

Effects of Delay on PCS Market Potential

To examine overall demand and cross-elasticities of demand between PCS and cellular, we carried out surveys of 3,400 households and business decisionmakers

- Respondents were given a discrete choice task in which they had to select between PCS and cellular at different price levels
- Overall price elasticities and cross-elasticities were estimated from these data

To examine the impact of delay on demand, we then used a “successive generation” diffusion of adoption model

We have developed a model derived from Norton and Bass (University of Texas) which takes into account the performance of successive generations of products - in this case PCS as a new, improved generation of cellular

Our perspective is that:

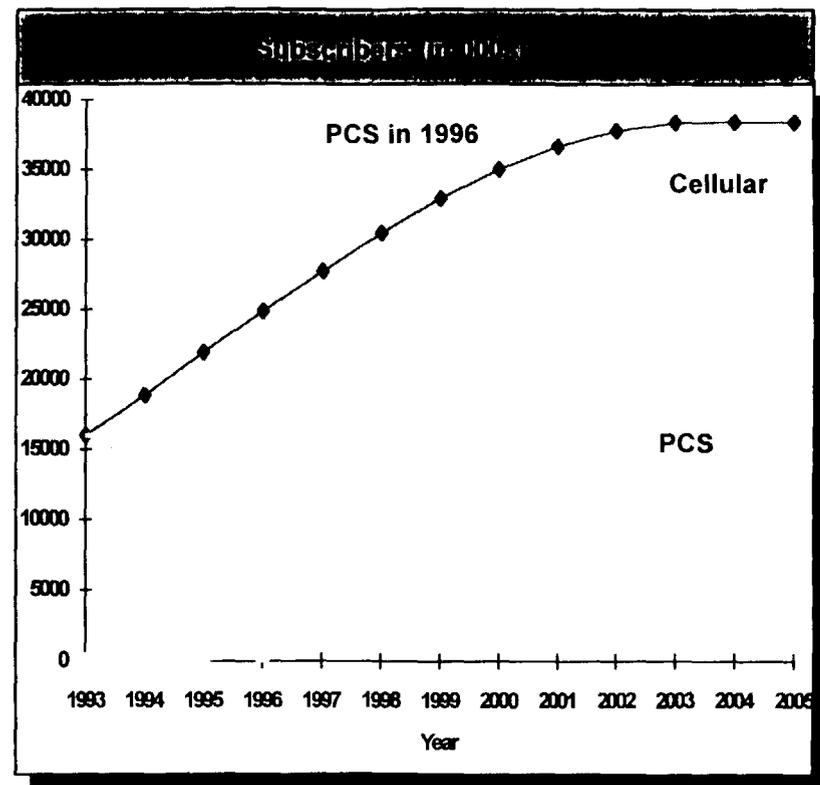
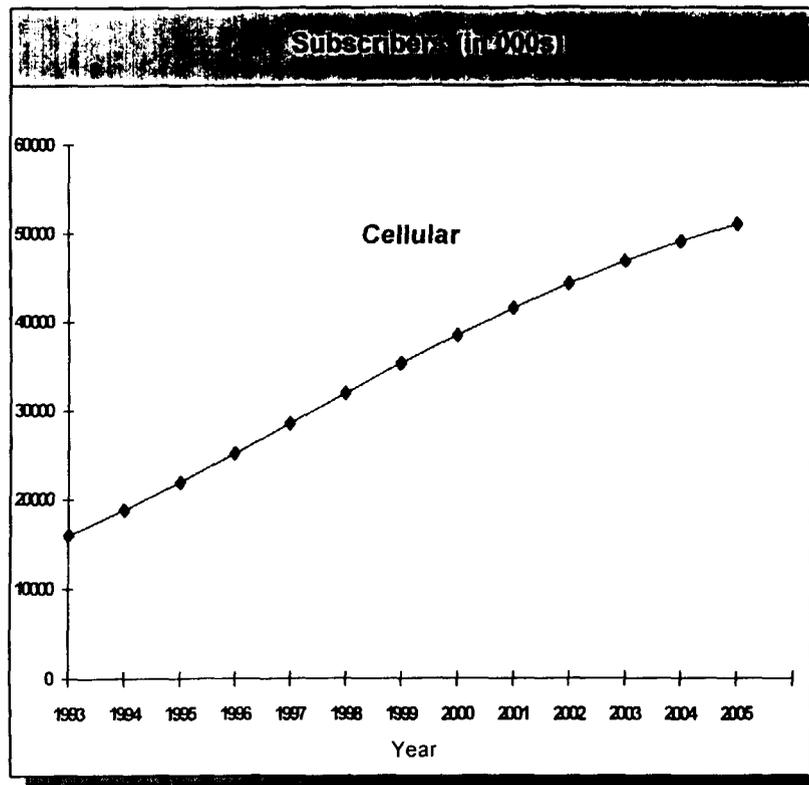
- The success of PCS will be built upon the earlier exposure of customers to cellular services
- The model accounts for the incremental impact of PCS in generating greater combined penetration of PCS and cellular
- We have examined the following propositions:
 - What will happen to cellular if PCS is never introduced?
 - What will happen to cellular and to PCS if PCS is introduced in 1996?
 - What will happen to cellular and to PCS if PCS is delayed by one or two years?

Modeling Assumptions

1. Assumes 90% of households are covered by both PCS and cellular services
2. PCS handsets are lightweight, inexpensive (under \$200) and have several hours of talk-time
3. PCS is priced at \$35/month; cellular at \$50/month
4. One adoption of services in each household -- households do not have more than one service (this assumption is, of course, not correct)
5. We have assumed that it will take at least 18 months to get a PCS business into full operation

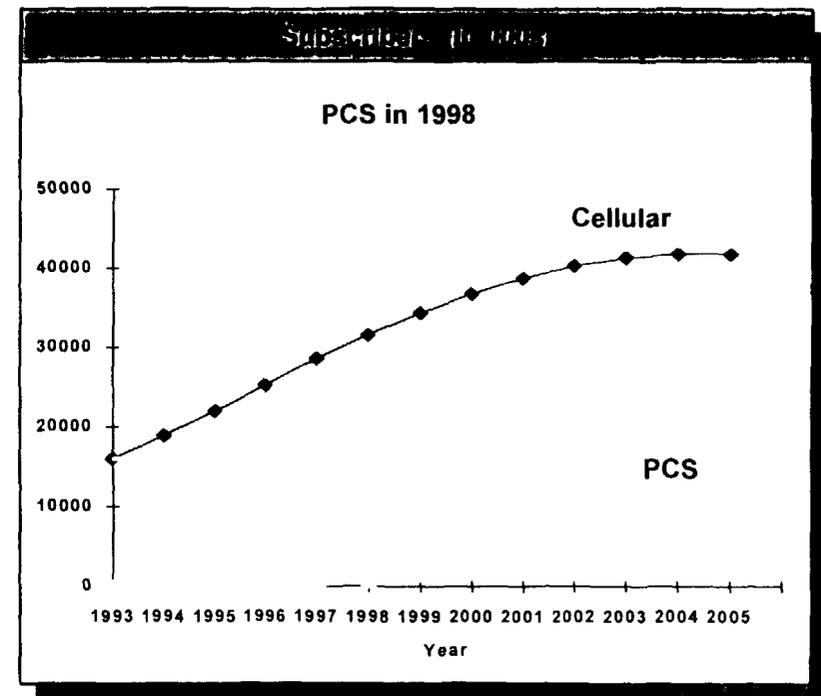
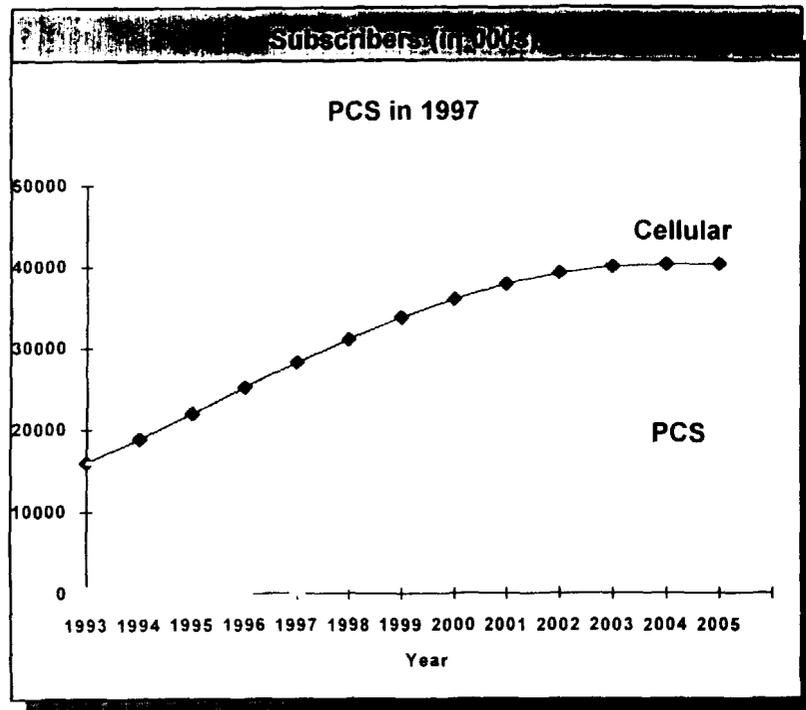
Effects of Delay on PCS Market Potential

In the absence of PCS, cellular grows to 51 million subscribers by 2005; if PCS is introduced in 1996, cellular only grows to 38 million and PCS reaches 17 million by 2005



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If PCS is delayed by one year (1997), PCS demand is reduced to 14.5 million and if it is delayed two years (1998) demand is further reduced to 12 million



Implications

1. These results suggest ultimate PCS demand levels are reduced by roughly 15% for each year of delay
2. This appears to be the case primarily because of the continuing growth of cellular which serves some but not all of the pent-up demand for PCS
3. Reduction in demand for PCS due to delay may make for a less than attractive business proposition-- particularly since the cash flow in early years has a great influence on the attractiveness of the business case
4. Slowing of licensing will strengthen the cellular position
5. Licensing delays may lead some potential bidders to "sit out" the auction because ventures may appear to be less profitable

COMPARING AUCTIONS OF 20 MHz AND 40 MHz PCS ASSIGNMENTS

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The Question:

- Are FCC Goals better served by
 - auctioning larger assignments (e.g. 40 MHz) or
 - auctioning smaller assignments (e.g. 20 MHz) and allowing aggregation
 - given that inherent limitations of 20 MHz assignments and the fundamentally superior economics of larger assignments will drive PCS providers to plan for larger assignments?
- Conclusion: Larger assignments serve FCC goals better
 - Aggregation can lead to inefficient and unattractive outcomes, delay, and transactions costs

Argument

- The secondary market cannot be relied upon
- Does an auction of 20 MHz assignments yield the same results from a policy standpoint as directly auctioning 40 MHz assignments?
- Simple examples to understand plausible behavior
- Aggregation can lead to inefficient or otherwise undesirable outcomes that may not be fixed in or fixable in the secondary market

Simplest possible example

- Two 20 MHz assignments A and B
- Three bidders: BP1, BP2 and SP
- BP1 and BP2 see synergy in getting A and B together
- In Example 1
 - BP1 is fiscally conservative
 - BP2 is a risk taker

Example 1: Defensive Escalation

VALUE OF SPECTRUM BLOCKS TO BIDDERS

(A and B are 20 MHz spectrum assignments; A & B combines the two into a 40 MHz assignment)

BIDDER	A	B	A & B
BP1	7	8	22
BP2	3	7	20
SP	13	11	14

Example 1: Defensive Escalation

SIMULTANEOUS MULTIPLE ROUND BIDDING FOR TWO 20 MHZ BLOCKS

ROUND	A ALONE	B ALONE
3	(7*,6,6)	(6,7*,5)
4	(7,9*,8)	(8*,7,8*)
5	(-,9,10*)	(8,9*,8.5)
6	(-,11*,10)	(-,9,10*)
7	(-,11,12*)	(-,12*,10)
8	(-,13*,12)	(-,12*,10)
9	(-,13*,-)	(-,12*,-)

(Note: (x,y,z) represent the bids of BP1, BP2, and SP respectively, where * indicates that the marked bid is the highest bid for the spectrum assignment at the time)

Example 1: Defensive Escalation

- 40 MHz auction would easily lead to efficient outcome: BP1 gets A & B for 20+
- 20 MHz Auction: Aggregation can lead to result that BP2 gets A & B for 25, which is higher than his valuation of 20 or BP1's higher valuation of 22
- Consequences
 - Inefficient Allocation
 - Hurts goal of rapid deployment of affordable service
 - Default?

Example 2

- Both BP1 and BP2 are fiercely competitive
- Their valuations are the same as
- SP values A and B at really low values

Example 2: Offensive Escalation

SIMULTANEOUS MULTIPLE ROUND BIDDING FOR TWO 20 MHZ BLOCKS

ROUND	A ALONE	B ALONE
5	(8,9*,-)	(10*,9,-)
6	(10*,9,-)	(10,11*,-)
7	(10,11*,-)	(12*,11,-)

(Note: (x,y,z) represent the bids of BP1, BP2, and SP respectively, where * indicates that the marked bid is the highest bid for the spectrum assignment at the time)

Example 2: Offensive Escalation

- 40 MHz auction: BP1 buys A & B for 20+
- 20 MHz auction: Competitive pressures and ego cause bidding to escalate beyond valuations
- Consequences
 - Efficiency?
 - Hurts goal of rapid deployment of affordable service
- Much like bidding for Paramount by QVC and Viacom

Example 3: Opportunism

- BP1 and BP2 are risk averse
- SP is not worried about default

Example 3: Opportunism

VALUE OF SPECTRUM BLOCKS TO BIDDERS

(A and B are 20 MHz spectrum assignments; A & B combines the two into a 40 MHz assignment)

BIDDER	A	B	A & B
BP1	3	5	16
BP2	5	7	18
SP	4	3	6

Example 3: Opportunism

- 40 MHz auction: BP2 wins at 16+
- 20 MHz auction: SP wins the bid for A betting that it will be worth the while of the other players to buy A from him at a profit. BP2 does.
- Consequences
 - Reduced public revenue
 - Transaction costs
 - Likely delay
- Existence of smaller blocks may stimulate new entrants to the bidding who are primarily motivated by profit to be made by opportunism

Other Possible Undesirable Outcomes

- Prudent risk-taking leads to overpaying for a 20 MHz assignment
- Rivalrous behavior
 - Cellular incumbents, others with existing infrastructure have an interest in preventing the formation of formidable competitors
 - May bid to prevent aggregation or make it slow and expensive
 - Defensive hostage-taking
- Capital Constraints
- Misjudging a competitor

Why One Cannot Rely on the Secondary Market for PCS

- Typical vision of market:
 - Many relatively undifferentiated buyers
 - No transactions costs
- The PCS secondary market will be different

The PCS Secondary Market

- Small numbers bargaining with complex players
- A limited number of firms in smaller number of consortia
- Even with simple motives, no experimental evidence or experience that would enable us to predict that the secondary market negotiations will result in economically efficient aggregation quickly, inexpensively or with certainty
- Firms/consortia have complex motives -- they compete and cooperate in a variety of converging industries
 - Rivalrous or anti-competitive behavior
 - Speculators
- Likely high transaction costs; time-consuming negotiations

Conclusion

- Aggregation can lead to:
 - Unnecessary inefficiencies
 - Other undesirable outcomes
 - Delays in providing service
 - High secondary market transactions costs
- These problems can be avoided or mitigated by directly auctioning off larger blocks

30 MHz Minimum Channel Allocation is Essential

➤ Northern Telecom's vision of PCS:

- » mass market wireless - penetrations in excess of 10% of pops
- » multimedia services incorporating evolving technology and advanced services
- » integration and interworking of voice, paging, 9.6 data, 56/64 data, >>64 data
- » low end user cost to stimulate mass market demand

➤ Northern Telecom has always maintained that channel allocations must be sufficiently large to support:

- » getting started and growing while spectrum sharing with incumbent microwave users
- » Multiple applications
- » Large scale economies and spectrum efficiencies
- » Technologically robust service and an attractive investment opportunity
- » The capacity, quality and variety of voice, data and broadband services envisaged, some which may consume bursty data for a single application

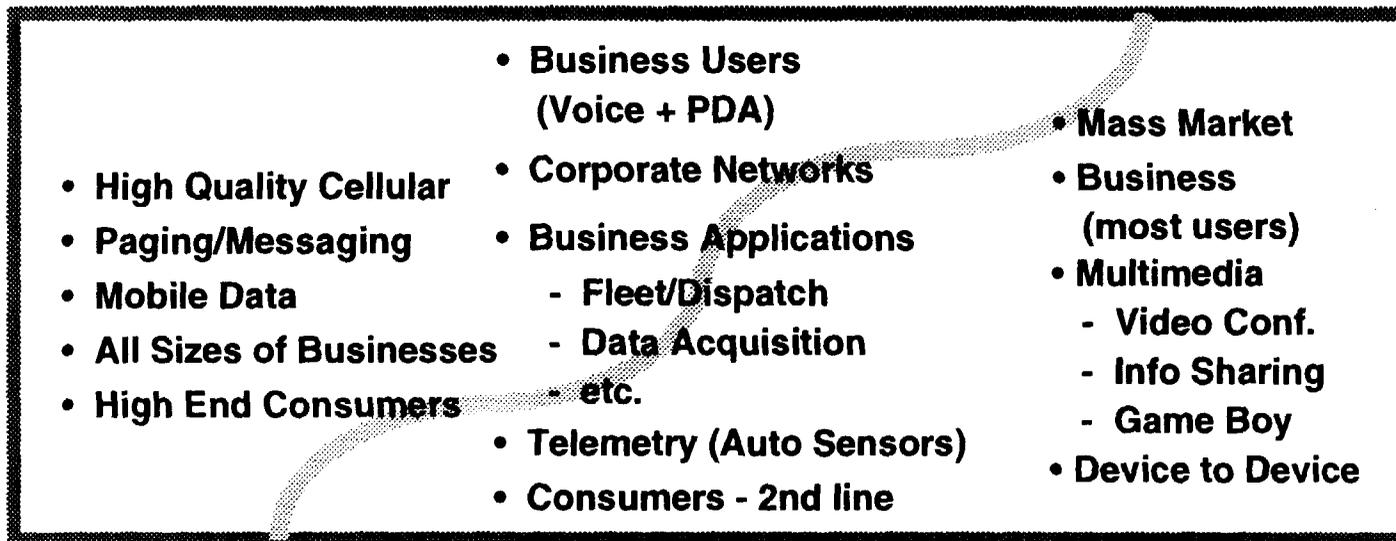
NTI believes 30MHz Allocations Minimum for US PCS Industry Success

- to achieve the vision of PCS and US global leadership
- to create viable PCS business opportunities for large to small players
- to achieve the rapid industry formulation

The PCS Market Segments

WIRELESS SYSTEMS

5m Subs → 15m Subs → 30m Subs



1995

2000

Reduction to 20Mhz will significantly delay the genesis of the industry