BEFORE THE OFFICE OF COMMUNICATIONS LONDON, ENGLAND

In the Matter of

Licence-Exemption Framework Review

RESPONSE OF CISCO SYSTEMS

Cisco Systems, Inc. ("Cisco") applauds and supports the work undertaken by the Office of Communications (Ofcom) in its Licence-Exemption Framework Review (LEFR or Framework). The proposed Framework will both promote the efficient use of spectrum that to date has not attracted significant use and encourage innovative new uses for that spectrum. Additionally, the Framework will assist Ofcom in developing a coordinated plan for future spectrum uses, while providing valuable information to the public and to industry about how the regulatory environment will develop. Simply put, the Framework will help both Ofcom and stakeholders plan for the future from a common—and well-crafted—baseline of understanding.

Ofcom is correct that constraints in transceiver technologies and radio-wave propagation make spectrum above 40 GHz ideal for licence-exempt and lightly licensed uses¹. In Cisco's view, the likely uses of this spectrum fall broadly under one of two possible types of technology deployments: (1) devices or systems employing omnidirectional antennas operating at low power, most likely for indoor use and (2) devices or systems operating high-gain antennas that transmit pencil-beam signals some distance,

¹ Cisco has no objection to the exclusion by Ofcom of certain services previously recognized by the ITU-R radio regulations as continuing to be designated for primary use. Consultation at 5.

most likely for outdoor use. Cisco agrees that a light-licensed or licence-exempt model can best encourage the most intensive use of the spectrum resource to bring tangible benefits to the UK economy by further developing the broadband infrastructure. In our comments below, we offer a few introductory remarks before responding to several of the specific questions posed by the Framework Review.

Cisco is a worldwide manufacturer of IP-based technologies for routing and switching, and is a leading producer of wireless local area networks (WLANs) utilising licence-exempt frequencies. Cisco has a major centre located in Bedfont Lakes, including a network security operations centre and executive briefing centre, as well as sales offices throughout the United Kingdom. In sum, Cisco employs approximately 3,000 people in the UK. Cisco is headquartered in San Jose, California. Cisco engineers actively participate in and lead the relevant standards organizations and industry interoperability associations supporting IEEE 802.11 technology, which has been successfully deployed in licence-exempt, light-licensed, and licensed regimes. Cisco was at the forefront of introducing software-defined radio devices in licence-exempt bands, as well as leading the industry on dynamic frequency selection functionality necessary to permit licence-exempt devices to coexist with governmental radars in the 5250-5350 MHz and 5470–5725 MHz bands. Cisco was also active in the initial regulatory proceeding at the U.S. Federal Communications Commission for lightly licensed "millimetre wave" systems at 70/80/90 GHz, which Ofcom has since adopted.

General Discussion

Cisco generally agrees with the approach laid out in the LEFR and with the proposals advanced by Ofcom. Articulating at a high level how spectrum above 40 GHz

will be designated is a crucial first step toward encouraging its use. Most importantly, it signals to the vendor community the expectation of the types of technology that might be deployed. The Framework does so without attempting to drill down on a particular technology with a particular set of features. While regulatory processes have at times resulted in the happy marriage of good spectrum technology and strong business models, spectrum policy worldwide is littered with examples of failed technology and failed business models, with the unhappy result that spectrum lies fallow or is utilised by an inefficient technology². Ofcom's proposal strikes the right balance in supporting future licence-exempt or lightly licensed broadband technologies without constraining the technical community in terms of specific technology solutions or applications that can be developed. With this decision, entrepreneurs and standards bodies can confidently begin solving the technical issues and address the business models that this spectrum could support.

Cisco supports Ofcom's goal of regulating with an eye towards the maximisation of the economic value of available spectrum. Cisco believes that Ofcom's proposed approach of dividing available spectrum into classes of spectrum commons is the right way to do just that, and that application-specific spectrum allocations are a second-best option to be used only when circumstances require them.

Cisco is a proponent both of licence-exempt regimes as well as lightly licensed ones. In our recent experience, we have seen tremendous value from lightly licensed

² For example, the U.S. allocated the 2.5 GHz spectrum band for "wireless cable" video programming services that found little success in the market, with the result that this band has been underutilised for years. Indeed, despite multiple attempts at reform—including an ongoing transition to a new band plan intended to facilitate wireless broadband deployments—much of the spectrum in the 2.5 GHz band continues to lie fallow to this day.

regimes that force a user to coordinate its spectrum use prior to initiating transmissions. This method, we believe, ensures the maximum number of users can occupy frequencies in a geographic area, and avoids the downside of the full geographic licence where the licensee has legal rights to its frequencies, regardless of the extent to which the spectrum is in use. Lightly licensed regimes have particular application where the expectation is that the use of the technology will require significant investment in equipment, such as a millimetre wave system, or where the technology will be deployed by a service provider. Cisco is also a proponent of licence-exempt regimes, where contention-based protocols effectively manage packet collisions, and agrees that there are likely to be uses for spectrum above 40 GHz that permit these self-managed technologies.

It is also important that Ofcom has proposed to make large amounts of spectrum available for licence-exempt and lightly licensed use. At higher frequencies, it is possible to tune any given antenna and power amplifier over a greater range of spectrum than is possible at lower frequencies. For example, using today's technology, it is possible to tune an antenna operating at 2.4 GHz over a frequency range of 250 MHz. But an antenna operating at 60 GHz can operate over a 6 GHz frequency range. Given this effect, it makes no sense to break up higher frequency bands into small frequency blocks that fail to take advantage of the inherent economies in antenna and power amplifier technology. Ofcom is correct to be looking at broad allocations for this portion of the spectrum.

Additionally, Cisco agrees that harmonisation offers substantial benefits to consumers both in the UK and abroad, and urges Ofcom to take a leadership role in such efforts. Harmonisation helps consumers use their equipment internationally and helps manufacturers create economies of scale in the production of equipment that redound to

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the benefit of consumers. Yet Cisco urges Ofcom not to prioritize harmonisation efforts unduly and to avoid slowing its own regulatory decision-making.

The LEFR also references an economic methodology to determine when spectrum should be assigned to licence-exempt or lightly licensed uses. Cisco agrees with Ofcom's general approach to evaluate net present value, considering what kinds of applications will emerge and comparing the expected values associated with those uses. As with any such analytic tool, however, the values identified in the LEFR for applications should be used with care. For example, the value for home data networking identified in the report of 4–8 bn \pounds^3 excludes the entire value of all entertainment-related home networking⁴. The actual value of wireless home networking across all uses seems intuitively to be much higher than that amount, a conclusion that seems to be supported by the study. With that caution, Cisco supports the use of the tools such as the Ofcom-commissioned study to assist it in making decisions about licence-exempt spectrum.

Cisco also wishes to lay to rest the notion that a "private commons" is a likely future development⁵. Many have talked about the concept of a spectrum "private commons"—spectrum licensed to and managed by a private entity, which in turn would make the spectrum available for use by others. Some have speculated that, in a private commons, the licensee would make the spectrum available for the use of any device whose manufacturer agreed to pay a royalty of some kind—and thus a "commons" would

³ See Consultation at 18.

⁴ See "The economic value of licence-exempt spectrum" at 32-33, Final Report, Indepen, Aegis, Ovum, December 2006, available online at http://www.ofcom/org/uk/consult/condocs/lefr.

⁵ We differentiate "private commons" from the example of a licensed operator servicing users using standardised, commercial off-the-shelf technology. In that situation, the licensed operator can attempt to sell its equipment to users, and can make a decision about whether to charge for airtime.

be achieved that was managed by a private entity rather than the government. As Ofcom has recognized, however, the concept of a private commons has more theoretical than practical appeal. This should not be surprising. The alternative to the private commons is well developed—in a public commons, many manufacturers compete to sell the most innovative, cost effective, and, to a significant extent, interoperable products. This characterizes the spectrum at 5 GHz today, and applies to some degree to the licenceexempt frequencies at 2.4 GHz. The public commons maximizes consumer benefits by spreading the risk of innovation to many, assures a virtuous cycle of innovation based on common and open industry standards, and promotes market expansion by assuring the consumer that the device he or she is purchasing is interoperable with other devices. In a private commons, the risk of innovation and of creating a virtuous cycle of innovation is entirely on one manufacturer and/or its partners. In a hypothetical private WLAN commons, for example, one manufacturer would need to manufacture consumer access points, laptops, sophisticated WLAN networks for business and service providers, and the multitude of other devices that are or will be attached to a WLAN. No manufacturer has that scope today, and such a full spectrum approach to a market is unlikely to develop. Moreover, in a private commons, consumers purchasing these devices are "locked in" to one manufacturer's technology, which may or may not be standards-based.

It is no coincidence that high-tech companies with an interest in licence-exempt spectrum, which are often assumed to have an interest in the private commons approach, have never expressed significant interest in taking on these risks. Simply put, managing a private commons, both because of risks and the transaction costs associated with implementing and running it, does not appear to present a viable business model. It is better, in Cisco's view, for regulators to allocate spectrum as unlicensed or lightly licensed while trying to maximise the value of those allocations.

Finally, while it is outside the scope of this consultation, it is worth noting that many of the leading developments in software defined radio and cognitive functionality, in which a device senses its radio environment and reacts to it, are occurring in the IEEE 802.11 technology family. Nothing in this proceeding should preclude Ofcom from considering the use of these technologies in bands below 40 GHz. While Cisco does not advocate that all bands should be open to non-primary users (whether licensed or not), Ofcom should at a minimum reserve its right to consider such uses in circumstances where such use would not devalue the licensed use or create harmful interference.

Responses to Specific Questions

Q1: Do you agree that the spectrum commons model should be the preferred approach for licence-exempt use of spectrum, and that application-specific allocations should only be considered where technical constraints or safety issues require this?

The preferred approach should be dictated based on whether there is a need for users to coordinate their use of spectrum before initiating transmissions, so as to avoid interference with existing users. As Cisco stated above, we believe that the future uses of spectrum above 40 GHz will likely be some form of the following two types of technology: (1) devices or systems employing omni-directional antennas operating at low power, most likely for indoor use and (2) devices or systems operating high-gain antennas that transmit pencil-beam signals some distance, most likely for outdoor use. Ofcom is well familiar with the "millimetre wave" technology developed for 70/80/90 GHz. That user-operated technology would be stifled by a full licensing regime that users would not participate in, much less understand. However, a licence-exempt regime would not be beneficial either, because users would not purchase millimetre wave systems without some expectation that the pencil beam connectivity that is enabled will work, interference-free. The solution is a light-licensed registration system that forces users to coordinate their use of spectrum in advance. A user installing a system who is "second in time" may need to move its signal path a few feet to accommodate an initial user, or the two users could work out some other arrangement for the use of the path. But the genius of the system is that as many users who want to register can do so, subject only to the path coordination requirement. This ensures that as the technology grows in use, the spectrum will be intensively used while remaining free from interference.

On the other hand, an indoor, residential "home networking" technology using a low power omni-directional antenna may need no coordination. In this case, a spectrum commons model should be the preferred approach for licence-exempt use of spectrum. With judicious use of politeness rules⁶ and polite protocols, the risk of harmful interference can be ameliorated. Once these ground rules for use of the spectrum are established, there is little reason to exclude an application from that spectrum so long as the device complies with those ground rules.

Application-specific spectrum designations, while on rare occasion helpful, are often bad policy. Any spectrum that has been allocated to a specific application is of course off-limits to any novel use, no matter how valuable the new technology might prove to be. When spectrum is available for any conforming use, however, manufacturers can bring more new products to market faster. Indeed, as Ofcom has recognized, application-specific allocation of spectrum can result in an "artificial scarcity of spectrum" when too much spectrum is underutilised by the applications assigned to it

⁶ Constraints on radiated power characteristics as functions of frequency, time, and space. *See* Consultation at 23 n.20.

but unavailable for use by applications that could take advantage of it⁷. This is not to suggest that there are no circumstances where application-specific allocations are best. In certain situations, there is no technical solution to the problem of interference. Instead, as with safety-critical applications like implanted medical devices⁸, the nature of the operations in a given band may require that they be protected from interference. But these situations are relatively uncommon, and can be easily identified.

Q2: Do you agree with the proposal for multiple classes of spectrum commons?

Cisco strongly supports Ofcom's vision of multiple classes of spectrum commons. If Ofcom proceeds cautiously in establishing rules for the various spectrum classes, the spectrum classes will facilitate, rather than hinder, the development of a great variety of innovative uses of spectrum.

It is certainly true that "spectrum class" rules will entail some common technology functionality among devices, at least with respect to the use of a given spectrum band. But in any given spectrum class, politeness rules will still allow multiple uses to share spectrum efficiently. Moreover, with different sets of rules in the various spectrum classes, innovators will be able to select the set of transmission characteristics most suitable to their specific inventions.

That such class rules are necessary is intuitive, but an example demonstrates just how important they are. The Remington Eye Ball, a remote surveillance device designed for law enforcement and other such purposes, broadcasts using analogue transmission on

⁷ *See* Consultation at 22.

⁸ See Consultation at 21.

the widely used 2.4 GHz spectrum band⁹. Having been designed using continuous analogue waveforms and without spectrum-sharing functionality, the Eye Ball disrupts other 2.4 GHz devices. No matter how "friendly" other uses of any given spectrum might be, the introduction of a single such "unfriendly" device can cause substantial disruption. Spectrum class rules can ensure that "unfriendly" devices do not cause a given band to be used inefficiently.

While spectrum classes offer great promise, Cisco also believes that Ofcom should proceed cautiously in this arena. In many cases, it may be wise to wait to see what kinds of technologies develop before defining spectrum classes. It is one thing to say that it is certain that a given spectrum class will be limited to "bursty" transmissions of relatively short duration. It is quite another to promulgate a rule prematurely and end up with a limit that proves to be regretted. Nonetheless, Cisco firmly believes that spectrum class rules need not stifle innovation. Well-designed standards, such as the IEEE 802.11 suite, implement politeness rules and yet have proved capable of being extended to support a wide range of new applications. Ofcom has shown through this Consultation that it intends to develop such rules carefully and in cooperation with relevant stakeholders.

Q3: Do you agree with the distinction made between the licence-exemption and light-licensing regimes?

Cisco generally agrees with the distinctions made between the licence-exemption and the light-licensing regimes set forth in the Consultation¹⁰. As stated above, we

⁹ Remington Arms Company, Inc. Request for a Waiver of the Part 15 Regulations, United States Federal Communications Commission ET Docket No. 05-183, Order, released November 18, 2005. See Associated Press, "Wireless camera can be hurled into danger", available at http://www.msnbc.msn.com/id/10382016/

¹⁰ *See* Consultation at 30.

believe the distinction should turn on whether the proposed use compels pre-coordination of frequency use. Cisco also believes that light licensing can be a more flexible concept than the Consultation might suggest. Cisco notes that light licensing is a concept that can leverage cutting-edge technology developments to control the operation and emissions characteristics of transmitters in the lightly licensed band.

The innovative work being done in developing spectrum-sharing technologies for the 3650–3700 MHz band (a light-licensed band in the United States) as part of the IEEE 802.11 "Task Group y" is a good example. The standard being developed will have robust cognitive radio functionality. It will have technology to sense both 802.11 transmissions and other technologies operating in the band. It will use a version of dynamic frequency selection, which will allow transmitters to change both frequency and bandwidth to find a clear channel for transmission. Transmission power control functionality will allow transmitters to change power as well. The standard will also contain procedures for managing retransmissions in the event of a busy channel. Fixed base stations, which will be registered in a database much like the sort described in the Consultation¹¹, will transmit beacon signals which mobile stations will be required to receive and decode *before* they are permitted to transmit. These technologies will permit IEEE 802.11y technologies to share spectrum dynamically with other 802.11y devices and with devices using other technologies¹².

¹¹ See Consultation at 27–28.

¹² Such technologies could facilitate additional sharing of other spectrum bands, as well. While the LEFR concentrates mostly on identifying new spectrum above 40 GHz and on policies for managing all spectrum, these technologies open up the possibility of sharing with other uses below 40 GHz as well.

This approach is well suited to situations where, for example, national security concerns require that lightly licensed base stations not operate in certain geographic areas. Lightly licensed technologies can be counted on to honour regulatory-mandated exclusion zones, because they will know their location, and their operating characteristics can be controlled by beacon technology. Licence-exempt devices cannot be counted on to override their operators' wishes. In short, the range of potential applications suitable for use in a light-licensed regime may be much broader than might be immediately apparent and could well include mobile devices.

Q4: Do you agree with the view that the licence-exemption and light-licensing regimes will converge in the future?

Cisco agrees that the licence-exemption and light-licensing regimes will tend to converge over the long term, but does not believe that it has yet been shown that light-licensing will cease to be a relevant strategy for managing spectrum. In Cisco's view, high powered uses featuring high-gain antennas to create pencil beams is one example where a lightly licensed system is likely to be the optimal choice for the foreseeable future. National security may present another context where light licensing may be beneficial. That is, it might not be acceptable for individual devices to simply listen for other, prioritized communication on a given band. It might be that national security concerns would dictate that devices *not* be able to determine where specifically a given frequency band was actually in use, but rather a database might be developed that would preclude the use of that band over a wider area (or several areas). In such a situation, a light-licensing regime might be a sensible way to provide protection without revealing sensitive information. For other types of technologies, future developments in software

defined and cognitive radio functionality may, over the long term, argue for licenceexempt treatment.

Q5: Do you agree with the proposed mixture of licence-exempt and light-licensed use of the 105–275 GHz spectrum? Do you agree with the bands that have been identified for such use?

Generally speaking, Cisco supports considering spectrum in the 105–275 GHz range for both light-licensed and licence-exempt use. Cisco notes that both regimes can be useful tools in particular instances to ensure that consumers can take advantage of innovative broadband technologies. Cisco therefore supports Ofcom's proposal. As Ofcom notes, delay would "ultimately slow down the pace of innovation and the emergence of new high-frequency services"¹³.

Q6: Do you agree with the view that the use of the 275–1000 GHz spectrum should be licence-exempt?

Cisco generally supports Ofcom's proposal to allocate 275–1000 GHz spectrum to licence-exempt uses¹⁴. While there are no allocations under the ITU-R Radio Regulations for this spectrum, Ofcom will make a significant statement about its view of the proper utilisation of these frequencies in assigning them to licence-exempt uses. The surest way to encourage innovators to develop technologies that would enable the use of these frequencies is to make them generally available. Moreover, by making this determination now, Ofcom will influence the decisions of other countries and the ITU as they consider how these frequencies should be allocated.

¹³ Consultation at 38, citing "The Future of regulation – not," P. Cochrane, in *Communications: the next decade*, a collection of essays prepared for the UK Office of Communications, November 2006, http://www.ofcom.org.uk/research/commsdecade/.

¹⁴ Excluding the spectral line measurement frequencies specified by Footnote 5.565. *See* Consultation at 36 n.39, 38.

Q7: Do you agree with the view on the levels of future demand for licence-exempt usage in the 40–105 GHz spectrum? Do you agree that the Group-A bands identified above should be considered for licence-exempt use? Do you agree that licence-exempt and light-licensed use of the Group-C bands identified above should only be considered when there is evidence of demand for such use?

Cisco generally agrees with Ofcom's approach in Section 6 of the Consultation. Ofcom's proposal provides it with the flexibility necessary to allocate spectrum in the 40–105 GHz range as needed in the future, but makes a positive start by identifying spectrum that can be considered for licence-exempt allocation now. Without expressing an opinion about the precise bandwidth necessary over the next 15 years to support the various uses for this spectrum identified in the Consultation¹⁵, Cisco commends Ofcom for the careful, thoughtful approach it is taking with regard to 40–105 GHz spectrum.

Q10: Do you agree with the harmonisation strategy discussed above in the context of licence-exempt devices?

Cisco agrees with the harmonisation strategy outlined in the Consultation. As recognized in the Consultation, a primary concern with harmonisation is that a decision made elsewhere may result in an inefficient use of spectrum resources in the UK. Nevertheless, the benefits of harmonisation are significant. A WLAN device that could only work in one country is obviously of much less value to the traveller than a WLAN device that is compatible with the infrastructure of many countries. Similarly, as the Consultation noted, a car-door opener should operate properly and not cause harmful interference in any country where that car might go. Moreover, any country that opted to have a substantially different frequency allocation from the international norm takes a risk that manufacturers might simply not design products for its market, or even if they

¹⁵ *See* Consultation at 39.

did, that they would do so after first designing for the larger, standardised market. Recognising that international standards will likely always present more of a challenge to change than a single nation's standards, Cisco strongly agrees with Ofcom's view that harmonisation should impose a minimum of restrictions and be as application-neutral and technology-neutral as possible.

If the major risk with harmonisation is that spectrum allocations are made without due regard to the needs of the UK market, Ofcom's task is clear: to ensure that the UK remains a leader on spectrum regulation policy. This Framework Review demonstrates Ofcom's commitment to do just that, by outlining a forward-looking, coherent approach to spectrum allocation. By remaining at the forefront on these issues, Ofcom will ensure that the UK's interests are protected.

Q11: Do you agree with the view that no additional regulatory instruments, beyond those available today, are required for the protection of licence-exempt equipment?

Cisco agrees that at this time no additional regulatory instruments are required for the protection of licence-exempt equipment. Through the promulgation of appropriate rules, and the judicious use of its existing investigatory and enforcement powers, Ofcom can provide appropriate protection for licence-exempt equipment and equipment deployed in support of lightly licensed regimes. Indeed, it has shown itself willing to take enforcement action, and there does not appear to be any indication that it has been unduly hampered in doing so. Should existing tools prove insufficient at some point in the future, Ofcom could always reconsider this question at that point, but until that occurs, there appears to be no reason for any additional regulatory instruments.

CISCO SYSTEMS, INC. Mary L. Brown Director Technology and Spectrum Policy Global Policy and Government Affairs

1300 Pennsylvania Avenue, NW Suite 250 Washington, DC 20004 USA 1.202.354.2923

HARRIS, WILTSHIRE & GRANNIS LLP

Scott Blake Harris Joseph C. Cavender

1200 Eighteenth Street, NW Washington, DC 20036 USA 1.202.730.1300