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

FCC 93-329

In the Matter of) GEN Docket No. 90-314
) ET Docket No. 92-100
Amendment of the Commission's) RM-7617, RM-7760, RM-7782,
Rules to Establish New) RM-7860, RM-7977, RM-7978,
Narrowband Personal) RM-7979, RM-7980, PP-4, PP-5,
Communications Services) PP-11, PP-14, PP-35 through
) PP-40, PP-53, PP-69, PP-79
) through PP-85

First Report and Order

Adopted: June 24, 1993 ; Released: July 23, 1993

By the Commission: Commissioner Barrett issuing a statement.

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INTRODUCTION

1. By this action, the Commission provides for operation of new, narrowband personal communications services (PCS) on spectrum in the 900 MHz band.¹ Such new services are expected to include advanced voice paging, two-way acknowledgement paging, data messaging, and both one-way and two-way messaging and facsimile. The regulatory plan we are adopting for narrowband PCS includes an allocation of spectrum, a flexible regulatory structure, and technical and operational rules. Issues regarding licensee selection procedures and the regulatory status of the service are the subject of legislation actively being considered by the Congress and will be addressed by the Commission in a further action. The narrowband PCS services authorized under these rules are expected to increase the productivity of businesses, result in significant opportunities for small business participation, make available to the public new services to enhance their communications, and assist American industry to maintain its leadership position in the global telecommunications marketplace.

BACKGROUND

2. The Commission initiated the PCS proceeding with a Notice of Inquiry in 1990.² The Commission subsequently issued a Policy Statement on PCS and has held an en banc hearing to address the issues raised in this proceeding.³

3. On July 16, 1992, the Commission adopted a Notice of Proposed Rule Making and Tentative Decision (Notice) in which it addressed both narrowband PCS services at 900 MHz and PCS at

¹ This proceeding also addresses PCS operations at 2 GHz. Since many of the technical and regulatory issues involved in narrowband PCS are different from PCS at 2 GHz, and in view of the fact that the spectrum proposed for narrowband PCS services is free of incumbent licensees and the matters associated with such incumbent users, we are addressing narrowband PCS at 900 MHz separately from PCS at 2 GHz. We will address PCS at 2 GHz in the near future. Because of the differences, we note that the issues and decisions herein, for example those on licensee eligibility and service area, are not intended to signal, and will not necessarily be reflected in, our decisions on 2 GHz PCS.

² See Notice of Inquiry, GEN Docket No. 90-314, 5 FCC Rcd 3995 (1990).

³ See Policy Statement and Order, GEN Docket No. 90-314, 6 FCC Rcd 6601 (1991). An en banc hearing on PCS was held on December 5, 1991.

2 GHz.⁴ In the Notice, the Commission enumerated the following four goals: 1) universality of service availability; 2) speed of deployment; 3) diversity of services; and 4) competitive delivery. It stated that these four goals should be optimized and balanced in providing spectrum and a regulatory structure for PCS.⁵ The Commission noted that the 900 MHz proposals include a variety of narrowband PCS services such as advanced paging, messaging, and advanced cordless telephones. These services include one-way systems with relatively low power transmissions from a subscriber to a base station, one-way systems with relatively high power transmissions from a base station to a subscriber, and one-way services that include facsimile, graphics and other imaging services. Also proposed are two-way services that would provide subscribers with more diverse messaging than is currently available, including for example, tracking and acknowledgement. In addition, two-way advanced cordless telephone services were proposed.

4. In view of the wide diversity of proposed services, the Commission proposed to define PCS broadly. Specifically, the Commission proposed to define PCS as a family of mobile or portable radio services which could provide services to individuals and business, and be integrated with a variety of competing networks. An allocation of spectrum for narrowband PCS was proposed at 901-902, 930-931 and 940-941 MHz. Comment also was requested on various combinations of four licensed service area options: 1) 487 Basic Trading Areas (BTAs); 2) 47 Major Trading Areas (MTAs); 3) 194 Local Access and Transport Areas (LATAs); and, 4) nationwide.

⁴ See Notice of Proposed Rule Making and Tentative Decision, GEN Docket No. 90-314 and ET Docket No. 92-100, 7 FCC Rcd 5676 (1992); Erratum, 7 FCC Rcd 5779 (1992). The narrowband aspects of the Notice were in response to ten petitions for rule making that requested allocation of spectrum for new paging and messaging services. The petitions were filed by: 1) Telocator on January 23, 1991 (RM-7617); 2) Montauk Telecommunications Company (Montauk) on June 6, 1991 (RM-7760); 3) Echo Group L.P. (Echo) on July 30, 1991 (RM-7782); 4) PacTel Paging (PacTel) on August 2, 1991 (advanced architecture paging, RM-7979); 5) Dial Page, L.P. (Dial Page) on October 11, 1991 (RM-7977); 6) PacTel on October 15, 1991 (ground-to-air paging, RM-7860); 7) Mobile Telecommunication Technologies Corporation (Mtel) on November 12, 1991 (RM-7978); 8) PageMart, Inc. (PageMart) on March 3, 1992 (RM-7980); 9) Skycell Corporation (Skycell) on May 29, 1992; and, 10) Paging Network, Inc. (PageNet) on June 1, 1992.

⁵ See Notice, supra, at para. 6.

5. The Notice included proposals for technical requirements, such as emission limits and frequency stability. The item proposed to pair blocks of spectrum from the 901-902 and 940-941 MHz bands and to provide for unpaired use in the 930-931 MHz band. Comment was sought on three alternative channeling plans providing both paired and unpaired channels and on the amount of spectrum that should be provided for each configuration.

6. In the tentative decision portion of the Notice, the Commission proposed to award a pioneer's preference to Mtel for development of innovative new technology that will increase spectrum efficiency.⁶ This tentative decision was based on Mtel's having developed and tested "Multi-Carrier Modulation" technology that is capable of transmitting a 24 kbps nationwide simulcast signal in a single 50 kHz channel and designing a complete advanced messaging system based upon this efficient technology.

DISCUSSION

Service Definition and Spectrum Matters

7. Narrowband PCS Demand. In the Notice, the Commission recognized the increasing demand for PCS services, including those narrowband PCS services that can be reasonably and efficiently provided using spectrum available at 900 MHz. In response to the Notice, the commenting parties confirm this demand for narrowband PCS. Several commenters also submitted a number of market projections indicating substantial demand for narrowband PCS services. Specifically, Arthur D. Little, Inc. (Arthur D. Little) estimates future demand for enhanced paging/messaging services would be 15 million units in 1995, 17.5 million units in 1998, and 21.3 million units in 2002.⁷ Telocator states that the 1991 market for paging services is 11.2 million subscribers (4.5% penetration of total market) and forecasts that the market for paging and advanced paging services will grow to 16.7 million subscribers in 1997 (6.3% penetration) and 22.99 million subscribers (8.13% penetration) in 2002, if licensing is complete in 1994. Similarly, PageNet states that advanced voice paging, its proposed narrowband PCS service, has an immediate consumer demand of at least 18 million people nationwide. Another paging concern, Dial Page states that four million current paging users and an additional four million new paging users would subscribe to a type of narrowband PCS it

⁶ See Notice at paras. 149-151.

⁷ Arthur D. Little's filing to December 5, 1991 en banc hearing on PCS at 17, GEN Docket No. 90-314.

refers to as Acknowledgement Paging (AP). Mtel submits another Arthur D. Little study concluding that demand for its nationwide wireless network (NWN) approaches one million subscribers that would increase to nearly ten million after ten years of service, assuming service in 300 markets.⁸

8. Based on the record in this proceeding, we continue to believe that there is a significant and growing demand for narrowband PCS services. We find that the establishment of narrowband PCS is warranted and that the public interest would be served through the provision of new and innovative narrowband PCS services to meet consumers' demands and needs for mobile and portable communications services.

9. Narrowband PCS Service Definition. In the Notice, we proposed to define PCS broadly as a family of mobile and portable radio communications services which could provide services to individuals and business, and be integrated with a variety of competing networks. We proposed that broadcasting⁹ be excluded from PCS spectrum and that fixed services generally be permitted only if reasonably ancillary to mobile PCS services.

10. Commenting parties interested in providing services in the 900 MHz range provided a number of examples of services that fit within this definition. The most commonly cited services are advanced paging and messaging services. Both of these services go beyond simply alerting the subscriber that a call or message is waiting, and allow the subscriber to respond and interact with the page or message. Motorola Inc. (Motorola) states that advanced messaging services are a major subgroup of narrowband services and will permit the provision of services such as electronic mail (E-mail) and the transmission of voice messages and graphic images.¹⁰ PacTel states that full two-way services

⁸ Mtel Reply, Tab 2, Arthur D. Little's "Quantitative Demand Assessment for NWN Services" at 9.

⁹ As broadcasting is defined at Section 3(o) of the Communications Act of 1934, as amended, 47 U.S.C. § 153(o).

¹⁰ Motorola envisions that in advanced messaging service, an outbound message to an individual involves five actions: 1) simulcast address; 2) unit acknowledges address with no frequency re-use; 3) message transmitted in local area with re-use; 4) unit acknowledges message data with re-use; and 5) steps 3 and 4 repeated if necessary due to errors. Likewise the inbound message initiated by an individual requires 5 actions: 1) inbound channel request with re-use; 2) outbound grant/assignment with re-use; 3) inbound message transmission; 4) outbound confirmation with re-use; and 5) 3 and 4 repeated if necessary due to errors. See Motorola Ex Parte Filing of October 6, 1992.

(such as two-way data) and limited two-way data (such as acknowledgement paging) should be provided for within the narrowband PCS concept and that a variety of advanced messaging services can be offered in 25 kHz channels. American Paging, Inc. (American Paging) discusses one and two-way messaging communications to deliver enhanced character sets, high/low resolution graphics, video, E-mail, facsimile, digitized voice, and a range of data products.¹¹ PageNet agrees that narrowband PCS should be defined as mobile or portable paging services including, but not limited to, data, advanced paging and messaging services.

11. Many parties argue that narrowband PCS should be restricted to some type of advanced paging or messaging, or that some type of limitation of use be imposed. A number of parties argue that due to the limited amount of spectrum available, narrowband 900 MHz PCS services should be more limited than broadly-defined PCS at higher frequencies. American Paging proposes that two-way voice communications such as advanced cordless telephone operations be prohibited. Motorola proposes that the entire allocation be dedicated exclusively for new advanced messaging and data services. Utilities Telecommunications Council (UTC) requests that some 900 MHz spectrum be allocated exclusively for non-commercial, internal use by traditional private radio eligibles. Grand Broadcasting Corporation (Grand Broadcasting) proposes that one megahertz be allocated solely for a mobile interactive broadcast radio service (IBRS). In-Flight Phone Corporation (In-Flight) requests that at least one nationwide 500 kHz block be allocated solely for audio broadcast retransmissions to airline passengers. Corporate Technology Partners (CTP) requests that 100 kHz control channels be allocated in the 930-931 and 940-941 MHz bands so that its Personal Communications Interface (PCI) can share frequencies between 930-960 MHz on a secondary basis, which would allow PCI/CT2 Plus roaming between the United States and Canada. Finally, American Petroleum Institute (API) proposes that 375 kHz be dedicated for emergency response communications for industrial/land transportation eligibles.

12. In reply comments, Motorola opposes the limitations proposed by CTP, In-Flight, and API. Motorola argues that the spectrum requirements of CTP's CT-2 services are significantly greater than other narrowband services and, consequently, that those services would be more appropriate in higher bands; that In-Flight's service is more similar to broadcast than personal messaging and would consume too much spectrum for each provider; and that API's proposal constitutes a conventional land mobile radio service already authorized in other spectrum. PageNet also opposes CTP, In-Flight and API's proposals, arguing that the

¹¹ See American Paging at 3.

allocation should be limited to advanced paging. Telocator agrees, stating that the spectrum should be used only for advanced messaging type services, and not for the uses suggested by API, CTP, and In-Flight. Telocator also opposes UTC's proposal to reserve a third of the allocation for non-commercial internal use by traditional private radio eligibles.

13. We continue to believe that a broad definition of PCS is warranted. We find that our concept of PCS as family of services is appropriate and will permit PCS to encompass a wide array of mobile, portable and ancillary communication services to individuals and businesses, and be integrated with a variety of competing networks. We find that narrowband PCS is an important first member of the PCS service family, and are adopting the rules proposed in the Notice for the definition of PCS and for permissible communications with minor editorial changes. We decline to adopt the suggestions of some commenters to limit narrowband PCS to advanced paging and messaging services. While we anticipate, given the stated interest in such services, that advanced messaging and paging services will be one of the predominant narrowband PCS services to be provided, at the same time, we do not wish to foreclose other potential narrowband services.

14. Further, we decline to allocate spectrum specifically for an advanced cordless telephone service, inasmuch as already we have permitted cordless telephones to operate in a number of frequency bands, including 902-928 MHz,¹² and have under consideration a petition for additional frequencies in a different band.¹³ Additionally, no set-aside for non-commercial use by traditional private radio eligibles, as proposed by UTC, will be made because we are not convinced that spectrum currently allocated for such private land mobile services is inadequate and because, in general, the services suggested by UTC appear to be within the definition of narrowband PCS and permissible in this spectrum. As there is no petition for rule making before us requesting that spectrum sharing in the 930-960 MHz band be permitted, we will not reserve spectrum for control channels in the narrowband PCS spectrum. Finally, we are adopting the restriction that the spectrum allocated for narrowband PCS not be used for broadcasting.

¹² See 47 C.F.R. §§ 15.233, 15.247, and 15.249.

¹³ See Petition for Rule Making filed by the Telecommunications Industry Association on August 20, 1992, RM-8094.

15. Spectrum Allocation/Channelization Plan. In the Notice we proposed to allocate 3 megahertz of spectrum at 901-902, 930-931, and 940-941 MHz to narrowband PCS. Specifically, we proposed to pair blocks of spectrum from the 901-902 and 940-941 MHz bands, and to provide for unpaired use in the 930-931 MHz band. Three alternative channelization plans were presented: twenty 50 kHz symmetrically paired blocks and twenty 50 kHz unpaired blocks; four 250 kHz symmetrically paired blocks and four 250 kHz unpaired blocks; and two 500 kHz symmetrically paired blocks and a 1 MHz unpaired block. Comment was requested on our proposals to provide both paired and unpaired spectrum and on the amount of spectrum that should be provided for each configuration.

16. There was no clear consensus on channelization. Although most commenters believe that the majority of channels should have bandwidths of 50 kHz or less, a number of commenters suggest that the channeling plan for narrowband PCS should accommodate both paired and unpaired operation and a number of varying channel bandwidths. There was general agreement among the commenters, however, that the 901-902 MHz band should be used for low power "talk-in" (mobile-to-base) operations.¹⁴ Motorola, for example, states that commenters have recognized the potential engineering and cost benefits of reserving the 901-902 MHz band exclusively for low power talk-in channels. Additionally, many of the parties support providing for some asymmetrically paired blocks (a mobile-to-base block of smaller bandwidth than the base-to-mobile block). These parties state that asymmetrical channeling is spectrally efficient since the response requirement uses less bandwidth than that needed for the message being communicated.

17. American Paging, Arch Communications Group, Inc. (Arch), The Ericsson Corporation (Ericsson), and Mtel support channel bandwidths of 50 kHz or less. Mtel states that no proven efficiencies would result from specifying blocks larger than 50 kHz, and that creating larger channel blocks would restrict entry opportunities and limit competition and diversity. PacTel states that large channel blocks such as 200 kHz are unnecessary and would result in "warehousing" of spectrum by applicants that can provide their service with less.

18. PageMart, PacTel, and Motorola each propose alternate channeling plans. Each of these plans would limit the 901-902 MHz band to low power transmissions and would provide for both

¹⁴ Parties generally pointed out that both the 930-931 and 940-941 MHz bands are adjacent to high power operations that would make such a low power "talk-back" operation more difficult. See, for example, Motorola at 19; PacTel Paging Reply at 10; PageMart Reply at 18.

symmetrical and asymmetrical channel pairings. All of the proposed channeling plans include some unpaired channels in 901-902 MHz to provide low-power response capability for existing paging licensees. In particular, PageMart proposes: five 200 kHz blocks, each associated with two 25 kHz blocks; five 25 kHz symmetrically paired blocks; ten 25 kHz blocks paired with 12.5 kHz blocks; ten 50 kHz unpaired blocks; and fifty 12.5 kHz unpaired blocks. PacTel proposes five 100 kHz symmetrically paired blocks; twenty-two 20 kHz blocks paired with ten 100 kHz blocks, eight 50 kHz blocks, and four 25 kHz blocks; and three 20 kHz unpaired blocks. Motorola proposes three 150 kHz symmetrically paired blocks; thirty-one 50 kHz blocks paired with 12.5 kHz blocks; and thirteen 12.5 kHz unpaired blocks for use by existing paging providers. Additionally, Motorola suggests that we allow licensees the flexibility to combine or split channels as long as they stay within their authorized spectrum.

19. We believe that the channelization plan for narrowband PCS should provide a flexible framework that will foster our goals of universality, speed of deployment, diversity of services and competitive delivery. Potential PCS providers propose a diverse range of services with varying channel bandwidth requirements. We find that a mix of paired, unpaired and varying bandwidths will provide the most flexible solution for meeting the stated needs of narrowband PCS providers. At the same time, we have reconsidered our original proposal to channelize and license the entire 3 MHz of available 900 MHz spectrum at this time. We now believe that less spectrum is sufficient to support the narrowband PCS proposals before us. Further, given the diversity in channel bandwidths and other operational considerations associated with these proposals, this approach will allow us to respond to growth and development of specific narrowband PCS services as well as potential new future services. In view of the above considerations, we are allocating the 901-902, 930-931 and 940-941 MHz bands to narrowband PCS. However, at this time we will only channelize and license two of the three megahertz of spectrum we are making available for 900 MHz PCS use. We believe this will provide an adequate amount of spectrum for the initiation of narrowband PCS and allow us flexibility in the future to channelize and license the remaining one megahertz of spectrum as this service develops.

20. Based on the record, it appears that most proposed narrowband services can be accommodated within a 50 kHz channelization plan. It also appears that the vast majority of narrowband PCS services propose low-power return path response capability. In this regard, we agree with the commenting parties that the 901-902 MHz band is particularly suited to use for low-power operations and that asymmetrical channel bandwidth pairings should be used to promote spectrum efficiency. As noted by Motorola and others, the communications requirements of response operations are substantially less than those of base-to-mobile

operations. Therefore, our channelization plan will provide twelve 50 kHz channels in the 930-931 MHz band asymmetrically paired with twelve 12.5 kHz channels in the 901-902 MHz band. We also concur with those commenters that suggest that some response channels be provided for use by existing licensees. This will permit existing paging operations to be upgraded and provide some acknowledgement and messaging capability. We will therefore provide eight 12.5 kHz channels for use by existing common carrier and private paging licensees. To accommodate unpaired 50 kHz operations, we are providing five unpaired channels. To accommodate uses that require symmetrical pairings, we are providing nine 50 kHz channel pairs (i.e., 50 kHz paired with 50 kHz).

21. Finally, we will permit the aggregation of channels in any of the paired or unpaired channel groups (e.g., up to 150 kHz paired with 150 kHz) to accommodate the wider bandwidth services. We believe that such an aggregation approach will permit the wider bandwidth proposals suggested by PacTel and Motorola, yet ensure that the spectrum resource is used in an efficient manner.¹⁵ Further, our technical rules will permit sufficient flexibility for licensees to use different modulations and other technical characteristics as suggested by Motorola.

22. Licensed Service Areas. In the Notice, the Commission stated that large regional or nationwide licensed service areas would provide for flexibility in the design and implementation of 900 MHz narrowband PCS systems.¹⁶ The Commission also noted that 900 MHz petitioners generally proposed either regional or nationwide services. The Commission tentatively concluded that PCS licensed service areas should be larger than those initially licensed in cellular; and requested comment on four options: 1) 487 BTAs plus Puerto Rico;¹⁷ 2) 47 MTAs with Alaska separated

¹⁵ We expect that under this approach PCS service providers will aggregate only the number of channels necessary to provide the quality and level of service desired. Accordingly, if service providers require 100 kHz channels for data but only 25 kHz for response they could aggregate two 50/12.5 kHz channels. If they require 150 kHz for data and response, they would be able to aggregate up to three 50 kHz symmetrically paired channels.

¹⁶ See Notice at para. 62.

¹⁷ A Basic Trading Center is defined in the Rand McNally 1992 Commercial Atlas & Marketing Guide, 123rd Edition, pp. 36-39 as a city which serves as a center for shopping goods purchases for the surrounding area. Shopping goods are those retail items a shopper ordinarily travels some distance to purchase and for which he or she compares qualities, styles and prices before buying. Most sales of shopping goods are made through general

from the Seattle MTA, plus Puerto Rico;¹⁸ 3) 194 LATAs; and 4) nationwide.

23. Most of the commenting parties support a combination of nationwide and regional licensed service areas for narrowband 900 MHz PCS services. For example, Arch and Motorola argue that some spectrum should be allocated to nationwide service. Echo states that the economies of scale available to nationwide licensees would translate into better and lower cost service to subscribers. PageNet states that at least some, if not all, licenses should be granted on a nationwide basis since it is doubtful that smaller carriers would be able to satisfy demand for service quickly and efficiently because of the difficulties inherent in aggregation. Mtel suggests allocating three nationwide spectrum blocks. Telocator also supports both nationwide and large regional licensed service areas, and states that there is a clear consensus that exclusively local licenses are not needed for narrowband PCS. American Paging proposes that 25% of the spectrum be licensed on a nationwide basis. Ericsson proposes that channels be allocated on a 40% regional and 60% nationwide basis.

24. A number of commenters support establishment of large regions for narrowband PCS. Telocator, with support from Dial Page and others, suggests that we establish five large regions

merchandise or apparel stores. Basic Trading Centers also serve their surroundings with various specialized services, such as medical care, entertainment, higher education and a daily newspaper.

BTAs are an area surrounding at least one Basic Trading Center. Each BTA is named after one or more cities which are its Basic Trading Centers. All BTA boundaries follow county lines and are drawn to include the county or counties whose residents make up the bulk of their shopping purchases in the area's Basic Trading Center or its suburbs. Some BTAs have 2 or more Basic Trading Centers, generally because residents may conveniently shop at either one.

¹⁸ A Major Trading Center is a city within a MTA that serves as one of the trading area's primary centers of wholesaling, distribution, banking, and specialized services such as advertising.

A MTA is an area consisting of 2 or more BTAs. A MTA's boundaries follow the boundaries of its BTAs. Each MTA is named after one or more cities which are its Major Trading Centers. See Rand McNally 1992 Commercial Atlas & Marketing Guide, 123rd Edition, pp.36-39.

for narrowband 900 MHz PCS service.¹⁹ Telocator argues that the traditional paging market is increasingly regional, national and even international in service coverage and that economic efficiencies in wireless messaging dictate nationwide and regional licensed service areas. It also states that larger licensed service areas are needed in order to achieve economies of scale necessary for development of low cost personal receivers. Telocator further submits that many paging providers have concluded that the economic viability of narrowband services in smaller licensed service areas is doubtful. Southwestern Bell Corporation suggests that there be nine to ten regions for narrowband PCS. The Small Business Administration proposes that the 47 MTAs be used as the basis for defining narrowband PCS licensed service areas. UTC suggests that we use either the 47 MTAs or the 194 LATAs.

25. Other parties support the provision of smaller licensing areas for narrowband PCS. Celpage, Inc. (Celpage) states that paging is essentially a local service and that there is no justifiable basis for designating only region-wide or nationwide service. Celpage and others, such as Freeman Engineering Associates, Inc. (Freeman), favor using the cellular metropolitan statistical area and rural service area (MSA/RSA) model for narrowband PCS licensed service areas. NYNEX Corporation also requests that we reconsider using cellular licensed service areas because MSAs/RSAs would allow the prospective PCS market to develop in a recognized cellular licensed service area and thus induce inter-service competition as well as intra-service competition, would help ensure more widespread deployment of PCS in both metropolitan and rural licensed service areas, and would be far easier to consolidate than to sell off portions of a larger licensed service area. CTP supports license areas that are based on the 194 telephone LATAs because it considers PCS as in part a wireless local loop service and feels that the strongest PCS network approach should match the local telephone system, which is on LATA basis.

26. While there appears to be interest in providing narrowband PCS services across a wide range of local, regional and national licensed service area sizes, the majority of the parties commenting on this issue favor large regional or nationwide licensed service areas. We concur with the commenting parties that large regional and nationwide licensed service areas would provide economies of scale, and should alleviate some of the problems licensees have experienced when they tried to aggregate smaller licensed service areas. As we noted above and in our original Notice, large regional and nationwide licensed service areas would provide for flexibility in the design and

¹⁹ PacTel Paging also suggests a plan for 5 large regions that is very similar to that proposed by Telocator.

implementation of narrowband PCS services. We also recognize that large regional and nationwide licensed service areas will further our goal of fostering the swift implementation and deployment of narrowband PCS services and systems. Accordingly, we are setting aside the majority of spectrum and channels for nationwide and large regional licensed service area use. For the regional licensed service area, we regard the 47 MTAs as a good compromise between the three to five large licensed service areas suggested by PacTel and Telocator, and the smaller areas suggested by other commenters for narrowband PCS. We find that the 47 MTAs would provide for more reasonable and homogeneous markets for the provision of PCS services. If larger licensed service areas are required for certain narrowband PCS services, nationwide PCS channels are available. In addition, aggregation of MTA licensed service areas will be permitted.

27. While the majority of the channels will be designated for nationwide and MTA use, we recognize that there are a variety of narrowband PCS services that could be offered at the local level. We believe that by providing channels at the local level,²⁰ we will foster broader participation in narrowband PCS, allow entry by smaller firms and businesses, increase competition and promote diversity in the provision of narrowband PCS services. Therefore, we will designate some channels for narrowband PCS use for the 487 BTAs. In addition, we are using BTAs for the licensed service area for the unpaired acknowledgement channels being provided for use by existing licensees. We conclude that this approach is appropriate given the limited number of channels and the fact that most existing paging is now licensed on a local basis.

28. As indicated above, the licensed service area and channeling plan we are establishing will accommodate operation of competitive PCS services at the nationwide, regional and local levels. The plan we are adopting is as follows:

²⁰ As suggested by NTIA, we also note that local participation in narrowband PCS could occur through franchising arrangements with nationwide and regional PCS licensees.

Licensed Service Area	Channels Available
Nationwide	3 - 50 kHz paired with 12.5 kHz 5 - 50 kHz paired with 50 kHz 3 - 50 kHz unpaired
Regional (47 MTAs, plus Alaska separate from the Seattle MTA; Puerto Rico and U.S. Virgin Islands; Guam and Northern Marianas; and American Samoa.)	7 - 50 kHz paired with 12.5 kHz 4 - 50 kHz paired with 50 kHz 2 - 50 kHz unpaired
Local (487 BTAs, plus American Samoa, Guam, Northern Marianas, Puerto Rico, and U.S. Virgin Islands)	2 - 50 kHz paired with 12.5 kHz 8 - 12.5 kHz unpaired for use by existing paging licensees

Licensing Issues

29. **Eligibility.** In the Notice we sought comment on whether there should be any eligibility restrictions for cellular and local exchange carriers (LECs) with regard to the provision of narrowband 900 MHz PCS services. We noted that unlike proposed PCS at 2 GHz, narrowband PCS is not likely to provide a competitive alternative to the existing wireline and cellular networks.

30. Most parties addressing this issue support allowing cellular entities and LECs to participate in the provision of narrowband PCS. Some parties do, however, suggest that certain restrictions be applied to participation by cellular carriers and LECs. Arch and Metrocall of Delaware, Inc. (Metrocall) suggest that cellular providers be allowed to participate in narrowband PCS, but only outside their existing licensed service areas. Similarly, Freeman and Metrocall support LEC participation, but only outside their landline service areas. Florida Cellular RSA Limited Partnership (Florida Cellular) proposes that LEC participation be allowed only through a separate subsidiary. UTC also suggests that some form of safeguards be imposed on LEC participation.

31. We conclude that it is appropriate to allow cellular entities and LECs to participate in the provision of narrowband PCS without restriction. The channeling and licensed service area plans we are adopting will ensure that there will be substantial competition among providers of narrowband PCS services. In addition, we believe that the nature of narrowband PCS is sufficiently different from that of the services provided by cellular systems and LECs that any ability they might have to exert undue market power or restrain trade will be negligible.

32. Limits on Holding Multiple Licenses. In the Notice, we requested comment on whether to permit licensees that may need more spectrum than is provided with a single license to acquire more than one license in the same market. Additionally, we presented alternative options that would place limits on holding multiple licenses: 1) limit operators to one license per market; 2) cap the total spectrum a licensee could acquire or use; or 3) decide license merger questions on a case-by-case basis.

33. Parties expressed general support for allowing individual parties to hold multiple licenses in the same market. American Paging proposes that a licensee be permitted to aggregate as many as five 50 kHz channels in each licensed service area. Celpage states that there should be no limit on licenses held per market because this would have anti-competitive implications and the marketplace and the financial wherewithal of the carriers will dictate how many carriers can compete effectively.

34. We conclude that some limits on the holding of multiple licenses are appropriate to ensure that narrowband PCS is offered on a competitive basis. At this time, as indicated above, we also want to provide opportunities for licensees to aggregate or combine channels to provide multiple offerings or wider bandwidth services. Therefore, we will permit a single licensee to hold licenses for up to three 50 kHz channels, paired or unpaired (*i.e.*, no more than 150 kHz paired with 150 kHz).²¹ This plan will allow PCS providers considerable flexibility to combine channels to accommodate specific service needs while also ensuring competition in the provision of services.

35. License Term. In the Notice, we proposed a ten-year license term for narrowband PCS with a renewal expectancy similar to that of cellular telephone service. We noted that without a relatively long license term and a high renewal expectancy, entrepreneurs might be reluctant to make investments in PCS. The commenting parties addressing this issue, which include Metrocall, Mtel and UTC, generally support our proposal for a ten-year license term. We continue to believe a ten-year license term is appropriate for narrowband PCS and will provide incentive for investment and rapid introduction of narrowband services. Accordingly, we are specifying a ten-year license term for

²¹ This limit is based on the total spectrum in the licensee's nationwide, regional, and local licenses at any geographic point. For example, a licensee could have one nationwide 50/50 kHz channel and two 50/12.5 kHz channels in the Atlanta MTA. The licensee would then be ineligible for another nationwide channel or a 50 kHz channel anywhere in the Atlanta MTA.

narrowband PCS. We will address PCS renewal issues at a future date.

36. Construction Requirements. Several commenting parties request that we adopt various schemes to ensure that service is promptly delivered to the public. Specifically, American Paging suggests that, in the absence of anti-trafficking requirements, the Commission adopt a five-year "fill-in" requirement comparable to current cellular policies to preclude "warehousing" of spectrum. NABER urges that we impose strict construction and operational standards with firm benchmarks as conditions for retaining a PCS authorization for the duration of the license term. Dial Page suggests that we require licensees to meet a construction schedule and a channel loading requirement. Freeman requests that specific time limits for construction be set and that if parties do not construct on time, that the construction permits be forfeited and the spectrum made available to other parties.

37. We believe that narrowband PCS will be a highly competitive service and that licensees will have incentive to construct facilities to meet the demand for service in their licensed service areas. While we do not believe that specific loading requirements are necessary, we find that narrowband PCS licensees should be required to meet certain minimum requirements for operation and service to ensure that spectrum is being effectively utilized. We therefore will require that narrowband PCS licensees meet the following construction requirements. Licensees of nationwide service area channels must construct at least 250 base stations within five years and 500 base stations in ten years.²² MTA licensees must provide coverage to approximately 25% of the geographic area of their MTA within five years and 50% of their licensed service area within ten years; or, alternatively, must construct at least 25 base stations within five years and 50 base stations within ten years. Licensees of BTA service area channels must construct at least

²² Our intention is to ensure that nationwide licensees provide service to a substantial portion of the country. The standards that we are adopting will require that nationwide licensees provide service to an area equivalent to about 20% of the geographic area of the continental United States. In evaluating licensee performance, we shall consider that each base station serves a geographic area of 3000 square kilometers (or a radius of approximately 32 kilometers). In cases where a licensee constructs lower-powered base stations that serve smaller areas, the licensee must aggregate those facilities to provide a service area equivalent to 3000 square kilometers. For purposes of complying with the construction requirements, we will consider such multiple facilities to be equivalent to a single base station.

one base station and begin providing service in their licensed service area within one year of being licensed. Failure by any licensee to meet the above construction requirements will result in forfeiture of the license and the licensee will be ineligible to regain it.

Small Business

38. Our regulatory structure, supra, provides significant opportunities for participation by small business entities. We are authorizing over 5,500 new licenses for national, regional and local narrowband PCS providers. The availability of these new licenses provide significant opportunities for small business participation through licensing at a local level and potential market opportunities with national and regional licensees. There also should be corollary opportunities for small businesses engaged in design and manufacturing associated with the new equipment and components necessary to implement these new services. In addition, we expect to address small business concerns in future proceedings when we consider details of the licensee selection process.

Technical Standards

39. In the Notice, we proposed a technical framework that would permit significant flexibility in the design and implementation of narrowband PCS systems, devices and services. The proposed antenna height, radiated power and out-of-band emission rules were intended as the minimum technical standards needed to limit interference both to the new services and to existing services.²³ The comments generally support our proposal to limit technical standards to those necessary to prevent interference.

40. Power and Antenna Height Limits. In the Notice, we proposed rules for power and antenna height that are similar to the existing technical standards for common carrier paging services contained in Part 22 of our rules.²⁴ We noted that services similar to those envisioned by the petitioners already

²³ Several parties in this proceeding draw attention to the need to develop a plan for allocating telephone numbering resources to new PCS services. We recognize the importance of numbering plan issues, including numbering plans applicable to PCS, and we intend to address these issues in a separate proceeding.

²⁴ The standards contained in Part 22 for common carrier paging services are similar to those in Part 90 governing private land mobile paging systems. See 47 C.F.R. Part 22, Subpart G and Part 90, Subpart P.

operate in segments of spectrum adjacent to each of the narrowband PCS bands and that many of the petitioners have stated that existing paging antenna height-power limits would be appropriate. We therefore proposed that nationwide narrowband PCS systems adhere to power limits identical to those of Section 22.505(c)(2) of our rules. This would limit nationwide paging to a maximum effective radiated power (e.r.p.) of 3500 watts, with no restrictions other than FAA limits on antenna height above average terrain. We proposed to subject regional narrowband PCS systems to an antenna height and power reduction table identical to that of Section 22.505(b). Additionally, we proposed that the minimum distance separation between regional base stations be 113 kilometers (70 miles). Finally, we proposed that the affected parties be allowed to negotiate alternative operating limits and agreements if the antenna height and power rules prove too restrictive.

41. Commenters agree that the antenna height and power rules should be based on the existing Part 22 paging standards.²⁵ However, Telocator requests that the rules proposed for nationwide licenses also be applied to regional licenses. Motorola also suggests that the power and height limits for nationwide and regional systems be the same and that the power limit be raised to 7 kilowatts (kW) e.r.p. per 50 kHz, as long as applicable emissions mask limits are met. Motorola argues that one of the major benefits of licensing large regional areas is allowing licensees to realize economies of scope in the provision of service over wide areas. Because the number of licensees operating on any particular channel would be limited, and thus coordination relatively simplified, Motorola believes nationwide paging power limits would not unduly complicate co-channel coordination and would have substantial wide area coverage cost benefits for regional systems.

42. In view of the fact that we are providing for large regional and local licensed service areas as well as nationwide licensed service areas, we are adopting 3.5 kW e.r.p. per authorized channel as the power limit for all narrowband PCS base stations. Additionally, all narrowband PCS base stations will be unlimited in antenna height except for those MTA and BTA base stations located close to a MTA or BTA border. We believe that these rules will allow all carriers to more quickly and economically cover their licensed service area and will generally provide comparable service to existing paging operations.

²⁵ We note that the height and power rules for the 931-932 MHz band has been proposed to be changed to 3.5 kW e.r.p. with no height restriction. See Notice of Proposed Rule Making and Order Granting Petition for Waiver, CC Docket No. 93-116, 8 FCC Rcd 2796 (1993).

43. For base stations located near a border, we are adopting the general approach proposed in the Notice in order to protect systems in adjacent MTAs and BTAs. Specifically, the antenna height and transmitter power of all regional and local base stations that are located between 200 kilometers (124 miles) and 80 kilometers (50 miles) from their licensed service area border are limited in accordance with the following table:

Antenna Height Above Average Terrain in meters (feet)	Effective Radiated Power (e.r.p.) (watts)
183 (600) and below.....	3500
183 (600) to 208 (682).....	3500 to 2584
208 (682) to 236 (775).....	2584 to 1883
236 (775) to 268 (880).....	1883 to 1372
268 (880) to 305 (1000).....	1372 to 1000
305 (1000) to 346 (1137).....	1000 to 729
346 (1137) to 394 (1292).....	729 to 531
394 (1292) to 447 (1468).....	531 to 387
447 (1468) to 508 (1668).....	387 to 282
508 (1668) to 578 (1895).....	282 to 206
578 (1895) to 656 (2154).....	206 to 150
656 (2154) to 746 (2447).....	150 to 109
746 (2447) to 848 (2781).....	109 to 80
848 (2781) to 963 (3160).....	80 to 58
963 (3160) to 1094 (3590).....	58 to 42
1094 (3590) to 1244 (4080).....	42 to 31
1244 (4080) to 1413 (4636).....	31 to 22
Above 1413 (4636).....	16

For heights between the values listed above, linear interpolation shall be used to determine maximum e.r.p.

44. We are extending the above table in order to allow operators to provide service in areas close to their licensed service area border. Specifically, regional and local base stations located less than 80 kilometers (50 miles) from their licensed service area border must limit their effective radiated power in accordance with the following formula:

$$P_w = 0.0175 \times d_{km}^{6.6666} \times h_m^{-3.1997}$$

P_w is effective radiated power in watts

d_{km} is distance in kilometers

h_m is antenna height above average terrain in meters

45. Furthermore, we will consider waivers to these rules on a case-by-case basis for licensees that believe additional power is required due to individual circumstances. Finally, in order to provide the flexibility needed to address particular operating circumstances, all PCS licensees are permitted to negotiate alternative operating limits and agreements with co-channel licensees in adjoining PCS licensed service areas if they so desire.

46. Mobile Power Limit. We proposed that mobile and portable stations be limited to a maximum of 7 watts e.r.p. We also proposed that mobile and portable transmitters have built-in the capability to automatically limit radiated power to the minimum necessary for successful communication with the associated base station. The comments generally support the proposed power limit; however, Mtel suggests that automatic power control would be extremely costly to implement and would have limited utility for decreasing interference. Based on the comments, we are adopting the proposed 7-watt e.r.p. power limit and are not requiring use of automatic power control.²⁶

47. Out-of-Band Emissions. In the Notice, we proposed to subject narrowband PCS systems to emission limits identical to those of existing Section 22.106(b)(4)²⁷ and that all operations be subject to provisions identical to Section 22.106(c) of our rules.²⁸ These existing rule sections apply to paging-type operations that employ digital modulation and bandwidths greater than 12.5 kHz. We requested that parties commenting on this issue take into account whether the licensed service area would be national, regional or local, the type of service offering, the method of communications (for example, simulcast microcellular) and the degree to which co- and adjacent channel or adjacent band services must be protected.

48. Mtel concurs that the proposed emission mask will sufficiently limit out-of-band power while permitting significant flexibility in system design and operation. UTC submits that narrowband PCS systems should be required to utilize adaptive power control and that the current out-of-band emission limits are not sufficiently stringent. Motorola states that the new spectrally efficient technologies fully utilize the available

²⁶ Motorola suggests that the rules should specify average power limits, and we are adopting Section 99.407(f) to clarify how the averaging is to be done.

²⁷ See 47 C.F.R. §22.106(b)(4); see also Section 99.411(a) of the attached Final Rules.

²⁸ See 47 C.F.R. § 22.106; see also Section 99.411(b) of the attached Final Rules.

bandwidth. Motorola suggests that the shape of the attenuation curve should be the same for any value of authorized bandwidth.

49. We agree with Motorola that the shape of the out-of-band attenuation curve should be the same for any value of authorized bandwidth and we are adopting its proposed changes to the out-of-band emission limits. Based on the channeling plan we are adopting above, the maximum authorized bandwidth of narrowband PCS channels will be 10 kHz for 12.5 kHz channels and 45 kHz for 50 kHz channels. In addition, if a licensee aggregates adjacent channels, we will permit a maximum authorized bandwidth of 5 kHz less than the total aggregated channel width.²⁹ On any frequency outside the authorized bandwidth, the signal level will have to be attenuated in accordance with the provisions shown in Section 99.411 of Appendix A. By adopting the more stringent out-of-band protection suggested by Motorola, the same adjacent channel interference protection will be provided to all narrowband PCS operations, independent of bandwidth.

50. Interoperability and Roaming. We proposed not to require inter-system operability among different licensees. Telocator and Metrocall agree that inter-operability and inter-system roaming should not be required. API states that it is of primary importance that each PCS system and equipment be compatible with other PCS systems.

51. We continue to believe that nationwide and regional licensing will permit wide area service capability. Consistent with our plan to provide narrowband PCS providers with broad discretion in the types of services they provide and the technologies used to provide those services, we believe that it is undesirable to require interoperability or inter-system roaming capability.

RF Radiation Limits

52. In the Notice, we noted that concern has been expressed over the potential for communications devices to create RF fields that may be harmful to human health. We requested comment on a number of issues relating to this matter. On March 11, 1993, we proposed to amend and update the guidelines we use for evaluating environmental radio-frequency (RF) radiation from FCC-regulated

²⁹ For example, an aggregated 25 kHz channel width results in a maximum authorized bandwidth of 20 kHz, an aggregated 100 kHz channel width results in a maximum authorized bandwidth of 95 kHz, and an aggregated 150 kHz channel width results in a maximum authorized bandwidth of 145 kHz.

transmitters.³⁰ The proposed guidelines are designated IEEE C95.1-1991 (IEEE guidelines)³¹ and differ from those they replace, the ANSI C95.1-1982 guidelines.³² For devices operating in the 300 kHz to 1 GHz frequency range, the 1982 ANSI guidelines categorically exclude radiators using input power of seven or less watts.³³ The new IEEE guidelines incorporate generally stricter criteria for hand-carried transmitters operating in the 450 MHz to 1.5 GHz range than the guidelines they replace.

53. Our record on this issue predates our March, 1993 proposal. API suggests that we obtain further data, including testing by federal agencies, and that we not authorize equipment that does not at least meet the current ANSI guidelines. CTP states that its units operate in the milliwatt range, and that the Commission should encourage use of devices with low RF radiation. Ericsson states that it has no information that suggests there is a demonstrated danger from RF from higher frequency digital transmissions, but that nevertheless, the Commission and industry should opt for low power PCS systems to reduce the hazards of RF energy. Motorola states that the permissible power levels associated with PCS radios should be based upon the uncontrolled environment, as defined in the new IEEE guidelines.³⁴ Additionally, Motorola suggests that there be no output power limits for base stations except where there is the possibility that people could come close to the base station antenna. In such cases, Motorola suggests that base station power be limited to that of mobiles.³⁵

54. Due to the important health issues raised by this subject, the fact that no general manufacture of narrowband PCS equipment has yet begun, and to provide for the expeditious initiation of narrowband PCS service, we believe it in the public

³⁰ See Notice of Proposed Rule Making, ET Docket No. 93-62, 8 FCC Rcd 2849 (1993).

³¹ Copies can be ordered from the Institute of Electrical and Electronics Engineers, Inc. (IEEE), 1-800-678-IEEE.

³² See 47 C.F.R. § 1.1307(b).

³³ In the domestic public cellular radio telecommunications service, mobiles are limited to 7 watts e.r.p. See 47 C.F.R. § 22.904.

³⁴ Motorola states that this limit would permit an output power of 0.67 watts for 900 MHz hand-carried transmitters, using a worst case frequency of 941 MHz.

³⁵ Motorola at 33.

interest to require PCS equipment manufacturers and licensees to comply with the IEEE C95.1-1991 guidelines pending completion of ET Docket No. 93-62.³⁶ For the purpose of type acceptance of narrowband PCS equipment we will require that all hand-held PCS devices comply with the IEEE specifications for "uncontrolled" environments.³⁷ Sample calculations are set forth at Appendix C.

PIONEER'S PREFERENCE

55. The Commission's pioneer's preference rules provide preferential treatment in its licensing processes to parties that demonstrate their responsibility for developing new communications services and technologies.³⁸ To be granted a pioneer's preference, an applicant must demonstrate that it "has developed an innovative proposal that leads to the establishment of a service not currently provided or an enhancement of an existing service."³⁹ Such an applicant will be placed on a

³⁶ Any rules adopted in this proceeding that do not conform with the final rules adopted later in ET Docket No. 93-62 will be modified accordingly.

³⁷ The IEEE guidelines specify two sets of exposure recommendations, one for "controlled" environments and the other for "uncontrolled" environments. Controlled environments are "locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where analysis shows the exposure levels may be above [the exposure and induced current levels permitted for the general public, but not those permitted for persons aware of the potential for exposure]." Uncontrolled environments are "locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or work places where there are no expectations that the exposure levels may exceed [the exposure and induced current levels permitted for the general public]."

³⁸ The pioneer's preference regulations are codified at 47 C.F.R. §§ 1.402, 1.403, 5.207 (1992). See Establishment of Procedures to Provide a Preference, Report and Order, 6 FCC Rcd 3488 (1991) (Pioneer's Preference Report and Order); recon. granted in part, Memorandum Opinion and Order, 7 FCC Rcd 1808 (1992) (Pioneer's Preference Recon. Order); further recon. denied, Memorandum Opinion and Order, 8 FCC Rcd 1659 (1993) (Pioneer's Preference Further Recon. Order).

³⁹ 47 C.F.R. § 1.402.

pioneer's preference track, not subject to competing applications, and if otherwise qualified will receive a license.⁴⁰ Other applicants will compete for remaining licenses in the normal licensing process. We awarded the first pioneer's preference to Volunteers in Technical Assistance (VITA) in the low-Earth orbit (LEO) mobile satellite service for its having developed and demonstrated the feasibility of using a LEO satellite system on VHF/UHF frequencies for civilian digital message communications purposes.⁴¹ In addition, in two other Tentative Decisions we have tentatively awarded four additional pioneer's preferences.⁴²

Grant of Pioneer's Preference

56. Grant of a pioneer's preference is based upon an innovative proposal. Our rules are intended to foster development of new services and improve existing services by reducing the delays and risks innovators otherwise would face with the Commission's licensing process. We noted in the Tentative Decision that the pioneer's preference rules have sparked substantial interest on the part of a wide variety of parties that we believe will lead to implementation of significant new services and technologies that benefit our nation.

57. In the Tentative Decision in ET Docket No. 92-100, we initially determined that Mtel, PP-37, should be granted a pioneer's preference for having developed and demonstrated the feasibility of significant innovations that will permit delivery of existing paging services and new advanced paging and messaging services in a spectrum-efficient manner. Specifically, Mtel improved by a factor of ten bit transmission rates for simulcast paging, developed the necessary technology, and designed an innovative proposal based upon these improved rates and technology that would result in more efficient delivery of current paging services and permit the provision of new messaging and related services.

⁴⁰ Id.; see also Pioneer's Preference Further Recon., 8 FCC Rcd at 1659.

⁴¹ See Report and Order, 8 FCC Rcd 1812 (1993).

⁴² See Tentative Decision and Memorandum Opinion and Order, 7 FCC Rcd 7794 (1992) (pioneer's preferences tentatively awarded to American Personal Communications, Cox Enterprises, and Omnipoint Communications in the 2 GHz PCS proceeding); Notice of Proposed Rule Making, Order, Tentative Decision and Order on Reconsideration, 8 FCC Rcd 557 (1993) (pioneer's preference tentatively awarded to Suite 12 Group in the 28 GHz local multi-point distribution service proceeding).

58. Mtel developed and tested "Multi-Carrier Modulation" (MCM) technology capable of transmitting a 24 kilobits per second (kbps) simulcast signal in a single 50 kHz channel. Mtel's system, by employing dynamic scheduling of the base and mobile transmissions, simulcast zoning, and user location registration, is capable of providing a broad range of two-way services in a single 50 kHz channel. By comparison, paging systems today transmit one-way messages at 2.4 kbps, one-tenth the bit rate of MCM technology. The 2.4 kbps rate employed by existing simulcast paging systems limits their service to short messages, but previously has been accepted as necessary for the mobile unit to correctly receive a message that is transmitted from different locations at the same time. Multiple carrier technology is not being used in simulcast messaging service today. Stacking multiple carriers in a channel to increase the data rate presents a number of technically difficult problems, including design of a small, inexpensive receiver capable of demodulating the more complex signal.

59. The more efficient technology developed by Mtel forms the technical foundation for its proposing to offer a variety of services in a system called "Nationwide Wireless Network" (NWN).⁴³ Mtel's proposed NWN is capable of offering consumers a broad range of two-way services in a single 50 kHz channel, such as advanced messaging with acknowledgement service in local areas or nationwide and a variety of information and messaging services, including transmission of text messages that are lengthy by paging standards. As explained by Mtel, it designed NWN to use terminals that will include a keyboard, display, and memory capable of being used for two-way transmissions of short or long data files and messages. In addition, the two-way capabilities will permit nationwide automatic determination of the general location of subscribers. Finally, Mtel proposes to deploy a base receiver network that efficiently accommodates a large number of users while permitting mobile units to transmit using low power.

60. Mtel's NWN is designed to provide frequency reuse and evolutionary deployment by subdividing the proposed network in an incremental fashion. NWN will register the location of its subscribers so that messages can be transmitted in the appropriate zone. This permits provision in each zone of different messages to different subscribers on the same

⁴³ The binary FSK modulation currently used by paging systems shifts the frequency of a sinusoidal carrier from one frequency (representing a binary 1) to another frequency (representing a binary 0) according to the baseband digital signal. Mtel proposes a multi-level FSK modulation (or Multi-Carrier Modulation) that would use multiple frequency shifts to increase the amount of information throughput.