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RESÚMENES DE LAS PONENCIAS
ABSTRACTS

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Ambient Networks : toward a Future Internet embracing the Wireless World

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Business perspectives

We are currently experiencing a formidable growth in mobile networks. There are currently more than 4 billion subscriptions worldwide. At the same time we are also experiencing a quick uptake of Internet usage although not at the same pace. Most of the growths in both cases are in Asia and where more and more Internet users experience the access to Internet over mobile networks. The forecast is that the dominant access to Internet will be the mobile network.

We are currently in a transformation mode where different business segments are merging continuously and rapidly into something new. Traditionally we have been looking at Cellular/Mobile communications, Internet, Media and Service distribution separately each having their own business drivers, model and corresponding architectures. We have a growing number of applications, devices and recourse based platforms that are multi modal and interconnected and working cross-domains.
Another high-hope of Future Internet is to enable the role of the user (individuals, SMEs, community networks) as content and services prosumer. In this new model, the same entity will be producer, mediator and consumer of services and multimedia content at the same time, and be able to seamlessly change roles based on the specific needs. Open competition is expected to be a key differentiator. In the same way one can see SMEs community networks becoming not only a content prosumer but also provide network services as well consuming such services in a cooperative networking fashion.

Evolutionary and Clean slate research

There has been a long discussion whether to have incremental research or have more audacious research, aka clean slate. We are now converging into the belief that clean slate research is a good way to achieve greater steps in results compared to incremental research but the results need to be migrated to the **current Internet.** We don't believe it is neither wise, economically viable nor even possible to disregard the current Internet.

Ambient Networks approach

Ambient Networks were run in 2 phases as 2 consecutive EU projects that started in January 2004 and were finished December 2007. The first phase focused on architecture issues whereas the second phase focused on application of the architecture on protocols, evaluation and prototypes. It was part of a larger consortium called Wireless World Initiative that consisted of a radio project called

Winner, a reconfiguration oriented project called E2R, applications and service platform and projects Mobilife and SPICE respectively.

The idea was to approach the issues in mobile networking from a complete E2E view.

Commercial Background

Drivers for mobile networking have gone from coverage over growth and bandwidth to focus more on ubiquity, simplicity and scalability.
Roaming was a killer for GSM working extremely well for voice but for data and new services? We need more of dynamicity and service based roaming. What Ambient Networks wanted to achieve was to provide a unified control layer to IP and can be seen as an evolutionary research approach. One of the important areas was to investigate how to facilitate roaming between operators and the approach was network composition.

Composition

Network composition is an approach that was advocated in Ambient to cooperate and compete in a very dynamic and changing world for operators and service providers. We have defined a way to interact in a secure and uniform way. We have defined a process for composition that includes media sense, discovery/advertisement, security and internetworking establishment, composition agreement negotiation and agreement realization.
This Enables automation of network co-operation establishment and defines the control plane interworking between Ambient networks, the co-operating functions are: connectivity, mobility management, multi-radio resource management, security, context management, internetworking, service adaptation, composition, compensation, etc

It is a uniform procedure independent of network type and technology and co-operation type. It minimizes human intervention and enables flexible co-operation between networks and providers. The dynamically agreed co-operation is defined in the Composition Agreement (CA).

Multi-Radio Access

Another very important area within Ambient Networks is the capability of multi-radio-access. The idea was that Multi Radio Access shall support efficient coordination of heterogeneous access technologies with different capabilities like 3GPP and non 3GPP Radio Access Technologies (RATs).

This coordination achieves significant gains for both providers and end-user with respect to service availability, total effective capacity, coverage and efficient radio resource usage. This work has provided input to the standardization work within 3GPP. One the inventions were the Generic Link Layer GLL to hide the differences of technology to IP and act as mediation and control of RATs.

4WARD approach

4WARD is an FP 7 project that has come into its second year. The method is to have combination of clean slate research approaches covering content centric networking, transport (called Generic paths), network virtualization, and integrated management and as a basis the architecture framework but also take into account business and regulatory perspectives as well as usage and socio-economics.
Network virtualization seems to be a credible approach to provide a path to future network architectures, where the physical infrastructure can support several different networks. We have reached an understanding of the architecture and business roles and are investigating a provisioning framework for a dynamic instantiation of virtual networks.

Content Centric networking tends to get more and more important as the content become more dominant in the networks. We want to find a more effective means to dissemination of information compared to the current means. The approach is inspired by Van Jacobsson's Information networking. We have defined an information object model that represents semantics like File (e.g., a text, movie, song, service, stream and real-world object (e.g., a book, person).

Management

Management has often been considered as an afterthought to the network design. This has in practice meant that specialized tools had to be developed after the deployment as an overlay to the network. We have taken a different approach by integrating management from the very start of the design. Monitoring and optimization functions as **embedded capabilities** of network components have been included and the approach is rather co-design than retro-fit
It supports self-management with reduced integration costs and shortened service deployment cycles. We call this approach **In-Network Management (INM)**.

Summary

Mobile and wireless networks will be the dominant access to Internet and for this reason we need to ensure that the Future Internet better supports mobile and wireless accesses.
Consumers, producers are only different roles and actors can take on both roles and we call this prosumers for networking, services and content.

We see that Vertical oriented business models move towards horizontal as a means to gain more market coverage.
We believe that Evolution rather than Revolution will be the norm but thinking out of the box is important to get major break-troughs in research.
Multi-access and composition are important results out of Ambient Networks and have contributed to standards in 3GPP as well as in IEEE 802.

Expectations of Future Internet are not only to solve current problems but future challenges like green IT.

The most promising results in 4WARD being close to standardization are Network Virtualization, Content Centric Networking and Management.

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The Future Internet Research challenges

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Summary description

The Internet has radically transformed the telecommunication landscape. New applications, new business models, new content delivery forms have been made possible with the Internet. Still, this is only a beginning as novel technologies like RFID or sensor networks are opening prospects for novel types of applications making use of contextualised information. In a not so distant future, it will be possible to develop applications mixing the virtual world of the cybersphere with physical information from the real world. Also, the number of services available from the Internet and their capabilities are expected to soar as user are takin an ever more proactive role to develop content, services and applications. These developments are on the other hand putting some limitations and constraints on the current Internet architecture, which was originally not designed to support essential features of today's on line world, such as security, mobility or even broadband connectivity. After an era when the Internet has largely influenced the telecommunication sector, we are now entering an era when the telecommunication sector has the opportunity to influence Internet developments.
Against this background, the presentation will review the emerging requirements and possible limitations of today's Internet, and outline how EU research is addressing those, with the objective of providing EU industry an opprtunity to compete in this domain whilst providing users with more innovation and trusted service capabilities.

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The Future of Satellite Telecommunications
and the Programme of the European Space Agency.

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Satellite Telecommunications constitute the most mature of space applications. At present, nearly 300 telecommunication satellites, placed in the Geostationary orbit, provide the infrastructure that allows the distribution and broadcast of more than 20 000 television channels, permit the establishment of thousands of circuits between telephone exchanges, allow the deployment of dedicated data networks, TV contribution links and many other systems.

Another variety of Telecommunication satellites is dedicated to mobile services. Mobile satellite systems permit the establishment of voice and data links to moving terminals situated on the land, on the air or on the sea. Currently two space system architectures are prevalent: either large satellites with very high gain reflectors placed in the Geostationary orbit (e.g. Inmarsat, Thuraya, SkyTerra and TerreStar), or constellations of tens of relatively smaller satellites orbiting about the Earth at altitudes that range between 600 and 15 000 Km (i.e. Globalstar, Iridium, Orbcom).

To these well established systems, that are classified by the International Telecommunications Union as Broadcasting Satellite Services (BSS), Fixed Satellite Services (FSS) and Mobile Satellite Services (MSS) we can consider adding two emerging categories of satellite systems that require specific consideration namely: Broadband Interactive Services mainly dedicated to the provision of Internet access to remote users and Mobile Broadcasting Services.

Broadband services are based on the use of a space segment with antennas that cover the service region with multiple narrow beams, in this manner the signal that is intended to just one individual is not spilled over a wide geographical area. This leads to a much more efficient system that those currently offered on conventional FSS transponders. These multi-beam systems use mainly the Ka Band (20-30 GHz) and aim to offer ADSL on the Sky at very competitive prices. Currently two systems are operational in the USA: WildBlue and Spaceway. Further several new systems are in the pipeline on both sides of the Atlantic, namely HYLAS and KaSat in Europe and Viasat in America.

This new generation of satellites will allow a substantial reduction of the cost of the space segment at the same time that allows the multiplication of the available capacity more or less in the same proportion. At the same time the volume production of user terminals will allow service offerings able to compete with terrestrial solutions in a wider range of commercialization scenarios.

Another important area of growth of satellite services is derived from systems dedicated to broadcast Radio and/or Television to mobile terminals. These systems have reached already nearly 20 million subscribers in the USA and over one and a half million in Korea. Europe also expects to get these services as a result of the Selection and Authorization Procedure for the S band frequencies that has been undertaken by the European Commission which has resulted in the award of two licenses to Solaris (Joint venture of Eutelsat and SES) and Inmarsat. Although unfortunately hindered by the faulty deployment of the antenna of the Solaris system the awarded band would be able to deliver a combination of TV and Radio products to a wide range of user terminals installed on radios and/or on user telephones.

The European Industry is in general terms well represented in the various links of the value added chain that constitute the satcom ecosystems: technology, equipment, systems, services and applications. In particular in the course of 2008, 10 of the 25 satellites global orders were placed with European Prime contractors. Nonetheless to maintain the competitiveness of the European industry requires a continuous effort of R&D.

In this context and in line with its charter the European space Agency maintains an ample program of R&D that aims to cover all aspects of the satcom activity. The proposed presentation will, from the perspective of analyzing the future of satellite communications, cover the market trends and foreseen evolution of the different services and the main technological developments that will be needed for their provision.

This introduction will be followed by a description of the ESA programme for future satellites covering the development of Payloads in different frequency ranges and with different characteristics. In particular will be addressed the concept of on board flexibility allowing the assignment of power and bandwidth to the different beams as a function of the demand and considering the interconnectivity between beams by means of either transparent or regenerative transponders. These developments are complemented with corresponding efforts in the ground segment for different services. In particular the support to the standardization of the so called DVB family and the development of Inmarsat (BGAN) mobile terminals will be highlighted.

Further the presentation will emphasise the most emblematic project undertaken and planned within the ESA Telecommunications programme in cooperation with Satellite Operators and Industry. These are AMERHIS, HYLAS, ALPHASAT and the SMALL GEO Missions.

In addition to the R&D support the Telecommunications program of ESA addresses also a wide range of activities that aim to resolve institutional issues. These involve the development of architectural solutions, corresponding technology and applications that aim to resolve specific problems of Governments and other public institutions.

A first example of these initiatives is the Iris Project. Iris is a satellite communication system that will complement the terrestrial solutions currently under consideration to renew existing Air Traffic Management systems. This new ATM infrastructure which is developed under the Single European Sky ATM Research (SESAR) programme of the European Union will have in Iris a satellite component tat will allow to increase the system capacity, improve the performance of the intended services and extend the system coverage to oceanic regions.

Another interesting institutional Project of ESA's Telecommunications is the development of a European Data Relay Satellite system (EDRS). The capacity of the EDRS system will allow the provision of high capacity links between a wide range of LEO spacecraft and their Control Centre. Today Earth Observation satellites communicate directly with the ground. This means that they must wait until they are in line of sight with certain stations before they can download the gathered data. This constraint obliges to deploy a wide network of stations over the whole Earth, presents limit in the amount of information that can be captured and delivered and involves a substantial delay between the observation time and the delivery time.

The EDRS system, which will be composed by several satellites at different orbital positions, will use a combination of RF and optical systems allowing the establishment of channels with very high capacity ranging in the region of 1Gbps. These channels will permit the delivery of high resolution images in real time wherever they may be situated in their orbit. The Telecommunications programme of ESA includes also the development of a wide range of applications that combine the use of different space resources, i.e. Navigation, Earth Observation and Telecommunications. These applications aim to provide solutions to a number of social problems. In this respect the applications initiative addresses satellite based solutions to Energy, Security, Transport, Development, Health and other subjects. In summary, with the perspectives of a brilliant future of satellite systems, ESA's Telecommunications programme proposes a wide range of technological developments that have as objective the enhancement of the competitiveness of the European Industry and the provision of solutions that will improve the life of the European citizens.

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Ambient Intelligence

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The term Ambient Intelligence refers to electronic and communications systems that are aware of the people's presence and act accordingly. These electronic devices would seamlessly help people in their every-day lives. Intelligence is hidden in the network without we even notice their existence. This feature has also brought up the concepts of the Internet of Things and Smart Dust.

With the Internet of Things we refer to a new paradigm where not just computers, but every kind of objects are connected to the internet. Even household appliances such as the refrigerator would have an internet address and be able to detect the presence or absence of some goods and subsequently make an order to the provider. A new dimension has been added to the world of information and communication technologies: from anytime, any where connectivity for anyone, we will now have connectivity for anything!

The increasing "availability" of processing and communications capabilities will be accompanied by its decreasing "visibility". Indeed Ambient Intelligence will be possible through the miniaturization of consumer electronic devices that are embedded in quotidian objects. Smart Dust refers to these ultra-small sensors, actuators and transceivers that will be the key for implementing ubiquitous intelligent sensing environments.

Working toward ubiquitous intelligent sensing environments, we are already witnessing the promising future of this technology with trial prototypes and early systems. Wireless sensor networks (WSNs) are under development in vehicles, smart houses, road and traffic safety applications, for emergency response, health monitoring, support for elder people, monitoring of farm animals, environmental purposes and other uses.

Among several European-level initiatives, CRUISE (Creating Ubiquitous Intelligent Sensing Environments) Network of Excellence, with 32 partners, started in 2006, and focused on research in WSNs and the integration of European researchers on this topic. Focal points of the joint research activities are some highly relevant areas: architecture and topology, protocols and data fusion, mobility and security, and transmission. The novelty of the CRUISE approach is to deal simultaneously with applications and basic research issues so that applications open new research topics, and basic research solutions make new services possible.

The wide diversity of applications leads to different requirements and challenges, making multidisciplinary research efforts necessary. Although many protocols and algorithms have been proposed for traditional wireless ad hoc networks, they are not well suited to the diverse architectural features and application requirements of sensor networks. The nature of WSNs adds extra requirements — the protocols and algorithms must cope with processing power, energy, remote configuration, and deployment constraints. Hence, self-assembly and continuous self-organization during the lifetime of the network in an efficient, reliable, secure, and scalable manner are crucial for the successful deployment and operation of such networks. Furthermore, cross-layer optimization plays an important role; on one hand for efficient coordination of data aggregation (sensing), and on the other hand in order to realize energy- efficient reliable communications with limited processing capabilities. In summary, sensor networks pose a number of new conceptual and optimization problems and many implementation challenges.

WSNs' unique feature is that they can capture the spatial and temporal dynamics of the environment or process they monitor. This characteristic makes them suitable for a large number of applications that could not be efficiently approached until now:

- WSNs are expected to find wide applicability in environment and habitat monitoring since they can easily be deployed in large areas, and capture the spatial and temporal state of the monitored environment. Of relevance here is event detection and localization, where an event can be the outbreak of a forest fire or release of a toxic substance in the drinking water reservoir.
- WSNs and advanced communication will allow better surveillance of goods and even enable decentralized decision making at goods transport.
- In emergency management (e.g., fire fighting and emergency aid after disasters), emergency forces cannot assume the presence of any communication infrastructure, but sensor information from different locations can improve their work.
- In medical care, outfitting care subjects with tiny wearable wireless sensors forming a body sensor network (BSN) would allow medical teams to monitor the status of their patients (at either the hospital or home).

These applications are very diverse, and have different needs in terms of large/small-scale deployment, interference-free/interference-prone environment, and information velocity required. New ideas are required to be developed in the following fields:

- WSN architecture and corresponding infrastructure completely depend on application needs. One goal of the architecture is to allow components developed for one particular system to be used in other systems. The development of energy-efficient, hybrid architectures, their scalability, topology discovery and management are important open issues.

- Resource limitations typically found in WSN devices accentuate the need for algorithm most often to conserve energy. New Medium Access Control, routing, end-to-end transport protocols and cross-layer approaches are needed.
- Some of the above mentioned scenarios concern collection and communication of very sensitive data for the individual. Thus, to properly protect network operation and not hinder acceptance of this promising technology, WSNs require novel security algorithms to achieve robustness and privacy while maintaining a good performance.
- Although a significant amount of research has been done on signal design and transmission techniques for wireless communication systems, including ad hoc networks, the findings and guidelines are not always the most appropriate to meet the unique features and application requirements of sensor networks. Further research is needed in modulation and coding techniques, channel estimation and synchronization that enable cooperative transmission.

There exist several standard technologies that allow the development of WSNs, namely, IEEE 802.15.4 and ZigBee, Z-Wave and other proprietary technologies such as INSTEON, the battery-less EnOcean (which makes use of energy harvesting) or the open source ONE-NET. The IEEE 802.15.4 defines the two first levels of the OSI (Open System Interconnection) layer model, i.e. the physical and the MAC (Medium Access Control) layers whereas ZigBee specifies the protocols for the upper layers, i.e. Network, Transport and Application layers. The other proposals either use IEEE 802.15.4 for the physical layer or a proprietary technology.

Zigbee, based on IEEE 802.15.4, is the most widespread WSN specification. However, several European R&D initiatives are trying to further develop several features that are required for Ambient Intelligence. e-SENSE project provided heterogeneous wireless sensor network solutions to enable Context Capture for Ambient Intelligence, in particular for mobile and wireless systems beyond 3G. The developed e-SENSE system architecture significantly enhances and extends the ZigBee system architecture. It allows an efficient integration of cross-layer optimized protocols and integrates advanced protocol concepts and new communication paradigms. SENSEI project is currently building upon e-SENSE results and will create an open, business driven architecture that fundamentally addresses the scalability problems for a large number of globally distributed wireless sensor and actuator devices.

The current deployment of WSNs brings several technical problems, such as the existence of a transitional region where communications are unreliable, the need of redundancy to circumvent obstructions and interference from other systems. The utilization of a dense network may solve many of these problems with the availability of a large number of nodes that are closely located. Also the packet size must be carefully considered in order not to overload the queues at the intermediate (forwarding) nodes equipped with reduced memory resources.

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Applications of the future Internet

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Introduction

Internet success has exceeded by far the original expectations of an end-to-end, simple communication network. The original Web, what we call Web 1.0, was a collection of nodes connected using the Internet protocol, was used mostly for e-mail applications and, gradually, to include some enriched text and music. The next generation, known as Web 2.0, brought about much more possibilities, including images and video, but, most of all, it led to interaction with other users. Internet was not any more just communication with a central server providing the information but communication between people. Web 2.0 is the success of the user generated content. The user becomes the hero [3] and he is deciding what it is important and what it is not. He creates all significant or trivial content.

We are moving to a third generation, what we call Web 3.0. We are starting to build this new network. Its main characteristic is immersive character. The differences between the real world and the Web, what we call the virtual world, are becoming blurred. The new Web should be three dimensional [4], we should be able to enter and walk around it; interact with the people and objects populating it as if they were part of our daily experience.

This future however, should not sound farfetched. It will certainly require important advances, not only in processing capability, storage and network security, but also in novel interfaces and behavioral sciences. But it is already being built. The Web 3.0 it is going to be a gradual process. Existing technologies already allow us to build very useful applications that should be tested and perfected; they should also be popularized and adapted. Building demonstrators for new technologies is an important step for the new Internet.

Internet of the future: enablers and applications

The sentence: “Internet of the future” [1] [2] is starting to be used to designate all that can be developed around the Web and what it represents, both socially and technically. So, when speaking about the new internet concept, it should include not only the improvements required in the network, to add more resilience, security and trust; but also its transformation into an element that will deliver storage and processing capability. And, more important, that will take into account the needs of the people and enterprises that are using the Web. Developing the Internet of the future means working on many enablers:

1) Enabling the Internet of Users, Content and Knowledge

Internet is the global hub for information and communication where different actors, including citizens, share their contents and connect with each other. They are connected to social networks and virtual worlds, sharing knowledge within a given community. They want all those features to be accessible anywhere, anytime and on any device. The network is becoming less relevant and now a new definition of Internet is at stake: "Internet is the people" [3].
As the Future of Internet is evolving to an Internet of people, efforts should be put in new tools to allow user profiling, recommendation systems, new applications to enhance the creation of online content by professionals and amateurs.
It will also become necessary to develop novel multidirectional interfaces and interaction mechanisms, including multimodality and "presence" [4] [5]. Those new interfaces, technologies, methodologies and certification models should be developed to ensure the Future Internet not excluding anyone and, furthermore, making the Information Society even wider.

2) Enabling the Internet of things

The term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. The internet of things is the enabler of the "ambient intelligence" which builds upon ubiquitous computing and human-centric computer interaction. The paradigm is characterized by systems and technologies that are: embedded, context-aware, personalized, adaptive and anticipatory.
Integrating "things" into the network is one of the major expected growths of the future network. For instance, some challenges are to ensure protocols adapted to object characteristics, to offer greater security to afford ubiquity and daily nature of network use, to integrate small, low capability devices, etc.

3) Enabling the Internet of Services

The term service would include a broad variety of applications that will use communication infrastructures. Of particular importance is the concept of Software as a Service that has to be extended to include all capabilities related to computing and storage. It will include developing new service deliver platforms, using open protocols. Three tools are considered important in building the future internet of services:
Semantics is thought to be the "unifying glue" that will put together all the bits and create the overall intelligent interconnected network.
Cloud computing: it includes the virtualization of infrastructures, through more flexible and granular optimization of processing and storage resources.

Autonomic computing: Its aim is to create computer systems capable of self-management, to overcome the rapidly growing complexity of computing systems management.

4) Enabling the Network

The network is the basic element on top of which the previous "Internets" shall be built. Its development includes developing advanced radio interfaces using, for example, cognitive radio and cognitive networks. The paradigm of self-learning networks is to be explored.
Moving beyond the basic transmission need, Future Internet should be a secure and trustworthy. It includes preventing illegal access to private content, hindering identity tampering, promoting collaborative security, guaranteeing digital identities, ensuring privacy and integrity in transactions and anonymity of access to contents and applications.

Developing applications

Those different, horizontal enablers should be aimed towards improving the quality of life, productivity of the citizens and reducing, at the same time, their energy footprint and disparities in knowledge. The future internet will consist of developing, using the enablers, applications focused in the final user.
The list of applications is very large, but as an example it could be mentioned:

- **The smart city concept.** The objective is the provision of all elements in the city, ranging from security for people´s life and goods, management of waste disposals, entertainment in the city, new ways of getting information, advertisement
- **Intelligent transport.** Design of intelligent, adaptive, context aware and self-healing transport systems including monitor and management of transportation networks to get a better distribution. It also includes gathering and distribution of reliable, real-time traffic information.
- **E-Health.** This is a very wide area covering from the interoperability of computer-based medical systems, management of electronic patient record, interconnection of hospitals and medical team remotely, etc.
  It also includes more specific applications such as enhancement in remote care of patients while at home (especially for chronic diseases) or in hospital, robotic based solutions.
- **Development of energy-friendly solutions.** This is motivated by two facts. On the one hand, there is a wide consensus that networks should actively contribute to reduce the carbon footprint of the industrialized society. On the other, many devices to integrate the so-called Internet of Things will be severely constrained in what concerns energy consumption,

computational complexity and storage capacity. In addition, a pervasive use of efficient Internet networks and services will have to assist to other sectors (transport …) to reduce their own energy consumption.

- **E-Government** It will cover the globalization of public services including the accessibility by any telematic means; the optimization of public services information databases and processes.

The main difficulties lie in solving interoperability to struggle against heterogeneity of administrative procedures and system

The strategy of experimental research

Together with the concept of Future Internet, it has appeared the need of experimentation [6-10]. Any technological development affecting Future of Internet may have multifaceted and even unexpected consequences. Therefore, new proposals for Internet services should not be limited to theoretical work, but also include early experimentation and testing in large and small-scale environments. Those experimental networks and testing facilities cannot be limited to one or two companies, but should be the result of joining together, users, application providers, network providers, etc in a team where together a new solution is designed.

As an example, a collection of possible applications in a big department store is given. Those examples are developed around the "shopping lab" concept and cover different areas of work, including the exhibition area, testing facilities, shop window, logistics, applications to the shop personnel to facilitate location and attention. The accent is given to the user experience inside the shopping center to make the buying process more enjoyable and easy. A collection of "*catch names"* have been given to make them more accessible and usable:

- WAYD. "What are you doing"? An application to locate personnel inside the shop
- WAN. "Where are the nails?" Designed to help the customer to locate an item in the shop.
- MYMENU. To help the user to find the ingredients for its meal

The objective of those examples is to show that the future internet is not only a futuristic dream but a reality that is being already built. Already, some European [11-14] and Spanish [15-20] initiatives are trying to work out the concepts and develop the basis for this future Internet. The objective can be to focus activities towards the formation of a large collaboration effort, which could take the form of a JTI [22] that should allow better organize European research activities.

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Bridging the gap between Research and Standardization
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The importance of standards in the ICT industry

There is ahave seen an explosion in the size of the 'standards industry'.
In the ICT industry, most standards are voluntary; there is no law to require their use. They should be seen as industry agreements on common interfaces, performance requirements, quality, process long history to standardization in industry, but it is really with the advent of the ICT industry that we es etc. The level of industry agreement can be quite broad, for standards coming from the larger standards development organisations, or quite narrow, for standards from small focused fora. Standards may be built by consensus in a formal process, or originate from dominant industry player (de facto standard) and be quite informal specifications. Just as there is competition between technologies, there is competition between standards, and between the bodies which develop these standards.

There are many purposes or benefits to developing standards for a particular technology. Standards can help lower development & production costs, by introducing economies of scale and allowing harmonisation of processes or components which add little value to a product. Standardization can help create a single large market for a product, which attracts new players and increased competition – which is good for consumers (e.g. the market for mobile phones, previously small and fragmented, today a global market dominated by the GSM family). Standards help achieve interoperability, or, together with branding, enhance confidence and recognition of a product category (e.g. WiFi, Bluetooth). Some argue that standards are a barrier innovation, but we argue that standards can help innovation: by innovating on top of a standardized technology platform, developers can leverage work done by others, concentrate on their new ideas, and do not have to reinvent the wheel. Most new software is developed to run on existing operating systems, using existing standardized APIs. Besides, since most ICT standards are voluntary, a significant new technology can be taken up by industry and introduced into standards, to replace an existing technology, if there are sufficient benefits. We see this even within the GSM family, where we are now using the third basic radio access technology (TDMA, W-CDMA and OFDM). It is not the standard itself which is the barrier to adoption of the innovative technology, but rather the level of industrial investment in the existing technology, and the level of return on investment in the new technology.

Due to these many benefits, standards have been developed to cover almost every type of product or service or component in the ICT industry. There are quite simply very few areas of the ICT industry which are not heavily standardized already, and even the newest fields such as cloud computing, standardization discussions are already taking place.

The standardization process is considered by industry to be a Business Process, supporting research, product development, marketing and promotion processes. It is used to put IPR into standards, to help secure investment in IPR and knowledge. Standards meetings can be a source of information on competitors, a place to form

partnerships or an opportunity to impress potential customers. Smaller companies can benefit from a common branding and marketing of a standardized technology, as they effectively get to benefit from big company marketing budgets.

Is there a gap?

It can be difficult for the research community to engage in the standardization process. Probably the largest difficulty is one of time and opportunity. Standardization can take time, depending on what is at stake economically. The time window where an opportunity exists to make major changes to a standard can close before research results are available.

Of course there is an issue of the cost of engaging in a standardization process – this takes time, significant amounts of manpower over a number of years, which requires long-term funding. In addition there are the costs of travelling to meetings, and the costs of membership of standards bodies or fora.

There may be a technical gap between research activities and standardization: standards committees are often focused on near-term objectives, developing specifications for products or systems which are close to being placed on the market, or are already on the market. The focus of attention on near-term activities may be such that the standards committee is simply not yet interested in longer-term research results. The research results may also be such that they make the currently standardized technology obsolete, and in the same way the knowledge and competence of the standards experts is made obsolete!

Even where a new technology is not a threat, it may be difficult for a group of researchers, already formed into a community, to infiltrate and find their place in a standards community, also already formed into a close-knit group. This has more to do with group dynamics and social aspects than pure technology.
In the ICT industry, researchers and others unfamiliar with the standards world face a further problem: there is perhaps too much choice of standards bodies, many with overlapping activities, and it is difficult to know where to turn!

Why standardization is important for researchers

A distinguishing feature of R&D activities in Europe today is the extent of cross-border collaborative research between industrial and academic partners. This can be considered a strength of European R&D: it enables technology transfer from universities and research centres towards industry and provides a path to capitalisation of research results.

Since standards have been developed to cover almost every product, service and component in the ICT industry, one can say that ICT markets are shaped by standards. If we wish that our ICT research will lead to new products, new services, or whole new markets, then clearly this research must lead to standardization activity. It is therefore important that researchers understand the world of standards, and make an effort to participate in this world. Standardization activities should not be seen as a dissemination activity in a research project, but rather as an opportunity to exploit research results. A full engagement in the standardization process is necessary to ensure that your results are taken on board. Organisations who want their technologies to be the basis of standards must take leadership positions to drive the work forward, and need to budget for a long-term participation.

Standardization issues should be discussed early in a collaborative research project; in particular the focus should be on the following issues:

- What key results from the project should be standardized?
- What standards bodies should the project focus on, or what are the key standards bodies related to the technology in question?
- How to get the timing right? What is the current status of the standardization process, how much opportunity is there to introduce major changes to the specifications?
- What sources of funding are there for travel and time spent on standardization activities. What about funding for membership of standards bodies?
- Which partners from the project will participate in standardization activities?
- What will these partners contribute: their own results, or the results of other partners? What agreements are in place to permit this?

Research results are important for standardization bodies

It is important for standardization bodies to be open to receiving input from research projects. SDOs are open fora for discussion and development of new industry specifications. There are relatively few barriers to establishing a new specification group or forum on an informal basis, therefore blocking or discouraging potentially disruptive research results can be self-defeating: the specification activity will continue, but elsewhere, reducing the usefulness of the SDO.

Standards bodies such as ETSI can take account of researchers needs and make life easier for them. Cost issues can be addressed with targeted fee reductions for researchers. Greater use of online and collaborative tools will reduce the need to travel, and the consequent expenses. SDOs can try to provide greater recognition and acknowledgement of research input. A standard is not a technical journal and cannot be a source for citations – SDOs do not require any proof of authorship, for example. But they could better highlight participation and contribution by researchers.

It should be easier to start new specification groups inside SDOs, to enable new communities to form. Initially these new groups may be driven by the research community, but as the technology matures and early specifications develop into something useful, industrial participants arrive and over time they will dominate and change the group. This is a sign of success – of the group, of the technology, and of the research input.

Key standardization projects at ETSI

The single most important standardization project underway at ETSI today is of course 3GPP. ETSI is one of the founder members of the Third Generation Partnership Project, which is a collaboration between 6 different SDOs in Europe, North America and Asia. This is the home of LTE standardization, but also UMTS, and indeed all legacy GSM/GPRS standardization.

At this stage the air interface specifications and standards for LTE have been agreed for over a year, and are currently undergoing implementation. Corrections and enhancements take place by a change control mechanism. LTE-Advanced studies are continuing, the corresponding features will be introduced as updates to the existing specifications for LTE, rather than as a whole new radio interface technology. Alongside the radio interface specifications, 3GPP is developing its Evolved Packet Core (EPC), or multi-access all-IP network, in a project known as System Architecture Evolution (SAE).

The development of LTE and EPC in 3GPP takes account requirements set by major 3G operators in their Next Generation Mobile Networks (NGMN) Alliance.
Standardization on Next Generation Networks is drawing to a close: there is now a single set of specifications between ETSI and 3GPP for a Common IMS. Our primary core-network technology committee (TISPAN) is completing work on IPTV specifications. ETSI will organise a workshop in March next year to consider which of the technologies resulting from European Future Internet research are suitable for standardization – this may trigger a further wave of activity in TISPAN.

Other activities in ETSI which may be of interest to the research community, and which you may be surprised to see:

- Cognitive Radio and Software Defined Radio activities in our technical committee RRS (Reconfigurable Radio Systems);
- Machine to Machine communications, looking primarily at M2M architectures and integrating M2M systems into next generation telecoms networks (TC M2M);
- Autonomic and self-* technologies as applied to network management, in our recently established Industry Specification Group AFI (Autonomic Network Engineering for a self-managing Future Internet);
- Measurement ontologies for IP-traffic analysis, in our MOI ISG;
- Quantum Key Distribution, in particular interfaces to offer QKD applications via telecoms networks, in our QKD ISG;
- Thin client architectures and interfaces for mobile devices, in our MTC (Mobile Thin-client Computing) ISG;

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Too Free or not Too Free?
The Substainability of the Internet Business Model

Luis Piñeiro
Ericsson España

Summary

The Internet has been a big success story that shapes our age, but, should the business model used so far change? This conference takes the current business model of the Internet (flat fee access and free content and applications) as a starting point and analyzes the implications that model has for operators, consumers and content providers. Using data from the last decade, we try to spot trends that tell us something about what's already changing and what might lie ahead.

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La Web del Futuro

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La Revolución TIC ha transformado una sociedad basada en el papel escrito en otra basada en la información digital denominada “Sociedad de la Información y del Conocimiento”, que no hubiera sido possible sin Internet y sin la Web. La Web es el enorme contenedor de datos que permite acceder de forma extremadamente sencilla a esta nueva y enorme oferta de información, aplicaciones y servicios, que se ha convertido en la espina dorsal de las nuevas infraestrucuras TIC. La Web tiene todavía un enorme potencial que desarrollar y grandes retos, tales como: La mejora de las tecnologías de busqueda; La Web semántica; Las tecnologías de gestión de la inteligencia colectiva,; El desarrollo de normas mas potentes y eficaces; Las infraestructuras de datos y servicios sostenibles y escalables (cloud-computing); La accesibilidad rapida, ubicua y universal a la información y a los servicios, así como su usablidad; La nueva economía y sus modelos de negocio; etc. Esta conferencia dará una panoramica del estado del arte en la Web, de sus principales retos, así como de su evolución hacia el futuro.

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Aplicaciones avanzadas de NGN y retos de interfuncionamiento

NGN advanced applications and inter-working challenges

Fernando Rodríguez-Maribona
British Telecom – Spain

Brief Introduction of the speaker

Fernando Rodríguez-Maribona is currently heading Network Engineering in BT Spain. In addition is responsible for Global In Country Voice Network Design in BT Innovation & Design organization.

Main responsibility in BT Spain organization is Design and Planning of the different network platforms to provide services BT is offering in Spain. It includes Access platform, Core network (SDH and DWDM), Data and IP (FR/ATM, MPLS, Eth, DSL) and Voice (TDM and NGN).

Working in BT Technical area for more than 12 years he has participated in different Network Evolution programmes like:

Deployment of first VoFR public network in 1996

Deployment of NGN network to support Voice Regulated services in 1999

Deployment of VPLS network to provide iVPN services in 2008

Implementation of a Global Application Server based on JNetX architecture to provide Intelligent Voice services in 2008

Introduction to NGN

We are currently living an era of Network transformation similar to the evolution from circuit to packet switching some years ago. Deployment of NGN in operators networks is a fact similar than deployment of IP PBX at customer premises rather than traditional digital PBX.

Initial driver for this evolution was cost reduction. We are now exploiting this benefit. A common backbone to support all services traffic is a reality and nobody is now considering deploying a specific network to run a unique application. In terms of access situation is similar. New technologies using different physical media - copper, fibre, wireless (regulated and not regulated frequencies) – allow wider bandwidths and consequently sharing for different applications.

Final benefit of NGN implementations will be fast applications and services development in an “agnostic” environment where linkage with vendor proprietary solutions will be every day less important. We are now starting to see this benefit, but this is still not a reality. We keep some heritage form the past and for example IMS architecture implementation has still a long run. IMS is the paradigm of opening, protocol inter-working and vendor independence. But it is still more expensive to deploy an IMS architecture and usage of different vendors in the different elements does not assure full support for applications and services.

NGN Applications

NGN has broken the concept of Network and services dependence. Last decade, network operators had to build complex and very expensive networks to provide every service. Every network had its own management system, OSS, BSS, provisioning tools, etc. There were some progress creating for example management umbrellas to hide networks at some level, but at the end every new service required a new network. There was also a big dependence on vendor technology. Standards were reserved for basic UNI and NNI but communication protocols between network elements used to be proprietary. A very good example is Intelligent Network deployments. INAP was a standard but SSP/SCP communication was an issue when these elements were from different vendors. Operators that decided to integrate elements from different vendors had to fight with inter-operability problems and frequently these problems ended in lack of functionalities.

NGN is a different story. There is only an “IP based” transport layer and on top of it different applications running in Application Servers to provide all services.
This imposes strict requirements for transport layer and terms as traffic prioritization and quality service assurance become more familiar every day.

Application Servers are triggered from remote locations, avoiding complex and expensive traffic transits just to reach the service access point.

Application Servers have an open architecture usually based on Open Standards and commonly used SW Development Keys that allows service and application creation to a wide community of developers. Instead of having general purpose applications difficult and very expensive to adapt to particular requirements, we have now specific applications developed and tailored for user communities. When there is the need to make a change to provide specific features, it is simple and cheap and sometimes it could be done by someone different to the one who made the initial development.

Another important aspect is application portability. Before IMS, there was a direct linkage between an application and the platform that was running it. When you needed to replace HW platform due to obsolescence or lack of performance, you also needed to replace the application usually impacting customers.

Now it is possible to take an application developed and running in a HW platform and to port it to another one. This is a reality even porting applications through different OS. This is clearly an investment protection argument that operators considers very positively.

Protocol Evolution

NGN deployment is contributing to a radical protocol simplification. In the old times there were hundreds of protocols. One for each service: X.25, X.28, FR, ATM, ISDN, SS7, IP, Eth and many others.
Now IP is base protocol for data transport and on top of it SIP is becoming the reference protocol for application delivery.
Of course it is not as simple as this. OSI stack of layers remains being fully applicable and there are different protocols at these different layers. Depending on complexity of service and specific requirements, there are still specific protocols to fit specific requirements.

Main problem of NGN deployments in relationship with protocol inter-working is the fact NGN have to provide solution to new applications but also to guarantee legacy services can still be provided.

This is causing new protocols have to include variants, exceptions, and specific implementations to support these legacy services. This is making protocol inter-working more complex and causing problems integrating different vendors platforms.

Typical problems in VoIP deployments (specially in inter-working between different vendors) appear in fax, Voice Band Data transmission, DTMF transit etc.
There is no an unique response to the question which protocol is the best one.
Some protocols have been designed to emulate traditional ones (it is the case of H323 that perfectly emulates ISDN Q931) and consequently are appropriate to provide emulation over IP of traditional services (PRIs).

But the full power of NGN (and IMS) deployments to provide advanced services is provided if Session based protocols are used.

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Nanotechnologies For Future Mobile Devices

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Abstract

The mobile phone is becoming a trusted personal device with fundamental new capabilities. New form factors of mobile device and their user interfaces require new concepts for transformable mechanics. Integration of electronics and user interface functions into structural components will be necessary. Modular architecture will enable use of optimal technology for any particular functionality and optimization of power consumption. Nanomaterials, new manufacturing solutions and energy sources together with increased memory and computing capacity will enhance the capabilities of mobile devices. Nanotechnologies will also enable embedding of intelligence into human everyday environments and body area networks. We have presented a concept device called the Morph that illustrates use and bene_ts of nanotechnologies in real life applications.

1. *Transformation of mobile communication*

During the following ten years mobile communication and the Internet will converge into a global information platform. Mobile phones have already become an enabling platform for digital services and applications. Mobile phones are powerful multimedia
computers with wide range of functionality, e.g., imaging, navigation, music, content management, browsing, email, and time management. Increasingly they will have advanced multi-access communication, information processing, multimedia, mass storage and multimodal user interface capabilities. In the continuation these trusted personal devices will also have new capabilities: Interacting with local environment via embed-ded short range radios, sensors, cameras, and audio functionality; Functioning both as servers for global and local internet services and as clients for global internet services; Serving as gateways that connect local information and global internet based services; Carrying the digital identity of the user and enabling easy-to-use secure communication and controlled privacy in future smart spaces; Sensing local context and the behaviour of its user.

Context awareness, including location, is the fundamental underlying capability of the future mobile devices. These context sensitive devices will open wide range of solutions for Internet services and mobile communication. Sensors, positioning and powerful signal processing embedded in mobile devices make it possible to detect, observe and follow different events and patterns in user's behavior and surrounding environments with precise location. Mobile device becomes a cognitive user interface that is continuously connected to the local environment and to the Internet services. Context awareness has also profound inuence on the development of future communication and computing solutions by enabling intelligent allocation and sharing of resources.

Form factors and user interface concepts of mobile multimedia computers will vary according to the usage scenario. The tendency towards smaller and thinner structures as well as towards reliable transformable mechanics will continue. The desire to have curved, flexible, compliant, stretchable structures and more freedom for industrial design sets demanding requirements for displays, keyboard, antennas, batteries, electromagnetic shielding and electronics integration technologies. A possibility to integrate electronics and user interface functions into structural components, such as covers, will be necessary.

Modular device architecture of mobile multimedia computers will consist of several functional subsystems that are connected together via very high speed asynchronous serial interfaces [5, 6]. The modular approach enables the use of optimal technology for any particular functionality, optimization of power consumption, and the modular development of device technologies and software. The same modular architecture can be extended from one device to a distributed system of devices that shares the same key content, e.g., a remote mass storage, display or a printer.

Nanoscience means capabilities to image, measure and manipulate physical and chemical processes at molecular level. These capabilities convert into nanotechnologies that are based on physical and chemical phenomena that emerge at nanoscale. Thus nanotechnologies are not just a continuation of the miniaturization roadmap but offer new capabilities to create solutions for health care, information technologies, materials and manufacturing. These pervasive capabilities will affect mobile communication [2]. Nanotechnologies for sensing, computing, radios, displays, structural and surface materials will enable creative design of future mobile devices and services.

Mobile communication and the Internet are converging: wireless communication will nd optimal solutions based on both regulated mobile communication (3GPP track) and unregulated local access (IEEE track) solutions. Flexible and efficient local access will support sensing, computing and actuation in mobile devices that are continuously onnected to the Internet services. Implementation of sensors and multi-modal user interface features together with energy efficient local connectivity will enable new mobile services and new paradigms of communication, e.g., ad hoc social networking. Context awareness and machine learning will create the user experience seamless connectivity and information access but require powerful embedded computing solutions.

2. *Sensing and signal processing*

Sensors can already be found as key features of various battery powered, hand-held devices. Especially, location, motion and gesture recognition are new pervasive elements of applications, user interfaces and services. One of the

enablers of this rapid development has been microelectromechanical systems (MEMS) based on micromachining of silicon (see a review in [4]). The need for low cost, reliable sensors for automotive applications initiated the mass manufacture of silicon MEMS sensors. The requirements of consumer electronics, especially of sport gadgets, mobile phones and game controllers, have driven further the miniaturization of MEMS devices. Today MEMS and CMOS technologies provide a solid basis for large scale deployment of sensor applications.

The opportunity to connect locally measured information to Internet services and to incorporate this local information into structured global information might be even more significant. Example of benefits include real time tracking of the spread of a disease or epidemic or interpretation of changes in traffic patterns on roads through a combination of local sensors and the Internet. The Internet is becoming a massive store of heterogeneous data and linked information. Extremely efficient search and data mining technologies are creating a dynamic and real time map of the physical world with its various economical and social networks.

Nanotechnologies may not revolutionize sensor technologies and applications. Existing sensor technologies based on MEMS and CMOS platforms have not yet fully met their potential to provide sensor applications and networks that improve the human everyday environment. However, nanotechnologies, i.e., different nanoscale building blocks and fabrication processes, will affect the development of sensors, their signal processing and actuators. Nanotechnologies will extend the applications of sensors to new potential fields, such as smart spaces, body area networks, remote health care, and pervasive environmental monitoring (see a review in [7, 8]).

Many nanoscale sensors are related to chemical and biochemical sensing where nanoscale transducers create a possibility to derive more detailed information on observed phenomena. Nanotechnologies offer a new possibility to create nanoscale transducers, memory and computing elements and to merge these elements together to form an intelligent sensor system. The same technology, e.g., silicon or ZnO nanowires or carbon nanotubes, can be used to create various functional elements for these systems. Several possible architectures, e.g., coupled resonator arrays, nanowire crossbars, plasmonics, and spiking neuron networks can be used for both sensing and signal processing.

3. *Morph - Nanotechnologies in future mobile devices*

Transformation of the device can essentially happen in many levels: transformation of graphical user interface, mechanical configuration, available applications and services. The Morph device [1] is transformable in many different ways. The user interface of the device can adapt to the context of the user in terms of functionality but also its appearance. Transformability can be used to enable the ease of use of the device, applications and services. The Morph device is transformable in its form and conformation. The Morph is a cognitive user interface, capable of sensing both the user and the environment, making decisions based on this information, adapting to the context and give feedback to the user. The Morph learns about its user and becomes a trusted personal companion.

The last forty years of development in electronics have targeted to ever increasing integration of functionality, i.e., very large scale integration. There is no doubt that this development will continue to build even more efficient solutions for sensing, computing and communication. However, interfaces of future devices with the physical world and their users require new type of intelligent and energy efficient sensors and actuators that can benefit of development of low cost electronics manufacturing and functional materials. Printed electronics creates capabilities to integrate functionality on low cost large area substrates, enabling new user interfaces, sensors and RFID tags. Functional materials research enables intelligent and responsive structural and surface materials.

The Morph has some new capabilities that are not possible with the existing technologies: a flexible and stretchable device made of transparent materials with embedded optical and electronic functions. We can list some of the technology requirements: Transparent device with display capability; flexible and partly stretchable mechanics with non-linear spacial and directional control of elasticity embedded into the materials themselves, with even rigid-on-demand actuators; Distributed sensors and signal processing in the transparent structures, e.g., pressure and touch sensor arrays; Transparent and flexible antenna, electronics and energy storage; Externally controllable and dynamic surface topography and roughness; Multifunctional, robust surface coatings providing protection of device functionality, dirt repellence, antireflection, etc; Transformability and conformability with intelligence that can extract conformation and context and adjust the functionality accordingly. The transformable compliant mechanisms need to be built deep into the material solutions of the device [2, 9]. Complex mechanical and electromagnetic metamaterials and artificial nanoscale material structures enable controllable flexure and stretch in the macroscopic mechanisms creating the desired functions.

4. *Conclusion*

We have discussed some major technological challenges related to mobile communication. The convergence of mobile communication and the Internet will bring digital services even nearer to human everyday life and the physical world.

Major technology disruptions may be related to pervasive sensing, cognitive radio, distributed computing and more flexible and efficient integration of electronic functionality based on nanotechnologies.

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Ethernet fiber access innovations and WDM-PON

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Summary Description

Today more than ever before, service providers are under enormous pressure to reduce operational costs while increasing business effectiveness. This often means implementing new future proof networking technologies and applications without compromising current infrastructure investments.

Consumer demand is quickly evolving away from traditional passive content consumption to a much more participative social network model that demands high capacity bidirectional information flows. This trend has invoked a major strain on traditional Copper Access infrastructure. Service providers' business connectivity model is evolving from static point-to-point circuits to on-demand, any-to-any communications. Evolution of this model and overall increasing bandwidth demand drive new network requirements that form the basis of the next-generation WDM PON Ethernet fiber access architecture.

Current Fiber-to-the-Premises solutions vary widely from high-bandwidth, symmetrical and dedicated fiber Ethernet-to-the-Home (ETTH), to traditional TDM PON, such as Gigabit PON (GPON), solutions that are asymmetrical, share bandwidth among users and are less flexible and scalable in addressing various residential and enterprise requirements from a single, shared infrastructure.

The WDM PON Ethernet Access solution offers an Ethernet point-to-point deployment model enabling the delivery of residential and business services over both point-to-point fiber and WDM PON fiber infrastructure, ensuring a dedicated light-path per customer over a standard Ethernet physical layer.

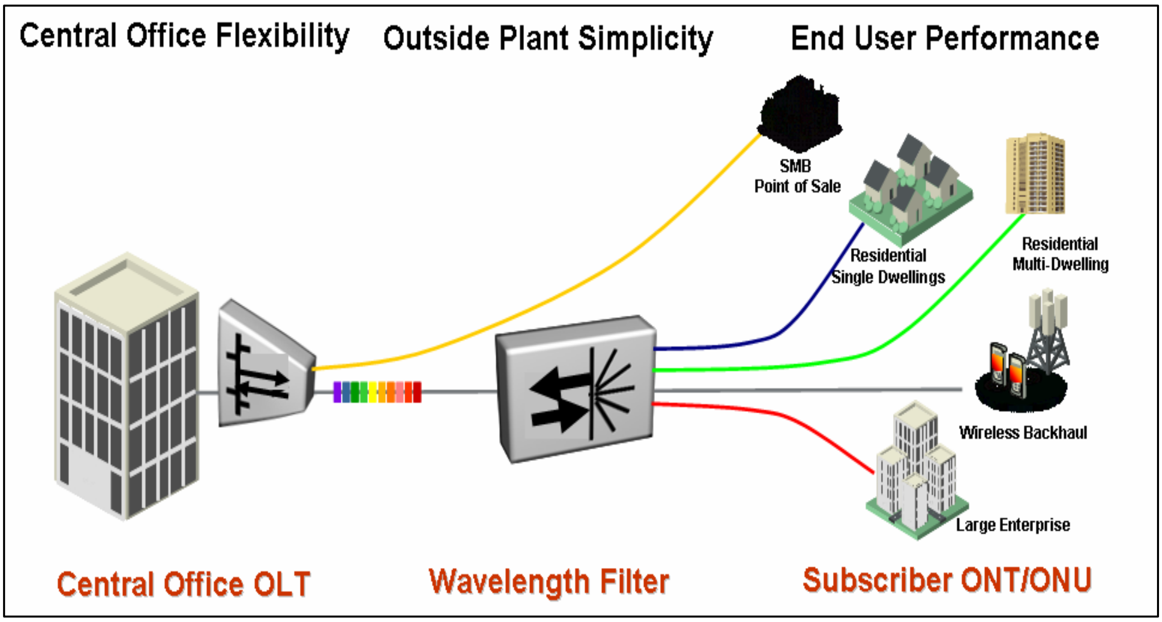
Building a new fiber access infrastructure based on a dedicated point-to-point light-path ensures that this major new investment in passive infrastructure is resilient against evolving technology and customer demand for the next 50 years and beyond. It is precisely the point-topoint nature of the copper infrastructure that has ensured its serviceability for many decades, from analog telephony to broadband, and through multiple technology transitions (analog, PCM, dial-up Internet, ADSL, ADSL2+).

Furthermore, using Ethernet as the physical layer for fiber access leads to a simple, low-cost, standard connectivity, ensuring multi-vendor interoperability and exploiting the most widely deployed technology in the industry.

The WDM PON Ethernet Access solution leverages new breakthroughs in laser technology and optical modulation schemes to eliminate the requirement for complex wavelength-specific lasers and allow for a lower cost WDM (Wavelength Division Multiplexing) optical solution suitable for the access network.

WDM Passive Optical Networking (PON)

The WDM PON technology is the newest generation of fiber-based solutions available Fiber access WDM PON solutions solve many of the shortcomings of the traditional TDM PON solutions. WDM PON provides all of the fiber-saving advantages without the limitations of TDM PON. Additionally, WDM PON significantly improves reach, scalability, security and is truly a converged fiber infrastructure for residential and business services.



In WDM PON, a single wavelength is re-directed to an end user from the central office via a passive wavelength router located in the outside plant (OSP). Unlike

TDM PON, the wavelengths are in point-to-point fashion and are independent of each other. Hence, one wavelength may be 100Mbps for residential or small business services and the other can be 1Gbps to service a large enterprise or multi-dwelling building. For PON infrastructures, WDM PON provides point-to-point connectivity that is independent of all other wavelengths deployed.

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Reaching Billions Connected Devices To The Internet
Alberto Spinelli
Director EMEA Product Marketing – Intel

The Internet has kept evolving rapidly, over the last few years and it is now becoming more and more pervasive, with people accessing to it from multiple interconnected devices. Market research foresees up to 15 Billion connected devices by 2015 and Intel is positioning itself to play a leading role by expanding its business in multiple new areas.

In order to drive its growth Intel has been investing and will continue to invest into 4 different phases of the "silicon value-chain": 1) Process technology, i.e. the way in which chips are made; 2) Microprocessor Architecture, to deliver more optimized, high performing and power efficient products; 3) Integration, making sure that more and more features and external components are built-in the processor; 4) Scale, investing in building newer factories that enable higher and higher volume production.

These investments have allowed and will continue to allow Intel to drive its product and process development at the pace of the Moore's Law, based on which every 18 months the number of transistors which can be built in the same piece of silicon double. Smaller and more efficient products, like the Atom microprocessor core allowed Intel to recently create modular Silicon-On-Chip (SoC) products based on the long-established standard x86 architecture, that has been over the last 30 years at the heart of personal computers and servers and that ultimately is the architecture upon which Internet has grown and evolved. The new SoC products, all based on the Atom core, make it possible for Intel to enter new business segments, specifically:

- Consumer Electronics
- Smartphones
- Netbooks and Netttops
- Embedded devices, such as In-Car-Navigation Systems, etc

These 4 segments are those on which Intel is focusing in order to drive volume expansion over the next few years.

My presentation will provide more details on the above segments

Starting from the Consumer Electronics Industry, it has evolved over the years into what we call today the Consumer Electronics 3.0, where Internet is the game changer and will enable connected and more interactive TVs in the market. In Western Europe 97.6% of the households have a TV and most want new usages, among which the ability to watch both broadcasted programs and video content from the web. Online video content usage has exploded over the last 2 years, with today up to 500 billion hours of videos in the Cloud. This is a phenomenon which is posed to continue growing, researches show that users would love to have the ability to watch that content seamlessly on their TV, but without the hassle of having to connect a PC to TV to make it happen. So IP in the television is going to happen, we foresee at least 185 Million users in EMEA to receive Internet TV by 2011.

Intel has entered the Consumer Electronics segment in 2008 with a Silicon-On-Chip solution (named CE3100) built on the intel x86 architecture and on the Atom core, which has the processing power required for rich media applications like 3D graphics, while consuming low-power and is equipped with technologies for seamless delivery of audio and video from both Internet and broadcast sources. Intel has built a solid Consumer Electronics product roadmap that will allow the introduction of faster, smaller and cheaper chips in the years to come. It aims to provide products which are by far market leading in terms of performance and that at the same time allow software developers to leverage on all the already existing library of code and proven tools which have been developed over decades for PC microprocessors, hence enabling a significant lower “porting time” and a far better time-to-market of their solutions.

In addition to the development of Consumer Electronics chips Intel has also been focused on developing the whole ecosystem. In particular, we have done through our ethnographers many researches on consumer usages and on what consumers want and we have subsequently developed, together with Yahoo, a software interface which will be sitting between the TV and the user. Following consumer feedback we have based our interface on widgets and we have developed it in a way that the user can fully surf the widget channel through the TV remote control. We have made this software interface mainly to stimulate the Consumer Electronics industry by providing one of the possible ways in which the user could interact with the TV, but several other different solutions are in the meantime being developed by third party software providers.

Looking at the smartphone space, market data show how consumer web site tastes have evolved over the years and the significant growth of mobile data and video. Market surveys highlight where smartphone users view today’s handheld experience lacking: there is a strong need for faster devices, longer battery life and especially the desire to be able to watch web sites over smartphones in the same way as they look on a personal computer. In order to deliver a great experience handhelds have to show great performance, low power consumption, internet availability with all the latest web technologies and outstanding software compatibility for the developers, so that they can bring applications faster on those devices. So what has been said regarding the Intel advantage in the Consumer Electronics is applicable also to handhelds: thanks to the Intel manufacturing technology and to the low power new Silicon On Chip based on the x86 architecture we can fulfil all these needs and we can enable a new generation of handhelds which bring the full internet experience in a pocket able form factor. Intel has also developed a new Operating System, called Moblin, which is an open-source Linux based OS aimed at obtaining the best performance and Internet experience out of an Atom core in a handheld form-factor and at providing telephone manufacturers the ability to create newly cool differentiated user interfaces.

The next wave of Billions connected devices represent an opportunity for Intel to expand its Silicon On Chip solutions also in several other areas, such as: industrial PCs, Robotics, energy efficiency Smart Grid and Smart Power products, sensors, ATM machines, In Car Navigation Systems, Home Media Phones, Medical devices, Point of Sales devices, etc, all areas which can benefit from a more horizontal x86 Intel Architecture based approach.

And finally, Intel will also continue expanding its already very successful netbook and nettop segments. Netbooks in particular have been a great success over the last year, allowing users who had already a personal computer to buy a secondary companion device with small form factor, okay performance for internet consumption and basic applications at a relatively low price. Netbooks have also allowed telecom operators to expand their product offering and to drive a faster convergence between personal computing and communication.

Intel see a great opportunity to expand netbooks in emerging markets, where the PC penetration is very low and in targeting more segmented user segments in mature markets, such as kids, youth generations and education.

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Big Telecom Systems R&D.

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1. Objectives

The objective of this Conference is to present the functional and implementation challenges related to the research and development of new Big Telecommunication Systems, and to define the process and methodology to follow for the design and development of such systems. It is based on the Systems Science background, Systems Theory, Systems engineering and the specific development concepts for R&D of Telecommunication Network Systems.
There are a lot of R&D Projects running in Europe, at national and international level, but when we intend to evaluate the Project results, in terms of operative/commercial products, systems and services the balance is very poor. It is a major objective of the present Conference to provide a clear view of the Big Telecom Systems development issues, as well as to outline an R&D guide to improve such results.

2. Big Telecom Systems: R&D Phases

The following research and development Phases shall be considered for a new Telecommunications System:

- System definition and specification
- Elements specification, for the subsystem, unit, subunit and equipment levels
- Elements design
- Elements development
- Integration and test, from equipment up to system level
- Elements and System acceptance

Due to scope constraints, the present conference will be focused only in Phase 1.

The major principles for the definition and specification of a new Telecom System are:

- Orientation to the global system and the overall telecom aspects
- Interworking of fixed, mobile, terrestrial and satellite types
- Audio/video/data and multimedia integrated services and applications
- Convergence oriented telecommunication systems (vs different network systems in the past), within an universal open architecture.

3. System definition

The objective of this subphase is to identify the System requirements, at the various levels, to provide the input for the design of a System architecture and the production of the System specification.

3.1. Service requirements

The telecom information contents can be audio, video, data and multimedia, for different type of services:

- distribution, with / without user request services
- interactive : conversational, retrieve, and messaging services

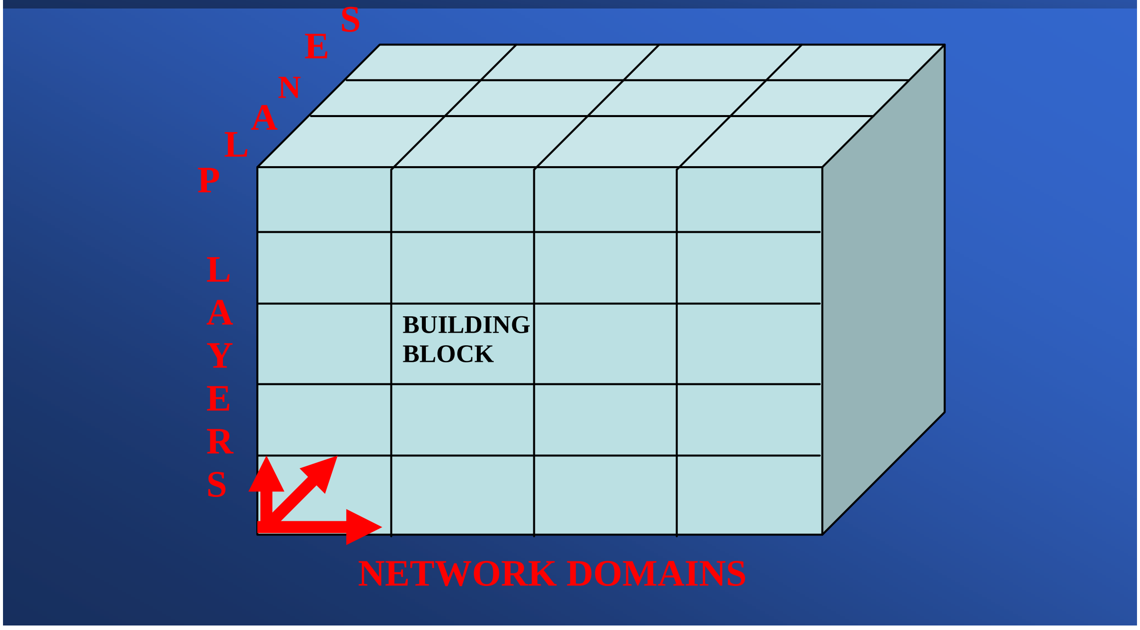
They are globally defined by standards: ISDN, ATM, Internet-IETF, ITU, ETSI, UMTS, 3GPP…and specifically defined by the Telecom Operators requirements.

A common understanding is required, to achieve effective R&D results, either for global or partial specific projects

3.2. Telecommunication Network requirements

- Global topology, for different operators
- To manage complexity: Reference to 3D telecom approach, with layers, planes and domains. See FIG.1
- Different areas: Line, radio, terrestrial, satellite, fixed, mobile, ..
- Various operator requirements: harmonization issues
- System dependent and system independent requirements
- Supplier systems external compatibility
- Evolutionary requirements: from the old electromechanical network to the digital network, fixed and mobile, then to NGN and today 4G mobile

FIG.1 - 3D TELECOM APPROACH



Telecom Building Block:

- *typically one unit or subunit*
- *defined on the basis of :*

- functions, interfaces and performances
- with respect to all around units
- for the various layers, planes and domains

3.3. Applicable Standards

They are the reference workframe for new systems, always in continuous evolution: from the old multifrequency systems, throughout the SS7 and TCP/IP, up to 4G-LTE today
Different standardization forums shall be considered: ITU, ETSI, ISO, IETF, DVB, EBU, ·GPP, UMTS, 4G…and standardization telecom areas: fixed communications, mobile, satellite, line and radio transmission, switching, routing, quality of service…

3.4. NGN requirements

During the long phase for the creation of the broadband Integrated Services Digital Network (B-ISDN), emerged with an unforeseen effect the Internet solution, which has fully conditioned the new public and private network architectures, both for fixed and mobile communications.
The first Internet generation, which has based its great development success in the simplification, even removing, of some basic telecommunication functions, has suffered a set of functional and performance limitations (QoS), which have not allowed to face the new multimedia services and application requirements. Therefore, in the last years from 2000, has emerged a new initiative of global convergence oriented to an integrated and effective solution, in cost and performances, identified as " Next Generation Network" (NGN), with the objective to provide a final solution to all these issues, at global level, under an industrial suppliers and telecom operators agreement. The fundamental requirements imposed by this new telecom network generation are the following:

- *multimedia services support, based on internet <u>multimedia</u> standards*
- *<u>services independient</u> from the type of <u>transport network</u>*
- *<u>open interfaces</u> to ensure multisupplier environment*
- *<u>interworking</u> with the existing services network.*
- *flexible <u>services creation</u> environment*
- *<u>escalability</u> performances*
- *integrated <u>network management</u>*
- *<u>high security</u> level*

3.5.Convergence requirements

In addition to the Basic NGN requirements the following network, service and architecture convergent requirements shall be applied:

- *to achieve unification for networks, services and terminals*
- *integration of different networks: audio, data, bcast, multicast, within a multiservice network.*
- *fixed and mobile network integration*
- *integration of services : audio, video and data info, in multimedia form*
- *to achieve a single multimedia terminal for any user environment, including ambient networks*
- *to incorporate all these requirements to the new fixed and mobile network generation architecture.*
- *future requirements: ambient networks, space networks, micro/nanosystems, NBIC convergence, ..*

3.6. Interworking and network evolution

It is mandatory to comply backward network compatibility, within a continuous evolution, a big technical effort is required to guarantee all network units interworking, with a big economical cost for operators and industry suppliers

There have had 3 big transitions: electromechanical - digital, digital basic- digital mobile and digital mobile- NGN, within a fixed-mobile convergence.

4. System architecture

The System architecture design is the input for the units specification, its input is the System TRS -Technical Requirement Specification.

A detailed definition of layers, planes and domains definition shall be performed, 3D telecom matrix is taking as implementation reference- See Fig.1, with the following major aspects items:

- transport part (multilayer) : access domain, switching, routing and transmission media
- service part (multilayer) and application I/F
- management plane
- functions, interfaces and performances definition, for all levels
- multimicroprocessor reference systems architecture

1. Overall Architecture requirements are the following:

•analogue and digital systems compatibility
•basic digital network systems (SS7) migration to Internet IP
•fixed network systems and mobile systems
•interworking and evolution 2G-3G-4G
•interworking and convergence mobile- NGN
•interworking and interoperability in all phases, among operators

2. Implementation requirements :
For the development of such System architecture the following Implementation aspects shall be considered:

a. Implementation technology

- system architecture level, dynamic approach
- advanced multiprocessor architectures and related performances
- hardware technologies
- firmware technologies
- software technologies
- application flexibility, modularity and evolution
- for multiprocessor architectures and system performances.

b. Technology status

- Deep state of the art knowledge related to :

- system architectures
- hardware architecture and technologies
- software architecture and technologies
- high background in preceding systems

- Previous feasibility studies, in different system areas
- Permanent technology updating and training

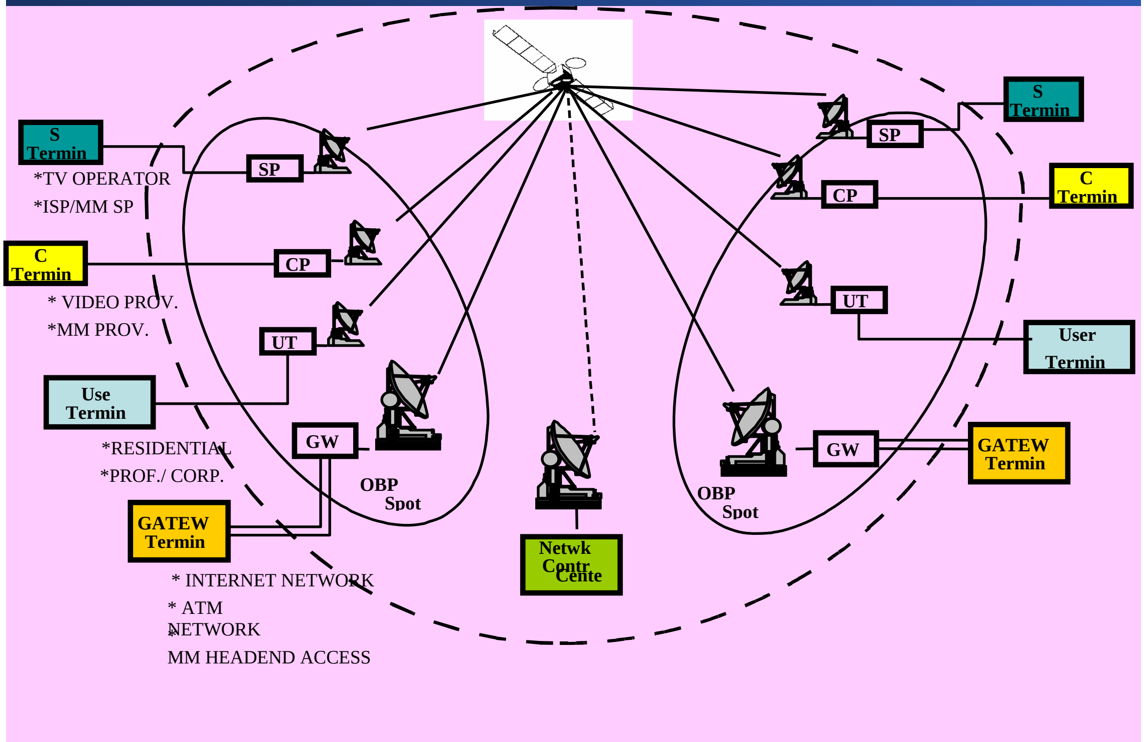
In FIG. 2, a Big Telecommunication Network Architecture is presented, where a variety of terrestrial and space, line and radio equipment and systems are integrated, to constitute a Global Telecommunication Switching/ Routing Multimedia Network.

5.. System performances

- Modularity : at overall System, HW and SW levels
- Reconfigurability
- Escalability
- Dimensioning, user manual editing
- Operation and maintenance
- System administration, operator oriented
- Quality of service
- Reliability and availability: HW, SW and system
- Security, for network, service and management
- Evolution capability, in a changing environment

Evolution to higher functionality and less size and cost, is a mandatory approach

FIG.2 - NGN MULMEDIA NETWORK SATELLITE SYSTEM ARCHITECTURE



6. System analysis

- Functional study approach
- System simulation approach, partial/total subsystems, units, subunits and equipments
- Actual system models build up:

- functional model : for layers, planes, domains
- reduced physical model, as part of the global system, for representative functions and critical issues

- Functional model, functional blocks, partial or global
- Logical model, partial HW and SW aspects
- Static model, one state within a process
- Dynamic model, call / session scenario and state sequence
- Signalling scenario
- States machine

7.Development tools

- System level (matlab, opnet..)
- Hardware development (vhdl..)

- Software development (telelogic..)
- Subsystems test
- Unit test, subunits and equipments
- Units integration and test
- System integration and test, partial/global
- Planning tools: basic for system deployment and exploitation by the operator

8. System specification

a. Technical issues:

- Fundamental task for the system development
- It is defined how the system will be ! before being really in operation
- Detailed functional architecture
- Subsystems definition
- Units definition
- Interfaces definition, for layers, planes and domains
- Performances definition

b. System exploitation

- Related aspects : product, cost, marketing,..
- Industry point of view :

- development costs, engineering, manufacturing, commercial,..
- marketing and business development

- Operator point of view :

- technical evaluation, product transfer, technology trainnig, ..
- operation, management and administration
- service explotation strategy
- comercial phase

c. Economic and social impact

- Related aspects : new services and related applications
- Impact evaluation of new services on users : communication facilities, at personal level, work facilities, transport, entertainment, ..
- Big impact cases, in the past determined by four big technological achievements : television services, digital services, internet services and mobile services
- the next technological step will be based on nanotecnology

9. Project management

- Technical direction methodology, some aspects herein presented
- Multiproject management approach :

- multiproject technical direction

- multiproject coordination
- multiproject administration

- Project definition and management tools
- Estimate and follow up of human, material, time resources, and related costs

For the System effective development the following major tasks shall be performed:

- Coordination and follow-up of the whole system functions and related activities
- Task review of the related development centres and companies
- Periodic meetings and design reviews
- Effective planning and coordination tools, at partial and global levels

10. CONCLUSIONS

1. The Big Telecom Systems belong to the very complex systems field, within the systems and networks science
2. A common understanding is required for the different R&D system players
3. A detailed definition of the various R&D Phases and Elements is needed
4. The full set of Telecom Network requirements shall be agree between industry systems department and operator
5. The evolutionary network and services requirements are a major technical and cost issue
6. Interworking and interoperability between different suppliers is required
7. The Next Generation Network and Convergence requirements is the workframe for future fixed and mobile systems
8. The participation of different R&D centres needs for a close and detailed specification and follow up of the full set of Elements
9. As the functional complexity increases, deep system analysis, advanced development tools and integration and test tools are major issues
10. System Specification to Lab Model and Lab Model to Product are fundamental steps

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