Is Fiber To The Home Affordable?

Michael Weingarten and Bart Stuck

Many assume the ILECs must replace their copper plant with fiber. But that may not be feasible economically.

In our last article, "Broadband UNE Decision: Where's the Evidence?" (*BCR* April 2004, pp. 14–16), we argued that the FCC's decision to eliminate unbundling requirements for incumbent local exchange carriers' (ILECs') broadband networks was made with minimal economic support. The Commission had based its decision on a finding that fiber-to-the-home (FTTH) deployment—which might be described as the ultimate broadband network—is economically viable for both incumbent and competitive carriers, but only under free market conditions.

Is this correct? Is FTTH deployment economically justifiable for ILECs—or CLECs? Under what conditions?

In reaching its decision, the FCC relied heavily on a study conducted by the Cambridge Strategic Management Group (CSMG) and commissioned by Corning. The passive optical network modeled in this study is broadly similar to the FTTH RFP issued by the regional Bell operating companies (RBOCs) in 2003.

Many of CSMG's modeling assumptions were accessible in an FCC filing, so we've undertaken to reverse-engineer CSMG's model for a sample central office (CO) located in Amarillo, TX. We use this as a platform on which we could answer different questions regarding the economic viability of FTTH deployment for ILECs and CLECs under different regulatory scenarios.

We also decided to reverse-engineer because we liked CSMG's approach:

a.) Calculate the incremental revenues for voice telephony, data, video and other services compared to a do-nothing status quo case.

b.) Calculate incremental operating expenses (opex), sales, general and administration (SG&A) and capital costs.

c.) From these, develop projected cashflows and net present values (NPVs) at the cost of capital.

Since we couldn't replicate CSMG's model exactly, our answers are based on our model outputs, which might be off slightly (but not directionally) from CSMG's own model outputs (given equivalent inputs).

For this article, we avoid the issue of whether unbundled network element (UNE) regulations provide an economic disincentive to ILEC investment; we focus on free market economics entirely. If ILECs can afford to build FTTH under free market conditions, then potential regulatory disincentives are relevant. If not, they are moot.

Background: CSMG Study Findings

ILECs and the FCC have used the CSMG study to support the argument that ILECs can justify investments in greenfield FTTH networks if they are freed from unbundling requirements. Specifically, CSMG found that in a sample CO in Amarillo, ILEC FTTH investment will result in positive NPV of $7 million. Based on an extrapolation from 1,500 Texas COs, CSMG estimates that ILECs, if deregulated, can justify FTTH deployment to 31 percent of U.S. households.

While CSMG did not perform a detailed economic model for CLEC entry, it argues that that "CLECs could deploy FTTH with similar or better economics" compared to ILECs.

We assess these issues below:

Issue 1—Can ILECs Justify FTTH Deployment (assuming full deregulation)?

Interestingly, the CSMG study output does not clearly demonstrate that FTTH deployment makes sense, even in a deregulated environment. For Amarillo, on a capital investment of $37 million, the 11-year NPV is *negative* $18 million (Table 1). Even worse, most of the capex is invested in Year 1, so the ILEC is locked into a massive investment that won't yield a return for at least a decade. The only way the deal pays off (with the aforementioned $7 million NPV) is by assuming a $110 million terminal value in Year 12 ($25 million on an NPV basis). Would you really want to wait that long to see a return?

And we're not sure we accept CSMG's NPV calculations, which are based on discounting a stream of free cash flows that appear to be calculated by taking EBITDA for each year and

Michael Weingarten (mikew @ signallakecom) and Bart Stuck (barts @ signallakecom) are Managing Directors of Signal Lake, an early-stage telecom venture capital fund (Boston MA and Westport CT).

TABLE 1: Free Market Case for Amarillo TX, Using Different Cashflow Methodologies

	Total NPV $Million	NPV Years 1–11 $Million	NPV Terminal Value Year 12 $Million
Assuming Original Model Fiber Construction Costs (0% Discount)			
CSMG Free Market Case	$7.0	($18.2)	$25.3
Free Market Case using Reverse-Engineered model and CSMG's EBITDA-capex methodology	$8.7	($17.9)	$26.6
Free Market Case using depreciation/tax cashflow methodology	$0.3	($16.0)	$16.3
Assuming 30% Discount on Fiber Construction Costs			
Free Market Case using depreciation/tax cashflow methodology	$6.7	($9.6)	$16.3

Source: CSMG, Signal Lake analyses. Assumed 10–year depreciation and 40% tax rate on pretax income.

FTTH makes sense for 31 percent of households—and *doesn't* for 69 percent

subtracting that year's capex. That's good shorthand for cashflow, but it ignores the fact that in later years of the model, the network is generating substantially positive EBITDA, on which it has to pay taxes. If we adjust for the need to pay taxes in the later years of the model, this reduces cashflow in these years. Even more importantly, it reduces terminal value substantially—the major driver of NPV in the model.

Offsetting this, our industry contacts suggest that CSMG's fiber construction costs (which represent 85 percent of total capex) may be high for scale operators, and/or that fiber costs have dropped since the study was done. For feeder fiber, the CSMG model assumes $58,000 per mile (aerial) and $200,000 per mile (in-ground); these numbers include associated PON splitters. Based on our independent inputs, we decided to run the model assuming 30 percent lower fiber costs.

The results of our revised modeling are shown in Table 1. As often happens when you critique a model (without a pre-set agenda), negative and positive adjustments tend to cancel out, and we ended up with an NPV almost exactly the same as CSMG's—and with the same over-reliance on terminal value. So net-net, we're underwhelmed with the economic case for building ILEC FTTH networks in a free market environment.

We also note that even if we are prepared to accept the idea that all of the NPV comes from terminal value, CSMG found that FTTH only made economic sense in 8 percent of COs and 31 percent of U.S. households. Put another way, FTTH did *not* make economic sense in 92 percent of COs and 69 percent of households. We suspect these percentages would drop to very low levels if we only counted COs in which NPV break-even was achieved in the first 10 years, without relying on a Year-12 terminal value.

■ **Issue 2: How Much Do These Numbers Change If ILECs Can Use Pre-Existing Feeder Fiber?**
Feeder fiber represents 33 percent of the total Amarillo capex. Given that ILECs have already deployed feeder fiber in many instances, to what extent can one justify FTTH builds, assuming zero incremental feeder fiber cost?

We ran the numbers (using the tax methodology described above and 30 percent fiber discount). The results (Table 2) indicate that eliminating the feeder fiber cost allows you to generate twice the NPV, although you still are relying on the terminal value for your return.

■ **Issue 3: Can CLECs Generate Positive NPVs With Facilities-Based FTTH Deployments?**
CSMG did not specifically study the economics of

TABLE 2 Free Market Case For Amarillo TX, With/Without Feeder Capital Costs

	Total NPV $Million	NPV Years 1-11 $Million	NPV Terminal Value Year 12 $Million
Including Feeder Fiber Costs			
Free Market Case using depreciation/tax cashflow methodology @ 30% fiber discount (from Table 1)	$6.7	($9.6)	$16.3
No Feeder Fiber Costs			
Free Market Case based on Signal Lake Reverse-Engineered Model; zero feeder capital cost	$13.2	($3.1)	$16.3

Source: CSMG, Signal Lake analyses. Assumed 10 year depreciation and 40% tax rate on pretax income.

Can Different Network Architectures Improve NPVs?

economic issues facing the industry□

If there is a central underlying theme to our discussion, it is that investing in a heavy fixed-cost network in Year 1 of a business case makes positive NPV problematic. So if we had to define our ideal architecture, it would be one in which we substitute FTTH's high fixed costs incurred in passing lots of households (who may or may not subscribe), with an alternative architecture in which more of the costs are incurred if and when households subscribe.

To some extent, this is what a fixed wireless network does (other options we could consider are VDSL from feeder fiber and broadband over power lines). Instead of spending almost 50 percent of your capex on distribution fiber, you can invest in radio transmitters. Depending on the reach of the radio cells and your willingness to roll out cells over time as you sign up subscribers, you potentially can save a lot of money versus the FTTH approach. (*Authors' note: Signal Lake has investments in fixed wireless, VDSL and free-space optics providers.*)

TABLE A ILEC And CLEC Capex For FTTH And Radio Scenarios

	Capex $Million	Index	NPV of Capex @13% $Million	Index
ILEC FTTH	29.2	100	24.9	100
CLEC FTTH	21.3	73	18.7	75
ILEC Radio	13.3	46	8.9	36
CLEC Radio	7.8	27	5.4	22

Source: Signal Lake analysis

To illustrate, we created two different wireless business cases:

- **Case A:** Build a minimal ILEC transmitter network in Year 1 in a way that covers the entire geography. Expand as needed to provide additional radio capacity.

Some Underlying Assumptions

Our Amarillo CO territory covers 347 square miles. We assume that at low capacity, a radio can cover a five-mile radius, or 78.5 square miles. This means that in Year 1, we will need five transmitters to cover the area, at a cost of $25,000 each ($125,000 total). As the subscriber base increases, we would add one transmitter for each additional 75 subscribers (with a shorter trans mission radius). Many of these transmitters will be installed in later years, at a unit cost that declines 20 percent per year.

Ultimately, with 16,500 subscribers, we will need 220 transmitters. This compares to approximately 1,000 feeder fiber pedestals. We therefore conservatively assume that feeder fiber costs can be reduced by 50 percent, and will be built out proportionately to the number of transmitters.

By using radio transmitters for last-mile connections, we save $19.5 million on distribution fiber and drop costs.

As for customer premises equipment (CPE), we assume the same price as wireline CPE.

- **Case B:** The same as Case A, downsized to reflect CLEC take rate. Since we only need 42 transmitters to serve 3,168 subs in year 2013 (4.2 percent of the 1,000 feeder fiber pedestals needed in the FTTH case), we assume conservatively that feeder fiber will be 20 percent of the ILEC FTTH cost.

Results—Capex

For an ILEC, capex drops from $29 million to $13.3 million, a 54 percent decline (Table A). On a NPV basis, the decline is 64 percent.

For a CLEC, capex drops from $21 million to $7.8 million, a 73 percent decline. On a NPV basis, the decline is 78 percent.

Results—NPV

For an ILEC, the NPV is now substantially positive (+$19.9 million; Table B). Even better, the NPV is positive in the first years of the build, and does not depend solely on terminal value.

For a CLEC, the NPV is slightly positive (+$2.7 million). However, the business model still depends on terminal value. This suggests that in many instances, CLECs would seek to use ILEC UNEs rather than building their own networks.So net-net, radio networks make a

TABLE B ILEC And CLEC NPV For Amarillo TX, Based On Radio Network Deployment

	Total NPV $Million	NPV Years 1-11 $Million	NPV Terminal Value Year 12 $Million
ILEC radio-based free market entry @ 13% cost of capital	$19.9	$3.6	$16.3
CLEC radio-based free market entry @ 15% cost of capital	$2.7	($1.9)	$4.6

Source: Signal Lake analysis

CLEC FTTH deployment. However, it did say that "a CLEC would likely have FTTH economics that would be similar or better than the ILEC, for two reasons: 1.) All voice and data revenue can be considered incremental (i.e., a CLEC would have no cannibalization of legacy products), and 2.) Build costs could be lower due to the use of lower-cost contract labor." Based on CSMG/Corning submissions, the FCC decided that CLECs had equally good entry economics for FTTH deployment.

Is this correct? We decided to test the CSMG/FCC hypothesis by running the model adjusted for CLEC economics along the following dimensions:

—**Market Share:** We think that CLECs will have significantly lower share than ILECs. CSMG said, "Based on our experience, one or two CLECs would together require about a 15 percent share of subscribers to be economically viable," and CSMG forecast a combined CLEC 16 percent share by 2013. We therefore decided to assume 10 percent *household* shares in 2013, keeping individual service shares proportional to CSMG's ILEC model (i.e., not every FTTH subscriber will subscribe to video, data *and* voice).

—**Incremental costs:** CSMG asserts that the great majority of FTTH-derived voice and data traffic would be incremental (in contrast to ILECs, where much of their voice and data traffic is pre-existing). Based on historical FCC data, we don't agree: As of June 2003, CLECs had 12 percent share of residential and small business switched access lines and 10.5 percent share of high-speed broadband provisioned via wireline (excluding cable modem).

So if our prototype CLEC is only going to have 10 percent market share in year 2013, we don't think that 100 percent of the FTTH revenues for voice and data will be incremental. However, given the increasing likelihood that narrowband UNE-P and DSL line sharing requirements on the ILECs will go away (and with them, much of the CLECs' ability to compete for residential/small business customers), we think that a base case of 10 percent share for video and data dropping to zero in Year 5 makes sense.

—**Capex costs:** It makes sense that CLECs could benefit from lower non-union labor costs for fiber construction. To quantify the savings, we relied on an August 2001 article, "The Low-Down on Fiber" by Debbie Sklar in *America's Network* magazine, quoting a fiber expert who suggested that labor cost represents 30 percent of fiber deployment costs (with the rest coming from construction equipment, dark fiber, right of way, insurance and permits). We therefore decided to assume that CLECs had a 50 percent labor cost advantage on 30 percent of fiber cost, for a 15 percent net lower cost.

—**G&A:** CSMG assumes ILEC G&A that is 1 percent of incremental revenues. Current RBOC overall G&A cost is 8.5 percent of revenues, so CSMG essentially is assuming that 88 percent of G&A is fixed and 12 percent is variable. We think that's high on the fixed side, but we'll accept it.

TABLE 3 Selected SG&A Costs As A Percentage Of Revenues

	SG&A % of Revenues
RBOCs	20.3%
Allegiance	46%
AT&T	21%
Level 3	26%
XO Communications	61%
McLeod	36%
Average CLEC	38%

Source: SEC filings

TABLE 4 Selected COGS As A Percentage Of Revenues

	COGS % Of Revenues
RBOCs	27.5%
Allegiance	51%
AT&T	51%
Level 3	56%
XO Communications	38%
McLeod	57%
Average CLEC	50.6%

Source: SEC filings

The FCC assumes CLEC FTTH economics are comparable to ILECs': We're not so sure

To decide how relevant this is for CLECs, we compared RBOC versus CLEC SG&As (we did not have separate CLEC breakouts for G&A). The result (Table 3) indicates that CLEC SG&A is roughly twice the ILEC rate. So by extrapolation, our modeling input for G&A percentage needs to be higher by 2× than the 1 percent for ILECs.

Arguably, however, the right number is substantially greater than 2 percent of revenues. After all, the 1 percent ILEC number assumes that the bulk of G&A costs are covered by the ILECs' large base business. For CLECs, where particularly in the later years of the model there will be no base case revenues, the G&A charge needs to include all G&A, not just incremental G&A. That means a 16 percent G&A charge, not 1 percent.

—**Gross Margin:** The same holds true for gross margin assumptions. The CSMG model assumes the following gross margins for different ILEC services: Voice: 70 percent; Data, 56 percent; Video, 55 percent, falling to 50 percent.

As we look at these percentages, we think that the cost-of-goods for voice and data reflect plant-specific and non-specific costs (excluding depreciation), while video COGS also include pro-

Reduced construction costs are key to making FTTH viable

TABLE 5 CLEC Free Market Cases For Amarillo TX, Including Feeder Fiber Capex

	Total NPV $Million	NPV Years 1-11 $Million	NPV Terminal Value Year 12 $Million
CLEC Facilities-Based FTTH @15% cost of capital	($14.6)	($17.0)	$2.4

Source: Signal Lake analysis based on CSMG model. CLEC obtains 10% sub share in year 2013.

gramming content cost. Each of these is scale-related (even programming content costs are subject to scale-related rate cards). Thus, CLEC cost of goods sold should be substantially higher than ILEC COGS, since CLECs operate at smaller scale. Offsetting this, however, the FCC has noted that CLECs benefit from non-union labor.

To get a rough handle on appropriate CLEC gross margins, we took a look at the margins for the same five CLECs compared to the RBOC average (Table 4). The result indicates that CLECs have a 23 percentage-point COGS disadvantage. Accordingly, for our model, we have reduced retail gross margins by 20 points for each service.

—**Cost of capital:** The current RBOC statutory cost of capital is 11.75 percent; CSMG assumes 13 percent cost of capital for the ILEC free market case.

To get a handle on latest thinking regarding CLEC cost of capital, we spoke to a managing director in telecom at an A-list investment bank. He advised us that 11.75 percent was appropriate for ILECs (yes, the 11.75 percent rate was created to reflect a monopolist rate of return, but since then, the cost of debt and equity has dropped substantially); our contact said 15 percent was appropriate for CLECs.

—**Tax Treatment:** For ILECs, we assumed that early year-tax losses would be offset by profits in the telcos' other businesses, so that there would be a cash tax refund. For CLECs with large early-year losses, we cumulate the tax losses until there are profits to be offset.

The results (Table 5) suggest that the NPV for CLEC deployment of an FTTH network will be substantially negative in all but high-density geographies. The underlying problem is that with FTTH capex being largely fixed-cost and with G&A costs also being scale-related, CLECs with 10 percent share or less cannot afford to deploy FTTH.

Conclusions

We begin with a caveat. Since we haven't created our own set of economics and models from scratch, it's possible that we have overstated FTTH deployment costs and that the real numbers are better than we have suggested (the model is particularly sensitive to fiber construction costs). We'd love hearing from people who think that FTTH is economically attractive and are prepared to do a follow-on piece if we see good arguments for deployment.

That having been said, our analysis is based on data submitted to the FCC by Corning, a leading FTTH proponent, and we assume that if anything, their model should tilt in the direction of increased NPV.

With that caveat, the above analysis suggests that FTTH deployment is far more problematic than the FCC believes, and may explain why we're not seeing more concrete signs of actual deployment. For ILECs, we can justify deployment, but only if we are willing to accept business cases that rely totally on terminal values to generate positive NPV. For CLECs, the numbers are substantially negative, despite FCC comments about additional revenue streams offsetting the high fixed costs of FCC deployment.

(As an aside, much of the CLEC FTTH action these days is coming from municipal deployments like Grant County, OR, where public electric utilities use their monopoly cashflow and their ability to borrow at 4.5 percent rates to fund FTTH buildouts. That's an entirely different economic proposition than relying on free market economics.)

Based on all of this, we have three reactions:

- What is all the fuss over fiber UNE rules about, anyway? We don't see the RBOCs being able to justify major plant buildout, so making fiber UNEs available to CLECs is a moot issue.
- To make FTTH deployment viable, the key is not Moore's Law-rate reductions in opto-electronics. We need to find ways to reduce the construction cost, since that is 85 percent of capex.
- If we can't cost reduce fiber deployment, we need to go back to the drawing board and consider architectures that shift investment from upfront commitments into costs incurred when actual subscribers are signed up (see "Can Different Network Architectures Improve NPVs?" p. 26).

In making these assertions, we recognize that we haven't looked at all costs in detail. Nor have we attempted to construct extremely geo-specific models. However, we believe that our admittedly high-level analysis has generated a substantial number of questions for business planners and people concerned with public policy, and we hope that our work generates greater awareness of the

Companies Mentioned In This Article
Corning (www.corning.com)