An Open Baseband Processing Architecture for Future Mobile Terminal Design

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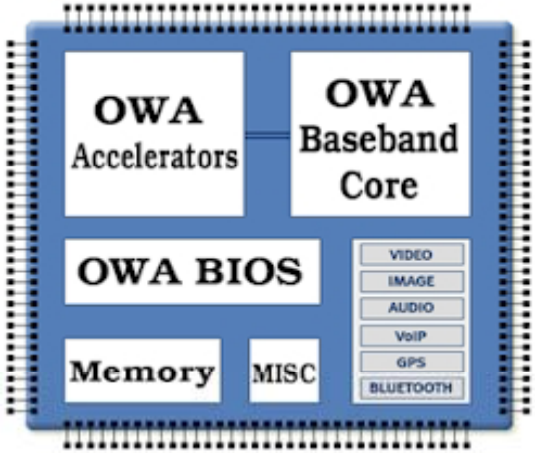


The future mobile phone can basically support any wireless standards by inserting different wireless interface SIM cards or multiple interfaces in one SIM card

---- referred to "LU Model" in the industry

"The mobile handset device is evolving from a traditional transmission-specific radio system to the future interface-based system. This future mobile phone will be relying on Open Wireless Architecture (OWA) platform for complete openness and simplicity", Prof. Willie Lu of Stanford University, Palo Alto.

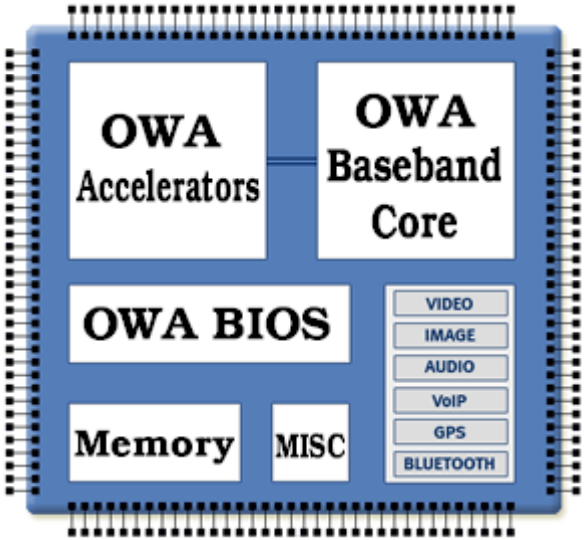
What's B3G or 4G in the future

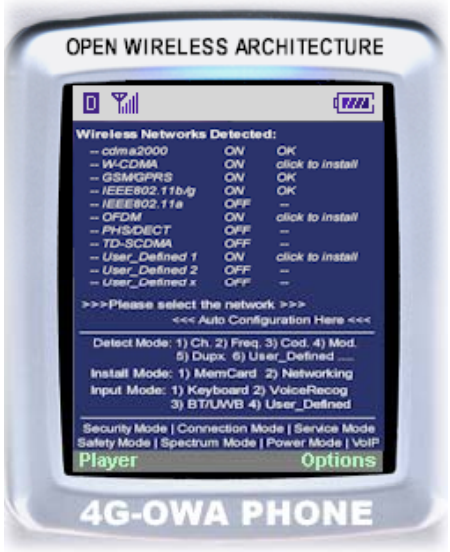
Open Wireless Architecture (OWA)

Cost-effective and spectrum-effective high speed wireless transmission

4G can support high-speed transmission, but
High-speed is NOT 4G

"The future radio is first, a computer, then an open wireless architecture (OWA) terminal"





Prof. Willie Lu in Stanford University, June 2004

Global Movement Towards OWA

"The wireless industry is rapidly transitioning from proprietary architecture to more flexible, cost effective open architecture systems. This transition is creating interesting challenges for developers, manufacturers, integrators, operators and end-users as they wrestle with complexities of open wireless systems",

Willie Lu, presented to F.C.C Technological Advisory Council (TAC), May 2002, Washington DC

OECD View on 3G Negative Aspects

•High licence costs as well as acquisition costs have impacted on the 3G business model of some operators.

•The market demand for 3G applications is difficult to predict at present.

•Initially, handset shortages and software problems in some 3G technologies slowed the deployment of 3G networks.

•Voice call handovers between 3G and older networks are still not smooth in some 3G technologies.

•There is uncertainty in pricing, particularly for access to broadband audio-visual services (multi-media content).

•The possible commercialisation of mobile systems beyond 3G (B3G) is viewed as arriving much earlier than expected, with consequent impacts on 3G technologies.

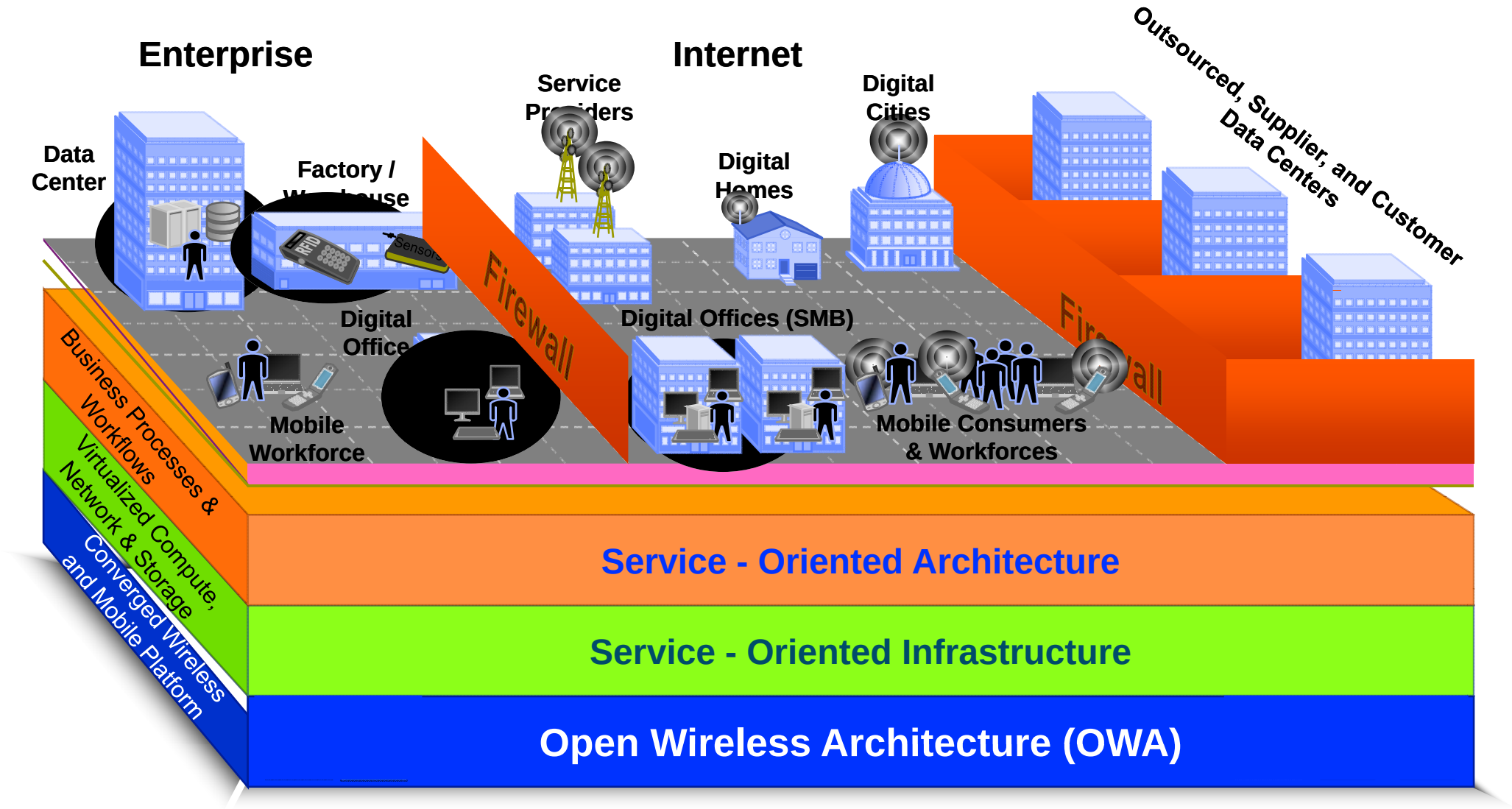
"Technically, 3G did not fundamentally improve the 2G architecture, and therefore it becomes the transitional solution only"

OECD view on Wireless Architecture

"As too many wireless systems come out every day, the current closed architecture and proprietary systems do not bode well for its success",

OECD Report, April 2005

The Future Services Environment

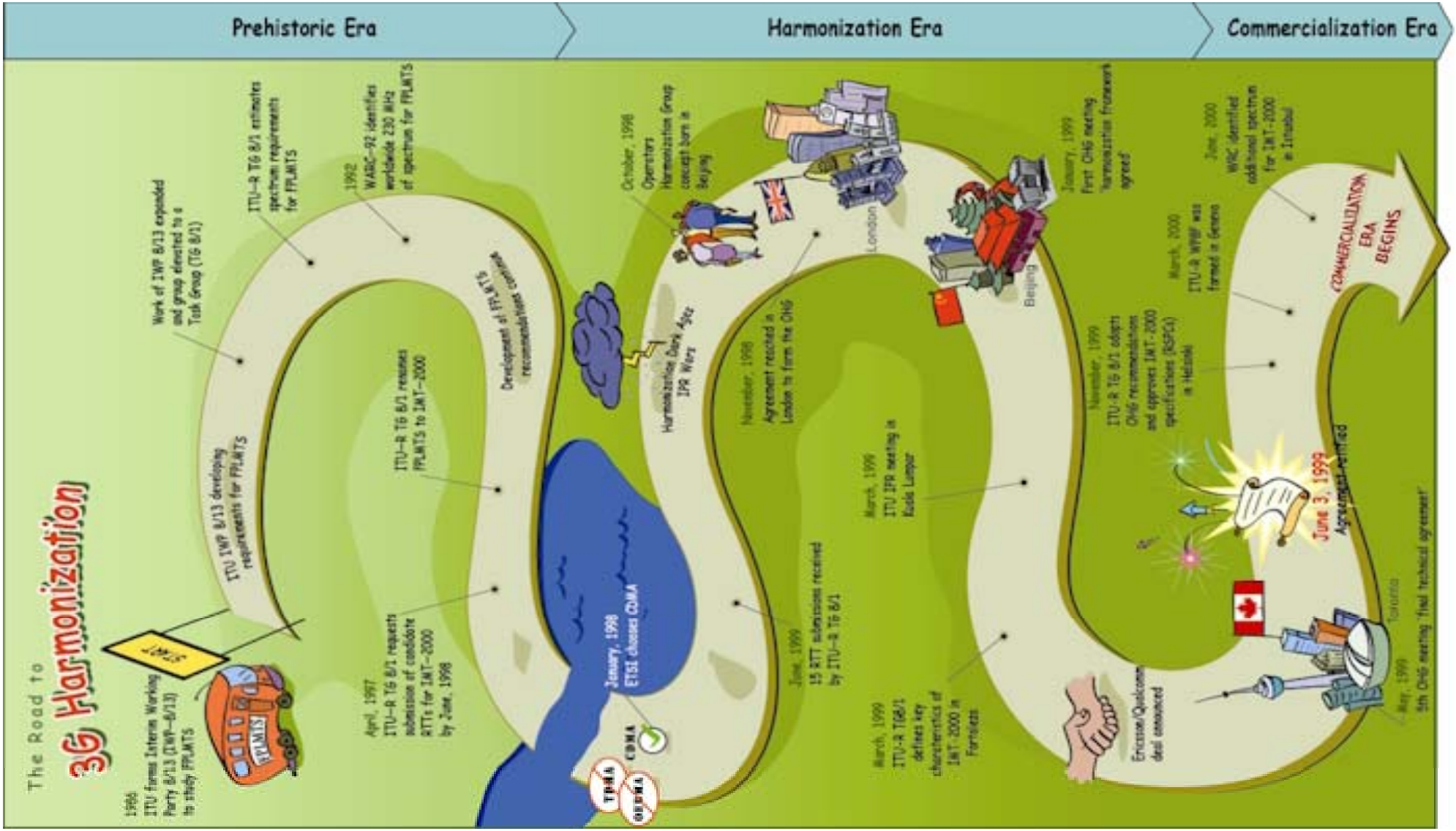


A True iPhone should comprise:

1. *Service-oriented mobility platform rather than wireless standard-specific platform*
2. *High spectrum utilization efficiency*
3. *Enhanced security features*
4. *Open air interfaces*

That's relying on Open Wireless Architecture (OWA) technology

Single Global Standard is IMPOSSIBLE



ITU Vision on Future Mobile System

Continuous evolution is foreseen in future mobile terminals, with use of new components, architectures, hardware, software platforms and improved user interfaces together providing increased performance. The key technologies that will enable the future advanced mobile terminals include:

- ❖ Open architecture platform supporting multiple standards
- ❖ Smart antennas, MIMO
- ❖ High efficiency power amplifiers
- ❖ New filters
- ❖ Improved RF modules, allowing higher operating frequencies and improved receiver sensitivity
- ❖ Advances in signal processing, additional processing power
- ❖ Improved battery technology with increased energy density
- ❖ Integration with wired terminal

However, these advances in technology will not altogether remove the frequency dependent limitations of transmitter and receiver hardware and semiconductor technology. Rather limitations will continue to exist despite the evolution. Having new spectrum ranges far from current bands would additionally increase the challenges with future RF components. This means that also from the component point of view the frequencies should be as low as possible.

Furthermore, future terminals should be capable of operating in several frequency bands and with different bandwidths (requiring improved RF modules). Terminals should have the potential of dealing with different systems (multi-mode) and they should also implement interference management to improve transmission capacity and performance (enhanced sensitivity and strategies for interference suppression).

Therefore, the future terminal should provide an open RF architecture which is re-configurable, extensible and portable for various air-interfaces and frequency bands.

Today 3G is in the first phase of its deployment. The capabilities of B3G systems are being continually enhanced in line with market and technology trends. We envision new technology concepts for wireless communications. Coincidentally, there is an increasing trend towards a convergence of different communication services and systems coming from completely different backgrounds. Such areas of convergence are, for example, mobile communications, Internet, broadcasting, wireless LANs, etc. Each of these represents a variety of applications, services and delivery mechanisms. These differing information flows are desired by the users to be available regardless of the means and manner of delivery. A case in point: Over the mobile phone one is able to receive voice communications, data messages, browse the web (with its varying content, such as information from radio and television broadcast stations), transmit video, listen to MP3 music, etc. The most important is, this mobile phone becomes the All-in-One integrated personal communicator at both home and office or on-the-move.

The future mobile phone will be constructed upon an open wireless architecture (OWA) platform.

China Long-term Strategy

除登月工程外, 中国未来最重大专项项目之一是建立基于开放结构的宽带无线(包括移动)通信系统, 以满足国家未来信息化建设.

Besides China Moon mission, one of the most important special programs is to construct an open-architecture based broadband wireless (including mobile) communication system to meet the nation's future ICT infrastructure development.

Translated from Xinhua News, Sina & mc21st, Feb. 17th, 2006

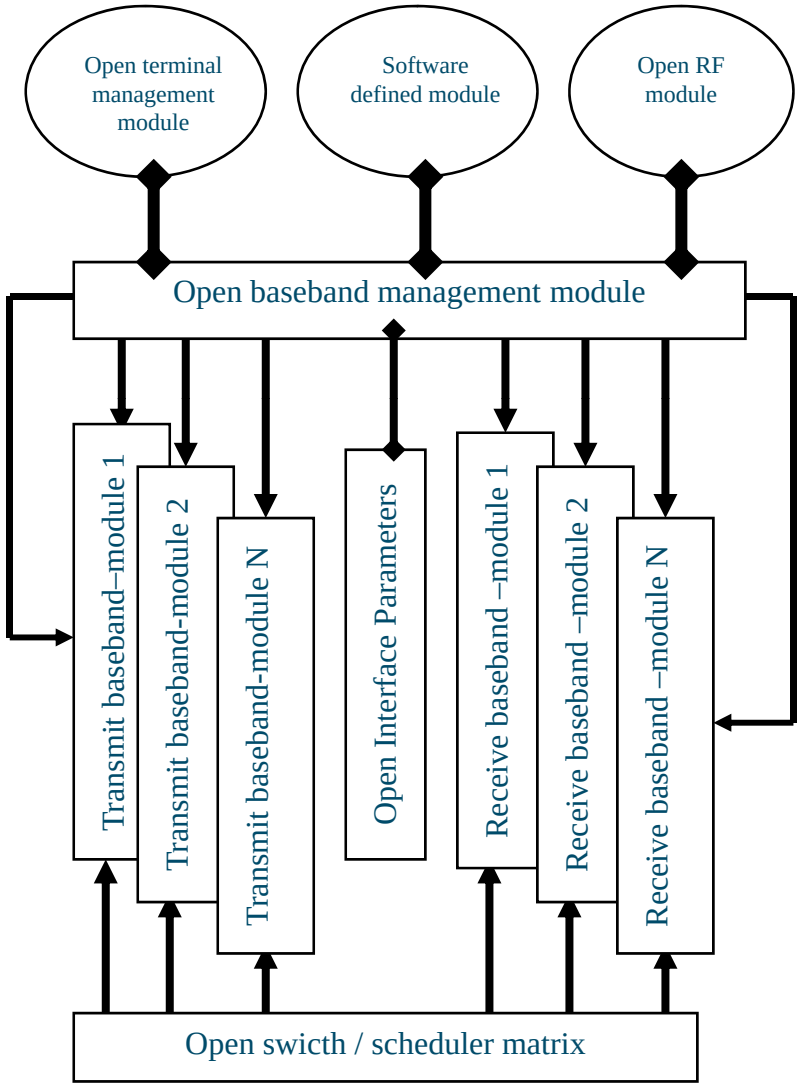
"The reason we had Apple Computer is because we defined the Open Computer Architecture,

The reason we had Cisco Systems is because we defined the Open Network Architecture,

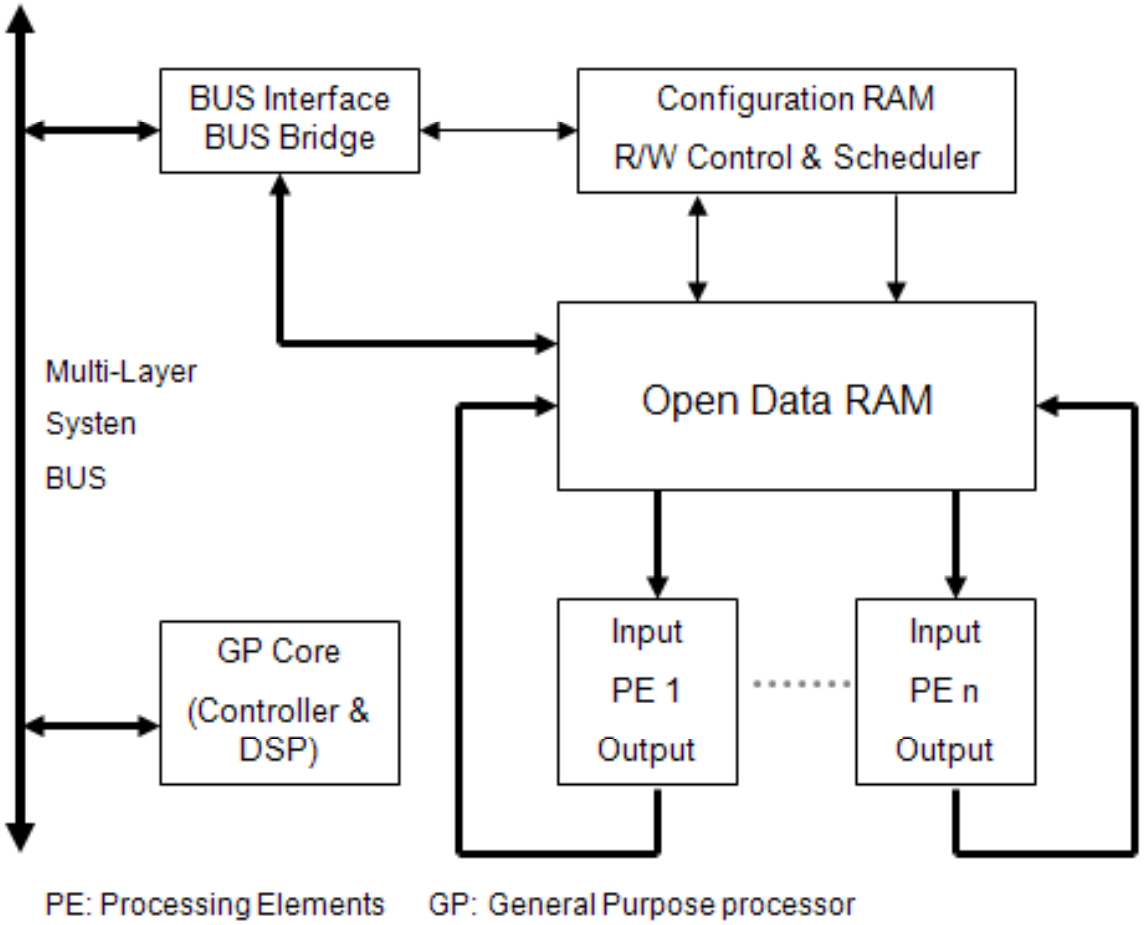
The world is at the edge to define the Open Wireless Architecture (OWA) to liberate the whole wireless industry."

Prof. Willie W. Lu, GMC'2005 in Chongqing of China
(Xinhua News, Oct. 12, 2005, Chongqing)

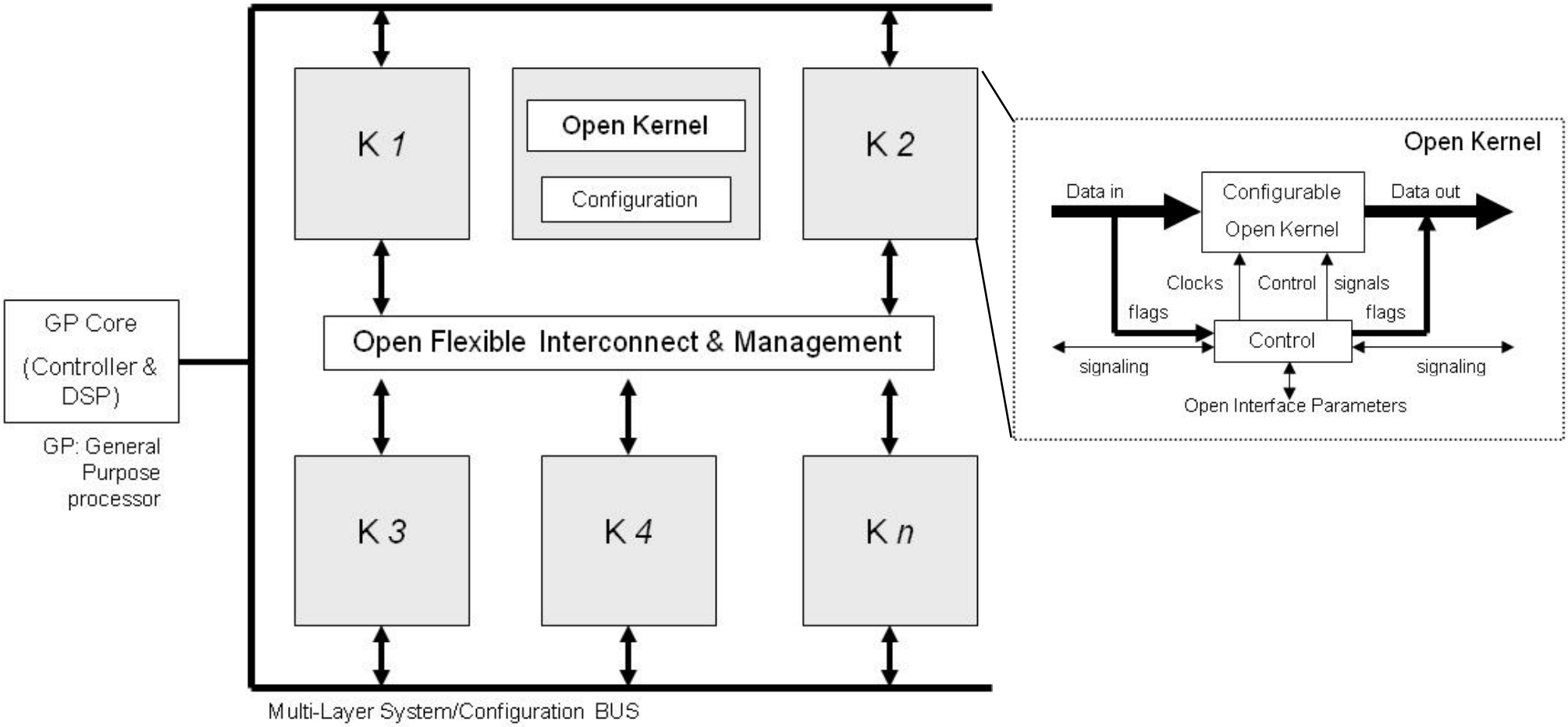
Open Baseband Software Architecture



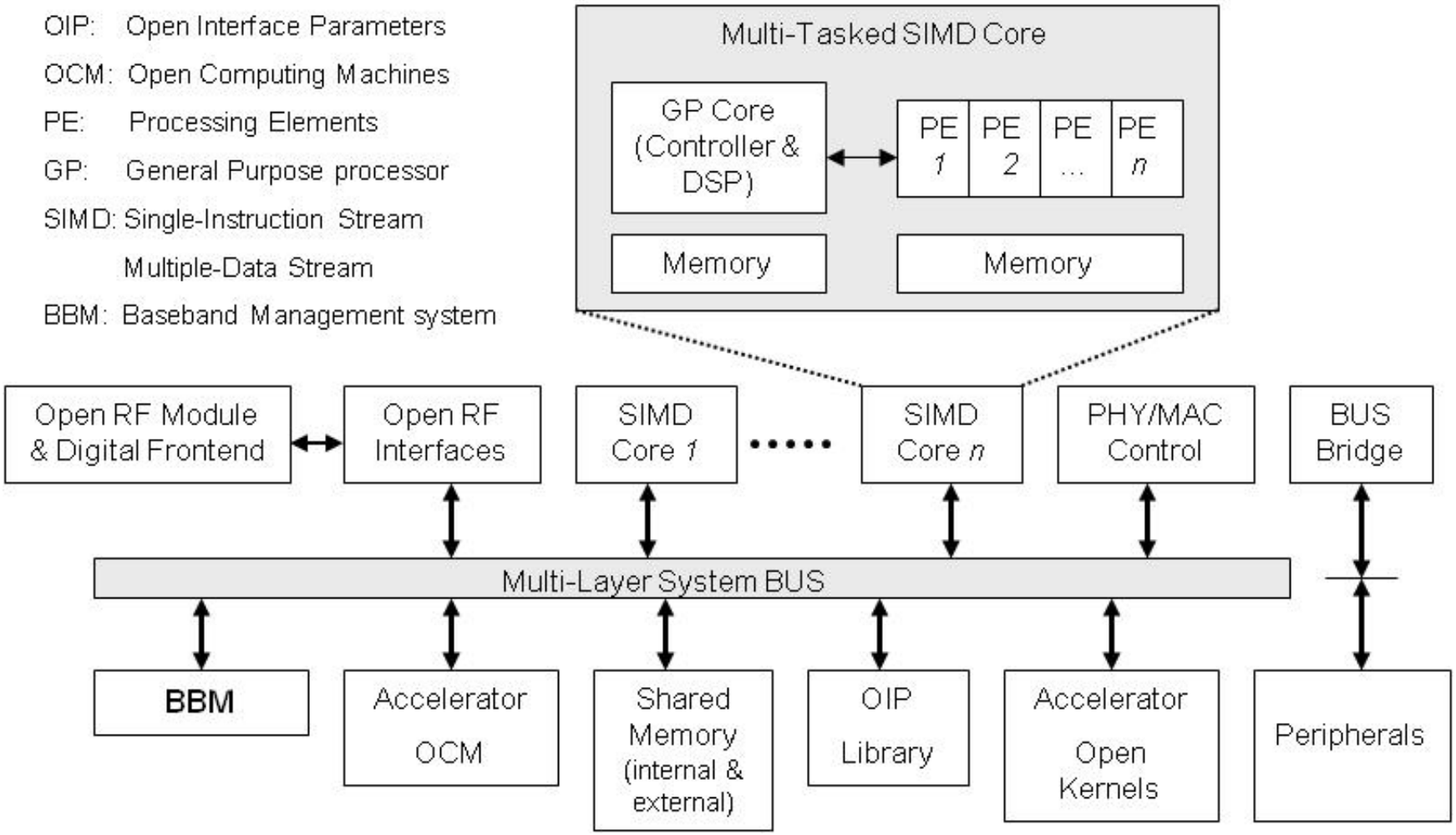
Baseband Open Computing Machines (OCM) Accelerator Architecture



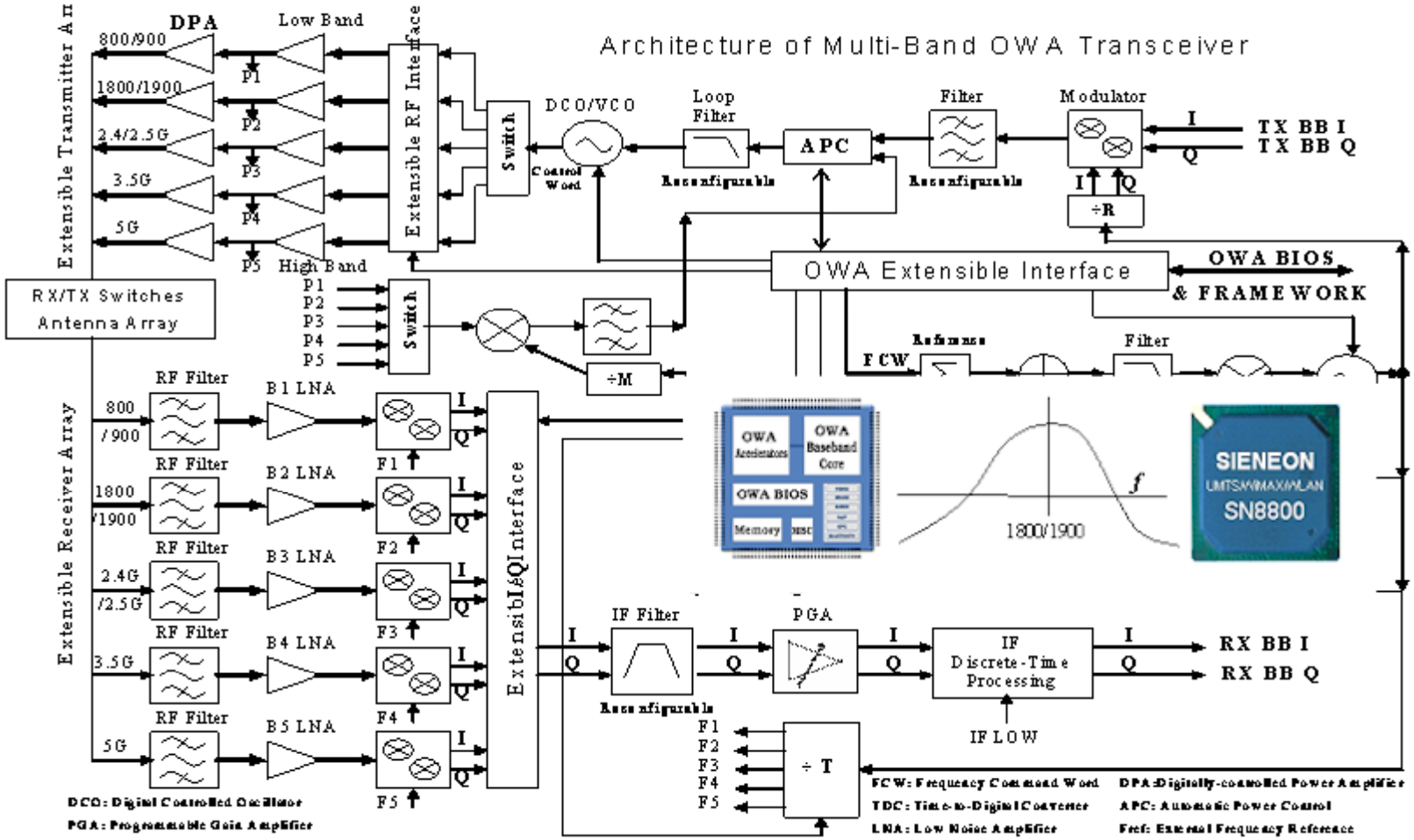
Open Baseband Processing Kernel Architecture



Open Baseband Processing Platform



OWA Multi-band Transceiver



Source : Dataquest (2000), IDC (1999)

End-user interaction will evolve from many purpose-specific devices to integrated smart environments

STAGE1 : TRADITIONAL DEVICES

- Individual standalone devices
- Traditional Form factor e.g. phones, PC, printer
- Wire-based point-to-point connections e.g. PC to printer

STAGE2 : DEVICE BOOM

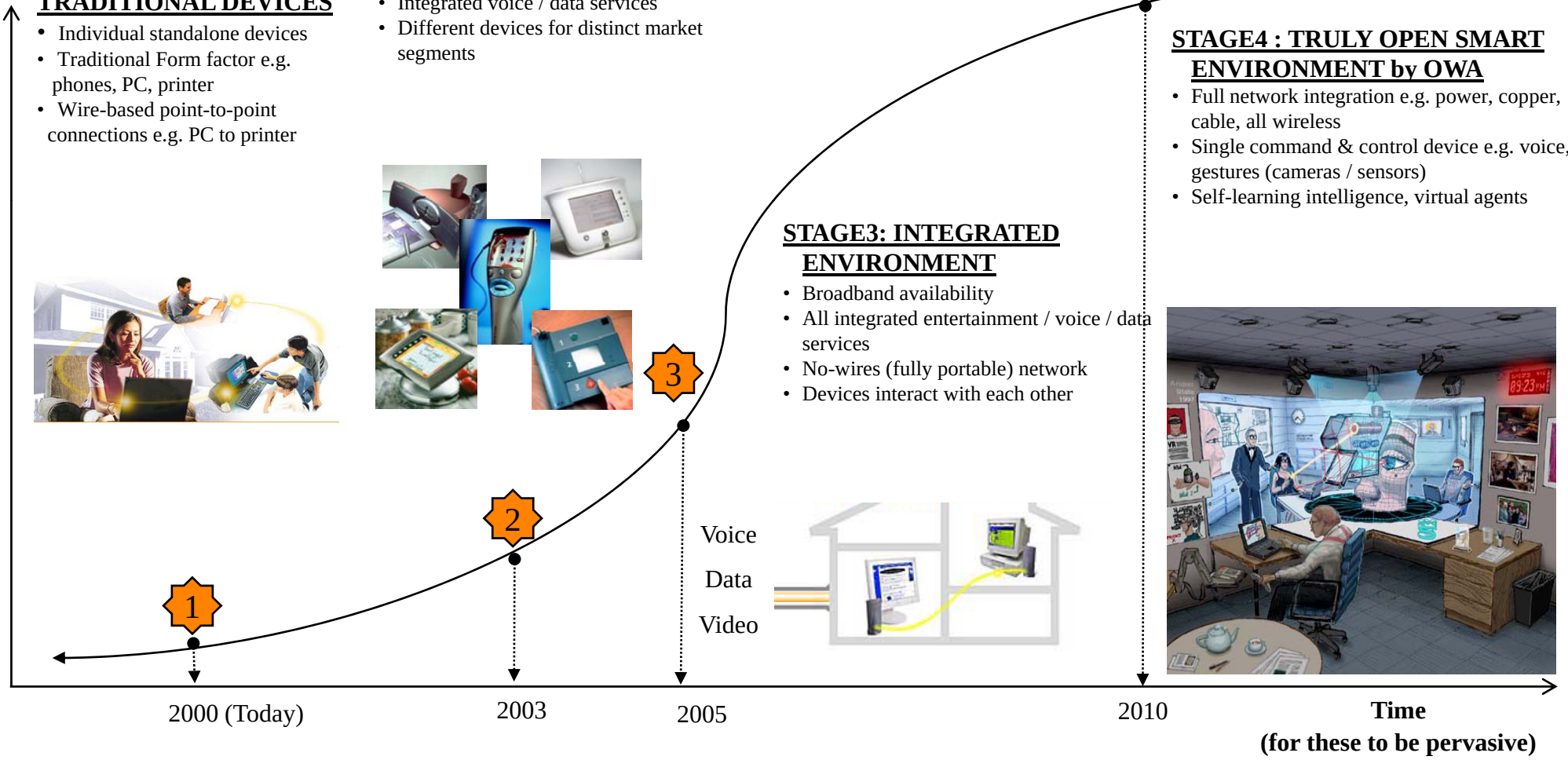
- Non-traditional device proliferation
- Integrated voice / data services
- Different devices for distinct market segments

STAGE3: INTEGRATED ENVIRONMENT

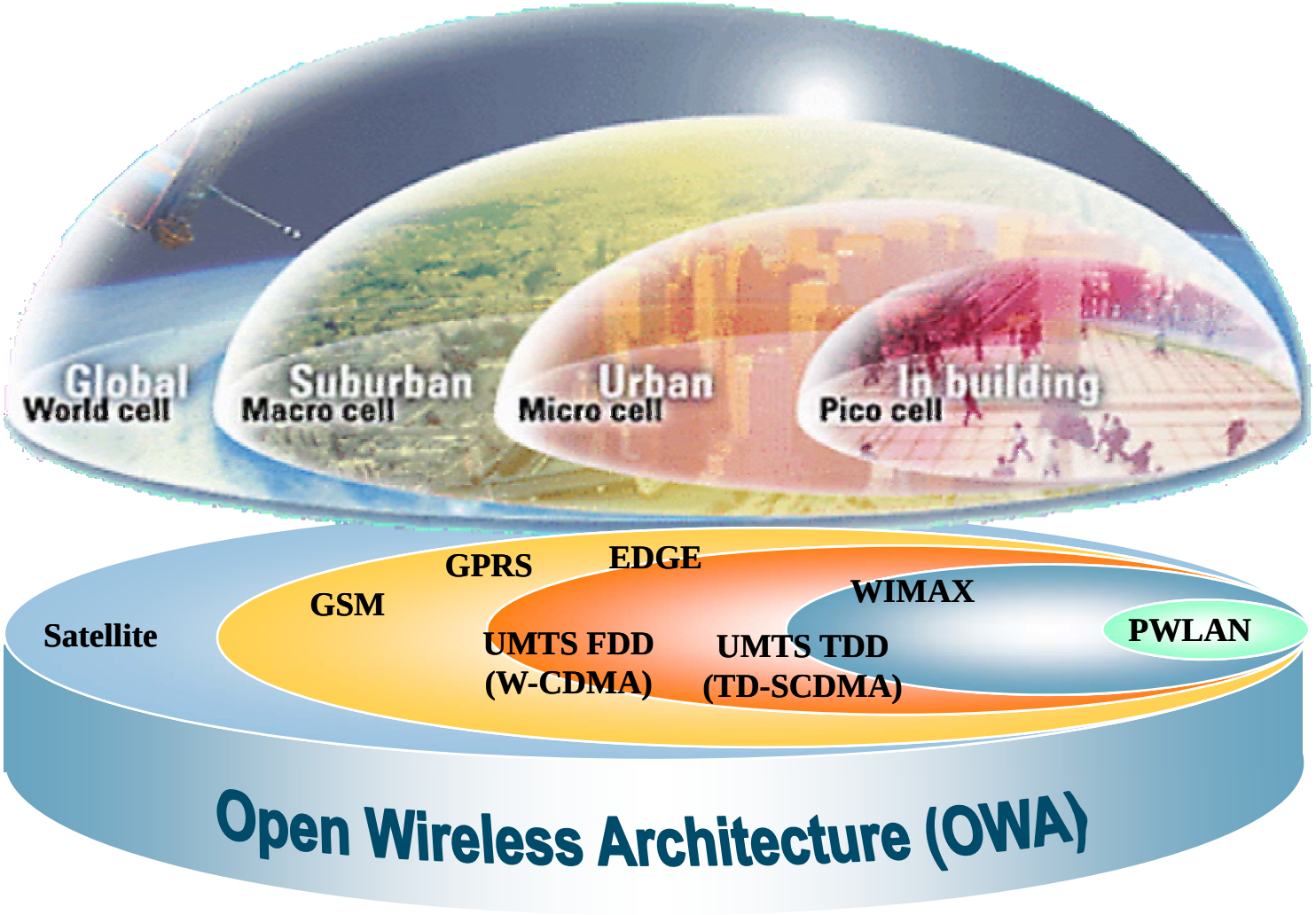
- Broadband availability
- All integrated entertainment / voice / data services
- No-wires (fully portable) network
- Devices interact with each other

STAGE4 : TRULY OPEN SMART ENVIRONMENT by OWA

- Full network integration e.g. power, copper, cable, all wireless
- Single command & control device e.g. voice, gestures (cameras / sensors)
- Self-learning intelligence, virtual agents



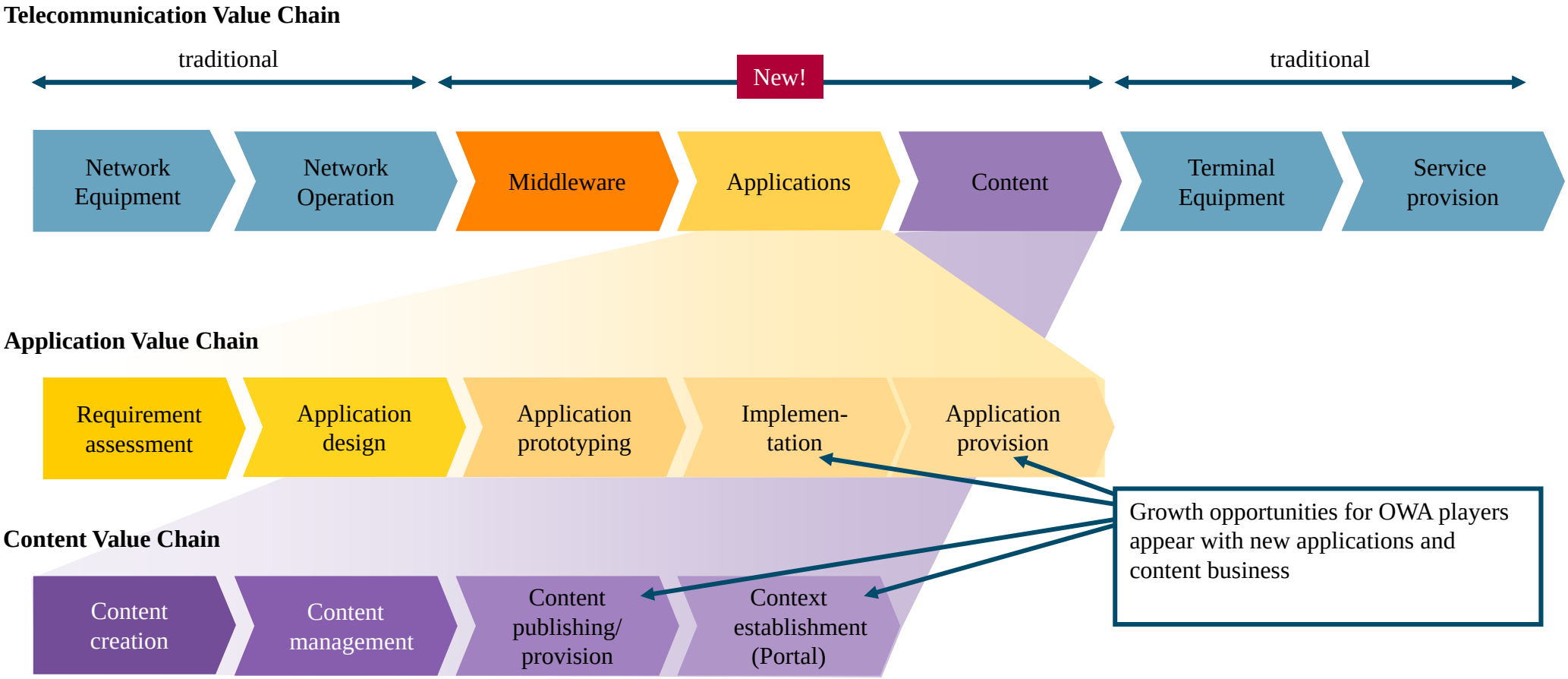
Interoperable Open Radio Access Technologies Provide Optimal Response to End User Needs



-Best for Spectrum Management
- Access vs. Mobile
- Spectrum Sharing
- Spectrum Recycling

Open Convergence – The Key for New Mobile Value Chain

Mobile Data Value Chain – Applications and Content are the Main Challenges and Opportunities in the New Mobile Data Value Chain



Source: Siemens

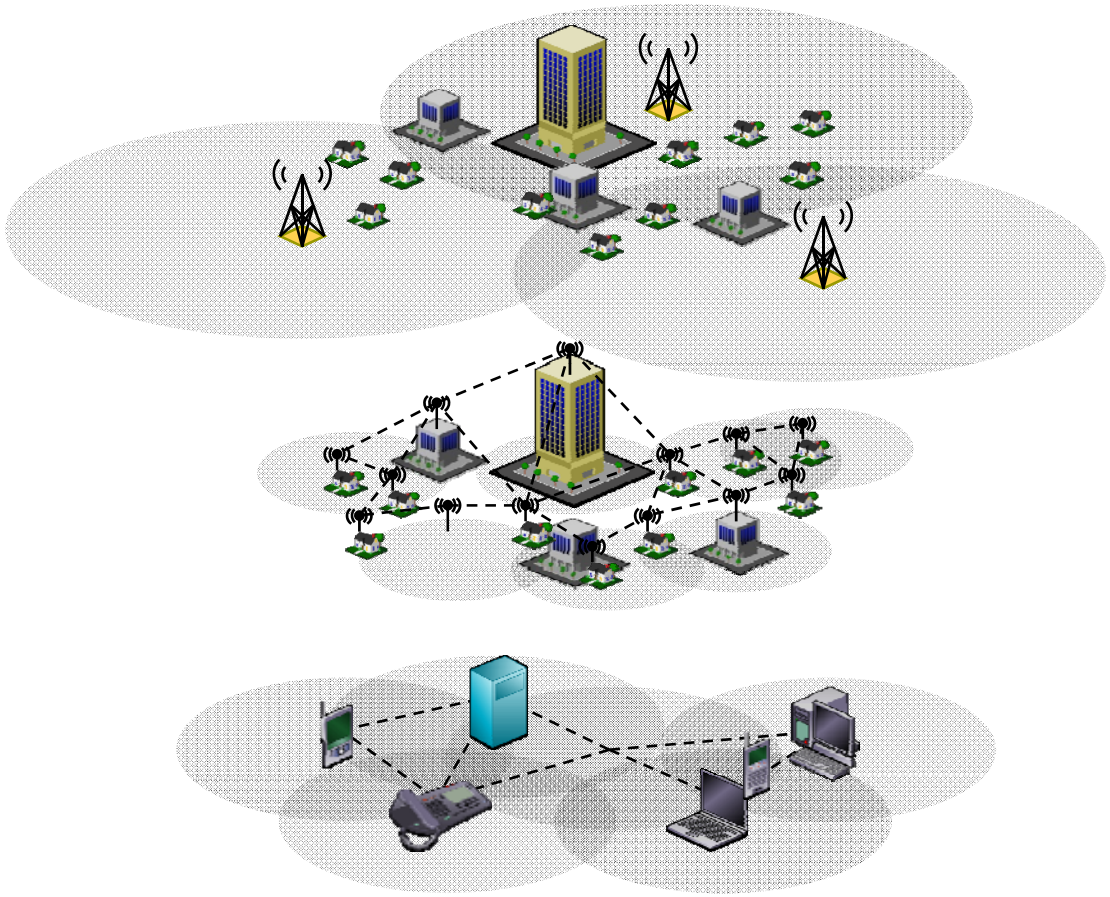
Open Convergence will Boost the New Mobile Business Model

Business Models – Customer Focus & Services Portfolio – What is the Main Focus of the Different Business Models?

	Mobile Communications Provider	Mobile Data Platform Provider	Integrated Mobile Service Provider
Description	Offers mobile network & Internet access + content-independent services	Mobile Communications Provider offering also content-independent services	Mobile Data Platform Provider offering also content-dependent services/ applications as well as operates portal
Product/ Services Portfolio – Retail	■ Mobile network & Internet access + ■ Content-independent services (voice, data, fax, SMS, e-mail, etc.) to end-users	■ Mobile network & Internet access + ■ Content-independent services to end-users	■ Mobile network & Internet access + ■ Content-independent services + ■ Content-dependent/VA services ■ Context establishment/ portals ■ (Content development) + ■ (Applications) to end-users
Product/ Services Portfolio – Whole-sale	■ Wholesale - Mobile network & Internet access to other mobile data service providers	■ Wholesale - Mobile network & Internet access + ■ Platforms (incl. payment, user-location, hosting, etc.) to other mobile data service providers	■ Wholesale - Mobile network & Internet access + ■ Platforms (incl. payment, user-location, hosting, etc.) to other mobile data service providers

Source: Siemens

The Un-Wiring of the Future through OWA Routing



Mobility / WWAN

- *A Million nodes @ $50k*

Nomadic / Mesh / WLAN

- *Millions of Nodes @ $100*

Sensor / Ad-hoc / WPAN

- *Billions of Nodes @ $1*

…connected through the OWA Packet Networks

4G Investment Hotspots

Open
Application & OS
Platform

Venture Technologies

Open
RF &
Antenna

Terminal
Power

Spectrum
Management

Open
Network
Core

B3G/4G
OWA

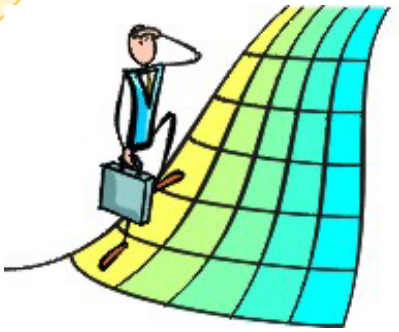
Radiation
& Safety

Security

Module
Control

Access
Control

Open
Signal
Processing



Definations of Future Radio Proposals

Software defined radio: A radio in which the preset operating parameters including *inter alia* frequency range, modulation type, and/or output power limitations can be re-set or altered by software.

Reconfigurable radio: Reconfigurable radios are radios whose hardware configuration and software can be changed under software control.

Cognitive radio: A radio or system that senses and is aware of its operational environment and can dynamically, autonomously, and intelligently adjust its radio operating parameters.

Open Wireless Architecture (OWA): defining the open interfaces in wireless networks and systems so that users can buy different parts from various vendors. OWA system is upgradeable and extensible. In addition, the system can support various standards through open interface parameters. OWA will converge with open computer architecture and open network architecture.

OWA Product Definition (RF, BB, NET, OS, APP)

- W-LAN/WCDMA/BT 3-in-1
- GSM/WiMax/TD-SCDMA 3-in-1
- Cdma2000/W-LAN/WIMAX 3-in-1
- WiMax/cdma2000/MIMO 3-in-1
- GSM/GPRS/UMTS/WLAN/WIMAX 5-in-1

Products change every 18 months, but architectures never change in at least 20 years