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Statement of

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Panel IV: PCS Spectrum and Technical Issues

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STATEMENT OF DR. DAVID C. NAGEL

Senior Vice President and General Manager

APPLE COMPUTER, INC.

SUMMARY OF POSITION

Mr. Chairman, Commissioners, and members of the FCC's PCS Task Force, good morning. I am Dr. David C. Nagel, Senior Vice President and General Manager of Apple Computer, Inc. Specifically, I am the Senior Vice President and General Manager of AppleSoft. In this position, I am responsible for setting the strategic direction and managing the Macintosh software business unit, as well as overseeing Apple's long range research program and directing development of enabling technologies to keep Apple at the forefront in human centered information products.

I appreciate this opportunity to appear before you today as you assess the rules governing personal communications services, and determine the additional steps that are necessary in order to make PCS, including Data-PCS and other unlicensed PCS services, a reality.

Data-PCS is a new technology that will enable users of personal computers to communicate data at high rates among groups of people over distances of up to 50 meters, without wires or other fixed connections. There is no technology or service available today that provides the benefits of Data-PCS to students, educators, researchers, workers, health care professionals, scientists, and others. Apple first urged the Commission to allocate spectrum for unlicensed Data-PCS in a Petition for Rulemaking we filed more than three years ago.

Since Apple filed its original Data-PCS proposal, the realm of "unlicensed PCS" has expanded to include certain voice services, such as wireless PBXs. Apple fully supports the allocation of spectrum to these unlicensed applications. While the Commission's PCS rules now provide for such voice services, the rules

fail as yet to provide for the deployment of Data-PCS. I would, therefore, like to address the additional steps that must be taken to make Data-PCS a reality.

In adopting rules governing unlicensed PCS, the Commission should recognize two basic differences between most unlicensed voice PCS and most unlicensed Data-PCS.

- **DATA-PCS IS THE ONLY NEW UNLICENSED PCS TECHNOLOGY THAT HAS BEEN IDENTIFIED TO DATE**

First, the proposed unlicensed voice services, such as wireless PBXs, are primarily modifications to or extensions of existing and planned voice services, such as cordless residential phones, cellular telephone and licensed PCS systems, or current wired services. They represent no significant advance in the state of the art and provide few new benefits to the public, other than convenience.

In contrast, high-capacity mobile, unlicensed wireless data services, such as Data-PCS, do not and can not exist now. Data-PCS is a new technology and not a modification or an expansion of an existing service. Data-PCS, for example, will be the primary and, in some cases, the only practical means of providing Internet access throughout schools, enabling doctors to connect to medical resources in hospitals, or allowing persons attending meetings to benefit from a copious and immediate exchange of information. These and other important needs cannot otherwise be met, unless frequencies are made available specifically for Data-PCS.

- **DATA-PCS REQUIRES COMPLETE BAND CLEARING PRIOR TO DEPLOYMENT**

Second, most unlicensed voice products, including all wireless PBXs, will operate in conjunction with a fixed base station. As a result, they can be frequency coordinated; that is, they can be deployed at specific sites or even in particular metropolitan areas starting right now, without the need for the spectrum to be cleared of microwave incumbents.

In contrast, Data-PCS devices are "nomadic," which means they will not be tied to any fixed base station. Users will take them wherever they need to exchange or access information: in their office, home, or dorm room; at the airport or a baseball game; in a colleague's house; on vacation; at a meeting or

conference; in a classroom, library, or laboratory; or at a supplier's warehouse, lawyer's office, or customer's facility. Moreover, they will not know in advance when or where they will use the device and cannot be limited to operating in pre-determined "clear" sites. Any provision short of "anytime, anywhere" communications among these data devices and "anytime, anywhere" access to network gateways simply does not recognize the realities of the computer industry's marketplace and of our customers' requirements.

Accordingly, Data-PCS devices cannot be frequency coordinated: without a base station, there is no way to limit their operation to "clear" sites, and without true portability, they lose their value. Thus, to deploy even the very first Data-PCS-equipped laptop or personal digital assistant (PDA), we have to remove the last microwave link (both co-channel and adjacent channel) from harm's way — the so-called "last link" problem.

If Data-PCS is to become a reality, the Commission must correct two problems, which, together, increase the delay and uncertainty associated with the band clearing process and, thus, may make it impossible to raise the capital necessary to clear the unlicensed data (asynchronous) band.

- **THE 1910-1930 MHZ BAND SHOULD BE ASSIGNED TO DATA-PCS**

In an effort to impose "equal pain" on voice and data services, the Commission gave only half of the relatively lightly loaded 1910-1930 MHz band to each of the two unlicensed applications — isochronous and asynchronous devices or, in other words, devices that generally can be frequency coordinated, and those that can not. One cannot, however, measure the "fairness" of this decision by looking at the spectrum division while ignoring its practical effect. This decision is "fair" only if one can answer the following question in the affirmative: "Do both data and voice services have an equal opportunity to occupy their respective bands?" The answer, unfortunately, is "no," because the present allocation would not provide sufficient usable bandwidth for Data-PCS, even after we incur the cost and delay of band clearing.

The problem with the current allocation is especially severe when one considers the problem of adjacent-channel microwave stations, which, in reality, must be treated as co-channel or be modified in order to avoid interference to

them. Due to the large number of microwave links in the 1900-1910 MHz sub-band, it is cost-effective to clear only the more lightly loaded 1910-1920 MHz portion of data sub-band, at least initially, before we can finance further band clearing out of the sale of Data-PCS devices. Even if this sub-band were cleared, however, it would be squeezed between a heavily-loaded microwave band on one side (1900-1910 MHz), and an unlicensed voice band on the other side (1920-1930 MHz), whose intended occupants have no motivation to clear the "last link" because wireless PBXs simply have no ability to roam the countryside.

Therefore, after spending years of effort and tens of millions of dollars to remove the co-channel microwave stations from half of the band, the computer industry could have as little as 2 MHz of usable bandwidth due to adjacent channel interference concerns (as discussed below), as opposed to its absolute minimum starting point of 10 MHz.[1] The problem would be much worse if the unlicensed bands were to be relocated to above 2110 or 2130 MHz, as opponents of unlicensed PCS have suggested, since there are even more stations per MHz to be cleared in those bands.[2]

Under the Commission's current allocation it is virtually impossible to see how the industry could meet its minimum objective of 10 MHz for Data-PCS. Despite the promise of Data-PCS, there is little likelihood that we would devote the necessary resources to a band clearing effort so unlikely to produce a usable resource.

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[1] The minimum, initial increment of 10 MHz would provide data rates similar to those that can be provided over Ethernet — the most common high-capacity wired network in use today — but would not provide for microcellular frequency re-use, so only one user network could function in an area at the same time.

[2] For example, OET's report "Creating New Technology Bands for Emerging Telecommunications Technology" (December 1991) states on page 8 that there are 6,823 fixed common carrier facilities in the 2110-2130 MHz band and its pair, 2160-2180 MHz. This is approximately 1,700 per 10 MHz — nearly eight times more links per 10 MHz than in the 1910-1930 MHz band, and nearly two and one-half times more than in the 1850-1990 MHz band.

The problem is even worse above 2130 MHz. OET states that there are approximately 13,035 private radio facilities in the 2130-2150 MHz band and its pair, 2180-2200 MHz. This is approximately 3,258 per 10 MHz — fifteen times as many links per ten MHz as in the 1910-1930 MHz band.

- **BAND CLEARING FOR DATA-PCS MUST BE A UTAM PRIORITY.**

Turning to the clearing process itself, the Commission should take additional steps to ensure that an adequate amount of the unlicensed asynchronous band will be cleared promptly on a nationwide basis.

The Commission has tentatively designated UTAM, Inc. as the entity responsible for clearing the unlicensed band. While UTAM says that it is committed to relocating all incumbents from the unlicensed band, as mandated by the Commission, in practice UTAM's primary focus is the early deployment of coordinatable voice systems in advance of band clearing. This conclusion is drawn from Apple's attendance at UTAM meetings, observing UTAM's governance and membership, its committee assignments and contracted tasks, and its statements in FCC filings, presentations to trade groups, and *ex parte* appearances. Apple, however, has yet not joined UTAM because it is concerned that, as presently constituted and governed, UTAM will not address Apple's concerns or the concerns of other potential users of the asynchronous band.

Clearing the unlicensed frequencies of existing microwave facilities is a complex, time consuming, and costly effort — more complex, time consuming, and costly than any of us, including the Commission, anticipated. As a result, the Commission must take steps to ensure that UTAM becomes and remains focused upon its primary band clearing obligation — which explicitly includes clearing the unlicensed asynchronous band for nomadic Data-PCS devices "as promptly as possible" — and otherwise fairly represents the interests of all users of the unlicensed band. At that point, Apple will be able to become a member of UTAM. Meanwhile, Apple will continue to work with UTAM.

- **CONCLUSION**

Nomadic computing is the driving unlicensed PCS application for data users. This is not simply Apple's position, this is the position of virtually the entire personal computer industry, the entire computer software industry, as well as the IEEE 802 Committee and the industry developers of Europe's new wireless LAN standard, HIPERLAN.

Satisfaction of the need for nomadic computing will be the criterion by which the computer industry will judge whether the Commission has made

adequate provision for data communications in the emerging technologies band. If the Commission provides voice PCS (licensed and unlicensed) 140 MHz of usable spectrum, but grants the computer industry only a fatally-encumbered 20 MHz, it will have failed to provide for the needs of the computer industry and will have lost the opportunity to create a truly new PCS technology.

The issue for Apple and other computer manufacturers has become quite simple: will the considerable expenditure of time, funds, and effort necessary to participate in the band clearing process established by the Commission result in an adequate number of usable frequencies for nomadic data? At present, it appears that the answer is "yes" only if the Commission corrects the problems identified above.

DISCUSSION

APPLE'S DATA-PCS PETITION FOR RULEMAKING

More than three years ago, Apple petitioned the Commission to allocate 40 MHz in the 1850-1990 MHz band for "Data-PCS," a new radio service that would make possible high-speed data communications between and among people using personal computers. The essential elements of Apple's original proposal were:

- A flexible regulatory structure that would encourage innovation in, and the evolution of, Data-PCS technologies and services;
- Unlicensed operation using an equipment authorization process modeled on Part 15 of the Commission's Rules;
- Non-discriminatory access to assigned frequencies by compatible devices for like purposes, with no requirement to share the allocated spectrum with dissimilar services, and with specific network access and usage details to be developed by the industry participants;
- Availability to all manufacturers;
- Open access to all users of personal computers, without the imposition of network connection fees or air-time charges; and
- The inclusion in the Rules of appropriate health and safety protections.

THE IMPORTANCE OF DATA-PCS

Apple's Data-PCS proposal hit a responsive chord for individuals and groups who understood its potential. Educators, students, and educational groups, in particular, expressed their awareness of the potential for increased effectiveness that Data-PCS could bring to the classroom, and their strong support for Apple's proposal. Their comments describe the benefits Data-PCS could bring to education:

- "Approval of Apple's petition will insure that students and teachers will no longer be confined to a rigid classroom set-up. Instead, computing and communications — and therefore — learning could happen any place, spontaneously, without the need for a wire network to access information and networks. This will dramatically change the nature of computing and learning will be enhanced using this technology. Being able to avoid the high cost of installing wired networks throughout the classroom or entire school will also be a major benefit."[3]

- "[Campus networking] has required substantial investments in fiber optic and other cables to provide the access needed. The fixed cabling for local area networks in buildings on campus limits the flexibility for the use of these computing and information resources. Classrooms must be specially equipped to provide computing access which means that scarce funds must be allocated to install cables rather than investing in needed tools (personal computers and work stations).... [Apple's] proposal ... would allow further application and use of these tools in the curriculum, in research projects and in ways that should improve instructional and research productivity."[4]

- "The higher education community increasingly utilizes information technology in support of our educational and research missions.... The introduction and use of the new tools, workstations and personal computers, is a critical element in the continuing improvement of quality and capabilities of our students and in our capacity to conduct research. [Apple's] proposal would both facilitate inexpensive networking of personal computers and workstations and provide significant flexibility in their use.... [A]doption of the Apple petition ...

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[3] Comments of Cities in Schools, Inc., RM-7618, at 1 (dated April 25, 1991).

[4] Comments of EDUCOM, RM-7618, at 1 (filed May 16, 1991). EDUCOM is an association of more than six hundred American universities and colleges whose goal (even at that time) was the creation of a national information infrastructure.

would enhance our ability to carry out our educational and research missions."[5]

- With Data-PCS, "professors will be able to transmit their lectures to an entire classroom where students can receive high quality copies of the materials. This will greatly enhance the quality of presentations, but will also save thousands of sheets of paper used annually to copy notes manually. Also, students in a dorm would be able to set up ad hoc local area networks and work with one another in their dormitory collaboratively storing and forwarding information between each other's personal data communicators.... With wireless communication devices, groups can share information as easily as they now talk on the telephone.... The easier access people have to information, the more we will learn and more productive we will become."[6]

- "The advantage to education ... is that wireless computing provides accessibility to users of personal computers without the need to acquire licenses or pay connection fees. It will enable community colleges to reduce expenses by eliminating costs for hard wiring buildings and by allowing more classrooms to serve as computer laboratories. We believe that is a significant advantage ... to the entire education community."[7]

- "Our district is a small rural district with older buildings. A draw back that is hampering us from networking is the amount of cabling and the space that it would require to run it in. Apple Computer's proposal would allow future technologies to eliminate wire and allow our district to network without using up precious space."[8]

- "Our scientific infrastructure would benefit greatly from Data-PCS. Currently one of the greatest costs of establishing a network for computers is the labor involved in laying down cable. Data-PCS would circumvent this. Beyond the logistical

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[5] Comments of American Council on Education, RM-7618, at 1 (filed May 16, 1991). The American Council on Education is an organization of 1,800 higher education institutions and associations.

[6] Comments of Joseph Ansanelli, RM-7618, at 1 (dated April 10, 1991). Mr. Ansanelli was a student at the University of Pennsylvania at the time he filed these comments.

[7] Comments of the American Association of Community and Junior Colleges, RM-7618, at 1 (filed May 16, 1991).

[8] Comments of Samuel A. Shama, RM-7618, at 1 (dated April 16, 1991). Mr. Shama was a technology teacher, computer instructor, and self-described enthusiast at the time he filed his comments.

hurdles this technology would overcome, it would revolutionize 'personal' computing. A person with a laptop computer would still have access to vast amounts of information regardless of whether she is in an office, laboratory, or classroom. Please allow Data-PCS to be made available to those who want it."[9]

- "[T]he ability for computers to communicate with each other without wires will provide the opportunity for great advances in the use of technology to improve education.... [N]o longer will classrooms and computer labs be shackled by the constraints of wires. As the world becomes more dependent on timely information, wireless data communications becomes more critical. Students need this type of access as well to learn in an information rich society.... America has always been a leader in computer technology. Perhaps advances such as these will allow for educational leadership to emerge as well."[10]

Consumer advocates, industry associations and other computer manufacturers echoed the need for Data-PCS. BMUG, Inc., a nonprofit educational consumer advocacy group representing approximately ten thousand computer users throughout the United States, noted that "[t]he ability to exchange and analyze information quickly and easily is becoming more important in American society, where mobility is increasingly an element of many working environments.

Data-PCS will allow and encourage productive interaction between workers where a wired network would be prohibitively expensive or physically impossible."[11] The IEEE 802 LAN standards committee stated that "there is an

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[9] Comments of Alberto Roca, RM-7618, at 1 (filed May 16, 1991). Mr. Roca was a molecular biology graduate student in the Department of Biochemistry at the University of Wisconsin-Madison who provided computer consulting to the researchers who work with that department at the time he filed his comments.

[10] Comments of Andrew Lawlor, RM-7618, at 1 (filed May 16, 1991). Mr. Lawlor was the coordinator for academic computing at a comprehensive university and president of a consortium for the advancement of undergraduate computing at the time he submitted his comments.

[11] Comments of BMUG, Inc., RM-7618, at 1 (filed May 10, 1991). The need for increased mobility has been reiterated by others. See, e.g., Comments of Alexander R. Morando, RM-7618, at 1 (filed May 16, 1991) ("... Data-PCS service is one way to bring the benefits of personal computing to people not confined to an office desk. I am familiar with field engineers with portable computers not being able to do a better job because they cannot readily access data from the company data base or conduct analyses using computers at their home offices.")

urgent need for an immediate allocation of spectrum to wireless local digital networks."[12] IBM argued that the "substantial improvement in information-sharing among the growing number of users of portable computing equipment promises to play a significant role in what [then] Chairman Sikes ... characterized as 'the decade of wireless communications.'"[13] Supporting comments were also filed by NCR, Tandy, GRid, CompuAdd, Cylink, and O'Neill Communications. In an article from the same period, respected industry observer Robert Samuelson stated that "computer-to-computer radio connections" are an example of "innovation in communications technology" and "data transmission to laptop computers" are a "huge" potential new use of radio spectrum.[14]

More recently, a variety of companies — including the Business Software Alliance, Compaq, Metricom, Microsoft, and the Software Publishers Association — have joined Apple in urging the Commission to adopt an acceptable frequency allocation plan for this service.

The benefits of Data-PCS will flow not only to the users of Data-PCS products. Society will benefit from the increased productivity, better education, enhanced R&D, and improved health care that Data-PCS will make possible. Workers and investors will benefit from the increases in employment, exports and profits that will flow from U.S. leadership in wireless computing technologies. Thus, the benefits of Data-PCS will flow throughout the U.S. economy, promoting U.S. interests (such as the rapid deployment of a national information infrastructure that is accessible to all) and enhancing U.S. competitiveness abroad.

DATA-PCS IS INHERENTLY MOBILE AND CANNOT BE CONSTRAINED TO FIXED, PRE-DETERMINED LOCATIONS

The development of computer technology over the past two decades has involved two important features: computers have increasingly been networked to give users access to information from a variety of sources, and computer users

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12 Comments of IEEE, RM-7618, at 2 (filed April 4, 1991).

13 Comments of IBM at 2 (filed April 10, 1991) (citation omitted).

14 "The Quiet Giveaway," The Washington Post, at A31 (May 8, 1991).

are increasingly demanding that they be able to use the power of their computers wherever the user may be.

As computers move from the desktop to the briefcase, however, the networking and portability features have become mutually inconsistent. Today, one sees laptop computers and PDAs on trains and airplanes, in homes, at meetings and conferences, on the beach and in parks, in classrooms, libraries, office buildings, and restaurants. Yet these computers cannot perform essential communications functions — they cannot exchange information with other computers, access databases, retrieve electronic mail messages, or communicate on the Internet or with other bulletin boards — unless they are connected to the fixed network or to another computer.

Data-PCS will make it possible to solve that problem, rendering the networking capability as personal and portable as the computer itself. This can occur, however, only if Data-PCS devices do not need to be linked to a base station, or operated only in designated "cleared" locations. The goal of Data-PCS is not to replace the wired network with a network of fixed, albeit wireless, base stations. It is to free users from the constraints of communicating only where they can "connect" to a fixed facility, permitting individuals instead to communicate on an *ad hoc* basis wherever they are — geologists in the field studying Mt. Saint Helens, students on a field trip to the ocean, business colleagues meeting while traveling together, or family members on vacation writing a family history.

Anything short of "anytime, anywhere" communications and "anytime, anywhere" access to network gateways does not recognize the realities of the computer industry's marketplace and of its customers' requirements.

UNLICENSED VOICE PCS PRODUCTS

Over time, the definition of unlicensed PCS applications has grown to encompass voice as well as data devices. AT&T, Northern Telecom, and others are now committed to using the unlicensed band to provide products such as wireless PBXs. Apple fully supports these efforts.

Data-PCS , however, is by far the most important of the new unlicensed PCS applications. Unlicensed voice products will augment existing services,

such as cordless residential phones, cellular telephone and licensed PCS systems, or current wired services, by slightly modifying or extending these services. They will not, however, provide new features, other than convenience.

In contrast, Data-PCS devices will give people capabilities not previously possible. Data-PCS and other wireless data technologies will serve a completely new function, rather than modifying or expanding an existing service. It will serve important needs that can be met only if frequencies are made available specifically for this purpose.

For example, Data-PCS will enable individuals to connect to information resources without laying cables, connecting to modems and phone lines, or working from a predetermined location. In many cases — whether because it is prohibitively expensive or time consuming to "hard wire" a facility, or because users do not remain fixed — it will be the only means for accessing these sources of information.[15] As the President's National Information Infrastructure, Agenda for Action, stated: "Many of the dramatic changes expected from the development of the information infrastructure will grow out of advances in wireless technologies. The ability to access the resources of the NII at any time, from anywhere in the country, will be constrained, however, if there is inadequate spectrum available."

Because Data-PCS represents new applications that cannot be provided using existing technologies, one cannot point to a prototype or "first generation" Data-PCS device. For this reason, it may be easier to "picture," and thus facilitate deployment of, an unlicensed voice PCS phone than a Data-PCS device. The proliferation of notebook and sub-notebook computers, the development of personal digital assistants, and the struggle to add even limited and costly communications capabilities to these devices, however, evidences the pent-up demand for mobile computing devices that can communicate on an anytime, anywhere basis. Moreover, Data-PCS is vitally important because it represents a revolutionary leap (rather than an incremental step) forward in communications

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15 In many older schools, Data-PCS will be the only means of connecting classrooms to the NII and other information resources, because the cost and danger of removing asbestos in the walls presents an insurmountable barrier to laying cable. This problem is shared by others working or living in older buildings.

technology; this characteristic should not be misused to obscure its benefits or deny that it is real.

NO EXISTING TECHNOLOGY OR SERVICE CAN PROVIDE THE HIGH-SPEED, RELIABLE COMMUNICATIONS THAT DATA-PCS WILL MAKE POSSIBLE

Data communications require a very high quality transmission environment. Information must be conveyed in such as way that it can be received with virtually total accuracy, no matter what happens in the transmission medium or the communications equipment. In addition, effective data networks must provide for high-capacity data throughput, a capability for real-time, information-intensive collaborative computing, and the ability to create spontaneous networks.

These requirements cannot be met by any existing technology or service.

Several SMR-based mobile data networks provide metropolitan-area coverage, but their air-time fees and limited data transmission rates limit their usefulness in many situations.

Transmissions in the 18 GHz band may not penetrate partitions in many buildings and are, therefore, unsuitable for the full functionality desired for Data-PCS. Moreover, the requirement for frequency coordination and fixed hardware limits flexibility.

Data modems used with the cellular telephone network provide extensive coverage, but they offer very low data rates at high costs per unit of connection time. Some proposed digital cellular systems could allow for increased data rates, but air-time charges would preclude widespread usage. Moreover, even when these all-digital systems are installed and have implemented the latest data protocol, they generally will be targeted at rates of only up to 9600 bps. With 10 MHz of clear spectrum, Data-PCS will be able to transmit at rates of several Mbps or better — more than a one-hundred fold increase.

Infrared is most suitable for very short range, line-of-sight peer-to-peer communications, but will not provide the mobile connectivity range desired for Data-PCS. Infrared transmissions do not pass through walls and, therefore, cannot be used to communicate with a printer or computer in an adjoining room. Moreover, while diffuse infrared can permit non-line-of-sight peer-to-peer

communications, these applications have such high power demands that they are incompatible with small, lightweight computing devices.

Finally, while several companies have introduced products using the ISM bands under Part 15, and while these products work well in many circumstances at this time, in the long run, the uncontrollable, disparate uses allowed in the ISM bands are incompatible with the need for a low error-rate, high-capacity transmission environment for data communications. For years, interested parties have recognized that the ISM bands will soon be overused, even without the enormous additional demand for spectrum that Data-PCS would represent. As NCR stated in its comments on Apple's Data-PCS Petition for Rulemaking, "The ISM bands will necessarily become less and less serviceable for large scale ubiquitously available radio services over time. A dedicated band for wireless LAN is clearly going to be imperative."[16]

Thus, existing services offer at best limited opportunities to satisfy some of the applications envisioned for Data-PCS. None, however, can satisfy in a comprehensive fashion the demand for computing devices that can operate at high data rates, with adequate reliability on an anytime, anywhere basis.

IF DATA-PCS IS TO DEVELOP AS ENVISIONED, THE COMMISSION SHOULD ALLOCATE THE 1910-1930 MHZ BAND TO UNLICENSED DATA (ASYNCHRONOUS) DEVICES

In the Second Report & Order, the Commission allocated the 1900-1920 MHz band to unlicensed asynchronous (primarily data) devices and the 1890-1900 and 1920-1930 MHz bands to unlicensed isochronous (primarily voice) devices. The Commission justified this action on the ground that it was dividing the relatively more lightly loaded 1910-1930 MHz band between voice and data technologies.

The Commission's decision to "split the baby," however, is neither in the public interest nor an equitable means of sharing the band clearing burden.

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16 Comments of NCR Corp., RM-7618, at 6 (filed April 10, 1991).

— **THE CURRENT ALLOCATION WILL STIFLE THE DEVELOPMENT OF DATA-PCS**

It is axiomatic that an increase in the number of stations that must be relocated or retuned will increase the delays associated with band clearing. The time needed to raise capital, negotiate with incumbent licensees, engineer, construct, and test replacement facilities, and, if necessary, request FCC resolution of disputes all rise as more stations are added to the relocation and retuning pool.

The Commission has recognized this fact. In the Third Report and Order and Memorandum Opinion and Order in ET Docket No. 92-9, the Commission estimated that it would take at least three years to clear the 1910-1930 MHz band, and that additional time could be required if more than the proposed 20 MHz were allocated for use by unlicensed devices. At the Commission's September 23 meeting, during which the Order was adopted, and at the related press conference, Dr. Thomas Stanley, Chief Engineer of the Office of Engineering and Technology, stated that, given the FCC's decision to allocate the 1900-1920 MHz band to data, nomadic data services would not develop "very early in the process," most likely for four or five years.

Apple believes that even the estimate of four to five years is optimistic and that the delay could be even longer, especially in light of unresolved adjacent-channel problems. Concerns about the delays associated with the current allocation have also been expressed by two of the three Commissioners who participated in the Second Report & Order.

— **THE PROBLEM IS EVEN MORE SERIOUS WHEN ONE CONSIDERS THE NEED ALSO TO CLEAR ADJACENT CHANNEL MICROWAVE STATIONS**

Not only must the last co-channel microwave station be removed from the band before nomadic data devices can be deployed, but any potential interference to wideband microwave receivers in adjacent channels must also be addressed before product deployment begins.

Adjacent channel stations must be treated as co-channel (and relocated from the band) or modified in order to avoid interference to them. Selective consensual frequency re-engineering, equipment modifications, or other

approaches still to be developed may mitigate this problem, but will not solve it.[17]

Until all adjacent channel links have been relocated, providers of unlicensed products will have to use a "guard band" to protect the facilities from interference. Proposals for guard bands of 2 to 4 MHz each (within the bands allocated for unlicensed), for example, in which non-coordinated PCS operation would be prohibited, are being considered by *ad hoc* industry groups. (The 2-4 MHz range is offered only as a basis for examining this issue, and is not intended as a proposal or guideline.) At this juncture, no consensus has been reached about the validity or the width of required guard bands, but, obviously, any such guard bands will reduce the size of the usable nomadic unlicensed band.

— **THE MINIMUM REQUIREMENT FOR DATA-PCS — AT LEAST TEN MHZ, AVAILABLE WITHIN APPROXIMATELY TWO YEARS, AT A COST CONSISTENT WITH THE BENEFITS END USERS WILL ENJOY — CANNOT BE ACHIEVED UNDER THE EXISTING SPECTRUM ALLOCATION**

To stimulate the necessary investment in Data-PCS, a reasonable starting point of frequency availability nationwide is at least 10 MHz, available within approximately two years, at a cost consistent with the benefits end users will enjoy. In light of the problems discussed above, it is virtually impossible to see how this could be achieved under the Commission's current spectrum allocation.

It is generally agreed that clearing the more heavily loaded 1900-1910 MHz sub-band is impracticable, at least initially. Accordingly, under the current allocation potential providers of unlicensed products would have to rely on the 1910-1920 MHz sub-band for Data-PCS, which presents this scenario:

- The unlicensed data industry would have to fund, in advance and without any assurance of timely completion, the relocation of approximately 212 co-channel microwave stations from the 1910-1920 MHz sub-band, at a cost of $53 million (212 x $250,000).

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[17] Even if the creative proposals that Columbia Spectrum Management has presented to UTAM and the Commission (which call for equipment modifications to many hundreds of adjacent-channel stations) are proven effective, guard bands of two MHz would still be required.

- The industry would have to modify an additional 290 adjacent channel stations, at an additional cost of $7.2 million (290 x $25,000). (These modifications would be performed on stations with very wide receivers that cannot be protected using guard bands — for example, an older 28 MHz receiver operating in a 10 MHz adjacent channel that would, without modification, receive signals from 9 MHz of the unlicensed band.)

- If guard bands of 4 MHz were required to protect the remaining adjacent channel stations then, upon completion of this relocation process, and after spending $60 million, only 2 MHz of cleared spectrum would be available for Data-PCS devices (10 MHz minus two 4 MHz guard bands). The total cost to the industry would thus be $30 million per 1 MHz of cleared spectrum, and the prospects for meaningful deployment in only 2 MHz of spectrum would be slight.

If, however, the Commission allocates the 1910-1930 MHz band to unlicensed asynchronous devices, the prospects improve dramatically:

- The industry could then relocate all 438 stations from this 20 MHz band, at a total cost of $109 million (438 x $250,000).

- The industry could modify an additional 412 wideband adjacent channel stations, at an additional cost of $10.3 million (412 x $25,000).

- If guard bands of 4 MHz were again required, then, upon completion of the relocation process, twelve MHz of cleared spectrum would be available for Data-PCS devices (20 MHz minus two 4 MHz guard bands). The total cost to the industry would thus be only $9.94 million per 1 MHz of cleared spectrum, and the industry's ability to deploy a large number of devices without overcrowding the available spectrum would increase significantly.

The difference between a realistic prospect of 12 MHz, as opposed to only 2 MHz, for nomadic data is of overwhelming importance to the computer industry. If manufacturers and potential providers of capital cannot see with reasonable certainty that a minimally acceptable Data-PCS band will be cleared of microwave users, and therefore available for product deployment, in the near term, they will not — and, indeed, should not — invest in developing Data-PCS products and clearing the Data-PCS band.

This problem cannot be "wished away" by denying the need for nomadic data technologies and focusing solely on some presumed need for or interest in fixed, coordinatable wireless LANs alone. The task of clearing frequencies for nomadic technologies is extremely difficult, but it must be addressed head-on.

— **ALLOCATING THE 1890-1910 MHZ BAND FOR UNLICENSED VOICE TECHNOLOGIES WILL NOT BLOCK, AND MAY FACILITATE, INTRODUCTION OF SUCH TECHNOLOGIES**

Some potential providers of unlicensed voice products will, no doubt, argue that they must have access to the "good" bands in order to permit early deployment of these devices and, thereby, pay for clearing the remainder of the unlicensed band. Apple would be gratified if these companies are committed to band clearing, and are willing to commit early deployment revenues from voice devices to clearing the data band. Such a policy has not yet been articulated by UTAM or some of those companies.

While Apple supports early deployment and cooperative band clearing efforts, early deployment does not in fact depend on the current allocation. Because most unlicensed voice technologies are coordinatable, providers of unlicensed voice devices will be able to use the entire 20 MHz unlicensed voice band from the start. In some locations, they will be able to deploy products immediately; in others, they may be required to move a small number of links in order to clear a particular location. In all cases, however, they will be able to focus their resources on a particular problem — for example, clearing specified frequencies in a designated market or portion of the country — completing the project, and beginning or continuing deployment in a relatively short time.

This confers two very significant benefits on voice products. First, the period after which revenues will begin to flow for these products will be measured in months, while for nomadic data devices, the period will be measured in years. Second, because band-clearing can be broken down into discrete tasks (*e.g.*, clear the New York market), capital can be raised in incremental steps. Taken together, these differences will make it significantly easier to raise capital to clear the voice band, and will make it far easier for manufacturers of voice products to absorb any increase in the total number of stations in the band.

Thus, the interest of unlicensed voice-PCS interests in the 1910-1930 MHz band is fundamentally different from that of providers of Data PCS: for voice providers, such an allocation simply makes it easier and cheaper, at some specific sites, to sell equipment; for Data-PCS providers, such an allocation will represent the difference between having the technology and not having it.

Moreover, several parties to this proceeding have described the benefits of a contiguous voice band encompassing 1890-1910 MHz. Such an allocation would enhance spectrum usage by reducing the number of interfaces between separate licensed or unlicensed domains, each of which requires the imposition of emission restraints at the band edge.

In addition to redesignating the 1890-1910 MHz band for voice (isochronous) devices, thereby providing a single contiguous 20 MHz allocation for isochronous operation, the Commission should eliminate the restrictive subdivision of the isochronous band. Currently, a portion of this band is sub-channelized into 1.25 MHz channels, thereby creating artificial partitions within the isochronous band that will discriminate against certain valuable technologies. UTAM, in fact, has apparently found it necessary to treat the two voice bands as involving the interests of two sets of totally different potential users; this has made the provisions for "fair" treatment of two sets of services, voice and data, into a three-way division or contest, each demanding "fair" consideration in clearing.

Instead of creating and deepening such a rift, the Commission should instead apply the less restrictive rules in Section 15.321(a), which now apply only to the 1890-1900 MHz isochronous sub-band, to the entire 20 MHz allocated for isochronous operation, and should reject any effort to expand technology-preclusive fixed segmentation approaches that might give an unfair advantage to selected technologies.

THE COMMISSION SHOULD ENSURE THAT THE DESIGNATED BAND CLEARING ENTITY WILL TAKE ALL STEPS NECESSARY TO PROMPTLY CLEAR THE ASYNCHRONOUS SUB-BAND ON A NATIONWIDE BASIS

As UTAM continues its efforts to develop band clearing and early deployment plans, two facts become increasingly clear. First, clearing the unlicensed band is a huge undertaking. Second, promoting early deployment of

coordinatable devices requires a tremendous amount of work and a great deal of money and, to a large extent, will not speed overall band clearing.

In light of these two factors, Apple reiterates that the Commission must ensure that the entity given responsibility for clearing the unlicensed band will adequately and reliably represent the interests of manufacturers of all unlicensed technologies, both voice and data. In particular, the Commission must be vigilant that the entity not only will create "a plan ...that will permit the implementation of nomadic devices and, in particular, nomadic data PCS devices, as promptly as possible," as required by the Second Report & Order, but actually will implement such a plan. Anything less would pose a serious threat to the development of unlicensed Data-PCS services.

Apple, therefore, urges the Commission to ensure that early deployment does not become an end in itself. Specifically, Apple urges the Commission to take steps to ensure that a fair share of UTAM's resources (both financial and other resources, including legal, engineering, and management personnel) will be devoted to clearing, as quickly as possible, the data band. Moreover, the Commission should require that the structure, governance, and practices of UTAM reflect the interests of all industries (voice and data) that will use the unlicensed band.