Cisco response to the Radio Spectrum Policy Group's draft opinion on the strategic challenges facing Europe in addressing the growing spectrum demand for wireless broadband

1. Introduction

Cisco welcomes efforts by the Radio Spectrum Policy Group (RSPG) to act on request of the European Commission to identify the challenges faced by Europe in meeting the growing spectrum demand for wireless broadband. We were pleased to note that the RSPG focused on potential licensed spectrum solutions, including specific bands identified by the Council and the Parliament, as well as the extent to which shared spectrum access could contribute to meeting the demand for wireless broadband. Cisco believes that both elements will be essential in addressing the continuing growth in wireless data.

Since its inception in 1984, Cisco has become the world's largest provider of networking technology, equipment, solutions and services used in the deployment and management of next-generation broadband networks. Among other mobile internet solutions, Cisco is assisting the shift to a 4G world through an innovative Evolved Packet Core solution; a Voice and Video over LTE solution that facilitates the transition from circuit-switched voice to packet voice; licensed small cell solutions; Radio Access Network backhaul; Mobile Videoscape to manage video delivery over mobile networks; mobile multimedia services and network intelligence solutions for optimizing the network and delivering new applications and personalized mobile services.[1]

Cisco has also been a global leader in the manufacture of products based on the IEEE 802.11 family of standards for unlicensed wireless local area network devices, developing a range of wireless access points, controllers, antennas and integrated management tools that meet the unique needs of the enterprise and service provider segments of the marketplace. Cisco continues to drive innovation in this space to maximize the effective and efficient use of unlicensed spectrum. Examples include the first carrier-grade, end-to-end Wi-Fi infrastructure for Next Generation Hotspots ("NGH") that supports roaming relationships among service providers that allow their users can to a wider variety of hotspots around the world, with automatic network access and latest generation security;[2] self-optimising

[1] Cisco mobile internet solutions:
http://www.cisco.com/en/US/netsol/ns973/networking_solutions_market_segment_solution.html#~solutions

[2] *See* Fitchard, "The next generation of Wi-Fi hotspots is coming," *GigaOm* (Feb. 23, 2012), available at http://gigaom.com/2012/02/23/next-generation-hotspot-standard. The majority of the Wi-Fi access points that Cisco has deployed over the years can be upgraded to NGH.

wireless networks, mitigating the impact of interference via CleanAir technology[3]; and a "context-aware" Wi-Fi location data analytics platform[4].

Mobile broadband is expected to continue to grow at an exceptional pace. Last year, global mobile data traffic grew 70%, reaching 885 petabytes per month at the end of 2012, up from 520 petabyes per month at the end of 2011. As we move to 4G, it is relevant to note that 4G connections generated 19 times more traffic than non-4G connections. In the period 2012 – 2017, Western Europe is expected to see a compound annual growth rate (CAGR) of 50%, resulting in an almost 8-fold increase in traffic, whereas Central and Eastern Europe is expected to see a CAGR of 66%, or 13-fold increase, in the same period.[5] With such a demand, the Draft Opinion is right to note that while technological progress will continue to improve spectral efficiency, the anticipated growth in data traffic will still require additional spectrum to be made available in order to meet these needs. As such, Cisco fully supports the efforts of the RSPG to advise the European Commission on the development of a roadmap for identifying candidate bands for mobile broadband in the period 2013 – 2020, meeting the Radio Spectrum Policy Programme's target of 1200 MHz in the process. As a rule, we encourage identified bands to be harmonised at a global level, with minimal national deviations. Nevertheless, in part due to efforts of other stakeholders to address these issues, the primary focus for our response will be to detail the case for assessing the extension of the 5GHz band for Wireless Access Services in order to meet the requirements for Wi-Fi.

2. Explosion of Wi-Fi

Driven by more users, more devices, faster broadband speeds and more rich media content, Internet Protocol (IP) traffic in Western Europe is expected to more than triple over the period from 2011-2016, growing from 7.3 Exabyte per month in 2011 to 24.4 Exabyte in 2016 at a CAGR of 27%.[6] In Central and Eastern Europe (CEE), it will grow even faster, expanding 5-fold from 1.2 Exabyte to 6 Exabyte at a CAGR of 39%. Put another way, IP traffic in Western Europe will reach 62 Gigabytes per capita in 2016, up from 19 Gigabytes per capita in 2011, and 12 Gigabytes per capita in CEE, up from 2 Gigabytes.[7]

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[3] Cisco White Paper, The Future of Hotspots: Making Wi-Fi as Secure and Easy to use as Cellular, *available at* http://www.cisco.com/en/US/solutions/collateral/ns341/ns524/ns673/white_paper_c11-649337.html.

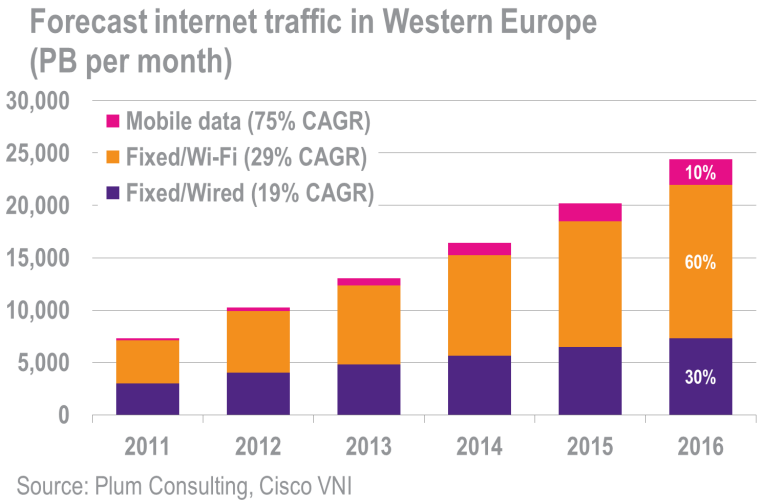
[4] *See* http://blogs.cisco.com/news/the-connected-mobile-experience. Copenhagen Airport has deployed Cisco's context-aware technology to improve operational efficiency, make smarter business decisions and provide a better travel experience for its passengers.

[5] The mobile data traffic statistics in this paragraph are from the 'Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012 – 2017' (February 2013). The countries covered by the regions of Western Europe and Central and Eastern Europe extend beyond the EU-27. See http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

[6] *See* http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html#~Country, filtering by geography and the 2016 Forecast Highlights category.

[7] *See id.*

Concurrent with this growth in IP traffic will be a dramatic increase in the portion of IP traffic that originates or terminates via Wi-Fi connectivity. As more devices are able to connect via Wi-Fi (with a growing number, including many tablets, only able to connect via Wi-Fi) and given the flexibility of wireless connectivity, Wi-Fi is rapidly growing in importance and Wi-Fi data is anticipated to exceed fixed-wired and mobile data by 2015, and greatly exceeds mobile data today (as illustrated for Western Europe below).



Beyond internet traffic illustrated in the figure above, a substantial new source of Wi-Fi growth is direct device-to-device connectivity. This includes content streaming from a device to a TV display. The content itself may already be stored or the traffic may originate on the internet and be further streamed from the device to the display. Wi-Fi may also be used as a wireless substitute for fixed connectivity (such as USB) for file transfer including connection to external storage devices for back-up and local content caching. Such applications put a premium on connectivity speed, particularly as portable device storage capacity grows.

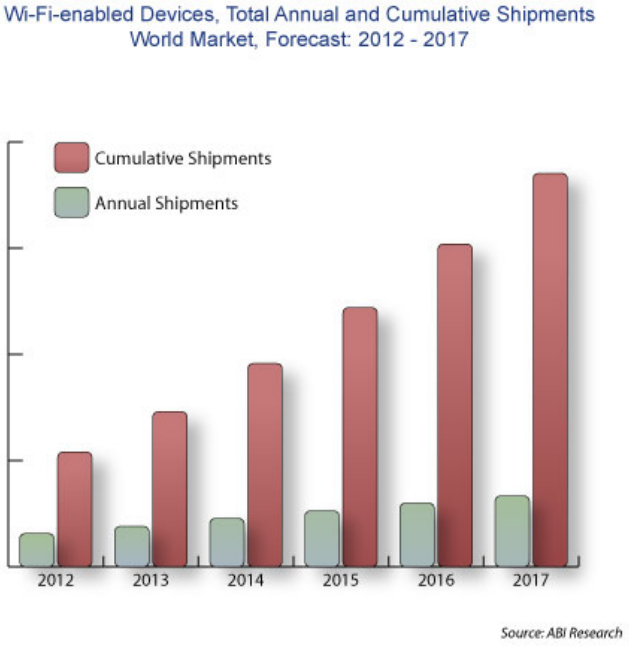
There are several drivers, not unrelated, that explain this seismic shift of IP traffic to wireless, and more specifically, Wi-Fi-enabled devices.

2.1 Wi-Fi devices have become ubiquitous – The first key driver of the growth in Wi-Fi connectivity to the Internet is the sheer ubiquity of Wi-Fi devices. Wi-Fi has rapidly become the way in which a wide variety of devices, including laptop and netbook computers, tablets, and smartphones (and increasingly other devices like cameras, printers, internet enabled radios, set-top boxes, televisions and even light bulbs), connect to the Internet.[8] The RSPG Draft Opinion recognizes as much in quoting the European Commission's Communication on Shared Use of Spectrum, stating that global sales of Wi-Fi enabled equipment will reach 3.5 billion units by 2014[9]. Indeed, as the chart below illustrates, while the

[8] *See, e.g.,* ABI Research Report, "Total Cumulative Wi-Fi Enabled Device Shipments Reached 5 Billion in 2012, Set to Double by 2015" (noting that the "[r]ecent explosive growth [of Wi-Fi] has been largely driven by the smartphone and laptop markets")

[9] Promoting the shared use of radio spectrum resources in the internal market COM (2012) 478 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0478:FIN:EN:PDF

cumulative total of Wi-Fi enabled device shipments only reached 5 billion in 2012 (well more than a decade after the first Wi-Fi devices shipped), it is anticipated that that figure will double by 2015 and more than triple by 2017:[10]



These projections are hardly surprising as the vast majority of smartphones have joined a wide range of devices such as laptop and netbook computers and tablets that already are almost always Wi-Fi enabled. In quoting data from Analysys Mason, the RSPG Opinion states that the proportion of data traffic attributable to Wi-Fi on handsets will rise from 55% to 61% and remains constant at 82% for mid-screen devices. Moreover, "[w]ith innovations in power consumption and management, reduced costs and ease of installation and provisioning, it is desirable, and now easy, to embed Wi-Fi into swarms of devices – medical monitors, home appliances, building control systems and real-time location tags to name just a few."[11] Wi-Fi devices will soon be proliferating in automobiles – IMS Research forecasts that the market for Wi-Fi in original equipment manufacturer (OEM) automotive applications will increase eight fold over the next seven years in North America and Western Europe.[12] It is now possible to even purchase a Wi-Fi-enabled treadmill.[13]

The Internet of Everything is real, and it is here today. Not surprisingly, the Wi-Fi Alliance certified 25 percent more products during 2012 than 2011, led by 64 percent year-over-year growth in certifications

[10] *See* Press Release, Wi-Fi Alliance, Wi-Fi Alliance applauds this week's FCC Wi-Fi spectrum announcement (Jan. 10, 2013), available at http://www.wi-fi.org/media/press-releases/wi-fi-alliance%C2%AE-applauds-week%E2%80%99s-fcc-wi-fi%C2%AE-spectrum-announcement.

[11] Adams, "Wi-Fi: Leading the Way in Enabling the 'Internet of Things'," *RTC* (December 2010), available at http://www.rtcmagazine.com/articles/view/101933.

[12] *See* http://www.imsresearch.com/press-release/InCar_WiFi_the_Journey_is_Just_Beginning&from=all_pr

[13] *See* http://www.hsn.com/products/proform-ifit-live-wi-fi-performance-treadmill/6929194.

for devices in the consumer electronics category.[14] Between 2011 and 2016, the number of Wi-Fi-embedded devices is expected to grow 39 percent in health, fitness and medical applications and 25 percent in smart meters and automation products.[15] And, these examples are merely the tip of the iceberg. The larger point, ultimately, is that the ubiquity of Wi-Fi devices whets the appetite for connectivity anytime, anywhere, and for as many devices as possible.[16] And that appetite is driving the growing demand for Wi-Fi connectivity.

2.2 The growth of Wi-Fi for licensed network offload – The second key driver of the growth of Wi-Fi traffic is the trend towards off-loading of mobile data from the licensed networks to Wi-Fi hotspots. It is now widely-recognized that:

> The days of Wi-Fi versus cellular are dead... Both technologies are crucial for supporting the never ending growth in data traffic. In the long term, each technology alone cannot meet this challenge – success can only be achieved by aligning the two. Wi-Fi hotspots are proving a valuable tool for managing surging mobile data traffic. Small cells, which now outnumber macro-cells globally, represent the future of cellular as it strives to achieve new levels of coverage and capacity for all mobile devices. By bringing the two together, we can deliver a better experience for all users across all devices.[17]

Indeed, the RSPG Draft Opinion recognizes that "[m]obile operators in particular have an interest in offloading the traffic from their radio access networks by encouraging the use of alternative wireless technologies such as Wifi, while retaining the customer within the network."

The benefits of off-loading are patent. As mentioned in the introduction to this paper, even with offload, mobile traffic is set to increase eight fold in Western Europe and thirteen fold in Central and Eastern Europe between 2012 and 2017. As illustrated in the figure below, the strain on the licensed networks would be far higher without offloading. Globally, as a percentage of total mobile data traffic from all mobile-connected devices, mobile offload is set to increase from 33 percent (429 petabytes/month) in 2012 to 46 percent (9.6 exabytes/month) in 2017 (Figure 8). Without offload, global mobile data traffic would grow at a CAGR of 74 percent instead of 66 percent.

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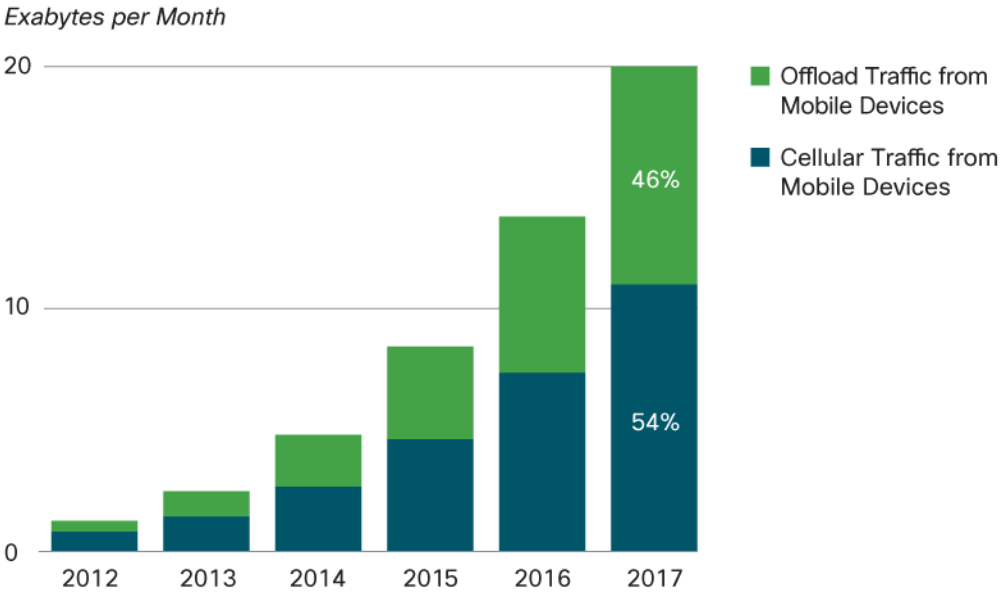
[14] Parker, "Wi-Fi Alliance certifies 64% more CE products," *FierceWireless* (Jan. 9, 2003), *available at* http://www.fiercebroadbandwireless.com/story/wi-fi-alliance-certifies-64-more-ce-products/2013-01-09

[15] Press Release, Wi-Fi Alliance, Wi-Fi Innovations and User Enthusiasm Propel Continued Sales Growth: Forthcoming Wi-Fi technologies will extend performance and ease of use in 2012 and beyond (Jan. 10, 2012) *available at* http://www.wi-fi.org/media/press-releases/wi-fi%C2%AE-innovations-and-user-enthusiasm-propel-continued-sales-growth.

[16] *See, e.g.,* "WiFi Demand Expected to Grow," available at http://www.enterprisecommunications.com/blogs/wifi-demand-expected-to-grow.aspx

[17] Meyer, "Small cell, Wi-Fi initiatives gain speed," *RCR Wireless* (Nov. 6, 2012) (quoting Gordon Mansfield, Chairman of the Small Cell Forum), available at http://www.rcrwireless.com/article/20121106/wi-fi/small-cell-wi-fi-initiatives-gain-speed. *See also* Paolini, "Small cells or Wi-Fi offload," FierceWireless (Sept. 18, 2012) available at http://www.fiercewireless.com/story/paolini-small-cells-or-wi-fi-offload/2012-09-18#ixzz2PcaiDtBh.



Source: Cisco VNI Mobile Forecast, 2013

The expansion of off-loading is being driven in large part by the development of the Wi-Fi Certified Passpoint Program. In 2010, Cisco and other industry leaders formed the Hotspot 2.0 Task Group within the Wi-Fi Alliance, for the purpose of rallying the industry around a common set of standards that would make network access at a Wi-Fi hotspot as easy and as secure as cellular network access. The resulting Wi-Fi Certified Passpoint Program now provides a user experience on Wi-Fi networks similar to that provided on licensed networks, with no need for the subscriber to log-in and with cryptographically equivalent mutual authentication and link layer security.[18]

2.3 Wi-Fi's role in device-to-device connectivity - A third key driver for Wi-Fi traffic growth is Wi-Fi's growing role in device-to-device connectivity (Wi-Fi Direct). This is somewhat independent of its role in relation to wireless broadband given the traffic may or may not originate or terminate on the internet and hence it is at the edges of the scope of enquiry of the Draft Opinion. Nonetheless, it is important in understanding the speed and capacity demands on Wi-Fi and hence the subsequent requirements for additional spectrum resources. An example of such traffic would be content streaming from a device to a TV display, which may originate from stored content including video and games (or may involve streamed internet content to the device and a further stream to the TV). Wi-Fi may also be used as a wireless substitute for fixed connectivity (say USB) for file transfer including connection to external storage devices for back-up and local content caching. Such applications put a premium on connectivity speed, particularly as portable device storage capacity grows.

3. The technology imperative

In response to the exponential growth in demand for Wi-Fi connectivity, industry has been developing the IEEE 802.11ac standard as the fifth generation of Wi-Fi and an evolutionary upgrade of the 802.11n

[18] See "The Future of Hotspots: Making Wi-Fi as Secure and Easy to Use as Cellular," Cisco White Paper, at 2 (2012) ("Cisco Hotspot 2.0 White Paper").
http://www.cisco.com/en/US/solutions/collateral/ns341/ns524/ns673/white_paper_c11-649337.html

standard. 802.11ac, which is a 5 GHz band-only technology, can deliver much faster speeds and more efficient use than its predecessors - it will enable multi-station throughput of at least 1 gigabit per second and a maximum single link throughput of at least 500 megabits per second.[19] 802.11ac achieves these gains via four key technology advances:

- Unlike 802.11n, which is limited to a maximum channel bandwidth of 40 MHz, 802.11ac permits channel bandwidths of 80 MHz and 160 MHz, which increase speeds by 117% and 333%, respectively;

- 802.11ac employs higher-density modulation, accommodating up to 256 quadrature amplitude modulation (QAM), as opposed to the maximum 64 QAM permitted under 802.11n (for a 33% speed burst at shorter, yet still usable, ranges); and

- Whereas 802.11n allowed only four simultaneous spatial data streams, 802.11ac provides for eight (for another 100% increase in speed).[20]

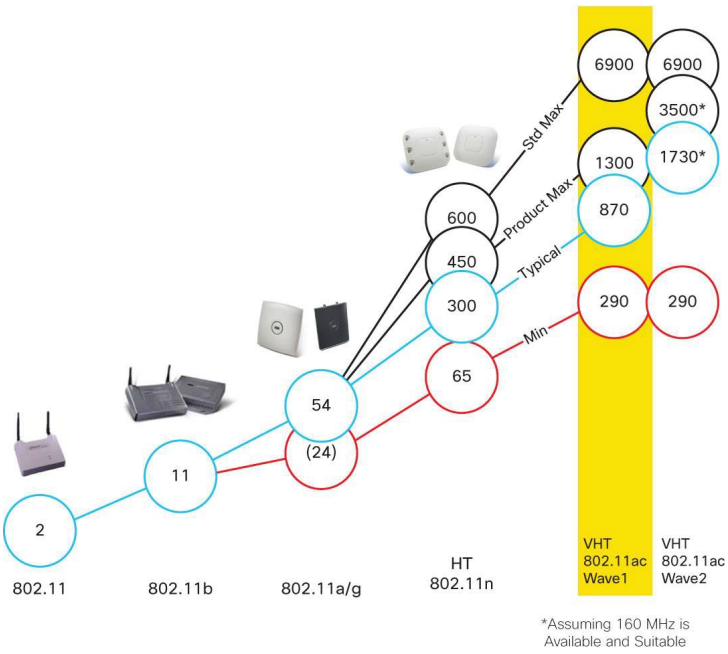
- With 802.11n, a device can transmit multiple spatial streams at once, but only directed to a single address. For individually addressed frames, this means that only a single device (or user) gets data at a time. We call this single-user MIMO (SU-MIMO). With the advent of 802.11ac, a new technology is defined, called multi-user multiple input, multiple output (MU-MIMO). Here an AP is able to use its antenna resources to transmit multiple frames to different clients, all at the same time and over the same frequency spectrum. It will be particularly advantageous for clients limited to a single antenna and will bring effective speed increases ranging from unity (no increase) up to a factor of two to three times.

The "real world" relevance of these improvements in IEEE 802.11ac is manifest. As illustrated by the following graphic, Cisco anticipates that that for the minimum permissible 802.11ac product configuration, speeds will be 4.4 times faster than the corresponding 802.11n product. Mid-tier and higher-end 802.11ac products are nearly three times faster than their 802.11n counterparts.[21]

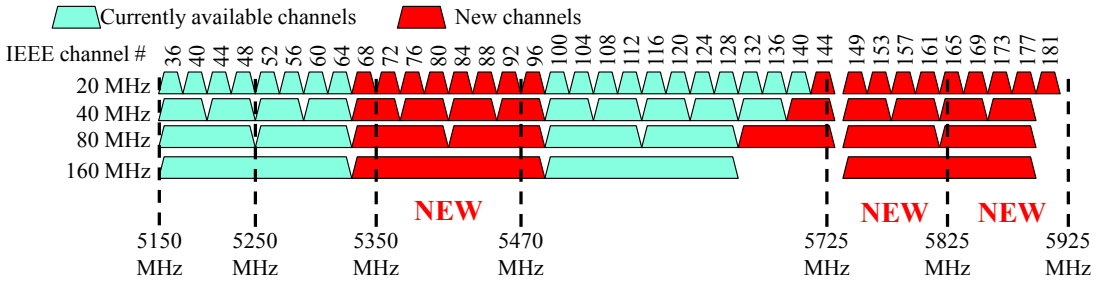
[19] *See,* "801.11ac: The Fifth Generation of Wi-Fi," Cisco Technical White Paper http://www.cisco.com/en/US/prod/collateral/wireless/ps5678/ps11983/white_paper_c11-713103.html#wp9000344

[20] *Ibid*

[21] *Ibid*



However, to fully achieve the gains achievable from the wider channels available under 802.11ac, larger blocks of contiguous spectrum must be made available.



While the currently available channels support a number of combinations of these wider radio frequency bandwidth channels, expanding the amount of spectrum authorized for Wi-Fi device operation in the 5 GHz frequency range will increase the contiguous spectrum available to accommodate broadband applications. The current numbers of 80 and 160 MHz channels available, at four and two respectively, limit the ability to conduct concurrent high-speed tasks. As shown in the figure above, additional unlicensed use of 5.35-5.47 GHz, 5.725-5.875 GHz and 5.875-5.925 GHz would allow nine 80 MHz channels and four 160 MHz channels. A 70% increase in spectrum available would therefore enable an increase of 100% of 160 MHz channels and 125% of 80 MHz channels due to the more efficient band plan.

Industry's embrace of the 802.11ac standard has been dramatic, and the public is already starting to realize at least some of the benefits of this fifth generation Wi-Fi standard. IEEE 802.11ac delivered an approved Draft 2.0 amendment in January 2012 and a refined Draft 3.0 in May 2012, with final ratification planned for the end of 2013. In parallel, the Wi-Fi Alliance is expected to take an early IEEE draft, most likely Draft 3.0, and use that as the baseline for an interoperability certification of first-wave

products in early 2013. Later, in conjunction with the ratification of 802.11ac, the Wi-Fi Alliance is expected to refresh its 802.11ac certification to include testing of the more advanced 802.11ac features. This second-wave certification should include features such as channel bonding up to 160 MHz, four spatial streams, and MU-MIMO.[22] Several vendors are already shipping pre-802.11ac devices[23] and some forecasts predict that by 2015, 100 percent of mobile hotspot shipments will be 802.11ac enabled[24] and that nearly one billion 802.11ac devices will ship worldwide by 2015.[25]

4. Matching end-to-end connectivity demands

Recently, Cisco commissioned a study by Plum Consulting to examine the need for additional 5 GHz spectrum for unlicensed Wi-Fi use in Europe.[26] The study makes the following findings:

> As Wi-Fi becomes the default form of connectivity it needs to keep pace with developments in the wider ecosystem if it is not to become the weakest link. The demands Wi-Fi needs to meet in order that it enhances rather than acts as a break on development of the overall ICT ecosystem are twofold:
>
> - Speed: Wi-Fi needs to deliver speeds consistent, on a shared contended basis, with available broadband access speeds (around 100 Mbps by 2020) and capable of meeting for short durations (with low likelihood of contention) high speed device-to-device connectivity needs (1 Gbps or more).
>
> - Capacity: Wi-Fi needs to be capable of delivering the above speed requirements whilst meeting demand from multiple simultaneous competing uses including user initiated demand and background activity such as automatic synchronisation, update, backup and monitoring tasks. Since wireless access is inherently shared the above two concepts are related – there must be sufficient

[22] *Ibid*

[23] *See, e.g.* Honig, "Netgear's R6300 router is first to use Broadcom 802.11ac chipset, will ship next month for $300, *Engadget*, (posted Apr. 26, 2012), *available at* http://www.engadget.com/2012/04/26/netgear-r6300-802-11ac-router/; PR Newswire, Buffalo's 802.11ac Wireless Solution Available Now (May 14, 2012), *available at* http://www.prnewswire.com/news-releases-test/buffalos-80211ac-wireless-solutions-available-now-151352155.html; Asus gaming notebook first to feature full 802.11ac, *Elecotronista* (June 7, 2012), *available at* http://www.electronista.com/articles/12/06/07/fifth.generation.wi.fi.standard.finally.reaching.consumers/

[24] *See* Zero to a Billion; 802.11ac-Enabled Device Shipments to Soar by 2015, In-Stat (February 08, 2011), *available at* http://www.marketwire.com/press-release/zero-to-a-billion-80211ac-enabled-device-shipments-to-soar-by-2015-says-in-stat-1391854.htm

[25] *Ibid*

[26] Williamson, Punton and Hansell, "Future proofing Wi-Fi – the case for more spectrum" (January 2012) http://www.plumconsulting.co.uk/pdfs/Plum_Jan2013_Future_proofing_Wi-Fi.pdf

> capacity to support shared use whilst preserving sufficient headroom for high speed (bursting) data transfer.[27]

Plum recognized that given the limitations of the 2.4 GHz unlicensed band and the emerging availability of devices capable of operating in the 5 GHz band, a rapid shift to use of the 5 GHz band for Wi-Fi will occur.[28] However, it concludes that while the development of 802.11ac has increased both the potential speed of Wi-Fi and the efficiency with which it utilizes spectrum, both sufficient spectrum to meet demand and wide spectrum channels are required for 802.11ac to achieve its full potential, which requires 80 or 160 MHz spectrum channels to deliver peak performance.[29] Perhaps most importantly, Plum concluded that:

> Making additional 5 GHz spectrum available could approximately double the capacity of Wi-Fi and allow higher speeds. However, to achieve its full potential the emerging 802.11ac Wi-Fi standard would also benefit from the availability of large contiguous blocks of spectrum. By modelling four different scenarios we have found that demand may exceed the current Wi-Fi capacity as early as 2016. If consumers are to experience the full benefits of the digital agenda target more 5 GHz spectrum must be allocated to Wi-Fi.[30]

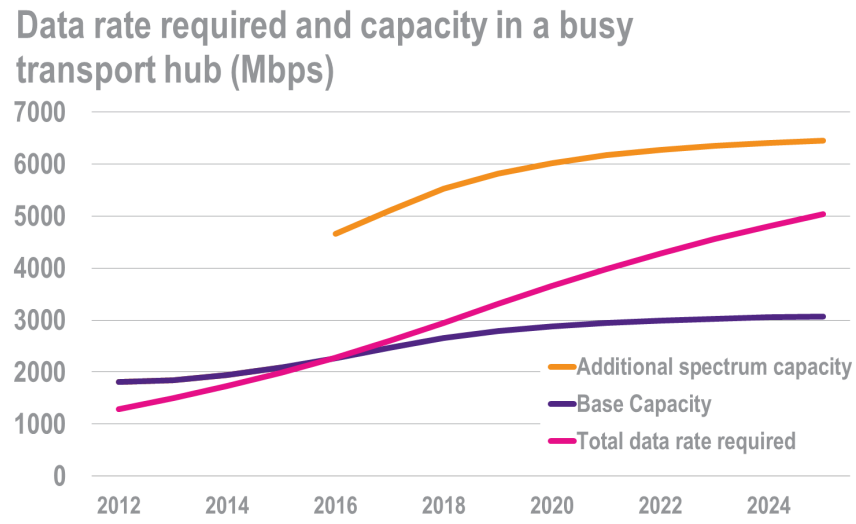
The four scenarios Plum modeled were a busy transport hub, a block of apartments, a shared office block and terraced housing. In each of them, demand exceeded existing Wi-Fi capacity by 2022, with the transport hub the first to feel the pressure:

[27] *Id.* at 11.

[28] *See id.* at 18-19.

[29] *See id.* at 20.

[30] *Id.* at 26.



Source: Plum Consulting

Moreover, the demand scenarios also suggest that in some situations, such as for the modeled apartment block, the contention from other users will reduce the maximum throughput in individual apartments below 100 Mbps. This means that even if the European Union succeeds in its target to have half of its citizens connected to broadband in excess of 100 Mbps by 2020, as the vast majority of their devices will be mobile and connecting to their fixed network over Wi-Fi, they may be limited by their local access network and not be able to benefit from those speeds.

5. Benefits of making additional spectrum available

The RSPG Draft Opinion focuses on the strategic challenges for meeting the demand for wireless broadband services. However, Cisco believes it is important to understand such challenges within the context of the benefits that may be derived from finding appropriate solutions. As such, we will briefly comment in this section on the economic benefits of making additional spectrum available for Wi-Fi. Plum considers that incremental benefit from increasing the allocation at 5 GHz would include[31]:

- Time savings and applications benefit from an increased likelihood that Wi-Fi capacity and speed in contended environments can meet the capability of other elements of end-to-end connectivity
- Greater savings from Wi-Fi offload of mobile traffic as additional spectrum both increases the capacity of Wi-Fi access points and improves service quality
- Time savings due to faster file transfer and convenience, time and cost savings from the elimination of physical cable connections.
- Competition benefits in the nomadic access market
- Cost savings in managed networks through reducing the number of access points that need to be deployed in capacity constrained environments

[31] *Id.* at 28-29

- New applications e.g. in health care and industry.

They are not able to quantify all of the benefits but do estimate the magnitude of benefits related to faster connectivity and mobile offload. They conclude that improved quality of service for Wi-Fi in contested environments would provide a Net Present Value benefit of €12.3 billion for Europe, whereas the net present cost savings from increased mobile offload would be a further €4 billion.[32]

Presuming that compatibility with incumbent users is found to be possible, the opportunity cost of making such spectrum available would be close to zero, as it would be allocated on a shared basis. As such, it is imperative that Europe leads the way in adopting an appropriate solution to reap these benefits.

6. Implications for the Draft Opinion

As a general observation, Cisco is pleased that the RSPG Draft Opinion considers Wi-Fi within the boundaries of resources required to meet the demand for wireless broadband services. As stated in the definition in section IV, wireless broadband can be described as high-speed wireless transmission of data and may be delivered via fixed, mobile or satellite platforms. Wi-Fi networks play a crucial role in ensuring end-to-end connectivity. Noted in both the subsection on trends in wireless technology under section IV and in the Opinion in section X, we also welcome the recognition that nomadic traffic is growing at an even faster rate than mobile traffic as well as the trend which has led to over half of smartphone traffic to be routed over Wi-Fi, which, as a result, is putting pressure on existing resources. Moreover, we are glad that the same sections, together with further explanation in section V on policy and regulatory issues, highlight that mobile operators are relying on licence exempt spectrum for offloading traffic in order to increase network capacity, improve coverage and save costs. This is both a driver of the growth of Wi-Fi traffic and represents an important component of the benefits to be derived from making more spectrum available for Wi-Fi.

In terms of the specific recommendations under section X, we support the call for the Commission to develop a strategic plan to meet the demand for wireless broadband services up to 2020, including the usage of the bands identified under Annex 2 and analysis of the need for licence exempt for wireless broadband. In fact, we consider the latter analysis to be covered by the candidate bands in Annex 2, which include 5350 – 5470 MHz, 5725 – 5875 MHz and 5875 – 5925 MHz. As outlined above, we believe these bands possess a strong potential for Wi-Fi usage, with the commensurate benefits this will entail.

The 'cons' identified in Annex 2 in relation to the use of these bands can be distinguished in three groups: the requirement for new routers in order to make use of the bands; the need for existing harmonized Wi-Fi standards to be developed further; and the constraints on usage stemming from sharing with incumbent users, including Fixed Satellite Service (FSS) Earth Stations and safety-related Intelligent Transport Solutions (ITS).

While end-user devices are likely to be able to immediately take advantage of the new spectrum, it is true that new routers would indeed be required if the identified 5 GHz bands were opened but this would not necessarily result in an incremental cost if they were subject to the normal deployment and

[32] *Id.* at 30-32

replacement cycles. This could, however, lead to a one or two year delay in the ability of the majority of deployed routers to make use of the additional spectrum and hence take advantage of the benefits this implies. As such, it would make sense to initiate compatibility studies and the regulatory process without delay.

The existing standards would also need to be updated in order to take into account the specificities emerging from the regulatory process. We are fortunate, however, to have a strong basis with the work that has already gone into defining the 5th Generation Wi-Fi standard at 5 GHz, IEEE's 802.11ac. In many ways, the standard anticipates the policy process given that it is shaped to function at 5 GHz with channels up to 160 MHz wide, the benefits of which we are unlikely to be able to truly exploit until additional spectrum resources are made available. Thanks to a dedicated community of engineers from across the major industry players, we would be well placed to take advantage of the additional spectrum and quickly implement it in the Wi-Fi technology ecosystem.

Cisco is mindful of the need to protect existing users of the candidate bands, including those mentioned and others not limited to airborne weather radars and other radars, Broadband Fixed Wireless Access (BFWA), Road Transport and Traffic Telematics (RTTT) and Earth Exploration Satellite Services (EESS). We are particularly sensitive to ITS given the role we have played in their development,[33] including Dedicated Short Range Communications (DSRC) anti-collision systems. We support the investigation of appropriate co-existence techniques, whether existing techniques such as Dynamic Frequency Selection, which is already required in the upper band up to 5850 MHz, or new considerations.

In terms of the timeframe, Annex 1 describes the candidate bands for Wi-Fi as being potentially available in the mid-term, defined as post 2015. Given the capacity and quality of service demands Wi-Fi is predicted to face in the coming years and the intricacies of the regulatory decision making process which can take several years to complete, we recommend that the compatibility studies are initiated as soon as possible in order to avoid undue delays.

As a final note, given potential bands for Wi-Fi are identified in the Annex and the role of Wi-Fi is lauded in the body of the Opinion, we are somewhat surprised that a more detailed consideration of the specific bands was not laid out in section VII on the Role of Shared Spectrum Access and Licence Exempt Spectrum or section IX on Key Frequency Bands with Potential for Wireless Broadband. While the RSPG cites its existing Opinion on the Collective Use of Spectrum, the aforementioned document does not directly reference bands at 5 GHz, which is not surprising given it was published in 2008, prior to the emergence of this policy discussion. It focuses instead on describing collective use, the types of services and bands in which they operate, advantages and disadvantages as well as general recommendations in

[33] Cisco intelligent and converged networks are forming the foundation for new infrastructures of connected roads, rails, airports and ports being built all around the world. As a result of Cisco's efforts, smart parking, traffic signals that adapt to real-time conditions, and roads that sense the surrounding environment all are becoming more common place. *See* http://www.cisco.com/web/strategy/transportation/intelligent_trans.html. Cisco Connected Roadways securely connect disparate intelligent transportation systems to improve traffic flow, reduce roadside incidents, and provide a centralized view of roadway systems improve resource use and operational efficiencies while facilitating greater collaboration between public safety and transportation system operators. The result is enhanced the meeting of security mandates, a reduction in the number of incident responses on roads, the timely clearing accidents to reduce more dangerous secondary accidents, compliance with air pollution regulations and improved communicating with Amber Alert Emergency Response systems.

relation to making spectrum available.[34] While it is secondary to the specific recommendations and identified bands, this would be a good opportunity for the RSPG to state their considerations.

7. Conclusion

Cisco welcomes efforts by the Radio Spectrum Policy Group to determine challenges and potential solutions to the demand for wireless broadband. We support the recommendation to the Commission to draw up a strategic plan to meet this demand up to 2020.

Specific to Wi-Fi, we are pleased to see its role as a component of wireless broadband recognized as well as its growth trends and the increasing reliance of operators in making use of its offloading capabilities. Wi-Fi traffic is continuing to expand at an extremely fast pace and industry has been working to develop the 5th generation of Wi-Fi in order to meet the demand and quality of service requirements. In order to make sure the technology is able to exploit its full potential so that end-to-end connectivity requirements will be met and the benefits of the technology realised, additional spectrum will need to be made available.

Given the demand imperative and the timeframe for regulatory decisions, we call for compatibility studies on the candidate bands for Wi-Fi at 5 GHz to be initiated as soon as possible and offer our assistance to the RSPG and the Commission during the process.

Should you have any questions about this paper, please do not hesitate to contact Chris Gow: chgow@cisco.com or +32 2 704 1573

[34] RSPG Opinion 'Collective Use of Spectrum' (2008) https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/rspg08244_finalopinion_collectiveuse.pdf