

## **# Spectrum Review Consultation Reply**

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### **# Introduction**

This response has been initiated by the Consume project [<http://www.consume.net>] Consume is a strategy for users to self provide, own and manage networks using a variety of network technologies. The technical focus to date has mainly, though not exclusively, been on license exempt radio technology based around 802.11 in 2.4 Ghz. Our strategy aims to create networks where the capital cost is directly borne by the users, and bandwidth is not charged for. It shares similar aims and goals to the many and growing free networking projects around the world of which it was one of the first. We have been involved with the DTi and the Radio Authority in establishing the legality of our approach and continue a productive dialog with other government agencies.

Consume is a meeting place for research and development, resolution of practical issues and information sharing between like-minded individuals. It is not an incorporated body and operates on a non-funded basis. I am co-founder and frequent contributor to the project.

This response is the view of the author and not necessarily that of other members of the group. In common with other Consume related information it is distributed to other members of the project and may be freely distributed and published as long as it remains in tact and is credited to the author. For further information concerning usage please contact the author.

### **# Issues Addressed**

This response document does not seek to cover all aspects of the review consultation document and while it replies to many of the specified issues for discussion, also covers areas that while mentioned and referred to have not been highlighted as discussion topics. These are covered as developments of arguments arising from the review.

i. How best can Government assess the economic gains from enabling more efficient use to be made of spectrum?

iii. How far can the over-arching principle, that spectrum users should bear the opportunity cost of their usage, be applied in practice?

xiii. To what extent would greater transparency of specific data on current and prospective spectrum uses support efficient spectrum use? What are the key issues and trade-offs pertinent to the provision, by RA, of an on-line database containing spectrum-utilisation details? How far is transparency compatible with commercial confidentiality and public safety and security considerations?

xv. To what extent is the review's distinction between radio spectrum used for marketed and non-marketed goods a helpful one?

xxx. How far have economic incentives from spectrum prices helped to encourage efficient spectrum use?

xxxix. What factors should guide regulators in setting the boundaries of licence-exempt spectrum use?

xl. What remit should regulators hold over licence-exempt spectrum use, other ensuring that it does not interfere unduly with licensed spectrum use?

xli. How far can developments in radio technology provide an alternative to regulation in licence-exempt spectrum bands, particularly where the potential for interference with other users is very low given the propagation and power characteristics of the signals concerned?

## **# Discussion Responses**

Economic gains from efficient use of spectrum

i. How best can Government assess the economic gains from enabling more efficient use to be made of spectrum?

Firstly we should look at what is meant by efficient use of spectrum. Efficiency is made up of several components. In the physical layer, efficiency is measured in how much signal is passed through the medium.

In the digital communication domain, which is set to and maybe already has become the dominant form of spectrum usage, efficiency of spectrum use can be measured as data throughput per frequency spectra per physical area (or volume). This is the efficiency of data delivery at the physical level.

Data is commonly delivered through a network, whether switched as in a traditional telecom network or packet based as in the case of the internet. Network utility and hence efficiency increases as the number of users increases. However an increase in user base can also slow the speed of data transfer through a network. An efficient network is one that maximises users and data throughput.

Secondly we should look at how economic efficiency relates to these more directly measurable criteria.

The over arching principle is that the network provides a substrate for and is an enabler of economic activity. A more efficient network can support more communication, and so support more structure, more social interaction, transactions and of course more commerce. A network such as money for instance gains utility by being pervasive. A large money network is more economically beneficial than a small one as it enables greater possibility of transactions.

A pervasive network is more economically efficient than a local closed one.

So economic efficiency is very similar to network efficiency. In fact I believe that by maximising the efficiency of the network you can maximise the efficiency of the economy that uses it.

An example of these effects from recent years can be seen in the Internet. It has provided a new space that has allowed new types of business and social interaction to develop.

Furthermore the utility of a network increases as its speed increases. The variety of communication possibilities increases as the network gets faster. New types of data communication such as video, sound etc. and hence creatively

usable spaces and social and economic possibilities are made possible. This is in addition to the larger amount of traffic that is enabled by speed increase. At present for instance the slowness of network connection is proving a barrier to new forms such as application service provision, and streaming media services.

The economic benefits of the network should be measured using traditional global and national economic indicators as access to the network effects the economy as everywhere it touches it. Examples are the speed of communication of an email, the information access of a web page, the simplification of supply chains etc. These effects are so pervasive and the modes of usage are changing so fast that measurements focused on specifics will not capture the reality of the situation and larger scale measures should be used.

Thus economic gains from spectrum efficiency should be measured in the same way at least in so far as the spectrum is utilised for data transfer.

Thirdly we should look at how the economics of a networks' usage relate to its implementation and running cost.

If networks become economically active the more pervasive they become then the lowering of cost of access and usage will cause larger uptake and hence economic activity. The most economically efficient network is one that has the lowest entry and usage cost. Any networking cost is effectively a tax on activity that takes place over the network, and barrier to uptake and hence economic activity.

There is however an economy that takes place in the provision of network infrastructure. It is my contention that the economic gains from this area of economic activity will be dwarfed by the economy that takes place over it and that the high cost of network communications is a barrier to further economic growth. The governments' policies of local loop unbundling for instance support this point of view.

In summary spectrum efficiency should be measured by its' efficiency in delivering network access, and the economic and social gains should be measured across the economy as a whole.

Economic principles of spectrum management

**iii.** How far can the over-arching principle, that spectrum users should bear the opportunity cost of their usage, be applied in practice?

The view of the review is that making spectrum users bear the opportunity cost of usage will lead to the most efficient usage of the spectrum, as users will be incentivised to maximise the economic gain from the license that they have acquired. The idea is that by engineering scarcity in the spectrum, network operators will be forced to value the spectrum more highly and hence channel development into using it responsibly and efficiently.

It is my view that the practice of auctioning access to spectrum, while generating politically expedient revenue for the government is an impediment to network provision across the spectrum and hence economically damaging in the long run. I believe that spectrum auctioning makes the mistake of assuming that the economic benefits of pervasive network access are measured in network operators profitability as oppose to the much larger benefits of pervasive low cost networking. In short spectrum auctioning seeks to maximise the wrong thing and in the process creates a barrier to uptake thus damaging the economy.

It is likely that spectrum license cost will lead to the license holders attempting to maximise revenue to service the license cost rather than maximise network efficiency. This revenue will most likely come from both network access

but also in maximising revenue by auction makes the license holder deliver and control the services that run over the network. Spectrum auctioning will lead to service re-bundling and closed networking as licensees explore every opportunity to exploit their investment in the license.

This will have several negative effects. License holders will be encouraged into the same position that the major UK telecom incumbent is in. i.e. controlling access to the network and the services that run over it. As has been seen with the intentional foot dragging of the wired broad band roll out, far from incentivising technological advance and faster cheaper network access this will tend to make network operators who control the purchasing of new networking technology to stifle development and hang on to their expensively purchased licenses and service monopolies.

A more direct and technical measure of spectrum efficiency than the estimated revenue of network operators would produce a better decision-making process for license awarding than auctioning. I believe that in practice the spectrum auctioning system will be superseded by more economically efficient forms of spectrum allocation and it should not be applied to areas of the spectrum that are designated for networking and communications usage.

National dimension

**xiii.** To what extent would greater transparency of specific data on current and prospective spectrum uses support efficient spectrum use? What are the key issues and trade-offs pertinent to the provision, by RA, of an on-line database containing spectrum-utilisation details? How far is transparency compatible with commercial confidentiality and public safety and security considerations?

In general openness and transparency should be encouraged. The creation of open protocols and standards by various international bodies has formed the basis of the creation and operation of the network (internet). In matters of technical infrastructure openness is essential to prevent damaging discrepancies (VHS/Betamax wars) and shared standards development is a key to creation of widespread technologies that underpin economic development.

Speaking from experience, "Consumers" manage collaboration between their self-provided networks through a node database that forms the core of information about people's configurations and other technical and non-technical data. As a tool for collaboration and research this has proved extremely useful and it continues to be a focus of our ongoing efforts. Eventually the database will dynamically describe the state of the network and the availability of resources to users who agree to share resources.

A spectrum database of the type described in (xiii.) could form the heart of a technical description of spectrum utilisation that could inform both researchers and potential designers and users of spectrum and even eventually devices.

Such a database could form the basis for international spectrum allocation and put the UK at the centre of global wireless development.

Tuneable devices that can both access a variety of frequencies and hence networks and manage their own power output to limit cell size and hence interference could communicate with this database or a distributed version of it to dynamically make best use of the locally available spectrum, or existing network resources. One of the best ways to limit network congestion is to share network access. This is possible where the spectrum and network is seen as a shared resource (the internet) but not where network access is restricted to single competing operators (GSM roaming charges). This relies on the transparency of access data.

Systems of this nature are best organised by collaborative and international standards bodies, and the access details built into open protocols that can be used by all. The process of creation of such a database and system could be similar and complimentary to the protocol negotiation that has defined hardware standards in license exempt bands (802.11/hiperlan etc.)

Spectrum use: marketed and non-marketed outputs

**xv.** To what extent is the review's distinction between radio spectrum used for marketed and non-marketed goods a helpful one?

The non-marketed areas that are described are focused on government-sponsored initiatives such as defence and emergency services. It should be noted that projects such as consume also fall into the non-marketed area without being publicly funded, by being self-provided and run on a strict non profit basis. The current prohibition on by way of business usage of 2.4 Ghz also locates users of the licence exempt spectrum in the non-marketed area.

The reviews' drive to increase marketed spectrum usage into parts of non-marketed areas, is in contrast to free networking projects direction of moving network access to a non marketed area.

Spectrum pricing and auctions

**xxx.** How far have economic incentives from spectrum prices helped to encourage efficient spectrum use?

At present the debt mountain with which successful 3G license bidders are saddled, has damaged those companies ability to raise money as witnessed by the collapse of Telco stock and credit ratings. This in turn is leading to a delayed roll out of 3G systems. As a result the 3G spectra are being used extremely efficiently at present and there is almost no congestion. There is also no traffic, no rollout, no usage and no market for services. This highlights the deficit in the auction policy. Spectrum efficiency should be regarded high if the usage of the spectrum is maximised in terms of throughput, not how little congestion exists. In this instance it appears that scarcity has been over-engineered.

In order to recoup cost 3G license holders have publicly said that they are going to considering asking users to fund the purchase of their network access products (i.e. self provide) to help fund the network rollout.

More seriously the global Telco share price collapse, which in Europe is in no small part due to the 3G license fiasco, has been at the forefront of the retreat from network and technology investment in general. The damage to the global economy is already being felt, and blamed largely on Telco instability. The overall economic impact of the experiment is decidedly negative on any analysis.

The auction disaster has also stopped other licenses being purchased all over the country. Thus while spectrum congestion is at a minimum, r&d in wireless networking, useful networks, reduced networking costs and the attendant potentially modernising improvements to the economy have effectively been halted by the barrier to access, effectively a huge tax, caused by the auctions.

The boundaries of spectrum regulation

**xxxix.** What factors should guide regulators in setting the boundaries of licence-exempt spectrum use?

By contrast with the 3G spectrum, the license exempt spectrum in 2.4 Ghz for instance is heavily used by numerous wireless technologies, the spectrum is heavily congested and even so still delivers 11 Mbit networking reliably (much faster than the undelivered 3G technologies). The extreme congestion there leads the RA to describe the band as a trash band.

In addition it supports, DECT telephones, bluetooth, and the original reason for license exemption microwave ovens. The congestion in the band is a measure of how successful its uptake has been.

The existing scarcity of unlicensed spectrum for instance is proving a fertile ground for the creation of noise resistant high speed networking technologies, which have very low unit cost.

It is no accident that the most rapid technological development and hence spectrum and economic efficiency is taking place in these globally license exempt frequencies where the opportunity cost is limited to the capital cost of equipment and network implementation.

Projects such as Consume are building effective networks in these spaces, equipment manufacturers (mainly American) are developing heavily and profitably, and users are buying equipment and self-providing networks. This is directly due to, zero entry cost, license exemption and open standards. License exemption stimulates development necessary for improving the efficiency of network devices, as it creates a wide market for the networking products.

It is interesting to note that prominent members of the investment community such as Nomura have expressed the view that license exempt technologies, 802.11 in particular, will ultimately be more successful than their licensed counterparts. This kind of thinking will certainly affect investment decisions and hence the viability of licensed networking projects.  
[[http://dek.spc.org/julian/consume/dox/will\\_wireless\\_lan\\_destroy\\_3g.pdf](http://dek.spc.org/julian/consume/dox/will_wireless_lan_destroy_3g.pdf)]

It is my view that license exemption should be extended to a wide range of spectra beyond 2.4Ghz and 5Ghz. I believe that correctly handled license exemption should form the basis of UK spectrum licensing strategy.

More practically a good first step would be the experimental license exemption of unsold licenses in 28 Ghz. These could be operated under license exemption to encourage development of those unused areas.

In Wales for instance the auction process has led to little or no planned fixed wireless provision there. The normal favoured license areas have attracted the bids and development and hence economic benefits. In this way the auction process contributes to the creation of a digital divide and rather than being a force for economic regeneration is a force for consolidation of the existing position.

Factors that should be taken into account in awarding license exemption should be.

1. Network efficiency (data throughput per physical area, per spectra)
2. Economic efficiency (lowest network cost, bandwidth cost, capital cost)
3. International standards (protocol harmonisation)

The success of 802.11 is in part due to the rigorous setting of international standards. Spectrum allocators should be heavily involved in all stages of protocol development and should favour open global standards to proprietary national ones.

#### 4. Open access (open networks should be preferred to closed ones)

Open access to spectrum, tends to make spectrum boundaries continuous rather than segmented. Spectrum segmentation created for commercial or other reasons is a major cause of spectrum inefficiency. There are heavily underused swathes of spectrum and heavily congested ones. Continuous spectrum allocation would lead to more efficient use. This would require spectrum users to share access to spectrum. If there was no licensing barrier and if the network access is open there is no reason why one user shouldn't use another users network. The co-operative sharing of network resources is a cornerstone of the Consume strategy.

As can be seen with the explosion of internet usage open networks create the substrate for economic activity that can drive gains in the national and global economy.

**x1.** What remit should regulators hold over licence-exempt spectrum use, other ensuring that it does not interfere unduly with licensed spectrum use?

An example of additional regulation can be seen in 2.4 Ghz. A prohibition on "by way of business" usage has been placed. This has given UK free network developers the breathing space to develop and experiment without the damaging effect of Telco competition. It is to be expected that in the existing semi-monopolised telecoms market, Telco participation in license exempt frequencies would be characterised by disruption as has been seen in the other local loop broadband rollout (ADSL). In a far more deeply liberalised telecoms environment such measures may not be necessary, but without restrictions such as these the chances of the development of a more economically efficient strategy are limited.

Consume would be very interested in participating in any review of this ruling or consultation based around it. Clarification of the legality of operation in the band has been a major part of our effort and we have consulted the RA and DTI on numerous occasions about it. At the moment the development of free networking and self-provision is the beneficiary of this ruling and the existence of this ruling is helping to provide the space to establish the Consume strategy.

**xli.** How far can developments in radio technology provide an alternative to regulation in licence-exempt spectrum bands, particularly where the potential for interference with other users is very low given the propagation and power characteristics of the signals concerned?

Protocols such as Hiperlan provide power-tuning specifications. Thus network devices can reduce their power to decrease their usage of the local spectrum. In the context of open access networks, this means that devices can intelligently increase the data transmitted through a given area by reducing their cell size. Dynamic protocols of this nature should be preferred over impolite systems. It should be noted that polite systems, become impolite when attached to closed networks. If devices can not share and route each others data, then a power tuneable device will increase its power until it can make its connections, a closed network device tends to shout, an open one to whisper.

#### **# Summary**

Efficient use of spectrum can be measured by data throughput and the efficiency of networks provided over the radio spectrum.

Economic gain is associated with network efficiency and the network forms the substrate for economic activity.

Economic gain should be measured using national and global economic indicators.

The economy of network implementation is small compared to the economy that can run over the network.

Spectrum auctioning while generating politically expedient revenue for governments is economically inefficient as it creates a barrier to network uptake.

Spectrum auctioning is economically damaging as it leads to service re-bundling and closed networking.

Spectrum efficiency should be measured directly not by network provider value. Transparency should be a requisite of spectrum allocation, and the creation of an open spectrum database by international agreement would be an advisable step. License exemption locates that spectrum in the non-marketed category.

Spectrum auctioning has been a failure and has damaged the national and global economy.

The failure of the process has caused many licenses not to be taken up.

License exemption has become the focus for wireless networking development and economic and social activity.

License exemption based on directly measurable criteria of network efficiency, economic efficiency, international standards and open access should be extended as a strategy for awarding licenses.

Unawarded 28 Ghz licenses could form the basis of trial to extend license exemption beyond 2.4 Ghz and 5 Ghz.

The current by way of business restrictions in the license exempt spectrum are creating favourable conditions for the growth of economically desirable free networking projects.

Polite protocols can increase the total data throughput of a physical space by reducing cell size and should be preferred.

## **# The future**

License exempt frequencies continue to be the focus for development of wireless networking technologies around the world both in commercial and non-commercial arenas. This is no accident but a result of spectrum regulation policies. The move to public wireless networking is taking place most actively in the license exempt spectrum rather than elsewhere. If the momentum is to be continued then extension of license exemption into other areas of the spectrum will enable rather than hinder the process. I look forward to the development of pervasive networking that I believe will have great benefits both socially and economically.

The free networking movement continues to gather pace as a global strategy for providing open access networking in the licence exempt space and Consume is at the forefront of the development in this area. We are also actively involved in consultation with the RA the Dti and Consume participants are currently involved with the Welsh Development agency and the European Intelligent Cities initiative in developing public access network strategies. We hope to provide a valuable focus for alternative and non-aligned voices in the network access debate and are continuing to develop what we hope will become the prevalent open networking strategy.