Post-IP WG

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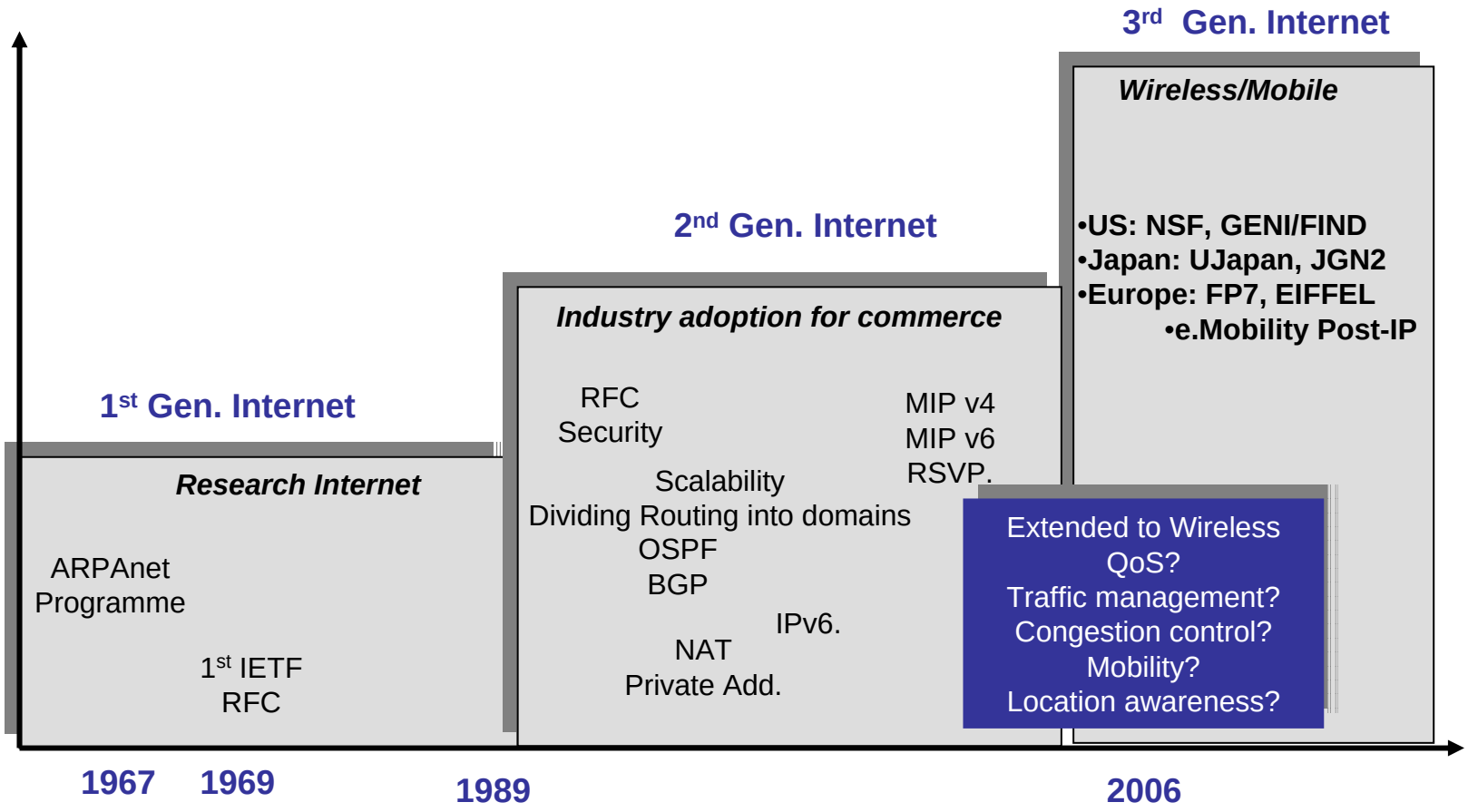
Brief History of Internet



eMobility

SEVENTH FRAMEWORK PROGRAMME

Evolved Internet Future For European Leadership

EIFFEL

EC INFSO DG Initiative in FP7

EIFFEL

The current Internet is reaching its limits

- The current Internet, was never designed to be a critical part of an economy's infrastructure. Today the Net-delivered services are reshaping the world (search, games etc.).
- In the future the Internet should be able to sustain a tripling of the number of people connected and the addition of billions—perhaps even hundreds of billions—of devices (sensors, tags, micro controllers).
- Users will likely expect to be part of the creative flow of content and process, not just consumers.
- When a network is this critical to just about everything, governments will seek control of what remains today a decentralized and somewhat anarchic system. How to balance the need for control with the creativity that spawns innovation—and profit?

Source : EC INFSO D

EIFFEL
Some questions

- In 15 years, at current trends, a hand-held device would have a terabyte of storage and ??? Gbit/s transmission rates? What happens then?
- How will we cope with spam, anti-spam blacklists, rogue packets, search engines power play, advertising invasion, privacy invasion, viruses?
- How will edge networks develop? Who will own the last mile? Should the user control the last mile e.g. CANARIE)?
- Which wireless constraints do we need to deal with?
- Will we have mobile access gateways? Who owns these gateways?
- Stronger copyright protection for cyberspace: “is it desirable, is it inevitable, is it irrelevant.?”
- Cost of distribution; close to zero. Will all business models that depend on controlling distribution vanish?
- How will industry globally reshape? Threats and opportunities for Europe? Who will be the new power brokers?
- Should Europe tackle this issue from the « target Internet » side or from the driver side (mobility, broadband, security..) where our industry is stronger?
- How will IPRs handling evolve? Should EU develop a dedicated IPR strategy? What is the role of standards in this evolution?
- How best to liaise and cooperate with other regions of the world (GENI, u-Japan, u-Korea, FuTURE…

Source : EC INFSO D

EIFFEL
What should be the next steps

- A decisive EU made action, that would position Europe as a contender of the Future Internet
- The agenda of the Internet of tomorrow can not be set in the US, China, Japan or Korea
- Strength of Europe is on wireless Internet
- Academics fully onboard, Network operators and vendors (e.g. eMobility) getting on board
- Coverage of complete value chain, services+content
- EIFFEL (European Initiative for Future Internet Leadership) agreed on 6 October 2006
- EIFFEL White paper in Helsinki IST conference
- Public open workshop on December 15th
- Once the initiative is launched it will be up to the proponents to make it happen
- Role of the Commission: Initiate, facilitate, support

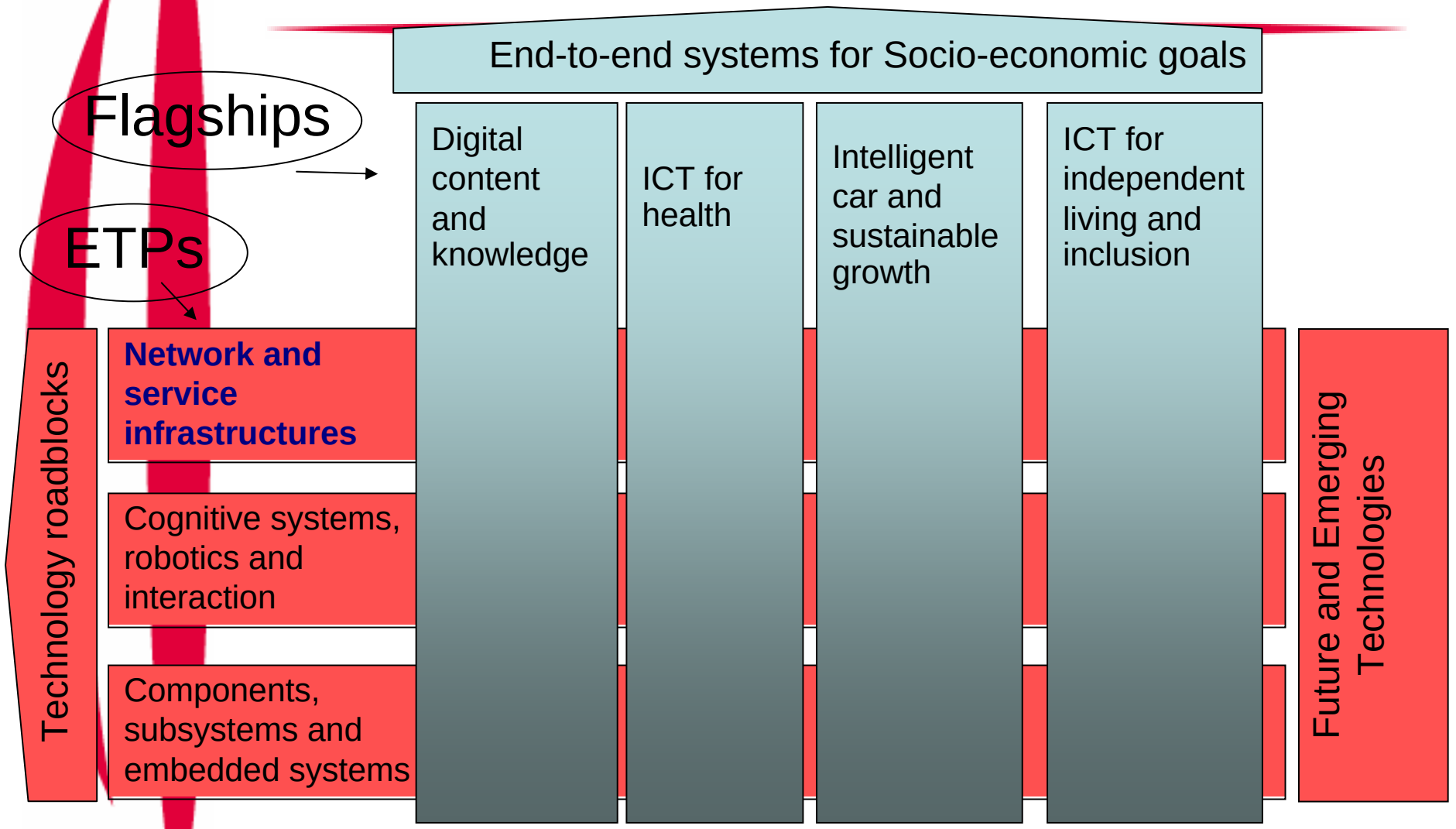
Source : EC INFSO D

EIFFEL Working Groups

- 1° Likely evolution scenarios, technological and socio-economic drivers
- 2° Technical Challenges
- 3° Policy challenges, risks and opportunities for Europe
- 4° Planning and Coordination Group
  - Possible ingredients of an EU based initiative:
    - Coordination Actions, Targeted Projects
    - Experimental facilities
    - Roadmap and Milestones

Source : EC INFSO D

FP7 ICT WP 2007-08 Challenges



Source : EC INFSO D

Challenge 1: Network and service infrastructures (2007-08)

Challenge 1:	585
1. The network of the future	200
2. Service and software architectures, infrastructures and engineering	150
3. Secure, dependable and trusted infrastructures	90
4. Networked media	85
5. New Paradigms and experimental facilities	40
6. Critical infrastructure protection	20

Source : EC INFSO D

The Network of the Future

- Ubiquitous Network Infrastructures and Architectures
  - Convergence and interoperability of heterogeneous network technologies
  - Flexible and spectrum-efficient radio access
  - High-speed end-to-end connectivity with optimised protocols and routing
  - Context awareness
  - Support of trillions of connected devices
- Optimised Control, Management and Flexibility of the future network infrastructure
  - Seamless end-to-end network and service composition and operation across multiple access technologies, operators and business domains
  - Reconfigurability, self-organisation and -management
  - Management in real-time of new forms of ad-hoc communications with intermittent connectivity requirements and time-varying network topology
- **Technologies and system architectures for the Future Internet**
  - Overcoming the expected long-term limitations of current Internet technology
  - Scalability from a device, service attributes and application environments perspective
  - Security and trusted domains
  - New forms of routing and content delivery in a generalised mobile and wireless environment

Source : EC INFSO D

Dec 15th Future of the Internet public workshop

Introduction (15'): Joao da Silva, DG INFSO Director for Network and Communication technologies

- **1. State of Play in FP6**
  - **a. Running Projects (15')**
  - **b. Test beds: Mario Campolargo. Head of Unit for Research Infrastructure (15')**
  - **c. Q&A (15')**
- **2. Presentation of FP7: Rainer Zimmermann, Head of Unit for Communications technologies.**
  - **a. Challenges, objectives and milestones (20')**
  - **b. Instruments: Streps, IPs, NoEs, Coordination and Support actions (15')**
  - **c. Q&A (15')**
- **3. The European Technology Platforms and the Future Internet (eMobility, NEM, NESSI, ISI)**
  - **a. Global ambitions (30')**
  - **b. NGI related work (30')**
  - **c. Q&A (10')**
- Lunch: 1 PM to 2PM
- 4. **The EIFFEL Think Tank**
  - **a. White Paper Presentation (40')**
  - **b. Proposed way forward (15')**
  - **c. Q&A (10')**
- **5. Open Discussion (60')**

Source : EC INFSO D

http://cordis.europa.eu/ist/ct/neweve/ws151206/ws151206.htm

eMobility

Global Environment for Network Innovation

&

Future Internet Network Design

GENI/FIND

US NSF Initiative

Challenges of the Future Internet

P. Freeman, NSF, OECD March 8, 2006

- Increasing dependence of society on the Internet
- Expected limitations of current Internet architecture
  - **Security, robustness, manageability, QoS, etc**
  - **At the limit of its extensibility**
- New opportunities enabled by
  - **Disruptive technologies: sensors, mobile wireless, photonics**
  - **New classes of applications in all areas of activity**
- Need to establish robust, experimental, scientifically validated technologies for network and distributes systems research

US Expectation: **Build national partner facilities to *complement* US GENI facilities and capabilities**

US Approach: GENI

- **Technology drivers: sensors, SW radio, Mobile Wireless devices, Photonic integration, SoC..**
- **About 100 M$ during 5 years? Budget oct08?**
- **Foundation research > Research prototypes > small test beds > Large scale test beds/ infrastructure/ facility > Deployment**
- ***Find*: 600 prop 30 M$, clean slate research**
- ***Planetlab* ……. extension**
- **Piggyback on strong US assets: Internet dominance**
- **Seems to be dominated by academics, not clear that there is strong industrial support beyond technology watch**
- **May lead to a radically new architecture, supporting security, ubiquitous sensors, mobile wireless devices etc..**

Overall recommendations of the WMPG panel to NSF (USA) are summarized as follows: (from GENI site)

Recommendation 1: Recognize that wireless will drive a fundamental transformation of the Internet during the next 10-15 years, and invest in research aimed at creating the necessary technical foundations.

Recommendation 2: Increase research focus on central network architecture questions related to future mobile, wireless and sensor scenarios.

Recommendation 3: Invest in the development of flexible wireless technologies and platforms necessary to implement programmable and evolvable experimental networks.

Recommendation 4: Fund development of large-scale experimental wireless networks for validation and competitive selection of new architecture and protocol concepts in presence of real users and applications.

Recommendation 5: Encourage collaborative research that would result in end-to-end deployment and evaluation of future wireless/mobile and sensor networks and applications over the global Internet.

NSF WMPG Planning Project Interim Report taken from Geni site

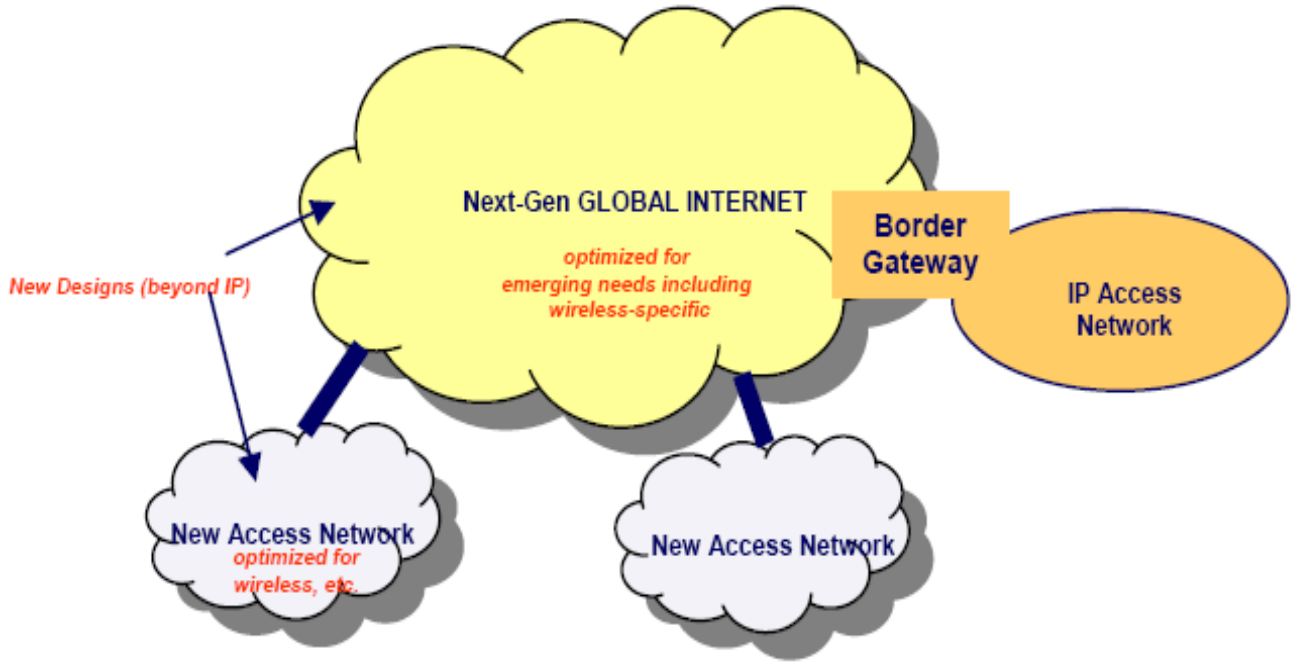


Fig. 4. Revolutionary deployment of new wireless/sensor access network and global Internet backbone

FIND/GENI
Major focus

- *Wireless, mobile and sensor devices will drive fundamental change of the Internet.*
- *Emerging wireless scenarios can be classified into three general categories: mobile data, ad-hoc nets and sensor nets:*

FIND approved Projects

1. CogNet - An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet
2. Dynamic Optical Circuit Switched (DOCS) Networks for Future Large Scale Dynamic Networking Environments
3. A Framework for Manageability in Future Routing Systems
4. Postcards from the Edge: A Cache-and-Forward Architecture for the Future Internet
5. The SILO Architecture for Services Integration, controL and Optimization for the Future Internet
6. Future Optical Network Architectures
7. A Geometric Stack for Location-Aware Networking
8. Design for Manageability in the Next Generation Internet
9. Sensor-Internet Sharing and Search
10. CABO: Concurrent Architectures are Better than One
11. Network Fabric for Personal, Social, and Urban Sensing Applications
12. Future Internet Design (FIND) Architecture and Outreach Coordination

e.Mobility WG
Post-IP

- **Participation open to all e.Mobility members**
- **1st meeting on 27-Oct-'06**
- **~35 Organisations participated.**

Starting Point for Post-IP Mobile/Wireless systems

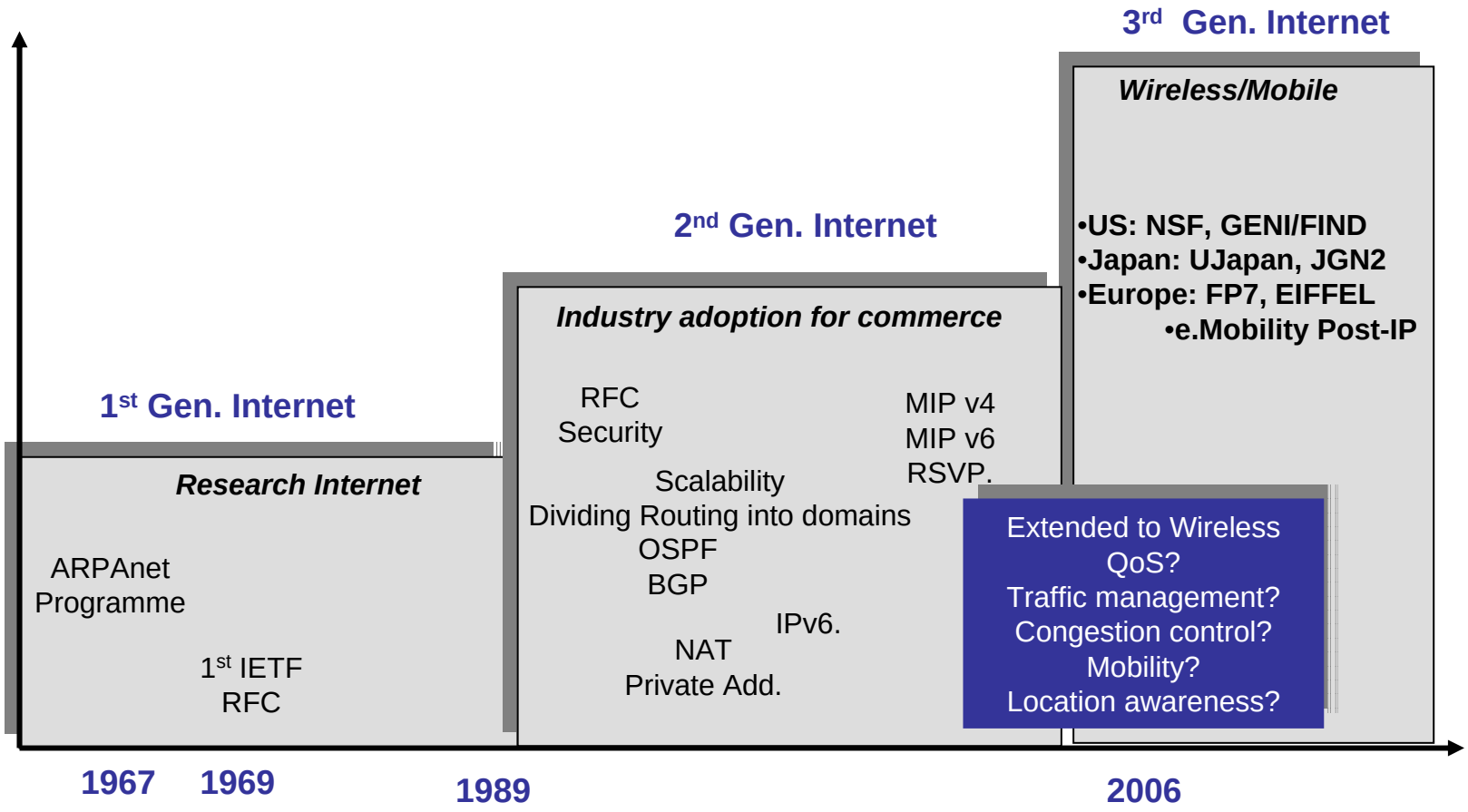
- Over 2 billion mobile phones worldwide,
- Only 500 million wired Internet terminals,
- Significant fraction (~20%) of these phones now have Internet capability through the 2.5G and 3G cellular services

- In 5 years, all mobile phones expected to be Internet-capable devices

Future Mobile Communications

- Power/bandwidth limited
- Dynamic in nature
  - user traffic, user mobility, Service mobility, Radio operational environments, range of services (not only telephony),
  - New network topologies (mesh, adhoc, multihop, hybrids)
- Variety of service delivery modes:
  - Uni, multi and broadcast
- Group communications
- No more one person one device,
  - more likely one person many devices and **device to device** communications
- Cross (layer, spectrum, network) operation
- Variety of systems, short-range to long-range
- Self-organisation & network management & QoS management
- Shifts from ***networking of networks*** towards ***services networking***
- Multi-modal services
- More emphasis on security, privacy, trust and dependability
- Flexible billings

Brief History of Internet

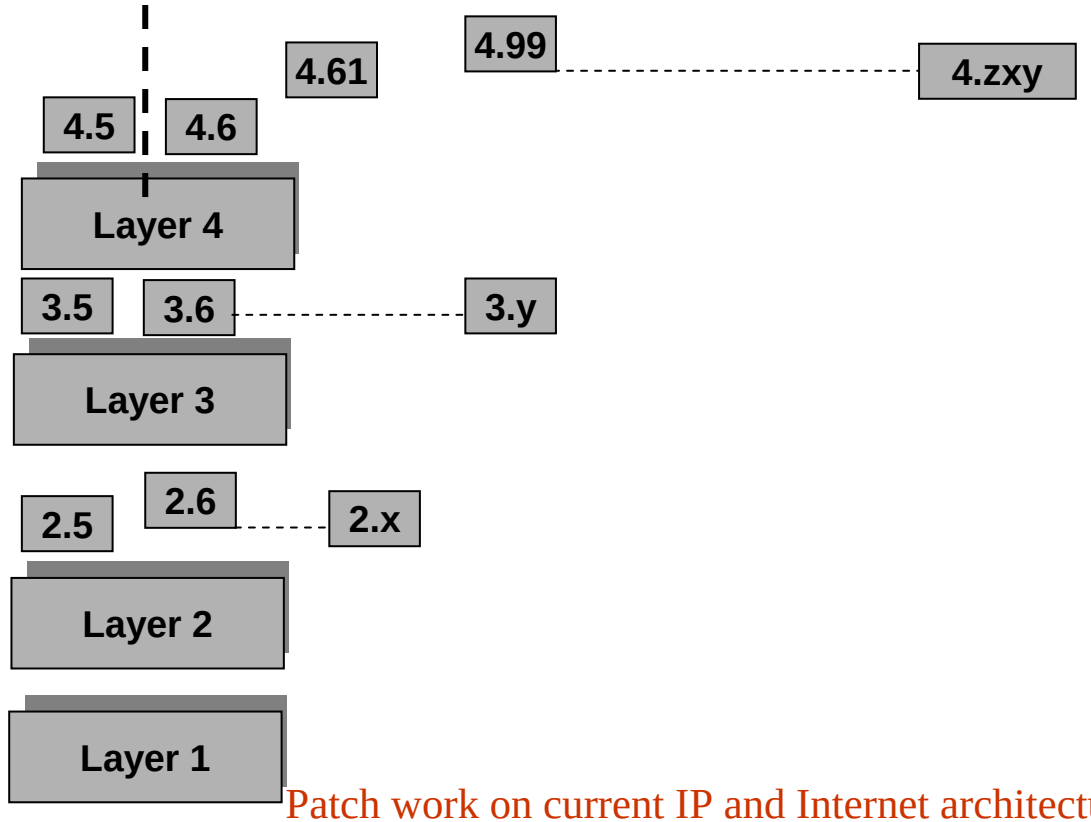


Current Internet vs Mobile Net

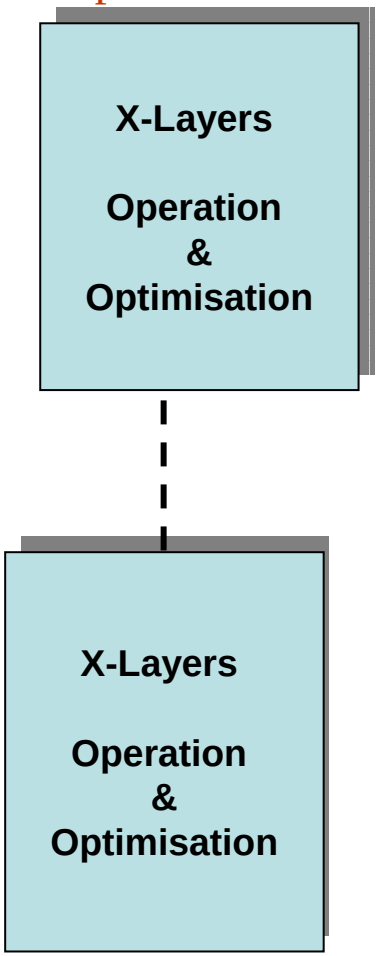
Fixed and Static vs. Fully dynamic

Mobility

Current Research Approach



Implications



Patch work on current IP and Internet architecture.. Evolutionary

Post-IP: Revolutionary Approach

Sources of Current Internet limitations:

- Architecture
- End-to-end paradigm
- Internet Protocols

Post-IP approach:

- New Architecture supporting multi-domain
- New Wireless-friendly Protocols capable of supporting variety of wireless networks, from low power sensor networks to wide area mobile networks

Issues identified-1

- Europe should focus on Mobile/Wireless aspect
- Define scope of test-beds
- Net. Neutral businesses of future?
- Spams
    - Principles of Architecture should be consistent with security
- Mobility support is key
- Intelligence for management
- QoS
- Net. Reliability for e.health, monitoring etc.
- Minimise number of bits for efficient wireless solutions (eg. Sensors)
- Complexity (intelligence at edge) more intelligence in the core needed
- Support of multicast and broadcast, 3-play services
- Simplicity to use
- Flat arch. is a problem, more flexibility in arch. needed
- Reconfigurability, auto –config., scalability of net

Issues identified-2

- Addressing and naming
- Uniformity of protocols
- Support of DRM
- Address for content as well as end to end connection
- Semantic web does not translate into address or anything
- Simultaneous use of wire and wireless
- New layering stack
- Anycast addressing and address size
- Guaranteed delivery (some people desire)
- Future terminals power requirements do not match technology trend and current internet protocols are not energy efficient

Architectural Limits

Design for network transparency

- Internet originally did not expose information about its internal configuration, but there is value to both users and network administrators in making the network more transparent

Enable new network services

- Internet originally provided only a best-effort packet delivery service, but there is a need for processing capability and storage capacity available in the middle of the network

End-to-end and its limitation

This principle has influenced the Internet architecture since its conception. This helps the network to:

- **Reduce number of states**
- **More scalable**

❑ Forces against end-to-end:

- **Need for authentication to Firewalls and VPN tunnel endpoints**
- **New service models such as distributed content delivery (through intermediate servers).**
- **Transport protocols inefficiencies**
- **Mobility management**
- **Difficult to measure throughput and latency between specified points, barrier to efficient traffic engineering, network management, QoS**

Current Internet Limitations

❑ Security

- Many security mechanisms but no "security architecture" that specifies how these mechanisms should be combined to achieve overall security.
  - The Internet architecture and its supporting protocols were primarily designed for a benign and trustworthy environment, with little or no consideration for security issues.
- DNS major targets for security attacks
- IPsec encrypts IP address (unicast) for anonymity only but not for multicast/broadcast

❑ Reliability

- hard to improve reliability of packet delivery within current architecture
- vulnerable to attacks, misconfigurations and failures

Current Internet Limitations

Usability

- Not easy to set up, manage and identify failures and problems

Post-IP challenges

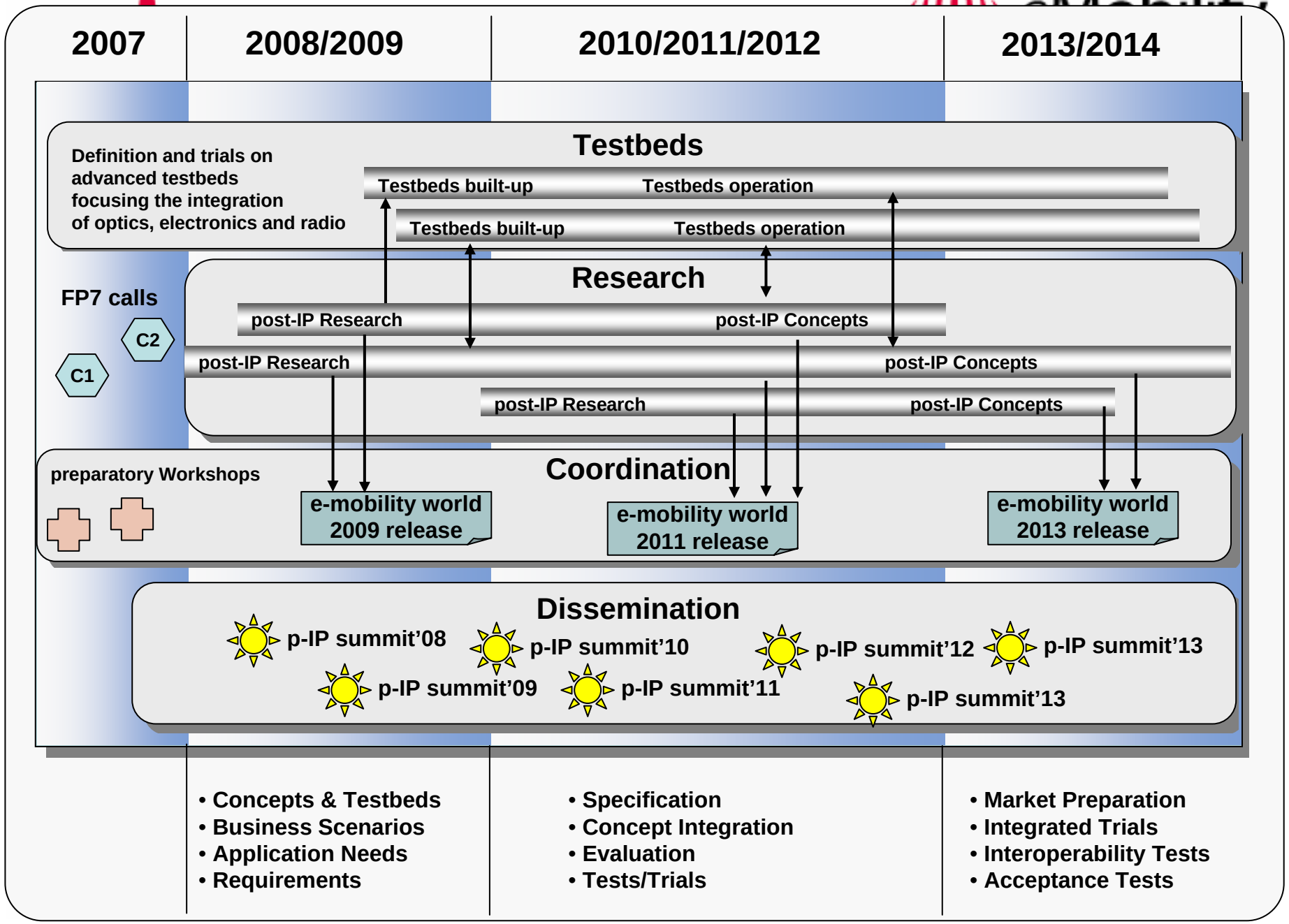
- **Mobility**
  - Post-IP must support mobility as a first-level objective.
  - Mobility at different layers (Application, Layer3, Layer 2)
  - Support service mobility across different devices and networks
  - Differentiate between errors on wireless link and network congestions
- **Security**
  - At least as good as current mobile networks
- **QoS**
- **Device, service and resource discovery and provision**
  - Automatic proximity service, devices and resources discovery.
- **Self-organising, self-healing and self-configuration with fault reporting mechanism**

Post-IP Challenges:

Mobility

- **Balance between identity and privacy**
  - identity for accountability
  - privacy for unjustified observation and tracking.
  - Different services require different security
  - Identification of users makes them more vulnerable to attacks.
  - Anonymity increased use of internet!!!
  - Difficult for distance-based tariffing
  - **Strike a balance between identification, anonymity & location**
  - **Net. Neutral businesses**

Milestone plan for Post-IP



Future Plan

- **Next meeting today at 16.30hr**
- **Dec.8th in Ericsson Brussel office**
- **Nov.20th First draft of White Paper**
  - **What are future services and how their usage is evolving?**
    - » **Editor: Henrik Berndt, Docomo.**
    - » **E.mail: Berndt@docomolab-euro.com**
  - **What are technical challenges?**
    - » **Editors: Frank –Uwe Andersen (Siemens)**
    - » **E.mail: Frank-uwe.andersen@siemens.com**
  - **Roadmap & Impact**
    - » **What can Europe do? and How?**
    - » **How to achieve major and timely impact? Do we have right standardisation process and forum in place?**
    - » **Editor: Henrik Abramowicz (Ericsson)**
    - » **E.mail: Henrik.Abramowicz@ericsson.com**