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The European Commission's Illogical 2.6GHz Decision

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Summary

In 2008 the European Commission decided to allow flexible allocations of paired and unpaired spectrum in the 2.6GHz band among member States. This decision is both illogical and harmful. Its consequences will frustrate the Commission's own goal of maximizing spectrum harmonization throughout the European Union for the benefit of its consumers and business and other users, while at the same time they will violate its stated principle of technology neutrality. This commentary demonstrates that an alternative pre-configured, common allocation of frequency blocks conforms more closely to the letter and intent of technology neutrality when the real world implications of necessary interference management are taken into account. Application of this decision by the Commission will entail preventable adverse economic and operational consequences for both operators and their customers, including loss of coverage of mobile services in border regions, reductions in usable bandwidth and international roaming capabilities, and higher costs and delayed availability of equipment. It will also place additional burdens on regulators, and restrict their freedom to choose how to award spectrum licenses, while enhancing the uncertainty for operators in valuing spectrum they may wish to acquire in this band.

Paradoxically the push for flexible spectrum allocation in the 2.6GHz band between the amounts and locations of paired and unpaired frequency blocks is not essential to respect the principle of technology neutrality in wireless networks. Indeed it is more likely to violate this principle than alternative structures for this band. The source of this misunderstanding, which has been eagerly propagated by the advocates of a specific technology – mobile WiMAX – lies in a failure to appreciate the inherent characteristics of technology neutrality in wireless networks which flow inescapably from the laws of physics and engineering and the need to manage interference between networks in adjacent territories and adjacent frequencies, as well as from economic realities. Technological neutrality for spectrum means that any ***constraints*** applied on the wireless technologies that operators may deploy should be kept to a minimum, while ensuring that ***interference*** is dealt with as efficiently and effectively as possible in the interests of all spectrum users. It does not and cannot mean that there should be no limitations on the

technologies that holders of spectrum licenses can deploy. So the question for any proposed band structure is whether it minimizes, not whether it eliminates, the associated restrictions (or from the opposite perspective expands the incentives) that influence the choices of network operators with respect to the technologies they can deploy.

The principle of technology neutrality is a worthy one. It is aimed at ensuring that operators and wireless technology developers are able and stimulated to seek out and implement innovations in wireless technologies for the ultimate benefit of the users of these networks with as few restrictions as possible. However, as will be shown, flexible spectrum allocations in which each jurisdiction (usually national) can choose how it wishes to award spectrum licenses for paired and unpaired spectrum actually create more restrictions on the freedom of maneuver of network operators than an alternative band structure which is harmonized to the greatest extent possible across national and regional borders. Furthermore these restrictions entail otherwise preventable adverse operational and economic consequences for users.

This conclusion may appear to be counterintuitive, since in vernacular usage words such as “flexibility” and “neutrality” (i.e. objectivity), as well as “freedom” and “innovation” enjoy generally positive connotations that are strongly correlated with each other. However, in the wireless arena the phenomenon of interference and the need to manage its impact for the sake of all customers largely defines the ways in which these praiseworthy ideals and aspirations should be interpreted in practice, and the conditions under which they can best be fulfilled. Ironically “flexibility” in band plan structure leads to less and not more “freedom” and “neutrality” for operators, while it also entails avoidable disadvantages for mobile customers.

The diverse variations in national band plan structures inherent in flexible spectrum allocation do afford somewhat greater flexibility to *individual* operators in making *initial* choices about the modes of operation they prefer and the spectrum they therefore try to acquire. But this flexibility is achieved at the expense of introducing more constraints (i.e. less flexibility) on operators *collectively* – and on regulators – as a result of their having to deal with the engineering and economic consequences of the *final* combination of all operators’ choices (i.e. their respective spectrum allocations in the band). The consequences include reductions in network coverage and the introduction of more complex and unpredictable limits on authorized power levels in base stations.

Yet in mid-2008 the European Commission published a Decision (2008/477/EC), referring to the Radio Spectrum Policy Group (RSPG)’s opinion on Wireless Access Policy for Electronic Communications Services (WAPECS) of 23 November 2005, that allows flexibility in the 2.6GHz band plan structure with respect to the allocation of spectrum for paired (for FDD or frequency division duplex) and unpaired (for TDD or time division duplex) operation between 2500-2690MHz. It justified this decision on the grounds of adherence to the principle of technology neutrality. This commentary argues that the decision is seriously flawed because it is based on a misunderstanding of the legitimate and practical meaning of technology neutrality as it applies to the use of spectrum. Furthermore, application of this decision will conflict with the more

fundamental goal of achieving spectrum harmonization in this band throughout the European Union, which the Commission itself has espoused for the benefit of users in all Member States.

The Commission should revise its decision and adopt a preconfigured allocation of paired and unpaired spectrum for the 2.6GHz band. This configuration conforms at least as well if not more closely to the letter, spirit and most importantly the intent of technology neutrality as the allocation flexibility built into in the Commission's current decision. Further in its favor this configuration offers significant advantages for operators and users as compared to the outcomes of the current decision in terms of greater ease and lower burdens of interference management, and superior economic and operational characteristics of the network deployments and mobile services that it will enable.

The Commission should act rapidly to make this change, since the problems and harm which adherence to its current decision may cause could soon become evident in the outcomes of the 2.6GHz auctions that are scheduled for the near future (2010) in both the Netherlands and Germany.

The European Commission Attempts to Square the 2.6GHz Circle

In June 2008 the European Commission published its Decision 2008/477/EC on harmonization of the 2.6 GHz band (2500-2 690 MHz) for terrestrial systems capable of providing electronic communications services in the Community. Regrettably this Decision establishes a condition - allowing national flexibility in the band structure - which if followed is almost guaranteed to ensure that achievement of the Commission's goal of harmonization will be difficult at best and highly unlikely at worst. The outcome of this decision could well create significant (and avoidable) financial and operational obstacles that conflict with the Commission's own goal of enabling users of electronic communications services in this band in one Member State to gain access to equivalent services in any other Member State.

The mistake at the heart of this decision is based on a misunderstanding of the practical meaning and implications of the principle of technology neutrality as it must and should be applied to the uses of spectrum. The laudable goal of technology neutrality is to facilitate maximum freedom of choice and stimulate innovation in wireless technologies *subject to the condition that they not harm or unfairly interfere with other legitimate uses and users.*

In this perspective there are two major alternatives (Figure 1) under consideration for the 2.6GHz band. The first (Option 1 as proposed by the International Telecommunication Union (ITU)) is characterized by preconfigured paired (for FDD operation) and unpaired (for TDD operation) frequency blocks, while the second (ITU Option 3) permits flexibility or discretion in the allocations (positions and amounts) of frequencies within the band for FDD or TDD operation by national regulators, and in principle also by the bidders for frequency licenses

which they - the regulators - award in this band. The Commission's decision effectively chose Option 3.

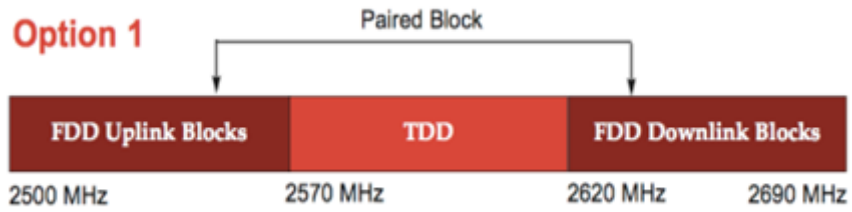
A third alternative (ITU Option2) is not considered since it violates the principle of technology neutrality by including only paired spectrum, ignoring the manifest demand that has been expressed for unpaired spectrum as well as the current usage of this mode of operation, most notably in China and the U.S.

To the uninitiated the latter Option 3 would seem to adhere most naturally and completely to the principle of technology neutrality, since in contrast to Option 1 it includes no preconditions on the ways in which the total bandwidth can be structured. However in practice Option 1 as will be shown conforms to technology neutrality at least as well if not more closely than Option 3, when the constraints *inevitably associated with any band plan* are properly appreciated. Furthermore Option 3 entails economic and operational disadvantages and risks not encountered with Option 1 when the real and practical worlds of physics, engineering and economics are taken into account in implementing solutions for managing interference.

There is an inescapable requirement for frequency coordination between networks operating at adjacent frequencies within the same area, or at the same frequencies in adjacent areas. Frequency coordination between 2.6GHz mobile operators must always resolve cross-border issues between operators using the same and adjacent frequencies. Under Option 3 additional more complex frequency coordination may be needed even within a country if 2.6GHz spectrum licenses are awarded with a flexible band plan structure on a regional and not a national basis.

The remainder of this commentary identifies and analyses the different constraints implicit in the two band plan Options, which as just noted no band structure can entirely exclude, as well as their varied consequences for interference management and other significant distinctions in their economic and operational implications.

Figure 1: Alternative 2.6GHz Band Plans



2500 MHz **2690 MHz**

Constraints

The constraints on operators that result from a band structure derived from *Option 3* will be more substantial and significant than under *Option 1, u*nless only one operator acquires all 2.6GHz spectrum throughout the European Union. This outcome is inconceivable, and furthermore is neither likely nor expected to be favored even within individual member States by national regulators[1].

Option 1 does not impose any constraints in terms of the radio access technologies that are expected to be significant contenders for next generation networks. Licenses are typically awarded for 15 or 20 years and are quite likely to be renewed. So regulators' choices in spectrum management should take into account the most thoughtful long term perspectives on the future of wireless technologies. They should not be unduly swayed by claims of superiority or earlier availability of one specific technology over another that can be as ephemeral or short lived as last year's most popular toy. According to their respective advocates (3GPP and the WiMAX Forum) both primary candidate radio access technologies (LTE and mobile WiMAX) will be available for deployment in paired and unpaired spectrum within the timescale in which future holders of 2.6GHz spectrum will deploy new mobile broadband networks. The only constraint that is imposed in Option 1 is the quantity of capacity that can be deployed respectively in TDD and FDD modes of operation. The amounts of TDD and FDD capacity proposed are consistent with global evidence for the respective relative strengths of demand for these two modes of operation.

Option 3 also imposes no constraints on each individual operator regarding its choice of LTE or mobile WiMAX (as in Option 1), neither does it constrain an individual operator's *initial choice* of the mix of FDD and TDD systems it wishes to deploy in the frequencies it acquires. However, in order to manage interference each individual operator will in practice inevitably be constrained by the decisions of other operators in this regard who win spectrum in adjacent frequencies and/or in the same or adjacent frequencies in neighboring areas (either in-country or cross-border). In other words, in Option 3 an individual operator's freedom will be constrained more severely and unpredictably (as shown in the following discussion of interference) than in Option 1 by its bi- and multi-lateral obligations with respect to frequency coordination.

[1] Although this circumstance has in effect largely developed in the U.S. market (Clearwire/Sprint Nextel), as a result of a series of unique historical and regulatory decisions that for now effectively prevent deployment of the most popular broadband wireless systems at these frequencies.

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Interference Management

The complexities of interference management between operators and the adverse economic and operational consequences for them and hence for their customers will be greater and less predictable under *Option 3* than *Option 1.*

Option 1 involves only two interfaces between FDD and TDD spectrum. Clear rules have been established for frequency coordination and interference management in this scheme. Provided that Option 1 is adopted by all neighboring countries these same rules apply both cross-border and in-country between regions, if licenses are offered on a regional basis. A regulator can choose to award licenses either via an auction or a beauty contest, or indeed any other process, since the configuration of the band is clearly established and visible to all parties.

However, under *Option 3* significant complications will be introduced into interference management, for example between several diverse arrangements of TDD and FDD spectrum blocks, if this Option results in different configurations of paired and unpaired spectrum between countries or between regions within countries. The resulting needs for frequency coordination in terms of guard bands and power levels will entail a loss of coverage as well as a greater reduction in usable spectrum compared to that which is caused by the conditions for interference management required in Option 1.

Interference issues involving TDD and FDD occur under the following scenarios:

1. FDD network in a band adjacent to a TDD network, for example two licensees in the same country.
2. FDD network in the same band as a TDD network, for example two licensees in neighboring countries with networks along the border (or possibly in neighboring regions within a country if regional licenses are awarded).

Both scenarios require a significant amount of coordination. In the first instance, a sufficient amount of guard band must be allocated so that the TDD and FDD networks do not interfere with each other. *Option 1* resolves this scenario efficiently, as the boundaries between TDD and FDD are well defined and only occur at two places within the band.

The second scenario is much more problematic. TDD and FDD systems cause mutual interference problems that are so severe that they cannot operate next to each other. The result is loss of coverage. The complexity of managing FDD and TDD interference is examined in detail in the white paper "Final Report for the WiMAX Forum, Cross Border Trigger Limits and Case Study for TDD/FDD Border Coordination in Europe," dated 14 April 2009, and written by Analysys Mason[2]. This work focused on interference between FDD HSPA (High Speed Packet

[2]http://www.wimaxregulators.org/sites/default/files/cross_border_trigger_limits_and_case_Study_for_tddfdd_border_coordination_in_europe.pdf

Access, the already widely deployed broadband 3GPP system) and TDD mobile WiMAX systems. The paper acknowledges the FDD/TDD difficulty in the following statements:

- "In both cases, FDD and TDD networks are using the same frequency, but in different countries. The coordination problem then depends on the respective operators coordinating their sites in border areas to ensure that sufficient isolation exists between respective sites, or a minimum separation distance is adhered to."

- "For an HSPA to WiMAX coordination scenario, for example, it is possible that the coverage area can be increased by using mitigation techniques, but it is quite difficult to achieve 100% coverage."

In contrast, if the systems on both sides of a border are based on the same mode of operation, they can be coordinated to provide continuous coverage at the border. Neighboring systems operating in the same band that are both based on TDD can be coordinated through selective use of subcarriers. Similarly neighboring systems that are both based on FDD can be coordinated through approaches such as use of preferential codes with WCDMA-based HSPA (Wideband Code Division Multiplex Access - High Speed Packet Access).

Option 1, if widely adopted, cleanly addresses this TDD/FDD interference problem, whereas *Option 3* does not, since there can be no guarantee that the outcomes of bids for 2.6 GHz spectrum in neighboring countries under this Option will be the same. If there were such a guarantee then there would be no point in allowing this flexibility. Furthermore, since 2.6 GHz spectrum will be attributed at different times in different countries, a 2.6 GHz operator and its regulator may be confronted with successive new issues of cross-border frequency coordination as and if its neighbors award this spectrum at later times.

Incentives for Technology

Option 3 creates an incentive not present under *Option 1* to use a single technology in both TDD and FDD frequencies in the band.

The flexible spectrum allocations of *Option 3* will likely lead to more unpredictable and numerous FDD/TDD interfaces than in *Option 1*. Thus in order to mitigate the severity of potential interference problems in the former Option there will be a stronger incentive to deploy one fully compatible technology for both FDD and TDD operation throughout the band, i.e. FDD and TDD LTE, or WiMAX only. This incentive which favors the choice of a common technology over independent and possibly diverse choices by different TDD and FDD operators in the band reinforces the operational restrictions that use of *Option 3* entails, thus refuting the claim of technology neutrality on which its justification rests.

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Predictability for Bidders in Seeking Spectrum

Use of *Option 3* makes it very difficult if not impossible for operators to foresee how much **usable** bandwidth they will eventually acquire if they win the frequencies for which they decide to bid. This increased element of uncertainty as compared to *Option 1* decreases the attractiveness of this spectrum.

Under the conditions of *Option 3* the amount of usable bandwidth that winners can exploit within the spectrum attributed to them will not be clear until after all the spectrum has been awarded. Only when the final configurations of paired and unpaired spectrum are established will it be possible to negotiate and confirm agreements between the respective operators and regulators to manage interference covering among other aspects guard bands and power levels. Hence under *Option 3* it may be unreasonably difficult for a potential bidder to assess the value of the spectrum blocks it seeks to acquire prior to the auction, so its bids are likely to be lower, or it may even choose not to bid.

Regulators' Freedom of Choice in License Award Procedures

Option 3 effectively makes it impossible to use any procedure other than an auction to award spectrum to operators in a competitive manner, thereby restricting the freedom of regulators to decide what procedure they prefer for spectrum awards.

A beauty contest, such as has been the practice of the French regulator ARCEP, and of the Finnish regulator FICORA until its most recent (November, 2009) 2.6GHz auction, is unfeasible under the conditions of *Option 3* in which the bidders are allowed freedom to decide whether and at what frequencies to deploy networks in FDD and/or TDD modes. The structure and amounts of the spectrum awards cannot be specified unless a regulator which chooses the process of a beauty contest either configures the spectrum according to *Option 1*, or establishes some other preconfigured allocations of paired and unpaired blocks of frequency. Hence the freedom of maneuver of the regulator with *Option 3* is more restricted along the basic dimension of the process for awarding spectrum than it is with *Option 1*.

There is therefore no basis for arguing that the Commission's 2.6GHz decision is praiseworthy - indeed the exact opposite is true - on the grounds that it allows more freedom of choice to national regulators in a way that respects the different characteristics and preferences of Member States.

The Cure of Flexible Spectrum Allocation is Worse than the Disease

Some commercial interests would like to see more TDD spectrum made available than in Option 1, and have been using the argument that adherence to technology neutrality requires flexibility in the quantity and location of unpaired or TDD spectrum. However, the "cure" they propose is worse than the alleged "disease", provided that a reasonable amount of TDD capacity is allocated. If technology neutrality is to have meaning it should minimize the number or severity of the constraints on operators, yet because of interference this "cure" (*Option 3*) likely entails more (somewhat different) rather than fewer constraints on a greater number of operators than does *Option 1.*

Economic and Other Consequences for Customers

Option 1 offers an opportunity to achieve *international harmonization of use of the 2.6GHz band*, whereas *Option 3* does not. *Option 3* is likely to lead to multiple different national band plans. As a consequence, *Option 1* is more supportive of the goal of minimizing the costs of equipment, hence the level of the retail prices and maximum affordability of mobile services, thanks to the international or even global markets for equipment designed for this band, if it is adopted worldwide. In contrast *Option 3* will require country-specific equipment which will be more expensive and probably come to market later, since its development will not attract a high priority from technology vendors who have finite resources for development and naturally focus on the largest perceived opportunities for themselves.

In addition international roaming will be facilitated between countries that have a harmonized band plan. This feature of mobile services is extremely valuable to significant numbers of users who travel on business and for vacations throughout Europe. International roaming is an aspect of the mobile market to which the Commission has paid significant attention with the aim of reducing the prices customers are charged when roaming abroad. A harmonized *Option1*-based band plan is consistent with this goal, while the economic and operational consequences of non-harmonized, country-specific band plans are not.

Example of Germany and the Netherlands

The problems and disadvantages inherent in *Option 3* are not hypothetical, but will be encountered in practice as a likely outcome of the imminent 2.6GHz auctions scheduled in Germany and the Netherlands.

In late October, 2009 the European Commission opened an infringement procedure against Germany for failing to allocate the 2500-2690 MHz radio frequency band for a wide range of radio services, including fixed wireless services. Under radio spectrum harmonization rules, all European Union countries have to ensure that all kinds of telecommunications services can utilize this band, adhering to the principle of service neutrality. At present, Germany only allocates this frequency band to mobile services.

Yet ironically the flaws in the Commission's own 2.6GHz decision may well have a far more adverse impact upon future users of 2.6GHz band services in Germany than any policy of the German regulator in the auction of this spectrum. This consequence arises from the 2.6GHz auction that will soon be held in Germany's neighbor, the Netherlands. Independently of the question of service neutrality, the 2.6GHz auction in Germany is likely to follow Option 1, whereas that in the Netherlands will not. The ultimate allocation of paired and unpaired frequencies in the Netherlands will be decided ***during the auction***. Hence the question will arise of how best to handle interference and frequency coordination in the border regions of these two countries in the likely event that some of the same frequencies will be allocated for FDD operation in one of them and TDD operation in another. These countries have an extensive amount of business and tourist travel and traffic between them, and the border regions include densely populated areas. As a consequence the outcomes of these two 2.6GHz auctions could lead to a "nightmare scenario" with respect to interference and frequency coordination, resulting in deployment delays and loss of coverage as a consequence of the negotiations that would have to take place between operators and regulators. Solutions based on unpredictable (until after the auctions), specific and perhaps unique TDD/FDD frequency configurations and arrangements would have to be implemented.

The case of the auctions in Germany and the Netherlands presents a real and imminent example of the potential harm to the interests of operators and users - and the frustration of its own goals - that is inherent in the Commission's 2.6GHz decision.

Conclusions

The Commission's 2.6GHz decision is akin to proposing that individual countries, or even individual regions, be allowed to choose which side of the road to drive on. Admittedly this analogy is imperfect or exaggerated since interference or "collisions" between electromagnetic waves are not as directly and immediately injurious to human beings as vehicular collisions. But in both cases the consequences are unnecessary and harmful chaos, or at the very least confusion. Diversity in driving on the left or the right may be acceptable when islands are involved (as between the U.K. and Ireland and Continental Europe), but would hardly be practical or advisable throughout the heart of the European Continent[3], any more than it would be reasonable for individual States in the U.S. to have the right to make this choice.

[3] Interestingly until well into the 20th century municipalities in Spain did choose on which side of the road to drive, and Madrid only switched to the right in 1924. Also in the U.S. Virgin Islands vehicles still do drive on the left, in contrast to the U.S. mainland. In Europe Sweden, not an island but still on the Continent's geographic fringes, made the switch to drive on the right in September, 1967 after years of controversy, while the Pacific island of Samoa performed the opposite move in September, 2009 (alcohol sales were banned for the first three days of the changeover) by switching to the left to accommodate the large proportion of right hand drive vehicles imported from Australia and New Zealand, both of which drive on the left.

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A nationally flexible band plan is not analogous to respecting the rights of Britons to continue to order beer in pints rather than forcing them to use liters. Their choice to do so has no adverse consequences for the beverage industry or drinking habits elsewhere in Europe. In contrast, it would not be sensible to let every country choose freely the best operating voltage for domestic appliances or to decide independently whether to deliver alternating or direct current to homes and other buildings in their territory. It is inconvenient enough that for historical reasons travelers in Europe have to cope with multiple electrical plugs if they wish to recharge their mobile phone or laptop batteries. There are of course many aspects of daily social, cultural, and work life for which it may be highly undesirable and/or economically unreasonable, or serve no justifiable or useful purpose to attempt to achieve harmonization or reduce heterogeneity within the European Union. But in the case of the 2.6GHz band plan structure there is value in striving for harmonization, while there are no benefits to be gained from diversity. Even worse, if a new form of national diversity is permitted or encouraged and then actually introduced into the structure of this band for mobile communications it will have predictable and avoidable deleterious effects.

Findings and Recommendation

Option 1 is substantially superior to *Option 3* in terms of its economic and operational implications for:

(1) Interference management,

(2) Burdens on regulators and operators in ensuring frequency coordination, and

(3) The costs and availability of wireless equipment, as well as

(4) Other advantages, e.g. in terms of international roaming, of an internationally harmonized band plan which can only be achieved in the framework of the former Option.

Option 1 is at least as consistent as *Option 3* with the principles of service and technology neutrality as they necessarily apply to wireless systems given the intrinsic need to manage interference. Both Options entail some constraints on operators - which are impossible to eliminate entirely - regarding their deployments of wireless technologies. These constraints differ between the two Options, but in practice they are less burdensome or restrictive for *Option 1* and hence more closely aligned with the letter, spirit and intent of technology neutrality than they are for *Option 3*. Furthermore the effects of the constraints in *Option 1* are predictable by bidders for spectrum and by regulators, whereas those in *Option 3*, which entail adverse economic and other consequences that conflict with the interests of both customers and operators, are not.

The Commission has mistakenly conflated technology neutrality with flexibility in the structure of the 2.6GHz band. The potential harm that may be caused by this error is compounded since it

creates a condition, under the false impression that FDD/TDD flexibility is the only or best way to ensure technology neutrality, that will in practice severely inhibit and may well frustrate the achievement of the Commission's own much heralded and more fundamental goal of harmonization for the benefit of users throughout the European Union. In effect the Commission is trying to "have its spectrum cake (flexibility) and eat it (harmonization) too". It should acknowledge the inherently illogical nature of2008/477/EC, based on new evidence about its consequences for mitigating interference and ensuring frequency coordination, and promulgate a new Decision that specifies *Option 1* for the 2.6GHz band.