UCM cluster Research
Input for the Future
Internet research
programme

Research on
Future Media
Internet in a global
context

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User Centric Media cluster of EU
projects
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1. **Summary**

Internet was designed and primarily used by scientists for networking research and for exchanging information between each other, however due to the explosion of the World Wide Web (which has started as a document repository) and its successful descendants (Web 2.0), along with the dramatic increase of net-based audiovisual material (networked media) that has been produced by professional and amateur users, Internet is rapidly transforming to a full fledged virtual environment that facilitates services, interaction and communication. Therefore the vision that the Future Internet will be an Internet of Media is about to be a reality soon.

Further, since the combination of media and networking moves in parallel with the user’s drive to acquire more control of their media, the individual “freedom” of expression is constantly increased. In this context, it is expected that in the near future the User Centric Media concept, which implies that the user will become an active member of the overall media chain by generating, distributing and experiencing high-quality media content, will flourish\(^1\). Moreover, recent advances in 3D processing give rise to innovative applications notably in gaming technologies and in virtual worlds which place new types of traffic demands and constraints on network architectures. 3D collaborative platforms create new requirements in terms of information representation, filtering, aggregation and networking. They also drive demand towards more sophisticated search tools and raise issues of identity management, ownership and trading of virtual digital objects, right of use, and personalized advertisements. These environments coupled with their usage rules hold the promise of a 3D Media Internet which will form the basis of tomorrow's networked and collaborative platforms\(^2\).

The aim of this paper is to identify concrete scientific challenges that will probably be the constitutional pillars of the **Future Media Internet** research, with a particular emphasis on 3D aspects, from the User Centric Media field of view.

2. **Introduction**

This position paper on the Future Media Internet (FMI) reflects the consolidated opinion of the User Centric Media (UCM) cluster composed of representatives of 15 ongoing FP6 & FP7 EU funded projects (see Annex 1 for a complete list of projects), under the guidance of the Networked Media Systems Unit of the Information Society and Media Directorate General of the European Commission. This paper describes the

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\(^1\) “The majority of the 7 billion online videos streamed each month are user generated” (Source Future Exploration Network)

\(^2\) NEM Newsletter, 17 March 2008
challenges provisioned by the experts for the upcoming years, concerning the FMI, paying specific attention to its provisional 3D characteristics. Towards this aim, three parallel, complementary though, Working Groups (WG) were formed:

- **WG1: Personalized & Creative Media**
- **WG2: 3D & Immersive Media**
- **WG3: Future Media Internet Communities**

Since the term User Centric Media implies high quality media content generated, distributed and experienced by end-users and taking into account that today’s society is becoming increasingly “literate” as a result of technological advances and lower costs in photography, cinematography, 2D/3D graphics design and animation technologies, it becomes clear that the content is expected to play a significant role in the FI. Therefore, the objective of the work of the aforementioned WGs is, by identifying the problems of the Current Internet, to define the main concepts of FMI and to discuss the research challenges that will realize it.

### 3 Research on Future Media Internet in a global context

After the evolution from web 1.0 into web 2.0, where the concept of the active user was introduced as the user to be at the centre of the collaborative web, we are living now a new, far-out event: the birth of web 3.0 or web 3D, which is provisioned to be the Future Internet or 3D Media Internet. The figure below (Fig. 1) clearly depicts how Presentation, User content, Persistence, Social and Interaction physics aspects are evolving from the static web to a fully interactive 3D Media Internet.

![Figure 1: The transition to 3D Internet](image)

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3 Intel
Naturally, the concept of FI comprises many different aspects, as it is depicted in Figure 2, such as Internet of Services (Service Web), Networks of the Future, Internet of Things and 3D&Media Internet. In this report the UCM cluster focuses on the 3D&Media Internet and tries to identify possible challenges that will have research, social and economic impact to Europe.

3.1 Key technology challenges

3.1.1 Future Internet of Personalised & Creative Media challenges

From the Personalized and Creative Media point of view the following changes were identified:

CHALLENGE#01 - PERSONALIZATION

User Centric Media should provide for advanced forms of filtering and navigating through content; User centric systems should allow for a very efficient way of locating the desired information based on user preferences and user profiles. Given the option to fine tune search and retrieval preferences, user centric media approaches will ease the way of locating and retrieving information in environments characterized by immensely large amounts of data and content, either professional or user created and available in single or distributed environments. The Semantic “interoperability” of content and feedback and recommender systems should be researched.

Further, research on technologies is needed that will allow:

\[\text{4 J. Schwarz da Silva: Setting a European strategy for the Future Internet, Brussels, 29 January 2008}\]
• Intelligent Sharing of Content; protection of intellectual property; modules for negotiating rights of use

• Intelligent Discovery of Content

• Intelligent Media formats, that allow to restructure content; describe it “different” or “better”; make it easier to share, find, use; provide the ability to repurpose it and the means to control its usage in terms of repurposing. What happens to intellectual property? Provide the ability of linguistic or cultural adaptation?

• Enhanced Media Creation Process with the ability to use AI engines to automate the actions and interactions of involved actors.

CHALLENGE#02 – ADAPTIVE MULTIMEDIA CONTENT

Create new approaches to media containers that allow a semantic-based, personalized creation and delivery concept. Define the Future Internet in relation to user media creativity; Introduce Collaborative authoring - where multiple authors can adapt, enhance and adjust a pre-authored piece of content, without compromising the integrity of the original article. Research for new forms of Interfaces and technologies that allow for enhanced creativity, foster cooperation and exchange, allow for Creation, Reuse and repurposing of content and Cultural and linguistic adaptation.

CHALLENGE#03 – CONTENT MOBILITY AND ACCESSIBILITY

Users should be able to use “their” content in a way suited to their personal preference. Media should adapt to a form that suits the user at a given moment in time and independent of locations and device. Provide people with the ability to transfer content from one device to another (for example, live news that can be transferred from the PC to the car). Put the audience in charge of programming; in the future users will seek to watch, read and listen to what they want, when they want, on any device they want.

CHALLENGE#04 – PRIVACY AND INTELLECTUAL PROPERTY PROTECTION

Future systems should address User Privacy issues carefully than currently considered. User information should be treated according to easily understandable policies that users have easy access to. Trust mechanisms should exist, that allow users to verify that systems use their information according to the agreement. Provide communities with a self-censorship framework to restrict abuse of content and individuals.

Copyright protection and or Ownership appreciation of the content and insurance of the content ownership are of significant importance in creating future user-centric repositories. Define the “Usage” framework of content, allowing users to define in what way their creations are used by others.

Moreover, research on Business Models and platforms for Content or Service providers is needed, taking into account the transparency of roles in UCM environments.
Can the new environments succeed and what factors are going to influence market and business adoption?

3.1.2 Future Internet of 3D & Immersive Media challenges

From the 3D & Immersive media point of view the following changes were identified:

**CHALLENGE#01 – AVAILABILITY OF 3D IMMERSIVE APPLICATIONS EVERYWHERE AND AT ANY TIME**

3D immersive media should be easily available for the user everywhere and at any time; thus new devices are needed able to improve the “everywhere presence” of broadband connections and development of more powerful terminals for 3D visualization. Therefore, research for more efficient coding, streaming, broadcasting and visualization in different kind of terminals are required.

**CHALLENGE#02 – REAL TIME 3D NAVIGATION AND PHYSICAL AND EMOTIONAL INVOLVEMENT OF THE USER**

The user should freely and easily navigate into the 3D environments and be able to interact with avatars and objects contained in it. Further, s/he should be emotionally and physically involved, and his senses and emotions should be stimulated at a very high level by 3D immersive media. Towards this aim there is a need for applications able to support haptic and sensorial interaction and applications for virtual and augmented reality, available also in a nomadic situation (thanks to the use and increase of wireless broadband networks) and mobile 3D interaction.

**CHALLENGE#03 – FROM 2D TO 3D CONTENT**

The transaction from 2D to 3D media should be as smooth and easy as possible. Thus, it’s of great importance to identify how to transform already available 2D contents into their correspondent 3D version in an easy and possibly automated way.

Apart from improving the 3D capturing techniques, developing, for instance, a much more sophisticated combined use of multiple cameras and range scanners (see **CHALLENGE #02**), new forms of transcoding real world and 2D media to 3D environments are needed, in order to allow the use and reuse of traditional digital media in the new environments.

**CHALLENGE#04 – INNOVATIVE 3D NETWORKS OF PEOPLE**

3D immersive media should be able to support a new form of social networking, as all the social relationships between people will not only pass through the use of “nicknames” and “pictures”, but also through an avatar, a graphic representation (more or less realistic) of the person that moves and acts in the virtual spaces (not necessarily a human avatar). As a direct consequence the communication languages will have to change and adapt (let’s think about the language, full of emoticons, we use when we communicate through skype, msn and other.)
Moreover, as the use of 3D immersive media is expected to be increasingly diffused in real business and working situations, the avatars will not only be a mere graphic representation of a real person, but will have to own a authenticated identity directly connected with the real personal identity of the user.

To achieve the latter new 3D forms of communication are needed that go far beyond the simple use of chat and voice chat (a specific code for avatar behavior will be probably invented in FMI). Also, 3D collaborative platforms of FMI should have new requirements in terms of information and motions representation, personalization, searching, aggregation and networking.

**CHALLENGE#05 – INNOVATIVE ORGANIZATION AND DISTRIBUTION OF THE 3D CONTENTS AND SERVICES**

It is almost a matter of fact that with FI, we will live the passage from informational to experiential web; the challenge related to this will be that of organizing contents and information in a new, innovative and intuitive way, in order to revolutionize the query, retrieval, fruition and creation of information/data/AV products. Therefore, more efficient search & retrieval systems are needed together with novel intelligent services so as to go beyond the current metaphors (paradigms). Also, there will be a need for real-time multiparty networked 3D multimodal applications for professionals as well as communities and gaming to foster user enjoyment and experience.

Moreover, specific research is required on media content-aware future networks to more efficiently set up distribution and processing mechanisms that will provide various 'value-added' services within the network and also research on new network information manipulators and algorithms for an efficient 3D content search and in complex 3D virtual distributed environments.

It will be also important to pay specific attention on the Quality of Experience (aspects combining several quality factors like network, service, content format quality and even “value” of content), with direct impact to socio-economic adoption of new services.

**CHALLENGE#06 – CUSTOMIZED 3D CONTENTS**

3D immersive media of FMI should give the user the possibility to personalize and customize the contents and the 3D immersive experience by his/her own. This automatically leads to another important issue to be taken into account: the protection of intellectual property. However, simple users cannot easily use professional tools such as 3DSMax for 3D modeling or Visual .Net for interactivity programming. Therefore, intuitive and easy-to-use editors to be used by the simple users are needed along with interoperable systems able to import and export objects compatible with the most popular 3D modeling programs.
3.1.3 **Future Media Internet Communities**

From the Future Media Internet Communities point of view the following changes were identified:

**CHALLENGE#01 - DYNAMIC SERVICE PROVISION**

Communities and networks based not only upon the relationships between people and digital artifacts but also upon networked things will demand new network and service architectures. Users as individuals or as members of communities will expect, and service providers must deliver, access to a range of different concurrent services, provided regardless of the user’s location and adapting to a knowledge of the user’s needs in terms of their context and of the capabilities of their accessing device. This will demand a service architecture that recognizes the user, regardless of device and location, and is capable of provisioning a service to them using a network built from a dynamically assembled set of capabilities that are adapted and optimized to provide the best possible service for a user’s given context.

**CHALLENGE#02 - TRUST AND SECURITY**

New media Internet communities will thrive only if they are properly secured from the damage that could be caused by malicious attack or negligence and if the users perceive the new communities to safe. In a world of pervasively connected objects and data, research should focus on reinforcing security against intrusion, on the management/utilization of the personal/community physical objects, on the privacy of the personal/community data and on the way trust between users and service providers is built and destroyed. Service providers would use the output of such research to better improve both the absolute security of their services and the trust that community members would place in them.

**CHALLENGE#03 - DYNAMIC SERVICE CREATION**

A network that links and coordinates things, people and media will need significant new research to help service providers build better services. Ideally it should be possible to dynamically construct services based on the ‘on the fly’ construction of networks of things people and media to a user in any location at any time. For this to become reality the capabilities, availabilities, locations and status of networked things must be discoverable, the use of any identified capability must be negotiated and contractually agreed potentially at both a business and protocol level. Such a vision requires research in the following areas:

- On methods and techniques required to elicit user requirements and to capture and interpret user behavior within new environments?
- On business models that will bridge the world of virtual and real things and that can support the negotiation and contractual agreement of capability between a service provider and the owner of a networked artifact.
- On methods of search and discovery, in real-time, of an artifact’s capabilities, location and availability.
3.2 European Economic Impact

The development of the FI will be one of the main drivers in the close future for people interactions in their daily life (work, communication, entertainment and provisioning of services for citizens around the world). This fact implies a huge transformation and potential impact from the economic point of view for the development of economies. In particular, people interactions in each of their roles during their daily life do it in a sort of communities. Examples of these are communities of work, communities of personal relationships, communities of games, etc. Each of these communities that are already impacting every day life activities will augment their capabilities and their potentials with the advent of the FI. In this context, new interactive experiences integrating the real and virtual worlds will enable a complete new set of services and business models. Ongoing activities at the European level will promote the early identification of such opportunities and therefore will provide Europe with a competitive advantage for impacting the networked societies of the future.

The massive creation of immersive environments distributed towards Internet will be a great technological opportunity for European Union and for the market in general, apart from being an innovative and prestigious step forward in the technological path.

In an economic perspective, the key element for an intelligent and complete exploitation of the new kinds of platforms will be the implementation of services that could enhance their flexibility and interoperability; the companies that will invest in developing such services will surely be winners. As it has been happening with web 2.0, Internet should adapt and mould its services bearing in mind that the user is at the center of them; customization and personalization will still be the key element of FI, but in a 3D immersive perspective.

Obviously, besides user generated contents, contents produced and released by traditional broadcasters and majors will continue to exist, but they will have to evolve in order to survive the epochal turning point of FI. Preferences and sensibility of the audience will change and content creators will have to intercept this new trend and modify their offers; cinema industry, for instance, will have to offer new experiences, much more immersive and interactive.

At the same time the electronic industry should also adjust its services, launching on the market immersive 3D devices (such as haptic and virtual reality devices) with a good quality/price ratio; the demand for these kinds of products can be reasonably predicted to increase massively during the next few years.

Finally, FI will lead to the emergence of brand new jobs, such as the Virtual Community Manager or the “ferryman” that helps and smoothes the passage from 2D to 3D, and also the birth of hybrid (virtual/real) jobs such as the psychologist for avatars. All these professions will probably be a prerogative of new generations with a positive great renewal of the working force.

To sum up, the emergence of a new Media Internet industry is expected to have huge impact on the current EU Media & Telecom companies because the FI will provide added value services from the network itself that will shift value from the application
layer to the network. However, this higher intelligence embedded into the network will
dwell the dawn of new 3D Media applications such as 3D collaborative environments
and virtual gaming applications. Therefore, the FI should provide new value propositions
to those companies which will be positioned either on the networking layer or on
the applications layer. New Business Models will be born to deal with these new pos-
sibilities and the landscape of telcos and media companies will vary depending on the
capacity of adaptation of the different companies.

### 3.3 Social Impact

With the evolution of the Internet, online communities will have a more active role im-
pacting society and daily life activities. In the context of the future internet, virtual
communities will be in one hand, closer to the physical world by impacting directly the
control, monitoring and operation of artefacts in the “tangible” world and on the other
hand by experiencing more immersive and engaging shared interactions into the 3D
virtual world. This will create new forms of socialization and interaction among people
by extending the today’s social virtualizations (e.g. second life) to more sophisticated
immersive realities where the behaviour in the virtual world will extend the way sociali-
zations and interactions in the real world occur and vice-versa. The opportunities of
new networked communities to impact in society will be multiple and will have direct
repercussions in the way people communicate, socialize, work and entertain in the
close future.

Virtual worlds and Internet in general are considered to be alienating media, because
of the fact that the user attention is fully concentrated on a small screen and on our
parallel lives in it, however the detractors of Internet do not take into account that any
kind of media, from the book, to the movie, from the newspaper to the TV requests
almost the same kind of isolation from the real world.

If we consider the issue in another perspective, we even find out that Internet Media in
general, and immersive media for FI in particular, are very powerful social aggrega-
tors, much more than traditional media are.

In an interesting short essay dedicated to Web 2.0\(^5\), Federico Moro individuates some
socializing characteristics of nowadays web 2.0 communities that can be detected, in
a much stronger way, also in 3D immersive media:

- the extraterritoriality
- the massive use of a multimedia type of communication
- the great incentive towards integration among people

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\(^5\) “Web 2.0 – Innovazione applicata ai servizi di rete”, November 2006,
http://www.openarea.net/Web2.0.pdf
• the great tolerance (mainly due to the anonymity)

New generations that are growing with these new media, will use FI immersive media in a natural and intuitive way and will therefore determine an acceleration of this phenomenon, making a real breakthrough.

3.4 International collaboration with Developing Nations and Emerging Economies

The opportunities that the development of high speed, pervasive connectivity will bring to International collaborations will empower the way to obtain mutual benefits between Europe and the developing world. In fact, in the context of the FI, several complementarities between the strengths of European and emerging economies are starting to be evident (e.g. European leadership in iDTV and mobile technologies and potential of Asian countries in software development, search engines, etc) and will increase in the future. The opportune and early identification of synergies between Europe and developing countries will foster the establishment of partnerships with specific countries that give added value in specific technological domains and market opportunities in the context of identification of clear mutual benefits.

More specifically, multiple regional initiatives are currently emerging in view of defining future global networks. Japan (through the AKARI Architecture Design Project⁶) and Korea⁷ have made public their ambitious initiatives, China is supporting the domain through an ambitious and integrated industrial policy, in the US the GENI programme⁸ and facility is a key contributor to the debate on the future of the Internet. These initiatives are not all tackling the issue of the Internet evolution as part of their core objectives, but are certainly related to technological and socio-economic scenarios (ubiquity, connected devices) that will clearly need to be taken into account when addressing the Internet of Tomorrow.

4 Conclusions

This report reflects the work that is currently being carried out from the User Centric Media cluster of 15 ongoing FP6 & FP7 EU funded projects. The main objective of this work is to identify the challenges that should be realized in order to reach the goal of the Future Media Internet (with specific attention to the 3D aspects of it) which is one of the main pillars of the Future Internet. Towards this aim three working groups were

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⁶ http://akari-project.nict.go.jp/eng/overview.htm
⁸ http://www.geni.net/office/office.html
formed within the body of UCM namely: the Personalized & Creative Media WG, the 3D & Immersive Media WG and the Future Media Internet WG. The provisioned research challenges from all WGs are summarized as follows:

- Intelligence embedded into the network protocols and into the content;
- True interactivity for all types of available terminal devices;
- Ubiquitous access to high-quality media content and content availability “anytime – anywhere”;
- Codec independence so as to ensure transportability and accessibility of the media content;
- Collaborative and shared environments for ease 3D content authoring from inexperienced users;
- Real-time 3D navigation combined with physical and emotional involvement of the user
- Creation of new forms of content so as to offer new visual sensations to the users;
- Creation of tools for the development of for computer-generated artificial worlds and environments;
- Efficient mixing real with virtual (computer-generated) objects/scenes;
- Augmenting communities’ social experience by stimulating all users senses: visually, aurally (sound, smell) and haptically;
- Enabling Inter Communities data exchange and adaptations so as to enhance sociability;
- Media personalization (at community and user levels);
- Virtual presence in networked communities;
- Ownership of media in multi-user evolving creation of content;
- Development and validation of new methods and techniques for user-requirements and media consumption patterns of communities;
- Development of theoretical frameworks for the comprehension and analysis of richer forms of man-machine interaction;
- Development and validation of evaluation metrics for innovative forms of remote interaction;
- Creation of bridges between real artifacts (internet of things), pervasively available media and virtual communities;
• Privacy and intellectual property protection mechanisms;

• Research on new formats and codecs to allow user-centric creation and manipulation of 3D multimodal media.

• Research on new network information manipulators and algorithms for an efficient 3D content search (including search in virtual worlds).

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## Annex I

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