

DELIVERING DIGITAL TELEVISION TO MULTIPLE PLATFORMS

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ABSTRACT

The last twelve months have seen Digital Television move from theory to practice with the launch of many new digital services. Whilst it is true that Digital Television offers many new exciting opportunities, it is also true that it creates a whole new raft of technical problems for broadcasters. In the UK, these problems are exacerbated by the competition between the three Digital Television platforms of satellite, terrestrial and cable delivery. For commercial broadcasters there is the option of not supporting all platforms. For the BBC as a public service broadcaster, however, it is important that our audience should have access to our services regardless of whether they have chosen satellite, cable or terrestrial for the delivery of their digital services.

This paper will describe some of the problems that the BBC has had to face in order to support the development of BBC Digital Television, and will also look at the solutions that the BBC and the UK industry has developed to overcome these problems. In particular, this paper will focus on the development of a system for tackling one of the more intricate problem areas - that of providing the information to support the various Electronic Programme Guide (EPG) applications.

INTRODUCTION

The development of digital television services in the UK has been rapid - November 1998 saw the introduction of terrestrial digital television services to complement those already available by satellite, and it is expected that digital cable services may launch in late 1999. This is the result of the efforts of many organisations but the BBC has had to work especially hard because of a number of specific constraints. First there is the need to fulfil a public service remit which brings with it the need to be available cross-platform. Arising from this, there is then the problem of developing in a horizontally integrated environment, where the same basic service has to be provided to different bearers in a variety of slightly different forms. Finally, it is important to bear in mind that the BBC's digital television services have not been created in a vacuum, and that the transition from analogue has, in places, constrained the architecture used.

These three problem areas are explored in more detail in the following paragraphs.

The Public Service imperative

The BBC is primarily a public service broadcaster, and has therefore adopted a policy of platform

neutrality. To make our programmes available to as wide an audience as possible, our wish is to be able to deliver our complete range of services through DSAT, DTT and DCable with representation equal to our competitors services on each platform.

BBC services are also extensively regionalised, for example there can be up to fourteen different variants of BBC 1 broadcast at any one time. This regionality occurs at both the national (England, Northern Ireland, Scotland and Wales) level and at the regional level (e.g. BBC 1 South East, BBC 1 North West etc). With the recent moves towards devolution in the United Kingdom, national and regional broadcasting remains an important commitment.

BBC services are also highly time reactive, to make best use of a limited number of services and to keep up to date with developing events. Schedules are planned with little slack and may well change very close to transmission.

Vertical/horizontal integration

If the BBC were free to choose a single platform for the delivery of its digital television services, life would be a great deal simpler. In such a vertically

integrated scenario, all elements of the signal chain could be optimised specifically for the chosen platform. As we have seen, however, it is important for the BBC's services to be available on all digital television platforms and so the prospect of horizontal integration looms where the same signal chain is required to support a number of different bearers.

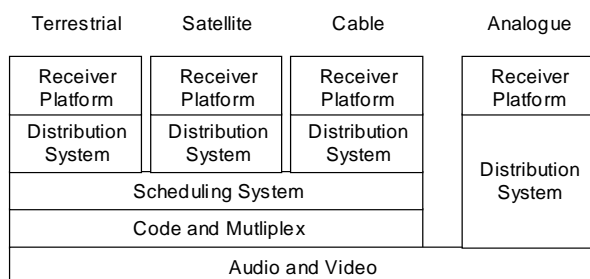


Figure 1 Horizontal integration

As can be seen from Figure 1, all signal origination processes must be capable of interfacing to a number of disparate systems. One of the key differences across all these platforms is the form of the EPG and the delivery of the programme information. DTT uses a DVB Service Information (SI) based system whereas the satellite and cable platforms will use proprietary formats, possibly as an addition to standard DVB SI.

The transition from analogue to digital

The BBC is further constrained by the need to implement digital television so as not to degrade the quality of service to the many millions of analogue viewers. Digital television has had to be grafted on to the existing complex infrastructure. In order to avoid the need to duplicate presentation staff for parts of the broadcast day the digital chain needs to be sourced from the existing analogue chain. Sustaining feeds for opt-outs also need to be shared – see Lewis et al (1).

REGIONALISATION

Regional broadcasting is an essential component of the BBC's public service offering and so it is important that our digital television services reflect this. Regional broadcasting is responsible for many of the headaches associated with the implementation of the BBC's digital networks because it has an impact in so many different ways.

The most obvious problem caused by regional broadcasting is the development of a suitable network architecture for originating the content. As will be seen later, the coding and multiplexing of

the various regional variants of BBC services is non-trivial. The situation is further complicated by the existence of a two level hierarchy of regional services as BBC services can be differentiated at the level of a 'National' region (England, Scotland, Wales or Northern Ireland) or at the level of an 'English' region (a sub-division of the England 'National' region).

A second problem is that of the service information to describe the programmes. Having established an infrastructure to support the creation of regional 'opt-outs' from sustaining services, appropriate information about the programme schedules needs to be generated and distributed to the various platforms.

Other subsidiary problems arise from consideration of programme rights issues where the BBC is not able to negotiate the rights to broadcast material outside a given region. Scottish football, for example, can only be shown in Scotland. For terrestrial and cable networks, sufficient protection from rights infringement is provided by virtue of the inherently local nature of the broadcast. Satellite, however, poses more of a problem and so Conditional Access (CA) systems must be used to ensure that appropriate access control is applied - even though the services are provided 'free to air'.

ORIGINATION AND DISTRIBUTION

The architecture of the origination and distribution of the BBC's digital television services is in some ways determined by the terrestrial services which currently offer the greatest level of regionality. For the terrestrial services, a number of DVB networks are created that correspond to the highest level of regionality for any of the terrestrial multiplexes (of which there can be up to six) for a given location. This guarantees that the boundary of a BBC terrestrial service will always consist of network boundaries. The SI for each network (or Service Insertion Point (SIP)) is fed by the 'Central SI Collator' described in Hibbert and Toomes (2), and is inserted into each transport stream before being distributed to the transmitters. The general principle is shown in Figure 2.

This structure allows us to get regional programmes broadcast by the various terrestrial services with the correct SI but this only half the story. For the bulk of the time, regional variants of BBC services will simply carry BBC network programming and so various sustaining and clean feeds must be provided to allow the regions to 'opt out' of the network programme when regional variations are active.

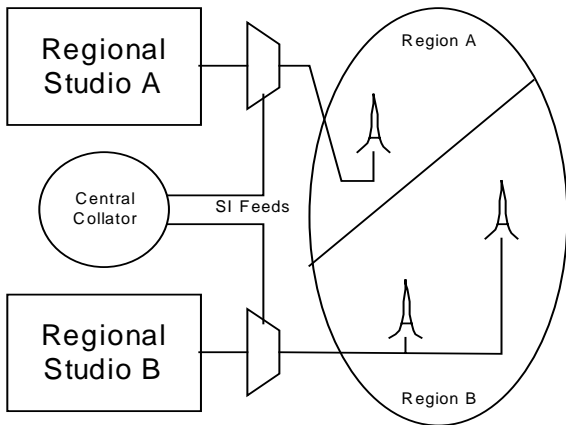


Figure 2 Insertion of SI for terrestrial services

In addition, for the BBC National regions, the resulting regional programmes have to be distributed to cable and satellite as well as the terrestrial network. Just considering satellite leads to a network architecture broadly similar to the one shown in Figure 3.

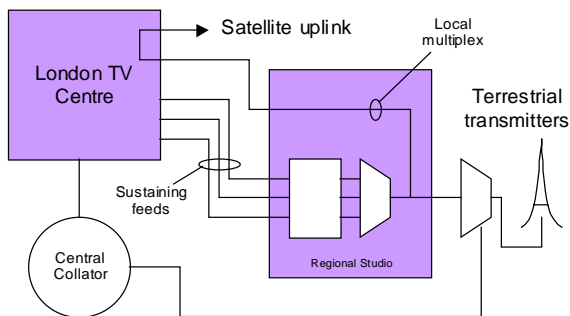


Figure 3 Network architecture for National regions

The Central Collator is important for terrestrial services as it allows SI to be cross-carried by all multiplexes - a mandatory requirement of the UK regulator. In order to provide a degree of isolation from problems with the Central Collator, however, the BBC can also distribute its own SI using the programme distribution network. A single insertion point for this SI is provided at Television Centre - but this means that for terrestrial services there are not one but two SI interfaces to be considered.

When considering SI, it is worth pointing out that for the 3 BBC National regions other than England, completely independent schedules are maintained which allows opt-outs from network programme to be freed from the constraints of network programme boundaries. For the 10 English regions, the situation is somewhat simpler as opt-outs can only occur within the programme boundaries of the overall English schedule.

SI AND THE EPG

The BBC was faced with the problem that within the BBC there was no consistent electronic format or style for programme synopses. Scheduling systems existed for strategic and presentation planning of the analogue services which with minor enhancements could cope with extra digital services. Automation systems existed for the analogue services and similar systems were being provided for digital television.

EPGs generally give the viewer the ability to view schedules for the forthcoming 7-8 days and also present a now/next service. Much of the information needed for the EPG was not held in any electronic form. Re-engineering the scheduling chain to accommodate extra EPG information was not considered viable in the limited time available for DSAT launch particularly when the requirements for digital television were still unclear and with the need not to jeopardise the analogue service.

A major concern of the BBC is that any information presented via an EPG shares the same editorial standards as the rest of our output. It is also important that the information is as up to date as possible to reflect last minute schedule changes. The BBC could only achieve the degree of reactivity and accuracy required by producing the EPG information directly.

Schedule Interface for Digital Television (SID)

Faced with this unique interfacing problem and severe time pressures the BBC decided to develop an in-house system. The system Schedule Interface for Digital television (SID), is required to allow the production of an EPG schedule from a raw transmission schedule. It manages the delivery of the EPG schedules to various third party and BBC internal systems. It also manages the delivery of now/next changes using information derived from automated playout systems, as shown in Figure 4.

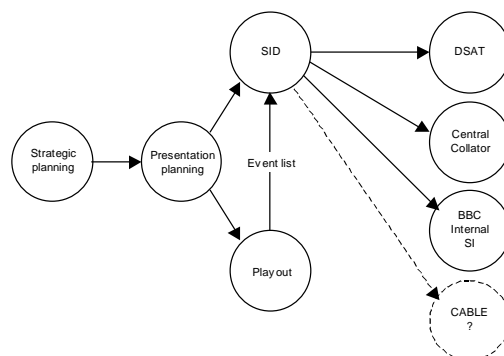


Figure 4 BBC schedule origination and distribution

EPG Production

A Windows 95/NT application has been written which allows an EPG editor to produce EPG schedules from the raw schedule used to drive the automation system or to be constructed from scratch. To ease the task of EPG editing, automated features are provided to allow user templates for regularly transmitted events, and automated merging of short events into longer EPG events. A customisable spell check facility is also provided.

The Windows application (see Figure 5) interacts with a custom designed Oracle 8 database running under the Solaris (Unix) operating system on Sun Sparc computers.

Wherever possible common authoring of information for each platform has been implemented. So far this has been reasonably straightforward to achieve but the perception of EPGs as a branding issue is diversifying their design. Common authoring will in future be much more difficult to achieve, and the cost of EPG production will inevitably rise.

Access to the schedules via the BBC Intranet is also provided via a web browser for simple view-only operations.

At any one time there are approximately 400 future schedules in preparation by a team of up to 8 people for the forthcoming 10 days.

Management of schedule distribution

Once a schedule has been edited and authorised for release then it must be delivered to the various BBC supported platforms. Further automated checking for overlaps and gaps of the schedule takes place.

Each platform currently supports different transfer mechanisms for schedule delivery, different billed day definitions and different update rules. The only common factor has been the establishment of wide area TCP/IP links to allow the timely delivery of schedules. From most platforms acknowledgement is received for each item in the schedule to show whether it has been successfully accepted for transmission. This status information is conveyed back to the EPG editor so any necessary corrections can be made. A summary screen allows the editors to confirm delivery of any given schedule to any given platform. Currently a schedule change can generally be reflected in the EPG within 10 minutes.

The architecture has been designed to allow the addition of further interfaces with no impact on existing ones. This separation also ensures that operational problems with one interface do not

prevent use of other interfaces. Currently most platforms operate on a store and forward principle - loss of EPG schedules from the BBC should not have an immediate impact to the viewer except when schedules are being changed.

The lack of any industry standard interchange format is a further hindrance to publishing of EPG information.

Now/Next Derivation

When a viewer first selects a service it is important that the now/next is accurate. It is recognised that many services can not run exactly to pre-compiled schedules and therefore most platforms provide a mechanism to trigger now/next changes in real-time.

SID monitors the playout of services from the automation system, reconciles the events found against the database and then sends triggers in real-time over the TCP/IP links to each of the platforms. Not all services are yet fully automated so some triggers are generated by clockwork from the database, this mode also provides a fall back mechanism.

The need for schedule changes to be notified to the viewer in real-time and not just to the automation system has a fundamental impact on how a broadcaster copes with last minute changes as these can no longer simply be made in the automation system. Systems, which weren't initially considered part of the broadcast signal chain, are now supplying information to viewers.

Once again the BBC has faced the problem that each platform uses a different protocol to signal now/next changes. Automation systems so far have not been able to support multiple different now/next interfaces.

Future Enhancements

The architecture is far from ideal, as information, which ideally should be available at the beginning of the chain, is not entered until the very end. Steps are being taken to move the point of entry back towards the beginning of the chain.

Last minute programme changes made in the automation system cannot currently be notified automatically to the EPG, but a mechanism to deal with timing changes is being implemented.

INTERACTIVE SERVICES

Interactive services are yet another area where there is wide divergence between platforms. The multimedia engine for the BBC's digital satellite services will be OpenTV as this is what is supported by the vertically integrated satellite receiver market. For terrestrial services, however, there is a requirement for the market to be open and so MHEG 5 has been adopted. Because MHEG 5 is an openly specified system that can be freely implemented in set top boxes and integrated digital receivers, this is beneficial for the development of a competitive receiver market. But it also provides us with another platform on which our interactive services must be supported. Although OpenTV and MHEG 5 differ greatly in the way in which they operate, it is important that the user experience of BBC services varies as little as possible between platforms. At the time of writing this paper, it is quite possible that a different HTML based solution may be adopted for cable which will require yet another translation of the services.

It is also worth noting that as well that maintaining a brand image across digital television platforms it is also desirable to maintain a synergy with other interactive services such as the BBC's Internet services (BBC Online). All in all, although the problems are not insurmountable, there is clearly a great deal of work involved in ensuring that all of these platforms can provide a suitably coherent view of BBC content.

CONCLUSIONS

All digital television platforms use DVB based MPEG 2 transport streams – but they are not directly compatible. Each interface requires individual consideration. This paper covers just a few of the technical difficulties associated with implementing these interfaces in such a way that the requirements for regionality and reactivity can be met. In the future more problems will have to be overcome – for example the delivery of services time-sharing the same bandwidth and the creation and deletion of MPEG service components for individual events across all platforms.

REFERENCES

1. Lewis, A., Ely, S., Fry, N., King, D., 1998. Digitising Auntie. Proceedings of the 1998 International Broadcasting Convention.
2. Hibbert, C., Tooms, M., 1998. A centrally based Service Information (SI) system for UK Digital Terrestrial Television. Proceedings of the 1998 International Broadcasting Convention.

ACKNOWLEDGEMENTS

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SID - [Edit: BBC 2 UK Analogue [W24 D4] [at 10:05, release statuses at 10:05]]

Schedule Edit View Schedule Item Table Maintenance Messages Window Help

Channel: BBC 2 UK Analogue Billed date: 15/06/1999 (W24 D4)

Time	Duration	Description	EPG Name/Description	St
1655 16:56:02	35:00 33:59	ESTHER NATURAL ...	Esther Natural Born Mothers: Esther Rantzen meets all kinds of mothers ...	📺🔔
1730 17:32:05	30:00 27:30	WHOSE HOUSE? 'A'	Whose House? Ross Kelly and Anna Ryder-Richardson host the gameshow in ...	📺🔔
1800 18:00:00	25:00 23:09	FRESH PRINCE OF ...	Fresh Prince of Bel Air Aint No Business Like Show Business: Will Smith stars in the ...	📺🔔
1825 18:24:29	45:00 44:06	HEARTBREAK HIGH	Heartbreak High Todd and Anita are an item and Draz has to be told. Carly thinks ...	📺🔔
1910 19:09:55	20:00 19:00	THE OZONE	The O Zone Jamie meets American singer Jewel, Jayne gets cozy with ...	📺🔔
1930 19:30:23	30:00 28:39	HOME GROUND AN ...	Home Ground An Englishman's Home: Tonight the show which showcases the ...	📺🔔
2000 20:00:30	30:00 27:59	TWO FAT LADIES ...	Two Fat Ladies Barristers: It's meatmania as the ladies head off to Lincoln's Inn to ...	📺🔔
2030 20:29:57	30:00 29:00	THE ANTIQUES SHOW	The Antiques Show Fiona Bruce reports from a Liverpool museum where a 1920s ...	📺🔔
2100 21:00:27	30:00 29:55	BUTTERFLIES	Butterflies The first series of the classic comedy starring Wendy Richard and ...	📺🔔
2130 21:31:50	50:00 49:09	UNDER THE SUN ...	Under the Sun Schoolgirl Killer: The harrowing story of a young Ethiopian girl ...	📺🔔
2220 22:22:27	10:00 9:03	TRADE SECRETS ...	Trade Secrets Explorers: From the Arctic to the Tropics our team of explorers will ...	📺🔔
2230 22:32:20	45:00 44:00	NEWSNIGHT	Newsnight Martha Kearney introduces in-depth investigation and analysis of ...	📺🔔
2315 23:17:40	40:00 39:00	GAYTIME TV	Gaytime TV Richard & Rhona have been travelling the country to find out ...	📺🔔

Summary | Title and Times/PICS | Genre | Format | CA/Triggers | Release Status

Stereo

DVB
H-of-H

EN	WA	
SC	NI	

Natural Born Mothers: Esther Rantzen meets all kinds of mothers from those who love their babies to those who can't abide them and asks "is there such a thing as a natural born mother?".

EPG Name: Esther

Triggers: Reactive

Group: None

P.R.: Undefined

Genre: Entertainment

Sub-genre: Factual

D-Sat: Lifestyle

DTT:

D-Cable:

Delete v Update

Figure 5 Screen-shot of the SID GUI