

# Rethinking Institutions of Spectrum Management

Ruth Milkman, Rapporteur



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The report from the 2017 Aspen Institute  
Roundtable on Spectrum Policy

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THE ASPEN INSTITUTE

*Communications and Society Program*

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*This report is written from the perspective of an informed observer at the  
Aspen Institute Roundtable on Spectrum Policy.  
Unless attributed to a particular person, none of the comments or ideas contained  
in this report should be taken as embodying the views or carrying the endorsement  
of any specific participant at the Roundtable.*

# Foreword

Each year the Aspen Institute Communications and Society Program convenes approximately 25 business, government, academic and non-profit leaders and experts to address regulatory issues associated with management of the electronic spectrum. Its allocation and regulation are arcane elements of communications policy-making, and require a deep knowledge of both the technical and legal aspects—yet it couldn't be more critical to the communications of this or any country. Despite the centrality of spectrum regulation and management to communications, it is often overshadowed by its more visible cousins. It is what broadcasters use to send their programs, telecommunications companies use to send data wirelessly, and the Wi-Fi that many use daily to access the Internet. It is radio-astronomy, garage door openers and satellite communications. It is the life blood of communications.

This said, there are new uses of spectrum that will challenge current regulatory regimes. The Internet of Things (IoT), Fifth Generation (5G) wireless technology and drones are a few of the newer uses, coming on top of an already heavily used resource. The question the group faced in the fall of 2017 was how the use cases of IoT, 5G and drones impact the apparatus that the government uses to manage this resource. That in turn is exacerbated by the different venues within the government that spectrum management takes place—the Federal Communications Commission for commercial spectrum, the National Telecommunications and Information Administration for government spectrum, many particular agencies for internal spectrum management, and the International Telecommunications Union for international coordination and management.

The aim of the meeting, then, was to determine if another structure or system for governmental regulation and for spectrum management is advisable, and to suggest what that alternative might look like.

This report, ably written by communications attorney and former FCC official Ruth Milkman, conveys several creative proposals from the group—and specifically from three working groups at the meeting—to address better management of spectrum in light of the new demands on the system. The most significant and developed of the

proposals is in dealing with drones. There, the group advocated for the Federal Aviation Administration to create a new Aviation Rulemaking Committee to consider a Spectrum Access System (SAS)-like regime for drones. Details are in the report.

A second major recommendation to emanate from the meeting is to establish an Executive Branch Interagency Coordinating Council to Manage Broadband Governance. By looking at broadband generally, rather than just spectrum, the Council would bring about more rational and coordinated policy. It would address issues of 5G, IoT and socially beneficial uses of spectrum. Again, the report details the specifics of what such a Council could do and why it is advisable. The group also considered another proposal, originally proposed elsewhere by Tom Leonard, for a General Services Administration for Spectrum, and the report details the group's consideration of the merits and disadvantages of that approach.

There are several other specific suggestions and recommendations in the report worthy of consideration by top policy-makers. What is clear is that it is time for a more coordinated approach to spectrum management.

## **Acknowledgments**

On behalf of the Aspen Institute Communications and Society Program, I thank the organizations who provided financial support to our work as a whole this year, and those who participated in the 2017 Spectrum Roundtable: Google, AT&T, Facebook, Verizon, Charter Communications, Ligado Networks, New Street Research and T-Mobile. Thanks, also, to Ruth Milkman for bringing the disparate and difficult concepts to paper in a readable and understandable manner. Finally, I thank our Project Director, Kiahna Cassell, for organizing and managing the Roundtable, and our Program's Managing Director Tricia Kelly for her assistance in editing and producing this report.

Charles M. Firestone  
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April 2018

RETHINKING INSTITUTIONS OF  
SPECTRUM MANAGEMENT

*Ruth Milkman*





# Rethinking Institutions of Spectrum Management

*Ruth Milkman*

## Introduction

Rapid growth in demand for spectrum continues. New developments, including the approach of 5G, make spectrum policy issues more complex and time-sensitive. Quickening new spectrum to availability is a challenge for the governmental institutions that manage the nation's radio spectrum.

5G applications include the Internet of Things (IoT), autonomous vehicles, augmented and virtual reality, high definition mobile video, and smart everything—factories, cities, infrastructure, buildings, homes and farms. According to Robert Pepper, Head of Global Connectivity and Technology Policy at Facebook, Inc., 5G applications will be heterogeneous, and heterogeneous devices and applications require heterogeneous spectrum.

These applications have heterogeneous requirements with respect to latency, speed, throughput, distance, power, mobility and spectrum frequency. For example, for machine-to-machine (M2M) communications, some will be low data rate telemetry, some continuous, some very short distance and some long range. Different spectrum bands will be used to support these applications—some shared, some dedicated. This changes the way we think about allocating spectrum.

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**... the stakes are high—getting spectrum policy  
right is important to economic growth, innovation  
and U.S. competitiveness in the global economy.**

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Key technologies required to support these applications include 5G networks, sensors, the cloud, artificial intelligence and data analytics. Although 5G may be short for the 5th generation mobile wireless

networks, in fact the architecture and equipment will be very different from previous transitions, such as 2G to 3G, or 3G to 4G. There are likely to be 10 to 15 billion IP-enabled M2M devices, billions of which will not be SIM-based, and these non-SIM-based devices may not be served by traditional wireless carriers. And the stakes are high—getting spectrum policy right is important to economic growth, innovation and U.S. competitiveness in the global economy.

As a result, spectrum policy issues are becoming even more complex. New issues arise more frequently, with a desire for swifter resolution. As Charla Rath, Vice President of Wireless Policy Development at Verizon Communications, noted, many of the spectrum policy issues are connected to scalability. This is further complicated by the pending arrival of 5G and IoT and the increased challenge of having two different organizations—the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA)—with overlapping jurisdiction, essentially dealing with the same problems.

In 2017, the Aspen Institute Roundtable on Spectrum Policy (AIRS) met for two days at the Aspen Wye River Conference Center in Queenstown, Maryland. A diverse group of twenty-six researchers, technologists, regulators and spectrum policy experts from the U.S. government, the United Kingdom's telecom regulator, industry, academia and nonprofit groups reviewed the history of the U.S. institutions that manage spectrum, and discussed how these institutions might be adapted to address new technological, marketplace and social realities. The group's intensive discussions resulted in a set of new policy recommendations for improving the ability of institutions of spectrum management to address the challenges of 5G, the Internet of Things and autonomous vehicles.

Charles M. Firestone, Executive Director of the Aspen Institute Communications and Society Program, moderated the sessions. This report, by rapporteur Ruth Milkman, provides an interpretive synthesis of the key themes, points of discussion and recommendations. Though not every participant agrees with or endorses every statement, this report represents the general sense of the group's deliberations.

## **Spectrum Institutions**

Peter Tenhula of the National Telecommunications and Information Administration provided a concise history of the legal framework for U.S. spectrum institutions, beginning with the Constitution and proceeding through the Radio Act of 1927. Tenhula described the basis for shared jurisdiction between NTIA and the FCC, as well as other arrangements previously considered. Tenhula noted that the themes of interference, interconnection and competition that appear in the Communications Act also are found in earlier statutes.

With that historical context, the group considered whether it would be possible to devise a different structure for institutions of spectrum management that would allow them to better serve spectrum-related needs. These needs include an abundance of bandwidth, which may be supported by spectrum as well as deployments of infrastructure such as additional fiber. This abundance of bandwidth should support current services as well as the heterogeneous, next-generation devices and applications, such as drones. Spectrum-related needs also include expanded coverage, as well as mechanisms to make mobile broadband available to people with low incomes.

In the context of seeking to address these needs, participants commented on a set of considerations. For example, though participants generally agreed that spectrum management institutions should strive for abundance, rather than scarcity, Preston Marshall of Google Access stated that spectrum is managed by people who get power from scarcity. To solve bandwidth problems, the approach needs to be holistic—it cannot put spectrum in one pipe and fiber in another. As participant and University of Colorado scholar Pierre de Vries said, reformulating St. Augustine, the prayer of entities that hold spectrum rights is “Lord, let spectrum be flexible, but not yet.”

Other considerations include the levels of management that are involved in making spectrum available and usable. These include local, state, federal and international authorities. Many in the group expressed a desire that decision-making processes at all institutions be transparent and inclusive.

Participants also generally agreed that the speed of technology and business development has outpaced the speed of regulation, and that

there should be a sense of urgency about the need for faster processes. In terms of bands poised for reallocation, however, the low-hanging fruit is gone, and current regulating bodies are not well set-up to identify economic trade-offs. Finally, the cost of any regulatory transition is a consideration as one envisages changes and shifting in institutional authority.

Within this overall context, three working groups worked to explore different approaches to governmental management of spectrum, regulation of related issues like privacy, and issues of enforcement.

WORKING GROUP 1: *Drones and other Security-Related Issues.* Drones are an example of a burgeoning technology and business that involves several federal, state and local agencies in the commercial and security sectors. What is the best governmental structure and set of operational protocols to achieve desired results (including preventing the use of drones for terrorist activities, flight interference, RF interference, breach of privacy, and local aesthetics)?

WORKING GROUP 2: *IoT, 5G and Business Apps.* In each of these areas, businesses will be innovating with new products and services using spectrum as a key resource. What are the governmental barriers to effective and efficient roll-outs and provision of services? What other non-economic issues are involved that implicate different government agencies, including state and local? How should these efforts be coordinated so that government functions most effectively and fairly?

WORKING GROUP 3: *Pro-Social Activities.* Government spectrum management and regulation are part of broader laws aiming to serve the public interest. This often includes pro-social goals such as universal service/digital inclusion, fairness, environmental considerations, historic preservation, and protection of civil rights and civil liberties. How do these goals factor into

the appropriate structure for spectrum management, including inter-agency relations? How do the economics of IoT and 5G affect broadband provisioning to people in urban, suburban and rural areas?

The working group recommendations included ideas for changes within the existing institutional framework, as well as for systemic changes to institutions of spectrum management.

## **Changes within the Current Institutional Framework**

### **WORKING GROUP 1: *Drones and other Security-Related Issues***

The Working Group on drones formulated an integrated approach to airspace and spectrum management for drones, making use of a Federal Aviation Administration (FAA) advisory group mechanism. The burgeoning technology and business behind drones involves several federal, state and local agencies in the commercial and security sectors. The group set out to devise the best governmental structure and set of operational protocols to achieve desired results (including preventing the use of drones for terrorist activities, flight interference, radio frequency interference, breach of privacy and local aesthetics).

Spectrum is important to drones—and as Jim Williams, Founder and President of JHW Unmanned Solutions, LLC, explained, air traffic is pilot-based. The FAA would like wireless connectivity to be licensed and protected because the loss of connectivity causes the aircraft to become autonomous—a bad word in aviation.

NASA engineer Marcus Johnson explained that drones need spectrum for separation, command and control, tracking, payload and access to airspace information. The level of autonomy on the vehicle is inversely related to spectrum needs. That is, a more autonomous vehicle needs less access to spectrum than a vehicle that is being guided and must be in more regular communications with its base. Typically, drones will use low airspace, and the FAA does not manage airspace below 1200 feet in general, below 700 feet in major metropolitan areas, but controls all the way to the ground near airports. To accommodate the broadening uses of airspace and meet FAA standards, then, there is a need for some spectrum to be protected.

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**... there is no FAA rule that drones must use protected spectrum and there is no standard for what to do if a drone loses connectivity.**

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But there is no FAA rule that drones must use protected spectrum and there is no standard for what to do if a drone loses connectivity. While hobbyists today often use unlicensed spectrum for line-of-sight operation of drones below 400 feet, it is widely expected that commercial operations (e.g., Amazon deliveries) will use licensed spectrum provided by one of the wireless carriers. In fact, Qualcomm has studies that show the LTE infrastructure, for example, will work fine below 400 feet for controlling drones. There are also drones that require licensed and protected spectrum, such as the Facebook Aquila project. According to Facebook's Head of Global Connectivity and Technology Policy, Robert Pepper, the Aquila project has a very high altitude unmanned backhaul capability, designed to operate over geographies where there is no telecommunications infrastructure. The individual drones have the wingspan of a Boeing 737, weigh 1000 pounds, and fly for three months at a time. They need to be brought down periodically for service.

It is expected that applications for drones will increase rapidly as multiple industries strive to create urban air mobility. Drones are increasingly used for policing, fighting fires and are even being prototyped for package delivery. Meanwhile, there are coming uses that will need agility and scalability for command and control spectrum. As Valerie Green, Executive Vice President and Chief Legal Officer of Ligado Networks observed, because of these increased needs and demands for limited spectrum, government institutions will need to work at faster speeds to resolve the issues associated with widespread and diverse deployment. Green noted that guidance is important, or some companies will go forward and ask permission later.

Preston Marshall, Wireless Architect at Google Access, described the development of the Spectrum Access System (SAS) concept in the FCC's 3.5 GHz proceeding, the Citizens Band Radio Service (CBRS). The SAS builds on existing frequency coordination approaches by leveraging advanced computing to maximize the number of users that

might be able to operate within a given area at a given time. This makes spectrum available where and when it is needed, and enforces protections and rights among use tiers. In the context of 3.5 GHz, the FCC contemplates authorizing multiple SAS administrators. This is a concept that could be useful in the context of managing the spectrum used for drones, and enabling prioritization of use, as well as preemption. The ecosystem would include multiple SAS providers that interact in a way that provides a unitary system. Among other things, this approach enables survivability if one SAS provider exits.

### *Presidential Memorandum on Unmanned Aircraft Systems*

Shortly before the Aspen Institute Spectrum Roundtable, the White House issued a Presidential Memorandum for the Secretary of Transportation regarding the Unmanned Aircraft Systems Integration Pilot Program.<sup>1</sup> Section 1 of the Presidential Memorandum states:

It shall be the policy of the United States to promote the safe operation of unmanned aircraft systems (UAS) and enable the development of UAS technologies for use in agriculture, commerce, emergency management, human transportation, and other sectors. Compared to manned aircraft, UAS provide novel, low cost capabilities for both public and private applications....

The private sector has rapidly advanced UAS capabilities to address the needs of recreational, commercial, and public users. To promote continued technological innovation and to ensure the global leadership of the United States in this emerging industry, the regulatory framework for UAS operations must be sufficiently flexible to keep pace with the advancement of UAS technology, while balancing the vital Federal roles in protecting privacy and civil liberties; mitigating risks to national security and homeland security; and protecting the safety of the American public, critical infrastructure, and the Nation's airspace. Well-coordinated integration of UAS into the national airspace system



(NAS) alongside manned aircraft will increase the safety of the NAS and enable the authorization of more complex UAS operations.

The Federal Aviation Administration (FAA) has taken steps to integrate UAS into the NAS at specific test sites and has issued operational requirements for small UAS operations in the NAS. Further integration will require continued private-sector cooperation and the involvement of state, local, and tribal governments in federal efforts to develop and enforce regulations on UAS operations in their jurisdictions. Input from state, local, tribal, and private-sector stakeholders will be necessary to craft an optimal strategy for the national management of UAS operations. A coordinated effort between the private sector and among these governments will provide certainty and stability to UAS owners and operators, maximize the benefits of UAS technologies for the public, and mitigate risks to public safety and security.

The Presidential Memorandum is a solid statement that the policy of the United States is to move forward to open the space for drones. In the context of this memorandum, the Working Group developed the following actionable recommendation: establish a competitive, coordinated multi-provider framework to manage the spectrum and air space.

### *Recommendations*

- **WHAT:** Establish a competitive, coordinated multi-provider framework to manage the spectrum and air space
- **HOW:** Through the establishment of an Aviation Rulemaking Committee (ARC) convened by the FAA
- **WHO:** Committee chaired by FAA and appropriate industry representatives with representatives from drone manufacturing, operators, service providers, regulators, law enforcement and public interest groups

- **WHEN:** Convene kick-off in early 2018 and complete effort with defined framework by the end of 2018

This recommendation addresses the urgency of the need to move forward quickly. The Aviation Rulemaking Committees convened by the FAA are not subject to the Federal Advisory Committee Act (FACA) and therefore may be able to move more swiftly than other advisory committees, and more swiftly than the agency might be able to move on its own.

Although the proposal would in principle cover all drones, there is a significant difference in the requirements for commercial drones versus recreational drones. Recreational (sometimes called hobbyist drones)—which take only line-of-sight flights—generally do not have the same airspace and spectrum requirements as commercial drones. Therefore, the flexibility and availability of unlicensed spectrum would appear to be more appropriate for the hobbyist.

Commercial drones, by contrast, have specific requirements in communicating including integrity, continuity and low latency. These are drones that take non-line-of-sight flights. Smaller drones may have space, weight and power limitations that affect the type of communications that can be used. These commercial drones also require the capability for remote identification, so as not to be mistaken for a UAS that is a threat. Finally, potential future regulatory directions for commercial drones are likely to affect spectrum requirements.

One approach: SAS-like Solution. The group sought an approach that combines management of both airspace and spectrum management, which means that the FAA, NTIA and the FCC will all need to be involved. One approach would be an “SAS-like” solution—similar to what the FCC and NTIA developed for the 3.5 GHz, whereby a Spectrum Access System allows for prioritization of use of specific frequencies in specific geographic areas.

The World Radiocommunications Conference resulted in the reallocation from federal government use of aviation spectrum in the C and L bands for commercial use. FCC action to adopt rules for the use of this spectrum is required before the spectrum can be used for drones; these rules should be supported by the FAA and NTIA. The group anticipated that one of the outputs of the ARC would be recommendations from the FAA and NTIA on service rules for spectrum use by drones.

The FAA will also need to take action in order to make the airspace available for drones for anticipated (and unanticipated) uses. Therefore, the ARC outputs would include recommendations for FAA guidance for:

- Flight over people
- Flights beyond visual line-of-sight; and
- Remote drone identification.

*Applications Require Differing Treatments.* The newly developed policy should consider various applications for drones. These include commercial applications, such as delivery, news reporting, mapping (such as mapping of real estate), and inspection of railroad tracks, oil and gas pipelines, and electric infrastructure. Another set of applications for government use might include delivery, law enforcement and public safety, military use and search-and-rescue missions. Academic institutions may use drones for education and research. Individuals may use drones for their hobbies, including photography or gaming. And of course, criminals and terrorists may seek to use drones for unlawful espionage, casing for future crimes, delivery and transport. They could even arm drones for domestic terrorism.

These applications have certain implications for spectrum policy, including spectrum requirements. Some drones, for example, will have payloads such as cameras, that require spectrum for communications. Participants recommend that payload communications use existing licensed and unlicensed spectrum and standards. For drones that use line-of-sight command and control, similarly existing licensed and unlicensed spectrum and standards are available. These drone operators may wish to use Wi-Fi, for example.

For non-line-of-sight command and control, however, a new spectrum arrangement may be required. Participants recommend that serious consideration be given to an approach under which carriers provide dedicated spectrum for non-line-of-sight command and control through prioritization and preemption, in a system similar to the Spectrum Access System (SAS) developed for 3.5 GHz. Under these arrangements, the drone operator would pay for service. This creates a monetization opportunity for companies that wish to participate in a coordinated system for managing spectrum and airspace.

Under this approach, the SAS administrator might be a license coordinator that can deal with both airspace and spectrum coordination (for example, the company ARINC is a frequency coordinator that manages spectrum for the airlines). There could be multiple SAS administrators, which would coordinate with each other to operate an integrated system. The users would likely be commercial operators of drones that need access to both airspace and spectrum for command and control. In the 3.5 GHz system, it is contemplated that a commercial user will be able to buy a CBRs “box” and obtain access to spectrum, with a choice of competitive providers of that spectrum access management. Preston Marshall suggested a similar system could be used for spectrum and airspace management. Others noted that the SAS is not yet fully operational, even in the 3.5 GHz band, and would need to be tested before it is applied to other bands. For this approach to work, it will be necessary to have transparency about choice, and the services being provided, and it will need to be done in a way that is accessible to all commercial enterprises, including small businesses.

The approach is a prioritization model for licensed spectrum, modulated by carrier prioritization and pre-emption capabilities. The higher-level spectrum policy framework would be as follows: For safety of life and critical infrastructure applications (e.g., flights over crowds of people, non-line-of-sight flights, “heavy weight” commercial drones such as the FedEx unmanned 767), licensed and protected spectrum is required for command-and-control communications.

*Other considerations.* The FAA, NTIA and FCC will need to develop policy with respect to other security and privacy considerations. By way of example, one would want to avoid drones operating as voyeurs, dropping cellphones into prisons, or flying near a stadium or airport.

The spectrum and airspace management will need to address additional concerns with respect to drones such as real-time control, safety, specific considerations for very large or very heavy drones, and range. It is essential to be able to control the behavior of a drone in real time, both for commercial purposes, and to avoid conflict with other drones or other operations in airspace. Safety issues are paramount, including concerns about loss of control of either the flight path or the physical payload. These safety concerns include cybersecurity risks, such as hacking or spoofing of the command and control functions. It is

important to be able to prevent an inadvertent or malicious flight path. All of these issues may result in damage to people or property.

The size and weight of the drone is also a consideration. For example, specific guidance may be required for very large UAS such as FedEx flying a Boeing 767 without a pilot. It is likely to be important to have a higher degree of confidence about the command and control functions and protections for such UAS. Finally, the Working Group considered a range of issues that need attention—for example, the longer the range of the drone, the more complicated the hand-offs may become across spectrum and airspace.

*UAS spectrum needs.* The group identified specific UAS spectrum needs, as well as spectrum bands for each set of needs. The first requirement is separation—keeping drones away from each other and, importantly, from commercial airlines. For this requirement, the following bands are available: C Band (5 GHz), ADS-B in 978/1090 MHz (ADS-B is the band that airliners use to identify their locations to others), Radar (L to W Band), and LIDAR.

A second requirement is command and control (C2). Hobbyist drones today can use the ISM unlicensed bands for visual line-of-sight communications. In addition, they can use a variety of licensed bands, including the C Band, the L Band, bands used for 4G LTE or 5G, and satellite communications.

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**It is important to be able to interrogate a drone to determine whether it is friend or foe, and whether counter-UAS measures may be required.**

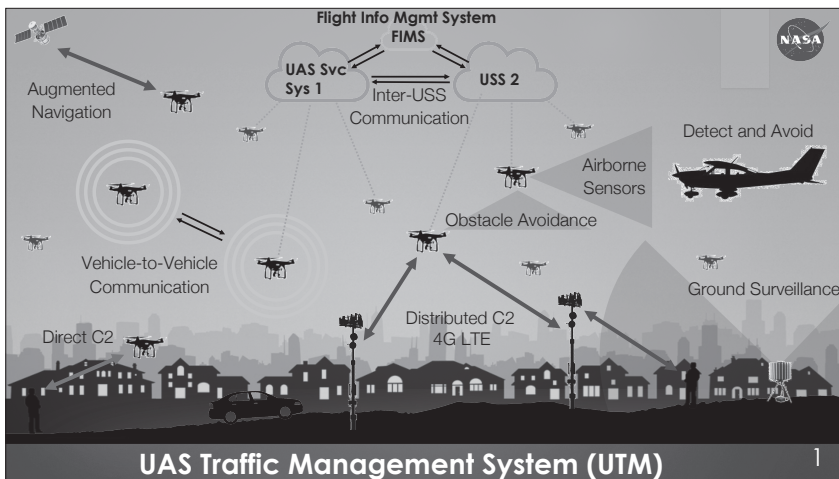
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Tracking is a third requirement, and can be done in the C and L Bands, as well as bands used for 4G LTE and 5G, and satellite communications. For visual line-of-sight operations, the ISM bands are available. Payload communications can be conducted either by using unlicensed bands (in a line-of-sight environment) or commercial bands used for 4G LTE or 5G.

The final requirement is UAS identification. It is important to be able to interrogate a drone to determine whether it is friend or foe, and whether counter-UAS measures may be required. It is conceivable that in the future, the drone (or payload) would have a need to be able to switch spectrum bands while in flight, similar to mobile phones.

The following two charts illustrate a potential UAS traffic communications and flight management and how it would interact with other existing air traffic management systems.

**Figure 1. UAS Traffic Management System**



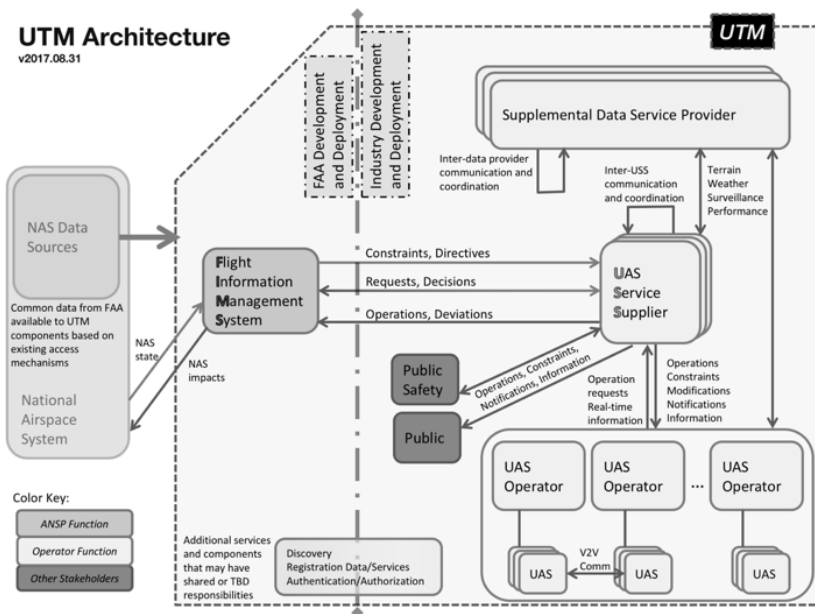
This chart of the UAS Traffic Management System illustrates the concept of airspace and spectrum management for drones, and shows how different types of communications in different spectrum bands could be used as part of an integrated system.

The upper left-hand corner illustrates satellite communications (e.g., GPS), which can be used to enhance navigation for drones, supplementing terrestrial-spectrum-based command and control. This is particularly important for non-line-of-sight operations. Also on the left side of the chart, the vehicle-to-vehicle communication could be used to maintain separation, or to allow drones to fly in formation. At the bottom left, direct command and control could be used for a hobbyist, flying under 400 feet, with line of sight.

In the top middle, the chart shows two UAS Service Suppliers, which are the SAS-type systems described earlier, interacting with the Flight Information Management System (FIMS) which provides information on airspace to commercial airliners. In the middle of the chart, radar would be the means of ensuring obstacle avoidance. At the bottom middle, this distributed command and control function could be provided via wireless-carrier-controlled 4G LTE systems, for flights that are non-line-of-sight.

On the right side of the chart, airborne sensors would include ADS-B, the frequencies used to allow commercial airliners to identify their locations. The function of “detect and avoid” could be used to maintain separation, and as described earlier, could be executed via multiple spectrum bands, including C Band, L Band, ADS-B, Radar and LIDAR. Ground surveillance is shown in the bottom right corner. Privately owned and operated ground-based radar systems can provide a detect-and-avoid service when airborne radar is not practical or cost-effective.

**Figure 2. Unmanned Aircraft System Traffic Management (UTM) Architecture**



The UTM Architecture illustration focuses on the functions of the UAS Service Suppliers, which would control drones in the context of overall airspace, and the interaction with the Flight Information Management System (FIMS). The UTM would be developed and deployed by the private sector, while FAA would develop and deploy the FIMS, which would provide information regarding airspace such as the operation of commercial airliners. On the lower left side of the chart, ANSP stands for Air Navigation Service Provider.

*Working Group 1 consisted of Dennis Roberson (coordinator), Pierre de Vries, David Edelman, Harold Feld, Marcus Johnson, Preston Marshall, Carl Povelites, Peter Tenhula and Jim Williams.*

## **WORKING GROUP 2: IoT, 5G and Business Apps**

In each of these areas (IoT, 5G and Business Apps), businesses will be innovating with new products and services using spectrum as a key resource. What are the governmental barriers to effective and efficient roll-outs and provision of services? What other non-economic issues are involved that implicate different government agencies, including state and local? How should these efforts be coordinated so that government functions most effectively and fairly?

The Working Group developed a set of recommendations, some of which require significant changes to the current federal institutions that manage spectrum, and others that propose incremental changes to the current system. The incremental recommendations are discussed in this section, and the systemic recommendations are discussed later in the report.

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**The key requirement for 5G applications will be abundant bandwidth, and that will require much more deployment of fiber.**

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The group began by describing what is meant by 5G applications. Participants mentioned sixteen different M2M verticals, including IoT, autonomous vehicles, smart everything (factories, grid, cities, infra-



structure, buildings, homes, farms), augmented and virtual reality, and high-definition mobile video. 5G applications provide an opportunity to advance the national purposes described in the National Broadband Plan, including health care, education, energy and the environment, economic opportunity, government performance, civic engagement and public safety.

The group further identified the key technologies as 5G networks, sensors, the cloud, artificial intelligence and data analytics. They noted that the transition to 5G network architecture and equipment will be very different than previous transitions. And they reiterated the point that 5G application requirements are extremely heterogeneous, with tremendous variations in requirements with respect to latency, speed, throughput, distance, power, mobility and spectrum frequency. Spectrum, in any case, is only one input. The key requirement for 5G applications will be abundant bandwidth, and that will require much more deployment of fiber.

Spectrum management for 5G will be different in degree, but not in kind, from spectrum management issues for previous generations. There will be more complex negotiations over multiple bands, and a proliferation of devices, users and affected parties. There is a sense of urgency about putting faster processes in place. The low-hanging fruit, in terms of reallocation of spectrum, is gone—meaning that making spectrum available in the future will be more complicated than in the past. Institutions and processes are already fraught, and some new players in both industry and government are unfamiliar with the territory. For example, the FDA will have to deal with pills that send signals when they have been ingested, and as they move through the body.

Participants also noted that there is a major disconnect between Wall Street and Washington, D.C. on the business case for 5G. Wall Street is not yet convinced there is a business case. But federal policymakers are moving forward because they want the U.S. to be a global leader with respect to 5G. Steve Unger, Group Director and Board Member of Britain's Ofcom, noted that European politicians similarly want to get ahead of the United States and China on 5G, and that there is a risk that the politicians will get ahead of the business case. The group had two main recommendations: lower transaction costs and remove local barriers to deployment.

### *Recommendations:*

**Lower transaction costs.** The first idea in this category is to continue and expand the flexible use policy, which has worked extremely well for commercial spectrum. The group referenced the 2016 Aspen Institute Roundtable on Spectrum Policy Report, “Revisiting Spectrum Policy: Seven Years After the National Broadband Plan,” which includes a more detailed discussion of ways in which flexible use policies could be expanded.<sup>2</sup>

The second idea is a GSA-equivalent for spectrum or a robust overlay regime, or perhaps some hybrid. The GSA-equivalent would require significant institutional change, and is discussed in more detail in the next section. An overlay regime, like that used to clear microwave licensees out of what became PCS spectrum, is also a tool used successfully in the past for commercial spectrum, and could be used in the future.

Tom Hazlett, Professor at Clemson University, recommended this overlay approach for the broadcast television spectrum, and although the FCC used an incentive auction instead, an overlay regime is still a candidate for use in additional bands, including the remaining broadcast television bands. Hazlett noted that T-Mobile, which acquired certain 600 MHz licenses in the broadcast incentive auction, is effectively implementing the overlay technique by creating incentives for early clearing by broadcasters.

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**“We’re all after systemic reform, but it doesn’t happen systematically; it comes through the PCS overlay and broadcast incentive auction. We have a lot of market experience that we didn’t have 20 years ago and certainly didn’t have 40 years ago.”**

*– Tom Hazlett*

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In the past, the industry has not used the overlay approach for government spectrum, but the group offered it as an option for government bands as well. Hazlett said, “We’re all after systemic reform, but

it doesn't happen systematically; it comes through the PCS overlay and broadcast incentive auction. We have a lot of market experience that we didn't have 20 years ago and certainly didn't have 40 years ago."

The third idea is to have more experimentation, and to learn from experiments. The fourth idea in this category is to introduce "rational carrots and sticks" for federal users.

**Remove local barriers to deployment.** The goal here is to create an environment for "well-intentioned and well-informed" local government processes, and address situations where cities or localities are a barrier to deployment of infrastructure.

Larry Downes, Project Director at the Georgetown Center for Business and Public Policy at Georgetown University, noted that infrastructure for 5G is different than previous generations of cellular infrastructure. There will be many more 5G small cells and antennae than there are macro towers today, and they will be attached to light poles, utility poles and building exteriors. Much more backhaul is needed. Therefore, the stresses on local processes are different. There are 50 states (plus D.C.), and tens of thousands of localities. All have processes built for 2G, 3G and/or 4G, which do not necessarily contemplate the differences that 5G poses, so that many cities have not yet adapted to small cells. In contrast, Managing Partner at New Street Research's Jonathan Chaplin described Asian cities where there are no bandwidth issues. Softbank had 500,000 small sites in Tokyo five years ago. Chinese cities have millions of small cells. The reason posited by Chaplin is that very easy, cheap access to real estate means carriers can easily and cheaply deploy infrastructure.

The group considered a set of options to remove local barriers, which are not mutually exclusive. The first idea is to do something like what Google Fiber did in getting cities to compete for infrastructure by adopting streamlined processes. A second approach is to have a set of mandates from the FCC and/or Congress. These could include "deemed granted" where applications are deemed granted if the locality does not act within a certain time period. Alternatively, one could have a shot clock that allows for some process if the locality has not acted within the specified time frame—perhaps going to court, or to the FCC to obtain a decision.

Carriers have also raised concerns about fees charged for sites. For example, Carl Povelites, Assistant Vice President of Global Public Policy at AT&T said that while lots of cities want to work with carriers, others do not, and seek to block deployment from an aesthetic or cost perspective. He said that some localities want to charge \$3,000 per cell site per month. One solution might be Congressional or FCC action to cap fees charged, or to establish guidelines for setting fee schedules based on local variables.

The FCC's Broadband Deployment Advisory Committee (BDAC) is another vehicle for removing local barriers, using techniques such as model ordinances and best practices. Preston Marshall said that Multi-Dwelling Units (MDUs) are a larger problem than streets, and will be an important issue for 5G deployments, which need to be indoors if they use millimeter wave spectrum, for example.

*Working Group 2 consisted of Larry Downes (coordinator), Jonathan Chaplin, Valerie Green, Tom Hazlett, Blair Levin, Robert Pepper, Charla Rath and Donald Stockdale.*

### **WORKING GROUP 3: *Pro-Social Activities***

Government spectrum management and regulation is part of broader laws aiming to serve the public interest. This often includes pro-social goals such as universal service/digital inclusion, fairness, environmental considerations, historic preservation, and protection of civil rights and civil liberties. How do these goals factor into the appropriate structure for spectrum management, including inter-agency relations? How do the economics of IoT and 5G affect broadband provisioning to people in urban, suburban and rural areas? The Working Group developed a set of recommendations.

The Working Group on Pro-Social Activities observed that heterogeneous use cases require new thinking, new licensing tools and different technology platforms. It is desirable that these technologies be used as widely as possible, so policies should encourage investment and abundance, in rural and underserved communities as well as urban locations. Simultaneously, it appears that 5G and IoT investment will initially be focused on urban areas. Doug Brake noted that 5G increases the risk of a digital divide, particularly with respect to rural areas and low-income people, and issues become more acute. As currently described, 5G does not increase coverage.

While recognizing the need for some support mechanisms, it is important not to crowd out private sector investment, but rather to leverage existing networks and infrastructure assets. It is necessary to be sensitive to the variety of users, use cases and technical characteristics—solutions are highly unlikely to be singular or one-size-fits-all. Finally, the development of effective policies will require user buy-in and trust across various stakeholders, and inclusion in the policy-development process. Luisa Lancetti, Chief Counsel at T-Mobile, noted that the need for education, information and buy-in is an issue today, not just when 5G comes along. Working Group 3 had two main recommendations: extend baseline connectivity, largely through the establishment of an Executive Branch Interagency Coordinating Council to Manage Broadband Governance, and expand privacy and cybersecurity.

### *Recommendations*

**Extend Baseline Connectivity.** The ultimate goal is ubiquity: robust mobile networks that are affordable for low income users. Access to these networks will enable education, economic activity and access to government services. The United Kingdom is working toward “digital by default”—a system in which access to government services is primarily online. As U.S. agencies similarly convert from paper to online methods, access to broadband becomes ever more critical.

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## **The ultimate goal is ubiquity: robust mobile networks that are affordable for low income users.**

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The first step in developing policies to extend baseline connectivity is to identify gaps (defined broadly) in networks (defined broadly). A focus of the recommendation is to leverage communications policy in conjunction with the provision of services by other government agencies, such as health care-related services and housing. Under this approach, government agencies would continue to deliver on their core missions (health care, housing, etc.) but the federal agencies with responsibility for communications would coordinate to encourage broadband adoption.

The second step is the establishment of an Executive Branch Interagency Coordinating Council to Manage Broadband Governance. The Council would include representatives from the FCC, NTIA, the Office of Management and Budget (OMB), and other federal agencies that provide funding and administer programs that support people with low incomes, as well as rural, tribal and underserved areas. Under this approach, OMB would serve as the lead governing authority on the council, and would oversee all deliverables and project coordination across multiple agencies with expertise on a particular issue. In addition to its federal members, the Council would also include representation (or otherwise seek input) from: mayors, governors, tribal nations, local utilities and other important stakeholders.

While such a council may be unwieldy at times, the group stressed the importance of user buy-in and trust across various stakeholders, and the need to be inclusive. Inclusive and diverse representation in terms of demographics, skills and backgrounds are critical to success. Jessica Zufolo, Senior Advisor at the Universal Service Administrative Company noted that unless policymakers talk early and often to certain stakeholders, such as tribal nations, these stakeholders may stop the process cold. One baseline connectivity objective could be to use coordination to extend networks along roads and rails, and leverage private sector investment to make mobile broadband available in more geographic areas. The goal is to have ubiquitous and affordable mobile broadband to enable education and activities required for government services. If government services are “digital by default,” as in the United Kingdom, Americans must have the ability to get online. Other potential topics for the Council are digital inclusion, adoption, digital literacy, job creation and transportation solutions.

The Council would also be a vehicle to communicate to agencies that serve low-income people about the importance of access to affordable broadband. These agencies include Housing and Urban Development (HUD) as well as agencies that administer social safety net programs like SNAP and Medicaid. Participants also discussed other ideas for improving access, such as zero-rating for .gov websites, and public Wi-Fi networks in public institutions—not just buildings, but buses, for example.

Although OMB is historically not involved in such a role with respect to communications networks, the group felt that it is important to have

an agency with budget authority, as well as management clout, to be accountable for achieving these objectives.

**Expand Privacy & Cybersecurity.** Considering the impact of 5G and IoT on privacy and cybersecurity, the group noted that it is necessary to have buy-in and trust for 5G and IoT applications and solutions across the mass market, and that concerns about privacy and cybersecurity could undermine use of next generation services.

With respect to privacy, IoT brings new challenges. For example, the informed consent frameworks used in the U.S. and Europe are designed for people who are capable of giving consent, rather than for things, which are not. Steve Unger said when Ofcom put out a request for comment on IoT, the respondents were generally not worried about spectrum, but were worried about privacy regulation. Therefore, Unger said, it is important to make sure the privacy regulator understands the telecom sector.

The group viewed the best solution to be federal privacy legislation that creates a uniform national framework and consolidates oversight under the Federal Trade Commission. Participants noted the trade-offs between a framework that provides flexibility but less certainty, and prescriptive laws that may not be adaptable in a timely manner as technologies change. Within the informed consent framework (recognizing that it may need adjustment for IoT), federal privacy modernization should provide some guidance on what data might be subject to opt-in and opt-out protections. Federal legislation would avoid duplicative or conflicting jurisdiction, avoid multiple state laws, and avoid the balkanization of the Internet ecosystem. The development of the legislation should recognize the trade-offs, and the need to consider consumer protection, industry credibility and the economic value of data.

With respect to cybersecurity, there is a danger that if a structure for dealing with cybersecurity issues is not already in place when the inevitable cyber-attacks on networks happen, the response could be ill-advised and have unintended consequences. The Working Group regards communications networks as vulnerable to attack, but thought that the federal government approach to cybersecurity should be holistic. The group did not recommend institutional changes, but rather would rely on the Department of Homeland Security, the National

Institute of Standards and Technology (NIST) framework, and the encouragement of continual sharing of best practices.

*Working Group 3 consisted of Nicol Turner-Lee (coordinator), Doug Brake (coordinator), Michael Calabrese, Alex Hoehn-Saric, Luisa Lancetti, Ruth Milkman, Steve Unger and Jessica Zufolo.*

## **Systemic Changes to Institutions of Spectrum Management**

Participants discussed ideas for systemic changes in spectrum management institutions, as well as ideas for changes with the current institutional framework. Steve Unger from Britain's Ofcom summarized the required elements for systemic change as follows:

- Sharpen economic incentives
- Involve institution(s) with budgetary authority
- Incorporate not only spectrum expertise, but expertise in the applications for which the spectrum is used—whether defense, aircraft or commercial mobile—into the system
- “Top down sponsorship”—unless direction comes from the top of the organization, it is unlikely to change.

Dennis Roberson of Roberson and Associates commented that all organizations are pathological, and sometimes change is required to get away from the old pathologies, even if new pathologies are revealed over the course of time. Roberson added that the fact of change may matter more than the specific nature of the change. The group identified some changes and recognized the concerns and challenges of managing spectrum internationally:

*GSA for Spectrum.* In discussion among the full group, a recommendation for a GSA for Spectrum<sup>3</sup> evolved to include three elements:

1. GSA for spectrum—an agency that is not NTIA would lease spectrum to federal government agencies;
2. Spectrum mining—a commitment to reallocate spectrum from government to commercial use on a regular schedule; and
3. A BRAC-equivalent for DoD spectrum.



Blair Levin, Senior Fellow at the Brookings Institution, proposed that much of spectrum expertise should be taken out of agencies and concentrated in the new agency. He acknowledged that it would be necessary for some spectrum expertise to remain with the agencies that are leasing the spectrum, but said that amounts should be asymmetric, just as GSA has much more real estate expertise than the individual agencies on whose behalf the buildings are leased.

Several participants thought that a GSA-like agency would be necessary but not sufficient, so that the spectrum mining piece becomes a key part of the proposal. For example, there could be a revolving fund, to fund studies in the way that the Spectrum Relocation Fund does. This would help government agencies figure out how to replace the functions provided by certain spectrum uses today. In addition to funding via auction revenues, there could also be a fee on unlicensed use.

The group generally agreed that spectrum is not a commodity, but that spectrum need not be a commodity to improve economic incentives—today, federal agencies are not economic actors.

Donald Stockdale, the Bureau Chief at the FCC's Wireless Telecom Bureau, questioned whether a GSA for spectrum would be more effective than the *status quo*. Stockdale posited that the approach underestimates three things: the need for White House involvement, the need for agencies using the spectrum to have some expertise, and significant transition costs. Steve Unger argued that an agency that is just a spectrum agency will be too technical, and that the agency would need to consider competition and consumer issues, as well.

Participants agreed on the advantages of having a regular commitment to making additional government spectrum available for commercial use. This could be implemented via reallocation or sharing, and sharing could either be interim or permanent. For example, it may be desirable to clear spectrum first, and then have a decision on whether it should be exclusive or shared. This approach is dependent on licensees knowing what their rights are. Participants also noted that there is not yet an existence proof of sharing, since 3.5 GHz is not yet fully implemented. In addition, a major obstacle is the budgeting process, which can make it impossible for agencies to replace existing assets or even plan for replacement, in a manner that would free up spectrum.

*Zero-based spectrum budget.* Senior Vice President of Public Knowledge Harold Feld noted that the statute already permits the Secretary of Commerce, in consultation with OMB, to cancel a spectrum allocation. Feld proposed that NTIA, Department of Commerce, and OMB “zero-base” the spectrum budget—requiring each agency to reapply for its spectrum authorizations and justify the use. In addition, each year agencies should be required to submit a spectrum budget and apply for authorizations through the Interdepartment Radio Advisory Committee (IRAC). This might be an approach that would yield spectrum that could be reallocated for commercial use.<sup>4</sup> In addition, Feld suggested that all agencies be required to use commercial off-the-shelf equipment and not have individual spectrum assignments.

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**...it would be essential to put together a persuasive argument for Congress to show that upfront investment in modernizing systems that use spectrum in a coordinated way would generate a significant return on that investment.**

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*Introduction of rational carrots and sticks for federal use.* The United Kingdom tried using spectrum fees as one “carrot and stick” approach. Donald Stockdale noted that there are real problems with federal government and commercial incumbency if these entities do not look at the opportunity cost of spectrum use. Stockdale noted the U.K. experience with spectrum fees and suggested the United States should consider this approach. Steve Unger suggested that spectrum fees are one way of sharpening economic incentives. The United Kingdom has had spectrum handed back by government agencies—perhaps not enough, but at least the “easy stuff” happens. Others suggested that spectrum fees are unlikely to work in the United States because agencies fear that they will not be able to achieve their missions without spectrum. Therefore, it would be essential to put together a persuasive argument for Congress to show that upfront investment in modernizing systems that use spectrum in a coordinated way would generate a significant return on that investment.

*Modifications to NTIA and FCC structures.* Michael Calabrese, Director of the Wireless Future Project at the New America Foundation, said that NTIA is too easily big-footed by generals, and is dependent on fees paid by other agencies. Calabrese asked whether it is practical to strengthen NTIA so that it can make decisions, while having agencies know that if they absolutely need spectrum, they can get it. Could NTIA become the GSA for spectrum? Ruth Milkman from Quadra Partners suggested that the FCC be reorganized so that spectrum decisions can be made with a cross-agency view, rather than by bureaus organized by industry segment or historical technology. Others agreed that one of the problems is too many siloed power centers, e.g., bureaus, which leads to fragmentation of policymaking.

*Extreme sharing.* Dennis Roberson proposed that there be a much greater emphasis on sharing, given the increasing means by which sharing can be accomplished. This should include, for example, government use of spectrum in geographies where carriers do not use specific spectrum, with appropriate compensation. Roberson said that all satellite communications spectrum should have a terrestrial component. He also suggested that most government spectrum be subject to sharing. The key is to figure out the most effective means of accomplishing the sharing in each scenario.

*International concerns.* International and standards processes are not controlled by federal spectrum institutions though influences run both directions. The international structure is complex and affects domestic policies, including countries with which the United States shares a border (Canada and Mexico), as well as the ITU. Increasingly the argument is being brought to the FCC that the international allocation should drive the domestic allocation. Both the ITU process and the standards bodies are dominated by incumbents.

## **The Role of Leadership**

The group discussed many principles related to leadership and spectrum institutions. First, whatever course is adopted, it will take leadership to move in that direction. Second, a sense of urgency is required, and it is not clear the urgency is understood and fully appreciated. Third, there must be an articulation of the vision and an enticing of

others to work to bring about that common vision. For example, some participants suggested declaring a bandwidth crisis to push the U.S. into committing to deploy 5G ahead of other economies. As stated by one of the working groups:

We need to declare a “bandwidth crisis” to inspire reform and innovation—billions of new devices need infrastructure, spectrum and bandwidth to connect—a national imperative for competitiveness, quality of life, aging population, etc.

We must deploy 5G ahead of other economies—both to maintain international technology leadership and to establish de facto standards for device design and frequency harmonization.

Participants also discussed specific leadership mechanisms. MIT Professor David Edelman described past involvement by the White House, for example in setting the specific 500 MHz goal for making additional spectrum available. Policymaker Steve Unger noted that targets are helpful but not sufficient and that detail matters. For example, if one hits the target amount for spectrum, but the spectrum is not useful, it has not really advanced the ball. Other participants discussed the need to hold the Department of Defense accountable, and the need for change agents. Both the Office of Science and Technology Policy (OSTP) and the President’s Council of Advisors on Science and Technology (PCAST) have served as change agents in the past. Change agents are useful, agreed Alex Hoehn-Saric, Senior Vice President of Government Affairs at Charter Communications, but it is also necessary to have an incentive structure.

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**Inclusion and transparency are important. If it is difficult to figure out where policy is being made, it is difficult to affect that policy.**

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In the past, principals sitting together, without staff, have also been able to make progress. Political appointees that have been successful

have won over the career staff. Noting that different communities have different ways of talking about things, Information Technology and Innovation Foundation's policy analyst Doug Brake said that it is important to get the language right.

Inclusion and transparency are also important. If it is difficult to figure out where policy is being made, it is difficult to affect that policy.

In the end, MIT scholar David Edelman asked whether spectrum leadership can truly be exercised. Edelman posited "three phases to Nirvana": (1) No one cares; (2) Big problem—get a czar; (3) Awareness at the senior level, and the development of core competency. Edelman said he felt we were still early in the process.

## **Conclusion**

Spectrum management, regulation and enforcement are arcane enough in themselves. Added to the complexity, though, is the labyrinth of governments, government agencies and other institutions of regulatory or semi-regulatory authority that providers of new applications and services must encounter to innovate in the field. While this has long been the case, the newest uses, such as drones, the Internet of Things, 5G, telemedicine, autonomous self-driving cars, and other new apps still pose more issues and complications.

The group generally agreed that spectrum management institutions already face considerable obstacles, including lack of economic incentives with respect to government users, and insufficient agility. These challenges will only increase with the advent of 5G, autonomous vehicles and the Internet of Things. In particular, the need for swift action, creativity and flexibility will increase, but these are all challenges today.

In searching for solutions, the group considered proposals for systemic change that would require legislation, such as a "GSA for spectrum," requirements for periodic reallocation of government spectrum, and spectrum fees. Most of the discussion centered on a GSA for spectrum, combined with periodic "spectrum mining," and perhaps the equivalent of a BRAC for Department of Defense spectrum. Still more thought would be required to develop the details of such an approach, to address the many issues that were raised as part of the discussion.

The group also considered proposals for change within the current system, including the development of an UAS Traffic Management system for airborne drones; a set of ideas for addressing the local issues that must be resolved to deploy the small cells and fiber that will be required for widespread development of 5G; and an Executive Council for improving baseline connectivity and affordability. The confluence of expertise brought together at the conference aims to advance the thinking of industry and policymakers in this ever-evolving field.

## Endnotes and Recommended Resources

1. Presidential Memorandum for the Secretary of Transportation, October 25, 2017. Available online: <https://www.whitehouse.gov/presidential-actions/presidential-memorandum-secretary-transportation/>
2. David Bollier, *Revisiting Spectrum Policy: Seven Years After the National Broadband Plan*, (Aspen Institute: 2017), pp. 17, 24-26, 28-29. Available online: <https://www.aspeninstitute.org/publications/revisiting-spectrum-policy-seven-years-national-broadband-plan/>
3. In 2014, Tom Lenard initially proposed the idea for a GSA-equivalent.
4. See Harold Feld and Dr. Gregory Rose, “Breaking the Logjam: Some Modest Proposals for Enhancing Transparency, Efficiency and Innovation in Public Spectrum.” Available online: <https://www.publicknowledge.org/pdf/pk-fed-spectrum-transparency-whitepaper.pdf>
5. See Federal Communications Commission. “Connecting America: The National Broadband Plan” (2010). Available online: [www.broadband.gov/plan/](http://www.broadband.gov/plan/)



# APPENDIX

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## *Rethinking Institutions of Spectrum Management*

Queenstown, Maryland  
November 6-8, 2017

### **Roundtable Participants**

**Doug Brake**

Policy Analyst  
Information Technology and  
Innovation Foundation

**Mike Calabrese**

Director, Wireless Future Project  
New America Foundation

**Jonathan Chaplin**

Managing Partner  
New Street Research

**Pierre de Vries**

Senior Fellow and Co-Director,  
Spectrum Policy Initiative  
Silicon Flatirons Center  
University of Colorado  
at Boulder

**Larry Downes**

Project Director  
Georgetown Center for Business  
and Public Policy  
The Georgetown University

**David Edelman**

Director  
Project on Technology, Economy  
and National Security  
Massachusetts Institute  
of Technology

**Harold Feld**

Senior Vice President  
Public Knowledge

**Charlie Firestone**

Executive Director  
Communications and Society  
Program  
The Aspen Institute

**Valerie Green**

Executive Vice-President and  
Chief Legal Officer  
Ligado Networks

**Thomas Hazlett**

H.H. Macaulay Endowed  
Professor of Economics  
Clemson University

Note: Titles and affiliations are as of the date of the conference.

**Alex Hoehn-Saric**

Senior Vice President,  
Government Affairs  
Charter Communications

**Marcus Johnson**

Research Aerospace Engineer  
National Aeronautics and Space  
Administration (NASA)

**Luisa Lancetti**

Chief Counsel, Law and Policy  
T-Mobile

**Blair Levin**

Senior Fellow  
The Brookings Institution

**Preston Marshall**

Principal Wireless Architect  
Google Access  
Google

**Ruth Milkman**

Partner  
Quadra Partners, LLC

**Robert Pepper**

Head, Global Connectivity  
and Technology Policy  
Facebook, Inc.

**Carl Povelites**

Assistant Vice President,  
Global Public Policy  
AT&T Services, Inc.

**Charla Rath**

Vice-President,  
Wireless Policy Development  
Verizon Communications

**Dennis Roberson**

President and  
Chief Executive Officer  
Roberson and Associates

**Donald Stockdale**

Bureau Chief  
Wireless Telecommunications  
Bureau  
Federal Communications  
Commission (FCC)

**Peter Tenhula**

Deputy Associate Administrator  
for Spectrum Management  
Office of Spectrum Management  
National Telecommunications  
and Information Administration

**Nicol Turner-Lee**

Fellow  
Center for Technology  
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Brookings Institution

**Steve Unger**

Group Director and  
Board Member  
Ofcom

**Jim Williams**

Founder and President

JHW Unmanned Solutions LLC

**Jessica Zufolo**

Senior Advisor, Strategic

Partnerships

Universal Service Administrative

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*Staff:*

**Kiahna Cassell**

Project Director

Communications and Society

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The Aspen Institute



## About the Author

**Ruth Milkman** is a partner in Quadra Partners, LLC, a strategic-advisory firm providing integrated expertise across business, finance and public policy in the context of converging communications technologies.

Ms. Milkman served as the Chief of Staff of the Federal Communications Commission (FCC) from 2013-2017 and Chief of the FCC's Wireless Telecommunications Bureau between 2009 and 2013. From 1998-2009, she worked as one of the leading telecommunications lawyers in Washington as co-founder of Lawler, Metzger, Milkman and Keeney, a firm serving clients ranging from start-ups to large established telecommunications companies and private-equity firms. Before joining Lawler and Metzger, Ms. Milkman held a variety of senior positions at the FCC, including Senior Legal Advisor to Chairman Reed Hundt and Deputy Chief of the International and Common Carrier Bureaus.

Ms. Milkman has a B.A. from Harvard University and a J.D. from the University of Michigan Law School. She served as a clerk for the Honorable J. Harvie Wilkinson III on the U.S. Court of Appeals for the Fourth Circuit.



# About the Communications and Society Program

*[www.aspeninstitute.org/c&S](http://www.aspeninstitute.org/c&S)*

The Communications and Society Program is an active venue for framing policies and developing recommendations in the information and communications fields. We provide a multi-disciplinary space where veteran and emerging decision-makers can develop new approaches and suggestions for communications policy. The Program enables global leaders and experts to explore new concepts, exchange insights, develop meaningful networks, and find personal growth, all for the betterment of society.

The Program's projects range across many areas of information, communications and media policy. Our activities focus on a broad spectrum of ICT issues such as artificial intelligence, broadband and spectrum policy, racial inclusion in communications, institutional innovation, and diplomacy and technology. Its major activity for 2017-18 is conducting the Knight Commission on Trust, Media and Democracy. The program also runs a project on the future of public libraries.

Most conferences employ the signature Aspen Institute seminar format: approximately 25 leaders from diverse disciplines and perspectives engaged in roundtable dialogue, moderated with the goal of driving the agenda to specific conclusions and recommendations. The program distributes our conference reports and other materials to key policymakers, opinion leaders and the public in the United States and around the world. We also use the internet and social media to inform and ignite broader conversations that foster greater participation in the democratic process.

The Program's Executive Director is Charles M. Firestone. He has served in this capacity since 1989 and is also a Vice President of the Aspen Institute. Prior to joining the Institute, Mr. Firestone was a communications attorney and law professor who has argued two cases before the United States Supreme Court and many in the courts of appeals. He is a former director of the UCLA Communications Law Program, first president of the Los Angeles Board of Telecommunications Commissioners, and an appellate attorney for the U.S. Federal Communications Commission.





## Select Publications from the Communications Policy Project

*Revisiting Spectrum Policy: Seven Years after the National Broadband Plan*, by David Bollier

In Autumn 2016, the Aspen Institute Communications and Society Program convened 25 leaders and experts in the technology, business, regulation and public interest for the Aspen Institute Roundtable on Spectrum Policy. The report, a result of the Roundtable, synthesizes the ideas that emerged from participant dialogue and recommends new spectrum policies that incorporate emerging technologies, consider various licensing approaches, and frame U.S. spectrum policy from a global perspective. 2017, 48 pages, ISBN Paper: 0-89843-660-5, \$12.00

*Streams of Connectedness & New Media: Fragmentation, Innovation and Democracy*, by John B. Horrigan

While greater consumer choice in media has spurred connectedness and diversity of creative voices, it can breed fragmentation, which in turn can degrade public debate. Participants of the 32nd Annual Aspen Institute Conference on Communications Policy, which took place in Aspen, Colorado in August 2017, explored policies for the new media landscape and identified two issues stakeholders should confront going forward: inclusion and content quality. Conferees grounded their recommendations in current Federal Communications Commission Chairman Ajit Pai's statement of principles—digital empowerment, the need for ubiquitous Internet access, the power of competitive free markets, and light-touch regulation. The report, written by John Horrigan, includes three proposals to address challenges in the new media landscape, such as investment in access and inclusion, changes in regulation to promote network deployment, and leadership and education. 2018, 40 pages, \$12.00

*Setting the Communications Policy Agenda for the Next Administration,*  
by Richard Adler

The 31st Annual Aspen Institute Conference on Communications Policy took place several months before the 2016 presidential election. “Setting the Communications Policy Agenda for the Next Administration” is the resulting report, synthesizing the ideas that emerged during the three-day dialogue. It explores areas where the new Administration should focus its efforts concerning communication policy. The report also includes recommendations to promote inclusion and expand opportunities for all citizens, how to encourage continued investment and innovation, and offers strategies to create a trusted online environment to protect citizen’s digital lives. 2017, 59 pages, ISBN Paper: 0-89843-655-9, \$12.00

*Preparing for a 5G World,* by Richard Adler

In October 2015, experts and leaders gathered on the Eastern Shore of Maryland to discuss the range of needs that the next generation of wireless innovation, 5G, is intended to address. This change in technology will bring forth many legal and regulatory issues as 5G reaches its full potential. Participants in the Aspen Institute Roundtable on Spectrum Policy focused on defining the key policy issues raised by the move to 5G and recommended actions to address these concerns. 2016, 67 pages, ISBN Paper: 0-89843-646-X, \$12.00

*Skirting Bottlenecks: Policies to Support Network Evolution, Digital Inclusion and Data Security,* by John B. Horrigan

The Thirtieth Annual Aspen Institute Conference on Communications Policy, titled “The Future of Broadband Competition,” took place on August 12-15, 2015 in Aspen, CO. Robust competition among communications providers has always been a crucial goal for policymakers, leading to robust, innovative and efficient delivery of services. But what does the competitive communications marketplace of the future look like? 32 leading communications policy leaders and experts gathered in Aspen to investigate policy goals that can ensure this robust, competitive marketplace, and consider how broadband markets can promise delivery of economic and social benefits that improve the quality of life in America for all. The report, written by rapporteur John B. Horrigan, offers five recommendations for the future of broadband competition. 2016, pages, ISBN Paper: 0-89843-643-5 , \$12.00

*Making Waves: Alternative Paths to Flexible Use Spectrum,*  
by Dorothy Robyn

The 2014 Aspen Institute Roundtable on Spectrum Policy (AIRS) gathered 26 of the top telecommunications policy experts at the Aspen Wye River Conference center in Queenstown, MD, to investigate whether the U.S., in light of recent progress in alternative approaches to spectrum allocation, should make the more drastic move to a regime that has all spectrum, other than some carved out for specific public benefit, to be considered general use spectrum eligible for the highest and best use available. The report, written by Roundtable rapporteur, Dorothy Robyn, tackles the task of describing what general purpose spectrum actually is; discusses the practical, political and institutional limits and ways to overcome them; and details the necessary technical advances and regulatory actions to make general purpose spectrum a reality. 2015, 68 pages, ISBN Paper: 0-89843-625-7, \$12.00

*The Atomic Age of Data: Policies for the Internet of Things,*  
by Ellen P. Goodman

The Twenty-Ninth Annual Aspen Institute Conference on Communications Policy, titled “Developing Policies for the Internet of Things,” took place August 13-16, 2014 in Aspen, CO. As the world becomes increasingly connected and more objects become embedded with sensors, the Internet of Things is poised to explode, with estimates of 25 billion connected devices by 2020. 35 knowledgeable participants gathered to examine how specifically should communications policies accommodate the new Internet of Everything? This report explores the nascent promises and challenges of the IoT. In examining the interplay between the vast increase in data created on the Internet of Things (IoT), and the resultant strain on the networks that carry this information, and the group came to a realization. Data needs to be thought of as “infrastructure.” 2015, 72 pages, ISBN Paper: 0-89843-623-0, \$12.00

*Video Veritas: Building a 21st Century Video Platform for a High-Performance Society,* by John B. Horrigan

The Twenty-Eighth Annual Aspen Institute Conference on Communications Policy focused on the future of video regulation. The resulting report, written by John B. Horrigan, looks at the changing landscape of video regulation and the fundamental shift in how video is being

viewed. While cable and broadcast television continue to be the dominant modes of transmission, over the top delivery of content via the Internet provides new ways to distribute personalized and targeted programming directly to the viewer. This, and the proliferation of mobile devices and tablets can deliver video to the viewer anywhere, anytime. As a result, the advertising-based broadcast business model is undergoing significant challenge and change. This report examines the evolving video ecosystem and offers recommendations for policy that can accommodate the new video market. 2014, 54 pages, ISBN Paper: 0-89843-603-6, \$12.00

*Spectrum as a Resource for Enabling Innovation Policy,*  
by William Webb

The 2012 Aspen Institute Roundtable on Spectrum Policy (AIRS) convened shortly after the presidential election to consider ways that spectrum policy could improve the economy through innovation. The 32 leading communications policy experts in attendance focused on how spectrum policies could help create an environment that makes it easier to use spectrum as a resource for innovative new goods and services. The participants first identified problems facing new entry and innovation today, and then recommended solutions, looking specifically at the interstices among licensed and unlicensed approaches, spectrum sharing and flexibility, and new institutional arrangements to manage these solutions. The report, written by British spectrum expert William Webb, sets forth 11 recommendations that he gleaned from the conference dialogue to guide future spectrum policy development with regard to facilitating innovation. 2013, 45 pages, ISBN Paper: 0-89843-584-6, \$12.00

*Rethinking Communications Regulation,* by Richard Adler

As the Internet and other information and communications technologies grow exponentially, and as a new ecosystem is emerging that could conflate previously distinct methods of communication into a single digital medium, questions arise as to whether the traditional silos of regulation are still appropriate. The report resulting from the 27th Annual Aspen Institute Communications Policy Conference addresses the overarching concern as to whether the Communications Act needs a radical revision. Written by rapporteur Richard Adler, the report considers the key goals of a new communications regime and offers regulatory and non-regulatory approaches for achieving these goals in a digitally connected world. 2013, 65 pages, ISBN Paper: 0-89843-583-8, \$12.00

*The Reallocation Imperative: A New Vision for Spectrum Policy,*  
by Preston Marshall

The report resulting from the 2011 Aspen Institute Roundtable on Spectrum Policy addresses new ways of allocating, clearing, using and/or sharing spectrum controlled by private parties and government agencies. Written by rapporteur Preston Marshall, the report attempts to step back and establish a broad vision for reallocating spectrum in the United States in the public interest, discussing new approaches that will facilitate more effective and efficient spectrum use. A number of recommendations are laid forth to guide future spectrum policy development, Congressional actions, and technology explorations. 2012, 54 pages, ISBN Paper: 0-89843-570-6, \$12.00

*Updating Rules of the Digital Road: Privacy, Security, Intellectual Property,* by Richard Adler

Given the current growth and importance of the Internet, the report of the 2011 Aspen Institute Conference on Communications Policy titled *Updating Rules of the Digital Road: Privacy, Security, Intellectual Property*, highlights the elements that will allow for greater use of broadband as the common medium: security, privacy and intellectual property regulation. Written by rapporteur Richard Adler, the report explores a range of threats that plague the use of today's communications media and provides a series of recommendations which aim to ensure that users' communications are secure, private and protected.

The report reflects the issues and ideas raised by business leaders, academics, and policy experts at the Twenty-Sixth Annual Aspen Institute Conference on Communications Policy. 2012, 70 pages, ISBN Paper: 0-89843-563-3, \$12.00

*Spectrum for the Next Generation of Wireless,* by Mark MacCarthy

*Spectrum for the Next Generation of Wireless* explores possible sources of spectrum, looking specifically at incentives or other measures to assure that spectrum finds its highest and best use. It includes a number of recommendations, both private and federal, of where and how spectrum can be repurposed for wireless use. In November 2010, the Aspen Institute Communications and Society Program convened the Aspen Institute Roundtable on Spectrum Policy, where 31 experts and leaders addressed the consequences and solutions to the increasing demand for

spectrum. *Spectrum for the Next Generation of Wireless* is the report resulting from the Roundtable discussions. 2011, 68 pages, ISBN Paper: 0-89843-551-X, \$12.00

*Rewriting Broadband Regulation*, by David Bollier

The report of the 25th Annual Aspen Institute Conference on Communications Policy in Aspen, Colorado, considers how the United States should reform its broadband regulatory system. Participants looked at international models and examples and examined how data and communications should be protected in the international arena. The resulting report explores a range of policies for U.S. broadband regulation, many of them derivative of the National Broadband Plan adopted by the Federal Communications Commission only a few months before the conference.

Participants also ventured into new and interesting territory with the novel concept of “digital embassies.” They saw this as a way of dealing with jurisdictional issues associated with the treatment and protection of data in the cloud, i.e., data that is provided in one country but stored or manipulated in another. The concept is that the data would be treated throughout as if it were in a kind of virtual embassy, where the citizenship of the data (i.e., legal treatment) goes along with the data. This policy seed has since been cultivated in various other regulatory environments. 2011, 37 Pages, ISBN Paper: 0-89843-548-X, \$12.00

*Scenarios for a National Broadband Policy*, by David Bollier

The report of the 24th Annual Aspen Institute Conference on Communications Policy in Aspen, Colorado, captures the scenario building process that participants used to map four imaginary scenarios of how the economy and society might evolve in the future, and the implications for broadband policy. It identifies how certain trends—economic, political, cultural, and technological—might require specific types of government policy intervention or action. 2010, 52 pages, ISBN Paper: 0-89843-517-X, \$12.00

*Rethinking Spectrum Policy: A Fiber Intensive Wireless Architecture*, by Mark MacCarthy

*Rethinking Spectrum Policy: A Fiber Intensive Wireless Architecture* is the report resulting from the Aspen Institute Roundtable on Spectrum

Policy, held at the Aspen Wye River Conference Center in November 2009. Written by rapporteur Mark MacCarthy, the report captures the insights of the participants, exploring innovative ways to respond to the projections of exponential growth in the demand for wireless services and additional spectrum. In addition to discussing spectrum reallocations, improved receivers, shared use and secondary markets as important components for meeting demand, the report also examines opportunities for changes in network architecture, such as shifting the mix between fiber and wireless. 2010, 58 pages, ISBN Paper: 0-89843-520-X, \$12.00

*ICT: The 21st Century Transitional Initiative*, by Simon Wilkie

The report of the 23rd Annual Aspen Institute Conference on Communications Policy in Aspen, Colorado addresses how the United States can leverage information and communications technologies (ICT) to help stimulate the economy and establish long-term economic growth. The report, written by Roundtable rapporteur Simon Wilkie, details the Aspen Plan, as developed in the summer of 2008, prior to the economic meltdown beginning in September 2008 and prior to the election of Barack Obama as President. The Plan recommends how the Federal Government—through executive leadership, government services and investment—can leverage ICTs to serve the double bottom line of stimulating the economy and serving crucial social needs such as energy efficiency and environmental stewardship. 2009, 80 pages, ISBN Paper: 0-89843-500-5, \$12.00

*A Framework for a National Broadband Policy*, by Philip J. Weiser

While the importance of broadband access to functioning modern society is now clear, millions of Americans remain unconnected, and Washington has not yet presented any clear plan for fixing the problem.

Condensing discussions from the 2008 Conference on Communications Policy and Aspen Institute Roundtable on Spectrum Policy (AIRS) into a single report, Professor Philip Weiser of the University of Colorado at Boulder offers a series of specific and concrete policy recommendations for expanding access, affordability, and adoption of broadband in the United States. 2008, 94 pages, ISBN Paper: 0-89843-484-X, \$12.00



*The Future of Video: New Approaches to Communications Regulation*,  
by Philip J. Weiser

As the converged worlds of telecommunications and information are changing the way most Americans receive and relate to video entertainment and information, the regulatory regimes governing their delivery have not changed in tune with the times. These changes raise several crucial questions: Is there a comprehensive way to consider the next generation of video delivery? What needs to change to bring about a regulatory regime appropriate to the new world of video? The report of the 21st Annual Conference on Communications Policy in Aspen, Colorado, outlines a series of important issues related to the emergence of a new video marketplace based on the promise of Internet technology and offers recommendations for guiding it into the years ahead. 2006, 70 pages, ISBN Paper: 0-89843-458-0, \$12.00

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