Transfinite Systems Ltd 6C Rathbone Square 24 Tanfield Road Croydon CR0 1BT United Kingdom

Ms Mrinal Patel Ofcom Riverside House 2a Southwark Bridge Road London SE1 9HA

27th April 2012

Dear Mrinal,

Transfinite Systems Ltd is pleased to submit this response to the call for input document "Spectrum Review: A review of the management of the spectrum currently used for point to point fixed links and other services that share this spectrum".

Transfinite welcomes the interest by Ofcom in management of the fixed service bands. We feel this is an area we have significant expertise and experience.

We have identified the following areas of concern:

- 1) Ofcom's significant market power
- 2) Consequential lack of flexibility in ability to set prices
- 3) Lack of support from Ofcom for SMEs
- 4) Lack of support from Ofcom on some international regulatory issues, in particular ESOMPs
- 5) Lack of involvement in other spectrum owners in regulatory issues, in particular ESOMPs

These issues are address in the document in more detail below.

If you have any questions regarding this response please do not hesitate to contact us.



Yours sincerely,

John Pahl Transfinite Systems Ltd



Background to Transfinite

Transfinite is an independent UK company, with an excellent track record of consultancy support, study work and software development. We specialise in products and services to analyse compatibility between radiocommunications systems and their use of the radio spectrum. Our tools have a particular emphasis on interference analysis, spectrum management and frequency co-ordination. Our study work has encompassed a wide range of communications systems including both terrestrial and satellite services.

Recently we were involved in the auction of spectrum in the 10 - 40 GHz bands and were successful, gaining a licence in the 28 GHz band. We intend to operate as a band manager providing access to our spectrum via a web based software solution called Visualyse Spectrum Manager (SM).

Visualyse SM provides all the necessary features to support issuing of licences including:

- Licence application
- Licence processing
- Licence search and display
- Technical analysis
- Management and reporting
- Engineering

Visualyse SM can offer users the ability to apply for licences via a web based portal as shown in the figure below.





General Comments

Transfinite welcomes this call for inputs regarding its review of spectrum management of in the UK for fixed services.

Background

We aim to provide a professional spectrum management service in bands that we manage, which include those that can be used for fixed services. We have spent significant company resources to get to a position where we are now able to offer end users spectrum access including:

- Participating in an auction and purchasing a block of spectrum
- Developing the IT infrastructure to support licensing activities including web server, software and databases
- Undertaking sales and marketing activities to identify potential users and open communication channels
- Tracking updates to fixed link planning algorithms and associated industry standards (e.g. ITU Recommendations)
- Ensuring there is a legal framework to support our operations by investigating legal options and encouraging the development of leasing
- Protecting our spectrum from potential harmful interference from short range radars (SRR) on vehicles by working within SE-24
- Working to protect our spectrum from potential harmful interference from Earth Stations on Mobile Platforms (ESOMPs) within SE-40 and FM-44

We feel that with this investment we are in a position to offer a service that is:

- Fast: our web based spectrum licensing portal can capture the requirements for a new link, plan, undertake interference analysis and then authorize it within minutes.
- Flexible: our licensing portal is based upon technology neutral principles so is able to handle a wide range of service types¹. In addition, we have the tools to quickly undertake detailed and accurate analysis of special cases and the responsive management structure of a SME.
- Cost effective: we have the low overheads of a SME and are able to respond to market demands and adjust pricing accordingly
- Competent: we have extensive experience of radio engineering (including fixed link planning, and interference analysis), IT systems (including web portals, desktop engineering tools and databases) and the regulatory environment (including UK, EU/CEPT and ITU)

¹ For example the tools can assess interference between fixed services (PtP and PtMP), mobile PtMP services and satellite Earth Stations, all of which could operate in parts of C band.



We would like to be able to develop this business further, using our expertise to provide UK stakeholders with a highly professional cost effective service.

We can see significant benefits to spectrum users in there being a flexible market of multiple private spectrum owners providing access to spectrum. In such an environment there would be:

- Competition between spectrum providers would drive the down cost of spectrum while ensuring the true market price is paid
- The private sector nature of their operations would permit flexibility in pricing and experimentation
- New ideas could be introduced rapidly by responsive commercial organisations and their benefits assessed
- There would be mechanisms and commercial incentives for spectrum providers to respond to demand for non-standard products or new technology
- There would be clarity in roles and reduced conflict of interest

A flexible market in spectrum providers would support Ofcom's obligations to promote both spectrum efficiency and competition on the supply side

However we have identified some issues that are harming our ability to progress with our business plan and would like to take this opportunity to raise them with Ofcom.

Transfinite's Areas of Concern

We have identified the following areas of concern:

- 1) Ofcom's significant market power
- 2) Consequential lack of flexibility in ability to set prices
- 3) Lack of support from Ofcom for SMEs
- 4) Lack of support from Ofcom on some international regulatory issues, in particular ESOMPs
- 5) Lack of involvement in other spectrum owners in regulatory issues, in particular ESOMPs

These are discussed further below.

We then make a number of suggestions, including for management of the lightly licensed bands, regulatory frameworks and views on the market.

Market Impact of Ofcom's Licensing Operations

The majority of the spectrum in the UK available for fixed links is managed and marketed by Ofcom.

It is noted that one of the major markets for fixed link applications is for backhaul used by the mobile operators. Some of these operators now own their own blocks of spectrum and so are not purchasing links in the open market. This is not an issue in its own right



but means that the demand for links is reduced and what remains is dominated by Ofcom.

Excluding fixed links spectrum owned by mobile operators, then if the Herfindahl index were to be calculated for the market of spectrum for fixed link it would be close to 1.

Ofcom's position as manager of the vast majority of fixed link spectrum can be classified as significant market power.

The relative low cost of fixed service spectrum compared to total cost of communication services suggests that Ofcom's dominant position is difficult to reverse given institutional inertia.

Given the points above we have identified that one of the key drivers for demand for our spectrum has been to provide products that are not available from Ofcom.

There would be a significantly negative impact on Transfinite's ability to operate as an SMO if Ofcom introduced new spectrum products, such as point to multipoint, given its dominant position within the market.

The problem is aggravated by the fact that Ofcom has multiple conflicting roles:

- Ofcom is the provider of spectrum on a block basis by auction (i.e. our source of spectrum)
- 2) Ofcom is a main provider of spectrum on a link by link basis through an annual licence fee (i.e. our competition)
- 3) Ofcom is the UK's national communications regulator (i.e. our arbitrator)
- Ofcom's obligations include to promote supply side competition (i.e. our supporter)

At present it is Ofcom's roll 2) that is causing the principle constraint on our ability to operate as an SMO.

Note that Ofcom has acted to support to liberalised access to spectrum: in particular we appreciate the work that Ofcom undertook to permit spectrum leasing within the UK.

Price of Fixed Service Spectrum

Our experience is that the market price of a link is effectively driven by the algorithm used by Ofcom.

We observe that there has not been significant questioning of use of this algorithm by customers nor comment that it is too high.

In particular we have not had customers approach us wishing to switch spectrum provider from Ofcom to Transfinite in order to reduce their spectrum costs. The price of fixed link spectrum is in general a minor factor within the total cost of communication services.



In order to avoid anti-competitive behaviour including cross-subsidisation, it is very important that the price of spectrum should cover all the associated costs, not just a marginal cost of administration. In particular it should include:

- Complete cost of IT systems should include full development cost and support for software, training, hardware, licensing, databases (e.g. terrain, maps etc)
- Appropriate amount of resources from international regulations, coordination, pricing, economics, documentation, lawyers, technical studies, consultations, industry working groups etc
- Support for the planning process including developing standards (TFACs, IRs, involvement in ETSI etc)
- Customer interaction and support including email, phone, customisation of products, updates to products, post, printed materials etc
- Overheads including office space, admin, web site, telephones etc noting there are standard algorithms to derive overhead rates
- Cost of spectrum as if Ofcom had purchased the spectrum at auction
- A factor to cover return on investment
- Opportunity cost of spectrum i.e. spectrum denied

There could also be the need to include additional charges if a customer asks for additional services outside the standard portfolio of spectrum products.

Reductions in the price charged for fixed links spectrum (such as for rural areas) could have a devastating impact on private SMOs given Ofcom's dominant role in the market

The current algorithm to price point to point links does not match engineering analysis of the degree to which one link denies another link the ability to operate. A methodology to derive the degree to which one system denies other systems the ability to use the radio spectrum was derived by Transfinite and Aegis in a project for Ofcom in 2004 entitled:

Evaluating spectrum percentage occupancy in licence-exempt allocations

The Final Report described the N-Systems methodology in which systems are introduced into a reference area at random until no more can be added due to interference constraints.

This methodology could be used to develop an evidence driven algorithm to calculate the relative price of different types of fixed links. The approach to use would be to identify how many links of a reference type (e.g. 16-QAM modulation 99.99% availability 40 dBi antenna 8 km path length) could be deployed within a reference area (say 50 x 50 km). This could then be repeated taking into account variations in the link's parameters, for example:

- Antenna peak gain
- Antenna gain patterns
- Modulation used



- Noise figure used
- Hop length
- Availability

By comparing the number of links that could be deployed with each of factors a "cost of spectrum" could be derived between different system types.

It could be appropriate to use spectrum denied metrics (as in the N-Systems method) in areas of high demand and a costs plus method in areas of lower demand.

Support from Ofcom for SMEs

Transfinite is a relatively small organization with turnover under £1m. However Ofcom's processes are often designed in ways that do not facilitate the involvement of SMEs.

For example auctions are mechanisms that favour organizations with the ability to raise significant amounts of capital. This means that there is the danger that spectrum could become concentrated in the hands of a few organisations (e.g. Arqiva). Other processes are slow involving multiple rounds of consultation which require resource rich organisations. Another example would be that the procurement process can favour large organisations and incumbents.

We would suggest that as part of Ofcom's Regulatory Impact Analysis that consideration is made of whether the proposal introduces biases against SMEs

Support from Ofcom on Regulatory Issues

There have been a number of issues in which there have been proposals to introduce new services into bands where we own spectrum.

In 2009 - 2010 there were proposals within SE-24 to introduce Short Range Radar (SRR) into bands up to 29.5 GHz, principally from vehicle manufacturers. We undertook studies that showed that this could cause interference into our links. Working together with Ofcom we were successful in reducing the frequency range for which SRR would be permitted to operate so that they would not cause harmful interference into our bands.

We are appreciative of the support that Ofcom gave during 2009 and 2010 to protect the FS community's interest from proposals to introduce SRR into the 27.5 – 29.5 GHz bands.

Recently there have been proposals from satellite operators to change the regulatory framework to permit Earth Stations on Mobile Platforms (ESMOPs) to operate in frequency ranges from 27.5 – 29.5 GHz. In particular it is proposed that there be transmitters on aircraft and ships operating in adjacent countries and international waters and airspace.

Our calculations suggest that the levels proposed would cause interference 32.5 dB above the level considered harmful. If measures are not in place to protect our links from harmful interference this could significantly reduce our ability to provide a service, maybe to the point of making it uncommercial.



We are a SME and do not have access to alternative spectrum and therefore this would end our ability to operate as a spectrum management organisation (SMO).

We do not feel that owners of FS spectrum in the 27.5 – 29.5 GHz band have received sufficient support from Ofcom on the ESOMP issue, particularly as it threatens our very ability to operate as an SMO.

The lack of support from Ofcom on this issue is not consistent with its objective to promote the development of a spectrum market with third party players.

Involvement in other Spectrum Owners on Regulatory Issues

It has been noted that other spectrum owners have not been active in regulatory issues.

There could be a number of reasons for this including:

- Lack of information i.e. being unaware of the process
- Inability to assess impact of proposed changes
- Lack of understanding of procedures that should be followed to respond
- Belief that Ofcom will act to protect UK spectrum owners
- Inability to undertake the technical work required
- Lack of resources to undertake studies and attend meetings
- Lack of interest in developing the band

We are unable to identify which of these reasons is being the lack of involvement of other spectrum owners in regulatory issues.

There would be benefit in Ofcom clarifying with spectrum owners the need to be involved in regulatory issues and what the impact would be of inactivity.

The ability to interact effectively within international fora such as CEPT and ITU could be considered to be a necessary criterion for an organisation to operate as a SMO. It should also be noted that this is a costly activity and hence there would be benefits in an SMO having a "portfolio" of bands to manage so that the costs can be shared over a wider base.

Lightly licensed bands

The lightly licensed bands are an attempt to relax the regulatory framework to permit rapid roll-out of point to point links. Information is recorded in a spreadsheet and there is process by which the first to be registered gains priority should there be interference in the future.

However the current regime has a number of short comings, including:

- The quality of the data is not good, with:
 - Location data must be given in national grid reference (NGR) which is not well understood by end users



- Location data accuracy requirements are low, which can lead to errors in the order of 100m
- \circ $% \left({{\rm{Location}}} \right)$ Location data is not checked so the start and end locations can be the same
- Location data is not checked so that paths lengths can be implausibly large
- Receive signal levels (RSLs) are sometimes entered in the wrong units (e.g. dBW vs. dBm)
- o Bandwidths and frequencies are something confused
- Frequency ranges are sometimes given rather than specific values
- The process is non transparent in that the spreadsheet provides a snap shot of data rather than live data
- There is the risk of interference or that applications will be rejected
- The process involves a time consuming manual re-entry of data

This process introduces risk to end users and lack of clarity as to the actual usage of the band.

We are in a position to be able to provide Ofcom with a solution that could easily be used to handle these bands and would provide a cost effective, low risk approach. We could provide a managed service based upon Visualyse SM to Ofcom along the lines of other third party agreements

We would be interested in discussing this further with Ofcom and stakeholders and have described our ideas further in a section below.

This managed service approach, if successful, could be introduced into other bands, depending upon preferred regulatory framework.

It could also be a way of supporting SMEs who could bid for the contract without having to purchase spectrum in an auction.

Selection of Preferred Regulatory Framework

A number of models for management of fixed services in the UK could be considered as shown in the table below:



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Framework type:	Command and Control	Managed Spectrum Service	Spectrum market involving multiple SMOs
Spectrum block owner:	"Ofcom"	"Ofcom"	SMO
Spectrum block manager:	Ofcom	SMO	SMO
Degree of competition:	None	One off between bidders to win management contract	Continuous between SMOs

Of the various approaches the one that has the most potential to bring the benefits of competition plus increased flexibility to spectrum users is a market for SMOs. This is not fully achievable while Ofcom is owner and manager of the main bands used for fixed services.

Moving towards a spectrum market in SMOs would solve the difficulty of Ofcom's conflict of interest while moving the UK towards increased spectrum efficiency and competition.

A number of routes could be envisaged to facilitate the transfer to a market based solution: the key factor is to make more bands available.

This could include making some bands (e.g. the lightly licensed bands) available as a managed spectrum service as an intermediate step.

Further downstream there could be auctions in overlay rights (i.e. excluding incumbents) for the existing FS bands or even full rights (i.e. including incumbents).

Other models for management of fixed services could be considered as are employed in the US, Australia and New Zealand.

Market forecast

We appreciate the work undertaken by Aegis and note it gives a range of outcomes. Our view would be that demand is likely to be towards the higher end rather than lower as:

- The telecoms sector is in general less affected by the slow down than the wider economy
- Mobile devices are increasingly the primary platform or at least an essential platform which can't be met by a fibre to the home (and hence fixed) internet connection
- There is increased use of higher specification devices, such as better cameras and larger screens, which drives demand for greater UL and DL capacity (e.g. HD viewing and uploading to FB)



- Rapid increase in penetration of smart devices driven by highly competitive mobile computing market with continual development of new devices
- This requires rapid introduction of new backhaul at a rate that would not be feasible with fibre. In addition some of the locations (e.g. street furniture) could be difficult to connect.

It was also noted that the Broadband Delivery UK has announced a £ 150m in capital to support the Mobile Infrastructure Project (MIP). This could increase demand for backhaul spectrum in rural and suburban areas and it wasn't clear if this was covered by either report.



Specific Questions

Most of the issues are covered in the sections above, but for completeness each of the questions are listed and where appropriate answered below.

Question 1

What are likely to be the key underlying factors influencing changes in demand for this spectrum (in terms of quantity of spectrum or preferred bands) over the next 5 to 10 years? Please provide band specific evidence to support your view.

Answer: no specific info available

Question 2

Will the reducing trend in the numbers of fixed links in the spectrum under review to support mobile backhaul continue? If so, in which bands will this reduction be most apparent and how will link capacity/bandwidth requirements change? What factors will have the biggest influence on the outcome? In your view, what will be the impact, on spectrum demand, of deploying next generation mobile networks for example using Long Term Evolution (LTE) standards?

Answer: no specific info available

Question 3

How might the changes to current or future public safety networks influence the existing and future requirement of the spectrum under review for fixed link backhaul for public safety applications over the next 5-10 years? In which spectrum bands is demand most likely to arise and how much spectrum would be required? May demand for bands currently used by public safety applications decrease? Is it likely that the public safety services may require access to the spectrum under review for other data networks or for alternative uses?

Answer: no specific info available

Question 4

How likely is it that use of CCTV by local authorities will significantly increase overall demand for fixed link infrastructure spectrum over the next 5 to 10 years? If so, in which bands is the additional demand most likely to be required and why? Do you have any information about the relative costs of wired and wireless CCTV links in urban and rural areas?

Answer: no specific info available



(a) What are the main factors (technical or regulatory) that determine preferences for one band over another for satellite applications? Do these factors vary between different types of satellite applications (Mobile, Fixed, Broadcasting and Science services)? In which bands will we see the most significant changes in demand in the next 5 to 10 years, and why?

Answer: international coordination implies that there must be a harmonised satellite band. Long lead times means these must be available well in advance of actual use and with confidence they will be available the lifetime of the satellite network. Sharing with services that use directional antennas (typically fixed) is easier than for low gain antennas (e.g. mobile).

(b) A number of the frequency bands under review are currently used for satellite Permanent Earth Stations (PESs), for example to feed Direct to Home satellite broadcast services. What are the continued and future spectrum requirements for satellite PESs (E-s & s-E) likely to be and in which bands? Please provide evidence to support your views.

Answer: no specific info available

(c) During recent years, some commentators have forecast significant demand for spectrum to support satellite consumer terminals. To date this demand has been slow to materialise. Do you have information which would help inform a more accurate assessment of future demand for spectrum in bands currently shared with fixed links?

Answer: no specific info available

(d) Are there factors specific to the satellite based communications sector which mean that it faces particular difficulties evidencing and satisfying demand for spectrum? If so, how might these be overcome?

Answer: no specific info available

Question 6

What is the likely timetable for rollout of Smart Grids and what impact will these developments have on demand for spectrum in the bands covered by this review?

Answer: no specific info available



What impact will DAB expansion have on demand for the spectrum under review? Are there any other demand drivers that Ofcom should consider in relation to broadcasting use or services related to broadcasting?

Answer: no specific info available

Question 8

a) What is the likely demand for broadband wireless access applications in the spectrum under review and which bands is this likely to specifically impact? How should Ofcom considers the demand for backhaul to support such applications and is such backhaul demand likely to arise in the spectrum under review?

Answer: no specific info available

b) Do you consider that the emergence of rural broadband fixed wireless access will influence overall demand for the spectrum under review and to what extent? Which bands is this likely to impact most?

Answer: no specific info available

Question 9

Do you consider that there will be a material additional demand from the PMSE community for access to the spectrum under review? Which bands under review is this likely to impact most and to what extent?

Answer: no specific info available

Question 10

How might the economics of new fibre provision (with or without reliance on regulatory remedies – whether active or passive), as compared with wireless provision of both terrestrial and satellite based services, impact on the requirements for wireless backhaul? We are interested in the possible impact, in terms of the extent of possible substitution for wireless links and in terms of the nature of wireless links affected (urban v. rural, lower / higher frequency bands).

Answer: no specific info available



What issues relating to spectrum access for different services do you think Ofcom should review? How might Ofcom start to rely more on commercial decisions when determining allocations of spectrum in the bands covered by this review?

Answer: no specific info available

Question 12

We would welcome views on the potential for more widespread use of market based approaches to the spectrum under review such as third party band management, and the regulatory steps which would need to be taken to facilitate this.

Answer: issue addressed in main document above

Question 13

(a) Do you consider that any changes should be made to the Ofcom licence fixed link product set?

(b) Might a more flexible approach to licensing, in bands where demand is unlikely to exceed supply for the foreseeable future, enable more intensive use of these bands? If so, what form might the licensing take and in which bands would this be appropriate?

(c) Are there other actions which Ofcom could take to improve spectrum efficiency by encouraging migration to or use of higher, less heavily used, bands, with a view to freeing up spectrum in popular lower frequency bands?

Answer: issue addressed in main document above

Question 14

What is your view on the impact of geographically uniform fees for spectrum bands included in this review? If you consider that a geographic fee modifier would promote more efficient use of spectrum, how might that modifier be constructed?

Answer: issue addressed in main document above

Question 15

Are there other aspects of the review on which you have evidence that would help inform our consideration of these issues and formulate proposals for consultation?

Answer: issue addressed in main document above



Is the proposed list of bands to be included within the review (as set out in Figure A.5.1 in Annex 5 appropriate?

Answer: yes



Visualyse SM and the Lightly Licensed Bands

Transfinite's Visualyse Spectrum Manager (SM) could be used to mange the lightly licensed bands.

This would bring a wide range of benefits including:

- Net cost saving is possible through:
 - Reduced work load for Ofcom staff because end users enter parameters directly using web form
 - Increased fee income due to the improved user experience that promotes use of the band
- Risk reduction and management due to:
 - o Reduced errors using automatic checking of input parameters
 - Better quality data as easy map based user interface including drag and drop rather than need to determine NGRs of sites
 - o Integration with existing Ofcom workflow
 - o Reduce reliance on a single software provider for Ofcom's licensing tools
- New and improved services provided to stakeholders include:
 - o Additional service of link interference analysis
 - o Additional web based search tools including by frequency and location
 - o Additional tools to display links on a map
 - o Additional online reporting tools

It could be the basis to use of a similar approach to the licensed bands

