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"Motorola's View of Wireless Communications"
12 May 1994

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Vice President, Marketing
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Moderator HARVEY SAPOLSKY [HS]:   Welcome to the M.I.T. Communications Forum.  Today we are privileged to have Motorola here as part of our new series featuring prominent companies in the telecommunications industry.  Representing Motorola is Jim Caile, who is vice-president for marketing for Motorola's cellular group.  He is a graduate of Loyola University and has an M.B.A. from the University of Chicago.  He worked for Ampex and Interpublic before joining Motorola.  He has been very active in the Telecommunication Industry Association, and leads the Association's cellular section.  I will now turn the floor over to Jim. . .

JIM CAILE [JC]:  Good afternoon.  It is an honor to speak at such a bastion of creativity.  To understand Motorola and where we are heading, it helps to understand our markets--for it is our customers that drive us.  The business world and the public at large have signaled their preference for work style and lifestyle mobility.  Networks have been installed in over 100 countries to reach people and machines on the move.  Over the last year, devices in service in the three key land mobile services [cellular, paging, and private radio] grew 30% to 119 million units worldwide, [and that number does not even include cordless telephones].

In the area of Private Mobile Radio [i.e., traditional two-way radio], there are now 36 million transmitters in service, an increase of over three million from last year.  Private customers, such as utilities and governments, are demanding more sophisticated system capabilities including encryption, data, telephone interconnect and messaging.  Also, trunked radio customers are evolving their systems to compete in the era of personal communications.  At the same time, there seems to be a growing need for people to be in touch at all times.  Thus, at the entry level, consumers are purchasing pairs of radios to remain in touch while hiking, fishing, camping, etc.

Paging has approached 50 million units [worldwide] in service, up about 14 million from 1992.  That is a growth rate of almost 40% in a business that a few years ago was projected, by a few so-called "visionaries," to disappear.  This rapid growth has been manifested in an increase in services and an expanded community of users.  For example, new services include data messaging to laptop and palmtop computers.  And two way messaging services are just around the corner.

Similarly, as costs go down, paging is becoming a consumer, as well as a business, service.  New form factors, bold colors and greater functionality are the norm.  Sales are increasingly through non-traditional channels--for instance, mass retailers such as Sears, Circuit City and Walmart.  Also new groups of customers, including young adults, teenagers and working parents, have found real value in paging.  It is a very cost effective way to stay in touch.  And cellular has actually spurred paging sales, not diminished them, as some had predicted.

Cellular had reached 33 million subscribers by the end of 1993, up 10 million from 1992--a 43% increase in the cumulative base.  With over 100 countries in service, the cellular industry is booming.  In developed countries, there are growing numbers of consumers who are purchasing cellular phones for personal reasons, such as safety and convenience.

In developing countries, ranging from Indonesia to Eastern Europe, cellular concepts are emerging as the wireless technology of choice for basic telephone service.  One can set up a working telephone system just by putting up a few towers.  Deployment of a modern cellular system is measured in months, as compared to the years, or even decades, required to bring wireline service to customers on waiting lists.  In Latin America, for example, where we have found cellular service to be substituting for wireline - the minutes of use per subscriber are 2-3 times the level of usage among cellular customers in the U.S.  When you factor in the future of wireless data, satellite systems like Iridium, cordless phones and wireless systems for home and office, you can see we've just scratched the surface.

1

A number of key market and technology forces are driving the growth in wireless communications. First, the push to improve productivity, responsiveness and the quality of life that wireless communications provide. Second, because of the changing political and economic scene in international markets, a number of new market-oriented economies are emerging. Third, over four billion people [four-fifths of the world's population] are entering markets newly open to Motorola's products. I should note that more than half of the people in the world have never used a phone. So the efficiency and cost-effectiveness of new wireless systems can have a profound effect on their lives. Fourth, smaller, more powerful semiconductor components are lowering the cost of computing power. This enables us to develop more affordable digital signal processing that can be put in the palm of one's hand. Fifth, and finally, as manufacturers leverage new technologies and bring down their costs, they increasingly attract and serve consumer as well as business markets.

Our vision of wireless communications is straightforward - enable people to communicate and access information seamlessly anywhere, anytime, and at their convenience. Consequently, over the years Motorola has provided innovative new technologies, the kind that literally created industries like cellular, paging, dispatch, trunked radio, and wireless data. Beyond new technology, what enables the creation of these new industries is growth in demand.

Of course, sustained growth also causes constraints. There is only so much capacity available in the radio spectrum; channels are becoming crowded. Two factors are working to alleviate that constraint. The first is the creative technical effort being applied globally to more efficiently use the spectrum. The amount of equivalent bandwidth per user is being driven down through frequency division, time division, code division and packet radio. The effect is the same - more conversations or data packed into a given amount of spectrum.

The second factor working to alleviate the capacity constraint is the increased spectrum being provided to extend the growth of personal communications. Regulators are allocating spectrum and deferring to free market principles to achieve competitive environments: a condition, I believe, that will drive exceptional value for consumers. In virtually every country, two to three times today's spectrum is being made available to current and new operators to fuel and satisfy the demand for service. In the U.S., for example, a total of 160 MHz at two GHz is now being added to the available base of spectrum, and the federal government is releasing another 200 MHz albeit at a more deliberate pace.

This cycle of new spectrum allocation, followed by technology expansion/renewal, is a key part of our industry's growth process. Overall, we believe the wireless industry will exceed $60 billion this year. However the total telecommunications market will probably reach $1 trillion. In the next 15 years or so, we believe wireless products and services will increase by a factor of 10, reaching more than $600 billion by 2010.

Over the same time frame, telecommunications will triple to $3 trillion. Therefore, wireless will increase its share of the telecommunications dollar, from 6% today to 20%. In terms of population penetration, the three core segments combined have penetrated today only 2 1/2% of the world's population. Even the largest of the three, paging, has achieved only 1% penetration. Total penetration can range from a tiny fraction of a percent in China, Indonesia or India, to a combined 20% in the US [and even higher in dense urbanized countries like Singapore and Hong Kong].

From a base of 119 million users today, we believe there can be well in excess of 300 million wireless users worldwide by the year 2000, perhaps reaching almost a billion over the next 15-20 years. The overall wireless industry growth will embrace a diversity of applications, with no single device or service dominating. Instead, there are likely to be multiple competing wireless networks. And there will be intense competition to interconnect and haul the traffic between individual wireless services.

A key component of growth, and one that will cut across all industry segments, will be wireless data. From fewer than 400,000 users today, the industry is forecast to reach

upwards of 20 million by the year 2000. Two-thirds of the applications will be mobile office and personal communications. Some of these units will be operating on private land mobile systems. Others will be adaptations to paging. A number of the new data units will be served by cellular and wide area PCN/S systems in either circuit switched or packet modes. Some number of these will be operating on Public Shared Data Networks, such as ARDIS, Motorola's joint venture with IBM, which is an outgrowth of private mobile radio systems.

The convergence of three major elements is creating this growth potential for wireless data services. These elements are as follows: the availability of public data networks, availability of small and low cost radio modems, and the development of applications and connectivity software. You could ask, "What's driving the need for wireless data and messaging devices?" In the US. for example, about 48 million workers, or more than 40% of the work force, are on the move; they do not spend much time sitting at their desks. This means that most of the vast investment that companies have made in data bases and applications only serves, conveniently, the 60% of the people left in the office. Whether their mobile workers have campus or wide area needs, successful companies are focusing on reducing cycle time, to provide faster service and increased customer satisfaction. The opportunity for widespread personal use for personal digital assistants [PDA] will build upon the business examples I just mentioned.

Over time, the consumer market for wireless data will, I believe, mushroom. People who argue that written correspondence is a lost art may be very pleasantly surprised at the effect of user friendly PDA products like Envoy. We have made substantial investments in nurturing the wireless data industry, and Envoy is the latest product in a long line of wireless voice and data products.

I would now like to spend a few minutes highlighting Envoy. The Envoy screen, with the Magic Cap operating system, looks just like a desk top. One can input information to his/her interactive address book in a remote desktop connection. One can also create a budget spreadsheet, examine a street map, or check one's OAG for his/her flight time. And that's before one gets to the fancy stuff like wirelessly scheduling a meeting with a group and automatically receiving a confirmation. One can send out a wireless telescript "Smart Agent" to a colleague's Envoy to search for a specific piece of information. One can draw a spreadsheet on a telecard, add in animation and a voice stamp, and send it wirelessly via Personal ink. As you can see, there are a variety of things Envoy can help one accomplish throughout the day; and Envoy is only one of the many products that will help drive wireless growth.

At Motorola, we have positioned ourselves to take advantage of this diversity of growth. We are involved in all major technologies and standards. There are times we wish the technology list could be a little shorter. However, we must deal with the reality that there are differences in viewpoints and service concepts at the regional and operator level. And beyond that, we must recognize that these differences will drive a variety of technical solutions.

Similarly, there has been a major shift in the standard setting processes. With so much technical diversity, it is becoming almost impossible to achieve consensus. What is evolving is a process that creates several standards, each in relative collegial bliss, and then allows them to compete in the marketplace. Not all proposals will become standards, and not all standards will be commercially successful. But the new process will, at the very least, get engineers out of the business of having to play Solomon on technology.

Consequently, as an equipment manufacturer, we must let customers decide which technology best serves their objectives. At Motorola, we are positioning ourselves to benefit from the growth of wireless regardless of customer choice. An example of this can be seen in the large number of air interface protocols that fall within the businesses reporting to the General Systems Sector. One could easily double or triple this quantity to represent the total company. And such a list would not even include the multitude of network protocols required to serve the world markets. In many respects these air and

3

network interfaces are as much art as they are science. Collectively, I believe, this know-how represents a key competence of the corporation.

In the time that remains I'd like to focus on the several wireless businesses that comprise, along with our computer operations, the General Systems Sector. The key wireless segments are: the Cellular Infrastructure Group [CIG], the Cellular Subscriber Group [CSG], and the Personal Communications Systems [PCS] Division. The Cellular Infrastructure Group is the world's second largest supplier of cellular systems. We believe that our RF offering is the most robust and reliable in the world. CIG's major areas of success include AMPS, NAMPS, TACS, TDMA for GSM and PDC, and CDMA. Our base stations are now certified to connect with seven major switch vendors.

This past year we proposed an open architecture standard to the Tele-communications Industry Association for the U.S. industry. Any cellular switch will be able to interface with any cellular base station. Work on the proposed standard has begun. Open architectures have been very beneficial to operators in Europe and Japan, and we believe U.S. operators will see the same cost and flexibility benefits. We intend to continue to lead this important effort.

The recent well publicized agreement with IDO in Japan provides a very satisfactory timetable to remedy the deficiencies of the earlier agreement on market accessibility. Furthermore, on April 1st, the Japanese market was officially opened to the benefits of end customer ownership of equipment. Prior to that date, customers could only rent equipment, at very high prices. This will help both the infrastructure and subscriber businesses. Despite the strong potential of the Japanese market, cellular penetration was just 2% by the end of 1993, versus 6% in the U.S. This latent opportunity combined with the continuing strong growth in the Asia-Pacific region makes the entire Pacific Rim a key growth area for wireless communications.

The Cellular Subscriber Group is the world's largest supplier of mobiles, portables and personal telephones. Over the last year we have seen a continuation of the shift to personal telephones in all regions of the world. By the end of 1994, we expect over 70% of the world's cellular sales to be portables. U.S. digital sales began in earnest last year, and we expect those to pick up steam as new TDMA cities go on line this year and CDMA launches next year. At the same time, we continue to see strong demand for AMPS/NAMPS. Five million new subscribers were added in the U.S. last year, 50% of the world's total. In Europe, sales of GSM phones were very strong in 1993. Germany was clearly the dominant GSM market last year, accounting for 70% of the new GSM subscribers. However, a number of other countries initiated service, and that bodes well for continued GSM growth. Just last month, we announced the world's lightest GSM phone at 6.9 ounces.

Last fall, when the first U.K. PCN [Personal Communications Network] operator went live, we were the first to ship subscriber products. We expect the PCN growth to continue as the recent operator in the U.K., Hutchison, and the first operator in Germany, E Plus, go commercial this year. The new PCN consumer tariffs have also stimulated the aggressiveness of the existing cellular operators - fueling the strong growth in the market. The trend toward multiple operators is gaining momentum worldwide, particularly as regulatory bodies recognize that growth accelerates in that environment.

Finally, to address the PCS equipment opportunity, we created an organization whose sole charter is to manufacture products for PCS. Potential U.S. and international PCS operators are pursuing four applications. First, there is the provision of cellular-like (wide area/high mobility) service. Next, there is a service focusing on pedestrian requirements. Typically this view embraces islands of coverage. In some core areas, the intent is to provide ubiquitous coverage, particularly for in-building voice and data applications. Our CT2 products currently provide a service of this type and are becoming very successful, particularly in Asia and parts of Europe. Finally, there is a growing recognition that wireless can provide reliable and cost-effective alternatives for the "last mile" of the subscriber loop.

Our conclusion to date is that no single technology can cost effectively meet all these requirements. For example, in the U.S., for cellular-like service in congested urban areas, both TDMA and CDMA will be implemented, including a version of the U.K. PCN standard upbanded to U.S. PCS frequency band. For fixed service, and by extension pedestrian service, we believe PPS2000 offers one of the best solutions. PPS2000 is a PCS system that has the cost, capacity and quality of a wire system, with the addition of pedestrian mobility. An additional benefit of our work on PPS2000 has been the development of our CableComm system. CableComm allows operators to offer phone service over existing coax or fiber.

When will these opportunities materialize? The U.S. PCS auction process is still unsettled, but we expect to see auctions occur in late 1994 or early 1995. We expect system operators to offer commercial service beginning in 1996. However things settle out, I do not think the fundamental market direction will be altered. There will still be multiple licenses per area. Cellular industry growth will continue to be very strong. In addition, trunked radio services might transition to participate in personal communications.

Based on this assessment, we think that competition for new subscribers will be intense. Therefore, subscriber populations by the year 2000 could be three or four times greater than today. We also believe that Motorola, and other suppliers, will have both the required production capacity and advanced system products to meet demand and facilitate differentiation. In a sentence - the market's needs will be robust and can be accommodated.

In conclusion, I want to note that the last 50 years in radio have prepared us for this opportunity. From the simplest one way paging device to the world's most advanced satellite communications system, we have positioned Motorola to be the premier company in wireless communications.

Thank you for your attention.

HS: We will now open up the floor for questions.

Q1: What do you think will happen, in the marketplace, to products like Envoy in the next couple of years?

JC: I think products like Envoy and Newton are going to go through a series of gestation cycles as we figure out what people want. I think they are neat, but whether other people will think they are neat, and plunk down their money to buy them, is something to be learned. I do think those types of products will penetrate the business market before they penetrate the consumer market because the business market can find the kind of utility that drives these products. That is the reason for the spreadsheets and meeting planing capabilities, on a remote basis.

The thing that we realized about businesses is that they think in terms of dollars per day in communications, while consumers think in terms of dollars per month. Therefore, you are probably talking a factor of four or five difference in terms of willingness to pay. So we will go after the business market, and maybe, the first time out of the bag, it will not be exactly what business wants. But I think the industry is fast enough on its feet to change direction.

Q2: Could you reveal a little bit about the overlap between satellite mobile and terrestrial mobile, and tell us a bit about the internal debate that might be raging within your own organization, and how it might unfold in the next ten or so years?

JC: The debate on satellite versus terrestrial actually took place five years ago. Iridium was never intended to be a replacement for either terrestrial wire or wireless. The cost to implement it is much higher than either wire or wireless communications. What we expect to happen is that people will buy units that have a terrestrial capability and the Iridium

capability in the same box. Other people will buy units that just have the Iridium capability. Businesses will have groups of these, and when going on a trip, you will take one of these boxes with you. Why? Because if you have ever tried to make a phone call from some of these countries, you would know that it is well-nigh impossible. So if you have a device that will allow you to punch in and call anywhere in the world, you will take it with you. Now, we are not talking about a great number of units, but if you add up all the companies and the people who send other people to various places around the world, it turns out to be a sizable number of customers.

So we have not ever really seen the system as something which would supplant terrestrial communications, except in a case where one cannot justify bringing wires out to an area. In that case, the government may find that it is cheaper to subsidize that phone service [e.g., rather than to run 200 miles of wire from Alice Springs to one of the cattle stations in the Australian outback] via Iridium. Then it depends on the government's will to provide communications to the people because it would probably be prohibitively expensive. Or then again, maybe not. It depends on the air time [i.e., how much time the guy in the outback wants to spend making phone calls].

In short, wherever you have wire, wire will win out, and wherever you have terrestrial wireless service, and the person has access to a terrestrial phone, they will use it because it is cheaper.

Q2, part II: With that in mind, how do you guys perceive the competition in the satellite-related industry, such as the recent Bill Gates and McCaw Cellular "800 Cellular System?" Is that viable relative to Iridium, or has your head start given you enough of a boost?

JC: I think the Gates proposal was the best validation for Iridium I could have ever hoped for. It took Iridium from being the lunatic fringe, and made it appear to be what it is, a common sense solution. When you are the first person out there with something new, people say, "What is that? You must be crazy. . .66 satellites up there." But then, when someone says they are going to put up 800 satellites, 66 begins to look pretty sane.

Now I will tell you, when we introduced the first cellular portable in 1984, we could not sell them. Not because it was not a great product or because it was not unique, but because it was almost the lunatic fringe. It did not have any competitor to validate it. It was not until Mitsubishi brought out a phone 18 months later, when we started to see ads proclaiming choice in cellular portables, that our business took off. That is the time I really welcome competition.

Q3: How has Motorola changed the way it operates its sales force? Are you still conventional? Do you still have a fixed office?

JC: Twenty years ago we sold directly to end users, principally companies, and to the carriers [at that time, the telephone companies and the radio common carriers who offered the service]. Over time, we have transitioned so that we have very little direct sales left across the corporation. Now we are trying to transition to a retail environment, in which the carriers are saying that they just want to sell the service [not the equipment]. Therefore, we will sell to the retailers.

Q3, part II: So you still invest in outside sales offices with people and service facilities?

JC: Yes, we still have some of those. It depends on the market; we still have them in the communications sector because a great deal of that sector is the sale of a small system to an entrepreneur or small businessman. Some of that can be done by a distributor, but not all.

Q3, part III: But the way your people work, that has not changed?

JC: Oh yes. We use a lot more paging, more wireless data, a lot more cellular phones than we did before.

Q3, part III: Why I am asking is that, at Compaq, they no longer lease offices; everyone has a home office.

JC: We have a lot of them, too. People have e-mail and just run their offices out of their homes. We have dramatically reduced our number of offices, but we still do have sales offices in regions, though many fewer than in the past. So in answer to your question, yes, that part has changed.

Q4: You mentioned that you were selling many more products through mass marketers. I wondered if you considered putting out some sort of an at-cost book that describes your products and services. It has been my experience with these mass marketers that the quality of technical guidance you can receive there varies widely.

But, for instance, Ford Motor Company used to have a car buyers guide that they would crank out for about $5, which was certainly worth what one paid for it. I wondered if you were considering anything like this at Motorola.

JC: We are investing much more money in sales training because of the high churn at the retail sales person level. They are not in these jobs very long, and they do not expend a great deal of energy learning, so you really have to do a lot of their work for them, which is not easy.

Q4, part II: But what I am talking about goes beyond sales training, where you would actually have an objective source that comes from Motorola. Even if it just talks about products in general, it would help explain these things to the public.

Q5: What are your thoughts on the user interface to a communications product? Where do you think we are going from "the 12 buttons", now that there are visibly computers behind them?

JC: I have asked myself whether you really need the 12 buttons. Then I think back to the time when I tested a voice-operated telephone. It worked very well. I could put a number in, and it heard me; it was speaker independent. But I got this clammy feeling thinking, what if I got a cold? What if it did not want to recognize me? That is one of the reasons I never got electronic locks on my car. I think the keypad is going to be there for a long time.

Q6: What is the future of ARDIS, the joint venture with IBM?

JC: Well, right now it is a 50-50 joint venture between the two of us. I do not see anything changing there. By the way, that project does not report into our area; it reports into the Paging and Wireless Data Group. So if anything is going on, they are the ones working on the relationship. But I think it kind of ebbs and tides. Sometimes they [IBM] feel they would like to own a little bit more of it, and sometimes we feel we would like a bigger share.

Q7: A few years ago at this Forum, Motorola and Federal Express appeared to talk about their radio data application. You mentioned that public safety, Fed Ex, and the IBM repair network were notable examples. Are there any other radio data applications, or is it really vertical?

7

JC: It is still very much a vertical market. There are a few consumers who, through a business we've invested some money in, called "Radio Mail," buy these. But I think it will continue to grow in the business market before it gets to the consumer market. Right now, however, it is really government, transportation, service/repair--it is a very narrow market. There are fewer than 400,000 in the world today--total, total, total.

Q8: You had a figure showing Envoy as the end of a progression including paging, mobile paging, cellular, etc. I thought that was a bit surprising as, it seems to me, Envoy brings something different from these other products/services. I was wondering if this was just a marketing expedient, or if there is a subtle cognitive issue here. Would ARDIS, for instance, fit on that line?

JC: I was just using Envoy to illustrate one more step along the spectrum of communications that can be provided. As the company has evolved, we have had to go out and push different products. I had to personally go out and sell cellular to a customer who ultimately sold their business for $32 million. But they had to be convinced; they did not want to buy it the first time I proposed it. But ultimately, they became an applicant and then, a systems operator. In general, Envoy is just typical of the wireless data products, and we are trying to kick start that industry. Sometimes you just have to persevere when you know in your gut that it is good. When people have a product and won't let it go, then you know you have a winner. If people put it on their desk or on their shelf and do not use it, then you have got a major fix coming, or you have got a real problem.

For example, around our place, Powerbooks are a perfect example. People will not give them up and they will not loan them to you. I am one of those rare birds who actually loans mine out on the weekends.

Q9: What do you think is the future of handwriting for these little devices?

JC: Tough. Not tough to do just handwriting, but tough to do recognition. One time, after four hours of work, a machine did a brain dump on me and could not recognize anything. I had to start from scratch. But I think it is an evolutionary thing, yet not necessarily a needed thing. What is important for me is that I can get a message from my secretary that says, "the flight is canceled. What do you want to do?" And I can write back and say, "change to something else." Meanwhile, I have not disturbed the meeting that I am in or the customer visit I am on.

Q9, part II: So why did Motorola buy Lexicus?

JC: I cannot answer that. Actually, it is outside of my area of involvement, and I can't keep track of everything the company does.

Q10: About six months ago, in the *Wired* article about Iridium, they mentioned that the amount of spectrum that Iridium would take up would obviate that spectrum's uses for other purposes. I wondered if you could talk about that a little bit.

JC: Anytime you allocate spectrum to a service, you pretty much eliminate its use for anything else. The exception, of course, would be the unlicensed spectrum from 902 to 928, the ISM [Industrial, Scientific, Medical] band, and all the things that go along with it. In that case, you are kind of at your own risk. You are not allowed to interfere with anyone else, and if you do, you have got to pull your product out. That does not make a very robust service for an end user; it is not predictable. It is okay for short range. But if you want to offer a wide area telephone service, you need a dedicated block of spectrum that you can control and manage, so that you can control the interference you give.

Interference avoidance techniques are what you need to control the capacity, but if you do not have control over that spectrum, you will not have a very good business.

Q10, part II: I believe the point of the article was that the spectrum required by Iridium was significantly larger than that of other proposed satellite communications standards for wireless telephoning and messaging.

JC: It gets down to the size of the spot beam, I believe. The bandwidth per talker is probably not more than 4.8 kilobits per talker. Obviously, with satellite, because you are operating with such a large footprint, you try to get it to 2.4. However, I do not think that any of the other service offerings are talking about anything fundamentally different, except maybe they may use a smaller spot beam. But I do not know that it would work.

There is, after all, an awful lot of pie in the sky regarding satellites. And I tend to trust the people who have made me successful over the years, and those are the engineers in our buildings. I do not know if I trust these other people as much because they have not made me successful. For instance, a number of companies claimed they'd have a digital phone by 1990. Well, two of these companies have gone out of business--they did not build anything, as it turns out. Every time someone tells me they can do something smaller, lighter, better, more spectrally efficient, I am a bit suspicious.

Q11: May we see your video?

*[Mr. Caile now shows a video, which contains a number of the services and products that will be available, from Motorola, at the beginning of the 21st century. The video shows a vision of a future dominated by wireless audio and video communications.]*

JC: Thank you very much.