Smart Grid Connectivity -- Good, But Good Enough?

Remarks by Steven R. Rivkin to Connectivity Week,
Santa Clara Conference Center, May 26, 2011

What's a D.C. telecom lawyer like me doing trying to figure the costs and benefits of the trade-off between fiber optics and wireless? That's a question I've urgently asked myself for the past few weeks which now I hope to answer.

Actually, the potential link-up of fiber and electricity networks is something I've pondered for more than two decades, ever since I first realized that the copper wires outside my window fit Mike Nichols' picture of an unhappy marriage: "Proximity there was, relationship there was none!" The obvious reason to pull telephone and power wires asunder in 1900 – electromagnetism -- has no basis to persist today. Optical fiber can be twinned with electricity, even bound up with a power cable in a single sheath, with perfect fidelity, harmony, and no static, so that jungle of copper wire no longer makes much sense.

But, going forward, "coulda" doesn't equal "shoulda," though it imposes a burden of proof on older technology that is proven to be less versatile. Clearly, power-line carriage has already failed the test for smart-grid connectivity: There's no point in relying on a network for intense data flows that shuts down just when you need it. As to the options still standing – fiber and wireless – my main aim today is to urge that the time is ripe for an authoritative comparison that will take into account all relevant public and private interests, long-range goals, and short-term strategies.

Cost is certainly significant, but not conclusive, and in the final analysis costs must be weighed against revenues under multiple contingencies, starting with a look at the experiences of pioneers like Chattanooga's EPB. But there are other, technological considerations that could balance out the presumed cost disadvantage. Bandwidth aside, there are four primary reasons why fiber deserves a fair shake for the smart grid. Security is the first.

1) Security. According to Corning, which knows a thing or two about fiber,

> **"[T]he dialectric nature of optical fiber makes it impossible to remotely detect the signal being transmitted within the cable. The only way to do so is by actually accessing the optical fiber itself. Accessing the fiber requires intervention that is easily detectable by security surveillance. These circumstances make fiber extremely attractive to governmental bodies, banks, and others with major security concerns."**

To the innate hazards of tapping, add the threat of mischief from worms such as Stuxnet. Cyber vulnerability has already disrupted momentum toward the smart

grid. Last month the U.S. Senate took up a bill – S. 813 -- "to promote public awareness of cyber security," mandating an executive branch study of "the threat of a cyber attack disrupting the electrical grid of the United States." Such a study, if ordered by law, would be timely to weigh the potential make-or-break vulnerabilities of fiber and wireless networks for the smart-grid. Earlier this month, the White House unveiled its own plan, but that has unfortunately been called "weak tea," so the need for perceptive initiatives remain acute.

Fortunately, great leaps forward are being made in cyber cryptography, especially for fiber networks. Consider the path-breaking work at Los Alamos National Lab and elsewhere on Quantum Enabled Security, whose functionality in the physics of light itself is generating high enthusiasm from potential vendor partners and from the U.S. Department of Energy, precisely for the smart grid.

2. Reliability. Optical fiber isn't fazed by potential obstacles such as distance, weather, and electrical interference. It is intrinsically dependable for critical infrastructure data communications. To the extent the smart grid greatly increases system complexity, smooth and confident exchanges of data from many disparate and widely spaced sources are essential, often in real-time.

3. Low Latency. Likewise, the multiple, interrelated elements of the smart grid must be coordinated simultaneously, placing a premium on precise correlation of network data communications. According to Ciena,

> **"For non-critical operations like polling of smart meters… latency requirements are not significant. [But for] most other applications latencies should typically be in the 10's of millisecond ranges… The most critical requirements will usually be around relay teleprotection within and between substations, where … both network delays and network recovery times in the event of a failure [must be] kept to the very low (<10) millisecond ranges (i.e. less than the time of one 60HZ power cycle)."**

As the smart grid thickens and intensifies, the data support mechanism must always keep up the pace.

4. Ubiquity. Simply because optical fiber can physically entwine electrical apparatus makes it possible to deploy intense instrumentation for measuring and control, free from illicit ingress or disruption, and open to remote inputs, distributed storage, and micro management. Coincidentally, the flow of this grid information in fiber networks would position high-bandwidth pathways to send and receive additional digital information for all the other applications of which the internet is capable. Thus the superior bandwidth of fiber can be a platform for a topology of bountiful, universal telecommunications: With fiber, we can get data from and to the grid – along with all other entities that need access to the internet.

These four important criteria I've singled out for adequate telecommunications support promise high quality connectivity with a footprint every bit co-extensive with that of the electric grid. The corollary of such telecommunications is its suitability as infrastructure for heavy and growing public and private traffic, an engine poised to draw value from an array of uses great enough to foot the bill.

As I indicated earlier, I think it's timely to zero in on this mandate and opportunity, for which the economic value of smart grid connectivity can the keystone of the arch. Accordingly, the full-bore U.S. government inquiry into cyber security which I urged previously should be broadened to examine all considerations relevant to adequate support for the grid and all other factors relevant to bringing such connectivity into being. The challenge to legal and political ingenuity will be every bit as complex and urgent as the technical challenges outlined yesterday by Aneesh Chopra.

In particular, I'd like to say now as a lawyer I'm no fan of the mantra of "facilities-based competition" that has bedeviled national telecommunications policy for the last decade and a half. For evidence of incipient failure we need only look to the impotent strategizing of the FCC's recent National Broadband Plan, whose muted goals fall far short of national need and technological opportunity. We should, instead, explore switching to a dynamic of "facilities-based collaboration" in which the providers of last-mile broadband can pool their capital and assets – new and old, including facilities with useful life such as dark fiber, in exchange for owning shares and rights to control slices of bandwidth. By statute, antitrust immunities would be assured, and state restrictions preempted. A central concern will be to induce electric utilities to invest their shareholder capital in the joint venture, in exchange for priority telecom access for their smart grids.

Call this a "Common Infrastructure Corporation," make it eligible for tax shelter and Federal grants, loans, or guarantees, and then sit back and watch "competition" in services flourish and fiber-to-the-home proliferate.

In conclusion, I'd like to offer a caution drawn from economic scholarship. Economists are rightly leery of what some call "path dependence," the stalling of technological progress caused by earlier decisions that over time have proved short-sighted. The most famous instance of path dependence is the mechanical typewriter, whose QWERTY keyboard was initially devised to slow down typing and stop jamming the keys; with the advent of electronic inputs QWERTY has proved woefully antiquated, though it continues to dominate through availability of equipment and human skills. Now, if we don't appreciate the opportunity and the promise of fiber connectivity for the smart grid, we could be headed down the same old path -- with wireless.