

The Future Internet: A Content Creation and Media Delivery Perspective

Draft to be reviewed by a working group in Bled

The Future Internet is not envisaged to be simply a faster way to go online. It will be designed to overcome current limitations and to address emerging trends including: user, terminal, content and service mobility, diffusion of heterogeneous nodes and devices, mass digitisation, new forms of user centred content provisioning, emergence of software as a service and of new models of service and interaction with improved security and privacy features.

It is envisaged that the Future Internet will eventually provide the means to share and distribute (new) multimedia business and user-centric services, with superior quality and striking flexibility, in a trusted and personalized way, improving citizens' quality of life, working conditions, edutainment and safety.

Technological achievements by 2015

The Networked Media sector depends on the continuous advancement of key technologies such as Information Technology, Networking, Electronic Equipment and Content. The continual innovation and adoption of these technologies in enterprises, the extended home and/or on the move, clearly illustrate the need to continue developing and enhancing these technologies, anticipating users' needs and exploiting new venues for research and development. The potential to integrate existing and future technologies and offer choices to customers will open up unprecedented opportunities for the creation of new niche markets, especially in terms of new services and enhanced access, which were inconceivable or very difficult to implement few years ago.

Main axes related to technological achievements in Networked Media sector include (but are not limited to):

- a) the “*challenge of the true broadband*”, where Gigabits (or even higher) per second connectivity will be offered on the home, while broadband, pervasive and affordable mobile networking services will be a common practice,
- b) the “*challenge of personalised intelligent media*”, elaborating on prominent key research directions such as real-time adaptation, interactivity and user inclusion
- c) the “*challenge of distributed control*”, where neither the infrastructure nor the service is controlled by a single entity.

In this evolving environment, user-generated/user-centric rich content as well as community networks and the use of peer-to-peer (P2P) overlay systems are expected to generate new models of interaction and cooperation and be able to support new innovative applications, like virtual collaboration environments, personalised services/media, virtual sport groups, edutainment. In this context, the interaction with content combined with interactive/multimedia search capabilities across distributed repositories and P2P (also mobile) networks and the dynamic adaptation to characteristics of diverse terminals are expected to contribute towards such a vision.

On the other hand, advances in 3D processing will give rise to innovative applications such as massive multiplayer mobile games and in virtual worlds placing new types of traffic demands and constraints on network architectures. These environments coupled with their usage rules hold the promise of a "3D Media Internet" forming the basis of future networked and collaborative platforms

in the residential and professional domains (including creation, delivery and rendering), in virtual/gaming applications, and in digital and electronic cinema.

The Future Internet of Media will not only radically change the entertainment industry, but also is expected to stimulate and enhance creativity, professional productivity and community relations.

Deployment Scenarios

New alliances between traditional IT, telecom, mobile service providers, media companies, suppliers of consumer electronics, (multimedia) search engine companies and other powerful players will drive the deployment of the Future Internet. They will have to overcome a series of deployment barriers:

- Multi-layered/Multi-viewed content coding, considering the evolving H.264 AVC/SVC/MVC and their emerging successors, as the major foreseen A/V coding technologies for multimedia content distribution over heterogeneous networks/terminals and large audiences.
- Virtual 3D collaborative platforms create new requirements in terms of information representation, filtering, aggregation and networking so as to provide real-time 3D navigation combined with physical and emotional involvement of the user.
- New 3D content formats from efficient mixing of real 3D captured content with Computer Generated Graphics (CGG) able to offer new visual sensations to the users.
- New network information manipulators and algorithms for an efficient 3D content search (including search in complex virtual environments).
- Increasing demand towards more sophisticated (multimedia) search tools, including tools for media professionals and P2P overlay networks.
- Identity management, ownership and trading of virtual digital objects, right of use, and personalised advertisements.
- Media-to-network cross-layer dynamic adaptation and use of network aware video coding techniques improving video quality beyond High Definition TV (HDTV) towards 3D and Ultra HDTV.
- Content distribution, distributed control, caching and P2P multi-source/multi-network content streaming offering balanced network requirements.
- New methods that will enable natural communication between people residing in distant locations without incurring the cost and trouble of travelling.
- New viewing methods (and displays) and in general consumption of both professional and entertainment multimedia content depends on the availability of high quality content and ubiquitous network access.
- Reducing start-up/modification/adjustment delays and increasing interactivity to support real-time multi-party network sessions, supporting virtual 3D worlds for professional as well as community and gaming applications.
- Increasing demand for personalisation and aggregation of services supported by high throughput multimedia streams and sessions including data from smart objects.
- New payment methods and business models for commercialisation of the Networked Media in new business markets.

Cross domain perspective

Innovations and break-through achievements in a single domain may create only limited impact. Overcoming current Internet barriers and addressing emerging trends can be achieved via a cross-domain revolutionary, rather than evolutionary approach. Cross domain areas related to Networked media that should be addressed include:

- **Network aware** video coding of 3D, Ultra-HDTV coding.
- **Multimedia aware** content processing in network nodes combined with high throughputs.
- Network architectures for multimedia delivery exploiting **cross layer interaction** of network elements.
- **Trust:** DRM, content sharing (identity management), ownership and trading of personal and professional virtual digital objects, right of use.
- **Involvement** of media industry in network and services design and architectures.
- The Internet of 3D Media will be characterised by an increasing demand for personalisation through the aggregation of services. It will need to be supported by multiple multimedia streams and sessions including data from smart objects (i.e. "Internet of Things").

Questions

- How will the developments in the content and media sphere impact the network and service architectures? What will be in the network and what in the service layer?
- *The Future Internet will be dominated by multimodal audio-visual content. High bandwidth, real time, low delay transmission in the Internet will become crucial. For transmission of audio-visual content it is not so important that there are zero errors (as for data), but that there is no delay beyond a certain threshold. The network layer has to guarantee this service. Potential approaches will include "hybrid" solutions where users can choose between real-time with higher error rate, and longer delays with zero errors.*
- *For future large-scale 3D networked media environments, higher bandwidth is required for content streaming and delivery, so that content producers do not need to be aware of the existence or not of the network layer: i.e. They can develop the same 3D media, without caring if the final application is using standalone content or networked and distributed one.*
- What are the new security, privacy and trust evolutions to be expected as a result of the development of 3D-Media Internet? Where to focus attention on? Identity, privacy?
- *Ideally, a single-layer DRM solution should be followed for 2D and 3D networked media in order to have them transparently experienced by the end users. However, both identity and privacy notions should be tackled, depending again on different user profiles, mobile devices etc. 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?

- *Privacy is becoming more important as more and more user-created content will become available. A multi-layer privacy concept is required where the user can decide who has access to which content. This must be ensured through proper security measures. Moreover, security, privacy and trust will not be affected by the rise of the 3D-Media Internet more than by any other internet evolution. The only relevant dependency will be that as the requirement for increased throughput (for 3D and similar content) and dynamic reservation of network QoS, will have to be accommodated for, the trade-off will balance in favor of more optimal and fast security and trust algorithms. Regarding digital content rights management, the current trend has showed that complex DRM systems have not been welcomed by users and user organizations due to the high supported granularity of content rights, thus taking away from the users their liberty to use the content anywhere and on any platform. In the evolved media Internet (or internet of things) we are facing a situation where multiple versions or digital counterparts of a certain object would be available for the users (through many forms and media). The industry will have then to switch from generic DRM policies that are often obscure and dysfunctional to personalized contracts with each user independently before the actual content purchase. These contracts should be extendable or renewable by the mutual agreement of all parties after they have been established. We believe that the focus of FI in terms of trust mechanisms should be informed by their implementation in social network applications (e.g. the “six degrees of separation” concept used to assign trust to a friend of a friend and the user recommendation voting mechanisms), and could be extended to all content transactions in the FI, including business applications.*

- *What needs to be done at the level of the network and service provisioning to allow for a greater personalisation of media services? What to do to contextualise applications for individuals and empower them to compose their own services?*

- *For improved personalization of media services, we need to create easy and affordable authoring tools for end users in order to be able to provide their own personalized and contextualised 3D content: e.g. for providing extra 3D models in Google-Earth it is quite easy to author a static 3D model with their authoring tool (Sketchup), publish it with one-step in their online 3D warehouse and make it available inside their application (Google-Earth). Similar approaches could be followed for more complex 3D networked media (animated scenes).*

- *User Centric Media could provide 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:*

- *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.*
- *Is there scope for an open service framework for media services?*
- *Currently there is available a number of open media frameworks such as OpenML, OpenKODE, OpenGL ES and OpenMAX, from the Khronos group as well as the MPEG-related standards. A single open media service framework will have to rely on such open media production and distribution frameworks and achieve true interoperability with them. Such an effort is quite ambitious as all these open itemized media frameworks are still under development.*
- *Media and Web Services simplify integration at the lower levels of interoperability stack, i.e. messaging and data format. However, integration at the higher of interoperability stack (business-level interfaces and protocols, processes, policies, etc) is still an open issue. We believe that integration at these levels requires high level models, framework, and tools to analyze service specifications and models and so facilitate interoperation. Such methods, frameworks and tools can be more efficiently built on top of an open service framework, based on existing related work in closely related fields.*
- *How to best address standards issues pertaining to content and media and ease the likely architectural differences between Telecoms, Media and IT service cultures?*
- *So far the telecommunication standards were media-agnostic. Virtually no optimization in certain media transfers through the network infrastructures was made. The advancements in network bandwidth and the overall improvement in network provision did not address successfully the QoS requirements for some real-time applications. We foresee that the FI standards will have to cater for specific media QoS, to be optimally transported through the network. FI will have to support any kind of synchronous applications that at the time are not feasible. Even Massive Multiplayer Online Games, one of the most successful types of synchronous multi-user applications of today, suffer from lack of a unified end-to-end QoS provisioning. Better support for network quality of service, especially dynamic network reservation mechanisms, is foreseen as a requirement of future development in this area.*
- *Do we need to rethink current business processes in light of the upcoming 3D Media Internet? What needs to be done to lower the barriers for service development? What are the implications for the repositioning of industrial players or which opportunities will be created for new players?*
- *The business applications will adopt several aspects of the social communities of today, in order to implement simple and human trust mechanisms. FI for B2B solutions will*

allow for limiting mediators or brokers while establishing business contracts between 2 or more parties. The Internet of things in FI will allow for presenting a more realistic and reliable view of business products (through 3D and multimodal interfaces) before B2B contracts or transactions, thus alleviating the obstacle of mistrust or distrust. The advancement in P2P networks and grids might get exploited as a new means of creating trusted farms or neighborhoods in the business world, as an infrastructure for collaborative applications.

- How will the 3D media and content services be influenced by the developments on the Internet of Things? Which critical search and find solutions need to be developed?
- *A clear challenge of this topic is to develop novel research algorithms on new network information manipulators and algorithms for an efficient 3D content search (including search in complex virtual worlds). Further, the "Internet of Things" will need a much richer automation part. There will be much more machine-to-machine communication which requires intelligent sensors, actuators, agents, etc. For media and content it means more automated and much more sophisticated tagging of content for providing personalized media. Adding metadata to the content will be an important issue. Besides, the emergence of the Internet of things will lead to the immense increase in available digital content. This content will be of various types and highly scalable algorithms will have to be devised in order to efficiently annotate it, store it, search through it and retrieve from it. As with the failure of addressing the expectations of AI during the sixties and the seventies, fully automatic services for the management of the digital content of FI are not to be seen during the next decade, thus heuristics, optimization techniques, grids and the exploitation of the human computing power will provide the means for realizing the so called Internet of Things.*
- What are the requirements for large scale test beds and experimental facilities as seen from a content and media perspective? Which are the key elements of such large scale European facilities?
- *New type of institutions is needed that will bring together inter-disciplinary expertise that can support such 3D Media Internet applications, including: 3D graphics, 3D design, virtual reality, computer vision, computer networking, mobile and ubiquitous computing, robotics and haptics to name just a few.*

Actions

- Document to be reviewed by the Working Group members.
- A revision to be approved as the starting point for consideration on Networked Media issues, challenge and evolution step in a Future Internet environment.
- Common deliverables and scheduling to be defined.
- Cross Domain communication establishment

References

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