# Chapter 2
# B3G/4G: Technology Trends and International Activities

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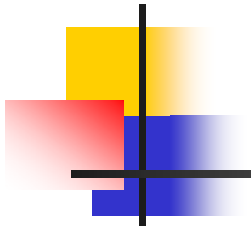
National Taipei University



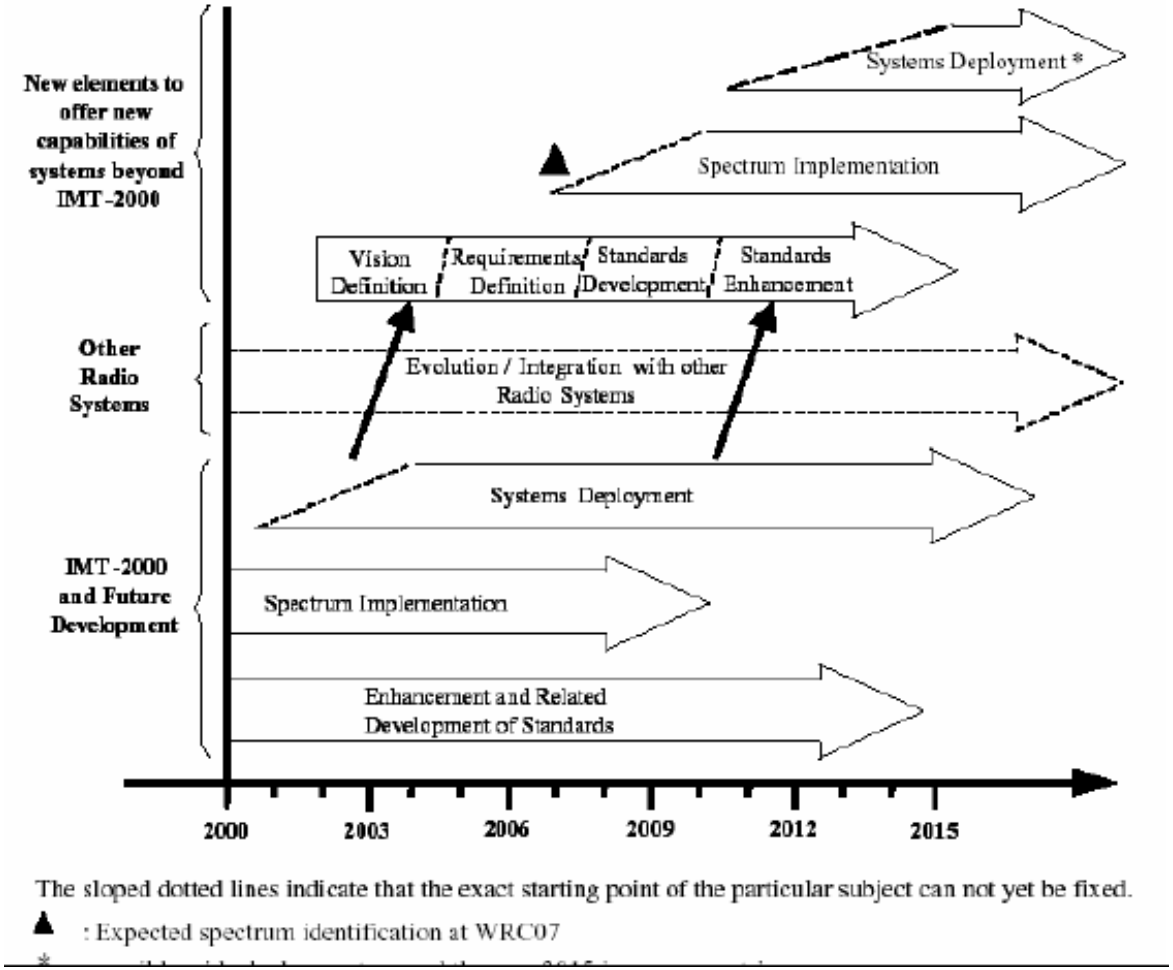
# Introduction

- Mobile systems experience a paradigm shift roughly in a 10-year cycle. Now is the time to begin the conceptual work on the systems **beyond 3rd generation** or **4G**.
- There has been a general downturn in communication and IT industry. Transition from a **voice-oriented** to **data-oriented** services is not smooth as expected. New applications that could attract significant traffic are hard to find.
- It can be expected that mobile access to Internet will outnumber of fixed access in a very near future.

# International Research Activities

- ITU-R WP8F
- Wireless World Research Forum (International)
- 4Gmobile (International)
- IEEE 802.20 (International)
- Mobile IT Forum (Japan)
- FuTURE (China)
- 4G committee (Korea)

# ITU-R WP8F (International Telecommunication union)




- Source: ITUR radio communication study group 8.
- Initial time plan approved, October 2002.
- Revised, February 2003.
- Voted, June 2003.

# Wireless World Research Forum (http:// www.wireless-world-research.org)

- Founded by Alcatel, Ericsson, Motorola, Nokia, and Siemens in early 2001.
- Objectives
  - To formulate visions on strategic future research directions, involving industry and academia.
  - To generate, identify and promote research areas and technical trends for mobile and wireless system technologies toward a Wireless World.
  - To contribute to the definition of international and national research programs.
  - Provide a global platform for discussion of results, exchange of view to initiate global cooperation towards systems **beyond 3rd generation**.
  - To contribute to making the wireless market a vibrant gowning global market, providing new opportunities for success for all sectors.

About the Forum - Wireless World Research Forum - Microsoft Internet Explorer

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Google G-EDAS 開始 書籤 4 已攔截 拼字檢查 翻譯 傳送到 設定

LEGAL SEARCH GO

WIRELESS WORLD RESEARCH FORUM

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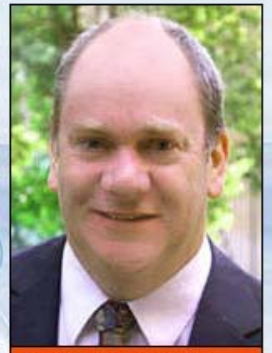
GENERAL INFORMATION | MEMBERSHIP | WORKING GROUPS | CONTRIBUTIONS



NIGEL JEFFERIES
FORUM CHAIR
VODAFONE

## Wireless World Research Forum

Dear Reader,

welcome to the web page of the Wireless World Research Forum.

For non-members, you can find background information on WWRF, as well as details of future meetings, and a guide to joining the Forum. Non-members can contribute to, and participate in, our meetings. Members have (via password) access to the latest documentation from the working groups and Forum meetings, and benefit from reduced attendance fees at the meetings.

The Forum is a global organisation, which was founded in August 2001. We now have over 140 members from five continents, representing all sectors of the mobile communications industry and the research community.

The objective of the forum is to formulate visions on strategic future research directions in the wireless

### LATEST NEWS

WWRF Meeting 21
Register now!
Deadline for early bird registration is September, 13

PIMRC 2008
Special Session : Visions for the Wireless Future - Trends and Challenges. Organiser: Angeliki Alexiou, Bell Labs, Alcatel-Lucent, (WWRF WG4 Chair)

Call for Papers:
Workshop on LTE-Advanced and ICC GreenComm Workshop, Dresden

網際網路

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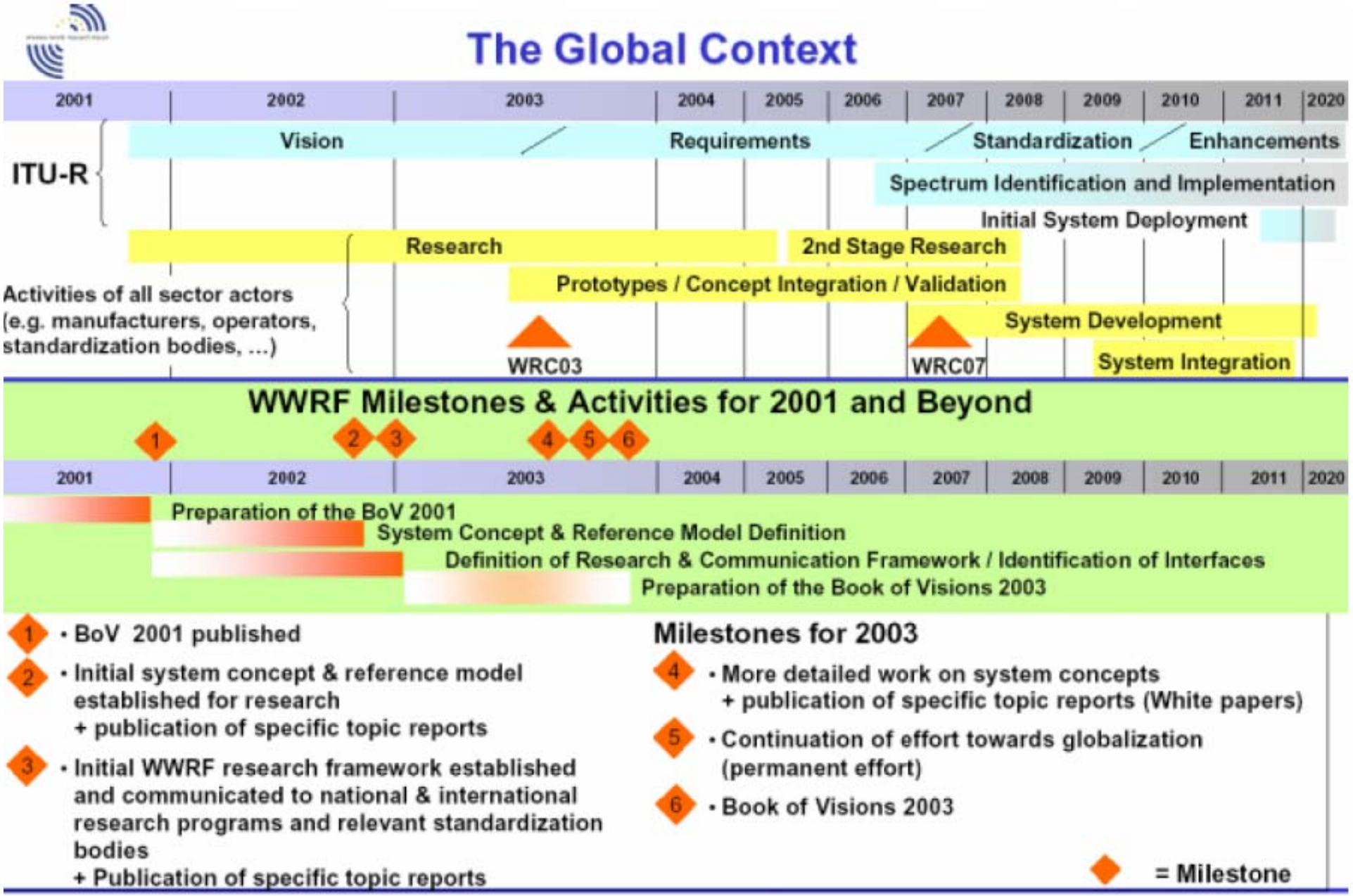
# Cont.

- Strategies
  - To harmonize views on future market requirement, research topics for future systems.
  - To build collaboration between academia and industry and between converging industry sectors.
  - To jointly develop commonly agreed research.
  - To disseminate and input results to standard bodies in order to ease future standardization and hence develop global market for products and services.

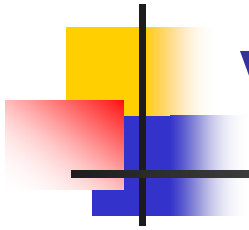
# Roadmap


The Global Context
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2020
ITU-R
Vision
Requirements
Standardization
Enhancements
Spectrum Identification and Implementation
Initial System Deployment
Research
2nd Stage Research
Prototypes / Concept Integration / Validation
System Development
System Integration
Activities of all sector actors
(e.g. manufacturers, operators,
standardization bodies, ...)
WRC03
WRC07
WWRF Milestones & Activities for 2001 and Beyond
1
2
3
4
5
6
Preparation of the BoV 2001
System Concept & Reference Model Definition
Definition of Research & Communication Framework / Identification of Interfaces
Preparation of the Book of Visions 2003
1 • BoV 2001 published
2 • Initial system concept & reference model established for research
+ publication of specific topic reports
3 • Initial WWRF research framework established and communicated to national & international research programs and relevant standardization bodies
+ Publication of specific topic reports
Milestones for 2003
4 • More detailed work on system concepts
+ publication of specific topic reports (White papers)
5 • Continuation of effort towards globalization (permanent effort)
6 • Book of Visions 2003
= Milestone

# Working Groups

- WG1
  - Scenarios and analysis
  - Reference model
  - UI technologies and techniques
  - UCD process
- WG2
  - Terminology (basic terms for WG2)
  - Business Model
  - Personalization
  - Ambient Awareness
  - Adaptability
  - Generic Service Elements
  - Enabling Technologies
- WG3
  - Vision and roadmap
  - Research challenges and priorities
  - Architectural Principles
  - Network Component Technologies for Cooperative Networks
  - E2E Reconfigurability
- WG4
  - Smart Antennas, MIMO systems
  - Ultra Wideband
  - New Air Interface (3 in this area)
    - Requirements and Technologies
    - Broadband Multicarrier
    - Mixed OFDM plus single-carrier
  - Ad Hoc Networking
  - Short Range Communications
  - Relay-based Deployment Concepts for Wireless and Mobile Broadband Cellular Radio
  - Wireless Internet

New document
First draft
Draft
Stable draft
Stable version



# Visions of WWRF

- **Cyberworld**: A world parallel to our real world created and sustained by the world's computers, wearable communication terminals and device-less interactions, where we can stay in touch with our agents, knowledge bases, communities, services and transactions.
- **Wireless world**: A set of technologies that will enable us to become permanent residents in the Cyberworld.
  - Radio Access
  - Connectivity
  - Services Platform
  - Cyberworld

# Multi-Sphere Models for Cyberworld

- **Level 1:** The PAN (Personal Area Network): Communication facilities will be contained in cloths and wearable items. On request they will start to discover and distribute a common virtual terminal over us.

- **Level 2:** The Immediate Environment : TV sets should know what programmes we are interested in, toasters might want to deliver toast with the right level of toasting and fridges might want to tell us what we probably would like to re-order as we might run out of milk over the weekend.

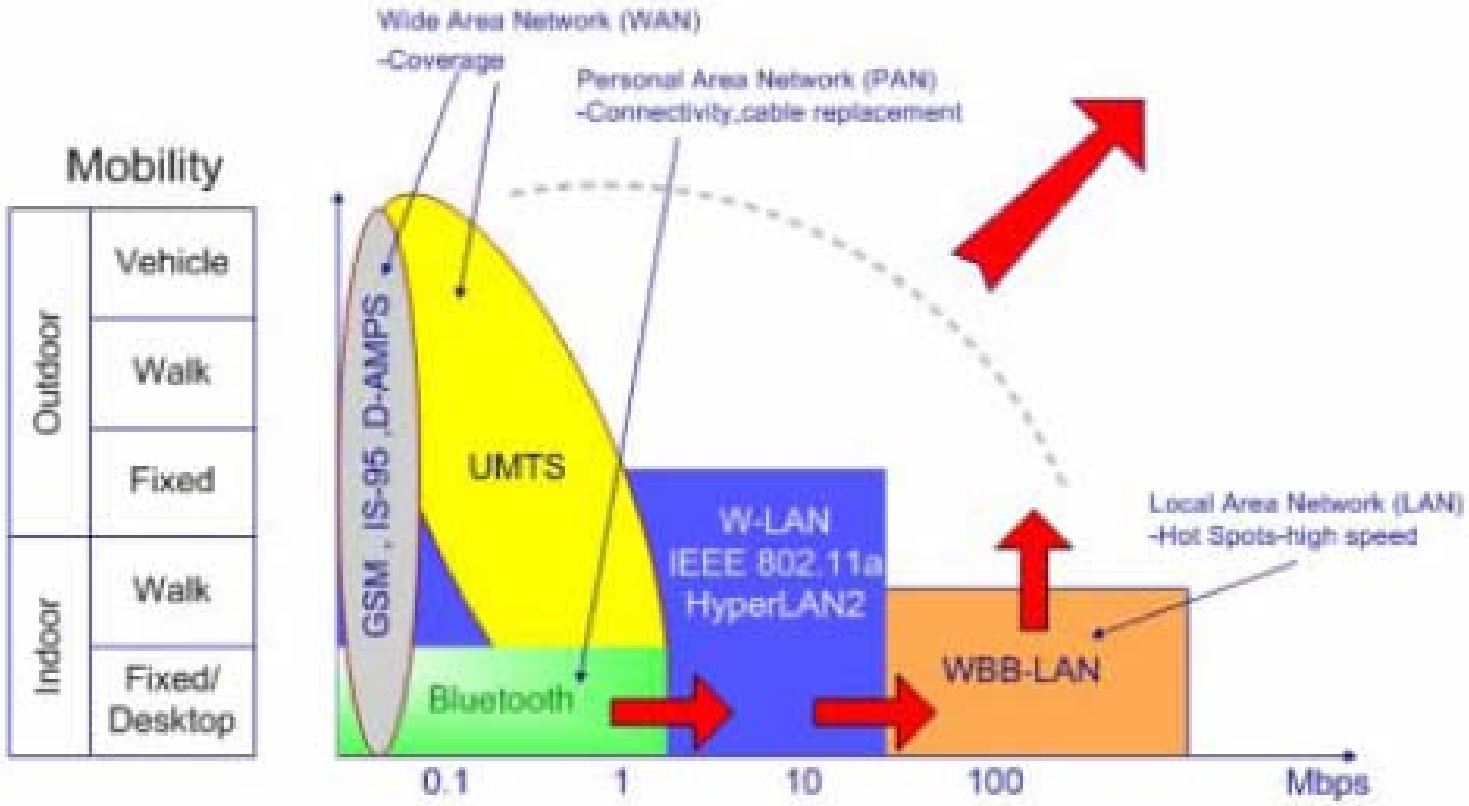
- **Level 3**: Instant Partners such as Car: For Relay Information, Entertainment on the Move

- **Level 4**: Radio Access : Wide Area Coverage

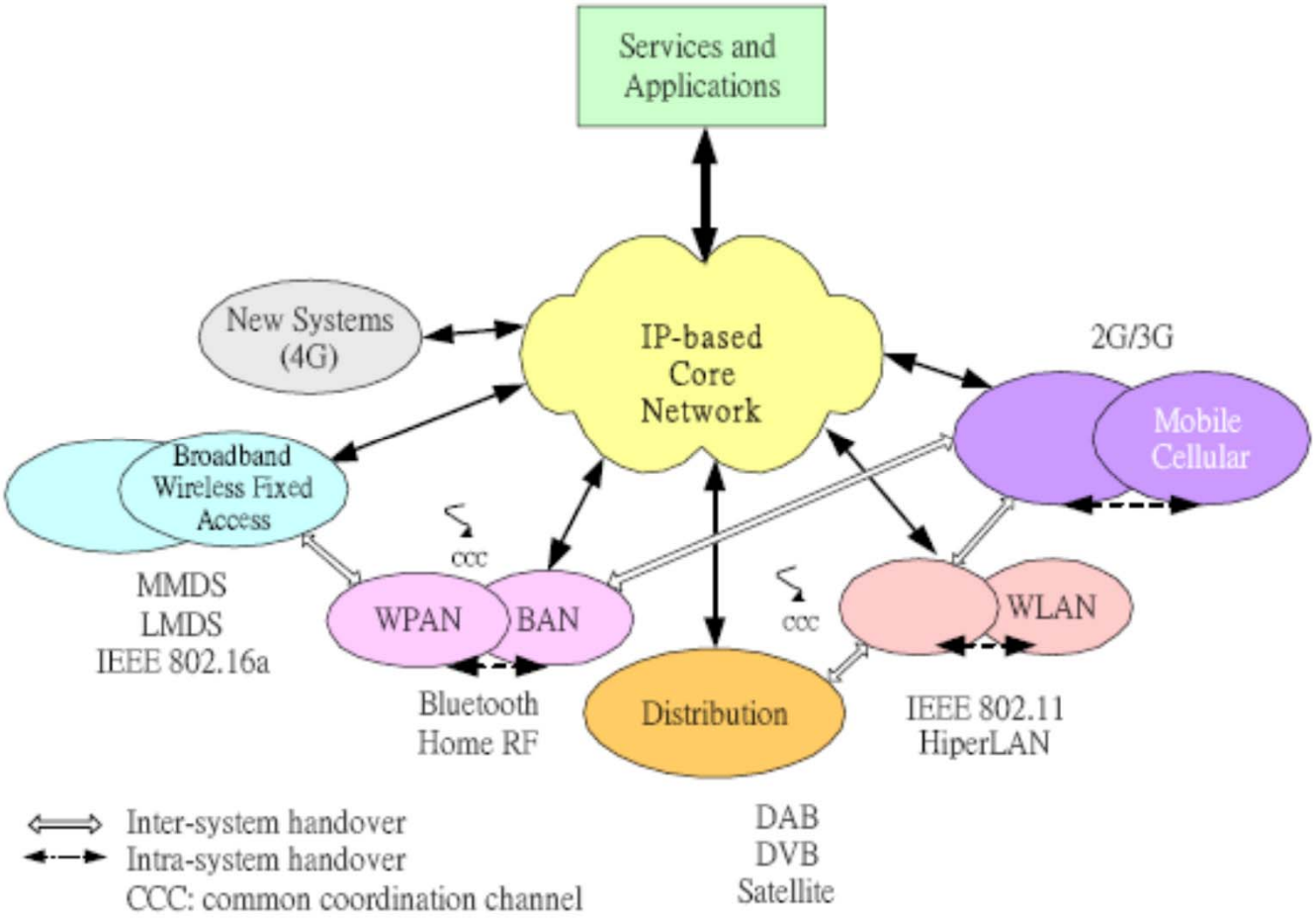
- **Level 5**: Interconnectivities: The value of communications technologies is to grow proportionally to the square of the number of the connected devices. It is crucial to maintain universal wireless interconnectivity, as in today's mobile Internet core networks.

- **Level 6**: Cyberworld: A parallel world created and sustained by the world's computers, wearable communication terminals and deviceless interactions, where we can stay in touch with our agents, knowledge bases, communities, services and tractions.

# Existing Wireless Access Environment



# Cooperative Networks



# http://4Gmobile.com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連結 Yahoo Google 臺北大學
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網址(D) http://4Gmobile.com/
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Google 開始 書籤 PageRank 6 已攔截 拼字檢查 翻譯 傳送到 設定
FOURTH GENERATION MOBILE TECHNOLOGY
More Open . More Simple . More Clean
THE RACE TO INNOVATE
Welcome to 4th Generation Mobile Initiative Frontpage
The World's No.1 Events on 4G Technology Movement
Email address for 4G Newsletter
Sign Me Up!
About Global 4G Mobile Initiative
Future wireless mobile communications will be shifted from today's traditional transmission-specific radio technology to an interface-based technology in order to be more compatible with computer system architecture. The future mobile device will therefore be first and foremost a computer, then an open wireless architecture (OWA) terminal. This OWA technology offers an optimal solution to open up the wireless platform for complete openness and simplicity and would support the service-oriented architecture and infrastructure that is necessary for future mobile phone development and advancement.
WORLD WIRELESS CONGRESS
San Francisco
4GMF
A GLOBAL INITIATIVE
The first mobile phone was invented in the United States back in the 1960s by Bell Labs, but the US mobile communications market has remained very much closed and far behind the international movement towards the open market of the global industry. Now the world is evolving rapidly into a personal communications era with true openness and freedom in mobile services, but in our opinion, the US is still lagging about ten years behind other countries, such as China, with regards to having a more open and competitive market in wireless communications.
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# 4Gmobile Forum

- **Mission**: To provide a technical forum to promote exchange of technology advancement resulted from academic and industry research and development efforts to facilitate the realization of the **4G** Mobile Vision.
- **Objective**: To define the Open Wireless Platform Architecture supporting the convergence of **broadband** wireless mobile and wireless access.

# Mobile Office Project

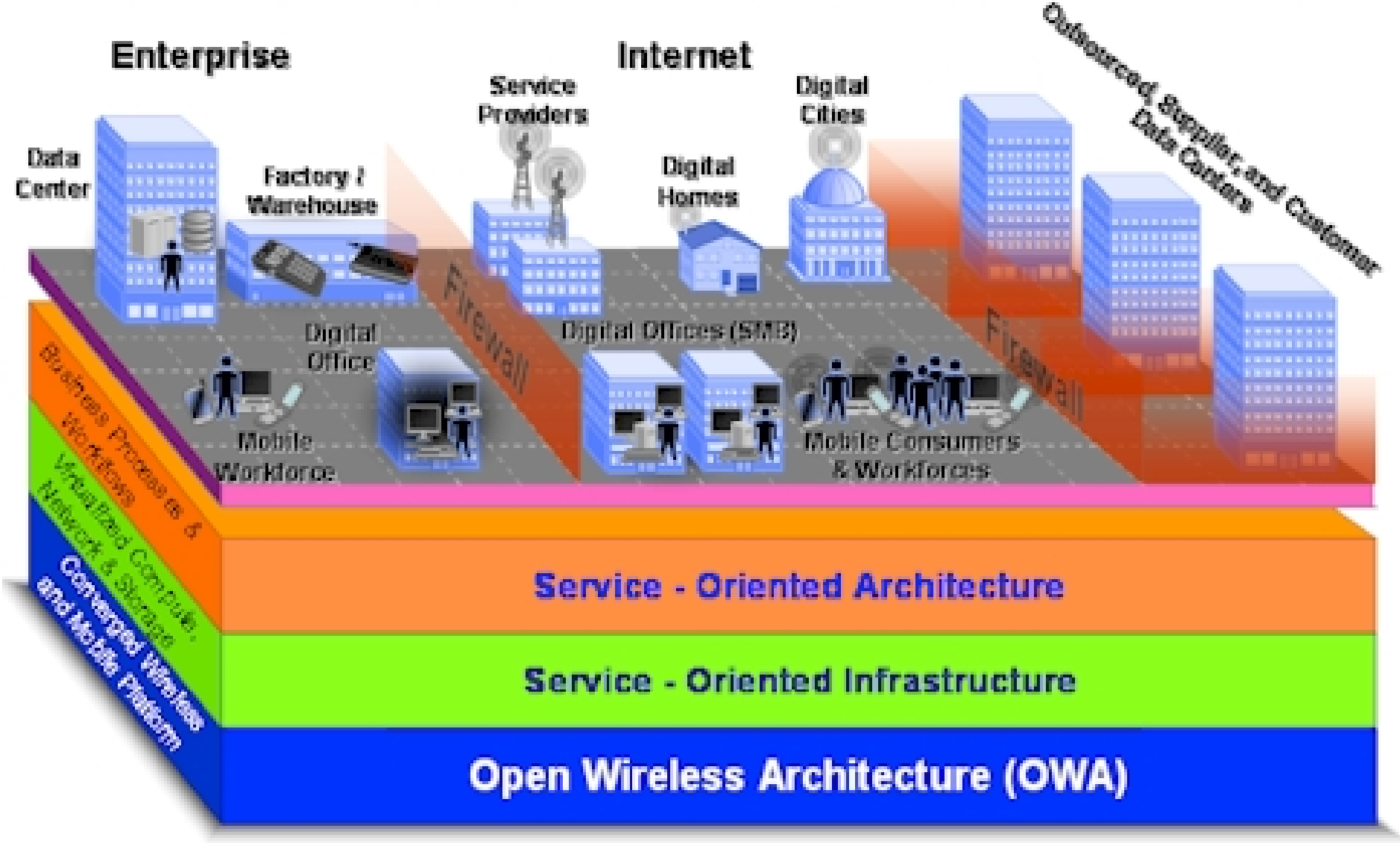
# What's 4G mobile technologies ?

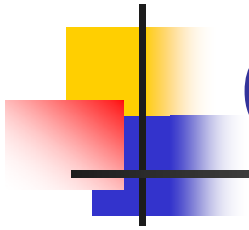
- **Answers:**
  a) Open Wireless Architecture (OWA)
  b) Cost-effective and Spectrum-efficient High-speed wireless mobile transmission

# Working Groups (2006)

- Working Group 1 on Terminal Power Technology
  Working Group 2 on System Architecture
  Working Group 3 on New Air Interfaces
  Working Group 4 on RF and Antenna Technology
  Working Group 5 on Signal Processing
  Working Group 6 on Access Control
  Working Group 7 on Wireless Networks & Ad Hoc
  Working Group 8 on Operating Systems (OS)
  Working Group 9 on Spectrum Management
  Working Group 10 on Radiation and Safety
  Working Group 11 on Secured Applications
  Working Group 12 on Quality of Services
  Working Group 13 on Programmable Modules
  Working Group 14 on Inter-operability and Optimization
  Working Group 15 on General Convergence

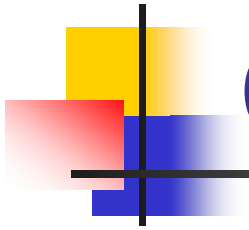
# The Future Services Environment





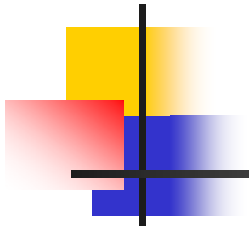
# Cont.

- With this technology, one integrated terminal with one global personal number can access freely any wireless air interfaces, and the radio transmission modules are fully software-definable, reconfigurable and programmable.
- The **All-IP** will be terminated at the wireless end-terminal to enable End-to-End direct signaling and QoS guarantee.



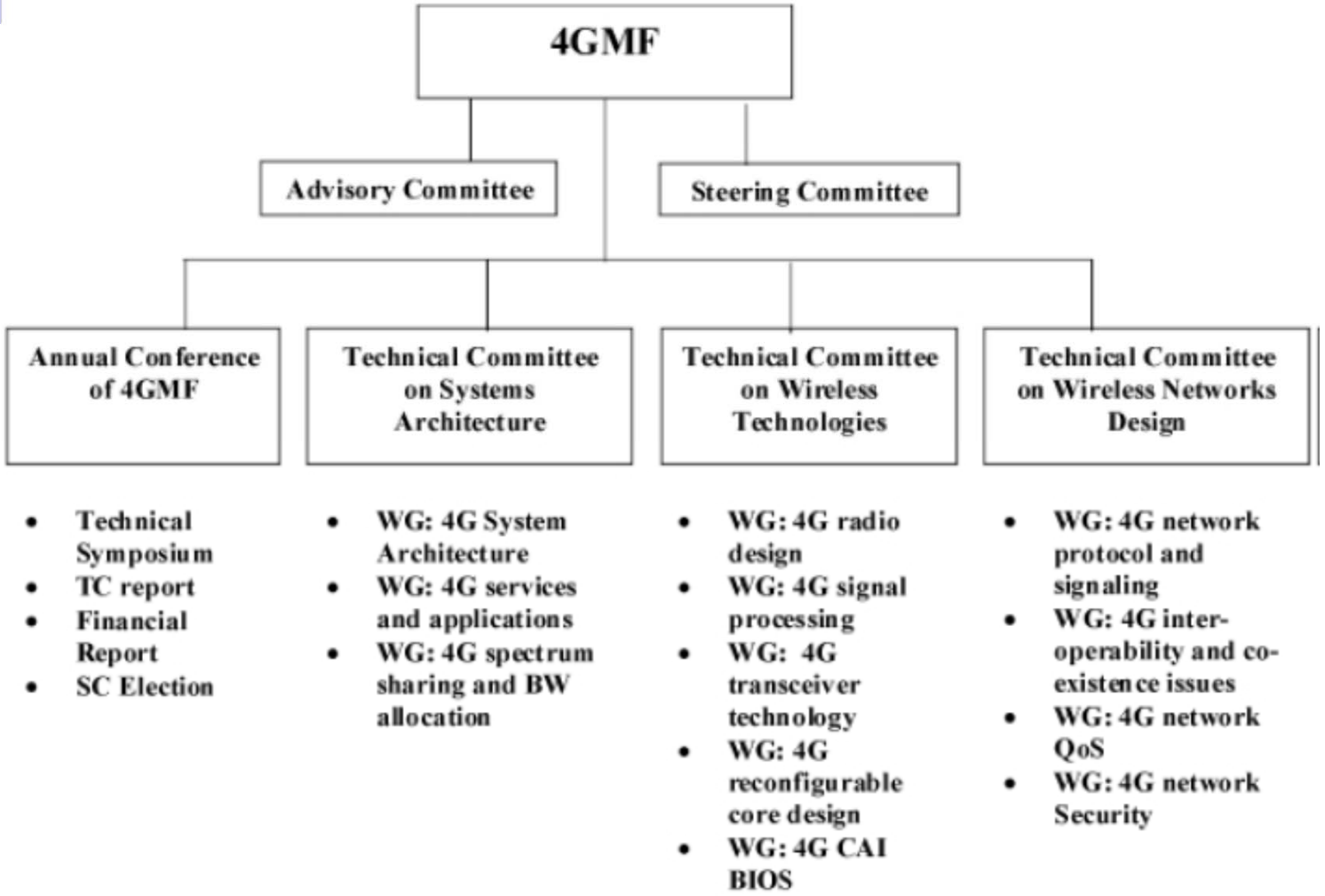
# Cont.

- The network layer and the lower layers will be combined together to construct the common broadband wireless super-engine of this 4Gmobile - **Open Wireless Architecture**.
- Activities
  - 1st annual 4Gmobile, October 2003.
  - Annual summit: World Wireless Congress
  - WWC 2004, May 25-28, San Francisco



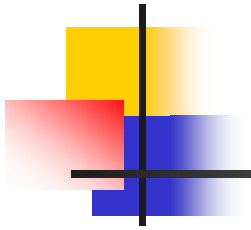
- 4GMF Deliverables
  - Proceedings of Annual Conference of 4GMF.
  - Annual Summary Book of Technical Reports
    - resulted from all Technical Committees. Specifications, air interfaces, protocols, system architectures and other similar guidelines related to fourth-generation mobile technologies that may be developed, adopted, published or otherwise made available to the public by 4GMF.

# Organization



# IEEE 802.20 : Mobile Broadband Wireless Access (MBWA)

http://grouper.ieee.org/groups/802/20



- Establisheded in December 2002 and to be Done by December 2004.

Mobile Broadband Wireless Access - Home Page - Microsoft Internet Explorer

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# IEEE 802.20
# Mobile Broadband Wireless Access (MBWA)


MEETINGS
- Next Meeting
- Future Meetings
- Conference Calls
- Members Only

DOCUMENTATION
- Contributions
- WG Documents
- Commentary

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MBWA 802.16 SG Document Archive


## IEEE 802.20 Mission and Project Scope

On 11 December 2002, the IEEE Standards Board approved the establishment of IEEE 802.20, the Mobile Broadband Wireless Access (MBWA) Working Group.

### • Mission

The mission of IEEE 802.20 is to develop the specification for an efficient packet based air interface that is optimized for the transport of IP based services. The goal is to enable worldwide deployment of affordable, ubiquitous, always-on and interoperable multi-vendor mobile broadband wireless access networks that meet the needs of business and residential end user markets.

### • MBWA Scope

Specification of physical and medium access control layers of an air interface for interoperable mobile broadband wireless access systems, operating in licensed bands below 3.5 GHz, optimized for IP-data transport, with peak data rates per user in excess of 1 Mbps. It supports various vehicular mobility classes up to 250 Km/h in a MAN environment and targets spectral efficiencies, sustained user data rates and numbers of active users that are all significantly higher than achieved by existing mobile systems.

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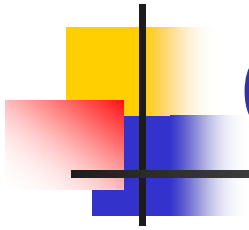
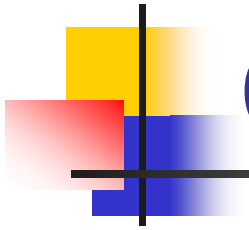


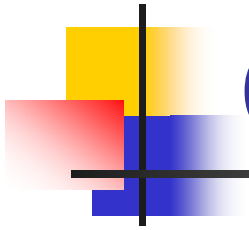
# Cont.

- **Objectives**
  - To develop the specification for an efficient packet based air interface that is optimized for the transport of IP based services.
  - To enable worldwide deployment of affordable, ubiquitous, always-on and interoperable multi-vendor mobile broadband wireless access networks that meet the needs of business and residential end user markets.



# Cont.

- **Scope**: to develop specification of physical and medium access control layers of an air interface for interoperable mobile broadband wireless access systems.
  - operates in licensed bands below 3.5 GHz.
  - optimized for IP-data transport, with peak data rates per user in excess of 1 Mbps.
  - supports various vehicular mobility classes up to 250 Km/h in a MAN environment.
  - targets spectral efficiencies, sustained user data rates and numbers of active users that are all significantly higher than achieved by existing mobile systems.



# Cont.

- **Purposes**:
  - Enable worldwide deployment of cost effective, spectrum efficient, always on and interoperable mobile broadband wireless access systems in order to address user needs for:
  - Mobile and ubiquitous Internet access.
  - Transparent support of Internet applications
  - Access to enterprise intranet services
  - Transparent access to Infotainment and location services
  - Fills the performance gap between the high data-rate low mobility services currently developed in IEEE 802 and the high mobility cellular networks.

# The IEEE 802.16 Working Group on Broadband Wireless Access Standards

developing the IEEE 802.16 **WirelessMAN®** Standard for Wireless Metropolitan Area Networks

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The IEEE 802.16 Working Group on Broadband Wireless Access Standards develops standards and recommended practices to support the development and deployment of broadband Wireless Metropolitan Area Networks. IEEE 802.16 is a unit of the IEEE 802 LAN/MAN Standards Committee, the premier transnational forum for wireless networking standardization.

> *People often take the view that standardization is the enemy of creativity. But I think that standards help make creativity possible -- by allowing for the establishment of an infrastructure, which then leads to enormous entrepreneurialism, creativity, and competitiveness.*
> -Vint Cerf, TCP/IP co-developer and Internet pioneer, in Fast Company, April 2000.

### Session News

- Session #41 Report highlights meetings of 9-12 January in New Delhi, India
- Session #42: 6-9 March in Denver, CO, USA; registration open

### News: New Standards and Projects

- **Going Mobile!** 802.16e approved as IEEE Standard on 7 December
- 802.16-2004/Cor1 approved as IEEE Standard on 8 November
- IEEE 802.16f published on 1 December
- New P802.16i project opened on 7 December

WiMAX Forum - WiMAX Home - Microsoft Internet Explorer

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WiMAX FORUM

Promoting interoperability standards for broadband wireless access

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**Not yet a member?**
Click here for information on how to join WiMAX Forum.

# Welcome to the WiMAX Forum

The WiMAX Forum is an industry-led, non-profit corporation formed to promote and certify compatibility and interoperability of broadband wireless products. Our member companies support the industry-wide acceptance of the IEEE 802.16 and ETSI HiperMAN wireless MAN standards.

## What this means for you:

- For **network operators** this means equipment interoperability across vendors
- For **component vendors** this means fewer product variations and higher volumes
- For **end-users** this means faster and cheaper access that is more widely available

▶ Find out more about the Mission of the WiMAX Forum

## NEWSFLASH:

**WiMAX Forum Announces First WiMAX Forum Certified Products**

On 19 January 2006, the WiMAX Forum, an industry-led, non-profit corporation formed to promote and certify compatibility and interoperability of broadband wireless products, today announced the first fixed wireless broadband network products to achieve the designation of WiMAX Forum Certified. At the WCA Technical and Business Symposium in San Jose, the WiMAX Forum revealed the first companies and products to complete certification and interoperability testing, including Aperto Networks' PacketMAX 5000 base station, Redline Communications' RedMAX AN-100U base station, SEQUANS Communications' SQN2010 SoC base station solution, and Wavesat's miniMAX customer premise equipment (CPE) solution.

The first round of WiMAX Forum Certified products were developed according to the WiMAX Forumdefined certification profile for 3.5 GHz systems, which is based on the IEEE 802.16-2004 and ETSI HiperMAN standards. Each hardware system was required to pass stringent and extensive test procedures, consisting of protocol conformance, radio conformance and interoperability testing in order to attain the WiMAX Forum Certification seal.

"The achievement of Certification is a result of the successful collaboration of our Certification Working Group, ETSI, Cetecom Spain and WiMAX system suppliers," said Ron Resnick, president of the WiMAX Forum. "Through an expanded and rigorous conformance and interoperability testing in our certification program, we believe there are more robust fixed WiMAX systems coming to market than what was originally expected."

## Member Companies

Booz | Allen | Hamilton
90 years delivering results that endure

## Upcoming Events

**WiMAX Summit 2006**
Sofitel Bercy Hotel, France
February 21-24, 2006
Speaker 1: Sai Subramanian
Speaker 2: Frank Draper

**3rd WiMAX Plugfest Event**
Sophia Antipolis, France
March 12-19, 2006
**The registration deadline is February 6, 2006**

- See all upcoming events

## WiMAX Certified Product Showcase

The WiMAX Product Showcase is now available to provide information on products certified by the WiMAX Forum.

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# System Characteristics

| Characteristic | Value for 1.25 Mhz | Value for 5 Mhz |
|---|---|---|
| Mobility | up to 250 km/hr | |
| Sustained spectral efficiency | > 1 b/s/Hz/cell | |
| Peak user data rate (Downlink (DL)) | > 1 Mbps | > 4Mbps |
| Peak user data rate (Uplink (UL)) | > 300 Kbps | > 1.2 Mbps |
| Peak aggregate data rate per cell (DL) | > 4 Mbps | > 16 Mbps |
| Peak aggregate data rate per cell (UL) | > 800 Kbps | > 3.2 Mbps |
| Airlink MAC frame RTT | <10 ms | |
| Spectrum (Maximum operating frequency) | < 3.5 GHz | |

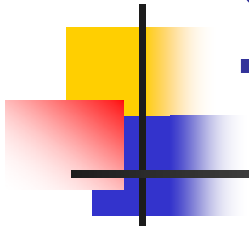
# Relationship with Other Cellular Systems

| Dimension | 802.16e | 802.20 | 3G |
|---|---|---|---|
| End-user | High data rate fixed wireless user with adjunct mobility service<br>Symmetric data services<br>End-user devices for fixed subscribers (CPE) and PC Cards for mobile devices<br>Support of low-latency data and real time voice services | Fully mobile, high throughput data user<br>Symmetric data services<br>End-user devices initially PC Card enabled data devices<br>Support of low-latency data services | Voice user requiring data services<br>Highly asymmetric data services<br>End user devices initially data enabled handsets<br>Lack of support for low latency services |
| Service Provider | Evolving off Fixed Wireless service providers and WISPs adding mobility as enhance-ment to service offering<br>Local/Regional mobility and roaming support | Wireless Data Service provider – Greenfield start or evolving Cellular carrier<br>Global mobility and roaming support | Cellular voice service provider evolving to data support<br>Global mobility and roaming support |

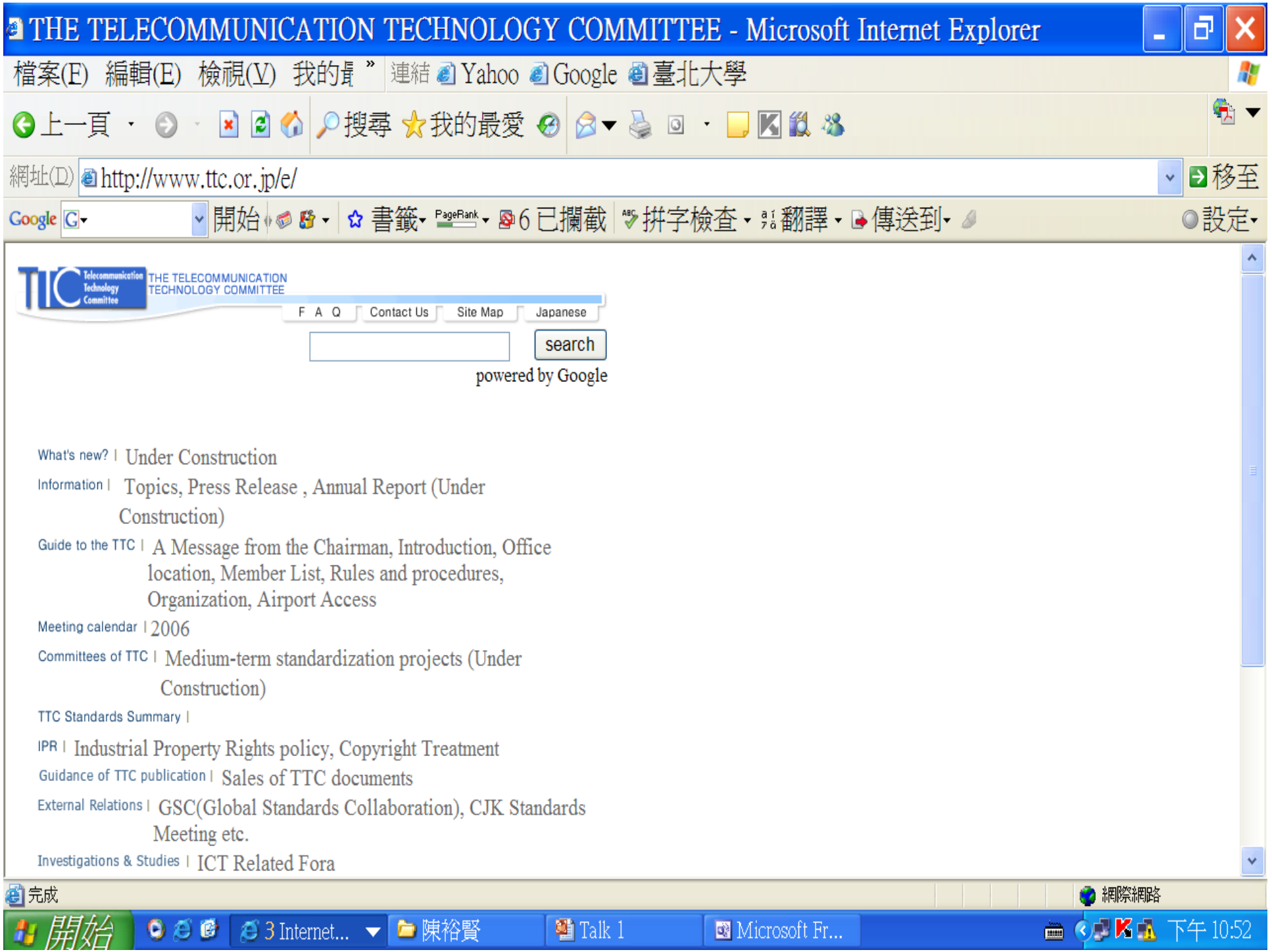
# Relationship with Other Cellular Systems

| Dimension | 802.16e | 802.20 | 3G |
|---|---|---|---|
| Technology | Extensions to 802.16a MAC & PHY | New PHY & MAC optimized for packet data and adaptive Antennas | W-CDMA, cdma2000 |
| | Optimized for and backwards compatible with fixed stations | Optimized for full mobility | Evolving of GSM or IS-41 |
| | Licensed bands 2-6 GHz | Licensed bands below 3.5 GHz | Licensed bands below 2.7 GHz |
| | Typical Channel BW >5 MHz | Typical Channel BW < 5 MHz | Typical Channel BW < 5 MHz |
| | Packet oriented architecture | Packet oriented architecture | Circuit oriented architecture – evolving to packet on the downlink |
| | Channelization and control for multimedia services with QoS | Channelization and control for mobile multimedia services. Mobile-IP Based | Channelization and control optimized for mobile voice services. MAP/SS7 based |
| | High efficiency data uplinks and downlinks | High efficiency data uplinks and downlinks | Medium efficiency data downlinks, low efficiency uplinks |
| | Low Latency architecture | Low latency data architecture | High latency data arch. |

# Japanese Telecommunication Technology Council (TTC)



- http://www.ttc.or.jp/e
- Mobile IT Forum (MAGIC )
  - Mobile multimedia
  - Any time, anywhere, anyone
  - Global mobility support
  - Integrated wireless solutions
  - Customized personal services
- NTT DoCoMo VSF-OFCDM System (Variable Spreading Factor, Orthogonal Frequency and Code Division Multiplexing)
  - To Be Tried.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Meeting calendar | 2006
Committees of TTC | Medium-term standardization projects (Under Construction)
TTC Standards Summary |
IPR | Industrial Property Rights policy, Copyright Treatment
Guidance of TTC publication | Sales of TTC documents
External Relations | GSC(Global Standards Collaboration), CJK Standards Meeting etc.
Investigations & Studies | ICT Related Fora
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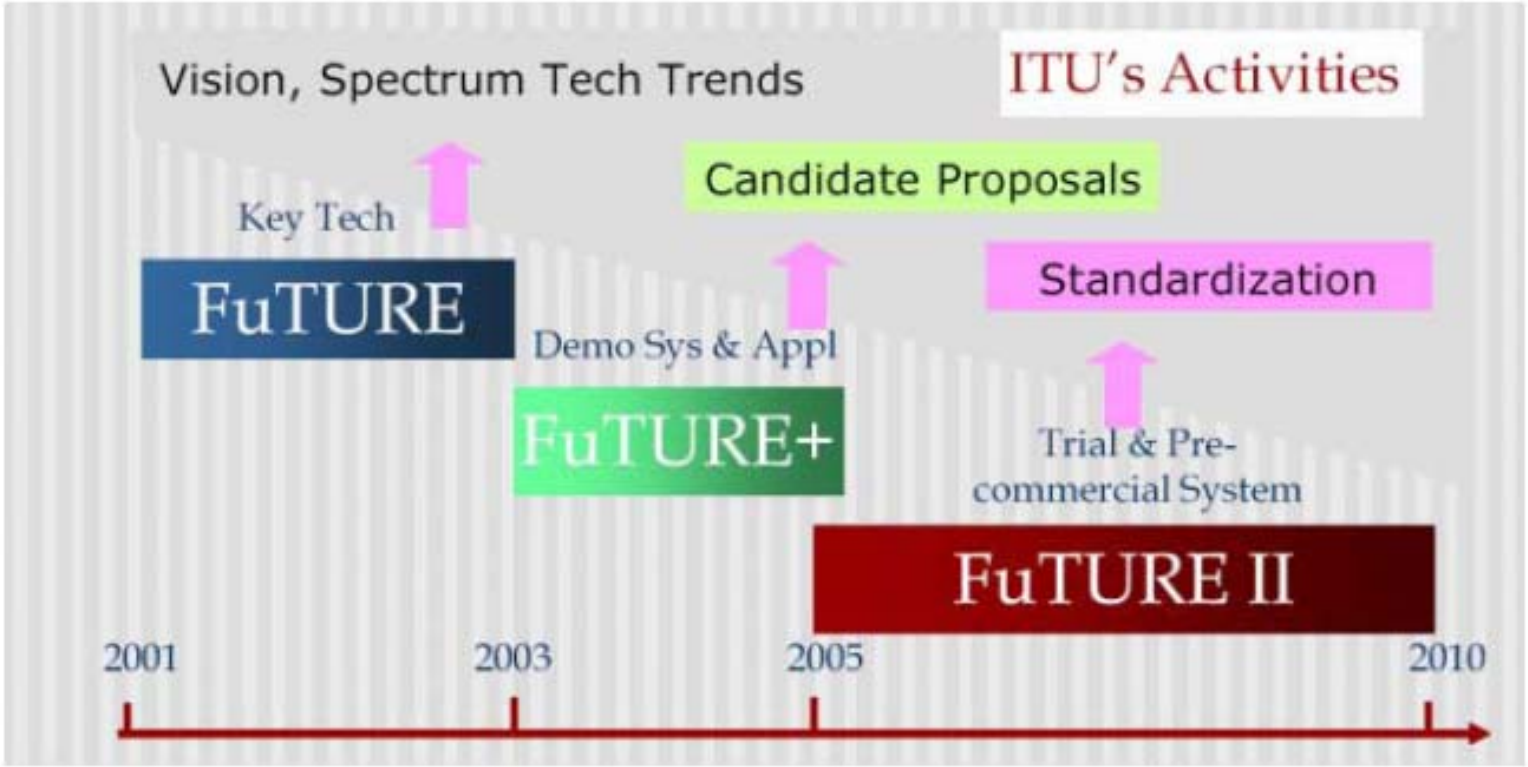
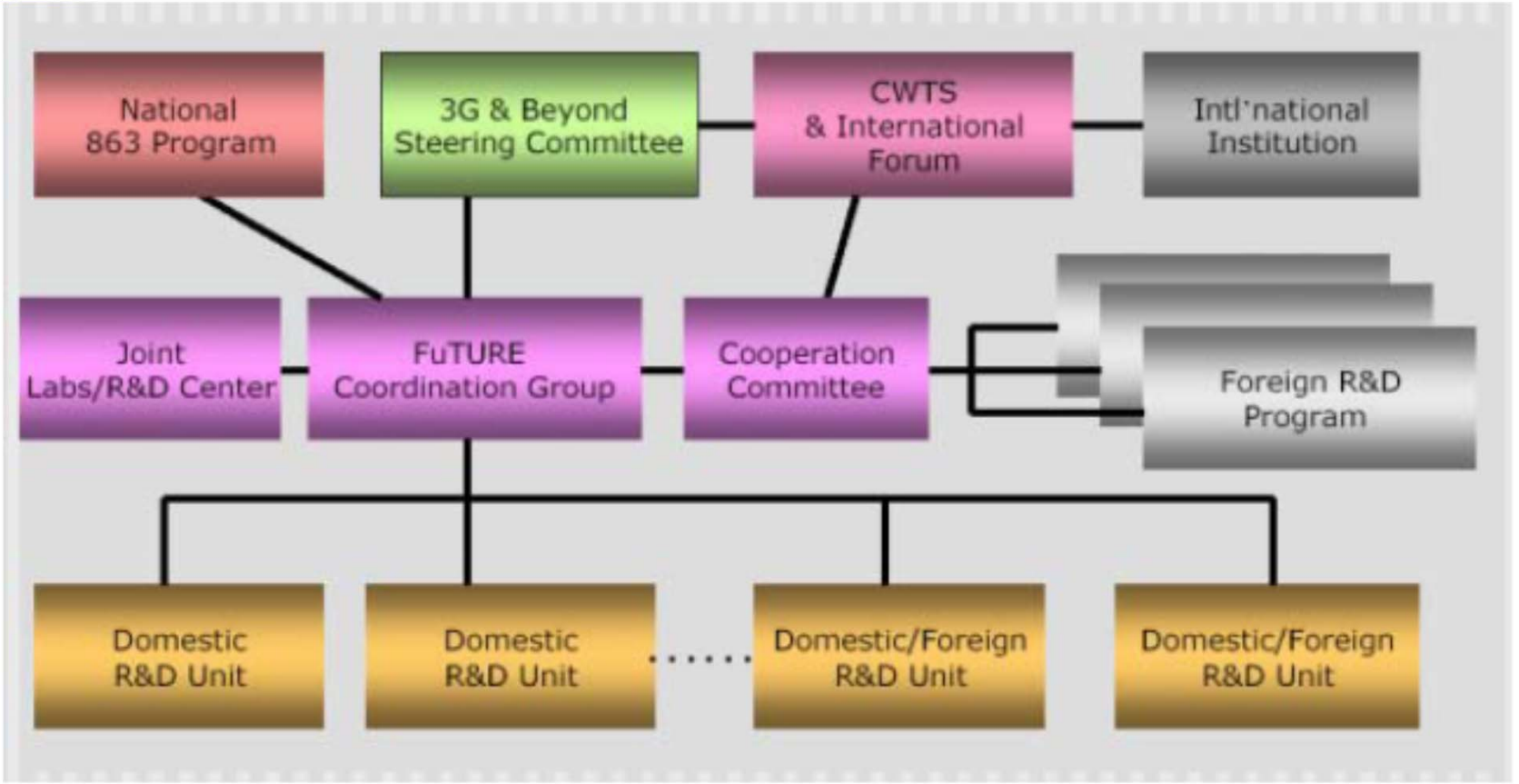
# FuTURE: Future Technology for Universal Radio Environment

- Part of China's 863 Program for 10th 5-year plan (2001-2005)
- **Objective**: To establish a universal radio experience environment that can meet the future application demands and development trends towards years of 2005 to 2010,

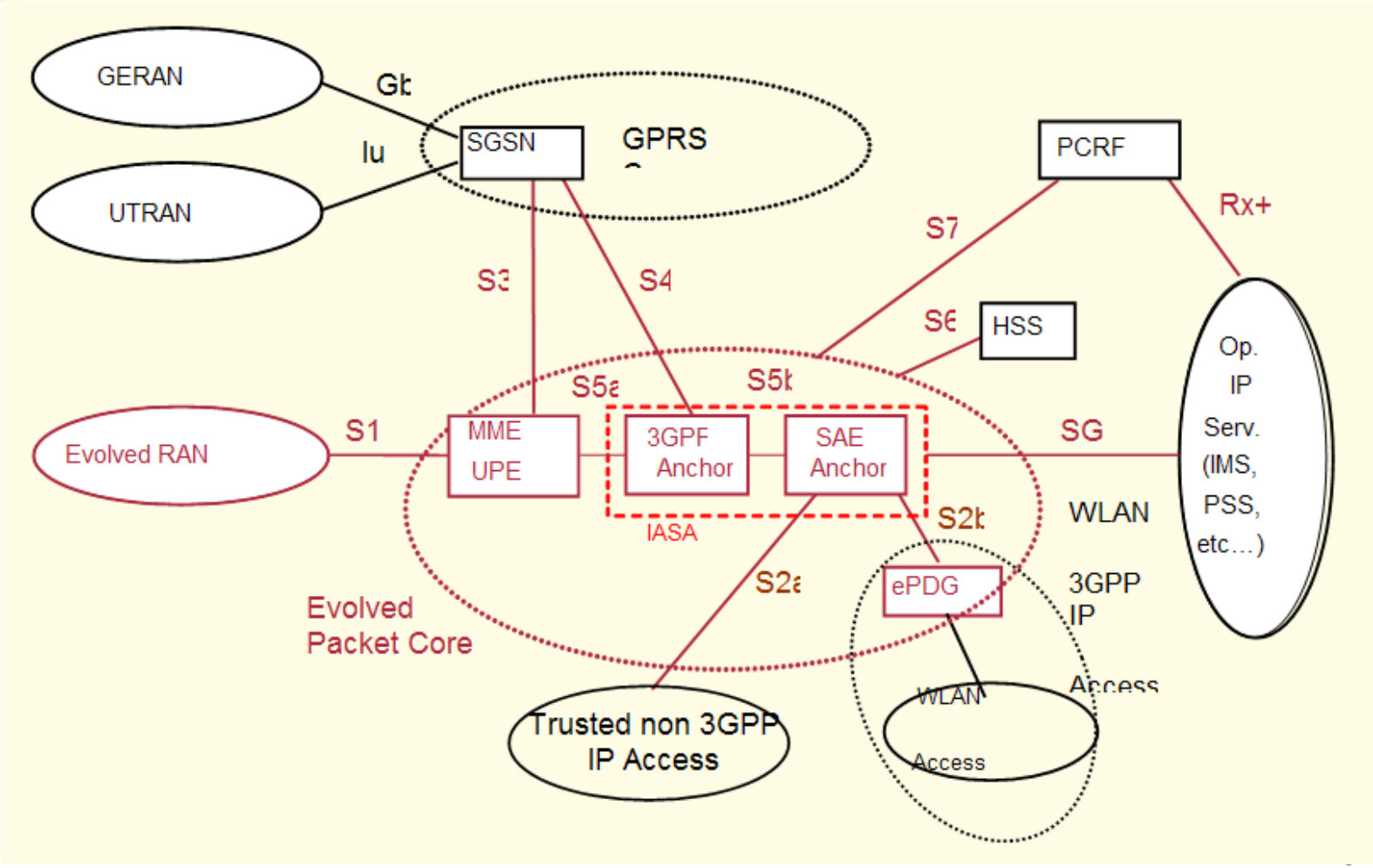
# Roadmap

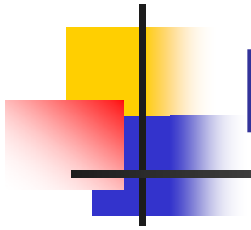

Vision, Spectrum Tech Trends
ITU's Activities
Key Tech
FuTURE
Candidate Proposals
Demo Sys & Appl
FuTURE+
Standardization
Trial & Pre-commercial System
FuTURE II
2001
2003
2005
2010

# Organization



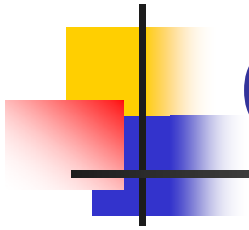
# 3GPP LTE (Long Term Evolution) (From 3GPP TR 23.882)





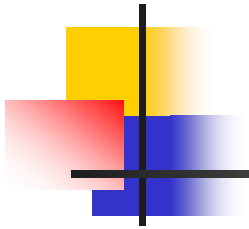
# Peak data rate

- Instantaneous downlink peak data rate of 100 Mb/s within a 20 MHz downlink spectrum allocation (5 bps/Hz)
- Instantaneous uplink peak data rate of 50 Mb/s (2.5 bps/Hz) within a 20MHz uplink spectrum allocation)



# Coverage

- Throughput, spectrum efficiency and mobility targets above should be met for 5 km cells, and with a slight degradation for 30 km cells. Cells range up to 100 km should not be precluded.

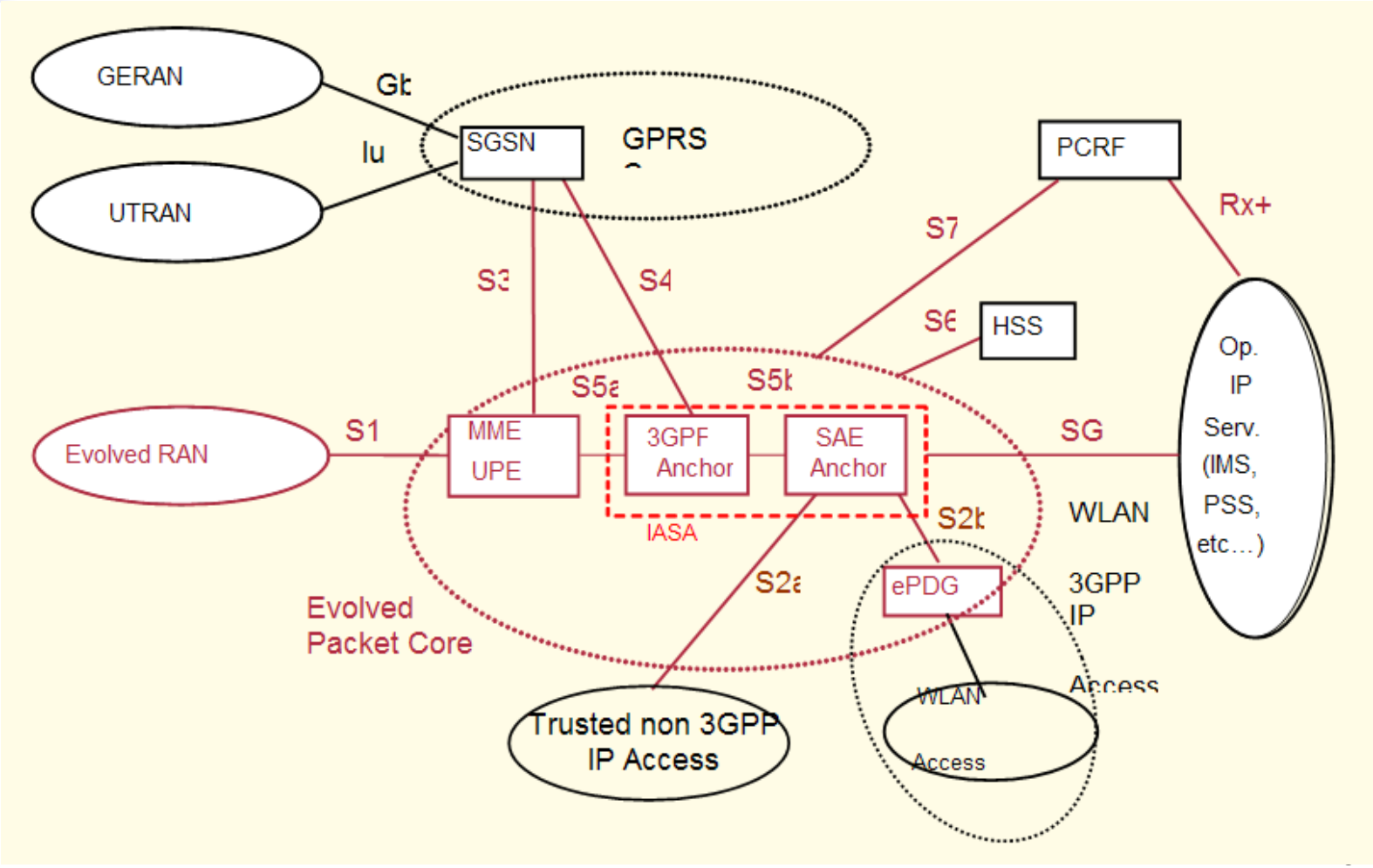


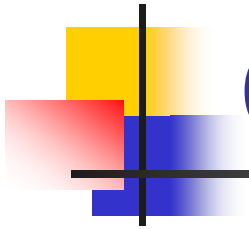
# Interfaces

- **S1:** It provides access to Evolved RAN radio resources for the transport of user plane and control plane traffic. The S1 reference point shall enable MME and UPE separation and also deployments of a combined MME and UPE solution.
- **S2a:** It provides the user plane with related control and mobility support between a trusted non 3GPP IP access and the SAE Anchor.
- **S2b:** It provides the user plane with related control and mobility support between ePDG and the SAE Anchor.
- **S3:** It enables user and bearer information exchange for inter 3GPP access system mobility in idle and/or active state. It is based on Gn reference point as defined between SGSNs.

  User data forwarding for inter 3GPP access system mobility in active state (FFS).

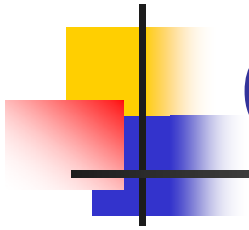
# 3GPP LTE (Long Term Evolution) (From 3GPP TR 23.882)





# Cont.

- **S4:** It provides the user plane with related control and mobility support between GPRS Core and the 3GPP Anchor and is based on Gn reference point as defined between SGSN and GGSN.
- **S5a:** It provides the user plane with related control and mobility support between MME/UPE and 3GPP anchor. It is FFS whether a standardized S5a exists or whether MME/UPE and 3GPP anchor are combined into one entity.
- **S5b**: It provides the user plane with related control and mobility support between 3GPP anchor and SAE anchor. It is FFS whether a standardized S5b exists or whether 3GPP anchor and SAE anchor are combined into one entity.
- **S6:** It enables transfer of subscription and authentication data for authenticating/authorizing user access to the evolved system (AAA interface).



# Cont.

- **S7:** It provides transfer of (QoS) policy and charging rules from PCRF to Policy and Charging Enforcement Point (PCEP).
  The allocation of the PCEP is FFS.
- **SGi:** It is the reference point between the Inter AS Anchor and the packet data network. Packet data network may be an operator external public or private packet data network or an intra operator packet data network, e.g. for provision of IMS services. This reference point corresponds to Gi and Wi functionalities and supports any 3GPP and non-3GPP access systems.