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**BEYOND LICENCED VS. UNLICENCED:  
SPECTRUM ACCESS RIGHTS CONTINUA**

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## 1 DIFFERENT KINDS OF DIFFERENCE

*“A lack of consistency among national spectrum policies - particularly on unlicenced ‘commons’ models - is becoming an issue. Lack of coherence from country to country in the fees and costs associated with spectrum access may be manageable in the short-term, but it could become problematic in the long term, as innovations sweep through the market...”*

---ITU News, issue 2 (March 2006), page 3

<http://www.itu.int/itu-news/manager/main.asp?lang=en&iYear=2006&iNumber=02>

*Paradigm: “a word too often used by those who would like to have a new idea but cannot think of one.”*

— Mervyn Allister King, Governor, Bank of England

<http://en.wikipedia.org/wiki/Paradigm>

It is widely accepted today that there are three main approaches to radio spectrum management:

- the traditional “administrative” approach, in which a regulator decides who can use what frequencies for what purposes in what locations under what conditions;
- the newer “tradable/flexible/market-oriented” approach, in which those who are authorised to use spectrum are allowed to re-purpose or transfer some or all of their rights. Tenders or auctions are typically used for the initial distribution of rights;
- “licence-exempt commons,” in which any number of users are allowed to share a band with no right of non-interference and no right to cause interference.

The evolution of radio technology may soon make other paradigms practical, but current thinking about spectrum management is still dominated by these approaches.<sup>1</sup> Each has advantages and disadvantages and they can co-exist, along with multiple variants within each mode. However, transitions from one mode to another are neither rigid nor symmetrical, nor are they equally easy to navigate. Thus, what will appear to be the optimum mix of channel assignment schemes depends on one’s starting-point, the sequence and difficulty of moves into new regulatory spaces, and the state of technology.

It is easy to relax restrictions on the transfer of existing licences, so this is a step that a growing minority of countries is willing to take.<sup>2</sup> Relaxing restrictions on the type of service and technology that licence holders may implement is trickier, but synergies with rights trading are significant, so this option appeals to a similar – albeit smaller – set of countries.<sup>3</sup>

Despite significant differences in procedures and outcomes, the tradable/flexible/market approach and the administrative approach are both based on individualised spectrum access rights which are at least semi-exclusive. Without some degree of exclusivity there is nothing to assign or trade. On the other hand, no user has any exclusive rights in a licence-exempt commons. That, plus the absence of an application→decision →permission gateway to spectrum access distinguishes this regime from the familiar framework of frequency management.<sup>4</sup>

Eliminating the need for an official permit to exploit frequency resources makes licence-exempt bands different in *principle* from licenced spectrum access, and the principle at stake is important in the contexts of economic, political and civil rights. According to Article 19(2) of the International Covenant on Civil and Political Rights – to which more than 150 countries have acceded:

“Everyone shall have the right to freedom of expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through *any other media* of his choice.”<sup>5</sup> [emphasis added]

That right is not absolute, however. Particularly relevant to radio licencing is Article 19(3)’s recognition that the need to protect “public order” may limit exercise of the right when harm is caused. On the other hand,

the Covenant establishes that a state’s right to interfere with its citizens’ communications is also not absolute, particularly when national security, public order, morals or health are not at risk.<sup>6</sup>

Physics provides a metaphor which may be useful here. Careful measurements have shown that the characteristics of a free electron differ from what one would expect if space were truly empty. Instead they suggest an electron surrounded by a cloud of “virtual” particles momentarily emerging from and dissolving back into vacuum. In a similar way, a “naked” right like freedom of expression is conceptually simple and clear, but in the real world, implementations always “cloak” abstractions, creating complex situations whose outcome can be counter-intuitive. That is not to minimize the value or utility of the abstraction.

So while licence-exempt bands are different from licenced bands in principle – and the principle involved is very important – the way licence-exempt bands are implemented makes for different kinds of difference and these are important, too.

### 1.1 WiFi in Africa

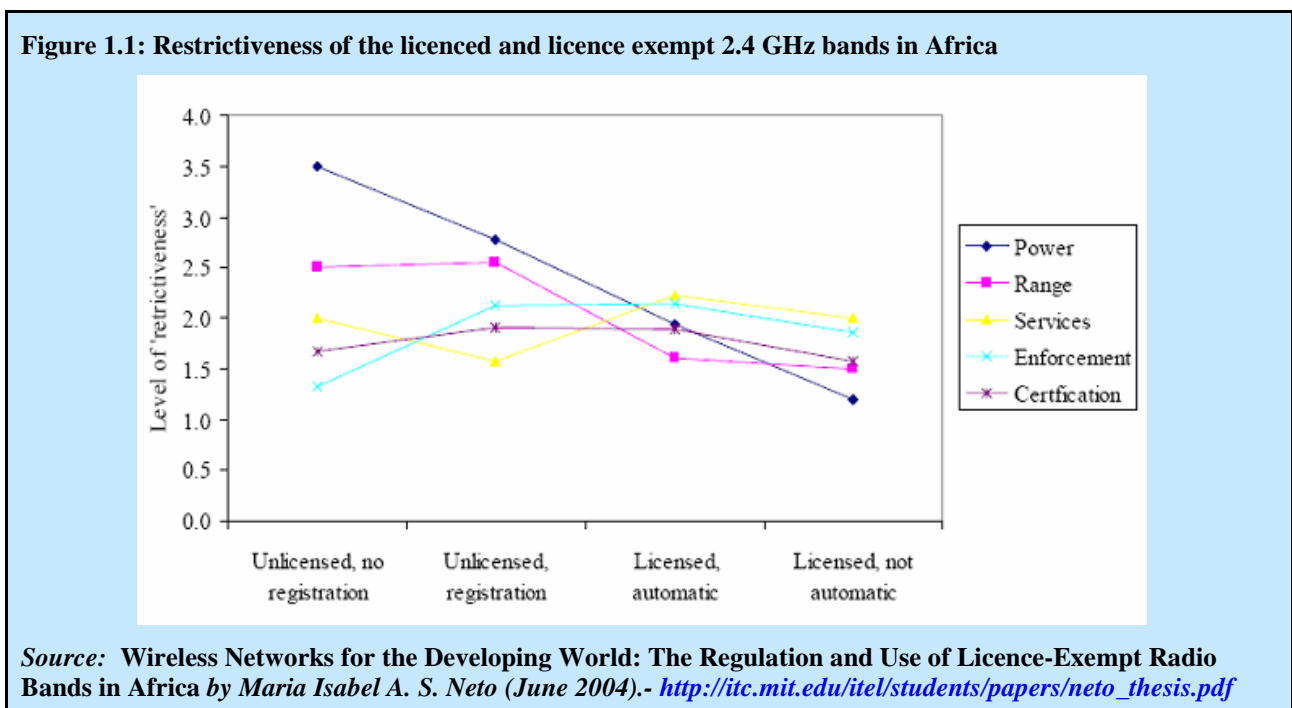
An interesting finding from Neto’s 2004 survey of regulatory policies for licence exempt bands in Africa was that regulators – at least on that continent – tend to impose tighter restrictions on unlicenced radio activities than on licenced, counteracting benefits that could come from a freer regime:

“[It is] useful to study the ‘restrictiveness’ trend between unlicenced and licenced bands. Are unlicenced bands, in general, more or less restrictive than licenced bands? In order to answer this question I have defined preliminary indexes for different types of restrictions... The higher the index the more restrictive a country is for a certain parameter – for example power, range, etc... [M]ore relaxed licensing regimes have, on average, more restrictive conditions placed on power and range. This is an important result, since it suggests that the African countries that use unlicenced regulation tend to place a burden on the conditions for use. [emphasis added and one typographic error corrected] It further indicates that should unlicenced bands be perceived as less successful, the reason could simply be the fact that the associated restrictions are higher...”<sup>7</sup>

This contradicts the naive assumption that unlicenced bands constitute a more permissive environment than licenced bands – as is indeed the case in some other parts of the world.

### 1.2 Insects cannot fly

In many regions, the popularity of licence-exempt bands among equipment producers and end-users is unprecedented. According to IDTechEx, 2.5 billion RFID tags were sold by the start of 2006 plus another



1.3 billion during 2006,<sup>8</sup> making this the most extensively deployed wireless technology. Some 540 million Bluetooth transceivers were bought in 2006; by 2009 annual global sales are expected to reach 1 billion.<sup>9</sup> Meanwhile, more than 200 million WiFi nodes were bought in 2006, with sales of 500 million forecast for 2009.<sup>10</sup> Bluetooth's modest link distance and data transmission rate restrict its range of potential applications but it is already expanding beyond the domain of personal audio to support medical implants, bar-code readers, running shoes and interactive kiosks. WiFi has been used mainly to link personal computers to each other and to the Internet but it is finding its way into a wide range of other products, from picture frames, industrial sensors, MP3 players and mobile phones to farm irrigation systems and parking meters.

It has been widely noted that the availability of licence-exempt spectrum stimulates innovation in products and services. As the ITU's *Trends in Telecommunication Reform 2004-5: Licensing in an Era of Convergence* observed:

“more and more policy-makers are questioning the utility of licencing and demanding that licences be adapted to achieve policy goals without hindering market development and technological advancement... The allocation of spectrum for licence-exempt use is increasingly viewed as a catalyst for the development of more efficient and cost-effective wireless technologies...”<sup>11</sup>

An advantage of open access, service neutral, shared bands is that there seem to be innumerable applications which were not predictably lucrative enough to justify the cost of securing a licence, but which proved valuable in the aggregate once they existed. It is a well-known problem in market research that people often don't know they want something new until it exists. So it is highly desirable to have space in the radio frequency spectrum for mass market experiments. Many see an analogy with the Internet: the ability to release new content and applications to a potentially global audience at relatively low cost and without difficult authorisation procedures seems to stimulate creativity and new business activity like nothing else.<sup>12</sup>

No phenomenon of such scale can avoid attracting idolisers and detractors. Spread spectrum's success in conquering the noisy ISM bands made it seem that a solution to the perennial problems of interference and channel scarcity might finally be at hand, leading to calls for the de-regulation of radio.<sup>13</sup> Meanwhile, economists who think spectrum should be treated as just another commodity tend to inflate the difference between licence-exempt and licenced, recasting difference as opposition. Exclusive vs. pooled rights can then be polemicised as economically-sound versus economically-unsound.<sup>14</sup> Saying that unlicenced bands are uneconomic evokes the memory of August Magnan, a French entymologist who wrote in 1934:

“Tout d'abord poussé par ce qui fait en aviation, j'ai appliqué aux insectes les lois de la resistance de l'air, et je suis arrivé avec M. Sainte-Lague à cette conclusion que leur vol es impossible.”<sup>15</sup> (Impelled primarily by what is done in aviation, I applied to insects the laws of air resistance, and I arrived with Mr. St.-Lague at this conclusion, that for them flight is impossible.)

Framing the discussion as an either/or policy choice obscures “the deep connections between the supposedly opposed property and commons positions in the spectrum debate,” as Werbach put it.<sup>16</sup> Market forces obviously operate in licence-exempt bands even without spectrum pricing – through equipment purchase decisions by countless individuals at the retail level and through manufacturers' product development and marketing decisions at the wholesale level. Regulatory criteria for equipment type acceptance constrain these forces – though not as much as licence conditions limit the choices of purchasers, designers and producers of radio equipment for licenced use. In that sense, licence-exempt bands are arenas for more creative competition among equipment vendors and service providers than the licenced bands. As Wu pointed out, “permissionless market entry is one of the holy grails of an effective market system”<sup>17</sup> and licence-exempt bands come closer to that ideal than other parts of the spectrum. The European Commission's Authorisation Directive<sup>18</sup> takes a similar line, deprecating “individual rights of use” requirements for electronic communication as limiting competition unnecessarily – as economically unsound, in other words.

Many European countries – and countries elsewhere – use class licences or general authorisation to

approximate licence exemption, further blurring the distinction between licenced and unlicenced. It is worth noting, too, that unlicenced is not the same as unregulated. Rules condition how a band is used, with or without licencing. Some proponents of the tradable/market approach criticise the license-exempt commons approach precisely because it is not sufficiently hostile to regulation.<sup>19</sup> Indeed, there is disagreement within the Open Spectrum movement on this point, although most proponents, from Paul Baran and Eli Noam onward, argue for *minimal* regulation rather than no regulation – without necessarily agreeing on what constitutes minimal regulation.

Still unaddressed are the problems at the core of the economic critique of licence exemption: if spectrum access is open to all, a band can easily become oversaturated; and if spectrum use is cost-free, there is no penalty for wasting it – until the channels become unusable. The suggestion is made below that imposing a price burden is not the only way to encourage spectrum conservation, and the tradable/flexible/market approach could itself benefit from the addition of non-monetary incentives.

### 1.3 Global survey of WiFi regulations

The earliest radio transmissions were unlicenced, but exemption from licencing can be said to have begun nearly 70 years ago:

**Figure 1.2: Licence-exempt communication in 1938**



Source: *Mechanix Illustrated* (July 1938), page 73

“In 1938, the [US Federal Communications] Commission allowed devices employing relatively low level RF signals to be operated without the need for individual licensing as long as their operation caused no harmful interference to licensed services... Typical kinds of equipment operated under these regulations were wireless record players, carrier current communication systems (such as, campus radio systems) and remote control devices...

“In 1985, Commission first authorized the operation of non-licensed spread spectrum systems in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands under Part 15 of the rules at a power level of 1 W which was significantly higher than previously permitted unlicensed use in other bands...

“In its 1989 revision of the Part 15 rules, the Commission established new general emission limits in order to create more flexible opportunities for the development of new unlicensed transmitting devices. These more general rules allow the operation of unlicensed devices for any application provided that the device complies with specified emission limits...”<sup>20</sup>.

Many other countries established bands for the operation of Industrial, Scientific and Medical (ISM) devices. But before the first IEEE 802.11 standards were approved, in the winter of 1999-2000, few of them allowed their ISM bands to be used for unlicenced communication.<sup>21</sup>

In 2005 the Open Spectrum Foundation began a global survey of WiFi and Bluetooth regulations, to see how countries were responding to the notion of unlicenced spread spectrum communication in the ISM bands and how their rules for such communication varied. So far, information has been collected from about 175 territories (most of these are countries, but semi-autonomous regions like Kosovo, Palestine, Hong Kong and Somaliland are included, too).<sup>22</sup> In addition to the texts of laws and regulations, we gather press reports and “reality check” observations from visitors, residents, development assistance agencies and other researchers, as there is sometimes a gap between official policy and implementation. We try also to acquire information spanning several years, to get a sense of how spectrum policy evolves in each locale.

With data updated to 1 December 2006, WiFi appears to be licence exempt in 67 of the 167 territories profiled in **Section 3** of this report, and “nearly” licence exempt in 16 more – about 50%, in other words. At the other end of the range, 14 countries – about 8% of the total – are believed to require individual licences for all WiFi networks,<sup>23</sup> although some of them admit to having problems enforcing that rule, and one – Egypt – has been considering the de-licencing of WiFi for years.

These figures are not free of uncertainty. In particular, one must decide whether to consider class licencing – which is common – as licencing or as a legal fig-leaf for licence exemption. Our approach is to look carefully at how and why it is used given the local legal context. As a result some countries using class licences have been categorised as having “nearly.licence-exempt” WiFi while others were categorised as having “light-licenced” WiFi. This procedure is imperfect but it led to insights discussed in this paper.

Like general authorisation, class licencing is usually found in countries whose laws prohibit the unlicenced use of radio. Many of these laws seem to have been enacted in response to Radio Regulation S18.1 or its predecessors:

“18.1 § 1. 1) No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station in question is subject...”

Now that various organs of the ITU and the 2004 Global Symposium of Regulators have embraced licence exemption as a “best practice” for applications like broadband wireless access and short-range devices, it might be appropriate to revisit this Regulation. A draft Question for Study to launch such a project is offered in **Section 2**, below.

Another category-blurring factor is phraseology that seems either self-contradictory or inconsistent with standard wordings used by regulators elsewhere. In Moldova, for example, the “general licence” needed to render a public telecommunication service is issued individually to those who apply for it.<sup>24</sup> El Salvador’s



1997 telecom law authorised “free use bands” in which licences are required.<sup>25</sup> And Tanzania’s regulator recognizes “exempt licences” as one of the three main types of licence.<sup>26</sup>

Most large surveys of WiFi regulation look for general patterns to simplify and consolidate the data. Ours is no different. Issues producing discernable groupings of regulatory treatment include indoor vs. outdoor use; commercial vs. noncommercial use, and systems that serve the public vs. systems for private use only.

However, a more important result is that from a global perspective – i.e., the view seen by companies which make most of the WiFi equipment – the mosaic of national regulations is quite diverse. It forms a virtual *continuum* of spectrum access rights, ranging from prohibitively restrictive, to countries like Mali, which Neto describes as having “no control, monitoring, or other oversight...”<sup>27</sup> Between these two extremes are dozens of shades of gray. Not only is the difference between licenced and unlicenced blurred by regulators using class licences to approximate licence exemption, but conditions are routinely attached to licences *and* to exemptions which undo the simplicity of broad categories. God is truly in the details.

Two further points about WiFi’s global spectrum rights continuum need to be made. The first is that its granularity has not forced manufacturers to make a hundred product variants, each for a different jurisdiction. The same chipset works everywhere, with software blocking a few channels in places where the full range of WiFi frequencies is not authorised. Nearly all the special conditions imposed by regulators have to do with where and how devices are deployed and used, not with the way they are built. Progress toward Software Defined Radio should make it easier for manufacturers to comply with distinctive local rules,<sup>28</sup> but in the meantime the situation for hardware defined WiFi is still tolerable.

Second, WiFi’s spectrum rights continuum is not manifest in any one country. Each country contributes one, two or perhaps three clearly defined steps. The continuum only exists as a transnational composite, and even then, “continuum” is more a metaphor than an exact description, since a close look reveals that it is actually composed of many small increments. But in a globalized economy, this “quantized continuum” is just as real as each set of national regulations. Information about WiFi regulation at the national level is increasingly available now that most regulators have websites, and professional channels of communication among regulators have improved, thanks to the ITU and the growth of regional associations of regulators. It is only a matter of time before all regulators perceive the transnational rights continuum as clearly as multinational corporations do, and when that happens it will become a strong influence in policymaking at the national level.

A spectrum access rights continuum is fundamentally different from traditional licensing, from a tradable-rights regime and from a licence-exempt commons. Therefore, it can be considered a new paradigm, even though it seems to have emerged spontaneously. Would there be any reason to develop such a continuum *intentionally*? Would that be useful?

#### **1.4 Multidimensional assessments, non-monetary rewards**

WiFi’s global spectrum rights continuum is distantly related to a scheme proposed by Kalle Kontson and Michael O’Hehir. In their presentation at last year’s ISART symposium, they outlined a “regulatory model that rewards the implementation and deployment of spectrum-efficient technologies by offering incentives in the form of progressively expanded tiers of spectrum access rights in proportion to device performance.”<sup>29</sup>

A device’s standing in the access rights continuum would be based on a “scorecard” assessing the device’s “good spectrum citizenship.” This scorecard would be a refinement of existing processes of equipment testing and type approval. Instead of a simple binary judgment – approved or not approved – devices would be graded according to a “standard set of metrics and tools to assess the worthiness of individual devices to reap rewards for good spectrum behavior, and restrict bad behavior.” Points might be awarded for spectral efficiency, resistance to interference, high data throughput, etc., while points might be subtracted for spurious emissions, lack of automatic transmit power control, the absence of interference mitigation techniques, etc. The net effect would be that higher scoring devices would enjoy more rights. That is not to imply that rights would depend simply on the total points earned, however. A key feature of the scorecard is

that it represents a multi-dimensional matrix that can link different kinds of rights to different equipment characteristics. But in any case, devices falling below some minimum score would have no spectrum access rights at all.

Kontson has a contract now with the US Department of Defense (DoD) to identify characteristics that should be reported on the scorecard, the scoring method, and models of how such a system might coexist with other spectrum management approaches. It may seem a speculative exercise, but this “Spectrum Scorecard Initiative” was presented as a “Key Theme for 2006-2007” by Badri Younes (DoD’s Director of Spectrum Management) at the US National Spectrum Managers conference last May.<sup>30</sup> Technologies that gain that level of support from the US military can have spillover effects in civilian life.

Marianna Goldhamer, chairperson of the IEEE 802.16h Licence Exempt Task Group (and Director of Strategic Technologies at Alvarion) proposed something similar – although simpler – at the ITU Workshop on “Radio Spectrum Management for a Converging World” (Geneva, 17 February 2004). On that occasion she offered a new Question for Study: how to define new rules for the co-existence of different classes of equipment whose power levels are determined by their “co-existence capabilities.”<sup>31</sup>

Evan Kwerel and John Williams also proposed a spectrum rights continuum, but based on payments rather than performance. They suggest letting licencees “charge manufacturers a fee for the right to produce and market devices to operate in [a given] band. Such contracts could provide different grades of access for different fees, thus providing for a wider range of uses than are possible under the current rules.”<sup>32</sup>

A system linking device performance to spectrum access rights would be challenging to implement. Unless carefully introduced, it could conflict with the awarding of spectrum rights by auction, trade or payment, and with the creation of technology-neutral bands enabling flexible use. However, there is a body of econometric research, dealing mainly with government procurement and the extraction of natural resources, which looks at auction design, bid evaluation and bidding strategies in situations where the bids are multidimensional, combining variables like price and quality. The quality component itself is normally multidimensional and represented on a scorecard created by the buyer. This work may be relevant to Kontson and O’Hehir’s proposal – and to other rights continua – as it suggests ways to integrate performance and pricing.<sup>33</sup>

To avoid conflicts with existing spectrum trading schemes, the use of device scorecards to regulate spectrum access might be introduced first in governmental bands – and/or in licence exempt bands, where non-monetary incentives for good behaviour are needed, and where spectrum is not bought or sold anyway. It is still not clear how quality of service requirements of applications hosted on other devices in range would be taken into account – or how the location of the device in operation would be factored in. Even so, the idea seems clearly applicable to cognitive radio overlays.<sup>34</sup> In a real-time market for interference or spectrum access rights, a device’s electromagnetic compatibility score could act as a proxy for interference risk and be converted into a coefficient modifying the cost of temporary spectrum use. Rewards, penalties and valuations make Kontson and O’Hehir’s concept market-like even though it is an administrative system.

## **1.5 Separating scoring methods from principles**

Economic principles contribute more to spectrum management than just income from auctions and tenders. Regulators seem to “buy” arguments for utilising market forces because they recognise the logic of letting spectrum users make acquisition and disposition decisions based on their own assessment of their own needs – which they understand better than the regulator. Decisions based on self-assessed need do not have to be monetised, actually. We can evaluate choices critically and quantitatively, even when no money changes hands. Economists argue that spectrum pricing is necessary to prevent bandwidth waste and to ensure “high value” uses are supplied with sufficient channel capacity. But what is actually needed are burdens and rewards, incentives and disincentives, that correlate with resource availability in the real world. Price is just a scoring method – and it may be too simplistic for multidimensional assessments of value.

Poor people and small corporations are disadvantaged in any cash-for-access system. That is rather obvious. I would submit that the proper goal for regulators is to minimise interference while maximising social benefits and encouraging improvements in radio technology, not to keep the poor from sending and receiving information. Therefore, it is worth asking: is there a rational method for awarding spectrum access rights which empowers users, maximises benefits to society and advances the art of radio without creating entry barriers that can only be surmounted with cash? Spectrum entry barriers should exclude noisy, deaf and inefficient equipment, not merely people who are underfunded.

That implies a strategy different from the liberalisation now influencing spectrum management – liberalisation defined as licence trading and after-markets rather than inclusion and freedom to communicate. Can economic mechanisms be distilled into an accurately targeted system of incentives and disincentives which produce desirable real-world results without relying on a metric that has negative repercussions on social equity? Can radio regulation break the authoritarian habit of forbidding everything that is not specifically authorised, and instead permit everything not specifically forbidden?<sup>35</sup> That would be true liberalisation.

## NOTES:

- <sup>1</sup> This is reflected in infoDev's ICT Regulation Toolkit, for example. See "Module 5. Radio Spectrum Management (Beta)" – <http://www.ictregulationtoolkit.org/en/Sections.1247.html> But other new paradigms have appeared on the horizon in recent years, such as (cognitive radio) overlays, (ultrawide band) underlays, and real-time markets for spectrum access and interference rights. The appearance of the first commercial products utilising UWB technology at the end of 2006 makes it likely that underlays will soon be accepted as a "fourth paradigm" in radio regulation.
- <sup>2</sup> In 1989 New Zealand became the first country to legalise tradable spectrum rights, as well as tradable band management rights. A more recent influential policy statement is the "Communication from the Commission to the Council, the Committee and the Committee of the Regions: A market-based approach to spectrum management in the European Union," COM(2005)400 final, Brussels, Belgium, 14 September.2005 – [http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2005/com2005\\_0400en01.pdf](http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2005/com2005_0400en01.pdf)
- <sup>3</sup> Synergies between flexibility and tradability were highlighted in a *Study on conditions and options in introducing secondary trading of radio spectrum in the European Community: Final report for the European Commission* by Analysys Consulting Ltd., DotEcon Ltd. and Hogan & Hartson L.L.P. (May 2004) – [http://ec.europa.eu/information\\_societypolicy/radio\\_spectrum/docs/ref\\_docs/secontrad\\_study/secontrad\\_final.pdf](http://ec.europa.eu/information_societypolicy/radio_spectrum/docs/ref_docs/secontrad_study/secontrad_final.pdf).
- <sup>4</sup> *Licensed commons* have existed since radio's first decade, of course, and they persist today in the Amateur Service, the Maritime and Aeronautical Mobile bands, some Land Mobile bands, the Citizens Band in some countries, etc.
- <sup>5</sup> The International Covenant on Civil and Political Rights came into force on 23 March 1976. The text is available at [http://www.unhchr.ch/html/menu3/b/a\\_ccpr.htm](http://www.unhchr.ch/html/menu3/b/a_ccpr.htm).
- <sup>6</sup> These issues are explored in Article 19's position paper on "The legitimacy of licence requirements for the use of wireless communications devices," by Daniel Simons (May 2005) – <http://www.openspectrum.info/article19.doc>.
- <sup>7</sup> *Wireless Networks for the Developing World: The Regulation and Use of Licence-Exempt Radio Bands in Africa* by Maria Isabel A. S. Neto, Master's thesis, Massachusetts Institute of Technology, Engineering Systems Division, June 2004, pages 91-92 – [http://itc.mit.edu/itel/students/papers/neto\\_thesis.pdf](http://itc.mit.edu/itel/students/papers/neto_thesis.pdf)
- <sup>8</sup> *RFID Forecasts, Players & Opportunities 2006-2016* by Raghu Das and Peter Harrop, IdTechEx, October 2006 – <http://www.idtechex.com/products/en/view.asp?productcategoryid=93>
- <sup>9</sup> "Bluetooth's finally fulfilling promise," by Russ Arensman, *Electronic Design News*, 1 October 2006 – <http://www.edn.com/article/CA6375177.html>
- <sup>10</sup> "Propelled by Hot Holiday Products, Wi-Fi Sales to Exceed 200 Million Units for 2006," WiFi Alliance press release, 11 December 2006 – <http://www.wi-fi.org/news/pressrelease-12-11-06-wifisales/en/>
- <sup>11</sup> *Trends in Telecommunication Reform 2004-5: Licensing in an Era of Convergence*, International Telecommunication Union, December 2004, pages 14 and 16 – [http://www.itu.int/ITU-D/treg/publications/Trends05\\_summary.pdf](http://www.itu.int/ITU-D/treg/publications/Trends05_summary.pdf)
- <sup>12</sup> Unfortunately, it also seems to generate spam.
- <sup>13</sup> "Those nations that deregulate communications will see an explosive and far-reaching expansion of available spectrum. We will drown in 'air' just as surely as we would be swamped with Manhattan housing for all income groups if there were no zoning boards, rent controls and planning commissions," George Gilder wrote in "What Spectrum Shortage?" *Forbes Magazine*, 27 May 1991, page 324-332; reprinted in the *US Congressional Record*, 20 September 1991.

- <sup>14</sup> See, for example, “The Spectrum Commons in Theory and Practice,” by Jerry Brito, Mercatus Center Working Paper in Regulatory Studies, March 2006 – [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=887932](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=887932). Thomas Hazlett has also been known to argue this way, most recently in “The Spectrum-Allocation Debate: An Analysis,” in *IEEE Internet Computing* (September/October 2006), pages 68-74 – <http://www.computer.org/portal/pages/dsonline/2006/10/w5pub.xml>. There he describes an under-used band for licence exempt PCS as “a tragedy of the anti-market.”
- <sup>15</sup> *Le Vol Des Insects* by August Magnan, Hermann and Cle (Paris, 1934), page 8.
- <sup>16</sup> “Supercommons: Toward a Unified Theory of Wireless Communication” by Kevin Werbach, *Texas Law Review*, Volume 82 (March 2004), Page 875 – [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=456020](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=456020).
- <sup>17</sup> Timothy Wu, 7 September 2006, in an online discussion of “Spectrum, Scarcity, and Centralized Control” – see <http://www.techliberation.com/archives/040559.php>
- <sup>18</sup> “Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services (Authorisation Directive),” *Official Journal L 108* [24.04.2002] – [http://www.legi-internet.ro/index.php/Authorisation\\_of\\_electronic\\_co/155/0/?&L=2](http://www.legi-internet.ro/index.php/Authorisation_of_electronic_co/155/0/?&L=2). Article 5 applies the policy to radio: “Member States shall, where possible, in particular where the risk of harmful interference is negligible, not make the use of radio frequencies subject to the grant of individual rights of use but shall include the conditions for usage of such radio frequencies in the general authorisation...”
- <sup>19</sup> Brito, for example (see note 14): “Once one understands that a commons requires a controller to set rules-of-the-road to facilitate sustainable sharing, it becomes apparent that the commons advocates’ aspiration to place spectrum use outside the control of government or private actors is untenable. This then raises the question, would advocates of a commons prefer that the controller be the government or private actors competing in the market? One might think that because they understand the inefficiency of government rule-setting very well, proponents of a commons would not choose a government controller. One would be wrong.”
- <sup>20</sup> *Report of the Unlicensed Devices and Experimental Licenses Working Group*, US Federal Communications Commission Spectrum Policy Task Force (2002), pages 7-8 – <http://www.fcc.gov/sptf/files/E&UWGFinal-Report.pdf>.
- <sup>21</sup> “A brief history of Wi-Fi,” *The Economist*, 10 June 2004 – [http://www.coe.montana.edu/ee/rwolff/EE580/history\\_of\\_wifi.htm](http://www.coe.montana.edu/ee/rwolff/EE580/history_of_wifi.htm)
- <sup>22</sup> Not enough data has been collected yet to establish the regulatory situation in 8 of these countries, so these are not reported here.
- <sup>23</sup> Algeria, Bahrain, Cuba, Egypt, Gabon, Gambia, North Korea, Mongolia, Myanmar, Sri Lanka, Tajikistan, Tanzania, Uganda and Zimbabwe.
- <sup>24</sup> “Положение о лицензировании в области электросвязи и информатики,” (Regulations on licencing in the field of telecommunication and informatics), National Regulatory Agency for Telecommunications and Informatics, Republic of Moldova, 2002 – [http://www.anti.md/Regulamente/ru/Reg\\_elib\\_licent\\_ru.htm](http://www.anti.md/Regulamente/ru/Reg_elib_licent_ru.htm).
- <sup>25</sup> “Ley de Telecomunicaciones” – Legislative Decree No. 142 (6 November 1997) – <http://www.siget.gob.sv/BusquedaPublica.aspx?sector=2&tipo=3&titulo=t2&ordenado=0&dir=DESC>. Article 59 speaks of “free usage bands which require a licence” while Article 60 concerns “free usage bands which do not require a licence.”
- <sup>26</sup> “Guidelines and Procedures for Licencing Electronic and Postal Communications in Tanzania,” Tanzania Communications Regulatory Authority, January 2005 – <http://www.tcr.go.tz/Licensing/ANNEX%2013%20%20LICENSING%20GUIDELINES.pdf>. The “Exempt Licence” is defined in paragraph 2.5.3.
- <sup>27</sup> *Wireless Networks for the Developing World: The Regulation and Use of Licence-Exempt Radio Bands in Africa* by Maria Isabel A. S. Neto, Master’s thesis, Engineering Systems Division, Massachusetts Institute of Technology (submitted June 2004), page 185 – [http://itc.mit.edu/itel/students/papers/neto\\_thesis.pdf](http://itc.mit.edu/itel/students/papers/neto_thesis.pdf)
- <sup>28</sup> See “Software Radio: Implications for Wireless Services, Industry Structure, and Public Policy” by William Lehr, Fuencisla Merino and Sharon Eisner Gillett, MIT Program on Internet & Telecoms Convergence (20 August 2002) – [http://itc.mit.edu/itel/docs/2002/Software\\_Radio\\_Lehr\\_Fuencis.pdf](http://itc.mit.edu/itel/docs/2002/Software_Radio_Lehr_Fuencis.pdf).
- <sup>29</sup> “Metrics-based Regulation of Effectiveness and Efficiency in Dynamic Spectrum Access Systems; the Art and Science of Dealing with Radio Complexity,” by Kalle Kontson and J. Michael O’Hehir, *Proceedings of the International Symposium on Advanced Radio Technologies, March 7–9, 2006*, NTIA Special Publication SP-06-438, US Department of Commerce (March 2006), pages 141-150 – <http://www.its.bldrdoc.gov/pub/ntia-rpt/06-438/06-438.pdf>
- <sup>30</sup> “Spectrum Transformation: Acceleration,” Powerpoint presentation by Badri Younes at Spectrum Management 2006, Arlington, Virginia, USA (16-17 May 2006) – available online at [http://www.nsma.org/conf2006/Presentation/Younes\\_NSMA2006ver7.ppt](http://www.nsma.org/conf2006/Presentation/Younes_NSMA2006ver7.ppt)
- <sup>31</sup> “Licence Exempt Spectrum and Advanced Technologies,” by Marianna Goldhamer – <http://www.itu.int/osg/spu/ni/spectrum/presentations/goldhammer.pdf>
- <sup>32</sup> “A Proposal for a Rapid Transition to Market Allocation of Spectrum,” by Evan Kwerel and John Williams, Office of Plans and Policy Working Paper No. 38, US Federal Communications Commission, November 2002, page 31 – available online at [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/DOC-228552A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228552A1.pdf).
- <sup>33</sup> “Optimal Auction in a Multidimensional World,” by Charles Z. Zheng, Contributed Paper 0296, Econometric Society World Congress 2000 – <http://ideas.repec.org/p/nwu/cmsems/1282.html>.

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<sup>34</sup> “Towards a Cognitive Radio based Distributed Spectrum Management,” by David Grandblaise, Clemens Kloeck, Klaus Moessner, Eiman Mohyeldin, Maran Kumar Pereirasamy, Jijun Luo and Ihan Martoyo, E<sup>2</sup>R Project, presented at the IST Mobile and Wireless Summit (Dresden, Germany), 19-23 June 2005 - [http://e2r.motlabs.com/dissemination/conferences/E2R\\_ISTSummit05\\_Towards\\_Cognitive\\_Radio.pdf](http://e2r.motlabs.com/dissemination/conferences/E2R_ISTSummit05_Towards_Cognitive_Radio.pdf)

<sup>35</sup> This final question was inspired by a new licencing policy announced in 2004 by Brunei’s Authority for the ICT Industry. AiTi adopted “a more generic description of the classes of activities, complimented by a negative list approach to allow AiTi to prohibit specific types of services or method of implementation....” From “Information on APT Broadband & ICT Brunei Darussalam,” presented at a meeting of APT’s Telecommunications Development Forum in Bangkok, Thailand (28-29 June 2004) – <http://www.aptsec.org/meetings/2004/ADF/ADF-INPUT/ICT%20Profile/Brunei%20APT%20Broadband%5B1%5D.pdf> See also “From Consumers to Users: Shifting the Deeper Structures of Regulation Toward Sustainable Commons and User Access,” by Yochai Benkler, [US] *Federal Communications Law Review*, Volume 52, Number 3, pages 561-580 (April 2000) – <http://www.law.indiana.edu/fclj/pubs/v52/no3/benkler1.pdf>

## 2 DRAFT QUESTION FOR STUDY

### QUESTION ITU-R ???/?

Technical conditions in which exemption from radio licensing is appropriate

(2007)

The ITU Radiocommunication Assembly,

considering

- a) Recommendation ITU-R SM.1538 (2003), which says, “There is a general agreement that when the efficient use of the frequency spectrum is not at risk and as long as harmful interference is unlikely, the installation and use of radio equipment may be exempt from a general licence or an individual licence...”
- b) that the ITU's survey of *Trends in Telecommunication Reform* (2004) found that “more and more policy-makers are questioning the utility of licensing and demanding that licences be adapted to achieve policy goals without hindering market development and technological advancement...”;
- c) that the 2004 Global Symposium for Regulators unanimously endorsed “Best Practice Guidelines for the Promotion of Low Cost Broadband and Internet Connectivity” which “encourage innovative approaches to managing the spectrum resource such as... allocating on a licence-exempt non-interference basis...”

recognising

- a) that Radio Regulation S18.1 says: “No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station in question is subject...”

noting

- a) that the allocation of spectrum for licence-exempt use is increasingly recognized as a catalyst for the development of more efficient and cost-effective wireless technologies;
- b) that there is growing public demand for short-range radio applications in which any risk of harmful interference is limited to a small area;
- c) that there are useful applications where the licensing of individual emitters is neither feasible nor necessary – radio frequency identification (RFID) tags, for example;
- d) that licencing is not the only effective means for preventing interference or setting requirements for public service;

decides that the following Question should be studied:

- 1 How can RR S18.1 be reconciled with the growing acceptance of licence exemption as a regulatory “best practice” under certain conditions?

further decides

- 1 that the results of the above studies should be included in a Recommendation and/or Report;
- 2 that the above studies should be completed by 2010.

### 3 RESULTS OF A GLOBAL SURVEY OF WiFi LICENCING POLICIES

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**Table 1.1: WiFi licencing – national thumbnails**

Updated to 1 December 2006. We have tried to be as accurate and current as possible, but we may have inadvertently misrepresented a country's policy. We apologise in advance for any such errors and invite readers to send corrections to [survey@openspectrum.info](mailto:survey@openspectrum.info). For links to data sources and background information about each country listed below (as well as additional countries not listed here) visit <http://www.openspectrum.info>.

<b>Afghanistan</b>	Licence exempt since November 2003, but “licenced network operators” and ISPs must register with MoC for “outdoor, retail or commercial use” of band. However, 2006 telecom law calls for creation of a Telecom Regulatory Authority that will undertake “a thorough review of spectrum policy..”
<b>Albania</b>	Licence exempt for power levels of up to 4 watts. No licence for commercial use.
<b>Algeria</b>	Since April 2006, a 9-page written application is required for “authorisation” to create or modify a RLAN or WiFi network
<b>Andorra</b>	Home use of WiFi seems to be licence exempt while public provision of data services is a state monopoly
<b>Angola</b>	Supposed to be licenced but enforcement a problem
<b>Argentina</b>	WiFi appears to be licence exempt; commercial Voice-over WiFi forbidden in Buenos Aires and other large cities since 2004.
<b>Armenia</b>	WiFi delicensed in May 2005 for both commercial and noncommercial services
<b>Australia</b>	Class licence
<b>Austria</b>	General licence - notify regulator only if providing commercial services to third parties
<b>Azerbaijan</b>	No need to apply for a licence if WiFi emissions are 30 mW or less and only used inside
<b>Bahrain</b>	Since July 2006, apply online for an individual WLAN licence (telecom law does not allow class licences for radio)
<b>Bangladesh</b>	New spectrum policy - in process of adoption - should clarify that WiFi is licence exempt
<b>Belarus</b>	No permission needed for indoor WiFi networks for self-use; otherwise, ministry “approval” needed
<b>Belgium</b>	Those who use WiFi to offer network services to the public must “declare” themselves to regulator; otherwise licence exempt
<b>Belize</b>	Regulations unclear - telecom licence may be needed if service offered to public
<b>Benin</b>	“Case by case” decisions before regulatory authority suspended in May 2006



<b>Bhutan</b>	ITU case study (2003) complained that “too many licenses” were needed for rural WiFi. ITU case (2005) said there are no regulations on use of 2.4 GHz. Inconsistency explained by passage of new telecom law in 2005? It permits licence exemption.
<b>Bolivia</b>	Situation unclear and likely to change with new government. Exclusive municipal concessions for 2.4 GHz had been common under previous regime..
<b>Bosnia &amp; Hercegovina</b>	Licence exempt since 2003.
<b>Botswana</b>	According to ACREG, “Regulations on spectrum allocation due for review to cater for newer technologies such as WIFI...”
<b>Brazil</b>	De-licenced in 2004. In 2005 power allowance raised to 400 mW EIRP in urban areas.
<b>Bulgaria</b>	Licence exempt. “General license” required since October 2004 for mobile phone network operators wanting to expand their service offerings into licence-free bands.
<b>Burkina Faso</b>	Licences issued automatically upon payment of fee, according to Neto, Gillett and Best (2004)
<b>Burundi</b>	Contradictory information.
<b>Cambodia</b>	Licence exempt in practice if not in law
<b>Cameroun</b>	Class licence for private networks; operator licence for public service.
<b>Cape Verde</b>	Situation in flux - new regulator to be created soon to facilitate “complete liberalisation” of telecom sector by end of 2007
<b>Central African Republic</b>	No licence for indoor use and no enforcement of the stated need to register (Neto, 2004)
<b>Chad</b>	Licence issued automatically for indoor use but power limited to 40mW (Neto, 2004)
<b>Chile</b>	Licence exempt – but licences enable use of greater power (up to 4W EIRP)
<b>China</b>	2.4 GHz was the first licence-exempt spectrum in China, but public provision of Internet service requires a Network Access License
<b>Colombia</b>	WiFi and Bluetooth exempted from licencing in 2004, but “concession” still needed to offer telecom services to others
<b>Comoros</b>	No regulator, minimal legal framework - class licence issued automatically
<b>Costa Rica</b>	Licence exempt up to 200 mW with no "external" antenna
<b>Cuba</b>	Only “licensed public telecom networks” and “legally-established organizations [and] companies” can apply for WiFi licences
<b>Cyprus</b>	Conforms to EU/ERO/CEPT norms - licence exempt
<b>Czech Republic</b>	General authorisation
<b>Democratic Republic of Congo</b>	Previously, WiFi licences were supposed to be issued automatically upon fee payment. But this was complicated by a private service (Congolaise de gestion des fréquences) vetting the applications for the ministry. A new telecom law passed in September 2006 may improve the situation.
<b>Denmark</b>	Licence exempt - Denmark has also de-licenced aeronautical mobile and some amateur bands

<b>Dominica</b>	Licence exempt
<b>Dominican Rep.</b>	Licence exempt
<b>East Timor</b>	Legal vacuum - no state agency issues radio licences
<b>Ecuador</b>	Systems with power/range exceeding that allowed for service within a “private” space must register
<b>Egypt</b>	Licenced but rules for exemption said to be “under study”
<b>El Salvador</b>	Contradictory information: national frequency allocations table says individual licences are required, 2002 ITU survey response says “free use” within power/range limits, 1997 telecom law spoke of “free use bands” in which licences are required.
<b>Equatorial Guinea</b>	State telecom monopoly provides Internet access (as well as fixed/mobile telephony); offers WiFi links and CPE equipment seems not to need licence
<b>Eritrea</b>	Apparently, the state-owned telco has free use of the band, while ISPs must pay (annual licence fee?)
<b>Estonia</b>	Licence exempt. Estonia is a world leader in hotspot coverage
<b>Ethiopia</b>	Licence exempt but no commercial provision allowed and only indoor use
<b>Finland</b>	Licence exempt
<b>France</b>	Licence exempt but outdoor emissions in the 2454 - 2483.5 MHz range limited to 10mW until 2011
<b>French Guiana</b>	WiFi prohibited throughout Guyane in the 2400-2420 MHz band, but between 2420 and 2483,5 MHz, powers of up to 100mW are authorised, indoors and out
<b>Gabon</b>	Private WLANs require authorisation, public WLANs require licences
<b>Gambia</b>	Licence required but no power limit, weak enforcement
<b>Georgia</b>	Was licence exempt - not sure if new law on electronic communication sustains.
<b>Germany</b>	Licence exempt - 100mW power limit but no restriction on antenna
<b>Ghana</b>	Conflicting information - may be licence exempt for self use, licenced for commercial/public service offerings
<b>Gibraltar</b>	Indoor use with “integral antenna” is license exempt; use outdoors or with “external antenna” requires SRD(LAN) licence
<b>Greece</b>	Licence exempt. Since June 2006, authorisation no longer needed for outdoor antennas.
<b>Grenada</b>	Type approval constitutes “class licence”
<b>Guatemala</b>	“Títulos de Usufructo de Frecuencias” mean no free spectrum - one must find local TUF owner and get his permission to use WiFi
<b>Guinea</b>	Current situation unknown. Before national assembly discussed new regulations in 2004, there was either no policy or automatic licencing.
<b>Guinea-Bissau</b>	Conflicting information
<b>Guyana</b>	Certainly licenced for WISPs and public access services, and possibly licenced for everyone else as well.
<b>Haiti</b>	Licence-free in practice

<b>Honduras</b>	“General permission” for private use of WiFi, “general license” for provision of public services
<b>Hong Kong</b>	Private use is licence-exempt, but those who offer service to the public need a class licence obtained by registering
<b>Hungary</b>	Licence exempt but providers of public services must register
<b>India</b>	Licence exempt with limits on outdoor antenna height and power (4W EIRP)
<b>Indonesia</b>	Licence exempt
<b>Iran</b>	New rules adopted in November 2006 seem to treat WiFi as just another [license exempt?] short-range device. But in October 2006 government told ISPs not to offer public access speeds higher than 128kb/s, which would prevent “last mile” use of WiFi including hotspots.
<b>Iraq</b>	Unknown, but unlikely that licencing could be enforced and wireless communication is rapidly growing
<b>Ireland</b>	Licence exempt - but public service providers need a basic telecom service licence
<b>Israel</b>	Licence exempt since 1 October 2003
<b>Italy</b>	General authorisation - geographic restrictions ended October 2005
<b>Jamaica</b>	Licence exempt from 1 June 2005
<b>Japan</b>	Licence exempt from autumn 2003
<b>Jordan</b>	Indoor use delicensed in October 2003 - outdoor use authorised on case-by-case basis
<b>Kazakhstan</b>	No licence for self-use, but outdoor use limited by military needs and licence needed for public service offerings
<b>Kenya</b>	“General class license” for use within premises or campuses
<b>Korea North</b>	Limited public use of data communications and restrictive media access policies make it unlikely that WiFi is licence exempt (except within Government?)
<b>Korea South</b>	Licence exempt since January 2003
<b>Kosovo</b>	Licence exempt in practice
<b>Kuwait</b>	Internet cafes and WISPs are licenced. It is not yet clear what rules apply to self-use at home.
<b>Kyrgyzstan</b>	New rules adopted in 2006: WiFi using an “integral” antenna is licence exempt; licences required for WiFi using a “remote” antenna; “permission” needed for WiFi in the capital city of Bishkek
<b>Laos</b>	We are not aware of any restrictions on WiFi in Laos
<b>Latvia</b>	Licence exempt.
<b>Lebanon</b>	The 2.4GHz band is licenced to the state telco, which imposes restrictions on outdoor use by WISPs
<b>Lesotho</b>	Licence exempt
<b>Liberia</b>	In transition - new regulatory agency started work in August 2006, no legal “authorising instrument” yet

<b>Libya</b>	State telecom operator acts as regulator. Agreement with the One-Laptop-Per-Child project for 1.2 million units (each equipped with WiFi) suggests self-use is - or will be – unlicenced
<b>Lithuania</b>	Licence exempt
<b>Luxembourg</b>	General authorisation
<b>Macau (SAR)</b>	Licence exempt for private indoor use
<b>Macedonia</b>	Licence exempt; notify regulator if offering access services to the public
<b>Madagascar</b>	Before passage of a new telecom law in 2005, WLAN licences were assigned by bidding. The new law enables a “free regime” but not known if this applies to 2.4 GHz now.
<b>Malawi</b>	According to Neto (2004), class licences are issued automatically for WLANs of up to 4 Watts - no voice allowed.
<b>Malaysia</b>	Class licences, automatically granted; no licence needed for hot-spots served by licenced ISP
<b>Maldives</b>	Licensing of outdoor use imposed in 2004
<b>Mali</b>	"No policy... no control, monitoring, or other oversight" (Neto, 2004)
<b>Malta</b>	In transition: early in 2007 regulator will announce which radio services need only “general authorization.” Until then, WiFi is exempt from licence <i>fees</i> to approximate licence exemption.
<b>Mauritania</b>	Both individual and class licencing used before August 2005 military coup.
<b>Mauritius</b>	Individual licences required for public service (max. power 10W); private use at lower-power is exempt from license fee, indoor use is license exempt
<b>Mexico</b>	Definitively licence exempt since March 2006, ending earlier confusion over its status
<b>Moldova</b>	“General licences” needed for public service are issued individually upon application; private use apparently licence exempt
<b>Mongolia</b>	Licence requirement, even for private use, is often ignored
<b>Montenegro</b>	Licence exempt indoors. Outdoor systems must be registered. Licence needed for public service provision
<b>Morocco</b>	Licence exempt since 2003, but in 2004 “free use” of WLANs prohibited in 20 locales, including Casablanca, Marrakech, etc.
<b>Mozambique</b>	2004 telecom law allowed regulator to exempt certain frequency uses from licencing, including ISM. Despite previous legal requirements, Wifi had not been licenced in practice.
<b>Myanmar</b>	1933 Wireless Telegraphy Act – apparently still in force, though modified – bans ownership of unlicenced radio devices
<b>Namibia</b>	Licence exempt but no use beyond private property boundary
<b>Nepal</b>	Licence exempt up to 4W EIRP since September 2006
<b>New Zealand</b>	“General User Radio Licence for Short-Range Devices” since 2003
<b>Nicaragua</b>	Indoor networks for self-use are licence exempt but all other uses of WiFi are licenced and charged spectrum use fees

<b>Niger</b>	Authorisation given more or less automatically after registration and payment of a fee; no power limit
<b>Nigeria</b>	WiFi for self-use is licence exempt; provision of service to 3rd parties requires an ISP license even if service is free
<b>Norway</b>	Licence exempt
<b>Oman</b>	Licence exempt - indoor use only
<b>Pakistan</b>	Regulator recently removed this FAQ answer from their website, suggesting a policy change that we have not yet confirmed: "Site approval is required even for setting up a point-to-point wireless system in de-regulated band"
<b>Palestine</b>	Palestinian use of 2.4 GHz band not formally authorised by Israel, but tolerated with no licence requirements
<b>Panama</b>	Licence exempt since 2002 at least
<b>Paraguay</b>	Licence exempt
<b>Peru</b>	Licence-free bands established in March 2004; wireless telecommunication authorised in ISM bands in June 2004.
<b>Philippines</b>	Indoor networks with "no external antenna" and EIRP not exceeding 250mW were de-licenced in September 2003. Outdoor WiFi delicensed in August 2005.
<b>Poland</b>	Licence exempt
<b>Qatar</b>	New telecom law (November 2006) will lead to new licencing regulations and demonopolisation of telecommunications in 2007. Previously, permission for WiFi in "confined spaces" was given on a case by case basis; only Qtel had right to offer commercial hotspot service
<b>Romania</b>	Licence exempt
<b>Russia</b>	Indoor use of WiFi delicensed in December 2004
<b>Rwanda</b>	Certain "low-power, short-range radiocommunications networks" are licence exempt, including WiFi
<b>St. Christopher &amp; Nevis</b>	Licence exempt
<b>Saint Lucia</b>	Licence exempt
<b>Sao Tome &amp; Principe</b>	Regulatory agency recently established. Negotiations on demonopolising telecommunication began November 2006; secondary laws still lacking
<b>Saudi Arabia</b>	Only permitted indoors but licence exempt since November 2006 - with user log kept at least 6 months;
<b>Senegal</b>	Licence exempt since April 2004, but buyer must sign a pledge to obey rules; retailer must record buyer's name and where device will be used
<b>Serbia</b>	Licence exempt
<b>Sierra Leone</b>	In transition - new draft telecom law will create regulatory agency
<b>Singapore</b>	Short-range devices - and localized self-use of WiFi - are licence exempt, but Internet access services are class-licensed because of non-local deployment and carriage of third-party traffic
<b>Slovakia</b>	Licence exempt
<b>Somalia</b>	No government, no regulator

<b>Somaliland</b>	No regulator, no licencing
<b>South Africa</b>	WiFi had been limited to “single properties” to protect Telkom’s rights, but municipal hot-zones now proliferating after regulator accepted argument that a city can be considered “one piece of land.” Pending law on electronic communication may improve situation.
<b>Spain</b>	Licence exempt since 2002
<b>Sri Lanka</b>	Licenced. Only indoor/on-premises use permitted.
<b>Sudan</b>	Communication networks may be established in the “free bands” but “only after approval by the Council.” Commercial wireless telecom service offerings must be licenced and if the network crosses a road, an open field or a public square, the licence holder must “coordinate with other institutions” and “obtain the approval and ratification of the competent authorities in the State.” But close reading suggests that networks in free bands for self-use within one's own property may not need licences if Council approves. Because ACREG lists only 23 WLANs with “permits” we suppose Council approval is generic rather than case by case.
<b>Sweden</b>	Licence exempt
<b>Swaziland</b>	No regulations according to ACREG
<b>Switzerland</b>	WiFi is licence exempt, but a “service license” may be needed to serve “third parties” on a subscription or contract basis. Register your net and Ofcom will decide if you need a service license.
<b>Taiwan</b>	Licence exempt unless used to provide “telecom services”
<b>Tajikistan</b>	Licenced, but regulator not likely to discover a home system only for self-use. However, new agency created in 2005 is toughening enforcement
<b>Tanzania</b>	All uses of radio require a licence but which type(s) apply to WiFi is not clear
<b>Thailand</b>	Only indoor use
<b>Togo</b>	Apparently licence exempt since April 2006
<b>Tonga</b>	“Persons who wish to operate under a class licence must first register with the Department” of Communications in the Prime Minister's Office
<b>Trinidad &amp; Tobago</b>	Licence exemption proposed in 2004. February 2006 frequency plan suggests exemption was approved but no policy declaration yet found.
<b>Tunisia</b>	We have only the 2002 rules, not the more liberal October 2004 update. In 2002, power was limited to 10mW and encryption was required for confidentiality. Neta (2004) reported that new rules were under development to create ISM bands.
<b>Turkey</b>	Licence exempt in “closed local areas,” on a “campus” or in an “open place” owned by user
<b>Turkmenistan</b>	Situation in flux after President’s death. Previously only “scientific research, medical services...technical production... [and devices] installed in cars, ships, planes or other types of transportation for personal use” were licence exempt.
<b>United Arab Emirates</b>	Licence exempt for indoor use; outdoor use restricted
<b>Uganda</b>	Since August 2006, home WiFi users need a “General Authorization License;” wireless ISPs need a “Capacity Providers License”

<b>Ukraine</b>	Bands that can be used with only “general authorization” are now being added to the allocation table, but WiFi not expected to be de-licensed until 2008
<b>United Kingdom</b>	Licence exempt
<b>United States of America</b>	Licence exempt
<b>Uruguay</b>	Personal use is licence exempt; commercial use requires government authorisation
<b>Uzbekistan</b>	WiFi for personal use is licence exempt, but WISPs need a license
<b>Vietnam</b>	Vietnam exempts some low-power devices from radio licensing, and ISPs can provide WiFi access without an additional license, but we are still not sure if WiFi for self-use is license exempt.
<b>Zambia</b>	Class license - but Neto (2004) reported there are "plans to deregulate some bands as license free"
<b>Zimbabwe</b>	Crackdown on unlicensed use began in January 2004. License costing \$1200 only allows use within own property boundaries.

Source: <http://www.openspectrum.info>