

## The Importance of Wholesale Competition to Market Performance

### Introduction

Fundamental changes are underway in the telecommunications industry, as new technologies replace the traditional circuit-switched architecture of the past. This technological change, however, does not necessarily alter market conditions or the need for appropriate regulatory policies to ensure that the vast promise of these new technologies flow through to the benefit of consumers and businesses. The premature elimination of wholesale regulatory obligations (such as unbundling) could lead to a substantial loss of retail competition.

The primary technological change underway is the emergence of packet networks that support voice, data, image and video applications in a common architecture. Understanding such networks requires an appreciation of the different logical/physical “layers” that define how packet networks operate. This paper provides a simplified description of the “layers model,” upon which modern networks are organized.<sup>1</sup>

Even the most advanced networks, however, must overcome a threshold problem: Before applications can be offered to customers, the last mile must be breached by broadband access facilities that extend to the customer’s location. While packet technology may be best able to *exploit* the capabilities of broadband facilities, they do not *reduce* the core economic cost of reaching customers through last-mile broadband facilities, including conventional broadband facilities today leased as network elements and special

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### Key Conclusions

- \* *Regulatory assessments of market conditions should be guided by a “layered model,” recognizing that competition at higher layers (such as retail applications) is dependent upon competitive conditions at lower layers, in particular the wholesale layer.*
  - \* *Where competition is not sufficient to produce reasonable wholesale offerings, wholesale-regulatory obligations (such as unbundling) must continue or consumers will be harmed.*
  - \* *The Omaha Forbearance Experiment demonstrates that functioning wholesale markets do not emerge simply because unbundling obligations are removed. As a consequence, the Omaha market is today characterized by market abandonment and collapsing competition.*
  - \* *The premature elimination of wholesale requirements will eliminate retail competition and consumer choice.*
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<sup>1</sup> Elements of this paper have been drawn from a more technical discussion filed by Rogers Communications in a proceeding before the Canadian Radio-television and Telecommunications Commission. See Report of Dale N. Hatfield, Adjunct Professor, University of Colorado at Boulder, filed in Telecom Public Notice CRTC 2006-14, March 15, 2007.

access.<sup>2</sup> Moreover, last-mile broadband facilities continue to be differentiated with respect to speed, control, quality and other dimensions.

It is this simple fact – *i.e.*, that last-mile broadband facilities are costly to install and, in many instances, inefficient to duplicate – that leads to the primary conclusion of this white paper. Just as packet networks are layered, markets have different layers, with an important division between the retail and underlying wholesale layers. Retail competition – and, importantly, retail deregulation – requires that wholesale facilities and services be available at reasonable terms.<sup>3</sup> As such, reducing the level of government interference in retail markets requires continuing oversight of wholesale offerings until wholesale-level competition is self-sustaining and sufficient to protect downstream competition in each relevant product market.

Equally important, policy makers must distinguish between identifiable customer segments that confront different market choices. For instance, in some areas, residential customers – or, at least those residential customers desiring packages that include voice, Internet access and/or video services – have a choice between their traditional phone and cable company. Even this limited choice, however, does not generally extend to the small and medium business markets, where competition remains dependent upon the continued presence of competitive local exchange carriers (CLECs) that combine last-mile access leased from the ILEC with their own network facilities (and/or network intelligence) to provide innovative next-generation services.<sup>4</sup>

Finally, the principal focus of this white paper concerns the business market, where cable-based providers have no significant presence. Even in residential markets, however, the evidence indicates that the entry of cable-based providers of communication

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<sup>2</sup> The most common broadband facilities in the enterprise market are traditional high-capacity access connections (*i.e.*, DS1 and DS3). Perhaps because such facilities are so common, they are frequently overlooked in discussions involving broadband policy, which generally focus on various DSL technologies and services used to serve the mass market.

<sup>3</sup> For simplicity, throughout the white paper, we use the phrase “reasonable terms” to include the full range of “terms, conditions and prices” under which an offering is provided.

<sup>4</sup> As explained in more detail below, modern technology does not require that the physical layer be replicated in order for an entrant to innovate. Rather, the physical layer is a form of *generic* input that can be shaped and modified by an entrant adding intelligence and electronics to define new services and applications. Consequently, under the appropriate conditions, robust retail competition is possible without waiting for the costly (and potentially uneconomic) duplication of each element of the physical layer. Perhaps most instructive in this regard is the example of new technologies that enable *faster* DSL services over *longer* copper loops, so long as those copper loops remain available to entrants under reasonable terms. The nation’s copper infrastructure is a resource developed over decades (typically under government protection from competition) that need not lay fallow as the incumbents overbuild portions of this infrastructure with fiber. Rather, the copper-resource should remain available to competitors willing to invest in the requisite supporting technologies to translate its latent capacity to dynamic new offerings.

services has not been sufficient to prevent incumbents from sustaining significant increases in price.<sup>5</sup> To protect consumers and businesses from facing higher retail prices, it is important that regulators remain committed to assuring reasonable terms and offerings at the wholesale layer until *competition* at that layer renders regulatory oversight unnecessary.

### **Understanding Network Layers in a Packet World**

Correctly designing regulatory policies for contemporary markets requires a clear understanding of the technological changes that are reshaping telecommunications networks. In terms of basic network architecture, it is apparent that the traditional networks – wireline telephony, cable television and wireless telephony – are developing in a similar manner. The key trends include:<sup>6</sup>

- \* First, and perhaps most fundamentally, all three platforms are evolving from the analog format to end-to-end digital transmission and switching/routing. Indeed, this conversion has largely been completed with the exception of certain last mile facilities.
- \* Second, all three types of providers are, for the most part, seeking to extend broadband digital facilities deeper into their network and, ultimately, directly to customer locations.
- \* Third, all three types of providers are deploying networks that increasingly rely on packet switching and statistical multiplexing with “intelligence” placed at edge of the network, rather than its interior.
- \* Fourth, in combination, the previous three developments lead to networks that are potentially capable of supporting a wide variety of similar applications – voice, data, image, video and rich multimedia combinations.<sup>7</sup>

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<sup>5</sup> For instance, Bank America recently reported: “Bell prices were up across the board Y/Y [year over year]. Entry-level Bell triple play prices were up 2.6% Y/Y and 7.3% Q/Q. Bell DSL pricing was up at every carrier, 5% sequentially and 2% Y/Y.” See *Battle for the Bundle: Consumer Wireline Services Pricing*, Bank of America Equity Research, April 14, 2008, p 1.

<sup>6</sup> For a more in-depth discussion of these trends see, “Emerging Network Technologies,” Dale Hatfield, Bridger M. Mitchell and Padmanabhan Srinagesh. *Handbook of Telecommunications Economics*, Vol. 2, S. K. Majumdar, M. Cave, I. Vogelsang, (eds.), 2005.

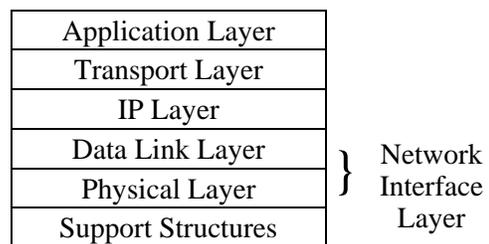
<sup>7</sup> Importantly, the traditional wireline, cable and wireless telephony networks remain differentiated with respect to speed, capabilities and quality for handling data, and are not coextensive. Thus, it cannot simply be assumed that all networks are equally capable of delivering all products in all settings – a more nuanced market analysis including definition of relevant product and geographic markets is required.

- \* Fifth, all three types of providers are using the Transmission Control Protocol/Internet Protocol (“TCP/IP”) suite of standards and protocols as the means of logically organizing their respective platforms and as a way of routing the packets of information – voice, data, image and video as the case may be – between different platforms and over diverse types of transmission networks (e.g., cable modems or Digital Subscriber Lines – “DSL”) and transmission media (e.g., fiber optic cable, coaxial cable, or twisted-pair copper cable).

Because of the importance of TCP/IP to these emerging networks, it is useful to discuss this protocol suite in more detail. Protocols are simply pre-established rules implemented in software or hardware that facilitate electronic communications between and among computers or other devices. It is common practice to subdivide or modularize functionality in an arrangement known as layering.

Layering basically means that each protocol layer has a well-defined task to accomplish. In the TCP/IP model, each layer provides a “service” (*i.e.*, some well defined sub-functionality) to the layer above, and relies upon or takes a service from the layer below. It is in this sense that the protocol layers are said to be “stacked.” Such modularity or layering has a number of advantages, including the ability to manage complexity by allowing software or hardware to be reused even if a change is made elsewhere in another layer.<sup>8</sup>

**Figure 1: Layers in the Internet Protocol (TCP/IP) Suite**



The TCP/IP protocol suite is typically modeled using four layers: application, transport,<sup>9</sup> Internet protocol, and network interface. The latter layer, the network interface layer, can be subdivided into two layers – the data link and physical layers. Although not formally considered part of the protocol stack, it is useful to note that the physical layer (*i.e.*, various transmission media) itself depends upon the use of rights-of-way, pole

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<sup>8</sup> Layering is a particularly useful conceptual construct because it allows one to visualize differing vertical layers (such as in a wedding cake) that are physically stacked, as well as differing horizontal layers (such as different layers of clothing). Protocol layering is analogous to different clothing layers, with information on the “outside” of a particular packet providing functionality (such as routing information) that is indifferent to the information within the packet (which may be related to the application).

<sup>9</sup> As explained further below, the “transport *layer*” in the protocol suite is not the same (despite the term) as the “transport *function*” (*i.e.*, the transmission of packets between two points) using physical facilities such as fiber and/or copper that policymakers are familiar with today.

lines, duct space, building entrance facilities and risers, wireless antenna sites and structures and so forth. This lowest layer will hereafter be referred to as “support structures.” These layers are summarized in Figure 1 (above).

The highest level in the model – the application layer – contains the information/data most relevant to the user, such as the sound of another’s voice, a frame in a video stream, or the data to display a web page on your computer. The transport layer – often but not necessarily TCP<sup>10</sup> – is responsible for such sub-functions as setting up connections between computers and for error and flow control. Thus an application like email, web surfing, or voice communication relies upon the software in the next layer down in the protocol stack (*i.e.*, the transport layer) to establish a connection and to ensure the reliable transfer of the information from the associated application (e.g., a portion of an image on a web page or a portion of a voice conversation) to the distant computer once the connection is established.<sup>11</sup>

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*The layered architecture of the TCP/IP protocol suite – coupled with intelligence residing at the edge of the network– creates a general-purpose platform that facilitates vigorous competition and innovation, so long as the ability to either access (or replicate) the physical layer and underlying support structures not act as a barrier to entry. If each layer is available on reasonable terms, a wide array of innovative services will be available to consumers and businesses from multiple providers.*

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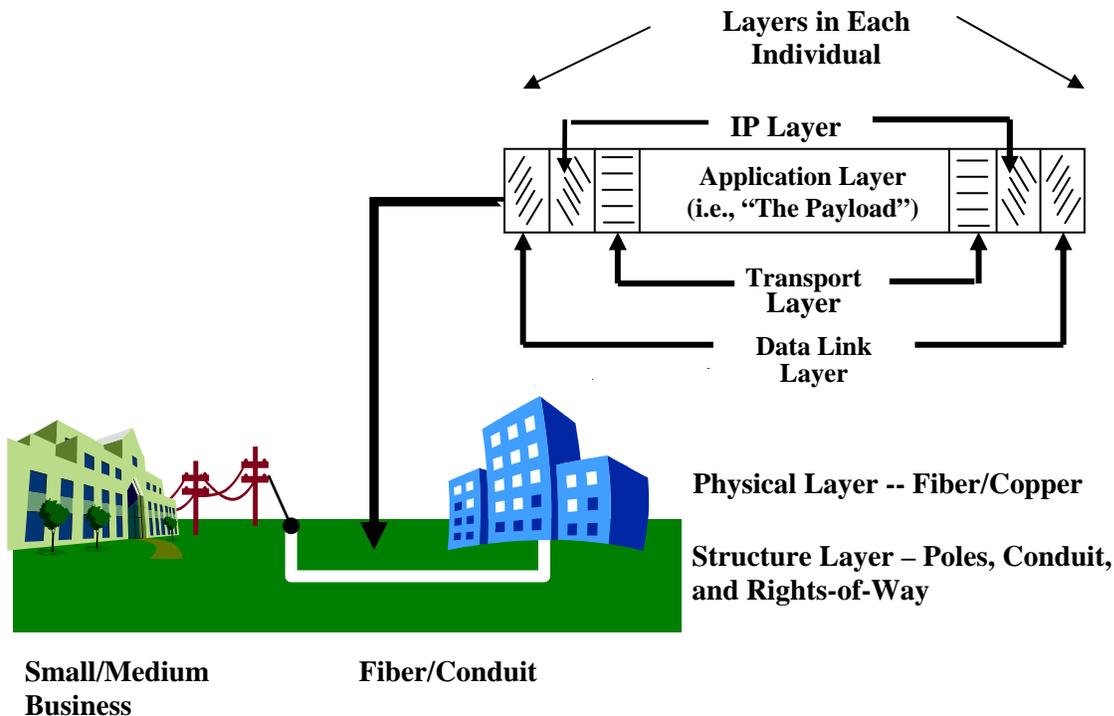
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The transport layer, in turn relies upon the functionality in the next layer down, the IP layer, to *route* the packet from one network node to another until the computer at the destination is reached. It is the IP layer that is responsible for the routing of packets through networks and the associated software resides in the devices (e.g., computers) at the edge of the network and in routers at nodes throughout the network. At the destination computer, the transport and application software layers work with the corresponding software in the originating computer to enable the reliable delivery and utilization (e.g., display) of the information in the packet. As noted above, the information being conveyed in the packet may represent voice, data, image, or video content.

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<sup>10</sup> TCP is the acronym for “Transmission Control Protocol.”

<sup>11</sup> As noted, the transport layer in the protocol stack is assigned duties commonly associated with the transmission of information, including lost transmission detection and handling, and managing the rate at which packets are sent to ensure that the receiving device is not overwhelmed. It is because the duties of the transport layer in the protocol stack are often necessary to the reliable transport of data (as a physical function), that the term “transport” is used in both contexts -- *i.e.*, as a distinct layer in the software model (the transport layer), and as a description of a specific transmission function, such as transport between central offices (for instance, inter-office transport).



The IP layer, in turn, requires a means – that is, a physical network – to actually convey the packet of information between nodes and ultimately to the destination.<sup>12</sup> The IP layer relies upon the network interface layer to access different types of networks.<sup>13</sup> The physical layer includes the actual medium used by the data link level such as twisted pair copper cable, coaxial cable, fiber optic cable, or radio spectrum. A simplified view of the interrelationship between these software layers (mostly unseen to users) and the applications demanded by users and physical structures that provide these services is illustrated above.

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<sup>12</sup> A key attribute or advantage of TCP/IP is that it was designed to utilize different network technologies, such as Ethernet, Asynchronous Transfer Method (“ATM”), or Frame Relay. This standardized packet of information is somewhat analogous to a standardized shipping container that can be efficiently carried on a containerized ship, railroad car or truck trailer.

<sup>13</sup> As noted, the network interface layer can, in turn, be divided into two layers as shown in Figure 1. The data link layer has the responsibility for reliably transmitting the IP packet over the next layer down – the physical layer. Common examples of the data link layer include Asynchronous Transfer Mode (“ATM”), Ethernet, portions of the Data Over Cable System Interface Specification (“DOCSIS”) used in cable modems, and portions of the WiFi (e.g., 802.11x) standards.

## **Network Layers and Regulatory Policy**

With this background, it is possible to relate the notion of layering in modern telecommunications networks in general – and the TCP/IP protocol suite in particular – to a generalized discussion of regulatory issues and obligations commonly confronting the Federal Communications Commission (FCC) and the states.<sup>14</sup> Overall, the following basic conclusions are most pertinent:

*First*, the layered architecture of the TCP/IP protocol suite, coupled with intelligence residing at the edge of the network, creates a general purpose platform that facilitates vigorous competition and innovation in the layers above the IP layer – that is, in the application and content layers.<sup>15</sup> Familiar examples include services like email, chat/instant messaging, music sharing and even the Worldwide Web itself, all of which make use of the transport and IP layers.

*Second*, even though the layered, open architecture of the Internet has created enormous amounts of innovation at the application/content layers (and may place pressure on many traditional business models), its success does not imply that there is vigorous competition in any or all of the lower layers of the stack – *i.e.*, at the physical and the support structure layers. Indeed, the economic characteristics of these, more traditional, network layers, make duplication expensive and, in many instances, inefficient.<sup>16</sup>

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*The governing principal of the layered model is that regulators should consider competitive conditions not only at the layer being reviewed, but should also look to the layer immediately below (to ensure a functioning wholesale market), as well as the layer above (to evaluate the consequences of any decision).*

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*Third*, in developing a modern regulatory policy, it is important to evaluate the rules applicable to telecommunications services in the context of the layered architecture. Specifically, those services or facilities that define the lowest layers in the model – such as the facilities that comprise the support layer (rights-of-ways and poles), the network interface level (e.g., Ethernet), or other

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<sup>14</sup> The use of protocol layering in telecommunications policy analysis is not new. For a more detailed treatment see Richard S. Whitt, *A Horizontal Leap Forward: Formulating a New Communications Public Policy Framework Based on the Network Layers Model*, Federal Communications Law Journal, Vol. 56, No. 3 (May 2004).

<sup>15</sup> As described here, the upper layers of the protocol stack tend to correspond to retail offerings made directly to end-users. For example, electronic mail may be a retail service offered to end users at the application layer and supported by the lower layers. In economic parlance, an application like email is “downstream” from the transport (e.g., TCP) layer. Or to give another example, IP as a service is downstream from the network interface layer (e.g., Ethernet), which may be offered on a wholesale basis.

<sup>16</sup> This point is developed in more detail in the “Fundamental Economics of Network Expansion” section below, which explains why it is so difficult – and often unnecessary – for competing last-mile networks to be deployed.

transmission components (*e.g.*, loops) – are even more critical to providing a solid foundation for retail-level competition (*i.e.*, the applications layer) than they have been in the past.<sup>17</sup>

A key regulatory issue concerns what services should be made available (or remain available) to competitors, and at what prices and under what terms and conditions. An important factor in any such a determination is the economic and operational difficulty that the competitor faces in duplicating the service itself (self-provisioning) or acquiring the service from another supplier.

Using terms introduced from the discussion of the layered model above, it may be economically and operationally (or technically) infeasible for a competitor to construct a new overhead transmission line at the physical layer, unless access to facilities such as utility poles are available from the underlying layer – the support structure layer. On the other hand, if generic transmission capabilities at the physical layer are readily available at cost-related prices and under reasonable terms as a result of regulation or competitive supply, it may then be feasible for the competitor to add the necessary hardware and software to create new services at higher layers in the protocol stack.

These examples demonstrate the usefulness of the layered model to analyzing policy issues raised in a variety of contexts, including requests for forbearance of Section 251 unbundling obligations,<sup>18</sup> and to evaluating the importance of particular price levels for Section 271 offerings.<sup>19</sup> The governing principal from the layered model is that regulators should consider competitive conditions not only at the layer being reviewed, but should also look to the layer immediately below (to ensure a functioning wholesale market), as well as the layer above (to evaluate the consequences of any decision).

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<sup>17</sup> In the circuit-switched environment, network technologies and services (primarily voice) were standardized, with little differentiation possible or required (*i.e.*, there is little demand for a *better* voice service, once networks reached very levels of reliability). A major advantage of new technology, however, is that it is far more flexible and makes possible a range of innovations that make it even more important that the basic ingredients (*i.e.*, the lower levels of the protocol stack) are available broadly and at reasonable rates.

<sup>18</sup> Section 251 of the federal Telecommunications Act of 1996 (“Act”) requires ILECs to offer certain network elements to entrants at rates based on Total Element Long Run Incremental Cost (TELRIC). Although the TELRIC methodology is frequently criticized by ILECs as producing low lease rates, the methodology has been affirmed by the Supreme Court as reasonable.

<sup>19</sup> Unlike Section 251 of the Act that applies to all ILECs, Section 271 imposes a separate and distinct obligation on RBOCs to offer specifically enumerated network elements – comprehensively including, loops, switching, transport and access to databases – at rates that are “just and reasonable.” There are significant and continuing controversies as to whether the RBOC prices comply with this standard, with the Courts generally concluding that only the FCC has the authority to determine compliance.

### The Basic Components of the Physical Layer

As explained above, competition among applications – otherwise known as retail competition – is fundamentally dependent upon market conditions “lower in the stack,” including the costly physical layer. Before turning to a fuller discussion of regulatory policy, it is useful to briefly distinguish among different portions or segments of telecommunications networks: access, transport and backbone (illustrated by Figure 2 below).

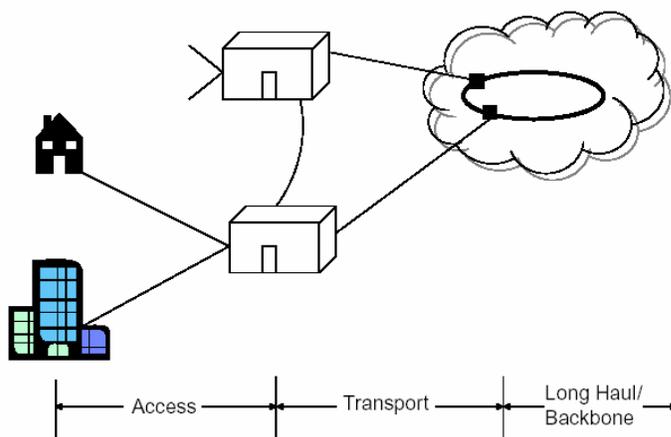


Figure 2 – Network Segments

The access segment of a network is the portion of the network that carries the communications traffic between the subscriber location (fixed or mobile) and a nearby node in the provider’s network. In the case of the traditional telephone network, this node is commonly referred to as the Central Office (“CO”).<sup>20</sup> The transport segment of a network carries communications traffic between and among these local nodes, and the nodes associated with the backbone or long haul portion of the network.<sup>21</sup> The backbone

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<sup>20</sup> In a traditional cable television architecture, the node could be the headend; in the typical cellular mobile radio network, it would be the Mobile Switching Center (“MSC”). In addition, in modern networks, there may be an additional node *within* the access segment of the network where concentration occurs. For instance, in the wireline telephone network, the individual twisted-pair copper loops associated with a particular neighborhood or building may terminate on a nearby multiplexing device known as a remote terminal. The individual communication paths corresponding to each loop are then separated by equipment at the Central Office. The devices, known generally as Digital Loop Carrier systems create difficulties in accessing unbundled loops for the competitive provision of broadband Digital Subscriber Loop (“DSL”) services at the data link layer.

<sup>21</sup> Note that the term “transport” is used to identify both a *layer* in the protocol stack and a *segment* of the physical network. To alleviate any ambiguity, the former will be referred to as the “transport layer” and the later as the “transport segment.”

or long haul segment of a network carries traffic between and among the metropolitan areas and smaller communities.<sup>22</sup>

The most common wholesale offerings supplied by incumbent local telephone companies are dedicated UNEs (*i.e.*, unbundled loops and/or transport) or “special access” services. These arrangements consist of a combination of the access segment and transport segment of the network, operating at the data link/physical layer.<sup>23</sup> An issue critical to the development of competition – and to the design of an appropriate regulatory policy – concerns the competitive conditions here, at the physical network layer, and in particular, for these dedicated wholesale offerings.<sup>24</sup>

### **The Fundamental Economics of Network Expansion**<sup>25</sup>

The benefits of competitive markets are that they lower prices, encourage innovation, reward efficiency and punish ineptitude (and indifference). Ideally, competition could emerge at each layer of the protocol stack and in each segment of the network (access, transport and backbone). Such competition would enable a competitor offering service to a customer to do so by (a) choosing from a range of competitively priced options for a particular layer and segment, or (b) choosing to build out a network to a desired layer serving a particular segment. These options reflect the classic “build or buy” decision that companies routinely face. In principle, the ability to build or self-

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<sup>22</sup> In the case of the traditional telephone network, the narrowband voice or voice-band data traffic can be switched at the various nodes (e.g., at the local CO or at an associated tandem office). Although the analogy is somewhat imprecise, circuit switching in the traditional telephone network can be likened to the establishment of connections and the routing of packets that occurs in the transport and IP layers in the protocol stack model.

<sup>23</sup> With dedicated facilities, no switching or routing is involved. Dedicated facilities are especially important to government agencies and businesses that have substantial volumes of metropolitan area and long distance voice and/or data traffic, as well as the CLECs and cable companies that seek to serve such customers, but have not yet constructed the necessary access and/or transport segments to reach them on a ubiquitous basis.

<sup>24</sup> It is also useful to note that the volume of traffic increases as we move from the access segment of the network to the transport segment to the intercity or long haul segment. While an individual local loop in the access segment may carry a single telephone conversation or data communications session, the transport segment would likely carry hundreds of such conversations/sessions to and from the long haul segment. Similarly, the long haul or backbone segment may be carrying thousands of such conversations/sessions between major metropolitan centers. This, in turn, has implications in terms of the economic feasibility of competition in each segment of the network – access, transport and long haul/backbone. That is, larger volumes of traffic equate to greater competitive opportunities.

<sup>25</sup> Portions of this section draw upon Dale N. Hatfield and David E. Gardner, *An Essay on Competition, Innovation and Investment in Telecommunications*, Aspen Institute, 1997 (Available at: [http://www.aspeninstitute.org/site/c.huLWJeMRKpH/b.787859/k.9B33/The\\_Twelfth\\_Annual\\_Conference\\_on\\_Telecommunications\\_Policy.htm](http://www.aspeninstitute.org/site/c.huLWJeMRKpH/b.787859/k.9B33/The_Twelfth_Annual_Conference_on_Telecommunications_Policy.htm))

supply a given segment of the network or layer in the protocol stack would protect against the exercise of any upstream market power held by a supplier.

The decision whether or not to make a particular investment (in this case investing in an expanded network) is straightforward at the conceptual level. An investment will be attractive if the return on invested capital (“ROIC”) is sufficient to compensate the investor for the time value of money and the risk associated with the investment relative to

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*A key economic characteristic of last-mile facilities is that the customer typically selects only one provider at a time. As such, providers confront a binary choice – winner or loser. Because wireline last-mile facilities cannot typically be reused by another consumer, or shifted to other areas where demand is higher, relatively few last-mile networks will be constructed.*

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other opportunities. A common method of evaluating investments that takes into account the time value of money and the risk is known as the discounted cash flow (“DCF”) approach. In the DCF model, the current value of an investment is assumed to be the future expected cash flow produced by the investment discounted back to the present at a discount rate (percentage return) that reflects the risk associated with the projected cash flow. If the current value of the potential investment computed using the DCF approach is equal to or greater than the amount to be invested, then the investor will have the incentive to make the investment. If it is less, then the investor will be deterred from making the investment.

In most circumstances, the reality is more complicated than the ideal competitive situation outlined above. For instance, cable companies, traditionally built their networks to provide entertainment video services to residential subscribers and they often lack the necessary facilities to serve enterprise customers in large office buildings and office parks. Even where a cable company has chosen to aggressively serve the enterprise market, it cannot instantaneously expand its own physical layer infrastructure to reach additional enterprise market locations.

On the other hand, in their respective territories, the ILECs typically have long established, ubiquitous (or near ubiquitous) infrastructure for serving those markets. Thus, as a practical matter, the cable companies and other CLECs remain dependent upon ILEC facilities and services for reaching some enterprise customers and the ILECs retain some degree of market power in terms of those facilities and services and, absent regulatory intervention, in the associated downstream markets.

Beyond the impracticality of instantaneously building out a ubiquitous network, the potential competitors face two broad categories of challenges in geographically expanding an existing network: (1) economies of scale and (2) added operational risks.

The first barrier to entry – economies of scale – arise when a provider of a product or service experiences declining average costs per customer over the relevant range of output. Economies of scale are typically associated with capital-intensive business where large, fixed, up-front investments are required in order to provide the product or service.

Other things being equal, this means that an incumbent provider with an established customer base will have low average costs because they will have already “ridden down” the average cost curve. On the other hand, a potential competitor, starting with few customers in a new geographic area, faces very high average costs, but must match – going in – the price set by the incumbent based upon the latter’s lower average costs. In a situation with strong economies of scale, this produces large negative cash flows at the start of an expansion project.

Moreover, in addition to the large negative cash flow associated with the up-front construction of fixed facilities, a new entrant often faces high up-front marketing and promotional costs in order to entice customers to switch from the incumbent provider with whom they may have had a long relationship. It takes time to acquire and switch customers over to a new network. This pushes the point at which positive cash flow is achieved still further into the future, further decreasing the value of the potential investment as reflected in the DCF analysis outlined earlier.

The second set of challenges are the added operational risks associated with the activities necessary to construct the actual facilities, such as successfully negotiating for access to rights-of-way or gaining access to buildings where customers reside. Not only is there the risk of not being able to successfully negotiate the necessary agreements, but also the normal time periods to do so once again push the point of positive cash flow further into the future.<sup>26</sup>

Returning to the layered architecture model, it is apparent that the lower layers of the protocol stack exhibit greater economic barriers and greater operational challenges than higher layers. For example, consider the support structure layer. It is economically unreasonable, operationally unrealistic, as well as aesthetically

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*As a general rule, the lower the layer in the protocol stack, the greater the economic barrier to duplication. Consequently, regulators should focus on establishing competitive wholesale conditions for network elements, services and structures at the lower (data-link to support structure) layers to be assured of robust competition at the higher layers (retail services and applications).*

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undesirable to expect a competitor expanding its geographic reach to construct a duplicate pole line to support a new transmission facility to serve a new area. Similarly, at the physical layer, it may be uneconomic and operationally unrealistic for a competitor to install and maintain a new fiber optic cable to serve a single distant customer, even if access to the necessary support structures is available at cost-related prices and on reasonable terms and conditions.

A key economic characteristic of last-mile facilities is that typically the customer will only select one provider at a time. As such, providers experience a binary outcome

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<sup>26</sup> Such negotiations are more likely to be contentious and drawn out if they involve the incumbent as a competitor and/or the other party (such as a right-of-way or building owner) has some degree of economic power.

as winner or loser. Because wireline last-mile facilities cannot typically be reused by another consumer, or shifted to other areas where demand is higher, network construction only occurs where the construction is incremental to an existing business plan (such as a cable provider adding telephony, or a telephone provider adding video), in response to pre-committed demand (such as a CLEC extending service to a business premise only after contracting with an anchor customer), or assured by the expectation of unusually high success (such as an ILEC extending service to an adjacent territory). Collectively, these factors mean that relatively few last-mile networks will be constructed and, where constructed, are unlikely to be ubiquitous.

On the other hand, at the application layer, expansion into a new geographic area to offer a networking service, for example, may be much more feasible with reasonable access to the lower layers of an existing network, because the up-front investment would be relatively small and fungible and no special negotiations would be required. As noted before, the economies of scale and the operational challenges tend to diminish as one moves up the protocol stack.<sup>27</sup> In some areas, there simply may not be enough business to justify expansion at the data link and physical layers in the access or even the transport segments of the network. (That is, even an efficient competitor cannot attract a sufficient customer base to make the investment attractive as the present value of the future cash-flow would not exceed the amount of the required investment using the DCF method.)

While an investment at the support structure or data link and physical layers may not be economically justified in less populated areas due to economies of scale and operational barriers associated with the lower layers, investment in downstream markets at higher layers may still be attractive in terms of the projected ROIC. This is because the economies of scale and the operational challenges may be considerably less at the upper layers. This, of course, assumes that access to the required lower layer or upstream facility is available from the incumbent at cost-related prices and under reasonable terms and conditions.

### **The Importance of the Layers Model on Regulatory Policy**

Given the clear benefits of competition, the public policy goal should be to encourage competition at all layers of the protocol stack, and in all network segments. The inescapable reality, however, is that efficient competition may not be economically and operationally feasible at each layer, and for each segment, of the network in every geographic area. As a result, the relevant question is how to best structure regulatory policy to achieve results as close to the competitive ideal as possible.

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<sup>27</sup> For example, if a physical layer digital bit stream such as a DS1 or DS3 is available at reasonable terms, then all that is needed to create services at the next layer (ATM, Frame Relay, and MPLS) is electronic equipment. Clearly, the economic and operational barriers to adding electronic equipment at the edge is less than the barriers to create the DS1 or DS3 transmission facility that exists between these end points.

The primary conclusion developed above is that telecommunications markets must be analyzed along several dimensions, including: (a) the *layer* in the protocol stack being evaluated, and (b) the *network* segment – i.e., access, transport or long-haul – when developing regulatory policy. These are the *technical* dimensions that are the principal focus of this paper, but they are not the only dimensions that are relevant. It remains important to also consider the traditional dimensions of customer-segment (residential, small business, or enterprise), as well as geography.

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*To be successful, any deregulatory initiative must first properly identify the boundary between the wholesale and retail layers and then determine the level of competition at each. Only where wholesale inputs are broadly available at just and reasonable terms – either because of competition at the wholesale level or as the result of effective regulation – can retail deregulation be expected to succeed.*

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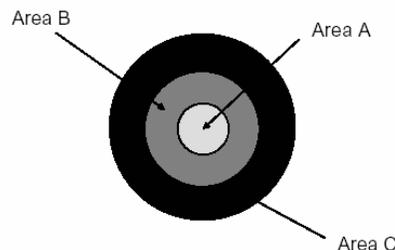
The primary focus on the technical dimension, however, was deliberate, for it is this dimension that is principally relevant to the core policy recommendation of this paper that any deregulatory analysis first identify the *boundary* between wholesale inputs and retail applications before then determining the level of competition in a market. Only where wholesale inputs are available and on just and reasonable terms – either because of competition at the wholesale level or as the result of effective regulation – can retail deregulation be expected to succeed.

The importance of wholesale-level market conditions cannot be underestimated. As a practical matter, there are several layers in the protocol stack – for instance, support structures – that it may *never* make sense to duplicate. In some geographic areas, portions of the stack (such as the physical layer for transport) may be suitable for duplication, but competition will still be limited unless lower layers in the various network segments are meaningfully available as wholesale inputs.

Consider the very common situation where a large enterprise customer has issued a Request for Proposals (“RFP”) to acquire a communications service – say a high-speed data service – at numerous locations over a wide geographic area. Within the geographic footprint of the RFP, assume there are three areas with the following characteristics:

Area	Economic Characteristics
A	Feasible for competitor to construct physical layer facilities (and above) in both the access and transport segments of the network
B	Feasible for a competitor to construct physical layer facilities in the transport but not the access segments of the network
C	Not feasible for a competitor to construct physical layer facilities in either the transport or access segments of the network

These three geographic areas are illustrated in Figure 3. Assume that the incumbent carrier already has the necessary physical layer facilities in both the transport and access segments of its network over the entire area while the competitor has physical layer facilities in Area A but not in Areas B and C. Further assume that the competitor has innovative services to offer (e.g., in terms of network management) in the layers above the physical layer.



Area A – Access and Transport Segment Physical Layer Competition Feasible  
Area B – Transport Segment but Not Access Segment Physical Layer Competition Feasible  
Area C – Neither Access or Transport Segment Physical Layer Competition Feasible

Figure 3 – Competitively Feasible Geographic Areas

The correct regulatory policy is to ensure that all lower layers – and network segments – that cannot be efficiently duplicated remain available as wholesale inputs to support competition in higher layers. In the scenario above, only the incumbent has the ability to offer service over the entire geographic footprint of the RFP. Consequently, even though some areas/layers may enjoy the *potential* for competitive entry, that entry would be frustrated (if not precluded) by the unique advantage of the incumbent that it – and, importantly, only it – is able to satisfy the entirety of the RFP on its facilities.

The logical progression of telecommunications investment is downwards, from higher-layers in the stack initially (such as applications);<sup>28</sup> and, with respect to network components, from network segments with higher levels of aggregation (such as inter-city) towards facilities with less (with the loop connecting an individual customer the most unlikely facility to be duplicated). Maximizing competition – and ensuring that the benefits from deregulation flow to consumers – requires that regulators carefully identify the boundary between retail layers/segments and the wholesale layers

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***The logical progression of telecommunications investment is downwards, from higher-layers in the stack initially (such as applications) to lower levels (i.e., the physical layer); and, with respect to network components, from network segments with higher levels of aggregation (such as transport) to the facility least likely to be duplicated, the loop serving an individual customer.***

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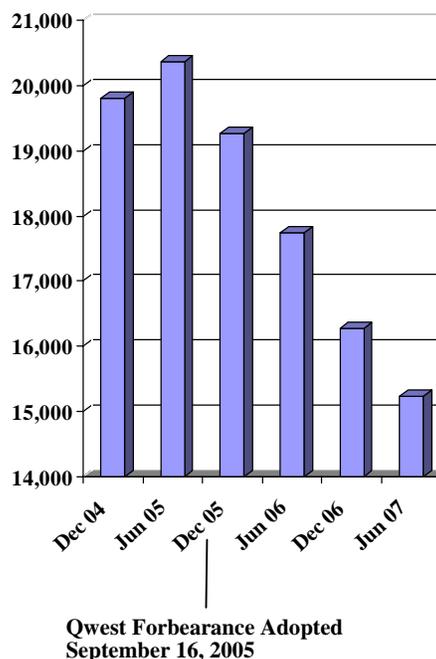
<sup>28</sup> Because access to rights-of-way and other support structures is likely to remain essential to the expansion of physical layer competition for the foreseeable future, continued regulatory oversight of the prices and terms and conditions governing such access will be needed in all geographic areas.

below and maintain regulatory requirements for those wholesale elements that are not competitive, to ensure these critical elements are equally available among rivals.<sup>29</sup>

The poster child illustrating the consequences of prematurely eliminating wholesale requirements is the Omaha market following the FCC’s predictive judgment that Qwest would continue to offer meaningful wholesale services, even as its legal §251 unbundling obligations were removed through forbearance.<sup>30</sup> Specifically, the FCC predicted that competition from the facilities of Cox (the cable-based provider of telephony services in the Omaha market), as well as Qwest’s continuing obligations under §271 of the federal Act, would keep wholesale rates at just and reasonable terms and thereby protect retail competition.<sup>31</sup> As it turned out, no such competitive wholesale market has emerged.

As Figure 4 demonstrates, the result of the Omaha Forbearance decision has been a collapse in wholesale volume, as Qwest increased rates unconstrained by regulation or the presence of facilities owned by Cox. Because the FCC failed to evaluate conditions at the wholesale level (at the critical physical layer of the protocol stack), the elimination of §251 unbundling obligations enabled Qwest to exploit its market dominance and increase prices by between 30% (individual DS0s) and 178% (DS3s).<sup>32</sup>

**Figure 4: Effect of Forbearance on UNE-Loop Competition - Nebraska**



<sup>29</sup> Again, turn to the example of the RFP discussed above. If wholesale obligations are removed prematurely, or cut-back below layers where continuing obligations are needed, efficient investment by competitors will be discouraged and customers will be denied lower prices and greater innovation. This is because such a policy would deny an efficient competitor from accessing the facilities/services corresponding to the lower layers of the protocol stack that would be needed to provide service at higher layers.

<sup>30</sup> See Petition of Qwest Corporation for Forbearance Pursuant to 47 U.S.C. § 160(c) in the Omaha Metropolitan Statistical Area, WC Docket No. 04-223, Memorandum Opinion and Order, (rel. Dec. 2, 2005) (“*Omaha Order*”). In Omaha, the FCC eliminated Qwest’s obligations to provide critical loop and transport facilities to competitors at regulated cost-based rates. These facilities were being used to connect to end-users to offer competitive services.

<sup>31</sup> See *Omaha Order* at ¶¶ 66 and 79.

<sup>32</sup> See Letter to Marlene Dortch, Secretary, Federal Communications Commission, from William Haas, McLeodUSA, November 17, 2007 (“*McLeodUSA Ex Parte*”). McLeodUSA further explained in this filing that it intends to exit the Omaha market if the FCC does not

These price increases caused a significant decline in competitive activity, with UNE loop volumes declining by 25% for the *entire* State of Nebraska.<sup>33</sup>

The failure for wholesale competition to emerge in the Omaha market is the product of a number of factors. The primary facility-based alternative to Qwest is the cable-telecommunications network of Cox Communications. With only two providers, there is little reason to expect an interest in wholesale offerings (which would support additional retail level competition). In addition, the cable-plant of Cox is generally deployed to residential areas, while most UNE-based competition focuses on the small-to-medium business market (as well as some enterprise customers).<sup>34</sup> In addition, the FCC's reliance on the continuing obligations of §271 as a legal obligation has little effect unless enforced, and a string of court decisions has gradually weakened the authority of state commissions to review the pricing in such agreements.<sup>35</sup> Collectively, the evidence is clear that the elimination of regulatory obligations to offer wholesale service at reasonable rates has seriously harmed competition in the Omaha Market.

### **Conclusion**

The emergence of layered network architectures has not lessened the need for regulatory oversight, in particular with respect to facilities that define the physical layer in the access and local transport segments. Retail competition and innovation is directly dependent upon lower layers in the protocol stack continuing to be available at reasonable wholesale prices, terms and conditions. Oversight is needed here because competitive wholesale markets have not emerged.

Where competition at the wholesale level assures such pricing and terms, reducing regulatory obligations makes sound policy sense. The Omaha Experiment,

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reverse its forbearance experiment. Notably, McLeodUSA (now merged with PAETEC) would continue to provide service in the adjacent Council Bluffs, Iowa market that was not included in the Omaha experiment.

<sup>33</sup> Source: Qwest Form 477 Filings at [www.fcc.gov/wcb/iatd/comp.html](http://www.fcc.gov/wcb/iatd/comp.html). Data specific to Omaha market is not publicly available.

<sup>34</sup> McLeodUSA estimates that Qwest is the sole provider of last mile facilities to approximately 98% of the commercial buildings in the Omaha MSA. *McLeodUSA Ex Parte* at 1.

<sup>35</sup> For instance, see *Verizon New England, Inc. v. Maine Pub. Utils. Comm'n*, 509 F.3d 1, order on reh'g, 509 F.3d 13 (1<sup>st</sup> Cir 2006); *Southwestern Bell Tel, L.P. v. Missouri Pub. Serv. Comm'n*, 461 F.Supp.2d 1055 (E.D. Mo. 2006), appeals pending, Nos. 06-3701, 06-2726, 06-3727 (8<sup>th</sup> Cir.); *BellSouth Telecommunications, Inc. v. The Georgia Public Service Commission*, No. 1:06-CV-00162-CC; *Competitive Carriers of the South, Inc. v. The Georgia Public Service Commission*, No. 1:06-CV-00972-CC (N.D. Ga. Jan. 3, 2006), appeals pending, Nos. 08-10521-AA, 08-10522-AA (11<sup>th</sup> Cir.); *Qwest Corp. v. Arizona Corp. Comm'n*, 496 F.Supp.2d 1069 (D. Ariz. 2007), appeals pending, Nos. 07-17079, 07-17080 (9<sup>th</sup> Cir.); and *Illinois Bell Tel. Co. v. O'Connell-Diaz*, No. 05-C-1149, 2006 WL 2796488 (N.D. Ill. Sept. 28, 2006), appeals pending, (7<sup>th</sup> Cir.).

however, demonstrates that the reverse is not true – that is, merely observing retail-level competition does not imply that wholesale inputs will be priced reasonably in the absence of regulatory oversight.

The nation stands on the cusp of an explosion of retail-level innovation, but only if competitors are assured continued access to local network facilities at reasonable terms, conditions and prices. Where Section 251 assures that access, the FCC should reject any further forbearance requests until sustainable competition at the wholesale layer is documented.<sup>36</sup> Where the FCC has reduced unbundling obligations – but Section 271’s requirement that access continued to be provided at just and reasonable rates – the FCC must be prepared to *enforce* that requirement or Section 271 will have no effect.<sup>37</sup>

In either circumstance, the key remains the same: Until a functioning *wholesale* market exists, the FCC should not eliminate its oversight of the incumbent’s *wholesale* offerings.

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<sup>36</sup> The FCC should also terminate the Omaha Experiment and restore cost-based prices in that MSA.

<sup>37</sup> The FCC’s “non-impairment” finding (which removes the obligation to offer an element at TELRIC-based rates), does not imply a functioning wholesale market that would assure just and reasonable rate levels as the result of competitive pressures.