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Washington, D.C. 20554

In the Matter Of:

Mobile Telecommunication Technologies Corporation	)	PP-37
	)	(Docket No. ET-92-100
Request for a Pioneer's Preference Regarding its Petition for Rulemaking to Allocate 150 kHz in the 930-931 MHz Band and to Establish Rules and Policies for a New Nationwide Wireless Network (NWN) Service	)	RM-7978)

REQUEST FOR PIONEER'S PREFERENCE

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for

MOBILE TELECOMMUNICATION
TECHNOLOGIES CORPORATION

Dated: November 12, 1991

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SUMMARY

Mtel warrants a pioneer's preference for its proposed Nationwide Wireless Network ("NWN") Service under the criteria enumerated in the Commission's *Pioneer Preference Order*.[1] In its concurrently filed petition for rulemaking,[2] Mtel has described a regulatory framework as well as a specific technical proposal for future land mobile two-way messaging. Mtel's *NWN Petition* provides a complete blueprint for a quantum leap forward in connectivity between wire based networks and the substantial community of portable computer users.

Mtel's proposed NWN will transfer data at speeds ten times faster than current paging systems in a comparable amount of spectrum.[3] Moreover, because of the combination of a single nationwide frequency and dynamically controlled zones, NWN messages will be able to average almost 40 times the length of messages to existing alphanumeric pagers. NWN alphanumeric messaging systems will be two-way as compared to today's one-way only paging systems. By applying innovative technology while enhancing proven techniques, NWN will afford portable computer users a universal service that offers flexibility far beyond that now available.

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[1] *Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services*, 6 FCC Rcd 3488 (1991) ("*Pioneer Preference Order*").

[2] In the Matter Of Mobile Telecommunication Technologies Corporation Petition for Rulemaking to Allocate 150 kHz in the 930-931 MHz Band and to Establish Rules and Policies for a New Nationwide Wireless Network (NWN) Service, filed November 12, 1991 ("*NWN Petition*").

[3] NWN would operate at up to 24,000 bps in a 50 kHz channel. Current paging systems operate on 25 kHz wide channels at 1,200 bps.

Unlike any existing or proposed messaging service, NWN represents a substantial enhancement over state-of-the-art paging. NWN is a complete two-way messaging service capable of supporting extensive data transfers from portable computers and user terminals, not merely "answer-back" or "acknowledgement" paging. NWN is highly efficient, accommodating a base of over 600,000 users in a cost-effective manner within a modest 50 kHz channel. NWN also permits graceful, incremental expansion that will culminate in nationwide seamless coverage comparable to cellular radiotelephone and wide area paging networks. Thus, NWN combines the convenience and coverage familiar to today's mobile users with the two-way data transfer capability necessary for the portable computing environment of the future.

Mtel's proposed NWN service incorporates a number of innovations that include a high speed simulcast transmission network and an intelligent advanced dynamic frequency management ("ADFM") plan. In contrast to today's messaging services, which generally transmit at 1,200 bits per second ("bps") or less in a 25 kHz channel, Mtel's proposed NWN service will operate at bits rates up to ten times faster in an equivalent channel, overcoming limitations due to destructive summing of multipath signals. Advanced Dynamic Frequency Management ("ADFM"), which incorporates substantial forward channel and reverse channel re-use as well as comprehensive scheduling, uses the high speed transmission medium to condense communications and maximize use of the spectrum. Collectively and individually, the innovations represent an advance in the state-of-the-art in simulcasting as well as an advance in mobile data

communications generally. NWN heralds a new era in efficient two-way messaging services.

NWN, however, cannot be licensed as a patchwork of multiple providers. The simplex single channel operation of NWN precludes adjacent operations unless (1) exhorbitant separation criteria are adopted, thus preventing NWN service from being deployed in large areas or (2) co-channel systems are integrated at the most basic level. Due to the complexity of the frequency management plan and the degree of intelligence required within the NWN infrastructure, however, the integration required would present severe difficulties between two licensees and could well be impossible as NWN coverage expands and adjacencies are daisy chained together. NWN thus is inherently nationwide in scope, and Mtel should be awarded a nationwide licensing preference.

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REQUEST FOR PIONEER'S PREFERENCE

Mobile Telecommunication Technologies Corporation ("Mtel"), by its attorneys, hereby requests the Commission to grant Mtel a pioneer's preference for the proposed Nationwide Wireless Network ("NWN") Service pursuant to Section 1.402 of the Commission's Rules, 47 C.F.R. § 1.402 (1991).[1] Mtel submits that its efforts to create its NWN service offering and to develop the associated technologies required to implement NWN service on a cost-effective basis warrant grant of a nationwide licensing preference under the standards enunciated in the Commission's *Pioneer Preference Order*.[2]

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[1] In the Matter Of Mobile Telecommunication Technologies Corporation Petition for Rulemaking to Allocate 150 kHz in the 930-931 MHz Band and to Establish Rules and Policies for a New Nationwide Wireless Network (NWN) Service, filed November 12, 1991 ("*NWN Petition*").

[2] *Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services*, 6 FCC Rcd 3488 (1991) ("*Pioneer Preference Order*").

I. INTRODUCTION

Mtel consistently has been a pioneer at the forefront of messaging developments.[3] Mtel's involvement in messaging services started in 1965 with an FCC license to operate what was then a state-of-the-art paging service. Seeing the future for messaging services, the company proceeded to obtain FCC licenses to provide paging services throughout much of the southeastern United States and in New York State.

In the early 1980's, Mtel also became actively involved in the FCC proceedings regarding allocating spectrum for a nationwide paging service. Mtel was convinced that consumers would respond favorably to a high quality nationwide service.[4] Ultimately Mtel's subsidiary, SkyTel, Inc. ("SkyTel"), was awarded a nationwide paging license at 931.9375 MHz.[5] Of the three applicants initially awarded construction permits for nationwide paging, Mtel was the first licensee and the only one to build and launch a successful nationwide messaging service. Development of this service, among other things, involved creating both a sophisticated central computer

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[3] Mtel and its corporate predecessors are referred to in this section generically as "Mtel."

[4] As predicted, SkyTel's nationwide service has become more and more popular. SkyTel had approximately 19,800 units in service as of December 31, 1988. By September of this year, that figure had grown to over 115,000 units in service.

[5] The license was awarded in 1985 to "American Satellite Paging." Since that time, the ownership of the company and the name have changed. The name was officially changed to "SkyTel" in 1989. At present, Mtel owns approximately 91 percent of SkyTel and the remainder is owned by Radiofone, Inc.

processing system and implementation of a spread-spectrum VSAT network. Mtel also built several innovative monitoring and alarm functions into the nationwide messaging network to ensure maximum reliability and minimum downtime.

Mtel's paging innovation continues. In addition to operating a nationwide messaging network, Mtel announced in August of this year the first 24,000 bps simulcast paging technology.[6] Even more recently, Mtel disclosed its plans to provide nationwide one-way wireless mailbox service to AT&T's Safari™ computer users through the SkyTel network. In this service, AT&T's Easylink™ electronic mail service will be linked to SkyTel via a gateway and permit users to send mail to Safari™ computers equipped with a low cost adapter.

Mtel has extensive experience in other high technology wireless communications services. Mtel, for example, is a major shareholder in the American Mobile Satellite Corporation ("AMSC"), the consortium licensed by the Commission to provide mobile satellite service in the United States. AMSC's mobile satellite service will provide a full range of advanced, high technology land, maritime and aeronautical message services, including public safety services. Mtel and its subsidiaries also hold licenses in the public air-to-ground service, the specialized mobile radio service, and various marine radio services.

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[6] *See Telocator Bulletin*, Vol. 91 No. 32, p. 2 (August 11, 1991). Previously, state of the art paging operated at 1,200 bps while much of the industry continues to employ 512 bps technology.

As a result of its wide ranging involvement with a broad base of communications systems, Mtel has unique insights into identifying public need for new radio services. Mtel's *NWN Petition* addresses one such deficiency in the ability of current commercial radio services to meet the growing data transmission needs of portable computer users. Although a number of radio based local area network concepts promise wireless office data transfer capability for portable computers, universal wireless two-way digital messaging has heretofore proved elusive. Some two-way data services have been designed for specialized applications. These services, however, lack universally accessible and adaptable public interfaces; the nationwide, ubiquitous coverage familiar to today's one-way messaging customers; and adequate building penetration characteristics.

Mtel's proposed NWN service offering addresses these needs in a manner that departs significantly from existing commercial radio service concepts. NWN is not an adjunct or complementary service, but rather a full service that contemplates:

- A nationwide system with wide area coverage of metropolitan areas.
- A graceful, evolutionary deployment scheme allowing NWN to circumvent saturation by subdividing the existing network in a low cost, incremental fashion.
- An architecture facilitating efficient two-way transmission of short as well as extended length messages.
- Portable user terminals equipped with displays, keyboards, and extensive memory resembling "notebook" or "palmtop" computers in size and weight.

- Acknowledgment and error checking of messages sent or received by user terminals.
- Nationwide automatic determination of the general location of subscribers.
- Enhanced, high-speed one-way messaging services.

Mtel believes its development and integration of a number of highly advanced technologies to create this service warrants grant of a pioneer's preference under Section 1.402 of the Commission's Rules.

II. THE PROPOSED NWN SERVICE

The NWN system is designed to offer high speed, affordable digital data transfer capability to user terminals similar to laptop and notebook computers. The fundamental transmission service provided by NWN is relatively simple: electronic messages originating from a wide variety of public and private interfaces will be collected, categorized, and distributed to wide area transmitters using a combination of landline and satellite technology. These transmitters will simulcast data for reception by individual NWN terminals, wherever the terminal is located. NWN user terminals, in turn, will transmit acknowledgements verifying error-free receipt of packets, and, depending upon the terminal's capabilities, also will be able to initiate substantial terminal-to-base data transfers.

While the NWN offering is simple when viewed from the end user perspective, the engineering required to provide NWN on an affordable basis is quite complex and

involves the integration of a number of highly advanced technologies. The key to Mtel's NWN service offering is the marriage of high speed, spectrally efficient enhanced multitone modulation techniques with an "intelligent" infrastructure incorporating a large amount of computer processing. By placing the burden of arranging compact and efficient communications on a central scheduler, Mtel will be able to meet demand with far less spectrum than would be possible using existing systems, thus reducing costs for end-users.

Mtel's NWN service offering will operate as a simplex system using a single 50 kHz channel. The forward (base to user terminal) and reverse (user terminal to base) transmissions will share the channel using a dynamic time division scheme to accommodate fluctuations in forward and reverse channel use. Both the forward and reverse channels in Mtel's system combine a number of advanced technologies to achieve synergy in operation. For forward channel transmissions, Mtel's innovative design includes:

- *Nationwide Simulcasting*. Simulcast operation will enhance coverage continuity and building penetration, as well as allowing low cost network growth.

- *Enhanced Multitone Modulation*. Enhanced multitone modulation techniques, particularly appropriate for simulcast systems, will allow transmission speeds of up to 24,000 bits per second ("bps") in a 50 kHz channel.

- *Adaptive Zoning*. NWN's architecture will provide automatic "follow me" delivery of messages to users changing zones, enhancing operational efficiency.

- *Variable Length Batching.* Forward communications will be organized in repeating cycles that are divided into dynamically adjusted address group time intervals, permitting efficient adaptation to variable load conditions.

Using enhanced multitone modulation, adaptive zoning, and variable length batching, NWN will be able to provide a high-speed, high-throughput simulcast network.

For reverse channel transmissions, Mtel's innovative design includes:

- *Multiple Receiver Load Balancing.* NWN's base station receiver network, by necessity, will be more extensive than the transmission network. The aggregated reverse channel capacity from all NWN receivers thus will be greater than forward channel capacity, permitting lower reverse channel bit rates, a simpler reverse channel modulation scheme, and less costly user terminals. The narrower bandwidth of the low powered signal of the terminals also will allow the signals to be "protected" within the 50 kHz channel. This will make for more robust reverse channel operation. To some extent, the reverse channel capacity also can be increased by deploying additional receivers.

- *Efficient Resource Allocation Protocol.* NWN proposes to employ a Contention Priority Oriented Demand Assignment ("CPODA") protocol to increase throughput by scheduling the great majority of reverse transmissions. Only a fraction of each reverse channel subcycle will be devoted to unsolicited transmissions that could limit spectrum efficiency because of "collisions" that would necessitate retransmissions.

- *Dynamic Scheduling.* Based on the known relative location of user terminals that have requested data transfers, network computers will dynamically schedule simultaneous responses to different receivers, achieving reliable, high throughput communication.

In conjunction, these technologies allow Mtel to deploy a base receiver network that efficiently accommodates a large number of users initiating short as well as extended digital terminal to base transfers.

Through an innovative combination of a number of advanced communications technologies, NWN can meet a substantial demand for digital two-way communications in a modest allocation. Mtel's ability to satisfy this demand is the result of three interrelated factors: precise system synchronization, nationwide operation, and extensive network computing power. Without precise synchronization, throughput would deteriorate, terminal battery life would decline, and reliability would be harmed by lost acknowledgments. Without nationwide operation, certainty of locating terminals would be lost and system synchronization would become haphazard. These two factors, when employed in a system that utilizes a high degree of computing power, produce a synergy in operation and permit a commercially feasible, singularly high throughput, two-way NWN offering.

III. A PIONEER'S PREFERENCE FOR MTEL IS WARRANTED BECAUSE THE NWN SERVICE IS A SUBSTANTIAL ENHANCEMENT OF EXISTING MESSAGING SERVICES

The Commission's *Pioneer Preference Order* provides guidelines and standards for grant of licensing preferences. In the order, the Commission indicated that it only would grant pioneer's preferences to applicants that have invested significant efforts to develop a new or enhanced service,[7] and stated:

> The Commission, in its discretion, will award a pioneer's preference to an entity that demonstrates that it . . . has

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[7] *Pioneer Preference Order*, 6 FCC Rcd at 3494 n.10.

> developed an innovative proposal that leads to the establishment of a service not currently provided or a substantial enhancement of an existing service. . .[8]

The Commission further elaborated upon this standard, stating:

> [W]e will consider the development of an innovative proposal to mean that the petitioner . . . has brought out the capabilities or possibilities of the technology or service or has brought them to a more advanced or effective state. Generally we believe that an innovation could be an added functionality, a different use of the spectrum than previously available, or a change in the operating or technical characteristics of a service, any of which involve a substantial change from that which existed prior to the time the preference is requested. Further, technologies that yield efficiencies in spectrum use, speed or quality of information transfer, or spectrum sharing, or which significantly reduce costs to the public, will be given careful consideration [for a pioneer's preference].[9]

As examples of a new or enhanced service, the Commission listed:

> [A]n added functionality provided to a broader group of customers than was previously available or a new technology that permits 1) increased ability to perform an existing work requirement; 2) increased capacity in an existing service; 3) a substantial cost reduction in an existing service; 4) improved quality of an existing service.[10]

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[8] *Pioneer Preference Order*, 6 FCC Rcd at 3494. Mtel, in fact, has attached to its *NWN Petition* extensive rule proposals for the NWN service.

[9] *Id.*

[10] *Id.*

Mtel believes that its efforts to engineer and develop the NWN service satisfy the Commission's criteria for award of a pioneer's preference. As shown below, Mtel's system integrates a number of advanced technologies in a unique and heretofore unknown fashion to achieve significant throughput gains while maintaining flexibility and graceful evolutionary capability.[11]

A. Mtel's Proposed NWN System Will Transfer More Data More Quickly to More Users than Existing Systems

Mtel believes that its proposal for the NWN service satisfies the Commission's *Pioneer Preference Order* criteria by substantially enhancing the state-of-the-art in messaging services.[12] NWN advances and brings to a more effective state the capabilities and possibilities of messaging as well as adding numerous functionalities to existing service concepts. NWN offers high-speed error-free data transfer capability to

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[11] Although Mtel is confident that its NWN service offering will operate substantially in accordance with the parameters described in the *NWN Petition*, there is no substitute for field experience in validating actual performance. *See Pioneer Preference Order*, 6 FCC Rcd at 3493. Consequently, Mtel concurrently is seeking an experimental license in the 930-931 MHz band to test aspects of its proposal in the Washington, D.C., and Dallas, Texas, metropolitan areas. Further technological development is to be conducted pursuant to an experimental authorization to be sought for Oxford, Mississippi. As shown in Mtel's experimental license application, Mtel intends to adhere to a schedule for testing that would fully validate all aspects of its proposal.

[12] Mtel also submits that its NWN service also is a substantial enhancement of the Advanced Messaging Service ("AMS") proposed by Telocator. *See Telocator Petition For Rulemaking to Amend Part 22 of the Commission's Rules Concerning the Use of 930-931 MHz for an Advanced Messaging Service*, Report No. 1836 (Feb. 7, 1991). Telocator's petition sets forth the generic need for additional messaging spectrum, listing in general terms potential services that could be made available if spectrum is allocated for new systems. Mtel's *NWN Petition*, in contrast, is a specific proposal detailing the rules and protocols necessary to implement a particular concept within the AMS framework.

and from user terminals. NWN also offers full two-way functionality, allowing user terminals to initiate substantial data transfers to the network. In this manner, aside from the individual technical innovations detailed below, NWN enhances the quality of communications that exist today, and warrants grant of a pioneer's preference.

Today's paging services are primitive when compared to NWN messaging. Paging systems, for example, are generally one-way services without receipt verification and do not permit the user to respond without resorting to alternative communications systems. NWN, since it is fully two-way, easily permits verification of message receipt using the built-in error detection protocol. Moreover, NWN allows a portable user terminal to initiate sophisticated return messages without moving to another location or interconnecting with another communications network. Even alphanumeric paging, today's state-of-the-art, typically limits messages to 80 characters. In comparison, NWN supports full document transfer, with average message lengths estimated at 3,000 characters.

At the same time, NWN brings these services to the consumer with a coverage area, convenience, and cost comparable to wide area paging systems. Due to the speed of the transmission network and Advanced Dynamic Frequency Management capacity enhancements, NWN will support over 600,000 users transmitting messages of approximately 3,000 characters on a 50 kHz channel, a spectral efficiency 0.36 bits per

Hertz.[13] In comparison, typical 1,200 bps alphanumeric paging systems limit messages to 80 characters and only have a spectral efficiency of one tenth that figure.[14] NWN's remarkable efficiency increases translate directly into a lower cost of service.

B. Mtel's Development of Enhanced Modulation Techniques Warrants Grant of a Pioneer's Preference

Mtel has developed highly advanced multitone modulation techniques permitting NWN to achieve bit rates up to 24,000 bps. Because the forward channel (base to user terminal) portion of the NWN network must carry extensive scheduling information in addition to outbound message traffic, the throughput of the forward channel simulcast transmission network is critical to the success of Mtel's NWN system. Mtel's initial calculations indicated that NWN would require data rates in excess of 4,800 bps, the rate typically regarded as the absolute ceiling for binary FSK simulcast systems.[15] Mtel believes that its breakthrough represents a significant advance in the state of simulcast technology and warrants a pioneer's preference.

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[13] This assumes a data rate of 18,000 bps. At 24,000 bps, the spectral efficiency would be 0.48 bits per Hertz.

[14] Spectral efficiency is a measure of the systems ability to transmit information in a specified bandwidth, as given by bit rate/bandwidth.

[15] As noted *supra* at note 6, Mtel has developed 2,400 bps paging technology. Currently, 1,200 bps is the highest speed deployed on a regular basis for paging. As discussed, *infra*, even the proposed European high speed paging system will operate at 6,250 bps using a sophisticated modulation scheme.

Until now, 4,800 bps was regarded as an absolute limit for binary FSK simulcast systems due to the destructive summing of "mis-synchronized" signals.[16] Practical data rates, however, have been much lower, effectively limited to 1,250 bps, because timing shifts in the delivery of the modulating waveform, transmitter jitter, and propagation anomalies have limited the baud interval to approximately 200 microseconds. For this reason, traditional simulcast messaging systems generally operate at speeds of 1,200 bps or less.

In order to derive additional throughput for the NWN simulcast system, Mtel intends to use enhanced multitone modulation techniques known as "orthogonal M-ary modulation." These techniques transmit symbols composed of multiple tones enabling a greater number of bits per baud and raising the bit rate despite the limit on baud rate.[17] Mtel will experiment with multitone on-off keying ("MOOK"), which would transmit eight bits per baud interval for an effective data rate up to 24,000 bps. Mtel also will experiment with a technique known as permutation frequency shift keying

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[16] "Mis-synchronization" of signals occurs when the waveforms are out of phase and cancel each other out. This situation occurs for a number of reasons, not all of which are under the control of the simulcast operator. Empirically, when mis-synchronization approaches 1/4 of a baud interval, successful demodulation becomes impossible. For a general discussion of synchronization and simulcast systems, see Appendix B to Mtel's *NWN Petition*.

[17] The baud rate is the rate at which individual symbols can be transmitted, and the bit rate is the overall throughput derived by decoding the symbols transmitted at that rate into a binary stream. Using advanced modulation techniques, it is possible to transmit a symbol in a baud interval that represents more than one bit, resulting in a data rate geometrically higher than the baud rate. Even with such advanced techniques, however, the European Radio Messaging System ("ERMES"), the fastest commercially contemplated simulcast system, transmits two bits per baud and a baud rate of 3,125 baud for an effective data rate of 6,250 bps.

("PFSK"), which would allow roughly 6.13 bits per baud interval for an effective data rate of approximately 18,000 bps.

Although these techniques have been explored on a theoretical basis,[18] Mtel does not know of any systems that use the sophisticated modulation methods contemplated for the NWN system. Consequently, Mtel has invested considerable time and resources in examination of MOOK and PFSK in a 50 kHz channel. For example, Paging Systems, Ltd., an English subsidiary of Mtel, has performed extensive computer modeling and research on high speed exciters and timing jitter. In addition, Mtel has been required to research a number of associated problems with the filters and other components necessary to implement a high power, linearly amplified multitone transmitter.

Mtel believes that its development efforts and use of innovative, enhanced multitone techniques warrant grant of a pioneer's preference. Use of enhanced multitone techniques will "yield efficiencies in spectrum use [and] speed . . . [as well as] significantly reduce costs to the public."[19] Further, these techniques provide "increased ability to perform an existing work requirement," "increased capacity in an

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[18] Although Mtel has developed a number of novel innovations for the NWN service, some of these innovations rely on theoretical and experimental bases established by others in the field. The Commission, however, has stated that integration of known technologies also warrants preferences: "it is not necessary that every aspect of the innovation be developed by the person seeking the preference." *Pioneer Preference Order*, 6 FCC Rcd at 3494 n.10.

[19] *Pioneer Preference Order*, 6 FCC Rcd at 3494.

existing service," and "a significant cost reduction in an existing service."[20] Accordingly, Mtel warrants a licensing preference for the NWN service.

C. Mtel's Innovative Advanced Dynamic Frequency Management Scheme Warrants Grant of a Pioneer's Preference

In order to maximize flexibility, permit graceful expansion, and increase spectral efficiency, Mtel has integrated a number of innovative techniques into a comprehensive advanced dynamic frequency management program ("ADFM"). ADFM relies upon precise system synchronization and extensive internal computing power to control tightly all transmissions. As shown below, Mtel effectively has increased the burden upon its network computers and the telecommunications infrastructure underlying the NWN system to improve efficiency and create a system that is responsive to temporary loading variations as well as long term growth needs.

1. Forward Channel Capacity Re-Use

Mtel's forward channel re-use technique does not lower overall throughput by using only a fraction of the bandwidth or time available for transmission, unlike most re-use protocols that require frequency or time division multiple access schemes. Mtel's adaptive zoning scheme permits virtually full capacity re-use for zones throughout the U.S. Forward transmissions are divided into nationwide or zonal time

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[20] *Id.*

slots. Although nationwide transmissions occur at the same time across the country, zonal slots will contain different data. As the amount of zonal traffic in a particular zone begins to saturate the number of available zone time slots, the zone can be broken out into additional zones to divide the traffic and permit graceful, low cost evolutionary growth.

In order to effectuate the forward channel re-use scheme, Mtel will place an enormous burden on its network computers to update continually the location of user terminal units. Unlike many location tracking schemes, however, Mtel does not intend to poll user terminals for location information or require user terminals to identify zone changes and "register," since these methods generate messages that do not carry otherwise useful information. Rather, Mtel's scheme relies upon the acknowledgements that user terminals generate to correct errors and to verify receipt of message data. If a portable unit does not acknowledge a message packet sent in a zone time slot because the user has moved, the packet is retransmitted using a nationwide time slot, a packet to which the user terminal will respond regardless of location. Based on this response, network computers will update the location of the user terminal and further packets will be transmitted in zone time slots in the user terminal's new zone.

2. Reverse Channel Capacity Re-Use

ADFM also incorporates an innovative dynamic scheduling system that takes advantage of the more extensive reverse channel network to allow significant capacity re-use for user terminal to base transmissions. Due to the lower power of portable user terminals in relation to the base transmitters, the base receiver network must be denser than the base transmitter network; *i.e.*, more base receivers than base transmitters are required to provide adequate service to a given area. Because there are only a limited number of base receivers capable of receiving a particular user terminal, it is theoretically possible to divide the aggregate reverse channel load among the receivers in the base network.

Mtel has developed a technique to deaggregate reverse channel load employing a computer processing system that logically associates a user terminal with all base receivers that captured the user terminal's signal. Deaggregating reverse channel capacity using this system is complex, however, and requires a network capable of determining which user terminals are within the service area of each individual receiver and using that information is used to schedule reverse channel capacity. In Mtel's system, as reverse channel capacity is scheduled, the network will allot time only on the subset of receivers associated with a particular terminal, allowing other user terminals to transmit to the remaining receivers during the same time interval.

3. Reverse Channel CPODA Scheduling

ADFM also incorporates innovations in the reverse channel network to maximize spectral efficiency through extensive use of scheduling. Mtel will accomplish this by scheduling reverse channel transmissions using a Contention Priority Ordered Demand Assignment ("CPODA") algorithm. Effective CPODA scheduling, however, requires the network to maintain tight control over access to all system resources. In Mtel's NWN system, this control is established by internalizing a high degree of computing power in the network and synchronizing all network transmitters to a global clock.

In Mtel's CPODA scheme, user terminals desiring to initiate a data transfer must wait for predefined "contention intervals" before requesting reverse channel time slots, the resource in contention. Upon receiving such a request, the network will schedule the necessary space on the reverse channel for the terminal initiated transfer. Thus, all transmissions -- other than the initiating request -- are scheduled. Because the request for reverse capacity is brief, the contention interval can be very short relative to the total amount of reverse channel time available, maximizing reverse channel throughput.

4. Mtel's Advanced Dynamic Frequency Management Scheme Significantly Advances the Current State-of-the-Art

Mtel believes that its comprehensive scheme for managing the limited spectrum requested for NWN warrants a pioneer's preference. Not only does ADFM incorporate a number of individual technical advances, the scheme as a whole operates in a synergistic fashion to increase system flexibility and spectrum efficiency by incorporating a high degree of intelligence in the infrastructure. Essentially, NWN is required to track and process a great deal of information to reduce uncertainty in the transmission portion of the network. In this fashion, Mtel's frequency management methods yield efficiencies and significantly reduce costs to consumers by allowing a single 50 kHz channel to accommodate a large number of users. As the Commission noted, such advances should be given careful consideration for pioneer's preferences.[21]

ADFM also has numerous benefits apart from pure spectrum efficiency. NWN's intelligent infrastructure, for example, allows the network to adapt to variations in loading conditions by adjusting the amount of time allocated for forward and reverse channel operation; by varying the forward channel time associated with various user terminal groups; and dynamically altering the number of reverse channel time slots allocated for particular user terminal units to ensure long messages do not affect system

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[21] *See Pioneer's Preference Order*, 6 FCC Rcd at 3494.