United Nations Educational Scientific and Cultural Organization

and

International Atomic Energy Agency

THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

**A WEB COMMUNITY TO FOSTER SCIENCE IN
DEVELOPING COUNTRIES:  WWW.ICTP.IT**

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**Abstract**

The experiences with the new ICTP website, aiming to satisfy the needs of a modern and appealing image as well as provide tailored on-line information and services to its scientists (in-house and around the world), are discussed as a case-study of an emerging web-based international community. This approach, which to our knowledge has not been similarly employed by the scientific community in the past, keeps in mind the special audience and the uniqueness of the ICTP scientific structure and organization. The present approach is a decentralized architecture that offers space and freedom for creativity specific to various scientific programs, while managing a minimal amount of common structure. The new website was developed using open source technologies and web standards certified by W3C.

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## 1. THE ICTP SCIENTIFIC AND MULTICULTURAL COMMUNITY

Founded in 1964 by Abdus Salam (1979 Nobel Laureate in Physics), the International Centre for Theoretical Physics (ICTP) operates under a tripartite agreement among the Italian Government and two United Nations Agencies, UNESCO and IAEA. Its mission is to foster advanced studies and research in developing countries. While the name of the Centre reflects its beginnings, its activities today encompass most areas of physical sciences including applied sciences.

Created during the Cold War in the heart of Europe, ICTP provided a rare line of communication between scientists from the East and West. ICTP soon emerged as a focal point of cooperation between the North and South, aiming to help scientists from developing countries to overcome their isolation and contribute to their state-of-the-art research in physics and mathematics. While details have changed with time, the basic relevance of the Center has remained unchanged. The Centre is an institution in which its scientific strengths are combined with a strong dissemination effort.

ICTP has pioneered in the implementation of web technologies since 1992 in order to help with the transfer of knowledge to remote areas [Canessa 1994, 2000]. Also, since 1996, ICTP has established extensive (in-situ) training programmes on information and wireless communications technologies, especially on the application of open source technologies, to facilitate Internet access to academic institutions in developing countries. It has also contributed to the production of the first Virtual Lab Toolkit of UNESCO [Canessa 2002], and launched in 2001 the electronic Journals Delivery Service (www.ejds.org) to reach individual scientists in regions with slow connectivity, using e-mail only or web-to-e-mail gateways. This has been made possible through individual arrangements with main science publishing houses (APS, Elsevier, IoPP, AMS, PNAS, World Scientific, OSA and others).

ICTP comprises of a large community of scientists world-wide. Since 1964 the Centre has received about 100,000 scientists, half of whom have come from the developing world. Visitors have represented some 170 nations and 40 international organizations. In recent years, more than 5,000 scientists visit ICTP annually to participate in its research and training activities, numbering more than 50, and to conduct their own research in various fields of physics and mathematics. Over the past five years, the number of women participating in ICTP activities has increased steadily and now stands at 21 percent. The majority of scientists from the developed world come at their own expense. Furthermore the Centre sponsors an Associates Programme, to provide research opportunities in physical sciences. Many Associates are connected to the Centre for periods of time on the order of ten years, during which they visit the Centre regularly for short periods of time while maintaining a viable research program in the countries of their origin. Other programs include support for external activities, joint (SANDWICH) Ph.D. Program, Diploma Program for young students from the least developed countries and the so-called TRIL (Training and Research in Italian Laboratories) Program which allows qualified scientists from developing countries to work for a year or two in various Italian laboratories.

Coinciding with the 40th anniversary of ICTP, a new ICTP website was made open to the public, with the aim of satisfying the needs of presenting a modern and appealing image to the world as well as provide tailored on-line information and services to its scientists (in-house and around the world). Keeping in mind the special audience and the uniqueness of the ICTP scientific structure and organization, the approach taken to set up this new website was a decentralized architecture, thus offering freedom for creativity following the scientific philosophy of each of its different groups. The new ICTP website was developed using open source technologies and web standards certified by the WWW Consortium [W3C].

The experiences with this novel approach, which to our knowledge has not been used before by the scientific community, is what we discuss in the paper as a case study of an emerging web-based international community: **www.ictp.it**


## 2. WEBSITE RE-ENGINEERING: DISTRIBUTED, HETEROGENEOUS ENVIRONMENT

The importance of a detailed planning of the website structure, strategy and content tree, even before considering the issues of graphical layout and interface design, was essential for the re-engineering of the ICTP website, keeping in mind more than a decade of experience on information services [Canessa 1994].

The approach adopted was simple, open, flexible, reliable and ready for fast deployment, because all of its components had such characteristics. The strategic plan for a new ICTP website included the following structure: A core part called *"header"* and a few *"satellite sub-sites"*, the latter providing in-depth information. This is schematically shown in Figure 1.

- The Header:
  The header provides the top level structure of the whole ICTP public website, with general information about the Centre and its activities, research groups and services. This header was based on (rather) static pages written in XHTML (transitional 1.0) for the content (mark-up) and relay on CSS1-Cascading Style Sheets (with some functions of CSS2) for the graphical appearance. Its strict separation of structure (pages and menu tree), content (textual information) and appearance (graphical layout) facilitates the conformity to accessibility rules, providing an attractive appearance and a uniform *"ICTP look-and-feel"* to visitors with modern browsers but at the same time giving full access to the information by using any browser, even at low bandwidth, including the special browsers for impaired people and some web-capable mobile devices. This is obtained in strict accordance with the web standards [W3C], without duplication of the structure (*i.e.,* no *"double versions"* or *"text-only version"* of the pages), and avoiding complex scripting and any use of proprietary/closed technologies. This header is fully searchable by external search engines and provides also an internal search facility that extends, up to a certain level, inside the sub-sites too. The (semi)static header of the website, having minimal dynamical contents (simple scripts), is intrinsically little vulnerable to computer attacks.


- Satellite Sub-sites
  When available, they provide in-depth information about the different research groups and their activities and news, as well as access to administrative services and facilities. The sub-sites are based on pages dynamically generated (HTML and XHTML-Extensible Hypertext Mark-up Language, CSS) by web applications like open source content managements systems (CMS) and web portal engines (based on MySQL, PHP or other languages), customized to have a look-and-feel similar to that of the header. Such sub-sites may not have the same accessibility features of the header, sometimes requiring modern browsers for the full access to the information (this is due to limitations of the actual technology of CMS and portals, and may be reduced or eliminated in the future). These sub-sites should meet the needs of the different ICTP groups and administrative offices or services.

### 2.1 Optimization of resources

Use of available satellite web services based on database technologies already implemented at ICTP such as the ICTP Library, the Agenda of SMR Activities, the SIS-Scientists Information System), have been linked to the header and slightly or even not modified or adapted to look more similar to the new main website.
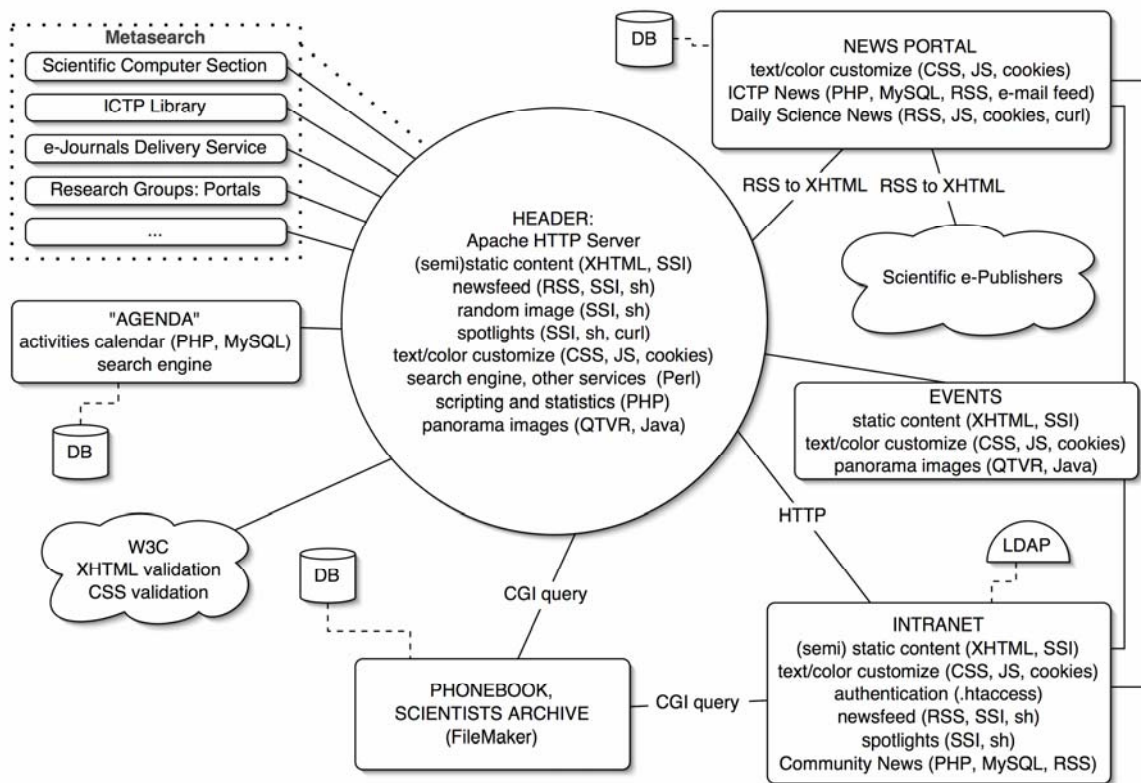
Figure 1.The ICTP web community components and technologies. Full lines indicate hyperlinks and other protocols.


## 3.   OPEN DEVELOPMENT AND OPEN TEST PHASES

Web contents started by collecting the information which was already available and distributed as official printed booklets and other publicity documents regarding the principal features, statistics, characteristics, mandate, and so forth of the Centre. In some cases there was no need for rewriting, as for example in the case of highlights of some scientific groups, simple statistics or history of the Centre. However, some new writing was needed especially for what concerns scientists, duties of the administrative staff, the achievements of the Centre and the up-dating of its statistics and functions. For this, the direct collaboration of the people themselves was required at an official level with adequate deadlines. The final collection, editing optimisation of all such material and incorporation into the header of the website took some months of hard work.

The consultancy of an external graphical designer was required at an early stage, to refine the graphical layout of the website, the new institutional logo, *etc*. Also, some commercial companies were invited for a demonstration of their proposals. However, these alternatives were not further considered because of the unique ICTP scientific structure and organization.  The ICTP Directorate preferred in-house expertise on web technologies to design the ICTP website at low cost and in a reasonably short period of time.

Choosing a new institutional logo was not easy, and it was helpful to get opinions about some prototypes. When occasionally some of them were tried on some people already, reactions ranged from *"it is not bad"* to *"can't we do better?"* Keeping in mind that the logo needed to be simple, printable in different sizes as well as black and white or colour without losing details with some easily recognized meaning (if possible), after some large debate the choice was that given in Figure 2. The essence of this logo may be regarded as the imprint that ICTP has made on the world at large.

Figure 2. ICTP logo.

During this period, prior to the official launch of the new ICTP website (early Oct 2004), all resident staff and scientists and visitors were invited to browse the whole site during its development and test phases and to provide their feedback. The status of the development and validation process of all the pages has been always visible in the site map. Explanations of some features and implementation strategies were provided during several open seminars, with participants from different groups and responsibilities. The goal was to facilitate at each step the participation and interaction among those interested to collaborate with the project for a new ICTP website. An open WebLog was also available for comments and suggestions that proved to be useful.


## 4. TECHNICALITIES, VALIDATION AND STANDARDS

The main effort of the ICTP web team was to make the new website easy to use from everywhere and by anyone.

### 4.1 XHTML, CSS templates

XHTML templates written in eXtended HyperText Markup Language -version 1.0 transitional, were used to build the structure of new pages (i.e., the contents, together with proper semantic information) inside the ICTP website. It is the modern evolution of HTML, with better defined and strict rules, and allows and even forces a sharp separation between the structure (semantic) and the appearance (graphic aspect) of any information that is published on the web. Templates of CSS1 were used to provide various pieces of information related to the presentation of web pages (such as graphical appearance for displaying and printing, typos, dynamical effects for menus, colours and multimedia decorations), in a way that they look similar to all other pages of the new website and provide a homogeneous *"ICTP look and feel"*. The home page consisted of 13 KB of XHTML content and 14 KB of CSS files.

The use of XHTML and CSS was strongly recommended on all the newly released ICTP web pages in order

- o to keep the structure of the web pages as clean as possible, and ready for future improvements (the ICTP web is ***"compatible with the future"***),

- o to allow access to the information provided in the website to everybody, regardless of disability. This modern concept of accessibility is strongly promoted by [W3C] and also required by law in many countries nowadays (the ICTP web is ***"accessible to everyone"***),

- o to follow the international recommendations defined by the W3C (the ICTP web is ***"compliant with web standards"***),

- o to optimise the bandwidth requirements needed for browsing the ICTP website, with special consideration for the developing countries (the ICTP web is ***"against the digital divide"***).

Figure 3. W3C logos to support standards

## 4.2 Persistent cookies and layout choices

Two persistent cookies, with text-only strings of information, were set in order to manage the colour choice (light blue or dark blue, for higher contrast) and the size of the fonts (small, medium or large) throughout the website. Such settings are shared among different servers (or satellite sub-sites in Figure 1) to obtain similar web page layouts.

An example of code used to select high contrast is

```
<a href="#" onclick="setActiveStyleSheetCol('HighContrast colors');
createCookie('ictp_colscheme','HighContrast colors',365); return false;" title="Change to High
Contrast">
<img src="/img/highcontrast.gif" id="butor" alt="Change to High Contrast" class="cust_c" /></a>
```

where

   **setActiveStyleSheetCol** corresponds to one of the functions used in the free Xaraya CMS
   Classic Theme (www.xaraya.com) which is W3C standards complaint,

and

```
function createCookie(name,value,days) {if (days) { var date = new Date();
date.setTime(date.getTime()+(days*24*60*60*1000));
var expires ="; expires="+date.toGMTString(); } else expires = "";
document.cookie=name+"="+value+expires+"; path=/ ;  domain=.ictp.it"; return true; }
```

## 4.3 e-mails and security

Unsolicited junk e-mail is often caused by displaying plain e-mail addresses on web pages. For scientists working in research institutions like ICTP it is important to be easily reachable through e-mail, so publishing their addresses on the web is necessary. We considered two possible solutions to avoid junk e-mail: *i)* the use of cgi-bin forms to send messages and *ii)* the encoding of e-mail addresses.

The use of cgi-bin forms presented some drawbacks. Although it may be possible to send attachments, the use of an automatic spelling check is usually needed as well as to send the same message to many recipients. Even more important, this method does not comply with accessibility requirements.

On the other hand, the use of an e-mail encoder helps to avoid e-mail harvesting from web pages while preserving the ease of use of the common "mailto:" tag in the source code of the web page. There are many available e-mail encoders on the web which allow the encoding of an e-mail address through the use of Character Entities, transforming the ascii e-mail address into its equivalent decimal entity.  The encoded e-mail address can be read and translated back into its original ascii text by almost any web browser.  For example, on the visible web page the string:

   "For more information, send an e-mail to: yourname@domain.com"

is written with a source code like this:

6

"For more information, send an e-mail to: <a href="**mailto: &#121;&#111;&#117;&#114;&#110;&#097;&#109;&#101;&#064;&#100;&#111; &#109;&#097;&#105;&#110;&#046;&#099;&#111;&#109;"**>
&#121;&#111;&#117;&#114;&#110;&#097;&#109;&#101;&#064;&#100;&#111; &#109;&#097;&#105;&#110;&#046;&#099;&#111;&#109;
</a>"

## 4.4 Browsing

Macintosh users navigating with IE 5 browser experience some problems related to that browser (IE 5 for Mac is now discontinued and unsupported by Microsoft). Today the best browsing experience may be achieved using Safari, Mozilla (MacOSX) or Netscape 7 (both Mac OSX and OS9 or higher). On GNU/Linux, the recommended browsers are either Netscape 7 or the latest version of Mozilla, and on Windows both Mozilla and IE 6+ may be used satisfactory.  Anyway, if one does not care about graphic appearance and advanced features of browsing experience (such as dynamical menus, page customisation and text resizing), all browsers are able to access the full information contents of the website, including text-only browsers (*i.e.*, lynx, from a Unix terminal) or very old ones. The website was tested with mobile devices like smart-phones and PDAs and it works reasonably well. Accessibility tests using JAWS screen readers from Freedom Scientific for visually impaired people were also satisfactory.

## 4.5 Web portals and news feeds

Experiences with web portals at ICTP started some years back and since then these have been running smoothly. These include the eJDS web portal (www.ejds.org) and the ARPL-Radio Communications Unit web portal (wireless.ictp.it), both running on an Apache dedicated server under Linux O.S. Among the many available open source web portals, PostNuke was a good candidate on the basis of security, support and documentation, easy to administer and create on-line communities (such as forums and news).  Similar to UNESCO.org and IAEA.org Web portals, ICTP Web portals offer forums to enhance communication, increase visibility and publish updated scientific and technological information.

The implementation of an alternative WordPress WeBlog was also used as another possibility to further simplify the tasks of managing information such as RSS (Rich Site Summary) news feeds to display it directly in the main ICTP Website and in its satellite portals. WordPress allows:

- o Instant publishing with no rebuilding
- o Full web standards compliance
- o Password-protected posts
- o Custom fields
- o Simple upgrades and installation (Uses PHP and MySQL)
- o Easy to customize
- o Multiple authors
- o Creation of multiple categories and sub-categories
- o Post by email

## 4.6 Synchronized rich-media/multimedia presentations

Another service directed to the scientific on-line community of ICTP includes synchronized rich-media presentations of some public lectures and seminars carried out on campus which integrate streaming audio and video with images, text or any other media type (as shown in Figure 4).

Typical scientific presentations are much complex in nature than relative simpler PowerPoint or Keynote presentations. In fact, they can include the simultaneous use of a blackboard, use of transparencies and a overhead projector, the display and explanation of animations, use of a laser pointer, the display of films and photos from experiments, devices etc. All of these items need to be synchronized when producing and archiving the on-line seminars by using pictures (that are produced, *e.g.,* by taking photos of the blackboard, by the conversion from PDF to JPEG or by scanning transparencies) with a combination of synchronized audio and video and, if available, computer animations or text transcripts too. Therefore, resources and skills required and time to edit the contents varies significantly with such classes of complex productions. Speakers are not asked to spend any extra time in preparing (any part of) their seminar's material which is being published on-line for educational and/or any other non-commercial purposes.

To produce the synchronized media presentations and the videos for Internet streaming, we keep in mind both the audience and their available computer facilities. A reasonable guess is given by an analysis of ICTP's website statistics. In practice, **www.ictp.it** receives more than 12000 unique on-line visitors per month with an average of 30 hits/visit. The visits are done using web browsers like MS Internet Explorer v5.0 and higher (74.6 %), Netscape v7.0 and higher (9 %), Mozilla (5.6 %), FireFox (4.3 %), Safari (4.2 %) plus others. Of these browsers, those with Java support are 86.6 %, browsers with Flash Support are 95.3 %, browsers with RealAudio playing support are 75.8 %, browsers with QuickTime audio playing support are 69.2 % and browsers with Windows Media audio playing support are typically 90.7 %.

By testing all the set of different (popular proprietary) technologies listed above, we consider the ICTP web-based presentations to be on an experimental basis. Most of these require a dedicated player to be installed on the user's PC (plug-in) with the exception of Java applets (but in some systems also Java support has to be downloaded and installed by the user).

Our main aim for production and delivery though is to:
- adopt open standards like Synchronized Multimedia Integration Language (SMIL) for the authoring of interactive audio-visual presentations,
- use MPEG-4 for better video compression,
- select low-bandwidth compliant applications that keep the video quality as higher as possible, to give also access to our contents using a dialup Internet connection whenever possible, (this means that significant restrictions are placed on the nature of the content due to bandwidth limitations as for example lower image quality and audio only delivery),
- use low-cost devices allowing wide range of applications powered by streaming audio and video technology,
- automate as much as possible the production of the scientific streaming presentations and to reduce any post-processing and editing,
- have the synchronized rich-media/multimedia presentations openly available on the net shortly after the live recordings.
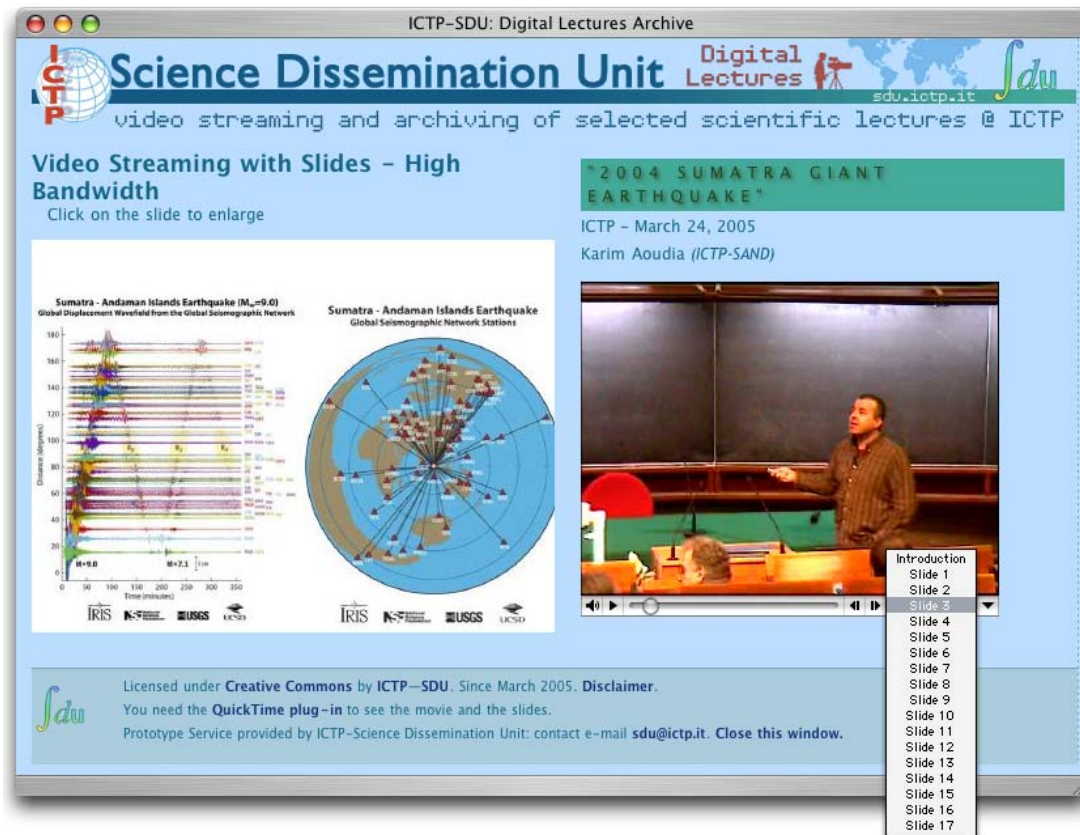
Figure 4. Example of synchronized web-based presentation with slides, audio and video at **sdu.ictp.it**

## 5.   CONCLUDING REMARKS

The model used to build up a web community directed to foster science in developing countries is essentially based on a two-layer structure to consider the different needs of ICTP groups/offices/services and the user-friendliness, especially at the level of administration. The header consists of rather static information that will not change over a relatively long period of time (e.g., head of groups, personnel, programmes, and so forth), but can be modified as the need arises. On the other hand, the second level aims to include the dynamical part of the information and services which constantly varies (e.g., seminar announcements, news, and forums).

The top level is such that contents and appearance are separated in order to facilitate further developments and improvements with little effort. Global changes in the appearance of the header can be incorporated by simply adapting a few files without touching the contents. Eventually this header could be incorporated into a CMS in a future project if time and local resources allow it.

Technologies like RSS to handle decentralized news feeds into main pages were also included. Another added value of this approach is the possibility of creating specific communities, within different sub-sites, web portals with the participation of scientists beyond the boundaries of ICTP.

The approach used only open source technologies and was motivated by the reference book of J. Zeldman [Zeldman 2003], considered a guide for future trends in web designing using W3C standards.

## ACKNOWLEDGEMENTS

## REFERENCES

Canessa E. and Balestra A., 1994. Displaying a TeXinfo Document via WWW and Gopher. In *Comp. Net. & ISDN Sys*., Vol. 27, p. 317.

Canessa E. and Fonda C and Radicella S.M., 2002, Virtual Laboratory Strategies for Data Sharing, Communications and Development. In *Data Sci. J.,* Vol. 1, p. 248.

Canessa E. and Onime C., 2000, Low-Bandwidth Communication Tools for Science. In *Linux J. Contents*, #75, (Strictly On-Line).

W3C - The World Wide Web Consortium at http://www.w3c.org

Zeldman J., 2003, *Designing With Web Standards*. New Readers, Boston, MA.