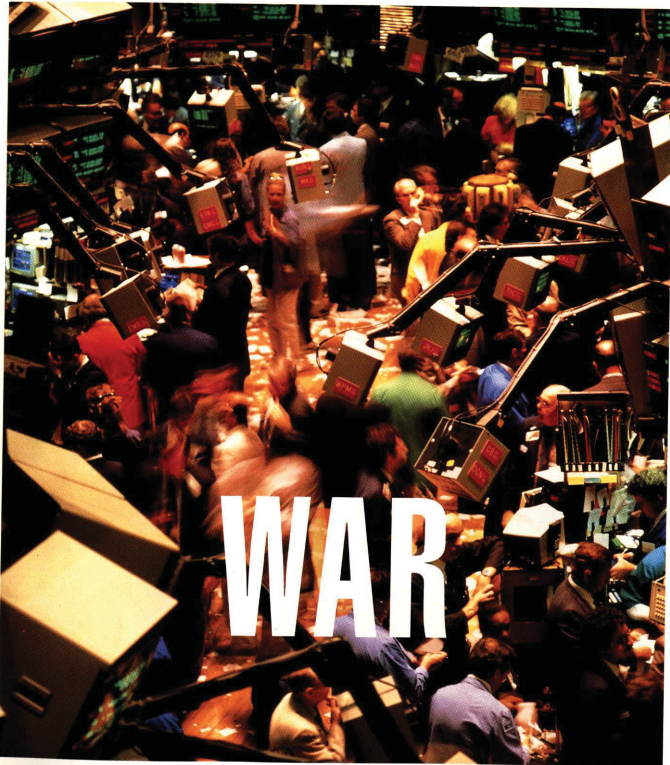


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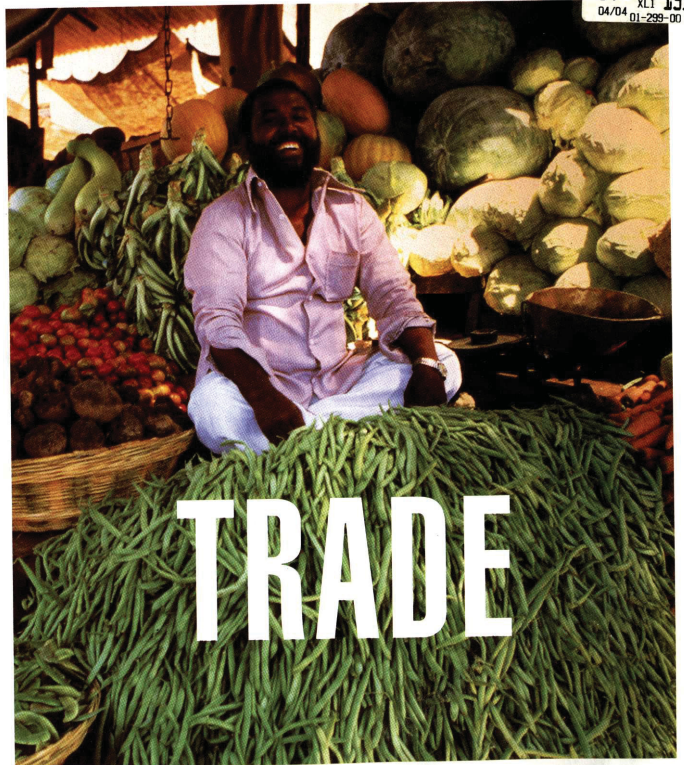
Is that which once began as a meeting place for buying and selling shares in companies still as it should be?

Or has the stock exchange floor degenerated into a battlefield where players bombard each other with numbers which have become increasingly detached from reality? The trade in company shares now involves 25 times more money than the trade in goods and services, for example. Is that a healthy situation for any economy? Perhaps we

would do well to step back from the frenzied pace of modern society and look around us, at cultures where the way people work and trade with each other is still close to the heart. Quite a few so-called primitive cultures, for example, are not nearly as primitive as we might think and sometimes provide better solutions for the ways in which humans interact with each other and their environment.

As Origin, we raise these questions because we ourselves

Origin: Amsterdam, Barcelona, Bombay, Brussels, Cambridge, Chicago, Cincinnati, Columbus, Dallas, Dortmund, Eindhoven, Fort Lauderdale, Hamburg, Kaohsiung, London, Luxemburg,



# TRADE

operate at the heart of modern-day technology. Which is why we have learned the importance of striking a balance between ends and means, of finding solutions which match the culture and environment for which they are intended.

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# WIRED

November 1993

First Monthly Issue      **Sluit Je Aan!**

**Q: Is the future as shocking as it used to be?**

**Alvin Toffler: How does a constitutional crisis in the United States, the breakup of China, a global revolt of the rich, and niche wars with personal nuclear weapons sound to you? The Wired Interview p61**



# Content

With this issue, *Wired* goes monthly, a step we had not planned to take until next year. But the overwhelming response to *Wired* – sellouts at newsstands, fifteen times more subscriptions than expected, floods of e-mail – forced our hand.

Your support means a lot to us. *Wired* is not a big media conglomerate. We are a start-up, founded and staffed by impassioned, dedicated individuals. Our mission is to cover the biggest story of the decade – the convergence of computing, telecommunications, and the media – for the most powerful people on the planet today, the people making this Digital Revolution.

## Get Wired (Monthly)

In the process, we are also trying to reinvent the magazine. To us, that means:

1. Taking advantage of what print is really good at. *Wired* isn't about delivering raw data, but high thought content and the sensuous look and feel that only comes from stimulating design, exacting prepress, and a US\$8 million Heidelberg Harris six-color press putting special inks on non-glossy, recycled papers.

2. Going beyond paper by making our hard-copy edition a gateway to our interactive services. Whether it's our Music Access line, which allows you to sample cuts of the records we review, or our online presence (America Online, The Well, MindVox, OneNet – for addresses, see page 108) where you can talk to our editors, reference back issues, or join conferences and chat rooms, our goal is to create a new kind of publication that is not complete unless you are plugged into both the hard copy and online experience.

3. Providing a level of service unheard of for magazines. Most magazines' idea of service is an eight-week wait for an address change. In an era of instantaneous communication, that's just unacceptable. When you call *Wired's* 800 number with a subscription query, or send a message to (advertising@wired.com) for our rate card, you talk to *Wired*, not some PO box in Colorado. And you get our immediate attention. (See masthead, page 16, for a full list of e-mail addresses).

Thanks again for your support. In gratitude to our early subscribers, we are extending your six-issue subscriptions an extra issue. As I wrote in our first issue, if you're looking for the soul of our new society in wild metamorphosis, our advice is still simple (only now it's monthly):

Get *Wired*.

Louis Rossetto  
(lr@wired.com)

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Cover: Alvin Toffler, photographed by Henry Blackham, July 1993, Los Angeles, California.

Dutch translation: Willem Velthoven (Editor, *Mediamatic* magazine), Jeff Mann, and Peter Rutten.  
Introduction: Nick Philip, C3.  
(Thanks to Simon at Optilux and Lior at Xaos Tools.)

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**W I R E D**  
1.5 November 1993

# IRIDIUM

(It's the cellular system where you remain stationary and the cells move.)

By Joe Flower

As big business goes, it doesn't get any bigger.

Imagine a 66-satellite system of such stupendous ambition that you can phone anyone, anywhere on the planet, even if that person is standing in the middle of the Sahara, or Antarctica. Cost: \$3.4 billion.

Players: Motorola, the big Japanese electronic companies, dozens of local PTTs, an alphabet soup of national and international regulatory bodies.

Here's the story of a dance that tells us a lot about who we are, what we expect, and how we deal with change at the end of the millennium.

Dick Tracy talked into his wrist. He had a little radio (and eventually, a tiny television) strapped there. The signal leapt, by the magic of comms, from Tracy's wrist to a satellite perched visibly over the buildings of the city like a Budweiser blimp. He could talk to anyone, from anywhere, because of that satellite. Pretty nifty.

By now we are used to people flipping open phones in restaurants, on ferries, in theaters during love scenes—teeny-weeny cellular phones that slip into a jacket pocket without making an unsightly bulge.

But our lantern-jaw crime-fighter would have tossed today's cellular phones into a desk drawer and stuck with his wrist gizmo. Why? Today's cellular phones have ghosts and cross-talk. The spectrum is crowded. Other people can overhear—the grand satraps of the underworld can certainly afford scanners. Sometimes when one "cell" hands you off to another,

you get dropped like a trapeze artist with a timing problem. A cellular phone can't always call everywhere. If you want to call London or Brunei, you may have to get to one of those clunky old phones that actually has a wire attached to it.

But worse than that, a cellular phone can't easily leave town. Mine won't work at all in that big nothing on the drive to Las Vegas. I could be out of touch for hours. If I take the phone to another city, I have to set my phone to "roam" and pay extra. If I go to Europe, the phone won't work at all. They have a whole different standard over there.

And even worse, someone who wants to call me has to know what part of the world I'm in. This can be a real problem. No, I'm with Tracy—I want a real phone, something I can toss in the pocket of my genuine Banana Republic photojournalist's vest and take anywhere. I want my agent to dial my

number and get me, whether I'm chatting with roustabouts in the oil fields of Kazakhstan or sipping kava in the Friendly Islands.

I know this problem worries you, too. I can feel your frustration, as you wander the tombs of Monte Alban without any idea what the Nikkei's doing, or sit in traffic between Heathrow and Soho with no way of dialing up Lagos.

Have faith. You have not been forgotten. The big boys are working on it. Give them another five years, and your troubles will be over. You'll be connected, always and everywhere, clear channel, error-corrected, voice- and data-capable, page-able, locate-able, and encrypted—all with one phone number, no matter where you are. Ask and ye shall receive.

Well, okay, you didn't ask, but they knew you were about to. How will they do this? With satellites, just like in Dick Tracy. Not the geostationary telecom

satellites like Telsat that we're used to—big things 23,000 miles out. No, we're talking "Big LEOS" (low earth orbit satellites)—much smaller gizmos whizzing by 300 to 750 miles out, and even one MEOS (medium earth orbit satellites) system at 5,600 miles out.

Who is going to do this? Ah. That's the \$300 million to \$3.4 billion question. Five companies and a major international organization are competing for this one, and others are trying to join in. No one has yet fired rocket one. Everyone is still in R&D on the system itself, the satellites, the handsets, and the ground stations. Yet the competition is already three years into a ferocious, public, many-sided corporate brawl conducted not in space,

Joe Flower (bflower@well.sf.ca.us) is author of *Prince of the Magic Kingdom: Michael Eisner and the Re-making of Disney*. He wrote 3DO: Hip or Hype? for *Wired* 1.2.



but in boardrooms, at international conferences, at lavish parties, in fax flurries and in global conference calls. In six years, Motorola alone has spent \$100 million on this idea, and in August it awarded Lockheed another \$700 million to build the birds. But so far all this is still just an idea: a cellular system with very tall towers called satellites.

On one level, this is just another dance of the behemoths. One or more of the systems will be built, and in a few years you can sign up, if you like. Yet it's a dance that tells us a lot about who we are, what we expect, and how we deal with change at the end of the millennium.

**The Product: What's the Plan?** Follow the bouncing ball. The Big-foot of this dance is Motorola. This is the company with the gold-plated system, the one you have most likely heard about, the one with the greatest number of satellites, the system with the highest price tag.

**In "negotiated rule-making" sessions this spring, everyone agreed to share the available spectrum — except Motorola.**

the biggest PR team, and the most peculiar design, castigated by a rival company CEO as "very inefficient and expensive," characterized by another as part of "a strategy that fundamentally seeks a monopoly."

It's called Iridium, after element 77 on the periodic table, because its original design called for 77 satellites. (Iridium also happens to be much more common in meteorites than in earth-bound stone.)

Now the design calls for 66 satellites, but no one at Motorola has called for changing the name to that of element 66. Dysprosium doesn't have the same ring, and its root meaning is "bad approach."

Iridium's 66 satellites will fly in eleven nearly polar orbits (tilted 86 degrees) 420 miles out. Because of these orbits, Iridium will blanket the globe. If you're on an oil rig off the

North Slope and Mama's at McMurdo Sound in the Antarctic, dial away.

The Iridium satellites will not only talk to handsets and ground stations, they will also talk to each other, forming a network aloft, passing on conversations, and handing them off when they drift out of range.

Because of these satellite-to-satellite crosslinks, the Iridium system will be able to handle calls to other Iridium phones without reference to any ground stations at all, once the link is established. Say you're stuck in traffic in your Jag convertible on Sunset in Santa Monica. Good time to call the manager of that hot new act you've just signed. You have no idea where this person is, but you do know his Iridium phone number. You turn on your phone and dial. The signal goes from your handset straight to an Iridium satellite, which sends a query through the network of satellites to one that is over Iridium system headquarters. There, a comput-

The other systems are variations of this theme. They have fewer satellites, in less-tilted orbits, or in higher orbits (which gives each satellite a bigger footprint). One company, Ellipsat, plans to use elliptical orbits, which skews coverage to the more-populated areas. (Ellipsat CEO David Castel says, "Frankly, my business plan can do without the people on Easter Island.") TRW's Odyssey system features high-flying MEO birds that use inertial guidance systems to point themselves, focusing their beams at their selected continents. Nobody but Iridium plans to crosslink its satellites — everybody else's birds are single bent-pipe repeaters, sending the handset's signal back down to a ground station that feeds into land lines. All their handsets are dual-mode — they are cellular phones first, satellite phones only if they can't make a cellular link. All code their messages differently than does Motorola, and all promise to do it for dramatically less money.

**The Dance: What's Really Going On?**

What's really going on is something between a minuet and a World Wrestling Federation Monster Mash. It has something in common with the Great Red Spot on Jupiter, a soliton — a vast storm of surprising stability that bubbles up out of the chaos, swallows everything in its path, and then sticks around, year after year, swirling, enormous, and nearly permanent. It began in late 1990, jump-started when tiny Ellipsat applied for an FCC license, followed rapidly by Motorola and the other competitors. They will stay locked in this vicious courtly scherzo until one or more of the systems goes up and others have given up — unlikely, according to those who watch it most closely, before the turn of the millennium. The dancers include all of the companies involved, plus the departments of state and commerce, the FCC, various world bodies, a hundred or so national phone companies around the globe, commercial airlines, technology giants in Europe and Japan, rocket makers in Russia, and even radio astron-

omers. Iridium even recruited the ambassador of Mali, plus his wife and staff, to act in a promotional video. The dance is political and corporate, but its realities can only be described deep in the differing technical choices made by Motorola and its competitors. Each technical choice affects the business end; the business decisions push the politics; the politics mold the technology, around and around it goes.

**Everybody Dance**

To make a system like this work (satellites in the sky, ground stations on the ground, listeners with phones to ear), you need several things. Most important is a piece of the broadcast spectrum (and things get rapidly more complicated if it's not the same piece in every country). Second, you need a license and an agreement with the phone company in every country in which you want to operate. Third, you need investors — but if you build it, they will come. If you have the spectrum and the licensing all taken care of, you will have little problem getting the investors. Fourth (and a distant fourth), is the technology itself.

The first two hurdles are very high. The spectrum that's available is small and not free for use in every country. Redesigning the equipment so that it won't interfere with the services already using that spectrum may make it overly expensive. Besides, it's nearly impossible to get every country in the world, even just the important ones, to agree on anything. Both Europe and Japan are busy developing their own cellular systems and have hopes for their own satellite systems. Why should they sign on? And if they don't sign on, the projects are probably dead.

Motorola got caught in a wringer right up front at the WARC (World Administrative Radio Conference) '92 in Malaga-Torremolinos, Spain. It had used its considerable corporate weight to convince the US government to ask for a piece of the spectrum around the world for Iridium and its competitors, even though a good chunk of that spectrum was already given over to radio

astronomers (not a group notorious for its political clout) and the Russian GLOSASS global navigation system — a system the FAA plans to incorporate into American civil aviation. This led to lots of head-scratching, work-arounds, technical footnotes, and power limitations, which did more damage to Iridium — the high-powered system — than to its rivals. In the end, WARC '92 did recommend that the spectrum be made available.

But Motorola's real problem at WARC was design. The system it proposed had nothing to do with landline systems. Technically cool for users — one price, global coverage, just flip on the phone and talk. Not cool for governments.

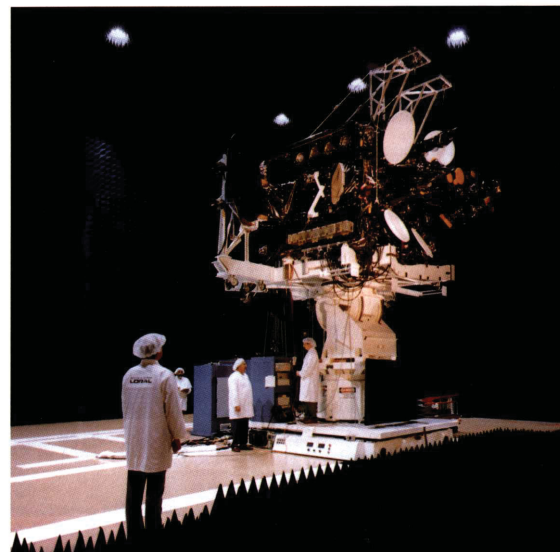
Almost everywhere except in the US, phone service is run by the government (usually as part of the postal service). In many small countries, it is one of the government's major sources of revenue, and international calls turn the highest profit. Motorola suddenly proposed a system that would move the profit away from these countries and into its own pockets.

Neat trick, but Motorola is the world's largest manufacturer of cellular equipment. Those who operate PTTs (post telephone telegraph systems) are its major customers. In many parts of the world, they are its partners. Motorola can't ignore them.

So Motorola's Iridium phone has become, like those of all the other systems, dual mode. When you turn it on, it's just a cellular phone. Only if no cellular net is available, or if you push the phone's satellite button, does it hook into the satellite system. Most long-distance phone calls from an Iridium phone would, in fact, never go through a satellite. So Motorola had its hands full with a major shift in strategy, first assuring PTTs around the world that it never meant to steal their revenues. Wouldn't dream of it. Then saying, "Wanna be a partner? Wanna come aboard? This could be very big."

**Say This Three Times Slowly: TDMA Versus CDMA**

So how will the different systems divide the spectrum that WARC '92



The sight is awesome. The feeling is one of awe. Is it the size? Or the strangeness?

To get here, we have gone through a security check, two electronic doors, and two airlocks. We have had our coats taken away and replaced with white lab coats, our hair wrapped in coverings, our shoes vacuumed.

We are in a room the size of a cathedral and the shape of a box, as tall as it is wide. All of its inner surfaces except the patch of floor on which we stand are covered in neat rows with thousands of narrow pyramids, each one two feet tall, six inches across at the base, blue, with a black tip. At an angle to the far wall, and at an angle to the side wall, two vast flats like drive-in movie screens stand cocked slightly toward each other, shiny, machined, rectangular, slightly curved, each edge lined by rows of long, narrow, white triangles, like gigantic cardboard cutouts of crocodile teeth. The light, falling from rows of halogen lamps in the ceiling high over-

head, is even and brilliant. There are no echoes. Every voice seems a whisper.

At the center of this end of the room stands a great, complicated, wheeled pylon, holding high in the oppressively silent air a monstrous bug seemingly concocted of masses of black plastic film, tape, gold-colored mylar

**In The Hall of the Space King**

(From the author's notebook: Loral Space Systems Satellite-Testing Facility, Palo Alto, California)

foil, cable, aluminum, and carbon fiber. Smoke-gray dishes protrude from its sides, pointed at the screens. A mass of yard-long, plastic-wrapped stalks of all sizes protrude from its face like horns or nozzles. A cone that could be a rocket nozzle — or a cheerleader's megaphone — protrudes from its back. Two men in white coats and white hair-coverings work at a console on the floor below it, acolytes in an arcane rite.

It all seems otherworldly and, for once, the feeling is entirely appropriate. This monster over our heads was not made for this planet. It is a satellite. Its true home is the stark darkness of orbit, of space and the solar wind.

made available? Imagine eight people at a dinner table trying to have four conversations at once, with nobody seated next to the person he or she is talking to. Cacophony. You could give each person one minute to talk while everyone else shuts up a minute for one biker to tell the other about his new super-stroke, a minute for one father to brag to another about his 5-year-old. Call this time division.

Or you could assign each conversation a language: the bikers talk in Farsi, the fathers in Nahuatl. As long as they know the right languages, and as long as no one shouts, everyone can have their conversations at the same time with no interference. Call this code division.

In January 1989, the US cellular industry accepted TDMA (time division multiple access) as the digital standard that would replace the current analog AMPS (advanced mobile phone system) standard. TDMA allows a cellular operator to divide up the signal into tiny fractions of a second, so three times as many people can use the system at one time.

Three months later, San Diego's Qualcomm Inc. introduced CDMA (code division multiple access), a new flavor of an idea that has been used in military satellites for decades. After three years of testing, the industry accepted it as a second standard, one that would increase the capacity of the system 10 to 20 times.

The big difference between the two is this: CDMA allows 4.4 trillion different codes, so different callers, even on different systems, can use the same spectrum at the same time. The time division in TDMA has to be done in one computer - two different systems can't use the same spectrum at the same time.

CDMA is into sharing. TDMA is not. Systems that use CDMA can all co-exist in the same spectrum. For different systems to use TDMA, someone has to divide up the available spectrum ahead of time.

All the global satellite systems are interested in sharing the available spectrum, and have decided to use CDMA - except Motorola (the Bigfoot), which has stuck to TDMA, and

demand exclusive rights to a segment of the spectrum (in addition to 200 MHz of spectrum for its satellites to talk to each other). Motorola's attitude has been characterized by Philip Malet, one of its lawyers, as, "Give us the spectrum and then let the others fight over what's left."

As long as there was only one system using TDMA, it could do all right in the same spectrum with other CDMA systems - if it kept its voice down. But Iridium is a shouter - TDMA, in Motorola's design, needs more power than CDMA to blast through to the inside of a cab or a building. The other systems can't sit next to a shouter.

The FCC's response was to order everyone to sit down and work it out. That didn't work. In "negotiated rule-making" sessions this spring, everyone agreed to share the available spectrum - except Motorola. So this fall the FCC is expected to issue its proposed rules, beginning a process that may take up to a year.

Congress has come up with one solution almost everyone hates: a bill authorizing the FCC to auction off pieces of the spectrum. According to Leslie Taylor, a consultant to Globalstar, "Auctions would really complicate things. Slow things down, and add cost - they create a tremendous pressure for the companies to come to some kind of agreement."

"An auction," says Ed Nowacki, vice president of federal systems for TRW, "would result in a monopoly. This is a public resource, and should be open to multiple access."

The likely outcome? They'll do it Motorola's way, giving 8 MHz (half of the available spectrum) over to Iridium. "Iridium cannot operate without that," according to Mary Ann Elliott, president of Arrowhead Space and Telecommunications. "Motorola won't get tossed out by the FCC," says another consultant, "because they have paid off so many people. They have mowed down the opposition."

But the 8 MHz that would be left for all the CDMA participants "is not enough," according to Nowacki. "The amount of traffic you could fit in that spectrum wouldn't make the project economically viable" for the

other companies. David Wye, of Congress's Office of Technology Assessment, says that such a solution "might, from an engineering standpoint, be completely useless."

Once the FCC hands out licenses, everybody has to reconvene before the International Frequency Rate Board, fighting off all comers to secure those frequencies on a global basis. If the US competitors don't work something out, says Arrowhead's Elliott, somebody else "will likely be in place and offering

The power mystery player is Inmarsat, an international organization with 66 member countries that already runs a voice and data satellite communications system for ships at sea. The terminals now cost \$45,000 each and are as big as file cabinets - even the newest, briefcase-size model costs \$25,000, plus \$5.50 per minute of use. Inmarsat wants to get into the handheld business, but hasn't yet decided just how it wants to go about it. The idea has a name - Project 21 - and

confusing, it's because it is," says David Wye at the Office of Technology Assessment. "None of these systems is operational. You can only do so many studies. Everything is up in the air."

Finally, there is one major tripwire that has everyone coughing politely and looking the other way: Section 310B of the Communications Act of 1934 categorically forbids the FCC from giving a license to any company with more than 20-percent foreign ownership. That would seem to rule out Iridium, for whom Motorola has been assembling a global concatenation of owners: Globalstar, with its European partners; indeed, almost everybody. But I won't mention this if you won't. We wouldn't want to spoil anything, would we?

#### Wild Rumors

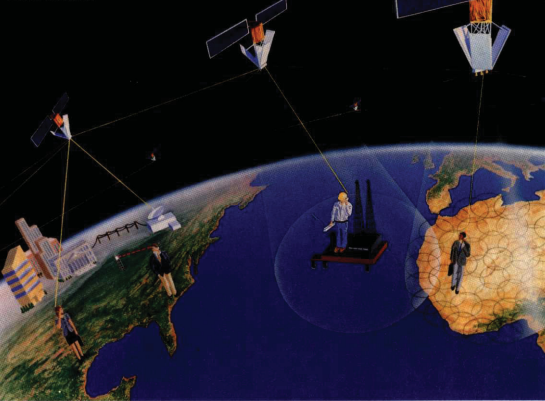
Because of its high price tag, its obsession with covering every inch of the globe equally, and its exclusivity, some people figure that Motorola originally designed Iridium for the US military and intelligence services (a "three-letter" system - DOD, DIA, CIA, NSC), just in time to see the Berlin Wall fall. Motorola admits that some Iridium technology came from military systems, but denies that the system was designed for the military.

The first meeting of potential Iridium investors in March 1991 had a cover charge, an entrance fee to assure that no one was wasting Motorola's time and resources in idle curiosity. The cover charge was "approximately \$1 million," according to industry sources quoted in Mobile Satellite News. Iridium spokesman John Windolph says, "That's ridiculous."

#### Get Serious. Who'd Pay For Global Phone Service?

Is there really a market for this? Motorola figures Iridium needs a million customers to break even. Even shoestring EllipSAT is looking for half a million. What happens as cellular expands its geographic coverage, as it goes digital (and data-friendly)? Does the market for satellite phones disappear? How many globe-hopping CEOs and

It's still just an idea: a cellular system with very tall towers called satellites.



hot-shot Hollywood agents are there in the world?

"I'd sign up for it in a second," says Richard Buckberg. "I've been looking for something like this for years." Buckberg, a consulting biologist, often spends days or weeks on remote mountainsides, counting marbled murrelets or spotted owls. He often has to check with his office, or consult clients. Once he gets outside of a cellular system, he falls back on the RCC, a suitcase-sized affair under the front seat of his truck. It consumes some 40 watts of power, it can't be removed from the truck, it can't send data, and it is complex to operate. He has to know the channel of each

"repeater" station on the route - and no one can call him when he's in the boonies. "A global phone that could receive calls and send data? That would be a godsend," he says.

Buckberg is far from alone. In fact, many people have jobs that

take them to remote areas without good phone service, and many of these people need to be able to send data: construction engineers sending plan revisions, oil-company geologists uploading test results, surveyors asking for previous maps, adventure tour operators posting itinerary changes. Others, such as salespeople, field producers for television networks, and reporters, may usually be within reach of a regular phone, but they can be hard for the home office to track down (even paging relies on the person you are calling to find a phone and call back). These groups constitute a second market for global phone service.

A third market is the in-fill crowd: people who can afford to pay for the service but live in remote, thinly-populated areas that will likely never be covered by regular cellular service.

Finally, in many third-world countries, both regular and cellular

phone services only cover a small fraction of the land area. If the governments of countries such as Botswana, Mongolia, and Peru want to know what's going on in remote villages, they can set up landline phone systems, with microwave and fiber links. Or they can try to teach the village leaders to operate a short-wave radio. But it would be far easier and cheaper to simply give each village leader a satellite phone - instant infrastructure. Globalstar has promised complete pole-mounted solar-powered terminals for \$2,000 each that would give a local village phone system direct access to the public switched network in the faraway capital, with no need to string wire

across the vast jungle, desert, mountain, or swamp in between. Add to that the many urban parts of the world (including many formerly communist countries) where

(continued on page 118)

The Dance Card	Motorola's Iridium	Loral/Dualcomm's Globalstar	EllipSAT's Ellipso	Constellation's Arises	TRW's Odyssey
Satellites	66	48	24	48	12
Cost (\$B)	\$3.37	\$1.6	\$4	\$29	\$1.3
Orbits	Circular 86° tilt	Circular 52° tilt	Elliptical & Circular	Circular	Circular 55° tilt
Turnkey	1998	1998	1996	1996	1998
Altitude (NM)	420	750	4880/312 6000	550	5600
Handset price (est.)	\$3000	\$700	\$1000*	\$1500	\$550
Price per minute (est.)	\$3	\$30*	\$50*	\$50*	\$65*

\* Plus ground charges. \*\* For \$200 cellular upgrade.

service before any US company has obtained a clear license."

Others are crowding onto the dance floor, elbows out, looking for room. A sixth company, San Diego-based Celstar, plans to enter the race with two geostationary satellites. Calling Communications Corporation of West Covina, California has announced a \$6.5 billion plan that calls for 840 lightweight LEO satellites and 84 orbiting spares. A number of other countries, including Russia, Singapore, Mexico, Tonga, Saudi Arabia, and Indonesia, have announced plans for systems that will compete for the spectrum given out at WARC '92. The American Mobile Satellite Corporation already has a license (the exclusive license, it claims) for "in-fill" mobile satellite service in North America, (for customers in areas not covered by regular cellular service) using geostationary satellites - and expects to be operating by late next year.



## Iridium

[continued from page 77] bureaucracy and antiquated systems can mean years of waiting for a phone line to be installed – a wait that is unacceptable to fast-moving international businesses.

Counting all of these groups, there is probably a very large market for satellite phones, especially if the phones (and the online time) can be kept affordable. Most systems aim to match the cost of cellular, 30 to 50 cents per minute, plus any land-line long-distance charges. Motorola aims to charge \$3 per minute to start with (including all charges).

And there's the rub: the Iridium design costs more. If you want your satellites to talk to each other, they have to have on-board computers to handle the complexities of networking. The computer has to have a backup, and so does its memory. They both consume power. And satellites that talk to each other not only need an extra set of antennae, they also have to be much more precisely pointed and positioned than satellites that just talk to the ground. Their positioning thrusters use more fuel.

Altogether, the Iridium satellites will be bigger, heavier, and more expensive to launch than those of their competitors. Ansohhead's Elliott says, "I don't know who would use it at \$3 per minute, if there was an alternative." Iridium's gruff, avuncular, white-haired, grin-ready CEO, Bob Kinsie, harrumphs, "Motorola knows the market. Those other guys are just satellite builders."

### \$3.37 Billion? Can Motorola Swing It?

Not by itself. It has been looking for partners for three years now. Other companies, with cheaper systems, need less investment. Yet they have been coy about whether they're succeeding in wooing partners.

Doug Dwyre, president of Globalstar (which counts among its partners such European firms as Aerospa-tiale, Alcatel, Alenia, and Deutsche Aerospace) told Satellite News,

"We don't really make a lot of noise about our investment successes, because we don't really see that it's quite necessary yet."

Another CEO brags, "We have taken away major investors from Iridium," but he won't name them. But on August 2 of this year, Motorola came up grinning, with an announcement of \$800 million in binding commitments and cash from an initial group of investors around the world. The group includes such American players as Lockheed, Sprint and Raytheon; a Saudi group; Kunichev Enterprise, the Russian rocket-maker; the Italian national phone company; a consortium of big Japanese players, including Sony, Mitsubishi, Mitsui, Kyocera and long-distance carrier DDI; and China's Great Wall Industry Corporation, the commercial arm of the Red Army.

The motive of the investors is clear: They are taking a chance on owning a slice of a de-facto world monopoly. Each of them will not only have a piece of the company, they will own the Iridium gateways and act as the local distributor in their respective home markets. For them it's a game worth playing.

But in any list, who's missing is as interesting as who's playing. The list does not include anyone from Germany, France, or the United Kingdom; either of the two Japanese national phone companies; anyone from Africa; or anyone from Brazil, whose national phone company is already working with Globalstar. The list is global but it is far from seamless, and many orbits from monopoly. But Wall Street bought the story: Motorola's stock rose seven and a half points in the week after the announcement.

### So Who's Winning?

There is something like a consensus among the competitors that one or more of the systems is likely to make it – researchers for Connecticut's International Resource Development say there is room for "at the most, two of the 'Big LEOS' systems" – and that Iridium is the most likely to succeed. The next

best bets are Globalstar and Odyssey, or a conflation of several of the CDMA plans.

But not everyone is so sanguine. One report from the Office of Technology Assessment says that spectrum problems alone "may make operating a truly global system technically unrealistic." And even enthusiast Elliott, of Arrowhead, points out that AMSC's system, due to start service next year, has taken thirteen years to get a full license, and concedes that "it is very unlikely that we will have any system operational before the year 2000 – and any system will be hard pressed to keep up with Innarsat."

This is a complex game on every level – one that involves the technical difficulties of building a system, the intricate many-sided revenue-sharing contracts among scores of PTs around the world, the legislative and bureaucratic minefields of scores of countries; one that also requires some diplomatic and political back-scratching. For instance, the technical demands of the Globalstar system call for about 125 ground stations eventually. But company officials estimate that they will need another 75 ground stations to solve diplomatic and political problems ("If you are giving our hated vile-dog enemy a ground station, we must have one, too, or you can't operate in our country, which is beloved of all the gods"). It will take enormous corporate persistence and large buckets of cash to get it done.

There are few rules on this dance floor, few edges. This particular long, hard waltz is emblematic of so many of the dances we do here on the edge of the millennium: frenetic, vast beyond imagining, fueled by historic changes so large they feel like the crack of continents, turning on technical advances so beguiling they seem magic, promoted by happy phalanxes of public relations people, defended by platoons of lawyers, built by armies of bureaucrats and technicians, happy for a salary, desperate for the damn thing to work.

So the Dance of the Long Knives will go on. And on. And on. ■ ■ ■

## Resources

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American Mobile Satellite Corporation, 1150 Connecticut Ave. NW, Washington, DC 20036. +1 (202) 872 7660.

Aries, Constellation Communications, Inc., 10530 Rose Haven St., Ste. 410, Fairfax, VA 22030. +1 (703) 883 1079.

Calling Communications Corporation, 1900 W. Garvey Ave. South, Ste. 200, West Covina, CA 91790. +1 (818) 856 0671.

Celstat, Inc., 532 S. Gertruda Ave., Redondo Beach, CA 90277. +1 (310) 316 6301.

Ellipsat, Ellipsat International, Inc., 1120 19th St., NW, Ste. 480, Washington, DC 20036. +1 (202) 466 4488.

Globalstar, Loral Qualcomm Satellite Services, Inc., 3825 Fabian Way, M/S G35, Palo Alto, CA 94303-4604. +1 (415) 852 5601.

Iridium, Inc., 1350 I Street, NW, Washington, DC 20005. +1 (202) 371 6889.

Odyssey, TRW Space and Defense Sector, One Space Park, Redondo Beach, CA 90278. +1 (310) 812 2424.

# "FORTUNE FAVORS THE BOLD." VIRGIL

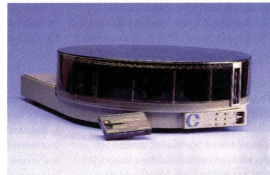


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