The FCC is admirably focused on the twin goals of (a) increasing innovation with respect to wireless uses, application, and devices by reducing barriers to entry for new, potentially disruptive technologies and competitors and (b) utilizing available spectrum as completely as possible.

The FCC seeks to make the policy process itself a locus of innovation, as economic and technical surveys are conducted, and principles are formulated, explored and enacted to determine which are most effective. Evidence-based policy-making seems to be coming to the fore.

Most interestingly, there are a set of what I might call “emergent principles” that seem to be resulting from FCC-led policy making innovation. In the service of advancing the dialogue, consider the following three principles: Business-interface neutrality, minimum effective regulation, and technology and regulatory co-evolution.

Emergent principle one: Business interface neutrality

A foundation of modern thinking about economic innovation (c.f. is that when the interfaces between stages in a value chain become open to new contributors, innovations bloom. Business-interface neutrality is a principle that has become almost foundational to the new policy making process. In regard to wireless, there is a corresponding emergent principle of "spectrum neutrality." Spectrum neutrality embraces simple rulemaking to allow devices of many shapes and sizes to communicate across the same spectrum. This principle is essential if we are to encourage development of new uses, applications and devices for wireless.

The arguments that support spectrum neutrality are similar to those of network neutrality. Both radio spectrum and the Internet are public media over which communication can be established. The fact that one exists "in the ether" and the other requires capital investment and operation tends to obscure their essential similarity from the standpoint of applications, users and devices.

The benefits of neutrality in electronic, physically-mediated networks were established long ago with the Carterphone decision that opened up the Bell System network to new devices. The principle of neutrality has currently reached a crescendo of relevance in addressing the Internet, and most independent observers agree that Internet network neutrality is essential to promote innovation in uses, applications, devices and communication architectures.

The corresponding principle of neutrality has been firmly established for spectrum, though it has not been articulated as such. In radio, we have long had some frequencies allocated with spectrum neutrality in mind, that is, the ham radio, citizen's band, and medical and scientific bands. Wifi and Bluetooth are contemporary examples of the principle of spectrum neutrality in action.

I observe that much of the interest in today’s "white spaces" rulemaking is from potential

new entrants who see an opportunity if the white space frequencies become open to all, in line with principles of spectrum neutrality.

Emergent principle two: Maximum sharing of networks and spectrum is attained by minimum effective regulation of devices.

Network and spectrum neutrality require regulation to ensure that devices can interoperate. Standards are essential. However, it is vital that we adopt standards that are as minimal as possible, so as not to create barriers to entry. We need to examine closely any regulations to ensure that they truly support neutrality, rather than tacitly favor a particular approach or party. We need a principle of minimum effective device regulation for maximum sharing of resources.

Emergent principle three: Regulation is technology specific and must co-evolve with technology.

As technology for sharing of resources advances, spectrum policy and device regulation can and should be specifically adapted to embrace the use of the new sharing technologies. Regulation and technology co-evolve.

Emergent principle three differs from the previous two, in that it requires insight into the specific technologies being regulated. Moreover, it requires that stakeholders in the policy process speak for what Mitchell Kapor has termed "the companies unborn." These are companies that will appear and thrive if rule-making and regulation co-evolve with them. The new FCC has been proactive in reaching for input beyond traditional stakeholders and into the realm of pioneers and visionaries. This is very encouraging. However, in order to make the principle of technology and regulatory co-evolution effective, explicit study of these relationships must move to the forefront of dialogue. We have an example of the challenge in the "white spaces" discussions underway, and its comparison to those that led to the Wifi and Bluetooth revolutions.

Wifi and Bluetooth are successful ecosystems that thrived under regulation that assured spectrum neutrality. Wife and Bluetooth devices are rather primitively regulated in order to achieve interoperability. Power limits, crash-detection and shared-communication protocols suffice. While these elements of regulation have been admirably minimal and open, the technology they support can only go so far in resource sharing. Technology marches on, and regulation must be adapted at each new advance.

There is, as always, a new communication technology advance at hand. Today we can achieve a much higher level of spectrum neutrality and resource sharing using peer-to-peer cooperative radio technology. Clusters of small radios auto-configure themselves into networks, mimicking in realtime and across open space the architecture of the Internet. These technologies have been proven in a number of specialized military and public safety applications, and there are firms now commercializing this technology for consumers and businesses. These approaches are often referred to as "MANET" for "mobile ad hoc networks." In order to embrace MANET build-out, our regulation needs

to focus principally on waveforms and computational algorithms, rather than power limits and crash detection.

We believe that the approaches currently being examined for "white space" do not sufficiently reflect the advances in technology that have been achieved since the days of Wifi and Bluetooth and their like. Essentially, proposed regulation focuses on geographic separation buttressed by registration, combined with power limits. The result will be a massive waste of spectrum compared to what can be utilized with currently-available advanced technologies for cooperative and cognitive radio.

We recommend that the FCC do a rigorous examination of new technologies for spectrum-neutral sharing of frequencies. The results of this examination would then be used to craft regulations to encourage implementation on a wide scale of more advanced technologies. Our belief, as explained below, is that the result could be an explosive increase in the use of broadband wireless technology in the United States, several orders of magnitude larger than that achieved by the Wifi and Bluetooth generation of devices.

More important, we believe that it would be helpful for the FCC to focus on the principle of technology and regulatory co-evolution, and explore process and institutional changes that can strengthen the process of putting this principle into action.

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