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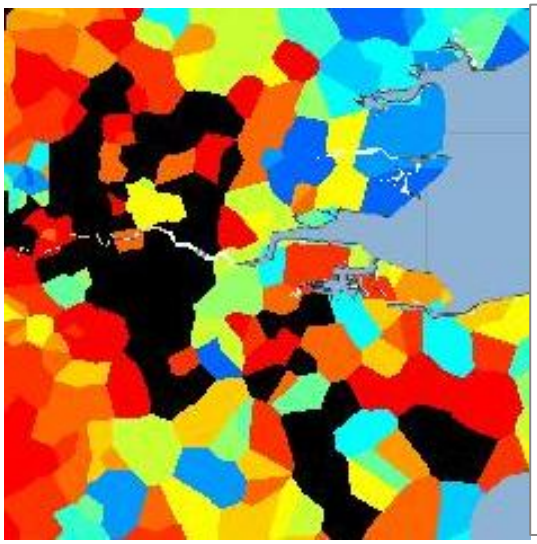
RETHINK

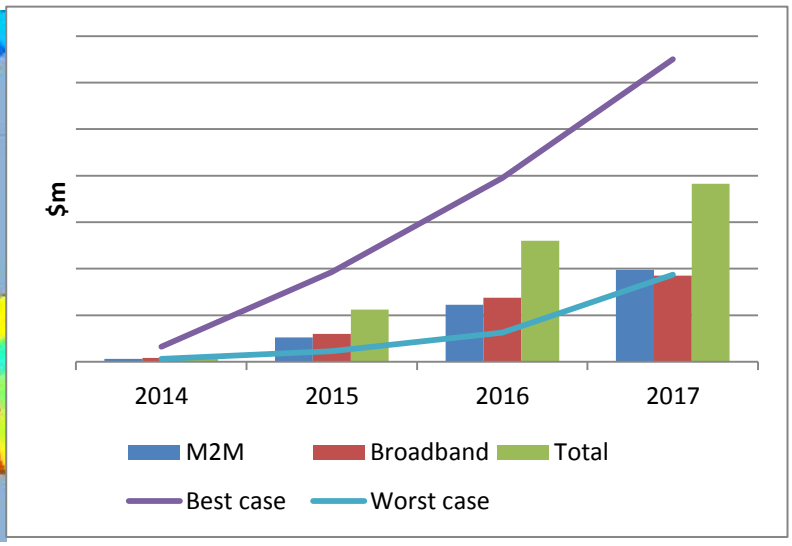
# White space devices: Global market and technology, risks and opportunities

*Shining a light on the dark corners of white spaces*

**White space bandwidth**



**White space device revenues**

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## About Real Wireless

Real Wireless is a leading independent wireless consultancy, based in the U.K. and working internationally for enterprises, vendors, operators and regulators – indeed any organization which is serious about getting the best from wireless to the benefit of their business.

We seek to demystify wireless and help our customers get the best from it, by understanding their business needs and using our deep knowledge of wireless to create an effective wireless strategy, implementation plan and management process.

We are experts in radio propagation, international spectrum regulation, wireless infrastructures, and much more besides. We have experience working at senior levels in vendors, operators, regulators and academia.

We have specific experience in LTE, UMTS, HSPA, Wi-Fi, WiMAX, DAB, DTT, GSM, TETRA – and many more.

## About Rethink Technology Research

Rethink is a thought leader in quad play and emerging wireless technologies. It offers consulting, advisory services, research papers, plus two weekly research services; Wireless Watch which has become a major influence among leading wireless operators and equipment makers and Faultline, which studies disruptive changes in media due to emerging digital networks.

# Executive summary

## This report:

combines the expertise and analysis of Rethink Technology and Real Wireless to provide a unique and independent insight into some of the key technical, commercial and market aspects relating to the current and future use of white space devices
gives sufficient detail to enable investors, technologists, product vendors and regulators to determine whether white space devices:

- Provide a credible and sustainable investment opportunity with sufficient near and mid-term growth opportunity
- Are supported by commercial momentum and confidence in the ecosystem
- Are supported by a regulatory framework that is based on thorough and detailed technical and economic analysis
- Can establish a sustainable product roadmap and plans for vendor relationships and interoperability

shines a light on the aspects of WSDs that have generally been 'hidden' by the industry and this report exposes the key issues that could cause:

- Delays to deployments
- Interference to TV viewers and other white space device (WSD ) users
- A stunt in the growth of the ecosystem
- Potential impact to the wider investment community
- A poor match between applications and the nature of white space spectrum
- Greater upside opportunities than have been recognised to date

is the first of its kind to combine detailed technical analysis with commercial and market data for white space device industry

## Report highlights:

### In-depth analysis of white space applications:

Survey of the key applications that WSDs can support
Analysis of the business and operator models
Reveals which applications will most likely be supported by vendors out to 2016

### A current view of white space technology performance and the multiple standards being proposed:

Highly detailed qualitative analysis of the technology features and standards
Insightful technical analysis of the available bandwidth across UK locations as an illustration of how bandwidth varies for differing applications and regulatory approaches

### International regulatory analysis:

Detailed analysis of current regulatory activity to support introduction of WSDs in the US and UK
Reveals the issues of a 'hidden' incumbent
Information that can support regulators in their plans to start implementing WSDs
Review of wider international regulatory activity from within Europe, Africa and beyond

### Commercial evaluation:

Evaluation of the WSD ecosystem including supply chain, chip vendors and database providers
Review of the latest field trials including the Cambridge White Space trial
Analysis of the leading players, their products, achievements and likely plans for future development and product launches

### 5-year market forecast:

Surveyed more than 50 companies either involved in WSDs or considering becoming involved
Identification of key risks to mass market development
Timelines to launch of commercial products
Reveals which applications are highest priority for companies
Forecast number of connections by white space networks in 2016
Projected revenues from white space chipsets and components 2014 – 2017 for M2M and Broadband applications

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# 4. Potential Applications for White Spaces

Even assuming the standards and technologies to exploit the white spaces effectively are finalized in a timely fashion, commercial success will rely on there being compelling applications for the resulting systems. There are plenty of examples of promising technologies which never found a commercial role (UWB, MobileFi), and even 3G took some years to find its 'killer app'. This chapter will examine the main application areas which are being explored for the white spaces, and how far they are attracting the level of interest and support which could signal commercial uptake. In particular, it examines the scale that might be available for those delivering services in white space spectrum, and surveys the early players in this field to discover which apps they are targeting.
As we have seen in earlier chapters, the applications which are attracting the most interest fall into two broad categories – various forms of broadband access, and machine-to-machine. In this section we drill more deeply into the sub-categories and their level of support, to ascertain which are achieving the most momentum in the early stages. Those trends will affect the impetus behind various types of devices, and the commercial viability, as studied in chapter 6.

The chapter will also raise two important issues surrounding white space applications – whether there is any usage, current or emerging, for which TVWS is uniquely suited; and whether there is already hidden fragmentation in the business case, if too many applications, with different technical and market requirements, are trying to use the spectrum.

## 4.1 The white space applications debate

The increasing volume of data being consumed by conventional wireless applications is only one reason why new sources of spectrum capacity are required. Another issue is that many applications which were previously unconnected, or relied on specialist networks, are now moving towards IP-based mobile broadband and fighting for capacity alongside voice and broadband access. Likewise, there are many specialist, vertical applications which are not well-served by mobile networks or Wi-Fi but do not individually have the scale to secure dedicated spectrum. This is clearly seen in the debates over white space spectrum, where several interest groups are keen to argue that the frequencies would be best suited to their particular requirement.

There is a split between those which favour the relative simplicity of just adding new capacity to proven use cases, and those which believe the new spectrum is a fine opportunity to kick off some new wireless services.

In addition, many believe that the main aim should be to agree on horizontal standards and create a single pool of capacity which could support many applications as they emerge, as happened with Wi-Fi, rather than targeting specific uses. "*It is important to view white space as a platform that a multitude of technologies can use, presenting incredible potential for application far beyond simply supplementing traditional cellular networks*," commented Fraser Edwards, head of RF systems at Cambridge Consultants, one of the participants in the UK trials.
However, others are already creating specialized devices and business cases for specific vertical segments, and argue that the 'platform' approach is too vague to attract

commercial or consumer interest. Only a service which will generate new revenues or critical services will be able to drive wide-scale adoption, is their viewpoint.
The two approaches do not have to be mutually exclusive, and some trials like those in Cambridge, UK see them coexisting – indeed, a combination of generic capacity and some targeted, revenue generating apps may be the most workable model for unlicensed spectrum. Nonetheless, while the white spaces may end up being used for many different purposes, each application will need sufficient momentum and investment to drive forward devices and end user interest. In many cases, these different applications will not coexist well in the same spectrum and may eventually require segmentation of the available capacity in a given area (see below). In this chapter we examine the main candidates, and whether the white spaces are inherently suited to running any or all of these applications.

## 4.2 Early interest

There will be more detail on the progress of key applications in the chapters on commercial progress and in the market forecasts. However, at this very early stage in development, no single application has yet become synonymous with the white spaces and it is important to assess all the functions which could run effectively in this spectrum. There are many candidates, especially as progress in geolocation databases and flexible radios is removing some of the old barriers to deploying encumbered and unlicensed spectrum.

Most applications which aim to harness the white spaces have a few basic features in common, notably that broad coverage, indoor penetration and low cost are particularly vital to the model. Neul provides a longer list of criteria which make a use case particularly suited to white spaces, and vice versa (this is particularly weighted to M2M). This includes support for a large number of terminals and users per cell; long battery life; mobility; global roaming; low cost equipment (chips below $2) and service charges; indoor coverage; strong authentication and encryption; broadcast messages; efficient transmission of small data packets even in sub-optimal conditions; low out-of-band emissions and strong interference mitigation.

However, this checklist could apply to many applications and be satisfied by some other bands. Beyond those foundations, there are few commonalities.

A survey of about 50 participants in the early white spaces value chain indicates the fragmentation of interests (see Figure 4-1). The study was conducted in April 2012. Respondents were made up of device makers (PC, mobile and specialist), device chip providers, white spaces specialists and start-ups, M2M suppliers and broadband wireless systems vendors. All had expressed an active interest in TVWS. A separate study was conducted of mobile operators and WISPs. Respondents were asked to select the top three applications which they see as commercially viable for the spectrum in the period between 2012 and 2015, and a fourth application which they believed would be significant, but in a longer timeframe.

They were asked to select their choices based on the criteria of:

- Commercial requirement
- Suitability of the spectrum to efficient operation
- Confidence in the ecosystem and funding available by 2015
- Shortage of other better solutions

In many cases, we can assume that political agendas, such as the desire to shift wireless business models away from carrier-controlled spectrum, will also have played a role.

The results, to be analyzed in detail in the forecast chapter, indicate the key application areas which have been identified as being well suited to the white spaces, as well as presenting commercial demand for new capacity and services. These might be expected to attract the highest levels of investment and R&D in the next few years, from major players, start-ups and financing bodies. It is notable however that there is a lack of consensus, with rural WBA, Wi-Fi, Grid and Smart city applications all having similar levels of support. This suggests a fragmentation of the efforts in developing TVWS applications, which risks creating several markets with conflicting aims and minimal economies of scale.

In most cases, the supporters of a particular application currently present their case, and their early tests and models, as though they were the only users of the spectrum. In reality, they could find themselves competing with, or coexisting with, other services with very different characteristics. Many issues arise when contemplating a 'free-for-all' where many applications can thrive side-by-side in the same frequencies. These include the small amount of capacity in the white spaces in some areas; interference problems between different types of device; and the need for certain services to have guaranteed availability. In reality then, some of the highlighted applications will look far less attractive if they have to share the spectrum with others.

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**Figure 4-1 Key viable applications for white spaces as identified by participants in the white space value chain (chip and device makers, operators, 43 responses).**




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