

**Remarks of Tom Wheeler  
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In the hit Broadway musical Hamilton Eliza Schuyler sings, “Look around, look around at how lucky we are to be alive right now.” Eliza, of course, is talking about the American Revolution. We can feel the same way about the revolution we are living through.

Our revolution is a network revolution. Driven by ever-evolving technology, the networks that connect us are changing...and the patterns of commerce and culture that depend on those connections are changing as a result. This is a time of incredible opportunity and reshaping. It is a time of testing. To be a part of it is a privilege.

Charlie Firestone has asked me to forecast what lies ahead for this revolution and the FCC. I’d like to begin this look down the road by first looking back.

From humankind’s earliest days, our networks have defined our existence. First, it was natural networks such as animal paths and waterways. Then, in the mid-19th century, technology-driven networks – the railroad and telegraph – replaced nature’s pathways. The reality those networks built is what our new networks are today tearing apart.

The railroad – the original high-speed network – conquered the geography that previously constrained human behavior. Because of the railroad, economic activity no longer had to be adjacent to the raw material, and scope and scale economies became possible through centralized production. The resulting products were then efficiently distributed to a geographically diverse but interconnected market.

On the heels of the railroad, the telegraph condensed time by virtualizing information. The flow of information had always been constrained by its physical package. Separating information from that package to move it by sparks enabled management of dispersed factories, created the first national news networks and financial institutions, and helped Abraham Lincoln win the Civil War. In the process, the first electronic network created the pathway to the network that defines our today and tomorrow.

Both these network revolutions – the railroad’s death of distance, and the telegraph’s end of time – combined to make the mid-19th century a still unmatched period of network-driven upheaval.

Make no mistake. The great network revolution of the 19th century was far from the gauzy images of honored memory. Revolutions are messy and painful. We tend to understand history by its results, rather than the dislocation, disruption and despair through which society passed to reach that result. It is that passage, I submit, that exemplifies the greatness of America. It is not something to be “made again,” it is something we are continually constructing.

Think back to how, in a time of seemingly overwhelming change, 19th and 20th century Americans showed perseverance and creativity as they confronted what new networks had imposed on them. Just to refresh our memories, these included:

- \* Monopolies that enriched themselves by abusing and exploiting their workers as well as their customers,
- \* Employment upheaval so deep it tore apart the family unit as the railroad carted the younger generation off the farm to heed the siren call of the industrial city,
- \* What they found when they got to the city was a lack of sanitation, squalor in their accommodations, and rampant disease.
- \* What they found when they reported to work was that they had traded away individuality to become cogs in a giant, soulless, exploitative industrial machine that worked them ten hours a day, six days a week,
- \* It was a machine that crushed those who attempted to maintain their small business production activities,
- \* And, lest we forget, anti-immigrant sentiment abounded; from “Irish need not apply” signs, to Samuel F.B. Morse’s anti-Catholic, anti-immigrant campaign for mayor of New York (yes, that Morse).

The greatness of America is told in the stories of how Americans responded to those new realities:

- \* Farmers organized the Grange to counter the power of the railroads with collective action – ultimately resulting in the first Federal regulatory agency, the Interstate Commerce Commission,
- \* Workers organized to bring strength in numbers to challenge the abuse of employers,
- \* Enlightened local governments embraced public sanitation, sewage, water and public safety services,
- \* And while anarchists engaged in acts of terror, and demagogues proposed themselves as saviors, new political leaders – including two named Roosevelt from opposing political parties – harnessed government in behalf of the people.

When I hear people speak of the current network revolution as “the greatest the world has ever seen,” I want to say, “Wait a minute, while it may end up with an equivalent revolution, we have yet to experience change as drastic and disruptive as that imposed by two new networks in the mid-19th century.”

Today, we stand in the shadow of those Americans who lived through their own network revolution. Just as they were, we are challenged to make sense of the new network realities.

That is our test at the FCC. For the past almost eight years, the FCC has sought to confront network change head-on; to harness the network revolution to encourage economic growth, while standing with those who use the network as consumers and innovators.

In that regard, the history of the network experience that preceded us is not some curiosity, it is a compass. I think of the lessons of the past as a “back azimuth,” a concept familiar to navigators in which a landmark in the rear is used to inform the path forward. In the communications technology space, our back azimuth is what I call the Network Compact: the responsibilities of those who build and operate networks. There are five components of the Network Compact: access, interconnection, consumer protection, public safety, and national security.

During our tenure – and I want to especially call out Commissioners Clyburn and Rosenworcel – we have struggled to adapt such old concepts to the new world. And we have been mindful that what we do will become the back azimuth for those who push on after us.

Access to networks is essential. At the start of the Obama Administration, the nation’s programs to support high-cost network construction, as well as connectivity for low-income Americans were built around the narrowband telephone networks of the 20th century. Julius Genachowski began the process of refocusing on broadband. We finished the effort by requiring that support for high-cost carriers could only be spent on broadband; and that those who received low-income support should have access to broadband and the Internet with those funds.

When I walked in as chairman, roughly 2/3s of America’s schools and libraries did not have high-speed broadband connections. Of the 1/3 that did, half of them did not have WiFi access to each student’s desk. The Commission’s new rules to reform and expand the E-Rate program means, according to a study by Education Super Highway, that by the end of last year roughly 80 percent of school campuses in America had access to high-speed broadband all the way to the students’ desks to open up the power of the Internet as a teaching tool. The penetration will be even higher at the end of this year.

Access to broadband increasingly means access to high-speed wireless connectivity. The mother’s milk of that capability is spectrum.

Based on the recommendation in the National Broadband Plan, crafted by Blair Levin, the Congress authorized the world’s first buy-back of broadcast spectrum so that it could be repurposed and auctioned for wireless network use. It took three years just to manage our way through the rules that would govern this never-before-tried process. The auction is now underway.

The wireless networks of the future will be different from those with which we have become comfortable. As computing moves to the power of the cloud, the delivery of that effort requires a network that is high-capacity, high-speed, and low-latency. Operating at speeds 10 to 100 times

faster than today's wireless networks, and with latency of one-one-thousandth of a second, Fifth Generation wireless – 5G – will redefine the networks of the next several decades.

But first, there needs to be spectrum. Last month, the Commission made the United States the first nation in the world to identify high-frequency spectrum for 5G.

As I have said many times, American leadership in 5G is a national priority. With this home-field advantage, American companies can develop and implement software, firmware, and applications that will create innovation and employment opportunities in our country. In order to accomplish this, the Commission – with the assistance of NTIA and the Department of Defense – moved at bureaucratic warp speed, moving from initial notice to final decision in nine months.

And when we're talking about network access, we are talking about access for all Americans, including those with special physical or intellectual needs. One of the results of our revolution is an unprecedented ability to use technology to attack physical and intellectual challenges that have existed for all of history. In this seminal moment, the Commission has accelerated the use of technology by those who hear with their eyes, or see with their ears, and welcomed onto our team individuals with intellectual disabilities.

While access *to* broadband networks is important, access *on* broadband networks is equally essential. This gets us to the second pillar of the Network Compact: interconnection. The ability to interconnect networks becomes crucial when the most important network of our day, the Internet, is but a collection of interconnected networks.

It took a couple of tries, but today, the Internet is fast, fair and *open* as the result new rules by the Commission. The original effort at Open Internet rules was bounced back to us by the D.C. Court of Appeals three months after I took office. Our trip to the right solution exemplified the importance of the issue, with over four million public comments and the consideration of a variety of regulatory solutions.

In the end, the Commission enacted a solution – subsequently sustained by the Court of Appeals – that classified Internet Service Providers as common carriers. The decision also set a course for the future by forbearing from some of the more ancient and intrusive aspects of common carriage that might have inhibited investment and innovation. And that decision worked. Since the adoption of the Open Internet order, broadband investment is up, fiber deployment is up, network usage is up, network revenues are up, and investment in new uses of the network is up.

By establishing bright-line rules forbidding blocking, throttling and paid prioritization, the FCC dealt with issues that had previously been observed. By establishing a general conduct rule, the Commission put a referee on the field to throw the flag on any future unjust or unreasonable activity.

The consumer protection component of the Network Compact was obviously at play in our net neutrality rules, as it also was in our actions maintaining consumer rights during the transition from analog wireline networks to digital networks. Other consumer protection items remain in progress, including giving consumers choice in the devices they use to access their pay-tv

services, dealing with competitive access to essential last-mile facilities, and protecting consumer privacy rights for network-generated information. While we intend to complete all these matters before the end of the year, their oversight will, no doubt, be priorities for the next Commission.

Our responsibility for public safety has taken the Commission to the limits of its authority. We have enhanced location accuracy requirements to help emergency responders better locate wireless 911 callers, required wireless carriers to institute the delivery of text 911 messages, and enforced network outage penalties when corporate failure has denied consumers the ability to make a 911 call.

As I have said each time I've testified before the Commerce Committees, however, Congress controls whether we have next-generation 911 services to deliver the expanded safety capabilities of digital networks to protect consumers. Since it appears unlikely they will deal with it this Congress, hopefully it will be a matter of high priority for the next Congress.

Finally, the national security has never been more closely connected to our networks – and thus the activities of the Commission – than it is today.

Since the time when tribes used animal paths as the route to mount assaults, networks have been the pathway of attack. Throughout history, wars have been fought as road and water networks were utilized as paths for attack. The electronic networks of today are no different. What is different today is that attacks are not just the provenance of nation-states; our networks can be assaulted by anyone with a connection. As the agency responsible for the nation's networks, the FCC cannot ignore this reality.

Building on the cyber security framework established by the National Institute of Standards and Technology (NIST), and working through a multi-stakeholder forum, the FCC and the network providers have established expectations for network cyber-hygiene. Through this new regulatory paradigm, industry and the FCC work together to develop standards and processes. While the FCC does not impose specific regulations, thus allowing the technology to evolve as rapidly as possible, we work with industry to inspect the implementation of the agreed-to policies while maintaining the ability to step in with regulation if necessary.

That's why, in our new 5G rules we have – for the first time – required that new network design must deal with cyber from the outset. In this new network that will drive the 21st century, cybersecurity will be a forethought, not an afterthought.

Collectively, these and other activities become the new back azimuth for the FCC of the future. There are those, of course, who have pledged to undo much of what I have just discussed, if given the opportunity. That, too, is reliance on a back azimuth – although using it to guide in a completely different direction. The American people will decide which path to follow; elections do have consequences. For instance, I've spoken about our decisions to preserve a free and open Internet, to modernize outdated programs to bring faster connections and Wi-Fi to schools and help low-income Americans get online, to protect consumer rights as we transition from analog

to IP networks, and to enhance 911 reliability. These actions sound like common sense – they are – but all were 3-2 votes at the Commission.

I hope future FCCs will follow our course and continually reassess and reapply the Network Compact's timeless principles to new realities. In many circumstances that will probably mean an expanded reliance on case-by-case assessments of innovative developments rather than broad rules or any kind of pre-approval. That does not mean, however, that the Commission won't be confronted with broad new policy issues from mergers to new technological applications.

But whether it is case-by-case, or broad policy reviews, we shouldn't kid ourselves; existing in the midst of a network revolution is difficult. And when you are the agency charged with overseeing the networks that are driving the change, you're either in the frying pan or the fire.

One more immutable lesson we can take from history is that networks are enablers. It is never the primary network that determines the future; but it is the secondary effects and applications of that network that are transformative. In that regard, we are watching a head-on collision in slow motion as the new networks create challenges to the old ways of doing business and the old policies that accompanied them. From energy to financial services, from health care to transportation, the effects of the new networks will upend traditional economic activities.

Government is where we will work this out. Those who chant, "Government is the problem" are wrong. Government isn't some faceless "them," it is "us." Government is where we come together to collectively address common challenges. If we don't use government to address our new challenges, we lose a lesson of history for which we will have only ourselves to blame.

Thanks to our new networks, the challenges of change will continue to multiply. In return, there is a natural inclination by some to protect the economic status quo, or wistfully call for a return to the mythic good old days. The inexorable and immovable force of technology, however, will not allow for either of these. How we step up to network-created challenges is our part in weaving the American fabric.

For the last eight years the Federal Communications Commission has been at the center of the debate over the form and function of our new networks. As such, we have set the stage for the derivative secondary effects that will determine whether this is indeed the greatest transformational period the world has ever seen.

Embracing challenges such as these is an American tradition. Of course, they're big and hoary – but we've seen that before. Whether we handle our revolution with results as good as those who preceded us will be our test. Our networks define who are; and we have an opportunity to define one of history's great network revolutions.

Look around, look around at how lucky we are to be alive right now.