IV. TELOCATOR SUPPORTS THE PROPOSED ALLOCATION OF SPECTRUM FOR UNLICENSED PCS DEVICES AND SUGGESTS ESTABLISHMENT OF AN INDUSTRY MECHANISM FOR RELOCATING 2 GHz MICROWAVE LICENSEES

A. The Commission's Recent Action in the Emerging Technologies Rulemaking Contemplates that Providers of Unlicensed Devices Must Provide Cost Compensation for the Relocation of 2 GHz Microwave Licensees

In its Emerging Technologies rulemaking, the Commission has adopted policies that afford 2 GHz microwave licensees co-primary status with licensed and unlicensed PCS uses. The involuntary relocation of current microwave licensees requires guarantees of cost compensation and the availability of comparable alternative facilities. While such reimbursement of costs is appropriate, Telocator and its members do not believe that these safeguards should be misused for windfall profits.

With respect to licensed PCS services, clear economic incentives exist for the new licensees who receive exclusive spectrum rights for defined service areas to assume the responsibility for funding and effectuating relocations consistent with Commission policies. In the case of unlicensed devices, however, there are numerous prospective providers of devices who would not hold exclusive spectrum rights for designated service areas. Moreover, there is no existing mechanism for different competing suppliers of unlicensed devices to collectively engage in the mutually beneficial task of band clearing to permit the introduction of their products and offerings.

The cost compensation task facing providers of unlicensed devices is both large and pressing. For example, there are approximately 450 microwave facilities licensed to over 100 different entities operating across the country in the 1910-1930 MHz band. Relocation of these operations is necessary for effective use of the spectrum by unlicensed devices. Under Commission requirements, this will require negotiations with each microwave licensee, funding for cost compensation and ensuring that comparable alternative facilities are available. The critical question is who is to pay these licensees and how is that cost to be recouped from the beneficiaries of the allocated spectrum?

B. The Formation of a Non-Profit Entity Is Needed to Provide a Cost Compensation Mechanism for Relocation of 1910-1930 MHz Microwave Licensees

Telocator believes that the creation of a non-profit entity, such as a consortium, is needed to assume relocation obligations on behalf of the unlicensed device industry. This entity would have to raise enough capital to begin negotiating with, and compensating, existing licensees. The money would be supplied by the companies planning to manufacture the devices that would use the unlicensed spectrum.

As a fundamental matter, the non-profit entity would seek and be open to the participation of any prospective providers of unlicensed devices willing to pay an equitable share of the relocation costs. These costs include negotiation and relocation

expenses, and a sufficient amount to compensate old users if their new facilities prove unsatisfactory in practice. The only other condition on participation in the consortium should be a commitment to abide by any and all applicable FCC rules.

Initial capital could be raised in one of at least three ways:

- Voluntary initial contributions. Voluntary initial contributions could be sought from those manufacturers interested in using the unlicensed spectrum to provide "seed" money for the consortium. A system would be developed to reimburse these founding parents for "excess" contributions based upon participation of other entrants.

- Loan. A financial institution could put up the money for the costs of transition. The institution would be compensated by the amounts paid by each manufacturer to the entity for a sub-license.

- Bond. A bond could be raised on behalf of the industry.

All manufacturers that want to sell devices using this spectrum would contribute to the cost pool either on a flat rate basis or based on their projected sales or revenues. To offset the incentive to underestimate future sales, representations as to expected sales could be checked against other publicly released materials, such as materials used to raise outside capital. In any event, all contributions would be equalized and reallocated.

The FCC, in authorizing use of the spectrum or in its equipment approval process, should help insure that all providers of devices contribute to the relocation costs. All providers of devices benefitting from the clearing of spectrum for their

products or offerings should contribute fairly and equitably to defraying the costs of relocating incumbent microwave licensees. This may require that the Commission's spectrum authorization or equipment approval processes place an affirmative duty upon prospective providers of devices to participate in the non-profit entity handling relocation tasks and/or contribute to the costs of that undertaking.

V. CONCLUSION

The Commission's Notice is a needed and vitally important breakthrough for the PCS industry and the public at large. The Notice defines appropriate goals for PCS policies and details a realistic regulatory framework optimally suited to maximizing those goals. In fleshing out the proposed regulatory framework, Telocator urges the Commission to carefully examine the collective insights of the PCS industry as a whole. In particular, Telocator believes the consensus positions described above, which represent the strong consensus of the diverse interests with a stake in PCS, on spectrum allocations, encouraging qualified entry, and developing service flexibility

will benefit the public by allowing many diverse PCS services to be brought to the public rapidly, efficiently, economically, and competitively.

Respectfully submitted,

TELOCATOR, THE PERSONAL COMMUNICATIONS INDUSTRY ASSOCIATION

By: Thomas A. Stroup

Thomas A. Stroup
Mark Golden
TELOCATOR
1019 19th Street, N.W.
Suite 1100
Washington, D.C. 20036
(202) 467-4770

November 4, 1992

TAB A

Telocator PCS Section

Marketing and Consumer Affairs Committee

Customer Requirements Subcommittee

PCS Demand Forecast

May 1, 1992

Introduction

Purpose and Background

This document was prepared by the Customer Requirements Subcommittee of the Telocator Marketing and Consumer Affairs Committee. It presents market size estimates that the Telocator PCS Section determined would be essential to understanding the scope and nature of any PCS service. Further, it also attempts to gauge the impact of competition among new services as well as their impact on existing services and, finally, to estimate the impact of a delay in FCC licensing of emerging services on market size estimates.

Overview

Several demand forecasting methodologies for PCS services were considered by the Customer Requirements Subcommittee in approaching this study. The approach chosen for determining demand was a series of surveys across industry experts already available in the Telocator membership. Among professional market researchers, this consensus-building "Delphi" methodology is considered meaningful in providing legitimate points of reference for analyzing future markets. Using this approach, the PCS results provide a meaningful reference point for further discussions by the industry. A major advantage in using Telocator members in this study is that they represent a very diverse set of viewpoints and expertise.

The Delphi technique deletes both high and low responses prior to calculation of final results to maintain statistical validity and prevent single responses from disproportionately skewing the overall results.

A majority of the PCS Section member companies responded to the survey, distributed in early 1992. These members include representatives from various industry types such as

network and CPE manufacturers, LECs, cellular carriers, research organizations and entrepreneurs. In many cases, members provided results of internal primary research conducted by their respective companies as the basis for their response, in other cases internal estimates were offered. Each respondent was asked to estimate future market sizes based on their expectations of price and cross elasticity between services, new and existing. To better gauge the effect of the timing of licensing, respondents were asked to provide separate estimates based on scenarios with licensing in 1994 (Matrix #1) and 1997 (Matrix #2).

In the attached survey results, the requested estimates for 1997 and 2002 are shown for each of the licensing scenarios. Market estimates are expressed in terms of population penetration. The average of responses for each service in each scenario is shown first in larger type and the range of responses, minus the highs and lows, is shown directly below. The range of responses is included to allow the reader further insight into the dynamics of the market when viewed collectively by diverse groups. Penetration estimates were for specific service subscriptions rather than for specific customers, this allows for one customer to subscribe to multiple services.

CPE price and monthly service estimates are expressed as a range of responses only and averages cannot be inferred from this information. It should also be noted that respondent's individual survey submissions were kept confidential.

Survey Assumptions

The following specific assumptions were used by the survey respondents in formulating their market estimates:

- Service descriptions and capabilities are based on definitions set forth in the Telocator Marketing Service Descriptions Document for Personal Communication Services.

- A fully competitive environment, where services coexist simultaneously and the demand for one service may influence the demand for others.

- Existing services evolve into more mature services possibly offering greater functionality. As an example, paging services evolve to advanced paging where customers are offered greater messaging capabilities. The matrices list these services together and a single forecast was requested. In addition, advanced paging is considered as any service provided over traditional paging channels.

- Cellular, Advanced Cellular, ESMR, and PTS all share similar service descriptions. Although at the point of licensing these services may not all provide the same set of capabilities, it can be assumed that over time each will meet their full range of capabilities as described in the service descriptions document.

- Telepoint / Advanced Telepoint and other listed services may include a pager for call notification. Subscribers for such services were counted as both a Telepoint customer, for example, and a paging customer.

- Some respondents viewed certain services such as Wireless PBX as a non-carrier service and projected monthly service at $0, others did associate a monthly service charge. These separate views explain what initially appears as a price aberration in the results matrix.

Summary

These market estimates provide the industry with useful information in evaluating PCS, its potential and impact on existing services. The study itself remains only an averaging of penetration responses from industry participants. There are, of course, other research methods that can be employed to evaluate future markets. The specific intent of this exercise, however, was to depict the views and existing findings of industry experts. Interestingly, the points of reference presented by this study are consistent with other industry efforts in forecasting future market potential. Specifically, this study and the TIA Ad-hoc Microcell committee report both gauge the PCS market in the neighborhood of 60 - 90 million subscribers.

The following can be used as a guide in reading the results matrices:

Matrix #1 *
Assumes Full FCC Licensing in 1994

	1997 Market Forecast			2002 Market Forecast		
	Market Penetration	CPE Price (Range of Responses)	Monthly Service (Range of Responses)	Market Penetration	CPE Price (Range of Responses)	Monthly Service (Range of Responses)
Service Description	Average of Responses			Average of Responses		
and estimate of 1991 Market Size	Range of Responses	Range of Responses	Range of Responses	Range of Responses	Range of Responses	Range of Responses
	Market Size			Market Size		

* High and Low estimates not included and estimates allow for multiple services per customer

Matrix # 2 *
Assumes Full FCC Licensing in 1997

	1997 Market Forecast			2002 Market Forecast		
	Market Penetration	CPE Price (Range of Responses)	Monthly Service (Range of Responses)	Market Penetration	CPE Price (Range of Responses)	Monthly Service (Range of Responses)
Service Description	Average of Responses			Average of Responses		
and estimate of 1991 Market Size	Range of Responses	Range of Responses	Range of Responses	Range of Responses	Range of Responses	Range of Responses
	Market Size			Market Size		

* High and Low estimates not included and estimates allow for multiple services per customer

Matrix #1

TELOCATOR PCS MARKET FORECAST - ASSUMING LICENSING IN 1994

Penetration of Population (1991 Base: 250 Million)

	1991 Existing Size Estimate	Year 1997 Market Forecast: % Penetration - Total Market / Range of Responses / Estimated Market Size	CPE Price $ Range	Monthly Service $ Range	Year 2002 Market Forecas: % Penetration - Total Market / Range of Responses / Estimated Market Size	CPE Price $ Range	Monthly Service $ Range
Paging	11.2 Million	Avg 6.30%			Avg 8.13%		
Adv. Paging	4.50%	Range 5.00% - 8.00%	$75 - $100	$8 - $15	Range 7.00% - 9.80%	$45 - $79	$7 - $15
		Mkt Size 16.70 Million			Mkt Size 22.99 Million		
Cordless Phone	35.1 Million	Avg 17.83%			Avg 20.83%		
	14.30%	Range 12.00% - 25.00%	$75 - $100		Range 8.00% - 48.00%	$50 - $75	
		Mkt Size 47.26 Million			Mkt Size 58.96 Million		
Telepoint	NA	Avg 2.14%			Avg 5.43%		
Adv. Telepoint		Range 0.60% - 4.30%	$159 - $250	$20 - $28	Range 2.00% - 8.00%	$75 - $150	$15 - $25
		Mkt Size 5.66 Million			Mkt Size 15.35 Million		
Cellular	6.1 Million	Avg 8.31%			Avg 12.43%		
Adv. Cellular	2.50%	Range 4.00% - 11.00%	$200 - $600	$62 - $85	Range 5.00% - 18.00%	$150 - $300	$50 - $75
		Mkt Size 22.02 Million			Mkt Size 35.17 Million		
SMR/ESMR	1.2 Million	Avg 0.84%			Avg 1.50%		
	0.50%	Range 0.50% - 1.00%	$500 - $900	$25 - $50	Range 0.50% - 3.00%	$300 - $800	$30 - $45
		Mkt Size 2.23 Million			Mkt Size 4.24 Million		
PTS	NA	Avg 3.55%			Avg 8.75%		
		Range 0.60% - 10.00%	$175 - $300	$35 - $65	Range 5.00% - 15.00%	$100 - $300	$30 - $65
		Mkt Size 9.41 Million			Mkt Size 24.75 Million		
Adv. Cordless/	NA	Avg 3.11%			Avg 5.71%		
Wireless PBX		Range 1.00% - 7.00%	$150 - $450	$0 - $55	Range 2.10% - 9.40%	$99 - $400	$0 - $50
		Mkt Size 8.25 Million			Mkt Size 15.17 Million		

* Penetration estimates for all services can total more than 100%. Allows for multiple services per person.

Matrix #2

TELOCATOR PCS MARKET FORECAST - ASSUMING LICENSING IN 1997

Penetration of Population (1991 Base: 250 Million)

	1991 Existing Size Estimate	Year 1997 Market Forecast: % Penetration - Total Market / Range of Responses / Estimated Market Size	Year 1997: CPE Price $ Range	Year 1997: Monthly Service $ Range	Year 2002 Market Forecas: % Penetration - Total Market / Range of Responses / Estimated Market Size	Year 2002: CPE Price $ Range	Year 2002: Monthly Service $ Range
Paging Adv. Paging	11.2 Million 4.50%	Avg 6.85% Range 5.00% - 9.30% Mkt Size 16.15 Million	$65 - $109	$8 - $15	Avg 9.04% Range 6.00% - 12.50% Mkt Size 25.58 Million	$40 - $79	$6 - $15
Cordless Phone	35.1 Million 14.30%	Avg 20.00% Range 15.00% - 25.00% Mkt Size 53.00 Million	$75 - $85	-	Avg 23.67% Range 12.00% - 50.00% Mkt Size 66.98 Million	$50 - $75	-
Telepoint Adv. Telepoint	NA	Avg 0.56% Range 0.00% - 2.10% Mkt Size 1.48 Million	$200 - $249	$25 - $30	Avg 2.64% Range 1.10% - 4.00% Mkt Size 7.46 Million	$99 - $200	$20 - $26
Cellular Adv. Cellular	6.1 Million 2.50%	Avg 9.06% Range 4.20% - 13.00% Mkt Size 24.01 Million	$200 - $600	$60 - $85	Avg 13.26% Range 7.50% - 18.80% Mkt Size 37.54 Million	$150 - $400	$40 - $75
SMR/ESMR	1.2 Million 0.50%	Avg 0.88% Range 0.50% - 1.20% Mkt Size 2.33 Million	$500 - $900	$25 - $50	Avg 1.85% Range 1.00% - 3.00% Mkt Size 5.25 Million	$300 - $800	$30 - $60
PTS	NA	Avg 0.17% Range 0.00% - 1.00% Mkt Size 0.46 Million	$250 - $500	$20 - $42	Avg 7.96% Range 3.00% - 25.00% Mkt Size 22.54 Million	$125 - $350	$35 - $65
Adv. Cordless/ Wireless PBX	NA	Avg 0.56% Range 0.00% - 1.50% Mkt Size 1.47 Million	$100 - $500	$0 - $50	Avg 5.67% Range 1.70% - 15.00% Mkt Size 16.05 Million	$100 - $400	$0 - $50

* Penetration estimates for all services can total more than 100%. Allows for multiple services per person.

TAB B

5/28/92
TE/92-5-28/076

TELOCATOR SPECTRUM ESTIMATES FOR PCS REPORT

An Analysis of Clear Spectrum Required to Support Emerging PCS Services

Prepared by:

Telocator PCS Technical and Engineering Committee

SPECTRUM ESTIMATES FOR PCS

EXECUTIVE SUMMARY

The purpose of this document is to derive estimates of clear spectrum required to support the emerging PCS services of Wireless PBX/Advanced Cordless, Advanced Telepoint and PTS services as described in the *Telocator Services Description Document*. Traffic estimates used in this analysis were provided by the Telocator Marketing and Consumer Affairs Committee document *Traffic Estimates for Emerging Technologies*. The demand and usage of PCS services are based on a 1994 licensing date and a projected 2002 demand..

It is recognized that other services such as satellite and wireless LANs will require spectrum. Based on technical sharing analysis work conducted in the Telocator Technical and Engineering Committee these needs will require separate and distinct spectrum segments and their spectrum requirement is not addressed in this report.

It is difficult to develop a single spectrum requirement number, as a range of technology complexities and implementation regimes are possible. Therefore, this document presents four scenarios that address representative cases of 32 and 16 Kbps voice coding, omni-directional reuse factors of 12 and 24, and typical cell site separations. The clear spectrum requirement is determined for each case. The analysis does not sanction any particular technology.

The "A" and "B" scenarios represent optimistic and conservative deployment assumptions based on current technology. The "C" and "D" scenarios correspond to optimistic and conservative deployment cases assuming future technology expected within a 10 year time frame. Initial deployment in 1994 will likely use 32 Kbps voice coding to obtain realizable and cost effective systems. Migration to 16 Kbps (or below) voice coding will accommodate service growth.

Within the four scenarios, spectrum estimates are calculated to support one, two, and three service provider cases. Equal division of traffic among providers was presumed within each service type. Trunking models dictate an increase in total trunks (i.e.spectrum requirement) as more providers are assumed with each additional provider decreasing the overall trunking efficiency. However, in the case of Wireless PBX/Advanced Cordless a "spectrum sharing etiquette" is presumed that allows multiple providers to share spectrum with no increase in the spectrum requirement.

SUMMARY OF CLEAR SPECTRUM ESTIMATES FOR PCS

The four representative scenarios used to derive the clear spectrum estimates required to support the emerging PCS services of Wireless PBX/Advanced Cordless, Advanced Telepoint, and PTS are summarized with the results:

SCENARIO	SITUATION	VOICE CODING Kbps	DUPLEX CHANNEL BANDWIDTH	OMNI REUSE FACTOR
'A'	current technology optimistic deployment	32	100 Khz	12
'B'	current technology conservative deployment	32	100 Khz	24
'C'	future technology optimistic deployment	16	50 Khz	12
'D'	future technology conservative deployment	16	50 Khz	24

Total Clear Spectrum Need of PTS(all) + Advanced Telepoint (rounded values)

Scenario		Single Provider (Mhz)	Two Providers (Mhz)	(per provider)	Three Providers (Mhz)	(per provider)
'A'	32 Kbps, N=12	84	97	(49)	108	(36)
'B'	32 Kbps, N=24	167	194	(97)	216	(72)
'C'	16 Kbps, N=12	42	49	(25)	54	(18)
'D'	16 Kbps, N=24	84	97	(49)	108	(36)

Total Clear Spectrum Need of Wireless PBX/Advanced Cordless (rounded values)

Scenario		Single Provider (Mhz)	Two Providers (Mhz)	Three Providers (Mhz)
'A'	32 Kbps N=12	27	27	27
'B'	32 Kbps N=24	54	54	54
'C'	16 Kbps N=12	14	14	14
'D'	16 Kbps N=24	27	27	27

Note: A "spectrum sharing etiquette" is presumed for Wireless PBX/Advanced Cordless that allows multiple providers to share spectrum with no increase in spectrum across multiple providers.

Adjustments must be made to these results if assumptions are altered.

METHODOLOGY

The T&E Access Subcommittee developed several deployment models that integrated the range of traffic estimates with various cell separation distances for certain baseline technology complexities and reuse factors.

The traffic estimate matrix (from the Marketing Committee) is included as **Attachment 1**. Values that reflect the peak demand on a cell site were selected from this traffic matrix for use in this study.

A key aspect of this analysis is the infrastructure placement. Cell site antenna separations that encompass "small" to "large" cells for each service category were analyzed. The range of options is presented here. Of the presented values, a singular separation was selected as representative (on a macro scale) within each category. Those choices are highlighted. It is recognized that actual cells in a fully deployed system may be either smaller or larger than the selected choice.

SERVICE TYPE	SEPARATION CHOICES (meters)
WPBX/ADVANCED CORDLESS	25, 40, **50**, 60
ADVANCED TELEPOINT	40, **100**, 500
PTS STATIONARY	25, 40, **50**, 60
PTS PEDESTRIAN	40, **100**, 500
PTS VEHICULAR	500, **1000**, 5000

The chosen traffic values and the selected cell separations used in the study are summarized:

PCS TRAFFIC ESTIMATES AND REPRESENTATIVE SYSTEM MODEL

SERVICE	USERS IN AREA	BLOCKING P=	MINUTES PER USER (peak busy hour)	ERLANGS PER USER	CELL SPACING (meters)
W-PBX/ ADVANCED CORDLESS	.19	.01	15	.25	50
TELEPOINT	1.6	.05	4	.067	100
PTS:					
PEDESTRIAN	3.0	.02	4	.067	100
STATIONARY	0.3	.01	15	.25	50
VEHICULAR	150	.02	3	.05	1000

ASSUMPTIONS FOR THIS MODEL

* High demand extract from Document MCCR/92-5-1/002 Rev 2 *Draft.*
* Demand in 2002 with licensing in 1994
* Penetration and pricing based on preliminary expert demand study conducted by Telocator
* Spectrum requirements for PCS application areas (e.g. W-PBX, Advanced Telepoint...) are calculated independently (with the exception of non-business Advanced Cordless which will share the same allocation as W-PBX and should require less spectrum that W-PBX.
* Clear spectrum for PCS. That is, no sharing of spectrum with non-PCS applications.
* Channel bandwidths stated subsequently are considered to be equivalent duplex channel bandwidths.
* The traffic model used for trunk sizing is generally Erlang 'B' (infinite population) except for the cases of W-PBX and PTS Stationary which are more appropriately Engset due to the finite population.
* Advanced Telepoint is considered as an additional traffic load to PTS Pedestrian and is likely to be served by a common infrastructure. Telepoint traffic will not be analyzed as requiring independent spectrum in this analysis.
* Adjustment factors are developed for multiple provider cases.
* W-PBX/Advanced Cordless analysis presumes a spectrum sharing etiquette that allows "N" users to share with no spectrum increase.
* Analysis does not sanction any particular technology.
* Reuse adjustment is required to accommodate three dimensions. Dynamic reuse of 6 is adjusted by factor of 3 and scaled by the assumed reuse of 12. (e.g. 3*6/12= 1.5

An overview of the calculation methodology is presented in **Attachment 2.**

SCENARIO SELECTION

The four scenarios analyzed using the above model and values are selected to present viewpoints of current and future technology. Also, consideration has been given to issues related to coverage and propagation variability.

VOICE CODING ISSUES

It is recognized that the following criteria for the defined PCS services: Voice quality approaching wireline (i.e. Mean Opinion Score value approaching 4.0), the need to carry voice band data up to 4800 baud delivered by traditional wireline voice modems, the need to transport facsimile, and a requirement for low cost subscriber and infrastructure equipment consistent with reasonable long battery life, will drive the technology selection towards 32 Kbps voice coding initially with migration towards 16 Kbps voice coding. The service offered will need to support both old and new coders. Therefore long-term spectrum requirements will be reduced over what would be required if only 32 Kbps coders were used A lower bound can be established if only 16 Kbps coders were used.

This document does not address the transition from 32 Kbps to 16 Kbps, nor does it presume availability of 16 Kbps technology at any particular point in time prior to 2002.

COVERAGE AND PROPAGATION ISSUE

Analysis of current efforts related to system design to ensure coverage of 90% to 99% coupled with the variability of propagation at 2 Ghz in various deployment environments (i.e. urban, in building, campus, street, etc..) drives the analysis towards an optimistic and conservative deployment view.

The principal factor that accommodates this is the reuse pattern or ratio. For the presumption of omni cells (as used in this model) the optimistic case reuse chosen is 12 and the conservative reuse chosen is 24.

REPRESENTATIVE SCENARIOS

The four representative scenarios are summarized:

SCENARIO	SITUATION	VOICE CODING Kbps	DUPLEX CHANNEL BANDWIDTH	OMNI REUSE FACTOR
'A'	current technology optimistic deploy	32	100 Khz	12
'B'	current technology conservative deploy	32	100 Khz	24
'C'	future technology optimistic deploy	16	50 Khz	12
'D'	future technology conservative deploy	16	50 Khz	24

PRESENTATION OF SCENARIOS AND RESULTS

SCENARIO 'A': Current Technology, Optimistic Deployment

32 Kbps voice coding @ 100 Khz duplex bandwidth for reuse = 12

SERVICE	TOTAL TRAFFIC erlangs	SINGLE PROVIDER Mhz	TWO PROVIDER Mhz	THREE PROVIDER Mhz	
WPBX/* ADVANCED CORDLESS	10.1	26.6	26.6	26.6	Engset (.82)

*(NOTE: Reuse adjustment factor applied to accommodate three dimensions.)

TELEPOINT	9.2	(NOTE: added to PTS pedestrian in calculating Mhz need)			
PTS-Pedestrian	17.0	43.2	48.0	54.0	
PTS-Stationary	16.0	25.6	29.7	32.0	Engset (.82)
PTS-Vehicular	6.5	14.4	19.2	21.6	
TELEPOINT +PTS (all) TOTAL:		83.2	96.9	107.6	
per provider		83.2	48.5	35.9	

SCENARIO 'B': Current Technology, Conservative Deployment
32 Kbps voice coding @ 100 Khz duplex bandwidth for reuse = 24

SERVICE	TOTAL TRAFFIC erlangs	SINGLE PROVIDER Mhz	TWO PROVIDER Mhz	THREE PROVIDER Mhz	
WPBX/* ADVANCED CORDLESS	10.1	53.2	53.2	53.2	Engset (.82)

*(NOTE: Reuse adjustment factor applied to accommodate three dimensions.)

TELEPOINT	9.2	(NOTE: added to PTS pedestrian in calculating Mhz need)			
PTS-Pedestrian	17.0	86.4	96.0	108.0	
PTS-Stationary	16.0	51.2	59.4	64.0	Engset (.82)
PTS-Vehicular	6.5	28.8	38.4	43.2	
TELEPOINT +PTS (all) TOTAL:		166.4	193.8	215.2	
per provider		166.4	96.9	71.7	

SCENARIO 'C': Future Technology, Optimistic Deployment
16 Kbps voice coding @ 50 Khz duplex bandwidth for reuse = 12

SERVICE	TOTAL TRAFFIC erlangs	*NUMBER OF PROVIDERS* SINGLE NEED Mhz	TWO NEED Mhz	THREE NEED Mhz	
WPBX/* ADVANCED CORDLESS	10.1	13.3	13.3	13.3	Engset (.82)

*(NOTE: Reuse adjustment factor applied to accommodate three dimensions.)

TELEPOINT	9.2	(NOTE: added to PTS pedestrian in calculating Mhz need)			
PTS-Pedestrian	17.0	21.6	24.0	27.0	
PTS-Stationary	16.0	12.8	14.9	16.0	Engset (.82)
PTS-Vehicular	6.5	7.2	9.6	10.8	
TELEPOINT +PTS (all) TOTAL		41.6	48.5	53.8	
per provider		41.6	24.3	17.9	

SCENARIO 'D': Future Technology, Conservative Deployment
16 Kbps voice coding @ 50 Khz duplex bandwidth for reuse = 24

SERVICE	TOTAL TRAFFIC erlangs	SINGLE PROVIDER Mhz	TWO PROVIDER Mhz	THREE PROVIDER Mhz	
WPBX/* ADVANCED CORDLESS	10.1	26.6	26.6	26.6	Engset (.82)

*(NOTE: Reuse adjustment factor applied to accommodate three dimensions.)

TELEPOINT	9.2	(NOTE: added to PTS pedestrian in calculating Mhz need)			
PTS-Pedestrian	17.0	43.2	48.0	54.0	
PTS-Stationary	16.0	25.6	29.7	32.0	Engset (.82)
PTS-Vehicular	6.5	14.4	19.2	21.6	
TELEPOINT +PTS (all) TOTAL:		83.2	96.9	107.6	
per provider		83.2	48.5	35.9	

ADDITIONAL OBSERVATIONS

Data Traffic

While the traffic demand estimates, did include some data traffic, the only data communications included was traffic that could be accommodated in a voice channel, i.e. 9.6 Kbps or lower. We explicitly did not include any estimate of the spectrum needed for proposals for a "wireless LANs." These proposals envision peak channel rates well in excess of 1 Mbps. Provision of this type of service will require a separate allocation of spectrum.

Impact of Spectrum Sharing

These estimates were derived assuming that these bands are totally allocated to PCS ("clear spectrum"). This obviously will not be true at the beginning of PCS (licensing was assumed to be 1994 in this analysis) when the allocation will be shared with existing fixed microwave service. Since initial PCS demand will be substantially below the levels used in this analysis (assumed to be 2002 demand), this should not create a problem. The relevant issue is whether by 2002 (when the demand has reached projected level) the useable PCS capacity is still significantly limited by the continued necessity to share with remaining fixed microwave links. Thus, these estimates will **understate the amount of spectrum needed, if significant fixed microwave links remain in service after 2002.**

Unlicensed Services

In the case of the W-PBX/Advanced Cordless service, operating in an unlicensed environment (perhaps Part 16 -PCS) it is conceivable that the assumption of a spectrum sharing etiquette that allows sharing of "N" providers with little or no increase in required spectrum may not be valid. In that event, the spectrum need would need to increase in an analogous manner to the multi-provider cases discussed previously.

Growth Beyond 2002

It is recognized that the demand stated for 2002 does not represent the ultimate demand for PCS service. It is envisioned that technology evolution and cell splitting will allow post 2002 demand to be met with the calculated spectrum requirement.

Cost Inputs

In general, the more spectrum that is available to meet a given level of demand, the lower the cost (for a given level of technology). Reducing cell size (thereby adding additional base stations) will usually provide additional capacity, but at a significant increase in cost. Obviously, the larger the total aggregate demand, the smaller cell size can still be economically supported. To provide precise estimates of the trade-off between total demand and economically feasible cell size would require an analysis of detailed system design studies. Since such a study is beyond the resources of the Committee, engineering judgment was used in selecting the cell size (or antenna-antenna spacing). While the cell sizes selected are significantly smaller than are likely to be used in the initial deployment, they are not the smallest cells that are technically possible. Two concerns motivated the use of larger cells The first concern was the need to limit infrastructure cost (discussed above). The second concern, was to allow the use of smaller cells to resolve extreme cases, where because of peculiar local circumstances (usage, propagation conditions, etc.) more capacity was required.

ATTACHMENT 1
PCS TRAFFIC ESTIMATES
TELOCATOR MARKETING COMMITTEE - CUSTOMER REQUIREMENTS

Service	Environment	Area of use	Users in Area	Blocking %	Minutes of Use/User (peak busy hour)
Telepoint	Public	100 m^2	.2 - 1.6	5	3 - 4
Wireless PBX	Office	10 m^2	.02 - .19	1	11 - 15
PTS	Stationary	10 m^2	.05 - .3	1	3 - 15
	Pedestrian	100 m^2	.5 - 3	2	3 - 4
	Vehicular	1 km^2	50 - 150	2	2 - 3

Assumptions underlying PCS traffic estimates

- Demand in 2002 with licensing in 1994
- Penetration and pricing based on preliminary expert demand study conducted by Telocator
- Pricing effects penetration and customer tolerances
- Estimates represent most expected ranges (90% confidence level)
- Ranges do not represent absolute worst or best cases
- Example of high density population is set at 1 person per 5 m^2, low at 1 per 10 m^2
- Estimates are currently preliminary and have not been submitted to the full Marketing Committee for approval (subject to change)

DRAFT
MCCR/92-5-1/002
REV 2

Attachment 2
Methodology used in Calculating Spectrum Requirements Estimates for One Class of Systems

1.0 Assumptions

Both the assumptions in Attachment 1 and the assumptions described below were used in deriving the spectrum estimates.

- Minimum bandwidth per port is defined in terms of 50 and 100 Khz "equivalent channels" in this study. Ports are designed to only use the minimum number of "equivalent channels" needed to support the traffic load i.e. modularity of channel assignment at port is one. It is recognized that this may not be a valid assumption for certain technologies, for example
  - Broadband CDMA systems that may require 40 Mhz or more to get started.
  - TDMA systems in low traffic density situations require enough spectrum for one carrier frequency per provider to be active to get started.

  In addition, it should be pointed out that:
  - Broadband CDMA systems may be able to share with fixed services within its minimum spectrum requirements.
  - TDMA systems will require additional spectrum, beyond the minimum required for traffic, when sharing with fixed services.. This is needed in order to find clear "slots" in which to operate.

- Reuse pattern = 12 or 24 in two dimension, 18 or 36 in three dimensions.

- The demand information given to the T&E Committee is in terms of user densities and traffic per user. This analysis assumes that there is sufficient traffic to require users to deploy enough cells such that they need to use the full reuse pattern associated with a radio technology.

2.0 Methodology

The steps used in calculating the spectrum estimates can be summarized as follows:

1. Determine size of serving area of a port using selected "economic" port spacing assumptions

2. Calculate traffic in an area (Use traffic data given to us by Customer Requirements Subcommittee to calculate load.)

3. Calculate channels required per port for this type of application by entering traffic data into Erlang B table or Engset, as appropriate, with assumed blocking assumptions for the serving area.

4. Calculate bandwidth required per port.

5. Multiply by reuse factor to get spectrum requirements for a single provider.

6. For multiple provider analysis, presume equal traffic sharing among the providers for each service type. Using this per carrier traffic load and the appropriate traffic tables, determine a correction factor that adjusts the single provider spectrum to that required by multiple providers each with smaller trunk quantities and lower effective trunking efficiency.