



An Coimisiún um
Rialáil Cumarsáide
Commission for
Communications Regulation

Response to Consultation on proposed 26 GHz Spectrum Award 2018

Submissions to Consultation 17/85

Date: 23/02/2018

ComReg: 18/12b

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1 Eircom Limited (trading as “eir” and “open eir”) and Meteor Mobile Communications Limited (“MMC”) (collectively referred to as “eir Group”)

eir Group

Response to ComReg Consultation:

Proposed 26GHz Spectrum Award 2018

ComReg Document 17/85



23rd November 2017



eir response to ComReg 17/85

DOCUMENT CONTROL

Document name	Eircom Group response to ComReg Consultation Paper 17/85
Document Owner	eir Group
Status	Non-Confidential

The comments submitted in response to this consultation document are those of Eircom Limited (trading as 'eir' and 'open eir') and Meteor Mobile Communications Limited ('MMC'), collectively referred to as 'eir Group'.



Response to Consultation

eir welcomes the opportunity to comment on ComReg's proposals regarding a 26GHz spectrum award (2018).

eir agrees with the proposal to run an award process so that spectrum in this band can continue to be used for National Block Licences. We note, as highlighted by ComReg in the consultation document, that the future use of the 26GHz band is subject to some uncertainty internationally and agree *"that the best course of action at this time...is...conducting an award process for the granting of new National Block Licences"*.

eir agrees with many of the details proposed for the award. eir agrees with:

- the use a Sealed Bid Combinatorial Auction (SBCA) format for the award. eir has no strong preference whether this is conducted in two phases with an assignment round or whether the SBCA is run in a single stage with frequency specific lots.
- 19 national block licences of 2x28Mhz size.
- the licences being for FDD use and for Point to point (P2P) links only.
- the registration of 'transmit high' and 'transmit low' sites and the maintenance of a register of site and transmission information.

However eir has concerns regarding some elements of the proposals in relation to licence duration and spectrum caps and requests clarification on some of the technical obligations. We discuss these in turn.

1. Licence duration

ComReg proposes 10 year terms for the new National Block Licences. eir generally believes licence durations far in excess of 10 year promote more efficient use of spectrum. However in the specific case of the these National Block Licences we do not object to a 10 year term taking into account the current international uncertainty regarding the future use of the 26GHz band. It must be acknowledged though that a 10 year term is very short in the context of users of the Licences making an adequate return on the equipment they deploy in the band. On balance weighing up return on investment and the potential change in use of the spectrum over the next 5-10 years eir believes 10 years is a reasonable term.



eir would not like to see a repeat of the current unfortunate circumstances in respect of the 3.6GHz spectrum whereby the spectrum licences have been issued to winning bidders since 1st August 2017 but the spectrum is not yet available for use and winning bidders have no clarity on when the spectrum will be available for use. eir believes it is imperative that the completion of the award and issuance of the licences is conducted promptly. If there are delays to the issuance of new National block Licences then the 10 year term should not start until the licences are issued and the spectrum is available for actual use by the licensee.

This ComReg initiative is driven by the fact that the current 26GHz National Block licences expire in 5th June 2018. This means that ComReg has only 6 months to design and conduct an award process, and to facilitate any transitional arrangements so that the spectrum can be licensed and used by winning bidders from 6th June 2018. The ComReg Action Plan sets out a challenging timeline for ComReg to issue a Response to Consultation and draft Decision in December, and to issue the Decision and Information Memorandum for the award in Q1 2018. ComReg must ensure it meets these deadlines and ensure that the spectrum is available for use by 6th June 2018. ComReg must ensure there are no delays but in the event that a delay arises, then as already noted, the 10 year term of the licences must be respected.

2. Spectrum cap / channel bandwidths

ComReg proposes a competition cap of 5 blocks per bidder. ComReg arrives at this proposal by considering that a cap of 6 blocks might result in an outcome where a fourth bidder is restricted to a single residual block. ComReg rejects a cap of 4 blocks on the basis that it may unnecessarily restrict demand when there are no significant concerns regarding the impact of the assignment on downstream competition. ComReg concludes that a spectrum cap of 5 blocks is preferable on balance. However we query whether a cap of 5 blocks will encourage the most efficient use of the spectrum. There appears to be an inconsistency between the proposed competition cap and the proposed maximum channel bandwidth of 112MHz which equates to 4 blocks. We agree with the proposed maximum channel bandwidth. As such we believe ComReg's duty to promote efficient use of the spectrum is better served by a spectrum cap of 4 blocks.

3. Technical obligations

ComReg proposes the mandatory use of Adaptive Coding and Modulation (ACM) on the basis that its use can increase capacity and generate environmental benefits / cost savings through



eir response to ComReg 17/85

fewer transmitters and reduced power consumption. eir does not believe it is appropriate to mandate the use of ACM. The use of ACM should be left at the discretion of the licensee taking into account the specific requirements for the fixed link that is being deployed. This is because ACM is not always necessary (e.g. where there is low demand for capacity on a link) and ComReg appears to have overlooked the fact that ACM is sold by vendors as an additional feature at an additional cost. We agree it is appropriate to encourage the use of ACM but it should not be mandated.

We note ComReg's observation that all antennas must be at least 'class 3' as defined by ETSI EN302 217-2 in order to comply with the Radio Equipment Directive 2014/52/EU (RED). It is not clear from the consultation whether it is intended that this mandatory requirement should apply to all antennas in the new 26GHz National block licences. The RED does not have retrospective application and we would welcome ComReg's confirmation that all equipment in the market prior to 12th June 2017 can be procured and used in the new 26GHz National Block Licences.

2 L.M. Ericsson Ltd (“Ericsson”)

Ericsson's response to ComReg's consultation on proposed 26GHz Spectrum Award 2018

Reference: Submission to ComReg 17/85

This document represents Ericsson's response to ComReg's consultation on the proposed 26 GHz Spectrum Award 2018, submitted on November 2017.

Our key points are:

- Ericsson is a strong proponent of harmonised spectrum use across Europe in terms of frequency ranges and technical conditions. This enables countries to benefit from a 5G NR eco-system of scale, which is at least as wide as the EU, as well as from potential interoperability and roaming capabilities.
- The Radio Spectrum Policy Group (RSPG) and the European Conference of Postal and Telecommunications Administrations (CEPT) have provided guidance for the use of 26 GHz band for early 5G NR deployments within Europe.
- As a result, Ericsson invites national regulators to consider making the whole of the 26 GHz band available for 5G NR use in a timely manner.
- Ericsson notes ComReg's uncertainty on the industry readiness of 26GHz for 5G, and would welcome the opportunity to clarify by way of a public consultation or discussion. Of note Ericsson would like to highlight:
 - The development of an ECC Decision on harmonised technical conditions for 26GHz for 5G is on track for delivery June 2018
 - The availability of a 26GHz 3GPP standard in 2018
 - Italy has announced its plans to auction 26GHz in 2018
 - UK (OFCOM) has started consultation on 26GHz and is expected to release the first slice of 26GHz late 2018 or early 2019
 - Germany (BNetzA) is looking to release 26GHz in 2018
 - France (ARCEP) is looking to release the first slice of 26GHz in 2018-2019
 - Sweden and Finland are making available some 26GHz for 5G trials
 - 26GHz 5G infrastructure and devices are expected to be available (from multiple vendors) in 2019
- Whilst many national regulators are considering a phased approach to the release of 26GHz for 5G, Ericsson has concerns that ComReg is proposing a 10 year licence extension to the Fixed Link licences in advance of a public consultation around 26GHz (the entire band) for 5G. This leaves many questions uncovered such as:

- Will there be any 26GHz spectrum released at all for 5G in the short term?
 - What is the future of the block of spectrum reserved for individual links?
 - What are the future plans for the FWALA licence blocks?
 - What is the expectation for the future usage of the National Fixed Link blocks after the proposed 10 year licence period?
 - What is ComReg's plan to enable a re-evaluation of usage mid-term of the proposed 10 year licence period, if encouraging new fixed link investment in this band but not allowing appropriate time for depreciation?
- Whilst the need for additional Mobile Broadband capacity in Ireland may not demand the availability of 26GHz (mmWave) spectrum for 5G in the short term, it should be understood the unique nature of this spectrum and its role in the much discussed transformation of vertical industries using 5G. The 26GHz with its ability to support very large cell edge peak rates and its ability to service Ultra Low Latency services (and high reliability) makes it very interesting for Industrial uses as well as Fixed Wireless Access (in some cases combined with the recent C-Band awards).
 - Ericsson understands that the 26 GHz band could be authorised applying a national licence practice, including the potential to support sub-leasing to a third party for 5G NR deployment.
 - Ericsson suggests ComReg initiates a public consultation on 26Ghz in its entirety, looking at the market interest in releasing this for 5G, and appropriate time windows for the 26.5-27.5GHz, 26.285 to 26.5GHz, and 24.5 to 26.285GHz ranges. The proposal should consider the need to clear the sub-bands as well as transform from an FDD band to a TDD band. Ericsson proposes that this consultation should be completed in advance of continuing with more detailed planning on re-awarding the national fixed link block licences.
 - Ericsson invites ComReg to consider aspects such that the phased authorisation proposal does not unnecessarily fragment the 26 GHz band, and subject to market demand, that individual licence rights holders can acquire at least 400 – 500 MHz and up to 1 GHz of contiguous spectrum. The greater the allocations the more flexible the spectrum will be to meet multiple use cases.
 - Ericsson clearly recognises the need for current licence right holders to have ample time to migrate their existing links from the 26 GHz band, and to have an attractive proposal from ComReg on where to relocate the frequencies. Such incentives could be the provision of larger carriers (required to support 5G backhaul) as well as lower licence fees, or reduced administrative burden on licence provisioning.
 - Given the above considerations Ericsson invites ComReg to carefully consider harmonizing its proposal on the 26 GHz band with other countries in Europe.

Ericsson would welcome the opportunity to discuss our response in more detail



Background information.

5G will bring new levels of performance and characteristics to telecom networks, enabling new services, new ecosystems and new revenue streams. 5G technology will encompass an evolution of today's LTE technology (4G) with the addition of new radio access technologies, often in higher frequencies. It will impact the entire mobile network and associated eco-system, from devices to radio access, IP core and into the cloud. 5G subscription uptake will commence in 2020, and is expected to be faster than for 4G. The development of 5G is being driven by new use cases that will impact both consumers and industries. New applications and use cases anticipated for 5G include safe, self-driving cars, remote controlled robots, haptic feedback-enabled drones, and fixed wireless access - rivalling fiber capacity - for residential homes. As a result, mobile operators are today planning for their 5G future.

Radio access technologies are a fundamental component of 5G. They must support massive numbers of connected devices and meet the real-time, high-reliability communication needs of mission-critical applications in addition to increasing network speed and capacity.

These new 5G capabilities must support:

- Massive system capacity
- High data rates everywhere
- Low latency
- Ultra-high reliability and availability
- Low device cost and energy consumption
- Energy-efficient networks
- Interoperability with existing wireless networks

To support increased traffic capacity and data throughput, 5G will extend the range of mobile communication frequencies. This includes new spectrum below 6GHz, as well as spectrum in higher frequency bands.

Low frequency bands will continue to be the backbone of mobile networks. New high frequencies, especially those above 10GHz, will complement low frequencies as needed to provide additional system capacity or wide transmission bandwidths for extreme data rates in dense deployments.

	Coverage Width	User Throughput	Latency	Mobility	System capacity
Low Band	***	*	*	***	*
Medium Band	**	**	**	**	**
High Band	*	***	***	*	***

Low Bands

- Suitable for use cases requiring wide area coverage, deep indoor and mobility
- Macro network deployments expected
- Throughput/capacity limited by spectrum bandwidth availability

Medium Bands

- Flexible for many use cases with higher throughput /capacity and lower latency
- Existing bands to be later refarmed to 5G
- Denser deployment

High Bands

- Extreme capacity/throughput and lowest latency
- Much wider spectrum available
- Hot-spot coverage or ultra dense deployment
- 28GHz mmW already being used for FWA and in live trials in the US and South Korea



The Radio Spectrum Policy Group (RSPG) and the European Conference of Postal and Telecommunications Administrations (CEPT) have identified three bands to enable 5G in Europe:

- Low bandwidth spectrum at 700 MHz;
- 3.4-3.8 GHz, which has the potential to allow wider bandwidths; and
- 24.25-27.5 GHz (the 26 GHz band), for ultra-dense very high capacity networks.

5G New Radio (NR) on 26GHz will be another valuable frequency layer in a mobile operator's existing heterogeneous (multi-layered) network. 26GHz deployments are expected on both existing grids and new Small Cell sites, supporting both outdoor and indoor deployments, enabling consumer and vertical enterprise solutions.

About Ericsson.

Ericsson's vision is a Networked Society where every person and every industry is empowered to reach their full potential. Realization of this vision means progress in everyday life of billions of people, millions of businesses, and a development towards a more inclusive, equitable and sustainable society.

At Ericsson, we embrace this future development and have set out our mission to lead transformation through mobility, where we as a leading innovator drive transformation of industries and communities towards a sustainable Networked Society.

For 140 years, our ideas, technology and people have created monumental impact: real turning points that have transformed lives, industries and society as a whole. The greatest changes are yet to come. Together, we innovate to create these future turning points, driving extraordinary impact in the Networked Society.

About Ericsson in Ireland

Ericsson Ireland operates in two locations, Dublin and Athlone, and has responsibility for three distinct business segments:

- Sales and Support for our Local Customers
- Research and Development (R&D)
- Professional Services delivered globally.

Our local customer base is the focus of our business. Since 1957 we have been a supplier and partner to the Posts and Telegraphs (P&T), subsequently eir, with whom we continue to work today. Over the years, our list of customers has grown substantially and now includes Vodafone, Three, Telefonica/giffgaff, Virgin Media, ESB, Irish Rail and many more. We continue to work in a progressive way with our customers; where once we sold telephony switches, we now deliver software to leverage digital services that will eventually lead us to 5G and beyond.

Our R&D center based in Athlone was established in 1979 and continues today to be one of the leading R&D sites for Ericsson globally. It is recognized across Ericsson for its world-class development systems that are optimized for high speed deliveries and superior quality products. It houses a full spectrum of network and IT competences needed to systemize, build and support next generation network management systems for Ericsson.



Ericsson Ireland also hosts the global hub for the delivery of high value professional services including Network Transformation, Network Design & Optimization, System Integration, Managed Services, Business Consulting, Operational Consulting, Technology Consulting and Learning Services.

Through collaboration and support of local schools and universities, educational and technology organisations and support of several charities, Ericsson Ireland has a strong connection with the local community.

We take pride in the diversity of our workplace: our employees are from 61 different countries and Ericsson Ireland was one of the first to install Women's Networks and LGBT Networks across Ericsson globally

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3 Global Mobile Suppliers Association ("GSA")

Consultation on proposed 26 GHz Spectrum Award 2018

GSA Response to ComReg 17/85

About the GSA

The GSA (the Global mobile Suppliers Association) is a not-for-profit industry organization representing companies across the worldwide mobile ecosystem engaged in the supply of infrastructure, semiconductors, test equipment, devices, applications and mobile support services. GSA actively promotes the 3GPP technology road-map – 3G; 4G; 5G – and is a single source of information resource for industry reports and market intelligence. GSA Members drive the GSA agenda and define the communications and development strategy for the Association. The Spectrum Group within GSA is the GSA focus group for global policy matters related to the radio frequency spectrum and radio regulatory matters pertaining to the successful evolution of International Mobile Telecommunication (IMT) of ITU and associated administrative, operational and technical aspects. This response is focused on and relevant to the European aspects of 5G spectrum and may not represent the position with other regions. The GSA has recently produced a report on making a success of 26GHz for 5G in Europe and this can be found on the website www.gascom.com.

GSA Response

GSA is pleased to provide its views on Comreg’s “Consultation on proposed 26 GHz Spectrum Award 2018”. GSA urges Comreg to reconsider its current proposal to conduct an award process for granting new National Block Licenses in the 24.5 – 26.5 GHz portion of the 26 GHz band, to fixed radio link systems on a primary basis for 10 years.

Furthermore, GSA believes that the 26.5 – 27.5 GHz band, currently unused in the country, should be considered and included in a possible new consultation for the 24.5 – 27.5 GHz range as a key band for the deployment of terrestrial mobile 5G services and applications.

GSA is convinced that the current proposal will reduce substantially the opportunity for developing 5G services and application in the country in a timely and harmonized manner in relation to other countries in Europe. Availability of suitable spectrum in the 24.5 – 27.5 GHz range is essential for 5G to unfold its full potential and achieve the targeted performance of enhanced mobile broadband of 5G with the user bitrates in the order of tens of gigabits per second (Gbps).

5G trials in the mmWave range of spectrum are proliferating around the world and a number of announcements have been made by chipset, terminal and infrastructure manufacturers on products availability in 2018 - 2019 timeframe. This 26 GHz band, in combination with the already awarded 3.4 – 3.8 GHz range, would place Ireland and its operators in the optimal position to implement and deliver the promises of 5G. Indeed at 3.5 GHz range operators can expect to get in excess of a couple of Gbps peak data rates over 100 MHz of contiguous spectrum bandwidth while at 26 GHz (24.5 – 27.5 GHz), blocks of 400 - 800 MHz of contiguous spectrum would, with the use of higher order modulation techniques, give consumers bitrate in the order of tens of Gbps. By combining these exciting new capabilities with the under-laid LTE coverage in the Non-Stand Alone (NSA) 5G architecture, the consumers will experience truly uniform fiber-like mobile broadband performance.

Consequently, GSA respectfully invites Comreg to:

- a) Review the current proposed assignment strategies for the 26 GHz band
- b) Consider awarding 26.5 - 27.5 GHz so that it is suitable for 5G by means of about 400 MHz of contiguous bandwidth for nationwide spectrum per network with availability for deployment in the 2018 - 2019 timeframe
- c) Consider how to enable the option for the deployment of 5G in the 24.5 - 26.5 GHz spectrum so that operators have the future flexibility to deploy 5G with geographic co-ordination: 5G can be deployed in urban and suburban areas, and fixed radio link systems in areas where demand for 5G is lower.

- d) Consider awarding the spectrum range 24.5 – 27.5 GHz in line with European and Global developments. This will be in line with the Radio Spectrum Policy Group (RSPG) opinion on 5G which recommends member states to make part of the 26 GHz band available before 2020, it would be in line with the direction that many countries in Europe are taking and will enable Ireland to take advantage of global availability of terrestrial 5G infrastructure and devices

GSA envisages spectrum in the upper part of the 26 GHz band (26.5 - 27.5 GHz) being deployed in the 2019 timeframe by many countries across Europe, supported by a wide and global eco-system of equipment, devices and chipsets leveraging on mmWave deployments in the US, Korea and Japan. Important market and eco-system developments on the 26 GHz band are highlighted hereafter:

In Europe:

- In November 2016, the RSPG recommended the 24.25-27.5 GHz as a pioneer band for 5G above 24 GHz.
- In December 2016, the EC Radio Spectrum Committee (RSCOM) issued a mandate to CEPT to study and assess the 24.25-27.5 GHz ('26 GHz') frequency band as a 5G pioneer band for use under relevant 5G usage scenarios and to develop channeling arrangements and common and minimal (least restrictive) technical conditions for spectrum use in the 26 GHz frequency band, which are suitable for 5G terrestrial wireless systems, in conjunction with relevant usage and sharing scenarios.
- In CEPT, ECC PT1 has been tasked to develop an ECC Decision on harmonized technical conditions for MFCN in 24.25-27.5 GHz taking into account 5G requirements by June 2018.
 - This activity is on track and draft ECC DEC for 26 GHz band is expected as early as December 2017.

In the Member States

- In Italy, the Government has announced it will award for 5G the 26.5 – 27.5 GHz band in Q3 2018 with rights of issue issued on December 1st 2018.
- In the UK the Government (DCMS and HM treasury) has published its 5G strategy in March 2017

- OFCOM have initiated a work program on 26 GHz band availability for early 5G deployment –
 - OFCOM is expected to release the 26.5 – 27.5 GHz part of the 26 GHz band in a first phase – band is currently managed by MoD but agreement between MoD and DCMS was achieved to release the band
 - OFCOM is expected to award the 26.5 – 27.5 GHz in the fall of 2018 or early 2019
- In Germany, BNetzA is designing a potential award of spectrum in the 26 GHz band and 28 GHz bands – auction is expected in 2018 timeframe
- In France, ARCEP spectrum consultation included 26 GHz – upper part of the band with the 26.5 – 27.5 GHz expected to be released first in the 2018 - 2019 timeframe
- Sweden PTS is looking at "large-scale 5G tests" in 26 GHz and decided to make available up to 1 GHz (26.5 – 27.5 GHz) for it in 2017 for trials
- Finland is looking at "large-scale 5G tests" in 26 GHz, decided to make available up to 1 GHz (26.5 – 27.5 GHz) for it in 2017 for trials

3GPP standardization timeline:

At its March 2016 meeting, 3GPP agreed to a work plan proposal ([RP-170741](#)) for the first 3GPP 5G New Radio (NR) specification that will be part of Release 15 – the global 5G standard. As part of this work plan, a large number of mobile industry leaders committed to accelerate the 5G NR schedule by introducing an intermediate milestone for an early completion of a variant called Non-Standalone (NSA) 5G NR. This intermediate milestone will enable 3GPP-based large-scale trials and deployments as early as 2019.

- Non-Standalone (NSA) 5G NR will utilize the existing LTE radio and core network as an anchor for mobility management and coverage while adding a new 5G carrier. This is the configuration that will be the target of early 2019 deployments (in 3GPP terminology, this is NSA 5G NR deployment scenario Option 3).
- Standalone (SA) 5G NR implies full user and control plane capability for 5G NR, utilizing the new 5G core network architecture also being done in 3GPP.

With the recently agreed upon proposal, a framework is defined to ensure commonality between these two variants, as well as making forward compatibility a key design principle for the standardization of the first release of 5G NR. This will enable in-band introduction of new capabilities and features in subsequent releases of the standard, such as the addition of new signals to support new industries or use cases to achieve the 5G vision to connect everything to everything. There will be two phases for the normative work in 3GPP (see the diagram above): the first release of the 5G specification (Rel. 15) will be completed by September 2018 (specifications for the Non Standalone (NSA) architecture supporting 5G-NR deployment using LTE as control plane anchor will be available in December 2017 while the Standalone (SA) architecture enabling the 5G-NR deployment with full control plane capability for NR will be specified by June 2018. The second release of the 5G specification (Rel. 16) will be completed by December 2019 with the ability to address all 5G use cases and requirements in time for the ITU-R IMT-2020 submission.

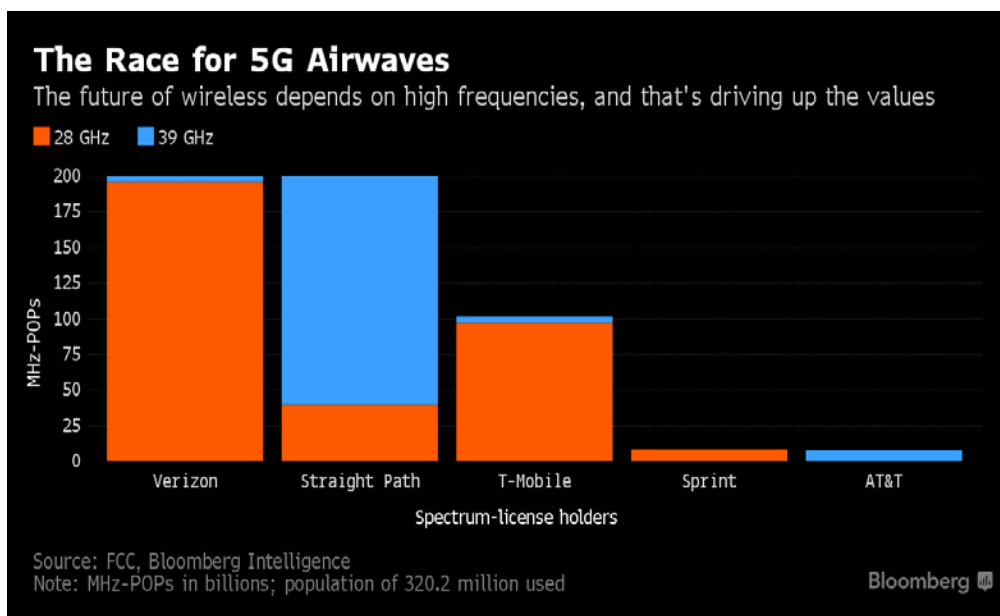
Two bands will be defined for 5G NR in 24.25-29.5 GHz frequency range: 24.25-27.5 GHz and 26.5-29.5 GHz with the target for completion by December 2017 and the latest by June 2018 during Release 15.

Outside Europe:

- Korean regulators are planning to allocate a total of 4 GHz of millimeter wave spectrum for 5G in three phases. The first phase will begin in 2018, focusing on millimeter wave in 27.5 – 28.5 GHz. Phase two will add 2 GHz of bandwidth in the 26.5 – 27.5 GHz and 28.5 – 29.5 GHz ranges. The third phase will add an additional 1 GHz of bandwidth in the 2021 to 2026 timeframe, for a total 5G mmWave bandwidth of 4 GHz. The band 26.5-29.5 GHz has been identified for a 5G trial service at the 2018 winter Olympics. Three operators in Korea have been allocated 1 GHz each in this range for the purposes of that trial.
- In July 2017, Japan's MIC (Ministry of Internal Affairs and Communications) officially identified and issued a public consultation concerning 5G spectrum identifying up to 2 GHz of millimeter wave spectrum, to come from the 27.5-29.5 GHz range. MIC plans to issue the final technical rules, including the precise frequencies, by next summer.
- In China, MIIT is currently consulting on the use of the 24.75-27.5 GHz and 37-42 GHz bands for IMT-2020/5G.
- In the US, about 11 GHz of spectrum (28 GHz, 37-40 GHz, and 64-71 GHz) has been made available for mmWave applications, with additional candidate bands identified for IMT-2020.

Most recently, FCC took further actions by releasing a draft ruling to make available additional millimeter wave spectrum above 24 GHz for 5G: 24.25-24.45 and 24.75-25.25 GHz band were identified in such draft FCC ruling.

The race for 5G airwaves in the US has been well described in the picture below by FCC/Bloomberg.



Eco-system Development in the 26 GHz

Equipment is available now for trials and will be available for pre-commercial and commercial deployments in 2018 and 2019 to serve and enable first commercial 5G implementations in Europe. A number of announcements have been made regarding commercial equipment availability.

- Intel’s 5G Modem supports 5G operation in both sub-6GHz bands and 28 GHz mmWave spectrum in the U.S., Korea, and Japan with a single device implementation. It pairs the 5G RFIC with the 28 GHz RFIC—supporting 5G New Radio features including low latency frame structure, advanced channel coding, massive MIMO, and beamforming. In combining the capabilities of the 28 GHz RFIC, which is already commercially available, and the 5G RFIC, the Intel® 5G Modem delivers on critical 5G requirements for multi-Gbps throughput, hundreds of MHz aggregated bandwidth and ultra-low latency.

- Qualcomm has announced the availability of its X50 Snapdragon modem which offers 28 GHz support, 4G/5G multi-mode with dual connectivity and up to 5 Gbps download speeds. The first commercial products featuring Snapdragon X50 5G NR modems are expected to be available in 2019.
- Samsung Electronics has unveiled its end-to-end portfolio of 5G mobile network products and solutions for 2017 which included chipsets, consumer devices for fixed wireless access connectivity, a 5G Radio Base Station (5G Access Unit) and Next-Generation Core Network infrastructure.
- Ericsson is planning to release commercial 5G base stations for 24.5 – 27.5 GHz and 26.5 – 29.5 GHz by the first half of 2019.
- Huawei, will be ready to provide E2E 5G commercial products compliant with the 3GPP standard in 2018, including New Radio and New Core equipment.
- Nokia will implement early 5G specifications, enhancing 5G FIRST with the 3GPP 5G Phase I protocol. Equipment for 28GHz is already available for trials since early 2017 as part of the 5G FIRST solution and commercial availability is planned for 2019. This RF can also be used for early trials at 26 GHz in the upper 1 GHz of the band.

Terminals and devices usually lag the announcements from the chipset and infrastructure community and announcements on these are anticipated over the next 12-18 months.

4 Imagine Communications Group Ltd ("Imagine")

Imagine
Consultation on proposed 26 GHz
Spectrum Award 2018
23rd November, 2017

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Executive Summary

Imagine welcomes the opportunity to respond to the Consultation on Proposed 26GHz Spectrum Award 2018.

Imagine believes that the way this award process is laid out disadvantages the smaller operator in that a auction as envisaged with limited caps will allow bigger players in the mobile and FTTH spaces to monopolise this award. [REDACTED]

The process as described also puts at risk incumbent use of the existing allocation [REDACTED]
[REDACTED]

The consultation or backup material does not provide clarity into the potential medium term use of the spectrum nor its longer term spectrum cost i.e. if and when mobile 5G NR (5G New Radio) will be supported nor what level of additional cost will be introduced at some arbitrary time during the license length.

This whole process will undoubtedly lead to spectrum hoarding in the hope that mobility or PTMP is allowed as well as inflate the cost to those operators who just want to use it for PTP. [REDACTED]
[REDACTED]

Imagine believes that caps should be introduced to ensure that there are adequate number of winners (beyond mobile operators and FTTH suppliers) to satisfy the different potential use cases for this spectrum as well as protect incumbent use and offer opportunity for new entrants. [REDACTED]
[REDACTED]
[REDACTED]

1.1 Harmonization and the 5G NR use case

It is noted that Dot Econ believes that some initial steps towards future harmonization of the 26GHz band for 5G have been taken at the EU level. While this is true at a regulatory level, Imagine believe that at a practical level progress on the potential use of 26GHz for 5G NR is moving at unprecedented pace globally. 26GHz has already been designated as one of the pioneer bands for 5G NR along with 3.5GHz. This is expected to be ratified soon at the next WRC.

In advance of this vendor roadmaps have been much accelerated as this band is one of the first that is likely to see commercial 5G NR deployments. Not only is it expected that 26GHz will be among the first 5G NR deployments (small cells) it is also deemed to be the spectrum of choice for the wireless drop use case for FTTH providers (last 100m) in a PTMP configuration.

As 26GHz is a short distance microwave technology, this is only relevant for 5G NR as a complimentary capacity enhancing technology in urban areas (small cells) and as the wireless drop for FTTH level (last 100m). It is going to be of limited use for mobile in non-urban areas.

These use cases are the current drivers of interest in this band even though plans for deployment are only in their infancy.

Because of these new use cases, Imagine believe that there will be significant hoarding of this spectrum from mobile and FTTH providers in the hope that mobility and PTMP will be allowed at some stage. Caps and obligations of use should be enforced so that along with this expected demand, incumbent operators and new entrants have a chance to win new spectrum or protect the spectrum that is in use to ensure continuity of service.

1.2 PTP vrs PTMP

Imagine believes there will be significant demand for PMTP as well as PTP. As mentioned above, this will be particularly relevant to the wireless drop use case for FTTH (last 100m). This will enable short distance high bandwidth service direct to the customer's home from close by aggregation points

Imagine believe that FTTH providers will hoard this spectrum in the hope that PTMP will be allowed at some stage in the future. Imagine recommend that by specifying that the PTP spectrum already in use will ever only be used for PTP will at least ring fence this spectrum off from potential hoarding bidders and ensure that it is used to deliver NGA type services today.

1.3 Competition cap

As Dot Econ have laid things out it is expected that there will 5 winners. As is seen by the demand in the other pioneer bands for 5G NR it is likely that mobile operators will be very interested in this spectrum band similar to that displayed in 3.5GHz. In addition, with FTTH a wireless drop use case, interest is likely to also come from other non mobile companies who have not held this spectrum in the past. As mentioned earlier this will naturally lead to spectrum hoarding by both these types of companies and drive up costs due to a limited number of winners.

Imagine believes this to very restrictive to the rest of the industry and caps should be set that allows for at least 6 winners.

1.4 License conditions

Imagine notes Dot Econs warnings on spectrum hoarding in the hope that this spectrum will be opened up for 5G.

“In terms of licence conditions, it is important that this award process does not become distorted by bidders speculatively acquiring 26 GHz spectrum in the hope that incumbent national P2P block licensees might subsequently be able to use these blocks for 5G applications without paying the full opportunity cost of liberalised spectrum. Therefore, appropriate licence conditions should be set to allow technologically-neutral use for P2P links, but not broader PMP or mobile use. This will provide ComReg with flexibility to assign 5G usage rights at some future date once the policy environment is clearer, potentially in coexistence with P2P usage rights.”

Imagine believes that it inevitable that this award process will become distorted by bidders speculatively acquiring 26GHz spectrum in the hope that they will be able to use these blocks for 5G NR and PTMP. Imagine doesn't believe that this is a matter of cost but a matter of securing the spectrum just-in-case (particularly in the urban areas for mobile and PTMP elsewhere). This will drive demand for this spectrum to higher levels than Dot Econ are predicting and Imagine believe this has to be mitigated by very strict and clear terms, obligations as well as spectrum caps that will allow for sufficient winners.

Imagine would go further and restrict the existing PTP allocations to just PTP with no possibility of mobile or PTMP. This would set realistic value on these lots and allow for companies to concentrate their investment in the areas that they actually intend to deploy giving certainty over their network investment.

There also should be obligations of use attached to this spectrum (particularly spectrum already in use).

1.5 Duration

Imagine believes that the duration of this license should be aligned with the 3.5GHz license and as such be 15 years.

1.6 Incumbent's usage of this spectrum.

[REDACTED]
[REDACTED]
[REDACTED] Due to lack of a clear timeline upto now, for this spectrum, Imagine have reasonably assumed that existing 26GHz licenses would be renewed and awarded in a reasonable timeframe. The current timeframe is too aggressive [REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]
26GHz PTP links are very high bandwidth (Gbps) and will require [REDACTED] investment in alternative infrastructure and in alternative spectrum to replace this. Current technology in other spectrums falls short of the same bandwidth as 26GHz [REDACTED]
[REDACTED]

Imagine estimate that to replace this technology within its network will be [REDACTED] ured in hardware costs alone. That assumes that equivalent hardware can be acquired otherwise each 26GHz link will have to be replaced [REDACTED] This also assumes that alternative spectrum is available in the areas it is needed.

Imagine believes that there is enough new spectrum (outside of the already allocated PTP spectrum) on offer at this award to not only satisfy the 5G NR and the FTTH Wireless drop use cases. Imagine therefore believes that the existing allocation of 26GHz spectrum should be ring fenced for incumbent usage for a number of years to allow for services to remain and network investments to be recouped. This would then allow for an orderly transition [REDACTED]

5 Qualcomm Europe Inc. (“Qualcomm”)

Consultation on proposed 26 GHz Spectrum Award 2018

Qualcomm Response

Qualcomm is pleased to provide its views on Comreg's "Consultation on proposed 26 GHz Spectrum Award 2018".

Qualcomm regrets Comreg decision to conduct an award process for granting new National Block Licences in the 24.5 – 26.5 GHz portion of the 26 GHz band, and maintaining the existing FWALA and Individual P2P link licensing schemes in this band, on a primary basis for 10 years as this will reduce substantially the opportunity for developing 5G services in the country. Furthermore, Qualcomm believe that the 26.5 – 27.5 GHz, currently unused in the country, should be considered and included into a new award consultation as a key band for the deployment of 5G services. Availability of spectrum in that range is essential for 5G to unfold its full potential and achieve the targeted performance of tens of Gbps.

5G trials in mmWave are proliferating around the world and a number of announcements have been made by chipset, terminals and infrastructure manufacturers on products availability in 2018 - 2019 timeframe. This band in combination with the already awarded 3.4 – 3.8 GHz would position Ireland and its operators in the optimal position to implement and deliver the promises of 5G. Indeed at 3.5 GHz operators can expect to get in excess of 2 GBps peak rates over 100 MHz of contiguous spectrum, while at 26 GHz, blocks of 400 MHz of contiguous spectrum will give well in excess of 12 GBps peak data rates. By combining these exciting new capabilities with the under-laid Gigabit LTE coverage in the Non-Stand Alone (NSA) 5G architecture, the end user will soon experience truly uniform fiber-like performance.

Consequently, Qualcomm respectfully invite Comreg to re-think its assignment strategies for the 26 GHz band and in particular to make available in the very short term to MNOs and other future users of 5G technology as a minimum the upper part of the 26 GHz range (26.5 – 27.5 GHz) making it possible early deployment of 5G services in the 2018/2019 timeframe in both 3.4 – 3.8 GHz and 26.5 -27.5 GHz pioneering bands. This will be in line with the RSPG opinion on 5G which recommends member states to make part of the band available before 2020.

Qualcomm envisages spectrum in the upper part of the 26GHz band being deployed in the 2019 timeframe supported by a wide and global eco-system of equipment, devices and chipsets leveraging on mmWave deployments in the US, Korea and Japan. Important worldwide developments on the 26 GHz band are highlighted hereafter:

In Europe:

- In November 2016, The Radio Spectrum Policy Group (RSPG) recommended the 24.25-27.5 GHz as a pioneer band for 5G above 24 GHz.
- In December 2016, the EC RSCOM (Radio Spectrum Committee) issued a mandate to CEPT to study and assess the 24.25-27.5 GHz ('26 GHz') frequency band as a 5G pioneer band for use under relevant 5G usage scenarios and to develop channelling arrangements and common and minimal (least restrictive) technical conditions for spectrum use in the 26 GHz frequency band, which are suitable for 5G terrestrial wireless systems, in conjunction with relevant usage and sharing scenarios.
- In CEPT, ECC PT1 has been tasked to develop an ECC Decision on harmonized technical conditions for MFCN in 24.25-27.5 GHz taking into account 5G requirements by June 2018.
 - This activity is on track and draft ECC DEC for 26 GHz band is expected as early as December 2017.

In the Member States

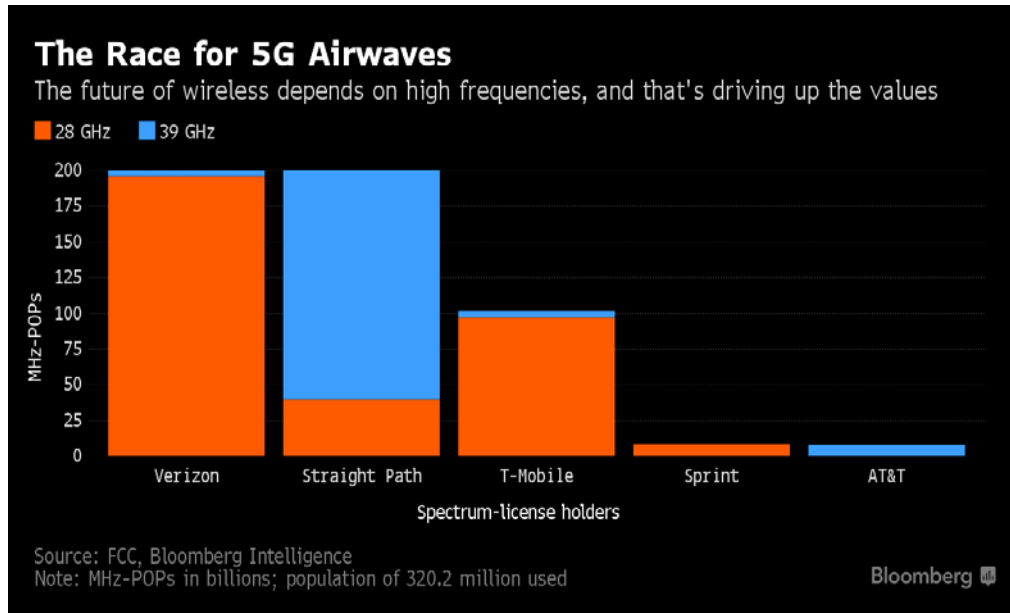
- In Italy, the Government has announced it will award for 5G the 26.5 – 27.5 GHz band in Q3 2018 with rights of issue issued on December 1st 2018.
- In the UK the Government (DCMS and HM treasury) has published its 5G strategy in March 2017

- OFCOM have initiated a work program on 26 GHz band availability for early 5G deployment –
 - OFCOM is expected to release the 26.5 – 27.5 GHz part of the 26 GHz band in a first phase – band is currently managed by MoD but agreement between MoD and DCMS was achieved to release the band
 - OFCOM is expected to award the 26.5 – 27.5 GHz in the fall of 2018 or early 2019
- BNetzA is designing a potential award of spectrum in the 26 GHz band and 28 GHz bands – auction is expected in 2018 timeframe
- ARCEP spectrum consultation included 26 GHz – upper part of the band with the 26.5 – 27.5 GHz expected to be released first in the 2018/2019 timeframe
- Sweden PTS is looking at "large-scale 5G tests" in 26 GHz and decided to make available up to 1 GHz (26.5 – 27.5 GHz) for it in 2017 for trials – release expected in 2019
- Finland is looking at "large-scale 5G tests" in 26 GHz, decided to make available up to 1 GHz (26.5 – 27.5 GHz) for it in 2017 for trials – expected release in 2019

Outside Europe:

- Korean regulators are planning to allocate a total of 4 GHz of millimeter wave spectrum for 5G in three phases. The first phase will begin in 2018, focusing on millimeter wave in 27.5 – 28.5 GHz. Phase two will add 2 GHz of bandwidth in the 26.5 – 27.5 GHz and 28.5 – 29.5 GHz ranges. The third phase will add an additional 1 GHz of bandwidth in the 2021 to 2026 timeframe, for a total 5G mmWave bandwidth of 4 GHz. Around 28 GHz (26.5-29.5 GHz) has been identified for a 5G trial service at the 2018 winter Olympics. Three operators in Korea have been allocated 1 GHz each in this range for the purposes of the trial.
- In July 2017, Japan's MIC (Ministry of Internal Affairs and Communications) officially identified and issued a public consultation concerning 5G spectrum identifying up to 2 GHz of millimeter wave spectrum, to come from the 27.5-29.5 GHz range. MIC plans to issue the final technical rules, including the precise frequencies, by next summer.
- In China, MIIT is currently consulting on the use of the 24.75-27.5 GHz and 37-42 GHz bands for IMT-2020/5G.
- In the US, about 11 GHz of spectrum (28 GHz, 37-40 GHz, and 64-71 GHz) has been made available for mmWave applications, with additional candidate bands identified for IMT-2020.

The race for 5G airwaves in the US has been well described in the picture below by FCC/Bloomberg.



Last but not least, it could be useful for Comreg to know that the first commercial devices featuring Qualcomm Snapdragon X50 5G NR modems are expected to be available as early as 2019. Qualcomm recently announced the expansion of its Qualcomm Snapdragon X50 5G modem family to include new multi-mode 2G/3G/4G/5G modems that will support the global 5G NR standard – both sub-6 GHz and multi-band mmWave – and Gigabit LTE on a single chip. The first commercial devices featuring Snapdragon X50 5G NR modems are expected to be available in 2019

6 Three Ireland (Hutchinson) Ltd ("Three")

26GHz Spectrum Award 2018

Response from Three Ireland



Three.ie

Introduction

Three is one of several network operators who use the 26GHz band at present. The 2008 National award has worked well for us, and we currently operate a large number of links under this licence. We cannot simply cease using these links in July 2018, so we have significant interest in the decisions that ComReg will make in this regard.

We are also aware that the 26GHz band is likely to be the second of two pilot bands for 5G in Europe. ComReg now needs to find a plan that avoids unnecessary disruption to current services in the band, while also avoiding delay to the roll-out of 5G.

Summary

1. The national block award of spectrum that ComReg ran in 2008 was a success. Three is a “heavy” user of the band and has a significant interest in what happens when the current licences expire in June 2018.
2. The 26GHz band has been chosen as 1 of 2 pilot 5G bands for Europe, though we understand that the precise band and the technical standards may not be finalised until the end of 2019.
3. Ireland is a small part of the global market for network and terminal equipment, so we will follow the standard European specifications for 5G. We will not want to take any decision now that would delay the availability of millimetre-wave 5G and will not want to fall behind other European countries for roll-out.
4. Current use of the 26GHz band by FWALA and Fixed point to point users (both National and Individual) is not compatible with 5G use in the same band.
5. ComReg needs to flag now that use of the band can be expected to change by 2022. The best option now is to wait until 2020 when the precise band to be used for 5G will be known, then allocate replacement spectrum for current use (where appropriate), allowing for a transition of approximately 2 years.
6. It would be wrong to re-award the band now for a period of 10 years. This would encourage investment in new equipment in the band requiring several years to recover that investment, which would lock-out 5G from the band until 2028.
7. Regardless of any other decision, Three will need a transition period of a minimum of 2 years from the time when it is known exactly what spectrum will be used to replace the current channels in the band, even if this is just a move within the same band.
8. Three’s Alternative proposal for the band is that ComReg should:
 - Extend the current licences on the same conditions for a period of 4 to 5 years (to 2022/2023), with all licence terms being the same except for fees. Fees should be updated;

- Run the process for new awards of spectrum in 2020, when the 5G band and standards in 26GHz are known;
- Make the 2 unused channels in the band available to any new user who may want them during the extension period.

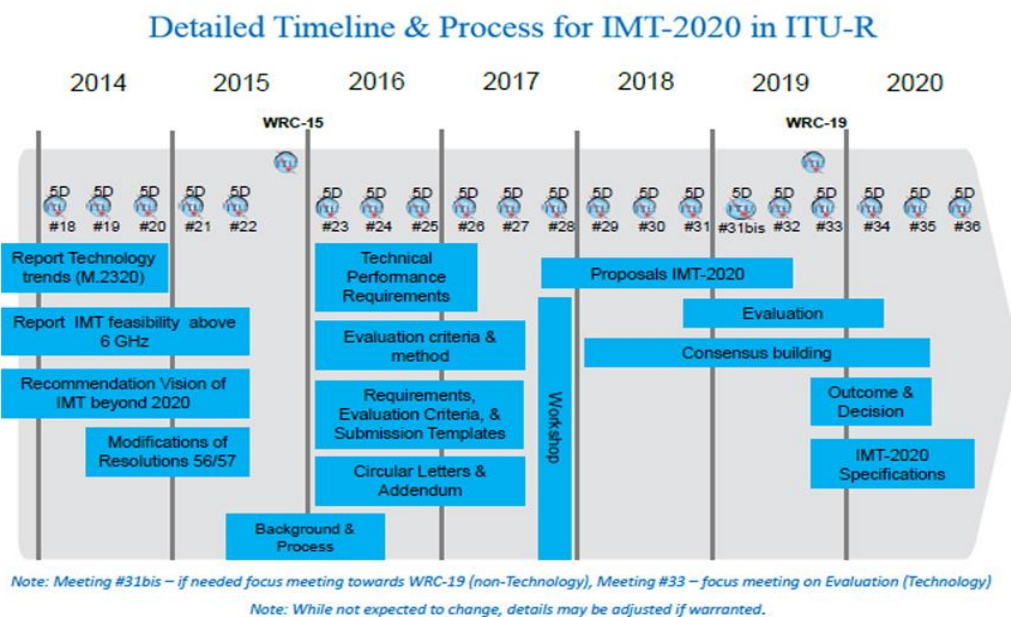
International Developments

It is Three’s understanding and expectation that the 26GHz will be one of the two pilot bands for 5G in Europe. We expect that harmonised technical conditions will be defined during 2018, and that the preferred band will be selected and decided upon prior to the World Radio Conference in November 2019 (WRC-19). CEPT countries are expected to seek a co-Primary allocation for mobile in this band in ITU Region 1 at WRC-19 and it seems likely that the same allocation will be made for Region 3 as it is strongly supported by China.

In November 2016, the ECC tasked ECC PT1 to develop a 5G harmonisation Decision for 26GHz. Then, in December, the European Commission issued a mandate to CEPT to develop harmonised technical conditions for the use of two bands for 5G (3.6GHz and 26GHz), with a deadline of June 2018 in order to allow for deployment of services by 2020.

The 26 GHz band is one of the bands being considered for global 5G deployments under Agenda Item 1.13 of the upcoming WRC-19. This agenda item considers a range of bands above 24 GHz for possible allocation to the mobile service, however it is Three’s understanding that 26GHz is the preferred band for CEPT and also for China.

According to the ECC, CEPT intends to harmonise the 26 GHz band in Europe for 5G before WRC-19. Work has been initiated on the development of an ECC decision to develop harmonised technical conditions for the use of 5G in this band in Europe and is following the timeline below.



The studies mentioned above on the 3.6 GHz and 26 GHz bands are planned to be completed by ECC PT1 in April 2018 in order to meet the deadlines set by the EC Mandate. In the case of the 26 GHz band, this will also provide a common European framework to feed into discussions to support global harmonisation at WRC-2019. Ultimately this will facilitate early deployment of 5G networks within CEPT by 2020, though realistically we believe it will be 2022 for large-scale deployment.

Current and Future Use of 26GHz in Ireland

As ComReg is aware, Three is a “heavy” user of point to point links in the 26GHz band, and we currently operate [✂ confidential section removed ✂]. The locations of these links are distributed across the country. We currently operate on a contiguous band of 5 of the 2x28MHz Blocks, having “converted” the original 2 point-to-multi point blocks to point-to-point.

The 2008 award has been a success from Three’s point of view and has given us the freedom to plan and deploy backhaul links, to a large extent, without making external applications and without needing to examine the impact of our deployment on other users. The use of 26GHz links has also proven to be an economical means to provide backhaul from mobile sites in many cases, in particular for many locations where fibre is not an option.

Three has an on-going requirement to provide the backhaul that is currently carried in the 26GHz band, and this will continue beyond 2018. We will require access to similar spectrum to provide this immediately after June 2018, and into the future. In particular, we will need access to a national allocation of spectrum that can be used in a similar way to provide comparable bandwidth/capacity over similar distances. As explained further below, we cannot easily change the existing equipment operating in the band, and there is no alternative band currently available to meet this requirement.

For the above reasons, what happens to the 26GHz band after June 2018 is not a trivial matter. In the absence of the proposals to use 26GHz for 5G, Three would agree with almost all aspects of ComReg’s proposal to re-award the spectrum as proposed in document 17/85 (the one area of difference would be in relation to the use of frequency generic or frequency specific lots) and would welcome the opportunity to secure access to some spectrum to provide backhaul for an additional 10 years.

Despite the above, we actually believe it would be a wrong strategic decision for ComReg to award licences in the 26GHz band now that would be expected to continue until 2028. There is currently some uncertainty regarding the precise sub-band that will be chosen for 5G services in the millimetre-wave band in Europe; however Three understands that it will

be within the 26GHz band, and that the final band and equipment specifications will be known before 2020, with early deployments happening from this time.

While Ireland might not necessarily want to be the first country to roll-out 5G in the 26GHz band, we would not want to fall behind our peers either – this would be damaging economically and also for Ireland’s image as a Digital Economy. If the roll-out of 5G services was delayed or impaired until after 2028, this would be damaging to the availability of mobile communications in Ireland, and for the economy generally.

The information available to Three at this time is that the optimal bandwidth for 5G services in the 26GHz band will be significantly greater than any used by mobile services to date, and several hundred Mega-Hertz of contiguous spectrum per operator should be the basis for the provision of 5G services. It will be a single block of spectrum operated in TDD mode rather than FDD mode. The requirement that the band is contiguous is important, as this means that the bandwidth required cannot be created by the aggregation of non-contiguous sub-bands.

The current use of spectrum within the 26GHz band for fixed links (National and Individual Licence) and also for FWALA is FDD. While there is currently 1,863MHz of unused spectrum in the band, it is disaggregated into three blocks of 434MHz, 222MHz, and 1.197GHz. The existing FDD use effectively “cuts up” the band and means that it is not possible to create more than one contiguous block of spectrum suitable for TDD use by 5G services.

For the above reason, it would be incorrect for ComReg to re-award the spectrum for a 10 year period now. This would effectively encourage new investment by current and perhaps new users of the band using FDD and the current band plan. This would come with an expectation by licensees of a 10-year use within which to recover that investment.

We do not believe the possibility to convert fixed link licences to liberalised use shortly after 2020 would be an adequate means to re-configure the band. At this time we do not believe it would be possible for fixed links using FDD mode to share with mobile services in TDD mode in the band. Three’s use of fixed links in the band is distributed geographically with approximately 50% in urban areas, so it would not be possible to share the spectrum using different geographical zones either. This means that fixed link users might need to cease use of the band in order for it to be re-farmed to mobile use. It would only take one fixed user licensed to use one channel to prevent the liberalisation of the band and delay the introduction of 5G services. The alternative is that new investors who begin using the band would need to cut-short their use which would make their investment in the band inefficient.

ComReg should now be signalling to all current users of the band, including Fixed National, Fixed Point-to-Point, and FWALA users that the band is expected to be allocated to mobile service on a primary basis at WRC-19, and awarded in Ireland on a liberalised basis shortly

after then. This will allow current users to plan for alternatives and will ensure that any investment made in the 26GHz band is made in the knowledge that there may be a limited time within which to recover that investment.

It will be necessary for ComReg to make alternative frequency assignments available for the services that currently depend on the 26GHz band. This might be in an alternative band, or it might be that they can be accommodated in the same or a different part of the current 26GHz band if the European 5G band does not align with 100% of the 26GHz band. This will not be known until probably early to mid-2019.

Transition Period

Regardless of the decision taken by ComReg at this time, Three will require a transition period if its use of the 26GHz band changes after June 2018. The time required to put in place an alternative will be a minimum of 2 years after the time when it is known what alternative frequencies are to be used in place of the current ones. This is the case even if it is just a move to a different part of the 26GHz band. This is because the equipment in use at the moment cannot be re-tuned by a significant amount without adjustment to the outdoor radio unit at each end.

Three currently uses equipment from two vendors in the 26GHz band, Huawei and Ceragon. There are two different models of the Ceragon linkset in use, and the switching range of the equipment is shown below:

[~~3~~ confidential section removed].

A change of channel beyond this requires a site visit and manual intervention to each transceiver in a link. Because of this, the cost of re-tuning existing equipment (where this is possible) is comparable to the cost of replacing the equipment entirely, however with new equipment a full lifetime service can be expected. For this reason, it is preferable to replace equipment with new kit (that can be reasonably expected to continue in operation for enough years to recover the investment) than to re-tune existing equipment in-situ.

For the above reason, it is not feasible to re-tune existing equipment operating in the 26GHz band, and a transition period of at least 2 years will be required from the time when it is known what the replacement will be.

Frequency Generic or Frequency Specific

As described above, re-tuning to a different part of the 26GHz band is not feasible. For this reason, a frequency generic auction that uses a separate assignment stage could deliver a sub-optimal outcome. If an existing licensee became a winning bidder in the main stage of the auction, but subsequently did not win their preferred lots in the assignment round, they would find their value for the spectrum significantly reduced, and may prefer not to have won so many or any of the lots in the first place, i.e. a significant part of their value is contingent on getting the same lots. For this reason, if there is an auction to re-award the spectrum in the band, then it should be a frequency specific one.

Three's Proposal

Three believes ComReg should aim to achieve the following from its current review of the 26GHz band:

1. To avoid a decision that would prejudice the roll-out of 5G services in Ireland;
2. To provide certainty to all users of the band as soon as the future use is known;
3. To provide for a reasonable transition from current use so as to avoid disruption to current services;
4. To avoid creating inefficient investments.

The expectation is that 26GHz will be used for 5G services in Europe during or soon after 2020. We will also have certainty as to which band will be used and how much spectrum is available for other uses by this time. Therefore, ComReg should not re-award the spectrum for a period of 10 years at this time. Instead, Three proposes that ComReg should:

- Extend the licences for the current Point to Point National licences for a period of 4 or 5 years (2022 or 2023);

- Continue to licence other existing services including Individual fixed links and FWALA over the same period (4 or 5 years);
- Flag now to all users that the spectrum may be withdrawn and re-awarded to new use after 2022/2023;
- In 2020, run whatever award process is needed for the 5G service in the band, but also for the spectrum to replace the current services in the band.

ComReg should extend the current 26GHz National point-to-point link licences on the same terms, with an appropriate adjustment to fees. The adjustment to the fees could be to set the annual spectrum usage fees equal to the average annual payment over the 10 years of the original licence, adjusted for CPI. It would also be appropriate to charge an upfront fee based on the relative proportion of the original upfront fee, again adjusted for CPI.

The two unused channels could be made available on similar terms to a new entrant if one emerged, however it is doubtful that one would.

The above proposal should satisfy the objectives outlined above, and also ComReg's statutory objectives for spectrum management:

- Promoting harmonised use of radio spectrum within the EU – this proposal optimises the likelihood of early availability in Ireland of the spectrum chosen within Europe for millimetre wave 5G services;
- Trans-European interoperability – this is maximised by the proposal above;
- Regulatory Certainty – this proposal gives certainty to all users and allows for an orderly transition when the facts are known;
- Efficient and effective use of spectrum – existing users can continue while the spectrum is available, and early availability is assured when more efficient services become available;
- Efficient investment in networks & services – this proposal avoids operators making investment in new equipment now that would need to be decommissioned prematurely to make way for 5G. Conversely, it avoids the situation where existing users block the take up of spectrum for 5G until they have run the course of their equipment life / end of investment.

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7 Vodafone Ireland Ltd (“Vodafone”)



Vodafone Response to ComReg document:

Consultation on proposed 26 GHz Spectrum Award 2018

Reference: ComReg 17/85

Executive summary

Vodafone welcome the opportunity to comment on the proposals in ComReg document 1785, the proposed 26GHz spectrum Award.

Vodafone strongly contend that this is not an appropriate time to hold an auction for spectrum in the 26GHz band and believe that the most efficient way forward is to extend the current 26GHz assignment by Administrative Assignment for a fixed period, we suggest 7 years. We agree that the use of this assignment can be limited to Radio Links.

While we recognise that work has begun on standardising Allocations for 5G in the 26GHz band we believe that there is still considerable work to be done in developing the standards and the use cases in this band. This work needs to be done before we can decide on the most appropriate band plan for future 5G at 26GHz. Whether this future band plan will accommodate both radio links and mobile use is still uncertain.

Apart from these standardisation issues it is likely that the deployment of 26GHz for mobile use will be at least five years away because there are other frequency bands becoming available that Vodafone and other mobile operators are likely to use for mobile before they use the 26GHz band.

The 3600MHz band has been auctioned and we await the draft Transition plan.

Comreg announced in March 2017 that they intend to progress the award of spectrum in the "700 MHz band alongside new rights of use in the 1.4 GHz, 2.3 GHz, and 2.6 GHz bands. "

Comreg 17/23

"In this regard, ComReg intends to progress its proposed process, or processes, for the award of new spectrum rights of use in the 700 MHz band alongside new rights of use in the 1.4 GHz, 2.3 GHz, and 2.6 GHz bands, together with any other substitutable or complementary bands such as the 2.1 GHz band."

Given the technical advantage of using lower frequencies for mobile coverage it is likely that all of these bands would be used before the 26GHz band.

While mobile use of the 26GHz band is some years away ComReg's document recognises that the 26GHz band is now used extensively by Vodafone for Radio Links to support services to customers nationwide and is a key ingredient of our network supporting mobile services for customers.

[REDACTED]

The radio links operating in the 26GHz band provide links to more than a 1000 mobile sites and are a key element of the network. In the last four years Vodafone have replaced the radio links at most sites in Ireland in order to provide the best possible service to customers. Any technical measure of efficiency would find the current Vodafone use of blocks 26GHz are very efficiently used.

Moving these links to another band or even within the band would be a very significant task – without any customer benefit. Depending on the new link frequencies that process would also require a very long Transition time.

We suggest therefore that the appropriate time to reassign this band is at least 5 years away, when the requirement for mobile in this band and a potential band plan is more clear. Given the importance of the 26GHz radio links to support mobile customers any process that moves the assignment of these links should happen a number of years before the move itself.

We conclude that it is reasonable for ComReg to complete an Administrative Assignment of these frequencies to cover the time until that future competition and Transition.

In the following section we give more details on:

Cost and Impact of moving existing links.

Justification for Administrative Assignment

Proposed Auction Format and Alternatives

Cost and Impact of moving existing links.

The radio links we currently use in the 26GHz band support more than 1000 links. These links support our mobile base-stations services nationwide.

Vodafone have made a very large investment in these links in the last 5 years to support better data services for customers. [REDACTED]

Frequency range of our current links.

The Radio Link equipment that we use in the 26GHz band is manufactured in two variant sub-bands.

We use Sub-Band 2 ODU's, which have the tuning range: 24997 -> 25445 and 26005 -> 26453MHz

This translates to channels 17 to 32 in a 28MHz raster

The alternative sub-Band 1 can tune 24549->24997 and 25557->26005

FREQUENCY RANGE: 24.5 ÷ 26.5 GHz - GO-RETURN: 1008 MHz ITU-R F.748-3 – Annex 1 and CEPT REC T/R 13-02 - f0=25501 MHz			
Sub Band	Lower Half Limits [MHz]	Upper Half Limits [MHz]	RF Filter Tuning Range [MHz]
1	24549 ÷ 24997	25557 ÷ 26005	448
2	24997 ÷ 25445	26005 ÷ 26453	

Table 2 – RF filter sub-bands for ASN25 and ASNK25

Cost of retuning these links to a different 26GHz band assignment - within Sub-band 2

- We have a total of 1035 links deployed in the National Block.
- [REDACTED]
- This includes Link design, Migration planning, network implementation and Project Management.
- Timescale would be in the region of 18 months to implement

Cost of moving to Sub-band 1 of the 26GHz band.

- **In this case all Radio ODU units would need to be replaced but the other components would remain as is.**
 - o [REDACTED]
 - o This includes Project Management, design, Hardware, Installation, remote commissioning, decommissioning, recycling etc.
 - o Time scale for implementation: 2 years approx.

Cost of moving to an alternative band outside 26GHz.

- o [REDACTED]
- o This includes Project Management, Surveys, design, Hardware, Installation, service migration, decommissioning, recycling etc.
- o Time scale for Implementation: 4 years approx.

All three moving options would have significant resource impacts on our organisation and would affect our ability to expand existing services while these projects are ongoing.

Our experience from similar network roll-out and build projects is that carrying out large scale equipment replacement programs is that they inevitably cause significant disruption to customer service. During the Vodafone 'Spring' program, where we replaced base-station equipment, the disruption caused significant negative feedback from customers.

Justification for Administrative Assignment

Vodafone believe that an Administrative Assignment of these 26GHz blocks is fully justified in the current circumstances.

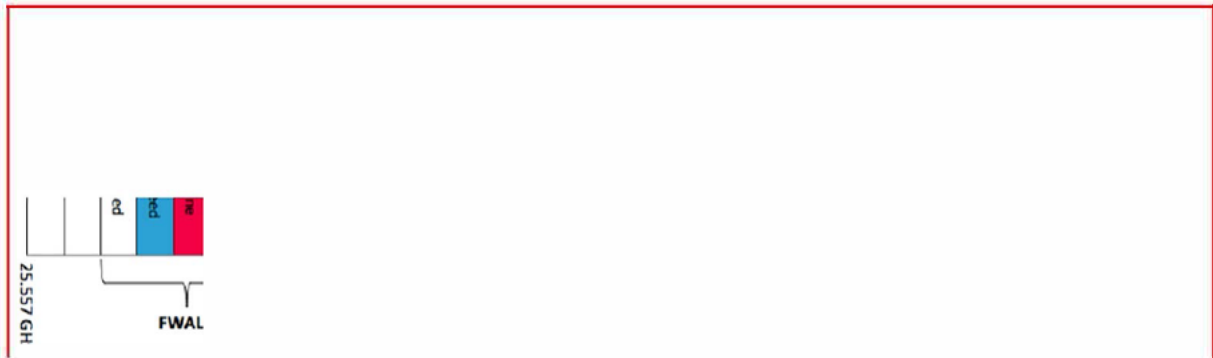
We agree that competitive auctions are normally the best way to assign new spectrum where demand exceeds supply and there are competing technology uses. But in the current circumstances we believe that there is more than enough spectrum available for radio links in the 26GHz band and no imminent alternative technology use. The blocks now assigned are very efficiently used. All circumstances are in place to fully justify Administrative Assignment.

Furthermore the very small amount of time available between the date of a possible Award and the end of the current licences also indicates that an Administrative Assignment rather than an auction is now appropriate.

Supply is much larger than demand.

Demand for this spectrum is much lower than the total spectrum available in the 26GHz band.

As pointed out in ComReg's document there are currently 5 unassigned blocks in the band 24.549 – 25.454. there are also unused blocks in this sub-band.



Comreg 1785

Figure 1: 26 GHz National Block Assignment Channel Plan

In addition to the unassigned blocks in this portion of the band there are significant volumes of spectrum currently unused in the rest of the 26GHz band.

From ComReg 1785:

- 13 In addition, 1 863 MHz of spectrum in the band is currently unassigned and not being used – see Figure 2 below:

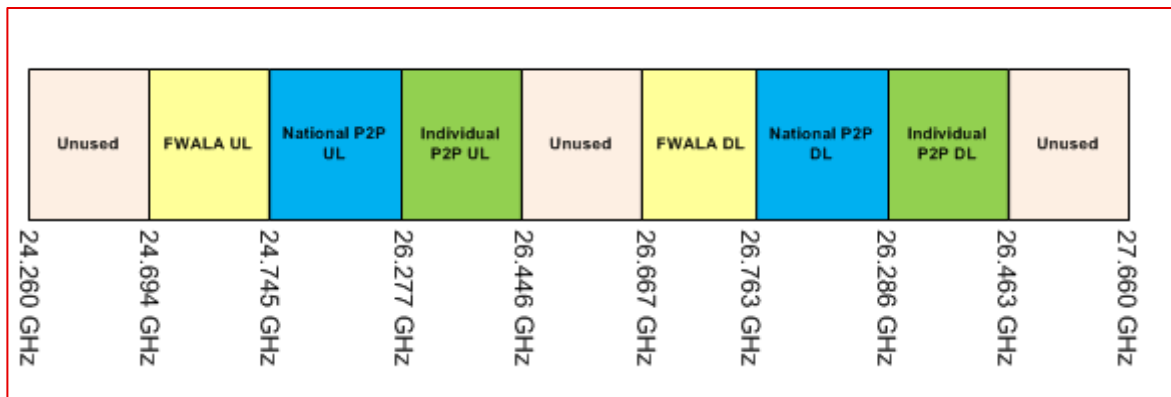


Figure 2: 26 GHz band plan overview

Given the total available spectrum in the 26GHz band then a reasonable assessment of supply versus demand would conclude that Administrative Assignment is reasonable in this case.

Efficiently used

We understand that in some cases it can be difficult to judge whether spectrum is efficiently used but Vodafone believe that in the looking at the overall usage of the 26GHz band it is entirely possible for Comreg to objectively assess that the spectrum currently being used by Vodafone in the 26GHz band is being efficiently used.

The very large number of links operated by Vodafone in this band to provide service to base-station sites and hence mobile customers compares favourably with the number of links in other parts of the part and obviously the Vodafone usage is much more efficient than the other unused parts of the 26GHz band.

Timing of Decision

It is stated in ComReg's [Radio Spectrum Management Strategy](#) document that Comreg will endeavour to set out future use of bands well in advance of expiry of licences "e.g. within the next 3 years"

From ComReg [Radio Spectrum Management Strategy 2016 to 2018](#) [Reference:16/50](#)

6.4 ComReg's radio spectrum workload is driven by a wide range of items including:

- the expiry of existing licences - where existing spectrum rights of use are due to expire within the near future (e.g. within the next 3 years), ComReg endeavours to set out its proposals on the future use of such bands well in advance of expiry including, where appropriate, defining and carrying-out an assignment process for same;

Given that the current licences for these block will expire in June 2018 it is now not possible for Comreg to meet this criterion. Specifically, we contend that is unreasonable to propose that a competition that would potentially re-assign the current block allocation away from Vodafone in June 2018 be run during the first half of 2018. There is no way that massive service disruption could be avoided without a long Transition Time.

To be sure that we avoid that disruption Vodafone would have to bid a value for these blocks much larger than their value as radio links - a situation that is clearly unfair.

As we have indicated in the section above on cost of moving links we would seek a transition plan period of 5 years if we were leaving the 26GHz band completely.

A much better solution is an Administrative Assignment for a period of 7 years: holding a completion for assignment of the overall band in approximately 5 years' time.

We believe that for the reasons above: Supply is Larger than Demand, current Efficient Usage, and Timing of Decision, that Administrative Assignment of the blocks in the 26GHz band is fully justified.

Proposed Auction Format and Alternatives

If ComReg decide to auction the spectrum, then we have the following comments on the auction format.

While the Single round sealed bid Auction worked well in 2008 the large investment we have made in radio links in this band now creates issues with this format.

[REDACTED]

[REDACTED]

An improvement on the proposed process would be to run a preliminary round seeking bids at the minimum price and then publish total demand. This would enable bidders to have some information on demand and bid accordingly should a second round be required.

Our preferred auction format would be a simple clock auction followed by a process to automatically assign frequencies as close as possible to the current assignments.

8 Cambridge Broadband Networks ("CBNL")

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Dear Sir,

re: ComReg 17/85 – Consultation on Proposed 26GHz Spectrum Award 2018

CBNL strongly supports initiatives to increase the use of 26GHz spectrum to provide advanced connectivity to Irish citizens.

In more than 50 countries worldwide, CBNL has deployed over 160,000 point-to-multipoint (PMP) systems in microwave and millimetre wave bands from 10 to 40GHz. Included in CBNL's product portfolio is an FDD 26GHz product suitable for deployment in the 26GHz band under discussion, and CBNL are in active conversation with local operators considering deployment using this band.

The high end-user throughput, wide coverage area and excellent ROI offered by microwave and millimetre wave PMP networks has rightly led to their study as a foundational technology for 5G.

We would like to make the following points in relation to the current consultation.

Technology Neutrality in National Block Licenses (Relating to §4.4, ¶s 158 163)

CBNL question whether it is necessary for the National Block Licenses to specify whether deployment should be P2P or PMP.

Both PMP and P2P technologies, in order to be operant in this band, must use frequency division duplexing. This facilitates the simple coordination of both P2P links and PMP area-covering sectors which do not mutually interfere, provided that a common downlink high or downlink low polarity is observed. (Such common polarity of downlink high/downlink low is equally important to avoid interference in a P2P only network).

CBNL believe that PMP and P2P are complementary technologies, and it is therefore desirable for an operator to be able freely to select one or other technology depending on the local environment. For example, for longer links the additional antenna gain afforded by P2P will militate for that approach. In contrast, in a dense urban environment,

contemporary link ranges will typically be ≤ 2 km. In this scenario, PMP system ranges are more than sufficient and the PMP cost advantages are attractive.

Notwithstanding the comment at ¶160 about the pace of technological development of 26GHz P2P being faster in 2011, CBNL believe that, owing to the intense interest surrounding millimetre wave spectrum for 5G, the situation is now reversed and that PMP technology at 26GHz is advancing very rapidly. We therefore believe there is scope for operator preferences to alter dramatically in the near future, at the very least to encompass the use of both PMP and P2P, as appropriate, within a single network.

CBNL would encourage a reconsideration of whether the restriction to P2P links only is necessary for the National Block Licenses.

Limited Amount of Spectrum Available for FWALA Restricts Service Possibilities (§2.1.2)

The existence of the Fixed Wireless Access Local Area (FWALA) assignment is an excellent initiative that acts to incentivise entrepreneurial entrants to the access market, and so benefits citizens in general.

However, as noted throughout the consultation (e.g. ¶167), consumer demands for bandwidth have risen, and are rising, seemingly inexorably. It is CBNL's view that five paired blocks of 28MHz is insufficient to meet this demand in a way that allows for local competition in a particular market.

When deploying FWA in urban environments, it is desirable for an operator to have access to multiple frequency channels. This allows self interference in the PMP network to be minimised, thereby guaranteeing high spectral efficiency and the optimal grade of service for the end user. Using multiple frequency channels also affords the operator the ability to deploy partially spatially overlapping sectors of coverage, which has two important advantages. First, it increases the capacity density of the network, which may be necessary adequately to serve the demand in a dense urban area. Second, it can help to mitigate line-of-sight issues because, if the first choice access point (AP) is occluded by a building, with overlapping coverage a second or third choice AP is likely to be an alternate parenting choice for a remote terminal.

Typical PMP FWA products deployed by CBNL today in 26GHz networks use paired 56MHz channels. Thus, if an operator is to have multiple channels, it is clear that the operator will need access to at least 112MHz of spectrum in total. The current sizing of the FWALA allocation therefore does not provide for more than one operator to deploy a high capacity FWA network in any given location, with the obvious competitive implications. The corollary to this is that, if there is to be competition, the competing networks will each be using smaller channel sizes than the state of the art permits, thereby limiting the throughput offered to end users.

Although perhaps the 10.5GHz FWALA is outside the scope of the current consultation, CBNL note that the 26GHz and 10.5GHz FWALA assignments are of equal size. In CBNL's experience (being a vendor offering both of these bands), FWA operators will often deploy both 10.5GHz and 26GHz systems with the latter used as high capacity offload for the

former, for the densest parts of a network. For this strategy to be successful, it is desirable for the operator to access more spectrum in the 26GHz band.

The outlook, of course, is for the end user throughput demands to continue to increase, and correspondingly for the desirable individual channel bandwidth to increase. CBNL would therefore strongly encourage an increase in the size of the FWALA assignment. We note that this could be achieved in a number of ways, including:

1. Extending the lower limit downwards from 24.549GHz towards 24.250GHz.
2. Adding one or two of the existing two 28MHz guard blocks at 24.689 – 24.745GHz to the FWALA assignment instead of to the National Block Assignment.
3. Some combination of the above.

CBNL would like warmly to thank ComReg for the opportunity to contribute to this consultation.

Yours faithfully,

A large black rectangular redaction box covering the signature area.