A view on future Communications

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Euro View Workshop

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Content

- ✓ Euro-NGI, presentation
  - ⇨ General Information
  - ⇨ Main Activities (Integration, Research, Dissemination)
- ✓ A vision on future communications

EC FP6 Networks of Excellence

- ✓ Designed to strengthen scientific and technological excellence on a particular research topic
  - ⇨ by integrating at European level the critical mass of resources and expertise needed to be a world force in that topic
    - overcome the fragmentation of European research
  - ⇨ creating a progressive and durable integration while at the same time advancing knowledge on the topic.
  - ⇨ where the main deliverable consists of a durable structuring and shaping of the way that research in Europe is carried out on particular research topic.
  - ⇨ Each network will also be given a mission to spread excellence beyond the boundaries of its partnership. Training will be an essential component of this mission.

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Euro-NGI, General Information

- ✓ NoE on Next Generation Internet
  - ⇨ More generally on future communication and information networks
- ✓ 59 institutions, 202 researchers, more than 300 PhD students, 18 countries
  - ⇨ Academy and industry
  - ⇨ Two research communities:
    - Network architecture and traffic engineering
    - Modeling and quantitative methods
- ✓ European Commission Contribution: 5 000 000 Euros (15% of the total budget)
  - ⇨ For the first 3 years
- ✓ Starting Date: December 1st, 2003
- ✓ Second phase, Euro-FGI starting on December 2006

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Consortium

- ✓ 51 Research Centres/Universities
- ✓ 4 Telecom Operators
  - ⇨ France Telecom, Deutsche Telekom, Telefónica and Telenor
- ✓ 1 major Manufacturer
  - ⇨ Alcatel
- ✓ 1 Institution with an important experience in technology transfer
  - ⇨ Coritel, partnership between Ericsson Lab Italy and three Universities
- ✓ 1 SMEs involved with the take-up of new technologies
  - ⇨ Infosim
- ✓ 1 Support on financial and contractual issues
  - ⇨ CDC

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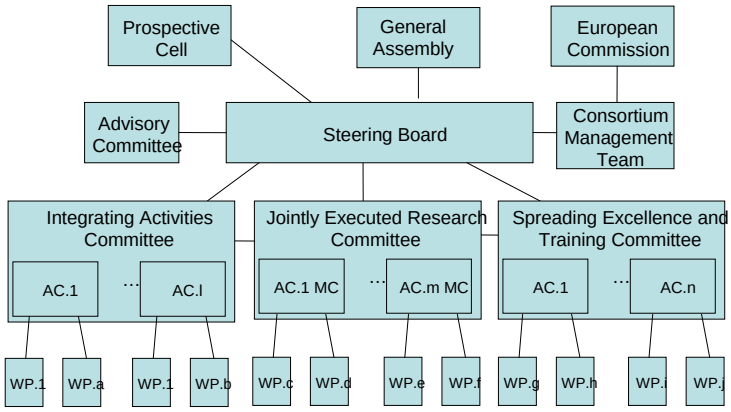
Organization Evolution



ACx: Activity x
AC.x MC: Activity x Management Committee
WPx: Workpackage x

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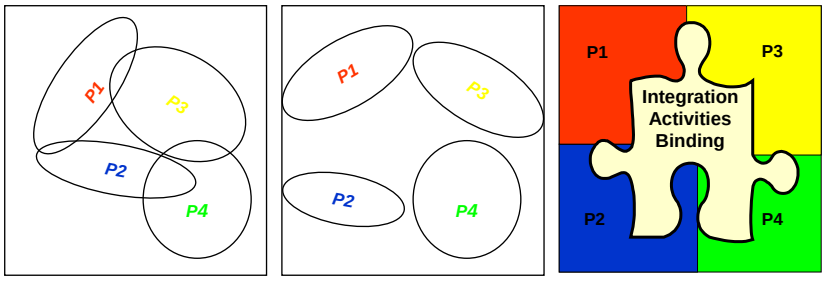
Main Integration Objective



Before Euro-NGI *Coordination* *NoE Target*

Px = Partner x

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Integration Activities Achievements

- ✓ Situation before and after the first two years of the integration process (as presented to the European Commission during the negotiation of the contract):
  - ⇨ Establishment of a Knowledge Roadmap
  - ⇨ Interconnection and sharing of platforms/tools/facilities and coordination of software development
  - ⇨ Building collective intelligence through Advanced Communication Tools
  - ⇨ Collaboration with cognitive and social behaviour experts for the implementation and evaluation of the collective intelligence
  - ⇨ Increase of the mobility for researchers and PhD students
  - ⇨ Creation of European graduated courses program for PhD students and of Summer Schools
  - ⇨ Organization of internal workshops for exchanging knowledge and coordinating jointly executed activities

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IA.8 WORKSHOPS

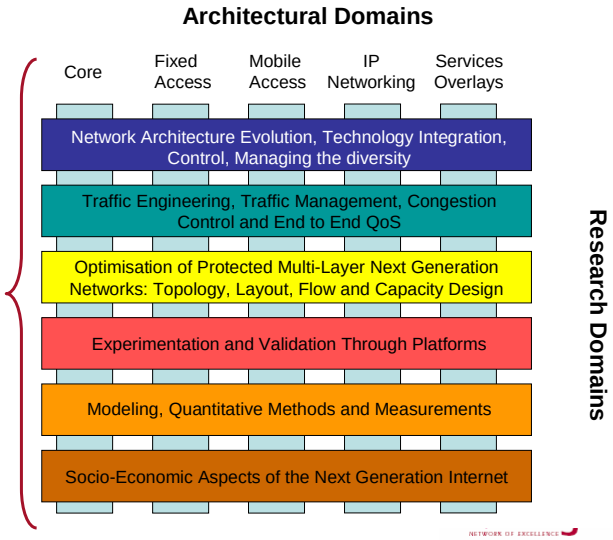
- ✓ The workshops planned for the reporting period have been successfully organized.
  - ⇨ WP.IA.8.1 New trends in Modelling, Quantitative Methods and Measurements
  - ⇨ WP.IA.8.2 New trends in Networking Architecture and Services
  - ⇨ WP.IA.8.3 Wireless and mobility in NGI
  - ⇨ WP.IA.8.4 Traffic Engineering, Protection and Restoration for NGI
- ✓ They had a very positive impact on the integration process as indicated on the corresponding reports and evaluations (see the corresponding deliverables).

Jointly Executed Research Activities

- ✓ Achievements Euro-NGI:
  - ⇨ Structuring and rationalization of the research effort through the organization of the ongoing research efforts into 6 Activities composed of several WPs
  - ⇨ Internal specific research projects on important topics not enough covered
    - for improving European knowledge in targeted topics considered of main importance
    - significant innovation potential
    - not sufficiently covered at present
    - sharply focused and designed to gain new knowledge and explore the need for more research effort, anticipating scientific and technological needs
  - ⇨ Maintain a prospective cell to ensure a long term vision

Joint Research Activities

6 research domains
25 workpackages



Spreading of the Excellence

- ✓ *Electronic dissemination - Euro-NGI web site*
- ✓ *Database of Euro-NGI publications*
- ✓ *Publish books and tutorials providing an integrated view of complementary domains*
- ✓ *Summer School*
- ✓ *Organization of international conference/workshops*
- ✓ *Collaboration with industry*
- ✓ *Relationship with external organizations*
- ✓ *Contributions to standardization*

Summary on Euro-NGI

- ✓ The integration process has evolved as planned
- ✓ The consortium has established excellent means for communication and collaboration
  - ⇨ a good balance of personal meetings and collaboration through electronic work spaces
  - ⇨ which helped in creating a much better awareness of the mutual fields of research and which brought up new collaborations.
- ✓ It has motivated the creation of effective research groups consisting of several partners with compatible as well as complementary research interests and expertise of international quality in both theoretical and applied aspects relating to the design and dimensioning of the NGI.

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Summary on Euro-NGI

- ✓ The main technical and scientific outcomes of the first year was a series of state of the arts and tutorials on the various covered domains
- ✓ During the second year, and thanks to the integration process, significant results from joint research were provided
  - ⇨ The Specific Research Projects would not have exist without Euro-NGI
- ✓ Spreading of the Excellence has progressed through the web site, publications database, Summer School, Conferences and workshops, PhD courses and several contacts and partnerships.

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Content

- ✓ Euro-NGI, presentation
  - ⇨ General Information and Euro-NGI domain
  - ⇨ Network Organization
  - ⇨ Integration Activities, Research Activities, Dissemination Activities
- ✓ A vision on future communications

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From Internet towards multiservice IP networks

- ✓ First generation, before 1992
  - ⇨ Research network
  - ⇨ Telnet, Email, File Transfer
  - ⇨ Low traffic, low number of users
- ✓ Second generation, the ’90s
  - ⇨ Commercial services, ISPs
  - ⇨ Web and basic peer-to-peer
  - ⇨ Traffic and number of networks explosion
  - ⇨ Mainly Best Effort approach and simple engineering rules
    - Main issue: capacity (transmission and addressing)

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From Internet towards multiservice IP networks

- ✓ Third generation, from now on
  - ⇨ Triple and quadruple play
    - Internet access, telephony, IPTV, Mobile convergence,…
  - ⇨ Services evolution and convergence
    - Network and services ubiquity, Locations and Context awareness, vertical handover, Always Best Connected, Community services and networks, Spontaneous and Autonomous Networking, etc.
    - Interconnection the real and digital worlds - WSNs
    - Home networking: beyond “just” networking
    - Machine to machine and ambient intelligence
      - – RFIDs, from today's web towards searching for objects
  - ⇨ Infrastructure services: virtualization, e.g. evolved VPN architectures, services overlays, etc.

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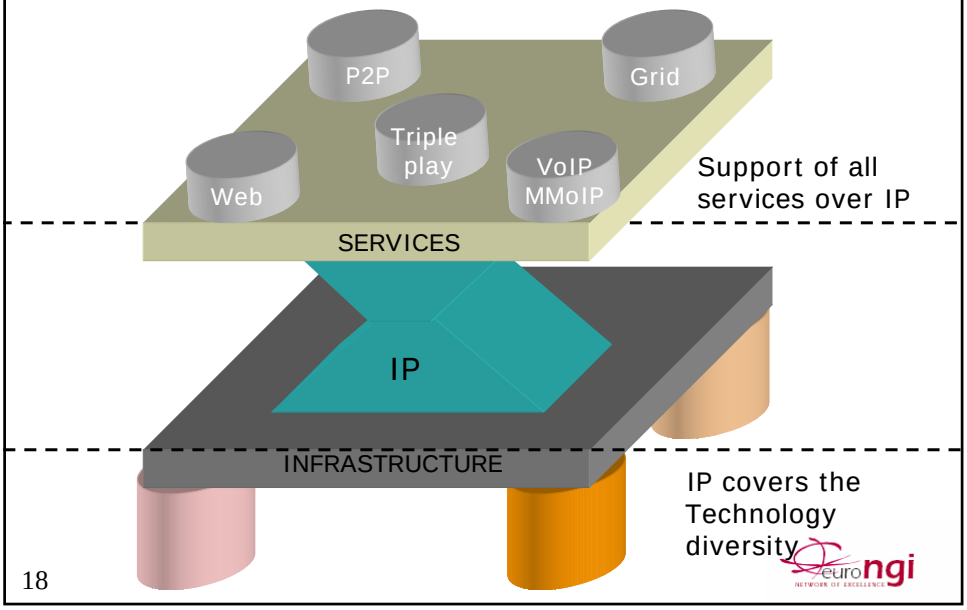
First step: IP Multiservice Networks



Support of all services over IP

IP covers the Technology diversity

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Towards a generalized convergence Horizontal Integration

- ✓ From extremely small to immensely big
  - ⇨ Sensor networks, Personal Area Networks, Ad-hoc networks, wireless mesh networks, access to infrastructure networks
    - The IP networking model is no longer applicable
- ✓ From Fix-Mobile Convergence towards Ubiquitous multi-technology access to convergent services
  - ⇨ Context awareness and Always Best Connected
  - ⇨ Seamless mobility across technologies, operators boundaries, terminals
- ✓ End to End services availability in a Multi-domain context
  - ⇨ Operated and spontaneous domains (e.g. based on mesh networks)
  - ⇨ From multiservice networks towards multi-network services
    - Services dynamically adapted to evolutionary user/community profile
  - ⇨ Integration of external facilities: e.g. Galileo

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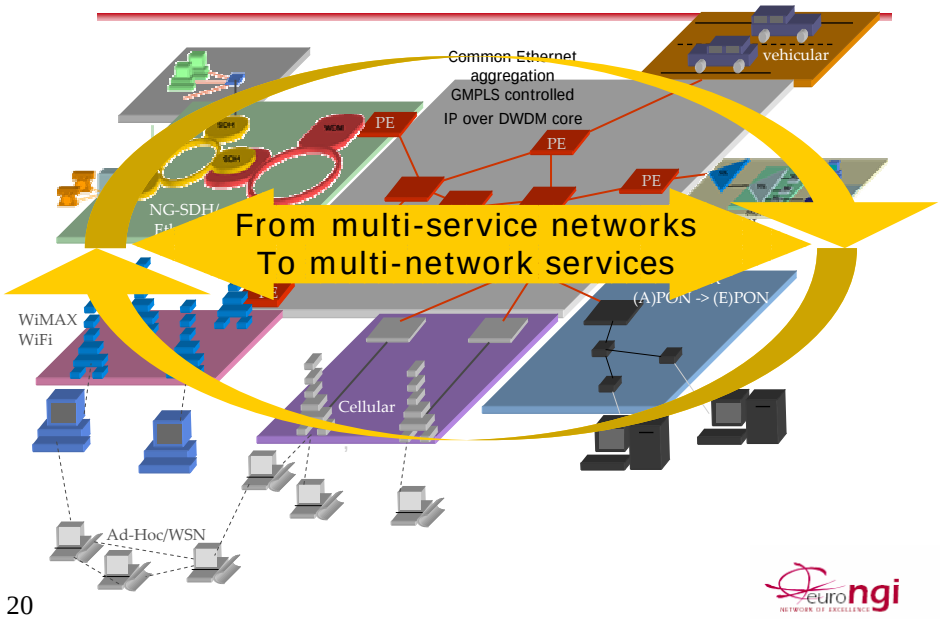
Multi-network Services



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Towards a generalized convergence Vertical Integration

- ✓ Multi-layer networks design
  - ⇨ IP/MPLS, Ethernet, all optical, etc.
- ✓ Unified control and management planes
  - ⇨ Multi-layer routing, protection, restoration, traffic management, congestion control, etc.
- ✓ Cross-layer design (physical, MAC and upper layers)
  - ⇨ including innovative air interfaces, optical packet/burst switching, etc.
- ✓ Automation and Advance management approaches
  - ⇨ Autonomic networks, close loop and policy based management, measurements and monitoring, etc.
- ✓ Services Overlays
  - ⇨ Service planes and related middlewares
  - ⇨ Spontaneous networking, communities
    - Peer-to-peer, ad-hoc networking, Autonomous networking, Grids, others

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Autonomous and Spontaneous Networking: Main targets

- ✓ Provide evolved services and facilitate new usages
  - ⇨ Networks transparency and virtualization
  - ⇨ Services dynamically adapted to evolutionary user profiles and spontaneous communities
    - Available everywhere, at any time
  - ⇨ Network “creation and adaptation” driven by the services
- ✓ Minimize OPEX
  - ⇨ Simplified configuration, control, management, resilience, etc.
  - ⇨ Self-x, with x=organization, discovery, configuration, etc.
- ✓ Enable new kind of systems
  - ⇨ Wireless sensor networks and their integration for evolved services support
  - ⇨ Multi domain mesh networks

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Examples of new networking technologies and architectures

- ✓ From 3G R4 and HSDPA towards HSDPA++, 3G LTE, 4G and beyond
  - ⇨ Multiservice, high speed mobility, global coverage
- ✓ Generalization of Fiber to the Home/Office
- ✓ Wireless technologies and Mesh Networks
  - ⇨ A finest access granularity and largest coverage for high speed access to the Internet
  - ⇨ Self organized Multidomain interworking
- ✓ Home Networking
- ✓ Ad-Hoc networks and Vehicular Networks
- ✓ Wireless Sensor and Actuator Networks
  - ⇨ From environment monitoring to physical world control
- ✓ New paradigms: Delay Tolerant Networks, Network coding based networking, etc.

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New requirements for beyond IP networks

- ✓ An architecture that deals natively with mobility and infrastructure less systems
  - ⇨ Contribute to ABC solutions
- ✓ Well adapted to the explosion of the number and diversity of connected devices
  - ⇨ From hundreds of millions of wired devices towards tens of billions of wireless devices
- ✓ Addressing and routing evolution
  - ⇨ Addressing capacity and structure, Separation of identification and location, New routing paradigms

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New requirements for beyond IP networks

- ✓ Self configuration and self organization
- ✓ Contribute to QoS provisioning
- ✓ Provide various levels of robustness, including those required for critical services
- ✓ Facilitate multicast (e.g. for IPTV)
- ✓ Contribute to the global security/trust architecture
- ✓ Maintain the simplicity as well as the hourglass “philosophy” ?

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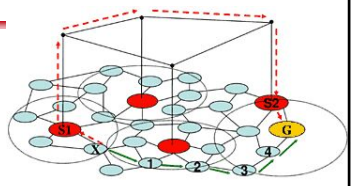
Summary on Network Architecture



- ✓ Objectives :
  - ⇨ Ensure coverage and connectivity
- ✓ Constraints
  - ⇨ Very dynamic networks with quick changes of the topology
  - ⇨ Nodes and technology heterogeneity
  - ⇨ Generalized mobility
  - ⇨ A multi-domain context (operated and non operated)
  - ⇨ Exponential growth of nodes
  - ⇨ End to end transparency required (QoS, etc.)
  - ⇨ Specific constraints like power limitations
- ✓ Challenges
  - ⇨ Requirement for a new networking approach, beyond IP
    - Includes cross layer design
  - ⇨ Requirement for new dimensioning, traffic engineering, control and management approaches
  - ⇨ Requirement for new tools for network modeling, monitoring, performance evaluation, simulation, testbeds and platforms

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Summary, A view on future communications

- ✓ The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it
  - ✓ Mark Weiser (PARC)
- ✓ Future communications will view multi-service/multimedia, generalized mobility, services convergence, ubiquity, context awareness and always best connected, security, self-organization, transparency and virtualization as the norm
- ✓ A keyword: convergence
  - ✓ An evolving concept

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Summary, A view on future communications

- ✓ Business models and regulation should evolve
  - ✓ Innovative BM could take advantage of community networks, peer to peer systems, etc.
- ✓ Future services and usages are almost impossible to predict, nevertheless, networking shouldn't be the bottleneck for innovation in this domain.

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