inter media

www.iicom.org

September 2011 Volume 39 Issue 4

by Phillipa Marks

Closing the spectrum gap

A supplemental downlink at 1.4GHz might be an answer

Industry forecasts suggest mobile data traffic could grow by up to 30 times current levels over the next 5 years[1]. To meet this ever increasing demand operators will need more spectrum and to adopt new technologies to use spectrum more effectively.

Governments around the world have announced ambitious targets for spectrum release to mobile broadband services to stimulate economic growth and to support universal service targets. For example targets of releasing 500 MHz or more over the next 5 to 10 years have been announced in the US, for the EU and in Japan.

With all the attractive spectrum that could be used by mobile services (i.e. that below 3GHz) already allocated to other services, releasing new bands is akin to navigating a minefield. So what else can policy-makers do to support mobile traffic growth? Where will the additional spectrum come from? One possible solution is the frequency range 1452-1492MHz[2]. In this article[3] we discuss the potential benefits from deploying a supplemental downlink in the 1.4GHz band to support growth in mobile multi-media traffic in the near term.

What is the spectrum problem for wireless broadband?

Regulators in Europe are busy releasing frequencies for 4G (the so called digital dividend at 800 MHz and the 2.6GHz band), but it is not clear where the next tranche of spectrum might come from in the next 10 years. To be useful, the spectrum needs to be available on a Europe-wide basis and it needs to be relatively unencumbered by other uses.

Up to now most spectrum used in Europe has been paired and this places limitations on the potential candidate bands. However, in practice mobile traffic is highly asymmetric - the ratio of downlink to uplink traffic in mobile networks is in the range 4:1 to 8:1. With the rapid proliferation of smartphones and, more recently, tablets, downlink to uplink ratios seem likely to widen to 10:1 and possibly more as the proportion of video traffic in networks grows. This suggests it could be more efficient to expand the available downlink spectrum.

A number of candidate frequency bands have been identified by the European Parliament for future release for mobile broadband in the Radio Spectrum Policy Programme. These include frequencies at 700 MHz (currently used by TV broadcasting), 1.4GHz (allocated but not used by digital audio broadcasting) and 2.3GHz (typically used by defence and emergency services). In the US a wide range of bands has been identified but most of these are used by other services, such as TV, radars and satellite.

In Europe and a number of other countries, the most promising candidate appears to be the frequency range 1.4GHz band which is largely unused (see Figure 1). The band is allocated to digital audio broadcasting (DAB) services but these services have not developed at this frequency range.

The CEPT[4] is considering the best future harmonised use of the spectrum in the 1.4GHz. The plan for the band configures the spectrum as a downlink only. The band could be used as a supplemental downlink together with other paired frequencies.

What is a supplemental downlink (SDL)?

A supplemental downlink uses unpaired spectrum to enhance the downlink capability of mobile broadband networks. It enables significantly faster downloads and supports a much greater number of users with mobile or portable

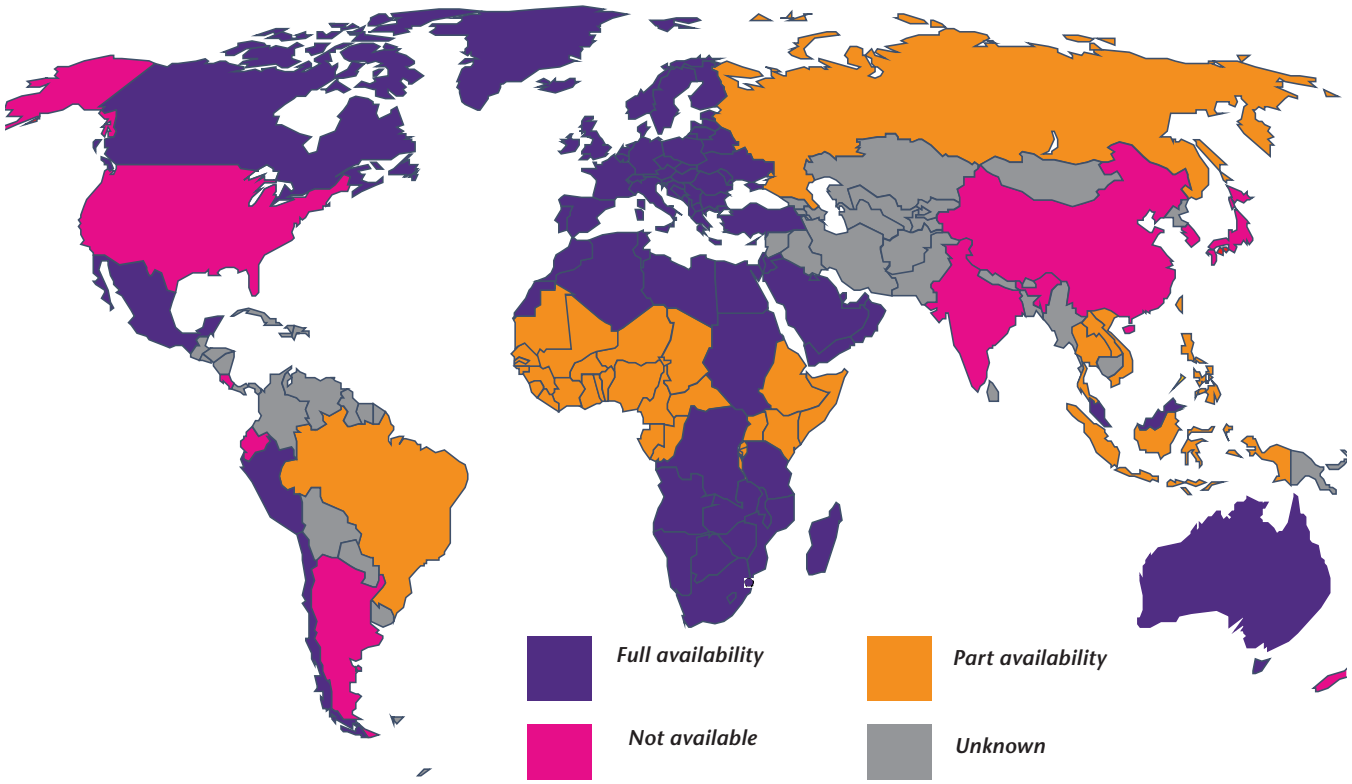
1 *The Big Picture*, Intermedia, July 2011 Volume 39 Issue 3

2 The band is variously called the 1.4 GHz/1.5 GHz/L band in Europe and for convenience we call it the 1.4 GHz band.

3 Plum was commissioned by Ericsson and Qualcomm to investigate the possible use of this band for delivery of enhanced multimedia services and broadband services. The study report is at http://www.plumconsulting.co.uk/pdfs/Plum_June2011_Benefits_of_1.4GHz_spectrum_for_multimedia_services.pdf

4 European Conference of Postal and Telecommunications Administration (CEPT).

Figure 1 1.4GHz Band availability for an SDL
(Source: Plum analysis of data from regulator websites)



wireless devices. Till now this approach has not been used in mobile networks because it requires new technology (sometimes termed carrier aggregation technology). But with the development of the HSPA+ and LTE-Advanced standards, supplemental downlink and carrier aggregation are now possible.

The technology allows the bonding of the usual downlink with a *supplemental* downlink channel(s), in a different band, into a single wider downlink channel as shown in Figure 2. This provides an efficient way of using spectrum because consumption of rich content and other data heavy applications is asymmetric.

A supplemental downlink is not just a theoretical possibility. This approach is already under consideration in the United States. Once it has the necessary FCC approvals, AT&T plans to use a supplemental downlink in its LTE network, aggregating 700MHz unpaired spectrum with other paired spectrum on which it will deploy LTE (outside of the 700MHz band). AT&T expects to be able to deploy handsets and equipment using a supplemental downlink as early as 2014.

The case for a supplemental downlink at 1.4 GHz

There is a substantial case for harmonising the 1.4 GHz band for supplemental downlink. It:

» Provides much needed downlink capacity given the asymmetric nature of mobile broadband and mobile multimedia traffic.

» Enables considerably higher user data rates and supports a greater number of users, all of which will substantially enhance the user experience.

» Could be in use by 2014. Furthermore, it is likely to be the only significant block of new spectrum available before 2018 (Figure 3).

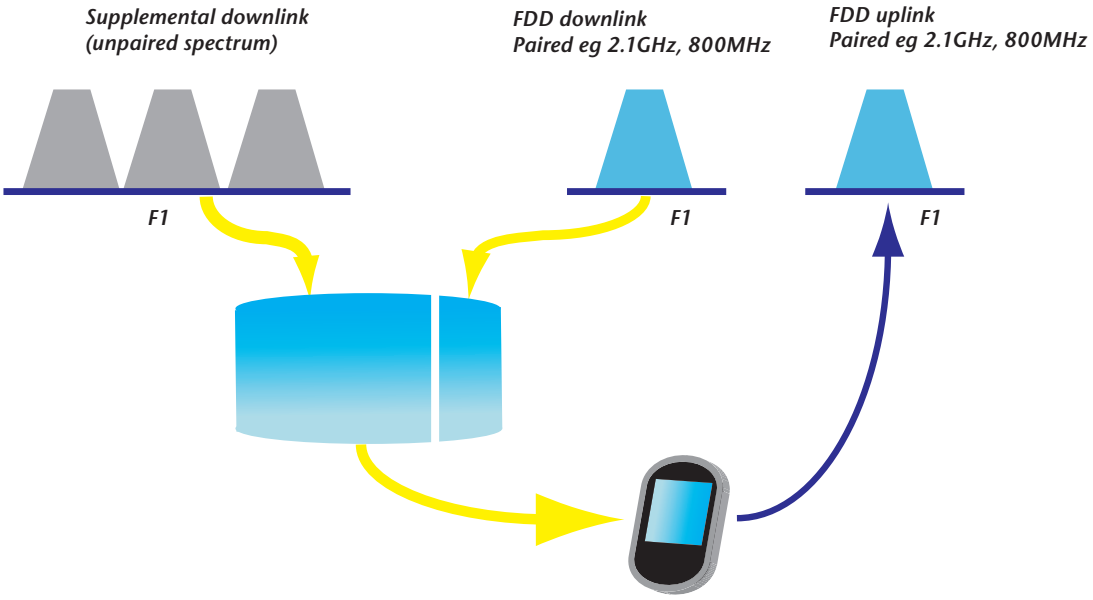
» The spectrum is readily available in Europe and in numerous countries outside Europe, providing the basis for realising significant economies of scale, which should drive down equipment costs.

» Offers much better coverage – in rural areas and into buildings – compared to other bands that could become available before 2020 (e.g. 3.5GHz). This is because of the relatively low frequency range and regulatory conditions which allow higher powered transmissions than other bands.

Plum has estimated the value to Europe of two principal benefits of an SDL at 1.4GHz:

» Lower network costs. By using the SDL to meet rising demand for mobile broadband, operators avoid investments in addi-

Figure 2 A typical supplemental downlink configuration
Source: Qualcomm HSPA+ enhancements in Release 9 (and beyond)



tional base stations. This benefit is shared between operators and consumers, with the bulk of the benefit going to consumers in a competitive market;

» The benefits of an enhanced user experience. These benefits to users (sometimes termed consumer surplus) come from faster download speeds in urban and suburban areas, support for a greater number of users and better in-building coverage.

The values obtained depend on the mobile broadband demand scenario (higher demand implies a higher economic value for the band), whether the spectrum is used by a single operator or split between several operators (the more the spectrum is fragmented the lower the economic value of the band) and consumers' willingness to pay for enhanced mobile multi-media services in future (the higher the willingness to pay, the higher the economic value of the band).

Assuming conservatively that the spectrum is split equally between four operators gives the results shown in Table 1.

These estimates show that the harmonisation and use of 1.4GHz for a supplemental downlink for enhanced mobile multimedia and broadband services could generate economic benefits worth as much as €54 billion for Europe.

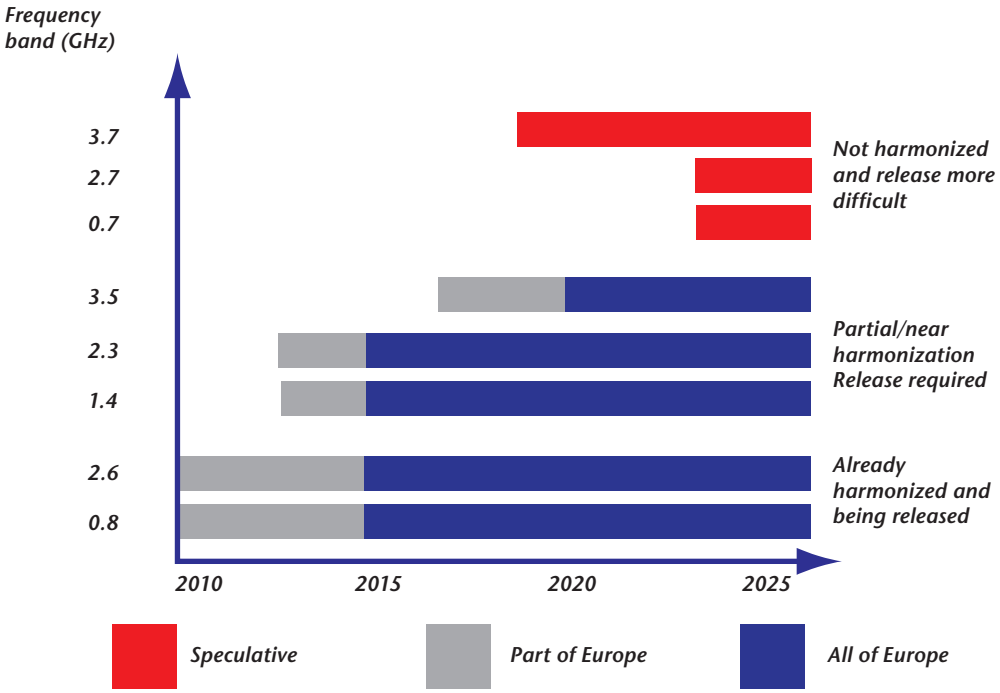
There are three additional major benefits from the use of an SDL at 1.4GHz. The 1.4GHz band:

» Supports delivery of the Digital Agenda target to provide 30Mbps access to 100% of the EU by 2020. This is an extremely challenging target for the market to deliver. Wireless has a key role in providing high speed broadband to remote and rural customers. The 1.4 GHz band can play an important role in providing very high speed broadband access required to meet Digital Agenda targets at lower cost than fibre or wired infrastructure. This will help reduce public subsidies for providing broadband in rural areas, which currently amount to around €2.5bn a year.

» Increases competition in the mobile broadband and content markets. Limited availability of spectrum below 1GHz means that in many countries, operators will have little or possibly even no low frequency spectrum to provide mobile broadband services. The availability of additional spectrum at 1.4GHz for an SDL will enable players to compete more aggressively in the supply of high speed mobile broadband and multimedia content. Increased competition is likely to result in lower prices for consumers. For operators more mobile broadband capacity would be available to experiment with new business models.

» Gives European suppliers an early opportunity in the development of innovative mobile multimedia services and new mobile broadband business models utilising an SDL. There is considerable scope for the adoption of 1.4 GHz for an SDL outside Europe such as in the Middle East and Africa, Australia, Canada and Mexico. Implementation of the standard in Europe

Figure 3 Possible timings for release of bands for mobile services



will open up new business opportunities in international markets, particularly for service and content providers with successful business models.

Conclusion

Mobile traffic will continue to grow exponentially over the coming years. This point is appreciated by many governments who have targeted to release significant amounts of spectrum in the next 5-10 years. The 1.4GHz band is widely available and currently underutilised across Europe as well as in many countries globally and thus offers a scalable opportunity.

Without additional spectrum the industry will struggle to deliver cost effectively the multimedia and broadband services people are likely to demand in the future. For example, the move to cloud based services makes little sense without good mobile connectivity.

The release of 1.4GHz for SDL could stimulate economic activity by allowing new applications and business models to develop and lowering the cost of delivering wireless services. The economic benefits could be worth as much as €54 billion for Europe and the band could be used to augment other low frequency spectrum used to meet the ambitious targets of governments to deliver universal high-speed broadband. Not only would the application of a supplemental downlink at 1.4GHz help achieve these targets in a relatively short timescale – the next 3-4 years – it will also help operators reduce their costs. In time the supplemental downlink could even be deployed in other frequency ranges that will be used in future by mobile networks.

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Table 1 Source: Plum analysis

	LOW DEMAND AND WILLINGNESS TO PAY (€BN)	MEDIUM DEMAND AND WILLINGNESS TO PAY (€BN)	HIGH DEMAND AND WILLINGNESS TO PAY (€BN)
Avoided infrastructure costs	4	15	26
Value of enhanced user experience	9	18	28
Total	**13**	**33**	**54**