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European Network of Centres of Excellence for Research and Education in Digital Culture

Work Package 2 – Deliverable 3

Expansion to the Mediterranean and Beyond

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Abstract	The objective of this WP is to explore how the emerging European network can expand to include the Newly Accessed States (NAS), institutions or networks from the Mediterranean area and other networks around the world. Moreover, links with the United States are examined.
Keyword list	Regional network, NAS, Mediterranean, digitalisation

Documents submitted

1. Report on NAS countries as a result of the University of Vienna, Austria survey
2. Report on Russia as a result of Centre PIC, Russia survey
3. Report on Mediterranean area prepared by the Foundation of the Hellenic World, Greece
4. Current Status in USA concerning cultural heritage as a result of the Foundation of the Hellenic World, Greece survey

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Countries covered

The survey covers 26 non-EU countries, namely:

1. Albania	8. Egypt	15. Lithuania	22. Slovakia
2. Algeria	9. Estonia	16. Malta	23. Syria
3. Belarus	10. Hungary	17. Morocco	24. Tunisia
4. Bulgaria	11. Israel	18. Palestinian Authority	25. Turkey
5. Croatia	12. Jordan	19. Poland	26. USA
6. Cyprus	13. Latvia	20. Romania	
7. Czech Republic	14. Lebanon	21. Russia	

Moreover, the FHW has organised the Greek national network contacting a number of institutions and networks in Greece that could be prospective members of e-culture net.

Detailed description of the digital culture situation and perspectives in Estonia, Czech Republic, Russia.

Detailed description of the digital culture situation and perspectives in Greece and other countries of the non-EU Mediterranean countries such as Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia and Turkey as well as the Palestinian Authority.

A few collaborative efforts in the USA are presented, concerning digitisation and exchange of cultural heritage knowledge. The next generation Internet is examined as a promising answer for supporting applications based on cultural heritage content.

Institutions and networks analysed

In each country the most valuable institutions in digital culture policy, research, content creation and promotion, education and training were contacted, namely:

- Ministries or other governmental organisations
- Universities
- Memory institutions: libraries, museums and archives
- Research and Technology Centres
- Non-commercial organizations and agencies for management, technologies, networking in culture and tourism
- Professional associations, unions, societies
- National and international e-culture networks and institutions with networking features
- National branches of UNESCO, IFLA, ICOM, ICOMOS, CIPA

The digital culture activities of the selected institutions were analysed with respect to perspective participation in E-cultureNet related to the research matrix topics, DEER, European Masters and Doctorate programmes and Integrated Projects. Letters of Intent and activities descriptions of the interested institutions were gathered.

As a result the following institutions expressed their interest to E-cultureNet activities in Letters of Intent:

CEE countries: 20 (14 more are expected)
Russia: 25 with total number of about 300 researchers (4 more letters are expected)
Mediterranean region: 2 (4 more are expected)

For CEE, Russia and Mediterranean region the most valuable internet-resources as well as relevant conferences and events are listed.

For some countries (Czech Republic, Russia) government policies in digitisation and digital culture are explored; for Russia administrative and financial issues, technical and Internet situation, prospects for broadband and mobile Internet are analysed.

Greece: 7 (6 more are expected)

Mediterranean region (non-EU countries): 6 (3 more are expected among them the Biblioteca Alexandrina in Egypt and the Royal Scientific Society from Jordan)

FHW continues to explore possibilities and making contacts for the inclusion of other institutions. The most important drawbacks in the process of establishing the Mediterranean network of institutions were the fact that the content was often delivered in Arabic or other local languages and that the digitilisation processes or projects are still deployed.

Conclusions

NAS countries and Russia
The level of cultural traditions in all fields as well as education and research in culture in general is very high. In the area of their digital presence, either in digitised form or originated as digital culture, varies from country to country, with some countries showing a very high level of expertise and investment in digital culture and education and research in particular (e.g. Estonia, Russia).

The diversity of traditions, together with the extreme diversity of standards of living and cultural traditions, the situation is quite fragmented. Many NAS countries have re-

oriented their cultural policies towards Europe and have participated, through their ministries as well as through their universities, museums, libraries, etc. in EU co-operation projects. Russian cultural and research institutions have just started to be involved in EU projects.

Networking has been practised in various areas such as libraries and museums, both on national levels and on levels of CEE countries and European co-operation. Many CEE and Russian institutions have participated actively on the international level (IFLA, ICOM, UNESCO, etc.). Initiatives such as Culture Link and Cultivate are of particular importance for this survey and for the purposes of E-CultureNet as future co-operation partners.

The opportunities that are opened up for East-West integration in E-CultureNet are welcome and interest is very big in joining this network.
The roadmap sketched provisionally by the co-ordinator of E-CultureNet is generally welcome and accepted.

In research and digitisation of cultural content, some countries show a dramatic lack of funding, while other countries show high standards of research in all areas of digital culture. In education, the situation is similar. Soros Foundation activities in CEE and Russia were significant and really stimulated and moved on digital culture activities but in future Soros influence and financial support will be considerably shortened.

NAS, Russia and Mediterranean countries developed an impressive volume of digital cultural heritage opened on the Internet mostly in national languages. There is a need to make it available for EU research and education through multilingual multicultural access.

Special attention should be paid on ethnography, cultural anthropology, folklore, intangible heritage studies in NAS and Russia as a base of further researches in these fields for development instruments for multilingual, multicultural access to diversified digital cultural heritage.

Semantic Web activities are of special importance. It is needed to include as many European languages as possible into existing and developing classification systems, automated dictionaries, thesauri etc.

In the coming years European Masters and Doctorates in digital culture will be readily accepted and welcome in NAS countries and Russia with their national academic courses and curricula re-oriented towards the Bologna Declaration with the three-tier system of BA/MA/PhD. Special training programmes (including distant learning courses) for CEE, Russia and Mediterranean digital culture specialists is needed to spread results of EU

projects, to forester integration into EU digital culture activities with support of common standards and meta-data.

The accession of several countries to the EU in May 2004 will further intensify the active participation of the countries concerned in the 6th Framework Programme and other programmes where culture in general and digital culture in particular are included and where funding opportunities are found.

For area-wide participation in DEER major investments in technical infrastructures such as broadband backbones and distributed high speed networks and services are obviously necessary. Information literacy will be a major factor in education as a prerequisite for wide active participation in such networks in all institutions concerned. Best practices have been made public and known, but systematic knowledge transfer is still needed in order to build up networks of excellence around the existing competence centres that are clearly visible.

What is needed to be done in the nearest future:

- Further digitisation of the available cultural heritage content, preferably in a standardised way in order to facilitate exchange
- Development of user-oriented Applications based on this content (mostly with advanced technologies such as immersive virtual reality productions)
- Relative demonstrations to the public and to scientific community through exhibitions or conferences
- Visibility of existing digital cultural content in Europe and world wide through multilingual multicultural access
- Wider participation in EU digital culture activities
- Networks of excellence for cultural heritage within the FP6
- Training programmes (including distant learning courses) for CEE, Russia and Mediterranean digital culture specialists
- Stronger co-operation between the Ministries of Culture of the involved European countries
- Establishment of connections with other countries, such as the USA, for knowledge transfer to NAS, Russia, Mediterranean countries
- Post-graduates and specialists exchange in the framework of European Masters and Doctorates Programmes

Greece and the Mediterranean countries

The criteria for the selection of organizations and networks were mainly qualitative. More specifically, FHW has contacted the most prestigious institutions in the region specializing in digital culture content creation and promotion. FHW's research focused on Greece and the Mediterranean non-EU countries, mainly the from the Middle East and North Africa. The selection procedure was structured as followed:

Greece:

The survey conducted in Greece focused on governmental institutions but mainly on academic institutions, research laboratories and memory institutions (libraries, museums and archives). The degree of digital content creation as well as of research activities on that subject conducted by these institutions is quite satisfactory. Moreover, many other organizations that were contacted by FHW and have not yet submitted letters of intent, have shown great interest in e-culture net aims and activities and they are expected to express their interest for being associated members in the near future.

Non-EU Mediterranean countries:

A. The research focuses on institutions (with a web-site) from non-EU countries such as:

- Algeria
- Cyprus
- Egypt
- Israel
- Jordan
- Lebanon
- Malta
- Morocco
- Palestinian Authority
- Syria
- Tunisia
- Turkey

B. Organizations typology:

1. Ministries or other governmental organizations: the digital content of these institutions ranges from country to country. These official data bases contain mainly archaeological and cultural (in a broad sense, especially local culture) information addressing a wide range of users (students, tourists etc.). The digital content of these

organisations provides links to the most important memory institutions of each country such as museums, galleries, libraries and universities. The degree of specialization of the programmes running within the framework of different ministries ranges: the majority of governmental organisations offer the conventional services (web page, links to relevant institutions etc.) while others develop more specialised programmes (like the Photographic Heritage Programme of the Ministry of Communication and Information of Egypt).

2. Universities with relative faculties and departments: FHW's research focused on Faculties of Arts, Education, Fine Arts and Technical Universities. Most of these institutions have on line libraries (or are in the process of creating on line libraries and specialized data bases) restricted to member users, and a number of them provide links to European and US universities. It is worth noting that many departments have started to design and develop on line courses.

3. Memory institutions:

a. Libraries: national libraries with on line services

b. Museums: archaeological and folklore-local art museums

c. Archives: specialised archives (mainly national archives, e.g archives of manuscripts, natural history archives etc.)

4. Research Centres: focusing mainly on foreign archaeological centers established in these countries (e.g. American or French archaeological schools). These institutions collaborate with state agencies and undertake a decisive role in promoting regional cultural information (e.g. the American Center for Oriental Research that has designed the Jordanian Antiquities Database and Information System (JADIS), which uses Microsoft's FoxPro database system to record data about known archaeological sites)

C. The question of correspondence of these institutions with the standards of e-culturenet. FHW conducted a comparative research among related institutions concerning their ability to participate in the activities of e-culture net. The analysis was structured according to the following axes:

1. Educational activities
2. Digitalization activities
3. Distribution activities
4. Content development activities
5. Other activities
6. On-line services
7. Known existing facilities

The analytical report of FHW contains the detailed presentation and evaluation of the institutions' activities and capabilities.

D. Statistics and conclusions concerning the organizations

As far as the Mediterranean region is concerned, most of the institutions found were academic institutions (universities and research centers) and governmental organizations (mainly ministries of Information and Education). In Greece there was a plethora of other specialized institutions (such as the National Center for Books, the Institute for Speech Processing, the Computer Technology Institute etc). In general, the creation of the Greek network was easier than the Mediterranean one. Statistics concerning the typology of institutions contacted:

- Ministries: 5,2%
- Cultural foundations: 1,3%
- Networks: 9%
- Libraries: 2,6%
- Museums: 5,2%
- Non government institutes: 2,6%
- Government institutes: 3,9%
- Educational institutes: 1,3%
- Research institutes: 20,8%
- Universities: 48,1 %

The most important drawbacks in this process were:

- The fact that most of the web pages were available in arabic or other local languages. (It should be noted that mainly English was used as an option for web sites that were translated in a European Language, with the exception of institutions from Morocco, Tunisia and Algeria that used French).
- Many of the institutions' services had technical problems or were in the process of being constructed.
- There are certain networks that have developed an important activity in this field but they can hardly fall into one single category: firstly, there are continental networks (encompassing institutions from all African countries e.g.newafrica.com) that provide a wide range of content creation services concerning culture (but also geography, politics, economy, education etc.). Secondly, there are regional networks such as MEVIC (Middle East Virtual Community) which is an attempt by academic nationals resident in the Middle

East, to open, promote and sustain intra-regional channels of communication and cooperation. Thirdly, "religious" based networks such as Arabnet which provides online resources on the Arab world. Fourthly, the national networks such as AlgeriaLinks.com which aims at the organisation of information about Algeria, making it universally accessible and useful. Finally, there are "independent" networks which are not based –exclusively- in their countries of origin such as Algeria Interface which is based in Paris

Current Status in USA concerning cultural heritage as a result of the Foundation of the Hellenic World, Greece survey

In the quickly evolving field of the Internet, there has been major concern for the preservation and further demonstration of cultural heritage of European Countries through information technology. Towards this end, stronger co-ordination at local, regional, national, European and International levels is required. A more systematic integration of the related efforts dealing with Infrastructure, Content, Context, and Communication, is necessary.

The next step is to facilitate access to cultural heritage knowledge, for example, through Internet search engines and databases. However, searching for cultural heritage information can be different than scientific, for example. As Kim Veltman states in [1] the essence of science may lie in the universality of its claims, while, in cultural heritage, the system needs to provide us with terminology and a definition which have been internationally agreed and at the same time indicate national, regional and local variants.

For instance, we have exceptional databases for the universal laws of science but we have very little by way of databases for the unique and exceptional expressions of culture. To achieve this is one of the great challenges for the semantic web of the future: not to replace humans, but rather to find new ways of making visible their abiding expressions. Hence a challenge lies in a new synthesis of knowledge at local, regional, national and international levels, together with new methods for reflecting these levels within our search engines and devices for navigating through networked knowledge. This is the challenge of cultural semantics.

This paper is structured as follows: Section 2 presents collaborative efforts in the USA, concerning digitization and exchange of cultural heritage knowledge. Because of the inefficiency of the current Internet to cope with the delivery of high quality multimedia content, the next generation Internet (Internet2) is examined as a promising answer for supporting applications based on cultural heritage content. Some noticeable examples are presented. In Section 3 relevant work and directions in the Mediterranean Area are presented with emphasis put on collaborations for content encoding and exchange.

Current Status in USA concerning cultural heritage

Networks for cultural content exchange

There have been several attempts by institutions and organizations (e.g. memory institutions, museums, libraries, research centers) involved in cultural heritage in the United States, to provide coordinative access to cultural heritage content. These movements have been motivated by the need to:

- ✓ Create collective libraries of art from museums worldwide, for educational purposes
- ✓ Reach the educational community in a coordinated and cost effective way
- ✓ Assist members to improve their information infrastructures and documentation practices
- ✓ Negotiate digital rights with artists and artists' estates and with museums in other countries
- ✓ Reduce risks through collective decision-making
- ✓ Adopt common standards and guidelines in the collection and digitization of the content
- ✓ Share expertise

The *Art Museum Image Consortium* (*AMICO*) [2] is a not-for-profit organization of institutions with collections of art, collaborating to enable educational use of museum multimedia. AMICO Members are building the AMICO Library™, a licensed digital educational resource available under subscription to universities and colleges, public libraries, elementary and secondary schools, and museums. Membership in AMICO is open to all institutions with collections of works of art, willing to contribute to the AMICO Library.

The role of *Archives & Museum Informatics* [3] is educational, aiming to provide consulting, publishing, and training for cultural heritage professionals. This is achieved through the organization of conferences, workshops and seminars, the publication of journals and monographs, and the consultation for archives and museums worldwide. These conferences provide internationally recognised venues for information sharing across a broad range of cultural heritage professions. The consulting services of Archives & Museum Informatics emphasize on inter-institutional collaboration, strategic planning and standards-based solutions. The **International Cultural Heritage Informatics Meeting (ichim)** aims to examine the relationships between Technology and Cultural Heritage, emphasizing on the interplay between innovative technologies and their application in the cultural sphere.

The *National Initiative* for a *Networked Cultural Heritage* (*NINCH*), initiated in 1993 [4][5], is a diverse, non-profit coalition of organizations created to assure leadership from

the cultural community in the evolution of the digital environment. NINCH pursues its mission by:

- Educating policymakers, the cultural community and the public about the critical importance of translating the vision of a connected, distributed and accessible collection of cultural knowledge into a working reality;
- Creating a platform for the community to collaborate in sharing ideas, resources, experience and research, learning from each other in order to advance the goal of an integrated, distributed body of cultural material accessible to all; and
- Providing a framework to develop and advance projects, programs and partnerships to benefit the cultural community.

In 2002 NINCH published its Guide to Good Practice in the Digital Representation & Management of Cultural Heritage Materials. The First Edition of the Guide was an online-only handbook for members of the community who were digitizing and networking cultural resources. The Guide was initially available on NINCH web site as an html document. In the next phase of production, it will deploy an innovative presentation interface with decision trees to enable users to navigate the text through a layered format.

ArtsConnectEd (ACE) [6] (May 1998) and the *Integrated Arts Information Access (IAIA)* (September 1997) [7] projects are complementary, interdependent collaborations between the Minneapolis Institute of Arts and the Walker Art Centre that provide online access to the rich collections and reference, archive, media, and curriculum resources of both institutions through one shared point of entry (Web page). The IAIA project supports the technical, academic, and production processes necessary to develop, convert, and retrieve information resources from both institutions, as well as the production of new educational content. ArtsConnectEd was initiated to support access to these multiple resources through the development of a central homepage and specialized query tools and indices. ArtsConnectEd contains a tremendous diversity of information resources including: text, images, audio, video, hypermedia, 3-D models and animation related to collection information, library card catalogues, object label and didactic panel copy, exhibition and institutional archives, educational materials, and full-text publications.

Other similar to ArtsConnectEd efforts have been realized but the above represents one of the most extensive and well-structured attempts to include, under one umbrella, resources for researchers, teachers, students, art lovers, and the general public in an engaging and interdisciplinary manner.

The Museum of Reconstructions, Inc. is organized exclusively for educational and scientific purposes. The Museum uses computer modeling technology to develop accurate and complete reconstructions of buildings, artworks, artefacts, and sites. Using scientific and scholarly methods and standards, the Museum develops, collects, curates, publishes, and exhibits these reconstructions on the Internet, in print, and in other forms. The Museum's computer models are based on measurements, facts, interpretations, and reconstructions published in authoritative excavation reports and surveys. All publications, exhibitions, and reconstructions developed by the Museum will be

distributed through its World Wide Web site [8]. In conjunction with specific reconstruction projects, the Museum will assist individuals and organizations in reconstructing and electronically publishing their findings and collections on the Internet, and will provide training and instruction in techniques including computer modeling, rendering, animation, web design, architectural drawing, and archaeological methodologies. By exhibiting and publishing accurate and complete reconstructions of fragmented buildings, artworks, artefacts, and sites, the Museum provides educational instruction to scholars and the general public.

The next generation Internet and highly demanding applications based on it

The main effort – the "Internet II" project

Building on the tremendous success of the last ten years in generalizing and adapting research Internet technology to academic needs, a number of U.S. universities joined together with government (federal R&D agencies) and industry partners (many of the leading computer and telecommunications firms, including IBM, Cisco Systems, AT&T, MCI, and Sun) in order to accelerate the next stage of Internet development, primarily in academia but not only there. U.S. university representatives urged Congress to cough up millions of dollars to help them build a new, speedier network. It is supposed to solve problems with congestion of private academic networks, and the unreliability of the public. The outcome of this effort is called Internet 2 or Next Generation Internet, was launched in October 1996 and is the main goal of a project known as "Internet II".
More specifically, the Internet II project brings focus, energy and resources to the development of a new family of advanced applications to meet emerging academic requirements in research, teaching and learning [9]. Both enhanced network services as well as the multimedia applications enabled by these services are included. Students and faculty can have access to high-speed transmissions for voice, video, and data. The Internet II project pledges to connect universities and laboratories to the network at speeds 1000 faster than their initial state. The work is developmental and pre-competitive in nature.

1.1.1.1 Objectives

The project addresses major challenges of the next generation of university networks. First and most importantly, a leading edge network capability for the national research community will be created and sustained. For a number of years beginning in 1987, the network services of NSFnet were unequalled anywhere else. But the privatisation of that network and the frequent congestion of its commercial replacement have deprived many faculty of the network capability needed to support world-class research. This unintended result has had a significant negative impact on the university research community.
Second, network development efforts will be directed to enabling a new generation of applications that fully exploit the capabilities of broad band networks, media integration, interactivity, real time collaboration, to name a few. This work is essential if new

priorities within higher education for support of national research objectives; distance education, lifelong learning, and related efforts are to be fulfilled.
Third, the work of the Internet II project will be integrated with ongoing efforts to improve production Internet services for all members of the academic community [10]. A major goal of the project is to rapidly transfer new network services and applications to all levels of educational use and to the broader Internet community, both nationally and internationally.
Indicative applications – services: digital libraries, 'virtual laboratories' and collaborative research, 'tele-immersion' (shared virtual reality), high-definition television (HDTV).

1.1.1.2 Internet II Funding Arrangements

Funding for the Internet II project includes both financial and in kind services and products of various types that are necessary for the project. Since most of the project effort occurs on or near university campuses, it is anticipated that the majority of funding from government research agencies and industry partners is in the form of grants to the participating universities.

1.1.1.3 Network Services

Internet II is designed to provide a variety of services "on demand" in support of advanced applications. These dynamically selectable services will include guaranteed bounded delay, low data loss, and high capacity. For example, in order to support delivery of advanced multimedia teaching materials from a digital library repository to a dispersed audience of learners, it will be necessary for the service delivery infrastructure to support "multicast" data delivery with guaranteed upper bounds within the transport components on delay and data loss.

New protocols to enable this functionality have already been defined and will be deployed early in the Internet-II project. These protocols include the IETF defined quality of service protocols such as RSVP and RTP along with IPv6, the IETF-developed replacement for the version of IP that is in current use on the Internet. In addition, Internet-II will provide access to the underlying network infrastructure for those environments that can support that access and for those applications that can make use of specific capabilities offered by the infrastructure.

1.1.1.4 Implementation

At the heart of the Internet-II design is a new technology for providing advanced communications services. The technology, referred to as a GigaPOP, is a complex of technologies developed over the first decade of the Internet integrated with new technologies developed by vendors and the Internet Engineering community. The Internet-II project will demonstrate proof of concept of this new set of technologies and services so that they can become the basis for the next generation of commercial Internet service offerings.
The GigaPOP is the point of interconnection and service delivery between one or more institutional members of the Internet-II development project and one or more service

providers. Typical institutional connections will be made via ATM or SONET services at very high bandwidth. The fundamental advance represented by the GigaPOP architecture is dynamically acquired "quality of service" in support of a broad range of new applications while maintaining a common interoperable "bearer service". Service characteristics include end-user definable capacity as well as latency.
The architecture of the GigaPOP also supports service delivery to regional or state-based not-for-profit consortia such as the Virginia Educational Network, the Washington State K-20 network, or the combined University of California and California State University system.

Equipment at a GigaPOP site includes:

- One or more very high capacity advanced function packet data switch/routers capable of supporting at least OC-12 (622 megabit/second) link speeds and switched data streams as well as packet data routing.
- Switch/routers supporting Internet Protocols (both version 4 and the new version 6), advanced routing protocols such as MOSPF, and "quality of service" protocols such as RSVP.
- SONET or ATM multiplexers to enable allocation of link capacity to different services such as highly reliable IP packet delivery, experimental test beds for emerging protocols, or special requirements determined by new initiatives among the Internet-II member institutions.
- Traffic measurement and related data gathering to enable project staff to define flow characteristics as part of the operational and performance monitoring of the GigaPOPs.

One or more wide area communications service providers will connect to the GigaPOPs in order to provide communications paths between the nationwide set of GigaPOPs and between GigaPOPs and the established commercial Internet.

Further efforts

The idea of the Internet2 has been investigated and exploited by collaborative structures and efforts that aim to apply the possibilities promised by high-speed connectivity to a variety of domains. On of these domains includes the field of Virtual Reality and its range of applications. As mentioned above, in order for participants to collaborate effectively, virtual environments require high bandwidth and low latency, not possible on the current Internet. Therefore, the research community has begun to investigate network infrastructures suitable for interconnecting distributed participants of a virtual environment. Three noticeable efforts are mentioned below.
The *Science, Technology, And Research Transit Access Point*, or *STAR TAP* [11], is a persistent infrastructure funded by the National Science Foundation (awards ANI-9712283 and ANI-9980480) to facilitate the long-term interconnection and interoperability of advanced international networking. Managed by the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago [12], the Math and Computer Science Division at Argonne National Laboratory and Ameritech

Advanced Data Services, *STAR TAP* exists in support of applications, performance measuring and technology evaluations. *STAR TAP* connects with the Ameritech Network Access Point (NAP) in Chicago, and enables network traffic to flow to international collaborators from over 150 U.S. leading-edge research universities and institutions, including supercomputing centres. STARTAP applications are among the most computation demanding and/or data-intensive today, and serve as test cases for the various network features that STAR TAP deploys.
Using *Cultural Heritage* as an application driver, the goal of the *Networked Virtual Environments Collaborative Trans-Oceanic Research* (*N*VECTOR*) project [13] is to link EVL's CAVE® and Tokyo's CABIN in order to better understand the requirements of multiple media flows among sophisticated virtual reality displays over great distances.
The *CAVE Research Network* (*CAVERN*) [14], is an alliance of industrial and research institutions equipped with CAVEs, ImmersaDesks, and high-performance computing resources all interconnected by high-speed networks to support collaboration in design, training, scientific visualization, and computational steering, in virtual reality. *CAVERNsoft* is the common collaborative software architecture for CAVERN. The goal of this project is to develop the next generation collaborative networking infrastructure to sustain collaborative, persistent virtual environments.

Networked virtual reality in education

A number of projects have been established in the U.S. to investigate the use of high-end immersive Virtual Reality for educational purposes.
The *Round Earth Project* [15], realized at the university of Illinois, at Chicago, is investigating how virtual reality can be used to help teach young children that the Earth is spherical when their everyday experiences tell them it is flat. VR is used as part of a larger strategy to create an alternative cognitive starting point where this concept can be established on its own before it is brought into contact with the learner's past experiences.
The *Narrative-based Immersive Constructionist/Collaborative Environments* (*NICE)* [16][17], [18] project was established to construct a testbed for the exploration of virtual reality as a learning medium within the context of the primary educational reform themes of the past three decades. With a focus on informal education and domains with social content, NICE embraces the constructivist approach to learning, collaboration, and narrative development, and is designed to utilize the strengths of virtual reality: a combination of immersion, telepresence, immediate visual feedback, and interactivity for constructing virtual reality worlds through collaboration.
The above projects have been demonstrated at many events and venues as networked virtual reality projects, using the 3-dimensional space of the CAVE® and other projection-based virtual reality displays for educational purposes. Furthermore, these applications served as experiments on learning with various forms of telepresence (learning in a remote environment with a teacher who is physically present, a networked video presence, a networked VR avatar, etc).

Demonstrations of collaborative, immersive applications over the Internet 2

1.1.1.5 The Grid collaboration

The iGrid, as a part of the StarTap initiative, is a collaboration between the University of Illinois at Chicago, the Indiana University, the Tokyo University and the Keio University, with the aim of empowering global research community networking.
Several live demonstrations of emerging applications have taken place over next generation telecommunication infrastructures, such as the Internet2 [19].
IGrid2000 most indicative demonstrations included:

- ✓ AccessGrid: Wide-Area Group Collaborative Visualization
- ✓ ALIVE: Architectural Linked Immersive Environment
- ✓ Argus: Controlling Real-Time Imaging Sensors from a Virtual Environment
- ✓ Cultural Heritage in Virtual Reality
- ✓ CyberCAD: Internet Distributed Interactive Collaborative Design
- ✓ Digital Cinema 2000: Super High Definition Digital Movie Communication System
- ✓ Distributed Particle Physics Research
- ✓ GiDVN: Global Internet Digital Video Network
- ✓ Haptic Collaboration in Networked Immersive Environments
- ✓ High Speed Networking with SUBARU Telescope in Hawaii
- ✓ Human Anatomy Lecture-on-Demand at the National University of Singapore
- ✓ MediaZine A Combination of Television, WWW, Telecommunications and 3D Computer Graphics
- ✓ Online Monitoring and Steering of Remote Black Hole Simulations
- ✓ Shared Miletus
- ✓ Video Avatar Communication in Networked Virtual Environment

Two of the above projects, Virtual Harlem and Shared Miletus, demonstrated the use of high-speed networking infrastructure for the transmission of 3D, video, and audio data of cultural heritage content, for research, education, and recreational purposes.

iGrid 2002 [20] challenged scientists and technologists to utilize multi-gigabit experimental optical networks, with special emphasis on e-Science, LambdaGrid and Virtual Laboratory applications. The result was an impressive, coordinated effort by 28 teams representing 16 countries, showcasing how extreme networks, combined with application advancements and middleware innovations, can advance scientific research. As a conference, iGrid 2002 demonstrated application demands for increased bandwidth. As a testbed, iGrid 2002 enabled the world's research community to work together briefly and intensely to advance the state of the art, by developing new network-control and traffic-engineering techniques; new middleware to bandwidth-match distributed resources; and, new collaboration and visualization tools for real-time interaction with

high-definition imagery. Much of the iGrid 2002 infrastructure will persist and be available for long-term experimentation.

IGrid 2002 included several application demonstrations, the most indicative of them are listed below:

- ✓ Collaborative Visualization Over the Access Grid
- ✓ Distributed, On-Demand, Data Intensive and Collaborative Simulation Analysis
- ✓ Global Telescience Featuring IPv6
- ✓ Griz: Grid Visualization Over Optical Networks
- ✓ High Performance Data Webs
- ✓ HDTV Transmission Over IP of a Cultural TV Production
- ✓ Image Feature Extraction on a Grid Testbed
- ✓ Kites Flying In and Out of Space
- ✓ Network Intensive Grid Computing and Visualization
- ✓ PAAPAB: Pick An Avatar, Pick A Beat
- ✓ TACC Quantum Chemistry Grid/ Gaussian Portal
- ✓ TeraScope: Visual Tera Mining
- ✓ TeraVision: Visualization Streaming Over Optical Networks
- ✓ The Universe: Distributed Virtual Collaboration and Visualization
- ✓ Virtual Laboratory on a National Scale
- ✓ Virtual Visit to the Site of Ancient Olympia

The latter demonstration, a Virtual Visit to the Site of Ancient Olympia, represents a collaboration between the Foundation of the Hellenic World (creators of the virtual reality content), the Greek Research and Technology Network (GRNET) [21], and the Electronic Visualization Laboratory of the University of Illinois at Chicago.

1.1.1.6 The INET Conferences

INET, which stands for "internet networking", is regarded as the premier event in the Internet industry and provides an international platform for advancing the development and implementation of Internet networks, technologies, applications, and policies. These conferences bring together leaders of the global Internet community; technology experts, policy makers and business leaders that meet to debate and discuss the technologies and policies, defining the future of the Internet [22].

During the latest INET conference several live demonstrations of Internet 2 applications have taken place. Under this spirit, the INET 2002's program was designed to provide new insights into the technologies, standards, and policies that will define the Next Generation Internet and show how it could shape our society. More than 40 sessions examined new developments in business, academia, government, and the non-profit sector.

More specifically the INET 2002 basic tracks were:

- ✓ Technology-including sessions on security, peer-to-peer applications, grid computing, the wireless Net, etc.
- ✓ Policy-including sessions on on-line privacy, intellectual property, domain names, anonymity, etc.
- ✓ Uses of the Internet-including sessions on e-government, on-line education, Internet and development, etc.

Relevant work and directions in the Mediterranean Area

Networks

CULTIVATE [23] is a European Cultural Heritage Network linking memory organizations across Europe and Israel. It includes IT staff, information professionals, researchers, managers, policy makers, libraries, museums, archives, galleries, non-profit making organizations etc. It provides a single point of information to the European Commission's cultural heritage research activities and to national and regional research programmes in these countries. CULTIVATE is the answer to the need for a newly structured network supporting the co-operation of all memory institutions (e.g. archives, libraries, and museums) under the European Commission's Information Society Technologies (IST) Programme. Most partners are national nodes for Cultural Heritage Applications in their countries and co-ordinate activities in their national network. They are also active in the co-operation at European level. Some of the national nodes have also undertaken tasks of European dimension. Among them are the Library Council (Ireland), the ILRT (Institute for Learning and Research Technology at the University of Bristol, UK), the Council for Museums, Archives and Libraries (UK), the Cultural Service Centre (Austria), the UKOLN, Bath, (UK Office for Library and Information Networking at the University of Bath), and the RBT, Oslo, (National Office for Research Documentation, Academic and Special Libraries).

The ***Network of Hellenic Academic Libraries*** *(NHAL)* [24] is composed of 32 universities and technical institutions, the Athens Academy and the National Library of Greece. The aims of this network are, mainly:

- ✓ The creation of a Union Catalogue of Greek Academic Libraries and the use of its documents by every member of the network
- ✓ The development and unification of standards for all kinds of library tasks
- ✓ The constant training of the personnel of the member libraries

- ✓ The cooperation with similar organizations in Greece or in other countries, for ensuring the participation of NHAL to international evolutions concerning collaboration of libraries and administration of intellectual rights.
- ✓ The joint contribution of electronic sources and informative services, as well as rights of remote access to electronic sources and services of information, including electronic scientific journals.
- ✓ The cooperative availability of material among the participating libraries
- ✓ Common activities towards the development of the participating libraries

NHAL is already a member of the International Coalition of Libraries Consortia, an international organization established to help the collaboration of libraries worldwide.

European Projects

DIGICULT: The Digital Heritage and Cultural Content [25] is a domain of research activity, concerning cultural heritage, within the Information Society Technologies (IST) Programme, which is part of the Fifth Framework Programme for Research and Technological Development (RTD), running from 1998-2002, and will continue to exist as a key thematic priority area within the 6th Framework Programme (2002-2006).
Research in the DigiCult domain concerns the development of innovative technological tools and systems for the exploitation of both traditional and digital cultural heritage resources. The latter comprise resources that have either been created as digital substitutes to the original objects held by cultural or scientific institutions (i.e. libraries, museums, archives, research centres, universities etc.) or are born digital, that is they have been created with the help of information and communication technologies and exist only in digital form. DigiCult research work is driven by the need to ensure that institutions holding such resources fully exploit the opportunities created by the advent of digital technologies for providing quality access by all European citizens to them, as well as for preserving them for the future.
Digicult Interactive *Cultivate Interactive* is a Web magazine, which is funded under the DIGICULT programme.
The COINE project: Libraries, museums, archives and other local institutions find new ways to engage with their users through the COINE Project [26]. It harnesses information technology to help people use information, photographs, audio recordings and other objects of interest to them in new ways. The COINE Project is part-funded by the European Commission Information Society Technologies (IST) Programme.
The idea behind the COINE Research and Development Project is to enable people to tell their own stories. New levels of interactivity will be possible for museums, libraries and other cultural bodies - visitors will be able not just to use 'exhibits' created for them, but to create their own. Children will be able to use pictures, texts and artefacts to record and share their family history. Older people might use oral history, photographs, video and

images of written documents to tell the story of their lives. Each story can then be shared, and authors can make links with other people's stories.
Running from March 2002 - August 2004 COINE intends to provide the tools needed to create structured, World Wide Web-based environments which allow content to be shared locally, regionally, nationally and internationally. The Project's findings will assist the development of standards for structured deployment and retrieval of digital resources in distributed networked environments. Demonstrations will test the application in different cultural settings across Europe, including among schoolchildren and citizens' groups.

The Archeoguide Project: The ARCHEOGUIDE project [27] intends to provide new approaches for accessing information at cultural heritage sites in a compelling, user-friendly way through the development of a system based on advanced IT including augmented reality, 3D-visualization, mobile computing, and multi-modal interaction techniques. The system will be tried out in one major European cultural heritage site. In this site particular emphasis will be given to virtual reconstruction of the remains.
The ARCHEOGUIDE system will address the requirements of a wide user selection that includes cultural site visitors, cultural site managers, researchers, and content creators. Cultural site visitors will be provided with a see-through Head-Mounted Display (HMD), earphone, and mobile computing equipment. A tracking system will determine the location of the visitor within the site. Based on the visitor's profile and his position, audio and visual information will be presented to guide and allow him/her to gain more insight into relevant aspects of the site.
The Archeoguide will offer the following features to visitors:

- ✓ Accessing information in context with the exploration of the site through position and orientation tracking.
- ✓ Personalized and thematic navigation aids in physical and information space through the use of visitor and tour profiles taking into account cultural and linguistic background, age and skills.
- ✓ Visualization in 3D of missing artifacts and reconstructed parts of damaged sites on Head Mount Displays.
- ✓ User-friendly multi-modal interaction for obtaining information on real and virtual objects through gestures and speech. In addition, tools enabling site administrator to organize the presentation of site information in creative ways will be provided.

Events

Lists with events concerning cultural heritage can be found in [28] and [32].
Some conferences are mentioned below:

- ✓ Amman Cultural Heritage 2002 – Multimedia for cultural heritage – Conference, Training, Exhibition, [29]

- ✓ 4th European Commission Conference on: "Research for Protection, Conservation and Enhancement of Cultural Heritage", From Cultural Heritage to Business, Strasbourg 22-24 November 2000 [30].
- ✓ Conference on Digitisation of European Cultural Heritage (Utrecht, October 20-23 1999), which attracted 160 participants. A number of important European projects were presented by speakers from university libraries, archives and research institutes. Some presentations concerned large-scale digitization efforts, like the Archivo General de Indias, which aim to make large amounts of material available in digital format. On the other end of the scale are projects developing new tools for research, for very specific types of materials, such as applications for creating digital text editions. Obviously a heading like "digitization"; has become too general to reflect the variety of approaches geared to different audiences [31].

Organizations-Institutions

The Foundation of the Hellenic World (FHW) [33] is a not-for-profit cultural institution based in Athens, Greece. It uses state-of-the-art, cutting-edge information and computer technology in its pursuit of the research, awareness and understanding of Hellenic history and culture.
Their staff is made up of archaeologists, historians, architects, museologists, museum educators, computer scientists, graphic designers, producers of multimedia programmes and 3D animation modelers. The FHW's field of activities include the following:

- ✓ Presentation of Hellenic history on the Internet from the Stone Age to the present day
- ✓ Creation of a Data Bank
- ✓ Registration of the genealogical trees of Asia Minor Refugees
- ✓ Creation of three-dimensional digital reconstructions of ancient monuments and areas
- ✓ Production of historical and cultural documentaries
- ✓ Publication of printed and electronic
- ✓ Arrangement of exhibitions, educational programmes, and projections of cultural tours through in immersive Virtual Reality theatres/exhibits, such as the "Kivotos" (a CAVE-like display) and the "Magic Screen" (an ImmersaDesk™).

Specifically, FHW's Virtual Reality Department [34], established in 1998, uses VR technology as a means to advance the research, understanding and dissemination of Hellenic culture [35]. The Department is a major interface between the general public and FHW's archaeologists, historians, scientists, educators and artists. Its main activities focus both on the establishment of an infrastructure and the creation of the educational

and exhibition content. The Foundation of the Hellenic World is the only place in Greece -and one of few worldwide- where state-of-the-art immerisve Virtual Reality exhibits are open to the public on a daily basis, while all programmes are created in-house by a team of specialised scientists and artists.

Semantic Web

The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation. Kim Veltman believes [36] that the semantic web should be about the meaning of humanity with all the richness of its cultural and historical dimensions. In his paper he reviews four approaches to the semantic web, namely that of:

- ✓ The W3 Consortium led by the vision of Tim Berners- Lee, which focusses on semantics in terms of logic [37].
- ✓ The Dublin Core (Metadata Initiative), which limits semantics mainly to the meaning of metadata elements and fields rather than the contents of those elements and fields [38].
- ✓ A small group within the AI community, which sees semantics strictly in terms of machine-readable instructions permitting autonomous software agents and hardware robots to operate and make decisions in the absence of humans [39] [40] [41].
- ✓ Cultural semantics entailing a commitment to meaning, which takes into account multi-lingual, multi-cultural, and historical dimensions at the local, regional, national and international levels .

He concludes that:

- ✓ the W3 Consortium approach is important, very useful for transactions, but does not yet answer the needs of human meaning.
- ✓ that the efforts of the Dublin Core is an important step forward, but that it cannot be seen as a comprehensive solution.
- ✓ the approach of a small minority in the AI community potentially undermines the vision of the W3 and is ultimately a threat to the human condition.

What we need is a semantic web, which embraces cultural dimensions, by providing new levels of access to knowledge at the local, regional, national as well as international levels. The essence of science may lie in the universality of its claims, in universals. The essence of culture lies in the unique, in particulars, in the exceptions to the rule. We have exceptional databases for the universal laws of science but we have very little by way of databases for the unique and exceptional expressions of culture. To achieve this is one of the great challenges for the semantic web of the future: not to replace humans, but rather to find new ways of making visible their abiding expressions.

Conclusions and future work

This paper presented a few collaborative efforts in the USA, concerning digitisation and exchange of cultural heritage knowledge. Indeed, because of the inefficiency of the current Internet to cope with the delivery of high quality multimedia content, the next generation Internet is examined as a promising answer for supporting applications based on cultural heritage content. Some noticeable examples were also presented. Added to this, relevant work and directions in the Mediterranean area were enumerated with emphasis put on collaborations for content encoding and exchange.
There are still many things to be done in the field of preservation and dissemination of cultural heritage knowledge, through information technology.

- ✓ Further digitization of the available cultural heritage content, preferably in a standardized way in order to also facilitate exchange
- ✓ Development of Applications based on this content (such as the FHW's immersive virtual reality productions).
- ✓ Relative demonstrations to the public and to scientific community through exhibitions or conferences.
- ✓ Networks of excellence for cultural heritage within the FP6.
- ✓ Stronger cooperation between the Ministries of Culture of the involved European countries.
- ✓ Establishment of connections with countries, such as the USA, for knowledge transfer to Meditarreanean countries

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