

FINAL



The Strategic Future of BUSINESS RADIO

Foreword

The use of professional radiocommunications by a wide variety of economic and public interest actors in the UK is and will remain a key factor in the well-being of the nation. Professional radiocommunications is enjoying a renaissance brought about by the introduction of digital technologies and software applications that provide significant additional benefit operational to the users. The introduction of other technology offers the possibility of creating double the number of communications channels where deployed. This could have great benefit in areas where the radio spectrum is congested. Thus the use of professional radio is expected to be expanded into significantly more uses than ever before, providing greater benefit.

Although the contribution of business radio to the UK is extremely large, it remains a little understood aspect of radio communications. The Industry is keen to promote better understanding of professional radio because of the consequences of lost value that may result from its absence.

The pressing need for efficiency in enterprise, the continued requirement for public services, spectrum shortages and new technology advances that address shortages and improved operational efficiency make this an appropriate time for a Strategic Review of Business Radio based on principles of the public interest.

Professional radio is almost always used as an essential tool needed to achieve some other prime goal. It is not like commercial public mobile telephones where spectrum is used to carry a call which in itself attracts the revenue. Thus the value of professional radio is in the benefits it enables and not directly from the call charges. This makes the assessment of the value of professional radio based on the business case of the communications provider misleading. A Government office having an overview of the wider public interest (for example, the Department of Business, Innovation and Skills, BIS) is probably best placed to perform this Review.

The Federation of Communication Services, FCS, has conducted research into the views of the professional radio industry. On the basis of the responses this contribution has been prepared in support of the proposed BIS Strategic Review of Business Radio.

The terms “professional radio” and “business radio” are interchangeable in this report.

Executive Summary

Industry strongly advocates that a Strategic Review of Business Radio is conducted by BIS on the basis of public interest. The recent introduction of successful digital technology and its future developments, spectrum shortages in critical areas, the need for ever-greater efficiency and resilience in enterprise and services of public interest make this an opportune time for a Review. In anticipation of this strategic review, the FCS has conducted industry research on a wide range of topics. The conclusions of this research form the basis of this industry contribution to the impending Strategic Review. The top-level conclusions of the research are summarised in the box on the right.

The financial value of business radio remains a topic for debate in some forums. This seems to the FCS to be a diversion away from more important issues. Nevertheless, a list is provided of sectors using professional radio and notes on the impact to operations were business radio to be withdrawn (as a way of highlighting its beneficial impact). The conclusion is that business radio provides very large efficiency gains for UKplc and many important benefits for the general interest objectives.

The research confirms that because business radio is a specially configured part of the operation of the end user organisation substituting it with a different service is not simple. Where there are safety implications, there is often no substitute at all. On the contrary, the new features and facilities offered by technology advances have given rise to an expectation of healthy growth.

Access to the spectrum in the key locations is likely to remain a critical issue for the industry over the next ten years.

Technological advances have opened the opportunity of reducing the amount of spectrum necessary for voice/message calls to half what is normally used today. Technology has also provided platforms for applications developers to use so that even more operationally efficient solutions can be provided. The older analogue systems are expected to decline in favour of these new digital technologies. These changes are important to regulators and

FCS SURVEY HIGH-LEVEL CONCLUSIONS

- 1. The value to the UK of the use of professional radio is very large.**
- 2. Professional radio is not easily substituted by other schemes**
- 3. New technologies have been introduced to combat the spectrum congestion problems and to meet enhanced user demands**
- 4. There is a strong expectation of future growth if key issues can be resolved**
- 5. A Strategic Review based on the wider public interest in 2010 is strongly supported**
- 6. Flexible regulation will be needed for the future to ensure the UK is well positioned to enjoy the benefits of the new efficiencies and improved safety schemes.**
- 7. Regulation and spectrum management through market mechanisms is not considered applicable to professional uses. A new, directed, management approach may be necessary.**

spectrum managers. More calls can be supported than before and users will want to realise the efficiency gains and so generate more traffic. In addition, the way the user may wish to use the new systems may have implications on regulation and spectrum planning.

Interference is predicted to grow even though digital technologies may be more robust. This is a concern because in high electrical noise environment, which is becoming more commonplace, communications can still be interrupted.

The research showed no support for the continued application of market mechanisms to business radio spectrum management. Business radio allocation may need to be returned to a more 'directed' regime. When conducting the research it was found to be difficult to fairly and accurately introduce totally new management concepts. Thus the research used old terms to assist understanding. In many respondents' comments, the term "command and control" was used. The results of the research reported in this document therefore faithfully reflect this terminology throughout the text when discussing the research results. However, the FCS recognises that there are difficulties with command & control approaches. The research clearly favoured 'command and control' over market mechanisms for assignment. Taking into account this outcome of research and the other factors discussed in this report, the FCS proposes that a new management method should be considered. The FCS calls this proposal "National Managed Radiocommunications" (NMR). Under this proposed new NMR approach, the appropriate management body would have powers to perform assignment, allocation and all other functions without the need of a formal Direction from the Secretary of State. The guiding principle would be public interest objectives rather than market forces.

There was some support for requesting changes that would meet these needs. However, the majority were concerned that having two radically different policy approaches pursued by the same body might be very difficult in practice. The FCS stresses that these contributions are restricted to professional radio communications. No comment whatsoever is made on future arrangements for public mobile communications.

The application of Administrative Incentive Pricing (AIP) at elevated levels is considered to be unlikely to modify the spectrum needs of professional users. They have what they need for their operation and cannot change it. Thus AIP as a policy tool to reduce spectrum holdings is not seen to be so effective in professional radio. A charge for the use of spectrum is long established.

Monitoring may provide an opportunity for detecting potentially unused spectrum. This would assist follow-up actions with licence-holders to check if the spectrum was still needed.

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Introduction

Business Radio is the term used in the UK (uniquely) to describe radio systems, services and products that are intended for the use of professional users. In the majority of cases, they have the radio as an essential tool necessary for achieving a prime purpose which is unrelated to the radio system.

There are many special features and characteristics needed by such users. Over the years practical experience in use has resulted in a set of design goals and operational behaviours that are very different from those applicable to commercial uses such as are provided for by GSM/LTE.

For regulators this presents a particularly difficult problem because a one-size-fits-all strategic approach is not likely to be effective for both types of scheme. The regime for public mobile radio may not work well for professional radio and visa-versa.

Technology

Business radio is undoubtedly enjoying something of a “renaissance”. It is clear that the traditional usage remains fairly strong but technology improvements have re-vitalised the entire sector. There are currently two strategically important development directions. First, technology has been introduced that directly addresses the current lack of channels. This is achieved by providing the capability to have the voice and message data communications (the most common user need) carried on a 6.25kHz channel. This is half the current channel size. Spectrum managers now have the opportunity to significantly increase the voice and message capacity. Secondly, in a normal-sized channel (12.5kHz), slotted communications are provided that permit voice and data communications. This can carry two separate communications but that would require coordination between the two entities involved. This approach has the major objective to provide platforms for applications to be hosted upon thus providing even greater user benefits.

These two technological advances have been inspired by user demand. In the first case, where the technology has (at last) been developed to split the 12.5kHz channels into two 6.25kHz channels, the demand was clearly from the market where significant difficulty is already being experienced in actually getting channels to use (due to congestion). In the second case, the strategy is to address demand for the radio communications to become more deeply integrated with the wider operational process. To achieve this a wide range of software applications is being provided.

These advances have come as a result of very significant levels of investment by the supplier community¹. The delivered schemes will increasingly have to be provided in their entirety

¹ The development of a workable solution to providing voice and data communications to professional standards in a 6.25kHz channel has been a goal for well over twenty years. These new technologies therefore

by the suppliers and distributors because the end-users are less inclined to have in-house expertise of their own. Thus we approach a new environment where there is a way to relieve spectrum congestion for voice and data communications while software applications on flexible hardware platforms provide a new opportunity for users to use professional communications to drive even greater efficiency gains.

These changes in technology have been launched into the market by competing suppliers. They are receiving positive reactions from user community and have already proved sufficient to encourage the development of further models and exciting new applications into what was once a purely analogue market. There is now discussion of the deployment of integrated data services that could stretch to mission-critical wideband and broadband applications in the future (requiring consideration of different spectrum bands).

It is far too early to predict with any great certainty where this might lead but it is clear that a transformation has started and the future for radio communications services that support professionals is assured in this new form. In consideration of the 10-year view necessary for a Strategic Review, many of these transformations should be considered effectively imminent.

Key Point 1:	Technology advancement has opened the opportunity to considerably reduce spectrum congestion and drive better user efficiency gains
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Regulatory and Spectrum Management Approach

Ofcom is an economic regulator with a focus towards consumers. Its functions are set out in the Communications Act 2003. Ofcom policy is to employ market mechanisms (e.g. auctions) for the assignment of radio spectrum to users in the belief that the entity placing the highest value on the spectrum (i.e. pays the most for the licence) is likely to be the one who will derive the greatest value from it by putting the spectrum to the most profitable use. This market approach is advocated in situations where demand for spectrum exceeds supply (the over-riding majority of cases).

In the case of professional radio, market mechanisms are the stated method by which important user groups such as the emergency services should obtain spectrum to meet their obligations to the public. One auction has been undertaken in the more general business radio arena but to-date, a first-come-first-served assignment method has been the predominant means to assign licences. This alternative approach has been necessitated because the available assignments are very fragmented and difficult to auction off in coherent 'lumps'.

represent a considerable achievement that will, in time, transform spectrum management basic assumptions internationally.

The use of market mechanisms for spectrum assignment appears to be applicable to situations where a direct causal link can be drawn between the utilisation of spectrum for a period to support a particular communication and the revenue derived from that same communication. Public mobile telephone networks are the prime example of this situation.

In stark contrast, when for example a public value objective is involved (where the causal link between the use of spectrum and the benefit of the prime objective is much less clear), market mechanisms are not relied upon to bring together sufficient spectrum to sustain the operation. Instead, specific actions have to be undertaken by the authorities to meet this need. The assembly of the spectrum for the 2012 Olympics was such a case. In reality many professional radiocommunications applications should be viewed as public value uses.

Administrative Incentive Pricing is applied to most business radio spectrum. The fees are intended to provoke a review by the licence-holder into whether the spectrum rights held are needed. Applying spectrum fees has been the practice in business radio for many years but is yet to be applied to all professional uses. Having a charge for the use of spectrum is long established. But, there is little agreement within the industry that increasing the fees will have the effect of reducing professional spectrum use. This is because the spectrum is supporting an essential communications tool and so is not a negotiable quantity.

The Value of Business Radio

It is important that the value of professional communications is firmly established once and for all. There have been attempts to portray the value of business radio as being minimal. This is not the case and such attempts are not in the interests of the UK either economically or in terms of the public interest.

Key Point 2:	The principle that professional communications is strategically important to the UK must be a fundamental point underpinning the Strategic Review
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Some uses of Business Radio

Business Radio is used in a very wide variety of applications covering many sectors of UK activity. Its use is often not immediately obvious to the general public until an incident occurs. For information, a selection of sectors employing business radio is provided.

- Aerospace
- Airports
- Banking
- Biotechnology
- Broadcasting
- Chemicals

Construction
Defence
Distribution Logistics
Electronics
Emergency services
Entertainment
Environmental
Events
Finance
Healthcare
IT sector
Lifeboats
Local Government
Manufacturing
Marine
National Government
Oil Industries
Petroleum Terminals
Pharmaceuticals
Prisons
Ports
Public Safety
Retail Stores
Retail Centres
Security
Sport
Telecoms
Transport
Utilities

In some schemes the operational staff also use public mobile networks. However, rarely are public networks utilised for mission-critical communications (quite correctly). Thus the public network is supplementary to the essential operational communications.

It is important to note that these user groups not only seek the supply of private systems but also often wish to have a complete suite of managed services. The size of the user fleets vary considerably. Some have hundreds of radios while many are for the use of only small teams of less than 10 staff.

These current uses form an impressive list already. However, professional radio communications with its characteristics of very high reliability and availability, even in peak periods, could become a radio communication implementation philosophy applied to other

important arenas. An example of such a future application is in Co-operative Highway Vehicle Systems (CVHS) for improved road traffic capability. This would also include Road Train applications using the Electronic Tow Bar principle. The concept of using intelligent systems to permit traffic to travel at speed much closer to each other is very attractive as a means to reduce road congestion. However, whilst the potential benefits are very large, without very high reliability radio communications it could be unsafe.



The future for ITS

Co-operative Vehicle Highway Systems (CVHS)

Dynamic data exchange between vehicles or a vehicle and infrastructure

Key applications:

- **ISA (variable speed limits)**
- **Collision warning/avoidance**
- **Electronic tow bar**



ITS United Kingdom - Better transport through technology

Assessing Value

Because the value of business radio is not considered as part of the business plan of most users except as an essential operational cost, the value to the nation of the use of business radio cannot be assessed in an easy way. However, it is possible to provide an indication of the value by examining the impact of the removal of the business radio facility.

Ground Operations – Airports

The logistical services necessary for the operation of airports use business radio. They are in a very price-competitive environment and need to consider maximising their efficiency in general. However, at the busy airports there is also the important driver of turn-round time for the aircraft.

The Dept for Transport indicates that the UK aviation industry carried 180 million international passengers and 2.1 million tonnes of freight. The CAA indicates 218million

passengers in total were carried in 2009. The value to the UK economy of the aviation industry is variously estimated to be around £20B. Clearly, without efficiently functioning airports, this would be seriously jeopardised.

The security of airports is also a major business radio benefit. This should be considered yet another security application using business radio (see below).

Transport

The use of business radio in the transport sector has changed significantly since the 7/7 attacks in 2005. Previously it was possible to run underground trains without business radio (possible, but not actually done for safety reasons). Now the safety rule is that the trains

No radio = no underground trains

cannot run without professional radio. Succinctly put, no radio = no trains. It is a pointless exercise to seek to calculate the economic loss were the

business radio service withdrawn. London would cease to function and the economic impact would be vast.

Similar rules exist for buses.

Over-ground trains also have equivalent safety rules.

Ports

Ports have safety regulation that calls for the use of business radio as a safety aid. Operational crews are not permitted to work amongst the containers without having business radio available to them.

Outbound tonnage through UK ports in 2009 amounted to 195 million tonnes, while inbound volumes amounted to 299 million tonnes, a negative trade imbalance of 104 million tonnes. This represents around 95% of total UK freight².

In a conclusion similar to the transport sector, taking the business radio away will have a vast impact. There is little point in closely evaluating the economic impact to the UK if 95% of UK freight was delayed; the port could cease to function at all because the disruption could not be accommodated.

Furthermore, were the rules to be changed such that operators could use some other means, the loss of efficiency would equate to a significantly higher rate of delays to loading and unloading. This would mean more ships missing the tides which would have knock-on effects at other ports elsewhere.

² Source: UK Ports & Logistics Ltd. This compares to the 2008 figures from the DfT which report the total tonnage as 562 million tonnes.

Security Guard

A security guard is required to patrol commercial premises, especially throughout the night. At present, they patrol alone (typically) but are equipped with a business radio that both connects the guard with the control room and monitors his condition and location.

Were that radio to not be available, the security function would be provided by either requiring the guard to patrol without such back-up (which presumably would result in a significant wage increase to compensate the increased personal risk and may have serious insurance implications) or the patrol would be conducted in teams of two or more (doubling the cost).

Note: In this application it is clear that the availability of an emergency button on the hand-portable is a key feature.

The UK security industry employs around 600,000 staff.

In year 2008/9 there were 297,000 burglaries of non-residential properties in England & Wales alone, of which nearly 200 were aggravated burglaries³. This translates to 6000 a week. It is clear that the security industry provides a valuable service at the current cost. Without business radio the whole structure would have to be re-evaluated with the likely consequence of increased robbery rates and costs.

Tower Crane Operators

Business radio permits crane operators to be guided by a team-mate on the ground. This greatly speeds up the use of the crane and also improves site safety. There are also routine situations where the crane operator cannot see the load being lifted and so is entirely reliant on the business radio communication with his colleague at the lifting location.

In extreme cases, the speed and immediacy of business radio operation can save lives. For example, a crane operator loading logs into a lorry needs to be immediately informed of a problem. The operational facility to stop a current action immediately is often critical. Using the wrong radio technology could turn an instruction “don’t release the logs!” into “release the logs!”⁴ by simply failing to open the communication fast enough, missing out the vital first word.

Using the wrong technology can kill.

“Don’t drop the logs!” becomes “drop the logs!” if the comms channel doesn’t open fast enough.

The use of business radio on a building site is commonplace. It not only assists the construction efficiency but has benefits towards safety of life.

³ Source: Crime in England & Wales, Home Office.

⁴ Exactly this incident occurred some years ago in a non-UK logging company. 90 tonnes of logs were dropped onto a vehicle with someone still in it. Miraculously, he survived and made a full recovery.

Shop Detective

This is a typical example of the significant benefits of group calling facilities.

Imagine a thief is detected in a large shop by the control room. Using group calling, the description (and even possibly a picture) can be quickly sent out to all the shop detectives greatly increasing the chance of an arrest.

Without group calling it is likely that the shop detectives would have had to have witnessed the theft personally. The result would certainly be the thief has a very much increased chance to escape with the goods.

Clearly, business radio translates into reduced losses from crime and so better profitability for the shop. Multiplied by the number of shops, this becomes a very significant contribution to the UK retail trade.

On the 11th March 2009 a Bill was introduced⁵ to increase the penalties for shop theft and change the current approach which was judged to be not working. The Bill received cross-party support because the level of crime was at the time believed to be in excess of 290,000 incidents per year (over 6000 per week) with a value of not less than £1Bp.a. In fact the Home Office Research Development Statistics Report subsequently indicated that for year 2008/9 the shoplifting offences totalled 321,000 for England & Wales alone.

The cost of a full set of preventative measures such as CCTV was quoted in the work leading up to the Bill as exceeding the losses according to estimates and so these measures are still generally not fully implemented. Business radio schemes to address some of these issues are unlikely to cost anything like that sum and they may well prove more effective in certain situations.

Note: The new digital technologies could integrate the radio system into the video surveillance system. A very fast transfer of the desired images to the detectives on the shop floor could be achieved.

Police Patrol Cars

Of the many important duties the traffic police have, one of the most visible to the public is traffic control after an accident on the roads.

Approximately 2500 people were killed on the roads in 2009⁶. Whilst this is a large number it is actually quite small by international standards. Part of the reason for the relatively low number is the rapidity with which the police are able to respond to such an incident and provide safe routes for on-coming traffic, thereby radically reducing further collisions. This rapid response is facilitated by professional radio services.

⁵ Anne McIntosh: <http://www.theyworkforyou.com/debates/?id=2009-03-11b.298.0>

⁶ Out of a total of 28,500 Deaths and serious injuries (Source: DfT)

It is instructive and somewhat sobering to consider the cost to the UK of additional deaths were the professional radio facilities taken away.

If we assume a modest rise of around 5% increase in the number of fatalities and

Accident/casualty type	Cost per casualty	Cost per accident
Fatal	1,648,390	1,876,830
Serious	185,220	215,170
Slight	14,280	22,230
Source DfT		

serious injuries resulting from the police not being able to reach an accident in time to stop further accidents, we can evaluate the cost to the UK of the loss of professional radio to the traffic police. The Dept. of Transport estimates the cost of a fatal road accident in the UK to be £1.5 millions (see the table above). To that we can add the cost to the insurance industry. Various figures are quoted by different insurance groups but £500,000 appears to be a typical value for a life and £50,000+ for a serious injury. Thus each additional road fatality costs the UK £2M and each serious injury costs £240,000. Over a year this would translate to £560M per annum. Over the life of the typical radio system this indicates using professional radio saves £5.6B.

Power Stations

Perimeter security of power stations has risen in priority in recent years following some break-ins by protesters⁷. Of course, there is no such thing as 100% security effectiveness and incidents will continue. However, due to the nature of the security operation, business radio is used in these applications to give the best chance of preventing accidents and stopping people being hurt while keeping the electricity flowing.

At first sight, having protestors at a power station is disruptive but not actually very serious on a national level. However, with the rise in priority of the nuclear power generation agenda, the security issue takes on a whole new dimension. It is one thing to have some activists trying to stop power generation in a coal-fired power station. It is quite a different matter if the activists try to force the shut-down of a nuclear station.

Note The security personnel at Ratcliffe were using business radio as were the police on arrival. Again, when it matters, business radio is the service that is relied upon. It is not substitutable in these cases.

No attempt in this document will be made to provide a monetary evaluation of the absence of business radio in these situations. It must be obvious that having a nuclear power station in the hands of people without proper training or (in the case of attacks by less well-intentioned groups) without scruple, even for only a short time, is a grave matter. It goes well beyond economics.

⁷ Example: 17th October 2009, Ratcliffe, Nottinghamshire; 80 Arrests.

Oil Industry

In common with many other industries, professional radio has a safety role in many operations. This extends to teams working in hazardous environments where flammable gas may be expected. Intrinsically safe equipment is a necessity in these situations.

It is not clear how the removal of professional radio of professional radio from these operations could be safely overcome.

Conclusions on Value

The above examples show a variety of impacts arising from the absence of business radio from operations. There are a significant number more to be considered. However, it is clear that the benefit of the use of business radio for the UK both economically and in terms of the public interest is very large. The FCS considers that the value is of such a magnitude that it appears to be unnecessary to perform further detailed evaluation. The old debate about whether business radio has value to the UK should therefore stop, permitting the Strategic Review to concentrate on what measures are necessary to ensure the greatest benefit can be gained for the UK.

Key Point 3: **The value of Business Radio to the UK is very large. It is unnecessary to focus the debate solely on the “value” of Business Radio but to widen the analysis to getting the greatest benefit for the UK instead.**

The Strategic Review

Professional radio communications are employed in a very wide range of applications. Some of these applications are clearly safety-of-life types of communications whilst others are not. However, the use of radio-communications is always, to some degree, mission-critical to the achievement of the prime goal. For this reason it has long been recognised that the professional uses of radio spectrum are vital to the well-being of the UK. This is both in terms of economic value and for the public interest. Today we face real congestion issues in some locations and bands. Entities that need spectrum in order to benefit from the efficiencies of business radio are being denied access.

This basic fact together with the recent advances in technology that actually do permit more channels from the same spectrum resource and the widening of the capabilities of the applications make it desirable that a Strategic Review of Business Radio is conducted on the basis of public interest. In order that public interest is fully included, it may be most effective if BIS were to conduct this Review.

Key Point 4: **It is very desirable that a full Strategic Review of Business Radio is conducted by BIS in 2010 on the basis of the public interest.**

The Topics for Inclusion in the Strategic Review

The business radio community within the FCS would like to propose the following topic list for consideration of being included in the review:

- Implications of technology advances on spectrum planning
- Future spectrum management assignment arrangements & licensing
- International matters – European issues
- Transition arrangements
- Numbering databases / registration
- Technology neutrality impacts
- Changes to stakeholders' and new behaviours
- Future-proofing, noise floor and building materials
- Spectrum traffic monitoring
- Enforcement for interference protection and product conformity
- Maritime & Aeronautical
- Specific points on critical national infrastructure
- Specific points on the emergency services
- New spectrum managers and trusted spectrum managers
- Administration matters
- WRC 2016 et al.

A Market Based Approach is Not Applicable

Spectrum used for consumer applications, where the business revenue is directly linked to the actual call itself, is relatively easy to evaluate in terms of a commercial worth. Using market mechanisms in these cases is believed to be an appropriate strategy. Business Radio communications are an important or essential component in the acquisition of a different goal. A communication's individual value is rarely (if ever) commercially enumerated and so the radio system is better viewed as just one of a number of costs incurred by professional entities in the process of addressing their prime goal.

An analogy would be a delivery company using radio to improve the efficiency of its service and diesel to power its vehicles. There is no question of using auctions to acquire the diesel it uses even though it is a scarce resource. The fuel is just an essential cost. If the price of diesel increases, the company simply has to pay more. It cannot reduce the amount it consumes except through the acquisition of better technology (i.e. buying better vehicles). The company will view its radio-communications in a similar way. It cannot reduce the amount of radio spectrum it uses because the impact on the efficiency of its delivery service (the prime goal) is adversely affected if fewer calls are made. So the increases in the traffic carried by the spectrum (that typically can be expected as time progresses) have to be supported either by obtaining more radio spectrum or by the introduction of new

technology that can make better use of the spectrum already available – probably both approaches will be necessary.

There is an apparent contradiction between the value of business radio (including all its variants) and the inability of the actors in the professional communications market segment to pay very large prices at auction.

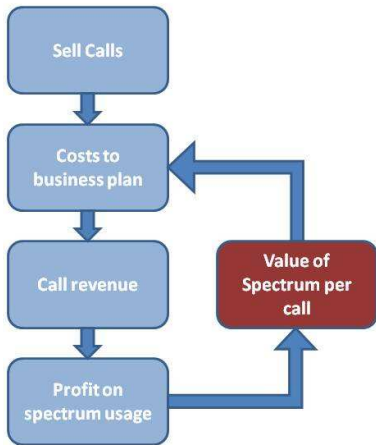


FIGURE 1 - DIRECT SPECTRUM VALUE

Of course, there is no real contradiction. The place in the value chain where the value of the overall objective is assessed is not the place (or even the same people or entity) where the business radio spectrum is paid for. A mobile network operator calculates that each call takes a certain amount of spectrum resource. In relation to the revenue, an accurate value can therefore be attributed to that spectrum unit. Significantly, they are in an environment where doubling the spectrum

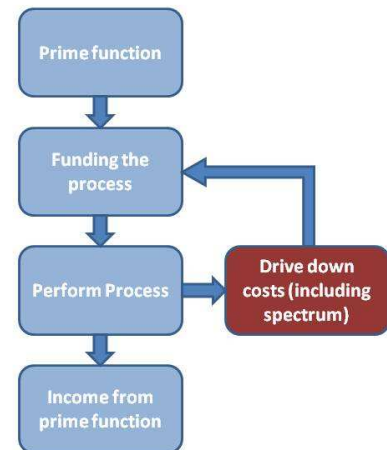


FIGURE 2 - INDIRECT SPECTRUM VALUE

available could double their capacity and so eventually their revenue (Fig 1). In the case of a business radio deployment, the end-user is typically rewarded by a completely different prime function with the radio-communications network simply being considered an essential cost. As with all costs it has to be minimised if possible (Fig 2). These solutions are under price pressure from their customers. There is no consideration of buying licences in the context of a spectrum-based business plan. The end user is likely to be interested in only his or her deployment rather than a unified scheme so the purchasing power is fragmented.

Key Point 5: **The evaluation of business radio spectrum is completely different because the people who derive the most benefit from the use of the spectrum are driven by unrelated goals.**

Mission Critical Calls

Not all calls have equal value to the UK. Some calls or data exchanges save lives, prevent injury or avoid significant commercial loss. Certain types of organisations are far more likely to undertake important (mission-critical) calls or data exchanges than others. Typically, these organisations take a lot of care over their communications and so have high-integrity communications. Business radio is very much more likely to be deployed by those organisations. Business radio has a very high proportion of mission-critical use. The price of

the spectrum is rarely a consideration for managers seeking to deliver an unrelated prime goal in this situation.

Key Point 6: Not all calls have the same value to the UK. Business radio carries a high proportion of mission-critical calls.

Certainty for Investment

Suppliers need certainty over the regulation applied to business radio. This is necessary because of the high level of investments necessary to bring new products to market.

Market mechanism policies for spectrum management provide no clear idea of either the designated spectrum band or the conditions of use. This makes designing equipment very difficult. It may also increase fragmentation and reduce international harmonisation. This makes providing users with scale economies difficult.

Key Point 7: Market mechanisms undermine the necessary certainty that suppliers need in order to justify important investment decisions.

Administrative Spectrum Pricing (AIP)

AIP has been applied to Business Radio for many years. The stated objective of the policy is to provoke a review by the licence holder of the amount of spectrum being used. It is difficult to envisage this working in the case of Business Radio. Any fee would achieve the prime goal of causing the rights holder to consider whether to pay or the return the spectrum (all invoices are reviewed irrespective of value). Because users either need the operational safety or efficiency gains provided by their professional radio system or they do not need system at all. They will not seek to reduce the amount of much spectrum they have if the price increases.

If the fee for spectrum was raised to the point the efficiency gains from the system were eliminated by the spectrum cost the entity would abandon the use of professional communications in their operations and accept the lost efficiency that would arise as a consequence. In the safety-related circumstances, if the spectrum charges would be raised the cost increases would be simply passed on to the end customer. There is no question of ceasing to use spectrum or even reducing the usage if safety were to be compromised.

There may be a view that by increasing spectrum charges industry will be provoked into making more efficient systems and introduce new technologies. This has not been the experience to-date. New technologies have been created in response to spectrum congestion and increasing user demand for more communications with better facilities, not in response to spectrum pricing.

Key Point 8:	Increasing spectrum fees is likely to simply increase costs and reduce the users' return on investment when purchasing these professional systems. Increased fees therefore mean reduced overall efficiency for UK enterprise and lower public interest achievement.
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Future Technology Vision

The next five to ten years should see very exciting technology advances in the business radio arena. There will be continued pressure to make more channels available. This will be alleviated to some degree by the 6.25kHz solutions provided that an appropriate regulatory environment is provided. There will also be enhanced demand for ever-more applications to meet end-user detailed operational requirements.

Today's solutions have made a good start and their early acceptance by the user community has greatly encouraged the supply industry to continue to invest. However, it is not possible to predict what the future development will be beyond the follow general statements.

The following statements have been guided by the Industry Survey reported at the end of this report.

Churn

Business radio uses very high reliability equipment that may well have a useful life of fifteen or even twenty years.

To-date, users are content with the system and replace units when they break. However, with the advent of the new opportunities provided by technology, this may no longer be a true reflection of the future market behaviour. The need for more channels or for better process integration could provoke upgrade decisions that would not otherwise have occurred.

Industry opinion has been sought on this. In general, it is believed that by the end of the period considered by the Review, most analogue equipment will have been replaced.

Analogue Professional Radio

This segment is the most well established of all professional use. It uses 12.5kHz channels in the traditional PMR bands. These bands are harmonized as tuning ranges across the CEPT region.

This is generally very high specification radio equipment. However, it cannot provide the enhanced user equipment nor work at 6.25kHz channel-spacing. Thus the general industry view is that analogue systems will slowly be replaced by digital solutions of various types. By the end of the 10-year period it is possible that analogue usage will have declined down to quite low numbers.

Low-cost, licence-exempt mobile-to-mobile communications

This market segment is expected to continue for the foreseeable future as today. This is because it appears to have found a market niche in segments such as sport and leisure that will sustain it. The current analogue units are expected to be replaced over time with the newer digital technologies. The cost points on this service are now very low and it is difficult to see how they could be reduced further.

This service is perhaps unique amongst the business radio family in that it is primarily intended for lower-priority communications with only occasional use. Nevertheless, there are some groups who use these equipments in certain security applications.

In summary, growth is expected to be modest overall with digital technologies replacing the analogue units.

Higher-Tier Business Radio

The introduction of new digital technologies is already acting as a major transformational agent for business radio. The suppliers of equipment have sought to address the two main problems facing the users. The first problem is having channels available on which to operate, the second is providing the facilities that will drive greater benefits.

The 6.25kHz technology recently developed is a major advance on previous solutions. It permits a theoretical doubling of spectrum capacity for voice and data message communications where deployed. It ought to prove to be of great benefit in congested areas like London. There is a lot of scope for further advances using this approach and it is expected that this will prove to be the only available solution for many future users. This is clearly something that regulators should actively follow up and make plans for accordingly with adjustments not just in the UK but internationally.

The DMR technology seeks to provide a platform upon which software applications can be hosted. It uses standard 12.5kHz channels but operates in a TDMA⁸ scheme. The development of these hosted packages is typically performed by other suppliers. This is a very important point as some of the end-user demand for new services might be met in future through software upgrades rather than hardware change-out. This greatly affects the overall cost of the migration. The demand for this approach has been to some extent proved. It is believed there is significant and growing user demand for advanced and flexible business radio.

It is important that regulation is kept 'technology-neutral' to avoid placing limits on the future development of these solutions.

Higher-tier approaches remain the solution of choice for several voice and data users. TETRA, although an old technology remains virtually unchallenged for many such

⁸ Time Division, Multiple Access

applications. Many on-site applications would seem to be sufficiently sophisticated to warrant the deployment of solutions such as TETRA. However, whilst there are such deployments, the lack of suitable spectrum coupled with high cost often results in a different approach being adopted.

The industry view is that higher data rates will be an essential component of future operations for these high-tier users. There is doubt whether TETRA will be modified to meet these higher data rate demands (>1MB/s say). Transitioning to another technology may well be the chosen approach within the time-scale of this review. This is of course a serious issue because it is not clear in what band such applications could be supported.

Some on-site solutions are particularly innovative. They combine the use of internet routers with business radio to provide wide area individual calling, professional grade communications. It is expected that this type of solution may become very common over the next five years. They replace expensive communications call switches in the radio system. This approach uses less expensive technologies in sophisticated ways.

Key Point 9:	Higher tier schemes are expected to enjoy strong growth and experience significant further technical advancement.
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Mobile Data Services

Mobile data services are difficult to define because they encompass a very wide range of different schemes. They range from simple message passing through to very sophisticated interchanging. Recently, the concept of interfacing with intelligent transport systems has been suggested by ETSI.

The possibilities for growth in this segment are recognised. It is believed that these solutions will continue to advance in terms of delivered benefits. The new traffic may have to be carried on a variety of spectrum bands in the future as data rates increase to wideband and broadband (1MB/s and above say).

Additionally, this segment also uses concepts of time division operation (for example such as were conceived under IR2008). Other schemes also work in time division and could easily be adapted to professional use were the market to be demonstrated. For example, a professional version of WiMAX or LTE could have a number of important professional applications.

Equally, some standard applications could emerge that would themselves drive high volume. For example, connections to smart metering in the home may be desirable.

Key Point 10:	A variety of solutions using mobile data could be a key growth area. Spectrum in other bands may be needed.
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Prime, mission-critical communications

These are usually very long-life, high integrity systems that are implemented with the very best technology available at the time.

The next five years will see the future emergency services plans being firmed up with possible extensions to the data-carrying facilities added to their field operational capability. No comments can be made on technology choices. However, it is worth noting that the emergency services will seek to maximise the benefit from the economies of scale through international harmonisation at ETSI. Work on this has started.

It is expected that the data carrying capability is to be significantly increased. The overall total amount of spectrum made available would also have to be increased. As the increased operational capability is very likely to include at least wideband content with perhaps localised broadband capability added (at discretion), the necessary increase in spectrum resources could be very significant.

The power utilities, ports & airports, refineries and a host of others all will need enhanced communications within the scope of the Review. All these groups do share a lot in common with the emergency services in terms of their operational requirements but they often have additional schemes that are equally important. Power utilities have extensive telemetry systems that control the provision of the electricity we use for example.

Key Point 11: **The Strategic Review will need to consider how future spectrum demands are met. The use of market mechanisms is problematic. The industry research has revealed significant support for a return to ‘directed’ management methods.**

Professional wideband and broadband

These schemes are not usually included in the professional class at present to any great extent.

High data rate systems are very much more difficult to implement to the same high availability standards as lower data rate systems. Even so, in a five-year timeframe there could be an increase in the number of these schemes. Commercial systems providing these data rates will become more common and it may be that it will be possible to leverage those facilities to provide professional class systems in some way. However, standards are also evolving and it is clear that some derivative of a commercial standard such as WiMAX or LTE could emerge.

The inclusion of wideband services into the professional portfolio has been done many times already of course. However, the resulting system is often on a “best efforts” basis. Many users make good use of these facilities but they are complementary to the main voice/data service and not considered appropriate for mission-critical content or safety

applications. Were professional higher data rate schemes to come available, it is believed that users would make use of them. This is impeded today by lack of spectrum on which to carry the traffic. This restriction also undermines investment in the research and development investments necessary to realise such systems. However, the operational efficiency gain would appear much less challenging for a user to justify investment if the solutions were priced moderately.

An international spectrum and regulatory harmonisation approach for professional wideband and broadband services would offer the potential of great benefits.

Market saturation is not a significant factor because of the low starting point in terms of penetration of the user base and the extent of integration remaining to be explored.

Key Point 12: Professional radio is not a declining market segment. Business radio is set to be transformed to provide significant new benefits through new technology. This transformation is only just starting.

Licensing Products for Business Radio

Ofcom currently offers the following licence types:

- Technically assigned licences
- Area defined licences
- Suppliers Light licences
- Suppliers UK Licences
- Simple Site Licences

This is a comprehensive scheme⁹ that places all requests for assignment into one of these five licence types¹⁰. The old system has been completely replaced.

There are some important points that will have significant influence in the next five years and could prove difficult for some applications.

Future Licence Flexibility

Future professional applications could well need band planning structures not used today. The current spectrum congestion, now can be alleviated by a technological approach in the form of the 6.25kHz channel scheme that, where applied, could double the spectrum capacity. The FCS believes that the future licence regime should be such as to maximise the opportunity to gain these advantages.

⁹ See: http://www.ofcom.org.uk/radiocomms/ifi/licensing_policy_manual_2/different_classes

¹⁰ For the sake of clarity, this analysis does not consider licence-exemption which also has a licence but it is not held by the user.

The future demand for more data, the need for ever-deeper integration into the operation of the users and the need for more channels could result in radio solutions that have a flexible approach to bandwidth demand. These could off-board communications to other schemes or particular communications to other channels and re-assemble them at the destination. There are likely to be arrangements that share spectrum dynamically in a very rapid manner. These approaches could be problematic under the current licence regime.

From a spectrum management perspective, this would affect the raster arrangements, the trading rules and the compliance requirements. Block-edge transmission masks may have to be introduced to cater for concatenated channels used in blocks. If interference continues to rise as industry expects it to do, there may be a case for looking at the inclusion of receiver performance parameters in specific cases.

Time Division of Licence Assignments

Some mobile data schemes operate on time-slots¹¹. Some users may seek to share capacity on a time-division basis. This possible solution may become attractive as spectrum continues to be scarce. In this case, the licence might be split into several time-shares for the same channel.

The potential for the use of such time-division strategies is not limited to mobile data applications. DMR has slots which could be used in a similar manner in the future. Whilst the current data rates are modest, nothing prevents this from changing in the next five years.

The details for this need to be discussed but the concept should at least be included in the Review.

Key Point 13:	The Review should include an examination of the licences to make them more flexible.
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Cognitive Radio

There is a lot of work in progress in relation to the so-called TV Whitespace to introduce cognitive radio (CR) into the band. There are two types of cognitive radio under discussion.

CR based on detection

CR based on a geo-location database

CR based on geo-location database looks to be a promising approach although the establishment and maintenance of such a database is, to say the least, somewhat

¹¹ IR2008 et al

challenging. Whilst this may be so for TV, business radio will be moving. A geo-location database may therefore be an ineffective strategy.

Business radio has several key characteristics which have to be preserved in order that the objective that gave rise to the communication succeeds. In relation to cognitive radio the key parameter is of course, the channel availability at the time needed. Transmissions from other services that block or even only interfere with mission-critical communications are to be avoided at all costs.

The use of detectors to inhibit transmissions when priority traffic is on the channel has been implemented in five-tone (and other) schemes for some decades. It is called “transmit inhibit when busy” or some similar phrase depending on the manufacturer. It works to a good degree in the intended situations but predictably, it suffers from the hidden node problem. This has limited its adoption.

Following this experience it is possible to say with some confidence that Cognitive Radio schemes should be kept out of business radio channels where mission-critical communications can be expected.

Key Point 14: **Experience over many years indicates that Cognitive Radio strategies should not be seen as a valid approach for new services in business radio spectrum carrying mission-critical communications**

In the case of licence-exempt spectrum, a properly designed CR system may prove of some advantage. It is possible that the suppliers of the business radio schemes operating in that spectrum may choose to introduce a similar device themselves. However, there are so many devices already in the band that the gain from the introduction of CR may be limited.

Software

Future user solutions are likely to be provided as much by software applications running on host hardware as by new products. The regulation that will be applied to software applications remains unclear. This lack of certainty, left unaddressed, will become increasingly problematic in the next 5 to 10 years. Who has the obligations for conformity and what the arrangements will be for assessment should be resolved as soon as possible.

Interference

As the amount of traffic increases and the variety of solutions grows, it is likely that a greater level of interference will be encountered. Digital radio technology often appears far more resilient to interference than analogue because it can block the interference from the user. However, there are still drop-outs and range reductions. These still cause communications to fail.

It is clear that having all the different technologies all mixed in together is not a technically optimum solution and so action to address this is necessary. Since there appears to be a significant rise in the noise floor already, it may be considered prudent to take action on this almost immediately. This may necessitate the revision of the international arrangement of the PMR bands under T/R 25/08.

Transition arrangements for this should be undertaken as soon as possible because the relatively low numbers of such units at present makes this the most opportune time for such changes.

In conclusion, interference is expected to remain a serious concern to the industry. A strong Radio Investigation Service is considered to be a very important success factor.

Key Point 15: Spectrum arrangements for an increased level of interference should be undertaken as soon as possible.

Numbering Databases

The introduction of digital technology necessitates control of the over-the-air signalling identity numbering for each scheme. MPT 1327 also had identity numbers so the problem is not new. Control and maintenance was performed at the top level by the Radiocommunications Agency (then continued by Ofcom).

It is most desirable that this control function be provided by an independent body in a manner that give ranges of numbers to prospective suppliers.

The maintenance of the database so that units can be identified by enforcement officers in any country would be an expected outcome.

The industry survey investigated what approach should be followed for this. However, it became apparent that this was actually a very delicate subject and so it is recommended that this is a topic for the Review.

Key Point 16: The creation, ownership and maintenance of numbering databases is a key topic for the Review.

Other Changes that Impact Business Radio

Business radio does not operate in isolation. The propagation characteristics for business radio (in common with other radio) are affected by new building materials which tend to contain more metals. This is particularly prevalent in cities.

Also the increase of computer data rates and the digital revolution has caused the noise floor to rise. This particularly affects business radio as it operates at lower frequencies and with more sensitive receivers. Cases exist of noise floors rising such that squelches are set

to 2.5 μ V today that were once operated efficiently when set to 0.5 μ V. With the growth of internet traffic this effect is expected to get more pronounced, perhaps making operation in some bands very difficult.

Industry has not performed an exhaustive survey on the noise floor rise. However, some reports of typical expectations indicate that the floor has risen by 9dB over the last ten years.

Access to Spectrum

The availability of suitable radio spectrum is central to gaining the benefits for the UK expected from business radio in the future.

The lack of available spectrum in congested areas is seen by industry as one of the key concerns to be addressed in the Review. In the case of the critical national infrastructure and emergency services users, there is already a strong debate in progress.

The Ministry of Defence is currently looking at what further access can be provided to spectrum they hold. This project is important for the future but at present there have been few actual new transfers or shares.

Assignment Processes

With the current focus on market mechanisms there is a real concern that future business radio applications will not be deployed because they are not supported by the necessary spectrum. By definition, this cannot be in the interests of the UK.

Key Point 17:	There is concern over the assignment of spectrum for professional applications through market mechanisms. Lost value is not in the interests of the UK.
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The majority of business radio licences have up to now been assigned on a first-come-first-served basis. This is an inevitable consequence of technology neutrality principles having removed the basis for technology-specific allocations, the fragmentation of the spectrum market and the near impossibility of assessing the commercial value of the spectrum. It is worth noting that as a principle, this policy attracts few complaints and indeed has support.

There are clear priority cases that have to be catered for in the national interest. It is proposed that a mechanism be created whereby this can be accomplished through Government intervention by the responsible Department(s). In practice this approach has already been used. The Olympics is a recent example. An extension of this policy to other public interest situations is proposed.

This intervention would extend to all bands where professional radio schemes were to be deployed. Thus a broadband scheme serving a purpose deemed to be in the national interest should be assigned spectrum in the relevant band under the direction of the Government Dept.

Key Point 18: **Assignment should continue on a first-come-first-served basis unless a case can be made for intervention by the Government. It is believed that a “directed” approach to assignment would be more effective for this segment than market mechanisms.**

It is worth noting that industry members operating away from the congested areas of London and other major urban areas find the current Ofcom system of assignment on a first-come-first-served basis (with discussions and agreements) very effective.

Spectrum Trading and Databases

Spectrum trading now has hundreds of entries on the register. However, even allowing for recent proposals, there are some serious problems with the use of trading as a means to access spectrum.

1. The new rules have short time limits that may reduce the value of any trade
2. The complex process which implies a large amount of legal costs greatly restricts the number of occasions a trade may be usefully undertaken
3. The difficulty of assembling a set of usable channels in a timely manner for a project due to licence-holder fragmentation remains severe.

Under these conditions, trading is not seen as a strategically important tool going forward. It is and will remain a valuable approach when seeking a small number of channels at a particular location from a willing seller. Several trades have been successfully completed on that basis.

Re-Alignments

The traditional PMR bands are fragmented and may be in the process of becoming more so as new technologies are deployed.

The deployment of different technologies, data systems mixed with voice and a number of other potential approaches could well be inhibited by today’s fragmentation. Re-alignment, although very expensive, may become the only option in the long term¹².

¹² The situation is similar to a computer. No-one likes de-fragmenting the hard disk. However, there comes a point when the slowness of the computer makes defragmentation the more attractive option.

This has international implications. Considering the need to provide very cost-effective solutions due to the nature of business radio markets, the economies of scale must be sought wherever possible. Today the transmitters and receivers are designed to operate over the entire tuning range. This allows the same hardware to operate in all the different national plans. There are severe technical problems for the engineers (the transceiver Q is perhaps as low as 4!) in meeting the harmonised standards all over the tuning range. There has been an impact on product cost.

Alignment and even sub-banding strategies based on intended use may provide significant overall advantages.

Key Point 19: **The review needs to include consideration of re-aligning the spectrum to open more radio spectrum for advanced uses. Improved certainty over harmonised frequencies may improve product cost.**

Commercial Spectrum Managers & Trusted Managers

The creation of a commercial band manager to look after business radio spectrum should be further explored in the Strategic Review as there is some support for this in principle. However, how it would be established, its duties and what spectrum it would be assigned remain to be resolved through discussion. At this stage it is not clear how such a body could avoid competition concerns without the establishment of two such bodies (or potentially more). Nevertheless, there is a view that a spectrum manager could be a viable option if spectrum could be made available.

The approach of a commercial spectrum manager for spectrum to be used by Government is expected to present even more challenges.

The establishment of a trusted manager is potentially a very different subject. This document makes no comment on trusted managers but assumes that this subject would also have to be included in the Review.

Key Point 20: **The Review should consider the issues surrounding commercial spectrum management**

Observation on Organisation

It is for Government to decide upon suitable organisational arrangements for spectrum management and regulation. In this report, industry puts forward observations and suggestions.

It would appear to industry that the effective and efficient regulation of commercial radio communications such as mobile network operation and professional radio communications

are very different animals that may not be at all easy to combine. The operational requirements are totally different. The products are different as is the end-user customer base. Furthermore, there seems little possibility of this divergence ending¹³.

Many professional users will make good use of the services of public networks and incorporate those services into their operation alongside the professional products. They will not generally seek to have mission-critical services on public networks unless they perceive there to be no alternative. Even then they will be extremely cautious of doing this and will have considered the impacts and additional risks. Equally, they will not seek to place traffic that the public network handles well onto the professional scheme unless other factors prevail at the time. Thus there may be no market drivers in existence that force the consolidation of these differences. Separate regulatory approaches seem to be necessary for the foreseeable future.

In addition, there are very few offices where an overview of the public interest can actually be provided; a Government Department such as BIS being perhaps one of the best placed to accomplish this. It would therefore be useful to consider establishing the professional use of radio as a group under the UK Spectrum Strategy Committee in a manner similar to that done for the Emergency Services. Indeed, the Emergency Services are only one manifestation of professional use.

It is not clear to industry how professional radio communications could ever easily fit into a regulatory paradigm that stresses the use of economics and considers consumer benefit. It may be time to consider a separated approach for the management of professional radio communications on public interest and enterprise efficiency principles. Industry hopes that the regulatory arrangements will be considered by the relevant offices as part of the Review. Whether the new body would be an independent Agency or, an Authority under a Government Department is of course, a matter for others to consider. Either way, there will be a need for excellent technical management skills to ensure the most efficient use of the spectrum. The necessary technical expertise currently resides in the Private Business Systems Group within Ofcom. Such technical expertise cannot easily be replaced or duplicated. Industry is keen that this vital resource and skill set is not lost.

These are matters of high priority because spectrum shortage and applied regulation affects the likely long-term benefits deliverable to the users and thus the growth of the industry.

The success achieved so far with DMR has provided excellent evidence that users see the benefits and are willing to move to new operational paradigms. Nevertheless, despite this

¹³ Whilst there have in the past been commentators who considered everything could be done on public networks, knowledgeable experts know this isn't the case and indeed, public operators should not be required to provision their networks for professional users; traffic characteristics without appropriate compensation.

excellent start, transformation is going to be a long duration project with very significant further work and investment necessary. The strategic gains for the UK are potentially immense.

The Review could also include consideration of an independent spectrum manager establish on a commercial basis. How this would work would be a matter for careful consideration.

Key Point 21: The Review needs to separate the management of professional radio from the management of the commercial use of radio.

Nationally Managed Radiocommunications

The research clearly indicates little support for market mechanisms as a means to assign spectrum for this sector. The discussions undertaken as part of the research indicated a preference for “command and control”¹⁴ mechanisms when compared to a market approach.

The FCS is clearly aware of the difficulties associated with command and control and so would urge that consideration be given to a new directed management approach. The FCS therefore proposes the Strategic Review considers the concept of Nationally Managed Radiocommunications (NMR). This is envisaged as a complete suite of management functions ranging from international harmonisation activities through to field enforcement. It would encompass new approaches to allocation to ensure the full benefits of technology can be obtained, assignment, licensing and fees, monitoring and all other associated tasks. It would not be limited to the spectrum matters but would include in its scope the entire range of professional radiocommunications matters.

The fundamental guiding principle for NMR would be the public interest.

There would be no need for formal directions from the Secretary of State for most of the activity although this facility would presumably remain in place.

Key Point 22: The Strategic review should consider the implementation of the concept of Nationally Managed Radiocommunications to replace the market approach for professional radiocommunications.

Enforcement (& Product Conformity)

The introduction of several new technologies and the greater utilisation of the radio spectrum could well bring with it several additional challenges.

¹⁴ The term “command and control” was used in the discussions with the respondents as a means to ensure the clearest understanding of the concepts involved. All respondents are familiar with command and control and so could make an informed comment.

Over the next five years the amount of traffic generated by professional applications is expected to rise significantly. This will place severe strain on the spectrum resource. The presence of illegal transmissions will be correspondingly more destructive. Thus the operations of the Radio Investigation Service (RIS) officers need to be enhanced to remove as much of this illegal channel occupancy as possible. RIS services personnel may need further equipment to identify illegal transmissions.

The changes in professional radio could involve the introduction of new products and systems that have bearing on the spectrum itself (for example short-term usage in congested areas perhaps with an over-the-air “kill” function). Whatever the new regulations will be that control this, it will be important that the products actually do obey the rules. Non-conformant product could become a significant problem very quickly in certain situations. Product conformity is expected to raise its priority.

The likely impact of the New Legislative Framework in relation to both the accreditation of test laboratories, notified bodies and market surveillance is noted in this context.

Monitoring the Spectrum

Market mechanisms are not intended to prevent hoarding and so spectrum could be withdrawn from use if the winner of the bid contest so chose. By this means a market actor could seek to eliminate competition by simply obtaining the entire available spectrum even though they had no need of all of it themselves. Under the current policy this is considered acceptable.

The professional radio spectrum could be considered a completely different matter. The uses to which it could be put may well have a national significance. Hoarding professional spectrum could very well be considered inappropriate. Professional radio spectrum may be auctioned in any case and so hoarding could be an issue to be resolved.

Other mechanisms may exist (or may have existed in the past) whereby spectrum is now not being used. It is understood that there is no firm data on how much such spectrum may be “lying fallow”.

The professional radio licence database records assignments. Monitoring remains the only available means to test whether the spectrum is actually being used or not. It is therefore recommended that the Review includes consideration of the deployment of enhanced monitoring facilities with a view to instigating a use-it-or-lose-it policy. Monitoring could identify quiet spectrum. This would guide further enquiries with the licence holder to see if they still have a need for that spectrum.

Key Point 23:	Monitoring should be enhanced to the point under-used spectrum can be identified
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International Implications

The regulatory and frequency matters associated with professional radio are mostly internal to the UK. However, there are some key points that are considered in this document that are thought require significant UK effort towards CEPT and the EU.

In the spectrum arena these mostly concern arrangements to harmonise spectrum blocks to achieve the economies of scale. There may be changes in standards to address block-edge masks etc.

There are a number of areas where the EU has no jurisdiction. Nevertheless, the EU is an important arena for the professional radio industry as the product conformity is addressed in DG Ent and spectrum matters are handled in DG Info.

Similarly, CEPT has several groups which look into professional radio matters¹⁵. The outcomes in these groups are instrumental in defining future market potential.

Industry therefore advocates continued representation of the UK at these important groups.

The PMR bands are currently harmonised as tuning ranges rather than as actual defined bands. As noted above, this has had long-standing product cost and complexity implications. Whether any action to assist this is possible could be a matter for the Review.

Industry believes there is a clear need for a review of the spectrum made available to critical national infrastructure and the emergency services. This may well include international arrangements to achieve harmonisation.

Specific Points on Critical National Infrastructure

Industry takes the view that even within the professional radio communications segment, critical infrastructure is a special case. This is because the implications of something going wrong could be so severe.

For example, the implications of a black-out of electricity are widely understood to be a matter of national importance once the black-out becomes widespread. The loss of electricity would soon result in the loss of transport, gas and water services. Our society could grind to a halt within days.

Professional radio services are widely used in the utilities to help prevent such occurrences becoming serious. Many of these systems need enhancement to be better integrated into the overall operation and that will need spectrum to sustain the resulting traffic.

¹⁵ FM38 is of prime importance

Because of low unit volumes, international harmonisation would be most desirable. All utilities face similar problems and so the economies of scale could bring prices down and making the market more attractive to suppliers.

Currently, the policy that spectrum for the utility services has to be obtained at auction assumes the following:

- That suitable spectrum happens to be being auctioned at the time they need it
- They have the necessary financial resources to guarantee success at auction

Of course, neither is likely to be the case. The utilities have an obligation to keep their services running and they need certainty in their planning. The market mechanisms approach assures neither objective.

Planning in the transportation sector (for example) is very long term. A 15-year view is essential for many projects. Considering the projections for congestion and its impacts on the nation the use of the radio spectrum by transport bodies is a part of these long-term plans.

Industry takes road congestion seriously. The road congestion figures from the DfT National Transport Model are provided:

Table 1: Summary of Key Forecasts

England, Forecast Change compared to 2003	Year	Traffic (Vehicle km)	Congestion (Lost time/km)	Journey Time (time/km)	Road Traffic Total Emissions		
					CO ₂	PM ₁₀	NO _x
Central Forecast	2010	4%	1%	0%	-8%	-40%	-43%
	2015	17%	17%	3%	-3%	-52%	-57%
	2025	32%	37%	6%	-3%	-48%	-57%

Source: NTM

Table 3: Forecast Traffic by Vehicle and Road Type

Vehicle kms, Change from 2003	Year	London	Large Urban Areas*	Other Urban Areas	Rural Areas	All Areas	Motorway	All HA Trunk Roads
Cars	2010	0%	3%	4%	4%	3%	4%	5%
	2015	12%	14%	14%	17%	15%	19%	19%
	2025	26%	28%	27%	32%	30%	37%	36%
LGV	2010	11%	11%	11%	11%	11%	11%	11%
	2015	31%	32%	32%	32%	32%	32%	32%
	2025	61%	62%	63%	63%	63%	64%	63%
HGV	2010	-1%	-2%	0%	-1%	-1%	-3%	-2%
	2015	4%	4%	5%	7%	6%	7%	7%
	2025	11%	11%	11%	16%	14%	17%	17%
All Traffic	2010	2%	4%	4%	4%	4%	4%	5%
	2015	14%	16%	16%	18%	17%	19%	19%
	2025	30%	30%	30%	35%	32%	37%	37%

* Large urban areas include Metropolitan areas and towns and cities with a population of more than 250,000; Source: NTM

The highlights from the PM Strategy Unit are:

Transport challenges faced by UK cities.

Assessment of impact of transport on the urban economy, health and environment

Estimated measurable annual costs:

- Congestion delays (£12.0 billion)
- Road collisions (£9.3 billion)
- Poor air quality (through particulate pollution) (£4.5 to £10.6 billion)
- Physical inactivity and growing levels of obesity (£10.8 billion)
- Greenhouse gas emissions (£1.2 to £3.7 billion)
- Noise (£2.7 billion)

Source: Prime Ministers Strategy Unit (2010)

Planning certainty and a clear vision are needed to make a positive impact on these dis-benefits. From the above figures it is clear why strategies such as the introduction of Integrated Transport Systems are being investigated. They will need professional-grade radio systems in order to work properly and safely.

As a further point, CNI users are known to have current and future needs for wideband and broadband professional systems.

Some CNI users have indicated that they currently have enough spectrum to run their existing operations. However, if anything changes or they need to change out their systems due to systems reaching end of life etc, they will need more spectrum.

Recently, there have been calls to allocate more spectrum specifically for transportation. A particular case is the 872MHz band, most of which is expected to be taken by the rail service

and have new technologies deployed in it. This is a developing situation and there are some views that this will take a long time to arrange.

The FCS believes that assignment policy as applied to CNI needs to be considered as a whole.

Specific Points on the Emergency Services

The emergency services are also professional radio users.

The acquisition of spectrum for the emergency services is also currently required to be through market mechanisms. In common with the CNI issues there is little confidence they will be able to obtain the spectrum they need at auction.

Industry believes the acquisition of spectrum at auction is problematic:

The NPIA obtains its funding from the Government, in order to be sure of success at auction, a lot of public money would have to be made available for the bid to guarantee success. This would then of course be immediately transferred back so there would be no net outflow from the Government.

This places the NPIA in difficulty because if sufficient funds to win the auction were not made available the NPIA would lose and so not get the spectrum. If however, sufficient funds were made available, the auction would be subject to challenge from the other participants and so the NPIA would not get the spectrum then even though they “won” at auction.

The emergency services appear to be in a “lose-lose” situation in regard to spectrum being obtained at auction.

The emergency services have been supported using special arrangements to meet their needs during the Olympic Games. This is now understood to be resolved. However, there appears to be a concern that after the Olympics, when the spectrum is returned to the normal owners, the capability of the emergency services’ communications to meet another incident such as the 7/7 bombings will be again in some doubt.

The emergency services are another group known to have actual future needs for wideband and broadband professional systems.

Annex - Industry Survey

Notes on the Research

In the development of this contribution to the Ofcom work the FCS conducted an in-depth survey of the 111 companies who are members of the FCS and are operating in the Business Radio segment. These 111 companies typically have around 200-300 customers with radio licences. Some members have interests in many more licences. The FCS membership therefore actually probably represents a group with interests in a very large proportion of the total business radio licences in existence¹⁶. The FCS therefore considers that conducting research amongst its members actually provides a fair reflection of the total industry.

The survey asked 36 questions on a wide range of strategic matters related to regulation and spectrum management over the next 5 to 10 years.

To supplement this survey, a randomly selected sample of approximately 20 telephone and face-to-face discussions with members and some non-members was undertaken to investigate specific points to a greater depth and to allow respondents the opportunity of raising further points.

27 organisations contributed responses to this document. This represents approximately **25%** of the membership. This response rate is considered adequate. The questions in the survey and the accompanying face-to-face or telephone discussions highlighted several topic areas which are included in the main body of the text of this contribution.

In total, **266 substantive comments** have been received from the organisations. There is a very good level agreement across the industry over many points. This document presents the outcomes of this research.

An analysis of the topic areas mentioned by the respondents is provided below.

In conducting the discussions with respondents familiar terms were used to avoid confusion management methods. Of prime importance the term “command and control” was used to describe a directed management function performed by the appropriate regulatory body. This was a valuable tactic because the respondents are all familiar with both the market approach and command and control so confusion could be avoided. To faithfully reflect the actually statements of the respondents, that terminology has been used in this document when discussing the research outcomes¹⁷.

¹⁶ Perhaps around 50%.

¹⁷ In the main text the FCS proposes the Review considers a new approach of Nationally Managed Radiocommunications that takes into account the wider range of relevant factors rather than a direct comparison of just the assignment techniques.

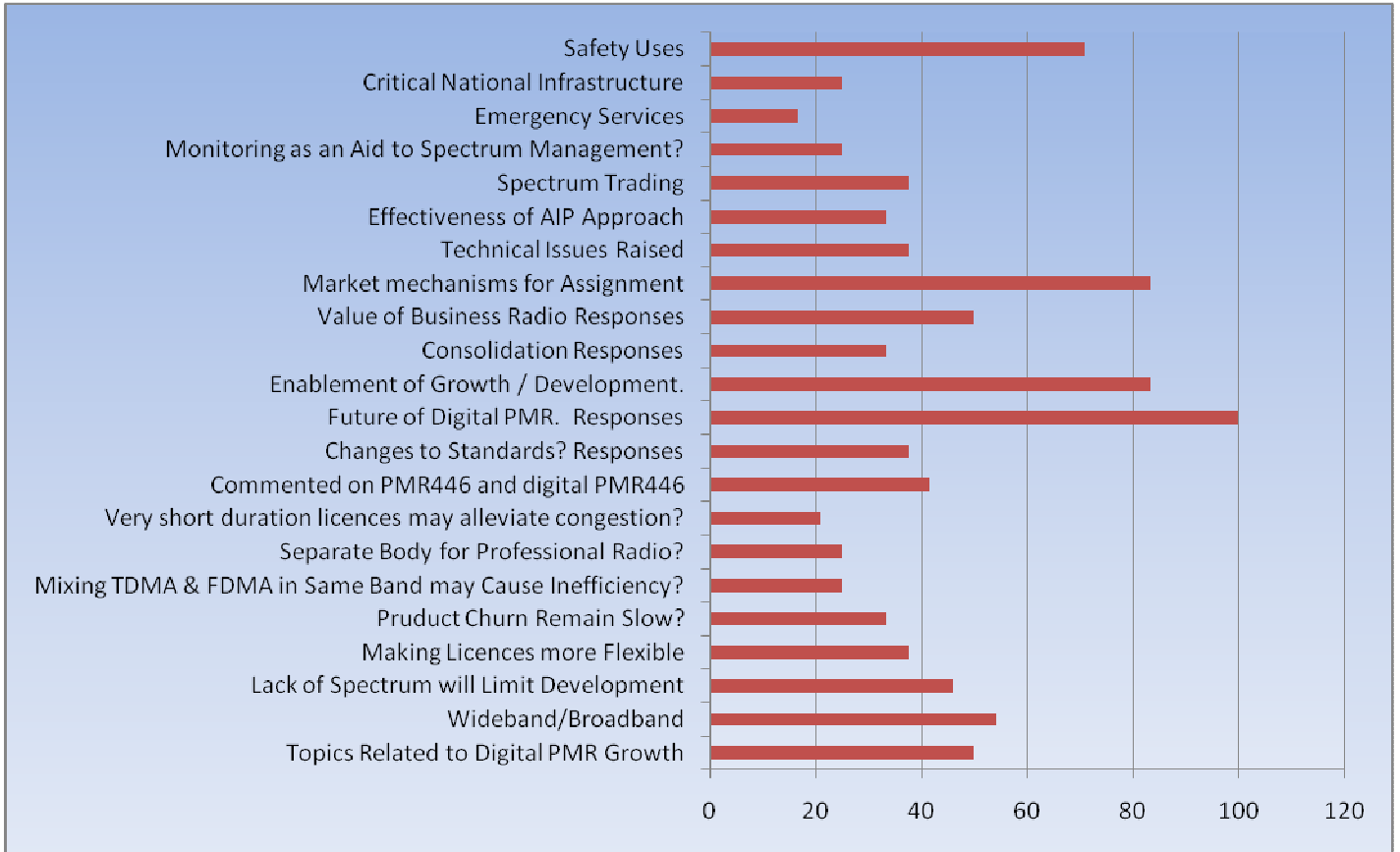


FIGURE 3 - RESPONDENTS KEY TOPIC AREAS

Figure 3 shows the percentage of the total number of responding organisations that made any sort of reference to the topic in any of their responses. Thus all the respondents made some reference to the future of digital PMR for example.

This chart therefore can be seen as an indicator of the topics that currently of interest throughout the sector. No inference of positive or negative can be taken from these scores. They merely indicate that a comment was made. Thus if one respondent replied “no” to a question and another replied “yes”, that would result in two scored in the chart above (recorded as a percentage of the total number of responses).

The research therefore indicates that digital PMR, spectrum assignment through the market, growth and safety are high priority subjects for the industry at present.

Although at a lesser level, the FCS draws particular attention to the interest in wideband and broadband professional solutions. This could be an important development within the period of the Review.

The Value of Business Radio

The research asked respondents for their comments on the value of business radio. This was from a negative view point considering what happens if the business radio service was taken away and substitutes (if any) provided. The research asked:

1. What would your customers actually do if they did not have business radio
2. What examples are there on the impact of the absence of business radio
3. What value do your customer place on business radio

Examples were requested for business radio value.

The results of this section of work are presented in the main body of the text. The responses indicated that serious disruption could be expected if business radio was withdrawn. There was little evidence of any viable substitute for business radio. But, operational communications is considered vital for the maintenance of the users' prime objective. Respondents also confirmed that although business radio is often an essential component of the delivery of the user's prime objective, it was treated as an essential cost. Pressure on price was also reported. Thus the value of the system was not related to the users' income in a direct way.

Themes

By examination of the results it has also been possible to extract some recurring themes from the comments of the industry respondents. These are themes that are frequently mentioned in the responses to a number of questions (apart from the questions that may specifically ask about the point). These were further amplified in the face-to-face discussions.

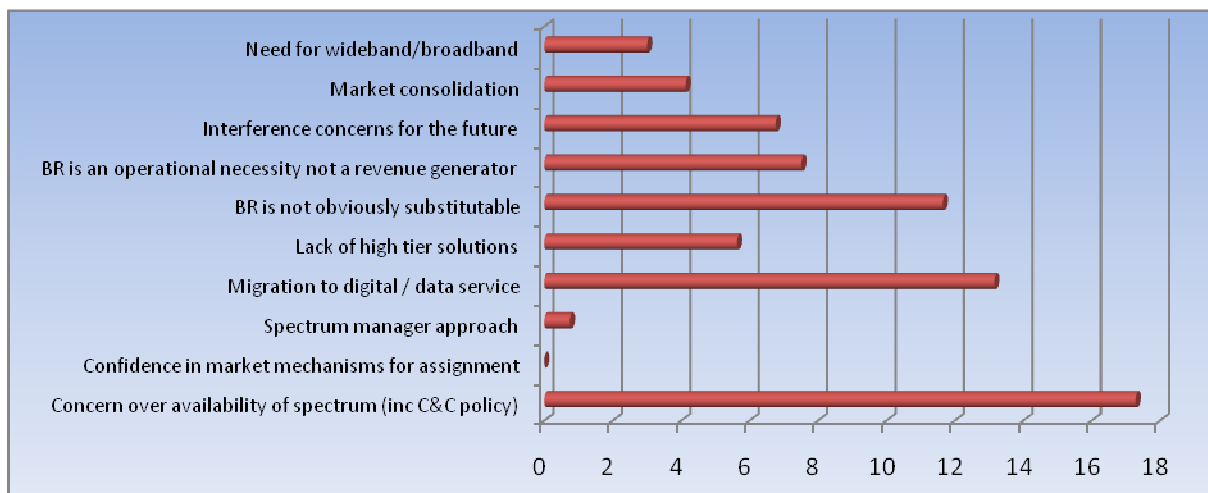


FIGURE 4 - THEMES DETECTED

It can be seen that there is a very high level of concern about the availability of spectrum and how that might be addressed (Fig 4). This includes whatever spectrum may come available from the current process of granting access to more spectrum held by the MoD.

On the other hand, there is no confidence in market mechanisms as a universal method of assignment.

One respondent made the point that a commercial spectrum manager may well be a viable option as long as some spectrum for the entity to manage can be found. This view did not extend to the management of spectrum for the emergency services or critical national infrastructure where not already covered.

The migration to digital technologies and the movement of user applications towards data services is seen as a focus point by industry. However, there were some concerns over the lack of suitable new high-tier solutions that can be deployed. There was an apparent focus on stretching mid-tier solutions upwards rather than adopting specialist high-tier solutions. This may be because of a lack of suitable spectrum to deploy such high-tier solutions.

The industry frequently notes that users' communications requirements are very much addressed by examining their operational requirements first and then proposing the best solution in those circumstances. Thus the radio-communication system supplied is chosen from the available technologies and/or scheme for 'best fit' with requirements. This has the consequence that users seeking to substitute the business radio scheme with another approach frequently cannot do so without an overhaul of their operational procedures and a re-assessment of safety risks etc. They find the business radio solution is not, in practice, easy to substitute. This has many consequences as examined in the main text. This effect is not expected to change with time.

There is a significant non-alignment of industry views with current market-based assignment and fee policy in the UK. The industry is well aware that their user base considers the radio communications to be an essential component in the achievement of a completely different (and largely unrelated) prime objective. Spectrum fees are just a fixed cost. There is no established relationship between the organisations' income and the price of spectrum.

The industry has noted that with the projected increase of traffic, the move towards technology neutrality and the simplification of licence structures, there is the potential for an increased level of interference in the future. Digital technology should be more robust in some respects but communications failures will still occur. The respondents indicated a strong desire that this remains controlled so that the problems are minimised.

There were several comments on the future consolidation of the industry in favour of the larger stakeholders. It was suggested that this could be driven by normal commercial processes, by spectrum captures and by technology.

The raising of the sophistication level of the technology may mean that the number of suppliers who can invest to the extent necessary may be reduced. This could have knock-on impacts throughout the industry.

Consolidation may also be forced by spectrum policy were it to be that the spectrum available to support the users' solutions was actually increasingly controlled by a reducing number of participants. In other words, having spectrum becomes the sole key to being able to provide solutions, irrespective of all other considerations.

The majority of the industry report seeing an increasing demand for professional standard wideband and broadband solutions to meet future operational needs. Wideband in this context is a few hundreds kilo-bits per second whereas broadband means a data rate sufficient to transmit good quality video (without that being taken to mean entertainment quality).

The respondents believe there appears little opportunity to meet these requirements within the current spectrum allocations. Some users have already started experimenting with innovative solutions at extremely high frequency (31GHz).

Low Tier Markets

The research revealed healthy levels of confidence that these markets (PMR446 and digital PMR446) will continue strong for some years yet. But, there are differences of opinion over how much growth can be expected. There was excellent agreement that while the analogue sales would continue strong for some years, the digital sales would form the major growth

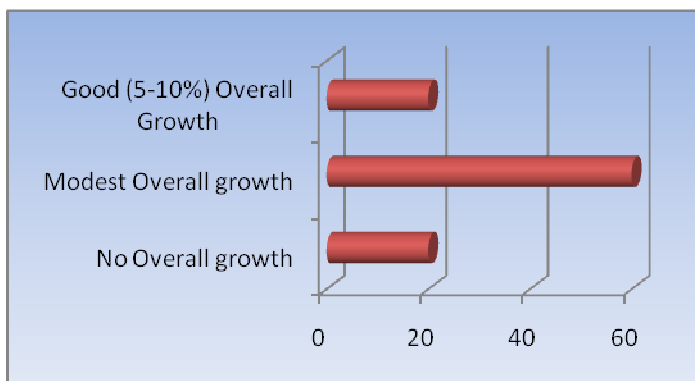


FIGURE 5 - LOW-TIER GROWTH

opportunity. The uncertainty therefore is over whether the growth of digital will be off-set by the decline of analogue and to what extent.

Further features and facilities provided by digital technologies were thought to be mainly about improving the user experience rather than

significantly increasing the range of users who adopt the low tier

approach (Fig 5).

One conclusion was that the spectrum currently allocated for analogue PMR446 (446.0 to 446.1MHz) may have to be opened for digital uses also. This may in turn have an effect on incumbent analogue users who may experience digital interference where none exists today.

Other contributions were that there may be benefit in again looking at the use of repeaters for these schemes and a higher power limit. However, these were phrased as proposals reporting a known user demand rather than a general market need.

One respondent made a strong point about market surveillance. This was that non-compliant PMR446 products are appearing on the market and it would be desirable were the enforcement regime to be tightened up to prevent this.

Mid & High-Tier Markets

In general, respondents are very ‘up-beat’ about digital technology being introduced into business radio.

The research did not indicate a very specific strategic difference between how the market viewed mid and high-tier solutions. They tended to be considered together as the user would be offered the right level of solution to meet their need. Thus no differentiation in regulation or spectrum management was expected¹⁸.

Importantly, whilst there is currently a lot of focus on technology issues as the new digital technologies start to have real impact on the user base, there was a view that technology would continue to advance at pace and so in a 5 to 10-year view, today’s technology would be improved on significantly.

Digital Business Radio Growth (Mid & High-Tier Solutions)

There is a level of confidence that business radio has the potential to start a period of increased opportunity and growth.

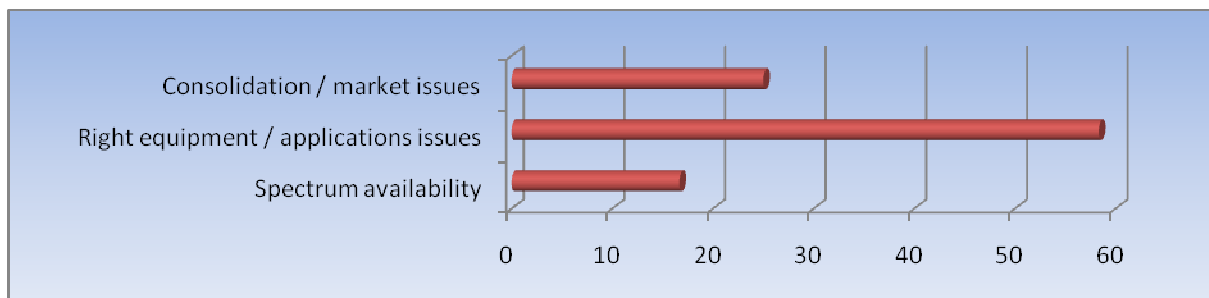


FIGURE 6 – HIGHER-TIER GROWTH IMPEDIMENTS

The research showed some concerns that some items may impede this growth (Fig 6). For simplicity these have been grouped into the three top-level classes shown. These classes interrelate.

The introduction of digital technology to the current user base will require some spectrum to support it. However, industry respondents recognise that a very large proportion of the user base already has licences. Thus the challenge will be to change-out the schemes within the current assignments rather than find new spectrum in every case. This implies a high level of growth might be possible for the industry at a relatively low risk from spectrum

¹⁸ For the avoidance of doubt, whilst there may be no expectation of differentiation between market tiers, different technology approaches are definitely expected to result in changes to spectrum management and regulation.

congestion. The industry recognises that the users will take advantage of the new features to do more with their equipment and so gain greater value. This will translate to higher traffic volumes and greater spectrum utilisation. Spectrum therefore remains a concern overall. The majority of respondents who directly addressed the spectrum scarcity issue answered that “yes”, they believe that spectrum will limit the growth opportunity (Figure 7 in % of responses). The research also noted the potentially positive impact of increasing the number of voice communications channels through the introduction of 6.25kHz equipment.

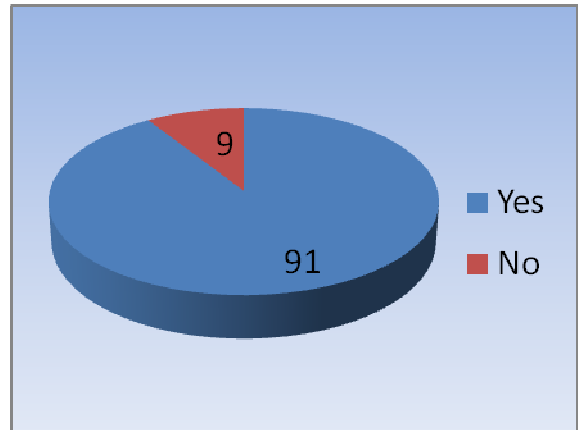


FIGURE 7 - WILL SPECTRUM SHORTAGE LIMIT GROWTH?

Having the right equipment available in a timely manner and software applications was also a deep concern for the industry. Respondents recognised that suppliers have a significant investment ahead of them on top of the investments made to-date. The supply chain needs to ensure higher value-add for the end user to stimulate the growth.

In any market transformation such as that which may be about to commence in the UK business radio segment, there will be changes that may see winners and losers in the industry. There are concerns over how stakeholders can maintain or expand their positions. Some respondents considered that this change may act to unveil tensions they believed to already exist in the market. There were several responses indicating their belief that there are too many smaller players in the market today. Consolidation is therefore a future factor relating to growth. One respondent believed there are possible changes in the supply side to remove over-competition which may be hampering investment in these low-volume markets.

This was one of the areas where specific comments on products were received. There is a clear perception that digital PMR will greatly benefit from the introduction of high-tier feature sets.

Respondents considered that growth can be expected in the very large system area (see comments about consolidation) where there are already dominant market players. Respondents firmly believe that other growth areas exist but are yet to become evident. The view is that once high-tier non-TETRA solutions appear, the sector will be able to address markets currently not addressable. Examples of Government sector applications (health, education) were given. It was also noted by respondents that this is a uniquely UK situation as in other countries there is less spectrum-based restriction on TETRA solutions for high-tier users.

Mobile Data was another sector that received strong support as a candidate for substantial future growth. Of those responding on mobile data, **80%** considered that the mobile data solutions would remain a varied set of quite different schemes in the professional arena. In areas where consolidation is possible the view was that public networks may meet a lot of requirements but there would remain a core of requirements that necessitated professional solutions. The limitation on the use of the public network is the operational requirements for mission critical communications.

Wideband and Broadband

The respondents indicated a clear demand for wideband and broadband solutions. Not only is the data becoming more complex, the sheer amount of it indicates need for a faster data rate solution. The respondents were asked to state whether there would be a demand for wideband and broadband solutions that they could address under the assumption that the spectrum necessary for such a solution could be identified. The result was a strong majority “yes” (Fig 8).

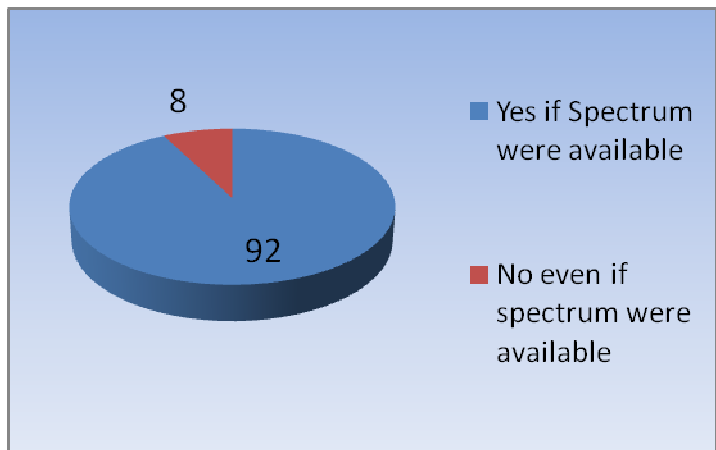


FIGURE 8 - WILL THERE BE DEMAND FOR PROFESSIONAL WIDEBAND/BROADBAND SOLUTIONS

Churn

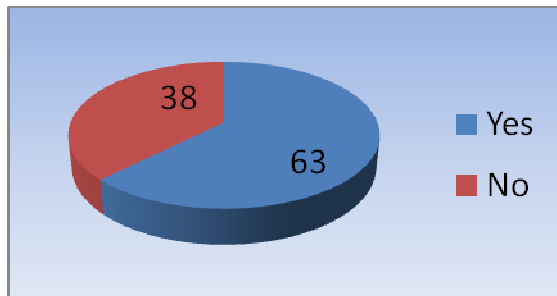


FIGURE 9 - WILL CHURN REMAIN RELATIVELY SLOW?

There was less good agreement over the predicted churn rate for business radio. The majority felt that because the systems are installed for operational needs, there will remain significant resistance amongst the users to changing-out ahead of natural obsolescence dates. Others felt that it may be possible that the user benefits associated with enhanced capability equipment may make earlier change-outs good business sense. Overall, the majority

were of the view that “yes” churn will remain slow (Fig 9). In the context of the ten-year period for this Review, it was considered by many that at the end of that period there would be very few analogue systems remaining. Some respondents did indicate very much quicker churn rates than ten years. They indicated that with the portfolio and spectrum issues resolved, digital equipment could be in the majority inside three or four years.

Several respondents reported a concern that if higher-tier solutions become unavailable either through lack of spectrum or spectrum fees, some users may be forced to use services such as PMR 446 and accept the increased operational risk.

Spectrum Management Matters

The research asked a number of questions on a variety of subjects related to spectrum management. Spectrum management is a high priority matter for many respondents.

Technical Considerations

Industry is very conscious that the introduction of digital technology into what were

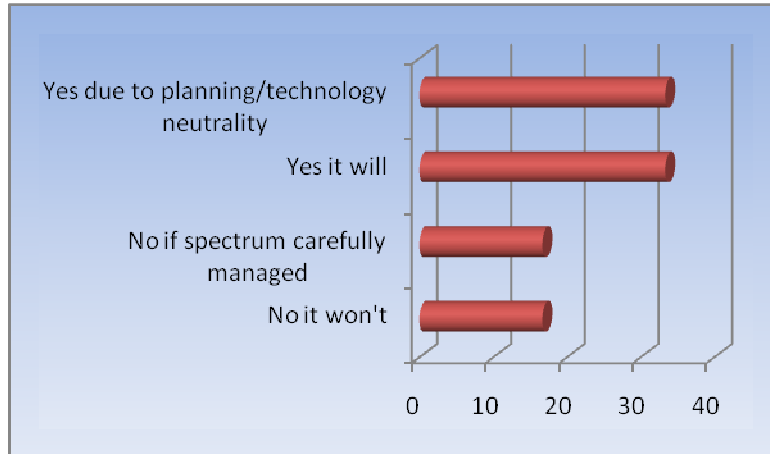


FIGURE 10 - WILL THERE BE PROBLEMS FROM MIXING TECHNOLOGIES?

previously analogue bands may have technical implications that could prove difficult in the future. The research asked whether there could be inefficiencies caused as a result of this change and the mixing of TDMA and FDMA in the same band. The responses were mixed. The industry considered that overall, there could be problems but that the extent

of such difficulty could be minimised through careful technical spectrum management (Fig 10).

Those considering that there would be no problem were doing so under the assumption that band plan arrangements would be such as to limit this¹⁹. However, one respondent pointed out that such arrangements could in themselves be inefficient.

Spectrum congestion is affecting licensing in a very direct way. One respondent provided evidence that they implement business radio schemes in a novel way to maximise traffic through-put and coverage in congested areas. Because they have based their entire business plan on this approach, the details are not discussed here.

It was stressed that the 6.25kHz FDMA approach could yield improvements in congestion where deployed.

Respondents were also asked for their view on the rise of the noise floor as this is a fundamental parameter in technically assigned licences. There was no survey data available but respondents were quoting they had experienced **9dB rise** over the last 10 years. No predictive data was provided.

¹⁹ Indicating confidence in the technical skills of the Private Systems Group

Licensing for Technology / Usage Changes

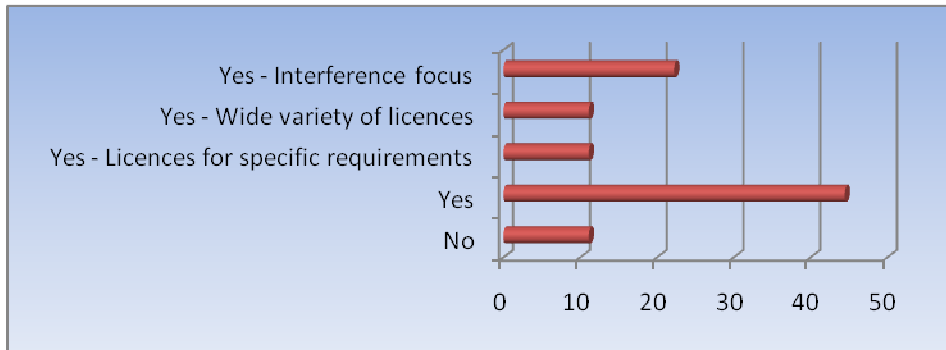


FIGURE 11 - APPROACH TO LICENSING

There were several proposals on basic principles to accommodate likely future changes in the technology, what it does and how it is used. These are summarised in Fig 11.

There was one respondent who saw no need for change to the existing system of licensing. Whereas several considered that some change should be made but were not clear on the detail except that greater flexibility will be required. There was a view that the regime should be completely changed such that an individual deployment scheme could be licensed with a unique licence. Others considered that it may be advantageous to return to having a wide variety of licences available. Users could then choose the most appropriate. It was also suggested that licences should be modified so that they refer only to emission limits and so the licence regime reflects interference potential²⁰.

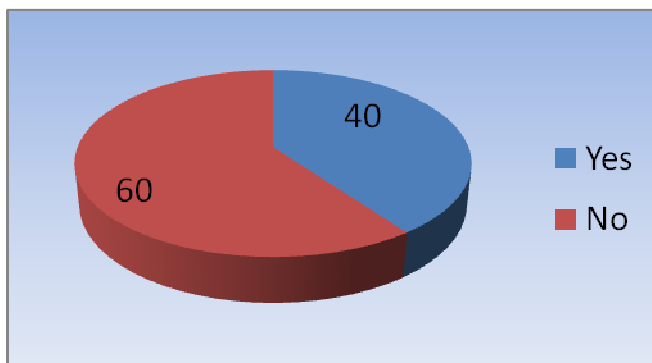


FIGURE 1 - WILL VERY SHORT DURATION LICENCES HELP OVERALL CONGESTION?

Another approach discussed was to add a series of very short-duration licence products to the portfolio so that use could be defined in the gaps in time when others are not using the spectrum. This would have limited application for many schemes but there may be some benefit from it. The

responses indicated a slight majority view that “no” this may not help congestion to any significant extent (Fig

12). Respondents did recognise that there are some applications where this will most certainly have some use. These are in data schemes where the time domain is already partitioned.

²⁰ This was not a proposal to use only the EMC Directive

Ofcom Strategic Approach

The theme of the lack of confidence in the use of market mechanisms to assign spectrum for

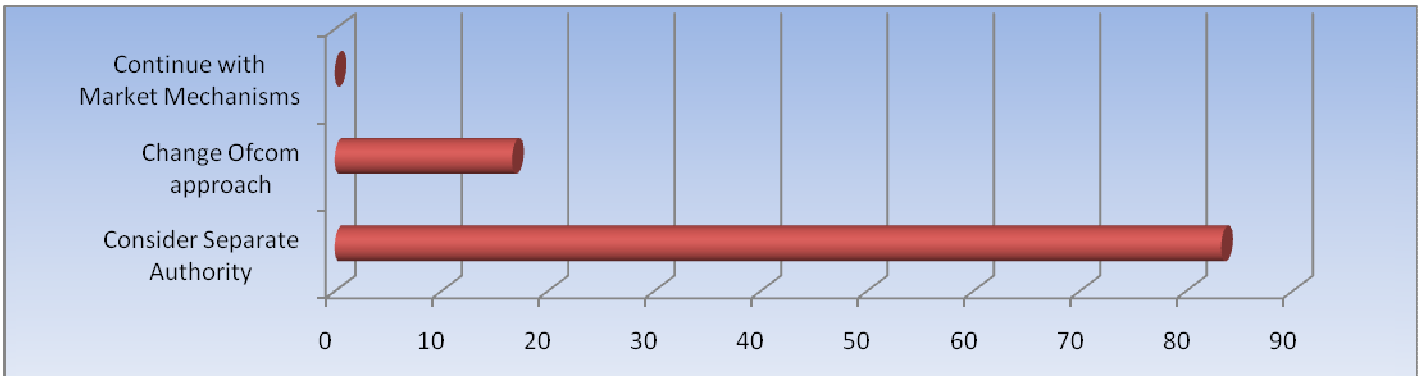


FIGURE 13 - APPROACH TO ASSIGNMENT

professional use was explored further in the research. The respondents were asked if they considered that the current market-based policy should continue to be applied to business radio. The results indicated market mechanisms were suitable for commercial networks but not for professional uses. The respondents thought that ‘command and control’ may well be a more efficient approach. There was also some concern over how such different policy approaches could be combined. Most respondents considered that a separate body may have to be established to address this (see Fig 13) because of practical difficulties in having two radically different management approaches in the same body. There was no support for continuing to apply market mechanisms. Some respondents considered that making such changes within Ofcom may be the best approach.

Administrative Incentive Pricing

Respondents were asked their view whether the application of Administrative Incentive Pricing would modify the spectrum requirement. **100%** of respondents replied that it would not. The systems they provide are carefully designed to use the right amount of spectrum, not more.

Respondents doubted whether it would be advisable to raise prices so high that users who are not using the spectrum consider returning it. The view was that the collateral damage caused by such a policy could have a negative impact on investment and growth leaving the users faced with increased costs without any corresponding benefits.

Spectrum Trading

The respondents were asked whether they agreed that it would be advantageous were Ofcom to establish a trading system, which permitted holders to advertise rights they wanted to sell. This is currently not available. **100%** of respondents disagreed. There was no support for such a system at all.

International Alignment

Respondents all agreed that international alignment of the changes introduced to maximise the benefits of scale was highly desirable and the appropriate arrangements should be a subject for the impending Review.

Spectrum Monitoring

Respondents were asked if they agreed that spectrum monitoring should be used to identify apparently unused spectrum to assist follow-on investigation work to identify assignments that are no longer needed. There was **100%** agreement on this point.

Commercial Spectrum Management

There was one response indicating a willingness to undertake consideration of this approach in the event that suitable spectrum to manage could be identified.

The Emergency Services

This was an open format section where participants were encouraged to provide comments without specific questions to prompt them. The following topics were uncovered. The detail is discussed in the main body of the text.

1. Large-scale managed services – users are moving to richer content mixes than are apparent today
2. The availability of spectrum is the key issue. There is a clear lack of spectrum overall
3. The requirements for the Olympics may be resolved but after that event is over, problems may again be experienced, especially during incidents
4. There is no substitute for professional radio. Note that users also use public services very effectively for different purposes
5. There was no support for the use of auctions to assign spectrum to the emergency services
6. Trading not a viable approach due to next user rule and costs
7. Respondents believe that wideband and broadband schemes both have clear future applications. The existing professional spectrum allocations cannot cater for these requirements
8. A return to a directed approach to assignment is favoured by many respondents
9. New MoD spectrum opportunities remain a key topic for the future

Critical National Infrastructure

In common with the emergency services, a free-format was used to permit the widest possible scope of response. The respondents are from the transport and utility sectors.

The following topics were identified in responses. These are expanded in the main body of the text.

1. The availability of spectrum for future operational needs is the biggest issue
2. Key features like 'group call' are still used extensively and will continue to be so.
3. For some users, their available spectrum is limited to today's day-to-day operational need. So if nothing changes or wears out and there are no incidents, they have enough spectrum. It was reported that some (Band 3) systems are being phased out and will need replacement. Spectrum in other bands will have to be used.
4. There would be severe restrictions on operations in the absence of business radio. "No business radio = no (underground) trains" for example.
5. Planning is done for the very long term in the transport sector.
6. Communications traffic volumes can be quite low most of the time but rise dramatically during an incident. The usage profile is very different when compared to a public network.
7. There is a clear need for professional future wideband and broadband systems. Some respondents have experimented with WiFi and WiMAX but found resilience to be poor. Thus these commercial approaches cannot be used.
8. Cannot support assignment by auction
9. No confidence in the use of market mechanisms for assignment.
10. Access to new MoD spectrum channels remains a key topic for the future

Acknowledgements

A list of the organisations which made significant contributions to this work is at the back of this paper. The FCS is grateful to all these organisations for their efforts.

2CL communications Ltd

Air Radio Ltd

Airwave Ltd

Arqiva Ltd

Capcom Communications Ltd

CoChannel Electronics Ltd

Comcir Ltd

DMR Association

eManagement (UK) Ltd.

Fleetcomm Mobile Networks

Icom UK Ltd

Intelligent Radio Solutions Ltd

JRC

Kenwood Electronics (UK) Ltd

London Buses Ltd

London Underground Ltd

Motorola Ltd

On-Site Communications Association

Procom Communications Services

Radio Contact Service

Signature Industries

Smye-Rumsby Ltd

STS Communications Ltd

TAIT Europe Ltd

TETRA Association

Yaesu

Zycomm Electronics Ltd

Abbreviations

Band 3	A range of frequencies between 174MHz and 225MHz
BIS	Department of Business, Innovation & Skills
CEPT	European Conference of Postal and Telecommunications Administrations
DG ENT	EU Directorate General - Enterprise
DG INFO	EU Directorate General – Information society
DMR	Digital Mobile Radio – an ETSI over-the-air protocol standard
ETSI	The European Telecommunications Standards Institute
FDMA	Frequency Division Multiple Access – a form of modulation applied to the radio signal
GHz	Giga-Hertz : 1000000000 cycles per second
IR	Interface Regulation: A regulation created under the Radio and Telecommunications Terminal Equipment Directive
kHz	kilo-Hertz: 1000 cycles per second
LTE	Long-Term Evolution: A communications standard intended to replace Third Generation Mobile telephony.
µV	Micro-volt: 0.000001 of a volt
MHz	Mega-Hertz: 1000000 cycles per second
NMR	Nationally Managed Radiocommunications. A proposal for a new method of ‘directed’ management of the professional radio communications
NPIA	National Police Improvement Authority
PMR	Private Mobile Radio

PMR446:	Low-tier PMR radio scheme operating at 446MHz
Q	Quality Factor. The ratio between the centre frequency and the operating frequency range
TDMA	Time Division Multiple Access – a form of modulation applied to the radio signal
TETRA	Terrestrial Trunked RAdio: An ETSI standard for high sophistication professional voice and data communications
WiFi	Short range communication protocol developed in the IEEE 802.11 committee
WiMAX	Medium range communication protocol developed by the IEEE 802.16 committee