

From “Broadband” to “Infrastructure”

You can read the print version [here](#).


Bits Versus Electrons

From Broadband to Infrastructure

By Bob Frankston

Imagine trying to build an electronic device if the company providing the wires had to make a profit on each circuit and interconnection. Today, the Internet allows us to design systems that can span the world, but we can't realize the full potential of those systems because the suppliers of the wires demand a payment for each connection. We need to rethink the interconnections as infrastructure rather than as a message-carrying service. The success of the Internet demonstrates that we now depend on network operators to ensure that services, such as telephony, work. The carriers are pushing back on neutrality because their business model is threatened by a level playing field. We should be encouraging innovative Internet-native business models rather than working to preserve an industry threatened by innovation.

The debate over network neutrality is framed within traditional telecommunications policy. As such, it considers the Internet to be just another service, such as phone calls or cable TV. But the Internet is different. When we used dial-up modems, we performed internetworking as users. With the advent of digital subscriber-line and cable modems, the telecommunications and cable companies engaged in the business of providing Internet service. Whether we used our own modems for dial-up or modems supplied by the carriers, raw packets themselves are a commodity whose

 We need to rethink the interconnections as infrastructure rather than as a message-carrying service.

value comes entirely from what we do with them.

Of course, the telecom providers wanted to use their facilities to provide valuable services. The regulators were properly concerned about the very real conflict of interest in having the facilities owners competing with their customers. The Internet was shoehorned into this framework despite the fact that it wasn't really a service. France's Minitel information service was one of the most successful efforts to provide smart services. The price or rate you paid was tied to the phone number for that service. It was very successful because it broke from tradition in its approach, but Minitel couldn't compete on a level playing field with the Internet and, particularly, the web. Cable TV isn't considered a network service like Minitel, but with everything becoming digital, cable content is increasingly moving to the open Internet.

The carriers are left with just dumb pipes. With network neutrality, they have little opportunity to earn money with the revenue from services in transit across those pipes, not even a service so basic as more reliable delivery. Furthermore, there is no differentiation;

all pipes are the same. This means competing pipes are like competing electric grids; it doesn't make economic sense. We have a single grid that supports competition by providers of content (i.e., electricity) using a common infrastructure. There is also competition from other energy sources. The problem, with or without neutrality, is that we're increasingly adept at programming around the network. The packets don't depend on reserved paths or pipes; they can each take a different path and are assembled at the end points.

Instead of trying to bring back Minitel, we need to look forward to expanding the level playing field. This means understanding that we no longer require networking as a service. We simply need a way to forward packets because we implement the services, such as Skype for phone calls, on our own computers. This not-a-network approach is also called the *end-to-end argument* [1]. That means services can be implemented at the end points (i.e., outside the network) without depending on network operators along the path. If we don't depend on network operators, they can't charge for services. This profound change isn't obvious because we still buy broadband services from a provider just like we did in the days of dial-up modems. We even call them cable modems.

A DIFFERENT APPROACH

In 1995, I was at Microsoft, which was based in Seattle, although I worked remotely from Boston. I had long been

cable modems the telecommunications (and cable) companies got into the business of providing “Internet”. Whether we used our own modems of dialup or the carriers supplied the modems, raw packets themselves are a commodity whose value comes from entirely what we do with them.

Of course, the telecom providers wanted to use their facilities to provide valuable services. The regulators were properly concerned about the very real conflict of interest in having the facilities owners competing with their customers. The Internet was shoehorned into this framework despite the fact that it wasn't really a service. France's Minitel information service was one of the most successful efforts to provide smart services. The price (or rate) you paid was tied to the phone number for that service. It was very successful because it broke from tradition in its approach. But Minitel couldn't compete on a level playing field with the Internet and the web in particular. Cable TV isn't considered a network service like Minitel. But with everything becoming digital, cable content too, is increasingly moving to the open Internet.

The carriers are left with just dumb pipes. With network neutrality they have little opportunity to earn money with the revenue from services. Not even a service so basic as more reliable delivery. Furthermore, there is no differentiation – all pipes are the same. This means competing pipes are like competing electric grids – it doesn't make economic sense. We have a single grid that supports competition by providers of content – electricity – using a common infrastructure. There is also competition from other energy sources. The problem, with or without, neutrality, is that we're increasingly adept at programming around the network. The packets don't depend on reserved paths or pipes – they can each take a different path and are assembled at the end points.

Instead of trying to bring back Minitel we need to look forward to expanding the level playing field. It means understanding that we no longer need networking as a service. We simply need a way to get packets forwarded because we implement the services (like phone calls – as with Skype) in our own computers. This “not-a-network” approach is also called the *end-to-end argument* (<http://bit.ly/EndToEnd>). That means services can be implemented at the end points (outside the network) without depending on network operators along the path. And if we don't depend on network operators, they can't charge for services. This profound change isn't obvious because we still buy broadband services from a provider just like we

Imagine trying to build an electronic device if the company providing the wires had to make a profit on each circuit and interconnection. Today the Internet allows us to design systems that can span the world, but we can't realize the full potential because the supplies of the “wires” demand a payment for each connection. We need to rethink the interconnections as infrastructure rather than a message carrying service. The success of the Internet demonstrates that we now depend on network operators to assure that services like telephony work. The carriers are pushing back on neutrality because their business model is threatened by a level playing field. We should be encouraging innovative Internet-native business models rather than working to preserve an industry threatened by innovation.

The debate over network neutrality is framed within traditional telecommunications policy. As such it considers the Internet to be just another service like phone calls or cable television. The Internet is different. When we used dialup modems we did internetworking as users. With DSL and

did in the days of dial up modems. We even call them cable modems.

In 1995 I was at Microsoft, based in Seattle but was working from home in Boston. I had long been building my own networks using the same principles as the Internet. I was fortunate to learn about the technologies as they developed and to work with some of the designers first hand. I knew that a local network wasn't even a network. It was just a shared wire (or radios). The networking was done entirely in the connected computers. But I didn't want to just dial up and connect one computer to an online service. I wanted my home entire network to be interconnected with the rest of the Internet (and to Microsoft's campus network). At that time, you were supposed to get a separate account for each computer just like you did for each phone line. After all, that's the way dialup modems worked. I took a different approach because I was interconnected to a network and all the computers would share a single connection. At that time the term broadband was used for a fat pipe that the provider would use to sell services. This is why ATT paid a high price for my local cable company – MediaOne; they expected to make money just as Minitel had, by selling phone calls, cable TV, meter reading and gaining a new revenue streams from e-commerce, meter-reading and whatever else they could offer. By using the intelligence in my computers all I needed was one shared connection and all AT&T saw was just a jumble of packets that all looked the same. And because I was working at Microsoft I was able to get this capability built into Windows. Users no longer needed a network professional to setup a home network. They could just buy what they need at any computer store! While I can't claim all the credit I do assume that this contributed to AT&T being bought by SBC. Today's ATT is really SBC.

We have today's regulatory system because the business model of telecommunications and the needs of the country for connectivity were not a good match. In the days of telegraphy and then telephony, the high capital costs and little differentiation required a regulatory agency to assure an orderly marketplace. We start by recognizing that the moving of the intelligence outside of networks inverts the model.

The Internet is not something we get through a broadband pipe. Instead we turn the pipe around and originate the services from within our own homes (or offices). We use that broadband pipe and any other facilities as commoditized resources. This means we need locally owned infrastructure that is more like sidewalks and roads than like train tracks. I'm careful to use the word infrastructure rather than utility to avoid the idea we're consuming anything anymore than we consume sidewalks when we take a

stroll. Water and electricity are metered by usage. It doesn't make sense to talk about using up a supply of ones and zeros. There is no scarcity of "Internet". We pay for sidewalks as a community. We join together to pay for the paths in an apartment complex or as a city for paving the paths. Sidewalks are not strictly necessary. We have them because they facilitate walking and make the city a better place. And like sidewalks, Ambient Connectivity is free-to-use. Today each innovative application like medical monitoring requires a separate negotiation with carriers who don't get much revenue from devices that generate little traffic. We avoid depending on relationships with a myriad of carriers just to assure connectivity. With Ambient Connectivity we get to "just works" and unleash major innovation. Imagine communicating without a monthly fee merely to connect. That monthly fee will soon seem as strange as paying just to cross the street.

As we transition to Ambient Connectivity we can continue to use the existing telecommunications infrastructure as just another wire. And that's the crux of the problem for the providers – they are indeed just another wire with all the value being in applications. During this transition we do need network neutrality more-than-ever in order to assure that the carriers don't fight the future by abusing their stewardship of our vital means of communicating. This is harsh for them but, it's just business. Companies like Comcast and Time-Warner have moved on and are now in the content business knowing full-well that the networks are no longer the focus of their business. Verizon and ATT are following along. They may or may not succeed in this strategy. Time will tell.

The battle over network neutrality is framed in the existing regulatory framework which treats the Internet as just another telecom service rather than something new. We must look ahead not backwards. We must seize opportunity to add trillions to the economy. Just think about what would happen if we just reduced everyone's Internet and cellular phone bills by perhaps \$100/month and returned nearly a thousand dollars a year to every family in America while providing a level playing field for new businesses.