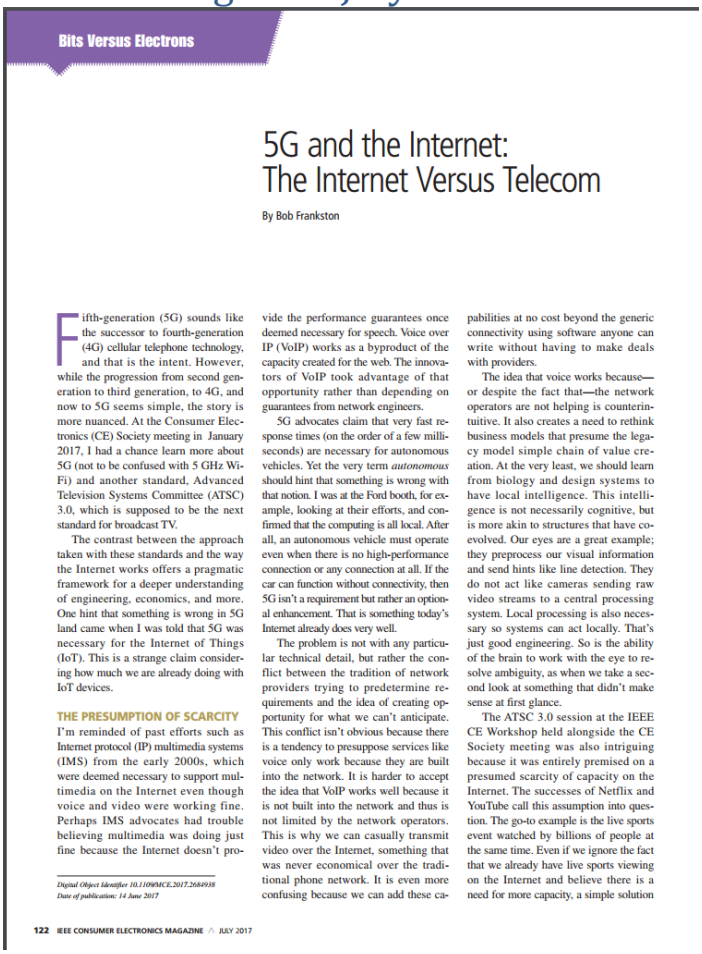
5G: Telecom Versus The Internet

IEEE CE Magazine July 2017



Bits Versus Electrons

5G and the Internet:
The Internet Versus Telecom

By Bob Frankston

Fifth-generation (5G) sounds like the successor to fourth-generation (4G) cellular telephone technology, and that is the intent. However, while the progression from second generation to third generation, to 4G, and now to 5G seems simple, the story is more nuanced. At the Consumer Electronics (CE) Society meeting in January 2017, I had a chance learn more about 5G (not to be confused with 5 GHz Wi-Fi) and another standard, Advanced Television Systems Committee (ATSC) 3.0, which is supposed to be the next standard for broadcast TV.

The contrast between the approach taken with these standards and the way the Internet works offers a pragmatic framework for a deeper understanding of engineering, economics, and more. One hint that something is wrong in 5G land came when I was told that 5G was necessary for the Internet of Things (IoT). This is a strange claim considering how much we are already doing with IoT devices.

THE PRESUMPTION OF SCARCITY

I'm reminded of past efforts such as Internet protocol (IP) multimedia systems (IMS) from the early 2000s, which were deemed necessary to support multimedia on the Internet even though voice and video were working fine. Perhaps IMS advocates had trouble believing multimedia was doing just fine because the Internet doesn't provide the performance guarantees once deemed necessary for speech. Voice over IP (VoIP) works as a byproduct of the capacity created for the web. The innovators of VoIP took advantage of that opportunity rather than depending on guarantees from network engineers.

5G advocates claim that very fast response times (on the order of a few milliseconds) are necessary for autonomous vehicles. Yet the very term *autonomous* should hint that something is wrong with that notion. I was at the Ford booth, for example, looking at their efforts, and confirmed that the computing is all local. After all, an autonomous vehicle must operate even when there is no high-performance connection or any connection at all. If the car can function without connectivity, then 5G isn't a requirement but rather an optional enhancement. That is something today's Internet already does very well.

The problem is not with any particular technical detail, but rather the conflict between the tradition of network providers trying to predetermine requirements and the idea of creating opportunity for what we can't anticipate. This conflict isn't obvious because there is a tendency to presuppose services like voice only work because they are built into the network. It is harder to accept the idea that VoIP works well because it is not built into the network and thus is not limited by the network operators. This is why we can casually transmit video over the Internet, something that was never economical over the traditional phone network. It is even more confusing because we can add these capabilities at no cost beyond the generic connectivity using software anyone can write without having to make deals with providers.

The idea that voice works because—or despite the fact that—the network operators are not helping is counterintuitive. It also creates a need to rethink business models that presume the legacy model simple chain of value creation. At the very least, we should learn from biology and design systems to have local intelligence. This intelligence is not necessarily cognitive, but is more akin to structures that have co-evolved. Our eyes are a great example; they preprocess our visual information and send hints like line detection. They do not act like cameras sending raw video streams to a central processing system. Local processing is also necessary so systems can act locally. That's just good engineering. So is the ability of the brain to work with the eye to resolve ambiguity, as when we take a second look at something that didn't make sense at first glance.

The ATSC 3.0 session at the IEEE CE Workshop held alongside the CE Society meeting was also intriguing because it was entirely premised on a presumed scarcity of capacity on the Internet. The successes of Netflix and YouTube call this assumption into question. The go-to example is the live sports event watched by billions of people at the same time. Even if we ignore the fact that we already have live sports viewing on the Internet and believe there is a need for more capacity, a simple solution

Digital Object Identifier 10.1109/MCE.2017.2684938
Date of publication: 14 June 2017

DOI: 10.1109/MCE.2017.2684938

The Internet vs. Telecom

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The contrast between the approach taken with these standards and the way the Internet works offers a pragmatic framework for a deeper understanding of engineering, economics and more. One hint that something is wrong in 5G-land came when I was told that 5G was necessary for IoT. This is a strange claim considering how much we are already doing with connected (IoT or Internet of Things) devices.

The Presumption of Scarcity

I'm reminded of past efforts such as IMS (IP Multimedia Systems) from the early 2000's which were deemed necessary in order to support multimedia on the Internet even though voice and video were working fine. Perhaps the IMS advocates had trouble believing multimedia was doing just fine because the Internet doesn't provide the performance guarantees once deemed necessary for speech. Voice over IP (VoIP) works as a byproduct of the capacity created for the web. The innovators of VoIP took advantage of that opportunity rather than depending on guarantees from network engineers.

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At the very least we should learn from biology and design systems to have local "intelligence". I put the word intelligence in quotes because this intelligence is not necessarily cognitive but more akin to structures that have co-evolved. Our eyes are a great example – they preprocess our visual

information and send hints like line detection. They do not act like cameras sending raw video streams to a central processing system. Local processing is also necessary so systems can act locally. That's just good engineering. So is the ability of the brain to work with the eye to resolve ambiguity as when we take a second-look at something that didn't make sense at first glance.

The ATSC 3.0 session at ICCE (IEEE Consumer Electronics workshop held alongside CES) was also intriguing because it was premised on a presumed scarcity of capacity on the Internet. Given the successes of Netflix and YouTube one has to wonder about this assumption. The go-to example is the live sports event watched by billions of people at the same time. Even if we ignore the fact that we already have live sports viewing on the Internet and believe there is a need for more capacity, there is already a simple solution in the way we increase over-the-air capacity using any means of distributing the content to local providers which then deliver the content to their subscribers. The same approach works for the Internet. Companies like Akamai and Netflix already do local redistribution. Note that such servers are not "inside the network" but use connectivity just like many other applications. This means that anyone can add such capabilities. We don't need a special SDN (Software Defined Network) which presumes we need to reprogram the network for each application.

This attempt to build special purpose solutions shows a failure to understand the powerful ideas that have made the Internet what it is. Approaches such as this create conflicts between the various stakeholders defining functions in the network. The generic connectivity creates synergy as all the stakeholders share a common infrastructure because solutions are implemented outside of the network.

From Networks to Connectivity

We're accustomed to thinking of networking as a service and networks as physical things like railroads with well-defined tracks. The Internet is more like the road system that emerges from the way we use any path available. We aren't even confined to roads thanks to our ability to buy our own off-road vehicles. There is no physical network as such but rather disparate transports for raw packets which make no promises other than a best effort to transport packets.

That might seem to limit what we can do but it turned out to be liberating. This is because we can innovate without being limited by a telecommunications provider's imagination or its business model. It also allows multiple approaches to share the same facilities. As the capacity increases it benefits all applications creating a powerful virtuous cycle.

It is also good science because it forces us to test limiting assumptions such as the need for reserved channels for voice. And good engineering and good business because we are forced to avoid unnecessary interdependence.

Another aspect of the Internet that is less often cited is the two-way nature which is crucial. This is the way language works by having conversations so we don't need perfection nor anticipate every question. We rely on shared knowledge that is not available only outside of the network.

It's easy to understand why existing stakeholders want to continue to capture value inside their (expensive) networks. Those who believe in creating value inside networks would choose to continue to work towards that goal while those who question such efforts would move on and find work elsewhere. It's no surprise that existing companies would invest in their existing technologies such as LTE rather than creating more capacity for open WiFi.

The Future of Networking

The simple narrative of legacy telecommunications makes it simple for policymakers to go along with such initiatives. It's easy to describe benefits including the smart cities which, like telecom, bake the functions into an infrastructure. What we need is a more software-defined smart city which provides a platform adding capabilities. The city government itself would do much of the work but others could add to the capacity and take advantage of the connectivity to provide services.

It is more difficult to argue for opportunity because the value isn't evident beforehand. And even harder to explain that meeting today's needs can actually work at cross-purposes with innovation. We see this with "buffer-bloat". Storing data inside the network benefits traditional telecommunications applications that send information in one direction but make conversations difficult because the computers don't get immediate feedback from the other end.

Planned smart cities are appealing but we get immediate benefits and innovation by providing open data and open infrastructure. When you use your smart phone to define a route based on the dynamic train schedules and road conditions you are using open interfaces rather than depending on central planning. There is a need for public infrastructure but the goals are to support innovation rather than preempting it.

Implementing overly complex initiatives is costly. In the early 2000's there was a conversion from analog to digital TV requiring replacing or, at least, adapting all of the televisions in the country! This is because the technology was

backed into the hardware. We could've put that effort into extending the generic connectivity of the Internet and then used software to add new capabilities. It was a lost opportunity yet 5G and ATSC 3.0 continue on that same sort of path rather than creating opportunity.

This is why it is important to understand why the Internet approach works so well and why it is agile, resilient and a source of innovation.

It is also important to understand that the Internet is about economics enabled by technology. A free-to-use infrastructure is a key resource. Free-to-use isn't the same as free. Sidewalks are free-to-use, and are expensive but we understand the value and come together to pay for them so that the community as a whole can benefit rather than making a provider the gatekeeper.

The first step is to recognize that the Internet is about a powerful idea and is not just another network. The Internet is, in a sense, a functioning laboratory for understanding ideas that go well beyond the technology.