not adequately support a meaningful group of subscribers with the advanced services, such as facsimile, for which the service is purportedly designed.

The AAP proposal fails to meet most of the important criteria of an advanced messaging service deserving new and additional spectrum allocation:

- high data rate at the cost of additional bandwidth per channel
- simulcast approach severely limits total number of subscribers that can be served
- simulcast approach creates inefficient use of spectrum, despite increased transmission speed
- increased data rate means more complicated and more expensive subscriber equipment
- two-way service not contemplated

SPECIFIC ISSUES

1. *Novelty of proposal warranting a grant of new frequency*

a. PacTel's Position

PacTel suggests that the following features of AAP are novel: (1) unformatted data (subscribers can format), (2) high speed relative to bandwidth used, and (3) new services (digitalized voice mail, facsimile, etc.).

b. PageMart's Response

(1) Unformatted data: With today's paging channels, data is formatted by the paging terminal to POCSAG, Golay, etc., or whatever other format is used for transmission. Thus, if it is required, virtually any format is already available in today's paging systems. Nothing new is offered in AAP.

(2) High-speed operation: High-speed operation is possible in a 25 kHz channel bandwidth, not just in a 50 kHz wide channel. A practical upper bound of data transmission is less than 0.5 bits per Hertz, independent of bandwidth in the range of 25 kHz to 50 kHz using constant amplitude modulation. Thus, whether 25 kHz or 50 kHz channels are used, the effective data rate for 2 channels of 25 kHz or 1 channel of 50 kHz is approximately the same (with the exception of the guard band frequency space used). However, "narrow" channels of 25 kHz would allow either more service providers and/or multiple channel throughput leading to less channel dispersion and greater trunking efficiency.

(3) New services: The easily-foreseeable advanced messaging services include the exchange of lengthy, complex files of text, graphics, mixed text and graphics, as well as facsimile. Such transmissions require higher data rates than conventional paging channels, as AAP proposes. But the simulcast model adopted for AAP will not support a meaningful number of subscribers. For instance, an average facsimile page would take approximately 2.6 seconds of transmission time at 24,000 bps, whereas a 1,000-character message would take only .04 seconds. Assuming a mix of messages per average subscriber of (1) approximately 15,000 characters or bytes per active subscriber during busy hour period; (2) code format efficiency of 0.58 (similar to POCSAG); and (3) 13% busy hour call rate, yields a capacity of approximately 3,212 subscribers (3,600 sec./busy hour X 1,740 bytes/sec. X 1 active subscriber/15,000 bytes X 100 total subscribers/13 active subscribers) in major markets. Consequently, a simulcast system would appear to be entirely inadequate

as a means of delivering meaningful data messages without frequency re-use at the local level in the top 20 to 30 cities where demand would be the greatest.

2. *The 930-931 MHz band should not be used simply to "fill in" coverage areas for existing paging services*

a. PacTel's Position

Page 8, ¶ 5: "For example, in the San Diego market, most subscribers demand Southern California coverage as opposed to just San Diego coverage. Because of these demands, PacTel has been required to file for 931 MHz paging channels throughout Southern California. However, PacTel has not been able to achieve a second regional frequency because of the method the Commission uses to authorize stations (i.e., Carey contours and Interference contours). Furthermore, in some areas, commuters are traveling over great distances for work and relaxation. It is extremely doubtful that subscribers will demand less than regional coverage of their AAP service when they currently demand regional coverage for their conventional paging services" (emphasis supplied).[6]

b. PageMart's Response

What PacTel is clearly attempting to do in its petition is to solve its paging business problem of not being able to coordinate regional systems in frequency bands currently set aside for paging by attempting to exchange the promise of using higher data rates for the grant to its paging operations of previously-unassigned spectrum.

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[6] Except as otherwise noted, all citations in this section are to the PacTel petition for rulemaking in RM-7979, filed August 2, 1991.

It is unnecessary and inappropriate to use bandwidth in the 930-931 MHz allocation to obtain higher data rates. Simple improvements in higher data rates are currently available in paging network technology. The latest conventional paging systems are capable of at least 9,600 bps (transmitter controller equipment) and would provide 80% of the effective potential gain in bits per hertz (assuming FDMA) possible with AAP (*i.e.*, 12,000 bps in a 25 kHz channel or 24,000 bps in a 50 kHz channel). Unfortunately, because PacTel is not specific as to achievable data rates in its petition, precise comparison is not possible.

3. *Increase in data speed that can be obtained from doubling channel bandwidth*

a. PacTel's Position

Page 6 (PacTel Notice of Details of Experimental Program). "C. Channel Spacing. For example, if a doubling of the bandwidth would support a quadrupling of the paging transmission speed, then increasing the bandwidth would be more spectrally efficient."

b. PageMart's Response

Simply doubling bandwidth cannot lead to a quadrupling of paging transmission speed. Once again, a practical rule of thumb is that the upper bound of the relationship between data speed and bandwidth is approximately 0.5 bits per Hertz. The only way to achieve gains beyond this limit is to somewhat reduce the frequency dedicated to guard bands if 50 kHz (10 kHz guard band) rather than 25 kHz (7.5 kHz guard band) can be used.

4. *The ability to offer regional system without new allocations*

a. PacTel's Position

Page 8-9, ¶ 6: "AAP may not be offered on existing channels today for several reasons. First, existing channels are not regional, so a licensee may be blocked by other carriers from building a regional system."

b. PageMart's Response

Many regional systems exist throughout the country today, covering the major urban and intercity commerce areas:

- California: at least 6 or 7 carriers offer statewide systems, including PacTel
- Texas: at least 4 or 5 carriers offer statewide systems, including PacTel
- Florida: at least 5 or 6 carriers offer statewide systems, including PacTel
- Northeast Corridor (New York City, Boston, Philadelphia, Washington D.C., and Baltimore): at least 5 or 6 carriers offer regional service

5. *The need for channel bandwidth greater than the existing 25 kHz*

a. PacTel's Position

Page 9, ¶ 6: "Second, depending upon the results of PacTel's experimentation, AAP may require different channel spacing that can be accommodated in the existing 25 kHz channel spacing. Third, AAP will require higher baud rates in order to offer the necessary capacity."

b. PageMart's Response

There is little inherent value in changing channel bandwidth for increasing data rate per hertz. There is some savings in guard band, but this had been given considerable thought before establishing 25 kHz paging frequencies in the original

FCC spectrum allocation. Rather, this would appear to be a tactic aimed at purposefully obsoleting conventional 25 kHz frequencies to garner additional unallocated spectrum in the 930 to 931 MHz band for conventional paging applications. Also, allocation of additional spectrum would solve another PacTel perceived problem with 931 MHz frequencies, namely state regulation, if the FCC preempts state regulation of regional systems.

Although it is true that higher baud rates will be necessary to offer advanced messaging services, PacTel overlooks the obvious in that higher baud rates are possible using conventional 25 kHz paging frequencies if the only technical change is a higher data rate than (see 9,600 band discussion) on conventional simulcast paging systems.

6. *Relevance of loading requirements to allocation of new spectrum for new services*

a. PacTel's Position

Page 17, ¶ 22: "PacTel suggests that applicants for additional authorization in the AAP service be required to show that their existing systems have been loaded."

b. PageMart's Response

On the one hand, PacTel argues that AAP is a new service providing sufficient additional value to warrant consideration for a grant of very scarce spectrum at 930 MHz. On the other hand, PacTel argues here that applicants (of existing paging systems) should be required to demonstrate that their existing are fully loaded. Either PacTel sees this 930 MHz band as merely additional conventional paging spectrum with an occasional customer with advanced

messaging needs, or PacTel sees it as an important new "Advanced Architecture Paging" system that requires allocation of new scarce spectrum and cannot function in existing allocations. Loading of current systems is relevant only if PacTel's intended use of the 930-931 MHz spectrum is for "spillover" from its current system. If the new allocation is for new advanced messaging services that require new spectrum because they cannot be provided in current allocations, the loading of existing systems is irrelevant. There should be no reason for PacTel to be concerned about loading of its existing paging competitors unless it believes that this newly-requested spectrum *could* and *would* be used for conventional paging, which would clearly detract from a licensee's capacity to provide the advanced messaging services for which 930 MHz was intended, and would be contrary to the purpose of allocation in the reserve band.

SUMMARY

In summary, PacTel has asked for the possibility of using up to 50 kHz bandwidth and the scarcity of regionally coordinated frequencies to support its case for needing new spectrum. But many other questions need to be addressed. A framework for addressing these questions can be found in the Bell System Technical Journal, January, 1979, by W.R. Young discussing "Advanced Mobile Phone Service: Introduction, Background and Objectives."[7] Whether measured against the criteria

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[7] Mr. Young's article outlines the major AMPS system objectives that PageMart believes apply to advanced messaging services: (i) large subscriber capacity; (ii) efficient use of spectrum; (iii) nationwide compatibility; (iv) widespread availability; (v) adaptability to traffic density:; (vi) affordability. When these Bell System standards for AMPS standards are applied to AAP, the following significant inadequacies are evident:

(i) **Large subscriber capacity:** AAP provides for less than 5,000 subscribers under realistic loading assumptions of 15,000 bytes per subscriber per 10-hour busy period per

set out in Section I for advanced wireless messaging services or these earlier Bell System standards for mobile telephone service, PacTel's AAP proposal fails to meet the threshold requirements for advanced messaging.

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day is approximately one facsimile per 5 subscribers. Therefore, any significant use of the advanced messaging service capability AAP would provide indicates it would essentially be available to only a very small percent of total population in any major U.S. cities (e.g., 0.04% in New York City).

(ii) **Efficient use of spectrum:** A data communication version of the AMPS efficiency algorithm would be bits/hertz/square mile. Since AAP doesn't employ any frequency re-use, the only dimension for improvement in higher data throughput for a given bandwidth and spatial area of service. Frequency re-use, on the other hand, can provide at least another order of magnitude of spectral efficiency (i.e., 10 to 30 times more efficient than simulcast operation—see PageMart, Inc. RM-7980).

(iii) **Nationwide compatibility:** As higher data rates (necessary to justify improvement in spectrum efficiency) are reached, system engineering trade-off issues become more complex, leading to potential non-concurrency in standards of operation between regional systems.

(iv) **Widespread availability:** Very high data rates imply a loss in receiver sensitivity which can be addressed by either a very expensive receiver design or a much higher density in transmitters, or a combination of both. The likely result is much greater transmitter density, which implies greater investment per coverage area and hence may limit universal coverage of metropolitan areas and true "regional" coverage that conventional paging systems provide.

(v) **Adaptability to traffic density:** Simulcast operations do not allow for "spatial unadaptability to traffic density" within a city or simulcast region. Only systems employing frequency re-use can "create" new capacity and address peak subscriber loading in a local area.

(vi) **Affordability:** High data speed for a given bandwidth will cause receiver designs to become more complex in order to minimize their sensitivity loss and avoid the problem of simply adding a great many more transmitters (e.g., each time data rate is doubled: 512 to 1,200, 1,200 to 2,400, 2,400 to 4,800, etc. for AWGN, typically a 3 db penalty in receiver sensitivity is realized). Also, more power is required to operate at higher speed, forcing either much shorter battery life and/or physically larger batteries impacting form factor.

The basic AAP proposal is that higher data rates are needed to provide new data-intensive services. However, using more bandwidth to achieve higher data rates (1) results in no significant improvement in spectral efficiency, and (2) cannot support a meaningful number of subscribers per system in larger cities that require the new services.

C. Dial Page Acknowledgment Paging (RM7977/PP35)

OVERVIEW

Dial Page requests that three channels of 25 kHz each be set aside for what it characterizes as a "new" idea: acknowledgment paging (AP). Unfortunately, the concept of AP is as old as paging itself, and the same problems still exist that have always existed. For most paging customers, the desired result is a two-way voice conversation; the demand for other, lesser forms of acknowledgment is very small. Yet adding an "acknowledgment" transmitter to the subscriber unit substantially changes the form factor, power consumption, battery life and portability of the device. The network infrastructure necessary for the return/acknowledgment transmission will be the weak link. If that network does not "hear" the return transmission, the sender receives no acknowledgment, and therefore must resend the page, just as in conventional paging. The use of double the bandwidth (for two channels, outbound and return) is simply not an efficient use of the spectrum in light of these factors.

Thus, AP fails to meet many of the important criteria of advanced messaging service:

- it does not permit the transmission of lengthy complex text, graphic and facsimile files
- it does not offer improvements in total information delivered to total subscribers
- it is an inefficient use of scarce spectrum
- it does not offer system capacity for a large number of users regionally and nationally

- it imposes a penalty on the complexity, size, weight, power consumption, price and portability of the subscriber communications equipment

- it offers only a nominal form of "two-way" service, the equivalent of conventional paging in each direction

First, in most instances, a page is sent in order to initiate a two-way voice communication. Thus, the only important outcome of sending a page is to receive a return two-way voice call. Put another way, the demand for acknowledgment to a page is effectively accomplished today by simply repeating the page if the sender does not return or acknowledge the page. Mainstream numeric paging is so highly competitive on service price and equipment price or rental that repeat paging on numeric-only pagers (about 80% of the embedded base) is the most cost effective way of ensuring the page is received, particularly since most systems offer service pricing which permits nearly unlimited call volumes. Likewise, in the much smaller alphanumeric paging market segment (approximately 5% of the total market), most important or urgent messages simply end with a request to "call to confirm." All other segments of paging, such as tone-only and voice paging, are declining steadily each year.

Second, the addition of acknowledgment capability substantially changes the subscriber equipment. The size and cost of subscriber equipment will be significantly higher. The subscriber unit would be broadcasting at up to 2 watts (consuming substantially more power than a paging receiver), thereby reducing the

portability and convenience of the unit, which will require larger batteries and/or frequent battery replacement or recharging. [8]

Third, the "weak link" in all wireless two-transmission systems is the return link broadcast from the subscriber equipment. Therefore, the receiver network (*i.e.*, the Dial Page acknowledgment receiver) infrastructure required to ensure acknowledgments are received will significantly increase the cost of the system and therefore subscriber service cost. The real issue, however, is what happens when the forward simulcast link completes the communication, but the acknowledgment receiver network does not receive the return link transmission due to the high likelihood that it will offer less range or provide more spotty reception than one-way paging coverage. In this case, the person sending the page does not receive the acknowledgment. The sending person will then have to repeat the page, despite the large, expensive infrastructure. and increasing the spectral inefficiency inherent in the system.

Fourth, allocating additional spectrum for AP is exceedingly spectrum inefficient in that 2 channels of 25 kHz are needed for communicating text messages which can reliably be accomplished today in 1 channel of 25 kHz, assuming the subscribers are within the paging system coverage area. If a subscriber is in a "fringe" paging area, either caused by difficult terrain or on the edge of the coverage area, the subscriber may be unreachable in either conventional or acknowledgment paging, and the only and the only additional value provided by AP is in knowing the page *may* not have been received. In fact, AP only adds value in that a

[8] To date, no rechargeable pager product has been able to establish itself in the pager market.

subscriber knows the message probably did not get received by the subscriber but, from that point forward, the sender has only the choice of continuing to send the message or not, just as in conventional paging.

Therefore, if only 5% of the total pagers today (11+ million) represent a potential market with approximately 30% (according to Dial Page) potentially interested in AP, this constitutes a total of less than 200,000 customers nationwide. This level of demand does not warrant allocation of scarce frequency spectrum, particularly when the technology employed is certainly not novel, and the cost of such a product would be significantly higher than conventional pager products.

SPECIFIC ISSUES

1. *Need for and/or importance of the service*

a. Dial Page Position

Dial Page offers little evidence or explanation in its attempt to establish the need for AP. It cites some market research it claims to have performed (pages 2, 8-9) as well as two examples of demand: a medical emergency situation and a salesperson operating out of a sales office.

Page 2: "Through its experience and market surveys, Dial Page sees a need for advanced paging service and has envisioned a system it believes will meet this need."

Page 3: "[A] user will never worry whether an expected page was missed. AP will reduce call backs, will give the user the convenience of an immediate reply, and will give the sender a positive message verification."[9]

b. PageMart response

This is counter-intuitive for the vast majority for all paging services. At most, only a small number of pages do not involve a return call to the sender. Further broken down, it seems that the only potential users for this service would be holders of alphanumeric pagers where messages can actually be received. Studies indicate alphanumeric pagers comprise approximately 5% of pagers in use. A request for acknowledgment placed at the end of the message would seem an easier solution than the costly one urged by Dial Page.

For the vast majority of pager holders, the only messages that can be received are numeric. As such, the message sender typically discovers acknowledgment through the return phone call. Ostensibly, the benefit does not even adhere to the holder of the paging service, but rather to the sender of the page. Even in the case of alphanumeric pagers, many of the pages require phone calls to the sender anyway, again doing away with the "necessity" of Dial Page's proposed service. When confronted with a present reliability rate of conventional paging of 90% overall, and 99.9% within most coverage areas (with a signal margin of 30 db) and 99.99% for signal margin of 40 db, AP is a service without a corresponding customer need.

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[9] All citations in this section are to the Dial Page petition for rulemaking, RM-7977, filed October 11, 1991.

Further, present paging technology either stores pages, or allows for "extra" pages when and where the service is needed, or both. The feature of continual paging does not offer a unique service, although it may offer a different means of performing this service (at a significant increase in cost). Dial Page emphasizes the convenience the user receives in affording the message sender an immediate acknowledgment of message receipt, as if the acknowledgment of the receipt were the primary focus of the page. Based on PageMart's experience in the paging industry, as well as the relatively huge percentage of numeric pagers vs. alphanumeric (80% vs. 5%), it is the actual call back that counts. As such, the user experiences little if any benefit by acknowledging receipt of a page immediately compared with a slightly delayed call back. Consequently, the core benefit offered by AP is the message sender's peace of mind. In most cases, this does little or nothing for the sender whose real need is to speak with the user. Furthermore, message senders will receive no benefit if the acknowledgment is delayed (i.e., pager off, pager outside of coverage) and will probably call back again anyway.

2. *Acknowledgment as a means of locating subscribers*

a. Dial Page's position

Page 7, footnote 12: "In addition, AP is important for facilitating the locations of users. With AP, a sender could locate the user first, and then send a high capacity page once the user is located. Thus, AP will make the spectrum more efficient."

b. PageMart's response

It is somewhat difficult to tell what Dial Page means by this assertion. Certainly locating the subscriber before paging the subscriber is either totally

unnecessary for local service or insignificant if it is for regional messaging. Dial Page's own data shows that between 24-34% surveyed were "interested" (we presume in such a messaging service), and 20% of Dial Page's existing subscribers have regional coverage (multi-market); therefore only 6% of the subscribers would be affected.[10]

3. *Extent of nationwide demand*

a. Dial Page's position

Pages 8-9: "The [Dial Page market] survey indicated that depending upon the cost to the subscriber, at $10 to $20, the penetration potential among existing subscribers was between 24 percent and 34 percent. . . . The survey of non-users also predicted that overall paging penetration would increase by 15 percent. . . . Combining current paging users with new users, the study predicts that four million customers would use AP on a national basis."

b. PageMart's response

The survey presents the only potential support for Dial Page's claim to mass market appeal. Unfortunately, the format of the study and study results have not been set forth in the petition for adequate analysis. As a result, we do not know whether the survey employed direct mail or a personal interview. We do not know how the questions were phrased and whether the price for the service alone (AP alone) was revealed. We do not know the breakdown of those "interested" into alphanumeric and numeric pager holders. We are concerned, however, that Dial

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[10] $(.24 + .34)/2 \times 0.2 = .058$

Page, with 180,000 subscriber units, sampled only 200 of its own subscribers but asked 1,000 non-subscribers who presumably do not know much about paging.

Since the statistical properties of the data are not presented no information is available to determine confidence levels. We do not know exactly what assumptions Dial Page uses in arriving at its four-million figure. These questions are representative of the many other questions which need to be addressed before this survey data assumes any level of relevance.

4. *Utility of acknowledgement in emergencies*

a. Dial Page's position

Page 8: "AP can be a critical improvement in reliability for an emergency situation."

b. PageMart response:

Dial Page offers the utility of acknowledgment in medical emergencies as a prime justification for its proposal. It raises the issue of dependability, and offers the acknowledgment of a page as an answer. Unfortunately, the acknowledgment does nothing for the patient involved. He or she still does not know what to do until the physician replies by phone. The proposed system may even unintentionally precipitate a tragic reliance on the acknowledgment while awaiting the doctor's return call, (e.g. the doctor is away from the paging unit). In such a case, an anxious patient would be more likely to rely on a false acknowledgment and avoid seeking other medical attention, thereby losing precious moments.

5. *Utility of acknowledgement in sales settings*

a. Dial Page's position

Page 8: "In addition, in a sales office when an account executive is out on call at a time when there is a customer demand, an office is able to page that salesman to respond to that demand and know whether that salesperson actually got the message."

b. PageMart's response

AP can enhance convenience in this situation only if the account executive carried an alphanumeric pager (about 5% of the total paging market). Even then, however, AP provides minimal value because the account executive can always call to confirm a message.

6. *Whether AP is sufficiently novel and advanced to warrant a grant of frequency*

a. Dial Page's position

Page 10: "Dial Page submits that AP service is exactly the kind of advanced service the Commission reserved for use on this frequency."

b. PageMart's response

Although facets of AP are different from one-way paging, PageMart's responses have shown that any differences are of so little real utility to subscribers that no grant of new frequencies can be justified. Further, AP does not represent a suitable advanced technology. This is verified at Page 6, footnote 9, of Dial Page's own filing: "Dial Page has been assured by equipment manufacturers preliminarily that the technology necessary for AP service exists today." Despite this availability, no one has pursued an experimental license on the available two-way conventional

mobile channels (which are lying fallow) that would be suitable for 25 kHz in both directions at 450 MHz.

7. *Spectrum efficiency*

a. Dial Page's position

Page 2, footnote 1: "Commission action setting aside spectrum for advanced paging services, pursuant to a request from Dial Page, could be an incentive to other carriers to develop other innovative needed services."

Page 4: "Dial Page submits that a new frequency allocation is necessary for the implementation of AP service."

b. PageMart's response

The Dial Page proposal is simply not robust enough to develop any significant new services with 25 kHz network links. Virtually anything would both require additional new spectrum and be limited to capacity constraints of any system transmitting data on a simulcast channel.

Allocation of separate channels for acknowledgment would unquestionably be spectrum inefficient. Moreover, AP is not really novel or substantial, but incremental. In fact, AP can be viewed as a superfluous, wasteful service offering that requires two 25 kHz channels that one 25 kHz channel does today, an offering for the benefit of a small minority group of subscribers who are willing to pay for acknowledgment service.

8. *Design*

a. Dial Page's position

Page 5: "Acknowledgment messages will be transmitted in short bursts of high speed data using a low-powered transmitter built into the pager (e.g., 2 watts)."

b. PageMart's response

The use of a two-watt transmitter would increase return link transmission performance but effectively result in a non-universally-portable product whose battery charge would limit its utility, unlike today's pager that operates for one month on one AA or even AAA battery cell. Further, given the documented concerns of increased wattage on health, this increase in power only increases the concern. The need for a two-watt transmitter also raises concerns as to unit and maintenance cost. In addition, the suggested amount of power is of questionable effectiveness in sending acknowledgments from within buildings.

9. *Receiver coverage*

a. Dial Page's position

Page 6: "Each receiver covers approximately a 27 square mile area."

b. PageMart's response

The coverage area of a receiver station is completely dependent upon such things as height, antenna/receiver characteristics, terrain, high rise buildings, etc. In-building, return link communication may require many receiver stations in major urban areas at great cost relative to the incremental service revenue (and with no increased subscriber capacity).

10. *Operation of acknowledgment*

a. Dial Page's position

Page 5. "Upon receipt of acknowledgment, the controller unit can store the acknowledgment for later retrieval, or send the acknowledgment back to the original calling party or a third party via the PSTN."

b. PageMart's response

This basic system concept is suspect in its operation. Either the message sender needs access to the public switched telephone network (PSTN), which allows them acknowledgment with convenience or, presumably, they must contact the ACK controller or receive acknowledgment from a third party. Seemingly, this requires the message sender to have PSTN access to receive acknowledgment. Otherwise, it is highly questionable that the acknowledgment will be received. It would be likely that many senders using an operator to input a message will not know or will not bother to access the ACK controller (somehow) and, therefore, will not receive the acknowledgment.

SUMMARY

The Dial Page AP proposal is a waste of scarce spectrum for a service for which paging users have not exhibited any substantial demand. Given the overwhelming predominance of tone paging users, the "real" acknowledgment desired by the party sending the page is a return telephone call. Dial Page's AP proposal is accordingly only a ghost of what the Commission envisioned as enhanced messaging services appropriate for allocation of the 930-931 MHz reserve band spectrum.

D. ECHO GROUP MDRS (RM-7782/PP-36)

OVERVIEW

Echo Group's proposed Mobile Data Radio Service (MDRS) is presented as an "inexpensive but highly advanced, spectrum efficient technolog[y] to meet the exploding demand for transmission of data by mobile users."[11] Unfortunately, the proposal is largely devoid of details that permit extensive critique of Echo's petition. What is clear is that Echo Group proposes a nationwide narrow band, TDMA cellular network dedicated to packet delivery of data communications. Thus, the proposed MDRS service will have all of the system costs and in-building performance limitations of conventional cellular systems with none of the cost economies and "learning curve" advantages enjoyed by current cellular operators. Moreover, in light of the development of data-over-voice technologies to provide a data service "overlay" for conventional cellular networks—such as the recently announced IBM CelluPlan IITM technology—it is extremely difficult to envision an MDRS system competing successfully in the marketplace.

The Echo Group MDRS petition therefore falls short of the necessary criteria for advanced wireless messaging in several ways:

- high network construction costs compromise service pricing and in-market availability
- realistic subscriber equipment costs preclude mass-market distribution
- spectrum inefficiencies compared with available cellular data "overlay" technologies

[11] Echo Group petition for rulemaking in RM-78782, at 1 (filed July 30, 1991). Except where otherwise noted, all remaining citations in this section are to the Echo Group request for pioneer's preference in PP-36, filed July 30, 1991.

- inferior in-building performance

SPECIFIC ISSUES

1. *Cost effectiveness of MDRS and MDRS subscriber units*

a. Echo Group's Position

Page 11: "The radios for Echo's system will cost approximately $100 and base stations less than $10,000 each installed, including critically redundant components."

Page 5: "[M]obile units will continuously adjust their output power to the lowest levels at which the base station can receive signals, thereby reducing interference and increasing efficiency. Mobile units will also be able to measure signals from several base stations and report these signal strengths to their home base stations. Base stations will then communicate with one another to effectuate necessary 'hand-offs' of mobile units."

b. PageMart's Response

These equipment descriptions indicate that an MDRS device would employ virtually the same technical capabilities as conventional cellular radios, with the attendant hardware complexities and costs. Inasmuch as the 930-931 MHz spectrum allocation is designed specifically for advanced paging and messaging services, however, the $100 figure for subscriber equipment should not be compared to current cellular radio hardware, but to paging units to which it compares unfavorably. Moreover, the $100 estimate represents the approximate cost and not the approximate retail price.

Perhaps most importantly, the application of narrow band technology at this particular frequency is almost certain to result in significant increase in manufacturing cost above the stated $100 estimate, in particular because Echo Group's plan calls for use of adjacent channels on a 5 kHz channel bandwidth, thus requiring more stringent front end filter and oscillator accuracy standards. In the absence of any description of how Echo Group plans to achieve this unrealistically low cost, it is likely no one knows how expensive this unit will actually sell for at retail. And since MDRS receivers would not be able to take advantage of the manufacturing economies associated with third- and fourth-generation conventional cellular radios, there is little chance that the cost of MDRS equipment would decrease in the future.

The $10,000 figure per MDRS base station is optimistic at best and is probably significantly understated. The equipment comprising the base station will have all the functionality of current cellular system with more stringent narrow band reception and broadcast requirements to avoid co-channel interference. Indeed, given the capital investment in base stations along with the dedicated wireline interconnect facilities between base stations, as described by Echo Group (pages 5-6), it would appear that with 5 channel pairs the MDRS system will have most of the cost of a cellular network—or $5,000 to $10,000 per channel per base station—without the airtime volume flowing from more than 300 channels which enables cellular systems to achieve economies of scale.

2. *Reception stability and spectrum efficiency*

a. Echo Group's Position

Page 3: "Echo proposes to construct and operate a nationwide mobile data radio system using ten 5 kHz channels . . . . The system utilizes a much greater percentage of the allotted spectrum within each channel to transmit information . . . which results in an increase in spectrum efficiency."

b. PageMart's Response

The heralded increase in spectrum efficiency comes at a steep price in reception. Because the guard band around the channel (to separate it from other frequencies) is so narrow, MDRS is likely to suffer from instability. While conventional cellular technology has more relaxed technical specifications on adjacent channel interference (which requires cellular system operators to leave the adjacent channel inactive in the same cell), Echo's equipment specifications must be far more "tight" to enable them to use adjacent channels on a 5 KHz channel bandwidth (with much more stringent front end filter and oscillator accuracy technical requirements) to achieve the spectrum efficiency they claim.

The reduction in guard band and the associated requirement for stringent technical parameters threaten the basic viability of MDRS service, even apart from its high cost characteristics. Echo Group states merely that its "proposed radio system employs packet transmission and is built upon a patent and proprietary techniques." (Pages 3-4.) It appears unlikely that Echo has developed new technology to overcome the co-channel interference problems inherent in its proposal, but the absence of technical information makes such an evaluation

impossible. More likely Echo hopes that the Commission will grant it spectrum in the 930-931 MHz band based only on promises of potential efficiency. Without any demonstrable showing of technical innovation, narrow band technology should remain within its assigned spectrum at 220-222 MHz and should not be the focus of this consolidated docket.

3. *Service Pricing*

a. Echo Group's Position

Page 11: "Due to these proposed radios and system design, Echo and other operators utilizing its spectrum efficient technologies can offer these services at prices significantly lower than that which current technologies would offer."

b. PageMart's Response

It is almost inconceivable that with a system requirement and hence, cost structure (in the best case) similar to cellular telephone, MDRS will be able to offer significantly lower cost without the benefit of voice services to offset cost. Moreover, it is unrealistic to expect that MDRS, with a proposed 15-20 base stations in a typical urban area, could compete in major markets like Los Angeles which have cellular carriers that have between 250 and 300 base stations. On the other hand, MDRS will find it enormously difficult to compete with the major equipment manufacturers such as Ericsson (Mobiltex) and Motorola/IBM (Ardis) , because the apparent proprietary design of MDRS will preclude subscriber and base station equipment from being manufactured on a mass-market basis and make "learning curve" advancement in service cost reductions virtually impossible.