

This is the script of a presentation  
given by Richard Marsden  
at the IEE on Tuesday 16 March 1999, as  
part of a colloquium  
“**Digital Television:  
where is it and where is it going?**”

In the last few months we've seen what can only be described as a revolution in television broadcasting in the UK, and the BBC is proud to be a part of that change. What I want to do in the next twenty minutes is to describe the new services that the BBC has created for Digital, some of the technical architecture and installations that support them, and some of the enhancements that are made possible by the new technology.

# *The BBC's Digital Television Service*

*Where are we now?*

Richard Marsden  
BBC Research & Development



The BBC's services will be present on all three delivery platforms, satellite, terrestrial and cable. Our services have been available on satellite since October last year and on terrestrial since last November. We are expecting Digital Cable to launch later this year. Our services will look broadly similar on all three platforms, although there are technical and practical differences between the platforms that we intend to exploit.

So what's on?

## BBC Digital Public Services



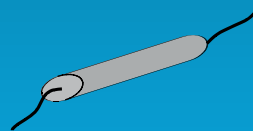
DSAT

October 1998



DTT

November 1998



DCABLE



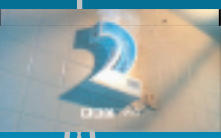

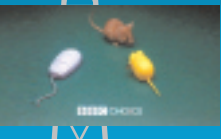

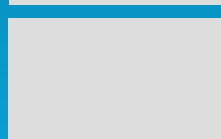
1999



On BBC Digital, you'll find BBC ONE and TWO, simulcast with analogue but in widescreen, then two new channels created specially for digital, BBC CHOICE and NEWS24. There will soon be an enhanced information service – currently called BBC TEXT, also a new learning channel later this year, and BBC PARLIAMENT, which launched just before Christmas. I'll say a little more about the new services later.

For DSAT we've taken two transponders on Astra 2A, each one giving us a capacity of just under 34 Mb/s. This lets us transmit the four national regional variations of BBC ONE – that's England, Northern Ireland, Scotland and Wales, plus the same for BBC CHOICE. We've squeezed PARLIAMENT in by taking a small slot on another Astra transponder.

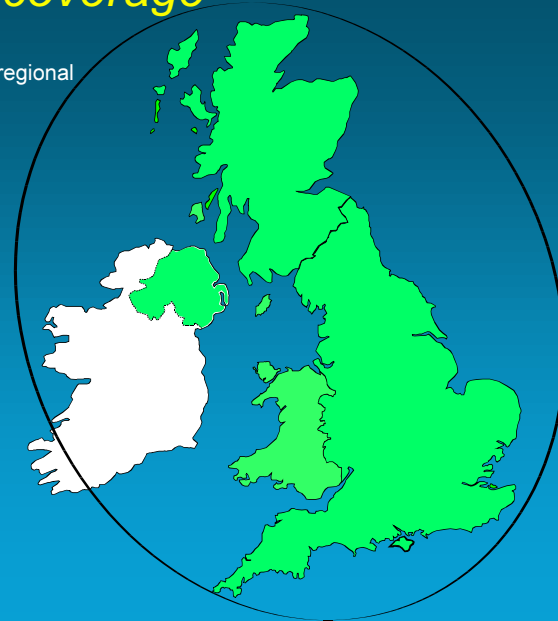
### BBC Digital public services

	<b>BBC ONE</b> Simulcast in widescreen		<b>BBC NEWS 24</b> in widescreen
	<b>BBC TWO</b> Simulcast in widescreen		<b>BBC TEXT</b> (information services)
	<b>BBC CHOICE</b> in widescreen		<b>BBC LEARNING</b>
			<b>BBC PARLIAMENT</b>

**BBC**

## DSAT coverage

BBC National regional variations only



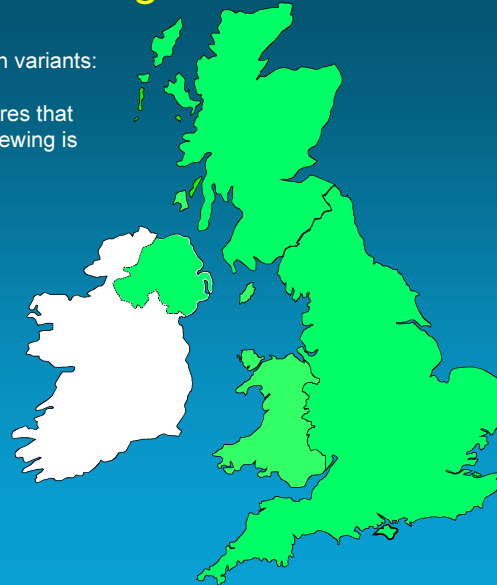
The satellite footprint covers the whole of the UK, but the signal can also be received in the nearer parts of mainland Europe. This spillover is unfortunate – we don't have programme rights to transmit outside the UK. So we have to encrypt the signal, with smartcards issued only to UK addresses.

For BBC ONE we have to go further – for some programmes we only have the rights for one National region – so your smartcard will only let you watch your local version of BBC ONE.

## *DSAT coverage*

BBC ONE region variants:

Encryption ensures that 'out-of-region' viewing is not possible



**BBC**

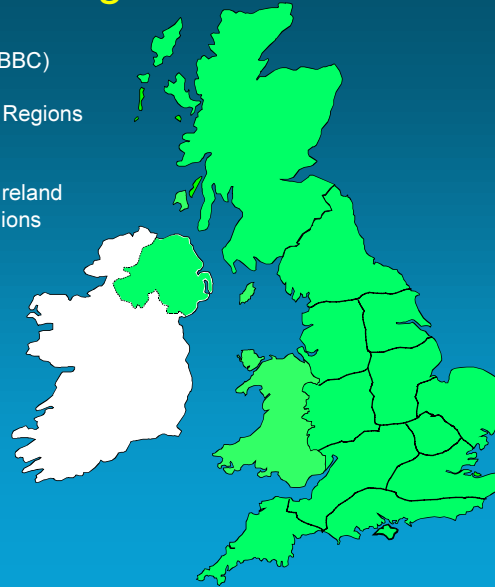
On DTT we have a single multiplex of about 24 Mb/s. That doesn't sound a lot compared to satellite, until you realise that each transmitter could potentially radiate a different multiplex. So on DTT we can carry the 10 English regions plus London, and the three national regions. We've still to install the equipment in the English regions – it'll be in service by the end of the year, so for the moment England has just one service. We do make one economy to save bit rate – BBC Parliament on DTT is an audio service only.

The fact that the BBC is both a regional and a national broadcaster has had a profound influence on our technical architecture. Early on, there were two key decisions – compression coders for regional contributions would be installed in the regions, and common coding would be used wherever possible for all platforms.

## DTT coverage

Full regionality (BBC)

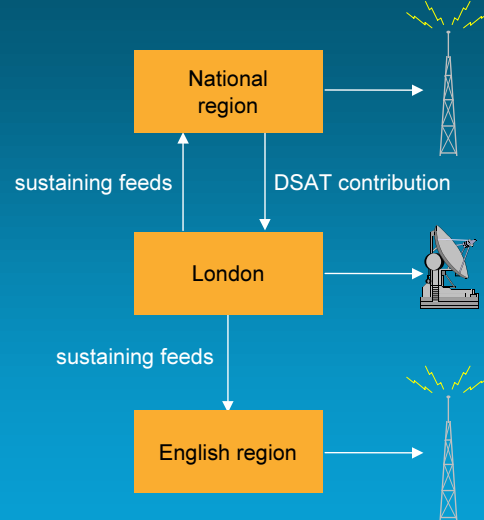
- Three National Regions
  - ▣ Scotland
  - ▣ Wales
  - ▣ Northern Ireland
- 11 English Regions



BBC

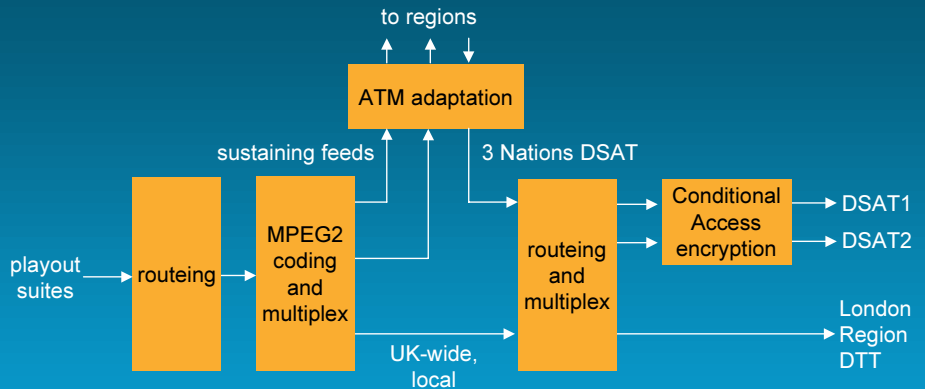
These are the main signal flows between London, a national regional studio centre, an English regional studio centre, the satellite up-link site and the terrestrial transmitters. The underlying concept is that regional variants are produced using sustaining feeds from London as a basis. The sustaining feeds also carry the UK-wide services that the regions need to complete their DTT packages, such as NEWS24 – because as you can see, the feeds to the terrestrial transmitters go straight out from the local studio centres – they don't go back to London. All the links between the studio centres are MPEG-2 main profile at main level, carried on ATM-based circuits.

## *The architecture - regional connections*



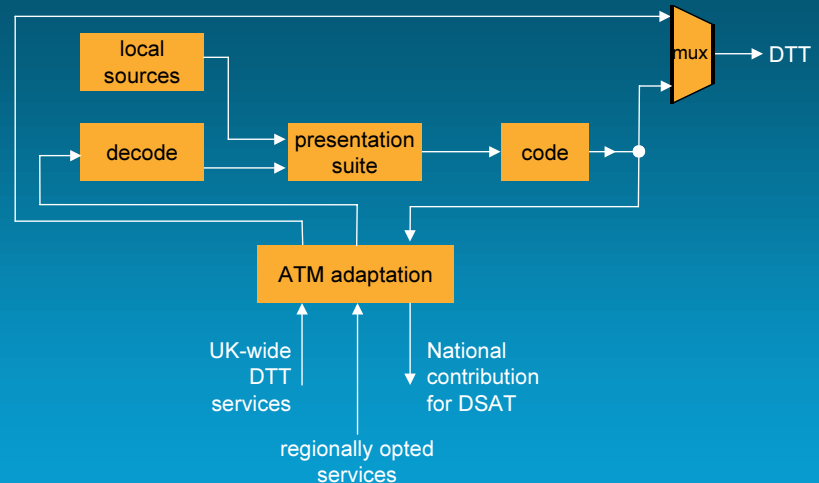
Looking at London in more detail – London codes the sustaining feeds and the UK-wide services, assembles its own service and the DSAT feeds. The video bit rate on each service is just over 5Mb/s, but the sustaining feeds of BBC ONE and BBC CHOICE are coded at a higher rate of about 8.7Mb/s. This is because inserting the regional variations involves a decode/recode operation, and the extra bit rate allows us a quality margin in which to do this. Note that the regional contributions for DSAT need simply to be multiplexed with the London material to form the two transponder feeds. There's no other processing of these contributions in London other than conditional access encryption.

## The architecture - London

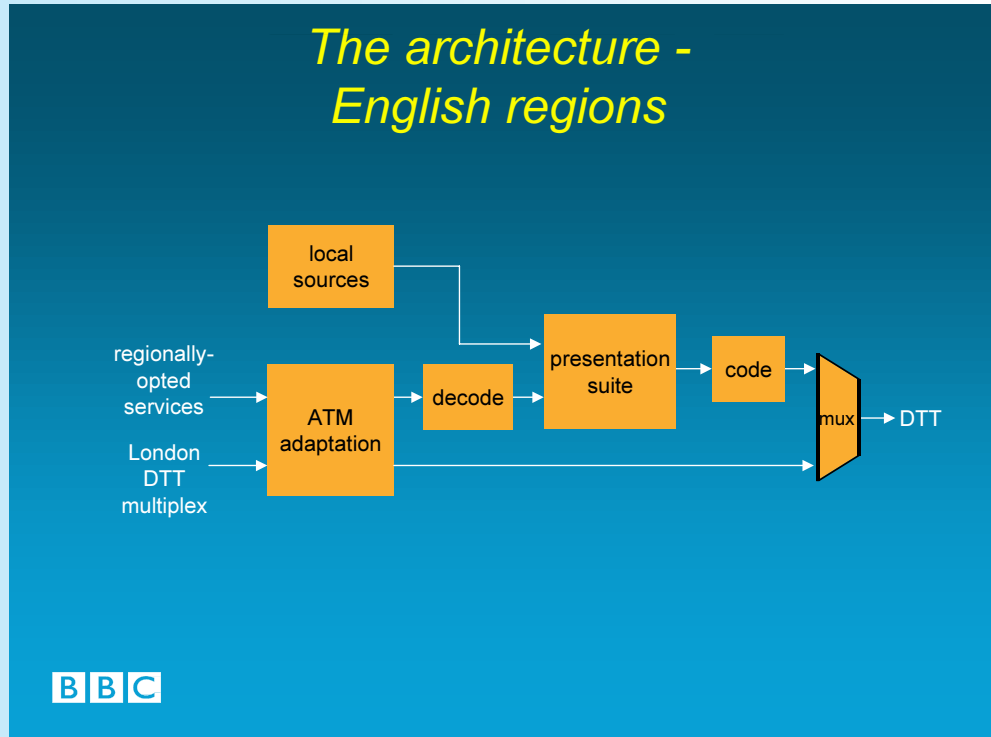


So, in a national regional centre, and these are in Belfast, Cardiff and Glasgow, the high bit rate sustaining feeds of BBC ONE and CHOICE are decoded, the regional content switched in in a presentation suite, and the signals recoded at the final emission rate. If you're wondering why we bother to code the sustaining feeds at all, the answer's simple – money. It costs a lot less to get a 9 Mb/s circuit to Scotland than one at 270 Mb/s. The final process is to multiplex in the remaining services, which are already coded at emission rate, and that completes the DTT feed. And as I said, the regional contributions for DSAT are back-hauled to London.

## The architecture - Nations



The English region is similar, but doesn't contribute to DSAT so there's no return feed to London. It's an even simpler arrangement at the moment because there aren't any English regional variations on DTT. So we send a feed of English DTT from London and pass it straight through. Well not quite. If we did that it would still carry the London identification, and we'd need to get everyone to rescan their set top boxes and IRDs when the regional service started operating. So to keep the service seamless we've already put the transmultiplexer in each region to put in the right identifier. There's another difference from the Nations. Even after the opting out facility is installed, and the high-bit rate sustaining feeds set up, the complete DTT sustaining feed will still be sent. This seems inefficient – why send BBC ONE at the high rate and as part of the complete multiplex? The reason is to protect the service – if there is a fault in the Region, and English regions are not staffed 24hrs a day, the transmultiplexer can immediately drop the local output and revert to the London feed – no regional opt-outs until the fault is repaired, but at least a service.



With digital comes the opportunity to develop and enhance the services themselves.

## *BBC Public Service DTT*

### Enhancements:

- Better programme schedule information
- Digital Text
- Better subtitles
- Disability services



Both the DTT and DSAT platforms carry programme schedule information. This allows the viewer to see schedules in various forms on the screen and for example to select a service directly without recourse to channel numbers. Both systems contain cross-carried information, giving the viewer access to schedules for all services, and indeed all service providers in his region, not just the one he is watching.

## *BBC Public Service DTT*

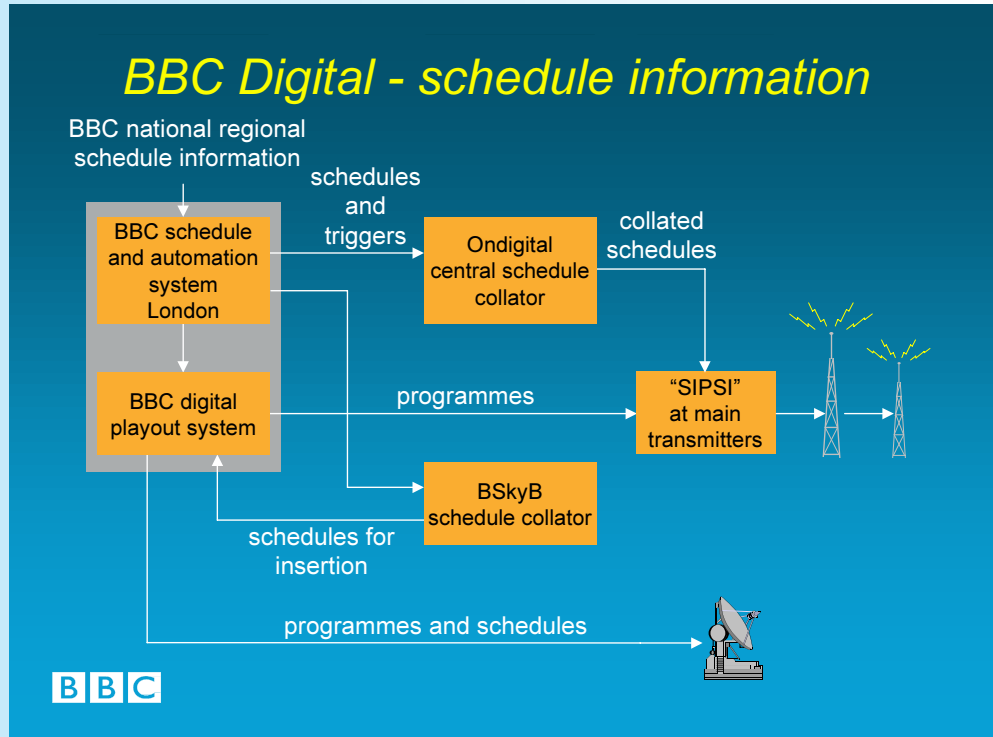
### Enhancements:

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On DTT, cross-carriage is achieved through a central schedule collator operated by ONdigital. Schedules for all BBC services are created in London, and this information is sent to the collator via TCP/IP links. The regional nature of DTT means that SI (that actually stands for Service Information, although schedule information is the bulk of it) will vary across the country. This situation is further complicated because the service providers don't follow a common set of regional boundaries, and some only operate nationally. The UK DTT transmitter network has therefore been divided into 29 SIPs – SI insertion points. Within a SIP, all the transmitters carry the same combination of regional services, both BBC and independent, or more strictly, need the same combination of SI.

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Each multiplex operator has chosen a slightly different arrangement for injecting SI, so this part of the diagram applies specifically to the BBC. Within each SIP one transmitter acts as the master, and receives the feed of collated SI in the form of a low bit-rate transport stream. This is already partly filtered for regionality at the output of ONdigital's collator – there are eleven separate circuits feeding different parts of the country – and the final filtering and injection of the relevant schedules then takes place at the transmitter, in the box labelled "SIPSI"

– SI insertion point SI injector. An independent path also exists for the BBC's own SI, in that it can be injected in the BBC transport stream at the originating studio centre, although at the moment we're not using that facility.

Other transmitters in the same SIP can then receive the BBC transport stream from the master site. There is no further transport stream processing, because the daughter sites can be detailed in the alternative

frequency list in the Network Information Table.

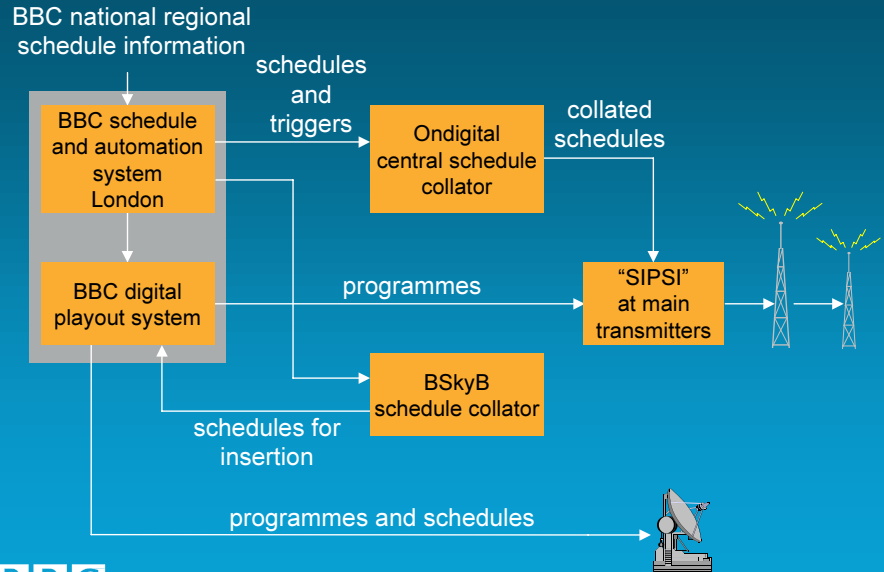
Currently both systems display the BBC's schedules using the published times as the reference. However real programme start and finish times often vary by a minute or two from the published times, and a lot more if a live event over-runs. So we also send real-time triggers, so that "now and next" displays can tally accurately with the programme on the screen.

DTT SI is assigned up to 500 kb/s in the BBC multiplex, and currently shows “now and next” information only, using published times as the trigger – and this is a typical display from a domestic television fed from an ONdigital set top box.



The DSAT schedule information system is operated by BSkyB. As with DTT, the BBC schedules are sent via TCP/IP to a central database. However, the arrangements for adding the data to the BBC multiplexes are much simpler, because there are only two transponder feeds and a single uplink site. The schedule data is sent back to Television Centre and injected into the transponder feeds before they leave for the uplink site.

## BBC Digital - schedule information



A bit rate of 1Mb/s is reserved in each BBC DSAT multiplex for SI. The DSAT system currently shows schedules up to 60 hours in advance, and the “Now and next” display uses the triggers from the BBC automation systems. Again a typical display on a domestic television driven from a set top box.





I should add that the BBC's services are also represented in the Sky Guide.



Digital text – first a few words about teletext – the DSAT system does support teletext. The BBC's teletext service is carried in standard DVB WST form in the transport stream for BBC ONE, TWO, NEWS 24 and PARLIAMENT. It's reconstituted by the set-top box and put back in the vertical blanking interval of its UHF and Scart PAL outputs. This allows domestic television receivers to decode and display WST in the usual manner.

An enhanced text service is currently being developed by BSkyB, based on OpenTV. The BBC will also provide a text service using this API.

However, UK DTT doesn't support WST. What it does support is the open standard MHEG 5, and the BBC is developing an enhanced Digital Text service based on the UK-profile as defined in the D-book.

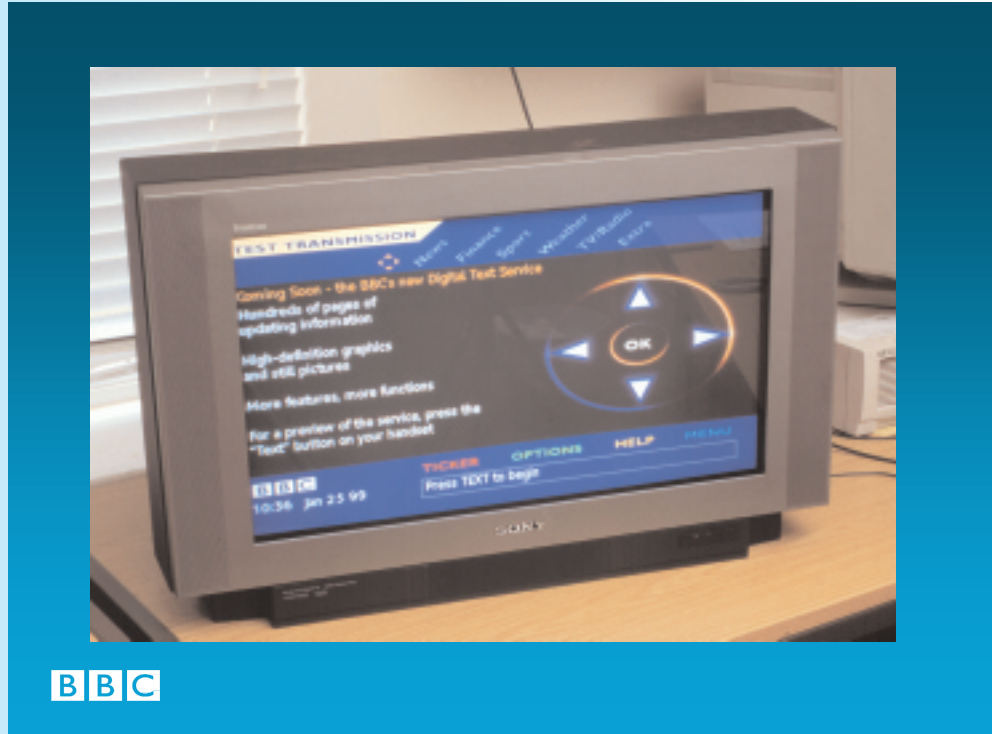
## *BBC Public Service DTT*

### Enhancements:

- Better programme schedule information
- Digital Text
- Better subtitles
- Disability services



We are already transmitting a limited carousel of pages, to assist manufacturers in developing decoders. If you want to find out more, we have a live demonstration, in collaboration with Sony, in the Faraday room, here today. We call it digital text, but it will also handle stills and graphics.

**BBC**

And on a related theme, subtitles. Work commissioned by the RNIB, in consultation with the ITC and the broadcasters, has resulted in new highly readable font for subtitles – Tiresias. The traditional coarse characters of teletext page 888 subtitles are replaced by proportionally-spaced anti-aliased letterforms, transmitted as run-length-encoded pixel data. This means they're rendered at the coding end, not in the set top box.

## *BBC Public Service DTT*

### Enhancements:

- Better programme schedule information
- Digital Text
- Better subtitles
- Disability services



DVB Subtitles are now carried by many BBC Digital programmes, and are already available to DTT viewers – and again, in the Faraday room, we have a demonstration.



Disability services – the BBC is working with other organisations through the Digital Technology Group (DTG) to support these services, specifically an audio description component for visually-impaired viewers, and signing for hearing-impaired viewers.

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## *Disability Services*

- Audio description - an optional audio “side-channel” containing a commentary on the picture action
- Signing - British Sign Language - an on-screen animated figure?

Both may be implemented as Common Interface Modules



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It's early days, particularly for signing, there's still some invention to do, although possible mechanisms have been identified, initially involving the use of the common interface.

## Disability Services

- Audio description - an optional audio “side-channel” containing a commentary on the picture action
- Signing - British Sign Language - an on-screen animated figure?

Both may be implemented as Common Interface Modules



Digital also means a move to widescreen delivery, 16 × 9. But, not all material is widescreen, and even if it's been shot in 1 by 9, the action may have been kept towards the centre of the image to protect the 4 by 3 viewer. And, after all, most people are still watching 4 by 3 televisions, even if they have digital set top boxes. This could take all day to explain, so I'll go straight to the message.

Whichever aspect ratio receiver is used by the viewer, the BBC is keen to see that the displayed image is the most appropriate for the material being transmitted, without the viewer necessarily needing to intervene. I hope you'd agree this shot of an opera wouldn't look quite right cropped 4 by 3. There's an aspect ratio flag in the MPEG header, which we do implement. But what

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**BBC**

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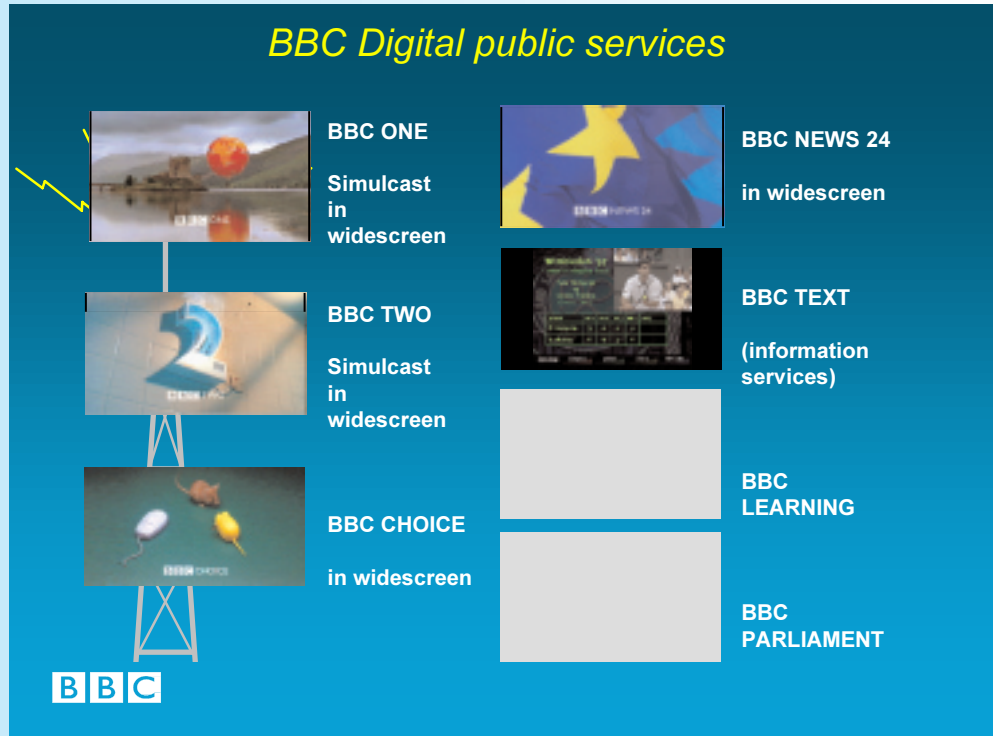
we really recommend is the Active Format Descriptor, or AFD. This is additional information transmitted in the stream, telling the receiver more about the way the frame was filled – is it unrestricted 16 by 9, were 14 × 9 shoot and protect limits respected, and so on. This information, coupled with the viewer's preferences should make it possible always for the receiver to select the best presentation.

And there's another advantage. AFD's can be changed at the start of any frame. Aspect ratio signalling can be changed only at what are called GOP boundaries – every 12 frames or nearly half a second in our current configuration. So eleven times out of twelve, you'll get a visible double-jump unless you fade the picture to black through the change, and we think that's presentationally unacceptable.

Last topic – I mentioned earlier that we're launching a learning channel this year. It will eventually contain a substantial text and interactive component. An immediate challenge is the lack of spare capacity on our existing multiplexes, and the expense of taking more.

We don't currently use statistical multiplexing – quality issues apart, there are two physical restrictions. Unless you're prepared to put in a very high speed link, the MPEG coders in a stat mux ensemble must be co-located. Second, if a service is to be included in two multiplexes, it needs two coders and the economy of common coding is lost. It's not therefore easily compatible

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with a broadcasting infrastructure like ours, where there is a mixture of local and central coding. However, on DSAT, it just so happens that one of the transponders carries only one service that isn't coded in London – BBC ONE Northern Ireland as it happens. So, we're going to break away from common coding. A second set of coding equipment is being acquired, to allow statistical multiplexing of the London-coded services on this transponder, and to get five services where we currently have four. For the other platforms, I can only say at this time that carriage arrangements are under negotiation.

Finally can I remind you of our demonstrations in the Faraday room, DVB subtitles and the digital text service. Both of these are being received live off-air, from our public digital transmissions from the Crystal Palace transmitter. I'd also like to thank the BBC for permission to give this presentation.

## *Demonstration - Live off-air*

- DTT DVB subtitles
- DTT Digital Text service - in conjunction with Sony

### *The Faraday Room*

12.30 - 14.00 (lunchtime)

15.00 - 15.20 (tea time)

16.45 - 17.30

