Evolution of the BBC iPlayer

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For more than ten years, EBU Members have been developing and refining their web sites in order to enhance and augment their core radio and television broadcasting activities. The web is no longer merely an information medium (providing textual and pictorial information) but has become an audiovisual content-distribution medium for the internet-connected PC user – for both linear (scheduled) programmes ("channels") as well as for non-linear ("on-demand") programmes.

The BBC's development of the iPlayer is undoubtedly one of the best examples of how broadcasters can exploit the internet as a new media delivery mechanism. It can thus serve as a blueprint for other broadcasters to develop their broadcast services on the internet.

This article is based on a series of phone-calls in August 2008 between Franc Kozamernik (EBU Technical) and Anthony Rose, BBC Controller Vision & Online Media Group, which includes the iPlayer.

For the uninitiated, some background information on the iPlayer is provided in the box on *Page 2.*

Franc Kozamernik (FK): *There is a lot of interest among EBU Members in the BBC's iPlayer developments. The EBU Delivery Management Committee (DMC) set up a Project Group D/WMT (Web Media Technologies) chaired by Paola Sunna (RAI), in order to develop and evaluate a similar development termed the "EBU Media Player", which will be capable of delivering all kinds of content including the streams received from satellite, terrestrial, cable and IPTV channels as well as VoD and catch-up TV. What advice could you give to the group?*

Anthony Rose (AR): The biggest problem in developing services such as the iPlayer is typically not so much the web site and media playout, or even the transcoding system, but rather the metadata and the content ingestion.

In the case of the proposed EBU project, a key design questions is whether it will be an automated system that will capture content from satellite or other source, or whether there will be a team who manually process and ingest content.

FK: *Our provisional idea is that our system will be fully automated. The system will allow users to find content via a variety of categories and other criteria. The metadata used will be broadcast via DVB-SI and TV Anytime, as appropriate.*

AR: There are a number of important questions which I think need to be addressed before one starts a project such as this. For example, is it the EBU's intention that each broadcaster creates their own

website to where users can access this captured content, or will the EBU provide a so-called white label solution, which means that the EBU develops a fully working website, which each broadcaster can then "skin" or brand to make it look like their own site? Will broadcasters need to arrange rights clearances for each territory, or can the EBU arrange this on behalf of all? Where will you source detailed metadata from (e.g. actor names, full programme descriptions, etc.)? Would you pull it from the DVB feed or will editors log in separately to apply enhanced metadata?

Perhaps the EBU project is more similar to the Redux project developed by BBC Research rather than the iPlayer? Redux is a technical trial using a fully-automated media ingest and capture system, is largely built on open-source technologies, and does not use DRM. Redux is being used within the BBC as a means for transcoding and providing content to BBC platforms. It is a very convenient and flexible input system.

In contrast, the BBC iPlayer is a well-staffed 24/7 operation with significant viewer traffic. We make sure that a comprehensive metadata scheme is exactly right. An essential asset of iPlayer is the right level of content protection for files and streams, as well as geo-protection, to address licence fee and content owner issues.

It is more likely that Redux can be made available to the EBU for testing rather than the iPlayer, given the sheer amount of resources that have been spent on making the iPlayer a viable commercial product. Many European broadcasters approach us with an interest in licensing the iPlayer. The question is whether they want a complete end-to-end system or whether they want individual pieces of the iPlayer production system, playout system or website. We spent several million pounds of taxpayers' money and could not give away that technology readily. However, in the case of Redux, the investment is substantially lower and the technology could perhaps be more readily available to 3rd-party broadcasters.

FK: *We would like you to focus on the iPlayer now. What was the BBC's motivation to develop the iPlayer?*

AR: Our motivation for designing the iPlayer has been to develop a consumer proposition to satisfy the end user, i.e. the BBC listener and viewer, in an age where people are acquiring their entertainment from the internet, not just from their TV set. What does the user really want? They do not care about codecs and metadata taxonomy, they want to find content that interests them. We did not want the iPlayer to become a regular video-sharing site like YouTube or a music store like iTunes, where people would need to sort through thousands of programmes to find one of interest. This is a different use case. The reason why people like to come to the iPlayer site is because it allows them to find a particular programme that they missed on TV or radio. They want to catch up with what

The BBC iPlayer in a nutshell

The iPlayer is a web application – available at **http://www.bbc.co.uk/iplayer** – that allows internet users in the UK to download and stream BBC television and radio programmes for up to 7 days after the broadcast.

Users are able to download and stream programmes as soon as they have been broadcast on BBC TV and Radio. Users can keep downloads and watch them as many times as they like during the following 30 days.

For selected series, all episodes of the series are available for up to 13 weeks, known as Series Stacking. The iPlayer will in due course allow users to subscribe to a programme series and automatically download each programme after it is broadcast.

Recently, simulcast streaming was added, allowing users to watch TV live in addition to the on-demand catchup services.

The iPlayer services can be accessed on broadband internet-connected devices such as PCs, Apple Macs and Linux computers as well as Apple iPhone, Nintendo Wii and Sony PS3 gaming consoles, Nokia N96 mobile phones, Windows Media compatible portable media players, and Virgin Media set-top boxes.

To follow new developments of the iPlayer, go to **http://www.bbc.co.uk/blogs/bbcinternet/iplayer/**.

The iPlayer now has over 1 million users per day, and up to 1.7 million stream and download requests each day. The iPlayer should reach the 300 million play-request milestone early in 2009.

they know exists but were unable to enjoy at the time of broadcast. It is possible that over the coming months and years, the iPlayer will become a general browsing proposition, with demand driven by you or your friends rather than by the linear broadcast schedule. However, today it is focused on catching up with regularly-scheduled BBC radio and TV programmes.

When we launched iPlayer streaming at Christmas 2007, the home page had only six featured programmes and that was all. The BBC marketing team chose these six featured programmes. If you liked one of these programmes, you were in luck as this was exactly what you could easily find, right on the home page. The problem was if you did not want one of those programmes, you had to do a bit of work and browse by category, by day or search by name and so on. That might have been a complex (or even unsuccessful) operation, so we tried to make it easier to find a programme.

The first home page design was essentially "*the BBC chooses what you watch*". Then we added a "*most popular*" zone on the home page – this was about what other viewers (rather than the BBC) recommended that you should watch. And then we also added a "*just in*" feature for those items that have just arrived and "*the last chance*" feature for items that would disappear soon. Finally, we also added a "*more like this*" option as a sort of recommendation system (similar to that used by Amazon). These content-selection mechanisms proved to be extremely useful and popular among iPlayer users.

FK: *The iPlayer does not use any ratings, as opposed to ZDF's Mediathek in Germany. Why?*

AR: Indeed, we have considered adding a rating mechanism, but we feel it's only useful where applying a rating is a means of recommending that programme to your friends, rather than rating the programme in the way it's done on YouTube. If you have a video website with a million videos, possibly uploaded by the users themselves and often of mediocre quality, then you need a rating system so that users can say which are worth watching and which are not. In contrast, when you only have 600 programmes of professional quality, it adds little value to invite viewers to rate them. For example, how do you rate a Parliamentary channel? Rating BBC programmes would not add much value for the iPlayer user. In one sense, the programmes are all pretty good and marketed for different demographics.

However, we need to develop more personal recommendations – which programmes are good for "you". When we changed the site by adding the above selection mechanisms such as *most popular*, we made it much easier to find programmes. Before launching these features, we asked ourselves whether:

- people would watch more programmes because they can find more programmes;
- they would make fewer page views (because navigation is better);
- they would make more page views (because they may browse more, as browsing is easier);
- people would watch more programmes but would watch for less time (they may see recommendations for other programmes and would just click on something else before finishing the current programme)?

Before we introduced these recommendation changes, there were about ten web-page views for every programme played. After these changes were introduced, the number of pages viewed dropped by 30% while the number of programmes played went up by 30%. These numbers showed

Abbreviations

CDN	Content Delivery Network	**LLU**	Local Loop Unbundling
CPU	Central Processing Unit	**PoP**	Point of Presence
DRM	Digital Rights Management	**RTMP**	(Adobe) Real-Time Messaging Procol
DVB-SI	DVB - Service Information	**RTMPE**	RTMP – Encrypted
HTTP	HyperText Transfer Protocol	**RTSP**	Real-Time Streaming Protocol
IP	Internet Protocol	**VoD**	Video-on-Demand
ISP	Internet Service Provider	**WMV**	(Microsoft) Windows Media Video

that our changes actually helped people to find their programmes more easily. Finally, the number of page views per programme watched settled to about five and stayed there.

It is interesting that the average viewing time per programme did not change. We found that people watch a programme they chose for an average of 22 minutes. We also found that, on average, people watched two programmes per day, giving an average viewing time of about 40 minutes per person per day. About 35% of programmes are viewed all the way to the end. This is an excellent outcome, because our programmes are usually 30 or 60 minutes long.

***FK:** What is the editorial relationship between the BBC website and iPlayer? How are they differentiated?*

AR: The iPlayer is a destination within the BBC website. In many cases a given programme is available both within iPlayer and elsewhere on the BBC site, allowing users to discover and view the programme in the context in which they were browsing the BBC site. For example, most people used the BBC sports site rather than iPlayer for the Beijing Olympics. We're promoting the iPlayer as the home for long-format content. The sports site, the news site and other BBC sites are typically focused on shorter formats, like news clips and programme trailers. They also cover live events such as the Opening Ceremony at Beijing: live streaming was watched by over 100,000 simultaneous users on the **http://ww.bbc.co.uk** website. A total stream capacity of 45 Gbit/s was provided by the Akamai content distribution network (CDN). For video coding, the On2 VP6 flash format was used.

The consumption of Olympic programmes on the iPlayer was also very good. Many people who could not watch the Olympic events while broadcast on terrestrial, cable or satellite networks were able to use the iPlayer and watch those programmes delayed. For example, the Opening Ceremony was the most-viewed programme on iPlayer. It added more than 20 percent to the iPlayer traffic after the event [1].

***FK:** How would you describe the structure of the iPlayer system? Which are the principal layers?*

AR: The iPlayer basically contains four layers, as follows:

- iPlayer destination portal site – this is what everybody sees;
- embedded media player – a Flash player which is used for media playout both in iPlayer and across the BBC site;
- media production – to create the content that can be used by the Flash player and is invisible to most people;
- a media distribution system.

***FK:** Could we start perhaps with the latter one first, please?*

AR: For On2 VP6 streaming, we currently use the Akamai CDN, whereas for H.264 streaming we currently use the Level 3 CDN, which is one of the biggest CDNs in the USA (in August 2008, Akamai did not provide for H.264 streaming).

***FK:** Why does the BBC iPlayer not use a Peer-to-Peer solution?*

AR: The BBC has explored a range of distribution solutions, but P2P does not currently provide the optimal proposition for streaming. First, viewers do not want to install any specific plug-ins. Currently to use P2P you need to install extra software. Second, P2P uses a computer's CPU and bandwidth, and most users generally do not like it.

If you are going to download some content via BitTorrent, you may agree to use P2P, and many people are happy to trade their bandwidth for free content. But in the case of the BBC, where people have to pay a licence fee of £130 a year, some are less than happy if we require that they use their bandwidth and install special software. This is especially true for people with low bandwidth and those who pay additional charges if they exceed a certain download limit. There were definite and substantial benefits from using P2P two years ago, but in that time the price of bandwidth has declined dramatically, such that today the use of P2P no longer provides substantial benefits. Of course nothing stands still in the technology world and, in a year or two, P2P may again be the preferred choice.

1. This interview was held during the Olympic Games. During the second week, as the Games moved into the final stage, the iPlayer consumption even increased by about 40%.

Of course, we know about Octoshape, Rawflow and a few others, and we have investigated using them for iPlayer distribution. But we are very happy with our current CDN-based streaming system; you click on play and the stream starts to render in about 300 ms. The only reason not to use a direct streaming facility could be cost and potential savings.

For downloading, we currently use the Kontiki P2P system which currently gives us a bandwidth saving of about 60 percent, so it halves our bandwidth bill for downloads. But we have to run a very complex server farm to make up the cost associated with it.

Actually the BBC is running a massive server farm itself, with over 200 computers, and we have 92 percent free peering. In fact, our bandwidth really does not cost us very much, at least not for downloads. If you look at all these various pieces, you wonder about the benefits of P2P. We believe that P2P works really well in some cases, particularly if you have a few programmes or a few files which are downloaded by many people, because then there is a good peering efficiency. It does not work well if you have an enormous catalogue, because the downloaded file only resides with a few peers.

For the Kangaroo project [2], P2P might work well for the 50 most popular programmes, but it will not be optimal to use P2P for a catalogue with lots of items.

We believe that the right approach is not P2P but caching at the edge of the network. We only have 500 hours a week of video content, which means that one TB of storage is enough to store our entire catalogue. This can be more efficiently done by simply putting a caching service in our network.

It may be a solution that, for the primary proposition, the user need not install any plug-ins. But you can have a secondary proposition which could offer better quality (say, high-definition TV). In this case, the use of a P2P plug-in may be justified, because distribution costs for HD streaming are very high and could be significantly lower by using P2P.

***FK:** How about a combination of P2P and CDN, which is now increasingly used by both CDN and P2P providers?*

AR: With the iPlayer we have a bandwidth bill which is not insignificant, but it is something we can afford. We do something like 100 TB per day of streaming traffic. This is a fairly significant amount of traffic. The cost of bandwidth is falling very rapidly and there is a lot of competition between the CDNs.

At the moment the cost is not too excessive. But imagine in a year or two when we have a TV set-top box with an integrated iPlayer and millions of people using it, and each of them consuming 1.6 Mbit/s for a TV stream. The bandwidth required would be 10 times what it is now. Obviously, if this happens we will have a problem. The question is, what is the best solution for this problem. Is it P2P, should we make this new box with P2P or shall we build an edge-caching solution in conjunc-

2. Wikipedia article: **http://en.wikipedia.org/wiki/Kangaroo_(video_on_demand)**

tion with other broadcasters and ISPs? We do not know the answer but we need to build an agile architecture that allows different transport layers to be plugged in. We should separate the delivery layer from the content delivery formats, the DRM and the download manager, so that we can flexibly glue in different propositions at short notice as needed.

We are of course monitoring the developments of Tribler and other future-generation P2P approaches, as well as hybrid systems where P2P is backed to a caching box, for example.

FK: *The BBC is renowned for its trials on IP multicasting. Could that be an option for iPlayer distribution too?*

AR: BBC Research has been trialling IP multicasting for a while. Different parts of the BBC may have slightly different objectives. In our case, we just want the iPlayer to work for everybody: go to the iPlayer site, find a programme on the home page, click it and play it. Other parts of the organization, such as BBC Research, look further into the future, and would like ISPs to build IP Multicast in their networks. Of course, we would like this as well, but the reality today is, as the UK statistics indicate, that only 5 percent of users are multicast enabled. It is probably not worthwhile to put much effort into making a multicast system for such a small number of IP multicasting-enabled users. It is really a chicken and egg situation.

Nevertheless, we are considering in the forthcoming months to use JavaScript or other means to detect if users are multicast-enabled, and if so, we may be able to give these users a higher quality stream. If they are not multicast-enabled, they would only get a lower quality stream. In this way, both ISPs and the users would have an incentive to introduce multicasting. The users are likely to choose those ISPs that have been able to upgrade their routers and can offer higher quality streams.

FK: *There has been recently a lot of noise in the UK about the increase in network load caused by the iPlayer traffic. It seems that some ISPs have filed complaints with the telecom regulator?*

AR: The press largely misrepresented the situation by saying that due to the iPlayer, the internet will collapse and everything will come to an end. Of course, this is not true. We spent a lot of time talking to ISPs and we continue to meet with them regularly. The reality is that about 7% of peak UK internet usage is due to the iPlayer. So, the iPlayer service is only a small fraction of the overall traffic and will certainly not cause internet failure.

In the UK, there are three classes of ISP delivery networks: cable (example: Virgin Media), LLU (Local Loop Unbundling) and IP stream.

The cost of reaching the end user with cable is very low. In the case of LLU, the ISPs invested a lot of money in putting some equipment in the local exchange, resulting in a very low cost-per-bit. The third class, so-called IP stream, is a rented bandwidth from BT Wholesale.

If you are looking for some figures, there are in total about 5000 points of presence (POPs) around the UK. About 1500 of them are LLU enabled. About 30% of users are on cable. For cable and LLU the cost is relatively low, while for IP stream the cost of bandwidth is very high. This hurts those ISPs. There is no problem with the amount of bandwidth as the iPlayer is no way near reaching the bandwidth limit. However, our audience statistics show that iPlayer usage peaks in the hours between 6 and 11 p.m., which is also peak traffic for ISPs. The ISPs license the bandwidth for IP stream, based on peak usage. For this reason, iPlayer traffic is costing those ISPs. It is not just iPlayer, all traffic from YouTube, Facebook and other services is costing them. Our statistics indicate that this traffic is even larger than the iPlayer's traffic.

The situation is quite complicated as some ISPs like Virgin Media (cable) are offering 50 Mbit/s packages. This encourages people to use more bandwidth. Virgin Media is happy with the iPlayer and higher bandwidth consumption. Other ISPs that offer an IP Stream service are less happy because the iPlayer traffic is costing them more.

FK: *So the situation is very complex, isn't it? How do you plan to resolve it?*

AR: The future lies in tiered services. What we need to do is to create the iPlayer services at different quality levels and then let ISPs offer different bandwidth propositions to users. For example, the user who enjoys higher bandwidth connections would pay more, and those who are satisfied with lower bandwidth connections would pay less. Of course, nobody should get a worse experience than today. We were offering streaming initially at 500 kbit/s. Today we are also offering 800 kbit/s and in three months time we might be offering 1.5 Mbit/s.

Some people will stay with 500 kbit/s, so they will not be able to experience our high-quality streams. If you sign up with Virgin, you will be on a 20 Mbit/s plan and you can download a film in 6 minutes, rather than in one hour if you only have a 2 Mbit/s line. So we could introduce a new scalable business model. For example, the user can get a good quality iPlayer service for, say, £10 a month but for £20, a much better iPlayer quality would be available.

If we can create iPlayer in tiers, then ISPs will be able to work out how to sell that. Every content provider should create such quality tiers and then ISPs will be able to build business models around these propositions. This can lead to win-win situations and ISPs will see video services as a profit centre rather than a cost burden.

FK: *Which bitrates are actually being used for streaming and downloading?*

AR: Back at Christmas 2007, we started with 500 kbit/s for live streaming and 1.2 Mbit/s for downloads coded in WMV (Windows Media Video). Now, we have introduced 800 kbit/s as well. In the future there should be no difference between downloads and streams but we are going to make a range of different bitrates, for example, 500, 800 and 1500 kbit/s.

The other thing we are going to do is pre-booking. The user will be able to download automatically a programme during the night. If you leave your computer on and if, for example, you watched Dr Who last week and the week before, it is likely that you will want to watch Dr Who next week. For ISPs, peak bandwidth is very expensive, but it is cheap during the night. We know that our top 20 programmes account for about 70 percent of all our bandwidth. In this way, most of our programmes could be delivered during the off-peak hours, downloaded and stored on the user's local hard drive. Thus, peak bandwidth usage could be significantly reduced. This is really a mixed economy where the difference between streaming and downloading is getting blurred.

In this scenario, our programmes will all be DRM'd and you will be able to either stream them or download them. A person with a good network connection will be able to stream, whereas the user with a poorer connection speed will download it and watch after the download completes or even during downloading.

The prime user experience is and will always be the iPlayer website. Imagine you go to the iPlayer website and you want to play something. Of course, you should not look at your hard drive to find out what is on it, your web page should now be smart enough to find out whether the programme is

already stored on your local hard disk, and if it is, play it from there, rather than from the BBC server. This complete seamless integration of on-line and local playout is what we would like to implement in 2009. Another advantage is that users can simply unplug their computer and watch the down-loaded programme offline, for example, while on an airplane.

FK: *Recently the BBC introduced the H.264 codec for the iPlayer and some users complained about poor accessibility. Why?*

AR: H.264 requires more processing power and better graphics cards. We have spent quite some time looking at this problem. There are a few H.264 compression settings that produce brilliant results but which require a high-end computer and graphics card. If you have a dual-core processor with a high-end graphics card, it looks fantastic, you can do HD at 4 Mbit/s. However, if you have a low-end portable computer, the quality is terrible, with the video running at 10 frames per second or less. So you need to carefully select the profile you use to ensure the video plays back seamlessly on a wide variety of target computers.

H.264 allows for three profiles – Base, Main and High – and for each profile you can turn on different features. We have gone for Main profile and we also turned on hardware scaling for full-screen play-back, as the default. In fact, we have now found that H.264 does not use more CPU power for the configuration we have chosen, compared to the On2 VP6 codec. Rather, the contrary is true in full screen mode and, because we use hardware acceleration, it uses less CPU power. The answer is that, if you are not careful, H.264 is unplayable on low-end machines, but if you choose carefully, H.264 could be a pretty good user proposition. It is bit more complicated than that because the older Mac computers have problems with H.264 and can play On2 VP6 more successfully. With some older computers there is a problem. But with newer computers, again if you choose wisely, you can actually get a better experience.

MPEG-2 is old and no longer in the running, as bitrate requirements are far too high. Two other candidates for encoding are Microsoft VC-1 and On2 VP6 or indeed On2 VP7. Many people have evaluated these, and other codecs, and the outcome is that H.264 is generally thought to be the winner. But it is not always that clear cut. For lower-end computers, On2 VP6 is the best choice. On the other hand, if you are targeting Windows computers and full-screen playback, I think Micro-soft has done a really good job with the Windows renderer, so that VC-1 plays back beautifully, even on lower-end Windows machines, but it does not work well for the Mac.

Microsoft Silverlight is a cross-platform application but it does not yet have the hardware-rendering capability that Window Media Player has, which is unfortunate.

FK: *Is this issue the reason why the BBC also considers Adobe AIR?*

AR: Adobe AIR works fine with H.264 and is a clear candidate for the download solution with its DRM system, partially because we have a requirement to be fully cross-platform, and AIR runs on PC, Mac and Linux.

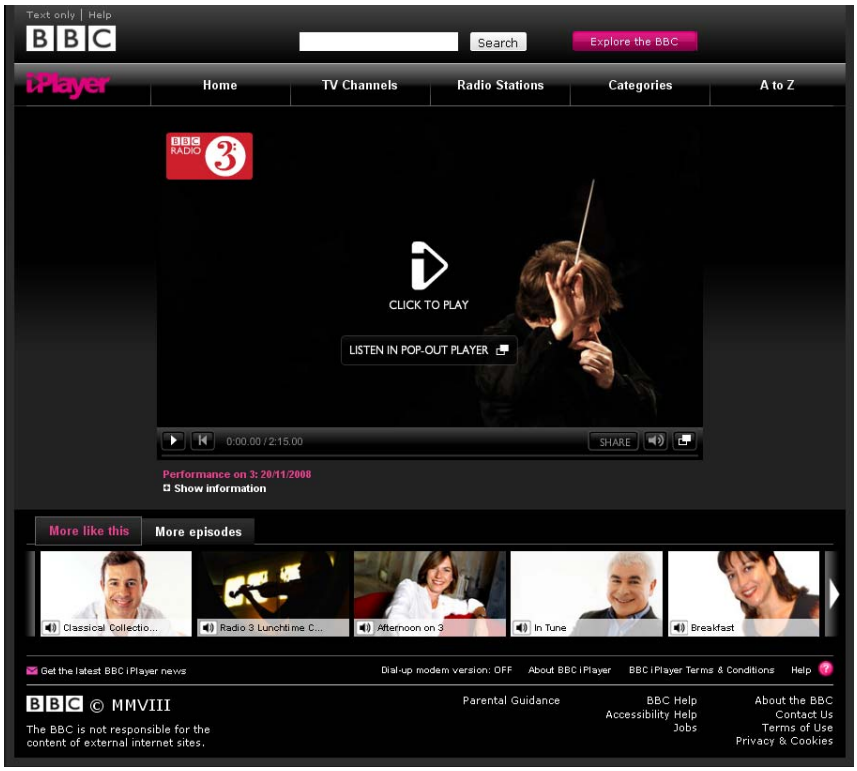
FK: *Broadcasters often face the problem of codec licensing. What is your experience?*

AR: iPlayer is now using H.264 and the question of licensing does not arise. If you use Flash, Adobe's agreements cover the playback licence fees. The BBC believes that there is no H.264 per-stream fee involved.

FK: *BBC Research is developing an open source, licence-free codec called "Dirac". The EBU plans to evaluate its technical merits, as many EBU Members are potentially interested in using it for internet delivery. Does the iPlayer have any plans to migrate to Dirac?*

AR: At the moment we believe Dirac is probably better focused on high-quality video encoding rather than on internet transmission. If you look at what is needed for successful internet transmis-sion and for putting in the production workflow (using TeleStream, AnyStream or some workflow software), you need a codec that you can put in the workflow software. Then, you need a streaming

server with a CDN that understands that particular codec format. You also need to have a rights protection model (DRM) and the user's computer needs a plug-in with a good renderer that can do frame-rate adjustments and so on. So, there are actually quite a lot of pieces that need to come together.



Currently Dirac is a stand-alone encoder and has not yet been worked into the different workflows. The Dirac player is not quite apt for real time on lower-end machines. There is no integration with CDNs and no plug-in has been developed, as of yet. Therefore it is premature for Dirac to be a consumer proposition at the moment but that will come with time.

FK: *How important is Digital Rights Management (DRM) for the iPlayer?*

AR: It is too narrow to look only at streaming and downloading. For general analogue or digital broadcast we do not have any DRM or any obfuscation, so people can do what they want, whenever, with the content received. Live broadcasting is readily recordable and there is no attempt to prevent people from recording it.

As far as streaming on the internet is concerned, we do not use DRM (in the conventional sense of the word) but we use some stream obfuscation technologies. Essentially, a stream must remain a stream, it must not become a download. So if a stream remains a stream, we believe we do not need to DRM it. In order to prevent a stream from turning into a download, we use technologies such as RTMP or other technologies that make sure a stream remains a stream.

FK: *What experience with using RTMP do you have?*

AR: If you link to a media file served from an HTTP server, your media player will pop up and begin playing it and that is called a progressive download. The played file would probably end up in your browser's cache and it would be very easy to copy this link and place it in another application which lets you save it. The problem with this approach is that it becomes easy to save a file that is meant to be streamed only. So we do not do that. Instead, a lot of companies offer streaming solutions which do not let you easily save the file. It will let your media player throw away the segments of the file after they've been played, rather than allowing them to be saved to your hard drive.

Microsoft has a solution and the product is called MMS. Then there is RTSP (Real Time Streaming Standard) which is an open standard, and Adobe has a proprietary standard called RTMP (Real Time Messaging Protocol) and another one, RTMPE, which is an encrypted version. The latter one offers better protection but requires more CPU power on the user's machine. Currently we do not see the need for it, as there is no widespread evasion or hacking. We monitor regularly whether content hacking occurs and, at the moment, this is not the case. Also, as the same programme was broadcast in the clear the evening before, the cost benefit is not there and we do not really see the need to DRM our streaming content.

Now, for downloading our position is different. For downloading, we have to DRM our files for two reasons. First, the rights holders expect that the content will be available in the UK only. Second,

content must only be available for a limited amount of time, so it can be commercially exploited, as is the case with BBC Worldwide's licensing of the Top Gear programme. Broadcasters in the USA who pay BBC Worldwide millions of pounds for broadcast rights would probably pay less if there was no DRM, as the content would be available elsewhere. This is the main reason why the rights holders demand DRM. In addition, it is a requirement of the BBC Trust (the BBC governing body) that files are only available for 30 days after download and seven days after being broadcast. So these are the reasons why we have to apply DRM to downloads.

Not all content owners however demand DRM. For example, we do not need DRM for our parliamentary channel. However, with time and usage restrictions still in force, we do need to apply it. We have, of course, the open source community saying that we should not use DRM at all.

FK: *You clarified why DRM should or should not be used for the iPlayer content, but then the question is which DRM do you use to control iPlayer usage?*

AR: The open source community criticises us for using Microsoft DRM and tells us we should use an open-source DRM solution. We have done a lot of due diligence and we have investigated all the viable DRM solutions. We have met with companies that develop them and we looked at the technologies themselves and evaluated them. The reality is that, until quite recently, Microsoft was the only viable one. It is free, secure and approved by Hollywood labels and approved by rights holders. It is easy to put on servers and clients. The problem is, however, that it is Windows only.

Other companies with DRM, for instance Apple, do not give access to the DRM system. The only way to allow content to be available using Apple DRM is to put content on the iTunes store and that really means disaggregating our content. Therefore, we do not have BBC iPlayer content available in the iTunes store. Apple would like us to give them our content and put it in a bucket with a million other programmes. For us that is equivalent to the BBC taking the content of BBC 1 programmes and giving it to competitors to put on their sites. This is clearly not acceptable. We have asked Apple for access to the DRM but so far they have not given us access.

The good news however is that other companies like Adobe are developing cross-platform DRM products. Adobe AIR now has DRM available for the PC, Mac and Linux. We hope to have a cross-platform solution by the end of this year based on Adobe AIR and Adobe DRM.

FK: *iPlayer services are not available outside the UK. At my home in Switzerland I received a message "Not available in your area". Why do you constrain iPlayer to the UK territory?*

AR: Two reasons: one is the rights reason. Licence holders sell their content in each territory. Traditional broadcasts are geographically targeted by the transmitter radiation and TV is generally very short range. But on the internet, streams can go anywhere. Licensing models change dramatically, they are still limited by, or are working within, a TV broadcast framework. The BBC is licensed to broadcast in the UK and these are the licence rights we typically acquire.

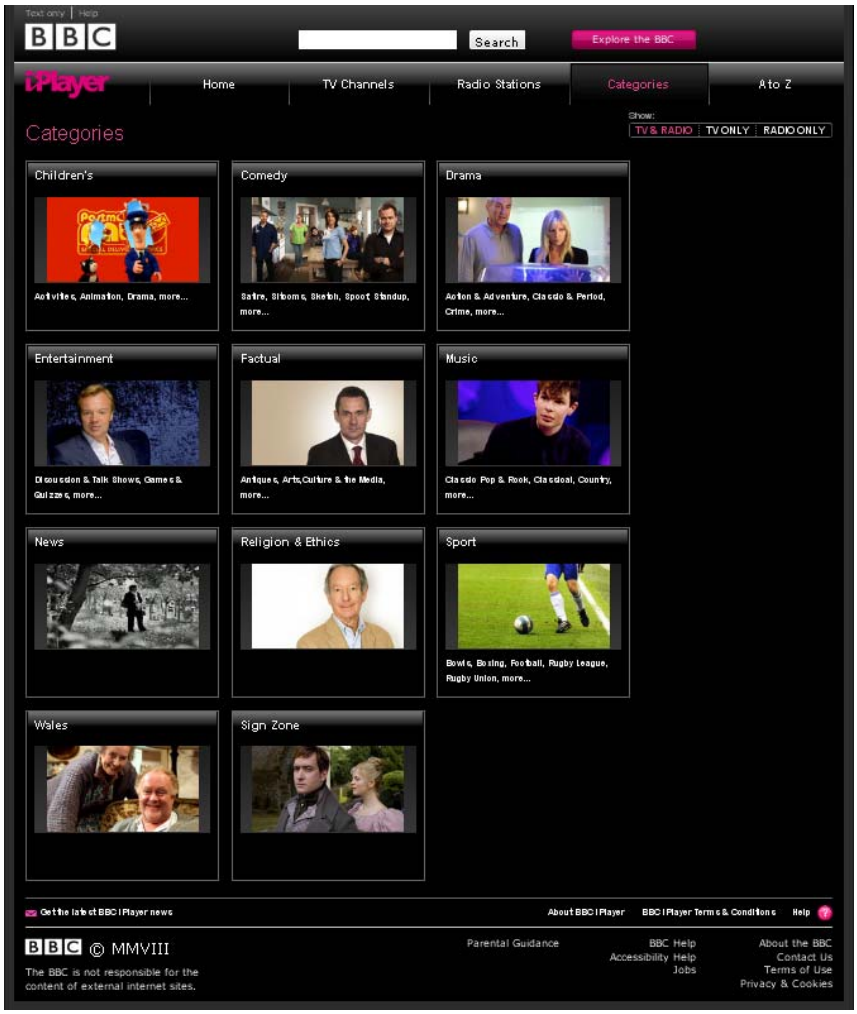
The other reason is less obvious: public services are funded by licence-fee payers in the UK. As there is always a distribution cost on the internet, it is not fair for a licence payer in the UK to pay for distribution to someone in the USA watching the content. Even in cases where we have rights to broadcast outside the UK or make content available outside the UK, we would not do it in such a way that UK licence payers fund the distribution. BBC Worldwide might fund it or may cover the distribution costs or may have ads to support the model. For these two reasons, we need geo-locking.

FK: *Which geolocation system do you use and how effective is it?*

AR: The answer is pretty simple. We use look-up tables of UK IP addresses, stored in a Quova database. These lists are regularly updated. We check the user's IP address and if it is located in the UK it is good and, if not, we say "sorry you can't have it".

Why do we not use the Akamai Geolocation database? First, it would lock us into exclusively using Akamai and we do not want to use Akamai for all services. In fact, H.264 content is now being

distributed via Level 3 Communications Inc. It is strategically better that we have our own central control system. Second, we need to maintain the whitelists and blacklists, so for example sometimes we want to set up a proxy to try and access iPlayer outside the UK, so we need the means to control this ourselves and not to rely on Akamai.



Another reason for not relying on a CDN company's geo-location service is that we really want to alert the user that the video won't be available to them as soon as they view the iPlayer web page, rather than waiting for them to click the Play button and receiving a streaming error.

We really need to know the geo-location at the time we render the web page, so that we can give the user a nice message saying that the content is not applicable to the user: "Sorry you are not in the UK, you cannot play TV but you can play radio". If we just relied on the CDN company's streaming service to enforce the geo-location, then the user would receive a stream error message and no explanation why they cannot see the content.

Things are getting more complex now with 3G access. For example, you may have a roaming arrangement with Vodafone UK. If you are in France, our system may think that you are still in the UK, even though you are actually in France. This is a new challenging area. It is not a widespread problem yet because roaming access is so expensive that it would probably cost you a fortune to receive BBC programmes abroad via a mobile phone and hence few people try. However, we will need to tweak the IP lists and work with 3G vendors to make sure that you are in the UK, even if Vodafone UK has a roaming agreement with France.

FK: *What kind of arrangements do you have with the ISPs to provide you with the users' IP numbers?*

AR: Quova makes those arrangements and it regularly updates the look-up tables. There is a way for ISPs to also update this information. We are quite happy with these arrangements; there is 99.9% effectiveness.

FK: *You have ported the content to mobile devices such as the Nokia N96 mobile phone. Can you please outline the process for doing this?*

AR: We have addressed the content creation not only for PCs but also for some portable devices. Previously, if you used Windows Media Video (WMV) files and downloaded them onto your portable media player, the WMV files may either have been refused by the device or they were played with significant frame dropping. As of September, we are now creating content specifically for Windows Media compatible mobile devices. We are creating a special low-resolution version which is small enough to download and play nicely on these devices.

Anthony Rose is Controller of the Vision & Online Media Group at the BBC, where he heads a team of over 200 people who are responsible for the BBC iPlayer, embedded media player, social media, syndication, programme websites and other projects within the BBC's Future Media & Technology division.

Mr Rose joined the BBC in Sep 2007, prior to which he was at Kazaa/Altnet. During his six years with them, he worked on a host of projects and patents covering P2P networks, DRM-based content publishing and social networking services.

Prior to joining Kazaa/Altnet, Anthony Rose was Vice President for Technology at Sega Australia New Developments, developing real-time 3D animation and 3D graphics engines.

The standard resolution on these devices is 320 by 240 pixels. At the moment the resolution of our main PC profile is 720 by 544 non-square pixels, which gives best quality on a PC but it is not suitable for small devices, so we plan to make a number of special encoded formats for these portable devices. As far as downloading these formats is concerned, we will offer a number of different options. These formats may still be primarily available from the iPlayer site intended for a PC, but we will develop several custom websites intended for downloading content to different mobile and portable devices, such as the Nokia N96 etc.

For certain devices which we think offer a great user experience, we plan to design a special version of the site. Such a site will tailor the content automatically to the characteristics of the mobile device (screen size, resolution, etc). The first of those devices was the iPhone. So if you go to the iPlayer site on an iPhone, you get a nicely tailored web version. The BBC will produce a custom version of the site for a selected number of other mobile/portable devices, so that the media will play automatically in the right format for that device.

FK: *Do you plan to bring the iPlayer to STBs and consumer devices such as TV sets?*

AR: The answer is yes. The challenge is that these devices often try to aggregate different content into one portal. To the extent that the box is just a playout device like Windows Media Extender devices [3], the answer is broadly that we would like the iPlayer content to be there. To the extent that device manufacturers are able to offer the iPlayer site experience, we would like to work with them. But, to the extent that they would like to take the BBC programming and put it in their own interface, broadly speaking, that does not work for us. It is not acceptable for the BBC to just give away its content to other websites that can then build a consumer business proposition around it.

If you Google "BBC IPTV", you will see announced plans to work on IPTV set-top boxes that are already open and available to either everyone or selected parties. This is a very good second-generation IPTV proposition. One of the problems is that often there are not many of these boxes on the market and it is really very hard to get onto these STBs. In other words, it creates a huge amount of work for us but few consumers would use it. The cost benefit really does not work out, which is why we are currently not working on this project. Today there are quite a few different providers and the market is still relatively small, say, several hundred thousand subscribers. But this may change in the future.

FK: *Thank you for clarifying the most burning issues relating to the iPlayer. I am sure that the EBU Members will find this article very interesting and useful. Should they have any further questions, could they approach you directly?*

3. **Windows Media Center Extender** is a set-top box which is configured to connect via a network link to a computer running Microsoft Windows XP Media Center Edition or Windows Vista to stream the computer's media center functions to the Extender device. This allows the Media Center and its features to be used on a conventional television or other display device. The household's Media Center can be physically set up in a location more appropriate for its role, instead of being in the living room. Additionally, with an Extender, the Media Center can be accessed at the same time by several users. The Xbox 360 gaming console is a very popular example of a Media Center Extender.

AD: Sure. You can give them my email address if appropriate.

Note from FK: Since the interview (which took place in August 2008), the iPlayer has been undergoing constant software development, with new features and functionality added almost every week.

At the Microsoft Professional Developers Conference in October, Anthony Rose successfully demonstrated the syncing of iPlayer content across computers and mobile devices, using a Microsoft desktop application called Live Mesh cloud, which is based on cross-platform Silverlight technology. The application automatically synchronizes downloaded shows across all the iPlayer-compatible devices on the person's Mesh network. That includes Mac computers, which also have a download client for iPlayer.

The new prototype iPlayer also featured several social-networking features, such as lists of the most popular shows watched by friends on the MSN Messenger list and updates on which shows each of the contacts had watched and downloaded. iPlayer users will also be able to rate scenes from the show as they go along – using the "Lovemeter" – which shows the parts of shows that people like the most.

Erik Huggers, the BBC's Director of future media and technology, recently stated [4] that the success of the iPlayer is proof that the corporation is right to bet its future on the internet. He stated that the online TV catch-up service has served 248 m items of content since it launched officially on Christmas Day 2007. The iPlayer service that is available through Virgin Media's cable service alone has served 49 m videos since June 2008. The soap drama, EastEnders, which pulls in an average of 18.9 million TV viewers each month on BBC1 and BBC3, attracts around 457,000 viewers on the iPlayer. The CBBC digital channel programme, MI High, has a far higher proportion of viewership on the iPlayer: it has a TV audience of 145,000, while 30,000 watch it on the iPlayer. Huggers insisted that the online audience did not cannibalise the TV audience. The iPlayer is popular during office hours through the day but, as viewership peaks in the evening around 9 pm, heavy usage typically continues for an hour longer than TV viewing.

The BBC's user data shows that the iPlayer is used by a range of ages. 15- to 34-year-olds account for 37% of viewers and 35- to 54-year-olds account for 43%. A further 21% of users are aged 55 or over and Huggers credited the iPlayer's popularity to it being easy to use.

The priority is to make the iPlayer available on as many digital platforms as economically possible. PC users still account for the vast majority of iPlayer viewers with 85% of the audience, with Nintendo Wii and Linux both accounting for 1%. The popularity of the iPhone and iPod Touch had taken the BBC future media and technology team by surprise. Apple Mac users now account for 10% of iPlayer viewers, while iPhone and iPod Touch owners account for a further 3%.

Here are three conclusive quotes from Erik Huggers:

> ***" The situations we're seeing are interesting – mum and dad are watching linear TV in the living room but the kids are watching in a different way ... on the iPhone, iPod Touch or a laptop. "***
>
> ***" Having seen all this and understanding more about the success of the service, the sort of users, when they watch it and what they watch ... I think the BBC is absolutely betting on internet protocol in a way where it's not just for the distribution side of what the internet enables. "***
>
> ***" We are completely re-engineering the way in which we make fantastic programming. "***

4. Guardian story: **http://www.guardian.co.uk/media/2008/nov/07/bbc-erikhuggers**