Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	ET Docket No. 02-135
Spectrum Policy Task Force	)	

COMMENTS OF CISCO SYSTEMS, INC.

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SUMMARY

This nation is in the midst of a revolution in wireless networking. Broadband wireless networks using "unlicensed" spectrum are rapidly being deployed in businesses, in schools, in homes, and in public facilities all across the country. These "unlicensed" networks have made businesses more productive, and are providing thousands of new access points to the Internet for consumers. Moreover, Cisco believes that these "unlicensed" networks have the potential to create an entirely new broadband network for all Americans. The Commission should encourage and foster this wireless networking revolution by making spectrum available specifically for "unlicensed" data networks, and by modifying its rules to minimize the potential for interference to (and thus optimize the frequency available to) such networks.

Individually licensed services will also play a critical role in broadband deployment, and there are steps the Commission can take to improve its management of both licensed and unlicensed services. *First*, the Commission's spectrum management approach must be sufficiently flexible to permit continued innovation. This means that as new technologies and services are developed that can operate without causing harmful interference to existing technologies and services, the Commission's spectrum rules must allow their deployment. It also means that individual licensees should be given more flexibility to use – or sell – their spectrum as they see fit. *Second*, the Commission should work wherever possible toward harmonizing U.S. spectrum allocations with international allocations – recognizing that, because of the unique nature of the U.S market, there may be some instances where harmonization would

not be in the public interest. *Third*, the Commission should allow experiments transmitting at low power in certain frequencies to be licensed by rule, rather than individually. That will allow the more rapid testing of new technologies and permit an even faster pace of technical innovation.

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As the Commission evaluates its overall approach to spectrum regulation, it should give considerable attention to the phenomenal growth of broadband wireless networking and other data applications using "unlicensed" spectrum.[1] Broadband wireless networks using "unlicensed" spectrum are rapidly being deployed in offices, schools, homes, and public facilities. They have already made American businesses more productive. And as broadband devices that consumers can simply buy, plug in and operate become increasingly available, a second wireless revolution is rapidly developing. In crafting its approach to spectrum management for the future, Cisco Systems, Inc. ("Cisco") believes the Commission should acknowledge this "unlicensed" wireless revolution – which may eventually create a new national broadband network. It also believes that the Commission, which helped create this revolution with its visionary Part 15 rules, can and should do even more to encourage and perpetuate it.

The Commission needs to do two things to foster the growth of unlicensed broadband networks. First, it must make more spectrum available for unlicensed uses. "Unlicensed" spectrum – which belongs to the public – is just as important to the public interest as is individually licensed spectrum and the Commission's allocation decisions should reflect that

[1] As a legal matter, the use of these bands is not "unlicensed" – rather it is licensed by rule. For the sake of simplicity, however, we will use the term "unlicensed."

importance. Second, the rules governing "unlicensed" spectrum – or at least that part of it allocated to wireless broadband networking – should be modified to optimize frequency use by minimizing the potential for interference. Common sense spectrum etiquette rules can have the same impact as the allocation of additional spectrum. The failure to adopt such rules, at least in some bands, would simply be wasteful.

Cisco also believes that individually licensed services have and will continue to have a critical role to play in the broadband grid that should eventually include all American homes and business. And there are more general steps the Commission can take to improve its management of both individually licensed and "unlicensed" services.

First, the Commission should ensure that its approach to spectrum management permits continued innovation. The growth of the communications sector and the U.S. economy – and the welfare of consumers – has always been closely linked to innovation. This means that Commission must ensure that new services and technologies (whether licensed or "unlicensed") can be deployed providing they do not cause "harmful interference" to existing services and technologies. The Commission should not allow any licensee to prevent other non-interfering uses within licensed spectrum. But it also means that licensees should be given more flexibility to use their spectrum as they see fit, and should be permitted to sell to others their rights to use the spectrum.

Second, the Commission should work *wherever possible* toward harmonizing U.S. spectrum allocations with international allocations. There is little doubt that where spectrum is harmonized economic efficiencies, and opportunities to export equipment and services, follow. Cisco recognizes, however, that on occasion the U.S. allocations (including the scope of permitted services, frequency-sharing etiquette, and requirements concerning channelization, in-

band power emission limits, out-of-band emissions, and antennas) should diverge from the international allocations. Our country's spectrum needs are sometimes different than the needs of other nations, and our allocation decisions should reflect that.

Third, Cisco also believes that the Commission should examine whether experiments transmitting at low power in certain frequencies should be licensed by rule, rather than individually. The more easily technology companies and manufacturers can experiment, the more innovation will quickly find its way from the labs to the home and office.

I. THE COMMISSION SHOULD ALLOCATE SPECTRUM SPECIFICALLY FOR UNLICENSED DATA NETWORKS.

Because of the increasing importance of wireless networking to both businesses and consumers, and the rapid advances in the technology, Cisco recommends that the Commission allocate more spectrum for "unlicensed" wireless networking. It should also make more spectrum effectively available for "unlicensed" bands by adopting spectrum etiquette rules that will allow more efficient use of the spectrum. Whether newly allocated spectrum is dedicated just to wireless networking, or is shared with other unlicensed users or even with licensed services, rules to mitigate interference will become critical to widespread wireless broadband deployment.

A. Wireless networking has made businesses more productive and could be the key to widespread broadband deployment.

When businesses and universities began deploying unlicensed wireless networks, Cisco believed that these networks would boost the productivity of those who used them. Empirical evidence now proves that these networks do, indeed, increase productivity. A study commissioned by Cisco found that wireless LAN users were able to be connected to their networks 1.75 more hours per day, making the average user as much as 22% more productive.

According to the same study, 63% of end-users reported that wireless LAN technology improved the accuracy of everyday tasks, while 51% of the healthcare organizations for which they worked found significant improvements in accuracy.

These statistics should not be surprising. The advantages of wireless LANs for businesses are manifest. Wireless LAN equipment is portable. That means workers can move around offices, spontaneously create focused work teams, and be more productive. Businesses can economize on office leasing costs by making office space available to traveling employees only when those employees are in the office. Doctors and nurses can chart at the point of patient care and be more accurate. And warehouse workers can check product inventory and provide that information to customers in real time. It all adds up to more tasks accomplished more accurately.

Presumably because of such efficiency gains, the market for wireless networking technology – primarily built to the IEEE's 802.11b standard – has grown phenomenally in commercial enterprises. For business customers alone, wireless LAN sales using the Wi-Fi standard (802.11b and 802.11g) totaled 613,000 network interface cards ("NICs") and 63,000 access points in 1999, 2,163,000 NICs and 389,000 access points in 2000, and an estimated 6,162,000 NICs and 1,168,000 access points in 2001.[2] In just 83.5 MHz of spectrum (in the 2.4 GHz frequency band) shared with a variety of users, wireless LANs have become an estimated $1.785 billion industry worldwide (reflecting a nearly three-fold growth between 1999 and 2001).[3]

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2 Cahners In-Stat Group, Life, Liberty and WLANs: Wireless Networking Brings Freedom to Enterprise, at 60, 63 (Nov. 2001).

3 Id. at 57.

Cisco believes that the extraordinary success of "unlicensed" wireless networks so far may foreshadow a fundamental change in the growth of broadband networks more generally. It is not just commercial enterprises that are investing in wireless LAN technology. Individual consumers are already taking part in the "unlicensed" broadband revolution. In the fourth quarter of 2001, despite a weak economy, Cisco estimates that consumer and home office wireless LAN sales totaled $226 million.

In addition, a variety of commercial enterprises and network operators are using the technology to create broadband public access points to the Internet. Today, there are already thousands of wireless "hot spots" deployed in the United States. T-Mobile currently has 576 locations (and is expanding rapidly) and is the provider to Starbucks.[4] Boingo Wireless now offers service in over 500 locations.[5] One consulting firm expects service providers to deploy over 42,000 wireless LAN base stations by 2006 in public locations across the United States and internationally.[6] These network operators will extend high-speed connectivity to the public beyond the home and the office, helping to meet the imperative of broadband deployment to individuals.

And even these developments may not fully capture the potential of "unlicensed" wireless networking. There are many who believe, and with good reason, that the "unlicensed bands" – if properly managed – may ultimately provide a wireless broadband connection to the home with all the capabilities of cable and wireline networks. Needless to say, the creation of a nationwide wireless broadband network would be a transforming event for the communications sector and the information technology age.

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4 See www.tmobilebroadband.com.

5 See www.boingo.com.

6 In-Stat/MDR, Revealing the Labyrinth: Hotspot Providers, Models, & Venues, at 1 (May 2002).

B. The Commission should allocate additional spectrum for "unlicensed" wireless networks.

Individually licensed wireless services are a critical part of our nation's communication grid and always will be. But, increasingly, "unlicensed" services are equally important and they should be given equal consideration in the spectrum allocation process.

Even when done in a rational, economically efficient way, individual licensing is a time-consuming and expensive process. "Unlicensed" spectrum, by contrast, provides both businesses and consumers with a fast, inexpensive way to build and use wireless networks: they just buy the appropriate devices, plug them in, and turn them on. This ease of use is one of the keys to the success of unlicensed broadband networks.

As with individually licensed wireless services, however, the success of "unlicensed" services inevitably create spectrum constraints. This may be even truer for "unlicensed" services, since the current bands allotted for "unlicensed" services are heavily used by both individually licensed services and a broad assortment of "unlicensed" devices. Accordingly, as the Commission makes future spectrum allocation decisions, it should not treat "unlicensed" service as the spectrum stepchild. It should make additional allocations for "unlicensed" broadband networks.

C. The Commission should minimize interference in "unlicensed" data networking bands.

As successful as the "unlicensed" bands have been for networking, the Commission's current approach to regulating these bands poses long-term risks to the continued growth of "unlicensed" broadband networks. The Commission has, so far, chosen to permit virtually any use of the "unlicensed" bands, and *not* to require unlicensed devices to incorporate advanced spectrum-sharing technology. As a result, the risk of mutual interference among "unlicensed"

devices is higher than it needs to be given the availability of new technologies. While the problem is surely not yet acute, even in the heavily used 2.4 GHz band, the Commission has not attempted to optimize the "unlicensed" bands for wireless broadband networking.

It is, of course, not necessary for the Commission to maximize every "unlicensed" band for wireless networking. A more open, even if less efficient, regulatory regime may have the benefit of permitting greater experimentation. But neither is it necessary – and surely it is not wise – to maximize every unlicensed band for experimentation. Some unlicensed bands should be maximized for *service*.

Accordingly, Cisco believes the Commission should set aside some "unlicensed" spectrum for data networking, and thus should craft rules so that devices used in those bands optimize frequency use. For example, the next generation of wireless devices will go well beyond the "listen before talk" technology that is today's leading interference mitigation technique. Soon wireless devices adhering to voluntary industry standards will use dynamic frequency selection and transmit power control to use the radiofrequency spectrum more efficiently. And on the horizon are wireless networking devices that will communicate with each other to optimize frequency use. These devices, for example, will exchange operational information to optimize frequency use and transmission efficiency. Cisco's engineers are also working on new wireless applications that operate at power levels that can minimize self-interference and optimize frequency reuse. As power levels go down, radiation range diminishes to smaller spatial area and starts to correspond to traditional "property boundaries" such as a residential lot or house walls, a corporate or university campus, and so on. Reduced power levels generally empower users to mitigate interference based on their ability to regulate who enters their property without the need to regulate the nature of emissions or who emits.

Cisco believes the creation of broadband wireless networks would serve the public interest, and that, with the rapid innovations in spectrum sharing technology, the Commission should adopt a regulatory approach that encourages the development of such networks. To do so, it should set aside some "unlicensed" spectrum for such networks, and ensure that devices used in this spectrum take advantage of available spectrum sharing technology.

II. THE COMMISSION'S SPECTRUM MANAGEMENT APPROACH MUST BE SUFFICIENTLY FLEXIBLE TO PERMIT CONTINUED INNOVATION.

There is little that is more important to the communications sector, and to consumers, than technology innovation. It is thus critical that the Commission's approach to spectrum management always be sufficiently flexible to permit – and even to encourage – such innovation.

This means as new technologies and services are developed that can operate without causing harmful interference to existing technologies and services, the Commission's rules must allow their deployment. No licensee should be allowed to prevent other, non-interfering, uses of the spectrum. By prohibiting only additional spectrum uses that cause "harmful interference," and by permitting all other uses of the spectrum, the Commission can both protect current spectrum uses and allow new technologies to develop and flourish.

There are innovative new technologies – particularly in broadband – that are able to use the spectrum in unfamiliar ways. The result can be new services for consumers. For example, ultra-wideband, although still in its infancy, is beginning to be deployed across many frequency bands because it can operate without causing harmful interference to existing users. Adaptive wireless devices with frequency and power agility, combined with clever spectrum sensing, similarly may operate without causing harmful interference. Any spectrum management model (or conception of licensee's rights) embraced by the Commission must not foreclose these and

other innovative technologies and means of using the spectrum – or permit private parties to foreclose such uses.

Permitting innovation also means allowing licensees additional flexibility to use their spectrum as they see fit. It further means allowing them to resell all or portions of their licensed spectrum for the remainder of the license term (provided that there is no modification to the requirements, restrictions, and duration of the original authorization). Secondary markets of this nature are likely to lead not only to innovation, but also to more efficient spectrum use, since there would be financial incentives for the licensee to sell unused (or underused) frequencies.[7] Finally, since the term of the license and the requirements imposed thereunder (including restrictions on allowing spectrum to lie fallow) would not change, the Commission's plan for any frequency band (which naturally includes prompt rendering of service to the public) would not be undermined.

Spectrum regulation, if done improperly, can stifle innovation either directly or by giving existing users of the spectrum veto rights over new uses. But with sufficient flexibility for both new uses and existing licensees, innovation will continue and the public interest served.

III. INTERNATIONAL SPECTRUM HARMONIZATION SHOULD BE ENCOURAGED BUT NOT RIGIDLY EMBRACED.

Increased harmonization of domestic spectrum allocations with international spectrum allocations would deliver measurable benefits both to American consumers and to American exporters. Harmonized spectrum allocations would benefit American consumers, who could use their wireless equipment (such as networking devices) while traveling abroad. This would be an important convenience for leisure travelers. But it would be more than just a convenience, since

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7 Nevertheless, this approach is not without its risks and costs. By allowing unrestricted disaggregation and sale of spectrum, the spectrum could become balkanized and the transaction costs for putting together a contiguous band could become prohibitive.

American companies (and the people who work for them) do business all over the world. An employee traveling to Asia or Europe will simply be more productive if the wireless card in his or her laptop operates abroad – allowing the employee to turn waiting time in an airport lounge into productive time. For the sake of U.S. consumers alone, harmonization should be encouraged.

But spectrum harmonization would also benefit American manufacturers and exporters – and, not coincidentally, the U.S. economy. The U.S. companies that manufacture communications and information technology products are without peer across the globe. Nevertheless, with greater spectrum harmonization, U.S. manufacturers would be even more effective competitors because harmonized spectrum makes it easier to sell abroad products designed and tested in the American market. They would also benefit by being able to take advantage of economies of scale. With harmonized allocations, U.S. manufacturers could use their other advantages to lead in the development of globally applicable technology solutions. For these reasons, too, internationally harmonized spectrum allocations should be encouraged.

But while harmonized spectrum allocations should be encouraged, Cisco does not believe that it will *always* be in the public interest for the Commission to adopt international allocations. There will be times when the United States will have different spectrum needs than other countries, and international allocations need not be slavishly followed when that occurs. Compared to Japan or Western Europe, for example, the U.S. has vast and relatively lightly populated rural areas. There is a consensus among U.S. policymakers, industry, and consumers that bringing broadband networks to all Americans is an important objective. Wireless devices (terrestrial or satellite) may be a means to do so, and the Commission should not hesitate to make domestic allocations that would permit this to occur – even if those allocations differed from

international allocations. So, to the extent that the communication and information services that are needed in the United States differ from those in other parts of the world, the Commission should be prepared to allocate spectrum differently.

IV. THE COMMISSION SHOULD REVISE THE EXPERIMENTAL LICENSING RULES TO PROMOTE INNOVATION.

Individual licensing can be burdensome. This is just as true with respect to obtaining an experimental license as it is with respect to obtaining a service license. Cisco urges the Commission to consider the benefits of eliminating the individual licensing requirements for experimental licenses where the transmitting power will be low and where there is unlikely to be interference to existing services in the frequencies used.

Obviously, prompt and accurate testing of new radio techniques or new equipment, such as handsets, is crucial to the pace of development and innovation. Obtaining an individual license in order to test new innovations slows that process and could stymie development of new technologies and new radio transmission techniques.

Today, experimental licensees operate on a non-interference basis to other licensees, so experimental licensees already are obligated to not cause harmful interference to the established radio services. See 47 C.F.R. § 5.111(a)(2). Cisco is not seeking to change this approach. Rather, Cisco thinks the Commission should consider whether an experimental license is always necessary when testing radio techniques and equipment in frequencies allocated to established radio services.

Where the possibility of interference is low (as would be the case in some but by no means all radio services), Cisco believes that the stifling impact of an individual licensing regime on the pace of innovation may outweigh the record keeping benefits of requiring an experimental licensing application. In particular, an experimental license may not be appropriate for short

engineering tests where the possibility of interference is low (though an experimental license would still be appropriate where systems are being deployed for demonstrations or field trials or where the tests may extend over a long time period). Because any experiment that causes harmful interference must be immediately ceased, the Commission should examine what frequencies with established radio services should be opened up to experiments undertaken at low power without an individual license.

CONCLUSION

The Commission should recognize, and embrace, the revolution that has occurred in unlicensed wireless networking. It should build on the success of the current unlicensed bands by setting aside unlicensed spectrum specifically for data networking – and adopting rules to maximize the efficient use of the spectrum for that purpose.

The Commission must also keep firmly in mind the importance of innovation both in wireless technology and spectrum usage. It must never give licensees the power to obstruct the use of new technologies or the provision of services if those technologies and services do not cause harmful interference. On the other hand, licensees should be given more leeway to use their spectrum as they see fit, and to sell their rights to use spectrum to others. This flexibility would promote both innovation and efficiency.

All else being equal, the Commission should work toward harmonizing U.S. spectrum allocations with international allocations because of the economic benefits and convenience that such harmonization brings. But all is not always equal. Sometimes this nation's spectrum needs will simply be different than those of other nations. In such cases, the Commission should not hesitate to diverge from international allocations.

Finally, the Commission should examine whether experiments transmitting at low power in certain frequencies should be licensed by rule, rather than individually. This would allow more rapid testing of new technologies and an even faster pace of innovation.

In considering new approaches to spectrum management, Cisco believes the Commission should keep in mind the ultimate goals of telecommunications regulation: better communications services for all Americans, greater productivity for American businesses, and continued technological innovation.

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