The Evolutionary Processes in Telecommunications

Is this a New Product Scenario?

Terrence P. McGarty[1]

Abstract

The structure of the telecommunications market may be at a point of significant change. In this paper we look at the issue of market shares amongst the major contenders in today's market. We first use data from available sources and assess the progress and changes since the later 1990s. Then we perform an analysis using the Bass Diffusion approach and use an element of game theory analysis which shows that the ILECs are at the point of potentially seeing their entire copper line business disappearing within seven to ten years. This study presents the data, the framework, a model, and it can be verified from prior approaches of Bass and others. Perhaps the telecommunications market as we have known it is to be totally restructured.

Contents

Figures

Tables

1 INTRODUCTION

In the summer of 2002 we prepared a paper at the request of one of the staff of the OSTP in the White House considering the status of telecommunications.[2] The concern addressed in that paper was that there may be a continuing of the collapse of telecommunications industry and that what was seen in the prior three years may only have been the tip of the iceberg. We examined specifically two companies; Verizon and Genuity. Genuity went into bankruptcy just a few months later. Its death throes were obvious to any observer at the time. In the case of Verizon we made three observations; (i) access fees were already more than 200% of its profit on the wireline side, (ii) wireless would exceed wireline by mid 2004, and (iii) the wireline side of the Verizon business was under attack by many other players. So what has happened? Verizon buys MCI and SBC buys AT&T. Why one may ask, to solve problem one I mentioned, specifically the access fee issue. By owning the IXCs, these two carriers could continue to control the access fee process and any small player negatively affected by access fees would have no leverage in the debate. There would no one to protest. Wireless exceeded wireline in January 2004 not June, we were a bit conservative in the date. As for the wireline side of the business, this paper goes into detail to show that it not only under attack but is already falling apart.

1.1 Issues and Questions

A key construct and concept used in this paper is that of a new product. A new product as we use it is a displacement product. It does not take "market share" away from the incumbent; it removes the incumbent's product from the market totally. In addition when we present products or services and talk about them we always look at the product from the consumer's perspective. Namely, the consumer has a relationship with a provider of a service and the consumer does not care who the other facilitators of the product or service are. This is a market structure as viewed by the consumer.

In this paper we address four issues:

1. *Who are the current competitors to the existing incumbent wireline business, and what are they selling? Namely is this a competitive product or a displacement product. Is it for example a 64 Meg DRAM versus a 16 Meg DRAM, or it is just a competitive commodity, namely is it all just oats?*

2. *What has the set of new competitors achieved in the market to date? Namely what is their market share and what growth are they obtaining? We provide here a litany of the facts, based upon publicly available data.*

3. *We then ask the question, if the new entrants are offering really a better product, then is the process we are looking at one of market displacement by means of a new product such as discussed by Bass and others and that what we perceive is the death of the wireline business? This is akin to the death of analog cell phone for example; they have been replaced by all digital phones. Equally it is akin to 45 rpm records displacing 78 rpm, and then having 33 1/3 replacing the 45, then tape replacing 33 1/3, then the CD replacing tape and so on. The products or services are fundamentally different but the underlying artifact provided, such as music or telecommunications remains the same. The method and means may change, a new product, but the experience is the same, possibly enhanced. In particular situation we are asking the question, is the old paradigm of pure commodity markets disappearing with the introduction of a displacement commodity?*

4. *We finally then ask the question, if we are perceiving a change to new products and the new entrants do have a better and different mousetrap, then what are the dynamics associated with the new market process and who may be the likely winner(s). It is our belief that the cable companies may be positioned to win the entire game in the next round. We had analyzed this in our 1990 paper presented at Harvard and this analysis is contained in an appendix attached hereto.*

[2] See McGarty, Imminent Collapse of Telecom, August 2002.

1.2 Earlier Observations

The question we pose herein is; given what we now know is the incumbent telecom market showing signs of distress, what would one then be concerned about as to the long term viability of these wireline incumbents? Let us first review what we have been saying for over twenty five years:

1. 1983-1984: Voice and data over CATV was a significant shifter of the telecom landscape. The author published several papers describing the provision of voice and data over a cable system In the 1990 Harvard paper these are detailed to a significant degree. All of the designs used a form of packetized communications and were primarily an 802.11 standard, now the standard for all wireless systems.

2. 1990-1992: Networking was changing, the Internet and IP were significant issues and access fee and policy was the sustainer of the incumbent status quo. We also noted in the 1990 Harvard paper that cellular was in a strong and sustainable position longterm.[3]

3. 1992-1996: Wireless became a key growth element in the industry. The author was involved directly as a start up implementer and the papers from 1992 through 1997 reflect the anticipated changes as we see them today.

4. 1996-1999: IP voice became a reality. Again the author was an implementer of this new technology. Also we prepared many detailed analyses of this market and saw it having a destabilizing influence. In fact, we started one of the first VOIP companies in 1996.

5. 2000-2005: This is the era of CATV voice and triple threat development. The CATV start was in mid-to-late 1999 with the AT&T acquisition of TCI. This created a very new entry to the telco market. The problem was that AT&T had deteriorated as a company and failed to understand what it needed to succeed and further it had acquired probably the worst cable company in the industry at an exorbitant price! What is critical in our analysis is that all of this impending change was seen by any reasonable able observer as early as 2002. This was the year when one could measure the shift, feel the actual upheaval and understand that all of this was soon to pass. Now, six years latter, the facts are not just compelling but overwhelming.

1.3 Approach of the Analysis

In this paper we take a three part approach.

First, we look at the current market for telephone services. Specifically we focus on the access lines and who has how many at this time. We review the history for the past six years. This is an important time frame because what we can now see in full forces was actually evident to anyone in the industry in the 1999-2000 time-frames. Specifically the results we present here are played out over the past six to seven years. Now they are incontrovertible. We look at the access line counts for the ILECs, which we shall characterize as the ***"old telcos"*** and also at the new purveyors of access lines, the cellular, CATV and VOIP players, who we shall call the ***"new telcos"***. What is important here is that we focus on the sale of the access line as a service providing voice telecommunications only, not all of the other elements which could be provided. Thus for CATV we look solely at the sale of telephone directly to the consumer replacing incumbent telco access line voice services, and the same applies for the cellular carrier. For cellular we count the number of people who have abandoned their fixed wireline for an all cellular mode. We use the available data to assess what the trend is in each segment of old telco and new telco.

3 The irony of all of this is that Armstrong's strategy at AT&T was correct but his execution was flawed. In our opinion, the TCI acquisition was totally in error.

Second, we then address the key issue we develop herein, that of asking the question; is what the new entrants are selling more of the same or is it fundamentally a new product? This is a major question because the choice of an answer will lead us down different paths. A new product answer will tell us that this new product may readily displace the old product. This approach has been taken historically by Bass in his classic 1969 paper on new product diffusion. For example the electronic calculator displaced the slide rule. DVDs have displaced VCR tapes. CDs have displaced audio tapes which displaced vinyl 33 1/3 records which displaced 45 rpm records which displaced 78 rpm. The new product eliminated the old! If the new telcos have truly a new product then they will eliminate the old product, namely the core business of the old telcos. The Bass approach allows us to proceed along the lines of answering this question.

Third, if this is a new product model for the new telcos, and if we currently see three competitors; CATV, cellular, and VOIP, then who will have what market share when the next war is fought in the telco market.[4] We approach this issue by looking at this in a manner similar to the way the long distance telco market settled out for a period. Namely it is somewhat of an oligopoly, several limited players where the end game is a dominant player with two sub-dominant competitors. We use game theoretic approach expanding on the classic Cournot model and incorporating the work of Buzzell (1980, also reported in Porter, 1983). Namely Buzzell found that in markets of this type the stable point was one of 40%:30%:20% and the remaining 10% shared amongst niche players. We find that a similar result applies here for the new telco share.

Fourth, if we believe that we are correct in issues two and three above, then what conclusions can be drawn from this analysis. We believe that whether we are correct or not, we are clearly at a mid point and indeed at a tipping point. The data is so clear at this stage it leaves no room for speculation as to the impact on the old telcos, namely the ILECs. The question is what will be the next stable point. We work through several of these issues as well.

1.4 Summary of Conclusions

We have several conclusions which we believe we should present here to ensure that the materials presented herein are placed in perspective:

1. *Based on the analysis of the current actual market data and tends, there is a clear and unambiguous indication that the customer perceives the provision of what is normally defined as telephony by the new entrants is that of a new product. As a result, the market changes, especially to the incumbents, will most likely be in a new product environment change; market share will not be the issue but market elimination will.*

2. *Customers establish relationships with vendors of services, not providers of infrastructure. Microsoft for better or worse can be seen as such an example. Thus VOIP over CATV, or even DSL, is a relationship with the VOIP provider, not the transport provider. Thus VOIP providers are par passu market contenders with a CATV provider of telephony.*

3. *Cable companies have, through their (i) networks,(ii) introduction of triple play, video voice and data, and (iii) their ability to support open networks, established themselves as the market leaders in this new product space. They may continue to grow and thrive.*

4. *However, the inherent capability of the transport medium allows for disintermediation. Namely, CATV facilitates VOIP providers, thus allowing the consumer to choose on price and features and not deal with a monopoly like provider. Video may also see such disintermediation as well. Namely having broadband access and basic cable, the cost of low cost broadband, it most likely will evolve so that independent video on demand players can provide video just as easily.*

[4] We also argue that the cycle we are seeing now is not a stable cycle. The introduction of broadband wireless in the unlicensed bands we believe is truly the next destabilizing influence. Market disintermediation by allowing low cost broadband wireless will possibly drive the next round winners from their peaks.

5. *The ILECs, the incumbent telcos, are facing an all too measurable rapid market decline. This means that short term, one to two years, we will see tremendous financial pressure on them which may result in significant financial market impacts; on the debt and equity markets. The concept of impairments will most likely be the initiator of this process. Specifically, Verizon, with Vodaphone as a 45% owner of the wireless property, could easily force this process by demanding a separate IPO of the wireless property to obtain better liquidity and value. This would mean a very difficult road for Verizon*[5].

2 CURRENT MARKET CONDITIONS

We first look at the existing market and its structure and trends. We have relied upon three sources of data: (i) FCC and other government reports which present market change, growth and share, (ii) company reports and related trade publication reports based upon company information, (iii) primary market research we have conducted.

We begin with an analysis of the incumbent wireline carriers and their change. Then we consider the alternative carriers. We leave until a later section the issue of commodity versus new product. The carriers we focus on are as follows:

Cellular: The growth of cellular communications has been dramatic. The number of subscribers will exceed 200 million by early 2006. This means that two out of every three humans in the US will have a cell phone. We have remarked earlier that in certain countries, Italy as an example, there are actually 2-3 mobile phones per person! Thus continued upside growth is possible. However as we stated in our earlier papers in the early 1990s, cellular is just a telephone.[6] It has become a bit more but first it is a phone. What we focus on here is not the total cellular market in the US but that portion of the market which represents those cellular customers who have totally abandoned a landline telephone. This is an emerging sector of people who by their choice of telecommunications have left the market for the land line phone and thus should show up as a loss to the incumbent old telco.

VOIP: Voice over Internet Protocol has been around for over thirty years. In the early 1970s researchers at MIT and working with DARPA developed a technique to use packet voice, with high compression and send it over the then Internet/ aka ARPAnet . Then in the mid 1990s, companies such as VocalTec developed low costs VOIP systems and operators such as Delta Three, Zephyr, ITXC and others deployed massive amounts of IP voice.[7] VOIP required nothing more than an Internet connection. In 1996 the VocalTec system allowed any PC users to obtain free long distance using the Internet. This worked even for dial up connections but it would be much more effective with a broadband connection. VOIP allowed for disintermediation of telephony. By later 1999, Net2phone had gone public and had AT&T as a minority shareholder. AT&T had taken all the right strategic moves, VOIP and cellular. They then cratered due to faulty management. VOIP in today's market is somewhat unique in that is requires an underlying transport mechanism but the value added is not provided by the transport provider but by a third party, the VOIP provider. VOIP as exemplified in this market model has certain advantages; it has a low cost of entry and it has a potentially low operating cost. However, in this market model, VOIP has significant disadvantages; there are no barriers to entry, there may not be any brand loyalty unless one finds a product extension strategy, and the switching costs for the customer are de minimis.

[5] We actually see a possible deadly embrace cycle for Verizon: (i) Verizon forced to write down its assets under FASB 121, (ii) debt downgraded (this has already begun as of January 16, 2006), (iii) Vodaphone, owning 45% of Wireless demands liquidity by spinning off Wireless, (iv) Verizon left with balance sheet of useless assets and new Wireless stock, still raises debt to build FTTH, (v) FTTH costs escalate and penetration and ARPU are too low, (vi) Verizon stock plummets, (viii) buyer comes in for remaining assets such as a Comcast.

6 See McGarty papers on wireless from 1991 thru 1998.

7 The author was founder and CEO of Zephyr and was a strategic partner with Delta Three.

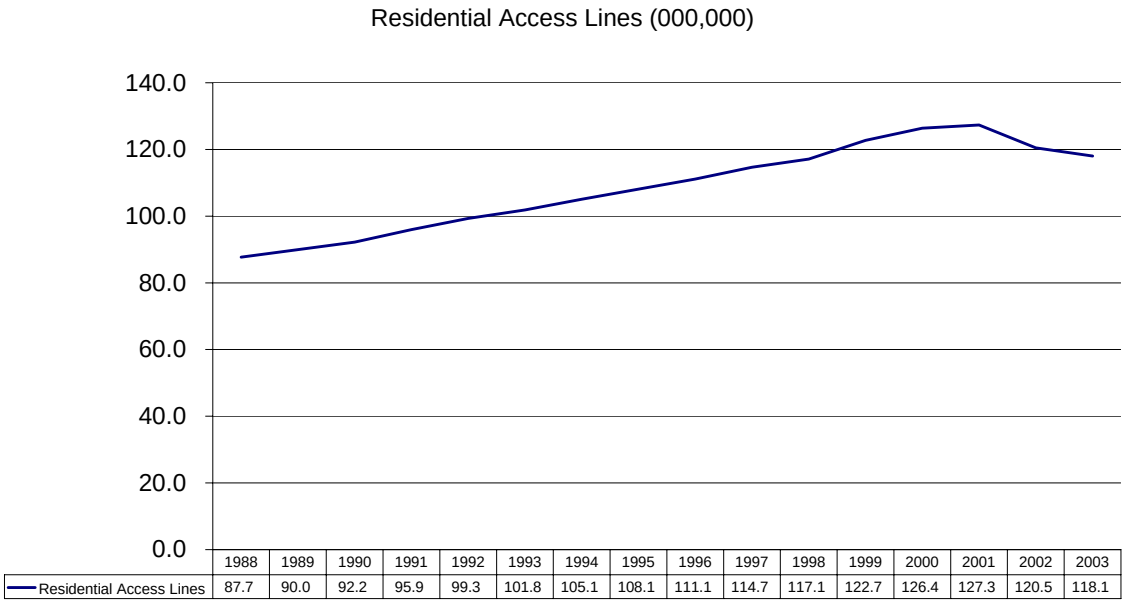
CATV: The cable companies have been playing with voice for over twenty five years. The first operational system was in Omaha in 1981 with Cox and its Indax system.[8] It used an 802.11 protocol and a packetized voice system It partnered with MCI at the time and was violently opposed by AT&T. There are many early FCC decisions relating to this first attempt. By the early 1990s companies such as Cox, Time Warner and Comcast were still pursuing both voice and data. However the technology was still in development. It was not till 1998 that Motorola and other manufacturers had systems to work effectively and economically. In 1999 AT&T announced that its acquisition of TCI would include telephony over cable and they stated that they would have over 500,000 subscribers by the end of 2000. Thus by early to mid 2000 the cable companies were effecting strong competitive threat.

CLEC: The CLECs have continued to grow. They started in 1996 with the new telecom law. They have had their ups and downs. It is not clear if the CLEC is a new product or just one bundled under a different packaging. Our analysis herein contends that the CLEC is nothing more than an old telco. They bring nothing new to the table and suffer from the same infrastructure problems of the ILECs, but with the added problem that they pay access fees and do not collect them.

These four alternatives are discussed below. We first discuss the incumbent wireline carriers.

2.1 Wire Based Carriers

The wireline carriers have begun to see declining access lines for the first time in their existence. This clearly is a canary. The following Table from the FCC Trends Report for 2005 shows that residential lines start to decline in 2001.[9] The problem with the FCC reports is that they are frequently delayed and frequently show less than the exact picture.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Residential Access Lines	87.7	90.0	92.2	95.9	99.3	101.8	105.1	108.1	111.1	114.7	117.1	122.7	126.4	127.3	120.5	118.1

Figure 1 Residential access lines from 1988 thru 2003. Note that the decline commences in 2000 and becomes significant immediately.

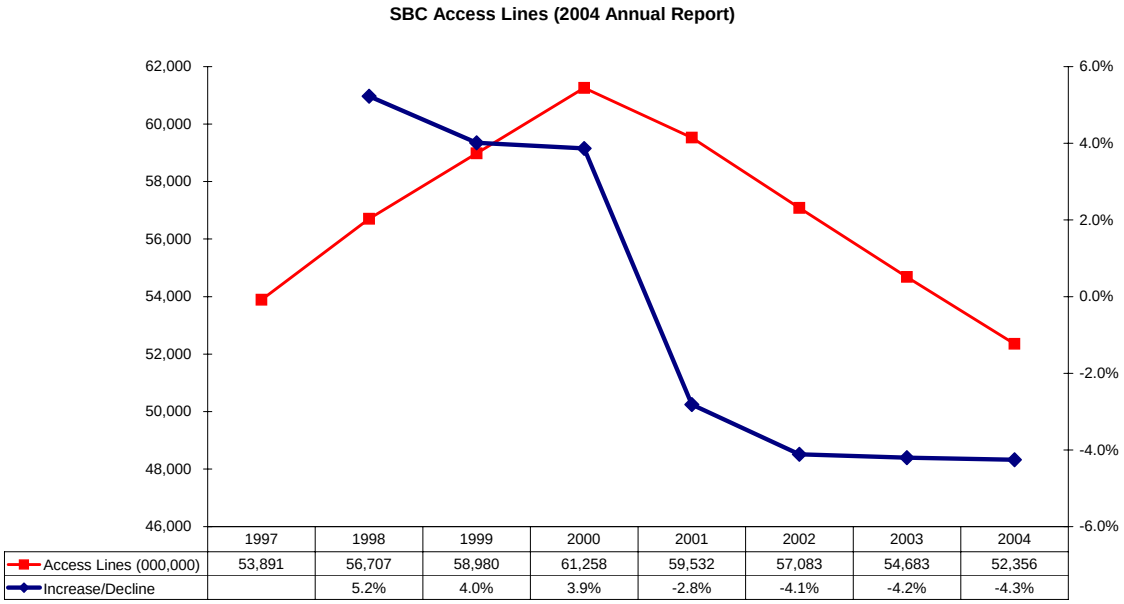
The figure below is from the SBC annual report for 2004, already a year old. It presents a better overall picture of the market decline. The peak year is 2000 and by the end of 2000, both SBC and Verizon were already sensitized to market decline. The reported declines occurred in 2001 although they were already

[8] See McGarty 1983 paper in IEEE.

[9] See FCC web site www.fcc.gov

being observed in 10-Qs for 2000. The annual rate of decline was about 4%-6% as reported. In our more detailed analysis of these numbers we find that the decline is truly greater than they report. For example the ILECs frequently add to the number of access lines which they count in their totals the DSL lines which may or may not be a telephone access line. As we noted above having a DSL and no phone line we may very well use VOIP and thus not use the access line. Is DSL therefore an access line or just a way for an IP service provider to get to the customer?

The next question is where are these lines going; are the disappearing or are the customers going to a competitor or alternate supplier? The answers are multiple; some to DSL, some say that a second line for fax is no longer required wit the Internet, some say to cable, to VOIP, to CLECs and even to cellular. We anticipate that the numbers for 2005 exceed all others. In fact 2005 may reach a double digit decline on a run rate basis. We will sow the reason for this shortly.



	1997	1998	1999	2000	2001	2002	2003	2004
Access Lines (000,000)	53,891	56,707	58,980	61,258	59,532	57,083	54,683	52,356
Increase/Decline		5.2%	4.0%	3.9%	-2.8%	-4.1%	-4.2%	-4.3%

Figure 2 The above figure depicts the SBC access lines thru 2004. The rate of decline is averaging a 4% compound annual rate.

The same or similar results are available for Verizon and the other ILECs. We have chosen SBC because they are one of the top two and because Verizon now obfuscates access line tracking in their efforts so it becomes very difficult to determine where they truly are.

The ILECs are quite concerned about the issue of becoming at best an access to the Internet. Specifically Ed Whitacre the CEO of SBC is quoted as stating:[10]

[10] See January 6, 2006 Baby Bells Are Mobilizing For Piece of Tech-Media Pie **JOSEPH SCHUMAN THE WALL STREET JOURNAL ONLINE: "....***AT&T executives have expressed support for charging companies to ensure that their content gets priority delivery, and Verizon Communications Chief Executive Ivan Seidenberg said he might favor reaching deals with companies to do the same...The phone companies envision a system whereby Internet companies would agree to pay a fee for their content to receive priority treatment as it moves across increasingly crowded networks. Those that don't pay the fee would find their transactions with Internet users -- for games, movies and software downloads, for example -- moving across networks at the normal but comparatively slower pace. The size and structure of the fee systems remain to be worked out, and the regulatory implications aren't clear, the Journal says. But already, the phone companies are meeting heavy resistance from companies that say making them pay for priority delivery of their content amounts to holding them ransom, thus hurting competition and, ultimately, the consumer."* Such an action has several major problems. First is the legality. The ILECs are still covered by common carrier law, six hundred years of it. That law states that you carry per pound not what makes up the pound. Thus lead, gold, chickens, all are priced per pound. The second issue is that the consumers have a choice and they are not going to pay a premium to an incumbent. Third, the blogs will go wild. The new product competitors could not have asked for any better action by the incumbents, specifically since these actions are self immolation.

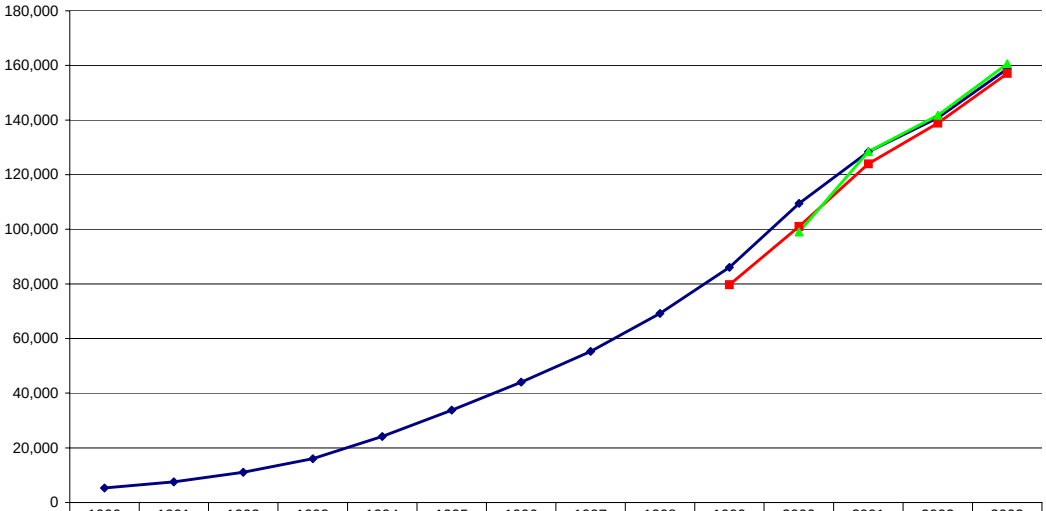
"Now what they would like to do is use my pipes free, but I ain't going to let them do that because we have spent this capital and we have to have a return on it," says Whitacre. "So there's going to have to be some mechanism for these people who use these pipes to pay for the portion they're using. Why should they be allowed to use my pipes?".....“The Internet can't be free in that sense, because we and the cable companies have made an investment and for a Google or Yahoo! or Vonage or anybody to expect to use these pipes [for] free is nuts!”[11]

Clearly is the ILECs are left at best with a commodity business of connection to third party advance services providers such as VOIP players and everyone else, what happens is that revenue for the commodity declines and the access cash flows disappear! It must be remembered that in our 2002 paper we showed then that access fees represented 200% or more of the wireline profit. It is clear than why Whitacre is so concerned. SBC is rapidly loosing access lines and the competition is eating away at whatever protection he may have had from the Government subsidy of an access line. Another important issue related to the Whitacre quote is that the ILECs are common carriers and there is over 650 years of law related to common carriers that make Whitacre’s cavalier attitude less than legal.

2.2 Cellular

In the period from 1992 thru 1996 we presented several papers stating that cellular was amongst other things “just another phone line”, but better. It is a mobile service, it can support data, and it provided a wealth of other services. In this section we will provide data on the trends in the cellular market which focus on the element of just providing telephone service, specifically by replacing the wireline telephone.

We first start by examining the total cellular market. The following figure depicts current cellular market growth as presented by the FCC.



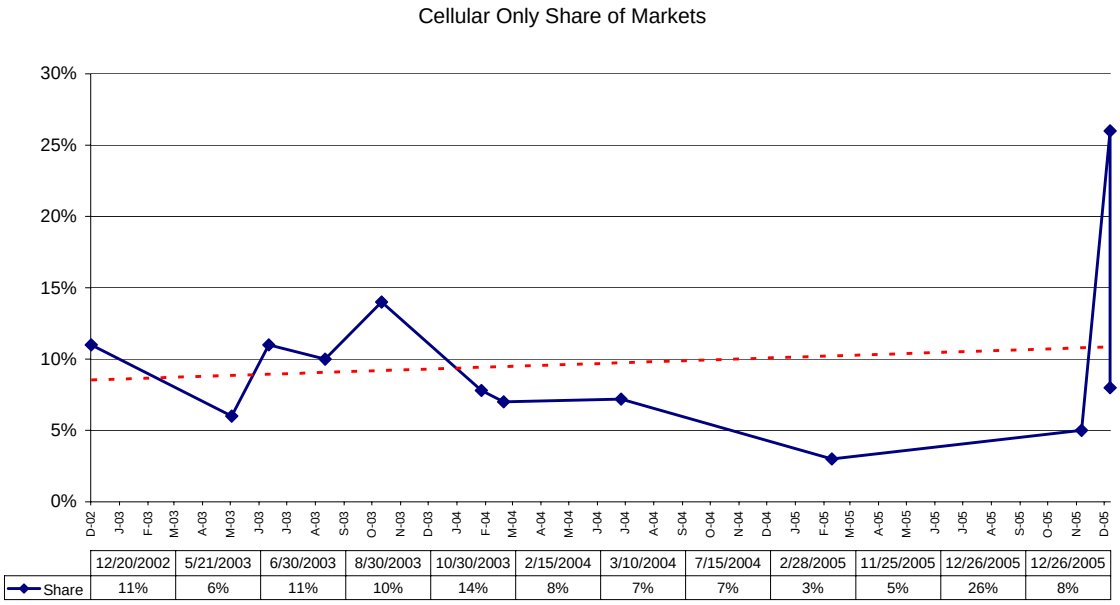
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CTIA	5,283	7,557	11,033	16,009	24,134	33,786	44,043	55,312	69,209	86,047	109,478	128,375	140,767	158,722
FCC Form 477										79,696	101,043	123,991	138,878	157,042
FCC Form 502											99,019	128,493	141,776	160,623

Figure 3 The FCC data regarding the growth of cellular subscribers in the US from 1990.

The above just shows growth of cellular customers. There is however significant growth of cellular only customers. We have performed over 35 market surveys in New England over the period of March 2003 and

[11] See http://www.dslreports.com/shownews/69002 and Business Week November 7, 2005 **Rewired And Ready For Combat** http://www.businessweek.com/magazine/content/05_45/b3958089.htm

January 2006.[12] The figure below shows the results from several of these surveys. We asked the question of how many people had a *cell phone only and had no use for a wireline phone*. The results below are for 12 towns and about 25,000 households. This is a substantial set of data. We have plotted the percent of cell only by the time of the survey. The towns are mixed but demographically similar. The result is about 7%-10% cell only and we see even towns with dramatically higher results. We do not see significant growth over a period of time but that may be due to the sampling.



	12/20/2002	5/21/2003	6/30/2003	8/30/2003	10/30/2003	2/15/2004	3/10/2004	7/15/2004	2/28/2005	11/25/2005	12/26/2005	12/26/2005
Share	11%	6%	11%	10%	14%	8%	7%	7%	3%	5%	26%	8%

Figure 4 The results of 12 market surveys in New England during 2003-2005 as to the percent of persons having a cell phone and no land line phone.

It is thus our opinion that cellular already takes 7-10% of the user base, namely market share. We believe that given the size of our sample space we have quite a good representative sample. In addition we believe that this percent is growing but we do not have adequate data at this time. However, market research by various entities have projected that cellular will take 15% of the share away from the incumbent ILECs by 2009.[13] We believe that given our data that such a share is very possible. What is more concerning is that the growth in share is quite dramatic when we have cross tabulated the data on age. The younger group of 18-35 year olds show almost double the rate already, namely in this segment we already see the results for 2009 predicted by the Yankee Group.

2.3 CATV

The cable companies initially focused on data, specifically the DOCSIS standard for Internet access. This was clearly a strategy in the mid to late 90's. As discussed before, by the later 90s they also restarted a voice effort. Companies such as @Home and others looked at data and voice as an integral part of their service set. AT&T also saw voice as a key element of their strategy in 98 and 99, with the acquisition of TCI. Motorola,

[12] See www.telmarc.com for details on several of these feasibility studies. We have provided details for Westwood, MA and Hanover, NH. Westwood was subsequently build out as one of the fiber to the home town by Verizon and it also is a Comcast town. Hanover, NH was a town where a Telmarc investment company called Merton Group actually obtained USDA Rural Utilities Service financing but had to abandon the effort due to the egregious demands by the town in the franchise process. The existing cable company was Adelphia soon to be Comcast. The town demanded that Merton cover more than twice the mileage of the incumbent and in addition provide a separate fiber network to all town facilities including a mountain top where the public safety transmission tower as!

13 Yankee Group analyst Kate Griffin has predicted that by 2009 15% of US HH will have cell phone only. She estimated that in 2004 the number was already 3% nationwide. This compare to our estimate based upon detailed market research of almost 7%.

General Instrument, subsequently acquired by Motorola and others saw voice as an immediate adjunct. Moreover, Net2phone and other VOIP companies presented a threat to the cable players by disintermediation their data and voice play. If the cable company provided only broadband data ten the VOIP companies could go around the cable operator and buy voice separately. However the VOIP customer had to have access plus VOIP. The cable companies tried the "triple play" in the late 90's. Comcast was one of the initial players.

In a recent Comcast presentation to the investment community they show that by 2006 the will have 20% penetration of HH with voice. This is just Comcast, but Time Warner and Cablevision are very close. Overall the penetration may be a bit lower but using the Cablevision number we can see that CATV will most likely be the overall winner. They started latter than all the rest but were positioned with a network and a customer base.

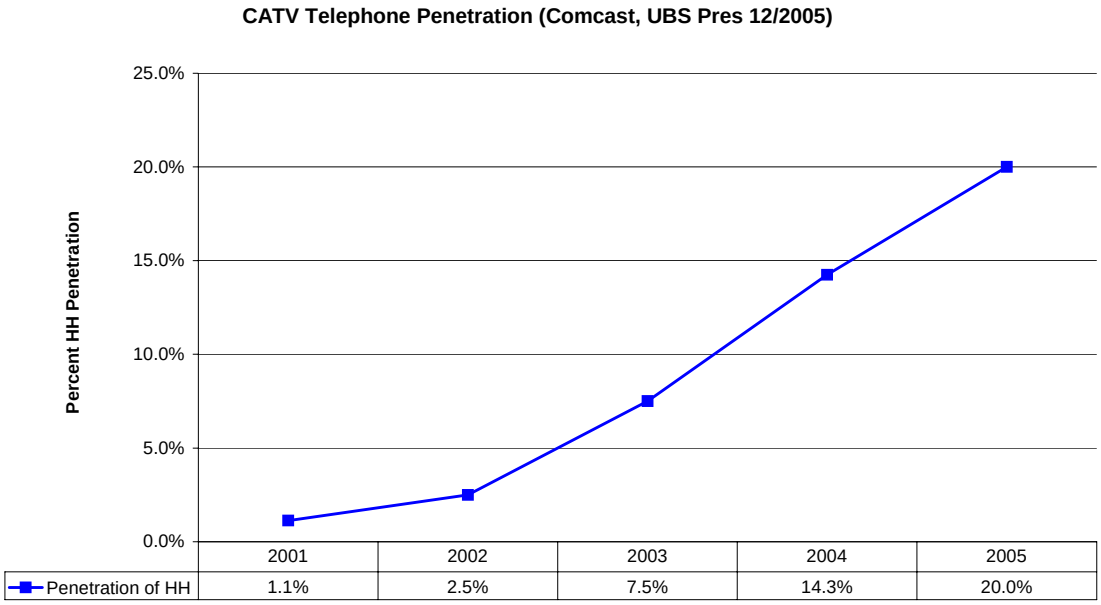


Figure 5 The number of HH and percent penetration of COMCAST with voice in their markets from 2000 thru 2005

We believe that the results shown by Comcast will be followed up by the other CATV entities. What is shocking is that the market share for Comcast was over a six year period. They started in 2000, a year and a half after AT&T did with their cable systems, and managed by very aggressive execution to make this level of penetration. Based upon our experience with cable penetration, we would anticipate that a 50% penetration is readily achievable by 2010 across the board with the major cable players.

The risk for cable is that if a subscriber buys broadband Internet then the custom may also get VOIP separately. This means that VOIP can disintermediate cable. We discuss this in the next section.

2.4 VOIP

Voice over Internet Protocol, VOIP, was also called Internet Telephony, and many other terms. Simply it is taking voice, digitizing and compressing it and then using the IP protocol to transmit it from point A to point B.[14] Although VOIP can use even a dial up line for transport it has sever limitations and really requires a higher speed line such as a cable modem or DSL line. Therefore to understand the potential of VOIP it is first

14 The author in McGarty. Sept 1996 Vocaltec Conference, presented the first full network architecture for a VOIP system and then shortly thereafter with VocalTec deployed the first international link jointly with Delta Three.

necessary to see where broadband connections have been going. The Figure below shows broadband growth based upon FCC data. The growth has been dramatic with cable clearly leading DSL.[15]

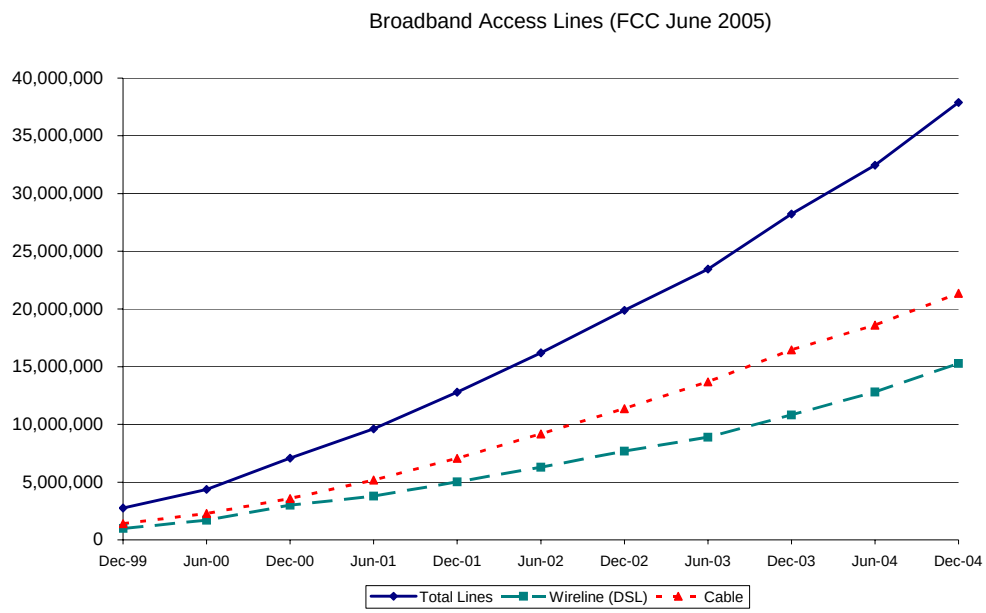


Figure 6: FCC Data on the total number of lines of broadband access thru 2004 including cable and wireline providers.

As of December 2004 the latest available FCC numbers indicate that cable has 40% and DSL has 26%. For a period the penetration was somewhat equal but that has clearly stopped. Verizon now sells DSL for as low as $14.95 per access for a limited data rate version. This can handle VOIP in some cases. The problem with good quality VOIP, however, is that a higher data rate on both directions is required. DSL frequently is worse than a dialup. Cable also has some limitations although the cable solution has improved as technology has been updated.

15 DSL has become much more cumbersome than cable. Cable modems are plug and play. DSL requires significant installation effort, for example terminating all telephone lines in your home so as to avoid interference and using highly complex software to allow the DSL modem to interoperate with your computer. It frequently requires 4 to 5 reboots just to install the software properly.

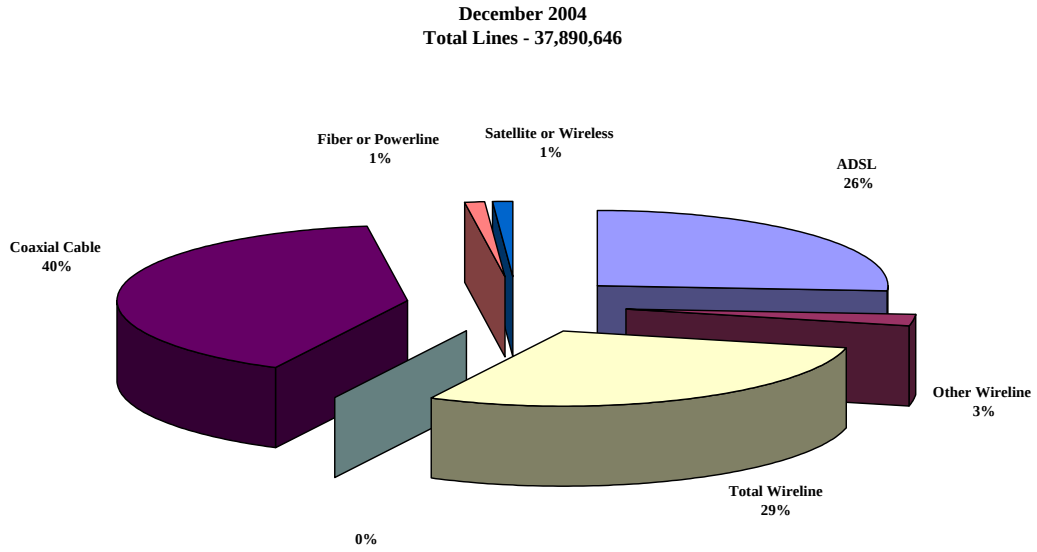


Figure 7 The FCC data on segmentation of broadband lines by provider for 2004.

The total US VOIP market has been analyzed by Telegeography and is shown in the following Figure.[16] They estimate a total of 4 million HH as of 2005 and growing to 16 million by 2010. Clearly cable will exceed this based upon current growth rates.

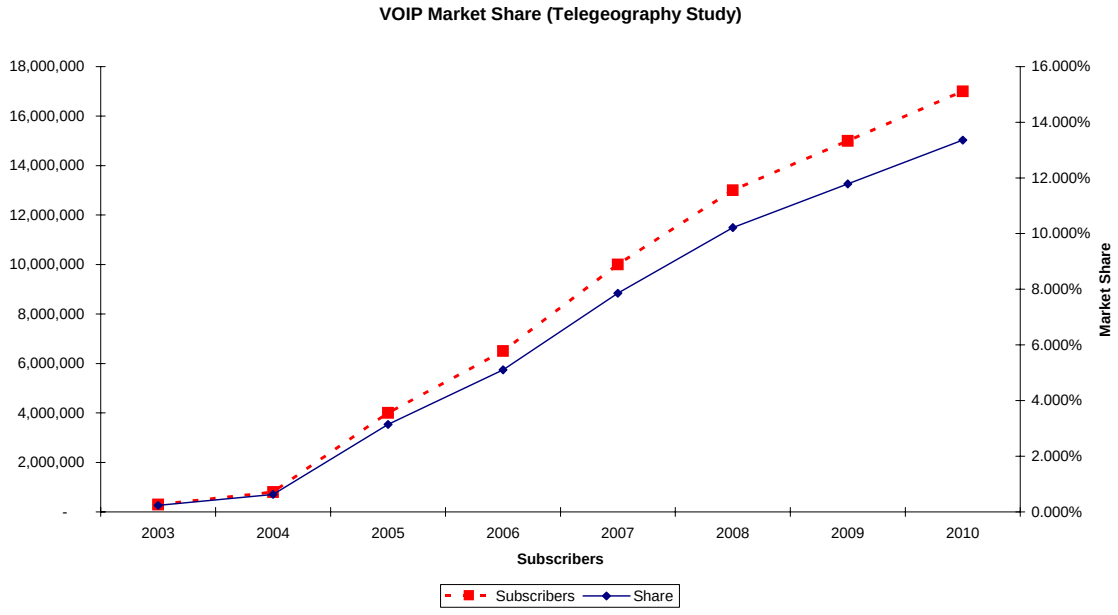


Figure 8 Telegeography results on VOIP market penetration and growth from 2003 thru 2010.

[16] See http://www.telegeography.com/

2.5 CLECS

The CLECs are a different type of alternative provider. We include them here since they are taking market share away from the ILECs but we believe as we shall describe in the next section that they are of the same class as the ILECs, old technology. Thus CLECs can get market share but if a new "product" is introduced they will suffer to the same degree as the existing LEC incumbent.

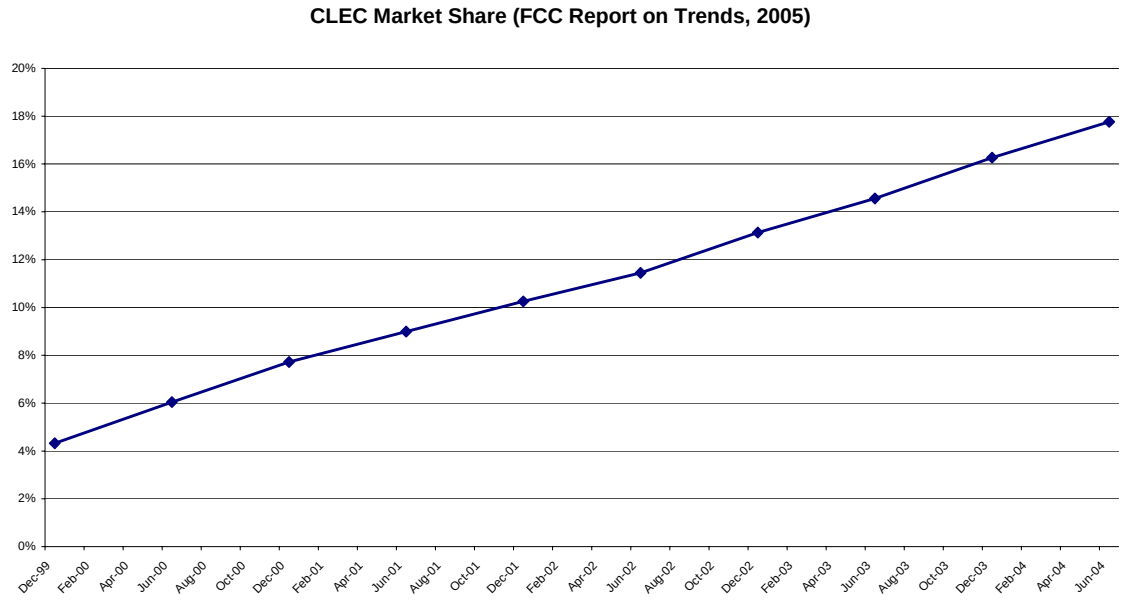


Figure 9 FCC data on CLEC penetration from 1999 thru 2004.

The FCC estimates that CLECs have over 18% share by then end of 2004. This is a significant share for a set of players who were almost universally bankrupt by 2001. However we will take the FCC data at face value for the moment.[17]

2.6 Summary

We have taken all of the data in the four competitors and combined it for the past five years. The results are shown in the figure below. The figure needs a bit of clarification:

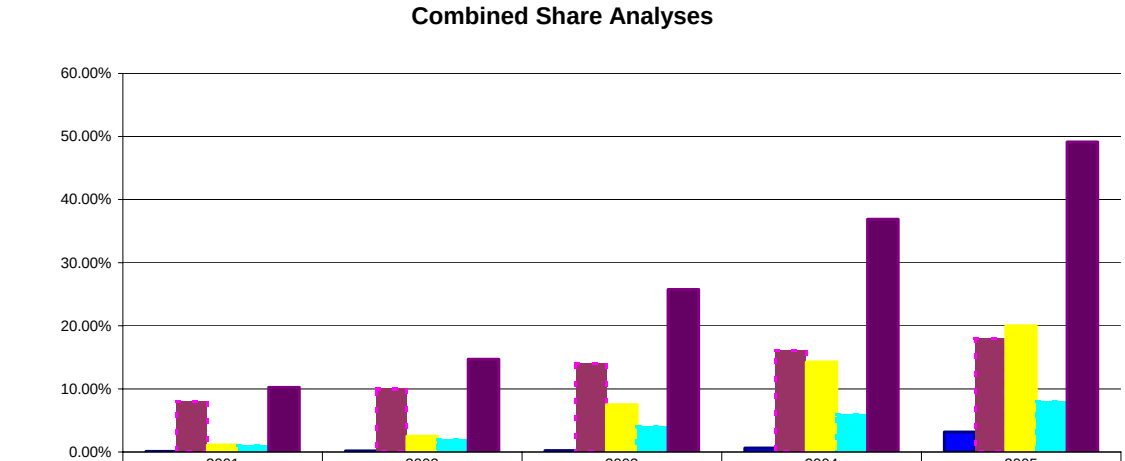
We have assumed that all CATV carriers act as Comcast. We know that not to be true but Time Warner does and both Comcast and Time Warner acquired Adelphia so that these represent a large base which will act as one in aggressively taking market. Thus the percent of the total access lines attributable to cable may be smaller on average at this time but we believe that based upon prior performance it will come up to par with Comcast.

The cellular number is fairly accurate and it may actually have been higher earlier on. There is a great deal of anecdotal evidence indicating as such but we relay solely upon our market research. In addition our market research does not include large urban areas. In Belmont, MA, for example, it was 11% penetration across all age groups in June of 2003! Thus we believe that cellular is higher.

17 This raises a question across the board as to the validity of the FCC data. The FCC collects this data but apparently never seems to verify its logical consistency. For example the growth curve for CLECs shows no slowdown for the telecom collapse. This goes against all other data and reason. We use the FCC data since it is a benchmark but we raise significant caution alarms.

VOIP is a complex issue. It assumes an Internet connection, which may be cable modem or DSL or even some third party broadband provider. There thus could be a back wash allowing a single DSL access line. We have not factored that into the equation.[18]

CLECs are a different character. They are different in a competitive way we conjecture because they have the ability to employ the new technology. It is not clear however that they are a player long term.



	2001	2002	2003	2004	2005
VOIP Share	0.10%	0.18%	0.24%	0.63%	3.14%
CLEC Shares	8.00%	10.00%	14.00%	16.00%	18.00%
CATV	1.13%	2.50%	7.50%	14.25%	20.00%
Cellular Share	1.00%	2.00%	4.00%	6.00%	8.00%
Total	10%	15%	26%	37%	49%

Figure 10 Summary chart showing the total market share of alternative voice providers and penetration by subscribe class.

3 MARKET DIFFUSION

Bass, in 1969, published a seminal paper on the diffusion of new products. We have applied his analysis to determine if this can be useful in assessing the change in the telecommunications market. The Bass analysis applies as he states to “new products” not just extensions of existing products. We would ague that the CLEC is an extension of an existing product whereas the IP based broadband enabled service is truly a new product. The important issue is to clearly define what we mean by a new product. Bass reviews the literature in his 1969 paper . Urban and Hauser devote a full book to this area in 1980. In the Urban and Hauser world, new products are characterized by example, you know it when you see it. For example they include the auto versus the railroad, the computer versus the calculator. Most of the definition of a new product is performed ex post facto.

However we believe that it is essential to our analysis and to others to combine the Urban and Hauser approach with a more analytical approach which can be verified. New products become replacements whereas new competitors take market share but do not replace.

Let us begin by considering a simple set of examples and then attempt to generalize.

1. Analog cell phones versus digital cell phones

18 Whitaker, the CEO of SBC has publicly bemoaned that fact that others are getting “rich” using “his” network, namely they provide DSL and the true money is now made downstream. A bit of sour grapes.

2. Slide rules versus digital calculators

3. Black and white televisions versus color televisions

4. DVD versus tape versus 33 1/3 versus 45 versus 78.....

5. Cell phones versus pay telephones

6. Digital cameras versus film

The changes we have summarized above become even more significant is we see the new telcos as new products displacing, and not just competing with, the wireline old telcos. New products are characterized by certain characteristics and some key elements of these are as follows:

1. The new product contains a ***fundamental technology change****:* each of the new telcos has a new fundamental technology element that makes the new product better and different.

2. The new product has ***expansive applications***: The new product does what the old one does "plus" a great deal more. This means that it does what the old product does plus provides significant value added features.

3. The new product provides a ***perceptive cost advantage***: The new product drives down the cost of some element in the overall process, namely it may be cheaper, it may be enabling of lower operating costs, and it may be more effective and efficient, allowing more features a the same price.

4. The new product allows an ***ease of transition***: The transition from the old to the new is easy, low cost and timely. A digital calculator does what a slide rule does but quicker and more accurately.

5. The new product has added features so it is ***not perceived as a commodity***: In a commodity market for example, the consumer wants oats and the best way to compete in the oat market is to beat the competition on price. Commodity markets are well understood as price only competition, despite attempts to differentiate on product grades. However a new product is not a commodity, it is a different "thing" altogether. It cannot be compared. Thus the cell phone is wireless plus it mobile plus its data, video, games etc. It is not just fixed to my home. It is fixed to me. It is not just a brand extension of an existing commodity. It is substantively new.

The new product is a displacement product. It removes the old product from the market. This is much more than the competitor product which merely gets market share. In the following table we present a comparison of the new telephony and the old. This we argue shows that the new telephony is a new product which can displace the old using the Bass diffusion approach. In the following Table we company the old telcos and the new telcos according to the characteristics of a new product.

Table 1: Characteristics of Old Telephony and New Telephony as New Products versus Product Extensions.

Characteristic	*Old Telephony (ILECs and CLECs)*	*New Telephony (Cellular, CATV, VOIP)*
Technology Change	The old telephony is a single threaded hierarchical design.[19] It is based upon a voice paradigm and even the data provisioning is voice based, such as ATM and SONET.	The new telephony is primarily IP based and having a single transport fabric it is data centric and is essentially a multimedia service. It as an IP based system can provide for a fully integrated service offering.
Expansive Applications	Telephony is single threaded. The application of DSL is really data over a copper pair. It can do just so much and is high on maintenance. You cannot do video on copper to any reasonable degree and broadband has its limits.	IP is the enabler which when combined with a broadband pipe allows for many new services in the same product offering. The transition is simple. As we agued in 1993 the cell phone is just a phone but more. CATV telephony is just telephony but it provides video and broadband over the same pipe.
Cost Advantage	The old telephony is a very complex labor intensive product offering. The CLECs are selling just the same a lower price. It is a commodity market.	The product offers more so even at the beginning there may be a perceived price advantage to the consumer. Thus even though cell phone may be a bit more expensive there are more hours of cell phone use today than there are hours of fixed land line use.
Ease of Transition	The classic case is the complexity of DSL. One of the major dictums of marketing services is "Never ask your customer to assemble your service" DSL demands the user to ensure all terminations are blocked, it requires multiple reloads of the computer and it has very limited data rates. These limitations are not self imposed but are inherent in the existing product infrastructure.	This is a critical element of a new product. The cell phone is relatively easy to transition to. It has a key board to enter numbers and it is delivered by the mail and purchased over the Internet. Cable has been there for many years and using cable telephony is just like using land line telephony. The same applies for VOIP and broadband.
Non Commodity	A phone is a phone is a phone. As AT&T once stated it is "black with a rotary dial". This says a bit more than just a limited offering of a telephone set, it states a fundamental limitation of the product offering.	The new telephony is complete with the ability to expand beyond being a commodity. Whereas old telephony is oats, new telephony allows for oatmeal cookies, oat bran muffins, cinnamon oat flakes and many other extensions.

19 For a good overview of this architecture and its implications see McGarty Harvard paper 1990.

3.1 Bass Model

We review the Bass model just to ensure that its assumptions can be understood. It is based upon the theory of survival analysis and in many ways is the predator-prey model one sees frequently in ecological systems. The Bass model is detailed in Appendix C. It can be summarized as follows:

1. *There are two types of customers; adaptors and word of mouth customers. Adaptors try anything once. Word of mouth enter is the product is good and they talk.*

2. *Bass uses what is called a logistic growth model, one that is seen in ecological growth environments. He then uses this and incorporates the adopters and word of mouth customers in a time varying analytical model.*

3. *Bass also then extends the model to include multiple new generations of products to sow how one can replace another.*

4. *Finally the Bass approach shows that one can using standard regression analysis approach take true market data and fit the model as well as hypothesis test. The fitting allows for projection and the hypothesis testing permits validation as to whether this is truly a new product.*

We have used the Bass approach and have obtained both forward looking models and have validated the new product hypothesis.[20] We now look at several applications of this to new products as performed by Bass.

3.2 Life Cycles

The following are three examples of the Bass approach to life cycles. Bass performs this analysis in several areas and his raw data is available. These three examples provide an interesting preview of where we see this going in the telco space.

3.2.1 IBM Products

The first case if the development and evolution of various IBM computer systems in generation form. The figure below shows this example. There are four generations and each generation has a larger market share. Also each generation appears to have a more rapid adoption rate. This is an expected result given that the customers have more comfort and an increased need for the systems. The problem with any IBM analysis is that IBM typically controls what their customers get and when. They were the ultimate monopolist.

[20] There are many alternative approaches to this market situation. One by Gersho and Mitra adds new dimensions but has not been shown to be acceptable to the marketing profession as a tool for "standard" application as has been the Bass model. However the Gersho and Mitra approach is of interest. See Gersho and Mitra, A simple Growth Model for the Diffusion of a New Communications Service, IEEE SMC-5 N0 2 March 1975 pp. 209-216. One can extend this model or create others using a Markov approach but including the birth and death effects. This approach would account for churn as well.

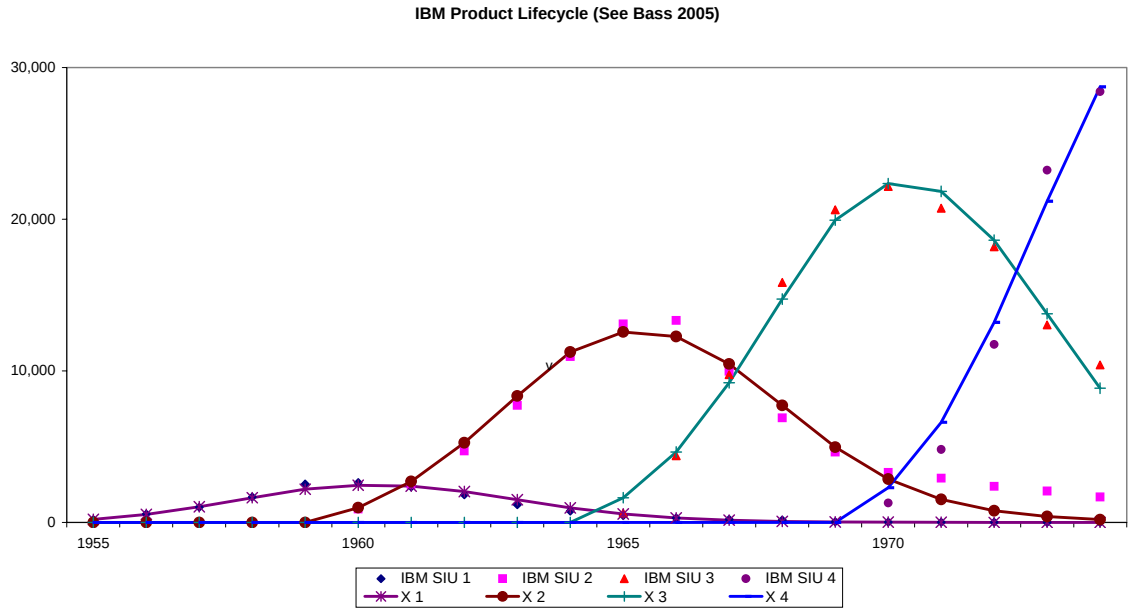


Figure 11 The analysis by Bass on IBM equipment generations.

3.2.2 Copier Market (Plain Paper vs. Coated)

The next analysis is an example of market share from coated paper copiers to plain paper copiers. Unlike the IBM case there are many competitors here and the striking observation is how quickly and how large the plain market became. This observation may be the same here in the new telcos. Remember that there is no need for one cell phone per person, there may be many.

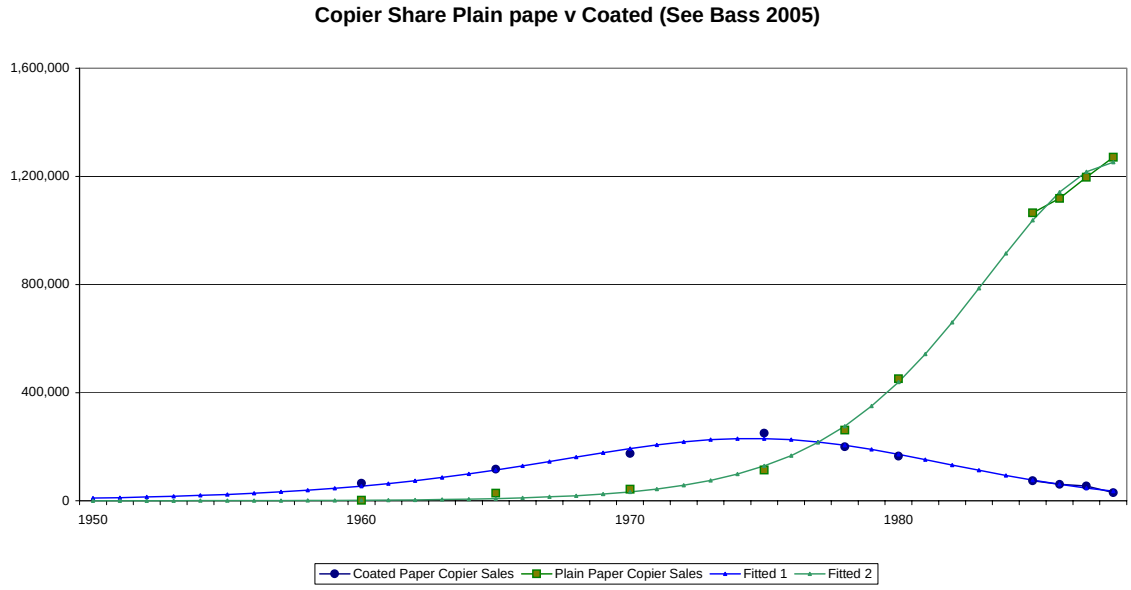


Figure 12 The Bass analysis of the diffusion of coated paper versus plain paper copiers.

3.2.3 Cellular Handsets: Analog v Digital

The third case if that of the displacement of analog cell phones wit digital. This case is midway between the fully competitive case of the copy paper and the controlled case of the computer. This could be somewhat controlled by the cellular carriers but we believe that it was driven by consumer demand.

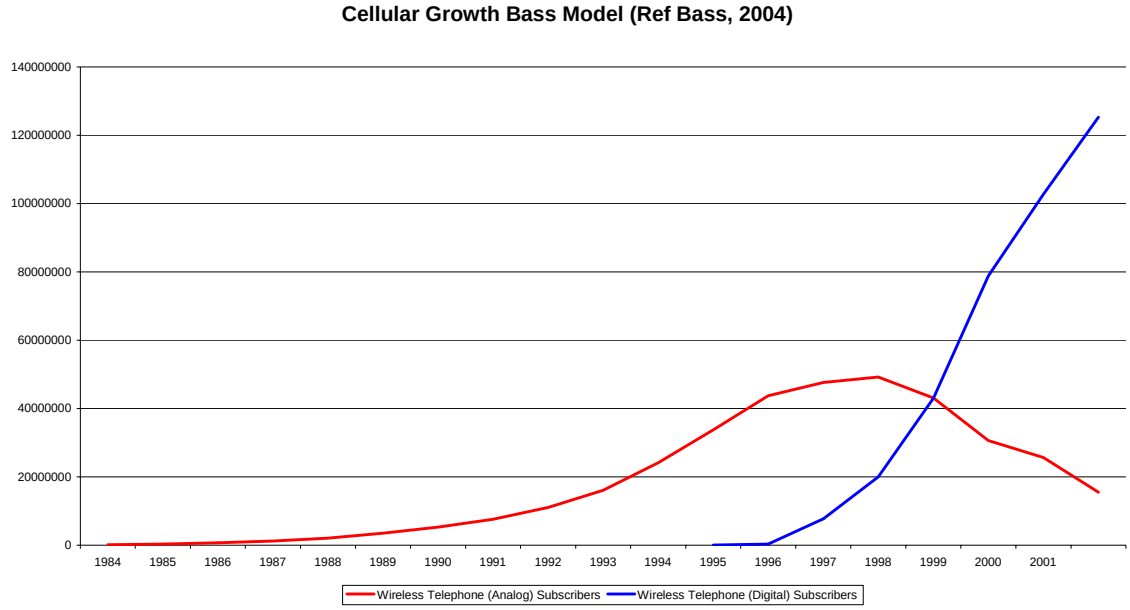


Figure 13 Bass analysis of the diffusion of digital cell phones replacing analog cell phones.

3.3 Application to Access Lines

We have applied this to the case of the incumbent wireline companies using the data Bass has developed for cellular. The following figure depicts the hypothetical diffusion using the data we have developed. It confirms the hypothesis that the market will become even at about 2009.

To determine this curve we have performed a regression analysis as suggested by Bass on the data we have obtained in the market analysis. The Bass approach has been shown to be statistically highly reliable for substitution markets. Thus we believe that the figure we have shown below reflects a reasonably attainable scenario in this market.

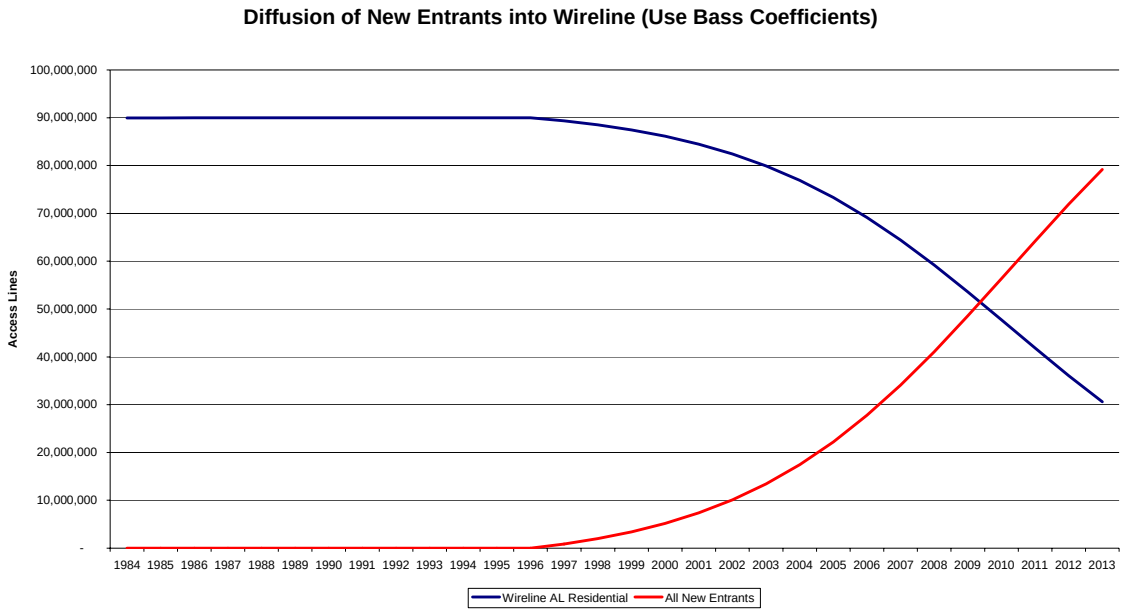


Figure 14 Estimation using Bass Methodology of the market penetration by new entrants into the telephony market and the loss to existing incumbents.

What are the implications of the above figure. For the ILECs it is quite troubling. First they are seeing shrinking market share and if they were to build true broadband then they would face the cost of a competitive market. Second they may have a significant amount of stranded assets, namely property plant and equipment which is unusable, and thus requiring some form of write-off. We discuss this latter. They are now facing a market with true churn due to competition and customer choice. The barriers to exit have been eliminated. This is a world with no FCC, it is a world of a second wave of dislocation, the first wave being that which destroyed a stand alone long distance business. Perhaps the concept of free voice is achievable.

4 OLIGOPOLY CONTROL

We have argued in the previous section that the three new offerings of Cellular, CATV and VOIP are similar new products that amongst other things provide voice. We, then using the Bass approach, showed what might occur given a fairly robust and well proven model of new product diffusion to the market share between old telephony and new telephony. The question we address in this section is: what is the share distribution between the new telco entrants?

4.1 Static Market Share

In a paper by Buzzell in 1908 and recounted in Porter in 1982, the authors speculated that in a commodity market where there was no differentiator between offering other than price that the natural stable market share is 40%, 30%, 20% and the remainder of the 10% shared by niche players. This has proven to be the case in many markets notably in the long distance after divestiture. In fact this may be used as a tool for antitrust analysis in any such market. The issue is what is the basis for this conjecture and how could we apply it to the current analysis.

We used a simple Cournot equilibrium. We assume a market of three players, the typical Cournot is a duopoly, and we assumed the price is determined by the market and is not under the control of any one player.[21]

[21] See Henderson and Quandt p 223, Bierman and Fernandez, p 33

We assumed the following simple model:

First we assume that the market price, p, is determined as follows:

$$p = A - B(q_1 + q_2 + q_3)$$

where the q s are the quantities of each of the three competitors. A and B are determined from market data experience. This type of pricing says that as the customer base increases the price per unit telco access sold will drop by some quantity with is a function of the total units sold to that time. We can estimate this quantity from the pricing from the past five years. We have done that and have used that number.[22]

We then assume the costs to each player were defined as[23]:

$$C_i = a_i q_i + b_i q_i^2$$

We have again used regression analysis on the data for each competitor's cost structure to determine a and b. The quadratic term is introduced to effect a cost element for churn, namely we have frequently observed in a new market with low switching costs for the new competitors that churn is a significant factor and the costs associated with churn are proportional to the square of the customer base.

Then we assume a Nash equilibrium solution is achievable and we can obtain the one that maximizes each players profit as defined by:

$$\pi_i = q_i p_i - C_i$$

The figure below shows the solution using the values we have obtained from data available on the three players; CATV, cellular, and VOIP.[24]

[22] We have used the FCC data base on pricing to determine this level of sensitivity.

[23] The linear and quadratic cost model reflects both normal operating costs plus churn costs via the quadratic term.

[24] See McGarty papers on cellular, CATV, and IP voice for price model details.

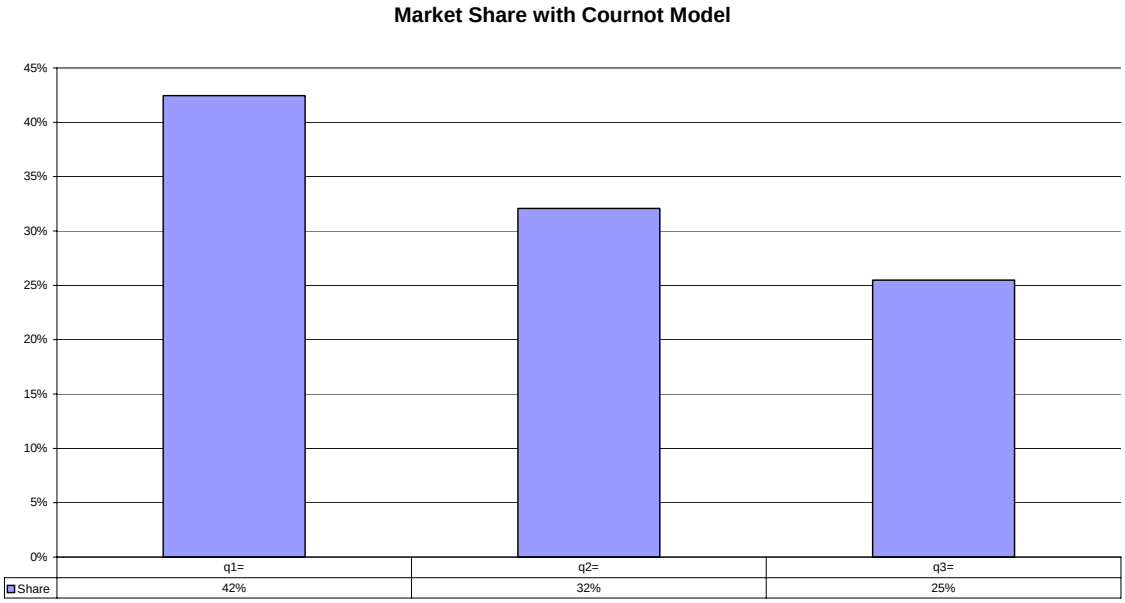


Figure 15 Calculation of market share using Cournot approach and using regression data analysis based on competitive costs of each player.

The above figure reveals some interesting results. It shows that the 40:30:20 rule is very nearly reproducible using the Cournot model. We believe that despite the limited acceptability of this as a true predictor of stable market conditions it does reflect what we would have anticipated given prior market data. Thus we anticipate this is reflective of relative shares.

4.2 Market Share and Diffusion

We then applied the Cournot approach to the Bass model to obtain market growth amongst the three contenders. This is shown below. We have then also cross-correlated this with what we know in actual counts thru 2005 and we find reasonably good agreement. Thus we believe that given the robustness of Bass and given the reliability in a truly competitive market of Cournot and given the agreement to date we have a reasonable market projection tool.

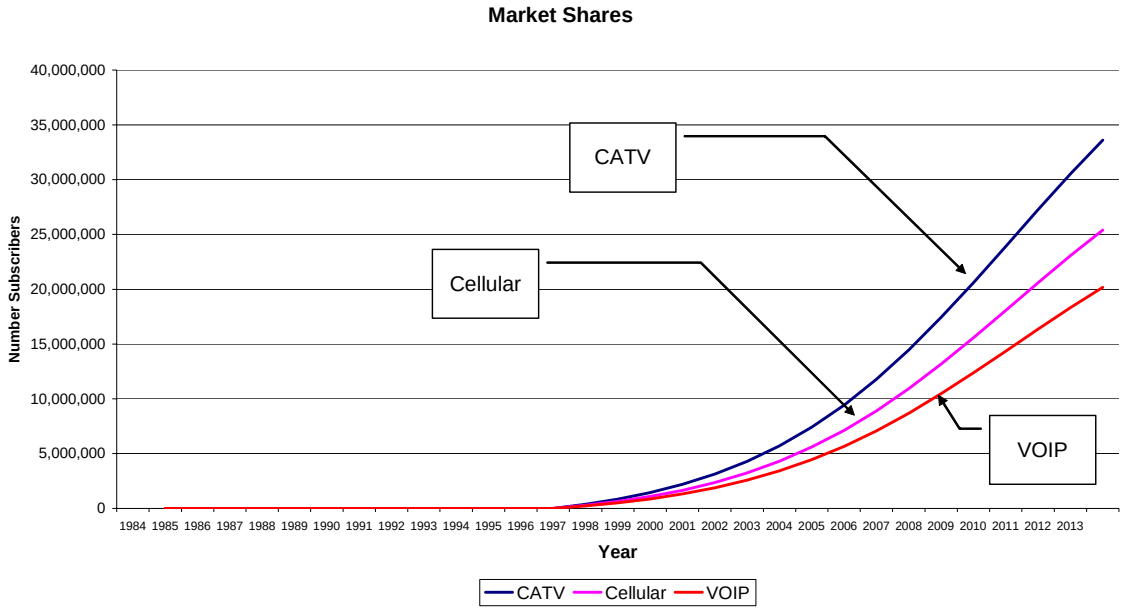


Figure 16 Application of Bass analysis on Cournot market share providing market share growth to CATV, Cellular, and VOIP.

5 CONCLUSIONS

What does this analysis demonstrate?

1. First, it shows that the data available already points to a collapse of old telephone and a rapid growth of new telephone. The data validating this is now available with volumes of facts supporting this conclusion.

2. Second, new telephone is we believe a new product. New products displace old products. The old telephone we believe is in a dying product life cycle and the new telephone is in the upsurge and will take over not just a share of the market but ALL of the market. This we believe is a very telling observation. This is not the ILECs loosing market share as AT&T did to MCI and the others, but the ILECs on the wireline side disappearing altogether![25]

3. Third, the main competitors at this time are VOIP, CATV and Cellular. We believe that as regards to new telephony they all are equally paired to compete. Each however has difference we did not fully incorporate in our model. We believe that these differences are secondary however at this time.

What are the implications of the results? We believe that there are many and that they are also quite significant.

1. *ILEC Financial Collapse*: If the old telcos are really facing a dramatic decline in wireline customer base then there is a question as to whether they must affect significant write downs of their assets. The accounting standard requiring such write downs, called impairments, is FASB 121[26] and, if this

[25] In our 2002 paper on the Collapse of Telecom, we did not focus on this factor as much but we saw cellular taking away share. We did not perform the analysis at that time on Cable, having already done so in the 1990 Architecture paper and in the 1996 IP telephony paper.

[26] See FASB 121 This Statement requires that long-lived assets and certain identifiable intangibles to be held and used by an entity be reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable. In performing the review for recoverability, the entity should estimate the future cash flows expected to result from the use of the asset and its eventual disposition. If the sum of the expected future cash flows (undiscounted and without interest charges) is less than the carrying amount of the asset, an impairment loss is recognized. Otherwise, an impairment loss is not recognized. Measurement

is taken into account, many tens of billions of dollars must be written off immediately. If the write down is done, then many of the debt notes which the telcos have would be put in immediate jeopardy. The notes would drop precipitously in value, worse than anything we saw in the late 90s with the CLECs. This could create another market shock, one arguably larger than any we have seen to date. It would shock the core of the telecom business. If they do not write down the assets in a timely fashion in view of FASB 121, then under Sarbaes-Oxley, there may be even more sever penalties to management and the Boards.

2. *Will Cable or Cellular Win*: The new players or new telcos are now swooping up market share at an ever more rapid rate. CATV players, specifically Comcast, and possibly Time Warner, could become the next generation of dominant players. This puts them in the position, via their franchise power, as de facto monopolies.[27]

3. *What is the Impact of Wireless*: We have not addressed the way for new entrants such as VOIP to enter the fray via a wireless connection. Cable and CATV are closed and proprietary systems, thus the have significant barriers to entry; franchise and spectrum respectively. In contrast new wireless systems allow new entrants, those using VOIP, and also providing broadband, video, mobility another network features to expand.[28] Wireless can become a significant de-stabilizer, especially license free wireless. It does not require a franchise and does not require a license. Mesh and Grid networks using 802.11 technologies are well ahead on the cost curve and we believe license free wireless represents another significant threat to destabilizing the new status quo.

4. *Fiber may not be "an Answer" not just "the Answer":* The changes in wireless just adds an additional risk factor to the ILECs who are investing very heavily in fiber. We have believed earlier that fiber was a very viable alternative but it is highly expensive. However after actually trying to implement a fiber to the home network, ahead of the ILECs, we found the franchise process was and is impossible to deal with. Franchises add easily $500 to $1500 per new subscriber to the already $3000 cost. The ILECs may very well have to "buy back" their former customers. They will not have the dominant market share! Perhaps the game is already lost for the ILECs.

6 ACKNOWLEDGEMENTS

I would like to than Lloyd Nirenberg and David Isenberg for their comments and insights and Bart Stuck for his assistance. I am in the final state the sole one responsible for the content but in the process of thinking through the facts and models and seeking insight, both Lloyd and David have contributed to the overall result by their review, questions and insights.

7 REFERENCES

NOTE: The author's papers may be retrieved on www.telmarc.com or http://mit.edu/mcgarty/www/MIT/

1. Bass & Bass, Diffusion of Technology Generations, see www.basseconomics.com .
2. Bass, F.M. A New Product Growth for Model Consumer Durables, Management Science, Vol 15 No 5 January 1969.
3. Bierman, H.S., L Fernandez, Game Theory wit Economic Applications, Addison Wesley 1998.

---

of an impairment loss for long-lived assets and identifiable intangibles that an entity expects to hold and use should be based on the fair value of the asset. http://www.fasb.org/st/summary/stsum121.shtml

[27] We have argued in our analyses of Franchises in 2005 that the franchise is a hidden cost of new broadband and that the Cable companies can use this power to keep any competitors out of the market. Verizon has tried aggressively as has SBC to counter this and the FCC has recently issued an NPRM trying to break this stranglehold. As we noted in our paper on the Franchise, based on extensive personal experience, the franchise and the local franchise bodies are the major block to the deployment of broadband i the US. We do not see the changing. The development of municipal broadband which we initially argued was beneficial has become another politically ploy of local governments. The municipalities have in many ways become their own worst enemies.

[28] See McGarty papers in 2005 on wireless.

4. Blackwood, M.A., A. Girschick, Theory of Games and Statistical Decisions, Wiley (New York), 1954.
5. Brealey, R., S. Myers, Principles of Corporate Finance, McGraw Hill (New York), 1990.
6. Buzzell, R D Are there Natural Market Structures, Journal of Marketing, Winter 1981, pp 42-51.
7. Copeland and Weston, Financial Theory and Corporate Policy, Addison Wesley (Reading, MA), pp. 185-225. See also S. P. Pratt, Cost of Capital, Wiley (New York) 2002.
8. Copeland et al, Financial Theory, Pearson, 2005, Koller, Valuation, Wiley, 2005.
9. Copeland, T.E., J.F. Weston, Financial Theory and Corporate Policy, Addison Wesley (Reading, MA) 1983.
10. Copeland, T.E., J.F. Weston, Financial Theory and Corporate Policy, Addison Wesley (Reading MA) 1983
11. Couch, S., T.P. McGarty, H. Kahan, QUBE: The Medium of Interactive Response, A Compendium for Direct Marketeers, Direct Mktg Assn., pp 162-165, 1982.
12. de Sola Pool, I., Technologies Without Barriers, Harvard University Press (Cambridge, MA), 1990.
13. de Sola Pool, I., The Social Impact of the Telephone, MIT Press (Cambridge, MA), 1977.
14. Dorfman, R.A., P.A. Samuelson, R. M. Solow, Linear Programming and Economic Analysis, Dover (New York), 1986.
15. FCC Trends 2000 http://www.fcc.gov/wcb/iatd/trends.html
16. Fleming T R, D P Harrington, Counting Processes and Survival Analysis, Wiley (New York) 1991.
17. Fruhan, W.E., Financial Strategy, Irwin (Homewood, IL), 1979.
18. Fundenberg, J. Tirole, Game Theory, MIT Press (Cambridge) 1991.
19. Gibbons, R., Game Theory for Applied Economists, Princeton University Press, 1992.
20. Gompers, P., and J. Lerner, The Venture Capital Cycle, MIT Press (Cambridge, MA) 1999.
21. Henderson, J. M., R.E. Quandt, Microeconomic Theory, McGraw Hill (New York), 1980.
22. Hosmer D W, S Lemeshow, Applied Survival Analysis Wiley (New York) 1999.
23. Kahn, A. E., The Economics of Regulation, MIT Press (Cambridge, MA), 1989.
24. Kalbfleisch J D, R L Prentice, The Statistical Analysis of Failure Data, Wiley (New York) 2002.
25. Koller T. et al, Valuation, Wiley (NY) 2005.
26. Kuhn, T. S., The Structure of Scientific Revolutions, Univ Chicago Press (Chicago), 1970.
27. Luce, R.D., H. Raiffa, Games and Decisions, Dover (New York), 1985.
28. McGarty, T.P., B. Pomerance, M. Steckman, CATV for Computer Communications Networks, IEEE CompCon, 1982.
29. McGarty, T.P., Business Plans, J. Wiley (New York), 1989.
30. McGarty, T.P., Financial Data Networking and Technological Impacts, INTELCOM, 1980.
31. McGarty, T.P., G. J. Clancey, Cable Based Metro Area Networks, IEEE Jour on Selected Areas in Communications, Vol 1, No 5, pp 816-831, Nov 1983.
32. McGarty, T.P., Local Area Wideband Data Communications Networks, EASCON, 1982.
33. McGarty, T.P., M. Sununu, Applications of Multi-Media Communications Systems to Health Care Management, HIMSS Conference, San Francisco, Feb. 1991.
34. McGarty, T.P., Multimedia Communications in Diagnostic Imaging, Investigative Radiology, to be published .

35. McGarty, T.P., Multimedia Communications Systems, IMAGING, Nov. 1990.
36. McGarty, T.P., R. Veith, Hybrid Cable and Telephone Networks, IEEE CompCon, 1983.
37. McGarty, T.P., S. J. McGarty, Impacts of Consumer Demands on CATV Local Loop Communications, IEEE ICC, 1983.
38. McGarty, T.P., Alternative Networking Architectures, B. Kahin Editor, McGraw-Hill (New York), October, 1991.
39. McGarty, T.P., Multimedia Session Management, IEEE Proceedings on Communications, 1990.
40. McGarty, T.P., Wireless Communications Economics, Advanced Telecommunications Institute Policy Paper, Carnegie Mellon University, February, 1992.
41. McGarty, T.P., Communications Network Morphological and Taxonomical Policy Implications, Telecommunications Policy Research Conference, Solomon's Island, MD, September, 1992.
42. McGarty, T.P., Architectures et Structures de L'Information, Reseaux, No 56, pp. 119-156, December, 1992, Paris.
43. McGarty, T.P., Economic Structural Analysis of Wireless Communications Systems, Advanced Telecommunications Institute Policy Paper, Carnegie Mellon University, February, 1993.
44. McGarty, T.P., Access to the Local Loop; Options, Evolution and Policy Implications, Kennedy School of Government, Harvard University, Infrastructures in Massachusetts, March, 1993.
45. McGarty, T.P., Wireless Access to the Local Loop, MIT Universal Personal Communications Symposium, March, 1993.
46. McGarty, T.P., Spectrum Allocation Alternatives; Industrial; Policy versus Fiscal Policy, MIT Universal Personal Communications Symposium, March, 1993.
47. McGarty, T.P., Access Policy and the Changing Telecommunications Infrastructures, Telecommunications Policy Research Conference, Solomon's Island, MD, September, 1993.
48. McGarty, T.P., Internet Architectural and Policy Implications, Kennedy School of Government, Harvard University, Public Access to the Internet, May 26, 1993.
49. McGarty, T.P., A Précis on PCS Economics and Access Fees, presented at the NPC SC Seminar on “Wireless Technology and Policy Implications” at MIT Lincoln Laboratory, in Lexington, MA, May 18, 1994
50. McGarty, T.P., Wireless: The Challenge of Using Bandwidth Intelligently, presented at the Symposium on Communications , Optics and Related Topics, held in honor of the 60th birthday of Professor Robert S. Kennedy, at Endicott House of the Massachusetts Institute of Technology, June 4, 1994
51. McGarty, T.P., Wireless Architectural Alternatives: Current Economic Valuations versus Broadband Options, The Gilder Conjectures; Solomon’s Island, MD, September, 1994.
52. McGarty, T.P., From High End User to New User: A New Internet Paradigm, McGraw Hill (New York), 1995.
53. McGarty, T.P., Disaggregation of Telecommunications, Presented at Columbia University CITI Conference on The Impact of Cybercommunications on Telecommunications, March 8, 1996.

54. McGarty, T.P., The Economic Viability of Wireless Local Loop, and its Impact on Universal Service, Columbia University CITI seminar on "The Role of Wireless Communications in Delivering Universal Service", October 30, 1996.

55. McGarty, T.P., Internet Voice: Regulatory and Legal Implications, Presented at the VocalTec Seminar on September 9, 1996, New York, NY.

56. McGarty, T.P., Communications Networks; A Morphological and Taxonomical Approach, Private Networks and Public Objectives (Noam, Editor),Elsevier (London), 1996.

57. McGarty, T.P., Competition in the Local Exchange Market: An Economic and Antitrust Perspective, MIT ITC Working Paper, September, 1977.

58. McGarty, T.P., The Economic Viability of Wireless Local Loop, and its Impact on Universal Service, Telecommunications Policy, Elsevier (London), 1997.

59. McGarty, T.P., Economic Factors on International Internet/Intranet Telecommunications, MIT Research Program on Communications Policy Conference Internet Telephony Interoperability Forum, Bristol, England, June 11, 1997

60. McGarty, T.P., Comparative Deregulation of Far Eastern Telecommunications Markets, Telecommunications Policy Research Conference, Washington, DC, September 28-30, 1997.

61. McGarty, T.P., Telecommunications Infrastructure, Technology, and Policy in Russia, A Plan for the Development of an Information Based Economy, Russian Freedom Channel Report, September, 1997.

62. McGarty, T.P., International IP Telephony, MIT ITC Working Paper, September, 1999.

63. McGarty, T.P., The Internet Protocol (IP) and Global Telecommunications Transformation, Tufts University, Fletcher School, March, 1999.

64. McGarty, T.P., The Application of IP Telephony to Local Exchange Carriers, MIT, Internet Telephony Consortium, March, 1999.

65. McGarty, T.P., IP Telecommunications QoS (Quality of Service), Is Service Quality a Sustainable Metric?, MIT Internet Consortium, Aquila, Italy, June 2000.

66. McGarty, T.P., The Evolution of International Internet Telephony, TPRC, Arlington VA, September 2000.

67. McGarty, T.P., Virtual Global Telcos: International Internet Telephony Architectures, in Internet Telephony, MIT Press (Cambridge), 2001.

68. McGarty, T.P., Internet Telephony Markets and Services, in Internet Telephony, MIT Press (Cambridge), 2001.

69. McGarty, T.P., The Internet Protocol and the Creative Destruction of Revenue, in Creative Destruction, MIT Press (Cambridge), 2001.

70. McGarty, T.P., Peering, Transit, Interconnection: Internet Access In Central Europe, MIT Internet Consortium, January 2002.

71. McGarty, T.P., Privacy in the Internet Environment, MIT ITC Conference, December, 2002.

72. McGarty, T.P., Municipal Broadband Networks: A Revised Paradigm of Ownership, MIT ITC Conference, December, 2002.

73. McGarty, T.P., The Imminent Collapse of the Telecommunications Industry, MIT ITC Working Paper, August, 2002.

74. McGarty, T.P., Privacy in the Internet Environment, MIT ITC Working Paper, November 2002.

75. McGarty, T.P., Current Telecommunications Legal Issues, Litigation v. Legislation: Is the 1996 Act a Beginning or an End?, MIT ITC Working Paper, December 2002.

76. McGarty, T.P., Municipal Broadband Networks, A Local Paradigm, Working Paper for Dutch Government, July, 2004.

77. McGarty, T.P., The Hidden Cost of Broadband, "The Franchise", Working Paper Telmarc, November, 2004.

78. McGarty, T.P., The Impact of Broadband Options on the Disaggregation of the Media Industry, Telmarc Working Paper, September, 2004.

79. McGarty, T.P., New Wireless Spectrum Policies, Alternatives to Outdate Spectrum Management, MIT Working Paper, March 2005. http://mit.edu/mcgarty/www/MIT/

80. McGarty, T.P., Broadband Alternatives, Synergies of Fiber and Wireless, MIT Working Paper October, 2005 http://mit.edu/mcgarty/www/MIT/

81. McGarty, T.P., Some Important Problems in Communications Theory, MIT Working Paper November 2005. http://mit.edu/mcgarty/www/MIT/

82. McKinsey, J.C.C., Introduction to the Theory of Games, Dover (New York) 2003.

83. Mesak, H and A Darrat, An Empirical Inquiry Into New Subscriber Services, Journal of Service Research, Vol 6 No 2 Nov 2003.

84. Niu, SC, A Stochastic Formulation of the Bass Model of New Product Development, Review of Marketing Science, January 2002.

85. Pindyck, R.S., D.L. Rubinfield, Microeconomics, McGraw Hill (New York), 1989.

86. Porter, M., Competitive Advantage, Free Press (New York), 1985.

87. Porter, M., Competitive Strategy, Free Press (New York), 1980.

88. Porter, M., The Competitive Advantage of Nations, Free Press (New York), 1990.

89. Shilov, G. E., Linear Algebra, Dover 1977.

90. Shubik, M., Game Theory in the Social Sciences, MIT Press (Cambridge, MA), 1984.

91. Spulber, D. F., Regulation and Markets, MIT Press (Cambridge, MA), 1990.

92. Urban, G L, J R Hauser, Design and Marketing of New Products, Prentice Hall (Englewood Cliffs, NJ) 1980.

93. Van den Bulte, C and Y Joshi, New Product Diffusion and Imitators, Wharton School Working paper, July 2005.

94. Von Neumann, J., O. Morgenstern, Theory of Games and Economic Behavior, Wiley (New York), 1944.

95. Wang Z, New Product Diffusion and Industry Life Cycle, PhD Univ Chicago, October 2003.

8 APPENDIX A: MCGARTY HARVARD PAPER, DECEMBER 1990

CATV MARKET DYNAMICS

In this appendix we develop the details of the argument that leads to the conclusion that the current CATV market is an established monopoly. We proceed by considering the set of cases tat may be considered in the evolution of competition in this market. The demonstration relies on an understanding of Game Theoretic analyses in econometric systems. The presentation is non-mathematical. Consider, now the following cases;

8.1 Case 1: Franchise Licenses (Exclusive):

The exclusive franchise license is inherently a stable monopoly (See Shubik, 1987 for a description of the applications towards game theoretic approaches). It allows for a maximization of the cable franchise fee by providing a maximum value to the underlying asset. The only competition that the CATV provider would then have is the alternative displacement competitors such as home video, off the air television, and the movie theaters. Generally, the pay as you buy alternatives such as rentals and movie theaters are incremental and more discretionary, whereas CATV is considered a fixed monthly expense. Thus there is an inherent bias on the part of the consumer, based on the standard consumer inertia factor, to rank order the cable purchase as the first choice. There is also, as has been shown in the past few years, been an inelastic demand for cable services, almost independent of price. The response of the local governments has been de minimus as compared to Federal Congressional bodies. The local governments have seen their local revenue increase almost 350% in the past five years.

8.2 Case 2: Non Exclusive Franchise, No Alternative Incremental Transport:

In this environment we assume that each CATV provider must build their own transport network and that the franchises are non exclusive. We will argue that the result of this is again a stable solution which is again monopolistic, assuming that there is an existing cable provider, established as the dominant. If there are no dominant providers, we will argue that the stable solution is that no CATV provider will either bid or survive.

It should be first noted that the value of the franchise is less in this scenario to the franchise holder.

Non exclusivity has reduced the potential revenue to the local government, so that this and the third scenario have lower marginal returns to the local government.

Let us now consider the two such classes of this case:

8.2.1 Prior Dominant Carrier:

Assume that there is a prior dominant carrier, one who has the existing franchise and that the build of the system has been completed and penetration in excess of a minimum level has been achieved. In this case, the customers have been captured, they are accustomed to the service and have adapted to the monthly fee.

Further assume that the service provided, namely the basic service channels and the pay channels are generally available to any CATV provider on a comparable basis. This is a key assumption, it assumes that there is no differentiator of the service based on the product. Namely, that all CATV products, that is the video content, is comparably the same.

Let us now proceed with the market dynamics under this scenario. It will be noted that this scenarios has the structure of a two person zero sum game. Thus, from an analytical point of view, the dynamics are those that satisfy the Nash criteria (see Shubik, 1984, p. 194 and Luce and Raiffa p. 140; also see the original work by von Neumann and Morgenstern).

We assume that the underlying competitive factor is price, since all providers have equal access to all products.

We assume that the dominant carrier has already established the system at an average cost less than any average cost of a subsequent carrier, and that the marginal cost per new subscriber for the established dominant carrier is smaller than for any new provider.

We assume that the established carrier has raised per monthly rates for several cost increase cycles so that the marginal revenue significantly exceeds the marginal costs and capital requirements. Thus the existing carrier has at least a positive marginal cash flow.

A new competitor enters the market. The new carrier must build a new system and must "buy" the new subscribers from the existing system or from the pool of non subscribers. The only economic way to do this is with lower prices.

The established carrier then responds with lower prices, still sustaining at least positive marginal cash flow. The new carrier, due to the entry cost structure, and the fact that it has considerable higher marginal cost structures, is at a negative marginal cash flow. This cyclic price war escalates until the newcomer is forced from the market.

The final stable point is again with the single player, who can again raise the rates and wait for another competitor.

The net result for the local municipality is lower franchise fees.

8.2.2 No Prior Dominant Carrier:

In this case, we can readily reach a conclusion based upon the results of the prior case. Since competition is based upon price, there is a stable solution if and only if there is a clear segmentation of the market by geography that allows for the reduction of prices to a level that meets positive marginal cash flow. Again, this solution assures only a minimal franchise fee for the local municipality.

8.3 Case 3: Non Exclusive Franchise, Alternative Incremental Transport:

Let us assume that no CATV provider must build their underlying network because it is provided by a third party. Thus there is limited capital investment provided and that transport is provided by a third party, such as the local telephone exchange company. Let us further assume that the transport can be provided at a cost that depends upon only each new subscriber an is available on the market on an equal price basis. Thus there is no competitive advantage on any transport provisioning. Further there is no competitive advantage on the provision of the video product. Thus the only controllable costs of each CATV provider is that of its local sales and operations organizations, all else being fixed. There are then limited scale economies available and thus the marginal costs generally equal the average costs.

Competition in this case is based upon price and the perceived quality of service. It can be shown that this case generates the most cost competitive market and that the franchise fees are minimal to the municipalities. However, it may be argued that the consumer may get the lowest priced service, the switching costs from one provider to another being minimal.

9 APPENDIX B: FASB 121

From FASB 121:

2. Long-lived assets such as plant and equipment generally are recorded at cost, which is usually fair value at the date of acquisition. The original cost usually is reduced over time by depreciation (amortization) so that the cost of the asset is allocated to the periods in which the asset is used. That practice has been modified in some circumstances when an asset has been determined to be impaired, in which case the asset has been written down to a new carrying amount that is less than the remaining cost and a loss has been recognized. Accounting standards generally have not addressed when impairment losses should be recognized or how impairment losses should be measured. As a result, practice has been diverse.

4. An entity shall review long-lived assets and certain identifiable intangibles to be held and used for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable.

5. The following are examples of events or changes in circumstances that indicate that the recoverability of the carrying amount of an asset should be assessed:
a. A significant decrease in the market value of an asset
b. A significant change in the extent or manner in which an asset is used or a significant physical change in an asset
c. A significant adverse change in legal factors or in the business climate that could affect the value of an asset or an adverse action or assessment by a regulator
d. An accumulation of costs significantly in excess of the amount originally expected to acquire or construct an asset
e. A current period operating or cash flow loss combined with a history of operating or cash flow losses or a projection or forecast that demonstrates continuing losses associated with an asset used for the purpose of producing revenue.

6. If the examples of events or changes in circumstances set forth in paragraph 5 are present or if other events or changes in circumstances indicate that the carrying amount of an asset that an entity expects to hold and use may not be recoverable, the entity shall estimate the future cash flows expected to result from the use of the asset and its eventual disposition. Future cash flows are the future cash inflows expected to be generated by an asset less the future cash outflows expected to be necessary to obtain those inflows. If the sum of the expected future cash flows (undiscounted and without interest charges) is less than the carrying amount of the asset, the entity shall recognize an impairment loss in accordance with this Statement. Otherwise, an impairment loss shall not be recognized; however, a review of depreciation policies may be appropriate.

7. An impairment loss recognized in accordance with paragraph 6 shall be measured as the amount by which the carrying amount of the asset exceeds the fair value of the asset. The fair value of an asset is the amount at which the asset could be bought or sold in a current transaction between willing parties, that is, other than in a forced or liquidation sale. Quoted market prices in active markets are the best evidence of fair value and shall be used as the basis for the measurement, if available. If quoted market prices are not available, the estimate of fair value shall be based on the best information available in the circumstances. The estimate of fair value shall consider prices for similar assets and the results of valuation techniques to the extent available in the circumstances. Examples of valuation techniques include the present value of estimated expected future cash flows using a discount rate commensurate with the risks involved, option-pricing models, matrix pricing, option-adjusted spread models, and fundamental analysis.

8. In estimating expected future cash flows for determining whether an asset is impaired (paragraph 6), and if expected future cash flows are used in measuring assets that are impaired (paragraph 7), assets shall be grouped at the lowest level for which there are identifiable cash flows that are largely independent of the cash flows of other groups of assets.

9. Estimates of expected future cash flows shall be the best estimate based on reasonable and supportable assumptions and projections. All available evidence should be considered in developing estimates of expected future cash flows. The weight given to the evidence should be commensurate with the extent to which the evidence can be verified objectively. If a range is estimated for the amount or timing of possible cash flows, the likelihood of possible outcomes shall be considered in determining the best estimate of future cash flows.

10 APPENDIX C: THE BASS MODEL

Assume we have a world in which a product is introduced and it is accepted and its market share grows. At the beginning there are early adopters who in many cases try anything new. However, if the product is good and the adopters start talking then the product begins to spread by word of mouth. It is this second driver than really ends up growing the market. We start as follows:

1. The number of products purchased will be m. This means that there will ultimately be m persons who will buy the new unit. This may be a color TV set or a digital cell phone. The value m represents to ultimate market size.

2. The number of previous buyers at time T is Y(T). At any period of time we define this number Y(T) as the cumulative number of buyers. This will hopefully grow with time.

3. p is the probability of purchase at T=0, it is reflective of the innovator. This is the early adopter we frequently see in the market. We will show that this can be obtained from the data or the real market penetration. Thus this, m, the total market, and the q factor we describe next are determinable from the actual data.

4. q represents the pressures that previous buyers have on the new purchaser. This is the word of mouth factor. This is how well the product is accepted in the market.

The likelihood of a purchase at time T given that no purchase has yet been made, P(T), is given by the following equation:[29]

$$P(T) = \frac{f(T)}{1 - F(T)} = p + \frac{q}{m} Y(T) = p + qF(T)$$

This says that the chance we get a buyer at time T is equal t the chance we get an early adopter plus the chance we get a referral from the word of mouth market. The word of mouth market, however, is being driven by how many we have sold to that point. This early on we are driven by all early adopters and latter we are driven by word of mouth. We have found in this market the CATV growth is highly word of mouth driven where the VOIP is early adopter driven.[30]

Now we define a term:

$$F(T) = \int_0^T f(t)dt$$

Recall that Y(T) is the total number of previous buyers so that we can define a variable S(t) as:

$$Y(T) = \int_0^T S(t)dt = m\int_0^T f(t)dt = mF(T)$$

29 Note that this model is the survival or hazard model we frequently see in medical statistics. See for example, Fleming and Harrington, Kalbfleisch and Prentice, or Hosmer and Lemeshow.

30 What seems interesting here is that CATV is marketing to the word of mouth crowd in man markets. The word of mouth approach to selling is after and helps the consumer reach a level of comfort. The early adopter approach such as Vonage is harsh and in your face which is consistent with this phase. The problem we frequently see, however, is that if the service fails to meet customer expectations, all one gets is early adopters and they disappear quickly as they adopt the next new thing. This is the risk of the VOIP players which seem to be uncertain of what customer service and reliability they are trying to achieve,

The above relationship will be important. We will solve for F(T) and, knowing m, this gives Y(T), the cumulative number of buyers of the new product at time T.

Therefore we determine the sales at time T, not the cumulative, as S(T), and this can be written as:

$$S(T) = mf(T) = P(T)\left[m - Y(T)\right]$$

This states that S(T) is nothing more than the fraction of total market potential, m, which converts during the time T, which is f(T). Then we know that P(T) is the probability that a purchaser who has not made a purchase up to T will buy, the number who would then buy is nothing more than the product of the chance that anyone left would buy, namely P(T), time who is left, namely m-Y(T), since Y(T) is the total who have bought up to T.

We can now substitute:

$$F(T) = \frac{1 - \exp(-(p+q)T)}{1 + \frac{q}{p}\exp(-(p+q)T)}$$

This is a key factor in the Bass analysis. Thus we use the above relationship to show how to obtain Y(T) the cumulative number of new users of the new product. Bass also shows that one can readily show how to estimate using regression analysis from existing data the q, p, and m for the new product.

Bass in a 2001 paper expand this analysis to multiple generations of new products building on the work of Norton and Bass from 1989. We provide the result for two generations, the Bass paper does it for three. The number of generations is readily reproducible. For two generations we have for the two products 1 and 2;

$$Y_1(T) = F_1(T)m_1\left[1 - F_2(t)\right]$$

$$Y_2(T) = F_2(T)\left[m_2 + m_1F_1(T)\right]$$

where:

1. m_1 is the total market size of product 1, and m_2 is the total market size of product 2. We can calculate these numbers by means of the same regression analysis on actual market data as we could do with the single Bass market.

2. We assume that Product 1 starts at time t_1 and Product 2 starts at time t_2, where $t_2 > t_1$. Thus in our analysis we assumed that old telco started at some time in the distant past so that we already have the result for that time achieved. Then we assume that the new telco starts at some recent time based upon the data. We assume here that 1999 was the start year based upon our analysis of the data. This is critical, since by early 2002 we already saw dramatic signs and in our research in 1999 we saw the beginning signs, especially with VOIP and cellular.

3. The p and q are the same for both products. This may be changed without a great deal of difference.

4. And Y(T) is the cumulative number of buyers of either one of the products at time T.