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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

October 27, 1997

By Hand

Mr. Dan Phythyon
Chief, Wireless Telecommunications Bureau
Federal Communications Commission
Room 5000
2025 M Street, NW
Washington, DC 20554

Re: *Ex parte Presentation:*

Implementation of the Commission's Rules To Establish New Personal Communications Services, Narrowband PCS

General Docket No. 90-314
ET Docket No. 92-100
PP Docket No. 93-253

Dear Mr. Phythyon:

Pursuant to its previous commitments in this docket, enclosed please find a study commissioned by the Personal Communications Industry Association (PCIA) entitled "*An Analysis of the Narrowband PCS (NPCS) Market in the U.S.*" The study is being provided in conjunction with the referenced proceedings to give the Commission additional data with which to fashion future licensing rules for the NPCS spectrum.

PCIA demonstrated in its initial comments in this proceeding,[1] on June 18, 1997 that it was premature for the Commission to channelize and license the one MHz of reserve NPCS spectrum because: (1) NPCS licensees were just beginning to build out their networks, and the future spectrum needs of the industry were unclear; (2) the premature release of the reserve spectrum could lead to decreased investor confidence in the ability of licensees to execute their business plans; and (3) an oversupply or inappropriate channelization of spectrum would increase the probability of inefficient spectrum usage. Given those facts, PCIA offered to coordinate a narrowband PCS spectrum needs study, and report the results to the Commission. With this information in hand, the industry believed the Commission could make a more-informed decision as to the release of the reserve NPCS spectrum as well as appropriate channelization and technical requirements for the service.

[1] *Amendment of the Commission's Rules To Establish New Personal Communications Services, Narrowband PCS,* FCC 97-140 (April 23, 1997) (Report and Order and Further Notice of Proposed Rulemaking)

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PCIA's position last year garnered widespread support. Those opposing any immediate reserve spectrum reallocation pointed to a number of public interest factors that supported their position. First, given the still embryonic nature of narrowband PCS, it was impossible to determine how its service offerings would develop, what types of applications the market would and would not support, and, as a result, the most effective way to channelize and license the remaining one MHz of spectrum. Second, parties expected there to be further technological advances resulting in new, innovative, and unforeseen messaging services for which spectrum should be reserved. Third, the release of more spectrum—before there was a demonstrated demand for new licenses—was believed to potentially diminish stock valuations, thereby making it more difficult for existing licensees to raise sufficient cost-effective capital to meet construction and coverage requirements. Fourth, the Commission had already taken a number of actions in recent years to increase the supply of messaging spectrum. Finally, it was asserted that an auction of the reserve narrowband PCS spectrum in the near future was unlikely to raise the substantial sums that might otherwise be realized if it were held at a later date, when the actual value of fully operational systems would be evident.

The attached analysis lends credence to a number of those industry concerns and confirms the wisdom of taking a thoughtful review of these issues before finalizing any decisions about the future of NPCS spectrum.

The report, produced by the independent consulting firm of Frost & Sullivan, provides a picture of the current state of the NPCS industry and an analysis of its future. It focuses on NPCS service providers, manufacturers (infrastructure and subscriber equipment), subscribers and end user services. Of particular interest to Commission staff should be the review of NPCS market drivers and restraints, projected demand for NPCS services and considerations for the future of NPCS.

Members of the industry will be discussing the report over the next several weeks. I welcome the opportunity to discuss specific aspects of the 65 page document with your staff as the Commission begins to focus again on these issues.

Two copies of this letter and the associated presentation materials are being filed with the Secretary's office for each of the referenced dockets, as required by Section 1.1206 of the Commission's Rules.

I look forward to a continuing dialogue with you on this important issue and its impact on the messaging industry.

Best regards,

Robert L. Hoggarth
Senior Vice President, Paging & Messaging

Enclosure

CC: Magalie Roman Salas, Esq., Secretary (with enclosures)

FROST & SULLIVAN

An Analysis of the Narrowband PCS (NPCS) Market in the U.S.

Confidential for **PCIA**

An Analysis of the Narrowband PCS (NPCS) Market in the U.S.

September 1, 1998
Revised October 1, 1998

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Database of Key NPCS Industry Participants

1

Executive Summary

Scope

Personal Communications Industry Association (PCIA) commissioned Frost & Sullivan to provide an analysis of the current state of Narrowband PCS (NPCS) in the United States, and to provide a forecast of the likely future of the industry through 2008. Specifically, the study explored the following objectives:

- The total size and forecasts of growth of the subscribers to NPCS from 1996 through 2008.
- An analysis of current (May, 1998) NPCS systems, equipment, and services in the United States.
- The drivers and restraints which are likely to impact the NPCS services market.
- A discussion of the key market trends in technology, user benefits, and new services for NPCS.

Information and data pertaining to these concerns has been collected and synthesized into this report. Over the course of this project, numerous findings were developed from an analysis of the accumulated data. Specific information for each

objective is found in Chapters 3 and 4 of this report. A brief summary of some of the most important findings follows.

Summary of Major Findings

The NPCS industry only began in earnest in 1996, after what can be characterized as a difficult birth. It is just beginning to develop, but it should have a bright future. There are three major segments to the industry: NPCS service providers, infrastructure vendors, and subscriber equipment manufacturers. Although this analysis focuses primarily on the NPCS service providers segment, the infrastructure vendors have a significant impact on the service providers and are central to the development of the industry, both in the current market and in the future.

In this section, the major findings in the current NPCS industry will be presented first, followed by the major conclusions about the projected demand for NPCS services.

The State of the Current NPCS Industry

Each of the three segments of the current NPCS industry are discussed below.

NPCS Service Providers

The NPCS industry has made significant progress in bringing advanced wireless messaging to the US market. The service provider segment has seen the most activity. Two trends have emerged in this segment in the early stages of the NPCS industry.

- Currently, four licensees (i.e., CONXUS, SkyTel, PageMart, PageNet) have commercially active NPCS networks, while the rest are either testing their networks or have had no concrete activity.
- Two-way data and text messaging services are very popular with NPCS subscribers, and although the number of voice paging subscribers is fewer than data and text messaging, the early results of CONXUS' offering are encouraging.

Some reasons behind this trend are examined in more detail in Chapter 4.

The number of subscribers to NPCS services has grown quickly:

- In 1996, 27,000 subscribers, all attributed to SkyTel, were gained after only a few months of commercial operations.
- This number grew to approximately 212,350 in 1997, with almost 98 percent attributed to SkyTel and its resellers.
- The remaining 2 percent were split between CONXUS and PageNet.
- About 98 percent of all NPCS subscribers held two-way data and text messaging subscriptions, whereas 2 percent held voice paging subscriptions.

NPCS Infrastructure Vendors

The reFLEX25 and reFLEX50 protocols for data and text messaging, and the InFLEXion protocol for voice paging, are the de facto standards for the NPCS industry. The NPCS infrastructure vendor segment is highly concentrated, with two major players dominating the market: Motorola and Glenayre. Three other companies are licensed to develop NPCS infrastructure, JP Systems, Philips, and Rodhe & Schwartz, but they have not been active in the current market.

Two trends have emerged in the current infrastructure segment:

- The emergence of the FLEX protocols as the de facto standards for NPCS has created a platform that makes highly efficient use of NPCS spectrum, particularly for data and text messaging applications.
- However, this situation has concentrated the industry and has created a bottleneck in the amount of attention each of the NPCS licensees receives from the two infrastructure vendors.

The bottleneck refers to the simple restriction of support time and technical assistance two infrastructure vendors can give eleven NPCS license holders. Although both Motorola and Glenayre have experience with NPCS infrastructure in their development laboratories, the two-way FLEX technologies are still relatively under-tested in the field under commercial traffic conditions. The handful of NPCS license holders who are deploying NPCS infrastructure often compete with each other for support and technical assistance from the two infrastructure vendors, as they strive to tune their networks before and after the commercial launch of NPCS.

This ratio of infrastructure vendors to NPCS license holders has three immediate implications for the NPCS industry.

- First, the carriers cannot readily obtain the NPCS infrastructure from a large set of vendors. If neither Motorola nor Glenayre can meet the demand of license holders for equipment or professional services, then there is nowhere else for them to go.
- Second, although there are other avenues available, capital for infrastructure build outs is largely restricted to vendor financing. Some NPCS license holders have not been able to afford enough equipment to complete the build outs of their license areas, further complicating the build out process.

- Third, the limited number of current licensees for the FLEX protocols may be restricting innovation in NPCS applications. The proprietary protocol means that far fewer potential application developers are able to participate in the NPCS industry than were the protocols open.

The overall conclusion from these three factors is that the build out schedules mandated by the FCC in the terms of NPCS licenses may be overly aggressive, and may need to be adjusted to accommodate this situation.

Another conclusion that can be drawn is that Motorola will play a critical role in the development and future of the NPCS industry. Motorola controls the FLEX protocols for two-way paging, and can make the barriers to other infrastructure vendors high. On the other hand, Motorola also has the potential to open the doors to competition from other infrastructure vendors, which may relieve the bottleneck present in the industry. Either way, the NPCS carriers currently have fewer infrastructure choices in their industry than carriers do in other wireless markets.

NPCS Subscriber Equipment Vendors

Similar to the infrastructure segment, the subscriber equipment segment is highly concentrated and controlled by Motorola and Glenayre, through its subsidiary Wireless Access. However, the impact of this segment on the overall industry is less than the infrastructure segment. In particular, the number of NPCS pager models is growing, and this segment has lower barriers to entry than the other two segments. In particular, the large consumer electronics manufacturers should be able to enter this segment much like they did in the broadband PCS handset segment, and promote a high degree of competition.

The Projected State of the NPCS Industry

There are a number of underlying factors that are expected to drive and to restrain the NPCS services market. Taken together, the drivers should have a stronger effect, overall, than the restraints on the market in the long term. NPCS services are expected to be viable in the US consumer market, but the future success of the industry will be highly dependent on all or most of the license holders building their NPCS networks and initiating commercial services.

Two restraints in particular may slow the promising future of the industry. The first is related to the high concentration of the infrastructure vendor segment. Moreover, since paging services are historically a low margin business, it is unlikely that this concentration will fall in the foreseeable future. Given the low ratio of infrastructure vendors to license holders, some license holders may not be able to meet their build out deadlines and be forced to relinquish their NPCS licenses.

The second restraint is related to the license holders' difficulty finding financing for network construction. The debt and equity markets for funding have not been promising for NPCS service providers, leaving vendor financing as the remaining option. This limited financing availability may further create barriers to meeting built out schedules.

Nonetheless, if these two restraints can be effectively addressed, then we believe that these companies will be able to build out their networks and offer competition in the NPCS industry. The time frame for this increased competition, and the benefits it should furnish the consumers, is likely to begin in 2000; it may be highly competitive industry as soon as 2002 or 2003.

The projected demand for NPCS services from 1998-2008 is summarized below.

- NPCS subscribers should reach 870,000 by the end of 1998, a growth of 310 percent over 1997
- In 2001, the number of subscribers is expected to reach over 17 million, with triple digit annual growth for 1997-2001
- By 2005, NPCS subscribers should reach almost 60 million, and this number should climb to 86 million by the end of 2008
- Breaking down the NPCS subscriber numbers into voice and data and text messaging services, by 2001 12 percent of the total 17 million NPCS subscribers are expected to be voice paging subscribers, while the remaining 88 percent should be data and text messaging users.
- By 2008, the number of voice paging subscribers should have grown to almost 30 percent of all NPCS subscriptions.
- The primary driver for voice paging should be its relative ease of use, which is expected to particularly appeal to niche segments such as the blind and the elderly.
- The migration of one-way paging subscribers to two-way systems should be slow at first, but should gain momentum as the forecast period proceeds.
- NPCS subscribers made up a relatively small percentage of the total number of paging subscribers in 1996 and 1997
- However, by 2001, one-in-five paging subscribers should be on NPCS systems; by 2004, one-half of all paging subscribers should hold NPCS subscriptions, and by the end of 2008, almost 70 percent of all paging subscribers should be on two-way networks

2

Research Methods

The process according to which this analysis was conducted follows a rigorous set of research guidelines developed by Frost & Sullivan to ensure the highest standards for our conclusions and recommendations. This proprietary process was further modified to fit the unique parameters of PCIA's research and consulting needs.

In the course of the project, Frost & Sullivan used both primary and secondary sources to complete this analysis of the NPCS industry. The secondary portion of the research served as a base from which the primary research proceeded. In addition, the secondary sources were used to provide checks to the data derived from primary research with market participants. The primary research served as the main source of quantitative and qualitative data for the analysis, and was used to update and modify the secondary data.

The secondary sources included the most recent Frost & Sullivan forecasting models for the NPCS industry, our database of drivers and restraints for this market, publicly available technical information on the FLEX family of protocols, and NPCS carriers' subscriber counts for 1996 and 1997. Our primary sources included interviews with NPCS license holders

and marketing officers in the service providers segment, as well as discussions with other paging industry experts. This research reflects trends and events until August 31, 1998.

The research process for this analysis is detailed in a step-by-step fashion in the next section.

Steps Used to Conduct the Research

1. The Frost & Sullivan project manager, lead industry analyst, and client liaison held an initial telephone consultation with PCIA to discuss research objectives, project design, and timelines for this analysis.

   Through this discussion, the parties gained a consensus on the definitions of the industry categories, the analysis targets, and the direction of the research to ensure that the measurements and analysis remained consistent with PCIA's objectives for the project.

2. Following the initial consultation, the Frost & Sullivan client liaison and the project manager constructed the formal research proposal. This proposal included a detailed definition of the project objectives, the project deliverables, the project time line, and a cost estimate for the entire project. This proposal was then sent to PICA for approval.

3. After receiving approval from PCIA, the lead analyst began by reviewing the proprietary Frost & Sullivan database of secondary information on the NPCS industry.

   This information served as the foundation for the forecasts, underlying drivers and restraints, and industry trends.

4. Once the foundation was constructed, the primary research phase began with the lead analyst interviewing NPCS industry participants.

The outcome of these interviews provided data which helped to further refine and extend the forecasts, cross-validate and modify the drivers and restraints, and to update the industry trends. In addition, the primary data provided further insight into the dynamic relationship between NPCS carriers and the infrastructure vendors.

5. Once the initial analyses were formulated, they were cross-checked and validated with additional interviews and with senior analysts in the Frost & Sullivan telecommunications research group.

6. After further refinement of the draft of the deliverable, the entire document was submitted to Frost & Sullivan's Strategic Review Committee (SRC).

   The SRC is a formal review panel tasked to review every custom consulting project prior to shipping it to the client. The committee is composed of the Chairman of Frost & Sullivan, the Research Operations Manager, the Vice President of Consulting, the Research Director of Telecommunications, and a senior consultant from the Frost & Sullivan Medical industry group, serving as an outside reviewer.

   The intent of the SRC review is to assess the content, clarity, and presentation of the document, and to ensure that it meets the research objectives outlined in the research proposal. Moreover, the SRC advises the lead analyst on further refinements to add to the strategic value of the deliverable.

7. Following the refinements suggested in the SRC process, the deliverable was sent to PCIA for review. The lead analyst and project manager then held a teleconference to discuss any adjustments that were needed to the document to meet PCIA's objectives.

8. Once these adjustments were made, the final document was then shipped to PICA for final review and acceptance.

3

The Current State of the NPCS Industry

Beginning in July 1994, the FCC conducted auctions for nationwide and regional licenses for NPCS in three radio frequency ranges: 901-902 MHz, 930-931 MHz and 940-941 MHz.

Eleven nationwide licenses were auctioned. The first nationwide NPCS license was awarded to Mobile Telecommunications (Mtel, now known as SkyTel) under the commission's Pioneers' Preference policy. In spite of the incentives to encourage a more diverse collection of winners, most of the nationwide licenses were won by players who already had well established core (one-way) paging operations. PageNet, the largest paging service provider, was the most successful bidder with three licenses. Other successful bidders were AT&T Wireless, Mobile Media, and PageMart.

Following the nationwide auctions, the 30 regional licenses were auctioned in November 1994. Similar to the nationwide auctions, many, but not all, of the regional licenses were won by companies who have existing paging operations, including small and minority-owned businesses.

Since the auctions, the NPCS landscape has evolved into a solidly developing industry. Four important events marked this process. First, some of the regional winners consolidated their holdings to create a nationwide footprint. The Benbow PCS Ventures-Pagecall merger is one example of this.

Second, Motorola's ReFLEX protocols for advanced two-way data and text messaging, and InFLEXion protocol for voice messaging emerged as the de facto standards for narrowband PCS networks. In the near term, this has been good for the industry, since it provides a common technical foundation upon which the industry can grow.

Third, the initial commercial implementation of SkyTel two-way data and text messaging by Mtel in 1995 had some difficulties. After a few months, Mtel scaled back SkyTel services because of technical problems with the underlying ReFLEX protocol. SkyTel, however, has gained a significant number of subscribers since the service was re-introduced near the end of 1996.

Fourth, NPCS license winners have had difficulty attracting investment capital. This has further restrained the development of the NPCS market.

This chapter will present an analysis of the current state of the NPCS industry. It will begin with an examination of the three main segments of the industry. In the first segment, NPCS service providers, the state of the development of each current NPCS licensee is described. Subscriber numbers and market shares are also presented, as well as a discussion of currently available services and end user benefits. The second segment will concentrate the NPCS infrastructure vendor segment, and its effect on the carrier segment. The third

segment will focus on the NPCS subscriber equipment segment. Following the analysis of the three segments, a discussion of the technology and market trends in the NPCS industry will be presented.

Overview of the Current NPCS Industry

This section will describe the current state of the NPCS industry in each of the three main segments of the market: NPCS services, infrastructure, and subscriber equipment.

NPCS Service Providers

Narrowband PCS licenses were auctioned off as early as 1994, but the pace of commercial roll out has been relatively slow. As of May 1998, four providers are offering their services commercially.

The first commercial launch of NPCS was by Mobile Telecommunication Technologies, Inc. (Mtel) in 1995, but Mtel ran into unanticipated technical problems with the ReFLEX protocol. Mtel later re-launched its two-way messaging system near the end of 1996. It has seen more encouraging success and data messaging in particular has had extremely high growth thus far. Other NPCS license holders are reselling SkyTel's data messaging services. SkyTel voice paging product, SkyTalk, however, is not yet as popular as its two-way alphanumeric services.

A second licensee to launch narrowband PCS commercially is PageNet, the largest domestic one-way paging service provider. PageNet launched VoiceNow, a voice pager in

selected markets in February 1997. VoiceNow did not show the level of functionality desired, manifested by problems with the software in the network, and because the coverage area had some portions where reception was unavailable. Consequently, PageNet scaled back its launch and limited deployment of voice paging services. The current focus of PageNet's NPCS activity is in the Chicago area, where it will concentrate on test marketing voice messaging. Its plans for Pocketalk will be determined by what happens in Chicago. It is also currently reselling SkyTel's two-way data services under the PageNet Two-way brand.

CONXUS Communications launched their Pocketalk voice paging service in November, 1997. The CONXUS offering seems more successful than the PageNet offering, and the company has been able to establish and grow a subscriber base. CONXUS is also planning to wholesale Pocketalk to a wide range of partners, from paging carriers to small retail wireless outlets. Their announced long term strategy is to build out a system that can handle both ReFLEX 25 data and InFLEXion voice messaging.

As an indication of Pocketalk's success, there were an estimated 2,000 subscribers to the voice paging service at the end of 1997. On February 17, 1998, CONXUS announced that Pocketalk had 6,000 subscribers, a growth of 200 percent in less than 60 days. On March 20, 1998, CONXUS announced that they added approximately 13,000 new subscribers to date. This means that the voice paging service grew from 2,000 subscribers in three months. Although this number is still less than the estimated number of text and data two-way messaging subscribers at this time (see the section on NPCS subscribers below), the growth for CONXUS is encouraging.

Finally, PageMart recently announced its intent to launch its NPCS Guaranteed Messaging service in August, 1998 in Colorado, Florida, Georgia, Maine, Massachusetts, Minnesota, Missouri, Nevada, New Hampshire, Ohio, South Carolina, Washington, and Wyoming. These markets are in addition to PageMart's testing activities in Texas.

Besides these four active NPCS carriers, three NPCS license holders are in their network planning and deployment stages:

- AirTouch is currently testing its NPCS network, and is, however, reselling the SkyTel data services.
- Arch Communications, together with Benbow PCS Ventures and PageCall, is also testing its NPCS infrastructure, and plans to resell CONXUS' Pocketalk service.
- MobileComm is testing its NPCS network in the Dallas and San Francisco markets, and anticipates a full commercial launch in selected markets in the second half of 1998.

The remaining four license holders are not yet in the testing phase.

- AT&T Wireless exited the NPCS market and has sold its two nationwide licenses to other companies.

  - On July 29, 1998, Metrocall announced a definitive agreement to purchase the Advanced Messaging Division of AT&T Wireless. Included in the sale was AT&T's 50kHz/50kHz nationwide NPCS license.

  - On August 25, 1998, TSR Wireless LLC purchased AT&T Wireless' other nationwide 50kHz/50kHz NPCS license.

- Ameritech, American Paging Inc. (APS), and Insta-Check have not made any public commitment to network testing or development.

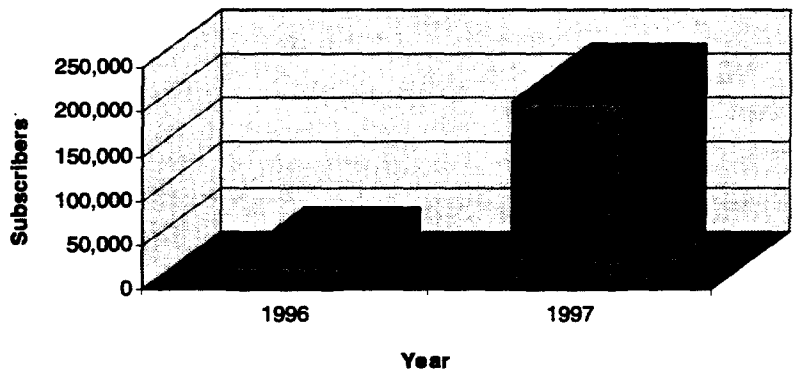
NPCS Subscribers and Market Shares (1996-1997)

Mtel initially launched its NPCS services in 1995, and relaunched the SkyTel services in 1996. At the end of 1997, three NPCS license holders were offering commercial services, excluding others who are reselling either SkyTel or Pocketalk.

For the purposes of this report, a subscriber is defined as a single subscriber unit with an NPCS carrier. For instance, a single unit could correspond to an individual using the service for business or personal use. This definition also includes a business using the network for telemetry purposes, such as Enron using the SkyTel network for automatic meter reading purposes (see below). In this instance, a single Enron account may cover 20,000 NPCS subscriber units on 20,000 electricity meters, equating to 20,000 subscribers.

Figure 3-1 shows the subscribers to NPCS for 1996 and 1997.

Figure 3-1
NPCS Subscribers

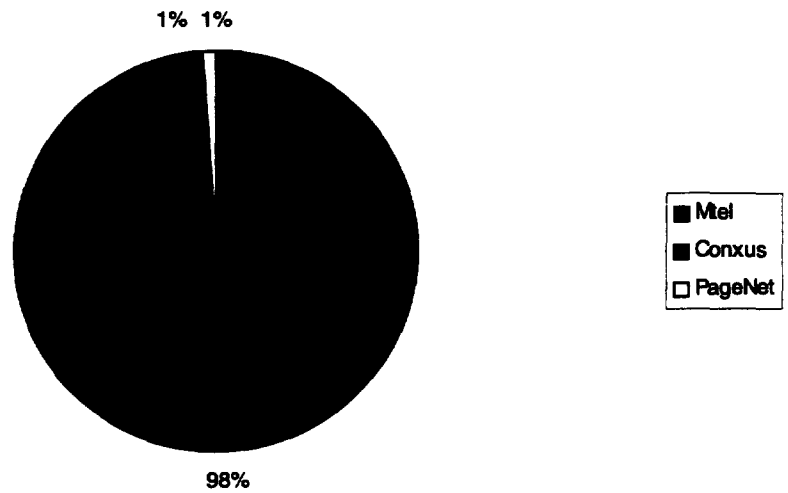


As Figure 3-1 shows, in 1996, there were 27,000 NPCS subscribers in the US. Virtually all of these subscribers were for

two-way data and text messaging. In 1997, the number of subscribers grew 686 percent to 212,350. Of these, almost 98 percent, or 203,900 subscribers, were using two-way data and text messaging, and 2 percent, or 8,500, were voice paging subscribers.

Figure 3-2 shows the relative market shares for the three NPCS carriers in 1997.

Figure 3-2
1997 NPCS Carrier Market Shares



In 1996, all NPCS subscribers belonged to SkyTel. As Figure 3-2 shows, Mtel still had a commanding market share of 98 percent of all NPCS subscribers in 1997, the majority of which were two-way data and messaging users. CONXUS and PageNet each had only a 1 percent market share. All of CONXUS' subscribers were voice paging users, while the majority of PageNet's subscribers were also using voice paging.

Available Services

On a macro level, there are three major classes of applications for NPCS possible. The first is primary outbound

messaging (base station transceiver to mobile unit), both voice and data. The second is full two-way communications with databases and other units. The third is primary inbound messaging (mobile unit to base station transceiver) from machines for functions such as alarm notification and telemetry. Of these three classes, the services most prevalent in the current market are data and voice outbound messaging.

Voice Messaging

NPCS in the 50 kHz/50 kHz band will support voice messaging services. This is a revolution in paging and voice messaging will be an extension of an answering machine which will enable users to store and retrieve important messages at remote locations.

Voice paging applications based on NPCS will use the InFLEXion protocol by Motorola. To illustrate, from a telephone, a sender can dial a specially assigned number for the receiver and leaves a voice message. The InFLEXion based system then sends out a broadcast "where are you" message to locate the receiver. As soon as the message arrives the unit wakes up from its sleep mode and sends out an acknowledgment "here I am" message. In this case, InFLEXion is used to transmit the voice. Thus FLEX will be used to locate the unit and InFLEXion will be used to send voice messages.

Data and Text Messaging

The ReFLEX25 and ReFLEX50 protocols from Motorola form the basis for the data and text messaging services possible with NPCS. NPCS, in its most simple form, is the next generation of paging services. Providers who hold NPCS licenses have the capacity to build networks that will enable users to

have full two-way data and text messaging communications. The availability of full two-way communications gives NPCS a competitive advantage over one-way numeric and alphanumeric services.

Although the 50 kHz/50 kHz channel pairings are highlighted above, other pairings also have significant potential to deliver data and text two-way messaging. The ReFLEX protocol only requires a minimum of 12.5 kHz inbound response channel and a minimum 25 kHz outbound channel, although it can also use a 50 kHz outbound channel, to deliver data and text two-way messaging. In addition, Motorola has stated that, depending on an NPCS carriers' capacity needs, data rates of 800, 1,600, 6,400, or 9,600 bits per second (bps) are possible on the 12.5 kHz inbound response channel (*FLEX Technology Q&As, from Motorola'sFLEX website at http://www.mot.com/MIMS/MSPG/FLEX/promo/qa.html*).

This means that the capacities in both nationwide and regional licenses are, at least theoretically, sufficient for a wide range of data and text two-way messaging applications. Moreover, Motorola designed the ReFLEX protocol to be highly scalable such that a carrier would be able to dynamically tailor its NPCS systems to support higher capacities and data rates in certain areas (e.g., urban clusters), while supporting less capacity and slower data rates in other areas (e.g., rural areas). It seems highly likely that the amount of spectrum currently licensed by NPCS carriers will be sufficient to support the subscriber numbers and applications forecast in Chapter 4, at least in the near term.

Several service types and features are possible with data and text messaging platforms. The mechanics of NPCS that enable these service types are briefly discussed below.

Receiver Location and Spectrum Efficiency

While two-way paging is the most obvious advantage of NPCS, the return channel in the NPCS system enables the sender to determine the receiver's location and status, while the receiver in the pager can send an acknowledgment on location. The system will not send the full message until the receiver is turned back on. However, if the receiver is indeed on, then the return message informs the system of the location of the transmitter closest to the receivers unit. At this point, the full message will be sent only to the appropriate tower, making a much more efficient use of NPCS spectrum.

Acknowledgment Paging

NPCS allows the receiver unit to send an acknowledgment message to the system indicating that it has correctly received a piece of information. Current paging systems send only moderate amounts of data and there is no way for the person sending the message to know whether the intended recipient actually received the message. In a large multi-block file transmission, in which a large data file is transmitted in parts or "blocks", even a single missed block can invalidate the entire transmission. As a result, most of today's data broadcast software uses a form of duplication, known as Forward Error Correction, to improve the chances of a clean delivery. NPCS systems, on the other hand, have the capacity to send out a block of information at a time, which the receiving unit acknowledges that it has received correctly. The system will need to re-send the message only if an error message is

returned. NPCS thus makes transmission of data more effective and efficient than one-way paging systems.

Confirmed Message Delivery

NPCS-based advanced messaging service offers confirmed delivery of the message sent. Unlike existing paging systems where the only way to know if a subscriber received a message is to wait for a return phone call or some other action that was prompted by the message, NPCS systems have the capacity which enables senders to immediately know if the message was received. Some systems enable the recipient to send back a short response chosen from a menu of custom tailored response options.

Telemetry Applications

NPCS networks can also be used for two-way data communications between fixed location devices. Over both ReFLEX and InFLEXion networks, NPCS can be one day be used to remotely monitor vending machines, photocopiers and security systems. It will also offer utility companies the ability to monitor meter readings remotely. For example, Motorola and SkyTel recently announced a contract with Enron, an energy services company, to use NPCS for automatic meter reading applications. Other potential telemetry applications which could use NPCS include healthcare monitoring and location monitoring for pets.

End User Benefits

The two-way data and messaging services available to subscribers present these users a number of benefits. For two-way data and messaging, in addition to the traditional benefits

of one-way alphanumeric paging, subscribers also have the benefit of message acknowledgment, the ability of store and forward for messages, and to respond to a message from the pager rather than having to locate a telephone. These subscribers also have access to two-way pagers which are relatively easy to operate, have extended battery life, and are small in size. On the other hand, two-way data and messaging service is not yet built out to provide nationwide coverage, or coverage that is as extensive as one-way paging coverage.

For voice messaging, the end user benefits are also promising, but are a bit different given its focus on audible messages. On the surface, voice messaging is simpler to use than data or text messaging. However, it is a relatively more novel product than two-way text and data messaging, which is an extension of one-way alphanumeric messaging. Once voice messaging becomes more popular, customers should find the same benefits attached to two-way data and text pagers generally apply to voice pagers. In addition, voice messaging also promises to provide rich meanings, since they are recorded in a sender's own voice, and contextual cues such as voice inflexion and tone can be included in the message.

One current trend among wireline telephony end users suggests that consumers value bundled telecommunications service packages. The bundling trend shows a potential to contribute to the growth of NPCS subscriptions if advanced messaging services can be combined with wireline services. One example may be to combine NPCS voice messaging services with a business voice mail account or a home answering machine to forward messages from either number to a voice pager.

NPCS Infrastructure Providers

The infrastructure equipment segment is highly concentrated, essentially 100 percent, with just two major players dominating the market: Motorola and Glenayre. As Motorola's ReFLEX and InFLEXion protocols for data and voice paging, respectively, have emerged as the dominant standards for NPCS, only three other companies are licensed to manufacture infrastructure equipment for the NPCS industry. These vendors, JP Systems, Philips, and Rhode & Stewards, however, have not yet entered the US NPCS infrastructure market. In addition, JP Systems is not licensed for the InFLEXion protocol.

The structure of this segment means that the carriers must rely on only two infrastructure providers. This situation has a number of consequences for the NPCS industry.

First, the carriers cannot obtain the necessary infrastructure from a large set of vendors. If neither Motorola nor Glenayre can meet the demand of license holders for equipment or professional services like network design and testing, then there is nowhere else for companies to go. This implies that the build-out schedules mandated in the terms of NPCS licenses may be overly aggressive because these two infrastructure vendors have a limited ability to provide infrastructure.

Second, as capital for infrastructure build outs is largely restricted to vendor financing, few carriers have been able to afford enough equipment to finance the complete build-out of their license areas. This has also delayed network construction, and makes it difficult to meet build-out deadlines.

On the other side of this situation, the limited number of current licensees for the FLEX protocols may be restricting innovation in NPCS applications. The proprietary protocol means that far fewer potential application developers are able to participate in the NPCS industry than were the protocols open.

It should be noted, however, that Motorola and Glenayre are not in an alliance in this segment. Both develop on the FLEX standards, but they do not seem to share advances or technical discoveries with each other. Thus this segment is not as monopolistic as the high market concentration would suggest.

NPCS Subscriber Equipment Vendors

At the end of 1997, there were four companies licensed to manufacture NPCS pagers based on the FLEX protocols, but just two players control the subscriber equipment market. Motorola dominates the market with a 65 percent market share (1997 figures). Wireless Access, which was purchased by Glenayre in September 1997, held an estimated 35 percent market share. Philips and Uniden are the other two licensees, but neither had any significant market share in 1997.

Despite the high market concentration in this segment, there are a number of models of pagers for two-way text and voice messaging on the market. Since Motorola developed the FLEX protocols, it has the benefit of a longer period of experience developing applications for it. The PageWriter 2000 pager with a QWERTY keypad is an early example of this experience.

Wireless Access, however, should not be viewed as being technologically bound to follow Motorola's lead in this segment.

It is logical to predict that Wireless Access will be able to develop competing products, and perhaps new ones ahead of Motorola as well, as it gains experience with the protocol.

Technology and Market Trends

Early delays have affected the pace of commercial roll out

The delays that affected the early launch of NPCS networks have caused other license holders to adopt a cautious, fast follower approach. While getting the product to market remains a top priority in the industry, most service providers seem to be concentrating on coming into the market with the right technology and a set of functional applications which will fulfill customer expectations. These NPCS licensees are performing stringent beta testing procedures to ensure that this can meet consumer expectations.

ReFLEX and InFLEXion have eclipsed pACT as the de-facto standards for NPCS applications

ReFLEX 25 and ReFLEX 50 for data messaging and InFLEXion for voice messaging applications are now the de-facto standards for NPCS. The only other standard that came close to competing with ReFLEX was pACT. pACT (Personal Air Communications Technology) was essentially a modified version of the CDPD (Cellular Digital Packet Data) protocol and was considered suitable for data messaging applications. pACT was promoted by a forum of technology partners led by AT&T Wireless and included Advanced Micro Devices, AirLink Communications, Panasonic, U.S. Robotics, and Ericsson. The goal of the consortium was to promote pACT as a worldwide open standard for two-way paging and messaging services.

pACT, however, lost out to the FLEX family for a number of reasons. First, FLEX got to the market well ahead of pACT. This was clearly important to carriers faced with the task of arranging infrastructure contracts under stringent build-out deadlines.

Second, pACT is primarily a data messaging protocol, while FLEX supports data on the ReFLEX version and data and voice messaging over the InFLEXion version. The choice for NPCS carriers was to take the flexibility of FLEX over the data-centric nature of pACT.

Third, pACT networks are designed as symmetrical micro-cellular networks, whereas a ReFLEX network is designed to be asymmetric, which allows simulcast transmission on a zone basis. The estimated cost of building the symmetric pACT network was found to be higher than the cost of building an asymmetric FLEX network. This consideration was significant for most of the carriers after the relatively high prices paid for their licenses.

Fourth, the majority of NPCS licensees already used FLEX networks for their one-way paging operations, and those networks could be easily upgraded to support ReFLEX and InFLEXion. pACT, on the other hand, is a new protocol and cannot offer the same level of backward compatibility as does FLEX.

Fifth, in spite of the clear advantages that were offered by FLEX, pACT was seriously considered as an option by a large number of licensees. However, when AT&T Wireless decided to reassess its desire to participate in the NPCS market, and did not deploy pACT, the industry became pessimistic about the future of pACT, as there appeared to be no other vendor who

would have the financial strength and technical ability to support it.

Thus, the FLEX family of advanced messaging protocols has emerged as the de facto standard over the only other serious contender.

Advanced data messaging is highly useful for the commercial user

Paging has a long history as a communications tool that is heavily employed by commercial subscribers to remain in contact with their offices. Advanced data messaging services based on NPCS should exhibit the same trend. Its two-way feature holds value for business users. Although initially higher prices may deter the personal subscriber from using two-way data communications services, these consumers may find uses for two-way data messaging as prices begin to fall. As a result, carriers are expected to focus most of their marketing efforts on the business segment for data messaging services when they are introduced, although it is anticipated that some personal users may also be attracted to two-way data messaging in the near future.

Alternate Technologies May Impact the Future of NPCS

Whereas the NPCS community currently dominates the two-way messaging application market, two other alternate technologies may offer services which are functionally very similar to NPCS. The competitive impact of these services on NPCS seems at this time to be limited. Nonetheless, they are significant enough that they do warrant consideration as potential threats to NPCS carriers in the two-way messaging marketplace.

Packet Radio

The packet radio networks traditionally associated with mobile data applications may pose a competitive challenge to NPCS network for two-way messaging. Packet radio carriers, such as ARDIS and BellSouth Wireless Data, Inc., claim that their networks can provide two-way messaging that is functionally similar to what the NPCS carriers can offer ("Mobile data carriers think two-way and telemetry will grow market", *RCR*, May 4, 1998). Importantly, only the Research In Motion (RIM) Inter@ctive pager is currently available as an end-user device for the packet radio networks.

Although the packet radio carriers state that they will compete with NPCS carriers for the two-way customer, the competitive impact will be minimal for two main reasons. The first is that the NPCS devices, particularly those for data and text messaging, are less expensive than the RIM Inter@ctive pager. The second is that the packet radio offerings have been almost exclusively targeted at the vertical industries, rather than at the mass market.

Wireless Telephony

Two-way wireless telephone service, including both analog and digital cellular, as well as Personal Communications Services (PCS), may present a moderate challenge to NPCS for two-way messaging subscribers. Certainly the short messaging and the voice mail functions of PCS networks can compete with the data and text and voice messaging features of NPCS, but there are some important restraints which diminish this competitive impact.

First, cellular and PCS handsets are generally larger than two-way pagers, and their display screens are typically

unsuited for longer messages. Second, the battery life of a wireless phone is also significantly shorter than two-way pagers' battery lives. Third, even though small devices now exist which can do two-way paging through analog cellular network, such as the Maxon RT-800, in-building penetration for these devices is still inferior to what NPCS can offer. Finally, service prices for cellular and PCS are higher than for NPCS service, although this distinction may close as costs, and therefore prices, become more competitive in the wireless telephony industry.

One advantage for wireless telephony, however, is that the prices for the cellular and PCS handsets are generally lower than for two-way messaging devices. Some PCS handsets, for instance, are available for $100, although they can range up to $900. NPCS devices, on the other hand, are typically more expensive, ranging from $185 to $300.

These higher prices are largely due to the low degree of competition in the NPCS subscriber equipment segment. Currently, only two vendors, Motorola and Wireless Access, have any significant share of the market for data and text devices, and only Motorola has any significant market share for voice devices. A small number of vendors, such as NEC and ReadyCom, Inc., are reportedly developing two-way messaging devices, but they seem to be waiting for the NPCS carriers to launch new service types before committing to a large-scale manufacture of NPCS devices.

4

An Analysis of the Future of the NPCS Industry

Chapter 3 presented an analysis on the current state of the NPCS industry. It focused on the three primary segments of the industry, and developed a model of the interactions between them as they affect the entire industry. Moreover, a set of market and technology trends in the market were described.

This chapter will take the market and technology trends in the current state and project them forward to estimate demand for NPCS services through 2008. This analysis will begin by examining the underlying market drivers and restraints in order to provide this estimate. Next, a forecast for the demand for NPCS services will be presented, as well as a model of the potential migration of one-way paging subscribers to two-way services.

NPCS Drivers and Restraints

To begin, the drivers and restraints of the NPCS services industry are examined. These drivers and restraints are the factors which underlie the trends in the industry, and taken

together, can provide a view of the dynamics which shape it. Figure 4-1 presents the market drivers, and Figure 4-2 presents the restraints. In addition to the drivers and restraints, their projected impact over the course of the forecast period is also shown.

Market Drivers

Figure 4-1

U.S. NPCS Market:
Market Drivers Ranked in Order of Impact
1998-2008

Rank	Driver	1-3 Years	4-6 Years	7-11 Years
1	Two-way Paging Feature	High	High	Medium
2	Advanced Features	Medium	High	High
3	Migration of One-way Users	Medium	High	High
4	Increased Mobility of Users	Medium	Medium	High
5	Size of the Subscriber Unit	Medium	Medium	High
6	Long Battery Life	Medium	High	High
7	Lower Prices	Low	Medium	High
8	Licensees' Previous Paging Experience	High	Medium	Low
9	Ease of Use for Voice Paging	Medium	High	High
10	Telemetry Applications	Medium	High	High

Source: Frost & Sullivan

The Two-Way Paging Feature

NPCS provides users with two-way paging and acknowledgment paging features. The ability to respond to a page without using a third communication device like a phone should have tremendous value for a broad section of customers and should drive the demand for NPCS, particularly in the near and middle term of the forecast period.

As described in Chapter 3, NPCS networks and channel pairings enable end users to take advantage of a number of two-way messaging features. Even with the relatively narrow channel width of a 25kHz/12.5kHz pairing, users are able to acknowledge messages using a pre-determined menu of responses which can be accessed by a scrolling window. The most recent subscriber equipment, such as Motorola's PageWriter 2000, also features a simplified keyboard which can be used to type custom messages to send or respond to pages. This two-way functionality is expected to be a primary driver for NPCS.

Advanced Features

In addition to the two-way paging feature, NPCS holds the capacity to provide advanced applications including email access, internet access, palm-top computing, facsimile and remote inventory tracking. The availability of a range of applications on a small and compact device is expected to provide a clear impetus to NPCS subscriptions, as broader applications will appeal to a broader section of end-users. These advanced features, although present to varying degrees currently, are expected to become more important in attracting subscribers after the turn of the century.

Migration of One-Way Users to Two-Way Systems

The introduction of the alphanumeric pager in the late 1980s represented a significant technological improvement over the traditional one-way numeric pager. As a result, a number of one-way subscribers migrated to this advanced level of services. Initially, the migration was slow, but began to accelerate in the early 1990s. The number of new subscribers to alphanumeric paging grew by about 400,000 per year from 1993

until 1997, when the jump was about 700,000 new subscribers. The accelerated migration of one-way numeric messaging subscribers to one-way alphanumeric subscriptions exhibited in 1997 may slow down in the future, however, if NPCS carriers can lure current one-way numeric and alphanumeric subscribers to two-way services.

The migratory trend of subscribers to newer, more advanced messaging systems, which include both data and text messaging and voice messaging, is expected to be repeated as NPCS based two-way messaging systems are introduced on a mass basis. This migration should pick up as two-way networks begin operating at optimum levels and are able to match the coverage and in-building penetration of one-way systems. Furthermore, as two-way messaging becomes more and more popular, the size and cost of the a two-way device is expected to fall, drawing more subscribers to NPCS systems.

It is uncertain if the time frame of the migration to two-way systems will be the same as that seen into alphanumeric systems. However, the results of SkyTel and CONXUS subscriber additions suggest that there is a potential for the migratory pace to be even faster than the 400,000 new subscriber additions shown for alphanumeric systems. For example, the guaranteed delivery feature of NPCS systems may be used to highlight the advantage of two-way over one-way alphanumeric messaging in marketing campaigns directed at the business segment. The added benefits of two-way messaging over one-way are expected to drive this migration, but the development of new applications such as internet access and telemetry may accelerate this migration even more.

(Note that a more detailed discussion of this migration is presented later in this chapter, in the One-way versus Two-way Subscribers section, and is depicted graphically in Figure 4-5.)

The rise in popularity of two-way messaging, however, may signal a concurrent suppression in the demand of one-way alphanumeric paging. Although there is little evidence to support this assertion as yet, falling subscription prices, coupled with smaller, less expensive two-way pagers, may present a challenge to the value proposition posed by one-way messaging services.

It is unlikely, however, that the demand for one-way messaging will disappear completely in the next 9 to 11 years, because some individuals are unlikely to feel that they need a two-way messaging product. Furthermore, the small form factor possible with one-way messaging (e.g., the Timex Beepwear pager) is yet to be challenged by a similar two-way product.

In sum, as the two-way systems become more robust, two-way messaging is expected to draw a number of one-way subscribers away, particularly in the middle and long term.

Increasing Mobility of Users

The increased mobility among today's workforce should drive the demand for NPCS applications. NPCS currently allows users to stay in contact, receive information and even send acknowledgment messages. Early indications from end users suggest that these factors are highly valued by the growing mobile commercial segment. NPCS will be one of the most cost efficient and effective ways to reach mobile business users, driving its popularity in the medium and long term.

Size of the Subscriber Unit

The size of the subscriber unit will be a key issue that is expected to also drive demand for NPCS. The first generation of NPCS paging devices were about the size of a bar of bath soap, although the more advanced models with a keyboard, for instance, are slightly larger. Whereas these units are larger than the traditional one-way paging units, they are still small enough to be carried around the waist, or in a briefcase or purse.

As the technology evolves, the minimum size of the unit is shrinking, appealing to those consumers seeking a compact mobile communications device. However, it is unknown if the size of a two-way text pager, for example, will shrink to the smallest current size of a one-way pager such as the Timex Beepwear and still maintain the ability to compose a text message for transmission to another pager.

Long Battery Life

The average single charge life of NPCS based two-way pager is between 20 to 30 days. Wireless Access' AccessMate, for instance, has an average charge life of over 30 days on a single charge. This is significantly longer than competing communication options like cellular, broadband PCS and SMR This feature will give NPCS an advantage over competing wireless options. This advantage may become especially important as the industry matures and subscribers demand more usage and functionality from their terminals.

Lower Prices

The cost of building and maintaining an NPCS network is typically less compared to the cost of building, deploying and maintaining a cellular or a broadband PCS network. Lower

infrastructure and maintenance costs typically translate directly into lower prices for subscribers.

Licensees' Previous Paging Experience

The majority of NPCS license holders already have well established core paging businesses. As these carriers begin offering their NPCS services, they will have the advantage of an existing customer base in their core paging segment. A sizable number of these core paging customers may upgrade their paging subscriptions and adopt NPCS. Furthermore, having been in the paging business for a long time, NPCS license holders have the advantages of well-established brand names, retail channels, re-seller contacts, a trained sales force, and customer service facilities. This prior experience will be a significant advantage as NPCS establishes itself in the wireless market in the near term, but this impact should diminish over the long term.

Ease of Use for Voice Paging

The voice paging services available with NPCS should be attractive to those people who are unfamiliar with, or do not wish to use, text based messaging. These individuals may include those people who are attracted to a messaging service based on the ease of speaking a the message, rather than typing it in. An obvious niche for voice paging is with the blind, who are likely to find voice messaging a highly useful mobile communications tool.

Telemetry Applications

One promising application for NPCS is for telemetry and remote monitoring and data collection purposes. The two-way

nature of NPCS certainly allows for a much more economical approach to tasks such as utility meter reading and inventory control. In fact, the electric utility industry is already using wireless telemetry in some settings. Motorola and SkyTel, for instance, recently partnered with Enron to use the SkyTel network to perform remote, automatic meter reading. NPCS carriers are also optimistic about selling capacity on their two-way networks for other types of telemetry applications such as security, vending machine, and healthcare monitoring.

Market Restraints

Figure 4-2

U.S. NPCS Market:
Market Restraints Ranked in Order of Impact
1998-2008

Rank	Restraint	1-3 Years	4-6 Years	7-11 Years
1	Complexity of Technology	High	Medium	Low
2	Low Investor Confidence	High	Medium	Medium
3	Scarce Capital	High	Medium	Low
4	A Conservative Approach to the Technology	Medium	Low	Low
5	Limited Technology Options	Medium	Medium	Medium
6	Too few Infrastructure Vendors	High	Medium	Medium
7	Site Acquisition Costs	High	Low	Low
8	Governmental Regulations	High	Medium	Medium
9	Lack of Adequate Coverage	High	Medium	Low
10	Competition from Incumbent Alternative technologies	Low	Medium	High

Source: Frost & Sullivan

Complexity of Technology

Despite the fact that the majority of NPCS license holders have well-established one-way paging operations, NPCS is a new technology quite distinct from that to which they are accustomed. According to some NPCS licensees interviewed for this analysis, the initial expectations for NPCS were that it would not be much more complex to implement than one-way messaging systems. In practice, however, it seems as if the technology is more problematic than first envisioned. Thus, proper implementation of the ReFLEX and InFLEXion protocols is only slowly being achieved.

A few service providers, such as MobileComm and Arch Communications, are currently testing procedures to determine whether the strength of their networks can provide the desired levels of coverage and in-building penetration. Service providers are also continuing to test their equipment to detect and debug flaws. Thus, complexity of NPCS technology is one factor restraining the large scale launch of NPCS. However, the impact of this restraint should diminish over time.

Investor Confidence

Another limitation on NPCS build-out is investor confidence. Not only is NPCS a new technology, but it is also a part of the paging industry, which has struggled financially in recent years. Furthermore, NPCS competes with broadband PCS (BPCS) for both subscribers and for capital. Some NPCS licensees interviewed voiced a concern that the problems surrounding some of the BPCS C-block auction winners, such as NextWave, have made the investment community very cautious about putting capital into NPCS licensees. Consequently,

investors have adopted a wait-and-see approach before committing significant resources to NPCS carriers.

Scarce Capital

Closely related to investor confidence, the growth of NPCS is being restrained due to the shortage of capital required to finance operations at various stages. NPCS license holders have access to three major sources of financing: debt financing, vendor financing and equity financing. NPCS licensees invested over one billion dollars to acquire spectrum auctioned by the FCC, and now need capital to install networks and begin commercial operations. Each of these three options is examined below.

Debt Financing

Capital at the moment is very scarce. Having accumulated high levels of debt to finance their FCC licenses, NPCS providers are not in a strong position to add further levels of debt. In addition, many of the license holders who also have one-way paging operations have accumulated relatively high levels of debt in the wake of the consolidation in the one-way paging industry in recent years.

A generic illustration of the cost of building an NPCS system may emphasize the difficulty of finding debt financing. The spectrum for a nationwide footprint costs approximately $100 million, whereas the infrastructure to build-out this area is roughly $200 million. This means that an aspiring NPCS carrier would need at least $300 million in capital to offer nationwide two-way messaging services.

Finding a source for this amount of money may be difficult, given the recent turbulence in the one-way paging

industry and competition with BPCS for funding. Thus, banks may not see NPCS licensees as the most attractive candidates for such large loans, and thus debt financing at this time does not appear to be a very viable financing alternative.

Equity Financing

As noted above, the investment community currently appears to be very cautious about funding a large number of wireless ventures. This has made the option of raising equity capital extremely challenging. Some license holders are investigating alternate forms of equity financing such as junk bonds, but the viability of these options is not yet clear.

Vendor Financing

The most viable financing option for NPCS carriers today may be vendor financing. Vendor financing is an important source of capital but has its own set of limitations. The NPCS infrastructure market is highly concentrated and the ratio of vendors to licensees is relatively low. Moreover, Motorola is also subject to vendor financing requests from other wireless technologies like BPCS, SMR, and cellular. There is also a heavy influx of international orders for infrastructure equipment. Also, bankruptcy problems in other parts of the wireless industry made vendors cautious in granting financing for NPCS providers.

Available vendor financing would see the service providers only through the network build-out stage. NPCS providers will require capital beyond the network deployment stage in order to finance customer service, marketing, distribution and network maintenance. At this time capital resources may be restraining the growth of the industry, at least

beyond those licensees who have already launched their networks commercially. Interestingly, certain venture capital firms seem to be gaining interest in wireless telecommunications, become interested in NPCS.

A Conservative Approach to the Technology

In telecommunications services in general, time to market is a crucial factor, and early entrants are expected to have a tremendous advantage over later competitors. In the case of NPCS, however, the complexity of the technology presented a set of problems for SkyTel and PageNet when they went to market before all of the issues with the systems were fully understood. However, after becoming more familiar with the technology, both of these companies are much more confident in their systems.

These early problems may have caused other carriers to take a more conservative approach to the technology. This may have had a moderating effect on the industry, but the NPCS industry seems to have a higher level of confidence in the technology today.

Related to a conservative approach to NPCS technology, is the idea that the mass market may not be highly aware of the two-way messaging technology. This is not surprising, since NPCS is only just beginning to become widespread in the U.S. However, just as the recent failure of PanAmSat's Galaxy IV satellite highlighted the importance of paging in many people's lives, it may well be that only when a percentage of the mass market is aware of NPCS, will significant numbers of new subscribers be added.

Despite these issues, it should be noted that the United States has assumed technological leadership in NPCS. As the early effects of the conservative approach diminish, it will be important for the continued success of the U.S. NPCS industry that all sectors of the economy become more comfortable with the underlying complexities of advanced messaging services.

Limited Technology Options

NPCS currently uses the ReFLEX and InFLEXion protocols which belong to the FLEX family of protocols by Motorola. These are the only technological platform options currently available to service providers as they begin commercial operations. Moreover, the availability of these protocols has been delayed several times. It is unlikely that a competing standard will emerge, so the bottleneck is expected to be moderately significant throughout the forecast period.

Too Few Infrastructure Vendors

Glenayre and Motorola are currently the only two infrastructure providers for NPCS. The NPCS infrastructure segment thus is highly concentrated, leaving service providers with little choice in infrastructure vendors. Under these circumstances service providers have to wait for the right supplies, retarding the pace of network deployment and restraining the NPCS industry. We do expect some other infrastructure vendors to enter into this market, but it may not happen until the middle of the next decade.

Site Acquisition Costs

Acquiring cell sites has become very challenging for NPCS providers, who must compete against other wireless

carriers in order to gain access to cell and antenna sites. NPCS requires more receivers compared to one-way paging, which means that new sites will still have to be acquired. With increased competition for the limited number of cell sites, the cost of acquiring them has gone up, creating a further financial burden on the NPCS providers. In a situation where finding capital is becoming increasingly difficult, the sharp increases in the costs of acquiring cell sites and base station sites is restraining the ability of NPCS providers to come to the market. Once these sites are acquired, however, this restraint is likely to lose its impact.

Governmental Regulations

Governmental interference, primarily at the municipal level, in carriers' activities to deploy their networks is inhibiting their pace of network deployment. City zoning boards have put a number of restrictions on carriers, including limits on cell-site placement and antenna heights. Many cities have issued moratoriums against cell site deployment. Furthermore, cities have been opposing cell site deployment over concerns of potential health hazards from electromagnetic radiation emitted by radio frequencies. These issues have had a general restraining impact on new wireless technologies and NPCS has not been an exception. The impact of this restraint is likely to be most significant in the near term, diminishing slightly in the middle and longer terms.

Lack of Adequate Coverage

Coverage is one of the key strengths that led to the survival of one-way paging. NPCS providers will have to ensure that users get coverage levels comparable to the conventional one-way pagers. While acknowledgment paging and other value-

added features will drive customer appeal, the early lack of adequate coverage will restrain the growth of NPCS. However, as the carriers build their networks to meet FCC deadlines, this factor should decrease in importance.

Competition from Incumbent Alternative Technologies

NPCS is coming out at a time when wireless technology is rapidly gaining momentum and penetration in the US consumer market. Currently, individuals have a number of alternative technologies from which to choose for wireless services, including broadband PCS, digital cellular, SMR, packet radio, and soon mobile satellite communications. NPCS will have to compete with these incumbent alternative technologies for the customer's attention. Broadband PCS, for instance, can offer many of the NPCS services. While these alternate services will not directly compete with NPCS in terms of messaging capacity, they will certainly give the subscriber another option from which to choose. Competition from alternative incumbent technologies may not affect NPCS in the initial stages, but it will act as a restraining factor as it evolves and matures.

Projected Demand for NPCS Services

The previous section in this chapter discussed the underlying factors that are expected to drive and to restrain the NPCS services market. Taken together, the drivers should have a stronger effect, overall, than the restraints on the market in the long term. The early indications suggest that NPCS services are viable in the U.S. consumer market, but the future success of the industry will be highly dependent on license holders other

than SkyTel, PageNet, or CONXUS building their NPCS networks and initiating commercial services.

We believe that despite the restraints placed on these companies, they will be able to build-out their networks and offer increased competition in the NPCS industry. The time frame for this increased competition, based on the license holders' announced plans for network implementation, is likely to begin in 2000, may become a highly competitive industry in 2002 or 2003.

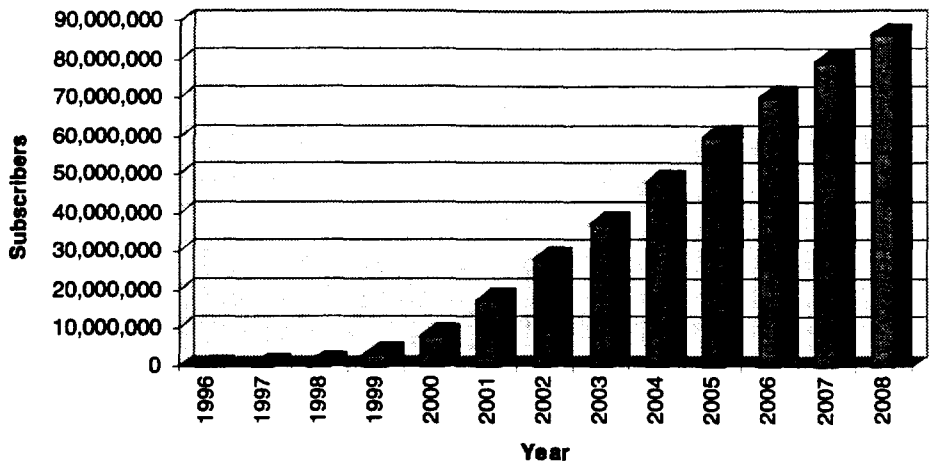
This section will present a series of forecasts for NPCS subscribers from 1998-2008. The first forecast will show the projected demand for NPCS from 1998-2008, also breaking it down between two-way data and messaging and voice paging services. The second will set NPCS against conventional one-way paging, showing the likely effects of the migration of one-way subscribers to two-way services.

NPCS Subscribers (1998-2008)

Overall Subscribers

Figure 4-3 shows the projected demand for NPCS services from 1998-2008, and the subscriber counts from 1996 and 1997 are included as a baseline.

Figure 4-3
Two Way NPCS Subscribers



As Figure 4-3 indicates, NPCS subscribers should number 870,000 by the end of 1998, a growth of 310 percent over 1997. This subscriber number should more than triple in 1999, as other NPCS licensees complete the initial stages of their network deployments and begin offering NPCS services. Six years into the commercial market for NPCS, in 2001, the number of subscribers is expected to reach over 17 million, with triple digit annual growth for 1997-2001. At the end of this period, it is expected that all licensees who wish to enter the NPCS services market will have done so, and the majority of them will have established the minimal coverage mandated by the FCC build-out conditions on their licenses.

Beginning in 2002, the growth should cool slightly through 2005. During this time, NPCS subscribers are expected to climb from 28 million to almost 60 million. The majority of NPCS carriers should have completed their network coverage plans by 2005.

Subscriber growth should continue for the remaining three years in the forecast period, although it will continue to cool as the total addressable market for NPCS services nears saturation. In 2006, it is estimated that just over 70 million NPCS subscribers will be active, and this number is projected to climb to 86 million by the end of 2008. The compound annual growth rate (CAGR) for 1998-2008 is expected to be 52 percent.

Two-Way Data and Text Messaging and Voice Paging Subscribers

As discussed in Chapter 3, two-way data and text messaging NPCS subscriptions seem to be more popular among NPCS subscribers today than are voice paging services, when measured by absolute subscriber numbers. It is difficult to determine if this trend will continue in the future, but some conjecture is possible.

First, the early success for voice paging was mixed: VoiceNow from PageNet did not attract a large number of subscribers, whereas the acceptance of Pocketalk from CONXUS grew, as noted in Chapter 3, relatively rapidly. The reasons for this are as yet unclear, although the differences between the two carriers may provide some clues.

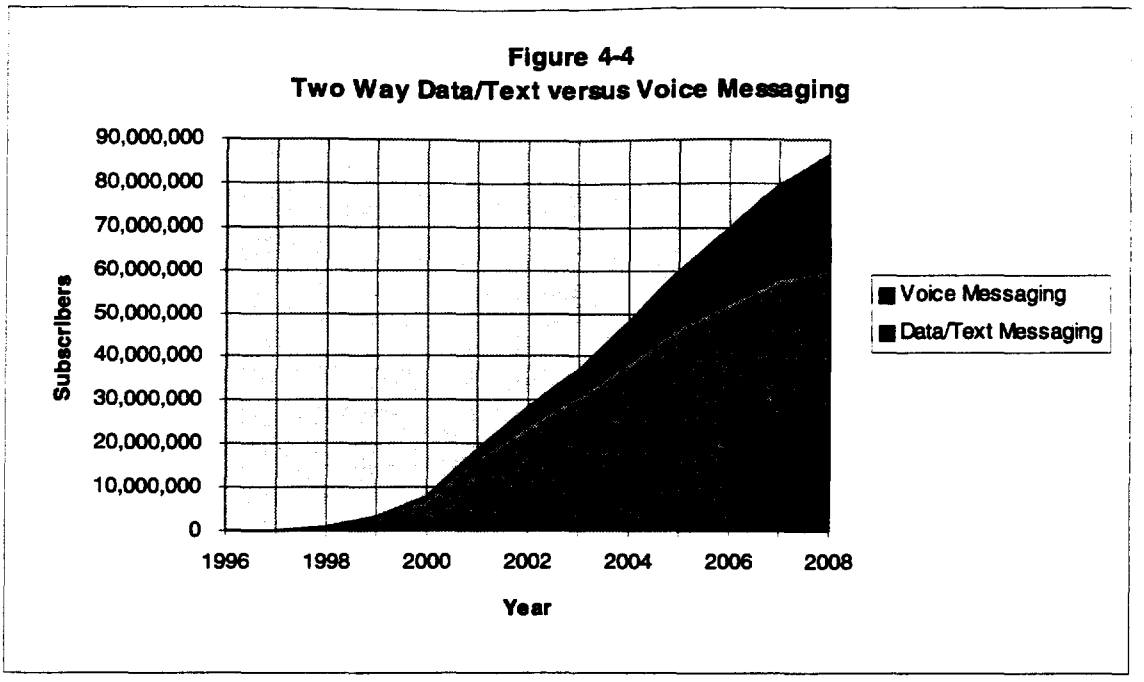
PageNet launched its services in February, 1997, whereas CONXUS did not launch until nine months later in November. It may be that CONXUS was more familiar with the NPCS technology than PageNet, and thus did not subject its early subscribers to the same coverage and software problems as did PageNet.

Also, PageNet instituted a per-call charge for VoiceNow, whereas CONXUS featured a flat-rate monthly pricing model. The per-call charges may have had the effect of discouraging

VoiceNow subscribers from heavy use of the services, while Pocketalk had no such restraints.

Taken together, it may be that the business model espoused by CONXUS is more applicable to voice messaging than that attempted by PageNet. Thus, the potential for voice messaging may be high, although it is too early to state if voice messaging will surpass data and text messaging in terms of the number of subscribers in the forecast period. On the balance, the number of new subscribers added to CONXUS' voice paging service in 1998 is very encouraging, and voice paging should exhibit healthy growth during the forecast period.

Figure 4-4 presents a breakdown between two-way data and text messaging and voice paging subscribers in the overall NPCS subscriber forecast. Note that the definition of subscribers in this analysis, detailed in Chapter 3, allows for a single individual to hold both a data/text messaging subscription and a voice paging subscription. Moreover, this definition also allows for telemetry applications to be considered as subscriptions, which implies that two-way data and text messaging has an advantage over voice messaging subscriptions in absolute terms of subscribers.



As Figure 4-4 shows, about 4 percent of all NPCS subscribers were voice paging subscribers in 1997, while the remaining 96 percent were data and text messaging subscribers. By 2001, however, almost 12 percent of the total 17 million NPCS subscribers are expected to be voice paging subscribers, with the remaining 88 percent holding data and text messaging subscriptions.

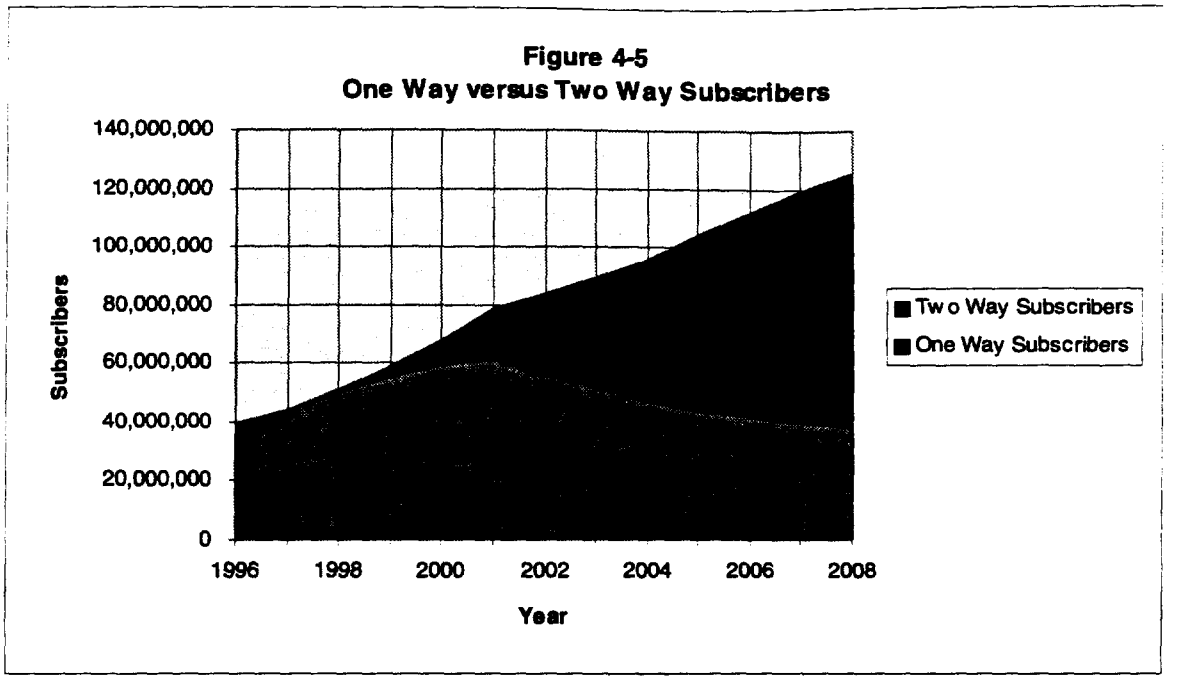
The growth of voice paging subscriptions is expected to be steadily gain momentum from 1998-2003, and it is expected that the growth will pick up speed after this. One factor contributing to this gain should be a renewed effort by carriers on the services as a higher margin service than data and text messaging. Another should be advances in end-user equipment which shrink the size and weight of the terminals, although the second generation product from Motorola due out in late 1998 represent a significant reduction from the first generation product.

In 2004, it is estimated that 10 percent of all NPCS subscribers will be holding voice paging subscriptions. By 2008, this proportion should have grown to almost 20 percent of all NPCS subscriptions. The compound annual growth rate (CAGR) for data/text messaging is estimated to be 48 percent for 1998-2008, while the CAGR for voice messaging in the same period is expected to be 76 percent.

One-way Versus Two-way Paging Subscribers

A market driver discussed above was the expected migration of one-way paging subscribers to two-way services. At the most basic level, this trend is projected because the added benefits of two-way paging, and a competitive pricing structure, should add value to the already popular one-way alpha-numeric paging services. Moreover, the telemetry and machine-to-machine applications possible on two-way networks are expected to further draw subscribers currently using one-way paging, such as home security services, to two-way systems.

In order to quantify this, Figure 4-5 presents a breakdown of total paging subscribers into one-way and two-way segments.



As Figure 4-5 indicates, NPCS subscribers made up an insignificant percentage of the total number of paging subscribers in 1996 and 1997. However, the number of NPCS subscribers should increase steadily, both in absolute terms and as a percentage of total paging subscribers, throughout the forecast period. In 2001, just over one-in-five paging subscribers should be on NPCS systems, rising to one-in-three by the end of 2002. In 2004, fully one-half of all paging subscribers should hold NPCS subscriptions. Finally, by the end of the forecast period, almost 70 percent of all paging subscribers should be on two-way networks.

The CAGRs calculated for each segment suggest that one-way subscribers will decline by 2 percent over the forecast, whereas the number of two-way subscribers should increase by 52 percent over the forecast period.

It should be noted that it is unlikely that one-way paging will disappear in the foreseeable future. The absolute small size and extremely low prices of one-way paging present a value

proposition that NPCS will find challenging to surpass. Furthermore, a segment of the total paging services addressable market may not want or need two-way NPCS services, preferring one-way services. Nonetheless, we expect a significant migratory trend away from one-way paging toward two-way NPCS services.

Considerations for the Future of NPCS

This analysis has painted a cautiously encouraging picture of the future of the NPCS industry in the U.S. A number of factors may impact the industry and change the forecasts presented in this chapter. We have attempted to identify what we believe are the three most salient factors, but it should be noted that this list is not exclusive.

Motorola

In all parts of this analysis, Motorola appears prominently. It effectively leads both the NPCS infrastructure and subscriber equipment segments, and owns the ReFLEX and InFLEXion protocols. With such a command of the basic infrastructure of the NPCS industry, Motorola's actions will undoubtedly have a significant impact on the industry. Moreover, any decisions made by other parties in the industry, such as the FCC or the NPCS carriers, will have to take into account likely responses from the infrastructure vendor.

Carrier Financing

In the market restraints section above, the issue of financing carrier build-out of NPCS networks was discussed. Of the three options available to license holders, debt, equity, and vendor financing, vendor financing is the most probable source for the capital required for build-out. This issue goes to the heart of NPCS carriers' ability to meet the build-out deadlines established by the FCC as part of the NPCS license requirements.

To set NPCS in perspective, vendor financing is common to other, newer sectors of the wireless communications industry. Many PCS carriers could not have built out their networks without the financial backing of the large infrastructure vendors such as Motorola, Lucent Technologies, Ericsson, and Nortel. A number of the new LMDS and broadband fixed wireless carriers such as Advanced Radio Telecom also rely heavily on vendor financing to build their networks.

Yet for all the capital assistance given to other types of wireless carriers, the situation is not analogous for the NPCS industry. Since there are only two infrastructure vendors, the overall number of financing sources is limited. Moreover, NPCS competes with BPCS for capital, which places additional constraints on carrier funding.

This places Motorola and Glenayre in a difficult position. On the one hand, they may be somewhat reluctant to over-extend their financing to NPCS carriers. On the other hand, if they do not somehow subsidize NPCS carriers, the market for their equipment may eventually collapse.

From the carriers' point of view, vendor financing is absolutely essential, particularly if they are to meet the build-out targets established on the conditions of their licenses. With these impending deadlines, financing becomes almost a life or death matter for the carriers. It is possible that without some provision to give carriers more time to obtain adequate financing for build-out, some carriers may be forced to default on the terms of the licenses. This would almost certainly be bad for the entire industry as it would decrease the value of the remaining licenses and would restrict competition in this developing industry.

NPCS Build-Out Deadlines

The issue of the build-out deadlines for NPCS licensees is contentious. A brief examination of the roots of this issue may provide some guidance to the FCC to resolve this problem.

First, when the NPCS license auctions began, it was thought that the two-way messaging systems would be only slightly more complex to implement than conventional one-way systems. As described earlier in this analysis, NPCS networks were in fact more complicated to design and tune than envisioned. It may be that the FCC should consider allowing more development time in future build-out deadlines.

Second, the cost of constructing an NPCS network was higher than was originally envisioned. When the auction and build-out rules were formulated, it was thought that the cost of a two-way network would be comparable to a one-way network. However, the cost of building a two-way network is actually about ten times that of a one-way network. Whereas this is

considerably less than building a BPCS network, it is still higher than what was initially expected.

The combination of these two factors suggests that the amount of time some NPCS license holders need to implement an NPCS network may be longer than was originally given to them. In order to promote competition within the industry overall, some provision to allow current NPCS license holders to find adequate financing and to build out a functional, competitive network should be considered.

The Future Value of NPCS Licenses

Another important undercurrent running throughout this analysis is that the NPCS industry has enormous potential. As Figure 4-3 suggests, there could be almost 90 million NPCS subscribers by the end of 2008. This implies that the NPCS licenses will have a high future value. However, this high value is not assured for a number of reasons.

First, as discussed in the section on vendor financing above, NPCS licensees are highly dependent on Motorola and Glenayre for build-out resources to meet the build-out targets. If the carriers cannot meet these targets and are forced to relinquish their licenses, then the future value of the licenses would decrease, stemming from a reluctance of potential bidders to spend large amounts of money on licenses which have not been profitable for the former license holders. Furthermore, any defaulting on the licenses may concentrate the carrier segment further, potentially restricting competition in the segment.

Second, adding more licensees at this critical stage in the development of the NPCS industry may decrease the value of

the current licenses. Additional licensees would certainly strain the already limited capital resources available for network build-out, potentially leaving some licensees without any source of capital. Furthermore, increasing the competition too much might start a wave of price cutting among carriers, similar to that seen in the mid-1990s in one-way paging which drove many carriers out of the industry. To state this another way, demand should drive supply of NPCS carriers, rather than the supply of carriers driving the demand. The FCC should consider delaying any additional auctions for NPCS spectrum until the current license holders have become firmly established.

Third, the future value of an NPCS license is significantly affected by the level of development within that license. If a part of the spectrum covered by a current NPCS license does not currently have infrastructure built to support narrowband services, the future value may be depressed because the build-out deadline remains the same, regardless of who the owner is. This means that any building must be done rapidly to meet the deadline, unless the rules specifying the build-out deadlines are modified.

Fourth, the future value NPCS licenses may be less than the current value. AT&T Wireless recently sold its NPCS licenses to Metrocall. AT&T paid approximately $80 million for them after the NPCS license auctions, but sold them to Metrocall for approximately $30 million. Without speculating on the reasons behind the 63 percent decrease in value, this example does indicate that the value of an NPCS license is not guaranteed to appreciate over time. Adding more licenses in the near term may reduce the future value of current licenses.

In sum, the future value of the current NPCS licenses should be protected now. Just as a new seedlings need to be protected from over-fertilization until their root systems are fully established, so too should the NPCS industry be protected from too much competition in its developmental stages.

5

Appendix: Database of Key NPCS Industry Participants

AirTouch Paging .....(972) 860-3210
12221 Merit Drive, Suite 800
Dallas, TX 72521

American Paging, Inc.....(612) 623-3100
1300 Godward St. NE
Minneapolis, MN 55413

Ameritech Cellular & Paging Services, Inc. .....(847) 248-2000
2000 W. Ameritech Center Drive
Hoffman Estates, IL 60195

Arch Communications Group, Inc......(508) 870-6700
1800 West Park Drive, Suite 250
Westborough, MA 01581

AT&T Wireless Services, Inc. .....(425) 827-4500
5000 Carillon Point
Kirkland, WA 98033

Benbow PCS Ventures, Inc......(707) 443-0806
1615 Highland Avenue
Eureka, CA 95503

CONXUS Communications, Inc. .....(864) 235-0940
15 S. Main St., Suite 810
Greenville, SC 29601

Glenayre Technologies, Inc. .....(704) 553-0038
5935 Carnegie Blvd.
Charlotte, NC 28209

Insta-Check Systems, Inc. .....(305) 592-7800
1691 NW 107th Avenue
Miami, FL 33172

JP Systems, Inc......(972) 484-5432
2695 Villa Creek, Suite 240
Dallas, TX 75234

Metrocall, Inc. .....(703) 660-6677
6677 Richmond Highway
Alexandria, VA 22306

MobileComm, Inc. .....(201) 440-8400
65 Challenger Road
Ridgefield Park, NJ 07660

Motorola, Inc. .....(561) 739-2000
Paging Products Group
1500 Gateway Blvd.
Boynton Beach, FL 33426

Motorola, Inc. .....(817) 245-2000
Paging Systems Group
5401 North Beach St.
Fort Worth, TX 76137

SkyTel (Mtel).....(601) 944-1300
200 South Lamar
Jackson, MS 39201

PageMart Wireless, Inc. .....(214) 765-4000
3333 Lee Parkway
Dallas, TX 75219

Paging Network, Inc. (PageNet) .....(972) 801-8000
14911 Quorum Drive, Suite 600
Dallas, TX 75240

Philips Consumer Communcations L.P. .....(770) 821-2400
Division of Philips Electronics N.V.
64 Perimeter Center East
Atlanta, GA 31416

Rohde & Schwartz Inc. .....(301) 459-8800
4425 Nicole Drive
Lanham, MD 20706

TSR Wireless LLC .....(877) 795-7464
400 Kelby St.
8th Floor
Fort Lee, NJ 07024

Uniden America Corporation .....(817) 858-3300
4700 Amon Carter Blvd.
Fort Worth, TX 76155

Wireless Access, Inc. .....(408) 653-1555
Subsidiary of Glenayre Technologies, Inc.
2101 Tasman Drive
Santa Clara, CA 95054