

Next Generation 3D Internet (Post-IP) leading to 4D Mobile Internet

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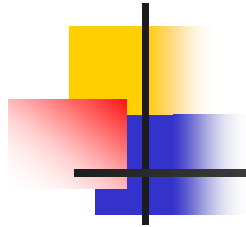
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Outline

- Vision Statement for Year 2020
- Mobile/Wireless Requirements
- Problems with evolutionary approach to NGI
- Post-IP NGI challenges
- 3D Internet to 4D Mobile Internet
 - Essential technologies



Next Generation Internet

In

Post-IP era

From

Mobile/Wireless Requirements

And

Future "Vision"



e.Mobility Expert Group **Unis** Vision 2020

“The improvement of the Individual’s quality of life,

Achieved

through the availability of an environment

For

instant provision and access

To

Meaningful, Multi-sensory information and content”



Future Mobile Communications

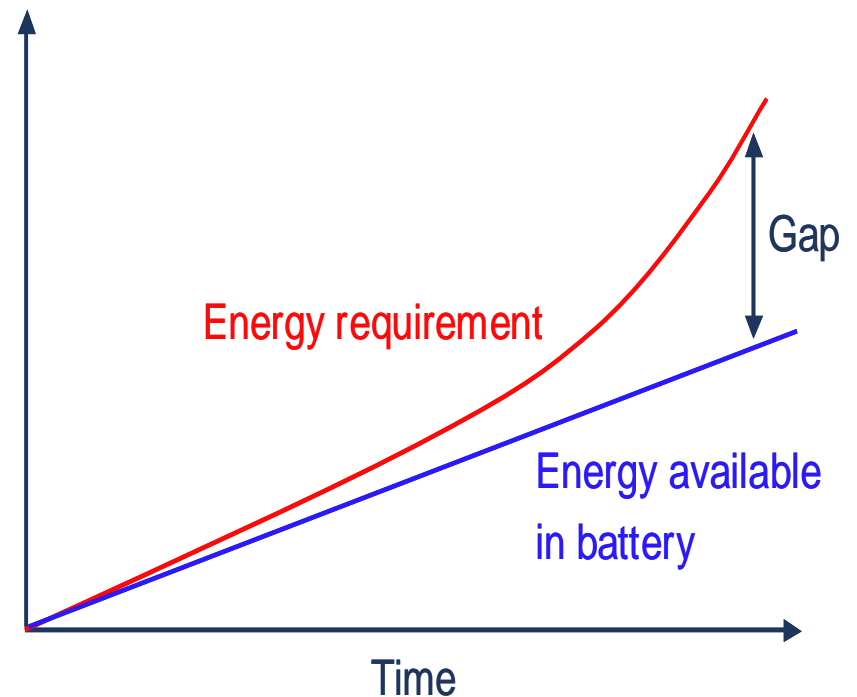
- ❑ **No more one person one device,**
 - ❑ more likely one person many devices and **device to device** communications
- ❑ **Self-organisation & network management & QoS management**
- ❑ **Shifts from *networking of networks* towards *services networking***
- ❑ **More emphasis on **security, privacy, trust and dependability****
- ❑ **Variety of service delivery modes:**
 - ❑ **Uni, multi and broadcast, (Streaming)**
- ❑ **Intelligent Cross (layer, spectrum, network) operation**

Main Constraints

- ❑ **Dynamicity in nature (Intermittent and dynamic connectivity)**
- ❑ **Power/bandwidth**

Energy Crisis

- Battery life does not follow Moore's law
- Transmitted Power + Dissipated Power
- More sophisticated signal processing
More dissipated power
- VLSI Technology progresses
Transmitted Power vs Dissipated Power





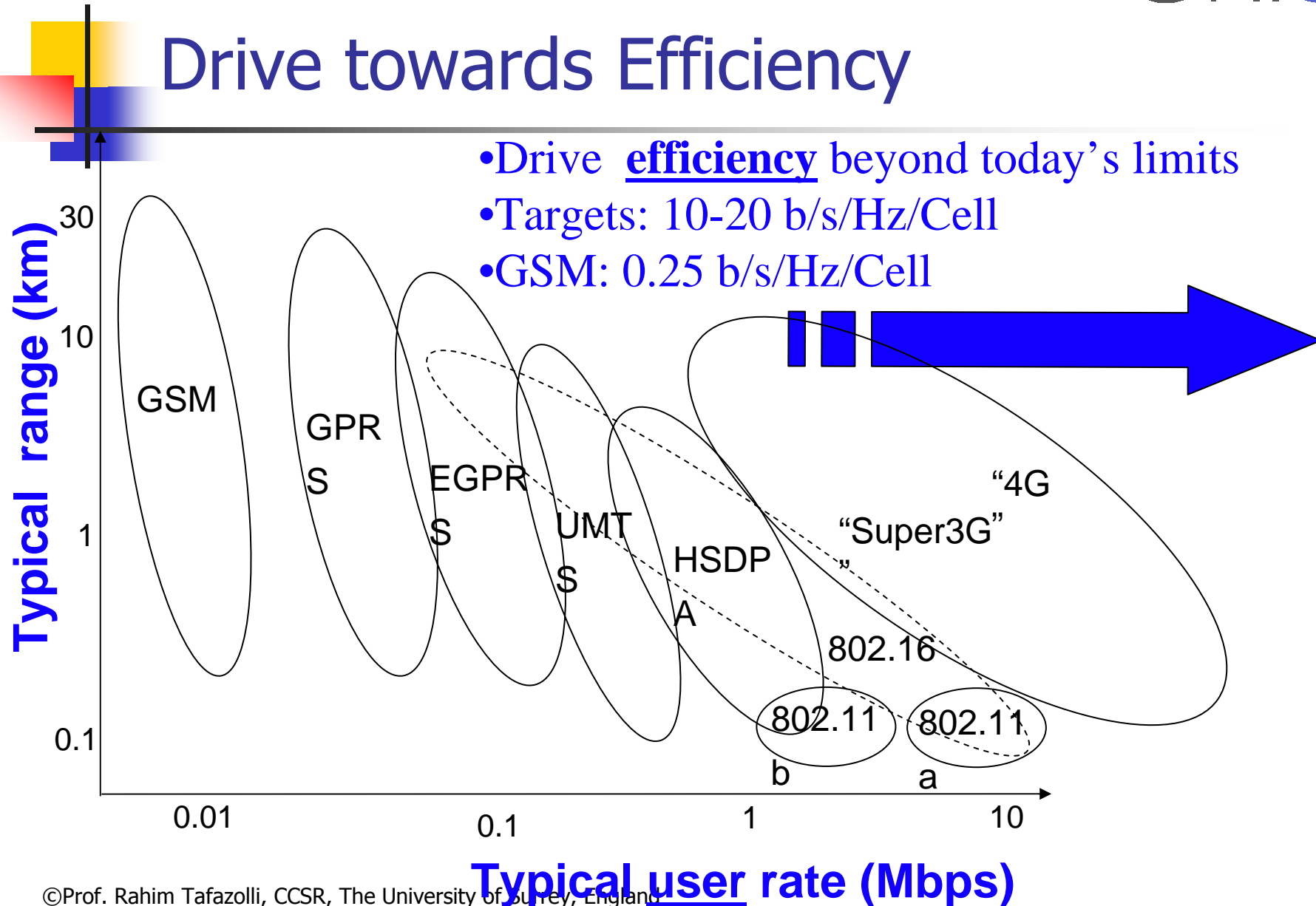
Energy Requirements

- ❑ According to ITRS (2004 revision), **power consumption in nanoelectronic devices must be reduced** by 75% until 2010 and **by 95% until 2016**.
- ❑ Battery technologies will need to be able to cope with the increased power needs of new VLSI systems
 - ❑ Currently, CMOS technology scaling, frequency increase and augmented capacity of the interconnects move at a much faster pace than the growth in battery capacity.
- ❑ Cost of memory is ongoing decrease trend
- ❑ VLSI advances will not solve the problem as major energy consumptions is due to higher layer protocols excessive signalling

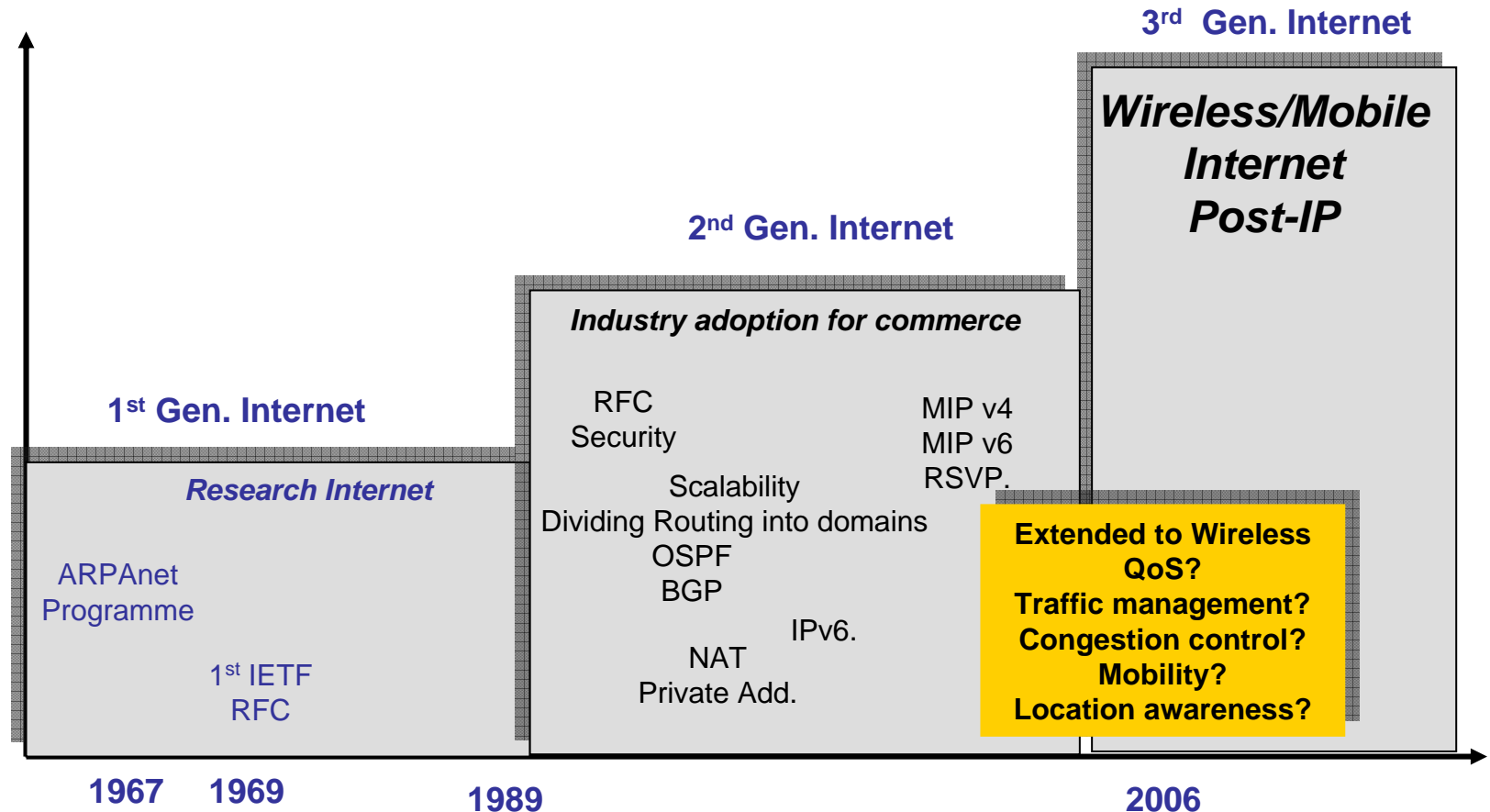
International Technology Roadmap for Semiconductors (ITRS) (<http://public.itrs.net/>)

Drive towards Efficiency

- Drive efficiency beyond today's limits
- Targets: 10-20 b/s/Hz/Cell
- GSM: 0.25 b/s/Hz/Cell



Internet Generations

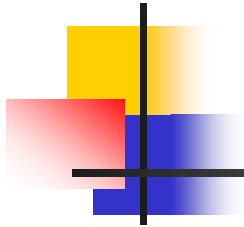




Definition

Post-IP \neq IPv7 or IPv8 or IPvxx

**Post-IP = Next Generation
Internet protocols and
architecture**



Why Post-IP (Revolutionary) approach

From Mobile/Wireless Viewpoint



Market points of View

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

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

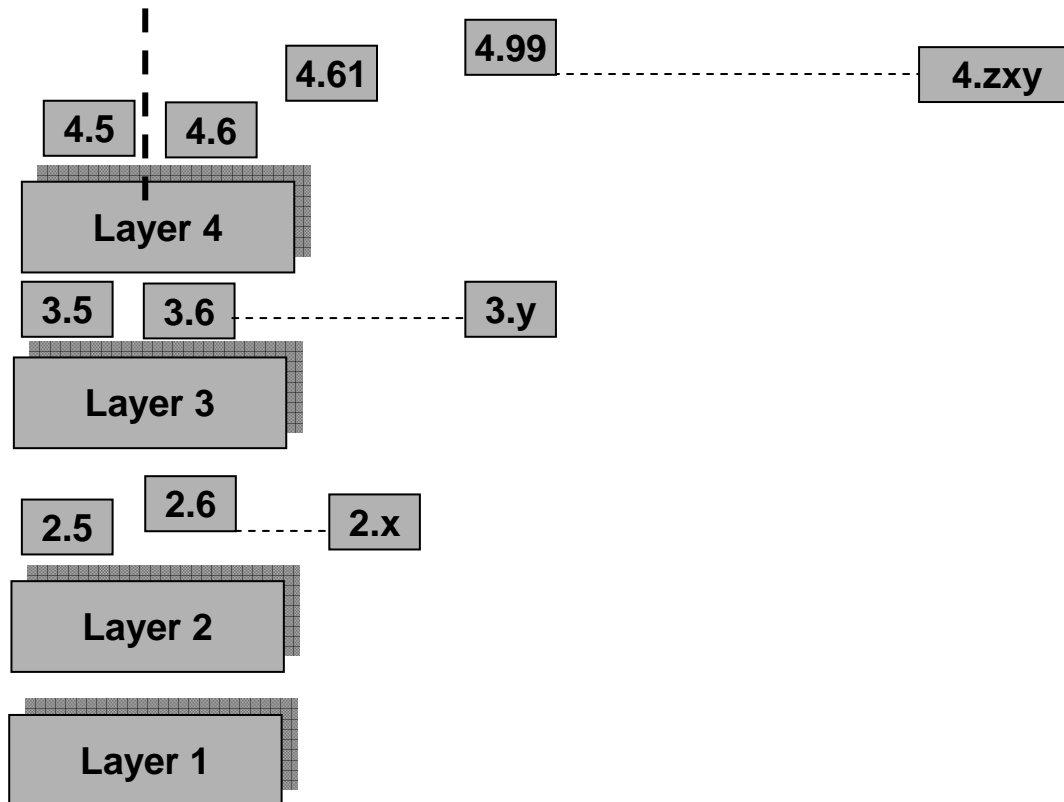
A Tale of Two (Cities) Worlds

- **IT Approach:**
 - Patch work to existing IP and Architecture
 - Solutions acceptable if scalable (why?)
 - lack of manageability
 - Network imposes max delay!!!! Shouldn't this be requirement from a service/application?
 - Stateless (end-to-end paradigm)

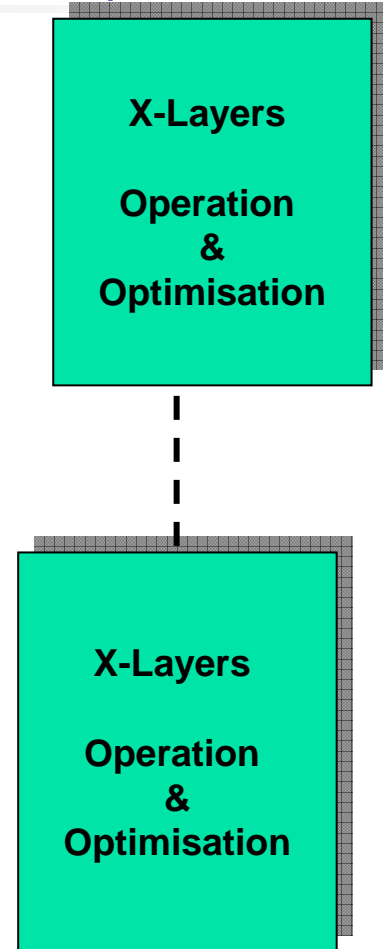
- **Mobile/Wireless Approach:**
 - Statefull systems,
 - Requiring dynamic management of scarce resources
 - Adaptive to radio/services dynamics
 - Security, Mobility key functions

Current approach complex, inefficient (power, bandwidth, latency)

Current Research Approach



Implications





Sources of Current Internet limitations and Design of Next Generation Internet

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

Post-IP approach:


- ❑ New Architecture with management capability
- ❑ New Wireless-friendly (Energy and spectral efficiency) Protocols capable of supporting variety of wireless networks, from very low power sensor networks to wide area mobile networks
- ❑ Starting point is:
- ❑ Mobility, QoS, Security



Challenges

- ❖ Allow for a wide spectrum of horizontal and vertical services offerings as options within a **general service framework** as well as for new business interfaces to freely embrace current Internet and mobile world and future service solutions, without restricting the degree of freedom the Internet provides today
- ❖ Design an overall system with integrated as core functionality **Mobility, QoS, Security** supporting intermittent and dynamic connectivity with energy and spectrum constraints in mind

Challenges

- 
- ❖ **New Protocol Framework** beyond-OSI layering, to overcome static layering and its disadvantages. Enable services to exploit network context information, and use self-organizing technology for optimisation
 - ❖ Decouple the IDs of information objects from their addressing, incl. users, nodes, documents, interfaces, domains and other structures. A key component of Post-IP is its **naming and addressing structure** not be restricted or tied to the architecture
 - ❖ Research into **migration strategy** between current and Post-IP Internet



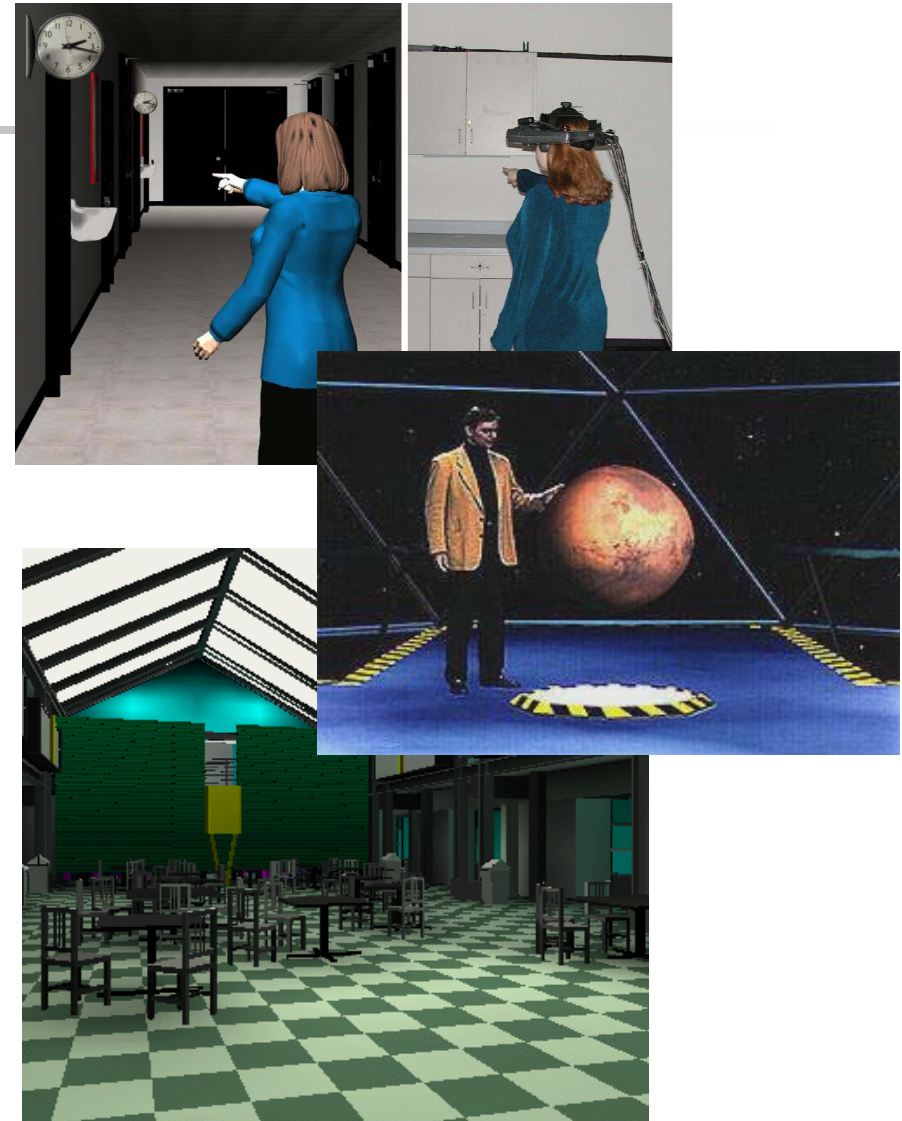
3D Internet

■ Current trend

- Social networking services (MySpace, Facebook, etc..)
- Allow users to create:
 - own profile (s), Avatars
 - New virtual world (s) (new gravity laws, topography, governments, etc.)
- Mainly text-based
- Now complemented with real-time voice (VoIP)
- Common, popular in multiplayer online games

Future

- Human live in 3D world
 - Natural extension; 3D (animation, graphics, world)
 - Business, trade
 - Entertainment, virtual holidays
 - Education, arts (3D toys design)
 - 3D story telling
 - 3D city life
 - Cyber socialisation
 - Human teleportation: Interactive, different locations and different time
 - Virtual worlds with no limitation of real world (e.g., eternal life/lives)





Expected Future steps

- **3D Mobile Internet**

- 3D Internet
- + Mobility
- + User Context
 - Where (MAP),
 - Who (contacts),
 - What (search engine; contents,...)
 - When (calendar/Organise; time, date, presence, ..0, user's
- + Environment Context information

- **3D Mobile Internet with emotion**

- 3D Mobile Internet + user's multi-sensory information

- **4D Mobile Internet-virtual real world(s)**

- 3D Mobile Internet with emotion
- + Alternation of user ambience (Actuators)
- +Human state of mind (sophisticated sensors)



Limitations & Challenges

■ Applications

- Limited by our imagination

■ Current technologies

- Current Internet architecture, protocols
- Power, bandwidth, Latency
- Network architectures
- Displays
- Cognitive User interface



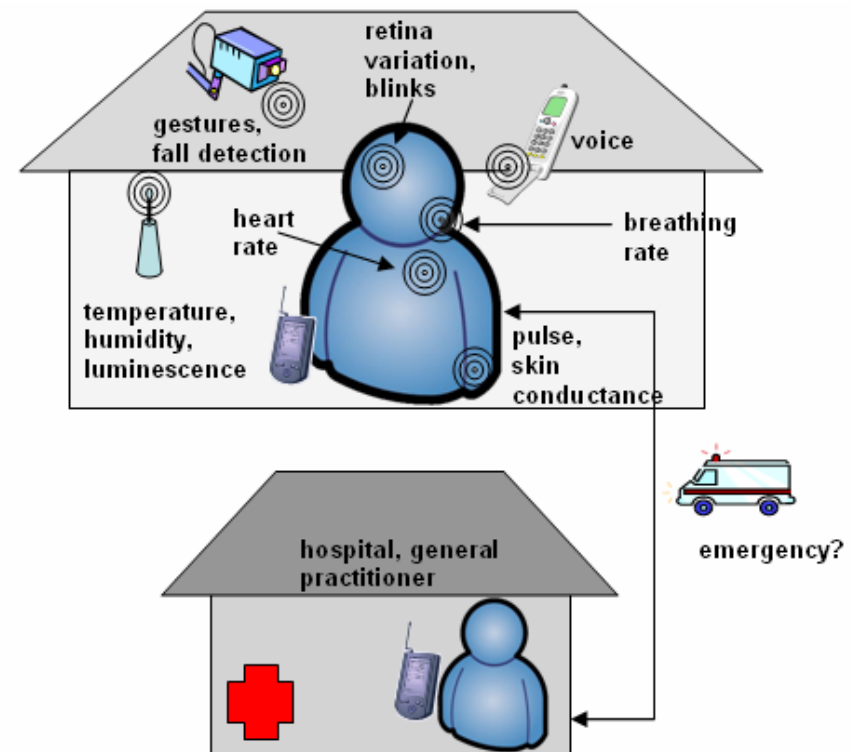
Research Challenges

- New video compression techniques
- 3D audio techniques
- Service architecture
 - 3D data hosting and rendering architectures
 - Media synchronisation and “always on” architecture and protocols
 - Service components discovery and integration
 - Security, privacy, reliability
 - 3D applications adaptation to suit different media such as wireless
 - Integration of user profile with services and into service platforms
- Radio including terminal
 - High Bandwidth and power efficient schemes with near zero latency
- Architecture and protocols
 - Session with several million participants support capability
 - Networked information architecture
- High resolution with high update rate of user location

Research Challenges

- Integration of Physical world Human Senses in Digital World

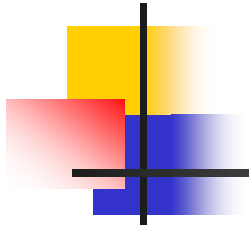
- Networked sensors
 - Energy efficient protocols
 - In-network data mining and data inference techniques
 - Resource discovery
- Networked actuators
 - Altering user's environment
 - Voice, video, lighting, temperature, smell,



Summary

Next Generation Internet design

- ❖ Network Architecture (s)
- ❖ Service Architecture (s)
- ❖ Network management architecture
- ❖ Protocols and protocol framework
 - ✓ Wireless and mobile dynamicity (protocol framework, collapsed protocol stack)
 - ✓ QoS, Security, Mobility
 - ✓ Self-healing and management
 - ✓ Emphasis on Information Networking
- ❖ 3D Internet applications and supporting technologies
- ❖ 4D Mobile Internet
 - ✓ BAN (Networked sensors), Networked actuators (environment and objects), PAN, Wide Area Cellular Network



Thank you