"From on a pedestal to in the pedestal"

Meeting the Challenges of FTTX: planning and passive infrastructure

by N. C. Stanley and D. D. Cousins of Beta Partners, LLC

copyright © August 2009

β BETA
PARTNERS

Executive Summary

Today's telecommunications carriers can only remain competitive by building revenue generating capabilities coupled with organizational flexibility and efficiency.
        Beta Partners, August 2009

Beta Partners recently completed an in-depth study examining how mid-tier telecommunications providers in the middle to small carrier arena viewed, analyzed, evaluated and selected a critical, expensive but often un-heralded capital asset: the passive physical infrastructure within their fiber optic networks. The analysis for the passive infrastructure was conducted as part of a more comprehensive study of how the mid-sized and smaller telecommunications operators are planning and responding to the challenges of ubiquitous broadband.

The study was constructed with a number of elements: a review of contemporary practices common in North America, a number of in-depth interviews with key decision-makers in Tier 2 and Tier 3 carriers, and a survey of selected individuals across a range of companies. The study examined a number of key drivers for network decision makers when faced with deployment and component selection, and investigated the increasingly common practice of using Total Cost of Ownership (TCO) as the primary method used to evaluate the choice of capital assets within fiber optic access ("last mile") networks. Other elements of the decision process were examined and ranked in order of importance within the targeted carrier audience.

Beta Partners believes that a common thread underlies much of the decision-making processes used by the industry. For the purposes of the study, the term "carrier" and "service provider" were used interchangeably and refer to the traditional telephone companies. Established cable television operators, along with facility-based competitive local service providers, municipal-owned facilities, and other entities will find the results likely apply to them, too.

The concept of Return on Investment (ROI) or Internal Rate of Return (IRR) is common and often talked about, but in fact is difficult to apply to many FTTx projects. The primary reasons are both the uncertainty of forecasting future revenue as well as the dependencies and inter-relationships with a myriad of factors from marketing and sales to billing and customer care. While they are moving towards a more rigorous ROI/ IRR analysis, Beta Partners believes that carriers can make effective and sound decisions around their infrastructure choices by using a well thought out, quantitative and consistent Total Cost of Ownership or TCO[*] approach. That a TCO approach not only works, but also works reasonably well, was validated by the research.

---

[*] Refer to the in-depth discussion of Total Cost of Ownership starting on page 23.

Once a FTTx project was given the approval to move forward and the alternatives were weighed, Beta Partners found that carriers made their selection of fiber optic passive infrastructure based upon two major attributes, both relating to operational considerations:

- *The single most widely used consideration* was the ease of installation and everyday use, as judged and validated by front-line technicians' hands-on experiences with the carrier's own operation and that of their peers.

- *The second consideration* was the compatibility, but not necessarily interoperability, with existing fiber optic infrastructure.

- Future operational effectiveness requires components and systems that allow fiber to be treated more like copper…more rugged, more modular.

- The underlying context for all critical decisions was a broad emphasis on the effective use of invested capital matched to in-revenue service components. Vendors whose products' first costs are a close match to the scale of the current deployment in terms of modularity and overall 'fit' specifically for the FTTx applications in these smaller tier markets, were given higher marks compared to others who claim some marginal superiority in long term scaling and growth. We call this "Use what you pay for".

The implications of the study's results are clear, however. Carriers are currently best served by a hard-nosed Total Cost of Ownership approach, even if not called by that term. Providers of goods and services to the telecommunication carrier marketplace need to understand what drives the carrier's choices and address those key issues in order to differentiate their products and provide the best possible value.

Overall, the study illustrated a set of best practices and useful insights to making the best decisions one can when looking at the specifics of fiber optic physical infrastructure. The study was not intended to be a cookbook nor a comparison between vendors. In fact, the study's interviews and surveys mentioned no vendor by name and its conclusions refrained from making judgments as to how one vendor could be superior and why. Instead, the conclusions put some streetlight illumination on the road to long term enterprise growth and prosperity and is in the form of a narrative which goes along with the normal practices found in contemporary companies who lie within the Tier 2 and smaller classes. It was not intended to be a large-sample statistical survey.

While we at Beta Partners believe many of the methods found to work well regarding passive fiber components may be extended to other network elements, the devil is still in the details. The complexities around active network components, technical skills, market and revenue focus, operational support systems and the myriad of choices associated with them are very important and will be developed as part of a series from Beta Partners.

The Times, They Are A-Changing…

Who is Beta Partners?

Beta Partners specializes in looking into and understanding the unique variables within a business and its strategic initiatives, quickly assessing how to capitalize on strengths for growth while working through the challenges. With a strong background in technology and operations within the telecommunication industry, the principals of Beta Partners have long been engaged with the dynamics of fiber networks, especially in the "last mile" where carriers are looking at significant investments today to keep up with the insatiable demands for bandwidth from business, industry and consumers. The real challenge facing carriers is not to squeeze a few more components from their capital budgets. Instead, the future lies with service providers who can find ways to make their capital investments work harder, enable new services, and by doing so, increase revenue.

The Beta Partners view of FTTx

Carriers are constantly re-examining their strategic initiatives, business planning, operations and staff for best effect. Within the firm, a comprehensive review of its supply chain is just one facet of the entire process. However useful, shaking the wrinkles out of one's vendor selections will not in and of itself single-handedly achieve future revenue growth. Network assets, next generation business and operational support systems, and vital personnel skills are significantly more important to make the best use of FTTx deployments.

The times are really changing. Carrier revenues, if they are for the most part not there already, will almost certainly be primarily dependent upon fiber-based services in the very near future. Building a fiber-based access network, including engineering, construction and commissioning, is among the most expensive undertakings of a carrier. Once in place, it represents a fixed investment with long-lived implications for the company's income statement and balance sheet. Doing the work to put the network on the most sound footing across all areas of technology is critical. We see it as a three-legged stool:

- Infrastructure – the network elements themselves. The current report focuses on the physical layer and that's the foundation of everything else. Several generations of gray boxes with flashing lights will come and go while the fiber optic cables and the equipment around them will stay much as they were installed on Day One.

- Services and content are what customers buy, not technology. When caught up in the vast array of choices facing carriers today, one can't forget that it's all about the applications.

- Of course, the customers themselves are part of the equation. Whatever wonderful services are delivered over the most up-to-date network, unless the carrier has the ability to effectively market and support them and position itself as the premier provider over the competition, the revenue and market position needed to support, extend and improve the network will not materialize.

Whatever the choice of technology as one climbs up the network model from physical media to applications, the technology is simply an enabler of services. The services the customer buys are the ultimate measure of a business's success … or failure. We have seen networks built on a hope and prayer and held together seemingly with duct tape and baling wire produce outstanding results while others engineered and planned to the highest and most modern standards fail miserably. The difference is the customer. For telecommunications carriers, looking ahead, however cloudy the crystal ball may be, is critical. Even the triple-play may just barely be adequate to justify a full scale FTTx deployment in the next few years, clearly something more will be needed. A more comprehensive view is beyond the scope of the present study and will be addressed by Beta Partners in the near future.

Over the past two decades, service providers have seen vast improvements in the nature and sophistication of fiber outside plant installations. From greatly improved splicing techniques to better practices for cable management and more widespread "fiber smarts" within the ranks of the technicians and outside plant crews, fiber is rapidly starting to look much more like copper…it's long lost any special mystique.

We believe that while on the surface there is nothing that appears revolutionary about today's fiber optic infrastructure technology, significant improvements supporting the rise of the ubiquitous fiber network are moving the industry closer and closer to finding the fiber optic equivalent of a twisted pair punch-down block. From vastly improved cables with superior transmission characteristics, to "bendable" fiber, to simple and reliable mechanical connectors, solid advances in a mature technology are a welcome trend for those literally "in the trenches". Carriers certainly need to place their attention up the network hierarchy – but having a rock-solid foundation at the physical level will pay huge dividends in the years to come.

Fiber Network Projects: The Path from Concept to Reality

Beta Partners was struck by the complexity and inter-related decisions that have to be examined and considered long before the first trench gets dug. Carriers often do not have the luxury of being able to take whatever time is needed to evaluate, plan and consider every facet of a FTTx project. Often, other events or driving forces require fast turnaround of design and a crisp and effective economic analysis. When funding is

approved, there frequently seems to be a tight construction schedule and tremendous pressure for rapid service turn-up and revenue generation.

Overview

There are multiple ways of delivering broadband services to customers. While the network technologies differ widely, they are all based upon some fiber infrastructure. Even wireless broadband will increasingly depend on the availability of fiber assets in the backhaul network in order to achieve the promise of true mobile broadband.

Today's designers, buyers and installers are well tuned into the market and technology. The senior management level is keenly aware of the expertise and insight within the operating teams and has consistently shown a willingness to engage them on all aspects of network element selection. Once the carrier's top management makes the philosophical and strategic decision to "go fiber", that's the extent of any 'top-down' decision-making. When it comes to implementation, the entire enterprise from executives to engineering supervisors to front-line technicians is part of the process.

Carriers know and understand the need to keep up with the latest advances by carefully monitoring vendors' offerings and, more importantly, keeping in touch with their peers. Changes tend to be incremental and are usually carefully tied to the carrier's existing practices. The mantra appears to be "only change one thing" at a time in order to be equipped to see if the change results in favorable cost movement or other positive results. That approach fits in well with the TCO context, which focuses on finding useful information within the enterprise and applying it properly.

Challenges still remain. The daily installation of individual drops to single-family homes is under control, though still expensive. Larger and more complex installations to larger residential structures (MDUs) remain costly and complex due to both the inside wiring issues as well as correctly matching network vendors (active electronics) to the situation. Cost-effective fiber inside wiring is just entering adolescence with "bendable fiber", and work-arounds using coax and twisted pair create their own sets of problems. Vendors are constantly introducing new techniques and technology, often driven by Tier One carriers deploying fiber in heavily urbanized areas. These technologies are rapidly being driven into all markets.

How things start

When looking at a major fiber network project, it's not surprising that a carrier will have a well-established process in place for evaluation and selection of components, products, services and systems. It's complicated and requires contextual, procedural and end-result understanding. In short, all that effort must produce the needed results.

There are as many paths for activity as there are companies. In the companies under study, common threads are hard-nosed realism and discipline in looking at what actually makes a difference. Fiber cable management and its associated components (cabinets, splicing, inside facility cables, patch cords, etc.) are contributing factors to a construction project's costs. They are clearly not the driving factor, but they have long-term

implications. When looking at the entire FTTx project, cost is always weighted by the business considerations – revenue potential, competitive drivers, corporate strategic choices, to name a few. In today's business environment it is no longer sustainable to have a business model, which is basically "build it and we'll hope they come". While it's true there was some element of that adage in the dot-com boom days, the collapse of a decade ago put paid to that concept.

Beta Partners found a high degree of awareness of the various facets around both process and making the actual choices. The leaders in the industry today are people very attuned to the need for effective planning. Throughout the industry, companies are consciously and deliberately working to improve their own effectiveness. And, to their credit, those that are investing in developing their capabilities are also keeping that planning skill in-house. From the Tier 1 down to the modest midwestern telephone co-operative, the insight gained only via experience can then be leveraged over the entire range of decision-making with respect to vendor selection, technology options, growth strategies, competitive response and new product development.

Also deserving of comment are third parties such as engineering and consulting companies. These knowledge companies form a vital and important segment of the industry by offering a vast depth of knowledge and experience tough to acquire at any one company, no matter what size. Using third party resources properly as part of the decision process is a valid method to leverage scarce talent. Even if the carrier has plenty of manpower for the tasks at hand, the engineering firms can serve not only as a primary source of new and unbiased information but also as very useful sanity checks, bringing fresh insights into even the most expert of technology teams. When it comes to the ins and outs of the RUS or stimulus program, a seasoned and experienced expert can guide the carrier to success.

Once the basic decisions on how to frame the key issues and how to evaluate some of the solutions are made, the challenge may be getting the right information to evaluate. Without good information going into whatever process is used, there is no assurance that the output will have the intended effect. Estimates and actual data need to be assessed <u>relatively</u> in order to understand the precision and risks of the output.

Carriers also understand that planning and weighing alternatives are costly, both in terms of the attention required as well as the time penalty. Nobody can afford "analysis paralysis". There is a point of diminishing return for most analyses. A crisp and well thought out approach for each project is clearly needed.

Time elements and external constraints can and do influence the overall process. Within the Tier 2 and smaller carriers, few individuals can devote their full time and attention to any one project, however important. Multiple calls on time and resources will always be present. Furthermore, the analyses and efforts focused on physical fiber connectivity are likewise being simultaneously conducted on the transport, network, services and operations layer as well.

Lighting up the alternatives

Beta Partners has seen that carriers are consistently demanding an understanding of the larger picture relating project first costs, ongoing operations and associated revenue, and ideally, a ROI analysis justifying the project. The next level of detail is to take a closer look at the actual planning approach; after all, the investment in the planning of a complex network is just as much an expense, though not of the same magnitude, as buying cable and cabinets and routers. What constitutes the best 'bang for the planning buck'? Strategy and planning requires selection from alternative courses of action. The way in which carriers go about their selection of the alternatives they believe are important to consider and analyze will determine the end result. It's the quality of the inputs as well as the integrity of the process that produce superior results.

For example, take the matter of what is called an RFx process. First, one has to figure out what to buy, so there's a Request for Information (RFI) produced. Those responses are gathered and analyzed in what is usually a time-consuming project. The next step is a Request for Proposal (RFP), which - if it is done well - allows for more accurate and complete information from a subset of the RFI responses to be evaluated. The final step is a Request for Quote (RFQ) where one actually begins to uncover the cost. Needless to say, a full-blown RFx process requires a great deal of work. Within the group of carriers studied, many have thrown up their collective hands and determined it is simply not worth it.

So, what is done instead? While Beta Partners saw a definite bias towards giving what has worked to date serious consideration, companies are showing a trend to deliberately set up within their operations a means to take a hard look at what is current across the supplier space and what's coming up on the various vendor's product roadmaps. Not surprisingly, considering the targeted audience, carriers in mid-tier markets show a very pragmatic approach and appear to understand that more planning does not necessarily improve outcomes. Significantly, we found that most carriers thought that they had struck a good balance between having the right information and the effort necessary to collect, analyze and absorb detailed planning data.

That said, Beta Partners has seen definite indications that the most forward-looking of the group are considering a more systematic approach in the near future. The trend is to improve the overall quality of the analysis and seek out more information, especially the key contributing factors which make up the TCO calculation. While stopping short of an RFx process, some of the discipline and objective measurements inherent in an RFx regime are highly useful tools when properly applied.

Finding the golden nuggets

Beta Partners believes that a common thread underlies much of the decision-making processes faced by the industry. Despite variations in size, geographic coverage and service profiles, we found that carriers have well-established ways of evaluating projects and, more importantly have the right talent in place to do the job. The study showed that most analyses showed a bias towards considering first costs (upfront capex), mainly because those costs can be forecast with reasonable accuracy. However, while service

providers believe they have a fairly good picture of the revenues associated with a build, the method used to link that revenue to investment can be improved.

So, how do people go about obtaining information? Getting the correct information to make good decisions is critical. How one approaches the matter can be almost as important as the information obtained and analyzed. Keep in mind that one collects "data". It is only after the data has been looked at, studied and analyzed by knowledgeable and skilled people does it really become 'information'. It's all too easy, between search engines, telecom buyer's guides and so forth to acquire huge amounts of raw 'data'. The real value is enabling sound decisions, which in turn almost inevitably are connected to financial considerations and long-term implications for cost and revenue associated with a given choice.

By far, the single most important source of information was the word of fellow colleagues and peers in the industry. That is not news to anyone reading this study, as the world of the mid-tier telecommunications carriers, which is the study's focal point, has long been collegial and co-operative. Even in the Internet era, a personal recommendation carries considerable weight. Word of mouth matters.

Beta Partners' in-depth interviews also validated that very important sources of information, lagging just behind personal references from peers, were the vendors themselves and use of application notes, vendor's representatives, white papers and other supporting information. Not surprisingly, clarity and applicability to the nature of the work being considered was critical. Mid-tier carriers have smaller, more streamlined operations and people wear many hats. Product literature, application notes, configuration guides and supporting materials oriented to the engineering and buying process of a Tier 1 multinational carrier are overkill for a several thousand-line carrier in the rural USA.

We also found a sharp drop-off in preference past the peer recommendations and the vendor information. Other sources of data and information included, with no particular ranking, the use of third parties (consultants and engineering companies), trade shows and seminars. Interestingly, when asking about the impact of advertising, product review and related sources in media and so forth, Beta Partners found little enthusiasm for those sources.

The mid-tier carriers don't have the luxury of a large in-house laboratory and seldom are able to test new products in controlled, non-revenue conditions. If they buy something, it generally has to go into revenue-related service with limited ability to make adjustments later. We found that carriers are willing, almost enthusiastic, to carefully select a particular sub-system or small-scale project, such as adding a frame here or a pedestal there, where a new vendor's product can be installed at lower risk. Doing so gives the front-line employees a chance to evaluate and wring out the bugs while still keeping core operations on a known platform. While certainly a conservative way to do things, it does allow the carrier the opportunity to find out what's new and useful and compare it to a preferred vendor's solution set. While clearly the process puts the burden of proof on the incoming vendor, it is simply a reflection of the highly pragmatic approach to infrastructure within the industry. An excellent source of information is one's own

organization. Beta Partners has seen a consistent and laudable approach to incorporate the front line technician into the selection process.

There's price and then there's "cost"

So now the project's been defined, the preliminary studies show the financials are a "go" and there is a good selection of information which has been systematically arranged and adjusted to show where there are clear alternatives. The engineering team has not only a good handle on the existing vendors, but has had a chance to check out some new kit. A few conversations with their peers at the last state telecom carrier's workshop provided some good feedback. Now, will it be Vendor A and their latest FTTx packages? How about Vendor B, a new supplier with aggressive pricing? Or will it be going back to the old standby, Vendor C, which the technicians can almost install blindfolded?

A very significant result from the study was the balancing act between first cost and operational considerations. When looking at the financial aspects, the study showed an understandable bias towards considering first costs (upfront capex), mainly because those costs can be forecast with reasonable accuracy. But, even with the attention given to it, first cost (the out-of-the-box price), was ranked relatively low compared to the strong bias towards two operational factors: ease of installation/operations and overall compatibility with the existing infrastructure, which is defined not so much as interconnection but in comparable practices and the granularity of the two vendor's scaling solution. For example, if one vendor scales in very large increments of 576 while another does so in very small increments of 6 and one tries to use both of them together, clearly something is not going to match up well.

The lower ranking of first cost versus operational factors could be for one of two reasons: either cost among leading vendors is roughly comparable, thus operational factors are what carry the day; or, longer term operational considerations over and above dollars and cents dominate the TCO equation.

While difficult to determine which one is actually the case, Beta Partners believes that, given the information obtained in the study, the second alternative is probably the more likely. The TCO approach, which weighs multiple factors together and emphasizes the role of the organization's knowledge and experience, better fits the overall approach to passive infrastructure component selection and procurement in the mid-tier carrier market. Labor rates are high and only going up, truck rolls are very expensive and time-to-market makes fast response critical. A TCO approach allows for inclusion of indirect costs (the nemesis of many operators) - floor space, density, jumper management, the headaches of finding and replacing dirty or loss-laden connectors, installation of fiber components such as splitters, OSP cabinet crowding, pedestal capacity and so forth. The major risks on the physical component level are focused not on the technology, since any reputable supplier will be assured of providing functionally operable components, but rather are focused on the long term costs and flexibility to achieve the business goals of the enterprise now and into the future.

Strategy means choices – so make a few

Beta Partners found a reasonably clear and consistent path was followed in the mid-tier carrier's decision methods. While there were variations in the way financial planning and project justification was undertaken and there were reasonably consistent methods used to gather information and organize the way a buying decision was framed, when it came time to pick and choose, only a few attributes came through loud and clear.

The single most influential factor used in the buying process was the *demonstrated* ease of use in installation, including flexibility in the operation of the fiber optic infrastructure components. After that, the compatibility with the existing fiber plant (and future additions in the same application area – outside plant, distribution, feeder, trunking, etc) was a factor. Finally, but not least, came the first cost and considerations for long-term flexibility, however defined, and capacity for growth in the fiber count associated with the component.

Carriers are understandably reluctant to jump headfirst into a major build with a totally new vendor in a key role, unless the benefits clearly outweigh the risks. Since fiber projects, especially FTTx, tend to be built all in one "go" across significant sized geographical areas, all of the individual sub-systems (frames, cabinets, pedestals) are procured and installed as part of a single project under one cost allotment. Putting in a new vendor or a totally new equipment configuration across the board carries some challenges. But there are ways to introduce new network technologies and vendors into the mix and to mitigate some of the risk. One just has to be smart about it and recognize that the modest risk investment may pay off handsomely later.

Taking a look at some of these factors in more detail, Beta Partners explicitly explored the topic of fiber optic cable "care and feeding". Carriers are more than familiar with the potential issues involved with fiber, such as ready access to fiber, jumper crowding, fiber damage, reliable connectors and bend radius control. Those operators who understand how important a sound and reliable fiber plant is to their company's mission seek out and buy well designed gear. They also make sure their technicians have the training to properly install and manage it. Thus, we were not surprised to find that carriers who purchase kit from well-regarded component vendors tended to see vendor claims of superior performance regarding the basics of fiber cable management as table stakes. In other words, fundamental cable management was not seen as a *primary weighting factor* when it came to picking and choosing among leading vendors. The survey found that, overall, problems in the field were few and far between. Given the study's results on the topic, it is clear that the fundamentals are well understood and the major fiber optic component vendors not only need to deliver, but also provide more differentiation on other aspects in the minds of the carriers.[*] That last point should not be taken as saying

---

[*] It should be noted that this is the case with telephone carriers who have much experience with fiber. Emerging carriers, as well as operators such as smaller cable television companies, who are relatively new to the higher-count fiber optic architectures of FTTx networks may not have had the carrier's level of hands-on experience. In some cases, decidedly inferior equipment was used to save money and that became the 'default choice' with regrettable results.

that the basics don't matter; they do indeed and very much so. In some ways, it's like buying a new high performance sports car: while one doesn't generally worry that the tires are up to the task demanded of them, a car aficionado is very much aware of their importance.

Pilot sites, parallel operations and contractual arrangements offer additional approaches to new vendor introduction. Developing a comprehensive risk assessment and mitigation plan is typically a part of every major project mentioned in the study.

Long term capacity and flexibility are considered slightly more important, though roughly on par with, first installed costs. That indicates carriers have sound reasons to keep operational factors (ease of use, flexibility and integration within existing systems, all which are factors in the TCO equation) as more important than simply out-of-the-box cost.   The quality and reliability of mechanical terminations are another key TCO component. Poor quality patch cords, for instance, have wasted many technicians' valuable time.

Here is where the voice of the front line technician comes in loud and clear. The emphasis is on the term "demonstrated" and not "perceived" or "claimed". Cost savings that are just part of a vendor's literature have little validity with the carriers. It is the experience of the technicians who have actual, hands-on experience with a product that weighs the most. Innovations in product design continue, however, as vendors continue to refine and improve the product set by adapting to the realities of the market and succeeding in "making fiber more like copper." Getting those innovations into the hands of the people who matter is critical for the vendor community. Carriers can and do experiment with new technology as part of their overall operations focus. Making it easier and faster for a carrier to collect and quantify the key factors in their own TCO calculation are lessons to be learned.

Is it really "pay as you grow"?

A common, widespread claim is that a vendor's particular product is "Pay as you grow". Parsed out to reality, the basic premise is that the carrier only has to fork out cash in line with the growth of … well, *something*. Sounds good, but in the case of fiber optic infrastructure, what is the "something"?

Beta Partners believes that in the case of fiber optic infrastructure, the reality is much different and a "pay as you grow" claim needs to be tempered by the very real attributes of the fiber network itself.

Ideally from an enterprise point of view, "growth" means revenue growth and with it the premise that incremental dollar of top line revenue requires, somewhere down the line, a few pennies of infrastructure cost. Decades ago, reaching back to the days of TDM switching and Main Distribution Frames, revenue growth meant more subscriber lines, which resulted in more frame terminations, protector blocks, line cards, etc. It may be simplifying things a bit, but there was a relatively direct relationship between revenue and incremental cost involved to produce that revenue.

With FTTx, the dynamics are far different. A single physical fiber circuit's TCO has conceivably no relationship to the revenue service it carries. An outside plant cabinet with a few dozen active fibers, each identically terminated, spliced and patched, could have a single subscriber's FTTP connection at $100 per month next to a high capacity cellular backhaul connection at $2,000 per month.

In the context of FTTx, then, what does "pay as you grow" mean? Growth, at least from the perspective of a vendor providing fiber cable infrastructure, is related to <u>fiber count</u> - that is the number of active fibers (those carrying revenue generating services) - and not revenue growth. It is here that there is a critical distinction and one with direct impact on a carrier's decision criteria.

As was mentioned above, FTTx installations, which dominate the capital budgets of many of today's traditional carriers in contrast to long-haul or trunking projects, tend to be all-at-once style installations across a particular geographic area with relatively slow additional growth in the physical infrastructure, compared to installed capacity. Counterpoint builds are common in greenfield deployments, of course, but those are relatively rare and often sporadic, being driven by demographic growth. Carriers can and do overbuild themselves, of course, but often on a piecemeal or a neighborhood basis. The lessons from a large-scale FTTx deployment still hold, however, and enforcing a consistency of vendor platforms across all aspects of fiber infrastructure (inside plant, feeder, distribution, drops, CPE, etc) has its benefits.

Likewise, facility-based CLECs (especially those whose parent is an ILEC), cable television providers (MSOs), municipalities and utilities can all benefit from a similar approach, adjusting for their own scale and deployment timeline.

Whatever the ownership model, once the enabling technology is in place, the business emphasis of FTTx is revenue growth in the service infrastructure; that is, selling more services to the same fiber-fed customer. Ideally, then, <u>revenue growth requires zero incremental cost, at least at the physical layer.</u> So, if revenue growth from a relatively fixed set of assets is what matters to the company, does selecting a vendor based on a "pay as you grow [physical fiber count]" make sense?

True, there are incremental subscriber additions to be considered, but overall, the upfront costs for feeder and distribution dominate and are allocated over the entire service area and its associated revenue base. Once the carrier is past the initial deployment stage, fiber component counts, which in turn drive real costs, rise relatively slowly in comparison to the revenue which that infrastructure supports.

Maybe it's "use what you pay for."

Beta Partners believes that the real focus, which is reflected in a TCO approach, should be less on "Pay as you grow' and more on what could be termed "Use what you pay for."

Brought down to basics, a "Use what you pay for" approach is reflected in:

- Matching the components used to manage the fiber to the in-service fiber strand count on a consistent basis across all areas (inside plant, feeder, distribution, drop,

---

inside wiring) and in all functions (patch panels, splice trays, cross connects, jumper storage, equipment terminations, etc.).

- Being modular enough to balance first cost with reasonable growth in physical fiber count without overspending for longer-term growth, which in fact may be somewhere in an undetermined future and difficult to forecast.

- Emphasizing ease of use for installation, initial service configurations and moves/adds/changes which generally occur within the size constraints of the initial deployment.

What that means is relatively simple. FTTx networks tend to have lower fiber count locations dominate, in terms of numbers, the physical locations. Relatively fewer locations are places with high fiber counts and those places tend to have relatively fixed configurations.

A fiber infrastructure component set which exhibits relatively granular (i.e. lower fiber count) incremental capacity has a better chance of matching its first installed costs to the actual number of _active, in-service_ fibers, and therefore makes best use of capital as well as the time and expertise of expensive front-line technicians.

So, what about future growth in fiber count? Is that to be ignored? Not at all. But the study has shown that the factors for ease of use, installation and ongoing maintenance for installed, in-service fibers may well outweigh the costs to install new fibers sometime in the future. Realistically, carriers emphasize increasing revenue by enhancing the services, not normally by incrementing fiber counts. A new fiber connection generally will mean a new customer and the incremental physical layer cost is relatively minor.

We believe a FTTx deployment, whether an overbuild or greenfield, with its widespread and spatially diverse capital elements is best serviced by minimizing unused construction capital – in other words "Use what you pay for". Carriers should recognize that there might be a minor cost penalty in the indefinite future when growth in fiber counts at a specific point requires additional equipment (a cabinet, for example). But when the initial selection of equipment provides the front-line technician the benefits of ease of use over the lifetime of the active, in service components, those TCO factors may well outweigh a possible future cost.

Rubber, meet road

Finally, it comes together. Purchase orders, contracts, and paperwork flow out. Trucks, diggers, reels of cable, frames, racks, panels, trays, and pedestals come rolling in. Crews arrive, find the hotels, the good eating places and usually the best watering holes. Is the process now complete? Or are there things to be learned still in planning and evaluating?

Here is the testing ground for the theories and concepts developed in the study and for those the carrier's own people will want to see. The planners and engineers should not put away their work, thinking the job is done, and get on to the next big project. Instead, they should join the front line technicians out in the field and test out a few things.

Does the technique, as Vendor A claimed, save a lot of time in the splice trailer? Is Vendor B's out-of-the-box product really ready to go right next to the pedestal or does the entire thing have to be unpacked and assembled in the shop and then loaded into the truck?   How does the entire package shape up for re-entry for access and maintenance, especially by somebody who was not on the original installation team? Are things laid out well? Can new connections be made or an existing one changed, not only on a sunny summer afternoon but in the dark of a rainy winter night? Sooner or later, something has to be changed, something breaks or is broken, or something shows up missing. Today's leading providers are anticipating the issues, developing timelines and assigning responsibility ahead of time.

It sounds basic, and it is. Nothing is magical here. But if the TCO is truly the dominant cost factor in the selection of a critical and long-lived component of a major network initiative, taking special care to prepare, measure, validate and correlate the TCO elements is well worth the time and effort.

The Wrap – Conclusions and Recommendations

There's a battle outside
And it is ragin'.
It'll soon shake your windows
And rattle your walls
For the times they are a-changin'.
   - Bob Dylan

Beta Partners found interesting and applicable information abounds in the everyday practice of the mid-tier carrier market that is the focus of this study.   A few lessons and recommendations can be drawn from the study.

For conventional telephone operating companies

- Look carefully at balancing the amount of time and effort spent in analysis with the information obtained. Front-line technicians with hands-on experience are an important source of information and can be key to sorting out vendor claims. Industry peers in similar situations may well have gone through the same process and are excellent sources of information.

- Carriers in the mid-tier typically don't own laboratories or dedicate many resources to product evaluation. We recommend they try out new products and new vendors in selected test sites, picking ones closely matching the <u>next build's</u> characteristics, and not a location that represents the past. Follow the results, paying close attention to how well the product's performance actually tracks the vendor's claims.

- Carriers need to continue to put a critical, but co-operative, eye on their existing vendors and to others of comparable quality and function, both in current products as well as future product roadmaps. How are they solving real problems with similar *service deployment strategies in like-sized carriers* (i.e., G-PON, point-to-point fiber, etc.)? Are these suppliers applying the hard-won lessons learned

about realistic expectations regarding growth and expansion as well as management of everyday life such as moves/adds/changes?

- Total Cost of Ownership (TCO) is a hard thing to measure well, and yet it currently is the key criteria to judge effective use of capital versus operational expense. The TCO tables (see the TCO discussion in the supplemental materials) provide a method readily applied, once the information is at hand, to most any carrier's operation. Interpretation, of course, is key. More complete ROI/IRR analyses are desirable and should remain a longer-term corporate objective.

- For carriers who still are primarily copper based in their access network, study and learn the techniques used by peers. It's not fiber down the copper cow paths; it is a totally new approach to revenue, customers and services. That's probably not news; however, internalizing the implications is hard, disruptive work.

For consultants or engineering companies

- Carriers are keenly aware of the need to improve their analyses of life cycle costs for major infrastructure projects. While a position as a technology advisor and engineering resource is the typical role of a third party, investing in better understanding of the TCO factors relevant to FTTx deployments may prove useful. Carrier clients are likely to be interested in a different perspective on their own analyses and validation of the underlying data. Being an objective and knowledgeable resource to assist in complex TCO analysis will position oneself better for the more sophisticated analyses the future will demand.

- A service which builds strengths in areas of key concern to carriers - such as reducing time and expense for all facets of the project - could supplement the client's limited resources in gathering data, analyzing vendor selection and matching first capital to revenue service. Today's physical component technology choices are generally mature and robust across the vendor spectrum. The proper choices for the carrier are made by looking at the incremental improvements in technician and installer labor, cost savings in reducing complexity and so forth.

For emerging operators, cable television providers, competitive access providers, municipalities and utility companies

- Understand that a FTTx network's growth and service dynamics with respect to the scope and depth of business operations are new and rapidly evolving well beyond the 'triple-play'. Revenue planning, customer demands and business operations demand a different approach - a new mind set in fact - compared to trunking or thin-route, purpose-built facilities (e.g., a network connecting a school district's buildings together).

- The underlying technology for the physical management of fiber optic infrastructure assets is mature, well known and competently executed by leading vendors. However, choices do matter and matching the right product to the use at

hand requires insight into various factors that may or may not be readily apparent, especially for superior operation and cost effectiveness within the complexities of a FTTx deployment.

- Fiber is the wave of the future. A ubiquitous fiber network is today's foundation for any advanced telecommunications service. Even wireless broadband is ultimately dependent upon a robust and widely available fiber network for backhaul and interconnection.

For vendors and suppliers

- Ease of use by the front-line technicians dominates the mid-tier carrier marketplace. Products oriented and positioned for the large, Tier 1 carrier will have to have their form, fit and information set adjusted for the reality of the mid-tier FTTx deployments and the means by which the customer segment gathers, evaluates and uses information.

- Look at the modularity factors and matching the right size component to the realities of the targeted market's in-service, revenue producing infrastructure as well as factoring in future growth. Examine the claims of "pay as you grow" when looking at FTTx real-world deployments and that the installed and in-service components match the out-of-the-box modularity designed into the product.

- Vendors need to examine ways to help customers wring the most out of their installations by providing excellent and effective customer support, rapid turnaround of engineering and product requests, and fast accurate delivery of products on-site and ready to go.

Sources of Information – Interviews and Survey

Beta Partners used two complementary methods to gather information and insight as part of the study.

In-depth interviews

Beta Partners contacted a select group of leaders in the industry for an open interview focused on their particular company's current and anticipated position on broadband fiber optic networks and their own view of the industry trends and concerns.

The interviews took place over a period of several weeks in July of 2009. A representative sample of the individuals includes:

- The chief engineer of a mid-tier telephone co-op which operates both ILEC and CLEC services

- A senior network engineer for a Tier 2 carrier

- A senior outside plant engineer and planner for a rural telephone company undertaking trial offerings of fiber based services

- A senior executive of a rural telephone and cable television operator deploying FTTx overbuilds within its service footprint.

- A senior partner in a well-established telecommunications engineering firm.

The interviews were lightly structured to obtain answers and inputs to a pre-selected issues list, but the format was very informal and the interviewee was encouraged to add their own thoughts and comments about any related subject.

The key areas were: their own methods for analysis and planning, priorities and key factors relative to outside and inside fiber optic cable management, major cost and operational considerations, linkage and importance of revenue considerations to fiber network component selection, and key areas where they saw gaps or deficiencies in the vendor solutions.

The interview results have been incorporated into the body of the study, but a few points came through:

- There is no single common approach to the methods used to deliver FTTx services – not only did all of the carriers have diverse methods among themselves, even smaller carriers had different networks in operation, driven by their various business decisions over the years.

- Deployment of FTTx ranged from "exclusively greenfield" to "we are overbuilding ourselves with fiber as fast as we can afford it".

- The trends were universally towards harder and closer looks at TCO and making reductions in operating costs using a continual improvement focus. One individual, to emphasize the detail he saw as being needed, used the phrase "Doing photons-to-pennies planning".

- Interoperability issues continue to nag at productivity and TCO. While interchangeability of components among different vendors is not in the picture, radically different approaches to solving the same problem can present a barrier to acceptance.

- Areas where they saw the largest gaps between where they are today and where they saw themselves being in the near future were around the need for continual upgrading of technicians' skills and retention of knowledge.

- They saw the industry as moving towards standardization and interconnection at all levels, bringing the best solutions to bear on the problem.

We received a lot of information from these experienced and articulate individuals. A few key quotes can show the range and depth of their experience:

- "Once we made the philosophical decision to 'go fiber', it made our lives easier in one respect and more complicated in another." - tier 2 carrier

- "With the initial cost of a fiber build coming in about what we used to see for copper, it doesn't take much insight to see the revenue potential is just so much greater with fiber." - rural telephone co-operative

- "Our copper plant is simply failing and starting to fall apart in places. We have to go to fiber: everywhere, all the time." - telephone and cable television operator

- "We do depend on our vendors for a lot of information. But with our people it is 'trust...but verify' as the rule." - rural co-operative

- "We've seen a lot more formal and in-depth reviews of technology, finance and operations, and not as separate tasks but as part of a comprehensive and sophisticated project investment review." - consulting engineering firm

Network professionals survey

Beta Partners developed and published a short internet-based survey, and invited a number of individuals to participate. All of these individuals worked within the telecommunications service provider industry, but most were in the Tier 2/3 carrier space. No attempt was made to study the practices and procedures of a Tier 1 multinational carrier, nor was the study intended to analyze such a market.

While the few dozens of responses would not represent a statistically valid sample size of the very large US telecommunications carrier industry, the answers that did come back were remarkably consistent across the sample size, indicating that there is a strong likelihood that the responses received are typical of the thinking in the Tier 2 and Tier 3 markets.

The questions were in a variety of formats and ranged from multiple choice to the "Strongly agree – strongly disagree" qualitative response. Note that the results below represent round numbers and some questions were not answered, which accounts for some answers not adding up to exactly 100%.

Some key findings from the questions, again reflected in the main body of the study, were:

- A very high majority (over 85%) of the respondents said they had good to very good confidence in their ability today to quantify project's expected revenue and first cost (capex) very well. A slightly less percentage (about 70%) felt they had as good a handle on TCO.

- When asked if they thought they would be able to do a better job in 2-3 years, almost everyone said yes but again, the TCO-specific response was lagging behind.

We considered these answers as confirming that carriers can and do pay a lot of attention to planning and that using TCO is a valid measure, one that is reasonably well understood but could improve.

- Almost every respondent (90%) said that their own organization had made a conscious and deliberate move for more careful evaluation of their own fiber optic component selection.

The survey then asked a few questions in a multiple choice format about how systematic and complete the business planning process was today and where they thought it would be in the same 2-3 year future period.

- Today, most carriers (about 2 out of 3) thought their own process was adequate to give them the answers that they needed, but was less rigorous than they knew it could be.

- In the 2-3 year time frame, the percentage of carriers who use a more structured RFx process changed from about 1 in 5 (22%) now to slightly less than half (44%) anticipating that an RFx process would be used.

- Consultants and engineering firms played key roles for some providers.

The questions, taken together, show an acknowledgement of the importance of a structured approach, even in relatively small operations of less than 5,000 access lines. The trend, over time, is a stated intention to do a better job, with 'better' being defined as using a more structured approach.

As the report discusses (See "Lighting Up the Alternatives"), gathering and evaluating information is critical to the decision making process. The outcome is only going to be as good as the inputs, the means by which the data is turned into useful information and the impact that information has on a decision.

A multiple-choice section, allowing only a handful of answers to be selected from a long list of information sources, showed these results:

- The clear preference (with equal number of responses) was for information gathered from colleagues and vendor information with trade shows and on-site demonstrations following behind.

- A few thought that project-specific research was useful, as was some information on the RUS list (although the utility could reflect the need to use RUS-approved products).

- As the main study asserts, consulting and engineering firms, trade press and media advertising also provided beneficial information.

Of major importance to the Beta Partners study was the actual attributes or key factors that, in the end, determined the outcome of the project's buying process. The respondents were asked to pick a handful of their highest priorities or most influential factors from a long list of various alternatives.

- The clear winner was "ease of installation" with over 24% selecting this as one of their choices.

- Next were "compatibility with existing infrastructure" (14%) and "capacity for growth", "vendor's reputation in the industry" and "a match to our technician's skill sets", all in the 10% to 11% range.

- First installed costs ranked relatively low (9%), comparable to the answer for OSS system compatibility (6%) and "OSP appearance in the community" (5%).

When it came to looking at price itself, we were mildly surprised to find that while a more formal and rigorous RFx process was intended to be used in the future, the most

common way the respondents obtained cost information and weighted the information was simple:

- 47% of the respondents said that their most common practice was, "Get a quote from preferred vendor(s) and buy if it's ok."

- In the next few years, a small majority (52%) thought they would use that same procedure.

- Most carriers admitted that they gave their present suppliers considerable weight if the product was working well (about 60%) but a significant portion felt they were either undecided or didn't give the existing suppliers much weight (40%).

- Interestingly, the only question that showed a strong break was the level to which carriers attempted to minimize the number of vendors in their network. Almost half (47%) said that they "disagreed" that it was advantageous to minimize the number of vendors for fiber components, compared to those who were undecided (12%) and those that "agreed" with the need to limit vendors (35%).

- Taking a closer look, the survey asked: "Is it important to use the right vendor for the application even if it means more vendors?" In this case, about half (47%) agreed, but not strongly. One quarter said they were undecided (24%) and about that many strongly agreed (27%).

Having such an informal means to obtain pricing and the way by which the carriers look at their existing suppliers both pre-sale and post-sale seems at odds with the stated intent to use more formal RFx style methods and also the explicit statements that they planned to use more formal methods in the near future.

We believe, based on the personal interviews as well as the other answers to the survey, that there is a definite trend at all levels of the organization, to do the right thing by the company's shareholders and the long-term benefit of the organization. Nonetheless, these are very busy people and the conservative nature of the business along with the legacy of a long established business (some have been in operation for over a century), make hard and fast responses difficult and sometimes seemingly contradictory.

Total Cost of Ownership – Fiber Optic Network Infrastructure

Introduction

The concept of Total Cost of Ownership or "TCO" has been around for a long time. According to Wikipedia:

> TCO analysis was popularized for the Gartner Group in 1987. The roots of this concept date at least back to the first quarter of the twentieth century. It has since been developed in a number of different methodologies and software tools. TCO tries to offer a statement on the financial impact of deploying a [information] technology product over its life cycle.

Beta Partners studied the wealth of TCO articles available, from TCO of automobiles to the TCO for major construction of federal buildings.

What does TCO really mean? How is it used?

In all cases, the core of TCO is to gather enough understanding of the true economic factors related to the acquisition or construction of an asset and assigning a singular dollar figure which is then used, for the most part, in one of two ways - but not necessarily mutually exclusive.

In the first case, a TCO analysis may be used to *choose between similar alternatives* which achieve the same result. For example, a TCO analysis of two vendor's central uninterruptible power units for a data center build. The units have the same load, run time and other functional requirements but different attributes for first cost, maintenance, etc. The TCO evaluation, if done correctly, provides a discounted cash flow and net present value figure and the lowest cost is the preferred alternative.

By examining a factor-by-factor comparison, it is then possible to identify the key elements that make the difference. In this example, perhaps one unit uses a higher efficiency rectifier so that the overhead cost in power consumption is slightly lower over time but at the cost of a higher purchase price for the more advanced technology. The savings in kilowatt-hour consumption over the lifetime of the unit (say, 10 years) offsets the increased price. The TCO calculation is contextual, in that the cost per kw-hour of electricity is the key determining factor. If the cost of electricity is not a factor, for whatever reason, then the TCO calculation based on that factor is meaningless.

The second use of TCO is to create a plan for *incremental cost reductions over time*. In this case, the asset under consideration is acquired based upon other factors besides the inherent TCO of the asset itself. Perhaps the entire project is so large that the first cost of the particular asset itself is negligible and the choice itself is driven by non-economic factors. However, once installed, the long-term costs of owning the asset become dominant and the TCO examination becomes one of determining the best place to focus on operational cost management. Or, more commonly, the asset is already in place and the challenge is to make the best of it. For example, a large business may choose to purchase all computer printers from a single vendor to minimize first cost and the number

of printing supplies purchased (which is a type of TCO) but the real focus is an intelligent printing agent which directs print jobs to the type of printer which is best suited for the application and results as well as monitors and allocates expenses to the cost centers which do the most printing.

The first task is to establish a Total Cost baseline for comparison, so that incremental changes and the resulting cost effect can be readily compared to the present configuration. Without the establishment of a Total Cost baseline or reference cost, it is very easy to make erroneous choices. Simply comparing cost element "A" with "B" may not find overall lower TCO if the choice of "B" raises costs in other areas.

In the printer example, the TCO analysis may show that lower costs for supplies, power and service calls result when there is an accountability mechanism present (direct dollar charges to people's budgets) as well as a mechanism which sits on top of things and directs routine jobs to cheaper printers and reserves higher quality for others.

In both cases, we believe that not only should TCO be a major determinant of a capital asset selection, but also that the process used to gain a better understanding of the makeup of the TCO is beneficial in and of itself.

Applying TCO to FTTx infrastructure

Beta Partners recognizes that the selection of the components used in the management of fiber optic physical assets is not done in isolation, but is almost always in the context of a larger project involving network architecture (GPON vs. point-to-point), physical constraints (aerial vs. buried, aesthetics and environmental impact), time to market and construction season considerations.

The study has also shown that existing infrastructure choices do create a bias which favors the existing vendor.

How the TCO factors are considered in view of the two primary uses of the TCO analysis (selecting between alternatives and/or driving focus on lowering costs within an existing solution set) is really up to the carrier. Getting to a good understanding is an important part of the journey to the destination.

The TCO is part of a life cycle cost:
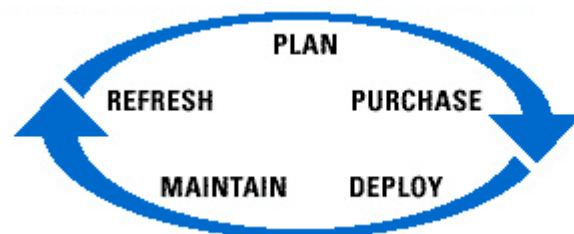
Different elements require different approaches

In Beta Partners view, the TCO elements fall into three categories:

Group 1.   Directly accessible and readily quantifiable hard data. Price (including shipping), cost of optional features, factory-installed jumpers and splice trays, splitters, etc. Included would be incremental costs for expansion, such as stand-alone splice trays, patch cords, etc. These data points are independent of the application or the revenue attached to the asset. Over time, these may be adjusted for future price changes by means of a flat rate inflation or cost adjustment factor.

Group 2.   Cost elements which are, as a set, considered significant, but require internal effort to quantify and understand, since they are either specific to the carrier or are contextual in the network setting. For example, a loaded labor rate for the front-line technicians doing the installation and commissioning would be one factor. The allocated cost of the third party contractor placing the hand-hole or doing the make-ready work will have to be identified and quantified. Once these elements are understood and quantified, they can be considered as relatively constant in the short term. For the mid to longer term forecasting, they may be adjusted using an inflation factor similar to one applied to the hard data set.

Group 3.   Cost elements which are unknown or can't be determined without either a field test or data collection/extrapolation to factor and assign costs. In the case of fiber optic component infrastructure, this could be the number of man-hours to actually install a particular type of cabinet with a representative number of live fiber circuits and pre-terminated number of installed fibers. The carrier may know the loaded labor rate (from #2, above) but doesn't yet have good information on the particulars – the time actually spent doing the work, all things considered.[*]

---

[*] Being based in Minnesota, Beta Partners understands that OSP work done in January requires a different approach compared to that done in June. Plus some heavy-duty heating.

A lifecycle look at major FTTx cost elements

As an example, take a look at a major FTTx project, start to finish. Here are some of the major cost elements that should, or could, be included.

Life Cycle Cost Stage	Elements or Components
Plan	Engineering & Planner staff and direct costs
	Marketing & Sales staff and direct costs
	Marketing & Sales activities including customer surveys, literature, advertising
	Legal (permits, environmental studies, taxes and fees, licenses, FAA clearance for radio towers, if used)
	Financing (RUS, BTOP, etc.)
	Vendor and contractor evaluation work
	Test and integration planning
Purchase	Capital costs – direct for hardware and materials
	Consultants and contractors
	Capitalized expenses for labor and related costs
	Shipping, storage, warehousing, carrying costs for inventory
	Spare parts initial buy
	Finance charges and costs for loan closing, legal services, insurance riders
Deploy	Installation labor and consumables
	Inside wiring and carrier-supplied CPE
	Right of way restoration
	Upstream Internet connectivity, routing, firewall
	Testing and systems integration, new test equipment
	Technician training and certifications
	Customer service and customer support training
	Updating corporate web site
	Migration of existing customers to new platform(s)
	Upgrade of computer or IT infrastructure, software licensing
	Changes, modifications or installation of OSS and BSS systems and components
	Security, network integrity and reliability evaluation, case testing and remediation work, security key certificate authority (if needed)
	Content licensing, conditional access and Digital Rights Management
	Increasing UPS capacity, portable gen-set purchase
Maintain	Ongoing routine maintenance for equipment
	Spare part acquisition
	Ongoing licenses for software and content
	Security audit and remediation, patch management
	Licenses and permits, content use audits
	Financial audit and accounting charges
	Increasing recurring costs for power, water, insurance, utilities, facility maintenance
Refresh	Change out of older components driven by capacity, function, end of life by vendor, damage, wear & tear
	[Repeat plan, purchase, deploy, maintain cycle for new network components]

Gathering the information

All three TCO element classes are applicable to fiber optic network component selection and evaluation. The process of gathering information is straightforward, even if the path to getting the information complete and correct is not.

- Examine each step in the Life Cycle Cost, using whatever means are best suited for the situation. In the TCO analysis for fiber networks, the "plan, purchase, deploy, maintain, refresh" cycle is typical of long-lived capital assets.

- Establish the base case.

- Determine what <u>significant</u> cost elements are associated with each phase in the cycle. Judgment will be needed, since some costs may be readily identified but so minor as not worth tracking.

- Assign each cost to one of the three groups. With a nod to Murphy, the most important cost elements will usually be the most difficult to quantify and often estimates will have to suffice. Flagging these for later refinement is a good idea.

- Figure out the timing, and apply a discount rate to future costs.

It seems like a lot of work and it is. Each service provider will have to use its own judgment as to the worth of the effort. However, as the old saying goes, "The plan is nothing. The planning is everything." A well-organized and directed TCO project may well flush out hidden costs or challenge long-standing assumptions in a positive manner.

Also, the analysis needs to be done with the end in mind. If the purpose is to compare two vendor's products, then TCO cost elements that are common to both can be ignored since that particular cost factor will wash out. If the purpose is to achieve incremental cost reductions over time, then each cost element will have to be analyzed.

Analyzing the Information

A spreadsheet or matrix may suffice for a basic analysis on a vendor-to-vendor comparison matrix. We'll show one vendor column for an example. Others may be added as needed.

Element (Group)	TCO Area	TCO Impact	Vendor X
Engineering specification writing for a three vendor bid on Project XXX (G2)	Plan	Track project hours and apply loaded labor rate of $56.75/hour	Estimated at 6 hours with conference call to vendor app engineer to validate configuration
288 Splitter Cabinet-no options (G1)	Purchase	Capital account, OSP, Project XXX	$9,999 delivered on site
288 splitter with option group "A" factory installed (G1) for 150 drops	Purchase	Capital account, OSP, Project XXX	$5,555 delivered with cabinet factory installed
OSP Contractor install hand hole, pull in cables ready to splice	Deploy	Same for all vendors, no impact	N/A
Cable prep, route, terminate, splice & patch to test-ready condition (G3)	Deploy	Will change by vendor due to differences in approach. Use loaded labor rate of $35.78/hour for technician and $125/hour for splice trailer on-site	Estimated to be 26.6 hours with 8 hours on-site based on Project YYY records
Change out bad or lossy jumper	Maintain	Loaded labor rate of $35.78/hour when on site plus one standard patch cord (of better quality this time!)	35 minutes. Travel time and truck are N/A. Patch cord $25.67
Add 1 drop to cabinet, post in-service. (G1&3)	Maintain	Loaded labor rate of $35.78/hour when on site plus one standard patch cord	35 minutes. Travel time and truck are N/A. Patch cord $25.67

The example is strictly illustrative. If comparing vendors, one must compare same configurations as used in the project (empty cabinet plus a package of options which result in a ready-to-install package at the site). Engineering time particular to the work necessary to prepare the bid package for three vendors is included (in this case 6 hours was allocated to Vendor A), but the engineering time for the overall project is not. The rest of the entries are pretty much self-explanatory.

The most important row in the example is the one dealing with the estimated time to get the installed cabinet ready for fiber network testing and service cut over. Not only does

each vendor's configuration affect the time, the total time and charges will have to be estimated based upon some data point, which may or may not be known. Perhaps the vendor itself provided some typical data, which may or may not be acceptable, or the OSP contractor has comparable experience. If the carrier's own staff is not keeping good records when doing engineering or fieldwork, they will have to start doing so if the data is going to be reasonably accurate.

The identical approach may be used when looking at the life cycle TCO for process improvement, quality control, cost accounting or other reasons. If a particular vendor has product-specific elements which impact the TCO calculations, then that cost should be identified. For example, Vendor A could require splice trays for intra-facility cable in increments of 24 while Vendor B has increments of 48. Or, perhaps both are increments of 24 but Vendor A's solution requires additional cable management devices while Vendor B's does not.

The entire TCO process, whatever the objective, requires the discipline of continual process improvement (CPI). It is not a one-time effort by a single individual. Instead, the work needs to be internalized throughout the organization and documented so that it is not dependent upon any one individual. A sound process can be applied to any long-lived capital asset, not just physical layer fiber optics.

Authors

David D. Cousins, managing partner

David has consistently found himself the catalyst in organizations large and small, business and not-for-profits alike. His knack for assessing, aligning and acting have benefited many organizations around the country and in Europe. As the managing partner for Beta Partners, he also brings other leadership strengths including, strategic and leadership team facilitation, business realignment results, and extensive relationships with the Minnesota investment community. He has run several large global businesses while at both Concert and AT&T.

For the last eight years, as managing general partner and principal in a communications and technology-related investment and management company, he has served as CEO of four IT-related firms and in executive sales, marketing, and distribution roles. Also during that time he has performed a number of investment assessments for individual investors, facilitated leadership changes, and has provided key business direction advice and alignment.

David personally consults in the following areas: leadership/team facilitation, business strategy, structure and operational results, channel identification, development and effectiveness, and marketing analysis.

Nicholas ("Nick") C. Stanley, technology principal

Nick has over twenty-five years experience in wire line telephone, long-haul transmission networks, cellular radio, telecommunications operational support systems and related technologies. He is currently consulting across a broad spectrum of telecommunications-related engagements.

Nick has a track record at E. F. Johnson Company, A. C. Neilsen, ADC Telecommunications, Sepro Telecom (Ireland) and most recently at Brilliant Cities, Inc. Besides working in the high-tech industry, Nick founded a consulting company specializing in international technology transfer and licensing, moving further into network systems, telecom information technology, network security and business support system areas.

Information about Beta Partners, LLC can be found at www.beta-partners.com.