paid an average of \$ 5 million per megahertz. This is darned cheap compared to what cellular systems currently fetch. McCaw Communications recently acquired a part interest in a Los Angeles cellular system controlling 25 megahertz. McCaw paid the equivalent of \$ 166 million per megahertz.

If the FCC lets Fleet Call upgrade, the taxi dispatch channels will become vastly more valuable -- and McCaw's will be somewhat less valuable. In competing with cellular operations, fleet will have plenty of pricing flexibility, thanks to intense competition in the fragmented mobile radio business. "Customers were paying \$ 15 for 75 minutes of airtime on a frequency that was functionally equivalent to a cellular one where cellular was getting \$ 100 for the same thing," says McAuley.

There are some hints that the agency will come down on the side of competition. FCC Chairman Alfred Sikes has campaigned for more efficient use of the radio spectrum. For example, the cellular industry has adopted new digital standards without having to get FCC permission.

In some areas, the FCC has dropped the need to allocate frequencies for different kinds of services altogether. For example, holders of satellite transponder licenses may transmit phone calls, data and TV and radio

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programming -- all simultaneously. Yet elsewhere in the spectrum, services are strictly segregated. Fleet's application shows how technology mocks the FCC's rigid, outdated zoning laws. If the FCC relaxed those laws, the free market would quickly decide how best to use the spectrum.

Already the mobile radio band is starting to bristle with new technology. Last year the FCC let New York-based Ram mobile Data set up a nationwide digital all-data network using mobile radio channels. The big fellows are moving in, too. Motorola, a large holder of mobile radio channels, recently started selling a data messaging service over some of its frequencies to trucking companies. Moving a lot of dispatch traffic to more efficient data services would free up more capacity for phone calls.

Will local regulators object to having a third player in the cellular business? Not likely, if the newcomers start by competing on price. "No public service commission in the country is going to say, 'Don't lower your rates,'" says McAuley. Lower rates could be a serious blow to cellular operators, many of whom have big debt burdens assumed in buying their systems.

News of this and other potential setbacks have already knocked billions of dollars off the market value of cellular stocks and bonds. But have the price declines fully discounted the threats?

GRAPHIC: Picture, Brian McAuley of Fleet Call with dispatch radio and portable phone, Steve Winter

1990 Forbes, August 20, 1990

LEVEL 1 - 27 OF 53 STORIES

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Communications Daily

August 13, 1990, Monday

SECTION: Vol. 10, No. 156; Pg. 4

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HEADLINE: Iridium Highlighted;  
CABLE OFFICIALS DOWNPLAY COMPETITIVE THREAT OF DBS

DATELINE: VAIL, Colo.

BODY:

"Sky Cable is an interesting business opportunity for Hughes [which will build satellites], and that's about it," TCI Vp-Finance Bernard Schotters told analysts at financial seminar here sponsored by investment bankers Hanifen, Imhoff. He was among several cable executives who predicted that direct broadcast satellites (DBS) such as Sky Cable would have little impact on cable. If satellites do have impact, they will be cable-owned, Schotters said. TCI and other cable companies own medium-power Ku-band K Prime Partners, which Schotters said "goes into major launch in September." He said K Prime "has all the [future] capacity for high power that Sky Cable has."

Cable probably is immune to DBS competition in U.S. if it treats customers right, other cable officials said in separate interviews. Customers used to cable aren't likely to switch to DBS "if they're happy with our service and the phones are answered," Jones Intercable Pres. James O'Brien said. "We see the advent of DBS as complementary to cable since it will serve areas that aren't economic for us."

Key question is whether DBS acquires access to cable programming, and Schotters said bills in Congress that would guarantee access would constitute subsidies to DBS: "Hughes and GE don't need subsidies." Economics should dictate higher program costs for DBS than for cable, he said, because it's cheaper per customer to sell programming to cable, with 60 million subscribers, than to DBS with just a few.

"I don't see DBS as a threat as long as I have competitive programming and my customer service is in place," Jones Mktg. Group Vp John Mathwick said. Cable advantages include "incumbency," he said, as well as ability to provide localized programming. Schotters said cable also will remain more popular for technical reasons -- satellite dishes can receive only one program channel per receiver at a time, while cable allows different channels to be seen on different TV sets or viewing of one program while recording another.

Motorola's Iridium plan was other satellite star of meeting. Vp James Caille predicted Iridium, which will use 77 low earth orbit satellites to provide worldwide cellular-type telephone service, will have "tens of millions of users" by early in next decade. Iridium isn't intended to compete with cellular, Caille said, describing it as best suited for relatively low traffic areas and acting as primer for eventual transition to terrestrial cellular.

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