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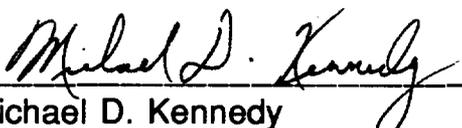
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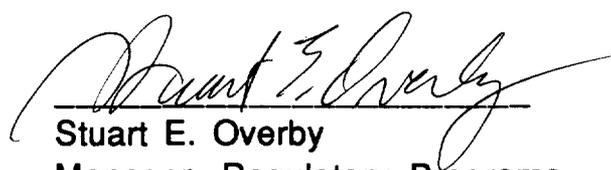
In the Matter of:)
)
Redevelopment of Spectrum to)
Encourage Innovation in the Use) ET Docket No. 92-9
of New Telecommunications)
Technologies)

Comments of Motorola Inc.

Motorola Inc. (hereinafter Motorola) submits the following comments
in the above captioned Notice of Proposed Rulemaking.

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I. EXECUTIVE SUMMARY

Emerging technologies such as PCS encompass a wide range of private and public wireless communications services which will create new jobs, spur investment, provide tools many U.S. businesses need to be more competitive in a global economy and offer improved safety and convenience for the public. These benefits in turn translate to additional business for the nation as a whole, including utilities, the petroleum industry, and railroads. With such benefits at stake, the Commission must make its number one priority swift completion of all regulatory actions required to make private and public PCS a reality. This includes 1) dedicating sufficient spectrum for emerging wireless technologies such as PCS to grow to their full potential; 2) taking specific and genuine steps to reaccommodate incumbent fixed users of the spectrum so dedicated; and 3) utilizing a sound and proven regulatory structure that allows "best fit" PCS solutions to be offered economically and without delay. Motorola recommends these three significant regulatory issues be conducted concurrently, reducing the cycle time required to bring emerging technology services such as PCS to reality.

Because of allocation decisions introducing various PCS services in Europe and Asia, Motorola and others in industry are already well on the way to developing technology platforms to support the wireless PCS vision. Unless favorable decisions are forthcoming from the Commission, however, U.S. businesses, governmental entities, and the public at large will be denied key communications tools which can provide a more efficient, safer and healthier world. In addition, U.S. industry will lose the lead it has achieved in exporting wireless products and services.

The critical and specialized communications requirements of the nation's utilities, public safety entities, petroleum companies, railroads and others must be met. Fortunately, UTC, Alcatel, TIA and others in the microwave industry have already made substantial progress in defining specific rule changes necessary to provide the capability for genuine reaccommodation of 1.8-2.2 GHz systems to alternative bands. The Commission therefore has the opportunity to put in place a win/win solution which accommodates both critical U.S. mobile and fixed requirements. A review of technology factors, in addition to studies by both the Commission and industry, indicate reliable fixed microwave service can be supported in alternative bands, primarily above 3 GHz. In addition, this transition will provide a natural opportunity for microwave users to upgrade from analog to digital systems. To the contrary, total reliance on sharing between fixed and mobile systems retard the growth of emerging technologies such as PCS and is likely to result in mutual interference between PCS and fixed microwave systems. It is imperative the Commission make specific changes to its rules now to reaccommodate fixed systems to higher bands.

As the Commission moves forward to propose a regulatory structure for PCS, dedicating spectrum segments for each member of the PCS family of services is a key ingredient in bringing best fit emerging technology solutions to the U.S. in a timely manner. Leaving PCS definition solely to market forces will significantly complicate the standards process, delay introduction of service, increase costs to the user and make best fit solutions difficult if not impossible. Further, many of the incumbent private fixed licensees also have mobile communications needs which will

require additional spectrum as new technologies provide new capabilities. Dedicating a portion of the emerging technology bands for private PCS and offering these incumbents first rights for licenses in that band segment may be a significant incentive that would help bring PCS to fruition without further delay.

Motorola also supports full compensation by new system licensees to incumbent users for the cost of relocating to alternative bands. Only minimal Commission involvement should be necessary in this process. However, Motorola recommends the Commission address up front a mechanism for resolution in the event unwarranted holdout situations develop which subvert the goal of bringing PCS and its benefits to the U. S. in a timely fashion. When given a genuine reaccommodation opportunity, provisions for full compensation to relocate and the added incentive of first rights to dedicated private personal communications system licenses, Motorola believes most private fixed users will negotiate in good faith.

The 220 MHz of spectrum in the 1850-1990, 2110-2150 and 2160-2200 MHz bands proposed to be reallocated for emerging technologies in the instant Notice of Proposed Rulemaking is a good initial step to help lead the U.S. into the new wireless communications era. As noted in the proposal, however, the Commission already has requests for spectrum to support new technologies and services far exceeding this 220 MHz. Motorola therefore recommends the Commission also vigorously pursue the 1990-2110 and 2500-2690 MHz bands to accommodate emerging mobile technologies in addition to the bands proposed for reallocation in the Notice. In addition, the Commission should pursue with the NTIA

immediate access to the 1710-1850 Federal fixed microwave band to help support reaccommodation of the longer fixed links now operating between 1.85 and 2.2 GHz.

II. EMERGING TECHNOLOGIES WILL PROVIDE CRITICAL U.S. BENEFITS

Creation of Emerging Technologies such as new Personal Communications Services (PCS) is the next step in a successful history of wireless communications offerings. Timely finalization of spectrum allocations for these services will create new jobs, spur investment, provide necessary tools for U.S. businesses to succeed in an increasingly competitive global economy, help governmental entities to meet increasing demands of protecting the public with limited resources, and offer the public new levels of convenience.

As Chairman Sikes recently recognized, in just the last decade, the cellular telephone business has grown to \$7 billion per year and provides 24,000 new, technology related jobs.¹ Similarly, private land mobile allocations stemming from the same Commission proceeding have provided best fit communications solutions for many of the country's key industries, as well as state and local governmental entities. Many small businessmen and businesswomen entered the communications field as a direct result of allocations for Specialized Mobile Radio (SMR) services.

¹Remarks before the University of Missouri, Kansas City on April 15, 1992.

Many of these small entrepreneurs had little opportunity to participate directly in providing cellular service as only two licenses per market were issued.

In addition to benefiting users domestically, mobile spectrum allocations serve as a springboard from which the telecommunications industry can compete globally. We have attained global leadership in the telecommunications field today because the Commission had the foresight to make spectrum available for land mobile development during the 70's and 80's. As a result, American companies not only responded to domestic user demands but also took land mobile advances abroad. This leadership enabled dedicated U.S. companies such as Motorola and others to pioneer technologies that led to such services as cellular and private trunking. Today, more than 60 countries now use American radio innovations.

The Commerce Department's export sales figures for this period show an impressive pattern of international trade in cellular, private and paging systems, all linked to the government's decision that spectrum should be made available to trigger this global leadership. In 1990, the total U.S. exports of radio based telecommunications equipment totaled almost \$1 billion. The May 1992 issue of Cellular Business magazine shows that almost 60% of the world's cellular subscribers use Advanced Mobile Phone System (AMPS) technology originally developed for the U.S. market. This article (copy attached as Appendix A) also lists a host of countries to which Motorola exports cellular equipment.

Going forward, all major segments of the communications industry are expected to grow rapidly as a result of technology advancements and user demand. Telecommunications as a whole should continue to expand at two to four times the growth rate of the general economy and is expected to become a three trillion dollar market for equipment and services by the year 2010. Given sufficient spectrum allocations, the wireless communications portion of that total is expected to grow even faster, reaching \$600 billion in the same time period with lots of momentum to grow well beyond that 20 percent of the total.

Other countries which have already moved ahead with allocations provide a preview of this expanding market. In the first two months of commercial CT-2 service alone, Singapore Telecom attracted 18,000 users of Motorola Silverlink personal communicators and demand continues to be strong.

As with our past successes, emerging technologies such as PCS will not happen in the U.S. without the partnership of government and industry. Motorola and others in industry are already investing vast resources in technology development to provide spectrally efficient, cost effective communication solutions required over the next decade and beyond. This investment, however, will be wasted if the Commission does not dedicate adequate spectrum for the full range of wireless emerging technologies and services needed in the U.S. market on a timely basis.

If the Commission falls short of its responsibilities in this area, U.S. businesses, governmental entities, and the public at large will be denied key communications tools that can be used to create a more

efficient, productive, safer, and healthier world. In addition, U.S. industry will lose the lead it has attained in exporting U.S. products and services as well as the corresponding loss of employment. Finally, users in other countries could be denied the benefit of our expertise in advancing their own communications systems.

III. SPECTRUM DEMAND

Motorola strongly supports the Commission's proposal to redevelop the 1850-2200 MHz fixed microwave bands for emerging technologies such as PCS. As the Commission recognized in its Notice however, spectrum requests to support various emerging technologies already exceed the 220 MHz of spectrum proposed for redevelopment.² Motorola's own analysis indicates over 300 MHz of spectrum is needed to accommodate the range of personal communications services the public will demand, even when existing cellular and private bands are "refarmed" with new, more efficient technologies.³ Notably, even the Utilities Telecommunications Council which has opposed the Emerging Technologies proposal recognizes that additional spectrum in the 1-3 GHz band is required to accommodate the private land mobile community's mobile requirements.⁴

² Notice at para. 4.

³ Motorola Comments filed in GEN. Docket 90-314 on November 21, 1991

⁴ UTC Reply Comments dated March 16, 1992 at page 49 in PR Docket 91-170 concerning refarming private land mobile bands.

Accordingly, Motorola recommends the Commission expand its redevelopment efforts to include additional bands below 3 GHz. Given these spectrum demands, it is not clear why the Commission rejected further examination of the 1990-2110 and 2500-2690 MHz bands to support emerging technologies.

The Petition for Rulemaking filed March 31, 1992 by the Utilities Telecommunications Council cited statistics by the National Telecommunications and Information Administration (NTIA) which indicate the 1710-1850 MHz Federal microwave band is less congested than the equivalent 140 MHz of spectrum in the 1850-1990 private microwave band. Given that both bands support comparable requirements with similar equipment, UTC has recommended opening the 1710-1850 MHz band to help reaccommodate systems now operating at 1850-1990 MHz. Motorola supports UTC's recommendation and urges the Commission and NTIA to accelerate discussions on non-Federal access to the 1710-1850 MHz band.

The 1990-2110 MHz auxiliary broadcast band supports both fixed studio-to-transmitter links (STL's) and "mobile" electronic news gathering (ENG) operations. This band is divided into one 18 MHz and six 17 MHz channels, each supporting a signal for television transmissions only 6 MHz wide. STL's are clearly nothing more than a fixed point-to-point microwave link that could be accommodated reliably at higher bands. ENG systems, while licensed as "mobile" generally operate as temporary fixed links using directional transmit antennas. It is also Motorola's understanding that many television broadcasters now employ satellite transmissions as an alternative to terrestrial ENG links. Further, video

compression technology improvements should allow accommodation of legitimate auxiliary broadcast needs in far less spectrum.

It is Motorola's understanding that even though the Commission has approximately 24,000 applications on file, the 2500-2690 MHz band contains relatively few licensees. Motorola therefore suggests this band be reexamined as a possible supplement to the 220 MHz of spectrum proposed in the Commission's Emerging Technology Notice.

The Commission's prior frequency allocations have provided U.S. government agencies, businesses and consumers with the world's widest array of wireless services. Each time the Commission has expanded the spectrum for mobile communications, new technologies and new services have been created to use the spectrum more efficiently, and to bring new benefits to a broader range of users. Previous allocations in the 800 and 900 MHz band served as the basis for the development and growth of technologies such as cellular telephone, trunked two-way private radio and enhanced nationwide and regional one way paging systems. Today, largely as a result of these allocations, the number of land mobile users in the United States has grown to 34 million. ⁵

Looking ahead to the year 2000, the numbers of land mobile users are projected to increase from 34 million to almost 150 million. Private and public systems will each account for over 40 million, while paging will have grown the most, to about 60 million. Along with the growth in

⁵ This includes 7 million cellular, 12 million paging and 15 million private land mobile users.

users, there will be significant growth in the amount of usage of services and expanded capabilities, such as interactive data, fax and video, if the Commission makes adequate spectrum available to support these emerging wireless technologies. These technologies will make wireless communications an even more vital part of America's drive to be more responsive and productive.

Throughout the world, countries and regions are making massive efforts to speed up wireless technologies. After years of talking in terms of 1, 2, and 10 MHz allocations, they now talk in terms of 100, 300 or 600 MHz. Motorola believes more spectrum will be allocated for new wireless services in all parts of the world in the next 10 years than was allocated in the previous 50 years.

In Japan, for example, approximately 600 MHz of spectrum is being freed up for Advanced Mobile Communications Systems. Japan's regulators clearly support that nation's mobile radio industry in developing new services for their home market as well as for export. While Motorola has developed both portable and mobile 1.5 GHz band private land mobile products for the Japanese market, these products or ones in proximate bands cannot be made available to users in the U.S. because spectrum is not yet available.

Over the last several years, Europe has been busy developing standards for future wireless services. Led by the United Kingdom, the European governments are making the spectrum allocations necessary to support these services. Both Japan and Europe are concentrating on large blocks of spectrum in the 1 - 3 GHz band. The implications of these

initiatives for the U.S. are significant. Japan and Europe recognize the head-start advantage for local suppliers in satisfying both the home-market and global market demand. Furthermore, they understand that their home markets can be used as springboards to export. The U.S. taught them this lesson through our 1979 WARC initiatives and subsequent successes with private trunking and cellular technologies, systems, and services.

European Digital Cellular, or GSM, and CT2, both European initiatives, have already appeared in the Asia-Pacific region--GSM in Australia and CT2 in Hong Kong and Singapore. In the past, America led the world introducing new technologies in the U.S. first. Now Motorola still introduces new technologies, but it is being done first in offshore markets.

The '90's will be remembered as the decade of personal communications. It will happen in Europe and in Asia. However, it will not happen in the United States unless the radio frequency spectrum is made available. Commission spectrum and regulatory decisions in the next one or two years will determine what technologies and services will be available in the U.S. and what will happen to the domestic telecommunications manufacturing industry. In short, the present Commission will be remembered for its role in determining whether or not the United States industry remains a leader in wireless communications in the future.

Motorola has been a pioneer in two-way land-mobile radio. We have developed and manufactured communications equipment since the end of

the 1930s. Today we have the world's largest research and development and manufacturing effort in wireless communications. Last year alone, Motorola invested over one billion dollars in telecommunications research and development.

The industry's strong R & D efforts must be married to adequate spectrum to meet the demands of tomorrow's users, as well as to remain a global leader in the future wireless society. R & D efforts spawn technologies that allow more efficient use of the existing spectrum, and create technologies that provide users new features, functions, and services in a cost effective manner. This ever-expanding market for cost effective best-fit communications solutions requires allocation of additional spectrum, even considering efficiency improvements being made in existing bands.

The U.S. Government must provide leading American technology suppliers and service providers, large and small, with the incentive to invest, develop and implement the best communications solutions for consumers in our country and the world. Business and consumer demand for wireless communications will be satisfied by a number of innovative private and public products and services, plus a variety of expanded capabilities if adequate spectrum is dedicated for emerging mobile technologies such as PCS. In the U.S., Motorola has identified a need for over 300 MHz of new spectrum to support these wireless service innovations.

The Commission should not be swayed from completing regulatory action dedicating adequate spectrum to emerging mobile technologies by

emotional arguments that fixed operations are inherently unreliable in other bands. Major users and suppliers in the microwave industry have already identified specific and accomplishable technical modifications that will assist in reaccommodating 2 GHz systems and the Commission has already proposed that the cost of moving be borne by new entrants. As addressed more fully in subsequent sections of these comments the Commission can, in fact, meet the critical requirements of incumbent users for reliable fixed microwave service in alternative bands. Emerging Technologies such as PCS can become a reality for the U.S. In short, the U.S. need not be relegated to a role of following Europe and Asia into the wireless world - it can lead.

IV. FIXED USERS CAN BE ACCOMMODATED RELIABLY IN OTHER BANDS

The Commission's staff conducted a study to examine the possibility of creating Emerging Technology bands.⁶ One important aspect of this study was the technical feasibility of relocating existing fixed microwave services operating in the 1.85 - 1.99 GHz, 2.10-2.15 GHz and 2.16 - 2.20 GHz bands to spectrum above 3 GHz or to alternative media. The analysis included both system reliability as well as capacity requirements.

The Commission concluded that the microwave bands at 4 GHz and 6 GHz can support the path length requirements of the existing 2 GHz facilities. In fact, in the Houston area where fading is severe due to

⁶ "Creating New Technology Bands for Emerging Telecommunications Technology" FCC/OET TS92-1, January 1992.

extreme weather conditions and proximity to the Gulf of Mexico, the longest existing path length is 39 miles for the 2 GHz bands and 44 miles for the 6 GHz private band. Accordingly, 6 GHz is not inherently incapable of supporting path lengths now accommodated in the 2 GHz bands.

Motorola agrees with this conclusion. As detailed in Appendix B of these comments, system outage calculations for various path lengths show no significant difference in system outage attributable to path differences at 2 and 6 GHz. For example, calculations for a 24 mile (40 km) path show a path related outage of 56 seconds per year at 1.9 GHz compared to 55 seconds per year at 6.6 GHz, using an 8 foot dish for either band. Similarly, for a 39 mile (63 km) path, the outage at 1.9 GHz is 574 seconds per year compared to 477 seconds per year at 6.6 GHz.

The Commission also concluded that microwave bands 6 GHz and below, namely, 3.7 - 4.2 GHz, 5.925 - 6.425 GHz and 6.525 - 6.875 GHz generally offer sufficient capacity to accommodate all 2 GHz facilities in the major metropolitan areas. There appears to be general agreement that the Commission's study methodology reflects the capacity/vacancy situation on a macro level but that a more detailed analysis is required to assess the feasibility of relocation for specific metro areas.⁷

Comsearch conducted such a study which was presented at the Entelec conference on April 1, 1992 and the results were provided to

⁷ There is a question concerning the actual current availability of capacity in the 3.7-4.2 GHz band for reaccommodation as the presence of television receive only satellite systems, both licensed and unlicensed use this band.

Telocator as well. The study explored the feasibility of transitioning existing 1850-1990 MHz systems in the Houston area into the 6525-6875 private microwave band. Notably, Houston and Los Angeles have the highest microwave path counts and Houston represents the highest density environment combined with the absence of significant terrain features.

Lack of significant terrain dynamics challenged the transition simulation by minimizing the degree to which terrain shielding could be employed in successfully transitioning 1.9 GHz systems to the 6.7 GHz band.

Telecommunications Industry Association Bulletin 10-E interference prediction methods and FCC Part 94.63 interference avoidance criteria were used in analyzing interference scenarios between the transitioned 6.7 GHz paths and the existing 6.7 GHz environment.

Results of the interference analysis are summarized below:

Paths analyzed	107
Paths successfully transitioned	103
Paths failing transition	4

If given the added option of transitioning longer paths to the 4 GHz or 6 GHz common carrier bands and shorter paths to the 10,12 GHz or 18 GHz bands, it appears that there is sufficient capacity to reaccommodate and expand existing facilities and to construct new facilities in the future. As Houston appears to be the most congested microwave area in the United States, it should be feasible to support both transitioning and

growth in other major metro areas such as Los Angeles and New York as well.

Another point of interest shown in the Comsearch study is that only 16 of the 107 paths utilize digital equipment. Transitioning to higher bands would provide users the natural opportunity to upgrade to a digital system. The choice of digital over analog systems would provide a number of benefits such as improved signal to noise performance for multi-hop systems and significant improvement in the data throughput. Analog systems provide 9.6 Kps while digital systems offer 64K Bps channel throughput. With the expected growth of data communications as compared with voice, the upgrade to digital microwave when transitioning from the 1.9 GHz or 2.1 GHz to alternative bands would provide the increase in capacity that will be needed to support future data communications. This may be a particularly good opportunity as the Commission has proposed full compensation by new entrants to reaccommodate incumbent fixed users to alternative bands - a provision Motorola supports.

First Rights for Private PCS Licenses

Even with full compensation for relocation, the telecommunications staff of fixed microwave users will find it necessary to dedicate significant time and effort to ensure a smooth transition from 2 GHz to bands above 3 GHz or alternate facilities such as fiber. Many fixed microwave facilities support critical safety, service and on-line production operations making it necessary for these telecommunications staffs to maintain a continuing involvement to protect against any

disruption of service during the transition.

To compensate these users for their cooperation and effort in supporting the transition and the resulting “clear” spectrum for PCS, the Commission should provide these fixed users the first rights for private PCS systems licensees. To accommodate these “rights”, the Commission must first allocate a portion of the emerging technology bands for private PCS and develop the necessary rules and regulations for the assignment of licenses to these private users.

As discussed in subsequent sections of these comments, service specific dedicated bands for private and public PCS systems is imperative for users, service providers and manufacturers to quickly move ahead with implementation of Emerging Technologies such as PCS. Absent such an approach by the Commission, the U.S. Telecommunications Industry will be seriously disadvantaged in maintaining its traditional leadership in wireless services.

V. RELIANCE ON SHARING ALONE IS NOT A LONG TERM SOLUTION

Reliance on spectrum sharing between the PCS Emerging Technologies and fixed microwave is at best a short term “band aid” approach for both PCS and OFS microwave. Clear spectrum will be needed to realize the benefits of PCS and the Commission must take steps to ensure incumbent fixed users continue to have access to reliable service in transitioning to alternative bands.

Further, as presented in our previous formal PCS NOI response and

subsequent discussions with the Commission, Motorola believes that multiple PCS offerings which are optimized for specific applications will provide the highest end user value and the competitive environment necessary to fuel technology development, system deployment, and resultant U.S. leadership. As noted in our Executive Summary and earlier discussions with the Commission, spectrum blocks supporting these services should be designated for both private and public PCS alternatives, such as low milliwatt power wireless office, RLAN, and consumer digital applications, in addition to larger cell exterior coverage public and private system offerings.

In many large metropolitan areas, reliance on spectrum sharing between existing OFS users will severely constrain emerging PCS. For example:

1) Reliance on sharing will severely limit the provision of wide area portable and vehicular coverage comparable to that provided by today's cellular and private land mobile systems.

2) Even microcell PCS system deployment for pedestrian use will be limited to specific positions of a metropolitan area where significant microwave deployment does not exist.

3) Non-licensed user provided services without any infrastructure may not be feasible on a shared basis with fixed microwave because users may roam anywhere and to any building height without regard to location

of microwave receivers. ⁸

Even for the microcell low power systems noted above, non-interfering co-existence between co-primary OFS and PCS systems will require extensive coordination. The Commission's 5-14-92 public notice clarifying permissible OFS system modifications recognized the need for microwave users to be able to modify their systems pending the outcome of this rulemaking. Upon completion of this and related PCS rulemakings, PCS licensees likewise will require the capability to respond to requirements for increased coverage and capacity through system modifications. Assuming a first in, first right approach even if the Commission chooses to make PCS and fixed microwave coprimary, expansion for both microwave and PCS licenses will be complex and possibly even prohibitive. Private PCS users and public service providers will be more reluctant to make the initial investment or to invest in expansion given the unknown future interference potential.

Accordingly, we conclude that if the Commission relies on sharing as a total solution, PCS growth will be severely limited, interference potential to existing OFS microwave systems will be increased, and the potential growth of existing microwave systems sharing spectrum with PCS will in reality, be greatly restricted. Genuine reaccommodation of microwave systems to alternative bands as discussed in the previous section of these comments is a more appropriate approach.

⁸ Motorola supports efforts by industry groups such as the WIN Forum to develop a solution to this issue.

While reliance on sharing will severely constrain PCS service, there will be some areas in which small islands of coverage can be initiated by spectrum sharing. This can best be achieved through interference avoidance techniques using narrow band frequency agile PCS systems. Although feasible, the added complexity and increasing interference potential to both PCS and Microwave systems will not provide the proper environment for competitive, cost effective maturation of PCS service in the U.S.

VI. PCS AS AN EMERGING TECHNOLOGY

In its Notice, the Commission indicated that the first use of the Emerging Technology bands would be for PCS. Motorola is a premier technology company with a vision of future technologies, products and services that can lead the U.S. into the new wireless era. Even so, we believe our vision is a conservative one, and that this new era will run far beyond many people's capacity to imagine its potential.

First, it is instructive to examine telecommunication needs in terms of paradigms--those patterns that determine the way we conduct our lives and our businesses. Many experts see these paradigms shifting, for example:

- From wired systems to wireless systems.
- From mobile to portable
- From voice to voice and interactive data, fax, images, and even video
- From business to consumer and business

One of the miracles of the 20th Century is the global telephone network, the largest single system ever constructed. With this system, one can cause a telephone to ring anywhere in the world. In the U.S., 93 per cent of the homes have at least one telephone. However, one reaches the party called less than one-third of the time. The rest of the time can be pretty well summed up by the phrase "telephone tag." That will change. In the 21st Century, as a result of the movement toward wireless systems and portability, communications networks will be geared to calling a person rather than a fixed location.

The movement toward portability is a trend that is now becoming increasingly obvious. In private two-way radios, portables have grown from 40 per cent of the units sold in 1980 to over 60 per cent today. In cellular, 30 per cent are handheld units, compared to only 10% four years ago. In some private and public market segments, portables account for over 70% of the units placed in service.

As the wireless industry benefits from the learning curve and corresponding lower costs, the continued expansion into consumer markets is inevitable. Many of the newer paging and digital microcell services will be more affordable and, in fact, ideal for the family. Many in today's generation are becoming more and more comfortable with technology and the improved quality of life it can provide on a personal, as well as business, level.

Perhaps not as obvious is the need for the wireless capabilities beyond voice communications - interactive data, fax, images, and video.

These services are all part of a paradigm shift to faster, better communications that can provide tools for businesses to become more competitive in the global market if adequate spectrum becomes available and appropriate regulation are put in place.

A more detailed examination of the various types of communication tools that technology can increasingly support in a wireless environment is in order. Motorola has defined these communication tools into eight categories - dispatch, telephone interconnect, transaction processing, fax, snapshot, decision making, slow video and picture phone - with each described below. Dispatch, telephone interconnect and some forms of transaction processing are offered on today's mobile systems. As we transition to the wireless world of the future, these tools will evolve and new ones will become commonplace as well. Various configurations and combinations of these eight basic communication tools will be available to users through private and public systems to meet the demand for best fit solutions at the most economical cost.

1. DISPATCH

Dispatch is primarily a voice communications tool which can be characterized by very short messages and extremely fast setup times and simple setup procedures. For example, the setup procedure usually consists of nothing more than depressing a push-to-talk button on a microphone. This is possible because communication is usually restricted to a specific closed group of users. The communication can generally be described as one to many. This can be conceptualized in terms of the dispatcher talking to a group of mobile users in a broadcast mode, a

dispatcher talking to a specific user with "monitoring" capability being provided to the other users, or an individual user communicating with a dispatcher and "monitoring" provided to the entire group. This service can provide individual-to-individual call through some type of addressing scheme and address entry; however, the predominant method in which this service is normally used through most of the world is in the group context.

Dispatch operation is the foundation upon which private and public shared systems have developed and requires little additional explanation. Public safety, public service, utility, transportation, construction and security are but a few of the many operations to which dispatch is a vital communications tool.

2. TELEPHONE ACCESS

Telephone access provides the opportunity for the mobile user to access the public switched telephone network. It is the key tool provided by cellular systems. For wide area private systems, however, telephone interconnect is normally considered ancillary to group dispatch. Call durations are significantly longer than dispatch and the setup time and procedures are longer and more complex respectively. Spectrum requirements increase accordingly. A healthy percentage of private and private shared systems utilize some form of telephone interconnect service; however, the access is usually restricted to very specific members of the fleet for wide area systems. There is also a large demand for local area wireless PBX service whose primary function is access to the telephone network.