The Bundling of Telecommunications Services in the Consumer Market: Recommendations for AT&T in the Face of Intense Competition with WorldCom and the RBOCs

by

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Abstract

The bundling of local telephone service, video service, mobile wireless service, and broadband Internet access is examined as a way to reduce customer churn and increase profits for AT&T in light of intensified competition by WorldCom and other relatively large players, including the RBOCs.

Pure bundling and mixed bundling are both examined as ways to achieve these goals and strategically promote the AT&T brand name with the younger segment of the consumer market. Market demographic data (both real and estimated) is used in simulations to show that mixed bundles are preferable to pure bundles and that offering a mixed bundle comprised of local telephone service, video service (typically cable television), and mobile wireless service leads to additional profit to AT&T of roughly $950M over the “status quo” (no bundles approach).

Recommendations are then made on how to deploy the mixed bundle of local voice, cable TV, and choice of wireless or broadband Internet to satisfy current market demands and build a bundling strategy which effectively locks out WorldCom, RBOCs, and other niche bandwidth players who will counter with their own competitive responses.
Acknowledgments

The author wishes to acknowledge the contributions of the countless MIT professors along the way who have contributed to this work. In particular, I would like to thank Henry Weil for providing the necessary insight to rescope the work when needed and for providing me with competitive insights which helped clarify the true dynamics of the telecom services market in the United States. In addition, I would like to thank professors Ken Morse, John Preston, and Howard Anderson of the MIT Sloan School Entrepreneurship Lab for inculcating in me the entrepreneurial spirit and teaching me the practical mechanics of entrepreneurship, most notably the importance of quantifying the value proposition. Finally, I would like to thank Glen Urban for publishing thesis work on the voice of the customer. The depth of some of this work made me realize the importance of high quality content in my thesis [1].

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Everardo D. Ruiz
January 9, 2000
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Executive Summary

Bundling of telecom services to consumers has been given much attention recently as both the number of services demanded by consumers and the number of providers offering those services has escalated dramatically. While AT&T's recent business philosophy has been to focus on high-value business customers, competition by WorldCom and others has eroded AT&T's market share among business customers.

At the same time, convergence in the new digital economy has led to accelerated consumer adoption of high-tech digital technologies such as advanced digital cable TV, broadband Internet access, and mobile wireless service while in contrast the local access land line telephone service revenue is flat [2,3,4]

While AT&T is poised to capture a huge portion of the consumer telecom services market by "conducting business as usual" in the telecom market and enjoying the benefits of its strong brand name, the demographics of US society are changing and the younger mobile sector of society is assuming a greater and greater role in driving the economy. This younger mobile sector does not have the same affinity for the AT&T brand name as does the middle aged and older, non-technical segments of the consumer population. Thus, it is important to continue to actively promote the AT&T brand name in this newer, younger generation of consumers, while AT&T tries to capture more of each telecom customer's wallet.

To achieve these goals, bundling of the various services into a "total" consumer offering is proposed. It is shown that the preferred approach to bundling in this vast, growing, and segmented market is a "mixed" bundle offering of local access (land line) service, cable TV (video) service, and mobile wireless service or broadband Internet
service. At the same time, the individual products shall continue to be offered at their current market prices. It is projected that this approach will lead to increased post-tax profits of roughly $900 million per year and will grow over the next five years as shown below.

Figure 1. Excess post-tax profit generated by offering a mixed telecom bundle to consumers.
Introduction

In recent years the world has witnessed an explosion in telecommunications competition on a world scale as data services have become an integral part of the global economy. As telecom privatization has swept the planet, the world has literally been transformed. Guarded, state held telecom monopolies have been broken up and commercialized. New service offerings have been unveiled to capture the world’s craving for bandwidth and bandwidth related services such as e-commerce, Internet, and digital audio and video content.

In recognition of this escalating hunger for data, global players such as British Telecom, MCI WorldCom, AT&T, and others have feverishly rolled out entire families of services including local telephone, long distance telephone, narrowband and broadband Internet access, video services, and wireless telephone service in a frenetic race to capture all of the consumer demand for telecom services.

However, in the process, many companies have found that growing too fast can be fatal. In the breakneck race to expand, bidding systems imposed to efficiently determine which companies will control the assets of these monopolies once they are broken up often severely penalize the winner, a phenomenon called Winner's Curse. Thus, growth must be handled judiciously so as to not underperform (fail to gain sufficient market share) or overperform and “grow broke.”

In this extremely competitive environment, given the criticality of properly managing growth while at the same time maximizing, the bundling of telecom services into consumer packages has taken prominence as a tool for maximizing shareholder value by (1) increasing telecom service profits, and (2) reducing churn (customer...
defection to competitors), without taking on the risk and uncertainty associated with merger and acquisition (M&A) activity.

Increased telecom profits in bundling result from several sources. The first source comes from "capturing more of the consumer's wallet." This seemingly obvious source of profit stems from the fact that the average consumer (or household) purchases multiple telecom services and typically purchases from several telecom service providers. Since price tends to be the dominant driver in selecting a service provider [5], if the bundle of services can be offered to consumers at a more competitive price (i.e. slightly cheaper), then the bundled service provider captures more "walletshare". A second source of increased profit from bundling comes when demand for the multiple services is negatively correlated [6]. Simply put, if a single provider offers multiple services, bundling of two services may be more profitable if a certain market segment has a relatively high reservation price for one component in the bundle and a relatively low reservation price for another component in the bundle, while for a different market segment, the opposite is observed: relatively low reservation price for the component which the previously mentioned group values highly, and vice-versa.

As mentioned previously, global players are developing their businesses through alliances and merger and acquisition activity. As a result, they have acquired data transport technologies which enable full suites of services to be offered to consumers over very large geographic areas. This is particularly obvious in the United States where competitive pressures have led to consolidation and thus the formation of several telecom mega-players capable of providing a complete consumer telecom offering: local telephone, long distance telephone, video (television), broadband Internet service, and
wireless service. The dominant players with this offering portfolio in the United States are AT&T and MCI WorldCom (assuming that the Department of Justice approves the MCI WorldCom-Sprint merger). In addition, a multitude of competitors capable of delivering portions of the AT&T or MCI WorldCom “total bundle” offerings are in the market and already delivering consumer services. Often these are the RBOCs, Regional Bell Operating Companies.

Given this fiercely competitive landscape, the author has been asked by C. Michael Armstrong, chairman and chief executive officer (CEO) of AT&T to evaluate whether or not consumer bundling makes business sense in the United States and if so, to recommend a deployment and pricing strategy in the form of a business plan. The bundle should be conform to the AT&T “any distance” strategy [7] and thus target the spectrum of consumer telecom services including local phone service, long distance phone service, video (TV) service, broadband Internet access, and wireless phone service.
Figure 2. AT&T's Armstrong is upbeat about consumer bundles...but wants the optimal strategy

Competitive Analysis

An analysis of whether or not AT&T should pursue a bundled services strategy in the consumer marketplace or not requires that a study of the bundled services industry/market be undertaken. The analysis conducted adopts a Porter's Five Forces approach [8]. Although buyer power is an important factor, it is felt that consumers' lack of collective bargaining power works to each competitor's advantage and is generally disregarded as favoring no competitor. Likewise, supplier power is not considered in depth because it is assumed that telecom equipment is migrating toward standards and is available from a sufficient number of providers so that competitive pricing is the market norm. The only caveat is that telecom equipment suppliers tend to partner with telecom service providers so equipment manufacturer margins may be slightly higher
than a truly competitive environment. However, telecom service providers can capture a greater portion of a given equipment provider’s production leading to a “tighter” relationship (and hence a tendency to not want to gouge the service provider even during equipment shortages). Thus, the competitive analysis focuses predominantly on the factors of intensity of competition, presence of substitute products, and ease of entry into the “any distance” (also known as “full service” or “total”) bundled services market.

The M&A activities by larger players such as AT&T [7], WorldCom (and Sprint)[9,10] have formed a dichotomy in the market: (1) AT&T and WorldCom, and (2) all other smaller or regional players. Thus, the market analysis will be conducted by examining in explicit detail the specific competitors, but focusing principally on WorldCom. However, where relevant, competitive analysis is also performed on other smaller players who collectively might be capable of forming regional alliances based on complementary assets.

Rivalry, Substitutes, and Ease of Duplicating the “Total” Bundle

The first facet which helps gauge the intensity of rivalry in the offering of bundled telecom services is the number of competitors which can offer the full range of telecom products to consumers. In essence, there are two possible competitive threats to AT&T’s proposed “any distance” bundle.

The first competitor is MCI WorldCom (including Sprint’s mobile wireless and fixed wireless assets complementing existing MCI WorldCom assets, less its long distance assets and at least a portion of its Internet assets which will probably be shed as part of regulatory approval).
The second potential competitor is one or more yet-to-be-formed combinations of the many fragmented players which could collectively offer the following services:

- local phone service (typically provided by RBOCs),
- long distance phone service (typically provided by long distance resellers),
- video/TV services (typically provided by “wireless cable” service and/or satellite service providers),
- broadband Internet access (provided by xDSL (digital subscriber line), fixed wireless, or satellite providers)
- wireless service (generally a single RBOC competitor per major trading area plus PCS license holders in major trading areas)

While it is tempting to suggest that the only real nationwide competitor to AT&T is MCI WorldCom (from here forward referred to as WorldCom), it should be noted that among the apparent fragmentation of all others in the market, significant alliances are forming and in some cases are already in place with large footprint alternative network providers such as Level(3), Qwest, Williams, IXC, and NEXTLINK. Each possesses its own strategy and is market-ready (or nearly so) with recently developed broadband technologies in hand to overcome the high costs of building out the “last mile” (also known as the “first mile”) to deliver residential services and thus compete with a national offering by AT&T. It should be noted, however, that groups of smaller “sub-bundles” also present a threat as well as could the purchase of separate telecom services if pricing were disruptive since consumer preferences sometimes favor a “best in breed”
approach. Alternative providers are likely to be enabled through even newer, substitute technologies, and are thus viewed as potential substitutes into sub-bundles.

WorldCom
Since WorldCom is viewed as the principal threat due to its sheer size, it is interesting to compare AT&T and WorldCom capabilities to better understand their individual strengths and weaknesses, including key assets, as shown in Table 1.

The unique assets of AT&T and WorldCom reflect the fact that AT&T and WorldCom both share their own unique histories based initially on geographic monopolies which expanded into national footprints through mergers and acquisitions and regulatory changes. Noteworthy too is the fact that while long distance telephone service began as a core product offering to both business and residential customers after the breakup into the RBOCs, business customers have embraced competition leading to roughly equal market shares in 1998 for AT&T and WorldCom of 39.4% and 38.7%, respectively [11]. By stark contrast, however, residential customers are still largely lopsided in demand distribution between the two players, giving AT&T and WorldCom residential market shares of 59.9% and 23.4%, respectively, or a factor of over 2.5:1 of AT&T over WorldCom. The curiosity is that this has occurred even though WorldCom has tried to brand itself as a younger, more agile and aggressive player and has landed major endorsements from pop celebrities such as Michael Jordan[12]. Given the ubiquitous choice of many long distance
<table>
<thead>
<tr>
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<th>AT&amp;T (including TCI cable assets)</th>
<th>WorldCom (including Sprint wireless and long distance assets)</th>
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<tr>
<td><strong>Local Access Customers</strong> (non-mobile wireless)</td>
<td>Customer base unknown.</td>
<td>Customer base unknown.</td>
</tr>
<tr>
<td></td>
<td>Cable telephony possible due to large cable assets including TCI, MediaOne and Time Warner.</td>
<td>Landline and LMDS telephony available in selected major trading areas in the following states.</td>
</tr>
<tr>
<td><strong>Local Potential Customers [13,14]</strong></td>
<td>All USA households</td>
<td>All USA households</td>
</tr>
<tr>
<td></td>
<td>Cable telephony to more than 63.7M homes (through ownership or agreement with large cable providers).</td>
<td>Full deployment into “currently available” states (above) represents 30-40% of USA population.</td>
</tr>
<tr>
<td></td>
<td>Remaining 40% using fixed wireless (Project Angel)</td>
<td>FCC applications being submitted for remaining states in 2000 to reach all USA households.</td>
</tr>
<tr>
<td><strong>Long Distance Customers</strong> (residential long distance market)</td>
<td>59.9%</td>
<td>23.4%</td>
</tr>
<tr>
<td><strong>Long Distance Potential Customers</strong></td>
<td>All USA households</td>
<td>All USA households</td>
</tr>
<tr>
<td></td>
<td>AT&amp;T (including TCI cable assets)</td>
<td>WorldCom (including Sprint wireless and long distance assets)</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Video (TV) Customers</td>
<td>54.2 M households (51% of US)</td>
<td>Customer base unknown.</td>
</tr>
<tr>
<td>Video (TV) Potential Customers</td>
<td>63.7 M households via cable (present)</td>
<td>50 M households</td>
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<td></td>
<td>42.5 M households via fixed wireless (goal) but appears to have almost nonexistent licenses to provide service</td>
<td>Holds 60% of LMDS license spectrum in USA and already provides Cable TV service in San Francisco, San Jose, Seattle, Chicago, Detroit, Houston; St. Louis, Tucson, Denver, Portland, New York and Rochester, Philadelphia, Washington, DC., and Norfolk. MMDS will help connect rural areas.</td>
</tr>
<tr>
<td></td>
<td>Excite@home just passed 1M subscribers, mostly AT&amp;T based.</td>
<td>LMDS: 60% of LMDS license spectrum in USA. Service theoretically already available in San Francisco, San Jose, Seattle, Chicago, Detroit, Houston; St. Louis, Tucson, Denver, Portland, New York and Rochester, Philadelphia, Norfolk, and Washington, DC.</td>
</tr>
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<td></td>
<td>In 1999, only 29 M households have been passed by high-speed cable systems (available from all provider).</td>
<td></td>
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<tr>
<td>Broadband Internet Potential Customers</td>
<td>AT&amp;T (including TCI cable assets)</td>
<td>WorldCom (including Sprint wireless and long distance assets)</td>
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<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>63.7 M households via cable (presently only 17.4 M AT&amp;T households have been passed).</td>
<td>50 M households</td>
</tr>
<tr>
<td></td>
<td>42.5 M households via fixed wireless (goal) but appears to have almost non-existent licenses to provide service</td>
<td></td>
</tr>
<tr>
<td>Wireless Customers [18]</td>
<td>8.8M subscribers ARPU: $66.20 (grew 29.5% and 9.2% per year from 1998 to 1999, respectively)</td>
<td>4M subscribers ARPU: $54.00 (grew 139% and 3.8% per year from 1998 to 1999, respectively)</td>
</tr>
<tr>
<td>Wireless Potential Customers (POPs) [19,20,21]</td>
<td>264.6 M (based on 95.8% of USA population of 276,219,000 persons)</td>
<td>170 M</td>
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service providers in the United States, this leads the author to concur that AT&T's prominent brand name has been and can continue to be a source of differentiation and therefore premium pricing in the long distance market.

As alluded to earlier, the core product of AT&T and WorldCom is no longer just long distance telephone service. Both companies provide a wealth of other services including local calling, video (TV) distribution, broadband Internet access, and wireless service to both business and residential customers.
After the breakup of AT&T into the RBOCs, local service was distributed among the many Baby Bells based on geography. However, as time has passed, regional consolidation has occurred and where there were once many players, there are now fewer albeit stronger players in the local telephone markets. WorldCom, now with the combined local assets of Sprint, has the ability to offer local service now to 30-40% of the United States population and plans to extend this though FCC approval to 100% of the United States in the coming year. Obviously, deployment cannot be terribly rapid in absolute terms, especially if land lines are installed for this purpose in a facilities based roll out. In fact, given that competition in the local market is imminent, it can be speculated as to whether or not these are even commercially viable solutions. Still, the fact is that WorldCom’s delivery of local services is progressing and ultimately is planned to encompass the entire United States.

Since developing a customer base through a dedicated facilities/land line approach will likely be too expensive, WorldCom will therefore deliver this service through local line leasing (resale of line and switch) from the ILEC (incumbent local exchange carrier), via an unbundled approach (line lease from ILEC with WorldCom switching) or through an MMDS or LMDS radio solution. Each of these solutions appears to be commercially viable since WorldCom can offer services (even offered under the Sprint brand name) with an underlying cost structure which minimizes the incremental cost per line based on sheer economies of scale which result from a large geographic service area as shown in Figure 4. Open access using cable in most areas is still a hotly debated topic but is not considered a viable alternative for WorldCom local
telephone service at this time, although over the next few years the courts may legislate (force) open access.

![Cable nation](image)

By completing a cable deal with Time Warner, AT&T will be able to offer nearly half of all American households local phone service through cable TV wires.

Source: AT&T and Time Warner

**Figure 3. AT&T national cable footprint**

Video (TV) services are another area where AT&T and WorldCom will compete for market share. As mentioned previously, the cable assets controlled by AT&T as shown in Figure 3 already deliver video content to roughly half of the households in America. Video services are an important component of a bundle which most consumers would regard as "complete", especially since this is the bundled approach that AT&T will push as part of its total bundle. While rhetoric abounds extolling the cost and bandwidth advantages of the existing cable infrastructure, in the end, the wireless
cable service which WorldCom can provide must be delivered using a solution which has different economics. MMDS (multipoint multichannel distribution system) is one such technology. WorldCom (largely through Sprint) already has experience operating this technology in rural areas and is well positioned to provide TV service (even interactive TV using this two-way capable technology since the 1998 FCC ruling permitting bidirectional communications in MMDS frequency bands). In addition, a similar radio technology, LMDS (local multipoint distribution system) is viable for video transmission and is therefore a cable TV substitute as well. Unfortunately, thus far, economies of scale are not sufficiently large to drive the costs down to even AT&T's "best guess" target price of roughly $300 per house, as expressed recently by Michael Armstrong [22].

Thus, it is felt the WorldCom will also have great difficulty in matching AT&T's low marginal cost. This in itself will give AT&T a major competitive advantage in providing television services to the bulk of United States residences. Although the upside to these wireless technologies is that the negative cash flow required to build out the service is incremental in nature, actual prices to install the necessary infrastructure are still relatively high, roughly $750 per household. Factoring in depreciation of the infrastructure into the marginal cost per month, the incremental cost of fixed wireless service to deliver video service (wireless cable) is still relatively high at $27.88 per month versus $12.59 per month for cable (again assuming a fully depreciated cable plant). Even in the best case where LMDS economies of scale are reached and the target price of $300 per household are achieved, the incremental cost of these wireless cable transmission systems is $18.50 per month per household. For the economics to
be comparable to those provided by the incumbent cable TV provider (who has already
depreciated the entire cost of the network), the cost to equip an average house would
have to drop to roughly $25 per household if the service were to be viable based only
on the video services revenue stream. Fortunately, once this hardware has been
installed, providing local voice, television, and broadband Internet services, are all
possible, which changes the value proposition substantially in favor of WorldCom. The
possibility to offer a range of services using these fixed wireless technologies today to
over 50 million potential subscribers in the major population centers of the United States
is shown clearly in Figure 4 and positions WorldCom to compete well with AT&T in the
“video-plus-other services bundle” space.

Figure 4. WorldCom’s fixed wireless service can deliver local phone, video, and broadband
Internet to population centers on both coasts plus major population centers in the South and
Great Lakes region.
Another key element in a bundled offering to consumers is broadband Internet access. Indeed, futurist “next generation” providers of backbone and last mile bandwidth such as Level(3) and NEXTLINK have banked their futures on an explosion in demand for graphics rich, bandwidth intensive applications [23]. As mentioned previously and shown in Figure 4, WorldCom can deploy wireless broadband and xDSL technology into areas where AT&T’s crown jewel cable systems are first to bring broadband. This piggybacking of broadband service on top of wireless cable TV service starts to reinforce the value proposition of wireless cable access using MMDS and LMDS and strengthens the competitive case against AT&T’s virtual monopoly on broadband. WorldCom will thus be a strong competitor in the broadband data space if it can secure what are viewed as key strategic partnerships with key content providers, as AT&T has done with Excite@home and others.

As a final component to a full consumer bundle offering, WorldCom will offer mobile wireless service through the wireless assets acquired in the Sprint merger. In response to AT&T’s wildly successful Digital One Rate plan which generated incredible demand for mobile service and handsets (causing the Nokia supply chain to collapse and jamming wireless spectrum in key market areas like New York City), Sprint reacted decisively with several “me too” plans and aggressive pricing, typically below 75% of that charged for the Digital One Rate plan. The success of Sprint’s wireless service has been astounding. Whereas the one rate plan created large demand, Sprint has capitalized on the “me too” effect and has grown from a much smaller provider into a mobile service provider with roughly 4 million subscribers, between one third and one
half of the number of subscribers presently owned by AT&T’s wireless unit, AT&T Wireless.

WorldCom presently owns cellular and PCS licenses covering 170 million POPs (potential subscribers) in 293 domestic markets as shown in Figure 5. This compares favorably with the national wireless footprint held by AT&T as shown in Figure 6 and is expected to lead to a severe wireless rivalry.

Figure 5. WorldCom mobile wireless national footprint
Alternative Service Providers

Local Telephone Service

With the signature by President Clinton of the Telecom Act in February, 1996, competition in local markets by CLECs (competitive local exchange carriers) was opened up and the way was paved for the ILECs, the Baby Bells (RBOCs), to begin offering long distance services. With this ruling, the field of potential suitors seeking to offer local access to consumers has exploded.

Companies offering local services to segments of the United States using conventional landline technology to provide local voice service include WorldCom, SBC
Telecom, Bell Atlantic, and Bell South. In addition, newer microwave distribution technologies such as LMDS have enabled companies such as NEXTLINK, WinStar, and Teligent to offer local service. And finally, consumers with cable television access have been bombarded with opportunities for low cost local telephone service via cable telephony. Companies (besides AT&T / TCI / MediaOne) in this space include Cablevision Systems (Long Island, NY), Comcast Cable (West Palm Beach, FL, and Baltimore, MD), Cox Communications (rollouts in Arizona, California, Louisiana, Nebraska, Virginia, and Connecticut), and Jones Communication (Alexandria, VA, and Prince George’s Country, MD) [24].

SBC Telecom is aggressively pursuing a full-service “one stop” strategy by leveraging its brand names (Ameritech, Southwestern Bell, Pacific Bell, Nevada Bell, SNET) in the top 20 US markets to deliver local service along with high-speed Internet access. In addition, it is expanding into another 30 markets to give a combined local service presence in 24 states plus the District of Columbia. The result is 60 million local service access for lines (an estimated half are residential) and xDSL delivery available to nearly 10 million POPs by January, 2000. Key attributes about the SBC Telecom business are summarized in Table 2. Clearly, SBC will be a “go for broke” competitor in the local telephone service business as AT&T invades its home turf when to offer a total telecom bundle. SBC will have to bundle its local service with xDSL service to protect its otherwise archaic copper network investment.
Another large local service competitor for AT&T is RBOC competitor Bell Atlantic. Covering the Northeastern United States, Bell Atlantic claims to hold 43 million access lines, 22 million of which are residential. Residential demand for access lines is growing at roughly 3 percent per year while local minutes grew slightly over 5 percent per year last year. This makes Bell Atlantic roughly two thirds the size of SBC in terms of access lines, but with higher revenues in the Northeast due to Universal Access regulations and higher than average per capita income. Thus, Bell Atlantic will continue to offer local service on its home service area, and likely bundle with regional long...
distance in the Northeast, taking advantage of the December 28, 1999 FCC ruling on Bell Atlantic New York 271 Order. As was the case with case with SBC, Bell Atlantic is aggressively pushing its xDSL service to protect its massive copper infrastructure, and is expected to bundle it with local service and additional services such as caller ID as part of its limited bundle strategy.

Another RBOC competitor to be dealt with is BellSouth. Its service area is shown in Figure 7. Key markets include Research Triangle (North Carolina), New Orleans (Louisiana), Atlanta (Georgia), and Miami, Tampa, and Orlando (Florida). BellSouth has stated that its strategy will be driven by three core investment pillars [26]:

(1) communications leadership, including “the convenience and value of one-stop shopping...”, (2) international growth, and (3) wireless service growth. BellSouth has already taken steps toward implementing the domestic portion of this strategy as evidenced by its FCC request to provide in-region long distance services using its own network or by leveraging its recently inked bandwidth alliance with Qwest. In addition, like other RBOC’s BellSouth is in the process of rolling out xDSL technology, making it available to over half of its local line customers. Clearly, this growth strategy puts BellSouth in direct competition with the proposed AT&T bundling of local, long distance (regional), and broadband services in the Southeastern United States.
The final RBOC competitor to be dealt with is US West. Its operational territory is the Northwestern US and is the product of the 1998 consolidation of Mountain Bell, Northwestern Bell and Pacific Northwest Bell who were assigned to U S WEST Inc., during the divestiture of AT&T. Probably its largest asset in providing bundled service
which will compete with AT&T is its recent merger with Qwest, which was approved November 2, 1999. In addition to a possible bundle including inexpensive long distance service, the Qwest-US West merger gives the US West local service area, shown in Figure 9, access to broadband MegaBit™ xDSL services through its existing local phone lines. While this is almost the identical facilities based strategy being employed by SBC, Bell Atlantic, and BellSouth, the merger with Qwest will allow almost immediate bundling of local and long distance services. In addition, US West has mobile wireless service in markets in Arizona, Colorado, Minnesota, Oregon, Utah, and Washington state which means that if it can acquire video technology (possibly through co-branding of satellite service), it could effectively challenge the AT&T total bundle for consumers.

Figure 9. The North and Midwest had been the exclusive local services domain of US West
The next set of competitors are LMDS license holders who hold licenses which theoretically permits coverage of the entire United States. LMDS is a broadband technology and is therefore being promoted a telecom service bundle enabler by the major LMDS license holders listed in Figure 10. The top three LMDS license holders are considered below since they hold roughly 98 percent of the LMDS POPS.

<table>
<thead>
<tr>
<th>LMDS license holder</th>
<th>POPS</th>
<th>Price/POP</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEXTLINK</td>
<td>201.3 M</td>
<td>$4.46</td>
</tr>
<tr>
<td>Hyperion</td>
<td>90.8 M</td>
<td>$0.51</td>
</tr>
<tr>
<td>WinStar</td>
<td>16.8 M</td>
<td>$2.58</td>
</tr>
<tr>
<td>Eclipse</td>
<td>11.4 M</td>
<td>$1.25</td>
</tr>
<tr>
<td>Actel</td>
<td>10.6 M</td>
<td>$0.92</td>
</tr>
<tr>
<td>Cortelyou</td>
<td>10.6 M</td>
<td>$2.39</td>
</tr>
<tr>
<td>ARNet</td>
<td>9.1 M</td>
<td>$1.27</td>
</tr>
<tr>
<td>Telecorp</td>
<td>8.2 M</td>
<td>$0.47</td>
</tr>
<tr>
<td>CoServ</td>
<td>7.5 M</td>
<td>$1.37</td>
</tr>
<tr>
<td>Vanguard</td>
<td>7.1 M</td>
<td>$1.25</td>
</tr>
</tbody>
</table>

Figure 10. LMDS license holders and the size of their service areas [27]

Nextlink is by far the most pervasive CLEC promoter of LMDS for bundling local service with other broadband services such as video and broadband Internet. NEXTLINK also owns significant fiber optic assets (typically SONET fiber rings) in 41 cities across 15 states as shown in Figure 11. It does not own its own long distance capability similar to RBOCs but it has agreements with long haul fiber optic transport provider Level(3) to supply long distance service between LMDS coverage areas covering “95% of the top 30 markets” [28]. Even though it owns no local access line facilities, it is capitalizing on existing local access lines by offering xDSL in areas not served by LMDS. While NEXTLINK’s strategy is initially to deploy bundle services to business customers, based on its massive license acquisition spending spree, it can be safely assumed that it intends to play in the residential bundling space since it controls
the bulk of the critical asset, LMDS spectrum in the US. In addition, it is likely that founder Craig McCaw will be able broker deals for all services it does not yet provide based on his “brand name”. Since the per subscriber cost of LMDS is still relatively high, service bundling is almost mandatory for positive cash flow in any reasonable period of time.

Hyperion Telecommunications is another large LMDS license holder which in theory can deliver local service as a CLEC to roughly one third of the POPS in the US. Hyperion is owned by Adelphia, and is the eight largest cable operator in the country with roughly 2.3 M subscribers. Its massive cable plant distributed through Florida, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Vermont, and Virginia can be integrated with its access to LMDS access to one third of the US population with a bundled service offering, including local, long distance, video, and broadband services. However, it has no mechanism by which to delivery mobile wireless service to customers. The underlying costs associated with Hyperion’s deployment of an LMDS based bundle offering are reasonably low and should
accelerate Hyperion's LMDS build out. This is clear since Hyperion paid roughly one ninth of that paid by NEXTLINK in spectrum auctions and is leveraging the existing infrastructure of public utility companies through strategic partnering. However, like NEXTLINK, Hyperion will focus initially only on business customers. Thus, Hyperion’s early LMDS bundle offerings will not *initially* threaten AT&T’s bundle. However, in the long term, it is felt that Hyperion will be able to compete effectively with AT&T to deliver bundled services where mobile wireless is not featured.

WinStar is the third LMDS competitor and holds licenses for about one sixth as many POPS as Hyperion. While this access appears relatively small, WinStar’s licenses grant LMDS access to the top 60 US markets and have allowed WinStar to already begin delivery of CLEC service to major metropolitan areas including Atlanta, Boston, Chicago, Dallas, Los Angeles, New York City, San Diego, San Francisco and Washington, D.C. To complement its last mile capability, strategic partnerships with Lucent, Williams and Metromedia Fiber grant WinStar the ability to offer long distance and broadband Internet service, making it a potential bundled service competitor. With the abundant financial resources from Microsoft and other major investors WinStar is competing as a CLEC in major Bell Atlantic and SBC strongholds and can offer bundled services today with the exception of mobile wireless service. While its short term to medium term focus will be on serving high profit business customers (and only extending into residential service through direct sales to building owners), WinStar could be a significant threat to AT&T’s bundle offering in the major population centers of Boston, Chicago, Dallas, Los Angeles, New York City, San Diego, San Francisco, and Washington, D.C.
Finally, there are cable systems which may offer local telephony as part of a bundled offering with cable TV service and video. Cablevision, Comcast, Cox, and Jones Communications are some of the larger providers, but competition in the local telephony market should be considered to be the incumbent cable TV operator in any given region. While, in general, this is AT&T operating under the brand names MediaOne and TCI, plus in some geographies, Time Warner, the field of cable MSOs (multi system operators) who will compete as CLECs using the cable medium is impressive as shown in Figure 12. The obvious potential for bundling of video and broadband Internet to voice local or regional long distance service is astounding since the infrastructure is mostly installed. Reliability, however, will continue to play a key role in determining the acceptance of the cable providers as viable CLECs. Still, the potential for excess profits generated from what amounts to excess capacity in the cable networks will be irresistibly lucrative.
<table>
<thead>
<tr>
<th>Rank</th>
<th>Cable Service Provider</th>
<th>Subscribers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time Warner</td>
<td>12,600,000</td>
</tr>
<tr>
<td>2</td>
<td>AT&amp;T Broadband &amp; Internet Services</td>
<td>10,749,000</td>
</tr>
<tr>
<td>3</td>
<td>MediaOne (now AT&amp;T)</td>
<td>4,965,000</td>
</tr>
<tr>
<td>4</td>
<td>Comcast Cable Communication</td>
<td>4,511,000</td>
</tr>
<tr>
<td>5</td>
<td>Cox Communication, Inc</td>
<td>3,742,000</td>
</tr>
<tr>
<td>6</td>
<td>Cablevision Systems Corp.</td>
<td>3,412,000</td>
</tr>
<tr>
<td>7</td>
<td>Charter Communications</td>
<td>2,318,000</td>
</tr>
<tr>
<td>8</td>
<td>Adelphia Communications</td>
<td>2,304,000</td>
</tr>
<tr>
<td>9</td>
<td>Century Communications</td>
<td>1,338,000</td>
</tr>
<tr>
<td>10</td>
<td>InterMedia Partners</td>
<td>1,292,000</td>
</tr>
<tr>
<td>11</td>
<td>Jones Inter Cable</td>
<td>1,291,000</td>
</tr>
<tr>
<td>12</td>
<td>Lenfest Communications</td>
<td>1,204,000</td>
</tr>
<tr>
<td>13</td>
<td>Falcon Cable TV</td>
<td>1,113,000</td>
</tr>
<tr>
<td>14</td>
<td>Prime Cable</td>
<td>912,000</td>
</tr>
<tr>
<td>15</td>
<td>TCA Cable</td>
<td>867,000</td>
</tr>
<tr>
<td>16</td>
<td>Cable ONE</td>
<td>733,000</td>
</tr>
<tr>
<td>17</td>
<td>FrontierVision Partners</td>
<td>702,000</td>
</tr>
<tr>
<td>18</td>
<td>Multimedia CableVision</td>
<td>514,000</td>
</tr>
<tr>
<td>19</td>
<td>Insight Communications</td>
<td>502,000</td>
</tr>
<tr>
<td>20</td>
<td>Fanch Communications</td>
<td>495,000</td>
</tr>
<tr>
<td>21</td>
<td>R&amp;A Management, LLC</td>
<td>458,000</td>
</tr>
<tr>
<td>22</td>
<td>MediaCOM LLC</td>
<td>358,000</td>
</tr>
<tr>
<td>23</td>
<td>Triax Telecommunications</td>
<td>340,000</td>
</tr>
<tr>
<td>24</td>
<td>Service Electric CableTV, Inc.</td>
<td>301,000</td>
</tr>
<tr>
<td>25</td>
<td>Harron Communications</td>
<td>280,000</td>
</tr>
<tr>
<td>26</td>
<td>Northland Communications</td>
<td>269,000</td>
</tr>
<tr>
<td>27</td>
<td>Tele-Media Corporation</td>
<td>266,000</td>
</tr>
<tr>
<td>28</td>
<td>RCN Corporation</td>
<td>261,000</td>
</tr>
<tr>
<td>29</td>
<td>Greater Media, Inc</td>
<td>252,000</td>
</tr>
<tr>
<td>30</td>
<td>Media General Cable</td>
<td>242,000</td>
</tr>
</tbody>
</table>

Figure 12. Top 30 MSOs (Multiple System Operators) [29]
Long Distance Telephone Service

In addition to WorldCom, several large sets of companies exist which have incentives to try to include long distance telephone service as part of a telecom bundle. These can in general be categorized into long haul network providers, RBOCs, and resellers.

The first group, present (or future) long haul network providers, consist of companies specializing in long distance data transport and include network providers such as Qwest, Level(3), Williams, or IXC.

Although Qwest shareholders recently approved the merger with US West, it is noteworthy that BellSouth is a 10 percent equity holder (predilution) in Qwest. The Qwest network, shown in Figure 13, has excess capacity at present due its deployment of WDM (wavelength division multiplex) technology. This excess capacity will serve as a temporary source of incumbent advantage compared only if AT&T and WorldCom bandwidth is exhausted which is unlikely, but possible. Qwest-US West is already starting to offer bundled services to consumers which means that it is an immediate threat to AT&T in the Northwest.

Level(3), however, has adopted a wholesale bandwidth strategy as it banks on data demand to exponentially outstrip supply, leaving network providers such as Qwest and WorldCom without any inexpensive means to upgrade their networks to expand capacity. The Level(3) strategy takes advantage of the tremendous barriers to entry created when new fiber optic network must not just be retrofitted into existing conduits, but built from scratch, possibly without even the benefit of existing right of way agreements. The Level(3) network is IP (Internet protocol) based to take advantage of digital convergence and positions Level(3) to partner with providers of any type of voice,
TV, or broadband service. The negative for Level(3) is that the network is not yet built and will instead be completed over the next few years meaning that it cannot compete until 2001 to 2002 to offer a bundle similar to that proposed by AT&T.

Figure 13. Qwest North American network

Another potential player with sufficient clout to try to orchestrate a long distance bundle with local service is Williams. As shown in Figure 14, Williams’ vast fiber optic network is well deployed in the US, but it is currently positioned mostly as a wholesale provider of network services to long-distance carriers and utilities. Similar to Level(3), Williams has planned for explosive growth in demand and built out the network leaving
behind extra conduits to quickly and inexpensively add future capacity. Its SONET backbone uses WDM technology and has excess capacity for the time being, but selling its excess capacity as part of a consumer-oriented bundle may be too far outside of its wholesale business model mind set. It is thus felt that Williams will be unable orchestrate a nationwide consumer bundle offer to compete with AT&T.

![Image of Williams' nationwide fiber optic network](image)

**Figure 14.** Williams' nationwide fiber optic network is comprised of both owned and leased trunks

IXC is yet another wholesale provider of bandwidth with the potential to compete directly with AT&T to offer consumer bundles. Its network is well equipped coast to coast and has benefited from negotiations to lease conduit space from utilities, rail right of ways, and even from long haul competitors. While IXC is still far from being a consumer-centric service provider, it has expanded its North American business plan to
include the delivery of retail long distance services to business customers and Internet service providers. Data convergence and IXC’s recent migration away from its default wholesale model leads the author to believe that IXC is capable of partnering to offer a full service telecom bundle in the next 12-18 months in most geographies.

The next logical grouping of potential long distance providers are the RBOCs. The long distance capabilities of BellSouth and SBC have both already been considered in detail in the local service section and will not be discussed further here. Bell Atlantic, though, deserves mention because it has been the most successful in breaking into long distance business (in-region only). With the December, 1999 FCC ruling allowing Bell Atlantic to compete in the long distance market in New York, the FCC has approved the first RBOC to compete in the long distance market. All previous RBOC attempts were rejected because the FCC felt that the RBOCs hadn’t done enough to ensure competition in their respective local markets as a prerequisite for entering the long distance market. Bell Atlantic thus has gained a real first mover advantage compared to other RBOCs and can compete effectively with the AT&T total consumer bundle offering since it can now offer local and regional distance along with wireless service and xDSL. Its ability to offer video service is described in the next section, Video (TV) Service.

The final group of long distance competitors which might be able to orchestrate a full service telecom bundle for consumers are the resellers which typically offer long distance service using a 10-10-xyz prefix. While these providers are very aggressive and consumer focused, it is doubtful that they have the clout or buying power to pull together the necessary suite of local, long distance, video, broadband, and wireless assets needed for a total consumer bundling offer. In addition, even if the long distance
resellers could orchestrate the bundle at consumer friendly rates, reselling local phone
service, video, broadband, and wireless collectively will be a very difficult sell to
consumers who are confronted with a similar offering but under the superior AT&T
brand name.

**Video (TV) Service**

At first glance it might seem that aside from commercial broadcast TV, the
delivery of consumer video service falls strictly in the domain of incumbent cable TV
providers. However, as discussed previously, MMDS and LMDS technologies enable
wireless cable service to compete directly with the entrenched incumbent. Note the
following excerpts from the National Cable TV Association [29] which illustrate the
vulnerability of the incumbents cable providers:

- Ameritech (SBC) has cable franchises in 83 communities in midwest, passing
  over 1 million homes, operates in 65 communities and has 150,000 subscribers
- GTE (Bell Atlantic) passes 520,000 homes in Clearwater, FL and Ventura
  County, CA, and had 73,000 subscribers at end of 1997.
- SNET (SBC) obtained first ever state-wide cable franchise in Connecticut and
  already offers service in over a dozen communities.
- BellSouth offers digital wireless cable (160 channels) plus up to 40 CD quality
  music stations in New Orleans, Orlando, Atlanta, Jacksonville, Daytona, and
  Miami using either cable plant or MMDS.
- RCN (Residential Communications Network) provides bundled phone, video, and
  Internet in New York, Boston, New Jersey, and Pennsylvania. RCN is also
  offering service in Washington, DC under the StarPower brand name.
It is interesting to note that access to the bulk of the US' 66,065,400 households[30] is due to several key factors. First, it is now technically feasible for competitors to use either MMDS or LMDS to deliver the service to the consumer residence. Second, competition with the incumbent is actively encouraged by the political and regulatory bodies. And third, unique, custom content such as special Disney programming (available through BellSouth Entertainment's Americast) is often included at no additional charge as part of the service agreement.

For this reason, an alternative technology for delivery of consumer video service is direct broadcast satellite (DBS) which provides up to 215 channels to consumers in North America [31]. A further satellite alternative is the EchoStar “dish network” or WebTV [32] which offers up to 500 channels. This service is value priced to be price competitive with cable programming which has been the staple of America’s video diet this decade. However, on its own, DBS is really a stand alone service. While the DBS potential subscriber base is effectively the entire United States leading to a very attractive value proposition based on the sheer economy of scale, there is virtually no way for DBS to offer a bundle with local or long distance phone service unless it is co-branded with services provided by a third party. Interesting, this is exactly what has happened.

Since by FCC ruling Bell Atlantic can provide local phone service, regional long distance, plus broadband Internet access (using xDSL) and mobile wireless service, it has successfully negotiated to co-brand DirecTV [33] so it can offer a complete telecom package. This bundle will compete directly with any total consumer bundle offered by AT&T. Only time will tell, though, if this offering gives first mover “bundling” advantage
to Bell Atlantic, which has been an aggressive competitor, but needs badly to improve its tarnished customer-unfriendly brand name. This leaves an opportunity on the table for AT&T.

Broadband Internet Access

In addition to the broadband offerings by AT&T, the RBOCs using xDSL (and occasionally cable) are able to deliver broadband Internet access. With the explosive popularity of broadband and simultaneous emergence of Voice-over-DSL (VoDSL), Voice-over-Packet (VoP), and Voice-over-IP (VoIP) technologies, it is possible to deliver broadband access and telephony directly through a single xDSL connection. Besides the RBOCs, the dominant national footprint suppliers of xDSL in the US are Covad, Rhythms, and Northpoint.

As expected, the RBOCs, eager to attract customers and preserve their massive copper infrastructure are pouring billions of dollars into rollout and promotion of xDSL. As a indicator, SBC is spending 6 billion dollars on Project Pronto, an alliance with Williams, to provide 77 million subscribers with xDSL by 2002 [34] BellSouth is deploying xDSL is its largest trading areas such as Ft Lauderdale, Atlanta, and Miami, with a goal of 51% of its 30 biggest trading areas' 12,635,950 lines being xDSL capable by 2001 [35]. BellSouth’s broadband arm, BellSouth.net, is supplementing broadband service via cable in select portions of Alabama and Georgia. Bell Atlantic's xDSL services are now available to over 8 million households in New York City, Baltimore, Boston, Northern New Jersey, Philadelphia, Pittsburgh, Washington DC, and Southern New Jersey metropolitan areas [36]. But the real players across the US are the xDSL pure plays, Covad, Rhythms, and Northpoint.
Covad claims to be the nation’s leading xDSL provider covering over 25 million homes and business in the largest metropolitan areas in the US, including San Francisco Bay Area, Los Angeles, Seattle, Sacramento, New York, Boston, Washington D.C., Baltimore, Chicago, Philadelphia, San Diego, Atlanta, Detroit, Minneapolis/St.Paul, Denver, Portland, OR., Raleigh/Durham, Austin, Houston, Dallas/Ft. Worth, Miami, and Phoenix.

As shown in Figure 15, Covad’s rapid growth strategy has been successful and will continue to expand through the year 2000. At that point, Covad will reach more than 40 percent of all US homes which compares very well to AT&T’s cable penetration. Covad’s customer mix is both business and residential through its TeleSpeed and TeleSurfer products, respectively. It is therefore quite easy to envision Covad as a bundled telecom service threat since it has a present market capitalization of roughly $5.3 dollars (on earnings of only $5.2 million) and could easily partner to provide VoIP based local and long distance telephony (without local access charges), in direct competition with a bundle offering from AT&T. A co-branding arrangement for satellite service similar to the arrangement with Bell Atlantic might also be an appealing bundle proposition, especially in areas where cable plant upgrades for broadband have not yet occurred, even though the bundle would lack mobile wireless service.

The second national footprint player offering broadband services is Rhythms. The Rhythms footprint overlays for the most part the national footprint held by Covad as shown in Figure 16. The market capitalization of Rhythms is an impressive 2.3 billion dollars on paltry earnings of only 0.5 million dollars. Rhythms’ mammoth stock market valuation gives it a bargaining position comparable to Covad in forging alliances to
provide local and long distance service using VoDSL and VoIP technologies. Due to its very low earnings, however, it appears that Rhythms has a significantly lower subscriber base than Covad. This lack of penetration relative to Covad means that despite its stock price, it holds less bargaining power than Covad when trying to assemble the necessary components to form a consumer telecom bundle. If Rhythms can partner with regional providers to enable telephony services the situation could quickly change. Otherwise, its position is much worse than that Covad since it doesn’t enjoy the economy of scale, revenues, or brand name of its closest competitor Covad. Thus, at present, Rhythms does not appear to be a likely competitor in organizing a competing bundle geared toward residential customers.

Figure 15. Covad xDSL service will be available to over 40 percent of all US households in 2000
The final non-satellite pure play in the consumer broadband Internet service provider space is NorthPoint. With market capitalization of over 3.4 billion dollars on earnings of only 0.9 million dollars, NorthPoint is merely a bandwidth reseller offering xDSL. NorthPoint has nearly an identical footprint as its competitors as shown in Figure 17. Likewise, NorthPoint appears to have no differentiating assets when compared with Covad and Rhythms. Given the phenomenal market valuations of Covad, Rhythms, and NorthPoint, and given the sharp drop in valuation which almost certainly would occur if a large charge of any sort is taken to "buy their way" into the consumer convergence market (presumably by offering some sort of consumer telecom bundle), it is felt that Covad, Rhythms, and NorthPoint will instead focus on battling each other for...
market share rather than entering the consumer bundle market and squaring off against AT&T.

A final broadband alternative is broadband satellite. A candidate service of this type is Hughes DirecPC system which at first glance would appear to be only a "standalone" bidirectional version of the EchoStar system. The novelty of the EchoStar system is that it receives data streamed down to Earth from the broadcast satellite, whereas uplink data (e.g. web page requests) is transported to the network (Internet) via a phone line. This unique asymmetry in the data flow path tightly couples the system to local telephone access, which opens a unique opportunity for bundling with a local phone service provider, either ILEC or a CLEC. Given the "hunger" of both ILECs
and CLECs to succeed in the local telephone service market, bundling of DirecPC with DirecTV video programming and local access may provide an attractive bundling opportunity to compete with AT&T for a sub-bundle of the total offering proposed by AT&T. The economy of scale afforded by satellite service is tremendous with incremental monthly subscriber cost estimated by the author to be $10.64 versus over $12.56 for cable. Thus, the potential of a DirecTV/DirecPC plus local telephone service bundle is a real threat for AT&T in all US markets.

**Mobile Wireless Service**

While there are many wireless service providers in the US, several major mobile service providers might be able to attractively bundle telecom services with mobile wireless service are the ILECs. The obvious competitors (besides WorldCom’s mobile wireless from the Sprint merger), are SBC Telecom, BellSouth, Bell Atlantic, and US West-Quest, with 5.8M, 4.5M, 5.7M, and ~1M subscribers, respectively [37]. A dark horse is the GSM service provider VoiceStream whose national footprint (including OmniPoint and Aerial) has captured 1.7M subscribers [38].

In the author’s opinion, all of these wireless players are threats to a national AT&T bundle offering for consumers since consumers are seeing mobile wireless service more and more as a core element of any telecom bundle. While AT&T has a national footprint and can bundle a host of services easily with any wireless offering which might be included in a bundle, the RBOCs’ regional footprints and VoiceStream’s national footprint can be used to simultaneously gain market share in the long distance market (by not having to two cent per minute per side termination charges) and local telephone market (either as a complementary service or substitute service). Also, given
the fact that these providers have all bid hundreds of millions of dollars for spectrum, the players will fight viciously to recover those costs and turn a profit as demand for wireless service continues to climb rapidly. Thus, all large wireless providers are a potential threat to AT&T's proposed consumer bundle offering.

Competitive Summary and Recommendations

WorldCom

Due to its newer, vast economy of scale and massive geographic presence, WorldCom will be formidable competitor in the complete consumer bundle space. However, due to regulatory issues and its incomplete build out, it will be some time before WorldCom can catch up to the head start which AT&T enjoys. Based on the accelerated competition through deregulation, the author estimates that WorldCom will be unable to offer a complete bundle using its own assets exclusively for another two years. However, based on its improved operational efficiency (through work force reductions and increased network utilization), its long term cost structure will be competitive or possibly better than that of AT&T, especially since it will be expanding the network through technologies which bypass the massive expense of the “last mile”.

AT&T still enjoys significant brand name advantage over WorldCom in the long distance market compared to WorldCom and should therefore leverage this against WorldCom in each of the segments: Local, long distance, video, broadband Internet, and wireless service. Licensing and learning curves are not expected to play significant roles in successful deployment of their bundle strategies since both AT&T and WorldCom are both moving into businesses which have not been well integrated in the past. This parity means that the significant difference is that WorldCom enjoys less
consumer brand name recognition and lacks several key assets, namely, “AT&T size” video content contracts for serving very large populations, and second, broadband content agreements for the broadband Internet portion of the bundle.

The final question is whether or not WorldCom can execute (deploy) better than AT&T. While WorldCom has positioned itself as a younger, aggressive service provider than the much older AT&T, WorldCom must deliver. If line provisioning becomes a bottleneck, as the explosion of consumer demand for Internet escalates, consumers will likely find the cable medium the mechanism of choice to enjoy TV and broadband, plus local and long distance telephone service if properly packaged and priced.

Alternative Service Providers

Due to its newer, vast economy of scale and massive geographic presence, WorldCom will be a force to be reckoned. However, additional concern comes from the sheer number of high market cap competitors whom are fighting for the consumer wallet. As a summary, each potential competitor (i.e. competitors which could delivery a technology/service space as part of a potential bundle which could rival AT&T’s) is tabulated below by technology used and service delivered in Figure 18.
<table>
<thead>
<tr>
<th>LOCAL TELEPHONE SERVICE</th>
<th>LONG DISTANCE (LD) TELEPHONE SERVICE</th>
<th>VIDEO (TV) SERVICE</th>
<th>BROADBAND INTERNET SERVICE</th>
<th>MOBILE WIRELESS SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANDLINE</td>
<td>FIBER OPTIC</td>
<td>CABLE</td>
<td>CABLE</td>
<td>PCS/CELLULAR</td>
</tr>
<tr>
<td>WorldCom</td>
<td>WorldCom (less Sprint LD)</td>
<td>WorldCom</td>
<td>WorldCom (less Sprint Internet?)</td>
<td>WorldCom</td>
</tr>
<tr>
<td>Bell Atlantic</td>
<td>Sprint LD buyer</td>
<td>CableVision</td>
<td>CableVision</td>
<td>BellSouth</td>
</tr>
<tr>
<td>SBC</td>
<td>Level(3)</td>
<td>Comcast Cable</td>
<td>Comcast Cable</td>
<td>Bell Atlantic</td>
</tr>
<tr>
<td>BellSouth</td>
<td>Qwest</td>
<td>Cox Comm.</td>
<td>Cox Comm.</td>
<td>SBC</td>
</tr>
<tr>
<td></td>
<td>Williams IXC</td>
<td>Jones Comm.</td>
<td>Jones Comm.</td>
<td></td>
</tr>
<tr>
<td>CABLE</td>
<td>SATELLITE</td>
<td>SATELLITE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CableVision</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Comcast Cable</td>
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<tr>
<td>Cox Comm.</td>
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</tr>
<tr>
<td>Jones Comm.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RADIO (LMDS)</td>
<td>RADIO (LMDS)</td>
<td>RADIO (LMDS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WorldCom</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEXTLINK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WinStar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teligent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xDSL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhythms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bell Atlantic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BellSouth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NorthStar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 18. Summary of AT&T competitors, services provided, and technologies utilized

Recommended Strategy

To improve profitability in the long term, AT&T will have to both reduce operating expenses and gain greater “wallet share” from the consumer market place. While this contrasts with AT&T’s recent philosophy to capture high-value business customers, it must be recognized that revenue generated by consumers is roughly equivalent to that generated by business customers. While consumers are in general “higher
maintenance” (higher cost to maintain) than business customers, consumers are increasingly taking advantage of digital services such as wireless and broadband Internet access. This growth in consumer spending on digital services is expected to be a driving force behind the e-commerce (digital) economy for the years to come and therefore AT&T’s strategy should reflect this fact. This growth will drive revenue growth. AT&T’s position to deliver all of these high-growth services provides a compelling economic story which simply cannot be ignored, even in the face of competition by smaller providers of individual services.

On the cost side, AT&T has recently made great strides in reducing its operating expenses but will have to continue to do so to remain competitive given the intensity of competition and skill of the WorldCom and the RBOCs. However, AT&T’s brand name in the consumer telephony market is expected to be portable to all other services it backs, giving it tremendous advantage over WorldCom, RBOCs, and other competitors. In addition, as AT&T strives to deliver the complete bundle of services to consumers, its capital investments, while massive this year, are strategic investments which are expected to enable the complete bundle offering. Starting immediately, AT&T is in an unparalleled position to deliver services to the majority of American households backed by what the author feels are the lowest marginal costs in the industry.

Thus, AT&T should proceed with a “mixed bundle” offering of local voice, cable TV (via cable or other technology), and either wireless or broadband Internet access. The choice of wireless service or broadband Internet access is left up to the consumer and in the future may be rolled into the bundle offering. While broadband Internet access is expected to grow dramatically over the next few years, it is felt that requiring it
as part of a bundle at this time is not warranted due its relatively low penetration at present of broadband compared to AT&T wireless penetration. As explored in the Financials section, the mixed bundle should be priced at a 5% and 10% discount from the combined “a la carte” prices of the individual components since even 5% represents hefty monthly savings to the consumer of nearly $5 from the average combined price of $92.05. The additional 5% (to a total of 10%) could be added in tiers if the consumer signs up for a 12 month to 24 month contract, which will help reduce consumer churn, especially in the highly competitive wireless sector. This reduced churn also helps AT&T build its brand name with the younger generation which does not presently share the same esteem for the AT&T brand name as older Americans and many persons in the middle aged population.

Bundle Rollout

The rollout of bundled services by AT&T is recommended as a two phase deployment. Phase 1 involves limited deployment in a relatively small test market trial to work out marketing and logistics issues. The second phase is the full service rollout to the bulk of major population centers in the US.

The phase 1 rollout is a test market deployment and is envisaged as a rollout into the New York City metropolitan area and will last three to six months. While this area is a large population center and generally not considered “small”, it has been selected for phase 1 to leverage the recent FCC ruling allowing long distance competition by Bell Atlantic. Since the AT&T protest to the Bell Atlantic ruling as unfair competition was overruled by the FCC, this is an ideal opportunity for AT&T to simultaneously begin implementation of its national bundling strategy while effectively trumping Bell Atlantic’s
long distance play with a bundle. By taking the offensive against Bell Atlantic with a rapid phase 1 deployment, AT&T shows itself as pro-competition while setting a precedent for other regional players such as the RBOCs who will challenge AT&T in other geographies by future offerings of some form of a bundle. Since this action will be the first signal to WorldCom, a competitive response is expected from WorldCom (described later).

Phase 2 rollouts will quickly follow the phase 1 rollout period of three to six months. The lessons learned during phase 1 must be integrated into the phase 2 rollout to ensure a smooth expansion of the bundle into other markets. Failure to learn from the phase 1 mistakes will risk alienation of the vast customer base, inhibit growth, damage the AT&T brand name, mostly in the group AT&T wishes to influence, the young mobiles. The potential for damage to AT&T by driving customers to regional or national competitors such as the RBOCs and WorldCom is tremendous and thus must be avoided at all costs. Thus, the delivery of services and integrated billing must be seamless. It should also be mentioned that the bundle will be likely be dynamic to allow AT&T to competitively position the bundle subject to prevailing conditions in the individual markets. This differentiation is expected to preserve AT&T’s premium pricing compared to WorldCom while capitalizing on AT&T’s inherently lower marginal costs. Phase 2 is expected to last 12 months and involve rollouts to the following major metropolitan markets (in order of population size): Los Angeles, Chicago, Washington, D.C., San Francisco, Philadelphia, Boston, Detroit, Dallas-Ft. Worth, Houston, Atlanta, Miami, Seattle, and Cleveland.
Probable Competitive Response

As stated previously, when signaling by AT&T occurs, competitors will respond in an attempt to protect market revenue. The probable competitive responses are (1) lower prices of the bundle components, and (2) form bundles.

In the first scenario (the most likely short term scenario), WorldCom and other competitors lower their prices for the bundle components in an uncoordinated manner. If the individual prices for local phone service, video service, and wireless service drop simultaneously, the AT&T bundle price must drop dollar for dollar to maintain the same "relative attractiveness". As shown in Figure 19 in the Financials section, price competition will drop AT&T's increased bundling profits by roughly 1.3 percent for every percent that the bundle price must be reduced if the original AT&T bundle discount was 10% or greater. For zero to 10% AT&T bundle discounts, AT&T profits drop roughly one percent for every one percent drop in bundle price induced by competition by WorldCom. It is believed that competitors will only try to match AT&T's bundle price (plus or minus a percent or so) since competitors' marginal costs are higher than those of AT&T.

The probable second competitive response (and most likely in the long term) is a competing bundle. The biggest threat is WorldCom due to its scope and resources. The economics are identical to those described previously in that the bundle price for AT&T must drop dollar for dollar to maintain AT&T’s relative attractiveness for bundling when a competing bundle is offered. It is expected that any bundled response by WorldCom will be delayed by 6 months compared to AT&T and that WorldCom will try to match AT&T bundle pricing less a percent or two to capture market share. AT&T’s profitability will still be significantly better than WorldCom's due to its owning the delivery
medium of choice, the cable TV plant. Since this scenario is approaching commoditization, AT&T will have to evolve its bundle to continue to gain excess profits beyond those afforded by its better-than-WorldCom marginal costs. This might include an expanded bundle which in addition to local and long distance telephone service includes mobile wireless service and broadband internet service. The bundle might also include video content which WorldCom is unable to duplicate or futuristic network services such as hard drive backup across the cable network or remote recording (caching at the AT&T premise) of video content for viewing at a future time via streaming techniques. This differentiation will help preserve the profits projected in the Financials section, even in the face of a bundle offering which competes directly with the AT&T offering.

Financials

The bundling of telecom services into a single consumer package has required considerable effort to craft. The bundle should create benefit consumers while creating two benefits to AT&T (and its shareholders). The first benefit is to attract consumers to competitively priced bundles of services which they might not purchase otherwise if priced separately, thus increasing profits via walletshare. The second effect is the increased demand (and thus profits) generated by the elasticity of demand coupled with the lower price of the bundle. Elasticity of demand is estimated as $-0.2$ based on work by Hausman [39]. Both effects are significant as will be seen below.

The key factor which leads to the success of telecom bundling is negative correlation of reserve prices for the various services across the consumer population.
While this may seem to defy the seemingly random distribution of the consumer population preferences, it does not.

Structured consumer preferences in the apparent “market noise” is well illustrated by the demand for wireless services. Worldwide, new demand is generated predominantly by young adults who are described as “young mobiles” and who have embraced the digital economy and its technologies. This market segment is composed of adults ranging roughly from 18 years of age to 35 years of age and represents roughly 25% of the entire US population[40]. Due to its mobility and technology savvy, young mobiles highly value mobility and high tech services such as wireless, broadband Internet access and video service (typically cable TV) with access to what seems to the older segments of the population like an incredible selection of channels. In summary, the young mobile set has a higher reservation price (willingness to pay) for wireless, cable TV programming, and Internet services than for fixed, land line service.

By contrast, another one fourth of the population lies at the other end of the age spectrum. This older, non-techie population, typically aged from 55 years of age and up, in general, manifests nearly opposite preferences as the young mobile group [41,42,43,44]. This older group has grown up respecting the AT&T brand name, but is significantly less mobile than the young mobiles. In addition, its “need” for services such as broadband Internet access and high channel count on cable TV are not as acute as for the young mobiles.

Thus, roughly 50% of the US population’s purchasers display some form of negative correlation for the services which would constitute part of the AT&T bundle offering. This negative correlation is essential for bundling to make economic sense
(beyond any strategic value such as increasing consumer switching costs and reducing customer churn). As outlined by Pindyck [6], bundling can be either pure bundling or mixed bundling, but mixed bundling tends to be preferable when marginal costs are nonzero, which is the case for a telecom bundle, especially since the bundle includes inherent television programming charges which are estimated to be roughly $9.25 per subscriber per month. A list of candidate technologies used to deliver the various services appears in Table 3. Estimated marginal costs for the various technologies for delivering the bundled services appears in
Table 3. How the technologies deliver the various services in a bundle

<table>
<thead>
<tr>
<th>Service</th>
<th>Cable</th>
<th>Mobile Wireless</th>
<th>Fixed Wireless</th>
<th>POTS</th>
<th>xDSL</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video (TV)</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Voice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Home Voice</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Home broadband</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Table 4. Marginal Cost for the various Services

<table>
<thead>
<tr>
<th>Service Technology</th>
<th>Estimated Marginal Cost per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Telephone – Land line</td>
<td>Possibly $9; Plus 1 cent per minute</td>
</tr>
<tr>
<td>Local Telephone – Fixed Wireless</td>
<td>$31.88 (MMDS/LMDS) (less when shared with TV or broadband Internet access)</td>
</tr>
<tr>
<td>Long Distance Telephone – Land line</td>
<td>Varies; 4 –5 cents per minute</td>
</tr>
<tr>
<td>Mobile Wireless Service – Cellular/PCS</td>
<td>$17.17</td>
</tr>
<tr>
<td>TV - Cable</td>
<td>$12.56</td>
</tr>
<tr>
<td>TV – Satellite</td>
<td>$10.64</td>
</tr>
<tr>
<td>TV – Fixed Wireless (MMDS/LMDS)</td>
<td>$31.88</td>
</tr>
<tr>
<td>Broadband Internet – Cable</td>
<td>$5.32</td>
</tr>
<tr>
<td>Broadband Internet – DSL</td>
<td>$22.66</td>
</tr>
<tr>
<td>Broadband Internet – Satellite</td>
<td>$17.28</td>
</tr>
</tbody>
</table>

Relative profit increase corrected for elasticity of demand

Figure 19. The relative profitability of pure bundling and mixed bundling versus no bundling
Based on a discount of 10% for most probably case (AT&T's use of the cable plant to deliver the non-wireless portion of the bundle), simulations show that AT&T's expected increase in profits by using mixed bundling is roughly 10%. Non-bundled services will continue to be offered at the going market price and the bundle price will be adjusted over time to track the sum of the individual component prices in a given market. Since the discount given to customers to attract them to bundling would be between 5 and 10 percent, it should be noted that the sensitivity of excess bundling profits is roughly −1% in revenue for each additional percent of discount offered over the −5% to −10% range as shown in Figure 19.

Based on a 2.5% annual bundle growth rate (after an initial rapid adoption by consumers) and operating and administrative expenses of roughly 30% of the cost of services provide (COGS) [7], pretax profits from mixed bundling prove to be superior to pure bundling as evidenced in Table 5 and Figure 20.

<table>
<thead>
<tr>
<th>Table 5. Pre-tax profit comparison of no bundling, pure bundling, and mixed bundling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Revenue (Pre-tax, $MM)</td>
</tr>
<tr>
<td>Profits - No bundles (Pre-tax, $MM)</td>
</tr>
<tr>
<td>Profits - Pure Bundles (Pre-tax, $MM)</td>
</tr>
<tr>
<td>Profits - Mixed Bundles (Pre-tax, $MM)</td>
</tr>
<tr>
<td>Mixed Bundling Extra Profits (Pre-tax, $MM)</td>
</tr>
</tbody>
</table>
Figure 20. Pro forma revenue and profits with and without bundling
Appendix A – Infrastructure Incremental Costs

The following are estimates of marginal costs of the various technologies used to deliver telecom services to the customer. The calculation of marginal costs for the various technology combinations which can be used to deliver local phone service, video service, mobile service, and/or broadband Internet service is extremely important because it helps gauge AT&T’s competitive position as a “bundle provider” when defending against WorldCom et. al. The key observation from Table 6 and Table 7 is that using the cable TV plant is the most cost effective mechanism to deliver the combination of bundle services to the consumer. Since AT&T will not be able to use cable technology in all markets due its large uncovered areas in its footprint, alternative combinations of technologies used by AT&T can be directly compared with competitors’ offerings to estimate underlying cost and profitability for each market.

<table>
<thead>
<tr>
<th></th>
<th>TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cable</td>
</tr>
<tr>
<td>Video (TV)</td>
<td>X</td>
</tr>
<tr>
<td>Mobile Voice</td>
<td></td>
</tr>
<tr>
<td>Home Voice</td>
<td>X</td>
</tr>
<tr>
<td>Home broadband</td>
<td>X</td>
</tr>
</tbody>
</table>
Table 7. Marginal cost of the various telecom technologies including tax (reprint of Table 4)

<table>
<thead>
<tr>
<th>Service Technology</th>
<th>Estimated Marginal Cost per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Telephone – Land line</td>
<td>$9, mostly due to taxes; Plus 1 cent per minute</td>
</tr>
<tr>
<td>Local Telephone – Fixed Wireless (MMDS/LMDS)</td>
<td>$31.88 (less when shared with TV or broadband Internet access)</td>
</tr>
<tr>
<td>Long Distance Telephone – Land line</td>
<td>Varies; 4 –5 cents per minute</td>
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<tr>
<td>Mobile Wireless Service – Cellular/PCS</td>
<td>$17.17</td>
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<td>$12.56</td>
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<tr>
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<tr>
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</tr>
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<td>$22.66</td>
</tr>
<tr>
<td>Broadband Internet – Satellite</td>
<td>$17.28</td>
</tr>
</tbody>
</table>

The estimated marginal costs are based on data available in the literature and have been calculated by amortizing the total estimated system cost over the assumed user base (typically half of system capacity) and then depreciating the system over a lifetime of three years. The exception to this rule is the cost of cable TV systems which have long been fully depreciated by their owners and thus only reflect the estimated upgrade costs (per mile divided by estimated number of homes per mile) required to deliver broadband Internet access.

Additional per user costs were then added to compute total marginal cost for each technology. These additional costs address the expense of hardware purchase (e.g. modems at the user premises and central office for xDSL) plus associated installation costs (“two guys and a truck” at a total assumed overhead rate of $100 per hour).
The calculation of marginal costs for each technology clearly demonstrates how taxation has created tremendous incentives for competitive technologies to emerge and through innovation bypass the existing delivery systems of each of the telecom services offered as part of a consumer bundle offering.
Appendix B – Economic Theory of Bundling

A fundamental concept from economics is the notion of “reservation price”. The reservation price is the maximum price that a customer will pay for a given good or service. Put simply, if the price of the good exceeds a given customer’s reservation price, that customer will not purchase the good.

As expected, a population of potential customers for a given service have varying preferences leading to a continuum of reservation prices rather than a single discrete “price point”. Therefore, if the potential customer population's reservation price distribution can be approximated by a continuous function, integrating that reservation price distribution function from zero to the price of the service is equal to the fraction of the population (or market segment) under consideration which adopts the service and pays for it. Calculations of this sort are easily performed in MATLAB or MathCad and must be performed to “sanity check” market penetration calculations and properly lay the groundwork for baseline (no bundles available) profit and bundle profit calculations.

In the telecom services market, it is easily shown that a significant portion of the population at large subscribes to multiple telecom services. However, due to consumers’ varying reservation prices, telecom services prices must be set component-by-component which may lead to sub-optimal profits for firms providing multiple telecom services such as AT&T. Bundling is a way to address this problem.

As the name suggests, bundling is the act of selling multiple telecom services together as package or bundle under a single price. If the services are only offered for purchase together as a bundle, then the bundle is defined as a pure bundle. If the goods are available both individually or sold together as a bundle, then the bundle is
defined as a *mixed bundle*. In some cases pure bundling is the preferred mechanism to improve profits for a set of goods or services, while in other cases mixed bundling is the preferred approach. An exploration of how bundling works helps to identify the roots which determine whether or not pure bundling or mixed bundling is the most profitable pricing strategy for the firm.

The case of pure bundling of two zero marginal cost services is portrayed in Figure 21. For a given customer (designated by color), the reservation cost is either above or below the "constant" reservation price (bundle price) contour (line). Customers laying on the vertical axis would pay up to the reservation price PA for telecom service A and customers laying on the horizontal axis would pay up to PB for service B. By inspection, customers whose reservation prices fall below the bundle price line will adopt the bundle whereas those above the line will not adopt the bundle. Clearly, the goal of pure bundling is to tune the bundle price will until the product of the number of bundle adopters and bundle price is maximized. This works well when the population exhibits a negative price correlation. In practical terms, this means that a given segment of the population has a relatively high reservation price for service A and a relatively low reservation price for service B while another segment of the population is observed to have the opposite behavior. This is illustrated by the red and blue customer reservation prices shown in Figure 21. Since negative correlation is a key ingredient in all successful bundles, a clarifying example of negatively correlated reservation prices is useful.

As an example, consider the potential market for services such as cable television, mobile wireless, and broadband Internet access. The market can be
segmented into older, middle-aged, and young consumers. Each segment has noticeably different reservation price distribution than the other segments although members of a given market segment are assumed to share the same “segment” distribution. For example, a large portion of the 55 year old and up segment of the US population highly values land line local telephone but does not value as highly cable TV and its vast offering of high cost sports and movie “premium” packages. This age group is also typically less mobile than the younger generation and therefore is willing to pay less for mobile wireless service. But this behavior is in stark contrast with the young mobile group of the population which tends to highly value home entertainment such as large, high cost cable TV packages along with broadband internet access and mobile wireless service. This is an example of negatively correlated reservation prices.

Figure 21. Reservation prices for two goods in a hypothetical pure bundle

However, despite the rapidly falling marginal cost of data transport, marginal costs are still significant for certain telecom products, especially those with massive fixed costs such as satellite constellations, or where programming charges (such as for
video and Internet content) are billed to the telecom service provider on a per customer basis. In addition, actual distributions of reservation prices are not perfectly negatively correlated. Under these two conditions, a mixed bundle approach may make more sense than a pure bundling strategy.

The reason a mixed bundle may be preferred is because certain customers who would otherwise adopt the pure bundle are adopting the bundle while their reservation price for at least one of the goods falls below its marginal cost. This is illustrated in Figure 22 and actually leads to reduced profitability since the customer produces a net loss for at least one of the telecom goods. Mixed bundling is designed to deter that segment of the population from adopting the bundle and instead promote purchase of one of the bundle components (or multiple services in a bundle with three or more components).

![Figure 22. Reservation prices for two goods in a hypothetical mixed bundle with nonzero marginal costs](image_url)
As a final note, it should be observed that these diagrams are simple but illustrate the power of bundling. The bundle concept can be expanded to include multiple services and thus serves as the basis of analysis of a large, single bundle which includes local phone service, long distance telephone service, video (TV) service, broadband Internet access, and mobile wireless services. In the AT&T bundle case, the bundle price line is really a three-dimensional or four-dimensional separating regions of bundle adopters and non-adopters. Consumers with reservation price points falling “below” that surface adopt while those with preferences “above” the surface do not adopt the bundle.
Appendix C – Bundle Profit and Price Calculations

Profits derived from offering pure bundling and mixed bundling were calculated (based on the marginal costs shown in Appendix A) to determine the optimal bundling strategy. It was suspected that a pure bundle offering would simplify the bundling arrangement both to consumers and to AT&T channel management, but that offering a mixed bundle at a fractional discount from the sum of the costs of the individual services would be more profitable. This suspicion was confirmed using MATLAB code written by the author. The resulting curves showing relative profitability as a function of bundle price discount are presented in the Financials section in Figure 19. The MATLAB files bundle_pricing_adv2.m and bundle_pricing_adv3.m compute profits from pure and mixed bundling, respectively, and their source code appears below.

Pure Bundling

The MATLAB file bundle_pricing_adv2.m was used to compute pure bundling profits for comparison with the case in which a mixed bundle is offered and the case in which no bundles are offered. Its source code appears below:

```matlab
% ***********************
% ** PURE BUNDLING **
% ***********************
% THIS SIM CALCULATES THE NUMBER OF BUNDLE ADOPTERS, NON-BUNDLE ADOPTERS, AND
% PROFIT FOR THE CASE WHEN A PURE BUNDLE WILL BE SOLD TO ANYONE FALLING
% ABOVE THE "BUNDLE LINE" (INDIFFERENCE CURVE BASED ON RESERVE PRICE).
% ACTUALLY THE BUNDLE LINE IS A SURFACE SINCE THREE DIFFERENT SERVICES ARE
% CONSIDERED (LOCAL PHONE, CABLE TV, AND WIRELESS)

clear
bundle_subs=0; % resets number of bundle adopters to zero
profit_nonbundles=0; % resets profit from bundle non-adopters to zero
t0 = clock; % resets the runtime clock to zero
```
N=10000; % Number of samples used per market segment (group)
Pb=24.53+33.55+33.97 % Initial reference bundle price ($) is merely the % sum of today's avg price of the components
PB=PB*0.80 % Bundle price multiplier (allows optimization over % bundle price)

% *******************************************************************************
% **** DEFINE MARKET SEGMENT PREFERENCES SERVICE BY SERVICE *****
% *******************************************************************************

% *** THIS IS THE CALCULATION FOR OPTIMAL LOCAL/CABLE/CELLULAR (MOBILE % WIRELESS) BUNDLE (RECALL THAT 24% OF US HOUSEHOLDS ALREADY HAVE THIS BUNDLE % PURCHASING SEPARATE PIECES) EACH MARKET SEGMENT, yy, IS DESCRIBED WITH % RANDN (NORMAL) DISTRIBUTION AND IS THUS SUMARIZED WITH THE MEAN (MU_x) AND % STD DEV SIGMA_xyy WHERE x IS THE SERVICE

% *******************************************************************************
% *** A. LOCAL PHONE SERVICE ***
% *******************************************************************************

MU_L=24.53; % mean price in $ for the entire population
MC_L=9.00; % marginal cost in $ per month

% *** A1. YOUNG, MOBILE PEOPLE (YM) ***
MU_LYM=MU_L+3.00; % mean price for YM
SIGMA_LYM=3.00; % std deviation of price for YM

% *** A2. OLDER, NON-TECHIES (ON) ***
MU_LON=MU_L+8.50; % mean price for ON
SIGMA_LON=3.00; % std deviation of price for ON

% *** A3. MIDDLE AGED PEOPLE (MA) ***
MU_LMA=MU_L+6.00; % mean price for MA
SIGMA_LMA=3.00; % std deviation of price for MA

% *******************************************************************************
% *** B. CABLE TV/VIDEO SERVICE ***
% *******************************************************************************

MU_C=33.55; % mean price in $ for the entire population
MC_C=12.56; % marginal cost in $ per month

% *** B1. YOUNG, MOBILE PEOPLE ***
MU_CYM=MU_C+25.00; % mean price for YM
SIGMA_CYM=15.00; % std deviation of price for YM

% *** B2. OLDER, NON-TECHIES ***
MU_CON=MU_C-3.00; % mean price for ON
SIGMA_CON=10.00; % std deviation of price for ON

% *** B3. MIDDLE AGED PEOPLE ***
MU_CMA=MU_C+5.00; % mean price for MA
SIGMA_CMA=5.00; % std deviation of price for MA
% **************************************************************
% *** C. WIRELESS MOBILE SERVICE ***
% **************************************************************

MU_W=33.97;   % mean price in $ for the entire population
MC_W=17.17;   % marginal cost in $ per month

% *** B1. YOUNG, MOBILE PEOPLE ***
MU_WYM=MU_W+8.00;   % mean price for YM
SIGMA_WYM=15.00;   % std deviation of price for YM

% *** B2. OLDER, NON-TECHIES ***
MU_WON=MU_W-13.00;   % mean price for ON
SIGMA_WON=8.00;   % std deviation of price for ON

% *** B3. MIDDLE AGED PEOPLE ***
MU_WMA=MU_W-2.00;   % mean price for MA
SIGMA_WMA=10.00;   % std deviation of price for MA

%% YOUNG, MOBILE CALCULATIONS **
%**********************************************************************
for l=1:N   %Resets YM population's preferences
  bundle_sub_YM(l,1)=0;   %Element set to 1 if YM(l) buys bundle
  bundle_sub_YM(l,2)=0;   %Element set to 1 if YM(l) buys unbundled local
  bundle_sub_YM(l,3)=0;   %Element set to 1 if YM(l) buys unbundled cable
  bundle_sub_YM(l,4)=0;   %Element set to 1 if YM(l) buys unbundled wireless
end

for l = 1:N   % Randomly generates YM(l)'s reservation
  local_reservation_price_YM(l)=MU_LYM+SIGMA_LYM*randn;
  cable_reservation_price_YM(l)=MU_CYM+SIGMA_CYM*randn;
  wireless_reservation_price_YM(l)=MU_WYM+SIGMA_WYM*randn;
  if local_reservation_price_YM(l)+cable_reservation_price_YM(l)+wireless_reservation_price_YM(l)>PB;
    bundle_sub=bundle_sub+1;
    bundle_sub_YM(l,1)=1;
  end
end

%**********************************************************************
% OLDER, NON-TECHIES CALCULATIONS **
%**********************************************************************

for l=1:N   % Repeats calculations for ON market segment
  bundle_sub_ON(l,1)=0;
end

%%
bundle_sub_ON(1,2)=0;
bundle_sub_ON(1,3)=0;
bundle_sub_ON(1,4)=0;
end

for l = 1:N

local_reservation_price_ON(l)=MU_LON+SIGMA_LON*randn;
cable_reservation_price_ON(l)=MU_CON+SIGMA_CON*randn;
wireless_reservation_price_ON(l)=MU_WON+SIGMA_WON*randn;

    if local_reservation_price_ON(l)+cable_reservation_price_ON(l)+wireless_reservation_price_ON(l)>PB;
        bundle_sub= bundlesub+1;
        bundle_sub_ON(l,1)=1;
    end
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% OLDER, MIDDLE AGED CALCULATIONS **
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

for l=1:N

    % % Repeats calculations for MA market segment

    bundle_sub_MA(l,1)=0;
bundle_sub_MA(l,2)=0;
bundle_sub_MA(l,3)=0;
bundle_sub_MA(l,4)=0;
end

for l = 1:N

local_reservation_price_MA(l)=MU_LMA+SIGMA_LMA*randn;
cable_reservation_price_MA(l)=MU_CMA+SIGMA_CMA*randn;
wireless_reservation_price_MA(l)=MU_WMA+SIGMA_WMA*randn;

    if local_reservation_price_MA(l)+cable_reservation_price_MA(l)+wireless_reservation_price_MA(l)>PB;
        bundle_sub= bundlesub+1;
        bundle_sub_MA(l,1)=1;
    end
end

MC=MC_L+MC_C+MC_W;   % Marginal cost of bundle is sum of marginal costs
                        % from the individual components.

profit_bundles=(bundle_sub*(PB-MC));  % Bundle profits is the number of bundle adopters
                                      % multiplied by (bundle price less bundle MC).

for l=1:N
% CALCULATE PROFIT FROM NON-BUNDLE ADOPTERS, ADDING PROFITS FROM EACH
% SERVICE THEY "DO" BUY. YOUNG, MOBILES FIRST
if bundle_sub_YM(1,2)==1;
    profit_nonbundles=profit_nonbundles+(MU_L-MC_L);
end

if bundle_sub_YM(1,3)==1;
    profit_nonbundles=profit_nonbundles+(MU_C-MC_C);
end

if bundle_sub_YM(1,4)==1;
    profit_nonbundles=profit_nonbundles+(MU_W-MC_W);
end

% CALCULATE PROFIT FROM NON-BUNDLE ADOPTERS, ADDING PROFITS FROM EACH
% SERVICE THEY "DO" BUY. OLDER, NON-TECHIES
if bundle_sub_ON(1,2)==1;
    profit_nonbundles=profit_nonbundles+(MU_L-MC_L);
end

if bundle_sub_ON(1,3)==1;
    profit_nonbundles=profit_nonbundles+(MU_C-MC_C);
end

if bundle_sub_ON(1,4)==1;
    profit_nonbundles=profit_nonbundles+(MU_W-MC_W);
end

% CALCULATE PROFIT FROM NON-BUNDLE ADOPTERS, ADDING PROFITS FROM EACH
% SERVICE THEY "DO" BUY. MIDDLE AGED, LAST
if bundle_sub_MA(1,2)==1;
    profit_nonbundles=profit_nonbundles+(MU_L-MC_L);
end

if bundle_sub_MA(1,3)==1;
    profit_nonbundles=profit_nonbundles+(MU_C-MC_C);
end

if bundle_sub_MA(1,4)==1;
    profit_nonbundles=profit_nonbundles+(MU_W-MC_W);
end

end

 clocktime=etime(clock,t0)

 bundle_sub_YM=bundle_sub_YM
 bundle_sub_ON=bundle_sub_ON
 bundle_sub_MA=bundle_sub_MA

 PB=PB
 profit=profit_nonbundles+profit_bundles
 percent_bundles=(bundle_subs/(3*N))*100
Mixed Bundling

The MATLAB file bundle_pricing_adv3.m was used to compute profits from mixed bundling for comparison with the case in which no bundles are offered. In the case where the consumer does not choose to buy the bundle, rather than use the standard theoretical practice of pricing any of the individual components just below the bundle price to maximize profits, the individual components are priced at the current average (mean) prices in the market (REFERENCE: Forrester data). Source code for bundle_pricing_adv3.m appears below:

```matlab
% *************************
% ** MIXED BUNDLING **
% **********************
% 
% THIS SIM CALCULATES THE NUMBER OF BUNDLE ADOPTERS AND NON-BUNDLE ADOPTERS
% (BUYERS OF INDIVIDUAL BUNDLE COMPONENTS) OF A POPULATION.
% IT FIRST CALCULATES THE PROFITS FOR THE CASE WHEN A BUNDLE WILL BE SOLD
% TO ANYONE FALLING ABOVE THE "BUNDLE LINE" (INDIFFERENCE CURVE BASED ON
% RESERVE PRICE). IN THIS CASE, THE BUNDLE LINE IS A SURFACE SINCE THREE
% DIFFERENT SERVICES ARE CONSIDERED (LOCAL PHONE, CABLE TV, AND WIRELESS).
% IT THEN ADDS IN THE EXTRA PROFIT ADDED BY NON-BUNDLE ADOPTERS WHOSE
% RESERVATION PRICES FOR INDIVIDUAL COMPONENTS ARE ABOVE THE ASKING PRICE
% (BASED ON AVG. MARKET PRICES IN USA).

clear
bundle_subs=0; % Initialize number of bundle subscribers to zero
profit_nonbundles=0; % Initialize nonbundle profits to zero
t0 = clock; % Sets runtime clock to zero

N=10000; % Number of samples used per market segment (group)
PB=24.53+33.55+33.97 % Initial bundle price ($) is merely the sum
  % of today's avg price of the components
PB=PB*0.97 % Bundle price multiplier (allows optimization
  % over bundle price)

% ************************************************************
% **** DEFINE MARKET SEGMENT PREFERENCES SERVICE BY SERVICE ****
% ****************************
% 
% *** THIS IS THE CALCULATION FOR OPTIMAL LOCAL/CABLE/CELLULAR (MOBILE
% WIRELESS) BUNDLE (RECALL THAT 24% OF US HOUSEHOLDS ALREADY HAVE THIS BUNDLE
% PURCHASING SEPARATE PIECES). EACH MARKET SEGMENT, yy, IS DESCRIBED WITH A
% RANDN (NORMAL) DISTRIBUTION AND IS THUS SUMARIZED WITH THE MEAN (MU_x) AND
% STD DEV SIGMA_xyy WHERE x IS THE SERVICE
```

79
A. LOCAL PHONE SERVICE

Mean price of local phone service for the entire population: $24.53
Marginal cost of local phone: $9.00

Mean price paid by YM for local phone = $24.53 + $3.00
Std deviation of price paid by YM for local phone = $3.00

Mean price paid by ON for local phone = $24.53 + $8.50
Std deviation of price paid by ON for local phone = $3.00

Mean price paid by middle aged MA for local phone = $24.53 + $6.00
Std deviation of price paid by MA for local phone = $3.00

B. CABLE TV/VIDEO SERVICE

Mean price of video (typ cable) for the entire population: $33.55
Marginal cost in $ per month: $12.56

Mean price paid by YM for cable service = $33.55 + $25.00
Std deviation of price paid by YM for cable service = $15.00

Mean price paid by ON for cable service = $33.55 - $3.00
Std deviation of price paid by ON for cable service = $10.00

Mean price paid by middle aged MA for cable service = $33.55 + $5.00
Std deviation of price paid by MA for cable service = $5.00

C. WIRELESS MOBILE SERVICE

Mean price of wireless in $ for the entire population: $33.97
Marginal cost in $ per month: $17.17

Mean price paid by YM for wireless service = $33.97 + $8.00
Std deviation of price paid by YM for wireless service = $15.00

Mean price paid by ON for wireless service = $33.97 - $13.00
Std deviation of price paid by ON for wireless service = $8.00

Mean price paid by middle aged MA for wireless service = $33.97 - $2.00
Std deviation of price paid by MA for wireless service = $2.00
SIGMA_WMA=10.00; % std deviation of price paid by MA for wireless service

%******************************************************%
% YOUNG, MOBILE CALCULATIONS **
%******************************************************%
for I=1:N
% Normalizes the array which stores population
% decisions on bundling
bundle_sub_YM(I,1)=0; % Element is set to 1 if person (I) adopts bundle
bundle_sub_YM(I,2)=0; % Element is set to 1 if person (I) adopts
% unbundled local service
bundle_sub_YM(I,3)=0; % Element is set to 1 if person (I) adopts
% cable service
bundle_sub_YM(I,4)=0; % this element is set to 1 if person (I) adopts
% wireless service
end

for I = 1:N
% This loop generates the random sample of the
% YM population's reservation prices for the
% varous services
local_reservation_price_YM(I)=MU_LYM+SIGMA_LYM*randn;
cable_reservation_price_YM(I)=MU_CYM+SIGMA_CYM*randn;
wireless_reservation_price_YM(I)=MU_WYM+SIGMA_WYM*randn;

if local_reservation_price_YM(I)+cable_reservation_price_YM(I)+wireless_reservation_price_YM(I)>PB;
    bundle_sub=.bundle_sub+1;
    bundle_sub_YM(I,1)=1; % If sum of reservation prices > than bundle
    % price, bundle purchased
end

if bundle_sub_YM(I,1)=1;
    if local_reservation_price_YM(I)>MU_L;
        bundle_sub_YM(I,2)=1;
    end
    if cable_reservation_price_YM(I)>MU_C;
        bundle_sub_YM(I,3)=1;
    end
    if wireless_reservation_price_YM(I)>MU_W;
        bundle_sub_YM(I,4)=1;
    end
end
end

%******************************************************%
% OLDER, NON-TECHIES CALCULATIONS **
%******************************************************%
for I=1:N
% These calculations are repeated for ON segment
% of the population below...

```matlab
bundle_sub_ON(I,1)=0;
bundle_sub_ON(I,2)=0;
bundle_sub_ON(I,3)=0;
bundle_sub_ON(I,4)=0;
end
```

for I = 1:N

```matlab
local_reservation_price_ON(I)=MU_LON+SIGMA_LON*randn;
cable_reservation_price_ON(I)=MU_CON+SIGMA_CON*randn;
wireless_reservation_price_ON(I)=MU_WON+SIGMA_WON*randn;
```

```matlab
if local_reservation_price_ON(I)+cable_reservation_price_ON(I)+wireless_reservation_price_ON(I)>PB;
bundle_subs=bundle_subs+1;
bundle_sub_ON(I,1)=1;
end
```

```matlab
if bundle_sub_ON(I,1)<1;
    if local_reservation_price_ON(I)>MU_L;
        bundle_sub_ON(I,2)=1;
    end
    if cable_reservation_price_ON(I)>MU_C;
        bundle_sub_ON(I,3)=1;
    end
    if wireless_reservation_price_ON(I)>MU_W;
        bundle_sub_ON(I,4)=1;
    end
end
```

```matlab
%%OLDER, MIDDLE AGED CALCULATIONS **
%
for I=1:N % These calculations are repeated for MA segment
    bundle_sub_MA(I,1)=0;
bundle_sub_MA(I,2)=0;
bundle_sub_MA(I,3)=0;
bundle_sub_MA(I,4)=0;
end
```

for I = 1:N

```matlab
local_reservation_price_MA(I)=MU_LMA+SIGMA_LMA*randn;
cable_reservation_price_MA(I)=MU_CMA+SIGMA_CMA*randn;
wireless_reservation_price_MA(I)=MU_WMA+SIGMA_WMA*randn;
```

```matlab
if local_reservation_price_MA(I)+cable_reservation_price_MA(I)+wireless_reservation_price_MA(I)>PB;
bundle_subs=bundle_subs+1;
bundle_sub_MA(I,1)=1;
end
```
end

if bundle_sub_MA(I,1)<1;
    if local_reservation_price_MA(I)>MU_L;
        bundle_sub_MA(I,2)=1;
    end

    if cable_reservation_price_MA(I)>MU_C;
        bundle_sub_MA(I,3)=1;
    end

    if wireless_reservation_price_MA(I)>MU_W;
        bundle_sub_MA(I,4)=1;
    end
end

MC=MC_L+MC_C+MC_W; % Total marginal cost of bundle is sum
% of individual components' marginal costs

profit_bundles=(bundle_subs*(PB-MC)); % Profit from bundles is number of adopters
% multiplied by profit/adopter

for I=1:N
    % CALCULATE PROFIT FROM NON-BUNDLE ADOPTERS, ADDING PROFITS FROM EACH
    % SERVICE THEY *DO* BUY. YOUNG, MOBILES FIRST*
    if bundle_sub_YM(I,2)==1;
        profit_nonbundles=profit_nonbundles+(MUL-MC_L);
    end

    if bundle_sub_YM(I,3)==1;
        profit_nonbundles=profit_nonbundles+(MUC-MC_C);
    end

    if bundle_sub_YM(I,4)==1;
        profit_nonbundles=profit_nonbundles+(MUW-MC_W);
    end

    % CALCULATE PROFIT FROM NON-BUNDLE ADOPTERS, ADDING PROFITS FROM EACH
    % SERVICE THEY *DO* BUY. OLDER, NON-TECHIES next...
    if bundle_sub_ON(I,2)==1;
        profit_nonbundles=profit_nonbundles+(MUL-MC_L);
    end

    if bundle_sub_ON(I,3)==1;
        profit_nonbundles=profit_nonbundles+(MUC-MC_C);
    end

    if bundle_sub_ON(I,4)==1;
        profit_nonbundles=profit_nonbundles+(MUW-MC_W);
    end

    % CALCULATE PROFIT FROM NON-BUNDLE ADOPTERS, ADDING PROFITS FROM EACH
    % SERVICE THEY *DO* BUY. MIDDLE AGED, LAST

end
Market Segment Characteristics and Models

Since the market is composed of various market segments, it is important to begin with at least a qualitative understanding of the various market segments which are purchasing telecom services and then try to quantify their purchasing preferences (reservation price).

While the number of factors influencing consumer purchasing decisions is vast, the author has segmented the market into three groups based on age and then made reasonable assumptions about distributions of reservation prices for the various services for each group based on published data from market research firms, industry association groups, and the US government. Typical information from these sources includes mean price paid for telecom services, telecom service penetration by years of age, service penetration, and estimated market size and growth rates.
Consumer segment reservation price preferences were modeled as normal distributions and are described mathematically in the following calculations. These calculations show that the distributions are consistent with existing market penetration figures for each service. In addition, the groups' reservation price distributions are presented graphically below to give the reader insight into the relative preferences (reservation prices) for different services as a function of age group demographic.
LOCAL PHONE SERVICE
Purchasing Preferences

Price := 0, 0.50 .. 50

Market Data and Estimate of Marginal Cost

\( \mu_L := 24.53 \)

Market price, based on available market data (e.g. DataQuest)

\( MC_{\text{local}} := 9.00 \)

Estimated based on billing, Universal Access, and excessive taxes

Assumptions about Purchasing Preference Distributions

Young mobile purchasing profile

\( \mu_{\text{LYM}} := \mu_L + 3.00 \)

\( \sigma_{\text{LYM}} := 3.00 \)

Older, Non-techie purchasing profile

\( \mu_{\text{LONT}} := \mu_L + 8.50 \)

\( \sigma_{\text{LONT}} := 3.00 \)

Middle aged purchasing profile

\( \mu_{\text{LMA}} := \mu_L + 6.00 \)

\( \sigma_{\text{LMA}} := 3.00 \)

\( \text{LYM}(\text{Price}) := \text{dnorm}(\text{Price}, \mu_{\text{LYM}}, \sigma_{\text{LYM}}) \)

\( \text{LONT}(\text{Price}) := \text{dnorm}(\text{Price}, \mu_{\text{LONT}}, \sigma_{\text{LONT}}) \)

\( \text{LMA}(\text{Price}) := \text{dnorm}(\text{Price}, \mu_{\text{LMA}}, \sigma_{\text{LMA}}) \)

Relative Fractions of the Population

(Resident Population Estimates of the United States by Age and Sex: November 1, 1999
(Numbers in thousands. Consistent with 1990 Decennial Census enumeration.)


<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>GROUP NAME</th>
<th>TOTAL (000's)</th>
<th>% of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 18</td>
<td>Minors</td>
<td>70,391</td>
<td>26%</td>
</tr>
<tr>
<td>18 to 35</td>
<td>Young and mobile (YM)</td>
<td>63,905</td>
<td>23%</td>
</tr>
<tr>
<td>35 to 50</td>
<td>Middle Age (MA)</td>
<td>64,476</td>
<td>24%</td>
</tr>
<tr>
<td>50+</td>
<td>Older, non techies (ONT)</td>
<td>75,093</td>
<td>27%</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

\( w_{\text{total}} := 0.23 + 0.24 + 0.27 \)

This factor will help normalize the relative weights of the population to the potential customers which does NOT include minors.

\( w_{\text{YM}} := \frac{0.23}{w_{\text{total}}} \)

\( w_{\text{MA}} := \frac{0.24}{w_{\text{total}}} \)

\( w_{\text{NT}} := \frac{0.27}{w_{\text{total}}} \)
Calculated fractional customer penetration. Actual penetration in the US is roughly 97%.
Thus the distributions assumed above capture to first order or better the purchasing preferences of the various age groups.
CABLE TV (VIDEO) SERVICE
Purchasing Preferences

Price := 0, 0.50.. 100

Market Data and Estimate of Marginal Cost

\[ \mu_c := 33.55 \quad \text{Market price, based on available market data (e.g. DataQuest)} \]

\[ \text{MC}_c := 12.56 \quad \text{Estimated based on billing, programming costs, depreciated physical plant, and taxes.} \]

Assumptions about Purchasing Preference Distributions

<table>
<thead>
<tr>
<th>Young mobile purchasing profile</th>
<th>Older, Non-techie purchasing profile</th>
<th>Middle aged purchasing profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \mu_{\text{CYM}} := \mu_c + 25.00 ]</td>
<td>[ \mu_{\text{CONT}} := \mu_c - 3.00 ]</td>
<td>[ \mu_{\text{CMA}} := \mu_c + 5.00 ]</td>
</tr>
<tr>
<td>[ \sigma_{\text{CYM}} := 15.00 ]</td>
<td>[ \sigma_{\text{CONT}} := 10.00 ]</td>
<td>[ \sigma_{\text{CMA}} := 5.00 ]</td>
</tr>
</tbody>
</table>

\[ \text{CYM (Price)} := \text{dnorm (Price, } \mu_{\text{CYM}}, \sigma_{\text{CYM}}\text{)} \]

\[ \text{CONT (Price)} := \text{dnorm (Price, } \mu_{\text{CONT}}, \sigma_{\text{CONT}}\text{)} \]

\[ \text{CMA (Price)} := \text{dnorm (Price, } \mu_{\text{CMA}}, \sigma_{\text{CMA}}\text{)} \]

Relative Fractions of the Population

(Resident Population Estimates of the United States by Age and Sex: November 1, 1999
(Numbers in thousands. Consistent with 1990 Decennial Census enumeration.)

<table>
<thead>
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<td>Minors</td>
<td>70,391</td>
<td>26%</td>
</tr>
<tr>
<td>18 to 35</td>
<td>Young and mobile (YM)</td>
<td>63,905</td>
<td>23%</td>
</tr>
<tr>
<td>35 to 50</td>
<td>Middle Age (MA)</td>
<td>64,476</td>
<td>24%</td>
</tr>
<tr>
<td>50+</td>
<td>Older, non techies (ONT)</td>
<td>75,093</td>
<td>27%</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

\[ w_{\text{total}} := 0.23 + 0.24 + 0.27 \]

This factor will help normalize the relative weights of the population to the potential customers which does NOT include minors.

\[ w_{\text{YM}} := \frac{0.23}{w_{\text{total}}} \quad w_{\text{MA}} := \frac{0.24}{w_{\text{total}}} \quad w_{\text{NT}} := \frac{0.27}{w_{\text{total}}} \]
\[
\int_{\mu_C}^{100} \left( w_{YM} \cdot \text{CYM(Price)} + w_{MA} \cdot \text{CMA(Price)} + w_{NT} \cdot \text{CONT(Price)} \right) \, d\text{Price} = 0.707
\]

Calculated fractional customer penetration. Actual penetration in the US is roughly 68% including correction for fraction of US homes passed of total US households. Thus the distributions assumed above capture to first order or better the purchasing preferences of the various age groups.

**Fractional Distribution of Cable TV (Video) Service Reservation Price for Young Mobile, Middle Aged, and Older Non-Tecnical Population Segments (YM, MA, and ONT, respectively)**
MOBILE WIRELESS PHONE SERVICE
Purchasing Preferences

Price := 0, 0.50.. 100

Market Data and Estimate of Marginal Cost

\( \mu_W := 33.97 \)  
Market price, based on available market data (e.g. DataQuest)

\( MC_W := 17.17 \)  
Estimated based on billing, infrastructure, AMPS/digital mix, plus 
applicable taxes based on reference sources.

Assumptions about Purchasing Preference Distributions

Young mobile purchasing profile

\( \mu_{WYM} := \mu_W + 8.00 \)
\( \sigma_{WYM} := 15.00 \)

Older, non-techie purchasing profile

\( \mu_{WONT} := \mu_W - 13.00 \)
\( \sigma_{WONT} := 8.00 \)

Middle aged purchasing profile

\( \mu_{WMA} := \mu_W - 2.00 \)
\( \sigma_{WMA} := 10.00 \)

WYM (Price) := dnorm (Price, \( \mu_{WYM}, \sigma_{WYM} \))

WONT (Price) := dnorm (Price, \( \mu_{WONT}, \sigma_{WONT} \))

WMA (Price) := dnorm (Price, \( \mu_{WMA}, \sigma_{WMA} \))

Relative Fractions of the Population

(Resident Population Estimates of the United States by Age and Sex: November 1, 1999
(Numbers in thousands. Consistent with 1990 Decennial Census enumeration.)
Source: Population Estimates Program, Population Division, U.S. Census Bureau,
Washington, D.C. 20233

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>GROUP NAME</th>
<th>TOTAL (000's)</th>
<th>% of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 18</td>
<td>Minors</td>
<td>70,391</td>
<td>26%</td>
</tr>
<tr>
<td>18 to 35</td>
<td>Young and mobile (YM)</td>
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</tr>
</tbody>
</table>

\( w_{total} := 0.23 + 0.24 + 0.27 \)
This factor will help normalize the relative weights of the 
population to the potential customers which does NOT 
imclude minors.

\( w_{YM} := \frac{0.23}{w_{total}} \)

\( w_{MA} := \frac{0.24}{w_{total}} \)

\( w_{NT} := \frac{0.27}{w_{total}} \)
Calculated fractional customer penetration. Actual penetration in the US is in the 35-40% range. Thus the distributions assumed above capture to first order or better the purchasing preferences of the various age groups.

Fractional Distribution of Mobile Wireless Service Reservation Price for Young Mobile, Middle Aged, and Older Non-Tecnical Population Segments (YM, MA, and ONT, respectively)
Appendix D – Enabling Technologies and Technology Integration

This section attempts to demystify some of the technologies utilized to deliver bundled data services to the consumer market. In a service by service review (local telephone service, long distance telephone service, video (TV) service, broadband Internet access, and mobile wireless service), the underlying technologies are examined with emphasis given to providing a simple overview of the technology. At the same time, this review serves to highlight some of the integration issues faced as these technologies are used to deliver a bundle offering to consumers.

LOCAL TELEPHONE SERVICE

POTS (plain old telephone service)

POTS is the twisted pair of copper wires typically wired into homes for consumer telephone service. The twisted pair provides a connection inside the residence to the telephone, usually via RJ-11 wall jacks, and is connected back to the local phone network switching office (known as the central office or C.O.). In the past, local phone service was provided by a single provider known as the ILEC, incumbent local exchange carrier, but with deregulation, markets are driven by competition.

Despite an abundance of attractive new technologies for delivering local telephone service to consumers, the bulk of newcomers to the local access market called CLECs (competitive local exchange carriers) still offer local voice service through POTS. Thus, the CLECs in general use three approaches to deliver voice service: a facilities based approach, a leased line or “shared” approach, or an unbundled loop approach, as shown in Figure 23, Figure 24, and Figure 25, respectively.
The unbundled configuration is the most feature rich for a fixed investment by a CLEC. However, it is the most politically controversial approach since it leaves the ILECs vulnerable to CLECs which can capitalize on the ILECs' only asset, its copper twisted pair local loop.

The leased line approach is most cost effective for the CLEC but it leads to local telephone service which is not easily differentiated from that provided by the ILEC.

By contrast, the facilities based approach is the most expensive approach and in general not considered economically viable since it requires a new copper plant to be installed by the CLEC.

![Figure 23. CLEC facilities based POTS solution delivering voice](image)

![Figure 24. CLEC shared line POTS solution](image)
**MMDS and LMDS**

MMDS and LMDS are radio technologies which enable high data rate point-to-multipoint data transmission capability using US radio spectrum. As reviewed earlier, MMDS is a more mature (more widely deployed) and operates near 2 GHz while LMDS operates at 24 GHz and even 38 GHz. The combination of these technologies to deliver broadband data with inherently low latency make MMDS and LMDS ideal technologies for extending high-speed digital service including telephone service past the local loop over the last mile to the customer premise.

The broadband digital nature of this technology also means that it can simultaneously transport video, voice, and Internet data over the same radio spectrum leading to an attractive economy of scale if all the components of a consumer telecom bundle are delivered using MMDS or LMDS. This is the ideal scenario for WorldCom and other LMDS providers trying to demonstrate the value proposition of their technology to the consumer.
Cable Telephony
Yet another alternative delivery method for local voice service is via the cable TV plant. Cable TV is an ideal medium in that it reaches the bulk of US consumer residences and requires no purchase of spectrum in overpriced FCC auctions. Cable TV plants which have typically been designed as simple tree structures to distribute video signals from the head end down the tree branches to the residences are being upgraded to provide voice and data capability back upstream using unused spectrum inside the cable while improving reliability.

Cable telephony services can be provided at virtually no marginal cost once the cable plant is installed since all that is required is a leased telephone switch with access to the local telephone network and several intelligent servers capable of converting and sending voice data as IP (internet protocol) data using the conventional architecture. To transmit and receive voice in a normal phone call, the consumer must possess the appropriate transmitting/receiving equipment at the consumer premise to code voice into IP packet data and reconstruct the IP data stream into voice. The cable telephony service provider must also improve reliability by modifying its tree-like network architecture to include redundant data paths which self-heal in the event of a limited cable system outage.

LONG DISTANCE
Terrestrial Microwave, Satellite, and Fiber Optics
Ownership of the long distance network at one time was dominated by AT&T, but now involves fierce competition for marketshare by players such as WorldCom, IXC, Level(3), and others. In past decades, point-to-point microwave relay stations operating
at roughly 2 GHz connected central offices over long distances and formed a terrestrial
"long haul" network.

For even longer haul "circuits" such as international calling, satellite
communication played an important role and led to the launch and service
commissioning of many geostationary communication satellites over the Earth's
equator. These satellites typically supported links of less than 1 Gbps.

However, over the past two decades improvements in fiber optic transmitter,
receiver, amplifier, and cable technologies has led to steep drops in the cost per long
distance switched minute and resulted in a phenomenal increase in supply of long
distance capacity. While early fiber optic cables transported analog voice data, modern
long haul systems are exclusively digital. Interestingly, the dominant digital
transmission rate for fiber optic networks is still the relatively low, standard SONET
(synchronous optical network) OC-3 rate (one sixteenth the OC-48 data rate of 2.488
Gbps). However, with the explosion in demand for bandwidth due largely to Internet
traffic demand, the installed infrastructure is being upgraded to support OC-48 and
higher data rates around most metro areas.

The dominant US fiber optic technology, SONET, is typically deployed in self-
healing bidirectional "rings" around the served population so that in the event of a fiber
outage (e.g. backhoe fiber cut), data traffic is rerouted the other direction around the
ring (within 300 milliseconds), often without the customer even recognizing that an
event has occurred. This has proven extremely reliable but is still rather expensive to
install due to the redundancy (protection channel) built into the network. In addition,
SONET is a time domain multiplexing (TDM) technology so it is not as spectrally efficient as system as other technologies such as ATM.

Wavelength Division Multiplexing (WDM)

A simple technique to expand the network cost effectively is to transmit data on more than a single wavelength. This approach is called WDM and more efficiently utilized existing fiber by transmitting data on different “colors” (wavelengths or frequencies), thus taking advantage of the inherently massive, terahertz bandwidth available in optical fiber. This is analogous to the way that commercial radio stations transmit on separate frequency channels, sharing the total available radio spectrum. WDM components were once viewed as exclusively the domain of high-capacity lightwave systems, typically operating at OC-48 data rates and higher per color. WDM systems with 16 and 32 channels (denoted 16-WDM and 32-WDM, respectively) have become commonplace and are highly scalable since each WDM channel is data rate independent.

Due to increased demand for bandwidth and heated competition among WDM component suppliers, companies such as Ciena and Lucent now even offer 128-WDM systems. This competition coupled with significant improvement in device yields has led to dramatic reductions in the cost of WDM optics and resulted in WDM optics being deployed further and further downstream in the networks. In some cases, WDM optics have even been deployed down into LANs (local area networks) as is the case with the Microsoft Redmond campus.
Asynchronous Transfer Mode

ATM (asynchronous transfer mode) is a packet-based technology which breaks up the transmitted data into fixed size packets and routes them through the network to their destination along many different network paths. At the far end (the destination), the packets arrive and are reconstructed into a single data stream (ultimately being reconstructed into a voice conversation). ATM uses the network more efficiently since bandwidth bottlenecks are identified real time and packets are routed around them through less congested spans in the network, reducing latency and minimizing dropped packets.

ATM is a relatively recent phenomenon in the US fiber optic infrastructure and is currently being installed by major long distance service providers, typically in conjunction with ATM-over-SONET hardware to minimize the cost of migration to ATM and preserve the massive investment already made in SONET infrastructure. Although ATM over SONET stacks overhead data on top of overhead data (leading to reduced network efficiency due to overhead data redundancy), ATM has been successfully deployed, mostly into large scale data networks and improves network efficiency and reliability.

Internet Protocol (IP)

A final technology to be considered as a long distance telephony enabler is IP telephony. This is also a packet technology much like ATM except the packets can vary in length. As is the case with ATM, in IP networks the switched circuit data (voice) transmission architecture gives way to a network architecture which is truly converged: all data types (voice and computer data) traversing the network
simultaneously. The caveat is that building a low latency network using this architecture is fundamentally different than building a SONET network and thus would require a fairly sizeable “upgrade and integrate” cost.

Since IP is the foundation of the Internet it is felt that the migration of voice service to IP is the final step in converging all networks into a single protocol, IP. This ideal “one world, one protocol” scenario is exactly what Level(3) envisages and has bet its billions of dollars of capital on developing over the next few years. In this IP everywhere scenario, a public IP network would continue to exist and voice data security would likely be protected through a VPN (virtual private network) technology utilized by consumers.

As a final non-technology wrinkle, it should be noted that if IP telephony becomes mainstream, local and long distance access tariffs will be jeopardized, which suggests that political entities such as foreign countries, especially those deriving massive revenues from taxation of international telephony, will dramatically slow adoption of IP telephony through regulation of IP telephony.

VIDEO (TV) SERVICE

*Analog TV*

Video services, much like local telephony, have roots in analog modulation. Current analog television channels in the United States occupy 6 MHz of radio spectrum when broadcast using airwave spectrum or transmitted through the cable TV plant. While analog has been the legacy modulation technology for video services, it is quickly being displaced by digital video signals in cable networks.
High-Definition TV (HDTV) and Digital TV

While HDTV was envisaged as a springboard into digital television, cable television system operators have already begun digital television deployment into their networks. These do not use HDTV but instead use error coding and compression to squeeze roughly ten conventional television channels into the 6 MHz bandwidth utilized in analog TV transmission. This improved spectral efficiency leads to more billable channels for the operator and higher revenues instead of the higher quality that HDTV delivers at the expense of higher bandwidth.

It is noteworthy that the cable TV infrastructure is in a period of continuous upgrade and the previous “all-cable” plant is being replaced with optical fiber, and in some cases, WDM optics. On the surface, optics, especially WDM optics, appear to be too expensive a technology to deploy into the cable network, but the cost of passive and active optical devices has plummeted in the last two years leading to optics being installed in systems where they were never expected to be cost effective.

BROADBAND INTERNET

The demand for Internet (e-mail and World Wide Web) access in the home, especially by the young mobile segment of the population, has fueled demand for bidirectional broadband service to the home. Broadband Internet can be delivered through various technologies including cable, xDSL, and fixed wireless (MMDS/LMDS), each of which is described briefly below.
**Cable Broadband**

The cable TV infrastructure has been upgraded to transmit digital signals to enable digital television. In many cable systems, the cable service provider is evolving the cable plant to support cable broadband by allocating a portion of the cable spectrum to forward and reverse data traffic to and from the Internet. While this is IP based digital technology, in its most common configuration, this spectrum is shoehorned into one or more 6 MHz bandwidth channel “slots” which previously were allocated to video signals.

This approach is in theory highly scalable since spectrum is now being more efficiently allocated to digital TV, freeing spectrum for consumer Internet data. Users thus enjoy fast broadband Internet access which gracefully slows as user base grows and begins to tax the digital transmission capacity of the limited Internet bandwidth. As latency increases, the number of 6 MHz channels allocated to broadband data can be increased to restore the network to the desired QoS (quality of service).

Until recently, however, hardware for broadband cable Internet was highly proprietary and created a vendor “lock in” effect. Today, though, the DOCSIS standard has been approved and is leading to standard, interoperable equipment from all providers and which is expected to lead to a larger, more rapid market penetration of cable broadband Internet.

**xDSL**

xDSL, also known as digital subscriber line, or simply DSL, is a low to medium cost alternative to broadband cable Internet access which uses DSL modems at the customer premise and central office to deliver high-speed data. DSL takes advantage of the unused bandwidth (the spectrum above voice frequencies) of the POTS.
infrastructure for signaling (transmitting/receiving data) but has limited bandwidth versus distance capability. Typical data rates delivered to consumer residences is 128 kbps and 256 kbps although alternative forms of DSL can deliver up to 8 Mbps under certain circumstances. The distance limitation of DSL is roughly 18,000 feet from the central office.

Some of the common flavors of DSL are ADSL (asymmetric DSL), HDSL (high performance DSL), and VHDSL (very high-speed DSL). ADSL is designed for consumers' Internet traffic since it was optimized for eight times more download data than upload data. The other versions of DSL, however, each enjoy their own custom features and are viewed as a promising technology family since they "piggyback" on top of the consumer's existing land line (POTS) which the consumer is already leasing from the local phone service provider.

**Fixed Wireless (MMDS/LMDS)**

MMDS has been deployed in some regions for over a decade for television distribution (wireless cable). However, LMDS is now being deployed in parallel with MMDS to provide bidirectional data service.

MMDS and LMDS were both described earlier as alternatives to POTS and provide exceptional bandwidth capability to consumers, although LMDS has not been deployed to the same extent as MMDS.
Mobile wireless services in the US operate in the 800 MHz and 1900 MHz frequency bands auctioned off by the FCC. The 800 MHz band is typically referred to as cellular band while the 1900 MHz band is usually referred to as PCS band. In the US at present, most subscribers pay flat monthly fees for a fixed quantity of air time whereas in most other countries, prepaid cellular is viewed as the prime business model. A brief description of the present US mobile radio standards (excluding GSM due its presently low penetration) is provided below to help demonstrate the difficulty in converging them to a single, future 3rd generation standard, "3G."

**AMPS**

The Advanced Mobile Phone System, AMPS, operates in the 800 MHz frequency band and is the oldest "large" mobile radio standard deployed in the US. While greater spectral efficiency is afforded by converting to digital standards such as D-AMPS or TDMA (IS-136), the author has often been quoted as saying "never bet against AMPS" since it is still the most widely deployed wireless standard in the US.

**D-AMPS and TDMA (IS-136)**

D-AMPS is a digital version of AMPS in that uses the AMP channel (frequency) assignments but assigns time slots to users operating on those frequencies. This yields three to six times the number of supported AMPS subscribers per cell depending on the voice coder adopted (full rate versus half rate).

IS-136 is the extension of the D-AMPS standard to the PCS frequencies and includes D-AMPS/TDMA interoperability specifications. It also describes a mode where
the handset can revert to AMPS mode when a digital control channel is unavailable.
TDMA and D-AMPS have identical spectral efficiency. A major advantage of TDMA systems is that they provide a road map to mobile wireless digital convergence since digital features such as integration of PDA features, e-mail and wireless web access are all possible. However, unless operated in a future multi-slot mode, data rates will still be limited to roughly 9.6 kbps which is unlikely to satisfy a consumer’s desire for anything beyond the simplest World Wide Web (WWW) applications.

**CMDA (IS-95)**
Code-division multiple access, or CDMA, is a digital spread spectrum technology brought to commercial market by Qualcomm. While the original application was as a military “stealth communication” technology, Qualcomm has succeeded in deploying the IS-95 standard worldwide. The fundamental data rate is 19.2 kbps when the roughly 1.2 Mchip per second spreading code is “despread”. IS-95 is roughly three times as spectrally efficient as TDMA since it does not transmit during periods of quiet in the speakers’ voices.

**Future Technologies**
Two future technologies which will likely impact AT&T’s bundle offering will be advanced technologies such as Bluetooth and 3G.

3G is the next generation of mobile wireless technology and will deliver data rates of 2 to 8 Mbps to the mobile subscriber. Two promising 3G standards are CDMA2000 and IMT2000. 3G and its large bandwidth are envisioned as the wireless web enabler since large amounts of data can be transmitted and received with the same
feel of speed as corporate or university intranets. The downside to 3G is that the cell sites will all have to be upgraded and cells will likely be smaller leading to increased infrastructure costs (and hence higher customer charges). Diffusion will also be slowed by the fact that mobile subscribers will have to replace their handsets to upgrade to more sophisticated 3G models.

A final technology with massive implications in shaping the future of mobile wireless technology is Bluetooth. Bluetooth is by contrast a short-range (less than 10 meters) wireless communications technology designed to exploit the wireless appliance concept. It is designed to provide connectivity between the phone and “home networks” (or office networks) and is expected to lead to feature rich “smart phones” which may provide new and exciting bundle opportunities for AT&T. Alternatively, these may provide a differentiated set of services which will strengthen competitors such as WorldCom or the RBOCs.
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