

Digital Radio

— a receiver manufacturer's viewpoint

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While DAB take-up has been very successful in a few markets, it has failed in other markets due partly to a lack of compelling digital-only content.

In this article, PURE Digital – the most successful DAB receiver manufacturer over the past five or six years – provides an upbeat analysis of what the future holds for DAB-based digital radio. The article concludes with a section from parent-company, Imagination Technologies, on the latest silicon developments for digital radio.

The first non-experimental DAB digital radio transmissions began simultaneously in the UK, Denmark and Sweden in Sept 1995, instigated by the BBC, Danmarks Radio (DR) and Sveriges Radio. The expectation back in those days, that radio listeners would be impelled to buy DAB radios largely on the basis of improved audio quality proved to be misplaced, resulting in a lack of demand by consumers and a resulting lack of affordable receivers from radio manufacturers. In fact, for the next seven years, the only DAB receivers were Hi-Fi tuners (with the exception of two extremely expensive “portable radios” which were effectively Hi-Fi tuners with attached speakers), appealing only to the relatively affluent audiophile market.

It was only when the BBC and commercial radio in the UK realized that content was the key driver of digital radio listening, and separately started transmitting unique DAB content, that a viable market could be envisaged, and development started on new DAB chipsets which would allow affordable DAB radios in various mainstream form-factors (kitchen, bedside etc.). The first tangible result of these developments was the development of the Chorus processor by Imagination Technologies. It was then licensed to Frontier Silicon and brought to market as the Chorus FS1010 chip. The Venice module produced using this chip was used in the EVOKE-1 – the world's first sub-£100 digital radio – manufactured by PURE Digital, a completely new digital radio brand.

The EVOKE-1 started shipping in August 2002 and, by the end of that year, it had single-handedly trebled the installed base of DAB radios in the UK. More importantly, it applied pressure on the incumbent radio suppliers in the UK, who saw over the next



year a significant loss of market share, and forced them to bring forward DAB product plans which otherwise had very little chance of being completed.

By the end of 2003, a number of other new radio brands had entered the market – having seen that digital radio provided a means to make inroads into what had previously been a market dominated by a few very traditional brands. Products from these new manufacturers – eventually along with new products from the traditional manufacturers – meant that the uptake of DAB digital radio, when viewed with August 2002 (rather than September 1995) as its starting point, has subsequently moved along a very standard successful technology introduction curve, in line with CD, DVD and others.



Looking at the UK audio market as a whole (combining radio with the burgeoning MP3 market) at the peak Christmas selling season, it would come as no surprise to know that the five top-selling products are all Apple iPods. What might surprise however is that after just one other product (a very inexpensive MP3 player), the next best-selling audio product is a portable DAB radio – the PURE ONE. And the next DAB radio appears after only another two iPods and a Samsung MP3 player. In fact, if Apple is excluded from the equation (effectively treating Apple as a market in its own right, which it effectively is), the DAB and MP3 markets in the UK have very similar values – £162M for DAB and £193M for MP3 for the year ending July 2007.

DAB, where it is successful, is **very** successful.

DAB geographical markets – a mixed bag

Successful DAB markets, and the reasons for growth

It is well known that the stand-out market for DAB digital radio is the UK, with around 7 million receivers now being used in approximately 27% of UK households. What is less well known is that a small number of other countries have seen similar success when viewed in proportion to the population.

Denmark in particular has a thriving DAB market, with a household penetration almost identical to that of the UK. Norway follows close behind Denmark, with Belgium and Switzerland not far behind that.

“Denmark in particular has a thriving DAB market”

So what is it about these countries which has created successful markets where other countries, notably France, Germany, Spain, Italy and Portugal have so far failed to generate any tangible success? What are the common elements which have combined to create successful market conditions?

Progressive regulation

Successful DAB countries tend to have regulators which have recognized the importance of DAB digital radio to the future of broadcasting within their jurisdiction, and have created regulatory regimes which have encouraged interest and investment from broadcasters. This has variously included automatic extensions of FM licences plus requirements on broadcasters to actively promote digital radio.

Enthusiastic public service broadcasters

The PSB in each of the successful countries has been prepared to lead the way on DAB transmission, as well as take strong measures towards promoting DAB on the platforms available to them.

They have also in the main produced unique digital content, seeing that as the key driver for digital radio up-take.

Commercial radio involvement

Each of the successful countries has a high PSB share of listening, but commercial radio is an essential part of the digital radio mix. Where commercial radio has been encouraged or been visionary enough to get involved, this has greatly accelerated demand, partly because the very direct digital radio promotion by commercial broadcasters tends to complement the more generic and broader promotion from PSBs.

“Each of the successful countries has a high PSB share of listening, but commercial radio is an essential part of the digital radio mix ”

Unique digital content

Of the four key selling points of digital radio (content, ease of use, extra features and improved sound quality), the one which consistently tops surveys of why we should purchase a DAB radio is **content**. The BBC has produced six digital-only stations, one of which (BBC7) is consistently mentioned as a key reason to buy a digital radio. Danish Radio has produced a complete bouquet of unique (essentially repackaged) services around the concept that people want to listen to their particular type of radio station exactly when they want to, not when the broadcaster decides to broadcast it. This model has been repeated in Norway and is also being adopted in Ireland. Even commercial broadcasters have produced unique content, generally focusing on strong niche markets. Some of these stations (e.g. Planet Rock in the UK) have taken significant market share.

Broadcaster promotion

Consumer demand is driven by promotion and in the successful countries where the broadcasters see that their future is assured – not threatened – by digital radio, this promotion is coordinated and takes place. Promotion drives awareness and demand and that in turn drives the retailers to buy, stock, display and again promote products. In this way a vicious circle ¹ is changed into a virtuous circle of demand and investment.

Stagnant DAB markets, and the reasons for slow growth

“There are over 300 DAB receivers available, many from reputable brands ”

As little as three years ago it might have been reasonable to blame the failure of some markets on a lack of available and affordable DAB receivers, but that is clearly no longer the case. There are over 300 DAB receivers available, many from reputable brands, covering a very wide range of price points starting from as low as £25 (32

Euros), and receiver manufacturers are keen to make their products available in as many markets as possible. So why aren't they readily for sale in the countries mentioned above?

1. No unique selling points (especially content) = nothing to promote = no promotion = no demand = no product in the shops = no reason to invest in DAB = no unique selling points...

Some of the reasons are of course the opposite of those above:

- In Spain for example, a seemingly reasonable attempt by the regulator to share out the available DAB spectrum evenly among the national broadcasters meant that the larger broadcasters are under-represented in the digital space, and are therefore reticent to promote DAB. The smaller broadcasters, although keen to promote DAB for the very same reason, have little or no analogue platform on which to do so.
- German public broadcasters have generally been less than enthusiastic about digital radio and, with a few exceptions, have not invested in producing unique digital content.
- Digital radio legislation and regulation in France was not given a necessarily high priority, and so took a very long time to come to fruition.
- In Italy, the job of promoting and lobbying for DAB digital radio sits not with a single body, but with a number of commercial radio groups, each with their own agendas and issues. Rather than coming together in the interests of creating a successful market which is then worth fighting over, the groups have tended to fight among themselves, leaving the digital radio market open for competitive technologies. Fortunately, recent news seems to indicate that a new era of cooperation has started in Italy, and that bodes much better for the future.

Some other reasons also exist however.

Failure to understand the radio receiver market

Broadcasters are at a point removed from the business of manufacturing and selling receivers and have at times put measures in place which although seemingly helpful, have in fact been negative. For example large-scale give-aways and broadcaster-subsidised radios has had the effect of stifling retailer demand. In fact, although broadcasters and manufacturers have the same ultimate goal (millions of receivers in the market), their preferred means and timescale for getting there are fundamentally different. Broadcasters would like to see £10 receivers in the market immediately. The major manufacturers on the other hand, have invested millions developing chipsets and radios and they need to see financial returns on that investment. For the manufacturer, a key part of this is to avoid a price crash which would result in minimal (or potentially negative) profit margins and ultimately in no incentive for the market to exist. This is almost a catch 22 situation, but not quite. The result is that it just takes longer than some might like for the market penetration to build.

Low penetration of in-car DAB receivers

It is undoubtedly true that the lack of in-car receivers has slowed down the acceptance of DAB. A large proportion of European radio listening is done in the car, and the long development cycles of car manufacturers, hindered by the heterogeneous nature of the market (see below), have been a major dampener. Adapters to retro-fit DAB into existing cars and after-fit radios have so far failed to take off, but the new PURE Highway – an affordable in-car DAB adapter which can be installed like a sat nav in a couple of minutes (see the photos below) – looks to be making a difference. Using FM



retransmission to get DAB radio onto the existing car stereo, while also supporting iPods and the ability to skip back to something you missed, has definitely created a jump in this sector and might prove the catalyst it requires while the car manufacturers get their plans in place.

Heterogeneous and confusing geographical market

The in-car issue above is compounded by the very different DAB experiences throughout continental Europe. Whereas an FM listener can drive from country to country and know that there will be content available, the same is not true of DAB digital radio.

Non-global market

All technologies require investment and in most cases such investment can only be justified within the context of a global market. While DAB digital radio remains successful in only a few markets it will not get the attention of the mainstream consumer electronics manufacturers – with a subsequent lack of investment, marketing and slower growth.

DAB – what sells and to whom

“ ... what types of devices are selling, and who are the people that are buying them? ”

Despite the doom and gloom of the previous section, investment is taking place in this sector and the market is growing, albeit slowly in most countries for now. But what types of devices are selling, and who are the people that are buying them? Most of the relevant statistics

come from the UK.

DAB consumers have principally been male biased (see Fig. 1, top left), relatively mature (Fig. 1, top right) and coming from the higher end of the social scale (Fig. 1, centre left). Some reasons for this customer profile are as follows:

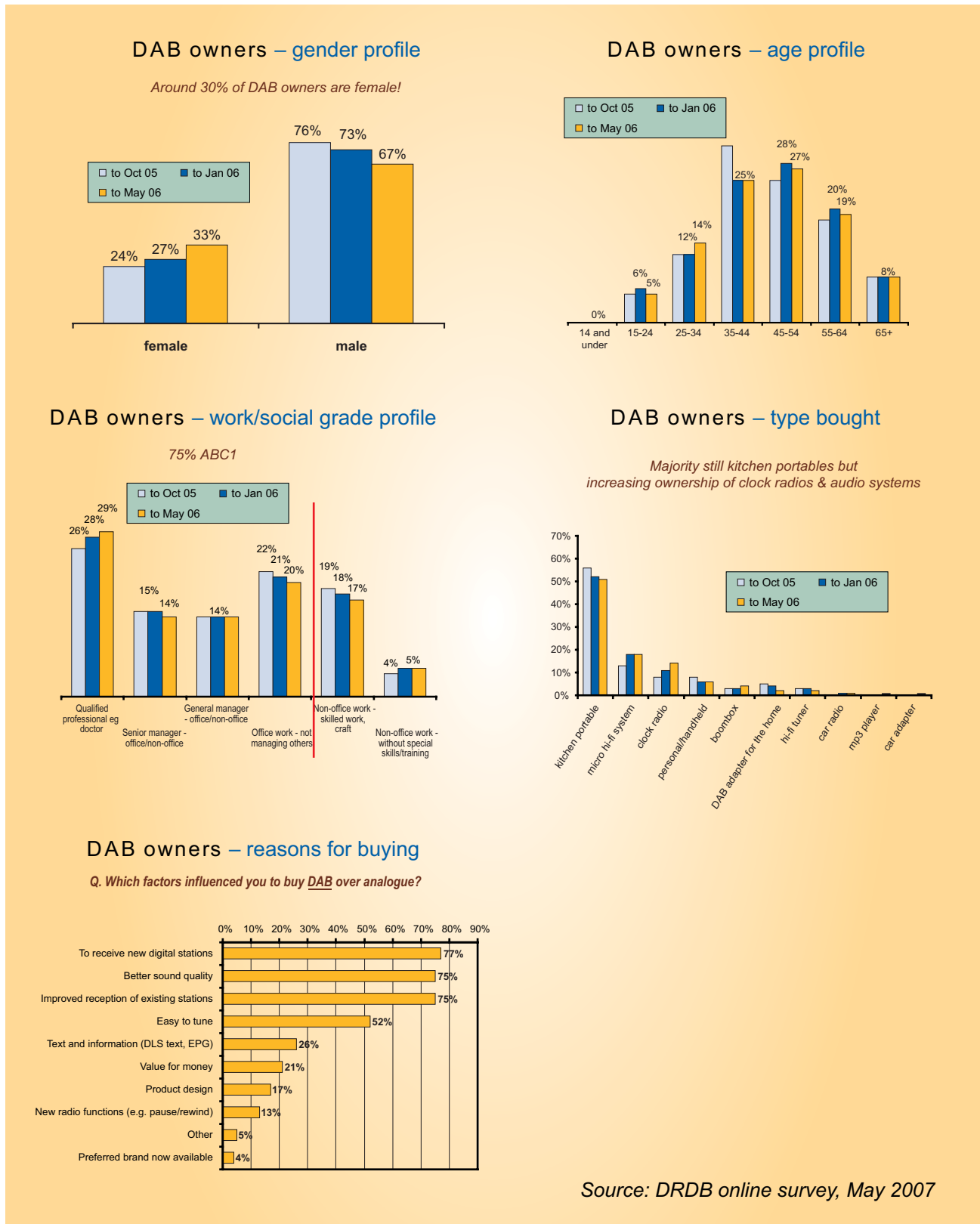
- 1) DAB radios are (and will remain for some time) more expensive than FM radios, and so purchasers of DAB radios are likely to be the people who have a real passion for radio. That tends to be the older generation who were brought up with radio (as opposed to TV).
- 2) DAB products have been focused at that demographic for the simple reason that those are the products which sell best. This could be thought of as another chicken and egg situation, but it is also true that most DAB products aimed at a younger audience have fared less well in the market.
- 3) There is a school of thought within marketing which says that sub-£100 is the "sweet spot" for a consumer electronics product for a man – the price at which it becomes a reasonably impulsive buy. That price is thought to be sub-£50 for women.

This reasoning is borne out quite strongly by PURE's experience of selling its classic wooden radio products (strongly AB social scale, strongly male, strongly mature), versus the experience of selling the more mainstream-styled and affordable (£49.99) PURE ONE. ONE still sells to the same demographic, but broadens it considerably to include many more women, C1 and even C2 social scale, and a slightly younger audience (perhaps helped by the presence of a pink version).

ONE has also sold over a quarter of a million units in less than 18 months, something which took over three years to happen with the current best-selling DAB radio – the EVOKE-1S (and its predecessors, the EVOKE-1 and the EVOKE-1XT). Although the DAB market was hailed as going mainstream when the millionth receiver was announced back in December 2004, it is actually the arrival of sub-£50 radios (effectively sub-70 Euro radios) and the 5 million sales point achieved in May 2007 which

heralded a real mainstream market, and allows us to look impassionedly at the types of receivers which actually sell in volume and the niche markets arising within the overall DAB receiver market.

No impartial figures exist to show the split between “basic” DAB radios and “advanced” DAB radios, and so we have had to look at the sales of PURE products in isolation. However, given that PURE has produced the most commercially successful advanced radios, the conclusions below are likely



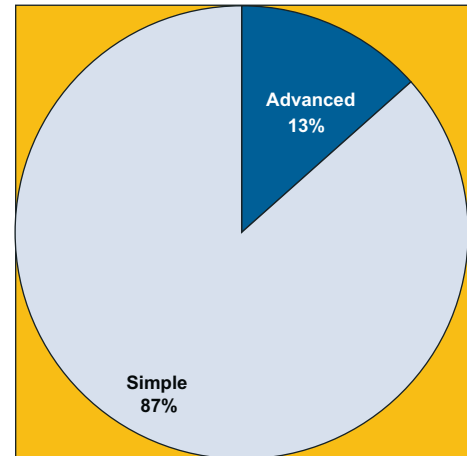
Source: DRDB online survey, May 2007

Figure 1
 Some results from a DRDB user survey, May 2007

to be only strengthened if the whole market was taken into account.

In this analysis we are defining “simple” radios as those without advanced features such as an Electronic Programme Guide, pause & rewind and record to an SD card.

Looking back over the last year, “simple” radios as defined above made up almost 87% of the sales of all PURE DAB products sold, leaving 13% of sales accounting for “advanced” receivers (see *pie chart*). Analysing this by radio category, it appears that people want simple bedside radios, some want advanced features in a kitchen radio, but many want extra features in a micro system, perhaps because it is a form factor which they want to think of as “future-proof”.



New DAB categories

DAB has undoubtedly been successful in the portable radio category, often called kitchen radios, to the point where the vast majority of the value of that market is DAB radios, even persuading some retailers to stop selling analogue radios. The same is true to a slightly lesser degree in the personal (handheld) category. But the real growth categories for 2007 have been the mini/micro system market, and particularly the clock radio (bedside) market. These are burgeoning on the back of the launch of excellent products from mainstream manufacturers. But looking out to 2008, there will be a few key categories which should see significant growth:

Combined DAB & iPod docks



The iPod docking market is still relatively small, but is rapidly expanding. Chronos iDock became the best-selling docking radio in the UK after only 1 month on the market.

In-car DAB adapters with FM retransmission

The PURE Highway is the first of what is likely to be a new breed of in-car radios and adapters – providing the choice of DAB as well as some of the extra features of DAB for the first time in the car, and most importantly in a format which can be fitted by the least technical owner.

DAB & Wi-Fi radios

Wi-Fi internet radios have been available for some time but have been relatively unsuccessful to date. Radios are expected soon which will combine the broadcast strengths of DAB with the “connected” strengths of internet radios, allowing access to thousands of internet radio stations, on-demand radio stations and podcasts, but more critically also allowing consumer interaction with the radio station as well as a possible link between the local strengths of radio and the social networking sites that are today present on the web.

New features of DAB

Many new features have been introduced into DAB products since the EVOKE-1 was launched with its very simple functionality and interface.

Abbreviations

AAC	Advanced Audio Coding	DVB-H	DVB - Handheld
DAB	Digital Audio Broadcasting (Eureka-147) http://www.worlddab.org/	EPG	Electronic Programme Guide
DAB+	DAB using the AAC codec	FM	Frequency Modulation
DMB	Digital Multimedia Broadcasting http://www.t-dmb.org/	PSB	Public Service Broadcaster
DRDB	(UK) Digital Radio Development Bureau http://www.drdb.org/	SD	Secure Digital (memory card)
DVB	Digital Video Broadcasting http://www.dvb.org/	T-DMB	Terrestrial - DMB
		TPEG	Transport Protocol Experts Group http://www.tisa.org/

Pause and rewind

Sometimes called “ReVu,” sometimes “PausePlus”, pause and rewind on DAB radios is relatively straightforward to implement, requiring some extra memory and processing, though the extra memory accesses can cause sensitivity issues if not designed carefully. Although there are quite a few products with this feature, it has not proven itself to be compelling to the consumer in the same way as it has with hard-drive-based digital TV systems.

Record to solid-state memory (normally SD card)

Perhaps the most successful advanced feature to date (especially when combined with pause, rewind and EPG), is the ability to set timed recordings of radio programmes – more so than immediate recordings of current content.

Electronic Programme Guide (EPG)

Consumers now commonly use an EPG on television to decide what to watch and what to record. DAB EPG, now in use widely in the UK and somewhat less outside the UK, is a much used feature, allowing consumers to find out what is happening on particular radio shows, and set timed recordings to listen to at their convenience. Radio, like many entertainment media, is becoming increasingly consumed “on-demand”.

Enhanced DLS (Intellitext, Journaline and DLPlus)

DAB scrolling text (DLS) is a much-appreciated unique feature of DAB, but is of course transitory. Enhanced DLS systems address this issue in different ways, but with the same ultimate goal – to store the information in a user-accessible database to allow them to access the information at their leisure. Systems currently being used allow users to find news headlines, sports results, weather and traffic information as well as a host of other data. At this point, WorldDMB has standardized on Intellitext, but is still considering Journaline and DLPlus as more data-centric approaches. Intellitext has the advantage that it requires no access to the data channel within the DAB stream, and relies very simply on structure within the visible DLS. The other formats use data to deliver tagging information with the advantage that they can deliver more complex data, but at the cost of more complexity for the broadcaster.

DAB slideshow

Currently in the trial phase, DAB slideshow is increasingly being transmitted by broadcasters in the expectation that it will add a strong visual element to radio in the same way that most MP3 players can display images of the band being listened to. Unfortunately, the significantly increased cost of the colour display, and the associated extra cost of full-colour DAB receivers which could show such

slideshows, means that this feature is likely to be implemented only on relatively expensive devices. However, such devices are likely to be attractive to the iPod generation, and so great hopes are held out for their arrival some time in 2009.

TPEG

Although part of the full DAB specification, TPEG has to date seen little support in receivers and subsequently little broadcast support. However, the BBC is now transmitting TPEG data and the 4Digital group (who won the licence for the second commercial national multiplex in the UK) also has plans to broadcast a TPEG service. This is of course of interest for in-car receivers and adapters, but is also increasingly being seen as of interest for static (in-home) receivers, where consumers could find out the traffic situation before deciding on a particular route to work.

New radio features associated with DAB

On top of these features which are driven by the DAB system, a number of other new features have been introduced on DAB radios, simply because they link well with a processor-based radio system. Some of these features are the SnoozeHandle (a touch-sensitive metal handle for bedside radios); the ability to go to sleep to one station and wake to another; USB upgradeability to allow new features to be added post-purchase; ChargePAK – a rechargeable battery pack – which has come about due to the relatively high power consumption of digital radios.

Advances in DAB silicon

Since the earliest days of DAB broadcasting, a number of key semiconductor manufacturers have been developing devices to enable the transition of DAB from low-volume trials to mass market adoption. However, it was the combination of silicon solutions delivering substantially above the minimum performance specified, together with a strong market push from a company truly focused on the success of DAB and backed up by all major broadcasters, that was needed to get the sales moving.

For any consumer product in an aggressive cost-sensitive market, high levels of integration are key to boosting the unit shipments needed to generate commercial momentum. Thus, semiconductor devices – in volume production – that are available to a wide range of manufacturers are essential for an emerging technology such as DAB.

“One of the most successful chips in the development of the DAB receiver market has been the FS1010 (Chorus 1) chip from Frontier Silicon ”

One of the most successful chips in the development of the DAB receiver market has been the FS1010 (Chorus 1) chip from Frontier Silicon, incorporating patented intellectual property from Imagination Technologies (the parent company of PURE Digital). Current estimates show that more than 70% of all DAB receivers sold worldwide use this chip, mainly as part of one of Frontier's Venice family of DAB

modules. Frontier Silicon continue to develop their silicon and module product families as the market for DAB radios continues to grow.

However, another market force has emerged that is also driving semiconductor devices for DAB. In South Korea, the T-DMB mobile multimedia service was launched towards the end of 2005. T-DMB uses exactly the same modulation, framing and signalling as DAB, but also specifies higher layers to

enable the reliable transmission of video and audio content, as well as extensive data services. Since the higher layers are often implemented in software, this has created a significantly larger market for chips that are capable of demodulating DAB transmissions – the Korean market alone for T-DMB was expected to reach more than 5m users by the end of 2007.

Extending the market for chips that are capable of receiving DAB is essential to support the relentless drive for lower costs. Another factor now impacting this is the worldwide interest in mobile TV, using systems such as DVB-H, ISDB-T or MediaFLO. An increasing number of these chips now also support DAB demodulation, as the market moves towards multi-standard receivers capable of supporting all the new standards. Imagination Technologies is a leader in this area, with a growing number of partners licensing their unique software-defined demodulation solution. These multi-standard solutions will increasingly enable any mobile-TV-enabled handset to also receive DAB – a key factor in achieving the “holy grail” of DAB becoming a reality in mobile phones.

The extension of the DAB standard to DAB+ (ETSI TS 102 563) allows as much as 3 to 4 times the number of audio services to be carried within the same multiplex as the older DAB system. This has opened up new markets for DAB – initially Australia and Eastern Europe, but should also reinvigorate markets such as Switzerland and Germany. However, the AAC+ codec plus Reed-Solomon error correction used in DAB+ makes significantly greater demands on the receiver subsystem. Unless the chips put more of these functions in hardware, these standards become more expensive to deploy. Fortunately, a growing number of chipsets using technologies (such as the ENSIGMA UCC multi-standard technology from Imagination Technologies) are capable of managing these extensions. Putting these functions in hardware and utilising the latest semiconductor manufacturing processes is enabling silicon manufacturers to continuously reduce power consumption while increasing functionality, thus ensuring DAB and DAB+ receivers continue to progress down the cost-reduction curve.

Audio decoding is another area that is changing. In dedicated DAB receivers, the audio decoding is usually done within the receiver chip itself. However, as DAB starts to become a feature in mobile TV and other multimedia mobile platforms, the audio decoding is being handled by the media applications processor driving other parts of the platform. This not only reduces the cost of adding DAB to mobile platforms, but also encourages mobile handset manufacturers to add low-cost multi-



Despite an honours degree in Software Engineering from Imperial College London and an early career in software development, **Colin Crawford** moved to the dark side and has for the past 6 years been responsible for all aspects of marketing PURE's digital radio products worldwide. Working closely with retailers and the broadcast industry, he has built the PURE brand from non-existent at the start of 2002 to its current position as #1 radio supplier to the UK, and #1 digital radio supplier in the world.

Mr Crawford represents PURE and its parent company, Imagination Technologies, on various trade bodies and has been a WorldDMB steering board member since 2004.

Tony King-Smith has more than 27 years experience in the semiconductor and consumer electronics industries. He is currently Vice President of Marketing for Imagination Technologies, where he is responsible for strategic and tactical marketing of all their semiconductor Intellectual Property (IP) technologies (including their DAB/T-DMB/DAB+ offerings). He also manages Imagination's strategic partnerships and ecosystem programmes, and sits on the Board of the company's subsidiary, PURE Digital.

Mr King-Smith graduated in Electronics and Electrical Engineering from the University of Melbourne. He then moved to Europe, where he progressed through a diverse range of multinational companies including Panasonic, Hitachi (now Renesas), LSI Logic, INMOS and British Aerospace. Through his work, he has developed a unique global perspective of the electronics industry from European, Asian, Japanese and US management perspectives.



standard receiver chips that only decode the basic transport stream, while they re-use their multi-media processors for audio decode and data services processing.

The semiconductor progress in chipsets that are capable of demodulating and decoding DAB and DAB+ continues to advance at a dizzying pace. In addition to ever-more mature dedicated DAB solutions from companies such as Frontier Silicon, the growing market for multi-standard mobile TV receiver chips and modules supporting T-DMB is now creating increasing opportunities for adding DAB receivers to other types of consumer products.

Conclusions

DAB has had a somewhat chequered reputation around the world to date but, when examined in detail, it can be seen that it has succeeded impressively where broadcasters have recognized the critical factor – that the transition to digital radio can only happen if the consumer is presented with very clear advantages, and in particular with new and unique digital-only content.

When this happens, radio consumers – particularly in Europe where radio listening is a fundamental part of the societal psyche – are very keen to embrace the new technology, especially when dressed up in a non-threatening form. This has enabled a strong digital transition in many countries and that in turn has allowed for the development of new and very desirable features and advantages in advanced digital radio receivers.

With the advent of the DAB+ standard and its resulting dramatic increase in broadcast efficiency, many new markets are showing keen interest to drive ahead with DAB digital radio at the heart of their radio strategy. The first DAB+ upgradeable receivers – the PURE Siesta, Chronos II and Highway – are

“ With the advent of the DAB+ standard ... many new markets are showing keen interest to drive ahead with DAB digital radio at the heart of their radio strategy ”

already shipping in volume. With many more to follow (80% of PURE's product range is scheduled to be DAB+ by the end of 2008) and DAB+ products coming from other manufacturers, we can look forward to a new era of dramatic growth in DAB digital radio around the world.