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Automating Production of Cross Media Content for Multi-channel Distribution
www.AXMEDIS.org

Content Production

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Preface

Digital-content market is urging better pricing and value-for-money for industry products and services. This is clearly evident in the recent price reductions by major companies in the sector. The containment of sale prices is a vital key when setting up a viable and sustainable business venture in the digital cross media content. Possible solutions to this challenge could be found by automating, accelerating and re-structuring production processes, and providing solution to the content protection. Such solutions will enable the production processes to be faster and cheaper, while at the same time providing new capabilities to support safer distribution. AXMEDIS aims to meet the challenges of market demand by:

i. reducing costs for content production and management by applying Artificial Intelligence techniques for content composition, representation (format) and workflow;
ii. reducing distribution and aggregation costs in order to increase accessibility with a Peer-to-Peer (P2P) platform at Business-to-Business (B2B) level, which can integrate content management systems and workflows;
iii. providing new methods and tools for innovative and flexible Digital Rights Management (DRM), including the exploitation of MPEG-21 and overcoming its limitations, and supporting different business and transactions models.

The AXMEDIS consortium (consisting of leading European digital content producers, integrators, aggregators, and distributors; and also information technology companies and research groups) is to create the AXMEDIS framework to provide innovative methods and tools to speed up and optimise content production and distribution, up to the production-on-demand capability, for leisure, entertainment and digital content valorisation and exploitation in general. AXMEDIS format can include any other digital formats and will exploit and improve other formats such as MPEG-4, MPEG-7, MPEG-21, as well as other de facto standards.

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1. Introduction of the Training Course

Course objectives
Present course is an introductory and preliminary step aimed to grant proper understanding and background on content production issues so to be able to profitably attend the *AXMEDIS Content Tutorial*. The course is focused on how to prepare and create content rather than on the whole mechanism to make content in automatic manner. This latter point is addressed in the *AXMEDIS Content Tutorial*.

Expected Audience
This course is addressed to people who are not too familiar with the overall process of content production but are, or may be, familiar with technologies and tools.

Learning outcomes
At the end of this preliminary and introductory course attendee will have gained a basic knowledge on:

- Content aspects design
- Effective & efficient content design
- Content classification & formats
- Authoring tools and content development applications
- Creating multimedia content from existing material
- Basic concepts on IPR, Copyright and DRM

Course content
The training course will cover the following arguments:

- Content management process
- An introduction to content design;
- Effective & efficient content design (readability, understandability, accessibility…);
- Content classification & formats (text, images, audio, video, animations, multimedia…);
- Authoring tools and content development applications;
- Creating multimedia content from existing material;
    - Subtitling, synchronization, compression and quality;
    - Multi platform packaging and delivery;
    - Languages related issues;
- Metadata (including Classification keywords, IPR and DRM specific metadata);
- Constraints (terminal nature and related fruition issues, connection, bandwidth, supported content, channel related content issues…);
- Accessibility;

2. Preparation

To profitably attend the present training course there are no special requirements, attendee will have solely to proceed to the following steps:

- **Resources (Facilities and Equipments) Required**
    - Download the tutorial slides from the URL specified hereafter;
    - Download the reference material marked with (*) in the reference section;
    - Download the short feedback Questionnaire form the URL specified hereafter.
- URL for any additional materials for this tutorial (e.g. FAQ, etc) or the latest update for this tutorial: [_____Insert URL here_____]

3. Course Content

3.1. Content management process

The first step in designing any content is to define the goals. Without clearly stated mission and objectives the design and production phases will drift, bog down, or continue endlessly. Careful planning and a clear purpose are the keys to success, particularly when working as part of a development team. Therefore first is necessary to analyze needs, expected target audience and goals, then gather information and finally start creating a development specification document that details what to do and why, what technology and content will be needed, how long the process will take, what will be spent to do it, and how results will be assessed. The specification document is crucial, as it is both the blueprint for the process and the touchstone used to keep the project focused on agreed goals and deliverables. Depending on the kind of content the development process may slightly vary, but in the overall the structure will remain basically the same. Taking as a reference the production of content in a multimedia environment we have that Definition and planning is usually divided into: Production checklist development, Technology selection, Support definition, Budgeting and Appoint a chief editor. What follows is then generally referred to as Information architecture and is usually divided into: Detailed design specification, Detailed description of content, Navigation structure, Detailed technical support specification, Supported technology identification, Technology resources identification, A schedule for implementing design and construction, One or more prototypes of sample contents and finally Multiple graphic design sketches or roughs. The last step that presents a number of sub-step worth to be explicitly mentioned here is Content design that is usually structured as follows: Content components detailed organization and assembly, Functional and logic components, Templates and Accessibility. Usually the content components, detailed organization and assembly is further subdivided into: Text editing and proofreading, Graphic design specs for all object types, Detailed composition or finished example, Content templates design, Illustrations and Photography. Ootherwise it will turn out into a too complex activity and its schedule will result too cumbersome. In this manner most of the activities can be planned in parallel with some overlap. The need for planning and structuring prior to pass to content design and production phase emerges clearly from the following picture that plots major themes for information delivery against linearity of the structure of content presentation and length of the typical user's contact time.

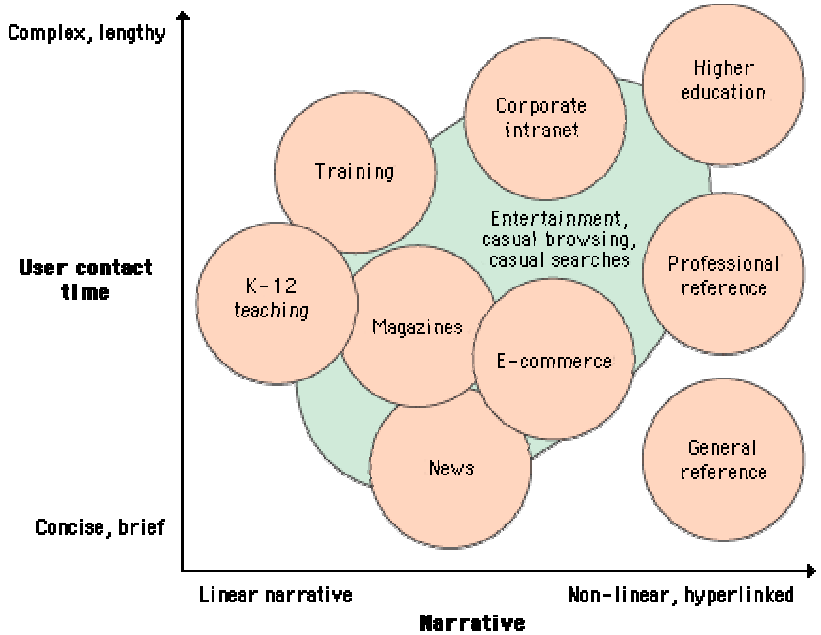


Figure 1. Linearity of content presentation structure vs typical length of user's contact time in information delivery

The diagram just presented is usefully complemented by the following image, where the various kinds of audiences are presented on a linear axis giving a clear perception of the balance among sensation vs. rigorousness of information.

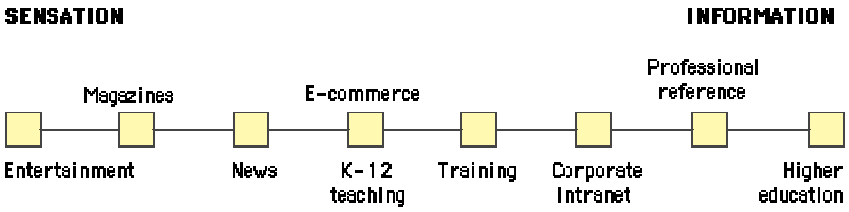


Figure 2. Audience related balance among sensation vs. rigorousness of information needs

A already stated, even if the content production process is more or less the same regardless the kind of content, terms adopted to describe each step are quite different, moreover concepts about structuring information are at present still mainly largely based on the organization of printed books, periodicals, library indexing and cataloguing systems that developed around printed information. Quoting the "*Web Style Guide – 2nd Edition*" we could say that the "*interface standards*" of books in the English-speaking world are well established and widely agreed-upon. As a matter of facts detailed instructions for creating books may be found in such guides as *The Chicago Manual of Styl*e or *Xerox Publishing Standards: A Manual of Style and Design*. Therefore although contents differ in terms of development process following their own nature, most of the guidance needed to design, create, assemble, edit, and organize multiple forms of media do not differ radically from current practice in print media. For example most Web documents can be made to conform to *The Chicago Manual of Style* conventions for editorial style. Text organization and much of what an organization needs to know about creating clear, comprehensive, and consistent internal publishing standards is already available in the *Xerox Publishing Standards: A Manual of Style and Design*. Following what just mentioned, we could say that each content could be regarded as a document and therefore its basic elements can be determined checking the following set of rules:

Who – the source should be always available
What – all documents need clear titles to capture the reader's attention
When – temporal reference is extremely relevant to determine relevance
Where – content location (URL) should always be present whenever available

3.2. An introduction to content design

As previously mentioned the design of any product has basically the same rules including the choice of a set of colours representing brand, product… and susceptible to seduce the targeted audience; choice of a set of fonts following the same rules etc. in other words: choose the main components of what will become the visual identity of the product. However these are not the most important part of what makes a product a commercial success. What makes a product a commercial success is its content value. Once a strong content value has been recognized to a product, this is promised to a commercial success for many years. It is obviously not possible to define rules to produce content with a good value. In fact, there seems to be no rule at all. The only constraint is the interest of the consumer, but at the same time one thing is sure: if content design has not been effective and efficient also a good content can be perceived as being less good than it actually is, while a so-so one if presented effectively and efficiently can turn out to be more successful. Good contents can often be hidden (at least partially) by a graphic layout, interface, etc. but not at the same level.

3.3. Effective & efficient content design

Communication can be effective and attractive but it also has to be efficient especially since cost related issues are concerned. In today's world, it is not possible to afford a communication process without taking into the account of proper budgeting requirements. Production and distribution costs will have a major impact on the process and therefore each step has to be carefully planned. Achieving the balance between effectiveness and efficiency is, or can be, very complex. Creativity and innovation have a high value and often are the main assets of the authors who are able to combine them and turn them into a real communication tool. Although it may seem obvious, a message to be received has to be clear. If this is a need in oral communication it is a must in multimedia communication. Due to production and distribu-

tion cost, a message has to be designed to be easy to understand, to be really effective, but all this has to be achieved in an efficient way. No TV channel can afford to broadcast something that is not sustainable in the long term. The same applies to books, magazines, CD, video, audio… Consumers today are accustomed to multi-million Euro mass media productions, and as a result have increasingly high expectations of the quality and professionalism of content, irrespective of how narrow or specialised the target audience may in fact be. In parallel, consumers are also accustomed to paying little or nothing for such mass media, therefore the production costs must become minimal for future content to be viable. Thirdly, content must grab and hold the attention of such consumers, who are bombarded with high-budget advertising and choices of channel. Messages therefore must be delivered in increasingly compelling and innovative ways. Research has shown that people receive a message more effectively if it is delivered in multiple forms (visual, audio, text, interactive…), *"A point no educational psychologist would dispute is that students learn more when information is presented in a variety of modes than when only a single mode is used. The point is supported by a research study carried out several decades ago, which concluded that students retain 10 percent of what they read, 26 percent of what they hear, 30 percent of what they see, 50 percent of what they see and hear, 70 percent of what they say, and 90 percent of what they say as they do something" [J.E.Stice].* The effectiveness of communicating a message can be substantially increased by multimedia if the content is designed with this in mind, although this must be traded-off against the available budget and other design goals and constraints. Ensuring effective communication when starting from existing content requires the following factors:

- **a clear objective for the new content** – in order to differentiate it from the existing content. A promotional website advertising a movie must make clear both its purpose and its relationship to the film (e.g. "official site")
- **use elements from the original content in a relevant way** – adding value to the new content yet maintains the integrity of the original. In the case of a game or animation to promote a movie, characters, logos, designs and sounds from the original film can be carefully used to identify the new content closely with the original, but these elements must make sense to the user in their own right, either as navigational elements with a function, or as part of the design template for the new content's presentation.
- **allow for new users unfamiliar with the existing content** – it should not be necessary to have seen a film in order to understand the images and navigation of a movie website. Design elements, even if taken from the film, must make sense in the new content in their own right.

3.3.1. Readability and Understandability

If a basic object to be usable has to be easy to “read” this is not enough. In this context, “read”, means the most generalized version of the fruition. The combination of objects exploiting different styles may result in poor “readability”. Easy readability is the need to create product and design that are capable of providing the flexibility to customise content for users and to upgrade them when better components come along. We give for granted that is clear the distinction between see and watch, listen and hear… this is all but marginal in the development of content. Another extremely relevant aspects to be taken into account, is the navigation structure and hierarchies inside the object. For example in many multimedia objects there are at least two different sets of possible navigation paths that allow the user to exploit the content. Usually there is a linear or sequential path and a hyper-textual one. In many cases there is also an additional navigation level (based on links) that allows to access to drilldowns or complementary info depending on user choice. The content related to drilldowns is often inaccessible with the ordinary navigation path but can be reached (according to user wills) via cross-links. Then there are subtleties to be taken into account in the production of objects especially multimedia ones. Usually each publisher has a sort of look and feel that is constantly expressed in own products and this often is accompanied by a specific style of the communication related to the content. This latter point is usually highly related to the target audience. The same content will be presented in a very different stile and format if the audience is belonging to a K12 audience or to a professional one. Most of the formatting of digital content is usually achieved following a well-defined set of steps, each aimed at determining the constraints and needs, nominally: target audience identification (children 3-6, K12, adult…), kind of communication need required (advertisement, company communication, leisure, edutainment, formal education, informal education, personal competencies training, professional training, re-training…), kind of delivery media (books, magazines, newspapers, computer, TV, radio, PDA, CD, DVD, class, blended…) and kind of fruition

(individual, group, class, blended…). There are some rules that can be followed to ensure readability of a content, most of them coming directly from the paper world, the other specifically for screen reading, or printing etc. Beside, there are some basic rules in ergonomics that should be followed to ensure a good usability of the final product. To be effective a "message" needs more than to be perceived, it needs to be understood. In other words it is not enough to ensure that the object is easy to be read, looked at, heard… It is necessary to be easy to understand it, so that the user can recall it, and to look at it as something acquired. One vital aspect of understandability of web-based content is the need for simplicity, minimising word counts and numbers of pages and ensuring that the key message is at the top of the page to avoid requiring users to scroll before reading it. Although this issue is emphasised with web-content where users have millions of choices of content just a few clicks away, the same principle of 'KISS' (Keep It Simple Stupid) is well established in traditional media design. It is also possible with multimedia to increase the understandability of content, which may already be clear and readable, by applying interactivity and learning techniques to develop the content from being a passive communication into an active communication. In the overall we can say that for achieving compound objects of some relevance is necessary to take into account the psychology of the end user as a crucial aspect for the success or failure. If a message is unclear or conveys a distorted message rather than the intended one (simply because the wrong aspect or language or format have been used) all incurred cost will have been a waist and represent a direct damage for the company promoting/selling the content itself. To a certain extent, it may seem that there is a high superposition between these two concepts; actually "*understandability*" means more than "*readability*": a text could be perfectly readable (in terms of font, layout…) but totally unintelligible as the language may be unknown, or the topic too specific, just as a written text may be useless for a blind person unless it is made properly accessible. Please note that even though what reported hereafter holds true for many "content objects", however, there may be different rules (or no rules in same case) for art, entertainment, games etc. To summarize we can say that to create, or select, truly "***attractive***" and "***user friendly***" content the author has to strive for **legibility** and **readability** applying the following basic principles of design:

- **Contrast** deals with physical (or physically perceived) polarities (opposites). It is usually referred to size, shape, textures, tone, and direction and it is used to attract and to emphasize.
- **Balance** means dividing space into equal or understandable parts. Our constant exposure to the balanced patterns of nature allows us to accept this principle as part of the cognitive process.
- **Proportion** is the relationship of visual elements, one to another and to the whole. We consider this particularly in relations of size, shape, colour and quantity. It can cause contrast.
- **Rhythm** is the use of shape, colour and other visual elements in regular and repetitive patterns.
- **Harmony**, the opposite of contrast, implies simplicity of design. Harmony does not interrupt, but allows for a smooth and even flow.
- **Movement** directs the eye (the mind) through logical, coherent and acceptable arrangement.
- **Unity** is a condition or quality of design that is achieved when individual elements are in agreement. Unlike harmony unity is active.
- **Attraction** is that visual reference which draws the eye to it immediately. Attraction does not indicate an assignment of meaning, but simply nervous energy stimulation.
- **Attention**, however does imply an assignment of meaning. Attention requires long-term memory, while attraction requires only short term or immediate memory.

For textual content it is necessary to ensure that font size should be adequate (not too small to be read in a normal situation); font size should be resizable (for people with low visual capabilities); font should be "san-serif" (this applies especially to small font and on screen usage); text lines should be properly spaced (not too packed, that is at least "single line" spacing); text should be properly balanced in respect to the page space (use proper margins and remember that too crowded pages are difficult to read, and give a perception of disorder); for example cantered display type contrasts with the asymmetry of the ragged right margin of left-justified body text and produces an unbalanced page. Moreover the relatively primitive text justification that is often provided today for many contents (and primarily for web-based ones) creates word-spaces problems that result in the so-called "rivers" of white spaces that seem to run across the page. Text-based content should present a proper balance between text and images: the most relevant object should take the majority of space and be located in the most attractive position; for text-

based content (but non text only) text / image mutual placement should respect rules like the ones related to areas of interest (AOI) and visualization focus.

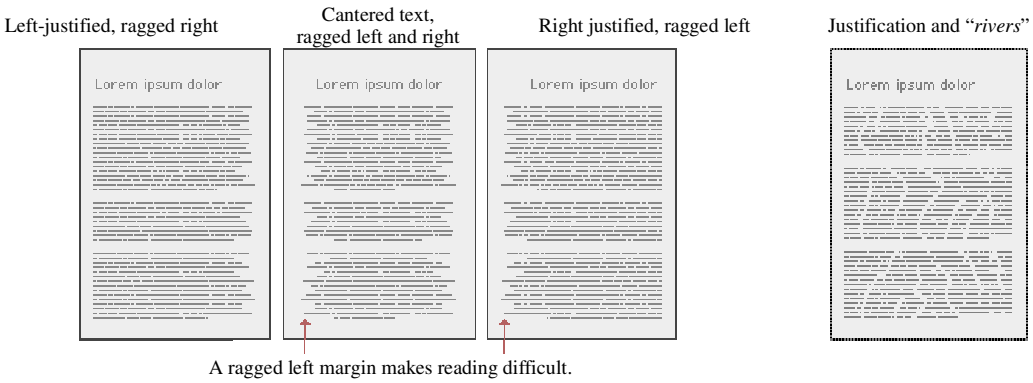


Figure 3. Text distribution, margins and related effects

Patchy, heterogeneous typography and text headers make it hard for the user to see repeating patterns and almost impossible to predict where information is likely to be located in unfamiliar documents:

Figure 4. Text and graphics distribution balance and related effects

Text title, summary and description should be available. Text should posses enough clarity in terms of expression, language used should be plain and explanation of technical/specific terms should be available via glossary or notes as well as translation of foreign terms (at least as a note if they are not commonly used and understood by the intended target audience). In addition to all this is worth recalling that:

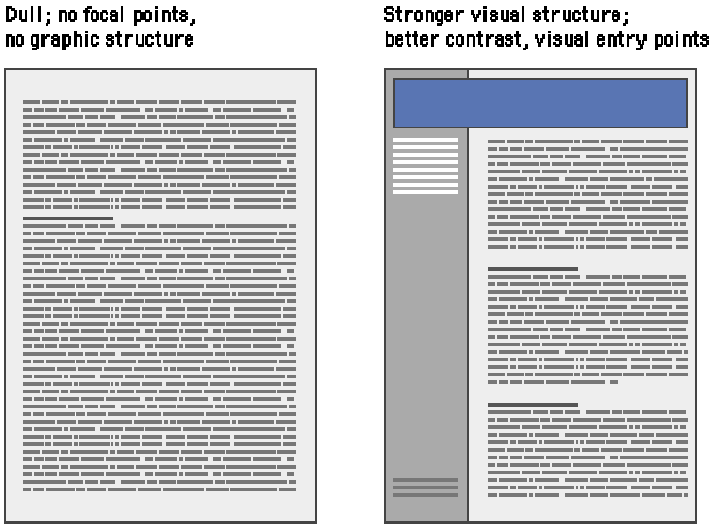


Figure 5. Text and graphics distribution balance and related effects

Green and red have to be used with attention due to the existence of colour-blind people; text and background colour, even the case of sufficient contrast, should not create readability difficulties and weaken sight; text should be clearly distinguishable from background, or characterised by sufficient contrast (contrast is not only the ratio between foreground and background colour, it also means the visual structure contrast as counterposition of elements. Whenever text (or in general content) may be resized, it is necessary to ensure that scrolling / panning facilities are available to prevent that access is affected by resizing. For web-based text, studies[1] indicate that around 79% of users scan a page to find a keyword or a phrase while only 16% actually read through the whole text.

Therefore: paragraph should be 5 to 6 lines long at most; sentences should be limited to 12 to 15 words and titles and sub-titles should be explicit.

[1] http://www.useit.com/papers/webwriting/writing.html

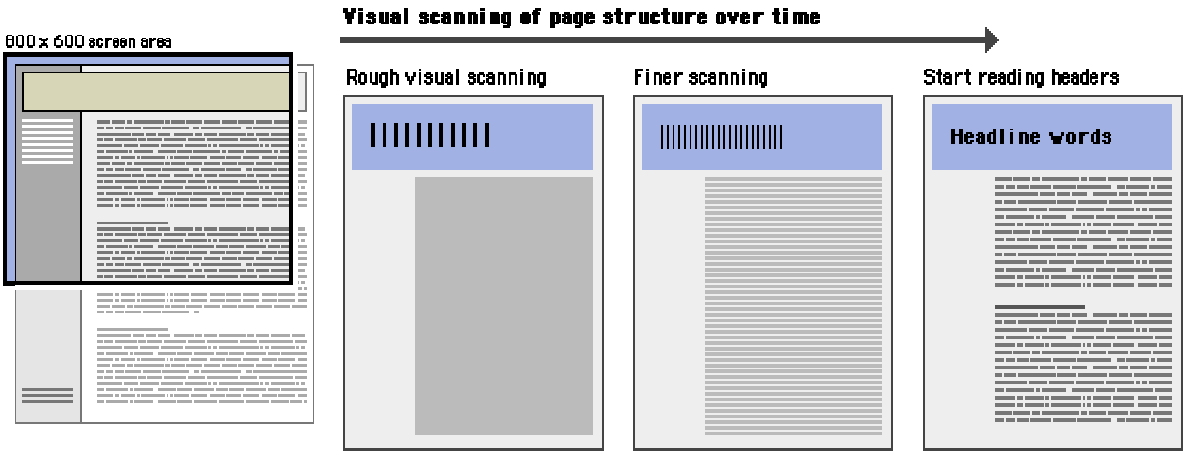


Figure 6. Screen vs page related effects and visual page scanning approach

What just mentioned is also due to the fact that we read primarily by recognizing the overall shape of words, not by parsing each letter and then assembling a recognizable word:

Tree Boy Dog

Therefore words formed only with capital letters are monotonous rectangles that offer few distinctive shapes to catch the eye:

MONOTONOUS RECTANGLES

Monotonous rectangles

We recommend selecting text that presents downstyle typing (only the first word and any proper noun are capitalized) for headlines, subheads, and text. Downstyle is more legible because as we read we primarily scan the tops of words as evident from the following example:

Legibility depends on the tops of

while is easy to notice how harder it is to read the bottom half of the same sentence:

Legibility depends on the tops of

Using initial capital letters in headlines, reader's scanning of the word forms is disrupt causing less efficient reading:

Initial Caps Cause Pointless Bumps

What just mentioned has also further consequences as choosing typefaces will further influence the efficiency and efficacy of selected content.

The most conventional scheme for using typefaces is to use a serif face such as Times New Roman for body text and a sans serif face such as Verdana or Arial as a contrast for headlines. Generally text-body is prepared in Times New Roman because it produces a reasonable balance between density of information and overall legibility. Most readers expect a serif font for long blocks of text and find Times New Roman comfortable to read off-screen from paper printouts. Various studies infer that serif type is more legible than sans serif and vice versa, we feel that one can truly judge type legibility only within the context of the situation. Reference text and our experience would suggest that one might use either a variation of the serif font or a contrasting sans serif face for the text body type. Nevertheless it is safest to use a single typographic family and vary its weight and size for display type and emphasis.

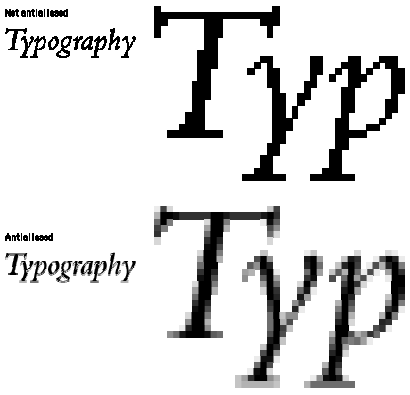


Figure 7. Antialiasing

If one chooses to combine serif and sans serif faces, is recommendable to select fonts that are compatible and don't use more than two typefaces (one serif, one sans serif) on a page. Another extremely important aspect to be taken into account in the selection phase, as far as text is concerned, is antialiasing. What just stated has both aesthetical and accessibility related aspects. In the following examples are initially reported samples of non/antialiasied fonts. The first image explains the meaning and reason for adopting antialiasing whenever there is a screen-based fruition of content. After all this it should be clear that text based content can be a quite complex object to deal with "per se", but there is also an other relevant aspect to take into account and that relates directly with content (more than to its graphical format, and that is the relation between content and its readability and legibility. While Readability is a measure of ability to understand written messages and deals with grammar, structure, and usage (normally associated with *plain language*); ***Legibility***, which is the dominant consideration in use of type and line art, is how the type is presented, and how easily we can recognize and identify a symbol (*letter*) or a group of symbols (*words*). Legibility can also extend to how easily we can recognize and identify the intended use of a graphic (as shown before). Without becoming too technical, these abilities to recognize and identify are a product of the cognitive process. In essence it is possible to consider that the human mind works best on a "*familiarity breeds content*" basis. The familiar is accepted readily while the unfamiliar is excepted. It is worth taking into account that readability formulas and indices[2] have been in use for a long time to measure the readability of educational texts, and are today also used to assess the readability of web pages; they are based on assumptions such as longer sentences and longer words lead to reading difficulty; "*unfamiliar*" words make a text more difficult to read; documents with few pronouns generally lack cohesiveness and fluidity; too many pronouns may indicate ambiguity; too much nominalization (verbs that are changed to nouns) in a document can sound abstract and be difficult to understand, etc. Nevertheless researchers found that readability formulas work well for English language text, however, they are not directly applicable to text in other languages, e.g. German text is often 15% to 20% more comprehensive compared to the English equivalent. The formulas may also underestimate the reading difficulty for math texts, poetry and other "*terse and condensed prose*", and "*materials that contain subtle variations in meaning*". Other critical quality factors are colour and contrast combinations. W3C Guidelines[3] recommend: *"Don't rely on colour alone. Ensure that text and graphics are understandable when viewed without colour. If colour alone is used to convey information, people who cannot differentiate between certain colours and users with devices that have non-colour or non-visual displays will not receive the information. When foreground and background colours are too close to the same hue, they may not provide sufficient contrast when viewed using monochrome displays or by people with different types of colour deficits".*

ACCEPTABLE	UN-ACCEPTABLE
ACCEPTABLE	UN-ACCEPTABLE
ACCEPTABLE	UN-ACCEPTABLE
ACCEPTABLE	UN-ACCEPTABLE
ACCEPTABLE	UN-ACCEPTABLE

Figure 8. A sample of text/background colour combination and related acceptability

For image-based content it is necessary to ensure that image dimension has to be balanced with respect to space assigned to text; image format should be selected according to usage (web, CD, DVD, print…); image compression format should be selected according to usage (*lossless* for print, CD, DVD… *lossy* for thumbnails, previews, web…); selected resolution should allow both *zoom-in* and *-out* with a quality level that can be considered generically accepted (depending on the context); image default display dimension has to be chosen depending on usage (print, web, CD…), panning should be avoided for the default appearance while is fully acceptable for a detailed vision like during zoom-in; image colour space should be selected according to usage (CMYK for print, RGB for monitor); colour depth (8/16/24-bits 256 colours…) has to be selected according to application context; image title/caption/description should be available; image additional description/information should be available to ensure accessibility; image readability depends also from framing type, therefore it is better to choose dimension and resolution in relation to image content (i.e. a square packed of people, a portrait, a manuscript, a music score etc…). The first thing to take into account when selecting content is the effect of vision problem/deficiencies. This is very important as usually people designing or selecting content are perfectly able to see and may

[2] e.g. Kincaid formula, Automated Readability Index, Coleman-Liau formula, Flesh reading easy formula, Fog index, Lix formula, SMOG
[3] http://www.w3.org/TR/WAI-WEBCONTENT/#gl-color

lack the knowledge of visual deficits. Just for reference we report hereafter a brief summary of colour vision defects:

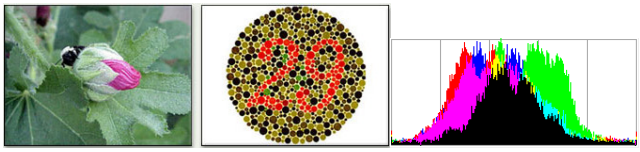
Table 1. Blue-Yellow Defects

Type	Form	Cause
tritanopia	dichromatic	missing S cones

Table 2. Red-Green Defects

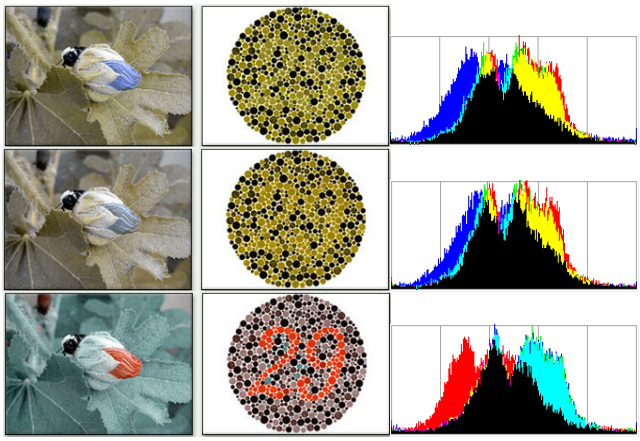
Type	Form	Cause
protanomaly	trichromatic	dysfunctional L cones
protanopia	dichromatic	missing L cones
deuteranomaly	trichromatic	dysfunctional M cones
deuteranopia	dichromatic	missing M cones

Having said so, let's take into account what happens to a set of sample images when the abovementioned defects occur. The following images are useful to explain the issue.



Normal – reference image is on the left (spectrum at the end), related test one on the right. For a person with normal sight is easy to read the 29 in the test image and to distinguish also a number of different colour spots defining the shape.

Figure 9. A sample image related spectrum and test pattern in relation to visual defects



Protan (L-Cone) – reference image is on the left (spectrum at the end), related test one on the right. In this case is much more difficult to distinguish the number 29 and the range of spots colour is quite limited with a quite high contrast.

Deutan (M-Cone) – reference image is on the left (spectrum at the end), related test one on the right. Also in this case is difficult to distinguish the number 29 and the range of spots colour is quite limited and with a lower contrast than in the previous case.

Tritan (S-Cone) – reference image is on the left (spectrum at the end), related test one on the right. In this case is much not so difficult to distinguish the number 29 but the background set of spots seems to be biased towards grey and blue.

Figure 10. A sample of image appearance in relation to visual defects

What just presented has some direct consequences in the content selection process, at least as far as metadata or supplementary information is concerned just as pointed out in the following examples.

Example 1

For *protanomalous* individuals a picture like the one aside presents some challenging aspects, as it will be easy to fail to distinguish a "*green traffic light*" from the various "*white*" lights. This will definitely have an effect in a driving manual or training course. It is true nevertheless that this could be considered a minor problem as the percentage of affected people is not too high and potentially most of them will have to take special training for acquiring a driving license or may be imposed some restrictions in the circulation.

Example 2

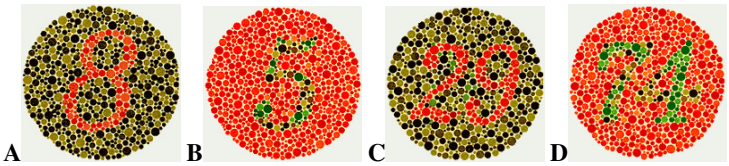
Using the side image of **tomatoes, limes** and **oranges** as a part of an advertisement convening some message related to colour may prove inefficient for *dichromat* individuals who will see no perceptible difference between red, orange, yellow, and green. All these colours that seem so different to the normal viewer appear to be the same colour for this two percent of the population. Again the percentage may seem minimal but in Europe this means over 6 millions individuals.

Just to give a further example of how subtle the issue could be we report hereafter some samples of test patterns used to assess vision related issues and the procedure to achieve them (at least one of them).

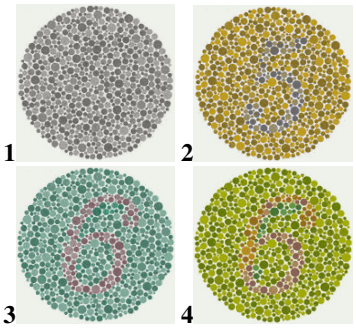
Vision test examples.

Normal people should see A=8, B=5, C=29, D=74.

Colour deficient people may see A=3, B=2, C=70, D=21.



Designing a test pattern in 4 steps



1. Select a random pattern of grey level dots.
2. Select a digit pattern that is defined by yellow/blue variation only. Observers able to do yellow/blue discrimination can detect it. Most people with red/green deficiency will still be able to do yellow/blue discrimination and so will see the digit 5 pattern.
3. Add another digit pattern defined by red/green variation and easier to see than the pattern defined by yellow/blue variation.
4. Add all three components: the random brightness pattern, the yellow/blue pattern, and the red/green pattern. Observers with red/green deficiency will not be able to see the red/green pattern; their response will be based on the yellow/blue pattern only.

Normal observers will see both patterns and since the red/green pattern is stronger they will base their judgment on the red/green pattern and see the digit 6. It is important to take into account that what just reported does not only apply to visually impaired as there are other phenomena that will bring to the same result even for normal people, just like images revealed by ultraviolet or grazing light. As already mentioned content selection is primarily guided by the expected target audience and usage of the content. Therefore what presented here should be used as a complementary set of info to be taken into account whenever accessibility has to be taken into account for any reason (content is devoted to institutional training in school or public administration…). Moreover the provided information can also be profitably used to design advertisement or promotional content with the highest potential audience. Having stated this it is worth recalling that if digital images are properly prepared according to professional standards, it will not be necessary to require a glossy print for quality evaluation. All publishers that accept digital images have specific guidelines for archival and usage. Although different entity will have different guidelines, here are some general requirements that will help in the selection and management process. In terms of **formats** it is worth remembering that usually digital files embedded within a "*document*" do not fit for publication. Usually those are low-res while in the editorial process are used the high-res ones. In other words, usually, they don't have the required resolution and characteristics for printout, therefore native TIFF or EPS files will be required while JPG files may only fit for web publishing. In term of **resolution** it is worth remembering that images must be scanned at the proper resolution in order to ensure print quality:

Table 3. Object resolution according to expected usage

Object	Resolution	Unit
Continuous tone (greyscale) / colour figures with no text	300	DPI/PPI
Continuous tone (greyscale) / colour figures with text	600	DPI/PPI
Black-and-white line art	1200	DPI/PPI

Whenever scanned images have to be used it will be better to select those black-and-white images scanned and save in greyscale mode (not black and white). While for continuous tone (greyscale) and colour images should be preferred those scanned in RGB colour mode, but saved in CMYK colour mode. All these info should be recovered in the image annotation or metadata. Often archives hold two versions of the same digital files: one with annotations and one without. In the event that the annotation needs to be edited, the clean copy can be used to re-label the image and obtain a new annotated one. If possible, it will be better to obtain the original image rather than graphics downloaded from Web pages because the resolution is too low for publication. Usage of scanned images/photographs from published materials should be avoided unless necessary as usually these images have been screened with a halftone pattern that will create an unpleasant moire effect. The **Image Size** used should be at 100% of the final print dimensions, so that scaling is not necessary. For **Graphs and Charts** it would be better not use greyscale (black and white solids or patterns are preferred), or 3-dimensional charts.

For audio content it is necessary to ensure that quality and compression have to be selected depending on usage (web, CD, DVD, mobiles, provisioning…). Sampling frequency should ensure adequate quality for the most likely rendering media or device (so that even if some degradation occurs no major defect will be perceived); bit-rate should be adaptable in accordance with user needs. Original recording volume level has to be selected depending on usage, it should be neither too high nor to low as in the first case it would be digitally distorted and in the second case noise level would be unacceptably high; "*readability*" may be affected by graphical background/interface (some combinations may result in a loss of attention to audio content); moreover it depends also from proper synchronization with text or notation (if present). Any sound effects, when coexisting with some speech, should be kept at a suitable level to not degrade the clarity of speech itself. Basically background audio level has to be adjusted so to ensure proper voice understandability; if necessary, an appropriate amount of audio compression should be used to maximise the audibility of the voice. Spoken language should be common one (possibly slang should be avoided, unless specifically needed for training / learning purposes); audio should be mono-compatible, if intended to be played also through mono devices (i.e. any stereo effects used should cause phase cancellation when played back in mono); audio title and description should be available. Audio transcription should be available, more specifically: for audio in foreign languages text based transcription or subtitling should be available. Text version should be available to ensure proper accessibility by hard of hearing people. If possible, audio content should be properly indexed (this could be crucial for classical music in order to easily reach the point of his interest). Even if this problem does not appear in CDs, it is very important for sound archives where often the audio content is not indexed.

For video content it is necessary to ensure that quality and compression have to be selected depending on usage (web, CD, DVD, mobiles…); frame rate (30 fps…) should be selected in accordance to rendering media, or device, and adaptable according to user needs; video standard (PAL, NTSC…) should be selectable so fit customers needs (references are NTSC in US, and PAL in EU, only rarely SECAM, mostly in France); window size should be user configurable (at least among a pre-defined set of values like: VGA, QVGA, SVGA, XGA…); video title and description should be available; video additional description information should be available to ensure accessibility; video image should be clear and sharp, focus should be good and colour combination balanced. Contrast level must be acceptable when played on target devices (i.e. dark areas not still visible, light areas not bleached out, yet adequate distinction between brightness levels). Playback artefacts should be avoided; any accompanying audio tracks should be correctly synchronised with video content, subtitling should be available (at least to manage when audio dubbing is not available). If possible, video content should be properly indexed (just as already mentioned for audio).

For animation-based content it is necessary to ensure that format and compression have to be selected depending on usage (web, CD, DVD, mobiles…). Frame rate (30 fps…) should be selected in accordance to rendering media, or device, and adaptable according to user needs; window size should be user configurable (at least among a pre-defined set of values like: VGA, QVGA, SVGA, XGA…). Colour depth has to be selected according to application context (8/16/24bits, 256 colours…); animation title and description should be available, animation additional description information should be available to ensure proper accessibility. Where possible, a suitable vector-based format (such as Macromedia Flash ".swf") should be used to allow smooth scalability for different playback devices.

For multimedia content it is necessary to ensure that all previously mentioned rules have to be applied to each production element. Players needed for fruition should be available for installation along with con-

tent (in case user has not the needed SW). The user should be able to select GUI effects (whether to have a 3D looking or flat interface…). Support info for content management and players needed for fruition should be available, each element of the content must be consistent in quality, use of colours, styling, frame rate, compression level, audio level, etc. in order to give the feeling of an integrated production. Interactive content (buttons, game functionality, algorithms and other scripted elements) must be: easy to use, fully reliable and resilient, compatible with target platforms, compatible with distribution network servers if responses are required. Detailed audio and text description should be available to ensure proper accessibility by people with vision or hearing impairment. In order to clarify and sum up all what exposed do far, we can examine slides, as typical form of multimedia content. Later on we will examine some example of more complex multimedia content. As far as presentations and slides are concerned, the most usual distribution format is PPT, PDF or PS. In some cases they are packed including the player. Slides are merely a visual tool aimed to support a presentation, help the audience follow during it and remember afterwards. Therefore the focus should be on the effectiveness in keeping the attention of the audience and to achieve this is necessary to take into account all that follows:

- Present only **one** thought per slide. So the audience will spend more time listening and less time reading if slides
- Let slides be a brief representation of what is being said.
- Do not overwhelm the audience with information.
- Use footnotes to eliminate distracting data.
- Do not read slides.
- Use audio/video excerpt only when really needed. Limit their length to keep presentation size under control. Remember that if a print-out is given info related to audio/visual content will be lost unless supplementary info are provided.
- Use already resized images to save storage. If possible use also formats that allow compression as if slides will be available for download it is advisable to keep file size into reasonable values. Eventually produce PDF format for download.
- Include an index of covered topics.
- Include a legend for acronyms.
- Include a reference section if needed or relevant.
- Include a contact page at the end.
- Limit titles to **seven** words at most. Longer titles should be broken into title and subtitle.
- Limit subtitles to **five** words at most.
- Use bulleted text because they are easier to read than full sentences.
- Each bulleted item should have no more than **ten** words per line.
- Each slide should have a maximum of **seven** lines of bulleted text per slide. If you have more, break the information into two or more slides.
- Capitalize only the first letter of words that begin sentences or that are proper nouns.
- Do not capitalize the first letter of every word in a sentence.
- Use upper- and lower-case text, not all capital. All caps take up more room, take longer to read, and make it difficult to identify acronyms.
- Make **title** font size at least **40**-points.
- Make **subtitle** font size at least **30**-points.
- Make the **body text** font size at least **26**-points. Do not use a font size smaller than 22-points. If it is needed to use 22-points or smaller font to fit text on the slide, break the information into two slides.
- For **footnotes** use a **12**- or **14**-points font size.
- Use blue, either solid or gradated shades, for backgrounds.
- Use yellow and/or white for text because both show up well against a blue background.
- Do not use pre-designed templates with unnecessary graphics.
- Do not use textured backgrounds. It makes it difficult to read the text.
- Do not use red and green colours for text because colour-blind members of the audience cannot differentiate between the colours red and green. Also, red and green text bleeds and is difficult to read. Limit these colours to bullets and clip art.

- Use images or clip art to strengthen the message (e.g. if the point is: "*smoking kills*", show a skeleton holding a cigarette).
- Do not add images or clip art if it does not enhance the meaning.
- Do not sacrifice content for images or clip art. If text is too small because a graphic takes up too much space, delete the graphic or place it by itself on another slide.
- Use the correct type of graph to illustrate data:
  - **line** graphs show **trends** over time,
  - **bar** graphs **compare** values,
  - **pie** charts **show** values relevance against a whole.
- Compare similar elements in one chart.
- Use **two** y-axes when elements are measured by different values (e.g. if one measurement is in percentage and the other is in centimetres, each element should have its own y-axis).
- Use symbols to distinguish between lines when creating black-and-white line charts.
- Avoid dashed, dotted or grey lines.
- Use two-dimensional graphs instead of three-dimensional graphs. The values in three-dimensional graphs are misleading and difficult to discern on a two-dimensional surface.
- Do not use a table if the same information can be presented as a short sentence, a piece of art, or as a graph or chart.
- Keep tables simple by including only the data needed for discussion.
- Compare similar elements. For example, compare demographics (gender, age, race, etc.) in one table, but compare operative findings in another.
- Limit tables to **four** columns and **seven** rows. Break larger tables into multiple slides.
- Compare numbers in columns, not rows. It is easier to compare stacked numbers.
- Round numbers if necessary (e.g. 0 and 100 do not need decimals).
- Use footnotes to eliminate distracting data from your table.
- Include a legend for acronyms.

3.3.2. Content classification & formats

This section provides information on the basic kind of objects and represents a sort of quick reference to be able to quickly recall specific object characteristics and needs / constraints to usage. It is necessary to recall to that content should be available either for B2B or B2C usage, but the same content will have to be selected and manipulated in a different manner according to its final usage destination.

3.3.2.1. Text

For web-based text, content can be either viewed online or downloaded as a printable document. The criteria whether to download or display online varies from producer to producer, but a de-facto standard is emerging that longer, more complex text is generally made available as a PDF and/or Word document, while shorter text should be only web-viewable, using HTML or within a media object such as Flash, QuickTime, RealMedia or WindowsMedia. Online text should be short and clear, maximum 2 pages to minimize scrolling and to allow for visually impaired users to scale font size up, etc. There are exceptions to this rule depending on the nature of the content, for example a one-page brochure might be made available as a printable PDF while a long reference document used by software developers might be published as HTML as well as PDF but broken into easy-to-browse, well indexed chapters and subsections. Also key to online text is the concept of static (fixed) text and dynamic text, which may be generated as the result of a calculation or streamed from an information service (e.g. in RSS format). In the case of dynamic text, some form of meta-tags is required in order to define the location and formatting of the text to be generated within the text object. With dynamic text pages, individual text objects within a page may need to be associated with images and other page layout elements, including multiple text boxes to allow for additional text to spill into another box gracefully. These steps are illustrated in the aside informal flowchart. What follows is a very basic set of rules for making content more accessible to end-users.

- avoid structuring using frames or tables,
- always provide titles, subtitles and summaries,
- provide optional audio dubbing or description.
- use XHTML instead of HTML to make the structure usable to translation tools (text to speech etc.)

Table 4. Text object most used formats, expected usage and constraints

Format	Description
PDF	Short for Portable Document Format, a file format developed by Adobe Systems. PDF captures formatting information from a variety of desktop publishing applications, making it possible to send formatted documents and have them appear on the recipient's monitor or printer as they were intended. To view a file in PDF format, you need Adobe Reader, a free application distributed by Adobe Systems. **Usage:** Ideal for online documents that need to be printed in a predictable layout and formatting by the end-user, for example instruction manuals, brochures etc. **Constraints:** Requires plug-in, although this plug-in is now almost universally installed. Limited interactivity compared with mark-up languages. Version compatibility issues exist where content is encoded using a recent level of writer software.
DOC	Standard textual format of document produced with several word processors (actually the extension .doc is typical of MS-Word or MS-WordPad) **Usage:** Editable documents, ideal for providing a template format, or for providing educational or corporate content that can be collaboratively enhanced (like this deliverable!) **Constraints:** Proprietary format, with limited cross-platform support; version compatibility issues can also arise, including complexities of embedded objects authored in other applications.
TXT	Standard textual format of document produced with several word processors (actually the extension .txt is typical of MS-Textpad) **Usage:** Ubiquitous, almost universal human and machine readable format. **Constraints:** No formatting capability beyond line breaks and tabs, plain text content only.
RTF	Rich Text Format. A standard formalized by Microsoft Corporation for specifying formatting of documents. RTF files are actually ASCII files with special commands to indicate formatting information, such as fonts and margins. Other document formatting languages include the Hypertext Mark-up Language (HTML), which is used to define documents on the World Wide Web, and the Standard Generalized Mark-up Language (SGML), which is a more robust version of HTML. **Usage:** Editable documents with greater cross-platform and cross-application support than DOC. **Constraints:** Relies upon common fonts installed, and can lose/change formatting rules from machine/word processor to machine.
HTML	Short for HyperText Mark-up Language, the authoring language used to create documents on the World Wide Web. HTML is similar to SGML, although it is not a strict subset. HTML defines the structure and layout of a Web document by using a variety of tags and attributes. The correct structure for an HTML document starts with <HTML><HEAD>(enter here what document is about)<BODY> and ends with </BODY></HTML>. All the information you'd like to include in your Web page fits in between the <BODY> and </BODY> tags. There are hundreds of other tags used to format and layout the information in a Web page. Tags are also used to specify hypertext links. These allow Web developers to direct users to other Web pages with only a click of the mouse on either an image or word(s). **Usage:** Ideal for online pages, with full browser support. Ideal for interrelated content with inline hyperlinks. Integrated meta tags for indexing and searching. **Constraints:** Difficult to ensure consistent printing across platforms and browsers. Online viewing not suited to long linear documents.
SGML	Short for Standard Generalized Mark-up Language, a system for organizing and tagging elements of a document. SGML was developed and standardized by the International Organization for Standards (ISO) in 1986. SGML itself does not specify any particular formatting; rather, it specifies the rules for tagging elements. These tags can then be interpreted to format elements in different ways. SGML is used widely to manage large documents that are subject to frequent revisions and need to be printed in different formats. Because it is a large and complex system, it is not yet widely used on personal computers. However, the growth of Internet, and especially the World Wide Web, is creating renewed interest in SGML because the World Wide Web uses HTML, which is one way of defining and interpreting tags according to SGML rules. **Usage:** Longstanding standard with close relationship to both HTML and XML. Used primarily for specialized applications. **Constraints:** Poor browser support, low rate of adoption.
XHTML	Short for Extensible Hypertext Mark-up Language, a hybrid between HTML and XML specifically designed for Net device displays. XHTML is a Mark-up language written in XML; therefore, it is an XML application. XHTML uses three XML namespaces (used to qualify element and attributes names by associating them with namespaces identified by URI references. Namespaces prevent identically custom-named tags that may be used in different XML documents from being read the same way), which correspond to three HTML 4.0 DTDs: Strict, Transitional, and Frameset. XHTML Mark-up must conform to the Mark-up standards defined in a HTML DTD. When applied to Net devices, XHTML must go through a modularization process. This enables XHTML pages to be read by many different platforms. A device designer, using standard building blocks, will specify which elements are supported. Content creators will then target these building blocks--or modules. Because these modules conform to certain standards, XHTML's extensibility ensures that layout and presentation stay true-to-form over any platform. **Usage:** Provides a practical mechanism to improve the rigour and hence reliability of HTML based documents. Improves cross-browser and cross-platform compatibility of mark-up based content. **Constraints: -**

Format	Description
XML	Short for Extensible Mark-up Language, a specification developed by the W3C. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations. **Usage:** Well structured tag hierarchy makes XML ideal as a machine readable content format, making it popular as the framework for creating parameter documents as well as cross-application, cross-platform content formats used for content management systems **Constraints:** Less common as a human-readable content format; XHTML (below) tends to be used for displaying content.
UNICODE	A standard for representing characters as integers. Unlike ASCII, which uses 7 bits for each character, Unicode uses 16 bits, which means that it can represent more than 65,000 unique characters. This is a bit of overkill for English and Western-European languages, but it is necessary for some other languages, such as Greek, Chinese and Japanese. Many analysts believe that as the software industry becomes increasingly global, Unicode will eventually supplant ASCII as the standard character coding format. **Usage:** Provides a framework for multi-language character set support, essential to the future of the Internet as growth in Far East users outpaces Western users. **Constraints: -**
ASCII	American Standard Code for Information Interchange, ASCII, is a code for representing English characters as numbers, with each letter assigned a number from 0 to 127. Most computers use ASCII codes to represent text, which makes it possible to transfer data from one computer to another. Text files stored in ASCII format are sometimes called ASCII files. Text editors and word processors are usually capable of storing data in ASCII format, although ASCII format is not always the default storage format. Most data files, particularly if they contain numeric data, are not stored in ASCII format. Executable programs are never stored in ASCII format. The standard ASCII character set uses just 7 bits for each character. There are several larger character sets that use 8 bits, which gives them 128 additional characters. The extra characters are used to represent non-English characters, graphics symbols, and mathematical symbols. Several companies and organizations have proposed extensions for these 128 characters. The DOS operating system uses a superset of ASCII called extended ASCII or high ASCII. A more universal standard is the ISO Latin 1 set of characters, which is used by many operating systems, as well as Web browsers. Another set of codes that is used on large IBM computers is EBCDIC. **Usage:** Almost all **Constraints:** The lowest common denominator of text file formats is ASCII. There are two forms of ASCII: standard and extended. Extended ASCII is a non-standard format containing codes for 256 characters, The first (lower), 128 characters are the standard ASCII character codes. The second (upper), 128 character codes are machine dependent defined by each hardware vendor for their own platform. Transferring plain text files between different systems can present problems e.g. End of line representation on Macintosh, Unix and Dos differ.

3.3.2.2. Images

In this section particular attention will be placed on the issue of possible rendering / distribution formats, bandwidth usage and similar issues that will deeply affect the choice of the author during content production/selection so to ensure the highest possible quality of achievable results. As a starting point it is worth comparing some basic features of some of the most used image formats for web-based content. **BMP** images are able to present all colours details but related file size is very large comparatively and thus requires a high bandwidth. **JPG** images are compressed images and are of moderate size. They are able to preserve most of the colour detail and are sufficient to be comparable to BMP images. The file size of **GIF** images is very small compared to other file formats and is best suited to narrow band environments. However the GIF images are not able to preserve all of the colour information

JPG Format **GIF Format** **BMP Format**

Figure 11. A comparison among sample images in different format of the same object

Once stated this is worth examining other formats and their usage in content production process. In more details is worth noting that while constructing a web-based resource is common to use **PNG** for images that are part of the GUI of the content (navigation, buttons, etc.). The comprehension algorithm is chosen to reduce the size of the image at the best (colour palette size etc.) Usually, only web colours are used for such images; since it's the only way to get them have the same aspect on different platforms. Therefore

the number of colour used on a same product is quite small and the highest compression rate allowed with PNG can be used, while is better to use **JPG** for content images. Care should be taken of not using the progressive compression algorithm of JPG, which produce files that are not recognized by some viewers (Flash player not to name it). Source images are usually provided uncompressed or compressed with a lossless algorithm. As just stated, for online projects, JPG is used for photographic images or images with soft graduation of colour or brightness, while GIF for solid coloured images with high contrast such as logos, coloured bars, etc, and Flash (SWF) images for vector-based shapes where either some scaling, animation or scripting (such as navigation) is required. It is also common to make use of the ability to colour HTML elements such as table cells and <DIV> layers extensively for solid colours in order to simplify repurposing and editing designs, as only HTML editing is then required. All online images are rendered to an output resolution of 72DPI. Examples of images and formats selected are shown in the table below. More detailed description of these formats is provided in the table on the following pages.

JPG - Photo image, soft graduation between colours and intensity.

GIF - Solid colours, no graduation needed

SWF - Vector image, scaleable, compact (this image is just 800 bytes)

Figure 12. A sample images in different format based on content type

In order to generate these formats, we work with very high resolution Photoshop or tiff format source bitmaps and Adobe Illustrator vector source files, only cropping and compressing to the target format once the design, layout and image size are defined. It is vital for end product quality not to work with already compressed images, unless uncompressed versions are not available (for example, in the case of images pre-compressed by a digital camera). For projects also requiring printed output, the high resolution bitmap (.PSD/.TIF) or native vector formats (mainly .AI from Illustrator, or .EPS postscript) are also used to render 200-300dpi output. For video and DVD production work, 72DPI resolution is used, with PAL standard (720x576) and widescreen (1024x576) image sizes used. Limitations on supported formats for DVD mean that JPG compression is used for still images even where GIF would have been more suitable (e.g. high contrast / solid shapes). What follows is a very basic set of rules for making content more accessible to end-users.

- avoid positioning using frames or tables,
- always provide a title, a description and a caption,
- provide an alternative text description,
- provide optional audio dubbing or description.

Table 5. Images most used formats, expected usage and constraints

Format	Description
JPEG	Short for Joint Photographic Experts Group, the original name of the committee that wrote the standard. JPG is one of the image file formats supported on the Web. JPG is a lossy compression technique that is designed to compress colour and greyscale continuous-tone images. Although it can reduce files sizes to about 5% of their normal size, some detail is lost in the compression. The information that is discarded in the compression is information that the human eye cannot detect. JPG images support 16 million colours and are best suited for photographs and complex graphics. The user typically has to compromise on either the quality of the image or the size of the file. **Usage:** Ideal for photographic and soft contrast images, to be viewed on screen especially where small file sizes are beneficial (web, interactive TV, mobile phone. Etc). Usually in archive / library environments is adopted the following rule of thumb: 300 dpi for intranet, 72 dpi for Web **Constraints:** JPG does not work well on line drawings, lettering or simple graphics because there is not a lot of the image that can be thrown out in the lossy process, so the image loses clarity and sharpness. Artefacts of compression look especially poor in printed form, so high-compression rate JPEG files are not recommended where printed output is required.
BMP	The standard bit-mapped graphics format used in the Windows environment. By convention, graphics files in the BMP format end with a .BMP extension. BMP files store graphics in a format called device-independent bitmap (DIB). **Usage:** Ideal for uncompressed image file exchange, especially between Windows applications. **Constraints:** More widely supported by Windows applications than by other platforms.

Format	Description
PNG	Short for Portable Network Graphics, the third graphics standard supported by the Web (though not supported by all browsers). PNG was developed as a patent-free answer to the GIF format but is also an improvement on the GIF technique. An image in a lossless PNG file can be 5%-25% more compressed than a GIF file of the same image. PNG builds on the idea of transparency in GIF images and allows the control of the degree of transparency, known as opacity. Saving, restoring and re-saving a PNG image will not degrade its quality. PNG does not support animation like GIF does. (http://www.ietf.org/rfc/rfc2083.txt?number=2083) **Usage:** Suitable for similar applications to GIF files. **Constraints:** Some browser support limitations
GIF	Short for Graphics Interchange Format, another of the graphics formats supported by the Web. Unlike JPG, the GIF format is a lossless compression technique and it supports only 256 colours. The compression algorithm used in the GIF format is owned by Unisys, and companies that use the algorithm are supposed to license the use from Unisys (Unisys announced in 1995 that it would require people to pay licensing fees in order to use GIF. This does not mean that anyone who creates or uses a GIF image has to pay for it. Authors writing programs that output GIF images are subject to licensing fees.) **Usage:** GIF is better than JPG for images with only a few distinct colours, such as line drawings, black and white images and small text that is only a few pixels high. With an animation editor, GIF images can be put together for animated images. GIF also supports transparency, where the background colour can be set to transparent in order to let the colour on the underlying page to show through. **Constraints:** GIF is less efficient than JPEG at compressing images with larger numbers of colours or brightness levels.
TIF	Acronym for tagged image file format, one of the most widely supported file formats for storing bit-mapped images on personal computers (both PCs and Macintosh computers). Other popular formats are BMP and PCX. TIFF graphics can be any resolution, and they can be black and white, grey-scaled, or colour. Files in TIFF format often end with a .tif extension. TIF files allow for additional channels beyond RGB, sometimes called alpha channels, to support transparency. **Usage:** Important as a file exchange medium in production workflow. Usually in archive / library environments is adopted the following rule of thumb: 600 dpi for conservative images (up to A4) off line, 400 dpi for conservative images (over A4) off line **Constraints:** Not optimized for compressed online viewing. More suited to content production, (especially image scanning, digital photography and editing applications) than to content distribution. There is difference between PCs and MAC when saving the TIFF files.
TGA	A photorealistic graphics file format designed for systems with a Truevision display adapter. Targa format developed by Truevision; usually 15 or 24 bit full colour images, compressed or uncompressed; maximum colours = 16.7 millions. The real name for this format is just plain "TGA" or "Truevision File Format", but a lot of people call it "Targa", after the Truevision video card that first used it. There's a lot of this name confusion in image file formats. It supports 1 to 32 bit images and professional features like an alpha (mask) channel, gamma settings and a built-in thumbnail image. TARGA image file format; this commonly has a .tga or .TGA ending. FrontPage can import TGA files. **Usage:** Image scanning and editing. **Constraints:** More widely supported by Windows applications than by other platforms due in part to its graphics card roots.
DIB	Short for device-independent bitmap, the bit-mapped graphics format used by Windows. Graphics stored in DIB format generally end with a .bmp extension. It's called device-independent because colours are represented in a format independent of the final output device. When a DIB image is output (to a monitor or printer), the device driver translates the DIB colours into actual colours that the output device can display. **Usage:** Ideal for uncompressed image file exchange, especially between Windows applications. **Constraints:** More widely supported by Windows applications than by other platforms.
PCX	Originally developed by ZSOFT for its PC Paintbrush program, PCX is a graphics file format for graphics programs running on PCs. It is supported by most optical scanners, fax programs, and desktop publishing systems. Files in the PCX format end with a ".pcx" (pronounced dot -p-c-x) extension. Two other common bit map formats are BMP and TIFF. **Usage:** Ideal for uncompressed image file exchange, especially between Windows applications. **Constraints:** More widely supported by Windows applications than by other platforms.
AI	Adobe Illustrator format. Used for vector graphics. **Usage:** Used for exchange of vector format graphics. **Constraints:** Primarily Mac-based format, with growing Windows platform support.
EPS	Encapsulated Postscript. Designed as a portable image file format that can include text layout, fonts, images, vector graphics, etc. Well supported as an import/export format by graphics and image editing tools. **Usage:** Cross-platform/cross-application exchange format. **Constraints:** Somewhat redundant with the growth of PDF, although still offers greater editability. There is difference between EPS preview for PCs and MAC
PSD	Photoshop format. Proprietary image editing file format native to the cross-platform image editing tool of the same name. Widely used across the graphics industry for print, web and television design, so has become an important image exchange format between designers. **Usage:** Cross-platform/cross-application exchange format for bitmap editing. **Constraints:** Proprietary format.

Format	Description
SWF	Macromedia Flash format. Although primarily used for animation and interaction, SWF files can be used for highly optimised still images based on vectors. They also have the advantage of being resizable (scaleable) without degrading image quality. **Usage:** Ideal for highly compressed vector graphics, especially where scaling of images to suit display sizes may be required. **Constraints:** Requires Flash plug-in support in browser or on device, although Flash is gaining wide adoption, including mobile phones, set top boxes and even in-car entertainment systems.
SVG	Scaleable Vector Graphics. An open format developed by Adobe, but not frequently deployed on the web. **Usage:** Similar benefits to SWF **Constraints:** Low level of adoption.

3.3.2.3. Audio

In the present section are reported basic information, constraints, suggestions and guidelines to produce high quality audio based content. In this section particular attention will be placed on the issue of possible rendering / distribution formats, bandwidth usage and similar issues that will deeply affect the choice of the author during content production/selection so to ensure the highest possible quality of achievable results. When taking into account the usual production process of audio content at origin is easy to realise that normally are used CDA formats for direct input from the audio CD. Typically, for a track of 5 minutes the file size is roughly about 50 Mb. This provides a high quality sound with all the sound effects (e.g. Dolby, 5.1 surround sound) preserved in it. This file format is not suitable for narrow band applications while instead it is convenient to use RM (real media) formats for listening to online streamed audio. On the other side this format is not able to preserve the sound effects but the file sizes are roughly 8-9 times smaller than CDA format. moreover a proprietary player (real media player) is needed to play such files. The other typically used format is MP3 which can provide good sound quality comparable to audio CDs with file sizes up to 10 times less. This file format is best suited for online music applications as it uses less bandwidth but provides near-CD quality sounds. Occasionally WMA files are used. To be able to ensure playability on any platform, without requiring much additional software installation from the user, Falshplayer is often used to play audio. The input audio format for flash is MP3. it is often possible to note that MP3 is used at different bit rate (depending on the original bit rate) but good practices suggest never to use VBR encoding. As source files, is either used AIF or WAV format for uncompressed PCM audio. Ideally sampled at 44.1Khz to avoid the need to resample (and hence degrade audio quality). Otherwise, a higher sample rate is preferred (usually 96KHz or increasingly, 192KHz). Source word lengths are either 24bit or 16bit linear. Just as with images, it is essential to start with the best possible quality source audio in order to maximise compression amounts and retain a good quality output format. Recordings need to be low noise, without distortion or glitches, as any such imperfections tend to be emphasised in lossy compression algorithms. If the source audio is of poor quality, is often common to apply audio noise gates, some modest EQ and limiting/compression to an audio file before applying lossy compression such as MP3, as this can help to improve clarity. Target output audio is usually compressed to MP3 for our online projects, in stereo, usually to 128KBPS for music or less for narrative or sound effects (some games sound effects can be compressed as low as 16KBPS in MP3 format and still sound acceptable, helping to reduce overall download time and enhance game performance on low-speed clients). While most work requires stereo or mono audio, some DVD work involves surround format, for which is required to exploit Dolby Digital 5.1, which is an efficient format with readily available compression software. When editing source material for this format, is necessary to work with either 6xmono or 3xstereo PCM audio files in AIF or WAV format. Although MP3 is still the most commonly used lossy compressed audio format online, there are evidences of benefits of adoption of the AAC/MP4 format and the WindowsMedia9 WMA format when specified for some well designed client project. Real Audio is another popular online format, which is tangentially more regularly offered as an option alongside WMA and MP3 online to maximise the ability for users to hear content. In some context (like the one represented by ANSC) archive digitization is being performed using WAVE file with different sampling rate depending on the original media for conservative storage: 16 bit 44Khz if the recording is taken from DAT or CD. 24 or 48 bit 96Khz if the recording is taken from original analogue tape. While for intranet use is planned the adoption of MP3 streaming at 128 Kbps. This should give enough quality to the listener (both of our oral traditional music archive and classical concerts). OD2 and parent company Loudeye encode and store lossless WAV files either ripped from CD or supplied directly from the label masters. For PC download 128Kbps / 192Kbps WMA v9 fixed bit rate is used. For streaming, 128Kbps / 64KBps / 32Kbps WMA v9 have been used, depending on the bandwidth available to the consumer.

Formats are currently being developed for over the air mobile delivery. For discovery (30 second clips) 32Kbps has always been adequate. Note that the actual bit rate used for each purpose is often subject to contractual agreement with record labels. All these are examples of successful initiative representing also a best practical case.

Table 6. Audio most used formats, expected usage and constraints

Format	Description
WAV	The format for storing sound in files developed jointly by Microsoft and IBM. Support for WAV files was built into Windows 95 making it the de facto standard for sound on PCs. WAV sound files end with a .wav extension and can be played by nearly all Windows applications that support sound. **Usage:** Exchange format for media production **Constraints:** Large file sizes. Windows-centric.
AIF	Short for Audio Interchange File Format, a common format for storing and transmitting sampled sound. The format was developed by Apple Computer and is the standard audio format for Macintosh computers. It is also used by Silicon Graphics Incorporated (SGI). AIFF files generally end with a .AIF or .IEF extension. The AIFF format does not support data compression so AIFF files tend to be large. However, there is another format called AIFF-Compressed (AIFF-C or AIFC) that supports compression ratios as high as 6:1. **Usage:** Exchange format for media production **Constraints:** Large file sizes. Mac-centric.
MP3	The name of the file extension and also the name of the type of file for MPEG, audio layer 3. Layer 3 is one of three coding schemes (layer 1, layer 2 and layer 3) for the compression of audio signals. Layer 3 uses perceptual audio coding and psychoacoustic compression to remove all superfluous information (more specifically, the redundant and irrelevant parts of a sound signal. The stuff the human ear doesn't hear anyway). It also adds a MDCT (Modified Discrete Cosine Transform) that implements a filter bank, increasing the frequency resolution 18 times higher than that of layer 2. The result in real terms is layer 3 shrinks the original sound data from a CD (with a bit rate of 1411.2 kilobits per one second of stereo music) by a factor of 12 (down to 112-128kbps) without sacrificing sound quality. Because MP3 files are small, they can easily be transferred across the Internet. **Usage:** Popular consumer download format. Efficient lossy compression algorithm, although less effective than newer algorithms. Widespread support. **Constraints: -**
PCM	Short for pulse code modulation, a sampling technique for digitizing analogue signals, especially audio signals. PCM samples the signal thousands of times a second; each sample is represented by 8, 16 or 24 bits. There are two standards for coding the sample level. The Mu-Law standard is used in North America and Japan while the A-Law standard is use in most other countries. PCM is used with T-1 and T-3 carrier systems. These carrier systems combine the PCM signals from many lines and transmit them over a single cable or other medium. PCM is also the modulation technique used for CD audio and WAV and AIF files. It is popular as a format because it does not compress the signal, so the only distortion arises from the digitizing process (A-D and D-A conversion). Any loss of quality is a function of the sample rate and word length, therefore the greater these two parameters are, the more information about the analogue signal is captured. **Usage:** voice and audio transmission in general **Constraints:** mainly for telephony
RealAudio	RealAudio provides high audio quality at a broad range of the bit rate spectrum, with its ability to scale from 12 - 800 Kbps. For low to mid bit rate files (< 128 Kbps), RealAudio deploys advanced audio compression techniques dividing original data from the audio spectrum into distinct frequency bands, bands which are imperceptible by the human ear are discarded, resulting in a decreased file size with virtually no degradation. At higher bit rates (> 128 Kbps - typically suited for download or high bandwidth networks), RealAudio incorporates the MPEG-4 AAC codec. RealAudio Multichannel enables more than two discrete channels, including the commonly configured 5 or 6 channel (5.1 channel audio). Delivers full surround sound experience: left, right, left-surround, right-surround, front-center, and low frequency sub-woofer **Usage:** Popular consumer download format. **Constraints:** Proprietary format, requires proprietary player.

3.3.2.4. Video

In the present section are reported basic information, constraints, suggestions and guidelines to produce high quality video based content. In this section particular attention will be placed on the issue of possible rendering / distribution formats, bandwidth usage and similar issues that will deeply affect the choice of the author during content production/selection so to ensure the highest possible quality of achievable results. Some of the most used video file formats are AVI, MPEG, MOV, RM and DAT. Normally the DVDs are able to preserve all the details for the video and the audio and provide high quality images and sounds for watching and listening respectively. However the file sizes of DVD movies are very large and hence require a very high bandwidth for online delivery. Moreover AVI file formats are able to give a good quality video and audio for a moderate file size and can be used for online delivery compared to other file formats. MPG (MPEG) videos can be of varying quality based on the degree of compression

applied to them. MOV video files are comparatively small in size but the quality of the video is not good. It requires the proprietary Quick Time player for playing, which is available for free download. RM files formats are the proprietary Real Media files which are normally available for online streaming videos. They require the proprietary Real Player for playing. The DAT file formats are those found in traditional video CDs. They are of moderate size and are able to provide good quality videos. However sound effects may not be encoded with this format. As for audio, is often common to use Flash to play video inside content, for the same reasons mentioned before: portability and ease of installation. The encoding format is Flash for Video (FLV) file format. FLV files contain encoded audio and video data that is highly optimized (through the use of Sorenson's Spark codec) for delivery through the Flash Player. Edited video content is encoded into the FLV format as it is imported into the Flash authoring environment (or encoded into FLV format from third party applications via the Flash Video Exporter plug-in). Once imported into the Flash authoring environment, FLV files can be converted to movie clips and can benefit from all of the programmatic manipulations ActionScript has to offer, or exported back out as standalone FLV files that can be invoked and streamed by the Flash player. Before starting a video-based project, is necessary to agree the target audience and communication goals with the commissioning client. This can radically affect the choice of development format, target medium/download formats to support, and of course budget. Defining the target audience helps to determine whether the output needs to be optimised for high-speed LAN (in the case of a corporate intranet, for example), broadband. dial-up, windows-centric or cross-platform etc. In many cases filming is carried out in miniDV format, which is transferred onto hard disk via Firewire for editing in native DV format. When this is the case it is also other adopted a QuickTime's DV codec for processing, content is not re-compressed more than necessary, and any titling or effects are simply rendered to DV format to be added to the original. In the case of movie trailers, work is usually commissioned to specialised companies that will then print a 35mm film version that can be digitised at maximum quality. Once a production has been edited for online content, is common to prepare and optimise the file by careful final editing including adjustment of compression parameters. Usually a number of compression tests iterations are required before achieving desired balance in quality and dimension for target video files (the actual files to be deployed). Actions such as cropping an unwanted moving background or noise around the edges from a video sequence, or increasing contrast can reduce the target file size by 20% without losing any quality in the content. In the case of film-originated content, a further step is required to remove "pull-down" artefacts, which occur because the film original frame rate was 24 fps whereas the digital video is 25 fps for PAL. Ideally, the final target video for the web should also be at 24 fps. Once the files are ready and parameter optimised, is usual to compress the final file(s) down to a set of target formats to allow maximum browser/player compatibility for the target audience. These formats are typically devised for a large audience:

- Large QuickTime file (progressive download) 10-50Mb
- Small QuickTime file (progressive download) 1-5Mb
- Real Media stream
- Large Windows Media file (progressive download) 10-50Mb
- Small Windows Media file (progressive download) 1-5Mb

This compression operation is carried out using Discreet Media Cleaner Pro, which can work in batch mode to generate a series of target files from a single source. Compression and preparation for other channels (like Digital TV, DVD, CD-ROM…) follow similar stages, in each case starting with the best available source content and optimising the compression according to the channel's constraints and capabilities. As well as the technical process, there are other important factors affecting quality and acceptance of the project by involved people: clients/content commissioners, people in charge of budget and expected quality level, consumer (who typically has high expectations based on mass media experience with multi-million dollar websites, games and movies). Film company clients expect very high quality web compression for movie trailers, and therefore the whole process result must be approved before a site can go live. What follows is a very basic set of rules for making content more accessible to end-users.

- avoid structuring using frames or tables,
- always provide titles, description and summaries,
- provide optional subtitling,
- use XHTML instead of HTML to make the structure usable to translation tools (text to speech etc.)

Table 7. Video most used formats, expected usage and constraints

Format	Description
AVI	Short for Audio Video Interleave, the file format for Microsoft's Video for Windows standard. A format developed by Microsoft Corporation for storing video and audio information. Files in this format have a .AVI extension. AVI files are limited to 320 x 240 resolution, and 30 frames per second, neither of which is adequate for full-screen, full-motion video. However, Video for Windows does not require any special hardware, making it the lowest common denominator for multimedia applications. Many multimedia producers use this format because it allows them to sell their products to the largest base of users. Video for Windows supports several data compression techniques, including RLE, Indeo, and Cinepak. A competing software -only video format is QuickTime. **Usage:** Low-end video players, supported by older PCs. **Constraints:** Limited quality, size and performance. Windows-centric.
RealVideo	Used for download or streaming, RealVideo delivers from dialup to HDTV. Provides compression and reduces bandwidth costs while enabling high-quality, rich media experiences. According to producer with the latest version (10) is possible to achieve the following bit rate reduction at same image quality: 30% than RealVideo 9, 80% than MPEG-2, 75% than HDTV, 45% than MPEG-4 (ASP), 30% than WMV 9, 15% than H.264 Visual quality has been improved by reducing distracting visual distortions (artefacts) wile all previous encoding modes are supported (Constant Bitrate, Variable Bitrate, and Quality-Based Encoding). The new version employs rigorous analysis to decompose & compress video content exploiting sophisticated image segmentation and motion analysis highly accurate mode decisions to improve bit efficiency and improved pixel prediction. HDTV quality video at <5 Mbps Supports all HD formats and resolutions including 720p and 1080i In terms of interlaced support RealVideo 10 bitstream can carry 60 fields / second interlaced content. (http://docs.real.com/docs/rn/rv10/RV10_Tech_Overview.pdf) **Usage:** live video brodcasting over Internet **Constraints:**
QuickTime	A video and animation system developed by Apple Computer. QuickTime is built into the Macintosh operating system and is used by most Mac applications that include video or animation. PCs can also run files in QuickTime format, but they require a special QuickTime driver. QuickTime supports most encoding formats, including Cinepak, JPEG, and MPEG. QuickTime is competing with a number of other standards, including AVI and ActiveMovie. In February 1998, the ISO standards body gave QuickTime a boost by deciding to use it as the basis for the new MPEG-4 standard. **Usage:** **Constraints:**
MPEG	Short for Moving Picture Experts Group, and pronounced m-peg, a working group of ISO. The term also refers to the family of digital video compression standards and file formats developed by the group. MPEG generally produces better-quality video than competing formats, such as Video for Windows, Indeo and QuickTime. MPEG files can be decoded by special hardware or by software. MPEG achieves high compression rate by storing only the changes from one frame to another, instead of each entire frame. The video information is then encoded using a technique called DCT. MPEG uses a type of lossy compression, since some data is removed. But the diminishment of data is generally imperceptible to the human eye. There are three major MPEG standards: MPEG-1, MPEG-2 and MPEG-4. The most common implementations of the MPEG-1 standard provide a video resolution of 352-by-240 at 30 frames per second (fps). This produces video quality slightly below the quality of conventional VCR videos. MPEG-2 offers resolutions of 720x480 and 1280x720 at 60 fps, with full CD-quality audio. This is sufficient for all the major TV standards, including NTSC, and even HDTV. MPEG-2 is used by DVD-ROMs. MPEG-2 can compress a 2 hour video into a few gigabytes. While decompressing an MPEG-2 data stream requires only modest computing power, encoding video in MPEG-2 format requires significantly more processing power. MPEG-4 is a graphics and video compression algorithm standard that is based on MPEG-1 and MPEG-2 and Apple QuickTime technology. Wavelet-based MPEG-4 files are smaller than JPEG or QuickTime files, so they are designed to transmit video and images over a narrower bandwidth and can mix video with text, graphics and 2-D and 3-D animation layers. MPEG-4 was standardized in October 1998 in the ISO/IEC document 14496. **Usage:** MPEG-2 required for current DVD and digital TV (satellite, cable and terrestrial) production. MPEG-4 slowly superseding MPEG-2 in these applications, but held back by the high cost of TV head-end hardware, high volume of set top boxes that would require replacement and consumer resistance. **Constraints: -**
Active Movie	A multimedia streaming technology developed by Microsoft. ActiveMovie is already built into the Internet Explorer browser will be part of future versions of the Windows operating system. Supporting most multimedia formats, including MPEG, ActiveMovie enables users to view multimedia content distributed over the Internet, an intranet, or CD-ROM. ActiveMovie's main competition is the QuickTime standard developed by Apple Computer **Usage:** **Constraints:**
Indeo	A codec (compression/decompression technology) for computer video developed by Intel Corporation. Although it is a software -only codec, Indeo is based on the DVI, which is a hardware -only codec. Competing video standards include Cinepak and MPEG. **Usage:** **Constraints:**

Format	Description
DVI	Short for Digital Video Interactive, a now-defunct technology developed by General Electric that enables a computer to store and display moving video images like those on television. The most difficult aspect of displaying TV-like images on a computer is overcoming the fact that each frame requires an immense amount of storage. A single frame can require up to 2MB (megabytes) of storage. Televisions display 30 frames per second, which can quickly exhaust a computer's mass storage resources. It is also difficult to transfer so much data to a display screen at a rate of 30 frames per second. DVI overcomes these problems by using specialized processors to compress and decompress the data. DVI is a hardware -only codec (compression/decompression) technology. A competing hardware codec, which has become much more popular, is MPEG. Intel has developed a software version of the DVI algorithms, which it markets under the name Indeo. **Usage:** **Constraints:**
Cinepak	A popular codec (compression/decompression technology) for computer video developed by SuperMac Inc. **Usage:** **Constraints:**
FLV	Flash for Video (FLV) file format. FLV files contain encoded audio and video data that is highly optimized (through the use of Sorenson's Spark codec) for delivery through the Flash Player. **Usage:** Ideal for combining live action footage into interactive SWF applications **Constraints:** Limited to same platforms and browsers as SWF

3.3.2.5. Animations

In the present section are reported basic information, constraints, suggestions and guidelines to produce high quality animations based content. In this section particular attention will be placed on the issue of possible rendering / distribution formats, bandwidth usage and similar issues that will deeply affect the choice of the author during content production/selection so to ensure the highest possible quality of achievable results. The most diffused industry standard format for animations is Flash, even though for professional usages are very often-used software tools like MAYA, 3D Studio Max, etc. These tools have a large footprint, and the resultant animation files produced are also large. However such animations are of high quality and can also be in 3D virtual space. In other cases, for generating animations, is possible to use a combination of Toonz, Flash, Adobe After Effects and Maya for authoring, while creating SWF and QuickTime outputs depending on the content. Toonz is used for traditional cell-style animation, Maya for 3d rendering and Flash for 2d web-based animation.

Table 8. Animation most used formats, expected usage and constraints

Format	Description
Flash	A bandwidth friendly and browser independent vector-graphic animation technology. As long as different browsers are equipped with the necessary plug-ins, Flash animations will look the same. With Flash, users can draw their own animations or import other vector-based or bitmap images, video, and audio files. Flash has includes comprehensive support for JavaScript scripting internally, which enables advanced front-end client software to be developed within a single SWF file. Flash was known as FutureSplash until 1997, when Macromedia Inc. bought the company that developed it. **Usage:** **Constraints:** Requires proprietary plug-in or player.
QuickTime	A video and animation system developed by Apple Computer. QuickTime is built into the Macintosh operating system and is used by most Mac applications that include video or animation. PCs can also run files in QuickTime format, but they require a special QuickTime driver. QuickTime supports most encoding formats, including Cinepak, JPEG, and MPEG. QuickTime is competing with a number of other standards, including AVI and ActiveMovie. In February 1998, the ISO standards body gave QuickTime a boost by deciding to use it as the basis for the new MPEG-4 standard. **Usage:** **Constraints:** Requires proprietary plug-in or player on non-Mac platforms.
Active Movie	A multimedia streaming technology developed by Microsoft. ActiveMovie is already built into the Internet Explorer browser will be part of future versions of the Windows operating system. Supporting most multimedia formats, including MPEG, ActiveMovie enables users to view multimedia content distributed over the Internet, an intranet, or CD-ROM. ActiveMovie's main competition is the QuickTime standard developed by Apple Computer **Usage:** **Constraints:** Requires proprietary plug-in or player on non-Windows platforms.
GIF	Although often overlooked, the GIF file format can be used to perform efficient animations based on a sequence of repeating frames. **Usage:** This is most commonly used for banner advertising on websites, but can be applied to other media channels also, such as interactive TV, as the GIF format can be memory efficient. **Constraints:** Best suited to small number of frames (e.g. less than 16) in a repeating loop. No temporal compression so file sizes multiply for each additional frame.

3.3.2.6. Multimedia

In the present section are presented the most relevant combination of basic content that are expected to be relevant in the AXMEDIS context. With the presented combination is possible to achieve also very complex objects as each multimedia object can be combined with another multimedia / simple object to generate a new object. The first point to take into account in this section is that we are dealing with multimedia to be used onto a set of different devices into a multiplatform environment comprising PDA and smart phones. This was not possible only a very little time ago. Such evolution is dramatically changing the market in terms of customer expectations and production processes. If once it was not even imaginable to develop or just even deliver multimedia content for a mobile phone, this is nowadays a reality (games, ring tones, images, backdrops, applications…). Yet at present some of the major limiting factors for the fruition of multimedia contents on devices like PDA, smart phones and mobiles are the following:

- Battery duration in relation to screen size, resolution, definition, illumination and number of supported colours
- Screen size, resolution, definition, illumination and number of supported colours
- Screen orientation (usually portrait on such devices and landscape in all others)
- Available memory storage
- Available computational capabilities of the device (particularly relevant when dealing with SW only based rendering methods)
- Easiness of usage of the device and its GUI

All those factors should be addressed as may be the one preventing a real burst in the usage of such devices. For example most software used for replacing accelerated graphic boards are demanding in terms of computational efforts, therefore it may be necessary to develop new techniques to handle this aspect. It may be desirable also to devise new methods of content production to deal with those aspects. Another important aspect that we consider as crucial for multimedia content management and production is accessibility. As a matter of facts accessibility refers not only to impairment managing; it is also a matter of making content and all relevant data available at all levels and in this sense is strictly related to metadata. For example for an image the essential data are not only the title and the caption but also the classification keywords and all info related to the shot (speed, shutter, focal…). In the editorial and content production environment the classification info are crucial as they are used to retrieve, use, store and process content. Similar considerations apply also to DRM info, as they are essential to enable real and profitable exploitation of digital content, therefore accessibility considerations should be applied to metadata management including DRM. Apparently an easy solution for these constraints could be sought in aspect adaptation. For basic contents this could be achieved with some algorithms (cropping, downscaling, rotation…) while for more complex objects may require an offline editorial process to derive a specific version of the content. Therefore even if technically adaptation is possible it has to be carefully taken into account the economical and DRM aspect of such adaptation. At present are already in place services of video streaming (mainly related to sport, news and reality-shows) but video streaming of a movie or other kind of content may be limited by the inherent copyrights acquiring cost. Yet streaming is a simpler case as the end user is accessing content on a pay per use base while a different issue is the kind of content that can be downloaded and stored on the end user device. At present for example in the audio industry the most relevant market is the one related to the ring-tones derived by songs or soundtracks, yet this is a very different issue if compared to the fruition of high quality music. In particular for the multimedia and audio-visual content has to be taken into account also the aspect of adaptation permission form the IPR owner, this latter aspect combines with the cost that may be required for the adaptation and the technical feasibility (at least in terms of quality preservation). Another relevant aspect to be taken into account during multimedia content development is related to style (like image, font, colour combinations, logos …) conveying the developer brand image and the desired communication through the delivered content. As a matter of facts this latter point is often highly related to the target audience. The same content will be presented in a very different stile and format if the audience is belonging to a K12 audience or to a professional one. Moreover most of digital content formatting is usually achieved following a well-defined set of steps, each aimed at dealing with constraints and needs of the target audience, nominally:

- Target audience identification (children 3-6, K12, adult…)
- Kind of communication need required (advertisement, company communication, leisure, edutainment, formal education, informal education, personal competencies training, professional training, re-training…)

- Kind of delivery media (books, magazines, newspapers, computer, TV, radio, PDA, CD, DVD, class, blended…)
- Kind of fruition (individual, group, class, blended…)

The key idea behind is that at each step of the previous chain of steps a refinement is applied so that the original idea is transformed into the final product. Most commercial products (unless they are simple/raw assets) are complex and built out of complex items. This does not necessarily imply that every digital asset has to be a complex one, yet at lest multimedia ones tend to be. On the other side simple assets (text, images, videos and audios) are often used as starting point for the development of products that are not necessarily digital ones. Yet sometimes, at industrial level some production steps are still handled in analogue especially when the digital equivalent is still too poor (for example a photo-colour image A3 size based on a 16 ASA film has a grain resolution that is far higher that the one achievable with a digital camera). Most of the achieved result is based on proper management of metadata attached to original sources and assets that have been processed to fill in the pages. Also pages structure and functioning are described via metadata. Therefore, as already pointed out previously, we can state that in content production the most challenging part is metadata management. The user (professional or not) will be highly relaying on metadata to identify, select and operate on digital assets. This is already the habit in most editorial environments and tools, where metadata are used during the search phase, the classification and archival phase and even during the processing phase (especially as far as annotations are concerned), but it is necessary to take into account that usually professional search and classification tools place emphasis on a keyword-based approach. This has a high impact as it is reflected both in the standards processing routine and in the professionals' habits, therefore compositional tools rules based should be able to manage metadata as one of the most relevant sources of information about an object, its "content", "history" and "processing". In the most efficient tools and work environments metadata also bear relevant info about rights and other relevant aspects related to the value chain. In the following subsections we will briefly point out samples of possible structures for content delivery of basic compound objects. The possible set of combinations is reported hereafter in terms of table and possible relations:

Table 9. Compound objects as result of basic object combination

Media	*Text*	*Image*	*Audio*	*Video*	*Animation*
Text		x	x	x	x
Image	x		x	x	x
Audio	x	x		x	x
Video	x	x	x		x
Animation	x	x	x	x	

A combination is defined as:

{ couples of media | { (couples of media combinations) } }

The formal description used could also be adopted, in essence, to describe every other set of compound objects as this formalism allows generalising in a simple way what would otherwise require a quite long and repetitive description of all possible instances of media combination. Therefore in the rest of the document only the most common samples will be dealt with in detail as all others may be derived as combination as described trough the adopted formalism. The first thing to note prior to enter into a detailed description is the difference presently in place in terms of content rendering among a PC based client and a PDA one (especially for web-based content). In essence, when taking into account web-based content, the most relevant market share is represented by MS-Windows based operating system (both on PC and PDA); therefore we have to deal with MS-Internet Explorer. This has a direct consequence ".css" style sheets are not supported on PDAs; therefore a content designed with this king of rendering management will not work properly. In case of simple distribution of content prepared by others, this aspect has to be taken into account under two aspects, nominally: rendering result and adaptation rights. Having clearly pointed out this as an example of the device dependent constraints to be taken into account in the content production process for multiplatform delivery we can now pass to examine the various basic sets of compound objects. Given the fact that usually test is used in almost every content (under one form or the other) we will refer to it as to the basic content (text can comprise music notation or any other form of description like formal logic, time notation…) what just stated applies also to non web based content as it could be the case of TV / CD / DVD / iTV based content.

3.3.2.6.1. Compound object made by a two objects combination

This is definitely the simplest form of compound object. Basically almost every web based page falls under this description, even if the page can host multiple instances of the basic set. Moreover this kind of object can be generalised according to the following definition:

{ text ∧ { (image | audio | video | animation) } }

3.3.2.6.2. Compound object made by a three objects combination

The level of complexity of this compound object is just a little above the one of the previous one. Most of the structure may be static (text and image) but the dynamic part of it may have several different way to be managed. For example audio may be launched automatically as soon as the overall object is loaded or only after direct user intervention. Audio can be simply the "reading of proposed text" or a background audio or a complementary one (like a narration) that will be used by the end-user as the primary guide to content (it can represent instruction for content usage…). Using the previously adopted formalism the generalised form of this object can be described as:

{ text ∧ (image | audio | video | animation) ∧ { (image | audio | video | animation) } }

What follows is just an examples of web based content where components are highlighted. It is worth noting that there are also image based portion of the content that are only functional to usage (like the navigation bar at the bottom right of this page.

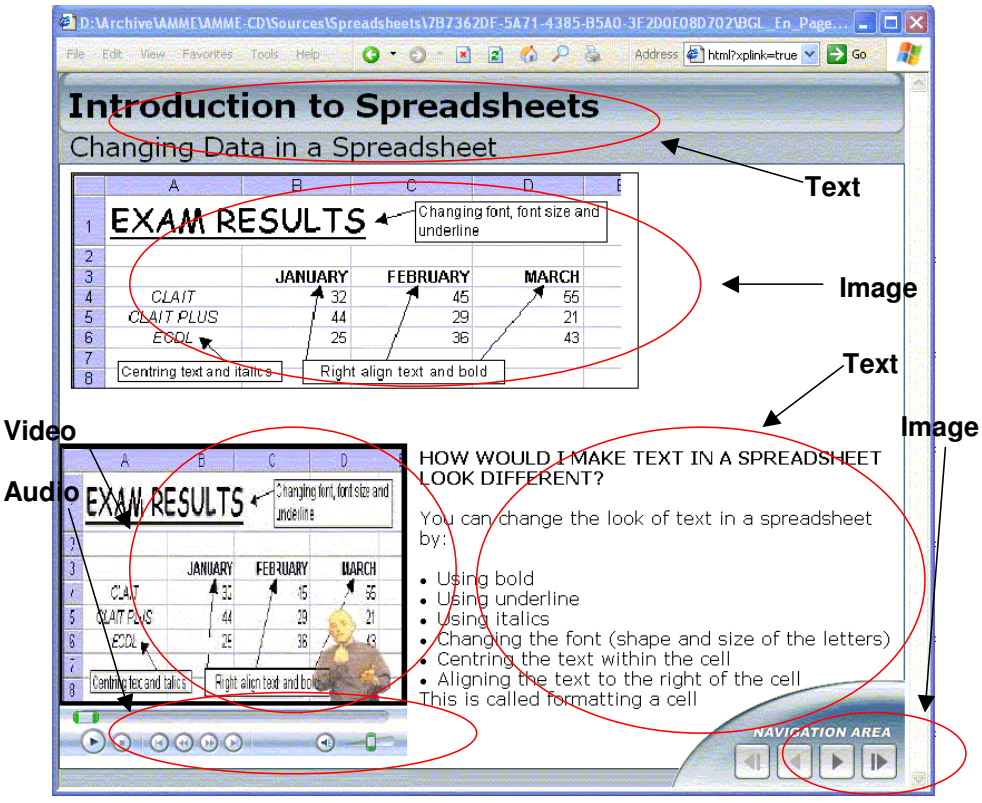


Figure 13. A sample web-based content page compliant to this kind of format

3.3.2.6.3. Compound object made by a four objects combination

The level of complexity of this compound object is still limited, yet there is already a good degree of complexity to be handled. Only part of the structure will be static (text + image) while, once again, the dynamic part of it may have several different way to be managed. Just like in the previous example audio may be launched automatically as soon as the overall object is loaded or only after direct user intervention, but the video, or animation, can embed audio too, therefore it will be necessary to take into account

content intelligibility. Using the previously adopted formalism the generalised form of this object can be described as:

{ text ∧ (image | audio | video | animation) ∧
(image | audio | video | animation) ∧
{ (image | audio | video | animation) } }

Summing up, foreseen basic content types are summarized in the following table, from now on, explanations and suggestions provided will only apply to those kind of basic objects.

Table 10. Objects classification in terms of complexity of content aggregation

Simple objects	Complex objects	Compound objects
Text / Images / Audio[4]	Video / Animations	Multimedia

A compound object accounts for all constraints coming from its components; it is given for granted that it has to be selected evaluating the most restrictive combination so to ensure that all constraints are properly met. It could also happen that the same content has to be available both for B2B and B2C. This implies that it has to be manipulated in a different manner according to its final usage. Therefore different sets of digital rights management (DRM) rules may apply to the same object, resulting in different licenses. Thus, maximum care should be placed in evaluating licenses and potential available rights (PAR) at selection time, as this will have great impact on subsequent processing steps. The issue of licensing is, in any case, out of scope of the present document, nevertheless it is given for granted that a careful exam of rights management has to be performed at both selection and acquisition time in accordance with "user" needs and expectations.

3.4. Authoring tools and content development applications

A good marketing strategy cannot rescue bad content; this is true for traditional publishing and even more for on-line one. Contents live and die by the quality of their design. Therefore, contents and its design have remained the most critical dimensions of success. Not surprisingly, the shortage of well-designed, engaging and relevant e-products is still high on the list of reasons for limited acceptance of content e-fruition. Producing multimedia applications, especially in the educational field, is a complex, time consuming and costly task. In more detail it is necessary to take into account that even if available content may be extremely rich and valuable for producing learning content, there are plenty of issues related to copyrights and content usability to be taken into account, nominally:

- Images are available but covered by copyrights and the clearance procedure is quite complex;
- Multimedia content (video, audio…) presents the same copyright problem as images;
- Text is available from many sources (from literature to newspapers…) but also in this case there is need for copyrights clearance;
- Content should be suitable for web-based applications (images, audio and video formats…) therefore may need adequate post-processing.

The editorial board following directions of the pedagogues involved in the content design usually performs content selection. The legal department performs copyright clearance once the list of chosen contents has been finalised. These are preliminary steps that apply to the product overall design. Then takes place the typical e- authoring process, which is structured as follows:

- An author begins the development process by choosing from a library of page templates or content wizards or by opening a blank page and selecting the navigation buttons, text placeholders, and other objects from a catalogue. A template contains placeholders for the text and media that an author wants to display and usually contains a common navigation mechanism and background image.
- Next, the author adds text, graphics and other media to the object placeholders in the page templates. All of the object placeholders can be modified by setting properties that define the appearance for each object.
- To create interactive content; for example an author can build a quiz by selecting question objects from a catalogue. The author can enter feedback for each response to a question. The feed-

[4] Up to a certain extent, also database records (like UNIMARC record as defined according to the provisions of ISO 2709), or a JPEG2000 image (http://public.migrator2000.org/pandorademo/) could consider basic objects.

back can be text, media, animations or other types of instructional material. The behaviour of a course can be based on the learner interactions with test questions.

- Authors can use the preview feature at any time to see the content in action from the perspective of a learner.
- When the content is ready for deployment, authors can publish it as Web-based content.

This implies that suitable basic assets are already available and catalogued. Often this is not the case and is necessary to deal with the process of making content available, nominally how to transform in learning objects structured and unstructured content. Also this process is usually performed by personnel usually skilled both in education and programming or at least in the usage of the adopted authoring tool with the specific support of graphics experts… The first step would be to properly select and classify content. Then it will be necessary to take textual content and turn it into smaller self-consistent chunks. During this step glossaries of terms will have to be defined and populated. Such glossaries will be available then as complementary/support units. Textual content may present a chapter/paragraph-oriented structure and such sub elements can be either logically related but self confined or logically related and interdependent. In the first case it will be simply necessary to segment text to the smallest self-confined/functional level and transform it into a learning object. In the other case it will be necessary to segment it, structure it and produce a set of interdependent objects (via pre-requisites). Finally it will be necessary also to provide relevant metadata and associate it to produced objects in order to grant easiness in the search & retrieve process.

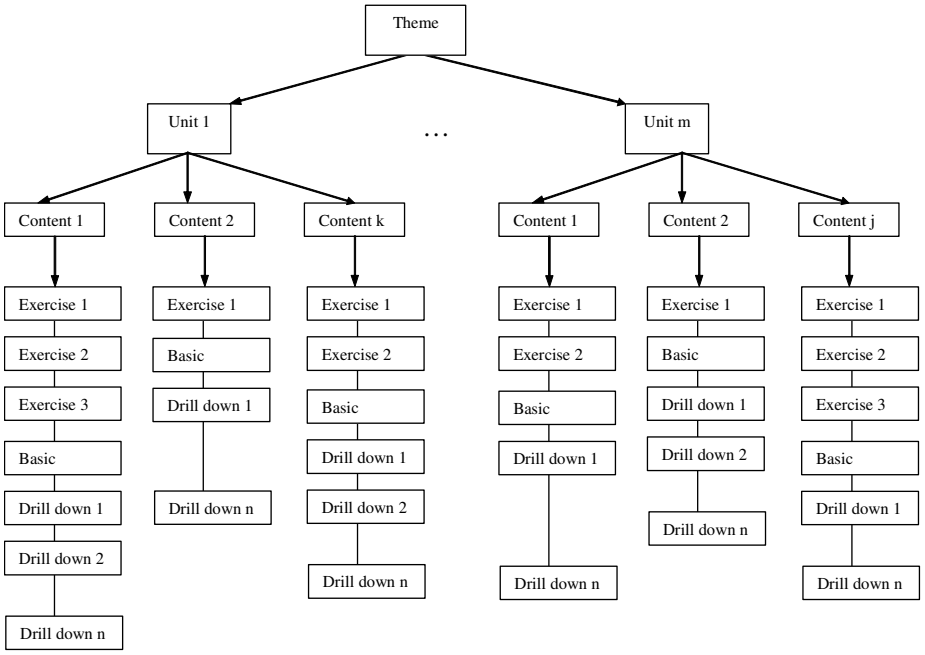


Figure 14. A possible content structure delivered in units with exercises & drill downs

Creation and usage of the same content from different groups of people that may also have different sets of languages is a real problem and has been taken into account since long in the publishing environment yet is still at its dawn in the e-world. Traditional publishing tended to solve this issue through co-editions in which publishers belonging to the different linguistic environment would edit the same content in their own language adapting images and any other multimedia content to the needs. This would result in a set of titles bearing in essence the same original copyright (for the original version) and a set of new ones for each language. If the passage from language "A" to language "J" would require a passage from language "C" this would be addressed with specific contracts and in the edition "J" will be mentioned both "A" and "C" copyright. Delivery is not really language dependent as the language selection for content would have been performed at the initial step (access….) and therefore handled via fruition interface relying onto production based efforts (which ends up in the packaging).

In the overall process a point constantly under exam is the content suitability. This could refer to target audience or to some specific market aspect or even to some local law restrictions that may occur during the production cycle. We can say in general that these are more subjective constraints than the one that

will be described afterwards and that related to technical issues. As a rule of thumb here are some general criteria that can be applied to evaluate content suitability:

Overall user selection criteria

- ***Potential audience.*** Who will use the resource? Will a narrow or broad audience use the resource? Will audience use justify the purchase?
- ***Life.*** How long will the resource last in terms of durability, technology, and interest?
- ***Price.*** Is the resource worth the price?
- ***Quality.*** Is the resource accurate, current, appropriate?
- ***Balance.*** Are other materials already available in other formats?
- ***Value.*** Has the resource received favourable reviews?
- ***Known.*** Does the public know the resource?
- ***Unique.*** Does the resource contribute in a unique way?

Need and Usage selection criteria

- ***Interests.*** Does the resource meet the interests and needs of the audience?
- ***Purpose.*** Will it educate, entertain, or both?
- ***Depth.*** Is the depth and length appropriate for the intended audience?

Content Quality selection criteria

- ***Format.*** Is the resource suitable for the format (i.e., audio, video)?
- ***Authority.*** Is the content creator known and knowledgeable?
- ***Authenticity.*** Is the content accurate and correct?
- ***Timeliness.*** Is the content current and up-to-date? Is the topic timely?
- ***Relevance.*** Does the content match the purpose of the work?
- ***Efficient.*** Is the content worth the effort and time in reading, viewing, or listening?
- ***Appeal.*** Is the content stimulating and interesting?
- ***Originality.*** Is the content interesting and imaginative (i.e., style, creativity, originality)?
- ***Vocabulary.*** Is the vocabulary appropriate for the intended audience?
- ***Aims.*** Is the resource appropriate for the subject (i.e., animation, documentary)?
- ***Organization.*** Is the content well organized, easily followed, presented in effective manner?
- ***Editing.*** Is the content well edited?
- ***Features.*** Are special features effective (i.e., background information, supplemental materials)?
- ***Special Needs.*** Are options provided for special needs (i.e., captioning, language choices)?

Technical Quality selection criteria

- ***Visual Elements.*** Are the visual elements effective (i.e., viewpoint, composition, focus, exposure, colour, clarity, special effects)?
- ***Sound Elements.*** Are the sound elements effective (i.e., sound quality, voice and music quality, clarity)?
- ***Editing.*** Is the editing effective (i.e., smooth, rhythm, continuity, pacing)?
- ***Technology.*** Does the technology work effectively (i.e., skipping, missing elements, poor navigation)

3.5. Creating multimedia content from existing material

Taken into account the specific nature of each distribution channel it is necessary to point out which are at present the best choice / combination of formats for each channel, part of this has been defined in the requirements but is nevertheless necessary to recall it here in order to ensure best possible design indication to ensure effective and efficient content production achieving the highest possible aspect quality and possibly ensuring therefore the highest possible profitability for all actors involved. When talking of supported content is necessary to analyse the difference among content to be used for education and content to be used for tourism, leisure, entertainment… for each the same basic raw assets can be exploited but then different sets of composition, aggregation and formatting rules have to be applied. Moreover (just as you say) is also necessary to take into account the fruition device. We would also add that all this will not be significant unless we also take into consideration the business model and fruition modality (pay per use/view, rental, purchase, subscription…). For example a reproduction of the "Guernica" painting by Pi-

casso can be used in a course about Spanish Civil War (JPG, Low definition), in a virtual art Gallery (PNG, High definition) etc. However, in our vision adapting the format to the context of use should be performed by an explicit Rule like "adapt format", which should be sufficient to answer any need regarding distribution channel, context of use, terminal etc. as this will empower authors with the maximum flexibility. Anyway, nowadays this operation works as follows: simple atomic operations, put together by a human in more complex rules defined to resolve a "functional" constraint, and since authors' audience and distribution channel are usually quite limited and well defined, is such content adaptation is avoided. Although most commercial audio releases will comply with the formats already mentioned above, there is no need to restrict the creative process to those formats. In fact many recording artists have indicated that they will make use of the digital format to experiment creatively. There are four key issues related to developing content from existing material:

- ***Ownership and clearance*** **-** The first implication of using existing material is the need to clear usage rights and if necessary gain clearance for the use of the content in the new production and for the new channel. Currently one of the key delays in today's production workflow, the peer-to-peer model being developed within AMXEDIS promises to eliminate many of the problems of clearance, ambiguity of usage rights, etc.
- ***Interrelated media*** **-** A common feature for this type of content production is that the content created is often strongly related to another piece of content (e.g. a movie that the content is promoting). This interrelationship sets strict constraints in terms of obtaining clearance from the original content producers and owners for the use of images, footage, logos, music, soundtrack clips, etc. It also adds a further level of sign-off/approval to the workflow where not only the clients (e.g. movie distributors) who are commissioning the multimedia content require sign-off, but also the original content producers - and in some cases the film stars and other stakeholders - require sign-off before content can be distributed on a new channel or in a new format.
- ***Repurposing*** **-** Another vital aspect of creating multimedia from existing content is the issue of repurposing, that is adapting content developed for one medium/channel to suit a different delivery channel, viewing device and context. The general principle for this process is to start with the highest available quality copy of the source material, as artefacts and distortion introduced by reduction, resizing and compression tend to amplify any imperfections in the content. A simple example is compressing an image to display on the web, where a compressed source Jpeg image, if re-compressed can look unacceptable with heavy Jpeg artefacts, while the same size output file compressed directly from a high resolution uncompressed bitmap source will be of a significantly higher quality. This principle also applies to video and audio, for example, converting a movie trailer from a high quality source such as DigiBeta with PCM audio soundtrack into a small streamed QuickTime or Windows Media clip can create a smaller file size yet greater quality than if the same trailer were created from an already compressed format such as consumer DV tape. The process of repurposing can be highly labour intensive, and is one that the AXMEDIS tools promise to significantly automate to reduce costs and production lead times.
- ***Integration*** **-** Although the multimedia integration process is similar for both new and existing material, the incorporation of existing material often requires customized styling and look and feel, as well as customization of any new content elements in order to closely match the existing material. For example content developed to promote a movie must be closely aligned in terms of colours, styling and 'tone of voice' to the clips, stills and other elements incorporated from the movie itself. This constraint necessitates a more manual production process with customization, although once the styling for the project is defined, templates and reusable sub-components can be defined for the project such as icons, navigation components, screen layout grids, etc. Another problem with integrating existing material can be the gaps or missing elements, for example missing suitable shots of an actor to be used on a film website. This can impact the production workflow and often requires rethinking the entire design to avoid needing the missing content.

3.6. A brief introduction to multi-language content

The fast globalisation of markets, the need for cooperation with publishers and distributors all over the world and the tendency to provide 7x24 service also in access to content or ODL, could already represent a major push to adopt multi-lingual solutions in terms of delivery and content, but this would be limiting and could cause serious problems every time some content has to be managed, revised or edited some-

where around the globe. It is also interesting to take into account that multi-language management is crucial to ensure proper accessibility to several kinds of contents, from movies to text. In many countries it is common to dub video content to match the taste of the local consumer. This has some clear advantages and some hidden disadvantages. For example, if we take into account a comedy, or any other audio-visual content, produced in an English speaking country relying on the implicit irony that can be achieved and exploited using English, it is apparent that it will not be possible to achieve the same result with dubbing. First of all because a literal translation of the original dialogue may present no comical / ironical aspect in the language used to dub, secondly as the achievement of a similar effect may require a totally new set of text that may be very difficult (if not impossible) to properly sync with labial movement of the characters speaking in English. Another relevant reason that is presently pushing content owners to tackle the multi-lingual issue is the fact that, more and more often, professional practitioners, and consumers, are searching for content on the web. Search engines will retrieve lots of content and often some pieces will be in a language unknown to the user. Most efficient search engines provide a set of basic translation services, but if someone really uses them they will find that the results are still quite poor. The search and retrieval issue is not marginal as it does apply not only to content available over the Internet, but also, and more relevantly, to content located into intranets, databases, archives, CMS, LCMS or KMS. Such dispersed and varied kind of "content repositories" represent often a major asset for a company or organisation as they hold and provide info, documents and other "objects" used for work, research, etc. and therefore have to be not only accessible, but quickly accessible to user. The combination of needs for a quick and reliable access to a specific relevant piece of information, document or object on the basis of a research is often (we could even say always) based on the archival procedure and the set of data available for indexing and retrieval. This latter point is not limited to a specific language, on the contrary is more and more pushing towards a multi language environment. The combination of the previously mentioned aspects is at present a huge issue and represents the object of many studies both at academic and commercial level. The primary objective of much of the abovementioned research and development is focused on the provision of a transparent way to support users in the search and retrieval process. This basically means to enable the user to place a query (even a complex one) into a selected language and retrieve content that is relevant, and available in the same language as the one used for the query, even when this implies the need to provide a translation or just a basic set of information taken form the object metadata and covering relevant aspects of the object itself. Another general problem for multilingual content is the need to understand the context of the text that is being translated. For example, subtitling needs to be consistently translated throughout the video so that places, objects and people are not given different translations in different subtitles due to lack of context. This is also true for text labels used within multimedia for labelling illustrations and animations. An automated translation process might not associate the labels as being related and therefore translate the same word or concept differently in separate labels. One may think that this kind of concern is purely academic and that a good translator could always work it out, yet this is not always true on a side because context is highly relevant for translation (it is the primary link factor to the culture embedded in the source language) and therefore special care has to be placed in ensuring proper contextualisation also in the target language. This brings along a major problem related to cultural aspect of languages. It is known that populations like the Inuit have over 40 terms to describe "snow" while people coming from other part of the world may have much less or even none. In other words quoting Adeline Yen Mah[5]: "Concepts are expressed by words. If certain English words are missing in Chinese, it follows that the concept expressed by those words will be absent in China, and vice versa". This nay force translators to adopt some strategies or work around to address the problem and convey the meaning, yet if this is basically feasible for humans is still far to come for automatic translators. The problem is even more evident when the addressed content to be tackled has got some artistic value as it is almost impossible to convey in a different language some subtleness or specificities that make that specific content a masterpiece. The Internet has changed considerably from the early days. Previously the bulk of online content was presented in English, however, the last 5 years have seen a burst in the volume of content in languages other than English, as well as in the number of non-English speaking users. Right now less than 35% of Internet users have English as their first language (compared to 50% in 2000). This trend is presently confirmed (mainly due to the development rates in Internet connections of countries like China and India) and it is predicted that such figures will drop to 25% by 2008. Indeed, some of the busiest sites in the world do not even have an English version like: *Daum.net*, a large

[5] Adeline Yen Mah – **"A thousand pieces of gold – A memoir of China's past through its proverbs"**, Chapter 16, pp 293 Harper Collins Publishers 2003

Korean portal available in Korean only and that is frequently reported in the top 5 visited sites in the world. Besides absolute volume of potential site visitors as measured by language, there are several other conditions to take into account when planning a web based multilingual content production, sales and distribution. For example if the provided Internet-based access to content is just for information provision service or branding, rather than for representing a point of sale, there are other areas to pay attention to like how do different cultures search for information. Each culture, and language, has its own underlying logic. Site navigation, keyword targeting and intuitive use will all vary between languages. Even within languages, there are strong differences. As a simple example, UK English speakers are more likely to search for the term "*vacation*" whereas USA English speakers will use "*holiday*" more frequently. On the other hand if the site is providing a point of sale, it will be crucial to take into account under what framework will users operate, for example if they will purchase online, or if their cultural constraints will imply that they would rather communicate directly with a local distributor. Furthermore it will be crucial to figure out how will users purchase, as it may be the case that online credit card purchasing is an accepted method within this language group/culture, while for other target group it will be needed to provide other purchasing options (telegraphic transfer etc.); each of this aspect will be reflected in the localized version. Last but not least it will be necessary to take into account the enquiry processing, as if the translated site is likely to generate an enquiry, this will need handle, yet for some sites it could easy to develop tightly structured generic enquiry forms, while for others email processing may be required. In the present section of the document are reported the most relevant issues related to language that affect content. We have already mentioned that audio-visual content is often dubbed, but this is just an example of how to deal with the issue of having content in a different language from the one of the user. Still in the case of audio-visual content is often possible to have subtitling. This in turn presents other kinds of issues like the synchronisation one. There is then another full set of cases to be taken into account and among them the most relevant is the one related to metadata management. It will be clear how relevant it is to have not only the content accessible in several languages, but also metadata. It may seem a paradox, but in some cases if metadata are not supporting multi-lingual management, even a fully multi-lingual content may fail to be used or found by a user having a specific language issue. What follows gives a quick summary of the issues of managing multilingual content/websites. It is generally accepted that there are seven key issues to be considered in respect of multilingualism, nominally: *Translation, Localization, Culture, Feedback, Design, Workflow and Non-Latin character sets.*

Translation - is essential for multilingual website and will require qualified personnel or the use of an external translation service; in any case proof reading of translated work is required. Machine translation should be avoided and, if considered, only with extreme caution as it may be a plausible alternative for infrequently accessed pages containing non-essential content. In this case, the use of short, unambiguously structured sentences and the avoidance of idiomatic phrases are essential, and sub-editing is still a necessity as, depending on content domain errors may be introduced despite the quality of the used system. On any site with significant translation requirements, translation costs are likely to dwarf all other running costs.

Localization - depending on the addressed content domain is a more or less complex process. Usually multilingual object (website, CD…) is a mixture of global and local content. Local content presents no particular content management issues while global content (which has to be translated across all language supported) does. Deciding where multiple language versions of content are going to be required and where content can be maintained separately for different languages is a critical decision that will affect how a the products should be maintained and what it will cost.

Culture - Differences in language are only part of what distinguishes different content instances. Graphical conventions, matters of taste, sense of humour, socially acceptable forms of address and issues of privacy all vary from place to place. Moreover it has to be taken into account that whenever a word is missing in a specific language it is often because the expressed concept is missing and therefore some important concepts may have no useful meaning if translated literally, or can even turn into tricky or sense-less piece of content (think of *"natura morta"* that should be translated as "*still life*" and not as "*dead nature"*). This may also become trickier when you take into account subcultures. For instance, in France, the "*stop*" sign is "*stop*" while it is "*arrêt*" in Québec, as "*Rollerblade*" is "*Rollerblade*" in France and "*Patins à roulettes à roués alignées*" in Québec.

Feedback - is another crucial issue, as responses to any feedback will need to be addressed in the language of the initial communication. User feedback should not be solicited in a language if it cannot be routed to a suitably qualified person/system/content that can answer/be accessed in the appro-

priate language. Scripts that handle interactivity, such as discussion forums, search results and feedback forms, will also need to be configured appropriately.

Design - is perhaps the most common, and an easily overlooked, difficulty encountered in developing multi-lingual products. This applies both at production and maintenance as it implies a consistent design across different language versions, and in particular of navigation layout. Text or graphic labels that fit the design constraints in one language may not work well in translation. The only sensible way to tackle this issue is to ensure that the initial design brief for a specific content already includes all language variations of branding and of the major navigational elements that could be of relevance or expected to happen (if the original content is relevant for the German market it would be sensible to design it in a way to host a German translation even if the original content is English or French…). Also, links between pages/components should not lead unsuspecting users from one language locale into another.

Workflow - even though this aspect may appear quite out of scope at first it is essential reminding that in a digital world often operations performed by users may be integrated either in a workflow as part of a work process (production, aggregation, distribution…) or as a part of a controlled value chain (acquisition and fruition of content on a pay per use basis). Simple workflow mechanisms usually offer some kind of notification when some action is performed on a content/page or when the content/page moves from one state to another. Translation workflow, on the other hand, requires that changes to a content/page trigger appropriate notification of required changes to the other language versions of that content/page. In addition, it is usually helpful to have some mechanism for identifying which elements, within the content/page, have changed.

Non-Latin character sets - Given the present structuring of the e-market and the inherent globalization the multilingual approach is impossible to avoid facing the need to address those markets where numbers are so relevant that can make the difference between a profitable and a just sustainable business (China, Russia, Arab countries). There are some interesting challenges associated with the creation and rendering of non-Latin alphabets, although modern browsers have better support for them than in the past thanks to Unicode as the recognized (and growing) international standard that includes most non-Latin characters and makes storage and retrieval of non-Latin characters in distributed environments (such as the web) much easier. Still Unicode support for some character sets (such as Bengali) is still not universal, so the use of legacy character sets may occasionally be necessary (at least in the short term), but, ideally, content should be stored and edited as Unicode. In addition, content/website pages should be published with an appropriate character set (either UTF-8 or a language-specific character set, such as windows-1256 an Arabic subset of Unicode) and language META tags; any characters that are not in the publishing character set should be published as html entities; and direction tags should be specified, where appropriate. It should also be possible to mix languages on a single page, allowing links to other language versions of the content/page to be handled simply.

3.6.1. Solutions and approaches

When dealing with multi-language support, it is interesting to allow the user to define an ordered list of preferred languages, so to ensure that it will be possible to fallback to a secondary language when some content would not available in the favourite one. For instance in case the user prefers reading in French, but does not mind read in English, such two languages could be selected as primary and secondary preferred for content and/or GUI. This could therefore provide the system with useful information to exploit whenever content and/or components of a site are missing in some specific language while is available in other (it is worth taking into account that this is a good solution especially whenever an on-line approach is followed). What just stated is relevant also in light of the fact that it is not only useless but also annoying to show the user content in Chinese in case this language is not understood or known. The same applies to audio-visual content and, of course, to multimedia. From what just stated is apparent that the most relevant aspect to focus our attention on in terms of media and multi-language support is concerned is the design level. It has already been shown how to deal with mCMS and what it is actually under the translation/localization process, therefore here it will not be necessary to re-instantiate what already presented, yet it is worth mentioning that in the media environment the multi-lingual issue has been tackled since a long time. In the movie and TV industries is usual to adopt either dubbing or subtitling policies for content to be delivered abroad. Usually whenever there is content that needs to be localized is usual, at professional level, to go for proper translation and localization process. This is usually a quite complex and structured process that often presents problems and unexpected issues. Therefore as a starting point

we would like to see how the process id rolled out and how it could be possible to smoothen it. Probably text is the widest category of content to be taken into account when dealing with multi-lingual issues as all other content will somehow include some test either as a specific part of the content or as metadata or as specific support to multi-lingual issue management (subtitling…). Language tags should be used for all text-based content. A simple example of the use of multilingual text and metadata is in the production of html, where keywords and page descriptions need to reflect the language of the page content. In these cases, for multilingual searchability and accessibility, the best user experience is achieved by declaring the primary language of each page using the <html lang="nn"> tag, where nn is an international language code defined under ISO-639 ('it' for Italian, 'en' for English, 'fr' for French, etc.). Once a page's language is correctly identified, keywords and descriptions will then be indexed in the relevant primary language. Multiple language versions of the same content are best presented as separate pages, each with an appropriate language identifier tag and with all keywords and descriptions as well as content translated. This ensures that the result will be returned in the same language as the query. The <link> tag of the header enables to link a version in a language to alternate versions in other language. This standard approach can be generalised to all XML documents, using the 'lang=' metatag to describe the language of the content. Also to support text readers and search engines, secondary languages used within text should be encapsulated within a tag using 'lang=nn'. Apart from the textual content that may appear on an image (an image could also be: a sales trend graphic, a market share pie representation…), images always present a relevant set of textual accompanying information. Some of this information is also embedded inside the image file format (JPEG header…). What we are referring here is the heterogeneous set of language related aspects that are related to the specified kind of object. For example when translating a composite document, such as a poster, the disposition of the text is really important. As a translated text is not necessarily as long as the original, it might be needed to adapt the layout or the styles, such as increasing or decreasing a font size. A similar problem exists with maps, where the tag over a location might need to be adjusted as a change in the width of the text can make two labels to overlap. These are just examples of content that are usually composed basically by images or transformed in images either for print or for usage as digital objects. What just stated has a even more relevant impact onto products where in the graphical user interface (GUI) there are graphic components holding text that is language dependent, like buttons, etc. this is particularly relevant in the case of packed interfaces (for example PDAs or mobiles) where even a small change in dimensions of a specific object may alter the overall balanced aspect of the GUI. This applies more and more frequently also to web-based applications where is becoming quite common to have GIF objects used to achieve a better overall graphical result for the interface. To these problems there is no unique solution, what is advisable is to take into account such aspects at design time and organise graphical components of images / GUI to accommodate the most probable set of languages that may be addressed at distribution time (whenever possible). We have already mentioned how relevant it is for this kind of content the linguistic issue and how subtle it could be the difference between a good quality and a poor quality multi-lingual management for this kind of content. Nevertheless it is important to see how this issue has been, so far, tackled. At this point is essential to place a clear distinction between audio and video content. As far as audio is concerned we have to take into account the following issue: a song either is available in a specific language or is not. For example there used to be the so-called "*cover*" versions of songs having had a relevant success. This phenomenon was quite common during the '50s and '60s and still applies to some countries (Italy, Spain, South America, China…) both with a localised version of the song or with a re-made one. Just to give some examples of the various possibilities is interesting to take into account that during their long staying in Hamburg, The Beatles, made a German version of Michelle, or that the Italian group Dick Dick made an Italian version of California Dreaming (Sognando California), or singers like Nec, Lura Pausini, Eros Ramazzotti, Rita Pavone, Raffaella Carra and others that have made Spanish versions of their best products. On the opposite side there is "*opera*" where usually no matter where it is performed, it is always performed in the original language (Italian, French or German) even if the public can access to both original and translated version of the text. As far as re-make of songs is concerned is sufficient to think to "Summer in the city" that has been sung at least from Lovin' Spoonfool, Joe Cocker, Joe Jackson each with his own stile and finally by Nelly in an Hip Hop version. As far as video is concerned the issue is far more complex. In this case there are a set of possible solutions, spanning from dubbing up to subtitling. One could try to limit the burden to provide several audio tracks to allow the user to select the desired one, this would be a very coarse solution as in case of absence of synchronisation the result may be quite distant from the user expectation, on in some cases even disturbing or annoying. A totally different issue is the one related to

the metadata associated to this kind of content as in this case it does not matter whether the content is audio or visual, it is just a matter of which languages are supported for the metadata management and how the info are stored. In this latter case (metadata) all that has been said for text and/or metadata applies. This kind of content is basically a combination of the previously mentioned ones and therefore presents the combination of all problems reported so far. At the same time this kind of content has an advantage in respect to the previously mentioned ones, namely they can benefit of all achievement of synthetic graphics that span from the possibility to automatically tune lips-sync up to enable things that are unfeasible to humans. Moreover the implicit digital nature of the product, further enhance the chances to achieve real and effective multi-lingual support.

3.7. Metadata

There are two types of element subsets defined here: the elements that should be filled in every metadata instance (mandatory elements) and the elements that would be very useful to be filled (recommended elements). Metadata include information on:

- Management
- Searching and finding
- Technical interoperability
- Educational attributes
- Digital rights
- Technical features

So far we have primarily focused on content related aspects, now our attention will be moved to metadata itself. This will be done in steps staring from underlying principles to then achieve a better detail. Given the fact that AXMEDIS has its own metadata it is necessary to see where superposition allows automatic replication/transferring of data and where it will be necessary to specifically insert relevant metadata. In practice we have:

- **Data common between AXInfo and LOM** – this data will be possibly automatically filled in at creation time.
- **Data common between Dublincore and LOM** – this data will be possibly automatically filled in at creation time.
- **Data specific to AXInfo** – this data will be filled in at authoring time.
- **Data specific to LOM** – this data should have been possibly filled in at authoring time.
- **Data specific to Dublincore** – this data will be possibly filled in at authoring time for classification and management purposes.

There are two types of element subsets defined here: the elements that should be filled in every metadata instance (mandatory elements) and the elements that would be very useful to be filled (recommended elements). All other elements of our full element set are considered as optional and there is also information about some optional elements. In addition to element explanations this section contains full listings of the vocabularies defined by the project and the data types to be used as value spaces of metadata elements. The purpose of the Metadata Application Profile is to support the exchange of information about online digital resources (Learning Objects) between partners. The metadata described in this application profile supports a variety of LO uses including management, searching, finding, technical interoperability and description of properties of individual LOs including: educational attributes, Digital rights and technical features. IEEE Learning Object Metadata standard (LOM) has been selected as basis for the set of adopted metadata and to support interoperability with other metadata schemes. The information model for the metadata is similar to that of LOM where metadata for a described LO is stored in a metadata element and actual content of an element is called a value. Values can be entered as free text, inserted in predefined format or they are selected from set lists, which are called vocabularies. There are five data types in the LOM information model briefly, LOM types are:

- **CharacterString**: text can be entered in the element directly.
- **LangString**: the text must identify its language and there can be one or more character strings in the element.
- **DateTime**: the element contains date and time information and there can also be textual information about this point in time.
- **Duration**: the element contains information about an interval in time and there can also be textual information about the duration.

- **Vocabulary**: the element contains source and value where source is a reference to publicly sourced and maintained value set and value is a value from that set.

In the remainder of the section are reported the principal metadata associated to a LO and their partitioning in are of major relevance. There are several areas and for each there is a set of values. It is nevertheless possible to modify this structure adding or removing data. Both operations have to be performed following IMS standards in order to avoid ending up with a metadata structure no more compliant. In the packager interface most relevant metadata have been grouped for easier input. In the advanced view is possible to insert, modify or delete data following the regular structure foreseen in IMS. It is worth noting that ISO-639 is included in the MPEG21 standards for: original primary spoken language and primary language of text element. Therefore it is wise to suggest that it should be applied the principle stated from W3C in respect to accessibility best practice in assigning language tags (within html) to the domain of MPEG21 objects, i.e. to identify the 'primary language' of spoken and written content wherever possible within an object.

3.7.1. Mandatory fields (LOM and Dublin core)

In the following paragraph are reported the metadata field that should be considered mandatory when compiling metadata. These are basically the fields that will enable efficient search and retrieval of LO.

- General.Identifier
- General.Title
- General.Language
- General.Description
- Technical.Location
- Educational.Intended End User Role
- Educational.Typical Age Range
- Rights.Copyright and Other Restrictions
- Rights.Description
- Classification.Keyword

Dublin core set comprises elements that are considered optional in the more general sense, but here have been considered as being part of the mandatory part of object metadata. This is basically due to the fact that they provide the only set of metadata that could generically fit to a wide set of content. The Dublin Core Metadata Element Set is composed by the following elements:

- contributor
- coverage
- creator
- date
- description
- format
- identifier
- language
- publisher
- relation
- rights
- source
- subject
- title
- type

To these elements it is worth taking into account also other ones (detailed hereafter) as they represent Other Elements and Element Refinements.

3.7.2. Optional fields (IMS, IEEE-LOM, Dublin core Sets)

Recommended elements are those that would be very useful to have filled in for every metadata instance that is exposed, but they could be left unfilled.

- General.Keyword.
- General.Structure.
- Life Cycle.Contribute.
- Life Cycle.Contribute.Role.
- Life Cycle.Contribute.Entity.
- Life Cycle.Contribute.Date.
- Meta-Metadata.
- Meta-Metadata.Contribute.Role.
- Meta-Metadata.Contribute.Entity.
- Meta-Metadata.Date.
- Meta-Metadata.Language.
- Technical.Format.
- Technical.Size.
- Technical.Facet.
- Technical.Facet.Value.
- Educational.Learning Resource Type.
- Educational.Learning Context.
- Educational.Typical Learning Time.
- Educational.Description.

Dublin core set comprises the following additional elements:

- abstract
- accessRights
- accrualMethod
- accrualPeriodicity
- accrualPolicy
- alternative
- audience
- available
- bibliographicCitation
- conformsTo
- created
- dateAccepted
- dateCopyrighted
- dateSubmitted
- educationLevel
- extent
- hasFormat.
- hasPart
- hasVersion
- instructionalMethod
- isFormatOf
- isPartOf
- isReferencedBy
- isReplacedBy
- isRequiredBy
- issued
- isVersionOf
- license
- mediator
- medium
- modified
- provenance
- references
- replaces
- requires
- rightsHolder
- spatial
- tableOfContents
- temporal
- valid

Whenever recommended best practice is to use a value from a controlled vocabulary, an important point is achieved as this could be easily make comply with multi-language issues as it would be sufficient to localize the related vocabularies to have localized also the management of fields referring to those vocabularies. It is worth mentioning that this is exactly the approach followed in managing similar elements in the LOM. As far as the audiences for a resource is concerned is worth noting that there are of two basic classes: (1) an ultimate beneficiary of the resource, and (2) frequently, an entity that mediates access to the resource. The mediator element refinement represents the second of these two classes. As far as resource references are concerned, recommended practice is to include sufficient bibliographic detail to identify the resource as unambiguously as possible, whether or not the citation is in a standard form.

3.7.3. IPR related fields

Information about who can access the resource or an indication of its security status. Access Rights may include information regarding access or restrictions based on privacy, security or other regulations. Recommended best practice is to identify the license using a URI, the same applies to elements used to indicate the entity. Examples of such licenses can be found at http://creativecommons.org/licenses/. Given the specific context is worth taking into account that MPEG21 offers a specific solution and support for this isse as detailed hereafter. DRM information in the AXMEDIS project will be expressed by means of rights expressions (licenses), described with MPEG-21 Rights Expression Language (REL). Other RELs will be considered during the development of the project. The vocabulary used in these licenses for the description of actions is described in MPEG-21 Rights Data Dictionary (RDD). Terms on MPEG-21 RDD are written in English, but the content of the fields expressed inside licenses are not bounded to any specific language. For instance, the title of the license could be written in Spanish or Italian and it will still be the title element, as expressed in the MPEG-21 REL XML Schema. XML elements are expressed in English language, like grant, exerciseLimit or play. Elements coming from other XML schemas, like the ones related to digital signatures (those starting with “dsig:”) are also written in English. The content of the elements can be expressed in any language, but there is no way to indicate which language is being used. For most of the cases, this does not represent a problem, as we deal with URIs or identifiers. For the case of information whose visual representation may change from country to country, like dates or numbers, the application in charge of showing DRM information should solve this problem, not the rights expression language.

3.7.3.1. IPR Metadata

We have distinguished IPR from copyrights as they are usually dealt with in a very different manner. In most cases it will be necessary to have a clear statement / disclaimer on copyrights holder, but in some case it will be necessary also to have something similar for IPR, which means that the rendering system should be able to handle these metadata and present them somehow to the user once accessing the content. This does not imply nor intend to replace “credits” that may be present and displayed as part of the object (usually a complex / structured one allowing navigation). The basic rational for this is clearly stated below and should be taken into account both at design and rendering time of a content due to its high relevance. Any digital resource and by extent, any creation, can be seen as an intellectual property. For an informal definition we can say that intellectual property refers to the intangible or intellectual na-

ture of works or creations and the body of laws governing such property. An intellectual property can be exploited commercially, based on the intellectual property rights applying to it. The rights holder can provide licenses to allow the exploitation. The terms of licenses may be either predefined or subject to negotiation. The rest of this section presents the different intellectual property rights and their relationship according to some international organisations, conventions and treaties, like Berne Convention, the WIPO Copyright Treaty or the EC Directive on Copyright 2001/29/EC or the US Digital Millennium Copyright Act. These relationships were defined in IPROnto, an ontology which represents the relationship among any entity related to intellectual property rights (IPR). Intellectual Property Rights (IPR) are legal instruments that provide a limited monopolistic right to the owner of things such as patents, trademarks or copyrighted works. They provide an incentive for the creation of and investment in new works (music, films, print media, software, performances, broadcasts, etc.) and their exploitation, thereby contributing to improved competitiveness, employment and innovation. The following figure shows the Intellectual Property Right together with its dependent rights. In the context of copyrighted works, IPR includes author's rights, which will be explained in more detail later, "sui generis" rights (applicable to databases) and neighbouring rights (especially concerning artist-interpreters, phonographic producers and broadcaster organisations).

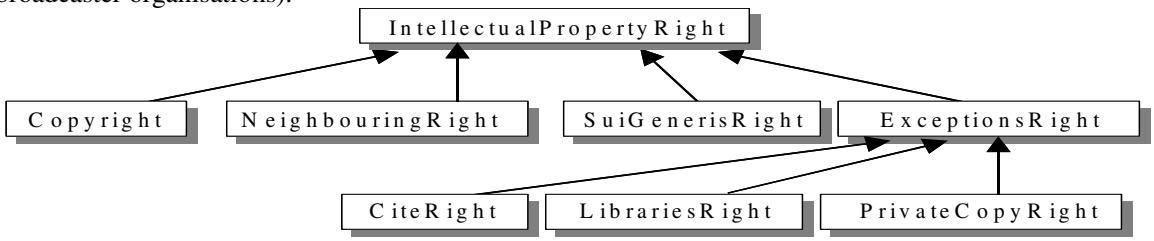


Figure 15. Intellectual Property Right and its dependent rights

While the concept of neighbouring rights originated from analogue technologies, it faces a substantial change in its scope in response to rapid developments in digital technologies which consist of digital, satellite communications and so on. Since digital technologies brought about new concepts like digital reproduction, on-line transmission, satellite broadcasting, public performance connected to computer network and the like, it is clear that the related (or neighbouring) rights must be taken into particular consideration when analyzing the implications of digital technology for the exploitation of protected works and achievements. The producer rights are identified by the following three elements included in each track: a circled capital letter P (P); the name of the owner of the exclusive rights; the year of first publication of the recording. The Copyright is automatically given to originators of works (creators) by the simple fact of their authorship. They include Moral rights that are independent of the author's economic rights and even after their transfer and Exploitation rights (economic rights), which are oriented to guarantee financial profit to originators of works. The following figure shows the relationship between Copyright, Exploitation Right and Moral Right.

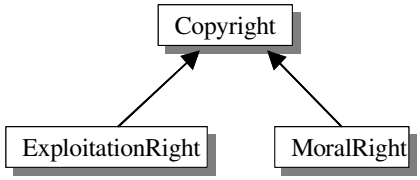


Figure 16. Copyright and its dependent rights

Moral rights are independent of the author's economic rights, and even after their transfer, the author has the following rights:

- **Dissemination Right**: exclusive right to disclose the work.
- **Paternity Right**: exclusive right to claim authorship of the work.
- **Respect Right**: exclusive right to object to any modification to the work prejudicial to his reputation.
- **Withdrawal Right**: Exclusive right to withdraw the work.

The next figure shows the Moral Right together with its dependent rights.

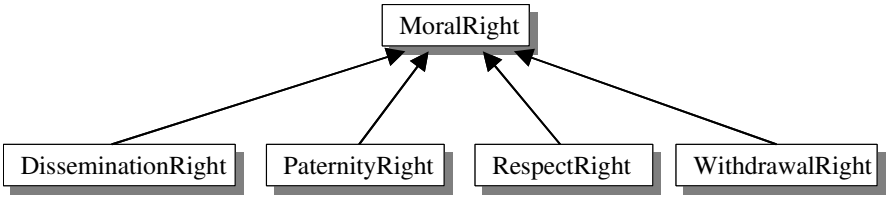


Figure 17. Moral right and its dependent rights

Exploitation rights (so called economic rights) are oriented to guarantee financial profit to originators of works. They include:

- **Reproduction Right**: Exclusive right to authorize the reproduction, direct and indirect, permanent or temporary, in any manner or form.
- **Communication to the Public Right**: Exclusive right for the authorisation of any communication to the public of their works. These includes that members of the public may access them from a place and at a time individually chosen by them. Examples are: public performance, broadcasting, interactive on-demand transmission, etc.
- **Distribution Right**: Exclusive right to authorize the making available to the public of the original or copies of the work by sale or other transfer of ownership (relevant only to tangible objects).
- **Transformation Right**: Exclusive right to authorize the manipulation of their works in any manner or form.

The next figure shows the exploitation right and the relationship with its dependent rights.

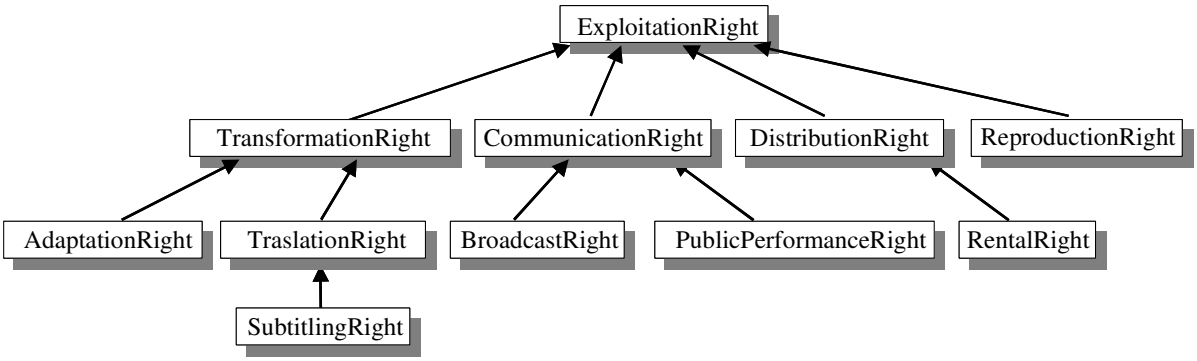


Figure 18. Exploitation right and its dependent rights

3.7.3.2. DRM Metadata

These are the most important metadata for objects, as they will condition their fruition. Please take into account that DRM metadata will affect also content aspect as if it is stated there that no degradation is allowed then (taking the example of a image) panning may be necessary during fruition on a device depending on screen dimension…. DRM metadata includes different kinds of information regarding AXMEDIS objects. From the one side, we can have protection information about how an object is protected and how we can control this protection. From the other side, we can have rights expressions information, including the semantics of the rights expressions that indicate how an AXMEDIS object is governed. In order to express protection information or rights expressions information, there are several standard initiatives, which describe the format of this information and the information that can be expressed. One of these standard initiatives is MPEG-21. Three parts of this standard are directly related with protection and governance information: Part 4, Intellectual Property Management and Protection (IPMP), Part 5, Rights Expression Language (REL) and Part 6, Rights Data Dictionary (RDD). There is also another international standard initiative for the definition of an open standard for the Digital Rights Management expression language, the Open Digital Rights Language (ODRL) Initiative. The Open Mobile Alliance is using this language as its DRM REL. Rights expression languages (RELs) have been proposed to express rights and conditions of use of digital content. RELs can be used for example to describe an agreement between a content provider and a distributor, or between a distributor and an end user. Part 5 of the MPEG-21 standard specifies the syntax and semantics of a Rights Expression Language (REL). In par-

ticular, it specifies the syntax and semantics of the language for issuing rights for users to act on Digital Items. One important concept in REL is the License, which could be considered as DRM metadata. A License is a container of grants that are formed by a principal that has the permission to exercise a right against a resource under some conditions that must be previously fulfilled. Next figure shows the structure of a REL License.

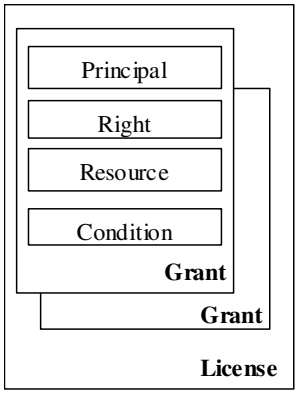


Figure 19. REL License

Inside a REL license, the most important element is the Grant. A Grant is an XML structure that is formed by four elements:

- **Principal** represents the unique identification of an entity involved in the granting or exercising of Rights.
- **Right** specifies an action or activity that a Principal may perform on, or using, some associated Resource.
- **Resource** represents the object against which the Principal of a Grant has the Right to perform.
- **Condition** represents grammatical terms, conditions and obligations that a Principal must satisfy before it may take advantage of an authorisation conveyed to it in a Grant.
- A **Grant** expresses that some Principal may exercise some Right against some Re-source, subject, possibly, to some Condition.

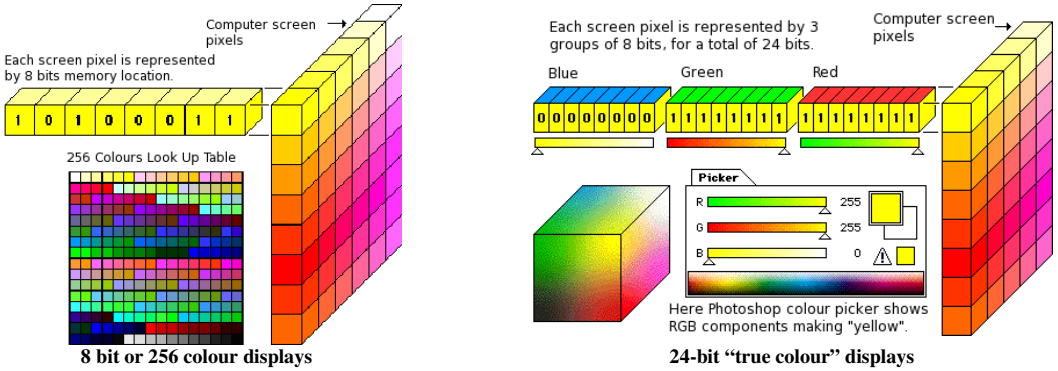
MPEG-21 REL makes use of the Rights Data Dictionary, part 6 of the MPEG-21 standard, that comprises a set of clear, consistent, structured, integrated and uniquely identified terms. The structure of the RDD is designed to provide a set of well-defined terms for use in rights expressions. Another part of MPEG-21 that could have in the future some impact in DRM metadata is part 4. The aim of this part, Intellectual Property Management and Protection (IPMP), is to allow controls on the flow and usage of digital items throughout their lifecycle. It is currently in a draft status. This standard considers two different concepts:

1. IPMP Digital Item Declaration Language, which provides for a protected representation of the DID Model, allowing both protection and governance of digital items.
2. IPMP Information schemas, structures for expressing information relating to the protection of content, including tools, mechanisms and licenses

The impact of IPMP in DRM metadata regarding AXMEDIS project has to be evaluated along its development, as the evolution of the standard is currently not clear. Nevertheless, AXMEDIS partners are involved in the specification of this standard part.

3.8. Constraints

It is worth starting from the difference that is implied by the various kinds of colours rendering formats:



8 bit or 256 colour displays **24-bit "true colour" displays**

Figure 20. Colour representation for screen rendering

The difference among these representation formats is crucial in content selection as it implies quite relevant limitations in the first case and even problems when objects with different characteristics are combined.

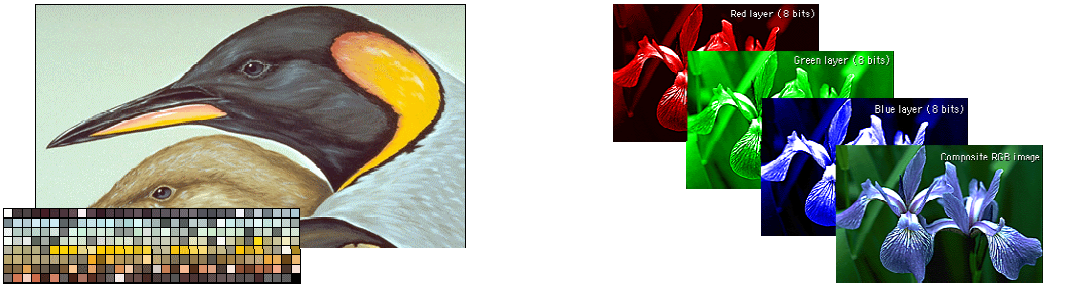


Image holding a 256-colour palette **Composite RGB image and related 8-bit component images**

Figure 21. Palette vs RGB Colour representation for images

For example to achieve a good colour rendering with a 8 bit format is often adopted the "*palette*" approach that leads to images with a different set of colours indexed and that when presented together may originate strange effects like colour inversion… on non "*true-colour*" devices. The same may apply in case of true colour images rendered on 65K or 256 colour capable devices, they will render the images in incorrect mode giving the end user a poor result.

Original full-colour photograph **Dithered to 256 colours** **Dithered to 1 colour**

Figure 22. Dithering effects on images

It is also necessary to take into account that different OS have usually also different default settings in terms of basic palette (at least as far as web content is concerned) as reported hereafter:

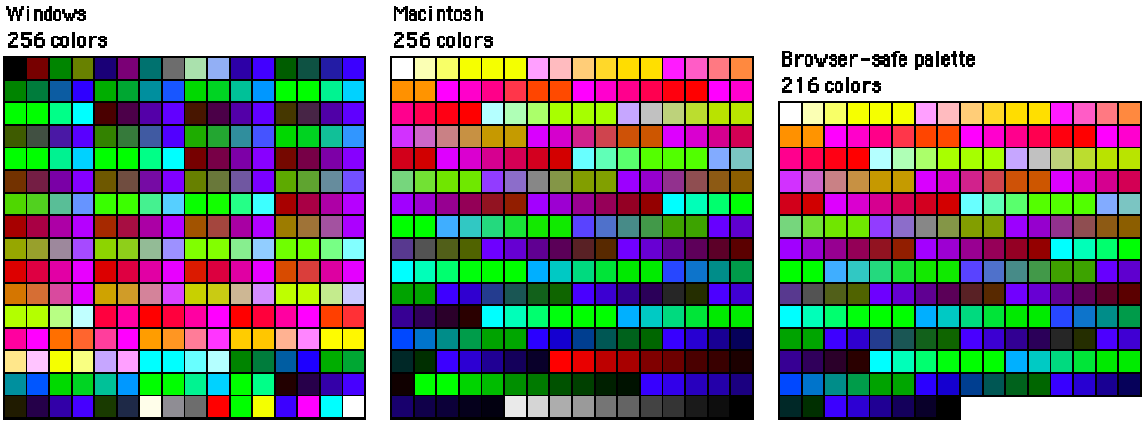


Figure 23. Palette comparison (Windows vs Macintosh) and Web safe palette

The adoption of a browser safe palette allows retaining image quality avoiding rendering issue as can be clearly seen in the following images taken from following site www.dartmouth.edu/~hist12:

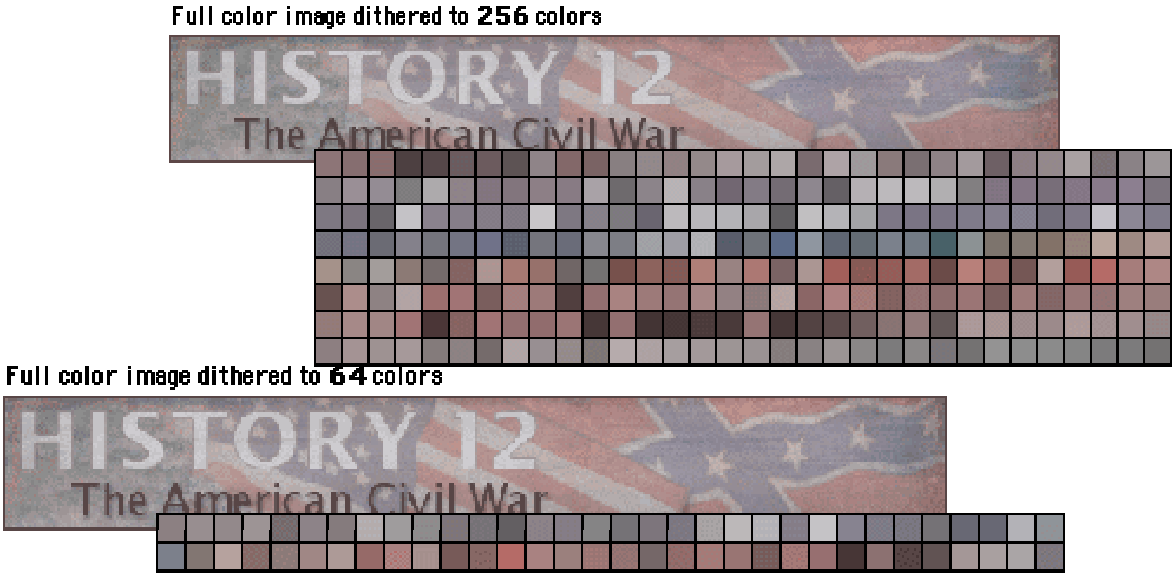


Figure 24. Optimised Palette result comparison (256 vs 64 colour)

Forcing a GIF made from custom palette colours to display within the limited system palette colours can result in image distortions. For example a Web browser running on an 8-bit display may not optimize a custom GIF colours and could force display original colours in the nearest equivalent in the browser palette distorcing the original colours, as in the example below:

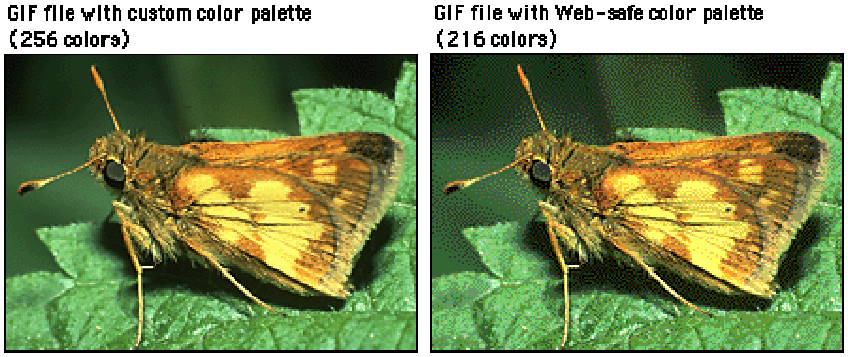


Figure 25. Optimised Palette vs web safe one

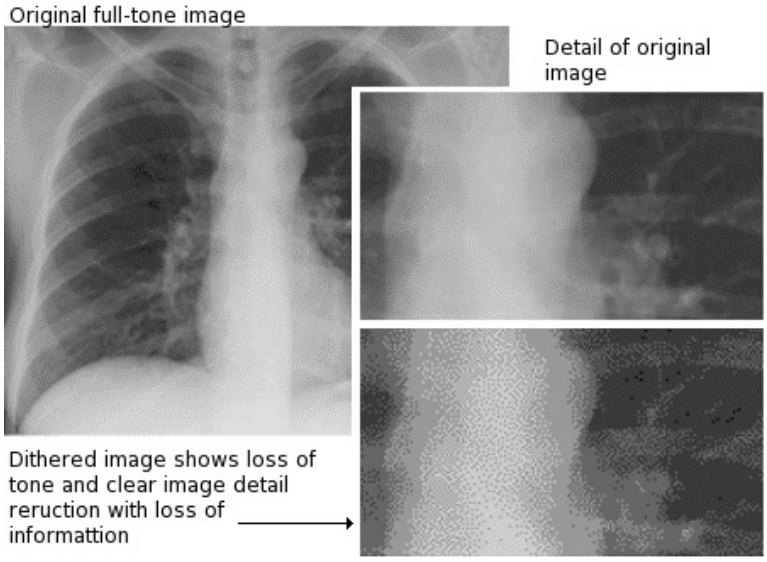


Figure 26. Problems induced by dithering in medical images

While the adoption of dithering and palettes may help much in having lighter graphics for certain purposes it may also have some very disappointing results especially as far as certain content are concerned (as apparent from the medical images reported for reference aside) therefore the utmost care should be placed when checking image handling performed on some specific content.

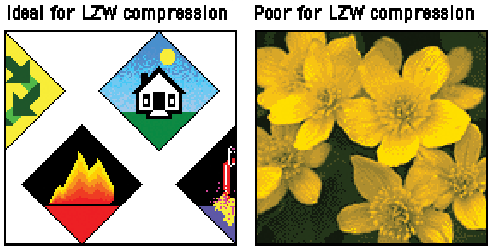


Figure 27. Images and LZW compression

Another relevant point to be considered while performing content selection is the eventual need for compression of the acquired image based content. If content has to be compressible for transmission needs, or for any other, it is crucial to know weather the acquired content is suitable or not. The concept of suitable, in this case, has to be specified as it could refer to the technical aspect (a synthetic image is more suitable for a LZW compression than a natural scene, just as presented in the example aside), or to the usage/content purpose one, just as an example is worth taking into account a medical image; from the following example is apparent that it is not suitable for being stored into a JPEG format as the inherent loss of information may alter the possibility for a proper use.

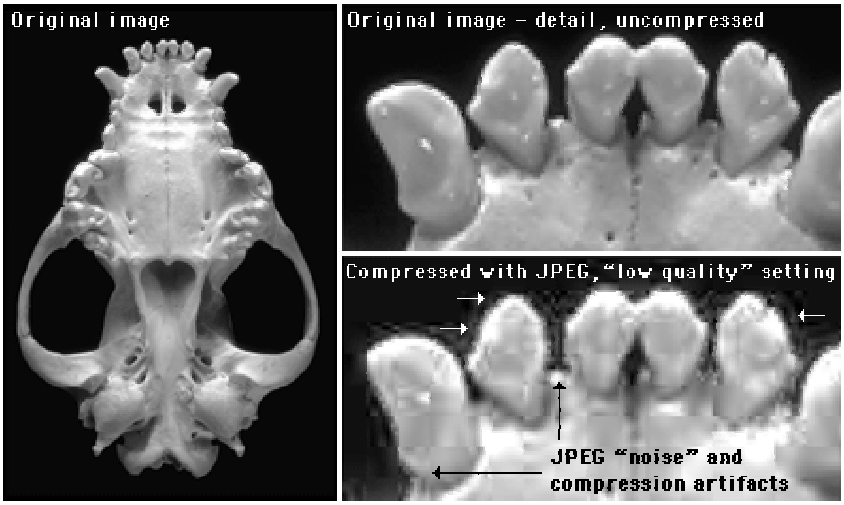


Figure 28. Medical image and artifacts induced by image compression

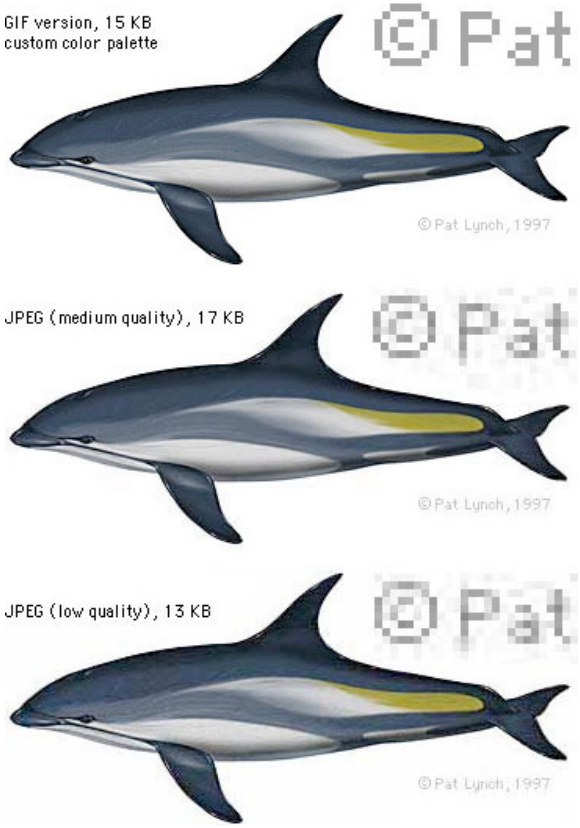


Figure 29. GIF vs JPEG compression

Another example of JPEG compression is shown below, note compression noise and distortion of the bottom dolphin; the image is lower quality than the original GIF, yet it could be acceptable on a small screen with a limited number of colours; what really makes this JPEG image unacceptable is the text loss in quality (the save in downloading time is not worth the degrading). Vector graphic illustrations have the advantage to be automatically antialiased when imported into raster imaging programs and converted. A last point to be taken into account when selecting image-based content is the different aspect ratio for an image and the different colour space between screen and paper based fruition. For a screen based fruition there are 72x72 pixels for a square inch with a colour resolution of millions of colours while for a text based one in the same square inch there are 150x150 dots but only four colours are available. This may turn out in different appearance in the same image once printed out in respect to the one originally viewed on the screen. Moreover, due to the different dimensions of a *pixel* in respect to a *dot,* the same image turns out to have different proportions when seen on paper or on screen at the same resolution.

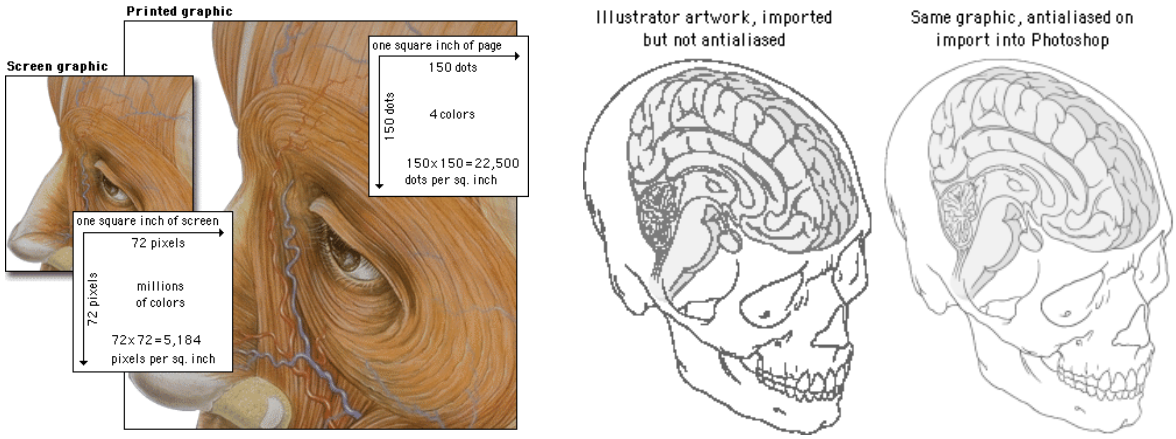
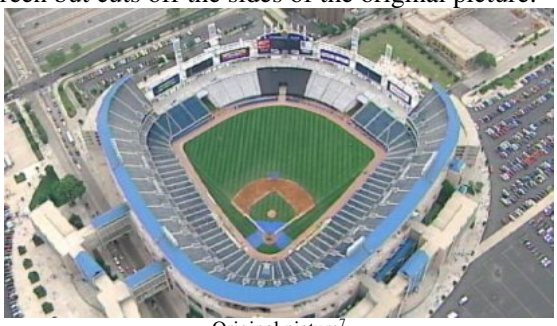


Figure 30. Print vs screen images (including antialiasing and vector graphics)

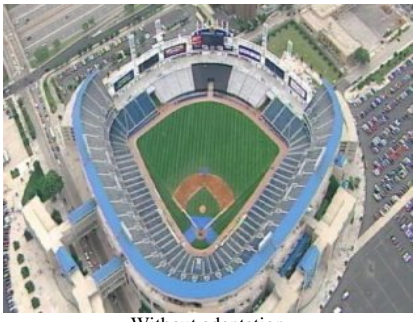
Hereafter are reported some examples of the issues that screen differences in aspect ratio and dimensions will imply at user fruition time. Reference is made to standard TV broadcast level. Images are taken from "Camera Systems" website portion related to widescreen by flying pictures live[6]. The most relevant points to be taken into account are that digital widescreen technology uses all lines available on a television screen giving a sharper picture particularly when viewed on a 16:9 screen, while on a conventional 4:3 set get squashed making the picture look taller and slimmer. Usually the widescreen signal is converted in a 4:3 either by letterbox or centre cutout. ***Letterbox***: Viewing the whole picture as a "letterbox" - but leaving black bands above and below the screen. For example, this may be the preferred option when viewing films on a 4:3 monitor. ***Centre cutout***: this cuts off the extra information to the sides of the

[6] http://www.flyingpictureslive.com/cameras/widescreen.html

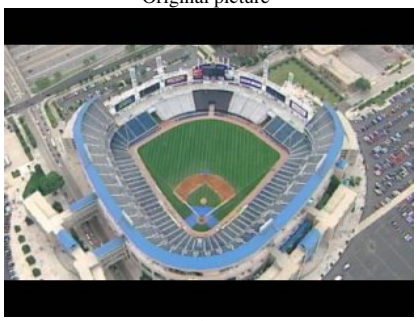
picture. Viewing the centre portion only of the original widescreen picture. This fills the 4:3 television screen but cuts off the sides of the original picture.



Original picture[7]



Without adaptation

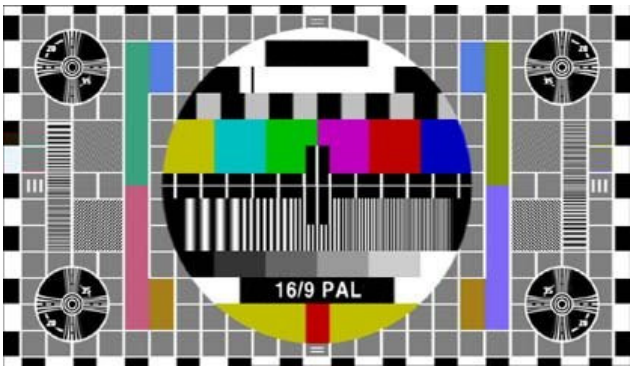


With ***Letterbox*** adaptation

With ***Centre cutout*** adaptation

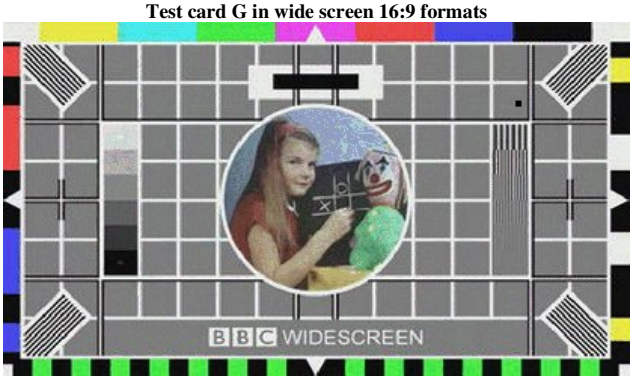
Figure 31. Distortion induced by adaptation of wide screen pictures to normal screens

What just stated is usually reflected also in Test card F/G, as apparent from the following pictures reporting it in wide screen 16:9 and 4:3 formats (the F format is from BBC).



Test card G in wide screen 16:9 formats

Test card G in 4:3 formats



BBC Wide screen 16:9 Test card F

BBC 4:3 Test card F

Figure 32. Test screens for 16:9 and 4:3 screens

[7] The off screen captures are from the same camera switched from 4:3 to 16:9 mode. Chicago's Comiskey Park Stadium shot in both 4:3 and 16:9 wide screen formats from the air the extra coverage is clearly appreciated

It is worth taking into account that adaptation may also occur when content prepared for display over a 4:3 screen is displayed onto a 16:9. As evident in the following images wide-screen TVs have ways to stretch, crop, or zoom the regular 4:3 image so that it fills the screen. These methods distort the image somewhat, but many wide-screen TV owners prefer looking at slightly stretched people rather than window box bars.

Table 11. Comparison among several most diffused way to adapt 16:9 to 4:3 screens

Normal or 4:3
Places window box bars on either side of the 4:3 screen. This solution provides a good image quality but present the side black stripes that are often disliked by the end user. Therefore the following solutions have been identified. Each of them has advantages and disadvantages that are quite evident from the picture.

Panorama, Theatre Wide, or Natural
TV makers have many names for modes that compromise between stretching and zooming to fill the screen. Some stretch the sides of the image more than the middle, so people in the centre of the screen look correct. Some crop a little so that they don't have to stretch as much.

Zoom or Enlarge
Magnifies the entire image, eliminating the window box bars but cropping the top and bottom of the image. Often, more than one level of zoom is provided. Depending on content image the superimposed distortion may be acceptable or not. In this case the results is comparable to original and the user may be satisfied.

Wide or Full
Used for native 16:9 content such as that found on DVDs. With 4:3 content, such as regular TV, it stretches the image horizontally, making people look shorter and fatter. Obviously the user may be quite annoyed with such a distortion, which may be quite evident in most of the cases.

Source: CNET (http://cnet.nytimes.com/4520-7608_7-1016109-4.html)

Table 12. Comparison among several most diffused way to adapt 16:9 to 4:3 screens and related distortions

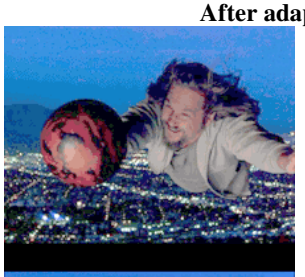
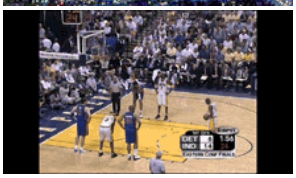
Before adaptation		After adaptation	
	Letterbox bars are visible at the top and bottom. You can see how the director intended the shot to look.		The image fills the screen, but it is less sharp, and it cuts off the left and right sides. Who knows what's in left hand?
	Output intended for 16:9 on a 4:3 stretches everything to look artificially tall and thin. Note that the spherical bowling ball is now oval-shaped.		Adapting image to match the 4:3 screen displays the image in its correct proportions. The bowling ball correctly shows its circular form.
	Black bars are visible on the left and right of the screen.		The image fills the screen, but it is less sharp, top and bottom parts are cut-off (the clock is no longer visible in upper left corner).
	Black bars are visible on the left and right of the screen.		The image fills the screen, but it's distorted, making everything appear wider and fatter.

Table 12. (bis) Comparison among several most diffused way to adapt 16:9 to 4:3 screens and related distortions

Before adaptation		After adaptation	
	Black bars are visible on the left and right of the screen.		The image fills the screen, keeping proper proportions toward the centre, stretching only extreme left/right edges.
	Black bars are visible on all four sides of the screen of this letterboxed documentary on the Discovery Channel.		The image fills the screen. It's not as sharp, but nothing is cut off.
	Black bars are visible on the top and bottom of the screen of this scene from The Return of the King's climactic battle scene.		The image fills the screen, but it's not as sharp and it cuts off the left and right making the scene somewhat more claustrophobic.

In the past years, the minimal resolution, mostly on laptop, was 800x600. But now it is more often 1024x768. The standard resolutions available on a desktop computer with a 21" screen are:

Table 13. Most diffused screen resolutions

Resolution	Ratio	Resolution	Ratio	Resolution	Ratio	Resolution	Ratio
640x480	4/3	1280x768	5/3	1600x1024	25/16	1920x1440	4/3
600x600	4/3	1280x960	4/3	1600x1200	4/3	2048x1536	4/3
1024x768	4/3	1280x1024	5/4	1920x1080	16/9		
1152x864	4/3	1600x900	16/9	1920x1200	8/5		

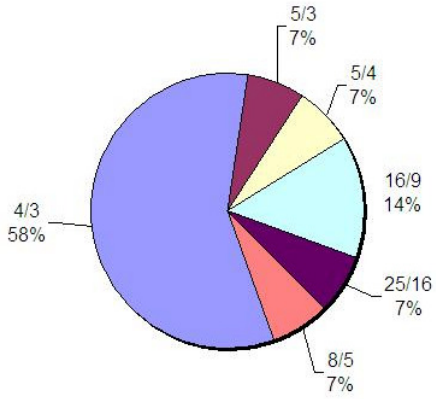


Figure 33. Distribution of the several resolutions over their ratio

The graphic shows the distribution of the several resolutions over their ratio. Given what just stated these are the available resolutions that could be expected so far to be the average and therefore our targets for the initial testing phase:

- For a PC the resolution is mostly 1024x1280, 864x1152, 768x1024 or 600x800.
- For a laptop or a Tablet PC the resolution is mostly 768x1024 or 600x800 (for the latter the screen can be rotated by 90°).
- For PDA, Pocket PCs have mostly 240x320 and 480x640 capabilities, while Palm OS have 160x160, 320x320 and 320x480.

The implications in terms of required delivery bandwidth (either for download or streaming) are extremely important. This is mainly due to the fact that user acceptance (and consequently economic revenues) may be deeply affected.

While it is not feasible to grant a 30 frame per sec at 640x480 16bit video data stream on a 56k GPRS connection it is feasible with present implementation of UMTS connections; therefore video streaming would not be considered via GPRS but may be considered via UMTS. It is also important to consider the Quality of Service (QoS) characteristics of the channel. All these factors are relevant for certain types of interactive or streamed content. When taking this into account (or even when taking into account the need for a reduction on object dimensions is extremely important to verify the readability of the result itself. This is particularly true when dealing with PDA and mobiles. Present screen sizes and resolutions of these devices are far from being comparable with those of high-end devices (PC or similar) so that the same content may result quite degraded once presented on such device. Quality implication may also be a limiting factor for content owners in respect to selling or renting the content itself (certain authors or pub-

lisher do not grant permission of usage of their content unless a specific quality level is granted and require in any case to be presented an actual sample of final result prior to grant usage authorization).
Subtitling and synchronization is particularly relevant when selecting content that has potentially an extremely wide audience, as language dependency may constraint its usage. In many European countries it is common to dub audio-visual material, while in others it is preferred to have the original audio and subtitling. Apart from this aspect that implies that object selection can be influenced (under this respect) by target market, it is also important to notice that whenever the same content is also used for educational purposes subtitling is highly desirable plus (feature to be de/activated on request) for better content comprehension. Subtitling is also useful for users with hearing disabilities and of course also for client platforms that do not support audio. There is finally another issue to be taken into account when selecting a subtitled content, namely: subtitling has to be easy to read (right font size, colour contrast level…). The key issues here are whether the content is already subtitled, or it may be subtitled, and secondly whether the target use requires subtitles. As a selection criteria, it is therefore not necessarily a 'showstopper' for video content to not be subtitled, but the availability of subtitles needs to be flagged somewhere in metadata to ensure that content is suitable for uses requiring subtitles. With the wide range of media related to the AXMEDIS, it is important to note that there are various technologies and approaches to combine different medias in order to achieve content accessibility for the end user. In this respect subtitling and synchronisation issues are particularly important. In terms of subtitling, there is a company involved with C4 and Broadcast Text called Softel Online.

3.9. Accessibility

Despite what is often thought, accessibility is a much broader issue than it is perceived. In essence true accessibility covers every aspect of content, from its format to its fruition and acquisition. It is an underlying constant in the whole production and fruition value chain. This takes its origin from a basic finding: "*all that is designed to be accessible is also more usable at all levels and form a broader set of users than the one for whom it has been designed*". This has a very relevant impact as it implies that accessibility starts at the design phase. If something is not design for being accessible it will be very hard to make it accessible afterwards. As this document deals with the selection process for content we would like to point out that to build accessible contents is required to take into account a set of basic criteria, starting from very simple ones (like adopting simple exposition, plain words, easy linguistic forms, clear fonts…) up to more complex ones (like those expose in the 508 article or the W3C recommendations for accessibility). In more detail we can profitably benefit from W3C guidelines adoption as (more and more often) content is available also in web format. The W3C has a specific initiative related to accessibility and also provides guidelines and checklists related to web content accessibility; such checklist is prioritized in three levels as apparent from the following abstract. Each checkpoint has a priority level assigned by the Working Group based on the checkpoint's impact on accessibility. In more detail, we have that:

Priority 1	A Web content developer **must** satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents.
Priority 2	A Web content developer **should** satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents.
Priority 3	A Web content developer **may** address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents.

On a side, in the context of traditional publishing or media production, the digital world makes it easier to produce content that is accessible both in the wider sense and to different kind of people with disabilities. On the other side it is often said that people with disabilities do not represent a significant market to justify any effort of providing really accessible content; yet according to Eurostat, in year 2000, people with some degree of impairment were accounting over 40 million in the EU (well over 10% of the whole population of the time). It has to be taken into account that, with a more general use of structured content, the constantly increasing volume of metadata associated to digital resources, and the growth in sophistication of production processes, it has become easier to produce really accessible digital resources. On some markets, it is considered as a requirement to provide accessible resource rather than "traditional" ones. This is the case in the Nederland where is mandatory to have a Braille version deposited for every newly published book. In addition, experience shows that resources that are conceived taking into ac-

count accessibility prove to have a far better quality also in their "standard" version. A truly accessible design can often enhance usability for all users. When taking into account websites this makes them also easier to be managed by automated access such as by search engines. A key to accessibility is to allow people access content in their preferred way. This can benefit both generic users as well as those with disabilities. Some user may prefer icons and others may prefer text; even fully able people may like to adjust text sizes depending on their viewing circumstances. On the other side search engines, just like blind people, generally cannot make much use of graphics. Different contents require different degrees of concern as far as accessibility is concerned; for example: a content providing information specifically related to blindness would need to be fully accessible to blind people while content about (or a site selling) spectacles, probably, would have far less reasons to be fully accessible to totally blind users. As far as educational content, like school books, is concerned, it is necessary to take into account that content is for now mainly text and images, therefore the first concern is to make it fully accessible also to visual impaired users. The work to do this is still at an early stage, but some basic rules do emerge and are integrated in the construction and design process.

4. Summary and FAQ

- One or more pages to reiterate key points which have been learnt
- FAQ – common questions that arise
- Etc …

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6. Glossary

For all domain specific terminologies used, to clarify the intended meaning and usage

Term	Explanation (including source if available)
CMS	Content Management Systems
Colour space	Effectively, the dynamic range of colour and contrast. A wide colourspace includes brighter whites, darker blacks and richer colours.
DCMIType	DCMI Type Vocabulary. A list of types used to categorize the nature or genre of the content of the resource
DDC	Dewey Decimal Classification. See: http://www.oclc.org/dewey/index.htm
Editorial format	In AXMEDIS, an editorial format is a combination of layout template and stylesheet that enable a set of source content to be formatted for a given distribution channel and output device. It therefore includes both format (fonts, colours, etc.) as well as layout (sizes, spacing, positioning of elements, etc.)
Frame rate	The number of still frames per second within a video file
IETF	Tags for the Identification of Languages see RFC 3066
IMT	The Internet media type of the resource. See: http://www.iana.org/assignments/media-types/
ISBD	International Standard Bibliographic Description, prepared by the Working Group on the General International Standard Bibliographic Description set up by the International Federation of Library Associations and Institutions (IFLA) Committee on Cataloguing (London, IFLA International Office for UBC, 1977). The Anglo-American Cataloguing Rules (second edition) are based on the ISBD general framework for the description of library materials, including the order of elements in the catalog entry and prescribed punctuation. http://www.ifla.org/VII/s13/pubs/isbd.htm
ISBN	International Standard Book Number. http://www.isbn-international.org/en/revision.html
ISO3166	ISO 3166 Codes for the representation of names of countries. See: http://www.iso.org/iso/en/prods-services/iso3166ma/02iso-3166-code-lists/list-en1.html
ISO-639	International Standard naming system for languages. ISO-639 codes now include subtags to identify dialects such as lang='en-GB' indicates British-English content rather than US-English.
ISO639-2	ISO 639-2: Codes for the representation of names of languages. See: http://lcweb.loc.gov/standards/iso639-2/langhome.html
KMS	Knowledge Management Systems
LCC	Library of Congress Classification. See: http://lcweb.loc.gov/catdir/cpso/lcco/lcco.html
LCSH	Library of Congress Subject Headings
LCMS	Learning Content Management Systems
LO	Learning Object (see IMS in references)
MARC	MAchine-Readable Cataloging. The five MARC 21 communication formats, Bibliographic Data, Authority Data, Holdings Data, Classification Data, and Community Information, are widely used standards for the representation and exchange of bibliographic, authority, holdings, classification, and community information data in machine-readable form.
MESH	Medical Subject Headings. See: http://www.nlm.nih.gov/mesh/meshhome.html

Term	Explanation (including source if available)
NDA	Non Disclosure Agreement, also called confidential disclosure agreement (CDA), confidentiality agreement or secrecy agreement. It represents a binding legal contract between at least two parties which outlines confidential materials the parties wish to share with one another for certain purposes, but wish to restrict from generalized use. NDAs can be used to protect any type of intellectual property or trade secret. As such, an NDA can protect non-public business information, know-how, patent-pending inventions, unpatented yet patentable inventions, unpatentable ideas, or copyrighted software.
NLM	National Library of Medicine Classification: See: http://wwwcf.nlm.nih.gov/class/
ODL	Open and Distance Learning
POPE	Produce Once, Publish Everywhere
QoS	Quality of Service – relates to telecommunications and the reliability and predictability of services. For example, a private line telephone link can have a guaranteed QoS whereas a voice-over-IP telephone connection relying on the internet will have no guaranteed QoS.
RFC1766	Internet RFC 1766 'Tags for the identification of Language' specifies a two letter code taken from ISO 639, followed optionally by a two letter country code taken from ISO 3166. See: http://www.ietf.org/rfc/rfc1766.txt
RFC3066	Internet RFC 3066 'Tags for the Identification of Languages' specifies a primary subtag which is a two-letter code taken from ISO 639 part 1 or a three-letter code taken from ISO 639 part 2, followed optionally by a two-letter country code taken from ISO 3166. When a language in ISO 639 has both a two-letter and three-letter code, use the two-letter code; when it has only a three-letter code, use the three-letter code. This RFC replaces RFC 1766. See: http://www.ietf.org/rfc/rfc3066.txt
Sample rate	The number of samples taken per second of digital audio within a file.
SMIL	Synchronized Media Integration Language
TGN	The Getty Thesaurus of Geographic Names. See: http://www.getty.edu/research/tools/vocabulary/tgn/index.html
UDC	Universal Decimal Classification. See: http://www.udcc.org/
UNIMARC	Standardised format describing cataloguing records, for more info http://www.ifla.org/VI/3/ubcim-archive.htm http://www.ifla.org/VI/3/p1996-1/sec-uni.htm See also MARC, ISBD, ISBN
URI	A URI Uniform Resource Identifier. See: http://www.ietf.org/rfc/rfc2396.txt
W3CDTF	W3C Encoding rules for dates and times - a profile based on ISO 8601. See: http://www.w3.org/TR/NOTE-datetime
Word length	The number of bits and hence the resolution and quality of a digital audio or image file. In the case of audio, this relates to the dynamic range of the audio, in the case of graphics this relates to the resolution of intensity for each primary colour. Normal values are in 8 bit groups (8,16, 24…).
XSL	Extensible Stylesheet Language