Mobile Communications & Technology Platform
Strategic Research Agenda

*e*Mobility
- staying ahead -

Picture of the Future
Information and Communication

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1. Context of the Strategic Research Agenda

Our way of life is changing from the clearly defined, traditional roles and is getting more complex, where the borders between, e.g., professional and personal lives as well as work place and home are getting less obvious. We are participating in varying social contexts in our everyday life, and we need a facility to maintain such relations: to communicate, to share items and time, and to manage today's complex lifestyles.

Future mobile and wireless communication systems have to support more comprehensively the new ways of living. To ensure the adoption of the new systems, users have to be included into the design process, i.e., the systems must be designed from the user perspective in a user centric manner. These systems will provide seamless access to any information/content, anytime and at any place, via any access and device independent of specific radio coverage. Therefore, users will be optimally connected anywhere and anytime – without user interaction – dependent on user profiles and other contextual information. These profiles are defined by or for the user, e.g., with respect to required QoS parameters, cost and the technical capabilities of the available device.

The drivers for these research activities are from the user perspective the continuity of experience through seamless connectivity and to overcome the digital divide in developing and emerging markets in the interest of the citizens, in particular:

- User centric content (device and context sensitive content driven by affordable and available broadband systems).
- Exploding applications (digitisation of everything at the edge of the network).
- Privacy, safety and security (critical for content that is purchased and created with respect to copyrights).
- Full mobility across heterogeneous networks.
- Always on, always here (sessions that cross networks and devices should continue seamlessly).

In order to support the user and to enable the adoption of sophisticated services and applications from the user perspective, the service platform and the networking infrastructure will take care of optimal provision of different access systems. These generic requirements from the user perspective result in the technical vision for systems beyond third generation.

In addition, future systems have to support changing and flexible mobile ecosystem for which profit is to be ensured for all involved new players as indicated in Figure 1.

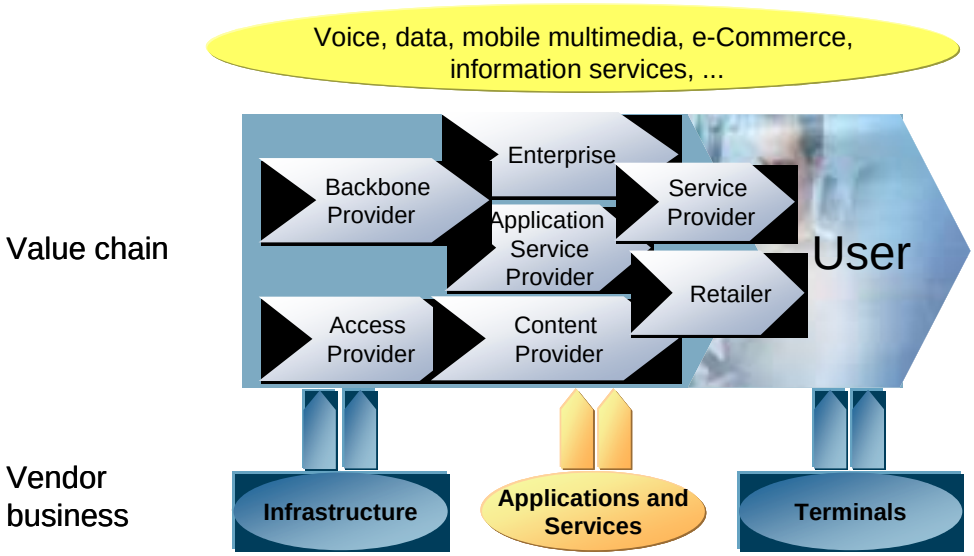

Figure 1: Future exemplary value constellation for mobile and wireless communications

These systems will require open interfaces in order to allow different players to interwork and to participate in the business. More flexibility and competition will improve the quality and cost benefits from the user perspective and will create new jobs in related industries such as services and applications as well as alternative operators beyond the today's players of vendors and public network operators. Such a flexible infrastructure will be the prerequisite to fulfil the Lisbon Agenda to develop Europe as the most competitive region in the world by 2010 and to provide broadband access anywhere. A radical simplification of mobile service creation and lifecycle management is seen as a challenge facing Europe in order to enable growth in the European data service business.

The European leadership in this area will be based in future on the best combination of legacy communication technologies such as QoS support, mobility support, reliability and security with legacy technologies coming from the IT industry such as cost, application platforms and open architectures and finally with the content industry with respect to content management and DRM (Digital Rights Management). The convergence of different industry sectors requires the development of concepts and technology building blocks in different technology fields, which will be integrated potentially in a different manner than the traditional OSI protocol stack to provide end-to-end solutions and to create value for the user.

Framework Programme 6 and the Eureka initiatives will provide around the year 2007 more matured research results on novel communication network concepts and radio technologies towards the implementation of the vision. In addition, progress can be expected particularly in the areas of:

- Dynamic network compositions,
- Reconfigurable radio systems,

- Mobility management across multiple access technologies,
- Support for moving networks,
- Network sensitive media delivery,
- Extended network support for context aware service design, and
- PANs and other short range radio access networks, which seamlessly integrate into public access networks.

Prototypes evolved from the different areas will exist by 2007. However, these prototypes, which will be built as concept studies and based on different platforms, will not have been integrated into a coherent system design. The likely high system complexity from these rather independent activities needs to be considered.

In the 2007 timeframe, the 3rd Generation evolution in the form of HSDPA (High Speed Downlink Packet Application) products will be widely available, offering 14 Mbps over the air downlink peak capacity. W-CDMA (E-DCH) up-link enhancements will be in production. MBMS (Multimedia Broadband Multicast Services) will have reached the status of large field trials. Early products should be on the market by then. Further evolution of 3rd generation systems will be under development towards even higher peak capacity and significantly lower latency. Similar further developments are also on the way in WLAN type systems.

The *e*Mobility Programme therefore focuses on research to be conducted between 2007 and 2011, corresponding to the lifetime of Framework Programme 7 in order to transfer the research results in Framework Programme 6 and the related Eureka initiatives towards close pre-commercial system design and implementation including larger-scale trials. Research and development in the *e*Mobility Programme will address challenges that:

- Were not resolved during FP6,
- Must be addressed in order to transfer early results from FP6 research to pre-commercial system prototypes,
- Prepare the foundation for cost efficient and competitive system designs,
- Provide tools and solutions for rapid mobile service creation, shortened time-to-market cycles, support for small and innovative businesses to grow, and
- Thereby sustain the European leadership in mobile networks and services.

To achieve its ambitious goals, as depicted in Figure 2, the *e*Mobility Initiative requires joint and multidisciplinary research in key areas such as ambient wireless access networks, simplified and flexible network designs, open mobile service creation environments and trust and security infrastructure solutions.

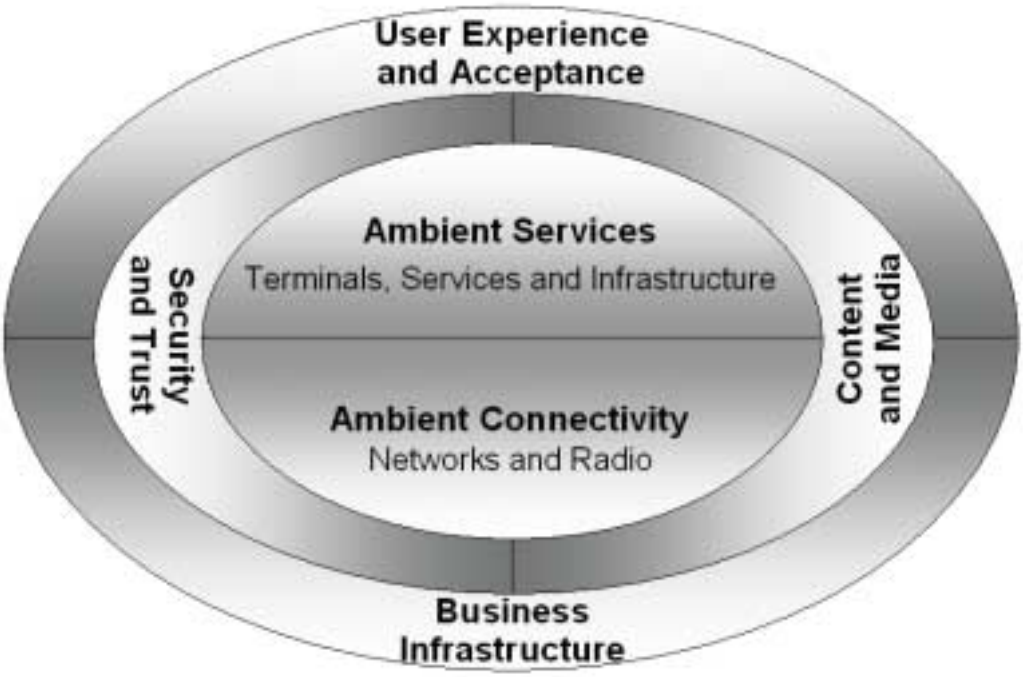

Figure 2: Research Areas

*e*Mobility research will include technology deployed as user field trials. It will expand and deepen the relationship between mobile technologies and segment-specific applications, such as *e*Health, *e*Government or *e*Media and 3rd party application developers. These applications and the easy access to media of any kind will support the needs of the citizens and will simplify their life. Therefore, open service creation environments will allow new ideas to grow rapidly from test cases to commercial offerings and will stimulate service designers and entrepreneurs to take advantage of the *e*Mobility platform.

These research activities will provide all the necessary systems and concepts to implement future systems with open interfaces, cost-efficient and spectrum efficient with high flexibility in the service creation in order to achieve short time-to-market in a global competitive environment.

2. Strategic Research Agenda

2.1 User Experience and Acceptance

2.1.1 Vision

Ultimately, it is the user experience that drives the adoption of new services. Thus, service platforms and enablers need to match with the growing needs of the users, which originate from a wide variety of different sectors, covering both enterprises and the consumers. It is therefore essential to put the research and development focus on device and user-centric elements, thereby increasing the business potential of a most flexible end-to-end environment.

This environment poses immense fundamental challenges often neglected in the research: What use will the end-users make of their devices and services? Which new devices and services will be acceptable to end-users? How can desirable service characteristics be facilitated on the basis of new and emerging enabling technologies such as positioning, context sensitivity, and adaptive multi-modal interaction? How will different players on the market – network operators, service operators, content and application providers, public authorities, user groups and individual users – interact and co-operate to create and provide the services effectively, timely, and securely while balancing the various interests and values of the different players?

This section gives just a flavour of the essential challenges that need to be addressed to translate inspiring visions, such as those expressed in the ISTAG Vision, the Wireless World Initiative scenarios or the European Service-GRID, into tangible business value.

2.1.2 Rationale and Objectives

User interfaces (UI) and usability are critical factors determining the success of any service. In multi-modal UIs, interaction modalities depend on the context in which the device is used. Interplay between contextual and interaction modality is critical to facilitate seamless use of the device irrespective of the situation. Tangible UI technologies for mobile, provide opportunities to meet the needs of the mobile user, e.g., using of RFID (Radio Frequency Identification) to support shopping, secure access, file transfer, etc. Also, virtual and augmented reality with future displays and input/output devices opens whole new opportunities for user interfaces and more comprehensive interaction.

From the enabling technologies side, context-awareness is fundamental for future mobile applications and systems to provide rich and consistent user experiences. This requires also interfaces with learning capabilities and adaptation (content, interaction modality, user interface) based on the context and situation. The research and development challenge is to create a flexible context-modelling framework with efficient means of presenting, maintaining, sharing, protecting, reasoning, and querying device, user and network context information.

In this new environment, we will have multiple devices with different capabilities that can automatically establish their local communication, and provide the user with multi-modal interaction with multiple services. Users will also need to access their services via an increasingly heterogeneous communications infrastructure, either via fixed communication links, but in particular via wireless communication links. Automatic, multi-modal, and simultaneous access to multiple services is expected to enhance the user experience and but also minimise the user's effort needed to arrange the communication and allow the user to focus their attention on essentials. However, the multi-dimensional heterogeneous usage environment poses several important challenges regarding zero-configuration and hidden complexity in order to make it easy for users to reach services with a minimum of effort.

In order to be able to answer to the questions above, one has to put totally new requirements on network configuration technologies as well as on mobile service creation and deployment methodologies.

2.1.3 Research Priorities

Multi-modality and context-awareness in user interfaces, as stated above, create fundamental research challenges that target enabling better user experience:

- Explore how context-awareness can provide rich and consistent user experiences for future mobile applications and systems. This includes developing a flexible context-modelling framework with efficient means of presenting, maintaining, sharing, protecting, reasoning, and querying device, user and network context information.

- Expand current user interfaces to user interfaces with learning capabilities and adaptation (content, interaction modality, user interface) based on the context and situation.

- Study the interplay between contextual and interaction modality for seamless use of the device irrespective of the situation. This includes natural interaction with the most appropriate modality based on the situation.

- Elaborate traditional interface approaches with virtual and augmented reality technologies, future displays and input/output devices, and bring new opportunities for user interfaces and more comprehensive interaction.

- Enable zero-configuration and hidden complexity in order to make it easy for users to reach services with a minimum of effort.

Assuming that hundreds or thousands of system functions and supplementary services exist and are widely spread across a multitude of business domains and assuming that more complex services can be composed based on elementary functions, network enablers and other useful services:

- How can (in such a distributed execution environment, with so many functional- and business relationships) a defined service quality be provided to the end-users or the enterprise customers?

- Can this service quality level be maintained even in situations were parts of the underlying system infrastructure no longer function?
- What type of recovery or ad-hoc replacement methods (redundancy concepts) would be required to still achieve a reliable system and service behaviour?

To conclude with the “Service, Service Infrastructure and Devices” section, none of the above areas – from user interfaces to enabling technologies and from devices to services – is sufficient unless one keeps in mind the users:

- How to ensure and improve the acceptability of services?
- How to develop software productions processes to take user requirements into account earlier?
- How to enable natural human system interaction between users, services and devices?

This calls for strong participation and involvement of human researcher, where one collects needs and requirements from actual users and iteratively validates results.

2.2 Business Infrastructure

2.2.1 Vision

As stated in the introduction above, future systems have to support changing and flexible mobile ecosystem. Therefore it is predictable that multiple viable business models will cohabit with the emergence of new actors leading to new supporting overall architecture. Indeed new business opportunities will be offered to all, including the end-users themselves, especially if the service creation process is pushed to their hands. A major shift in paradigm has to be reached by starting business modelling from the market requirements and not only from technological aspects.

2.2.2 Rationale and Objectives

The main question regarding business issues of current and future wireless systems concerns how to maximise the potential of the technical change in terms of business objectives. However, a knowledge gap exists as to the degree to which economic, financial and organisational aspects are integrated with technological models in innovation trajectories. It also concerns how and why specific value configurations come into being and how they evolve.

To close these gaps, an extensive business modelling activity which connects technological choices to the social, economic and political dimensions of market creation is necessary. Business models are defined as a description of how a company or set of companies intend to create and capture value with a product or service through the integration of various commercial, organisational and process models within a technological architecture.

The aim is to develop and validate a number of viable business models that have the potential to provide long-term commercial underpinnings for the design and operation of future wireless services. In the case of future user-centric services, this means the creation and analysis of innovative, open and flexible, business models. These models should be able to incorporate a range of different types actors (i.e. end-users, media industry, carriers, manufacturers, services providers, financial sectors, software industry and so on) in a more or less standardised set of business roles and relations, and should be able to underpin a number of different application classes (i.e. content delivery, environment interaction and enhanced communication).

2.2.3 Research Priorities

To achieve this, a multidisciplinary approach unifying methods drawn from economics, organisational studies, social psychology and management studies needs to be developed and adopted. This approach will involve active field research into

- User and provider requirements and case studies of current and emerging business models for different classes of applications;
- The construction of business model prototypes together with both qualitative and formal work on scenarios and migration paths - closely aligned with the service architecture activity;
- The implementation of business models thru dedicated high level architectures;
- The validation of the scenarios through simulations and demonstration activities.

2.3 Ambient Services

The potential separation between business related to access provisioning, and business related to services (as it has been discussed in the previous section) has led to new challenges as far as the profitability of emerging business models is concerned. In order (1) to implement a viable mobile perennial eco-system, and (2) to reach this global objective that is the enforcement the European leadership in mobile terminal and services, it is of the utmost importance to consider what are the key drivers leading to boosting the service market in Europe. We consider that the following key topics have to be addressed:

- **Terminals and service/user related issues, including adoption by the end-user:** as heterogeneity and complexity increase, the end-user drastically requires support from the service provider in order (1) to provide her with the best possible service experience in a fully operating environment (always on) and (2) the appropriate information or services at the fingertip.
- **IT/Telco convergence, heterogeneity and adoption by the industry**: The adoption by the industry of an architecture implementing the fix/mobile convergence passes through a consensus-based standardisation of such an architecture. One of the major achievements of such standards is the IMS, the evolution of which according to the new identified trends is to be addressed.
- **New innovative services**: The wide diversity of available technologies provides intelligence enablers and mart services are therefore not only a promise but are considered today as a key driver to service adoption.

- **Service creation process**: The availability of a Service Creation Toolkit and mechanisms to fasten service deployment to the platform will decrease the time-to-market for services, and enable cost-effective development and deployment of “very short lifespan” services. It will provide the foundation needed for creating a much more diverse service market than is possible today;
- **Security**: Of course security cannot be addressed in this section only as it is spreading across all layers from radio, network to services and even terminals. Nevertheless a large amount of issues relates directly to the service level, in particular privacy, integrity, AAA, viruses and worms attacks and intrusions.

In this section, we concentrate on the terminals, services, service infrastructure and service creation. The other topics are covered under separate sections of the Strategic Research Agenda.

2.3.1 Terminals

2.3.1.1 Vision

The user’s communication environment becomes more and more complex, and composed of more and more devices and communication channels. At the same time this environment offers more and more powerful capability. A tiny part of the targeted end-users being technology aware it appears quite crucial to assist her while “consuming” the available technology. The user has already understood that this available technology can enable much more than just communication; a new brand of innovative services, not to say intelligent, is awaited as a mean to ease every day’s life. But the thin trade-off between assistance and intrusion in one’s life is to be found, not to forget privacy and more generally security issues that can be, if not solved, a high hurdle to service adoption. The amount of available information (including the information related to the user) increases and needs to be managed in order to face problems such as loss or theft of terminal, misuse and to enable terminal sharing (one terminal, several users) or terminal multiplicity (several terminal, one user).

2.3.1.2 Rationale and Objectives

In order to provide the user with the best possible service experience a new kind of relationship is to be implemented between the end-user and the various providers (terminal, access, transport, service) that will result in a full support of the user at all levels, from the terminal to the services, including the management of his personal data and their migration and backup.

2.3.1.3 Research Priorities

- Personal and mobile gateway automatic configuration;
- Always on environment: OS and software updates, zero-configuration, self-learning systems;

- Data management and synchronisation: how to manage the huge amount of user information? How to select the most appropriate information according to a given situation? How to handle the underlying complexity before presenting to the user? How to migrate it across different domains and across different terminals and devices? How to fusion different sources of information into a single one?

- Dynamic desktop: how to provide the user with the most appropriate data and service environment, still context aware.

- Intelligent Customer Care or how to provide smart support in real-time in case of technical difficulties: remote diagnosis systems, auto-diagnostic, self-healing systems

2.3.2 Innovative Services

2.3.2.1 Vision

To propose a new dimension of “mobile intelligent services” that answer to our specific needs inherent in our mobile way of life that requires more immediate assistance than in a static and perhaps more comfortable situation. This assumes that the mobile services will have to be intelligent enough (1) to understand the whole situation or context (2) to behave accordingly either reactively – meaning that a context change has been detected and that the service adapts accordingly its behaviour – or pro-actively – in this case the service detects in advance something the user is not aware of and propose to adapt its behaviour accordingly –- in order to provide the best appropriate assistance to the user. This domain of mobile intelligence offers a wide landscape of new possibilities driven both by new mobile equipments capabilities (sensors, connectivity, multimedia support) and new related usages.

2.3.2.2 Research Priorities

- Proposing automated context-aware and semantic-based robots or agents (e.g. mobile reflexes and dynamic services) that provide pro-active or on demand seamless support in various situations of the daily life.

- Pro-activeness: Proactive behaviours means that a service is able to anticipate, i.e. according to what it knows about the world, or let’s say about the end-user’s world it is able to provide solutions or alternatives to a problem that has not necessarily already happened. Research in deduction and planning techniques, modelling of user behaviour or modelling of “life” is necessary to achieve pro-activeness and to make “ambient intelligence” just happen

- Multi-modality and augmented reality enabled services that enhance the ways to use mobile services thanks to smart sensors, distributed media restitution and aggregation facilities.

- Reasoning capability: while a huge amount of data is available through sensors and devices, and huge amount of information is available, e.g., on the World Wide Web, there is no real flexible way to infer knowledge, i.e. interpreting these data and information according to a given domain (for instance transport or medicine). Research is needed to provide large-scale reasoners ready-to-use by mobile application making then benefits of this mass of available information.

- Managing in an efficient way the huge amount of information either gathered (or pushed) by (to) the user allowing an efficient and accurate a posteriori retrieval of information (knowledge base management, automatic knowledge clustering, contradiction/validity period checking).

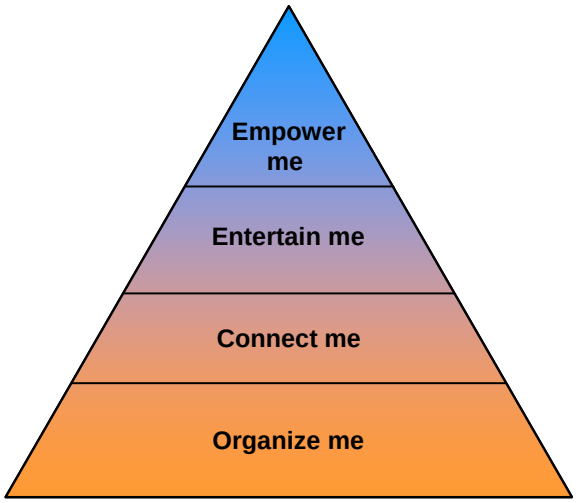

Figure 3: Hierarchy of users

Succeeding in this direction is of course not independent of concerns related to the service architecture. Thus, implicitly new mobile equipments are now not only terminals but a kind of mobile gateways as well, with the related issues of capabilities discovery and automatic configuration. The value brought by the combination of such intelligence in combination with a diversity of mobile devices may lead to enhanced services and usage for general-purpose end user as well as vertical market (e.g. health, transport, retail, tourism, etc.).

2.3.2.3 Trials and Validation

A key success factor for all these innovative areas is their suitability to real concerns of the users and the reality of existing infrastructure. It is the reason why a way to take into account these concerns would be to push the concepts of demonstrators to live experiments involving a large numbers of users.

Another decisive parameter is the economical relevance of the technologies and services either directly as an immediate value creator or indirectly as a result of their enabling effect.

Measurable benefits both in terms of individual and potential business experiences are then some strong criteria that may lead the research in the domain of Mobile Services and Service Architecture.

2.3.3 Service Infrastructure

New service infrastructure is needed that takes into account IT/telco convergence, heterogeneity and adoption by the industry.

2.3.3.1 Vision

The long experience of the Internet and its extension to the mobile space has already driven to the emergence and adoption of a wide number of standards for both the fixed and the mobile spaces. For example, one of the major achievements of such standards is the IMS (IP Multimedia Subsystem) that is a significant progress in the domain of convergence between voice and data on the one hand and fixed and mobile services on the other. The evolution and enhancement of IMS must be addressed.

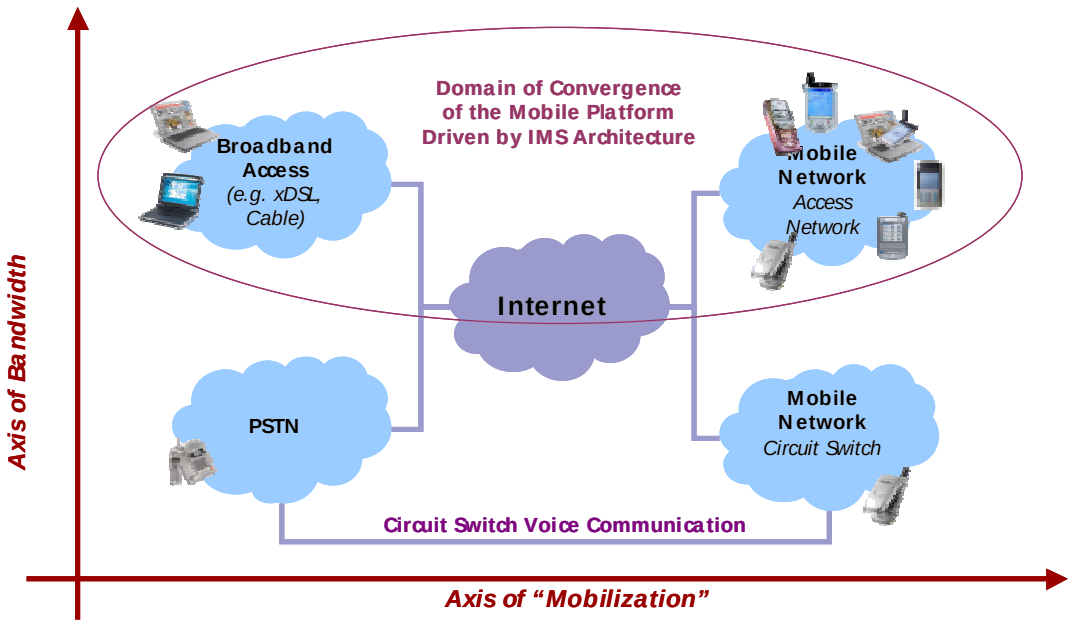

Figure 4: Trends in Service Architecture: The Telecom Evolution

2.3.3.2 Rationale and Objective

In terms of innovation for mobile services and service architecture, the objective must be now to "make it happen" and to take advantage of the progress achieved in parallel in other domains such as radio and networks infrastructure, in order to contribute to a wide adoption of the mobile services as well as the fixed ones seamlessly.

To achieve these goals, all the players of the mobile arena have to make progress in the area of Service Architecture. The objective is to remove the hurdles preventing the adoption of mobile services by the market by providing the “missing links” in addition to the existing standards and components.

2.3.3.3 Research Priorities in Service Architecture

- Providing a homogeneous and open service execution platform on the terminal side in order to facilitate the deployment, the adaptation and the execution of any mobile services. Today the heterogeneity of software environment such as the Operating System on mobile terminals makes this concern very tangible. For instance, a widely adopted Open Source initiative could bring a very significant improvement to solve the current fragmented situation.

- Overcoming the heterogeneity of mobile and fixed infrastructures at the service level, in order to smoothly educate the market with service architectures that simplify the way to communicate seamlessly in heterogeneous environments. Such a concern is important to manage, in order to move from legacy architectures to new generation ones.

- Providing enabling components that support more “intelligent” mobile services (support for semantic publishing and discovery, reasoning, knowledge inferring, learning, profiling, contextual information gathering etc.)

- Proposing a standardised architecture in order to support and facilitate the adoption of a new generation of services by considering the evolution of usage of mobile equipment. For instance, in addition their standard use, mobile handsets can be used as mobile gateways between sensors, players or others gateways.

2.3.4 Service Creation

2.3.4.1 Vision

While it is foreseen that more and more companies will get involved in the service creation business, it is quite obvious that for profitability concern, the proposed services are going to target the largest audience possible, ignoring then services that are of interest for just a few people. As a matter of fact the service creation power has not been pushed in anyone’s hand as the web page creation has already been for a long time. Easy-to-use creation environments (at home or on the move) are therefore needed to enable all users making their own customized services. At the same time, while competition increases, in becomes more and more crucial to decrease drastically the time – to – market, especially from service creation to service deployment. Then not only the “basic” end-user is concerned with service creation, but the professional is, as well.

2.3.4.2 Rationale and Objectives

In contrast to the radio and network technology evolution, with innovation cycles of up to one decade, the design phases and innovation expectations on mobile services are much shorter. Upgrades every few months and major service launches every couple of quarters are commonly expressed expectations already today. Standards in this area are developed iteratively by partner alliances and active involvements of the open-source software developer community. Introducing systems and methods that permit the maintenance of this pace of constant mobile service innovation and rapid time-to-market will lead to a sustainable competitive advantage for the mobile industry. Making novel mobile service creation environments inherently aware of the underlying communication network characteristics and the users' mobile device capabilities will lead to a competitive edge for the European mobile service and network business.

A drastically simplified service creation-, testing- and deployment process, in a merged information technology and telecommunications world, will present one of the biggest challenges required to make the approach pervasive and the vision of Ambient Intelligence a reality.

In contrast to current information technology style service creation tools and processes, a mobile service creation environment demands, in most cases, online testing facilities, utilizing network resources from different operators and data sources from multiple content providers. Today, no systems or methods are in place permitting the thousands of software developers, with a background in information technology, to participate in the mobile service creation process. This innovation and business potential is largely untapped as yet. The initial efforts made in the 6th Framework Programme need to be substantially expanded during the 7th Framework Programme to rapidly change this situation.

2.3.4.3 Research Priorities

In order to foster the mobile service creation and deployment business, essential research challenges need to be addressed:

- Research and develop open mobile service creation and deployment concepts and environments that do not depend on a specific execution platform that could become unfavourably dominated by a single organisation,

- Investigate how long lasting standardisation processes can be shortened to meet the time-to-market demands of the service innovation life cycles,

- Study the potential of overlay network technologies for bridging different platforms from different vendors while still permitting independent system evolutions,

- Examine how mobile service creation environments could be designed to leverage wide-spread information technology style development tools, while taking the mobile network specific characteristics and the multitude of mobile terminal capabilities and design factors into account,

- Research mobile service creation methods that avoid the parallel development of service instances for all types of devices and all types of data transports,

- Investigate and prototype network support functions that permit the creation of situation aware services, while still keeping the mobile service logic slim and suitable for mobile devices with their limited processing capabilities,

- Explore how Web Services technologies, automated code generation tools, XML based data-, interface- and interaction description-languages can be enhanced to permit on-the-fly integration of platform features, services, access networks and devices,

- Research generalised user-interface descriptions methods and languages for fixed/mobile services that permit an automated and on-the-fly generation of mobile device specific clients (like WSDL for service invocations today). This would greatly speed the mobile devices and services innovation cycles. Personalised and device specific use interfaces could be automatically generated once newly designed mobile terminals are introduced into the network and a first service invocation takes place,

- Study techniques for semi-automated composition of services, based on pre-existing sub-services and network support functions.

Assuming that thousands of skilled software developers start creating mobile services for all types of devices and networks, questions such as the following will be asked:

- How can large numbers of developers be provided with online testing facilities in multi-operator environments?

- What business and security measures have to be put in place to permit this mass service-creation to emerge?

- How can successfully tested new services be rapidly deployed to investigate their usefulness and business potential?

- How can plug-and-play deployments of new services be supported from a system design perspective?

- How can mobile services entrepreneurs be supported by automated value-sharing relationships?

- What types of protection mechanisms need to be put in place to prevent abuse of a drastically simple and flexible service creation and deployment environment? What new types of business models and relationships could emerge?

- How can such a simplified mobile service creation and deployment environment be used to gain a knowledge step for the European society?

- Based on this knowledge step what measures need to be put in place to sustainable strengthen the competitiveness and the European leadership in the mobility enabled IS/IT domain?

2.4 Ambient Connectivity

2.4.1 Networks

2.4.1.1 Vision

*e*Mobility will enable a level of networking as pervasive as microprocessors are today, fundamentally changing the way we live and work. Elementary location sensing is becoming universally available for mobile users and in the future, devices will scan the surroundings of mobile users, or sense the physical situation of the users themselves, extending their capabilities. The user's personal space will be interconnected with the surrounding environment through the wireless world using sensors, actuators, multi-modal interfaces and new management and control systems.

2.4.1.2 Rationale and Objectives

Flexible growth from small-scale, up to Europe-wide, *e*Mobility systems and services needs to be supported, enabling a wide variety of man-to-man, machine-to-man and machine-to-machine solutions for all the various application areas. This implies full data and multimedia connectivity between and amongst users and devices and sensors in their main locations (for example, in the home, office and car). Mission-critical applications in the area of driver and pedestrian safety, medical support systems and health care on the move will need support from networks and services.

Within the *e*Mobility Initiative, the main focus is put on simplicity and flexibility for operators, service designers, providers and users enabling a large step forward towards simple and flexible future networks.

The support of the applications will require considerable research efforts.

The scope and major objectives of the research are therefore to enable the:

- Development and integration of Ambient Wireless Networks technology with innovations in the applications field to provide new types of networks, e.g. home networks, office networks, body networks, campus networks, vehicle networks, moving networks, and production networks,

- Harmonisation of actuations among sensors, monitoring and control applications working under critical requirements (e.g. security, availability, reliability, speed of action among other requirements),

- Flexibility between ad-hoc and structured network approaches,

- Evolution towards context awareness of networks towards cognitive networks,

- Integration and support of existing and future mobile and fixed access solutions,

- Support of network sharing between mobile operators,
- Extended capabilities of mobile and fixed transmission infrastructure regarding low-cost support of all types of traffic,
- Support for billions of terminals of different kinds including re-configurability of devices and services,
- Support of thousands of 3rd party service developers with a limited background in telecommunications,
- Always-on systems:
    - Information can be accessed anytime, anywhere as if it was stored locally (e.g. music database on mobile players),
    - All services that are used in one location shall be made available everywhere.

2.4.1.3 Research Priorities

Today's trend is that large, feature-rich systems tend to become complicated to specify and even more complicated to build and to operate. Research in the 6th Framework Programme is already tackling this problem to some extent, in projects, such as Ambient Networks, DAIDALOS, and E2R.

System support is needed to make it simple for service designers to test their ideas in real environments. The spirit of entrepreneurs must be enlivened to encourage the start of new business and to let them grow to global scale businesses.

An *e*Mobility system inherently fulfilling these requirements will use technology as developed in the 6th Framework Programme, but requires further research on the:

- Design of network architectures and definition of functional requirements for auto-configuration, auto-connectivity, self-organisation and self-management of heterogeneous devices in heterogeneous and dynamic (access) networks in view of seamless support of various professional and private, fixed and mobile services, ranging from low data rate, non real-time to broadband, interactive services.
- Strategies for intelligent distribution of services across multiple access technologies including:
    - Integration of existing and future radio access technologies,
    - Spectrum management (Automated spectrum access, Flexible spectrum management, Spectrum sensing and adaptation).
- Scalability of network and service control technology which can deal with all scales of network from small, ad-hoc networks up to large scale corporate and public networks employing a common networking concept.

- Auto-configuration and self-management mechanisms which are able to autonomously deal with dynamic configuration changes (including small footprint networking technology), including:
    - Wide-band radio access (multi-mode, multi-band),
    - Decentralized radio resource management,
    - Application-based charging,
    - Multi-hop radio networks,
    - Software configurable radio interfaces,
    - Multi-link phones (terminal and router and repeater functions).
- Ability to cope with a wide range of radio technology as well as application middleware to support applications of all kinds,
- Layered mobility support, which enables ad-hoc cluster mobility as well as user mobility across networks,
- Integration of sensor networks, which efficiently use the resources of larger networks (from PANs to WANs), for communication,
- BS Switching capability: create a Base Station with switching capabilities similar to the PBX´s in the fixed network,
- Delivery of information and media flows to users, adapted to their current access situation, location dependent interests and preferences,
- Unified solutions for personal networking (PN), interaction with body area networks (BAN), new types of home networks, vehicle networks, wireless sensor networks (WSN), deployment and operation of emergency Networks, and other network types,
- Security and robustness to sustain attacks and which embody embedded self-healing configuration mechanisms, (QoS and policy-based networking (e.g. policy-enabled service on demand), firewalls, authentication and trust management technologies),
- True multi-media support: Basic technologies for content distribution over heterogeneous networks (e.g. transcoding, link adaptation, application transport FEC) Video Codec and Media conversion,

Validate ambient network technology under realistic conditions (including results obtained in the 6th Framework Programme by incorporating new radio and services middleware).

2.4.2 Radios

2.4.2.1 Vision

The vision of future mobile and wireless communication comprises the integration and interworking of cooperating radio access systems such as new wideband wide-area systems for high mobility, fixed wireless access with low mobility for the interconnection of hot spots, systems for short-range communication and WLAN (Wireless LAN) applications in hot spots including peer-to-peer communication for low mobility applications, PANs (Personal Area Networks) and BANs (Body Area Networks) and finally fixed access systems in an heterogeneous environment. The today's distinction between wireless and wireline systems will disappear in future. Therefore, mobility key functions will be researched and standardised in a converged manner across mobile and wireless as well as wireline systems.

2.4.2.2 Rationale and Objectives

Ambient radio research is one part of the overall system design. The challenging requirements of future systems such as the ITU-R Recommendation M.1645 on "The Further development of IMT-2000 and systems beyond" with high targets for research and investigation radio systems are critical with respect to their immediate impact on the trade-off between wideband radio coverage requirements, network deployment cost to achieve reasonable cost for end users, the available frequency bands and carrier frequency range. The radio component has a direct link to the economic success of future solutions, where the physical limitations will have an impact on the potential economic exploitation at reasonable cost.

The radio interfaces for future systems for the different application areas and deployment scenarios will be developed and optimised to the application area in terms of flexibility, peak data rates and granularity of data rate allocation, latency, power consumption and frequency range. As far as possible the different access systems should be based on a common platform in order to ease the implementation of multi mode devices. New spectrum efficient access technologies, deployment concepts and signal processing methods are needed. This requires the development of hardware and software platforms to enable effective and easier implementation of such complex and sophisticated algorithms, in particular for the terminals with critical given constraints in terms of power consumption and cost.

International standardisation of new radio interface concepts is expected to start after WRC 2007 based on the expected identification of new spectrum.

These activities have to be supported by detailed link and system level simulations and larger scale trials. The scope of work should be on the design of the different required radio interface systems using complex signal processing algorithms including advanced antenna solutions, their commonalities in order to ease interworking, and implementation issues for the development of larger-scale real-time trial systems. In addition, the impact of new frequency ranges after WRC 2007 needs to be investigated. New methods of flexible and adaptable frequency usage and sharing methods as well as the impact on the system design and implementation need to be considered.

Bringing the new radio access concept closer to market introduction is in the focus of this research area. Nevertheless, also the evolution of existing systems as part of the overall platform and of the new concept needs to be prepared by pursuing basic research of promising techniques. Newly identified technologies need to be validated and tested according to benchmarks and assessments through related prototyping, system simulations and filed trials. These results will be contributed to the international standardisation activities in order to achieve global impact.

This results in the following major research areas for a coherent and consistent approach:

- Radio interface and related topics
- Radio network and deployment concepts
- Antenna technology
- Reconfigurability
- Spectrum issues and coexistence
- Implementation issues
- Trials and prototypes
- Regulatory framework and standardisation

The results of these research activities should provide a consolidated global consensus approach regarding the overall system concept and the defined new access technologies.

Specific objectives are:

- To develop cost & power competitive flexible-reconfigurable radio interface and baseband solutions in order to allow terminals to adapt/roam transparently across various networks thus increasing overall services coverage.
- To develop radio solutions, technologies & platforms able to provide capacity up to X MBit/s/cell (e.g. 100 MBit/s per cell) or link speed up to X Mbit/s per user (e.g. 25 MBit/s per user), or link speed in high velocity scenarios up to X MBit/s (e.g.10 MBit/s/user@150 km/h....) at limited costs and power consumption. Such systems may be deployed in available frequency bands and/or in newly identified frequency bands with scalable peak data rates.

2.4.2.3 Research Priorities

Radio Interface and Related Topics

New radio interface concepts will be part of the overall system beyond 3G. Such access systems and the impact of available and new frequency bands have to be investigated. The following areas need in-depth attention.

- Advanced future services will be constituted of multimedia-based services (e.g. video broadcasting, audio/video communications, etc.). New radio interfaces for true multimedia support have to be able to cope with Quality of Service requirements of such services with respect to pure data or voice communications (higher throughput and much lower latency than today's systems, etc.). The definition of reasonable and challenging requirements defines the technical goals, which should be achieved.

- With respect to spectrum availability constraints bandwidth and resource savings on one hand and Quality of Service enhancements are additional requirements.

- Detailed design of the different new radio interface systems with maximum commonality in order to develop a flexibly platform, which can be implemented at lowest possible cost and to achieve economy of scale and international roaming.

- Preparation of evolutionary radio access concepts and further evolution of existing radio access systems and their integration in the evolving network infrastructure in order to leverage deployed investment combining efficiently flexible data rates, power aspects, mobility and multiuser support.

- With respect to efficient spectrum usage multiuser access schemes with service oriented variable throughput and situation-aware radio interfaces should be developed and optimised.

- Investigation of the impact of new frequency bands for future systems (potentially new frequency bands after the identification at WRC 2007, bands for fixed wireless access, WLAN bands, and microwave frequency bands above 50 GHz) on the radio propagation including a scientific and biomedical study of the impact of newly identified frequency bands on the human body.

- Identification and investigation of alternative frequency bands to minimise radiation and the impact on the human body.

Radio Network and Deployment Concepts

New requirements such as significantly increased peak data rates and newly identified frequency ranges – potentially higher than today's frequency bands – have a significant impact on range and the network economy. Therefore, new concepts need to be investigated:

- Investigation of alternative deployment concepts beyond the classical cellular approach in order to increase range and to provide coverage in an economic manner.

- Integration of cellular systems with other access technologies (e.g., broadcast plus a cellular backchannel) as part of the overall system concept for systems beyond 3G.

- Development of decentralised/self organising network topologies in particular for dense networks in order to avoid the planning effort to improve network reliability.

- Investigation of operator-less radio access networks concepts for special application areas (e.g., disaster relieve, campus networks, etc.).

Antenna Technology

Antennas are an essential building block for mobile and wireless communications, which improve the link budget, which reduce the impact of interference and improve the general network economy:

- Development of adaptive antennas for devices with small size for diversity reception, beam steering and MIMO transmission.

- Investigation of antennas with small visual impact for more acceptable deployment from an aesthetic perspective.

- Development of new materials, techniques and structures for multiband antennas to reduce the antenna size for a given frequency range.

Reconfigurability

Future mobile and wireless communications will support a multiple access environment based on heterogeneous networks. Therefore, reconfigurable systems in all network entities will be essential to support flexibility and new business models. This results in the following areas of research in the domain of radio access systems (similar activities are needed for the other network entities):

- Increase the emphasis and the critical role of flexibility and reconfigurability of software defined single and multi-antenna multi-standard radio systems and related platforms. In the area of radio access systems reconfigurable hardware and software platforms, algorithms and protocols for the entire signal processing chain from the antenna (for single and multi-antenna systems) to the transceiver and the baseband processing have to be investigated by taking into account complexity.

- Research is needed on cognitive (spectrum agile) radio systems (i.e. development of proper sets of intelligent algorithms and policies for interference mitigations, coexistence issues, etc.) as enabler for a potential paradigm shift towards a more efficient frequency allocation and usage to support new services and applications, business models and competition.

Spectrum Issues and Coexistence

New radio access systems – especially for the support of systems with higher peak data rate and throughput per user – will require sufficient available frequency spectrum in order to enable the required Quality of Service and competition between different players. There are different means such as the identification and allocation of new frequency bands for mobile and wireless communications and/or innovative means for the use of available frequency spectrum. The economic exploitation of new radio access systems requires frequency spectrum as the "real estate" for new business opportunities. Therefore, the following areas need to be addressed:

- New methods of frequency usage and sharing methods for available and newly identified frequency spectrum are needed in order to use the scarce frequency spectrum as efficiently as possible. These means will be application driven. Proactive investigations on innovative solutions are needed based on today's allocated spectrum in conjunction with means like cognitive radio systems.

- Methods for coexistence and cooperation of new and legacy radio access technologies in adjacent frequency bands and for sharing scenarios in the same frequency bands are essential for the trade-off between the efficient use of spectrum and the required Quality of Service. The impact of these schemes for coexistence and cooperation of new and legacy radio access technologies on the other issues such as Ambient Networks, Services and Applications etc. need to be considered.

- Investigation of the mutual impact of coexistence issues and licensing schemes.

- Research on implementation issues for new integrated efficient technologies for solving multiple radio co-existence scenarios such as filter technologies, MEMs, etc.

Implementation Issues

A multiple access environment in heterogeneous networks will result in more complex systems with respect to signal processing, protocols and management. In addition, requirements on environmental issues and the impact of electromagnetic radiation on the human body have to be considered for the design of new systems. In order to address these future requirements, research in the following areas is needed:

- Implementation issues for reconfigurability and cognitive radio systems for a multiple access environment and new frequency usage and sharing methods in a heterogeneous environment.

- The implementation of Software Defined Radio systems at low cost and low power consumption requires:

    - Algorithm architectures to co-design for the digital baseband modem.

    - New architectures of RF front-ends matching with the microelectronics roadmaps and including advanced technologies and components such as RF MEMs.

    - Joint optimisation of the front-end and the digital baseband modem, including analogue and RF behavioural modelling as well as digital compensation of their impairments.

    - Cross layer optimisation to exploit flexibility in order to save power.

The increased complexity and flexibility of mobile and wireless solutions also triggers the need for appropriate design methodologies that should enable European industry to achieve both short time to market and a high reliability. Moreover, the requirements for low cost and low power consumption solutions ask for in-depth investigations on the impact of submicron integration on the circuit and system level. Therefore, novel design methodologies are essential. Specifically, the following needs are identified:

- Efficient analogue-to-digital co-simulation
- Analogue and RF behavioural modelling and synthesis
- Synthesis and verification of reconfigurable architectures
- System level (SoC, NoC) methodology and tools

The potential migration to higher frequencies asks for the exploration of RF CMOS circuits beyond the current limits.

Development of techniques for low power consumption for power efficient computing architectures and wireless digital signal processing, which will be applied in terminals and also in network equipment in order to extend battery life time and to support environmental requirements:

- Long-lasting power supply for mobile devices such as advanced conventional chemical batteries, micro fuel cells, advanced solar cells, new technologies where energy is generated by changes in the energy entropy (e.g., pressure, temperature, movements, light, etc.) and the combination of different power sources, energy scavenging techniques and piezo materials for low power PAN/BAN, low data rate radio links or RFID.
- Improved power dissipation techniques applied to telecom equipment to control climatic conditions under difficult conditions.
- With respect to the impact of environmental conditions and the later phase out of equipment such as easy recycling communication equipment should be designed with environmental-friendly materials.

Investigation of techniques to minimise the size and weight of telecom equipment.

Research on ultra low power radio structures for self powered PAN and BAN radios.

Investigation of low cost radio systems on silicon for very high carrier frequency ranges such as above 50 GHz radios:

- Silicon technology for active components and for passive components.
- RF design techniques and building blocks.

Trials and Prototypes

New mobile and wireless systems are increasingly being designed based on link-level and system-level simulations. New radio access systems will be integrated together with legacy systems at a packet-based platform. Trials and prototypes for key technologies are an essential part of research to gain practical experience with novel technologies. However, with respect to the complexity and deployment cost no full networking trials are expected. Trials are related to the following issues:

Development of larger-scale prototypes for the following areas:

- Wide-area networks with full mobility and for DSL type (Digital Subscriber Line) scenarios without the support of mobility.
- Hotspot system prototypes for multi-user environments, such as airports, stations, etc.
- Prototypes for end-user terminals.
- Prototypes of short-range networks (PANs, BANs, HANs) providing a range of characteristics tailored to different applications.
- Integration of broadcast type systems in the entire platform.
- Feeder system concepts for the interconnection of hotspots.
- New networking concepts such as relaying and multi-hop systems to improve coverage for higher throughput at higher carrier frequencies following the potential identification of new spectrum at WRC 2007.

Integration of these prototype systems for trial applications under conditions as close to real world as possible.

The corresponding prototypes have to support the needs of developed country markets and of developing as well as emerging country markets in order to provide mobile and wireless communication technologies for the next growth markets.

Regulatory Framework and Standardisation

The economic success of new systems depends on the grade and approach of regulation, the market access conditions, the global acceptance of solutions and the time-to-market based on the grade and approach of the international standardisation process. Research results will be disseminated to the international standardisation and regulatory process in order to generate impact based on the ambitions of the European economy in order to maintain and improve the position of European industry with respect to economic growth and the creation of jobs. Therefore, both the regulatory framework and the international standardisation process will be addressed:

- Contributions on technical concepts, system solutions, mechanisms and algorithms to the international standardisation process based on research results.
- Contributions to the regulatory framework, e.g. in the area of spectrum usage.

- With respect to the technology progress what needs to be regulated and to be implemented in order to ensure Quality of Service and competition in the market? Means of self-organising have to be considered for more efficient usage of spectrum.

- One example could be to open large parts of the entire frequency spectrum for usage by mobile and wireless applications. The "decision policies" for access to spectrum based, e.g. on context/ambient aware-regulation, should be regulated to ensure a fair access to spectrum by all stakeholders.

The research activities will cooperate closely with the relevant standardisation and regulatory bodies, which will be active in the field at the time, when research results will become available.

2.5 Security and Trust

2.5.1 Vision

The vision of *e*Mobility assumes competitive advantages in European enterprises exploiting the strong leadership in wireless access and network technologies. *e*Mobility will exploit the dominant role of wireless access in the technology convergence process in order to provide advanced services over a wide range of technologies (including access, network and service layer). Such an environment apart from the challenging technology inter-working issues will involve several business players making thus the value constellation more complex. However, *e*Mobility realisation will heavily depend on the ability to hide the technology and value constellation complexity from the user.

In such an environment security will have a central enabling role as it will allow for the provision of services to the user and support trustful transactions between the business model players in a stable value constellation.

2.5.2 Rationale and Objectives

Technology convergence will be a key driver of the evolution of wireless communications towards *e*Mobility. The converging sectors of the industry (including areas like internet and IT, infotainment, mobile communications, consumer electronics, etc.) carry a different history on security perspective and technical solutions. Therefore, security should integrate and evolve the existing security technologies through open standards in order to meet the requirements of the future advanced service products.

The role of security is essential in all parts of the future network architecture. Security should be taken into account in the operation of the terminal, the radio access network, the core network and the service platform part and in all layers including hardware, operating systems, protocol stacks and applications addressing the relevant constraints and security threats (virus, DoS, Spam, etc.). The great challenge for the future security framework is to maintain simplicity and efficiency without leading to heavy implementation solutions.

The level of offered security should adapt the service needs in terms of user authentication, information encryption, privacy, anonymity, identity management, and content delivery. Security demanding applications like m-payments, m-health, content distribution, user profile management, are expected to drive the evolution towards the *e*Mobility security framework. It should be noted that security threats in future services may also have implications to the relevant regulatory and legislation framework which should be modernised accordingly in order to allow for *e*Mobility vision realisation. R&D activities can provide an early indication for such implications.

*e*Mobility vision will also evolve the business model by including a wide range of business players (terminal manufacturers, operators, service providers, content providers, hot spot operators, etc.) which will constantly interact even in real time in order to achieve the delivery of user attractive services. The stability of such a complex and demanding value constellation requires a trustful transaction framework which will ensure appropriate interfacing between a massive number of business players.

Ultimately, it is the user experience that drives the adoption of new services. Thus, service platforms and enablers need to match with the growing needs of the users, which originate from a wide variety of different sectors, covering both enterprises and the consumers. It is therefore proposed to put the research and development focus on device and user-centric elements, thereby increasing the business potentials of a most flexible end-to-end environment.

Trustworthiness depends on adequate provisions of security throughout in the chain of communications and its environment.

Security has to be one of the design criteria pervasive in the system and services engineering. The way security is included has strong implications for functionality, efficiency and costs. The objective is to identify and develop options providing for appropriately tailored trustworthiness taking into account both private and public concerns.

2.5.3 Research Priorities

The research priorities for security, trust and business infrastructure aim at the development of the security infrastructure for *e*Mobility vision and include the following areas of research:

Security in the Future Network Architecture:

- Device: The device will be in a central position due to the direct user interaction, the support of application software and the connectivity will provide to various access networks. The following areas of research should be addressed:
    - Secure Software Environment including O/S:
    - Virus protection (virus, trojan, DoS attacks)/Intrusion Detection
    - Secure exchange of user profile data
    - Safe Terminal Re-configurability
    - Secure Execution Environment (especially for critical applications)

  - Secure SW Download
  - Proper handling of Content (DRM compliance)
  - Mobile trusted computing platform/kernel (H/W & S/W)
  - Open SW layered architecture (O/S, Application): allow for a business model neutral approach
  - Proper HW architecture: exploit HW level security
  - Exploitation of Extended SIM card
  - Subscriber Certification
  - Security solutions should be adapted to the mobile device capabilities: CPU, memory, power, etc.

- Radio Access Network: The evolution towards a heterogeneous wireless access environment introduces challenging issues for security which mainly ensure seamless secure roaming:
  - Access Control Security
  - Requirement for seamless security handover
  - Protection against attacks
  - Adaptation to access technology capabilities/constraints
  - Support ad-hoc wireless access networks
  - Extend security framework to Short-range interfaces
- Core Network: Future composed networks will introduce new security requirements to be addressed:
  - Robust Network Entities are required
  - Secure Network Re-configurability should be ensured
  - Safety, Security and Availability of Infrastructure is essential
  - Mobile network/transport security and privacy
  - Defense mechanisms against attacks (e.g., DoS) / Intrusion Detection Mechanisms
  - Secure Interoperability and Interworking with other networks
  - All-IP Evolution & Firewall Technologies

  - Trust & Authentication Entities and Global Architectures for multi-technology, multi-operator environments
  - Secure management and configuration of Personal Networks

- Service Infrastructure: Future service platforms will introduce new security requirements to be addressed:
  - Trusted platforms for mobile security & privacy
  - Mobile Application security & privacy
  - Privacy-preserving mobile applications with tuneable anonymity
  - Location based services versus location privacy
  - Secure Transactions (especially mobile payments)
  - Secure Content Handling (DRM)
  - Secure interoperability between services offered to different environments (multi-technology and multi-operator covering both wireless and fixed access)
  - User-centric mechanism allowing (authorising) controlled release of personal information
  - Secure User Identity Management
  - Single sign-on based on mobile authentication
  - Authorisation privacy
  - Authentication via security tokens using mobile devices
  - Defense and response to security attacks

- Security and Trust in Future Business Models: Issues related to secure transactions between business infrastructures require to support advanced services need to be addressed including the exchange of sensitive information like charging, accounting, user profile data, user location, context, etc. In addition technologies to allow for secure and trustful transactions among multiple business players should be investigated.

- Regulatory issues and Legislation implications: The research activities can provide early detection of regulatory and legislation issues which may include for example recognition of modern security crime, adoption of security technologies as a trustful basis for treating sensitive information (e.g., user private data).

- Customer Perspective: Commercial success of eMobility vision heavily depends on user confidence. In this context, the user needs should be taken into account in any relevant research activity while user trials should be exploited in order to capture the user perspective on security aspects.

- Security Framework and Associated Technologies: The security framework of the future should contain evolved security mechanisms in the areas of:

    - Authentication
    - Encryption
    - Identity Management
    - Privacy
    - Digital Rights Management
    - Trusted Transactions Environment

The technologies to be exploited in order to build such a framework include a variety of options (e.g., Wireless PKI, XML Security, SIP Security, Firewall technologies, etc.), which should be properly combined in order to provide a flexible and efficient framework.

2.6 Content and Media

DRM and content creation. Links to content industry/area.

2.6.1 Vision

TBA.

2.6.2 Rationale and Objectives

TBA.

2.6.3 Research Priorities

TBA.

2.7 Basic Research

2.7.1 Vision

Basic research will continue to open up new options to meet present and future requirements.

For mobile communications further improvements in user friendliness, transparency, autonomy are in need of better solutions.

Basic research drawing on several disciplines are, for example, expected to overcome the dependence on key-boards, offer more efficient power supplies and many other questions.

2.7.2 Rationale and Objectives

The focus of the *e*Mobility Initiative is not basic research. However, in this domain some basic research can have a very profound impact and inversely problems do arise which may need additional basic research.

2.7.3 Research Priorities

The priorities are to be seen as a complementary activity of basic research carried out in other frameworks and objectives. These activities are to fill gaps and transfer of research results.

Human interface

While much progress has been made in facilitating the interaction with equipment and the services, the present solutions remain a major bottle-neck. Terminals without keyboards, improved transparency of the interactions,

Power supply

The batteries remain a major constraint to the use of mobile technology. While improvements have been made this will still apply for some time. A major improvement depends on new technology at present at the basic research stage

Protection of users

The work on identifying risks due to radio emission has so far been inconclusive. While it may prove to be of no concern, a better understanding of the biological effects would help to avoid problems as well as lessen concerns.

2.8 Accompanying Measures

2.8.1 Vision

The pervasiveness of mobile communications is expected to grow progressively to impact on all spheres of life and social interactions.

2.8.2 Rationale and Objectives

As such many factors will affect technology requirements and inversely affect social requirements.

To create awareness of these evolutionary processes taking place in very different frameworks (from education, social policies, regulations, business, laboratories, etc. a continuous effort is required, as experience has shown.

2.8.3 Research Priorities

The *e*Mobility Initiative includes several Action Lines (outlined in the June report of the Platform working group), which need to advance concurrently and which interact in numerous ways. The perception of demand and socio-political priorities will shape the evolution of regulations and policies providing the context in which technology is being developed. Inversely new technology options will require regulations and policies to be reviewed and adjusted. The same applies to the other Action Lines. A strategy and measures to provide an active exchange will play a large part in reaching consensus and developing a common regulatory framework for the current European Union of 25 member states and reaching agreement on a consistent set of standards, both of which play a crucial role in stimulating the information markets, services and investments.

This part of the R & D Programme aims at developing the scenarios and transition strategies as a contribution to the work on the Action Lines I-IV.

Specifically this will entail:

- The development of a socio-economic scenario and the related road map describing the scope, scale and benefit of *e*Mobility as it affects the socio-political and economic objectives of the current European Union of 25 member states.

- The development of a road map for regulations reflecting the requirements of a deployment of the new technologies in a framework ensuring a fair balance of private and political interests.

- The identification and description of requirements for standardisation or common functional specifications permitting the migration towards *e*Mobility.

- The reflection on the adaptation and mobilisation of information resources towards the creation of the Infospace essential for the innovative uses of *e*Mobility in all spheres of life. This is to include studies on the potential of *e*Mobility to address key socio-economic needs such as protection of the environment, reduction of energy consumption, etc.

In the format of an annual "**eMobility-Conference**" the state-of-understanding will be presented and an opportunity provided for the active participation of interested parties.