ORIGINAL
FILE

Before the
FEDERAL COMMUNICATIONS COMMISSION RECEIVED
Washington, D.C. 20554

JUN 16 1992

Federal Communications Commission
Office of the Secretary

In the Matter of:	)	
	)	
Petitions for Rule Making for	)	
Opening of the 930-931 MHz	)	ET Docket No. 92-100
Paging Reserve Band	)	
	)	RM-7977, RM-7978, RM-7979,
Requests for Pioneer's Preferences	)	RM-7860, RM-7980
to Provide Data or Paging Services at	)	
Frequencies In the 930-931 MHz	)	PP-35, PP-36, PP-37, PP-38,
Paging Reserve Band	)	PP-39, PP-40

REPLY COMMENTS OF PAGEMART, INC.

Roger Linquist
Chairman & CEO
PAGEMART, INC.
6688 N. Central Expressway, Suite 900
Dallas, Texas 75206
214 750-5809

Jeffrey Blumenfeld
Glenn B. Manishin
Mary E. Wand, Telecommunications Consultant
BLUMENFELD & COHEN
1615 M Street, N.W., Suite 700
Washington, D.C. 20036
202 955-6300

Attorneys for PageMart, Inc.

Dated: June 16, 1992.

No. of Copies rec'd 044
List A B C D E

SUMMARY

On June 1, 1992 parties to this consolidated docket filed comments on six alternative proposals for use of portions of the 903-931 MHz band for widely varying data and messaging services. For the most part, parties used the comment procedures to challenge the feasibility of competing proposals, as described by the technical filings that accompanied the parties' initial requests for a pioneer's preference or were filed separately.

As PageMart shows in these reply comments, no party has successfully challenged the theoretical, technical, or commercial feasibility of PageMart's "Personal Information Messaging System" ("PIMS"). Rather, PIMS emerges as the single proposal comprising a truly personal, portable and ubiquitous wireless messaging service, and the only proposal meriting the allocation of scarce spectrum reserved for enhanced paging services.

Most importantly, while the other parties generally propose either specific applications, or specific technologies, or some combination of the two, PageMart's Personal Information Messaging Service is the only proposal before the Commission that has the throughput capacity and functionality to support *every new application described by every applicant.*

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of:	)	
	)	
Requests for Pioneer's Preferences	)	ET Docket No. 92-100
to Provide Data or Paging Services at	)	
Frequencies In the 930-931 MHz	)	PP-35, PP-36, PP-37, PP-38,
Paging Reserve Band	)	PP-39, PP-40
	)	

REPLY COMMENTS OF PAGEMART, INC.

PageMart, Inc. ("PageMart"), by its attorneys, hereby submits its reply to the comments on the petitions for rulemaking and requests for pioneer's preferences for allocation of the 930-931 MHz paging reserve band which the Commission requested by June 16, 1992.[1]

INTRODUCTION

On June 1, 1992 parties to this consolidated docket filed comments on six alternative proposals for use of portions of the 903-931 MHz band for widely varying data and messaging services. For the most part, parties used the comment procedures to challenge the feasibility of competing proposals, as described by the technical filings that accompanied the parties' initial requests for a pioneer's preference or were filed separately.

As PageMart shows in these reply comments, no party has successfully challenged the theoretical, technical, or commercial feasibility of PageMart's "Personal Information Messaging System" ("PIMS"). Rather, PIMS emerges as the

---

1 By Public Notice released April 30, 1992 (Mimeo No. 22912) the Chief Engineer established a schedule for comments and reply comments on the various pioneers' preference requests filed before June 1, 1992.

single proposal comprising a truly personal, portable and ubiquitous wireless messaging service, and the only proposal meriting the allocation of scarce spectrum reserved for enhanced paging services.

Most importantly, while the other parties generally propose either specific applications, or specific technologies, or some combination of the two, PageMart's Personal Information Messaging Service is the only proposal before the Commission that has the throughput capacity and functionality to support *every new application described by every applicant*.[2]

I. PAGEMART'S "PERSONAL INFORMATION MESSAGING SERVICE" IS THE ONLY PROPOSAL BEFORE THE COMMISSION THAT IS CONCEPTUALLY BROAD ENOUGH TO MEET CUSTOMER NEEDS WELL INTO THE NEXT CENTURY.

As PageMart noted in its opening comments in this docket, to allocate spectrum, the Commission must convince itself that the service approved for the band meets the needs that customers will have today, tomorrow, and into the next century.[3] In today's business environment the routine exchange of electronic files, facsimile, images and lengthy mix of graphic and text files is already a necessity. In the future, this need to exchange complex and lengthy files can only increase.

Further, as the success of cellular technology has shown, customers are coming to demand wireless connectivity to a variety of services; that is, connectivity which is location-independent, rather than dependent on the wireline network.

---

[2] As noted in PageMart's June 1 filing, many of the proposed applications can be supported in the current paging allocations, by more-or-less conventional paging techniques.

[3] Comments of PageMart,Inc., June 1, 1992 at p. 2.

Advanced messaging services of the future must go beyond the "enhanced paging" applications proposed by the other applicants for pioneers' preferences in this spectrum band. Wireless messaging of the future must be capable of transmitting vastly increased volume of information without sacrificing service ubiquity or subscriber capacity. At the same time, the service should be compatible with low-priced and low-power receiving and transmitting equipment, so that potential ubiquity is not diminished because of high price, diminished portability, or unrealistically short battery life. Only the Personal Information Messaging Service ("PIMS") proposed by PageMart supports adequate throughput in terms of total information delivered to a large number of total subscribers for complex, lengthy text, facsimile and graphics files while permitting low powered and low priced communications equipment.

Other than PageMart's proposal for PIMS, the requests for pioneer's preferences in the 930-931 MHz band are narrowly drawn to serve only niche markets, or merely represent some advance in a single technology. They are not broad new advanced personal messaging services. They are, instead, minor improvements in one or two areas that on the whole fail to meet the concept of truly advanced wireless messaging services. PageMart's review of the parties' initial comments in this docket has uncovered nothing to cause it alter its conclusion that the proposals presented are a mere shadow of the true potential for this next generation of communications technology.[4] Proposals that do no more than increase the speed of ordinary paging in wider channels, increase throughput in exchange for increased equipment cost, or require the construction of vast new

---

[4] Comments of PageMart, Inc., June 1, 1992, at p. 5.

nationwide networks are not advanced. They offer little that is new or that cannot be provided using existing allocations and systems. Only PageMart's PIMS proposal meets all the criteria for an advanced system set forth in PageMart's opening comments,[5] and therefore is the only proposal worth the allocation of scarce spectrum.

The Commission is facing an allocation decision that could signal the dawn of an entire new industry. That industry will consist of a wide variety of applications, probably including many of the individual applications now being proposed and undoubtedly also including many not yet conceived. As usual, the market will decide which applications are needed, appropriate and worthwhile. The challenge, therefore, is to allocate spectrum not for a particular application, but for one or more system approaches which will permit the widest possible variety of individual services and applications. Only this approach will permit the development of a robust industry, with sufficient volumes to reach that critical mass of users which supports aggressive competition among equipment and service providers, as well as volume-driven improvements in technology and reductions in user prices.

Approaching Advanced Messaging Services from this perspective, cognizant that AMS must encompass at least the currently-proposed applications,[6] suggests that the following characteristics must all be satisfied by a system design:

---

[5] *Id.*, at p. 8.

[6] The two other petitions are PacTel Ground-to-Air and SkyCell. As PageMart indicated in its June 1 Comments, PacTel Ground-to-Air can be provided today, at least by nationwide carriers, in existing paging allocations. Further, SkyCell's proposal is essentially to embed a more-or-less standard pager in a CT-2 handset, which can certainly be accomplished in existing paging spectrum.

- Two-way control for acknowledgement, which is critical for error correction for longer messages
- Provide for the largest number of users *in each coverage area* to receive messages of significant length, therefore characterized by highly-spectrally-efficient operation
- Based on 25 kHz channels that can be grouped into channel blocks for economies of scale and trunking efficiencies
- Provide for multiple competitors to enhance user benefits
- Support at least the applications suggested to date:
    - · two-way non-real-time packet messaging with two-way control (PageMart, MTel, Echo)
    - · one-way messaging with two-way control (PageMart, Dial Page, Metriplex, MobileComm)
    - · one-way digitized voice with two-way control (PageMart, PageNet)
    - · one-way digital/voice (PageMart, Freeman)
    - · high speed one-way paging with or without wireless return link (PageMart, PacTel AAP, Global)
    - · one-way broadcast (group call messaging) (PageMart, Montauk)

PageMart's PIMS proposal satisfies all these criteria. It is a system over which all these listed applications can be provided. It is based on traditional 25 kHz wide channels. It provides for multiple competing providers, in fact proposing two nationwide licensees, as well as two additional licensees in each coverage area. It provides for two-way control, a crucial component of accurate long-message-transmission. And finally, even allowing for multiple messages of up to 15,000

bytes per active user per day, it can effectively accommodate 50,000 users in *each coverage area* for *each 25kHz* allocated,[7] a scale which no other application even approaches.

In addition, PageMart's proposal, which puts the subscriber transceiver unit onto an industry-standard PCMCIA Type II card, will permit users to have low cost, low power, one number portability in conjunction with whatever device they own now or in the future, ranging from office computers and facsimile machines, to portable and laptop computers, all the way to sub-notebooks, handheld and pocket size devices. Further, PageMart's is the only approach which permits large amounts of data to be transmitted to large numbers of users within each coverage area without requiring any action by the user; in fact, everything from conventional facsimiles and file transfers, to the transmission of complex reports and computer graphics, can be downloaded to the user's PCMCIA-equipped device while that device is turned off. Thus PageMart's approach enables the most sophisticated uses and applications, while offering users true "appliance" convenience, easier even than a standard facsimile machine.

Even more compelling is that although PageMart's proposal is the most far-reaching of all those now before the Commission, it is not based on theoretical studies still mired in computer modelling exercises. Rather, PageMart's innovation is at the system conception and design level, while implementation utilizes existing technology in almost all facets of the design save for the PCMCIA card which is already in prototype.

---

[7] Based on allocation of 10 channels of 25 kHz. This reach, and consequent spectrum efficiency, accommodates 10 to 30 times more subscribers *per coverage area* than, for example, could the MTel proposed system, assuming equal message size.

II. SUFFICIENT SPECTRUM SHOULD BE ALLOCATED TO PERMIT THE DEVELOPMENT OF A ROBUST AND COMPETITIVE INDUSTRY

The Commission has increasingly recognized that market forces, and not regulation, must dictate the services which will be available. Thus the Commission's allocation and channelization decisions must enable the widest range of applications while placing the fewest restrictions on the development of those applications. For example, sufficient spectrum should be allocated to permit the development of a robust and competitive industry offering multiple applications. This will permit the economies of scale and scope which will drive down user prices.

Channelization decisions must be consistent with this approach, to avoid "balkanizing" the available 1 MHz, thereby possibly restricting the kinds of services which can be developed not only now but well into the future. With very few exceptions, the applicants, including PageMart, have indicated that their services can be provided over 25 kHz channels. [8] By staying with a standard bandplan totalling 40 25 kHz-wide channels, the Commission would retain maximum flexibility, including for reserve allocations, while permit licensees to make their own decisions on channel use.

For example, PIMS is conceived as two nationwide licensees, each with 10 channels of 25 kHz, and two additional licensees in each coverage area—"local" providers—each with 6 channels of 25 kHz. Since virtually all the current proposals, including the most sophisticated PIMS proposal, can be accomplished in

---

[8] MTel, MobileComm and Freeman are the notable exceptions, apparently requiring 50 kHz wide channels (or 150 kHz for Freeman). Echo requires 5 kHz wide channels.

25 kHz channels, any applicant advocating a radical departure, such as double-width channels, should bear a heavy burden of demonstrating how its proposal offsets this inefficient use of the spectrum by achieving comparable efficiencies through other methods.

III. THE COMMISSION MUST CONSIDER THE FEASIBILITY OF THE REQUESTS FOR PIONEERS' PREFERENCES IN PRACTICAL TERMS

It is clear from the June 1 filings that "feasibility " is in the eye of the beholder, which seems to result from several varying definitions of the term. Three levels of feasibility appear to be under discussion:

- **Theoretical feasibility,** which appears to mean a design or set of technical performance objectives which appear possible in that they do not violate any laws of physics. This level of feasibility is commonly demonstrated by a combination of technical narrative and computer modeling.

- **Technical feasibility**, which appears to mean that equipment can be built to function and meet performance specifications using either existing components (*e.g.*, semiconductor devices) or components successfully prototyped.

- **Commercial feasibility**, which appears to mean that equipment can be built in production volume and accordingly meet target cost/performance requirements and business objectives.

All of the petitions appear to have generally met the test of theoretical feasibility. However several petitions, notably those of MTel, Echo, MobileComm, PageNet and PacTel AAP appear to rely on untested high speed coding techniques to achieve the "advance" they claim as significant.

For example, while MTel claims to have demonstrated feasibility through a combination of textbook citations and consultants' computer modelling, that is clearly only theoretical feasibility. Indeed, the application explicitly states that MTel's demonstration of technical feasibility must await the outcome of its 6-month-long, 7-step "Ongoing Validation Program" (MTel at 19). Of course, even if that test is successful, the Commission will have to decide whether a three-transmitter network in Oxford Mississippi adequately tests the network's robustness and ability to overcome the critical multipath and intersymbol interference challenges posed by RF-intensive and RF-hostile markets like New York City and Los Angeles, where demand is likely to be greatest.

PacTel's AAP proposal is apparently not sufficiently advanced in the planning stages for PacTel to be able to describe its system design.

PageMart's approach is significantly different. Its innovation lies in its system conception and design. PIMS delivers the most data to the most subscribers in each market not by pushing the envelope of data modulation technique or speed to a point which can be accomplished today only in computer models, but rather by an innovative approach to system architecture. PageMart's proposed initial data speed of 4800 bps is even lower than today's European ERMES standard. As a result, the PIMS subscriber transceiver unit is a low power, low cost, highly portable unit already in prototype on a PCMCIA Type II card. Virtually all the other parts of the network could be assembled today from "off the shelf" components and technologies, as is dramatically demonstrated in Appendix A, attached. This permitted PageMart to supply in its initial filing not only a compelling demonstration of technical feasibility, but realistic estimates of market prices of each

of the system's components. Thus, while applicants like MTel struggle to push past the stage of theoretical feasibility, PageMart has already demonstrated technical feasibility, and, to a large degree, commercial feasibility as well. [9]

IV. THE COMMENTS OF ARCH, PAGENET, ECHO GROUP AND MTEL DEMONSTRATE NO SERIOUS TECHNICAL OR MARKET PROBLEM WITH PAGEMART's PIMS PROPOSAL

The voluminous comments filed as of June 1 make detailed response in the extremely short time period provided by the Commission virtually impossible. PageMart below focuses on the few substantive comments advanced regarding its PIMS proposal. none of which offers any serious or valid technical or market issue meriting the Commission's attention in this proceeding.

---

[9] The fact that MTel is still mired in computer modelling, and proposing tests only in non-RF-hostile environments like Oxford Mississippi may explain the procedural stratagem it attempted in its June 1 Comments. Specifically, MTel purports to read the Commission's rules to have required all parties to have filed on June 1 a separate piece of paper denominated "Demonstration of Technical Feasibility". Of course the rules required no such thing, as demonstrated by the fact that only MTel claimed to have so read them. Rather, the rules only required that each applicant demonstrate that its proposal was, in fact, technically feasible as PageMart did, for example, in its February filing. MTel's difficulty apparently lies in the fact, apparent from its lengthy June 1 filing on feasibility, that it has so far demonstrated only theoretical feasibility, that its first very limited attempt at demonstrating technical feasibility will take at least six months to complete (with no hint when that test will begin, and that it can give no indication when it might be able to demonstrate commercial feasibility. Thus it seeks a spectrum allocation based on little more than an interesting idea which is not theoretically impossible.

Its procedural maneuvering is, unfortunately, at least as creative as its engineering. For not only does MTel attempt to invent a procedural hurdle by a misreading of the rules, it also attempts to rewrite the rules to excuse itself from commenting on other parties' June 1 filings. While it is not unprecedented for some parties, such as the Department of Justice or various public interest groups, to reserve their comments until the Reply round, an applicant can have only one reason for choosing this approach: by filing no comments until the Reply round, it deprives the other parties of an opportunity to respond to its criticisms and Comments. The Commission should not countenance this "innovative" approach, and should reject any Reply round comments from MTel which attempt to set forth comments appropriate to the June 1 filings which MTel chose to skip. Should the Commission permit MTel to file such comments out of time on June 16, it should give the other parties -- but not MTel -- an opportunity to respond to them.

Finally, the Commission should make it clear to MTel that only substance, and not procedural maneuvering, will serve as the basis of the Commission's decision in this important proceeding.

ARCH COMMUNICATIONS GROUP

Arch urges the Commission to reserve 930-931 MHz for "base-to-mobile one-way messaging, and not two-way messaging or mobile-to-base messaging as some of the petitioners have proposed, " based on its concerns that existing allocations are not sufficient to accommodate demand for conventional paging services. (Arch Comments, pp. 2-4.) Contrary to its stated desire for "advanced one-way paging services," however, Arch essentially proposes that the Commission allocate the 930-931 MHz reserve band for "Plain Old Paging" services on a broader, wide-area basis.

Conventional paging—whether regionally or nationally—cannot be deemed "advanced" messaging in any way, because it represents nothing more that expanded geographic coverage. There are already numerous regional paging providers and a handful of nationwide providers in operation. Arch's concern over the lack of available paging frequencies in certain markets may have merit, but this should be addressed separately by the Commission, rather than as a false form of "advanced" paging service.

Arch also proposes that the Commission need not allocate 930-931 MHz for two-way services because "these services can and will be offered on other two-way channels such as cellular or the Personal Communications service allocations being proposed at 1.8-2.2 GHz." (Arch Comments, pp. 6-7.) However, PageMart's PIMS proposal should not be confused with offering PCS, nor should PCS be equated with the type service PIMS will bring. Although PIMS is a two-way service like PCS, it is very much unlike PCS in that it does not require two-way, real time interaction with remote computers or duplex voice communications. PIMS utilizes the

delivery advantages inherent in its paging technology, namely low cost, high spectral efficiency and in-building penetration.

PAGENET

PageNet insists that several of the requests for 930-931 MHz pioneer's preferences, including PIMS, "essentially recycle various existing two-way mobile data proposals." (PageNet Comments, p. 7.) PageNet is wrong. First, PageMart clearly pioneered the cellular paging concept for advanced messaging services, and has already submitted patent applications for this innovation; PageNet's Voice Now service is in many ways a direct copy of PageMart's system design. Second, and more fundamentally, PIMS is not a mobile data service because it is non-interactive, non-real time packet data; PIMS does not require real time, interactive operations of remote computers. PIMS is thus an advanced, paging technology-based messaging service in the spirit of the Commission's reserve 930-931 MHz band frequency spectrum.

PageNet's suggestion that there 's "no public interest justification whatsoever to allocate the 930-931 MHz band for this purpose" (PageNet Comments, p.9), is equally wide of the mark. PageNet does not appear to recognize the difference between mobile data service that is capable of real time interactive, two-way wireless communication for remote work stations interconnected to a real time computer system (such as ARDIS, Mobitex and cellular data) and messaging services that are, non-real time, two-way, non-interactive, but capable of supporting messages of variable length (including facsimile) to a wide array of commercially available, highly portable computers, including palmtops, pen systems (including Apple's "Newton," a palmtop pen system) and notebook computers. Mobile data, as

compared to personal information messaging services, currently supports only niche market segments, such as field technicians (the basis for the joint IBM/Motorola program named ARDIS), truck drivers (an important segment of all mobile data providers, including Mobitex and RaCoTek) and various field service personnel. On the other hand, IBM's CelluPlan II offering, provides burst data over voice capability for cellular telephone service providers, which is another mobile data service that will even further expand the real time, interactive data market segment.

PageMart's PIMS proposal addresses a fundamentally different and larger market segment, serving the needs of a wide variety of business and potential consumer users that require not only a low-cost service, but also low-cost equipment in the form of an RF modem that can be easily fitted to commercially available portable personal computer products. To cite an early indication of the enormous potential need for this type of service, Motorola's EMBARC nationwide paging service is dedicated to messaging through such innovative equipment as their News Stream (store and forward paging receiver) and the extremely successful HP95LX palmtop computer. Also, nationwide paging providers such as SkyTel are actively promoting the HP95LX-News Stream product to traveling business people for the purpose of E-mail delivery, messaging, calendar updates and numeric paging. The main issue facing EMBARC and nation-wide messaging providers, such as, SkyTel, today is message-handling capacity and error correction. This, more than any other reason, is driving service providers and network infrastructure suppliers to accelerate plans to introduce high-speed coding products and software, including

data compression techniques, to deal with the capacity problem in the paging business as soon as possible.[10]

The basic issues are: (a) transmission of larger and larger amounts of information is prohibitively expensive unless the throughput per city is dramatically increased (and the cost per character or bit is significantly decreased) over conventional paging data rates, and (b) the longer the message, the greater the likelihood of errors requiring re-transmission for a useful data service. Consequently, if throughput is not added (via two-way packet data service), then PageNet's position may be a "self-fulfilling prophesy." In other words, if subscribers cannot get what they want, they will either be forced to use a specialized two-way mobile data service provider (and pay for more expensive, less integrated equipment) or not subscribe to the service at all.

The PIMS approach proposed by PageMart can be viewed as the consumer-oriented service for the mass retail-consumer market, as opposed to ARDIS, Mobitex, etc., which represent the "industrial-oriented" service for corporations that, in some cases, require a lease line, X.25 connection to the service provider. Furthermore, the subscriber transceiver module required for PIMS service is based on the PCMCIA Type II card standard that can convert a wide array of commercial portable computer products into two-way packet data messaging equipment,

---

[10] The fact is that paging is a very cost-effective communication mode in general and is the most cost-effective way possible among all types of wireless communications services to communicate to groups of business people through its group broadcast capability. For instance, a sales organization often wishes to update its field sales force on product announcements, new applications product availability and even price changes. There is not a more cost-effective way to communicate sales or "bulletin board" information to large groups of people than paging. However, a large emerging need is surfacing also with respect to personal E-mail service. Business people on the go using public, private or LAN-type E-mail networks wish to stay in touch and desire to have their E-mail sent to them, or an abbreviated version of sender - subject - cc distribution-type information so they may stay in touch with office activities.

including the highly portable palmtop products. In this regard, PageMart, working in conjunction with an equipment peripheral manufacturer, has recently successfully prototyped a 900 MHz paging card store and forward receiver adhering to the PCMCIA card specifications. With further use of VLSI chips, the card can easily contain 900 MHz transmitter circuitry also. PageMart believes the market for low-cost, low-power, small form factor two-way packet data service (possible with paging-type technology) will enable future products like Apple's Newton to achieve the $3 trillion worldwide market by the end of the decade that Apple chairman John Sculley envisions through the collision between the computer business, home electronics, telecommunications (wireless) and publishing.

Thus, PageNet's argument that "other frequency allocations, including 800 MHz SMR and 220 MHz, are in a better position to provide enhanced two-way data services than the 930-931 MHz band" (PageNet Comments, p.17) illustrates its confused approach to advanced messaging. PageNet confuses the fundamental difference of paging-based technology with mobile computing technology, such as cellular telephone, 800 MHz SMR and 220 MHz. PIMS is completely different in the type of wireless communication link provided, namely non-real time, non-interactive, packet data transmission. The great user benefits of PIMS to subscribers is that messages are automatically received when the unit is on (without worrying about battery drain as in cellular telephone transceiver/modems) and if a subscriber wishes to send a message there is only a single key (or pen activated icon) to press to send a message. Absolutely no computer literacy is required to be fully operational as a PIMS subscriber.

This is simply not the case with any of the mobile service providers cited by PageNet because these systems are based on real time, interactive data transmission service that offer subscribers essential wireless remote computing capability. Their subscribers must not only be computer literate, but must engage in a computer "session" to receive information or input information. Clearly, the dramatic business growth of these services are a partial indication of demand for this type of service; but, PIMS is directed at the mass market segment of users who either do not have the computer skills, do not wish to devote the time or to be bothered with remote computing activities necessary for retrieving messages using mobile computing. Furthermore, this service will be offered with a removable PCMCIA card transceiver that will enable any type of portable personal computer to be "message ready." Furthermore, given the basic simplicity of paging technology and by "piggybacking" on the large potential volume of the one-way, PCMCIA pager card, the two-way PCMCIA transceiver pager card for PIMS should be available at retail in volume (under cost-based pricing) in the $100-$150 range (for example, this would include 128 K bytes memory and a transmitter circuit, but would avoid the cost elements of LCD display electronics, external control panel and special case packaging – simply the PCMCIA card enclosure.

PageMart's PIMS system in fact goes many steps further than PageNet's Voice Now proposal:

1. Network Control. Both PIMS and Voice Now require a simulcast polling channel to locate the subscriber transceiver unit for its best serving transmitter base station by asking it to transmit a signal on the channel set aside for return link communication (ACK/NACK channel). In PIMS, the subscriber transceiver unit

automatically provides the system or network controller with the transmitter identification of the best serving base station. In the Voice Now system, the receiver base stations measure signal strength at each receiver and then their network controller goes through an elaborate procedure to attempt to determine the best serving transmitter. This can be a very difficult process using PageNet's approach if calibration of receiver signal strength varies with seasonal changes in vegetation, if their calibration grid is not detailed enough, and if "line of sight" from the nearest transmitter (to strongest received signal receiver station) is obstructed. Subsequently, both systems isolate (or attempt to, in PageNet's case) forward data transmission to one best serving transmitter to realize frequency reuse within a contiguous service area with conventional paging transmitter "cells."

2. Messaging Capabilities. PIMS can provide any type of one-way paging type service that Voice Now can provide, including digitized voice messages and very short messages over its polling channel. The reason PageMart's pioneer's preference request focused on text, graphic and facsimile-type messages is the tremendous growth in the personal, portable computer platform industry that is demanding low cost, simple to use, wireless data communication capability. Apple Computer is not alone in projecting an explosion in small, highly portable computer platforms that require wireless communication ($3 trillion market estimated by the year 2000), since virtually every major computer manufacturer and a host of smaller companies are or will be offering key or pen-based portable, personal computers that communicate over the next several years.

However, it is not clear that voice paging will make a comeback after rapidly declining over the past 10 years since the introduction of numeric and alpha-

numeric display paging and the coming wave of communicating computer platforms. Although it is true that voice storage capability is a feature lacking in traditional voice pagers, it is also true that voice messages (a) still lack privacy in public places, (b) have a greater array of substitute products available now as opposed to 10 to 15 years ago when their popularity peaked (cellular telephone service and the explosion in two-way portable service products such as Motorola's low cost Radius line), and (c) the relatively high cost of voice paging subscriber equipment, which will be the case for Voice Now's digitized voice page with its digital vocoder two-way signaling and power requirements (bearing in mind that full featured numeric pagers are typically selling at retail at $79-$99).

3. Frequency Re-Use Design. PIMS goes well beyond the Voice Now proposal for frequency reuse by addressing the need for high quality, reliable in-building service with both building cells and office cells (that use the natural rf field containment in high rise office buildings coupled with low power 0.1 to 1.0 watt ERP transmission). Frequency reuse now can multiply substantially with PageMart's novel approach to transmit messages through the smallest possible cell to achieve the greatest possible frequency reuse and enhance message throughput. This also allows PageMart to substantially increase system capacity over time without the need to simply reduce power in its geographical cells and perform "cell sub-division" similar to cellular telephone service to create more capacity/throughput).

PageNet's opposition to allocation of the 930-931 MHz band for two-way services (PageNet Comments, p. 11) is somewhat misleading. PageNet rests its argument on the very subtle difference between PageMart's two-way command and control link that is also capable of two-way data transmission with PageNet's two-

way command and control "only" system. The fact is, however, that two-way command and control is required for accomplishing frequency reuse—a major breakthrough in spectrum efficiency for paging type messaging applications. While PageMart's PIMS system is consistent with 25 kHz channel assignments in other bands, and PageNet's proposal requires a similar type of two-way command and control channel (and bearing a striking resemblance to PageMart's PIMS system), PageNet seems to view its own system quite differently. The major difference between PageMart's frequency use and PageNet's frequency use plan is that PageMart's system is fundamentally more flexible and provides subscribers the option to communicate on the return link by seizing a data channel for transmission in a variety of cell's (geographical, building and office) for maximum potential frequency reuse.

Beyond PageNet's curious objection to other non-real time, non-interactive, packet switched services, the fact remains that for the next major improvement to be made in paging service, simulcast operation for data delivery must give way to cellular (single transmitter base station) operation for data delivery (one-way) if great increase in throughput and spectrum efficiency are to be made. Even more curious is the fact that it is this very two-way command and control return link that is fundamental to PageMart's proposal and indeed the method by which PageNet gains the "frequency reuse based" throughput improvements necessary for its "one-dimensional" digitized voice paging service.

PageNet's efforts to suggest a "technical flaw in PageMart's proposal" based on transmitter power and location is incorrect. (PageNet Comments, p.15.) PageNet's system architecture (one-way data, two-way control) is fundamentally a

direct derivative of PageMart's original proposal. Thus, PageNet's three-step process to eliminate these problems would, of course, be available to PageMart since the same basic system architecture is being implemented.

What PageNet appears to be unaware of, however, is that co-location of transmitters and receivers is possible; receiver locations do not have to be separate from transmission sites. Several technical reasons exist for this conclusion

- As a practical matter, very few PageMart urban sites would operate even at 1,000 watts ERP, let alone 3,500 watts ERP, in order to make an optional trade off between cell size, cell cost and frequency reuse under geographic cell deployment. The reason for PageMart's requesting 3,500 watt ERP authorization is to eliminate radiated power restrictions to the extent possible.

- Some sites that PageMart wishes to use may have 3,500 ERP tenants (although this would almost require no line loss, with greater than 10 dbm gain antennas, given most commercially available paging transmitters are 300 watts or less). The calculations made in PageNet's Exhibit 5 in regard to a 3,500 watt ERP site, are strictly hypothetical and bear no resemblance to how any one would design their system. Site management means that no one, including PageMart, would place their receiver in the "main beam or side lobe" of an interfering 900 MHz transmitter. In fact, site management means that one locates their receive antenna in the null field space of the interfering transmitting antennas and/or use multiple antennas with combine to achieve the unwanted signal rejection along with the desired coverage. On a going forward basis, this is one of the site lessors responsibility to work with new and existing lessees to achieve rf compatibility and has been common practice since the first commercial two-way telephone mobile system operation existed. 30 to 40 dbm reduction in unwanted interference can be achieved in this manner.

- The assumptions made in Exhibit 5 assume the performance of a common emitter bi-polar mixer front-end which were not designed for and cannot effectively cope with high level adjacent band signals. Both commercial receiver design approaches and components exist that are designed specifically to cope with high level adjacent band signals. The key components in these designs are the ring or GaAs FET mixer, which has high 3rd order intercept, plus amplifier-like properties. 20 to 25 dbm

reduction in unwanted interference can be achieved with this approach.

- Many approaches exist for unwanted signal cancellation through sampling and vector summing at the antenna site. Depending upon the particular site need, this approach may or may not be used. The amount of unwanted signal reduction that can be achieved with this approach is between 20 and 40 dbm.

- If all three techniques are utilized, the additive unwanted signal reduction of between 70 and 115 dbm can be realized. Although the two-way mobile industry has dealt with this generic problem to varying degrees for years, the military and commercial aircraft industry has had the greatest experience in unwanted signal rejection. Therefore, people in the wireless and mobile communication industry may not be aware of these existing technologies and commercial availability.

PageNet's capacity comments (PageNet Comments, p.18) are contrived and misleading. First, PageMart's capacity estimates range from 4,800 bps to 9,600 bps to 12,000 bps data rates and for subscriber unit capacity estimates as a function of data rates from 109,000 to 618,000 or more, depending upon system maturity. Since subscriber capacity on PageMart's system continue to increase over time based on installation of office and building cells capacity, projections depend on what point is referenced in the PIMS system development. With this in mind it is illuminating that PageNet chooses, without discussion, to compare PageMart's "growth phase," as opposed to "mature phase,"capacity figures with PageNet's theoretical upper limit of capacity based on 100 percent utilization of its control channel capacity. PageNet then proceeds to compare its unproven 16 QAM modulation approach with the lowest data rate limit (4800 bps) that PageMart modeled and its "growth phase" case. If practical assumptions are used for loading, subscriber demand, retransmission efficiency, and building and office cell development in the mature phase then PageNet's 5X "oversight" of PageMart's 500,000 subscriber loading of a major city

(with all subscribers receiving an average 15,000 characters per day during the 10 hour busy period) significantly understates PageMart's capacity per MSA.

Furthermore, PageNet suggests that its system will be only limited by the paging or control channel capacity and not by the messaging channels by using 16 QAM modulation.[11] In fact, PageMart is unaware of any mass produced equipment that uses this modulation technique that the PageNet proposal depends so heavily on for throughput and capacity. Also, 16 QAM is far more sophisticated than standard paging coding schemes; PageMart is not aware of any conclusive experimental data on problems associated with multi-path or intersymbol interference (ISI) problems in major urban environments using 16 QAM. Because the 16 QAM receiver must make decisions on very small differences in amplitude, any non-linearity introduced by ISI effects in a highly reflective urban environment could significantly degrade the receivers error rate performance. Therefore, the capacity estimates are (1) theoretical, (2) not proven in low cost, mass volume, subscriber equipment, and (3) overstated in that most voice mail systems permit 30-second, not 15-second voice messages which would reduce Voice Now's capacity by PageNet in half.

Finally, PageNet's suggestion that PageMart's cost estimates are invalid because PageMart has not itemized the "expenses incurred in building out infrastructure" (PageNet Comments, p.18) is spurious. PIMS achieves its superior spectral efficiency and hence cost per character estimates on its novel frequency reuse approach as opposed to attempting to maximize data rates in very narrowband

---

[11] Quadrature Amplitude Modulation belongs to the general class of multiple amplitude and phase shift keying or MAPSK modulations that cannot use the simple "hard" limiter FM detector design approach of conventional low cost pagers that are based on constant amplitude modulation).

channels (as in the 5 kHz channel pairs in the 220 MHz spectrum allocation or in wideband channels, e.g., MTel's 50 kHz channels for its NWN proposal). Moreover, PIMS truly has the potential under mature system development, with full trunking utilization on all 8 data channels, to achieve the 1¢ to 10¢ per 1 K bytes[12] (1 byte per character) delivered data price objective, since the subscriber unit is first located as to its best serving transmitter before a single base station cell transmits the message (this is in contrast to the regional or nation-wide simulcast now required by traveling business subscribers to receive alpha-numeric messaging service).

Because PageMart's PIMS system is based on commercially available equipment and conventional paging site operations, it is relatively easy to extrapolate costs to arrive at the 10¢ per 1 K bytes that was given in PageMart's Rule Making document (RM 7980) as a very conservative estimate. Assuming a 30X improvement over a Simulcast System and an 8X improvement in data rate (1,200 to 9,600 bps), this means a current paging system charge of 1¢ per character local alpha message, could be reduced to 0.42¢ per 1,000 characters in a PIMS message, all other costs being held equal. However, PageMart recognizes that there will be greater infrastructure cost per data channel with a cellular system approach, but even if operating and infrastructure cost were tripled, total cost would less than double (since technical cost is typically less than 20% of total costs) and a potential mature systems operating target price of 1¢ per 1 K per character could be potentially realized

---

[12] Note that Mobitex, two-way real time interactive remote computing service, has a published airtime usage price of 20¢/1 kbyte.