

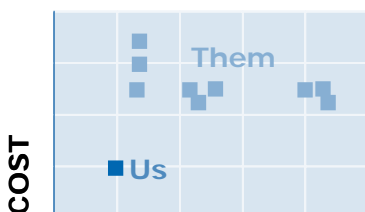
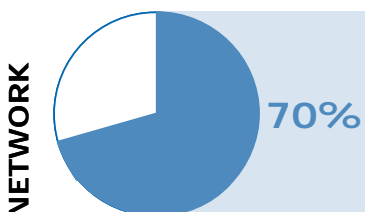
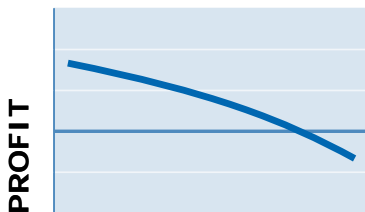
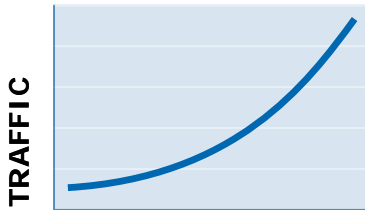
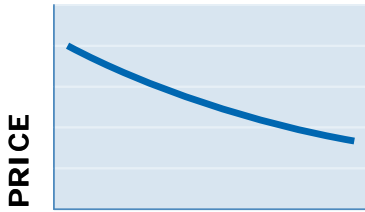
HOW TO AVOID BUILDING AN FTTX BRIDGE TO NOWHERE

*Revenue and Cost Model Imperatives for
Sustainable Service Provider Strategy*

June 2009



EXECUTIVE SUMMARY



Several strategic challenges are mounting for today's telecom service providers. Amid fighting for share of a fixed if not contracting customer spend on telecoms and entertainment, competition from broadband alternatives continues to force down prices over time in most markets. Changes in end-user behavior, especially in entertainment, are dramatically raising requirements for dedicated, streaming bandwidth and therefore network costs. Meanwhile, over-the-top delivery models disaggregate or even de-monetize richer revenue streams like on-demand video and wireline voice — the latter trend compounded by wireless substitution. All these demand an overhaul of the access network to deliver huge increases in bandwidth while maintaining the sophisticated, wire-speed service intelligence required for differentiated traffic management and high quality of user experience.

While a worst-case scenario of the collective impact of these challenges on profit over time may appear dire, there are signs that the world need not evolve in only that direction. A handful of sensible strategy options remain for service providers, including:

- ▶ seizing first-mover advantage to build more defensible share in markets still at an earlier stage in their life cycle
- ▶ innovating on services to create a wider scope of value exchange with customers, for example branching out into home security and surveillance, e-health, or fixed-mobile convergence
- ▶ pursuing an aggressive lowest-cost provider approach to outrun the competition on pure bandwidth, or
- ▶ potentially changing the rules of the game through usage-based pricing.

Many of the most robust of the potential strategic moves require dramatic reductions in network operating cost structure to keep business models viable. Operator stats for cost per access line vary widely today, beyond what can be explained by scale or teledensity alone.

One key contributor to these differences in overall performance is the cost efficiency of the current field of access concentration equipment, which varies widely as well. One platform stands well apart from the rest — by a factor of 2x or more: Zhone's new MXK intelligent terabit access concentrator sets new performance and cost efficiency benchmarks for the industry, addressing many of the going-forward challenges in profitable access network operation. For the sake of sound and defensible strategy, operators would serve their interests well by giving the MXK a test drive in their networks as soon as is practical.

TABLE OF CONTENTS

Part One: Forces at work on service providers' business models

Competition1

Subscriber behavior changes2

Traffic and cost structure implications8

Resulting revenue and profit pressure 11

Part Two: Toward sustainable service provider strategies

Top-line strategy 14

Cost structure as a strategic weapon 18

Conclusion 21

PART ONE: FORCES AT WORK ON SERVICE PROVIDERS' BUSINESS MODELS

COMPETITION

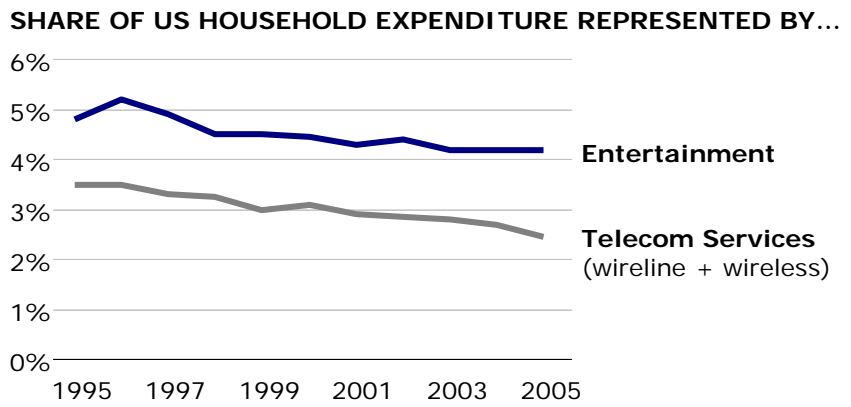
The specific nature of the competitive dynamic in telecom services varies from market to market, but there is no shortage of evidence of increasing competitive forces. For wireline service providers — in particular the telephone companies that are the primary focus of this paper — this is especially true. While they continue to hold a natural monopoly position on last-mile twisted-pair copper (and to a growing extent PON fiber) connections to homes and businesses in their service areas, they are typically no longer the subscriber's only choice. Unbundling regulations have created opportunities for alternative carriers on the same physical infrastructure, with imperfect success but material results nonetheless. More important, completely separate and distinct infrastructure alternatives from cable, wireless, and satellite providers create at least duopoly market structure in most geographies.

As AT&T noted recently,¹ “Our wireline subsidiaries expect continued competitive pressure in 2009 from multiple providers, including wireless, cable, other VoIP providers, interexchange carriers, and resellers. In addition, economic pressures are forcing customers to terminate their traditional local wireline service and substitute wireless and Internet-based services, intensifying a pre-existing trend toward wireless and Internet use.” Indeed, one of Zhone's customers in the US reported recently that they lost 7% of their residential voice lines *in the first quarter of 2009 alone*. And competition is not just an American phenomenon. As just one example, in the arena of video services where an increasing number of carriers have taken the battle for growth and share, Pyramid Research reports,² that in Europe, “IPTV...is under a lot of pressure to withstand severe competition from well-established cable and satellite TV.”

The competition is driven by the supply-side pursuit of growth and superior returns to shareholders on capital investments in the face of a fixed to declining share of subscribers' overall economic activity on the demand side. As profiled in Exhibit 1, consumer spending on all telecommunications services, as a share of total household expenditures, has been declining gradually for the past decade.³ Their spending on entertainment, often considered the ‘greener pasture’ for telecom service providers to enter, has been essentially flat over the same period. In the current environment of pronounced declines in economic activity, which

The share of household spending represented by telecom services and entertainment has been flat to declining over the past decade.

EXHIBIT 1



most expect to be followed by a long road to recovery,⁴ there appears to be little reason to expect these trends to reverse.

The threat of outright loss of subscribers to alternative services has led to lower prices over time in contested markets. Exhibit 2 indicates that among the top five ILEC broadband providers in the US, prices for a given class of service have declined on average a little over 10% annually for the past six years.⁵ Prices are declining worldwide as well,⁶ as shown in Exhibit 3.

SUBSCRIBER BEHAVIOR CHANGES

Beyond subscribers’ fickle pursuit of a better deal on broadband or voice, the subject of end user behavior merits a closer look. In particular, over-the-top services for voice and video show signs of potentially very large revenue and cost structure implications for service providers of any stripe.

As anyone outside the most Luddite of households will attest, there is something fundamentally different happening in the context of communication and entertainment in the youngest deciles of our demographics. Many a parent has paused in mild wonder at the sight of their children and their friends gathered around a laptop, intently exploring the seemingly limitless world of video clips on YouTube for hours on end. Statistics on the growth of YouTube and dozens of other Internet video

Competition continues to push retail price per Mbps down for residential services.

EXHIBITS 2, 3

AVERAGE RESIDENTIAL RETAIL PRICE PER Mbps

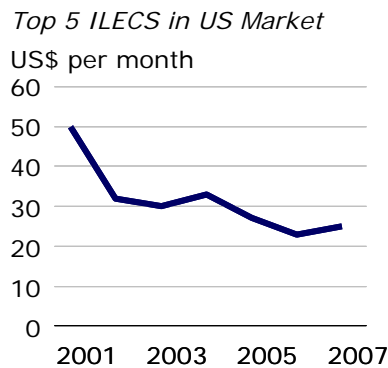


EXHIBIT 2

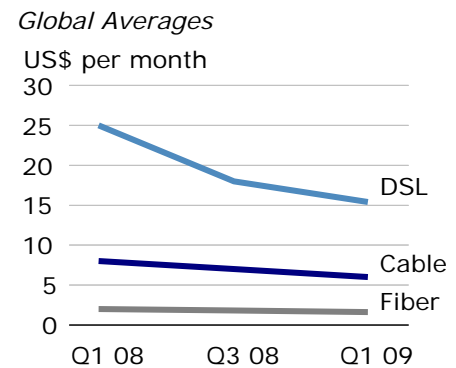


EXHIBIT 3

Anecdotal evidence suggests subscriber behavior is shifting at an increasing rate to fundamentally new modes, especially in entertainment consumption.



EXHIBIT 4

sites⁷ (Exhibit 5) appear to confirm what this anecdotal evidence from our children suggests: this is a growing and potentially very large phenomenon. In the US market alone, over 150 million people watched at least some video over the Internet in April, 2009. They averaged 13 minutes per day of online video time, a 70% year-over-year increase over April 2008, and streamed a total of 16.8 billion clips at an average of 3.5 minutes each.

The phenomenon is moving quickly past the amateur user-generated content that fueled much of its early rise. In April ABC announced that it would join the other large broadcasters in making a good portion of its broadcast content available free on Hulu (and that its parent, Disney, would invest in the site).⁸ Big brands like CBS, Disney, Viacom and Turner already own spots in the top 10 site list, and Time Warner and Comcast (with their TV Everywhere and Fancast initiatives, respectively) are both moving aggressively into the Internet video scene.⁹

A number of industry players have invested significant time and energy in a recent attempt to put this 13-minute Internet video phenomenon in the

It's more than anecdotal: 150 million Internet users watched a total of 16.8 billion on-line clips in April 2009, a 70% increase over April 2008.

VIDEO STREAMING FROM TOP 10 SITES IN APRIL, 2009

Millions of Clips Watched

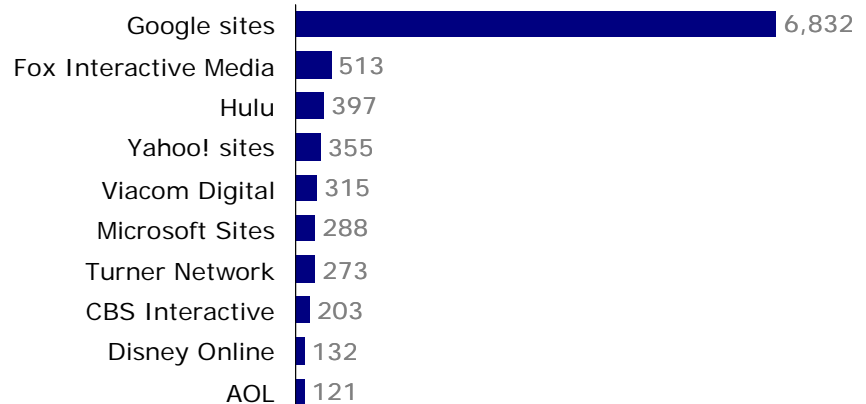


EXHIBIT 5

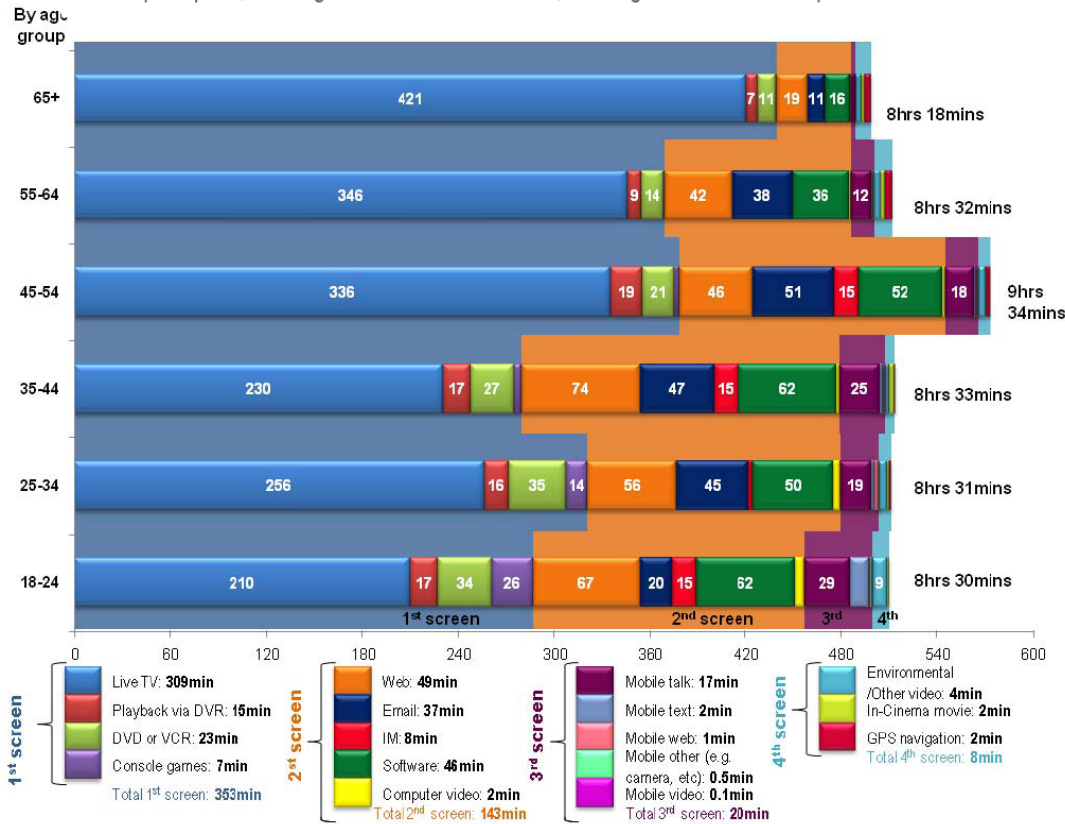
current context of how people use their “screen time” in a general sense of the term, with some very interesting results.

An extensive study of user behavior published this past March by the Center for Media Design at Ball State University,¹⁰ in a large joint effort involving the Nielsen media research company and 35 of its clients, offers very detailed and fact-based profiles of how people interact with the multiple screens in their lives. Rather than using self-reporting, with typically uncertain reliability, this survey employed a small army of observers to follow their subjects around through their day, recording at 10 second intervals on a purpose-built hand-held device exactly how their subjects were interacting with media and devices of any sort. A sample of 376 survey participants (all from the US) covered the spectrum of age groups and other demographic variables. Each was watched repeatedly, for a total of 952 observed days. Exhibit 6 on the next page provides a comprehensive view of their results, in both absolute minutes and relative share of time. The study divided the world into the media industry’s currently-standard multi-screen definitions: the first screen was television (in all its variations), the second the computer, the third the cellular phone, and the fourth a combination of cinema, GPS, and ‘environmental’ video sources such as screens at grocery-store check-out lines.

A couple elements of the results are worthy of note. First, the *average* American continues to spend a positively shocking amount of time on television — nearly six hours every day! The number of minutes of airtime at play in the first-screen domain remains very large, roughly 30 times the airtime currently occupied by Internet video. This leads to the second primary observation: On one hand, while the average time spent on Internet video is still relatively small, it’s not hard to see how it can expand steadily. The behavior by age group at a quick glance appears to follow anecdotal evidence — the younger the sample, the more time is spent with the other screens, as well as alternative uses of the first screen. It’s not difficult to imagine this profile shifting up this graphic over time, with the introduction of today’s teenagers, causing the roughly diagonal dividing line between conventional broadcast television and everything else to shift to the left. Users more accustomed to second- and third-screen modes of media interaction will be more likely (as is already shown by the thin yellow wedges) to spend more time on Internet video. On the other hand, however, it also looks likely that this will follow an informal law of technology adoption forecasting — that substantial changes in behavior tend to take a generation to occur.¹¹ So while it’s plausible to see continued high rates of growth for Internet video from its current relatively tiny baseline of time consumed, substantial replacement of straight broadcast TV will likely take many years to unfold — and there’s no way to tell where an asymptote for the minimum amount of conventional broadcast TV may lie. The credibility of forecasting assumptions about this phenomenon will

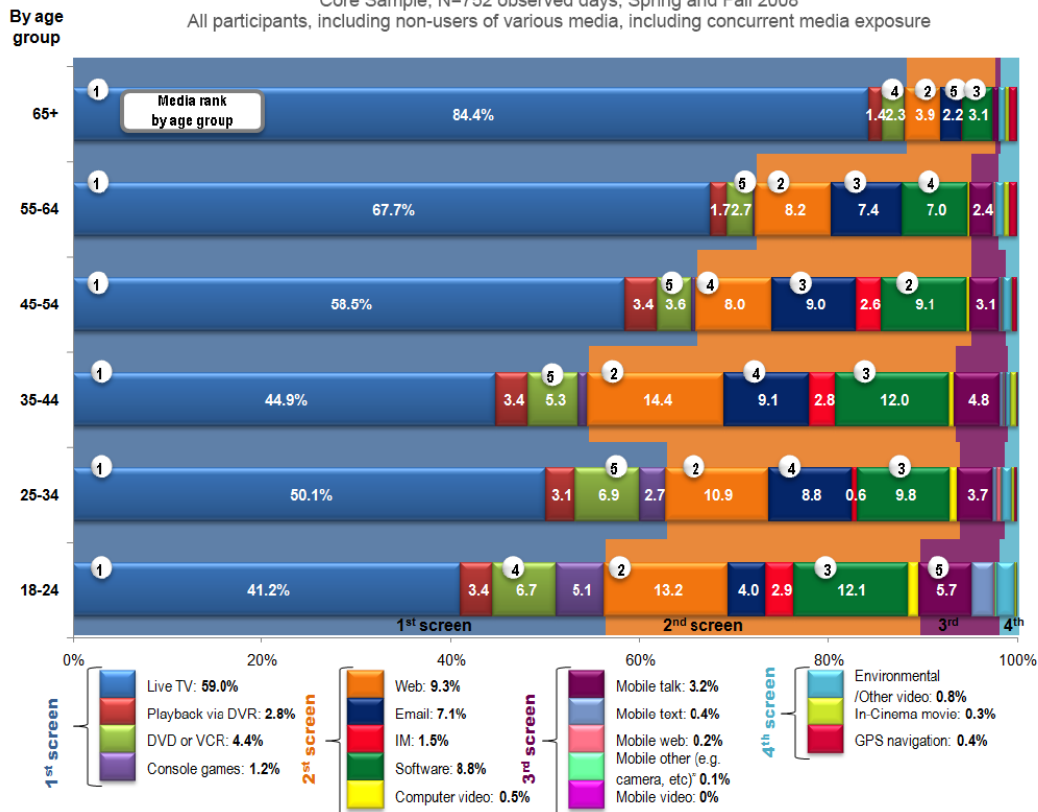
How Consumers Accumulated Screen Time

Average Daily Minutes, Core Sample, N=752 observed days, Spring and Fall 2008
All participants, including non-users of various media, including concurrent media exposure



Share and Ranking of Average Daily Minutes for Screen Media

Core Sample, N=752 observed days, Spring and Fall 2008
All participants, including non-users of various media, including concurrent media exposure



Americans' screen-time habits vary significantly by age group and are indeed diversifying away from conventional television.

EXHIBIT 6

play an important role in assessment of the Internet traffic forecasts examined in the next section.

Before turning to traffic, three more anecdotes from the real world of over-the-top and other service substitutes will provide useful input to assessment of their overall revenue implications.

As many are aware, Netflix, one of the more innovative entrants in the video rental business, launched an on-line streaming video service in early 2008. Netflix has not yet chosen to publicize any general usage statistics, but there are a couple clues as to the impact. The company reported in January that at year-end 2008, “millions” of their roughly 10 million subscribers were using the feature.¹² More telling stats have been offered in their February announcement of early results from their partnership with Microsoft.¹³ With 1 million Xbox users activating Netflix subscriptions on Xbox LIVE, and then watching 1.5 billion minutes of streaming video over two months, for those million customers these two companies have almost tripled their average minutes of use for Internet video — given that they were spending 24 minutes a day watching videos streamed by Netflix alone. This compares to the 23 minutes the average consumer in the Nielsen/Ball State study sample group spent on DVD, VCR, and on-demand or pay-per-view watching on their first screen. For the Xbox consumer, this was clearly a credible substitute for the offers of subscription TV services. Sony’s response through a series of subsequent press releases¹⁴ highlighting new content partnerships, HD and Blu-Ray quality, and their 9 million registered PlayStation Network members suggests Internet delivery of streaming content has become part of a new round of escalation in the long-running gaming console wars, certainly a plausible catalyst for more rapid growth in this form of traffic.

Turning from video to voice, the original core of telecom sector revenues, there are stories of substitution and rising impact from free services that are more developed (in terms of scale and history) and therefore more troublesome.

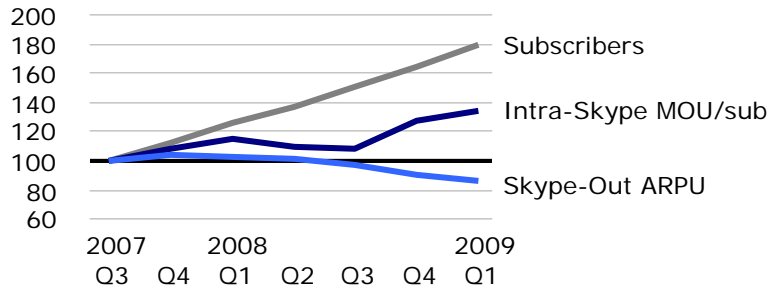
As the leading provider of over-the-top VoIP service, Skype’s key performance indicators bear watching (see Exhibit 7). They continue to gain subscribers at a roughly 40% annual growth rate,¹⁵ reaching 443 million users at the end of Q1, 2009. While usage remains relatively light (at just 20 minutes per month, on average, for the sum of intra-Skype and Skype-out calls), usage per subscriber is growing at a 16% annual rate. And Skype’s ability to de-monetize the voice market continues to grow. The figures indicate that as their subscriber base grows, Skype-out minutes are declining slowly as a proportion of overall usage — an indication of the network effect, i.e. more Skype users can talk for free to each other, since there are more Skype landline voice industry, the nearly 10:1 ratio between free and paid minutes suggests their de-monetizing impact on the value exchanged

Skype's largely revenue-free usage growth shows the increasing de-monetization power of over-the-top VoIP.

EXHIBIT 7

SKYPE KEY PERFORMANCE INDICATORS

Normalized to 2007 Q3 = 100



between subscribers and their service providers is likely exceeding 1%, globally, and growing. And they're not alone — Zhone customers have indicated that VoIP alternatives of many varieties are clearly taking a tangible bite out of their voice business.

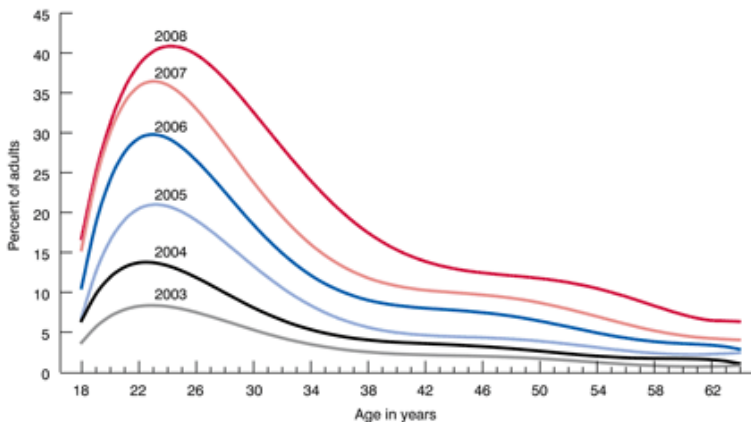
The larger voice revenue issue is of course wireless substitution. Recent surveys in the US¹⁶ have shown that 18.7% of households now have no landline voice service and rely exclusively on mobile phones, a proportion that continues to grow at a roughly 30% annual rate. An additional 14.5% of households received all or most of their calls on their cellular phones, despite having a landline, so further growth of the zero-land-line segment appears plausible.

An additional factor on the business revenues side is the continued slow migration of legacy T1/E1 and frame relay services to Ethernet in the First Mile (EFM) service over fiber or copper, the latter of which is often provided by alternative carriers and therefore represents outright revenue loss.

Wireless substitution for wireline voice has a large generational component, suggesting much more to come as today's youth mature.

EXHIBIT 8

Polynomial regression equations fitted to a plot of the percentage of adults living in households with only wireless telephone service, by single year of age and by year of interview: United States, 2003–2008

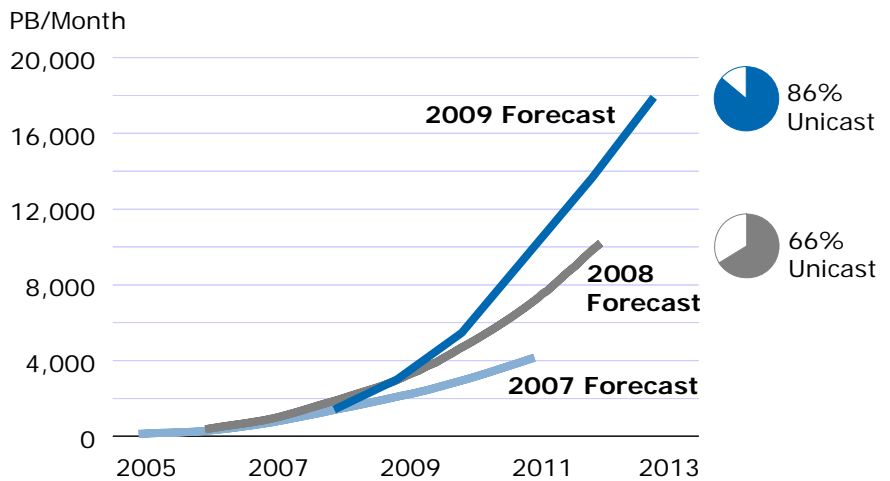


Cisco's Visual Networking Index forecasts keep growing higher, and more biased toward unicast video.

EXHIBIT 9

GROWTH IN INTERNET VIDEO TRAFFIC FORECASTS

Global traffic actuals and forecast for Internet video to PC, Internet video to TV, video communications, and gaming



TRAFFIC AND COST STRUCTURE IMPLICATIONS

Related to the over-the-top services discussed above — especially the video applications — is the issue of the cost structure impact of growth in network traffic.

Cisco's Visual Network Index¹⁷ aggregation of Internet traffic forecasts across many analysts and applications has become a common reference tool in the industry and provides a useful baseline for this assessment.

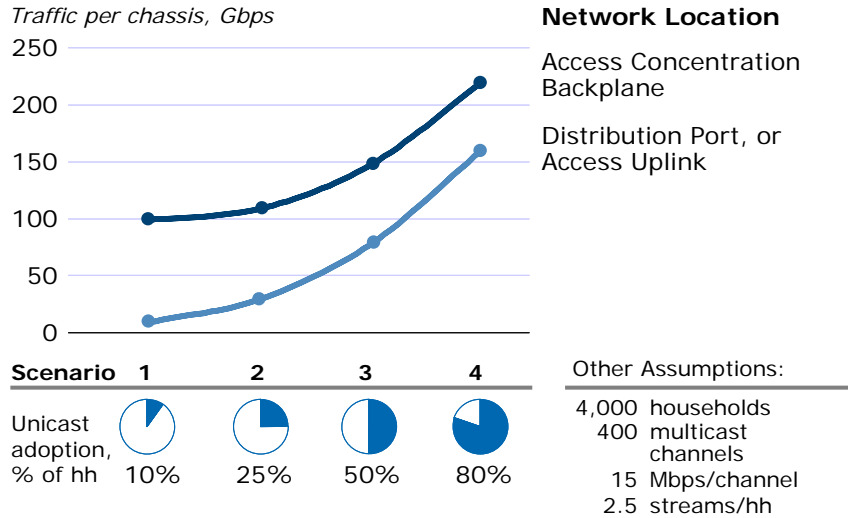
Exhibit 9 summarizes two important points about the subset of the forecast related to Internet video applications. Laying the 2008- and 2009-version forecasts for these categories on top of the original 2007 forecast, it's clear that the last two years have yielded an acceleration in expectations for this segment of traffic. Of more importance to access network design is the fact that a greater portion of the expected traffic is unicast — nearly 90% in the out-years of the current forecast, up from about 2/3 in the 2008 version.

The significant access-network implications of an explosion in unicast video traffic becomes clear when compared with the requirements of today's largely multicast video environment. Exhibit 10 shows the impact on distribution network ports (or the access concentration uplink, equivalently) and the backplane traffic requirement for the access concentrator.¹⁸ The baseline scenario 1 represents today's triple play requirements — with IGMP multicast channel replication in the multi-service access platform (MSAP), so any given channel being consumed by more than one subscriber need only be streamed from the head end down to the MSAP once.

The shift to unicast video yields dramatic changes in requirements for access concentration technology.

EXHIBIT 10

UNICAST-DRIVEN REQUIREMENTS IN ACCESS CONCENTRATION



As an increasing proportion of households adopt unicast usage models (whether VOD through the access network provider or in over-the-top services), the demands on both the uplink and backplane of the MSAP increase substantially. On-demand and over-the-top streams cannot be replicated for efficiency's sake on-board the MSAP (or anywhere else, for that matter), because they have no cross-subscriber synchronization. The cost structure implications of these changes are significant — if the access concentration and distribution network platforms selected for today's network do not have the scalability required to handle this approaching tsunami of traffic with minimal upgrade costs, more significant (and costly) forklift upgrades will likely be required over the course of the next few years.

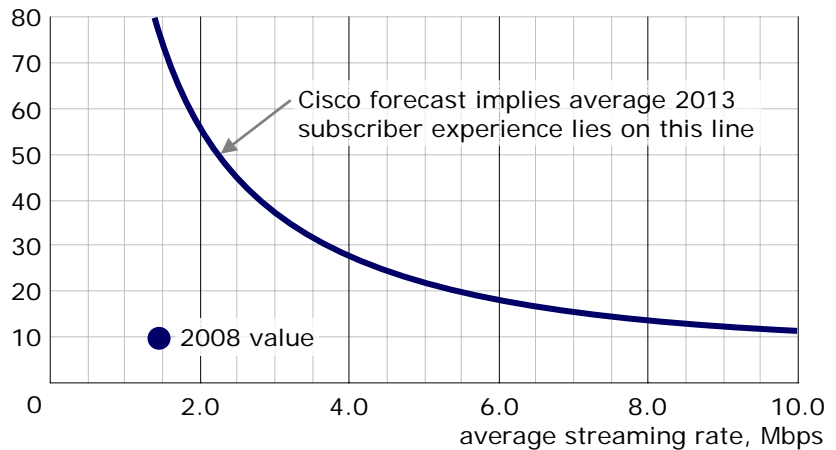
A little back-of-the-envelope deconstruction suggests the bandwidth implications of changes in subscriber behavior could be more significant than Exhibits 9 and 10 suggest. While the aggregate traffic numbers in Cisco's most recent forecast may appear surprisingly large, when factored down to GB per broadband subscriber per month (3.2 GB in 2008, 25.8 in 2013), and then disaggregated into the component assumptions of average video minutes per day per broadband household and average streaming rate, the figures actually begin to look potentially a little too conservative. Exhibit 11 shows the 1/x relationship between minutes of video per day and the streaming rate for the 25.8 GB/subscriber/month value for 2013 in the Cisco forecast. One has to ask, will everyone in the average broadband household collectively choose to watch less than 20 minutes a day of less-than-HD content four years from now? Given that there are 300+ minutes of first-screen time in play for each individual in the household, the vast majority of their screens will be HD capable by 2013, and the fact that the Netflix/Xbox crowd is already breaking this boundary, it certainly seems

Disaggregating Cisco's Internet video traffic forecast into minutes per day per subscriber and streaming rate suggests it may still be an underestimate of what's ahead for the industry.

EXHIBIT 11

USER EXPERIENCE PROFILE OF CISCO FORECAST — 2013

average video minutes per day per broadband subscriber



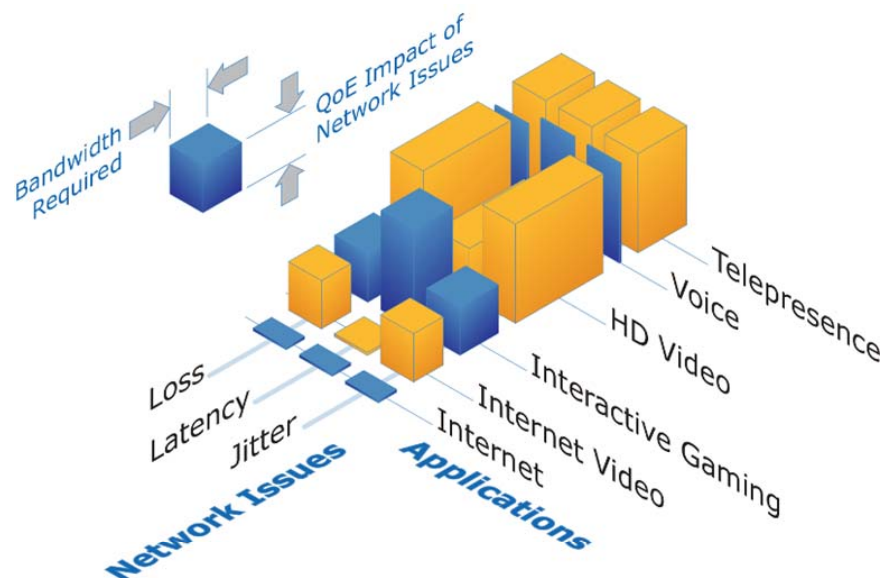
possible that the 2010 version of Cisco's forecast of forecasts will ramp to higher traffic levels still.

One final point on cost structure implications. Performance requirements for access network equipment in this high-bandwidth future go well beyond just the raw bandwidth itself. As illustrated in Exhibit 12, there are substantially different network behavior requirements across the range of applications that must co-exist in these networks. To ensure subscriber satisfaction with their quality of experience, and to enable differentiated traffic management, MSAPs employed over the next several years must provide ever greater intelligence. Inspecting packets and taking appropriate action at dramatically higher wire speeds, all while supporting a wealth of

Successful networks are about more than bandwidth — they also need intelligence to ensure quality of experience, service manageability, and policy implementation.

EXHIBIT 12

SERVICE AND PERFORMANCE REQUIREMENTS DIFFER



configurable options for traffic prioritization and segregation, access control, security, and manageability is no trivial task. As this paper's final section on operator decisions and operating cost implications shows, the choice of MSAP can make a substantial difference in service provider business model sustainability.

REVENUE AND PROFIT PRESSURE

The preceding sections profiled a number of changes afoot in service providers' environments, each of which has the potential to materially effect revenues and costs. As one final step before turning to the question of what service providers might consider or are already doing in response, it's worth a quantitative look at the *potential* scale of the impact of all these factors to get a sense of appropriate urgency.

Exhibit 13 (see next page) provides both top- and bottom-line views of the combination of all the factors discussed for sake of illustration.¹⁹ Given the reasonably extreme degree of their cumulative impact, it seems unlikely that market dynamics will be allowed to play out this scenario in full, but the math is informative as a worst-case scenario to consider. The curves in the graph are cumulative from top to bottom:

(1.) The baseline curve shows the results of modeling in some detail the operations of a hypothetical mid-sized telco providing triple play residential and conventional business voice and data services on a new FTTx network and some residual copper plant. Operating income at the outset is in the 20-25% range, nominally improving gradually, under baseline conditions, as broadband penetration grows modestly through the period (2% per year) and the cost of core network bandwidth falls over time (10% per year). Initial residential market penetration is 60% for voice, 50% for broadband, and 40% for television services. Business market share is 80% for voice and 80% for data.

Curves 2 through 7 show the incremental impact of adding in the phenomena described above.

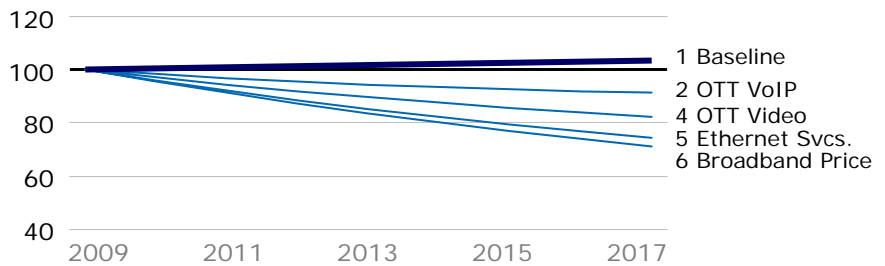
(2.) Loss of share and revenues to residential over-the-top and wireless voice services — profiled here for sake of illustration as a 5% decline per year in market share and a 4% reduction per year in revenue per user.

(3.) Increase in the proportion of HD video content (i.e. bandwidth) and the number of broadcast video channels (and associated content fees) required to maintain a competitive video-services offer — profiled as a 5% annual increase in the number of channels on offer and a 5% annual increase in the average streaming bandwidth (which starts at 12 Mbps in the baseline). It is assumed that any gains in encoding and compression

The telecom market trends in motion today could spell real financial challenges for wireline service providers, as revenues and margins are both pushed lower.

PRO FORMA TELCO REVENUE, NORMALIZED TO 2009 = 100

As a Function of Key Trend Assumptions (Cumulative)



PRO FORMA TELCO OPERATING INCOME %

As a Function of Key Trend Assumptions (Cumulative)

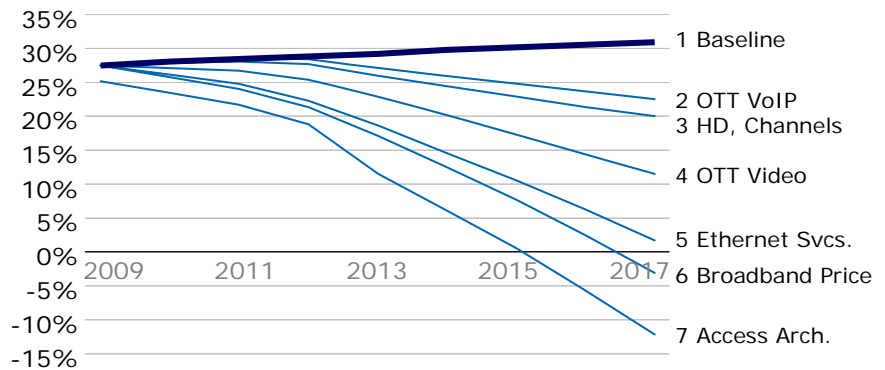


EXHIBIT 13

efficiency over the period will be overrun by demand for HD and higher-quality versions of it.

(4.) Increase in adoption of over-the-top video services — profiled as a 2% annual decline in video services share, a 2% annual decline in broadcast video ARPU, a 4% annual decline in on-demand video ARPU, and a 30% annual increase in busy-hour broadband usage per average subscriber (starting at 1 Mbps in the baseline).

(5.) Migration to Ethernet business services — for illustration, a 5% annual decline in market share for T1/E1 services and a 2% annual decline (each) for ARPU in voice and data services.

(6.) Downward broadband pricing pressure over time — profiled as a 2% annual decline.

(7.) Selection or retention of suboptimal access network infrastructure — as profiled in the final section of this paper, this can have as much as a 10% impact on relevant costs in network operations, network engineering, customer service, and systems (IT) from incomplete leverage of the inherent advantages of the multi-service access concept, compounded by a mid-period replacement of CO-side access infrastructure because of scaling limitations from some current architectures being sold today. As noted

above, there is a rapid rise ahead in access concentration bandwidth requirements from the accelerating shift to unicast streaming traffic. The final section of this paper looks in more detail at the scaling limitations for some platforms that will drive substantial forklift upgrade activity.

Exhibit 13 shows clearly that the sum of these market trends is troubling indeed, echoing in quantitative form the concerns some Zhone customers have expressed about the fundamentals of their businesses in the longer term, and characterizing in all-too vivid detail what Simon Sherrington, an analyst with Light Reading has called “the elephant in the living room of the industry.”

These curves depict one possible future, but it is certainly not guaranteed to occur. The second part of this paper will highlight a number of strategies operators are using to tip the odds back in favor of sustainable business models in tomorrow’s broadband world.

PART TWO: TOWARD SUSTAINABLE SERVICE PROVIDER STRATEGIES

Unfortunately, while the storm clouds gathering in the access business that raise questions about long-term viability for current operator models are reasonably easy to spot, strategic responses that build real confidence are more elusive. A few anecdotes from Zhone’s customer base²⁰ as well as the broader operator community do offer a handful of interesting leading indicators, however. These are grouped into top-line and bottom-line (or cost structure) oriented thrusts in this second part of the story.

TOP-LINE STRATEGY

On the revenue line, the observations of promising operator moves can be grouped into a handful of basic strategic directions:

- get there faster
- do more
- change the rules of the game
- give them more of what they want

Each direction and its illustrating examples are explained in turn below.

Get there faster.

Some operator activity among Zhone customers in markets at an earlier stage in their life cycle can be characterized as leveraging the truth in the well-worn William Gibson quote, “the future is already here, it’s just not evenly distributed.” While Part One included a reasonable amount of evidence that the drivers of concern about operator strategy have all been seen in the real world, they haven’t begun to penetrate all markets in equal measure. In some smaller markets in the US and as well as in the newer broadband markets in the Middle East and Latin America, there remains opportunity to tilt the strategic balance through first-mover advantage and establishment of early dominant market share —the equivalent of seizing control over the chessboard center in order to run the middle game. While churn remains a danger in any telecom market, the advantage of bringing a good number of new subscribers into the user base and keeping satisfaction up through high quality of service standards remains a formidable barrier to competitors’ later incursion.

In Zhone’s customer base, the operators in these markets are pursuing aggressive FTTx deployments that put their capabilities ahead of many networks in the more developed world and that will allow them to offer a triple-play voice, broadband, and video bundle that may be last-year’s news in top-tier cities in Europe or North America but is nonetheless expected to earn them substantial subscriber gains and net new adoption in their market. Efficient use of capital in executing this strategy is key for these markets, where customer latitude for telecom and entertainment spend is more constrained, a point addressed in the next section on cost structure.

Do more.

In more mature markets where the future of voice, broadband, and video competition, disaggregation, and de-monetization has already fully arrived, there are a couple directions in which an operator can take things further.

The first category is modest but still useful enrichment of the features offered within the triple-play bundle itself. Analogous to the simple “custom calling features” like call-back or call waiting that have generated revenue gains on the traditional voice side over the years, there are “custom broadband features” that can be used to improve the customer experience of triple play and increase stickiness. Firewall, anti-virus and SPAM filtering, web server, parental controls, cloud storage, etc. are all possibilities, some of which may require external partnerships. Bringing unified communication concepts from the enterprise space into the residence is also a useful avenue. In particular the simple but well-liked feature of caller ID pop on the TV screen can help prevent migration to disaggregated voice services.

The second direction involves the development of what Yankee Group has dubbed “wider economy services”²¹ to extend the service portfolio beyond the triple-play baseline (see Exhibit 14). While Yankee admits that telco attempts to branch out beyond voice, video, and broadband into additional communication-related or -driven services are very early stage, there appear to be sensible directions to consider adding to the service bundle. The concepts of home security, monitoring, and health care are especially likely to see development, based on early indications from attempts in Japan and elsewhere — and a handful of operators have already launched home security offers at this writing. While there remain barriers to development and adoption, for example the burden of dealing more directly with the vagaries of infrastructure in individual homes, the “stickiness” gained by branching out into other categories of service on the same broadband infrastructure — as well as the service revenue itself — appear likely to merit at least exploration of these concepts. Service providers must be self-aware that their current organizational competencies may not equip them

Yankee Group's framework for service diversification and evolution offers a number of rational paths for scope expansion.

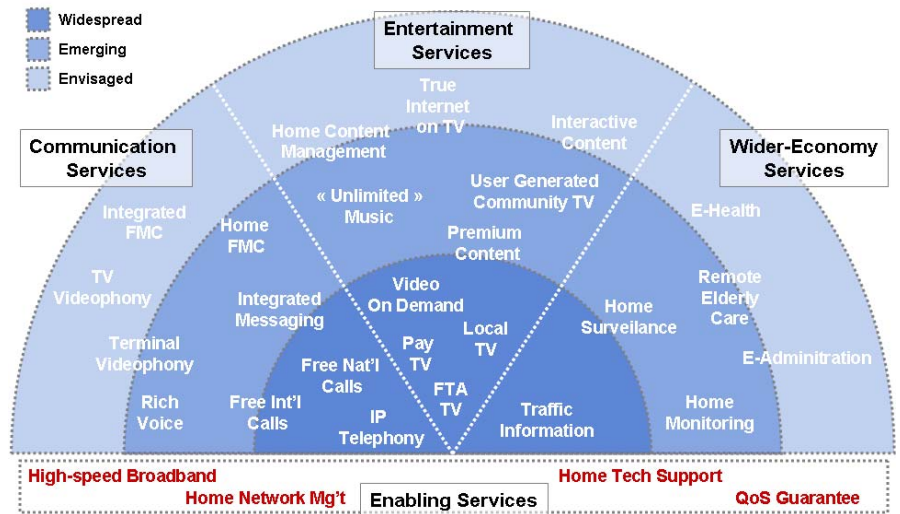


EXHIBIT 14

well enough to make these branching-out services thrive in their operations, and that new talent may be required.

Service providers' typical talent specialization is stretched even further by the third possible extension of the baseline triple play value proposition — into more favored or even exclusive video content. This has long been the central arena for competition among major broadcast as well as movie studio properties, and by extension among their distribution channels, and the telco entrants into the video game need to learn to play better at that level as well. As the market for video content continues to diversify and fragment, there is a new openness to experimentation with exclusives and other alternative arrangements for specific types of distribution (often for windows of time) that can lead to new ways to monetize and retain value for both content and service provider — an approach Time Warner Cable, as one example, is developing now. One obvious angle to consider is that a properly-equipped FTTx network should allow a service provider to deliver higher image-quality fare than is the current standard for over-the-top services, or at least a higher quality of customer experience with on-demand service (given that the likes of Netflix still suffer somewhat from being on the bleeding edge of what typical broadband services will support with consistently high quality).

For smaller telcos relying on intermediaries to package video content for them it will obviously be less feasible to play at the level of movie and TV studio deals, but they can certainly apply the same logic in local relationships, perhaps for sports coverage.

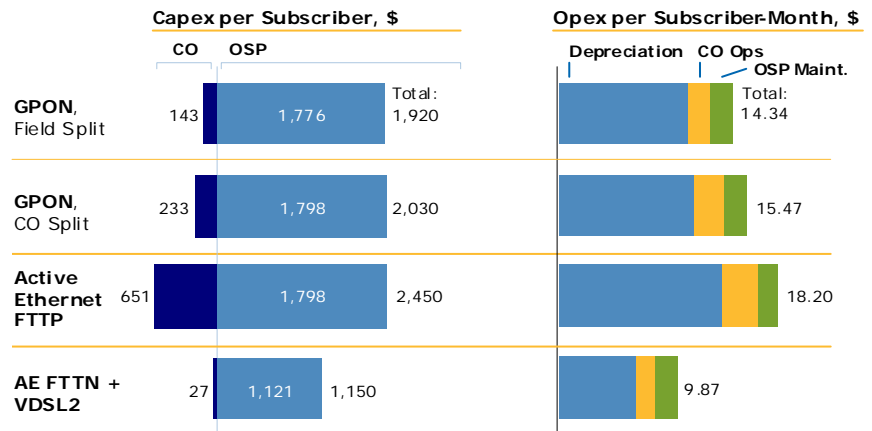
Change the rules of the game

One clear way out of the trap of skyrocketing usage and de-monetized or disaggregated services is usage-based pricing. Unfortunately the concept is

Deploying GPON with splitters in the CO costs little extra and provides bandwidth upgrade headroom of differentiating strategic value.

EXHIBIT 15

RELATIVE COSTS FOR FTTX ARCHITECTURE VARIANTS



fraught with issues in many markets. There is, however, a fundamental reality behind it, profiled in Part One, that will be increasingly difficult for policy-makers to ignore: survival of for-profit operations of broadband networks in the long run may depend on it. Prescribing an approach to altering the conditions in a given market to make this possible is beyond the scope of this paper, but it should be seriously explored by any telco interested in long-term viability, since there appears to be a moment in the industry’s evolution right now where it is safer to discuss — as suggested by British Telecom’s recent advocacy for the concept — and this may allow rational conversations and outcomes in this area to occur.

Give them more of what they want

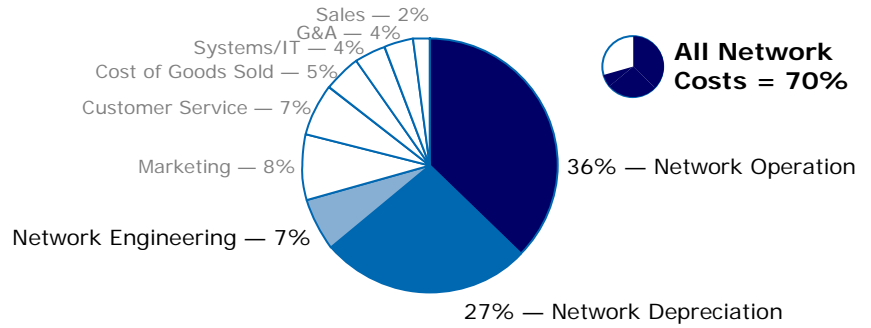
Some Zhone customers are wisely not counting on usage-based pricing to come into fashion, and instead forging ahead in mature markets with an aggressive cost leadership strategy. They are deploying FTTx networks with very high per-subscriber capacity at very low cost built into their plans — configuring their fiber to support point-to-point 1G services with minimal upgrade expense. They are watching their costs very closely in the immediate term by choosing highly-integrated MSAP gear and an initial centralized GPON architecture to minimize both up-front capex as well as opex costs (see Exhibit 15).²² The combination of high bandwidth scalability and low cost gives these operators a powerful strategic advantage to maintain profitability in the face of the trends in Part One, to a degree they expect their competition will not. The key tools to making this strategy successful are covered in the final section.

Network costs represent 70% of a typical operator's expense structure — clearly a significant factor in financial performance.

EXHIBIT 16

TYPICAL TELECOM SERVICE PROVIDER COST STRUCTURE

Operating Expenses by Major Category



COST STRUCTURE AS A STRATEGIC WEAPON

The market trends in Part One and a number of the strategic directions outlined above highlight the importance of cost structure in successfully meeting customer needs in a competitive world and maintaining profitability while you're at it. As the evidence in this final section will show, how an operator chooses to approach the design, implementation, and management of their network can create a strategic weapon of considerable force or a strategic deficit of similar proportions.

The Network Matters

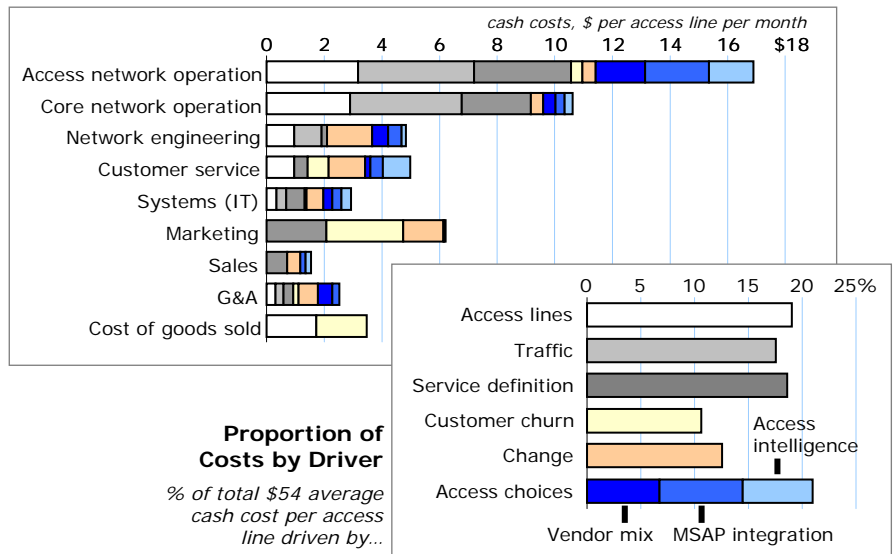
As Exhibit 16 shows, network operation and engineering represent roughly 70% of the operating expenses of the typical telco.²³ Further, looking through an activity-based costing lens at the same figures,²⁴ it's clear that at least 20% of the total cash costs of operations are driven by access choices

Access network decisions drive as much as 20% of the cash costs of operation, including activity in most parts of the organization.

EXHIBIT 17

ACTIVITY-BASED COST VIEW OF TELECOM EXPENSE STRUCTURE

Costs by Activity and Driver



Service provider efficiency varies widely, with little correlation to scale.

RANGE OF TELECOM OPERATOR COST PERFORMANCE

Cash operating costs per month per access line

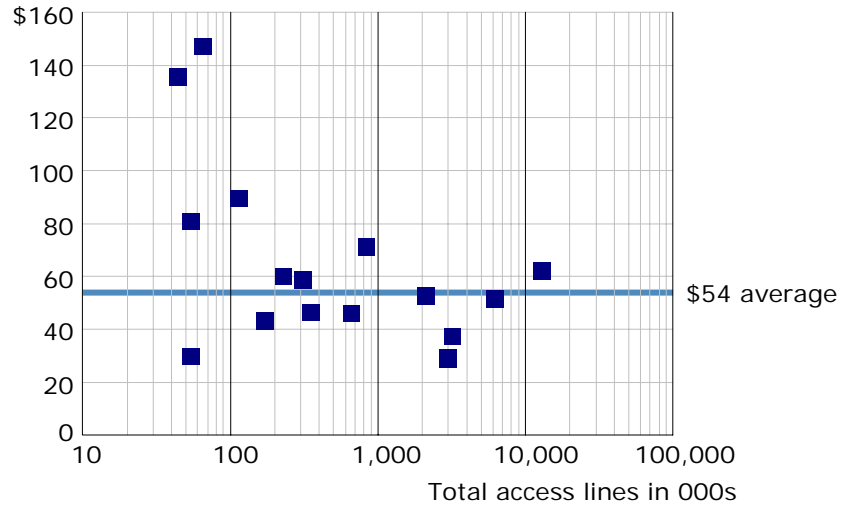


EXHIBIT 18

— the number of vendors in the mix, the degree of MSAP integration, and the ‘access intelligence’ — the extent to which the platform supports automation of service provisioning, for example (see Exhibit 17). For a new FTTx deployment, depreciation of the access network can represent a full 25% of operating expenses. Clearly, these are large levers to pull one direction or another in an operator’s P&L, and getting these choices right can have significant effects on strategic position.

Access Cost Performance Varies Widely

Given the increasingly strategic importance of cost structure in the service provider world, it is surprising to see how the leading operators perform along that dimension. As Exhibit 18 shows, they are all over the map.²⁵ The expected downward slope of cash costs per access line as a function of number of access lines — i.e. a scale curve — does appear to be faintly visible in the data, but with an R² of only 0.22, it is difficult to conclude that size alone is the primary determinant. There are clearly other factors at work as well.

Exhibit 19 offers a clue regarding one of the most important of those other factors: the cost efficiency of the access network platform.²⁶ As the exhibit shows, cost effectiveness varies dramatically between currently-available platforms, especially along the dimension of capital cost per access line. The most extreme cases are those older platforms in the field that have seen recent upgrades to their uplink capacity to accommodate today’s broadcast-oriented triple play model, but for which no fundamental overhaul of their architecture has been completed. These are least equipped to upgrade into the terabit scale the advent of 90% unicast streaming of HD content will

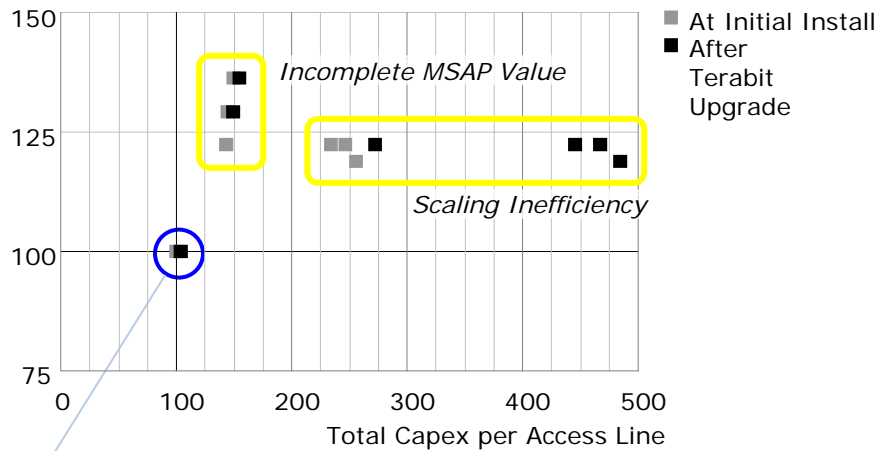
FTTx platform cost performance varies substantially across the currently-available options.

EXHIBIT 19

RELATIVE COSTS FOR LEADING FTTX ACCESS PLATFORMS

Normalized to Lowest Cost Platform = 100

Total Operating Cost of Ownership per Access Line



require and will very likely need complete ‘forklift’ replacement within the next few years.

The results from other vendors that *have* upgraded their primary FTTx platforms to scale more efficiently but that have not chosen a well-integrated multi-service approach to the platform are visible on the vertical access — where incomplete MSAP and management-layer integration yields higher operational cost of ownership.



A New Strategic Weapon for FTTx Operators — the MXK Intelligent Terabit Access Concentrator

Zhone’s new MXK™ intelligent terabit access concentrator reflects a clean-sheet approach to truly scalable multi-service architecture, designed to meet the rapidly evolving demands on access networks profiled above. MXK platforms offer unrivaled bandwidth — delivering non-blocking service to 3,600 100-Mbps GPON or 360 1-Gbps Active Ethernet customers per chassis — while leveraging Zhone’s well-proven SLMS access operating system for sophisticated service intelligence and ease of management in an multi-service access architecture. See <http://www.zhone.com/mxk/> for more details.

CONCLUSION

This paper has provided a brief introduction to the several classes of strategic challenges mounting for today's telecom service providers. While a worst-case scenario of their collective impact over time may appear dire, there are good reasons to believe the future not evolve in only that direction. A handful of sensible strategy options remain for service providers, from first-mover advantage to lowest-cost provider goals and potentially changing the rules of the game through usage-based pricing. Many of the most robust of the potential strategic moves require dramatic reductions in network operating cost structure. Operator stats for cost per access line vary widely, as do the cost efficiency stats for the current field of access concentration equipment. One platform stands apart from the rest: Zhone's new MXK intelligent terabit access concentrator sets a new benchmark for the industry, addressing many of the going-forward challenges in profitable access network operation. For the sake of your strategy, you should give the MXK a test drive in your network as soon as is practical.

About Zhone

Zhone Technologies, Inc. (NASDAQ: ZHNE) is a global leader in multi-service access solutions, supporting more than 700 of the world's most innovative network operators. The company offers the industry's only fully-integrated portfolio of MSAP, FTTx, EFM and Wi-Fi access technologies, improving network agility and reducing the costs of delivering the full spectrum of access services, including residential and business broadband, VoIP, and High-Definition IPTV — over copper, fiber, and wireless. Zhone is headquartered in California, and its MSAP products are all manufactured in the USA, in a facility that is emission, waste-water, and CFC free.

NOTES

1. AT&T 2008 Annual Report, in the Management's Discussion and Analysis of Financial Condition and Results of Operations section on Competition, p. 36.
2. Stela Bokun, Pyramid Research, *Europe Telecom Insider*, Vol.1, No. 4, June Edition.
3. James Alleman and Paul Rappoport, International Telecommunications Union Document FoV/02, *The Future of Communications in Next Generation Networks*, January 2007, pp. 3–4.
4. *The Economist*, "Economics Focus: Damage Assessment", May 16th 2009, p. 84.
5. United States Telecom Association presentation, "Wireline Broadband Pricing 2001-2007", June 2008, p.2.
6. Fiona Vanier, Point Topic, "Broadband Analysis: ISPs push speeds in the race to retain market share" posting, June 5, 2009.
7. comScore press release, "Americans Viewed a Record 16.8 Billion Videos Online in April Driven Largely by Surge in Viewership at YouTube", June 4, 2009.
8. Jason Kilar, Hulu's CEO, "Like Minds", a posting on <http://blog.hulu.com>, April 30, 2009.
9. *The Economist*, "After the divorce: Jeff Bewkes of Time Warner has a plan to save cable television — half of it, anyway", May 7, 2009.
10. Ball State University Center for Media Design, *Video Consumer Mapping Study — Key Findings Report*, March 26, 2009, p.21.
11. Donald Lehmann, Columbia University Graduate School of Business, lectures in Managing Innovation, 1993-1994.
12. Reed Hastings, CEO, scripted comments in Netflix, Inc. Q4 2008 Earnings Call, transcript available on Seeking Alpha (www.seekingalpha.com).
13. Netflix, Inc. press release, "One Million Xbox LIVE Members Download and Activate Netflix on Xbox 360", February 5, 2009.
14. For example, Sony Computer Entertainment America and NBC Universal press release, "PlayStation Network's Video Delivery Service Partners with NBC Universal to Offer Lineup of Hit Movies and Television Shows", March 10, 2009.
15. Om Malik, gigaom.com, commentary on Skype subsidiary stats in eBay Q1 2009 results, April 22, 2009.
16. Stephen Blumberg and Julian Luke, Division of Health Interview Statistics, National Center for Health Statistics, "Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2008", May, 2009.
17. Cisco Systems, Inc. white paper, "Cisco Visual Networking Index: Forecast and Methodology, 2008-2013", June 9, 2009 (and the two previous editions).
18. Zhone modeling.
19. Zhone analysis, applying growth and decline assumptions in the text to a baseline informed by and calibrated with analysis of recent financial results from the 16 largest publicly-traded telcos in the United States, as well as Zhone experience with deployment and operating economics of various broadband infrastructure alternatives.
20. Note that the Zhone customer anecdotes and trends are offered in anonymous, generic form, given the sensitivity of the subject of operator strategy.
21. Joint global study by Yankee Group and the FTTH council of 20 service providers using new FTTx networks. Contact Mary Kelly at Yankee Group for more details of their results, mkelly@yankeegroup.com.
22. Zhone deployment benchmarks (from customers' experiences) and analysis.
23. From analysis of 16 public operator financials, continued.
24. Zhone customer anecdotes and prior operational ABC experience.
25. Analysis of 16 public operator financials, concluded.
26. Based on detailed Zhone competitive intelligence work, customer test-lab anecdotes, and industry-analyst validation.

