

LIGHTHOUSES, PILOTS AND BITRATES RIDING THE WAVES OF INTERNET RADIO

NICK SHARWOOD-SMITH

Wave Science Technology Ltd, London, UK

This paper is about Internet radio broadcasting. That is, the live streaming of a branded programme output, to a schedule, in real time. It does not directly deal with podcasting, downloading or time-shifting.

The paper examines the current issues confronting the set up and accessibility of Internet services. It examines some of the issues facing Internet radio as it expands from being strictly a niche medium and the potential for it to become a mass-market provider. The paper also discusses aspects of the financial models for Internet radio.

INTERNET RADIO

Why, it might be asked, is there a fuss about digital radio, and particularly about Internet broadcasting, at all? In terms of audience share, the UK still overwhelmingly listens to analogue radio with 74% of audience share still held by AM and FM services. Of the 16.6% of those who do listen to digital services, over two thirds use a DAB receiver¹. Of the remainder, nearly half listen to digital services from the comfort of their settee via DSat or DTT. Assuming that anyone who listens to Internet radio does so deliberately and knowingly, this then leaves Internet radio with a share of less than two percent of the listening audience.

Were Internet radio as constrained in its service area as conventional transmissions this might be a problem. But it is not constrained and the fuss is about the fact that Internet radio provides a medium for 'broadcasting' that has completely different characteristics from its predecessors and offers some very interesting possibilities for future development. As can be seen from Table 1 below, until the arrival of

DSat radio distribution there had been a steady trend in UK transmission systems from the start of medium wave to the arrival of DAB. On the increase were the fidelity of the broadcasts, the choice in listening, the number of transmitters required to serve the population and - inevitably - the costs of setting up a network.

DSat broke this trend by providing a platform for the transmission of hundreds of radio stations over a massive service area. The drawbacks were the need for an expensive set-top box and a fixed satellite dish to deliver the signal. For those reasons it is unlikely that the current model of satellite delivery will ever make great inroads into the UK's listening audience.

What Internet radio does is to follow some of the trends set by DSat, but also to provide a much more compelling experience for its users. The reach of Internet radio is Global – and you can't get much bigger than that.

It has the capacity to carry an almost limitless number of stations – currently over 10,000². It also has the potential for the transmission of high fidelity digital

TX Method	Audio Fidelity	Typical Service Area	Transmitter Network	Stations on the dial	Issues
AM	Low	100's miles	Few	10 +	Interference,
FM	High	10's miles	Many	20 +	Expensive network
DAB	Selectable	10's miles	Many	30 +	Expensive network
DSat	High	100's of miles	Very Few	100+	Set-top box only
Internet	Selectable	Global	Distributed	10,000 +	Unicast network

audio and the ability to offer listeners vast amounts of information about its services. Perhaps most importantly it can be extremely cheap to start-up, compared with a conventional transmission network. So how does it work?

Niche Broadcasting

If you wanted to start broadcasting an Internet Radio station the technical requirements would be extremely basic and would be found within many millions of UK households. Assuming that you have a home PC or Mac with Web browsing software, and a broadband connection there are sites that you can use to assist you:

In true Net Community style US sites such as www.live365.com will provide links to a predominance of internet-only stations and will offer a simple route for prospective broadcasters to set up their own stations. Visitors to the site will quickly discover that streaming music, even to small numbers of people, is not without a cost with intrusive advertising and prompts towards a VIP Subscription service.

At www.shoutcast.com (now a subsidiary of Time Warner) the push is to use their proprietary Winamp Media Player, but again the site is organised very much for a community of users.

Mainstream Broadcasting

If you are already a broadcaster your needs for streaming live audio will be slightly greater and so you will require the services of a company that provides a

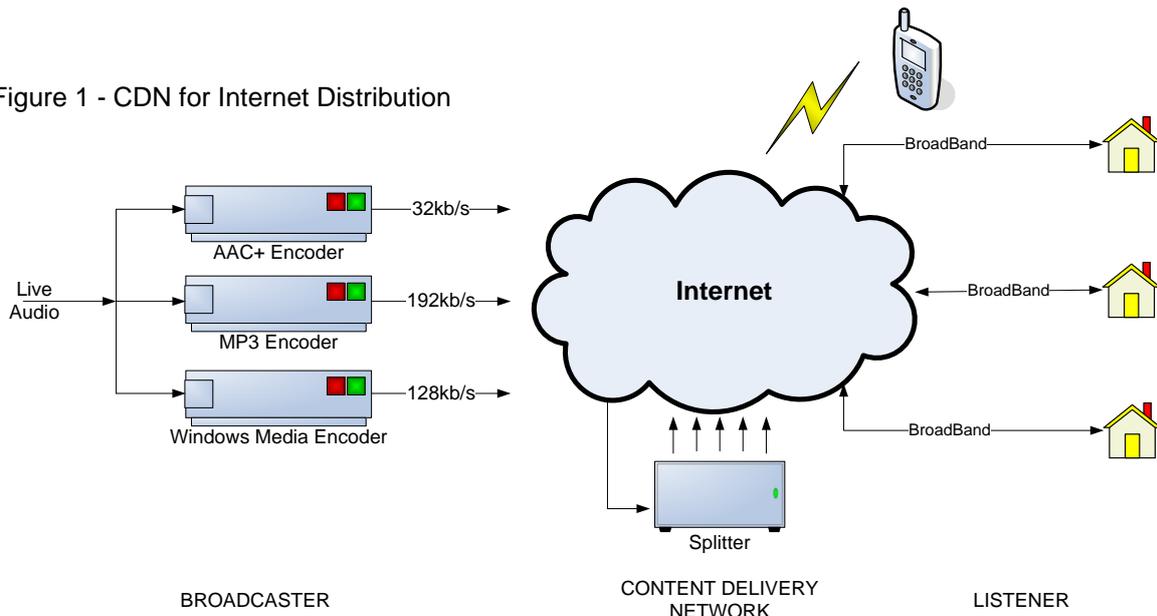
specialist Content Delivery Network (CDN). Figure 1 shows how a CDN makes content from a client available to multiple users. International providers are companies such as Akamai Technologies, Level 3 Communications or Limelight Networks. They will guarantee to deliver your content at a variety of bitrates to multiple users and it should be clear that you are paying for a delivery service with high availability, scalable volume on demand and a suite of globally-based resources that can be used to provide mutual support.

There will be a requirement for several different bitrates and different encoders in order to serve the widest possible number of users. It is not too difficult to find references to no less than thirty-eight different media players for Windows, Linux and Mac using decoding rates from 16kb/s – 320kb/s, but mostly in the range from 56kb/s 128kb/s.

Naturally there are some brand leaders and Windows Media Player, Real Player, Winamp and iTunes would feature strongly due to their prevalence in the marketplace. A feature of Internet systems is that they are constantly evolving however, and other encoders and media players are bound to emerge over time.

So putting a service on the Web is reasonably straightforward, but how do listeners go about finding your station? Well, inevitably there is a Microsoft page www.windowsmedia.com/Mediaguide/Radio that will lead to you to a site with a genre-based selection of stations. Other sites listed in Appendix 1 will offer

Figure 1 - CDN for Internet Distribution



you hundreds of choices. The international sites will offer you over ten thousand possible ‘stations’ to receive.

Naturally, with that range of choice, every site offers different ways of navigating between stations, typically by genre, location or language. Many sites will offer a guide as to the bitrate and encoding format of each station, so that a choice can be made on quality or ease of connection.

Other sites offer slightly more commercially targeted choices. Due to the widespread interest in Internet broadcasting, it is possible to receive Internet radio, not only on your PC or Mac, but also on dedicated hardware, usually marketed as an ‘Internet Radio’.

Internet access is also provided for some Networked domestic player/recorders like the Sonos or the Squeezebox which can be Ethernet cabled to a broadband router, or function over a broadband WiFi link. They contain storage, a user interface with remote control and the processing to carry out encoding and decoding of audio streams. They will usually handle multiple encoder algorithms³.

million people tune in to your station, in a Unicast world the cost of distributing a service is directly related to the number of listeners, the length of time for which they listen and the bandwidth used to transmit the service to them.

So to provide a streaming service for less than one hundred listeners at a bitrate of 56kb/s would be inexpensive, but should that service become popular and be streamed to 100,000 listeners then with the current model for Internet access, it would become 1000 times more expensive.

If you have a large number of listeners, across the globe, then it is likely that you will benefit from a CDN with a presence in many countries and your bill will therefore be in Gb/s or Tb/s transferred, per month.

This then is the dilemma for Internet distribution at the moment. Should a station become popular, its costs will escalate. Alternatively, should the station decide to improve the quality of listening and increase the bitrate of their transmissions then again their costs would increase.

TX Method	Data Services	Start up costs	Mobile Use?	Cost per listener hour
AM	None	Transmitter, specialised studio equipment	Yes	Reduces as the number of listeners increases
FM	RDS	Transmitter(s), specialised studio equipment	Yes	Reduces as the number of listeners increases
DAB	Limited	Transmitter(s), specialised studio equipment	Yes	Reduces as the number of listeners increases
DSat	Limited	Transponder lease, specialised studio equipment	No	Reduces as the number of listeners increases
Internet	Almost limitless	Encoding equipment	Yes	Increases with audience and audio fidelity

Table 2 – Transmission networks compared

Unicasting not Broadcasting

Amongst all those thousands of Internet stations, the listenership is naturally divided sparsely. This is, for many Internet stations, a blessing, since although this paper has referred to the Internet as a broadcast medium, as currently configured it is a Unicast medium. That is to say, each stream forms a unique transmission path from the originator or from their Agent (such as a CDN) to each listener.

Looking at Table 2, whereas in a conventional Broadcast world the costs of your transmitter or network will be the same whether two people or two

Regulatory issues

Unsurprisingly as the volume of Internet streaming and downloading has grown, so copyright and regulatory issues have come to the fore. The difficulties of controlling music sharing sites have received a large amount of press as did the recent strike of Hollywood writers, who were keen to protect their online interests.

The problem is that regulation has previously been arranged on a geographical basis and the statutory controls of regulators working within a sovereign state do not fit easily with a global transmission medium. Bodies such as PPL (Phonographic Performance Ltd)

who collect royalties on behalf of artists and music producers, should obviously continue to protect their members interests, but how? From a public service perspective, should the BBC licence fee be used to provide Internet listening for expatriates who do not pay a UK TV licence fee? Should the UK's commercial radio stations restrict live stream access to users from the United Kingdom only? The latter coming as a response to a March 2006 PPL announcement that they would only grant radio stations the webcasting rights to stream to the UK, or the stations would face additional costs.

Financial Issues

With Internet transmission, subscription, advertising and sponsorship are all possible funding models. Advertising to a global market is not a simple matter however and relies on attracting brand names that are globally recognisable.

It is arguable that subscription might fund a high quality Internet distribution business, possibly using micropayments, which are now common for Internet trading.

Table 3 uses publicly available data from a nationally recognised broadcaster to look at the financial implications for running successful stations with both high and medium listenerships, using the Internet as a transmission medium – with the inherent assumption that all listeners, both mobile and at home, have moved to Internet reception.

The other assumption that has been made is that costs for distribution will continue to fall. The figure of £0.04 per Gbyte will probably be achievable, but is unverifiable due to the commercial sensitivity of a true figure for such a volume of data.

The calculations have been made using a series of bitrates:

32kb/s and 64kb/s since they represent the lowest feasible data rates for a service mixing speech and music

128kb/s since it is a common DAB coding rate

192kb/s representing the highest current DAB coding rate

FLAC which provides roughly 2:1 lossless coding and is therefore the highest fidelity currently available

By comparison with the costs below, the BBC Annual Report for 2007 quotes both Radio 2 and Radio 3 distribution costs as being £4,200,000.

As can be seen, even with the current unicast web topology, the costs for a listenership the size of Radio 3 do not look unsustainable.

By comparison, Radio 2 will probably be content with more traditional methods of reaching its audience until the web becomes a multicast network.

THE FUTURE

The current Unicast topology of the Internet is undoubtedly a constraining factor for Internet

Table 3 Annual costs for example radio stations

BBC RADIO 2 - National station	
Listening for:	12.5 hours/week average for 12.8 million people
BITRATE	Annual Costs
32k	£4,792,320
64k	£9,584,640
128k	£19,169,280
192k	£28,753,920
FLAC (900kbps)	£134,784,000
BBC RADIO 3 - National station	
Listening for:	6.1 hours/week average for 1.9 million people
BITRATE	Annual Costs
32k	£347,144
64k	£694,287
128k	£1,388,575
192k	£2,082,862
FLAC (900kbps)	£9,763,416

Based on £0.04 per Gbyte distribution cost

transmission. Should substantial areas of the Net be upgraded to provide Multicast then the Internet would emerge as a genuine alternative to conventional transmission systems.

Internet Radio is currently not a viable proposition as a mobile service. Extension of network coverage in the UK for services such as WiFi or 3G would need to improve to a level where they provided consistent uninterrupted data coverage, before the prospect of widespread mobile Internet reception could be a possibility. If, or when, this is achieved, it would have a major impact on increasing listenership although it should also be noted that the mobile telephone infrastructure is not designed for dealing with widespread use of data streaming services.

The Internet provides a bi-directional data flow and as well as the provision of large amounts of data – in the mould of services such as ‘last fm’ - there are possibilities for ‘smart’ delivery. For instance mobile devices could request a service at a low data rate, to ensure stability of reception – say 64kb/s; a personal computer in an office providing background listening might request the same service at 160 kb/s to feed a PC loudspeaker and a home subscriber might pay for a premium 800 kb/s feed to provide genuine CD quality, suitable for a home hi-fi.

Since the provision of multiple codecs at the origination of the bitstream is only marginally more expensive than providing a single coding option, there is ample scope for larger stations to upgrade. This might be done either in the interests of efficiency – as better coding is developed – or to provide access for the wider community of users whose replay options may be limited by hardware or software incompatibility.

Whatever the future, Internet Radio is very much here to stay and offers the prospect of high fidelity digital transmission direct to users as evidenced by sites offering commercial high-bitrate recordings⁴.

The inherent flexibility of Internet transmission makes it the only transmission medium that can sensibly deal with evolving coding technologies and formats such as 5.1 surround sound. It is relevant that high end audio devices are beginning to contain Ethernet connectivity in order to access downloaded material. It must be hoped that they are engineered to remain upgradeable rather than follow the fate of DAB early adopters.

APPENDIX

Feeds of UK and Eire stations can be found at www.mediauk.com or www.radiofeeds.co.uk.

For more international stations it is worth looking at www.radio-locator.com which is a US-based search site or www.mikesradioworld.com which links to international broadcasting stations which offer web streaming presence, grouping them by country or continent.

Reciva - www.reciva.com - is an Internet radio and Digital Media Player company that provides technology to companies that manufacture Internet Radios. They also host a site which provides listeners with a list of the stations that these radios can access.

FOOTNOTES

¹ Source, RAJAR Q4 2007. The remaining 9.4% of listeners were not certain whether their radios were digital or analogue!

² The exact number of Internet Radio stations is a matter for conjecture, since these stations may both start up and cease transmission without any need for regulatory approval. The figure of ‘over 10,000’ is used on several search sites and the author has no reason to doubt its veracity.

³ Squeezebox for instance quotes support for MP3, WAV, WMA, AAC, and Ogg Vorbis encoded bitstreams. Squeezebox also has support for the lossless compression technology FLAC

⁴ Linn records – www.linnrecords.com offers Classical and Jazz recordings at ‘Studio Master’ quality using FLAC coding.

Mainstream Pop and Rock music seems to be wedded to the MP3 format, but just to prove that there are alternatives, music is available in FLAC coding from the Music Today site <http://stores.musictoday.com> by ex-Grateful Dead members Phil Lesh and Jerry Garcia. http://stores.musictoday.com/store/default.asp?band_id=258