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Foreword

This Technical Report (TR) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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Introduction

This Code of Practice for enhanced Teletext has a three years history:

In November 1992 - during one of their regular meetings in Geneva - the German-Austrian-Swiss-Dutch elements within the EBU Teletext/Data Services Group agreed "to produce, as soon as possible, and in line with current developments in the media and equipment markets, unanimous proposals to put to the industry that will lead to the introduction of higher Levels in EBU Teletext services".

The aim of this higher Level Teletext initiative from the editors group within the EBU was to enhance the attractiveness of Teletext to the viewer by raising the Level of presentation.

A Higher Level of Teletext Group with representatives from the Teletext/Data Services Group, the EBU Sub-group V2 and members of industry was formed to make concrete proposals. Since 1993, the Technical Committee of EBU and EACEM discussed the revision of the EBU Teletext specification to accommodate new and higher Levels. The result was Level 2.5 (and - for future application - Level 3.5) for which the finalization of the specification took place in sessions of a working party of EACEM (WP 2.1) and EBU in spring 1995 in Munich/Germany and Perugia/Italy.

On the proposal of Jan van Lier/Philips (chairman of the EACEM Working Party 2.1), EACEM and EBU decided to set up an Application Group to draft guidelines for broadcasters about to take their first steps along the way of introducing enhanced Teletext in Europe. (The names of the members of this Application Group are listed in annex C).

In August/September 1995 - around the official launch of Level 2.5 at IFA 1995 in Berlin - this Code of Practice was completed and finally reviewed by the editorial staff of the Application Group consisting of the chairman Alexander Kulpok (ARD/ZDF-Videotext/Berlin) and Gerhard Eitz (IRT/Munich), David Tarrant (Philips/Southampton), Peter Weitzel (BBC/London) and Uwe Welz (ARD/ZDF-Videotext/Berlin).

As with the rest of the Level 2.5 activity, this Code of Practice is a result of co-operation and support of a large number of people and organizations. Broadcast engineers and Teletext editors, TV set and semiconductor manufacturers, the EBU and EACEM all took part in this task.

The present document was compiled and written without intimate knowledge of operating an enhanced Teletext service or sufficient experience with Level 2.5 editing software. Of course, any failings or errors shall remain the responsibility of the authors. We welcome all comments, reports of experience, supplements or corrections for a second version of this Code of Practice which we will publish after a considerable period of experience with editing and broadcasting Teletext Level 2.5.

1 Scope

The present document is intended as a companion document to the full specification, EN 300 706 [1], defining the data and transmission format within enhanced Teletext systems. It is primarily aimed at Teletext editors, service providers and network operators. The intention is to explain in relatively simple terms the new display features and possibilities that are available with enhanced Teletext. The focus is very much on which parts of a large and complex specification have to be implemented to produce a Teletext service that is more visually attractive than has been possible previously.

The present document outlines the basic features of enhanced Teletext and highlights the key parameters for a successful service. It makes recommendations as to how aspects of the specifications should be implemented and suggests strategies to maximize the transmission efficiency of the additional data that will be required.

It should be noted that the present document was compiled in advance of any first-hand experience in editing or operating an enhanced Teletext service. It is anticipated that a subsequent version will be able to draw upon the knowledge and experience that operating real services will bring.

2 References

For the purposes of this Technical Report (TR) the following references apply:

[1] ETSI EN 300 706: "Enhanced Teletext specification".

[2] ETSI EN 300 708: "Television systems; Data transmission within Teletext".

[3] ETSI TR 101 231: "Television systems; Register of Country and Network Identification (CNI) and of Video Programming System (VPS) codes".

[4] ETSI TR 101 288: "Television systems; Code of practice for an Electronic Programme Guide (EPG)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

basic page: normal display page in a Teletext service without any display enhancements. It may include extension packets for extended characters (e.g. Level 1.5), navigation (e.g. Fastext) or VCR programming (e.g. PDC)

enhanced Teletext: Teletext services using presentation Levels 2.5 or 3.5 as defined in EN 300 706

Levels 1, 1.5, 2.5 and 3.5: Teletext presentation Levels as defined in EN 300 706

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

BTT	Basic TOP Table
DRCS	Dynamically Re-definable Character Set
EACEM	European Association of Consumer Electronic Manufacturers
EBU	European Broadcasting Union
EPG	Electronic Programme Guide
FLOF	Full Level One Facilities
GDRCS	Global Dynamically Redefinable Character Set
GPOP	Global Public Object Page
IRT	Institut für Rundfunktechnik GmbH

MIP	Magazine Inventory Page
MJD	Modified Julian Date
MOT	Magazine Organization Table
MSB	Most Significant Bit
PC	Personal Computer
PDC	Programme Delivery Control
POP	Public Object Page
TOP	Table Of Pages
TV	TeleVision (set)
UTC	Universal Time Coordinated
VBI	Vertical Blanking Interval
VCR	Video Cassette Recorder
VPS	Video Programming System

Other specialized terminology is noted through the use of *italics* where it first occurs in the present document.

4 What is new about Level 2.5 Teletext

All current Teletext display pages use Level 1 or 1.5 presentation features. In the present document these pages are termed "the basic page" and consist of packets (rows) 0 to 23 and, optionally, packets 24 and 27 for Fastext (FLOF) and 26 for extended characters (Level 1.5) and PDC.

Display enhancement at Level 2.5 is achieved by overlaying additional information at selected points on the basic page. This procedure guarantees compatibility between the different Levels. Level 2.5 Teletext is fully backward compatible with the basic page. A Level 2.5 page can be displayed by existing decoders as a page without enhancement.

Within the Teletext Level 2.5 specification there are several possibilities for display enhancement which will contribute to a better presentation of Teletext pages. In particular, a greater number of colours, enhanced character sets, more display attributes, improved graphics, redefinable character sets (DRCS), side-panels and objects.

In addition to the presentation features, EN 300 706 [1] includes navigation-related enhancements such as information which a TV set may use to aid the acquisition and storage of pages.

4.1 Colours

The eight colours of the basic page are extended to 32. These 32 colours are organized into two palettes of 16 colours each. Whilst the first palette consists of fixed colours (the 8 basic colours and the 8 basic colours in half-intensity), the second palette is pre-set with 16 pastel shades which can be redefined by the editor.

The colours may be used within the text area as foreground (i.e. for characters) and background colours. Background colouring is not restricted to the text area, but can also be used in the area around the text window, filling the whole screen. A *full screen colour* is selected for the area above and below the text window. Similarly the area to the left and right of the text window can be filled with a *full row colour,* with a different colour on each row if required, or the *full screen colour* can be used as a default. *Full screen colour* can be overwritten by *full row colour,* which can be overwritten in the text area by background and foreground colours.

It is relatively easy to map the colours used on the basic page to a different set of 8 colours.

Recommendations:

For reasons of transmission efficiency it is recommended to prefer the half-intensity colours of the first palette and the default pastel colours. If you define a new colour palette, ensure that you can use this new palette on most of your pages.

When using a new palette, be aware of the remapping function which offers an easy and efficient way of replacing the colours of the basic page.

First set the full screen colour and consider it for use as the default row colour for all rows. If necessary, re-colour separate rows afterwards.

4.2 Character sets

The G0 and G1 character sets (primary alphabet and block mosaic graphics respectively) for basic pages are extended with two more sets: G2 = supplementary character set and G3 = smoothed mosaic graphics and line drawing character set. In addition, diacritic marks can be added to any G0 character to support all Latin-based European languages.

Recommendation:

For reasons of transmission efficiency when improved graphics are required, prefer to use symbols from the G3 set instead of DRCS.

4.3 Attributes

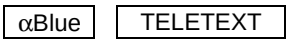
The basic attributes like flashing, double height, etc, are extended by some more functions. The flashing function is enhanced with several new modes, and all could appear on a page at the same time. The sizing function is upgraded by two modes: *double size* and *double width*. There is also an *underline* function.

Recommendations:

For Level 1 compatibility be aware that each character covers two screen locations horizontally in double size and double width modes.

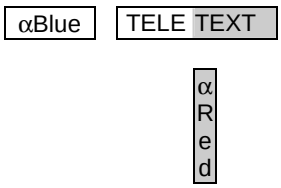
The use of attributes is different to Level 1. Level 2.5 supports both serial attributes (like Level 1) and parallel attributes. The following example illustrates the improvement:

At Level 1 a word is shown in a colour which is selected by a serial attribute in front of the word:



This setting causes that the word **TELETEXT** to be shown in *blue* throughout. Any change of colour within the word is not possible without using a space for a new colour attribute.

Level 2.5 enlarges the editorial possibilities by offering parallel attributes:



This combination causes the letters **TEXT** to be shown in *red*, whilst the letters **TELE** remain in *blue*.

In Level 2.5 the attributes can be placed at virtually any character position and have influence from that point on for the rest of the row unless otherwise reset. More than one enhancement can be applied at any character position.

4.4 Dynamically Re-definable Character Sets (DRCS)

If the G3 set does not fit to your enhancement ideas there is a new way to improve graphics. Up to 24 new characters with a resolution of 12 dots horizontally by 10 dots vertically can be defined for one page. The foreground and background colours are defined by the page.

Recommendation:

Be aware that the definition of DRCS can cost a lot of transmission capacity. Check the possibility of using G3 characters instead of DRCS, or use the defined DRCS symbols in several pages.

4.5 Objects

Level 2.5 Teletext includes the possibility to combine any collection of characters, symbols or attributes in a single entity called an *object*. Such an object may be transmitted once and used many times on different pages thus saving transmission capacity.

Recommendation:

The use of objects is beneficial, but quite complex. Please read clause 6 in the present document and clause 13 in EN 300 706 [1] very carefully.

4.6 Side panels

Level 2.5 extends the normal Teletext format of 24 rows by 40 characters with an additional 16 characters per row. These may be placed one side or the other of the basic page, or divided either side, in areas known as *side-panels.* They are likely to be used for additional navigational information, logos (e.g. sports logos) or graphics.

Pages with side-panels may be compressed when displayed on a TV set with an aspect ratio of 4:3 so that all 56 characters fit on the screen. Depending on the division of the characters between one or two side-panels, the position of the basic page may be shifted.

Recommendations:

Information in side-panels should be additional and not integral to the page. Be aware that the information given in a side-panel is not seen at Level 1, nor is it mandatory for a Level 2.5 decoder to display it. In normal use a side-panel should be the whole 16 characters positioned either to the left or the right of the basic page.

The presence of side-panels and the division of side-panel characters between subsequent pages should not change very often (i.e. it should be consistent throughout a magazine or sub-section of a database). Otherwise the basic page may be seen to jump horizontally from page to page as the viewer navigates his way through a series of linked pages.

4.7 Level 3.5

Teletext can be developed further. Level 2.5 is not the end of the developments to enhance Teletext. The specification also includes Level 3.5. It will offer more graphical display improvements, 96 DRCSs with greater colour resolution and bold, italic and proportional fonts.

5 Objects

Objects are one of the most powerful features of Level 2.5. An object can be understood as an accumulation of different enhancements put together into one entity. The "invention" of objects is a result of the intention to re-use enhancements on a number of pages and to save transmission capacity.

Objects satisfy a number of different requirements, for instance the "styling" of Level 2.5 pages, the repeated use of smoothed graphic maps and logos, etc. They are also the mechanism by which side-panels are transmitted.

Editorially, objects will be available at the editing workstations, but their creation and transmission requires very careful management by the origination system.

5.1 Types of objects

There are three different types of objects: active, passive and adaptive objects (see EN 300 706 [1], clauses 13.3 and 13.5). At first sight, the differences between the three types are not easy to understand. However, an example of each kind of object will explain its function and the consequences of its use.

5.1.1 Passive objects

In very simple terms a *passive object* could be a logo, or similar, "stamped" over the basic page. A passive object does not import any attributes from the basic page and does not affect the page outside of its boundaries. On starting the object the attributes are reset to the default conditions implied at the beginning of a row on the basic page. The set of attributes defined by the object is only applied to the column positions where the object explicitly defines a character.

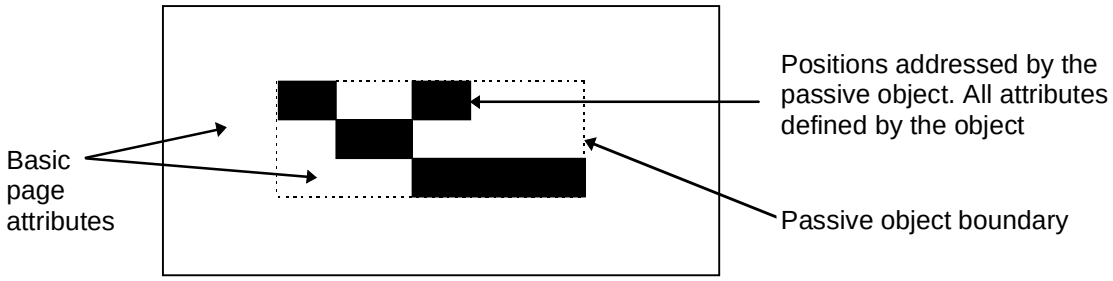


Figure 1: Passive object

5.1.2 Active objects

One function of an *active object* is to place style-setting attributes into the page. Examples are banner headlines or principle templates for pages. On entering the area affected by the object, the set of attributes defined by the basic page remains unaltered. They have effect within the object's boundaries unless superseded by attributes defined by the object itself. The set of attributes in place at the right-hand boundary of the object affects the rest of the row unless superseded by attributes defined by the basic page.

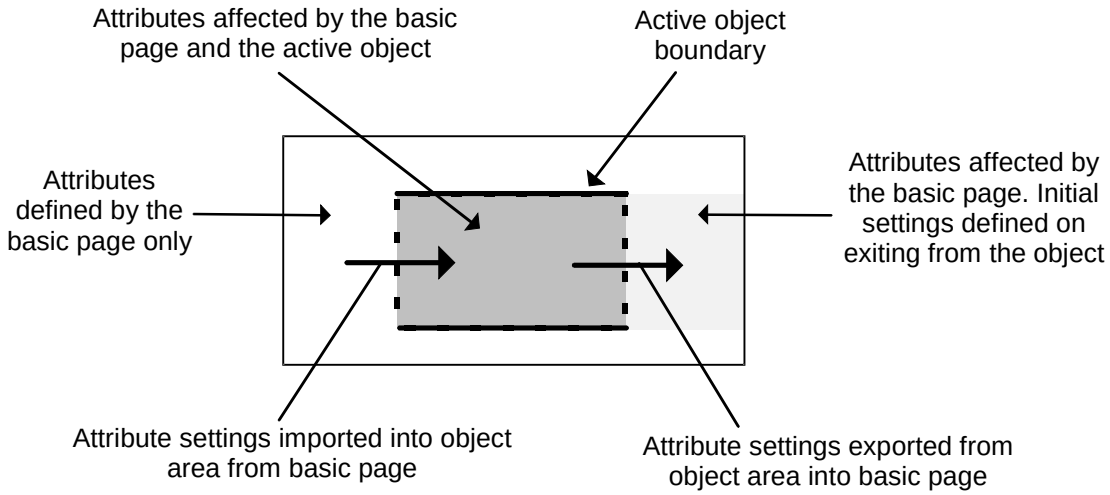


Figure 2: Active object

5.1.3 Adaptive objects

An *adaptive object* allows an area of the page to be replaced while maintaining some or all of the existing attribute settings, for example substituting Level 1 graphics with DRCS. On entering the area affected by the object, the set of attributes defined by the basic page remains unaltered. They have effect within the object's boundaries unless superseded by attributes defined by the object itself. At the right-hand boundary of the object, the attribute settings revert to those of the basic page at that position.

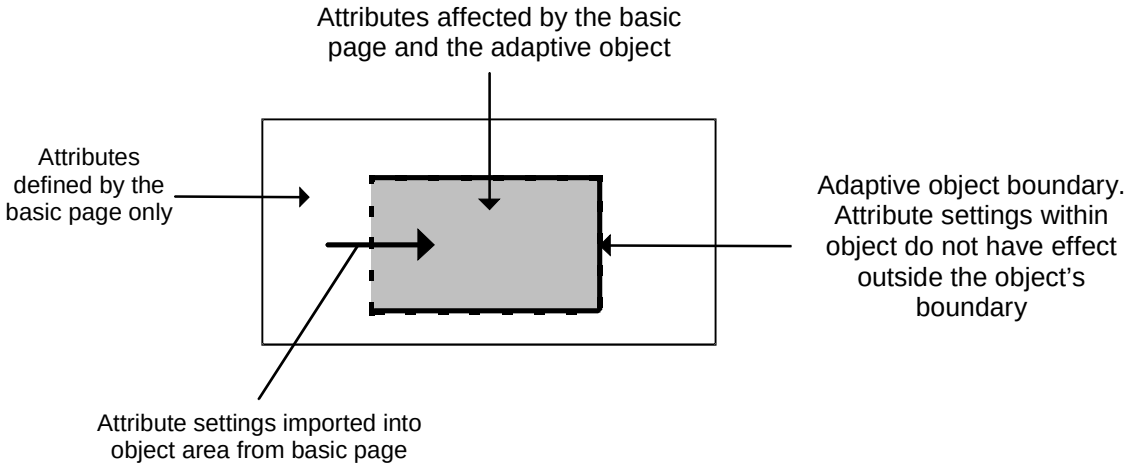


Figure 3: Adaptive object

5.2 The use of objects

The usefulness of objects is extended by the fact that one object can call up another object according to the following simple rules:

- an active object can invoke adaptive or passive objects;
- an adaptive object can invoke passive objects;
- a passive object cannot invoke any other object.

The following is an example of the use of objects and these rules:

An active object is called which sets up the style for the page and then invokes a logo as a passive object, then smoothes the graphics using an adaptive object. The adaptive object may then call another passive object which could be a mini-logo.

Recommendations:

A few objects can enhance the appearance of pages without causing problems with their management. Be aware that the number of objects open (i.e. overlapping) on one single page is restricted.

Objects can be *global*, *public* or *local*. Local objects are defined within packets 26 appended to a basic page and can be used on that page alone. For global and public objects the necessary information is to be found in special object definition pages. Global objects are more likely to be stored by a decoder (i.e. they are treated with higher priority) and can accessed by any page. Public objects are treated with lower priority and, in general, their use may be restricted to fewer pages.

Recommendations:

Prefer the use of global objects to local objects.

The use of local objects needs careful thought. It removes all need for object management, but it is not an efficient method if the same object is required by more than one page. Also, they can have a negative effect on Level 1.5 decoders as they fill the memory space with useless data. In turn, this can lead to an increase in the time taken to process a page.

6 Saving capacity

All the information which is overlaid on a basic page to turn it into a Level 2.5 page is transmitted as additional data. The details of how the information is transmitted are of little interest to the editor, but a general awareness of the efficient transmission of additional data is very useful.

The supplementary data for enhancement is transmitted in extra packets, both appended to basic pages or standalone, and in additional enhancement definition pages. The actual order of transmission of enhancement data can be complicated as it depends on how the supplementary information is used and organized. In turn this, in combination with the depth of enhancement to the basic pages, determines the number of extra packets.

The key principle is that enhancement data should be used several times by several pages and not only once by one page. This can be achieved by the use of objects, packets 28 (on a page-by-page basis) and packets 29 (on a magazine basis) for colouring and side-panel control, EN 300 706 [1].

Recommendations:

Create enhancement data that you will use more than once. When organizing your service for Level 2.5 start by creating enhancement data for the complete service, then for single magazines (global use) and then for single pages (local use). Taking this advice ("prefer global use to local use") into account will save capacity.

The transmission of enhanced data can be partially done in packet slots which are currently unusable due to the need to obey the 20 ms rule of the original Teletext specification. Dummy headers are sometimes inserted in these *filler packet* slots. Therefore, do NOT assume that the reduction or addition of one enhancement packet to a page will directly affect the cycle time.

If care is taken in the amount and type of enhancement data, there will be a minimal effect on cycle time. However, some apparently minor changes will have serious effects on the service as received. When using more than six VBI lines per field in serial mode there will be almost no effect on cycle time as there are many filler packets. In parallel mode there will be a greater effect, as the basic transmission is more efficient.

Further recommendations designed to save transmission capacity are given elsewhere in the present document.

7 How to work with Level 2.5

The world of Level 2.5, which offers lots of possibilities for graphically more attractive Teletext services, has consequences on the work of the editors. As mentioned previously, this Code of Practice is a general introduction to Level 2.5 written without practical experience of any editing software. In this clause we wish to summarize hints which should be taken in account before planning the editorial work with Level 2.5.

7.1 Working on two Levels

It is not without reason that the picture of overlaid acetate is often used to describe the relationship between Teletext Levels 1 and 2.5. In spite of all the enthusiasm about the enlargement of editing possibilities we have to keep several things in mind - above all the fundamental principle of compatibility with Level 1. Although this problem is solved technically by the specification, editors should be aware that they are editing for two different Levels.

The work with two Levels will be reflected by the editing software. It is necessary to review your page output on both Levels. There are important reasons to check your editing output not only on your PC monitor but also on a TV set. Several Level 2.5 features like the flash modes or the complete colour palette might not be shown sufficiently accurately on every PC monitor.

Recommendation:

Check both versions of the page, preferably on a TV set, while editing.

7.2 Enhancing Level 1 - the overlaying principle

In simple terms, the enhanced data to overlay the basic page should not transport elementary information. For the next few years Level 1 decoders will still form the majority and, by definition, cannot display enhancement data. This should consist only of supplementary information for the near future.

The main work - editing news as fast as possible - will probably still be done in Level 1, while Level 2.5 features will be applied to enhance this information in an effective and graphically attractive manner.

The overlaid enhancement can define the general layout of a whole magazine (e.g. a standardized background colour), the layout of a single page or simply an area of a page. You should remember that the overlaid area has to be congruent to the respective area of the basic page. As one example you might have a table on the basic page consisting of election results. With Level 2.5 this table can be turned into an attractive graph. But remember not to go beyond the margins of the original table!

Another typical enhancement application in Level 2.5 might be the smoothing of banner headlines by using the G3 smoothed mosaics character set, as well as applying logos and supplementary background colouring.

First of all, you should enhance the introductory page of your service (usually page 100). A page which should benefit from enhancement is the weather forecast. Some simple graphical improvements will revitalise this page. Another example might be the "TV Guide" pages which can be easily upgraded with broadcaster logos. And, for all these examples, define your **own** colour scheme!

7.3 More about colours, attributes, objects and side-panels

The overlaying principle of the enhancement of Teletext pages does not only include the more technical aspect of how to do it, it is also a question of planning the Teletext service.

Level 2.5 offers a considerably wider palette of colours for display. Your Teletext pages can be enhanced by new back- and foreground colours from the set of 32 colours, half of which are definable by the editor. Mathematically, you have a vast number of colour combinations. In reality, the number of these combinations is much smaller. It is up to the editor to find the best combination for his service. Remember that some people are colour blind and may not appreciate certain background/foreground colour combinations. If you use the chance to create your own colours for your service, use them on as many pages (or magazines) as possible. Otherwise you risk problems with the allocation of colours and pages.

The handling of several different colour palettes for different pages or magazines may lead to other problems. If you use global or public objects you should be aware that they may appear in different colours on different pages - depending on the colour palette in use for the respective page or magazine.

As already mentioned, in the side-panel you should either send supplementary data in addition to the basic page or a kind of navigational information for your Teletext service. Never use the side-panel for elementary information because it will not appear on Level 1 decoders.

7.4 The organization of enhancement

The features given in Level 2.5 will encourage your creativity as an editor and will enable you to produce more attractive pages. For instance, there are rules to be made for the creation of new colour palettes or default objects. For an efficient management of objects you should organize a "library" of DRCS and objects. All colour palettes, DRCS and objects should be available on all editing terminals.

With more features there is a greater need for system management to organize your Teletext service efficiently.

8 Transmission management

This clause covers aspects of the management of the enhancement data which the editing and transmission system should take care of automatically.

Because of the limitation (laid down in the Level 2.5 specification) that the total enhancement data should not take more than 500 packets and should be transmitted once every 20 s, there is a "new" process in the origination systems concerning the transmission management for the whole service.

The new enhancement data pages required are:

- Magazine Organization Tables (MOT);
- Object definition pages (GPOP and POP);
- DRCS definition pages (GDRCS and DRCS);
- Magazine Inventory Pages (MIP).

The starting point for an efficient Level 2.5 operation is the *Magazine Organization Table* (MOT). The MOT contains an entry for each page of a magazine. It contains pointers to the page numbers of the object and DRCS definition pages required to achieve the display of the Level 2.5 version of that page. It can also invoke the display of an object (a *default object*) without the need to append packets 26 to the basic page.

Objects are described in (*Global) Public Object Pages* (GPOPs or POPs). In these the objects are stored like subroutines which will be invoked through the data in the MOT (as default objects) or from the data in packets 26. *DRCS pages* transport the redefined characters or graphic shapes.

The *Magazine Inventory Page* (MIP) is a system page which contains information for the decoder to help it decide whether to store a page or not. The creation of the MIP is likely to be done by the transmission system with some guidance from the editorial system manager. The MIP has an entry for every page in the magazine placing it in one of seven main categories: Normal page, Subtitle page, Current TV programme related page, TV schedule page, Data broadcasting page, Editorial system page (e.g. MOT, TOP, POP or DRCS page) and Engineering extra function pages. A TOP page contains already some of the information in the MIP. Also, some of the information in the MIP is useful to multi-page decoders which are not capable of a Level 2.5 display.

Recommendations:

It is recommended to use hexadecimal pages for the transmission of enhancement data.

The new generation of Level 2.5 decoders do not need the 20 ms memory erase time which is necessary for the Level 1 decoders. Thus the enhancement data pages can be transmitted in the filler packet space. The one exception is the MIP because of its usefulness to a wider range of decoders. In annex A it is shown that sufficient filler packet capacity is likely to be found in serial mode transmissions using 6 or more VBI lines per field to transport the 500 enhancement packets in 20 s.

9 Minimum service

In order to establish a Level 2.5 service which will not increase cycle time to an observable extent a *minimum service* is proposed.

Such a service could have the following features:

- full screen colour for all pages in each magazine;
- a (broadcaster) logo on each index page (or any other important pages which you want to be highlighted). The number of invocations of this logo is not important if the logo is always implemented at the same position as it could then be invoked as a default object via the MOT.

These enhancements will increase the cycle by two extra pages per magazine and one standalone packet. A MOT and a GPOP are needed for the logo, and packet 29 for the full screen colour and the colour palette.

There is an added benefit in that the packets 29, in conjunction with page header control bits, will define unambiguously the character set requirements (i.e. alphabet(s) and national option sub-set) of each page, see clause 11.3.

10 Technical epilogue

This clause deals with a number of Teletext issues not directly related to Level 2.5 that were identified by the EBU/EACEM group during their discussions. Further topics are dealt with in the normative and informative annexes of EN 300 706 [1].

10.1 Allocation of page numbers and page sub-codes

Any page address up to including hexadecimal FE with a sub-code up to and including 3F7E, can be used for a page carrying data and can be specified as a linked page in a packet 27. However, normal decoders allow the user to enter page numbers in the range 100 to 899 only. Access to other pages in the hexadecimal range is possible via packet 27 links in the FLOF code of practice.

Pages used for enhancement data (objects and DRCS definition pages) should have page numbers which include a hexadecimal digit to prevent these pages being captured as normal display pages.

Page numbers with the tens or units value set to F are often used for engineering or system control purposes and thus they may not be available for editorial purposes.

The page number FF in all magazines is reserved for use as a null page address. The full-page address of FF with a sub-code of 3F7F is reserved for use as a null link in packets 27.

To enable multi-page decoders to handle rotating pages (otherwise known as rolling pages or multi-page sets) in an intelligent manner, the sub-codes of these pages should be set according to the following:

1) Single, non-rotating pages should use the sub-code value 0000.

2) The following applies to rotating page sets where the editorial content is significantly different from one page to the next, for example "news-reel" sequences or today/tonight/tomorrow weather details.

Rotating page sets of up to 79 separate pages should use sequential sub-codes. The first 9 pages should be numbered 0001 to 0009, the next 10 pages numbered 0010 to 0019 and so on up to 0079. An intelligent decoder may choose to store these pages individually, allowing the user to step through the sequence at this own rate. If the editorial content of a certain page is not different from the preceding page, the current page may be transmitted with the same sub-code as the preceding page.

Rotating page sets comprising more than 79 sub-pages should use unique sub-codes greater than 0079 on all the pages. It should not be assumed that intelligent decoders will attempt to store these pages individually. Many decoders store the last received sub-page that is greater than 0079 overwriting this on the next reception of a page with sub-code greater than 0079.

3) The following applies to a rotating page set where the editorial content is not significantly different from one page to the next to the extent that an intelligent decoder need not store each page individually. In other words, it is intended that the user sees a new version of the page with minor updates as soon as it is transmitted. A typical example is an index page which rotates to highlight a different topic.

Sub-codes values greater than 0079 should be used on each page. To ensure older decoders update their displays each time a new version is transmitted, a unique sub-code should be allocated to each page in the set.

Some decoders store pages with sub-codes S2, S1 identical in the same location even though they have been transmitted with a different S4 value. This overwriting can be useful in transmitting pages which have very slight editorial differences - for instance an animating advertisement on each different S2, S1 sub-page, so that they are seen to be changing by the viewer.

4) The sub-code may be used to transmit time-related information, for example an alarm clock page.

Separate rules apply to the allocation of sub-code values to enhancement data pages. These should be implemented automatically by the transmission management system.

It should also be noted that it is allowed to use different FLOF links on different pages within a sequence of rotating pages.

10.2 Use of the Update bit (C8)

The Update bit (C8) is used by the editor specifically to indicate that an update has occurred. The expected effect in the decoder is that, where a page display has been cancelled by an appropriate user key ("cancel page", "picture", etc.), the setting of the Update bit will cause a prompt, which may involve automatic redisplay of the page. An application where this is standard practice is for newsflash pages. The unnecessary or inappropriate setting of the Update bit can cause annoying redisplay of a page or newsflash that a user wishes to cancel. The setting of the Update bit is thus an editorial decision.

10.3 Language definition and the preferred use of packets 29/0

Existing Level 1 and Level 1.5 decoders have, in general, a limited language capability and determine the language of a page from the C12, C13 and C14 control bits in the page header. The decoder is often designed to meet the needs of the local market only. Many existing decoders do not decode correctly all possible combinations of these bits but, by chance, default to the correct language if a non-supported combination occurs. By definition, Level 2.5 decoders have a much wider language capability, including the ability to display more than one alphabet. They will be more likely to display the wrong language, or even the wrong alphabet, under these circumstances. Therefore it is recommended that the correct settings for these bits are always transmitted.

The C12, C13 and C14 control bits on their own provide insufficient information to identify uniquely the language of a page. For example, the combination 000 is used for both English and Polish. Thus Level 2.5 decoders require supplementary information to resolve this ambiguity. The relevant information can be transmitted on a page-by-page basis via packets 28/0, or more efficiently, on a magazine basis by packets 29/0. However, packets 29/0 also allow the simple but effective Level 2.5 enhancements of full screen/row colours and colour re-mapping. Thus the introduction of packets 29/0 in advance of any more complex Level 2.5 transmissions using objects and DRCS is recommended.

Where a service comprises pages in different languages using different alphabets, for example Estonian (Latin) and Russian (Cyrillic), it is recommended to use parallel mode transmissions and dedicate particular magazines to each language. This ensures the correct alphabet is used when the decoder is displaying rolling headers while searching for a page.

Broadcasters are encouraged to transmit packet X/29 to define the primary and secondary language sets, particularly if the secondary language set is a Latin set so that the appropriate language option can be set, for instance to display the @ character which is 4/0 in the English options.

10.4 Interrupted pages

In order to keep some existing decoders working, it is recommended that Level 1 pages be re-transmitted completely, including all extension packets, after any interruption.

Pages carrying enhancement data (MOT, POP, DRCS) may be interrupted and can continue with the transmission of the remaining part of the page following the page header. Special rules apply to the setting of the sub-code and certain control bits under these circumstances. Refer to EN 300 706 [1], clause A.1.

10.5 Parallel magazine transmissions

In order for a decoder to maintain the time field at the end of the header row, it is necessary to transmit a page header at least every second. This is particularly important with parallel magazine mode transmissions where a limited number of pages in a magazine and the infrequent allocation of a transmission slot can result in the time field changing erratically.

Where the number of pages in a magazine is limited and transmission slots are allocated infrequently it is good practice to terminate explicitly each page with a dummy header (page number FF) if the page is not to be terminated implicitly by the immediate transmission of another page in the same magazine. An example is the transmission of subtitles where the page is the only one in the magazine. The purpose of the dummy header is to terminate the acquisition process within the decoder and prevent corruption of the received data by noise and, at Level 2.5, to activate the processing of any enhancement data required by the page.

The combination of TOP and parallel transmissions is not recommended due to the limited performance of existing decoders. This is caused, amongst other factors, by a lack of memory in a significant number of decoders. Therefore, where a parallel transmission is implemented, the use of navigation via FLOF or the MIP is encouraged.

10.6 FLOF and TOP Navigation Protocols'

10.6.1 Introduction

Navigating a teletext database can be very slow if the user has to keep referring to index pages and then has to select pages by entering 3-digit numbers. If the service provider supplies additional data to categorize each page, i.e. a keyword or indication of the subject matter, and combines this with machine-readable page numbers, navigation can be simplified for the user. Speed of access to pages is usually increased as well when these techniques are used with multi-page decoders.

The two navigation enhancement methods in current use are FLOF (Full Level One Facilities) and TOP (Table Of Pages). These are specified in EN 300 706 [1] in clauses 11.1 and 11.2 respectively. Codes of Practice for each are presented in annexes H and I respectively.

The two protocols were designed independently and have generally been regarded as being mutually exclusive. In other words, a transmission would adopt one or the other, or neither. Many decoders have been designed on this premise. Clause 10.6.4 summarizes the problem that can occur as a result of using both protocols in the same transmission.

10.6.2 FLOF

10.6.2.1 Key points

FLOF requires two extra packets to be transmitted per page. A packet X/24 provides an extra row of text to be displayed at the bottom of the main page. This contains four keywords, each in a different colour - red, green, yellow and blue (or cyan). The viewer is provided with four special keys in matching colours on his remote control handset. These permit single-key access to the corresponding pages. The editor chooses the pages to reflect the likely responses of the viewer once he has read the current page.

The decoder is informed of the relevant page numbers by the second additional packet - a packet X/27/0. This defines up to six page numbers. A decoder will normally try and pre-capture as many of these pages as possible, subject to its memory capacity. The first four page numbers map directly to the four coloured keys. The last page number maps to an index page related to the current page. There is usually a dedicated key on the handset for selecting this page. No dedicated key is provided for accessing the fifth link.

A full 7-digit page address can be specified by each of the six links in the packet X/27/0. A subcode value of 3F7F indicates that an explicit sub-code value is not being specified and only the 3-digit page number should be used. A page address value of xFF.3F7F indicates that no particular page is being specified and any associated direct access key should be temporarily disabled.

The display of the packet X/24 is conditional on the setting of the most significant message bit in the Link Control Byte carried in the packet 27. The packet X/24 should only be displayed if this bit is set to 1.

FLOF is fully compatible with both magazine serial and magazine parallel methods of transmitting a page-format Teletext service.

EN 300 706 [1] states that a packet 8/30, format 1 is an optional component of a FLOF compliant transmission. This statement should not be interpreted to mean that the presence of the packet implies that packets X/24 and X/27/0 are also being used for navigation purposes. A packet 8/30 format 1 has a stand-alone function and carries various items of data relating to the broadcast channel. The navigation aspects are restricted to recommending an initial page by which the user should enter the service. Other contents include channel identification, time and date. This type of information is important for VCRs and NexTView EPG decoders. Thus the packet is quite likely to be found in a transmission that is not using packets X/24 and X/27/0 for navigation.

10.6.2.2 Identifying a FLOF transmission

- A FLOF compliant transmission will include some or all pages with a packet X/27/0 with the MSB of the Link Control Byte set to 1. It is likely that such pages will also have a packet X/24. However, it is possible that not all pages in the service will have FLOF components.
- The presence of a packet 8/30 format 1 should NOT be interpreted as implying that a service uses packet X/24 and X/27/0 for navigation purposes.

10.6.2.3 Recommendations to service providers

- Since a decoder will normally enter a teletext service via page 100 or the initial page referenced by a packet 8/30 format 1 (if different), it is recommended that these pages have FLOF compliant packets X/24 and X/27/0 when the FLOF navigation protocol is used anywhere within the service.
- The combination of FLOF and TOP in the same transmission is not recommended; see clause 10.6.4.

10.6.3 TOP

10.6.3.1 Key points

The TOP system transmits additional information that categorizes the Teletext pages. For each page in the service, the page number and a text string describing the theme or content is broadcast in a machine-readable format. Unlike FLOF, this additional data is transmitted via special pages and no packets with addresses greater than 23 are employed.

A decoder is free to interpret this additional information in its own way. Typically it constructs and displays menus of pages grouped by theme or content rather than page number. In the background, a multi-page decoder will be acquiring some or all of the pages referenced by the menu currently displayed. The viewer selects a page by theme or content and, if has been pre-captured, it can be displayed immediately. Four coloured keys on the remote control handset are used to move around the menus and select pages.

A number of different data pages are allowed for in the TOP specification but common to all implementations is the Basic TOP Table (BTT) page. The contents of this page indicate the page numbers of the other data pages, if used. The BTT information is always broadcast on page 1F0 and is coded Hamming 8/4 throughout packets 1 to 23.
EN 300 706 [1] specifies the coding of the Page Function and Page Coding fields of a packet 28/0 format 1 which can be added to the page to define unambiguously that it is a BTT page. However, this is not a mandatory requirement. Identification codes exist for the other types of TOP data pages. The packet should be coded according to table 6 in clause 9.4.2.4 of EN 300 706 [1]:

- Triplet 1, bits 4, 3, 2, 1: 1000 - BTT page
- Triplet 1, bits 7, 6, 5: 011 - 8/4 Hamming coding throughout
- Triplet 1, bits 18 - 8: 00111111111 - Default value for pages which are not level one pages or data broadcasting pages
- Triplets 2 to 13 - Do not care (reserved for future use). All bits set to 0 is recommended.

The page numbers used to carry TOP data can also be indicated via Magazine Inventory Pages (MIP). The BTT will always be in magazine 1. The code value for a TOP data page is 0xFE.

A lack of memory in many decoders means that TOP is not particularly suited for use with parallel mode transmissions.

NOTE: There is no minimum cycle time for the BTT page specified in either EN 300 706 [1] or the IRT's TOP specification (No. 8, R5, 2nd edition, 1991).

10.6.3.2 Identifying a TOP compliant transmission

- A TOP compliant transmission will include, as a minimum, the BTT information on page 1F0. However, further checks ought to be carried out in case this page is actually being used for data broadcasting purposes. A page used for data broadcasting purposes and coded to the Page Format - CA method described in EN 300 708 [2] should include a packet 28/0. This packet 28/0 should be checked to see if the Page Function and Page Coding fields identify the page as carrying TOP data, see above.
- If a packet 28/0 is missing from a page 1F0 AND the majority of bytes in packets 1 to 23 pass a Hamming 8/4 check, it is very likely the page carries BTT information.
- A decoder should search for the BTT page for a time much greater than the recommended minimum transmission rate.
- If present, a Magazine Inventory Page for magazine 1 should indicate whether a BTT page being transmitted. Other TOP data pages should be indicated in the same MIP or in MIP(s) for other magazines, as appropriate.
- TOP is unlikely to be used with parallel mode transmissions.

10.6.3.3 Recommendations to service providers

- The BTT page should be transmitted at a minimum rate of once every *10* s. (It should be noted that some older decoders may require a more frequent transmission).
- The service should include Magazine Inventory Pages as appropriate to confirm that TOP data pages are present.
- An appropriately coded packet 28/0, format 1 should be added to the BTT page to confirm its function.
- Where page 1F0 is used for data broadcasting purposes according to the Page Format - CA method described in EN 300 708 [2], a properly coded packet 28/0 should accompany the page.
- The combination of TOP and FLOF in the same transmission is not recommended; see clause 10.6.4.

10.6.4 Combined FLOF and TOP transmissions

Since the FLOF and TOP navigation protocols introduce different additional components into the transmission, it is possible to add both to the same Teletext service. However, this is not recommended, as some existing decoders may not be consistent in their operation each time they tune to a particular channel. Sometimes they might work in FLOF mode, other times in TOP mode. Their response will be determined by which additional component they find first.

Some existing receiving systems have been designed to accept dual-standard transmissions. Usually the user or the dealer is able to configure the equipment so that it always operates in one particular mode if both protocols are encountered.

10.7 Preferred use of packets 27/4

Packets 27/4 links provide a complete definition of the particular POP and DRCS sub-pages carrying the enhancement data required by the associated basic page. (This is in the form of 16 flags for the 16 possible sub-pages). The MOT only provides the page number and an indication of the total number of sub-pages. Thus the transmission of a packet 27/4 can speed up the processing of a Level 2.5 page by a decoder.

In some circumstances the transmission of a packet 27/4 is essential, for example to support the "news-reel" type of page where a selection of pages, possibly from different magazines, with different enhancement data (POPs and DRCS) is presented on a single page number as a rotating page. The information available from the MOT is insufficient to identify the requirements of each page.

10.8 Objects in row 24

The use of objects which spread from rows higher up the screen into row 24 is not recommended, as many decoders will display row 24 below rows 0 to 11 when operating in "page expansion" mode.

10.9 The advantages of transmitting a MOT

The MOTs will always be captured by Level 2.5 decoders and stored permanently. Thus the decoder may search for the basic page and the required enhancement data pages simultaneously. With some Level 2.5 decoders the memory will be large enough to pre-capture and store all the enhancement pages. The requested page can then be displayed as soon as the basic page is acquired.

If the required enhancement data pages are only indicated through packets X/27/4 appended to the basic page, they can only be requested after reception of the basic page.

The default object feature within the MOT allows enhancements to added to any page without the need to append packets 26 to the basic page and thus saving transmission capacity.

10.10 Limiting the use of packets 26

Packets 26 should be used primarily for Level 1.5 data and global (or public) object invocations to minimize the number of packets 26 appended to each basic page. A large quantity of enhancement data should be packed into an object and transmitted in an object page even if the enhancement is to be used only once. This approach will save transmission capacity as the object page can make use of the filler packet space. In addition, the effect on the processing time of some Level 1.5 decoders will be minimized.

10.11 Special characters

The Euro currency symbol is invoked at Levels 1.5, 2.5 and 3.5 by local enhancement data (packets 26), or at Levels 2.5 and 3.5 from within objects. A column address triplet is required with a mode value of 01111 (character from the G2 supplementary set) and a data (character) value of 5/6. This assumes the Latin G2 set is the currently selected.

The @ symbol as used in internet addresses can be accessed in Level 1 from the character code 4/0 in the English national G0 option set. It is available in Level 1.5 where the Latin G0 character set is used. It is desirable to support the @ symbol in all languages, in the second edition of EN 300 706 [1], the @ symbol replaces the * symbol when invoked with a NULL accent.

Manufacturers of Level 1.5 equipment are encouraged to support these symbols.

Broadcasters should transmit a suitable default characters on the Level 1 page.

10.12 Packet X/28 format 1

There are two packet 28/0 formats in EN 300 706 [1], format 1 (clause 9.4.2) and format 2 (clause 9.4.3). Format 1 was invented as part of the Level 2.5 development. Format 2 is what remains of the original WST/SPB492 coding scheme. This survived because it is used in Page Format - CA data broadcasting as defined in clause 5 of EN 300 708 [2].

Format 1 has three sub-coding schemes:

- Basic Level One pages (LOP) - table 4.
- Page Format - Clear data broadcasting pages as defined in clause 4 of EN 300 708 [2], table 5.
- Pages other than these two types, e.g. DRCS pages - table 6.

According to table 7, the three fields in the first triplet of a packet 28/0 format 2 accompanying a Page Format - CA page can only have the following values:

	Page Coding			
Bit:	18	17	16	15
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1

Set to '0'					
14	13	12	11	10	9
0	0	0	0	0	0

Page Function							
8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0
1	0	0	0	0	1	0	1

Inspecting bits 1 to 7 of these sequences against table 3 in clause 9.4.2.1 yields:

7	6	5	Page Coding	4	3	2	1	Page Function
0	0	0	7 bits + odd parity	0	0	0	0	Basic level one page
0	0	0	7 bits + odd parity	0	1	0	0	GDRCS page
0	0	0	7 bits + odd parity	0	1	0	1	(Normal) DRCS page

Thus the page could be a level 1 page or a DRCS page. However, according to clause 9.4.2.4 it CANNOT be a DRCS page because bits 8 to 18 are not set to 11111111100.

Bits 8 to 14 of the first triplet of a packet 28/0 for a level 1 page define the default G0 and G2 character sets, and bit 15 to 18 are part of the second G0 set definition. The bit sequences shown above are all valid when interpreted against tables 32 and 33 respectively.

Thus it is not possible for a decoder to distinguish between a level 1 page and a data-broadcasting page solely on the coding of the first triplet of a packet 28/0.

The coding scheme for the data broadcasting packet 28/0 cannot be altered because it pre-dates the Enhanced Teletext specification and there are installed decoders that are designed to the current specification.

However, a level 1 page is likely to have a number in the range x00 to x99 while a data broadcasting page is likely to have a page number which includes elements in the
range A to F.

10.13 Channel identification

It is strongly recommended that all teletext transmissions include at least a Packet 8/30 format 1 to enable the channel to be identified. See TR 101 231 [3].

For compatibility with nexTView TR 101 288 [4] reception it is preferable to use Packet 8/30 format 2 or VPS where available for channel identification.

10.14 Date and time setting

It is recommended that to enable the accurate setting of time and date a Packet 8/30/1 is included in any transmission. This time shall be UTC with the appropriate time offset bits set.

Because of features of some decoders which fall back on the use of bytes 38-45 of a Packet X/0, it is strongly recommend that a packet 8/30/1 is transmitted if any X/0 bytes 38-45 do not contain the current time.

The use by decoders of a text string in packet X/0 to determine the date is deprecated and the use of the MJD in Packet 8/30/1 is encouraged.

10.15 Level 2.5 data on magazine 7

Problems have been encountered with some receivers that do not correctly receive Level 2.5 information on magazine 7.

Annex A:
Cycle time in serial transmission mode

By its very nature cycle time involves a mathematical treatment. A displayable page consists of a header (row zero) and a number of other packets. A full page takes 24 packets. If a row has no information, it does not need to be transmitted.

Table A.1 shows the number of vertical blanking intervals (VBIs), each 20 ms in duration, required to transmit pages of between 18 and 30 packets on 1 to 12 VBI lines.

Table A.1: VBIs required to transmit pages of different sizes

No. of VBIs	Number of packets per page												
	30	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**
1	30	29	28	27	26	25	24	23	22	21	20	19	18
2	15	15	14	14	13	13	12	12	11	11	10	10	9
3	10	10	10	9	9	9	8	8	8	7	7	7	6
4	8	8	7	7	7	7	6	6	6	6	5	5	5
5	6	6	6	6	6	5	5	5	5	5	4	4	4
6	5	5	5	5	5	5	4	4	4	4	4	4	3
7	5	5	4	4	4	4	4	4	4	3	3	3	3
8	4	4	4	4	4	4	3	3	3	3	3	3	3
9	4	4	4	3	3	3	3	3	3	3	3	3	2
10	3	3	3	3	3	3	3	3	3	3	2	2	2
11	3	3	3	3	3	3	3	3	2	2	2	2	2
12	3	3	3	3	3	3	2	2	2	2	2	2	2

Table A.2 shows the number of filler packets per page over the same range of packets per page and VBI lines.

Table A.2: Number of filler packets per VBI/page size combination

No. of VBIs	Number of packets per page												
	30	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	1	0	1	0	1	0	1	0	1	0	1	1
3	0	1	2	0	1	2	0	1	2	0	1	2	0
4	2	3	0	1	2	3	0	1	2	3	0	1	2
5	0	1	2	3	4	0	1	2	3	4	0	1	2
6	0	1	2	3	4	5	0	1	2	3	4	5	0
7	5	6	0	1	2	3	4	5	6	0	1	2	3
8	2	3	4	5	6	7	0	1	2	3	4	5	6
9	6	7	8	0	1	2	3	4	5	6	7	8	0
10	0	1	2	3	4	5	6	7	8	9	0	1	2
11	3	4	5	6	7	8	9	10	0	1	2	3	4
12	6	7	8	9	10	11	0	1	2	3	4	5	6

The previous two tables are fundamental - but it is more useful to see how many pages can be transmitted in about 20 s, a typical reading time for one page (see table A.3).

Table A.3: Number of pages in 20 s per VBI/page size combination

No. of VBIs	Number of packets per page												
	30	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**
1	33					40					50		
2	66	66	72	72	77	77	83	83	90	90	100	100	111
3	100	100	100	111	111	111	125	125	125	142	142	142	166
4	125	125	142	142	142	142	166	166	166	166	200	200	200
5	166	166	166	166	166	200	200	200	200	200	250	250	250
6	200	200	200	200	200	200	250	250	250	250	250	250	250
7	200	200	250	250	250	250	250	250	250	333	333	333	333
8	250	250	250	250	250	250	333	333	333	333	333	333	333
9	250	250	250	333	333	333	333	333	333	333	333	333	333
10	333	333	333	333	333	333	333	333	333	333	500	500	500
11	333	333	333	333	333	333	333	333	500	500	500	500	500
12	333	333	333	333	333	333	500	500	500	500	500	500	500

Table A.4 shows the vast number of filler packets that a service using more than six VBI lines per stream contains. The shaded area shows the combination of packets per page and VBI lines per field where there are more than approximately 500 filler packets per 20 s (i.e. corresponding to the maximum amount of Level 2.5 enhancement data at the slowest permitted transmission rate).

Table A.4: Number of filler packets in 20 s per VBI/page size combination

No. of VBIs	Number of packets												
	30	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**
1													
2		66		72		77		83		90		100	
3		100	200		111	222		125	250		142	284	
4	250	375		142	284	426		166	332	498		200	400
5		166	332	498	664		200	400	600	800		200	400
6		200	400	600	800	1 000		250	500	750	1 000	1 250	
7	1 000	1 200		250	500	750	1 000	1 250	1 500		333	666	999
8	500	750	1 000	1 250	1 500	1 750		333	666	999	1 332	1 665	1 998
9	1 500	1 750	2 000		333	666	999	1 332	1 665	1 998	2 331	2 664	
10		333	666	999	1 332	1 665	1 998	2 331	2 664	2 991		500	1 000
11	999	1 332	1 665	1 998	2 331	2 664	2 997	3 330		500	1 000	1 500	2 000
12	1 998	2 331	2 664	2 997	3 330	3 663		500	1 000	1 500	2 000	2 500	3 000

Annex B:
Commercial name

The term "Hi Text" has been proposed as the commercial name for enhanced Teletext services and decoding products compliant with EN 300 706 [1] and the present document.

Annex C:
List of members of the EBU/EACEM Application Group

The following members of the EBU/EACEM Application Group contributed to this code of practice ETR:

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