TELETEXT – OLD DIGITS IN A NEW AGE

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ABSTRACT

Teletext is a well established method of delivering textual information to the home. For example, the BBC's CEEFAX service regularly attracts 15 million analogue television viewers each week. As such it provides a mature and stable source of "television friendly" content which can be re-published on the emerging digital television systems.

However, Teletext has other properties that allow it to support much more than just information services. It exists in analogue, digital and MPEG forms, all available with accurate synchronisation in time. This makes it ideal for the carriage of programme Metadata and sometimes essence alongside the programme video and audio throughout the broadcast chain up to the point of final emission to the viewer. The BBC uses Teletext to distribute subtitles, automation status, scheduling data, AFD information, opt-out control and programme timecode.

This paper will attempt to describe how Teletext is not only a valuable tool for existing analogue television services but also has a place in the roll-out of new digital services. It provides a generic overview of how Teletext has recently been enhanced as a transmission standard and offers some examples of how the BBC has taken advantage of this new functionality. It further describes how an existing Teletext infrastructure may be used to provide a migration path to more exotic data broadcast environments now being supported by digital platforms.

INTRODUCTION

For many existing broadcasters, including the BBC, Teletext forms an essential part of their analogue television offering. However, even in the rush to digital Teletext is still proving to be a useful and popular component of these new systems. This is partly due to its maturity in a rapidly evolving environment and partly due to efforts to define a future role for it.

In the past few years the Teletext specifications have been reviewed and expanded. Existing parts, such as text services (ref 1&2) and dataservices (ref 3) have been enhanced in a compatible way. Whilst new functionality, such as support for Electronic Programme Guides (EPGs) (ref. 4&5) has been added and Web like services, such as Teleweb and IP over VBI are being introduced. Efforts are being made to ensure that these extensions are being including in the appropriate emerging standards. This suggests an industry still finding ways to use a familiar tool.

TELETEXT

At its simplest Teletext can either be page based - which is the familiar text pages but also includes forms of databroadcasting, such as EPG, or Independent Data Lines using Teletext packets independent of the page structure as a data channel.

Teletext is the carrier for a number of services, for instance in the UK there are typically 6 services being carried via Teletext to the home or office:-

Databroadcasting; National text service; Local text service; Country and Network Identify, Programme Delivery Control and Subtitles.

Databroadcasting can cover a range of services from strictly commercial to EPG and "IP over VBI".

In addition Teletext is the only dataservice which co-exists in the Analogue (PAL or SECAM), Serial Digital (Rec 601) and DVB (ref. 6) domains and has a intimate link with the TV Frame so enabling (almost) frame accuracy in delivery.

Thus it is easy to use this for simulcasting the same information as well as working in most

broadcasters' infrastructures (ref. 7). Processing and decoding equipment is cheap being based on mass-produced chips for domestic reception.

Editorial aspirations to enhance the viewing experience for the audience receiving analogue television and Teletext co-existence in multiple signal formats that forms the background to this paper.

Existing Text services Editorial enhancements

A Level 1.5 decoder can display with only the three primary and three secondary colours, plus black and white. However many newer televisions have level 2.5 decoders which support pastel colours and can also colour the borders outside the Teletext display area.

With no extra editorial effort, and with no effect on the speed of the service, a single Teletext packet X/29 for each magazine can be transmitted every few seconds. This can map the basic colours to less saturated colours and provide a background row and screen colour which is defined by the broadcaster.

If a more dynamic and graphical output is required then level 2.5 is the next step. With some careful planning and transmission, effective page templating some very attractive and "different looking" pages can be constructed that will be displayed in a manner that is still attractive to the level 1.5 viewer. The majority of large systems supplied to broadcasters in the past 3 years have the ability to transmit level 2.5.

On the speed of transmission a number of techniques can be used. However with more television sets being equipped with some page storage, many of the problems of access times to pages and sub pages reduce. At about 1 K byte per basic Teletext page the total memory requirement is not great.

But there are some tricks that can be employed which can help to minimise the apparent time to access a page for those viewers with sets without much memory.

However the calculation of what a trick does to the timing of all the pages to fit in the available transmission capacity is not simple (ref. 5).

Recently some transmission systems have been supplied which work by allocating a proportion of the available bandwidth to each magazine. This gives a finer degree of control than the allocation of lines in magazine parallel (where magazines are allocated into streams which are each allocated one or more TV lines) and is equally applicable to magazine serial (where all the pages are transmitted on all available TV Lines in numeric sequence).

Technical issues

In all the editorial discussion the concern has been on pages as an entity and how they are scheduled for transmission. At a technical level, the individual packets, (one per TV line) that make up the Teletext transmission and the rules pertaining to their transmission are more important. The key rule "Page erasure interval" means that the transmission of a page takes an integer multiple of fields, with TV Lines that occur between the last transmitted packet and the penultimate line of that VBI, which is where the new page starts, being occupied by "filler packets".

This table gives some statistics - more details can be found in References 2&5.

VBI lines	26 packets (pkts)/ Page			24 packets (pkts)/ Page		
	VBI/ Page	Pages/ sec	% filler pkts	VBI/ page	Pages/ sec	% filler pkts
7	4	12.5	7.1%	4	12.5	14.2%
6	5	10	13.3%	4	12.5	0%
5	6	8.3	13.3%	5	10	4%
4	7	7.14	7.1%	6	8.3	0%
3	9	5.5	3.7%	8	6.25	0%
2	13	3.8	0%	12	4.2	0%

Filler packet space can be used for other Teletext services, such as independent data line databroadcasting and for the broadcast services packets 8/30 format 1 which identifies the broadcaster and includes date and time and packet 8/30 format which carries programme delivery control, (PDC). Packet 8/30 has extremely tight timing requirements and thus take priority over the text service.

About 7 years ago BBC started using the techniques of replacing filler packets with Teletext packets containing real information to combine two multiple TV line Teletext streams of databroadcasting which had priority and the BBC Text service Ceefax which occupied a large number of TV lines. The purpose was to maximise the bandwidth available for the Ceefax and used a multiple input databridge that controlled output lines of the Ceefax transmission system.

The techniques have extended and multiple input databridges are being widely used in a variety of modes to maximise the number of active packets in the output Teletext streams. The need for control to the text transmission system has been removed and the input streams are totally autonomous. Typically three text streams (coming from two locations) and two Data streams plus Subtitles are combined, thus maximising efficiency and removing the need for a separate line to be allocated for subtitles (see Appendix 2). Further guidance on the use of the VBI can be found in Reference 8.

Future systems

When considering future systems, technology and editorial requirements need to be considered together.

There is some opportunity to add databroadcasting without impacting any existing Teletext text service by making use of inherent inefficiencies as outlined in the previous section. If further databroadcasting capacity is required, simple changes to the text service can free-up bitrate with minimal editorial impact.

The services that can be offered at the moment are a Teletext Based EPG ("NexTVieW") which is supported by many TV set manufacturers in their top-of-the-range sets. This is beginning to pick up favour in the German speaking countries.

There are a number of "web like" applications that are being developed using Independent Data Lines for transmission to Personal Computers and some to TV sets.

Storage in the home means that the databroadcasting can have cycle times of an hour or more.

The key systems are PC based:- Intercast - and IP Over VBI and TV / Set top box orientated Teleweb and Web TV.

Broadcasters are also looking at ways of using Teletext text as a delivery method that works now, to experiment with the origination and backroom systems for interactive and enhanced television and to see how the audience reacts.

Most of these are based on triggering from the programme schedule or timecode, to allow related Teletext pages to appear and disappear just before, during, or after a programme.

Teletext as the universal data distribution system for broadcasters

Teletext has a number of important properties:

- Linked to the video signal frame structure
- Uses space which may otherwise not be used
- Exists in a number of video signal formats:- analogue PAL or SECAM, Serial Digital and DVB/MPEG

In addition in Analogue and Serial digital signals it is embedded in the video and thus should be fairly difficult to strip off and thus loose.

Most broadcasters use Teletext text for subtitling (Ref. 6) and thus must ensure that inter-site links pass at least one TV line pair of Teletext, and often there is more available. Even with one line pair available with subtitles there still is over 9.6 kbits/s of data capacity available.

Databroadcasting, which has a vast number of commercial possibilities in emission, has uses for broadcasters themselves on their own inter site video links

A variety of equipment is commercially available to do such functions as

- **Audio** – low bit-rate for talk-back, Linear PCM or "ISDN like" MPEG-2 Layer II or aptX™
- **Data –** opt-out control; remote machine control and schedule transmission
- **Other systems** - Signalling Timecode and Mixer Status in Subtitle headers; storage of Metadata (for example using a simple Key-Length-Value format).

CONTENT PROVISION FOR DIGITAL TELEVISION INFORMATION SERVICES

The BBC is currently involved in the roll-out of services on all the DTV platforms; DTT, DSAT and DCABLE. In the UK, all these delivery systems are exploiting the need for new receiving equipment and the necessity for increased memory and processing in the receiver, as an opportunity to introduce new multi-media environments for broadcast applications. These environments generally provide greater flexibility in the structuire of the broadcast stream, data compression, downloadable applications as well as data allowing custom navigation, flexibility of graphics layout, and improved text and graphics. Faced with this it could appear that the use of Teletext might be out of the picture?

The ideal content production system?

However exotic the presentation, it is often argued that an information service is only as useful as the information it provides, essentially text and graphics/images. So, even once the editorial

design of a service that exploits the capabilities of such new receiver environments is completed, there is still the issue of generating large volumes of content on a daily basis.

The ideal content production system (CPS) might sensibly include a "What You See Is What You Get" (WYSIWYG) editing environment, based around the final editorial design for the service. However, there are a number of practical realities worth considering before embarking on such a strategy.

For many broadcasters, an editorial staff already exists for the creation of Teletext content for analogue services – in the BBC's case over 60 people nationwide. Duplicating a similar size of team to support just digital services might well be a time consuming and expensive operation. Furthermore, the existing Teletext staff are likely to be skilled in the rapid generation of "television friendly" information, i.e. easily readable in screen size portions.

This economic driver for using existing Teletext staff may be a strong one, but Teletext editing systems tend to be very Teletext-centric (although this is not so true for some of the newer systems emerging) which can make republishing to other platforms difficult. So, if following this strategy it might be sensible to migrate the editing system used by the journalists to a more "object based" WYSIWYG one, and indeed this is the BBC's long-term strategy.

The BBC's launch strategy

The BBC has not pursued this in the short-term for a number or reasons:

- The requirements of such a system are still unclear due to the limited industry experience of operating information services for the new digital platforms.
- No suitable third party could be found who could provide such a system within the BBC's timescale.
- The BBC's technical resources were already stretched with the roll-out of the wider DTV infrastructure.
- Even assuming the most optimistic adoption of DTV, the viewers accessing the information in the analogue form, i.e. broadcast as Teletext, will outweigh those accessing it via digital by a ratio of at least 10:1 during the launch period.

This resulted in a strategy to develop a CPS based on downstream processing of information extracted from the existing Teletext database used to support analogue services. This approach had the attraction of having minimal impact on the operational Teletext service, and by making the processing highly automated required only a small number of new staff. The trade is clearly one of reduced disruption, risk and cost against editorial control.

Launch system overview

The CPS that the BBC has created consists of a series of processes as follows:

- Story Entry. Stories are entered as normal using the editing system linked to the Teletext database supporting the analogue service. However, tags can be added to rows of the Teletext frame that are subsequently discarded when broadcast on analogue, e.g. row 0. These tags can be used for any digital service specific feature, e.g. reference to a related image, alternative headline, flagging an important story.
- Data Extraction. This is based on a scripting language that forms part of the Teletext database that the BBC is using. Scripts can be set up for specific pages or group of pages that extract useful blocks of data, e.g. headline text, body text, sub-table text. The effectiveness of the extraction process is clearly dependent upon the functionality provided by the scripting language for spotting the desired information within the layout of the page. However, extraction is also improved by the use of a known in-house layout for the page being processed.
- Story Mapping. This is also based on the same scripting language used for Data Extraction. Whilst Teletext effectively has a flat navigation structure (based on page numbers), the BBC's editorial proposition for digital platforms is based on a hierarchy of menus. This means that Teletext stories must be mapped into this structure. In the BBC's case this is helped by the fact that related stories in the CEEFAX service are grouped together using ranges of page numbers. Further mapping rules can be applied within each range to spot particular keywords. Known Teletext index pages can also be parsed allowing stories mapped into a particular menu to be re-ordered based on news-worthiness.
- Coherency Check. This process checks the output of the Story Mapping and ensures that all files described in the mapping are present. Where necessary it handles menus that have no stories mapped into them, e.g. by display of a suitable caption or by removing the menu, as editorially required. Any problems are recorded by the setting of "flags".

- Content Format. This is required to re-format Teletext stories for presentation by the new digital application environments. Examples of the processing required are conversion of character codes, re-pagination due to the use of proportional fonts, de-capitalisation of headline text and suppression of Teletext specific references, e.g. “See CEEFAX Page 123”. Again, any problems are recorded by the setting of “flags”.

- Service Preview. Before going to air it is important to be able to check the results of the upstream, automated processing and if necessary, preview individual stories. Manually checking each story prior to broadcast would be time consuming and operationally is unacceptable due to the potential delay in breaking stories getting to air. The ”Previewer” tool provides a simple user interface that lists the menus in the service structure. For each menu simple icons are used to display a summary status for the stories into it, based on the “flags” that have been set during processing. This allows a system operator to quickly see where there are problems. The status of an individual story can then be checked and if necessary previewed using an integrated digital platform emulator. Obviously this preview is only as valid as the emulator used. The flow through of new and updated stories can be controlled manually or by the use of automatic filters applied to the “flags”. This provides a means for stories to be blocked or passed on for broadcast based upon the severity of the problem encountered during processing.

- Application Build, Playout and Insertion. This stage is obviously specific to the particular digital delivery system.

This approach is clearly not ideal since journalists generating content are not really able to optimise this for presentation on the digital platforms. Furthermore, the feedback loop for resolving problems is for the “Previewer” operator to contact the journalist who created the problematic story. This feedback loop is used as much to drive long-term change as for short-term fixes, i.e. to help refine the rules used in the automatic processing and to encourage CEEFAX journalists to conform to “digital friendly” styles.

The system in use

In November 1998 the BBC went live with a CPS developed to support the launch of digital information services based on the system described in the previous section.

On the same day that the CPS went live, a MHEG-5 based DTT Digital Text “barker” service also went on-air containing a small number of editorially selected stories. This immediately provided a focus for those operating the CPS and acted as an invaluable source of feedback. This has allowed the CPS to be steadily refined and enhanced over time.

In May 1999 the DTT “barker” was replaced by a full “DigitalText” service containing over 800 pages republished from the BBC’s CEEFAX service. Work is already well advanced for the launch of similar services on the other delivery systems of digital satellite and digital cable.

CONCLUSIONS

Teletext will clearly last at least until the end of existing analogue transmission of television as a means of providing textual information. However, it is has already found a new lease of life in the launch of some DTV systems, due to the slow emergence of stable multimedia environments for consumer devices such as television receivers. It may also provide a useful stepping stone for those migrating to such digital platforms.

For the engineers, the fact that Teletext exists in the major forms of signal streaming, and is used for subtitling, means that there are ample opportunities to insert data which will be passed through systems without degradation because it is embedded and time locked to the video signal.

ACKNOWLEDGEMENTS

Peter Weitzel thanks the Director of Technology BBC Resources Ltd for permission to publish this paper.

Jeff Hunter wishes to thank his colleagues throughout the BBC for their contribution to this work.

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APPENDIX 1

The Structure of a Teletext packet:

The first two bytes are a clock run in of alternate Zeros and Ones, followed by a unique framing code 11100100.

The next two bytes are termed the magazine and Row address and define the address space for packets. The magazine is coded in three bits of byte 4 and a packet in the four bits of byte 5 and the remaining bit of byte 5, Bytes 4 and 5 are 8:4 hamming encoded. Thus for each magazine there are 32 available packets

A text page is made up of a header (Packet zero) and then in the next field (or frame) any enhancement information (Packets 26 to 29) and then the page text rows (packets 1 to 23 or 24). This rule which was originally to allow decoders to erase the previous page before loading the current one means that there usually are TV lines which carry Filler packet which have no meaningful information.

Packet number	Function
0	Page identifier and page terminator.
1 to 23	These packets carry the display data of basic Teletext pages.
24	Fastext prompts.
25	“Displayable labels for key word search” - rarely used.
26	Used for Programme delivery Control and to reference alternative symbols and diacritical marks.
27	Editorial and compositional page linking.
28	Page specific display related data.
29	Page specific display related data for a magazine and character set referencing.
30	Independent data lines – Databroadcasting.
31	Independent data lines – Databroadcasting.

APPENDIX 2

The following figures illustrate the use of databridges.

Figure 1: Original Configuration Using Feedback

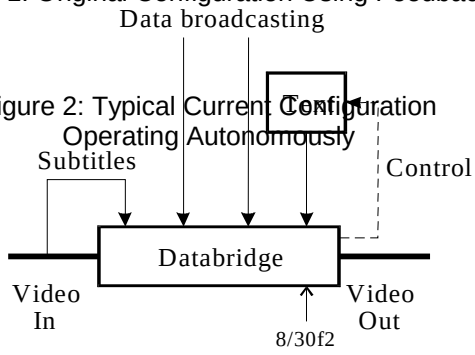

Figure 2: Typical Current Configuration Operating Autonomously