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Abstract (for dissemination)	The main purpose of this document is to provide an outline which can be used to elaborate a complete Future Media Internet Roadmap. The roadmap will be elaborated following the insights and suggestions about how and where Europe should make efforts to improve its competitive position in the area of Future Media Internet (FMI) from the variety of experts which have been consulted.					
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EXECUTIVE SUMMARY

The Future Media Internet Roadmap has been elaborated following the insights and suggestions on how and where Europe should make efforts to improve its competitive position in the area of Future Media Internet (FMI) from the variety of experts which have been consulted (see annex I for the list).

The starting point for this is the reality that Europe reaps relatively little economic benefit from Internet innovation, whether in media or other areas. At the same time there is a consensus that research in the internet area is world class and that, in general, it can be considered comparable to that which is being carried out in other parts of the world, especially USA and Japan. The original objective of this Roadmap was to pinpoint areas where Europe has already established a lead and where it would have been possible to take advantage of this fact through directed investments in research as well as other areas of relative weakness where it would have been unwise to invest. One of the main results of the consultation with the experts was that significant areas of comparative advantage and comparative weakness do not exist. The conclusion that therefore comes from that is that Europe should invest in those areas that are economically promising towards the future.

Disclaimer

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No	Participant name	Participant short name	Country	Country
1	Universidad Politécnica de Madrid	UPM	Coordinator	Spain
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Table 1. Partner List

1 Introduction

1.1 Context and Objectives for this Document

The main purpose of this document is to provide insights and suggestions about how and where Europe should make efforts to improve its competitive position in the area of Future Media Internet (FMI). The starting point for this roadmap outline is the reality that Europe reaps relatively little economic benefit from Internet innovation, whether in the media or other areas.

In general the basic target to be addressed here refers to research and technological directions and challenges in the area of FMI but it should be noted that the authors feel that it is both difficult and probably unwise to strictly limit the scope to purely technical questions in the media internet area and so some mention will be made to more general technological challenges, which have a strong bearing on media (such as Internet architecture for example) and to economic, policy and/or organisational questions which may also have a strong impact on the implementation or uptake of innovations coming from the technological research sphere.

The most important input for this document was the nextMedia deliverable D3.1 "Situation in Europe versus the one in Japan and United States". Perhaps the most important conclusion of that document was the perception of the relatively healthy situation of European research in the area of FMI. This has extremely important implications. If the cause of the lack of European Internet "champions" is not the lack or weakness of research in the field then the cause must be elsewhere – legal or policy issues?, cultural questions?, weakness of venture capital markets?, etc.

Moreover, it would seem that, in general, Europe does not have significant areas of strength or weakness in research in FMI as compared to other areas of the world. One of the initial goals of this Roadmap had been to identify particular research areas where Europe had a significant competitive advantage and thus to recommend these specific technological areas where more emphasis (and research funding) should be placed. If these areas do not really exist then the implication is that the goal of this Roadmap should be to indentify promising areas of research independently of the situation in Europe in this area.

The document is organised into three main areas, Base Technologies, Application Areas and Economic and Policy issues.

2 Base Technologies for FMI

The main areas for the future research trends for FMI include the following:

- Architectures and technologies for converged and scalable networking
- Streaming Content
- Optimised searching based on contextual information
- Optimised searching based on user feedback
- Content Recommendation Systems
- Optimised content searching, finding and retrieval

Other areas such as "Architectures for 3D augmented worlds", "Optimized quality of experience" and "Enhancement of multi view point coding" may be considered important as well but are thought to be less vital than those chosen here.

2.1 Architectures and technologies for converged and scalable networking

Within the framework of Future Media Internet, it is expected that the number of nodes (computers, terminals mobile devices, sensors, etc.) will significantly grow (to more than 100 billion), the services and open application interfaces will expand in a similar way and many of these services will be addressing essential societal needs in the domains of healthcare, transportation/automotive, emergency services, etc. Reliability, availability, and interoperability required by these services impose in turn to increase robustness, survivability, and collaborative properties of the Internet. In parallel, the advances in video capturing and content/media generation have led to larger amounts of multimedia content and applications offering immersive experiences, e.g., 3D videos, interactive immersive environments, network gaming, virtual worlds, etc. compared to quantity and type of data currently exchanged over the Internet.
All these applications create new demands, which to a certain extent can be addressed through "over-dimensioning" combined with the increase of Internet capabilities over time. While the latter can be a satisfactory (even as temporary) solution to some cases, analyses have shown that increasing the bandwidth to peta-bps on the backbone network will not suffice due to new qualitative requirements in, for example, highly critical services such as e-health applications, clouds of services and clouds of sensors, new social network applications like collaborative 3D immersive environments, new commercial and transactional applications, new location-based services and so on.
In this section, we will try to define a roadmap towards enhanced architectures and technologies that will lead to converged and scalable networking. In more details we expect the following steps:

- **Fast & Seamless access**. The first step towards the new architecture will be faster and seamless access from everywhere. The IPv6 will progressively replace IPv4 and Content Delivery Networks (CDNs) or Hybrid CDNs (which will company the classical client-server, the CDN and the P2P paradigms) will evolve, towards a "cloud" network architecture, which will enable services like efficient streaming audio/video, storage in the network, etc. In parallel, virtualisation methods will hide the network heterogeneity (ad-hoc networks,

opportunistic networks, networks of networks), with the need of a seamless and generalised handover, in support of the complete range of services and applications.

- **Metadata & Semantics**. In parallel to the network evolution, also the Multimedia data will become a significant constituent. Content will evolve to individual objects, which will be related to and interrelated with other content. Semantics-based technologies will close the "semantic gap" between low-level feature analysis and high-level conceptual annotation, allowing more precise and simultaneously personalized audio, video and image retrieval.
- **Content aggregation & transformation.** The next step will be to define in the network entities that will be able to adapt content based on the network and user requirements and business models. These functions will allow from simple content compression to content aggregation, transformation, enrichment or even personalisation.
- **Consolidation.** Finally, to support the full media lifecycle, media objects will be packaged with metadata which will be transmitted with them through the network, and will need to be supported in the network infrastructure, including their correct interpretation and modification. The content networks will evolve towards self-organizing and self-adaptive networks. They will be able to support open access, increasing heterogeneity of end-points (multimode devices, people, things) and sustain a large number of devices, many orders of magnitude higher than the current Internet and handle the large irregular information flows.

2.2 Streaming Content

Streaming media is poised to become the de facto global media broadcasting and distribution standard, incorporating all other media, including television, radio, and film. Future Internet as a dynamic and distributed environment should enable new services and seamless, scalable and trusted multimedia content delivery, increasing the robustness and resiliency, enriching the PQoS both within the network and/or at the end-user terminal. In order to realise these services, a number of issues and research challenges have to be considered:

- P2P video streaming should be addressed to achieve peer retrieval optimization and application of proper coding techniques. Another important topic will be the distribution of multiple views over a P2P overlay and optimization of the visual quality and PQoS via exploitation of advanced source coding techniques (SVC, MVC, MDC).
- Multiple Description Coding (MDC) is becoming an important approach to achieve error resilience in media streams by fragmenting a single media stream into more substreams referred to as descriptions.
- Multi-View Video Coding (MVC) enables efficient encoding of sequences captured simultaneously from multiple cameras using a single video stream. H.264/AVC is the current state-of-the-art monoscopic video codec providing almost twice the coding efficiency with the same quality comparing the previous codecs.
- Scalable Video Coding (SVC) is becoming a trend in transmission of and access to multimedia content over Internet. SVC enables encoding of video content to

produce a single scalable bit-stream that can be seamlessly adapted to network or terminal properties while providing high compression efficiency.

- Cross-layer control (CLC) and optimization is an escape from the pure waterfall-like concept of the OSI communications model with virtually strict boundaries between layers.

Multimedia Content Streaming is a research challenge to enable a wide range of innovative services and applications, including peer-to-peer (P2P) video streaming, Internet Protocol Television (IPTV), live video consuming on mobile devices, interactive online gaming, cloud computing and resource sharing, ensuring the quality of experience, security, bandwidth efficiency, content personalisation, adaptation and scalability.

2.3 Optimised searching based on contextual information

Search Optimization will be driven as an attempt to improve how the Search Engines discover both the search intentions and the contextual information. In this way, the context of a search query will provide to the Search Engine with meaningful hints to answer the current query in a more precise way. The main challenges in the future of search processes based on the contextual information are:

- First, capture and model the query context. The fundamental challenge in order to achieve a general context-aware search is to elaborate a comprehensive model which can combine the different and heterogeneous parameters affecting the search context and produce a context-aware content re-ranking, query suggestion, or recommendation.

- Other important challenge, in the optimization of searching based on acquired contextual information, is to instead of adapting the query to adapt the response to the user context. The generated results from a query can anticipate the user's desires according to the user profile.

- Besides personalization, the context can also be used to modify or enrich the content metadata, and apply this kind of information to improve the search process.

Search Optimization can be considered as an attempt to improve the way that the Search Engines discover both users' search intentions and the contextual information. In this way, the context of a search query will provide the Search Engine with meaningful hints to answer the current query in a more precise way. Research challenges of this type include capturing and modeling both the user's intention and the content's context.

2.4 Optimised searching based on user feedback

Relevance feedback is an automatic process that was introduced to produce improved query formulations following an initial retrieval operation. It is well known that the original query formulation process is not transparent to most information system users. In particular, without detailed knowledge of the collection make-up, and of the retrieval environment, most users find it difficult to formulate information queries that are well designed for retrieval purposes. This suggests that the first retrieval operation should be

conducted with a tentative, initial query formulation, and should be treated as a trial run only, designed to retrieve a few useful items from a given collection. Relevance feedback procedure exhibits the following main advantages:

- It hides to the user from the details of the query formulation process, allowing the construction of useful search statements without intimate knowledge of collection make-up and search environment.
- It breaks down the search operation into a sequence of small search steps, designed to approach the wanted subject area gradually.
- It provides a controlled query alteration process designed to emphasize some terms and to deemphasize others, as required in particular search environments.

Taking it into account, it is important for the Future Media Internet trends to improve the performance of the classic algorithms (such as *Rocchio* or *tf-idf* algorithms) using new ways to model the user behaviour considering different types of interactions.

> User's (implicit or explicit Relevance) feedback is an automatic process that can be used to produce improved query formulations following an initial retrieval operation. It is important for the Future (Media) Internet trends to improve the performance of the classic algorithms using new, more effective ways to model the user behaviour considering different types of interactions.

2.5 Content Recommendation Systems

The Future Media Internet challenges in the Content Recommendation Systems field can be grouped in three convergent threads:

- Improvement of Multimedia Content-Based Recommendation Systems. In this area, the main objective is to achieve a robust modelling of intrinsic multimedia properties and not only extrinsic parameters such as the year, place, or syntactic and semantic tags introduced by users or administrators. New algorithms which will take into account the image inherent characteristics (e.g. aesthetics, objects) and automatic-annotated characteristics will have to be developed.

- Improvement of implicit information modelling methods for obtaining more realistic and less invasive input data. This implicit information usually comes from the user interaction, but usually it can be also inferred from the user content consumption. There are important factors to take into account, such as physiological, psychological or cognitive factors, inferred from the content essence (for example, in a video, the sound intensity, the shot change speed...).

- Improvement of hybrid recommendation techniques, which combine heterogeneous content-based, social-based and contextual techniques. In the majority of the cases, a single recommendation technique is not the optimum solution. In the future, the hybrid techniques will be customized and dynamically adjusted to each user, depending on its preferences and the nature of the content prieces.

The Content Recommendation Systems is a sound challenge which should advance in providing improved content-based recommendation using a robust modelling of the content inherent characteristics and not only high-level characteristics, improve the implicit information modelling methods for obtaining more realistic and less invasive input data from the users, and the combination of the said systems with a hybrid recommendation engine, optimally mixing heterogeneous content-based, social-based and contextual techniques tailored to the users' profile.

2.6 Optimised content searching, finding and retrieval

Assuming the availability of an optimal, user-centric, search and retrieval engine, when users search for content, they should be able to:

- Express their query in any form most suitable for them;
- Retrieve content in various forms providing the user with a complete view of the retrieved information;
- Interact with the content using the most suitable modality for the particular user and under the specific context each time.

To do so, an optimized multimedia content search engine should go beyond the traditional text based techniques and provide also content-based multimedia retrieval capabilities.
A lot of research has been contacted in content-based multimedia retrieval methods the later years, however most of it aims for retrieving a single modality of content. Cross modal retrieval was recently appeared as a solution to go from one modality to another. However, for a search engine to fulfill the needs described above, true multimodal capabilities are a necessity. Multimodal retrieval is a sound research challenge for modeling and developing truly "holistic" multimedia search engines that understand and approach the content from the viewpoint of each end-user.

Multimodal and cross-modal retrieval is a sound research challenge to produce a Future Media Internet optimized content search, finding and retrieval, using as input any kind of media (text, audio, video, images) or a combination and resulting in a multi or mono-modal reply which contemplate in addition the query and result context from the viewpoint of each end-user in a networked media environment.

3 Application Areas and Services for the FMI

Obviously there are many areas that can be considered as extremely important application areas for the the Media Internet but the areas of Trust & Security, Cloud Networking/Cloud computing, Multimedia Search and Virtualization are especially important for the future.

3.1 Trust, Security & Privacy

In the last decade, the efforts regarding the security in Media were centred on the so-called DRM (Digital Rights Management) systems. Current DRM systems are quite limited; they work only in the "copy `protection" aspect of the problem, the economical side. The adopted point of view is always that the contents are published by a few editors, the big shops like iTunes, and the contents must be copy-protected against the common users.
Several concerns were expressed against this traditional type of DRM, and they are unresolved yet:

- Copying is avoided, but also the "fair use" of the contents is impossible.
- Users can use the contents only in one device or a limited number of players in the best case, and only in very specific ways. It is impossible to lend DRM protected content to a friend, for instance.
- The digital preservation is also very problematic.

Being very limited, the current DRM systems are basically now obsolete.

- Contents are consumed by streaming, and they are stored mainly in the cloud. New systems of security, totally cloud-aware, are needed.
- The paradigm has changed. The contents are mainly generated by the users, not only by the big publishers, so other aspects become relevant.
- The media contents are items in the social networks. Usually the user wants to share the contents with some persons, but not with others. The need of a "copy protection" becomes the need of "privacy protection", and this aspect is not resolved yet.
- It is not possible to guarantee the authorship or the non-manipulation of the contents, the digital identity is not assured currently.
- The contents nearly always are stored in a cloud, and the user cannot enforce the privacy of the contents, depending on the good intention of the owner of the cloud infrastructure, because the users loose the control of their contents.

3.2 Cloud networking/Cloud computing

Cloud Networking/cloud computing will address many distributed applications (some event claim that cloud networking will lead to a "Service Jungle"). Some services that are expected to involve include:

- *Social Networking in the cloud:* This application will allow social friend to share tasks, projects and events, add project information, share calendars, share ideas, Web links, blogs etc.
- *Office Synchronization:* This application will enable users to store and backup documents and multimedia files in the cloud, share the files with their colleagues, utilise various searching capabilities and have some real-time collaboration features.

- *High performance computing:* This application will bring workflow, business process and integration capabilities to the cloud and let users design, connect, deploy and measure day-to-day or complex workflows.
- *Virtual Organisations* spanning across countries and organisational domains.

3.3 Searching capabilities

Search and retrieval of content is so correlated with most of the existing applications of ICT systems, which is sometimes difficult to isolate and examine solely. Moreover, we should notice that since search and retrieval technologies are so powerful in building new user behaviours, novel applications which have never been thought until today are expected.

Some of the areas that are expected to evolve through the evolution of the search capabilities of the Future Internet are:

- New infotainment applications with major involvement from the user
- Commercial applications and new efficient recommender systems
- Information extraction from huge video archives e.g. for homeland security (security – surveillance cameras etc.)
- Bridge Virtual Worlds with "Reality" and provide search and delivery tools for new applications. Different Worlds can exchange information based on user interaction
- Physiological signals based on the emotional state or activity of the user can interact with search queries (heart beat, brain waves, etc)
- Access to complex, possibly multimodal and deformable information from a rudimentary query (based on imperfect and cross modal- descriptions of the searched information)

3.4 Virtualization and infrastructure

One of the main challenges for Media technologies is the risen costs of infrastructure. More people uses Media services each year, and they demand more technical quality too.. In a few years, High Definition will be the minimum acceptable, and 3D will become widespread. Interactive systems or multi-view contents also will be popular.
From the technical point of view, all these trends technologies have in common the high requirement of resources. The solution will be more scalable infrastructures, where scalability leads to a non-linear increase in costs.

- Scalability is especially significant in view of the growing number of devices, the exponential increase in data, the increasing need for processing data on-the-fly, and the pervasive need for security. But in general, the scalability currently is poor in the practice.
- New design of platforms/infrastructures and services/applications optimised for virtualisation; are needed.
- Issues of availability, dependability and security for virtualised infrastructures will be also challengers for the near future.
- For economical and ecological reasons, the use of energy must be minimised. This includes both the hardware and the algorithms.

3.5 Other future areas and services

Apart from the above research challenges, other also promising future areas are:

- Immersive and 3D Applications: new physically strong experiences (exertion games, realistic simulation and training, new entertainment experiences, personal enriched communications as tele-presence) are enabled through sophisticated representations of virtual and real worlds.
- Multisensory Media Integration: simultaneous stimulation of different senses beyond audiovisual content (tactic or smell) will also impact Human perception.
- Augmented Media Experiences: the enrichment of the physical world perception through the interaction with elements of the virtual-world/digital-content will modify the perception of reality and enable new services.
- Contextualized Media Consumption: a selective FMI information consumption will depend on the context (personal profiles, media type, location, devices, etc) to present information.
- Real-Virtual Worlds Search and Delivery: new applications will include searching facilities enabling multimedia/multimodal search for both the real (objects) and the virtual (data) world.
- Social Networks: Social Networking is a highly evolving area with hot topics such as: social gaming and social television, immersive social networks, dynamics and evolution of SNs and trend prediction for business and marketing.

4 Economic and Policy Issues

4.1 Business Models for the FMI

While the focus of this Roadmap is on technological and research challenges for Europe in the area of Future Media Internet, the question of business models cannot be ignored. In the medium to long run no advance that isn't supported by appropriate business models will be able to succeed. This is especially important now as we are beginning to see a point of inflection. A number of only loosely associated trends are changing the economics of the Media Internet.

At the same time as Over the Top (OTT) providers such as Netflix are proving to be viable, advertising, which has until now been by far the dominant business model, is starting to decline in importance

- Software as a Service in the media domain, while still not overly common, is showing to be possible
- The prevalence of User Generated Content
- The entrance of social media, as a provider of content, as a gateway for consumption of content and perhaps most interestingly, as a monitor of media consumption
- Hybrid Broadband Broadcast and Connected TV

As a result of all these trends, one of the areas of the FMI that will see the greatest change in the coming years will be in Business Models. The main drivers are consumer demand, technological improvements and the need/desire for monetisation of content. All 3 of these drivers are mutually dependant - greater consumer demand leads to technological improvements to meet that demand, technological improvements are often costly and require that stakeholders (in all parts of the value chain) somehow receive compensation, better monetisation leads to increased availability of content thus increasing demand and so on.

Until now the 2 main business models in media have clearly been basic advertising and subscription models but increasingly newer business models are appearing (or much more sophisticated versions of adverstising and subscription) such as .

- Selling experience and participation in a virtual community
- Selling information gathered from online experience
- Selling accessories for virtual communities
- Selling content extracted from virtual communities

One of the most important developments is the rise of the multisided business model. Of course advertising is a simplified type of multisided business where advertisers pay content distributors for access via commercials to the viewers of the content being distributed. But increasingly, a significant proportion of revenue for internet companies comes from data gathered from one set of users to generate revenue from a separate set of customers. In many web-based areas (Google, Facebook) this is already the case but the same will more and more be true in the media sphere.

4.2 Implications for Policy and Innovation in Europe

As was pointed out in the introduction the perception amongst experts in the area of FMI is that European research in this area does not lag behind and is not of lower quality than that which is carried out in other parts of the world, especially USA. But if that is truly the case, then it begs the question why then are basically none of the really important Internet companies European? Why does none of this world class research lead to important Internet companies? It is not within the scope of this document to go into a detailed analysis about why this is true. But if the intention of the document is to help policy makers and stakeholders in the area of FMI to implement technological and research strategies that can help Europe bridge the gap in FMI then it is important that they keep in mind the limitations and stumbling blocks that exist in Europe in transforming research into valuable market innovations.

Some of the most important of these stumbling blocks, limitations and bottlenecks are probably:

- Fragmented legal frameworks and uneven enforcement of policy in different countries in Europe
- A weak entrepreneurial culture compared with USA
- University curricula that don't take into account the latest Internet trends and that aren't closely enough tied to industry
- A weak tradition of and mechanisms for spin offs associated to educational institutions
- A lack of mechanisms to identify, mentor and stimulate start ups and to create partnerships between these start-ups and established industry.
- A poorly developed venture capital market as compared with USA both in terms of initial seed money but also especially in terms financing the followup period in start-ups.
- Disjointed and fragmented R&D programs, especially between member state financed R&D and European financed R&D
- Lack of agility in R&D financed projects. From time of conception of an idea until the end of the resulting R&D project 4 to 5 years may have gone by and the results are usually still just pilots (i.e. not market ready)! As well, the competition for financing (less than 1 proposal in 10 is funded) makes long term planning difficult especially for smaller organisations and SME's.
- A relatively long period of time is required for the establishment of new companies in Europe as opposed to USA
- Relatively low usage of ICT in European enterprises

Independently of whether the technological and research related recommendations in this document are followed, resolving some of the above issues would go a long way towards reinforcing the European position in the Future Media Internet.

The different stakeholders with an interest in FMI (EU, member states, enterprises - IT, media, telecommunications, SME's, entrepreneurs, researchers - academic, commercial) need to be conscious of the problems facing Europe in this area and so work together to find solutions that lead to a transformation in Europe . The role of the EU here must be to facilitate and lead this transformation through policy initiatives.

This section will cover the implications for the European policy and a set of recommendations from nextMEDIA coming from the results of the Roadmap elaboration.

5 Conclusions

There are clear areas for research trends for the FMI where the experts that were consulted considered such as architectures, streaming technologies, optimised searching based on contextual information or user feedback and recommender systems. In terms of promising application areas the experts considered trust, security & privacy
cloud , search and virtualization to be the most important.

Nevertheless while the basic scope of this Roadmap is to identify promising research areas for the Future Media Internet, as has been pointed out several times previously in this document, the strengthening of the European position in the FMI goes well beyond the confines of FMI. This is true both because technologically there is not a clear dividing line between FMI and what is more generally Future Internet and the fact many of the most important causes of the lack of European Internet champions are organisational, economic and financial, legal, cultural and educational.

6 References

nextMEDIA Deliverable 3.1 "Situation in Europe versus the one in Japan and United States". Available at http://www.gatv.ssr.upm.es/nextmedia/index.php/results/deliverables

"EU Competitiveness on the Web" Available at: https://daa.co-ment.com/text/ax5Al8SHnnI/view/

ANNEX I: List of participants in the survey

NAME	ORGANISATION/COMPANY	POSITION
Nuria Oliver	Telefónica R&D	Scientific Director
Jan Bouven	Alcatel-Lucent Bell Labs	Visual Communication Department Head
Jesús de Pablos	Atos Origin	Director de Innovación
Gabriele Galimberti	Cisco Systems	Technical Leader Eng.
Thomas Steiner	Google	Research Scientist
Brian Quinn	Intel	Research Manager
Xavier Anguera Miró	Telefónica I+D	Research Scientist
Sandeep Singhal	Microsoft Corp	General Manager, Windows Networking
Amar-Djalil MEZAOUR	EXALEAD	Project Manager
Damien Alliez	NDS	Program Manager
Adolfo María Rosas	Telefónica I+D	Expert
Luciano Baresi	Politécnico di Milano	Associate Professor
Point	JCP-C	CEO
George D. Stamoul	AUEB	Professor
Hannes Tschofenig	NSN	Senior Standardization Specialist
Horsten Herezt	Intel	Director Intel Visual Computing Institute
Takahiro Hara	Osaka University	Associate Professor
Yoshiharu Ishikawa	Nagoya University	Professor
Susumu Takenchi	NICT	Researcher
Kyoko Yamori	Asahi University	Associate Professor
DR. Koji Zettzu	NICT	Senior Researcher
Kihyung Nam	Latin America Lab, Mobile Communication Division / Samsung Electronics	Engineer
Byunggook Kim	Samsung Electronics	Storage Security Engineer
Kostas Pentikousis	Huawei Technologies European Research Centre	Senior Research Engineer
David Griffin	University College London	Principal Research Associate
Gonzalo Camarillo	Ericsson	Expert