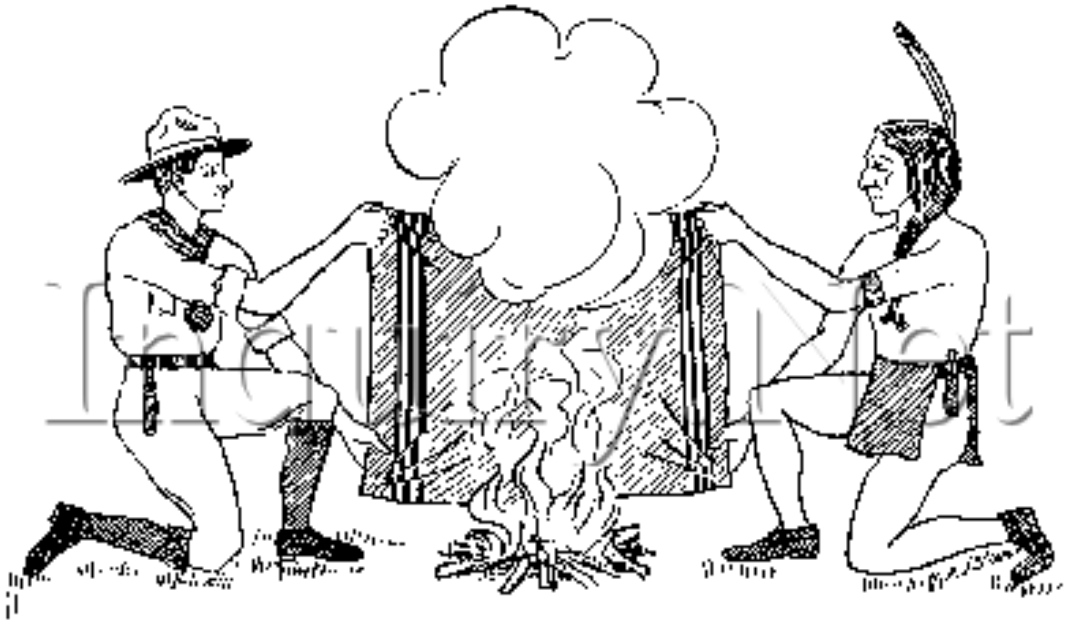
工程與生活

Wireless Technologies

電信所洪萬鑄

Wireless Communication ?



SMOKE SIGNALS

The Pioneers of Mobile Communication

It all started 100 years ago

Heinrich Hertz, 1857-1894

- Electromagnetic waves 1887

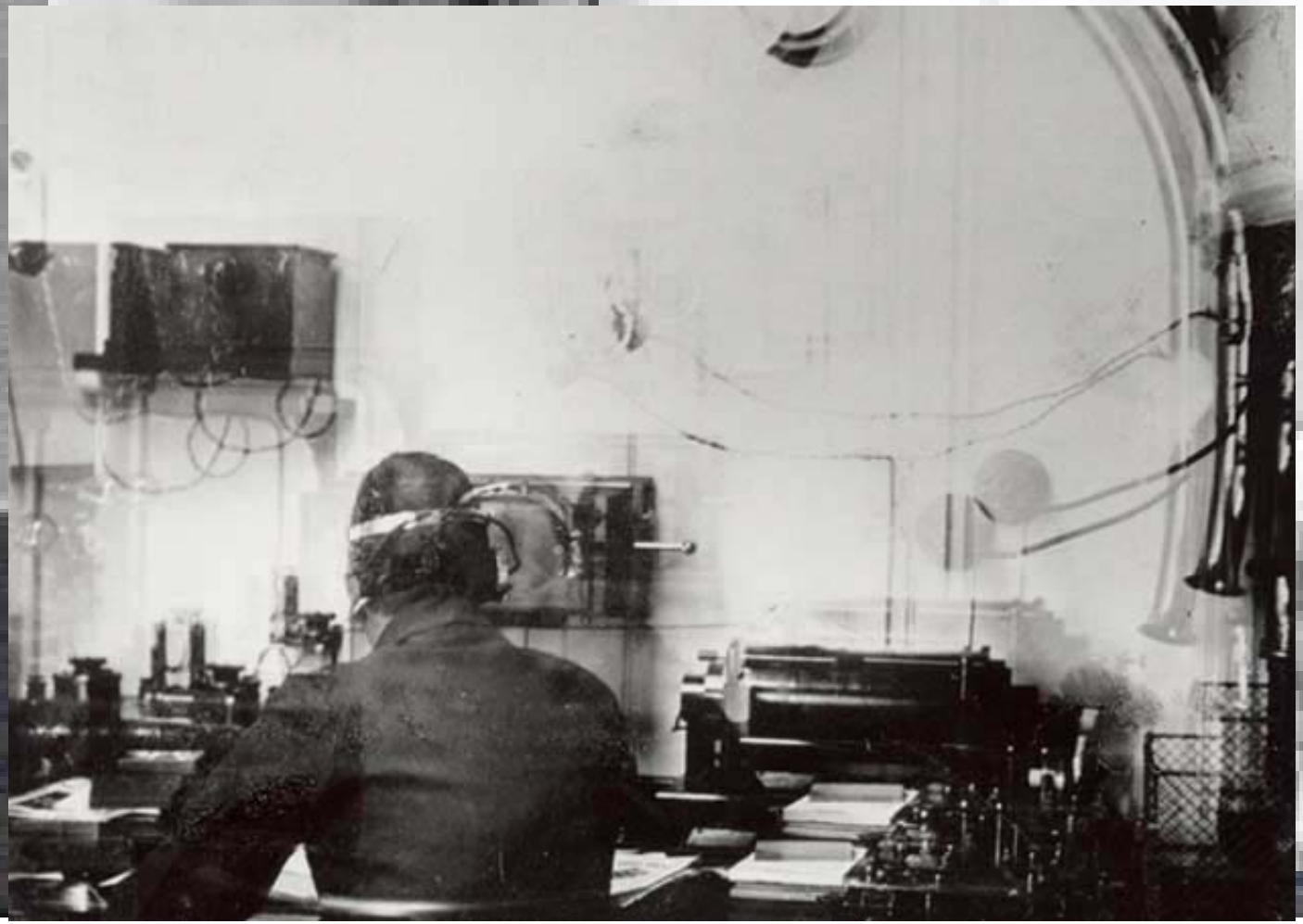
Guglielmo Marconi 1874-1937

- First radio 1897

Reginald Fessenden 1866-1932

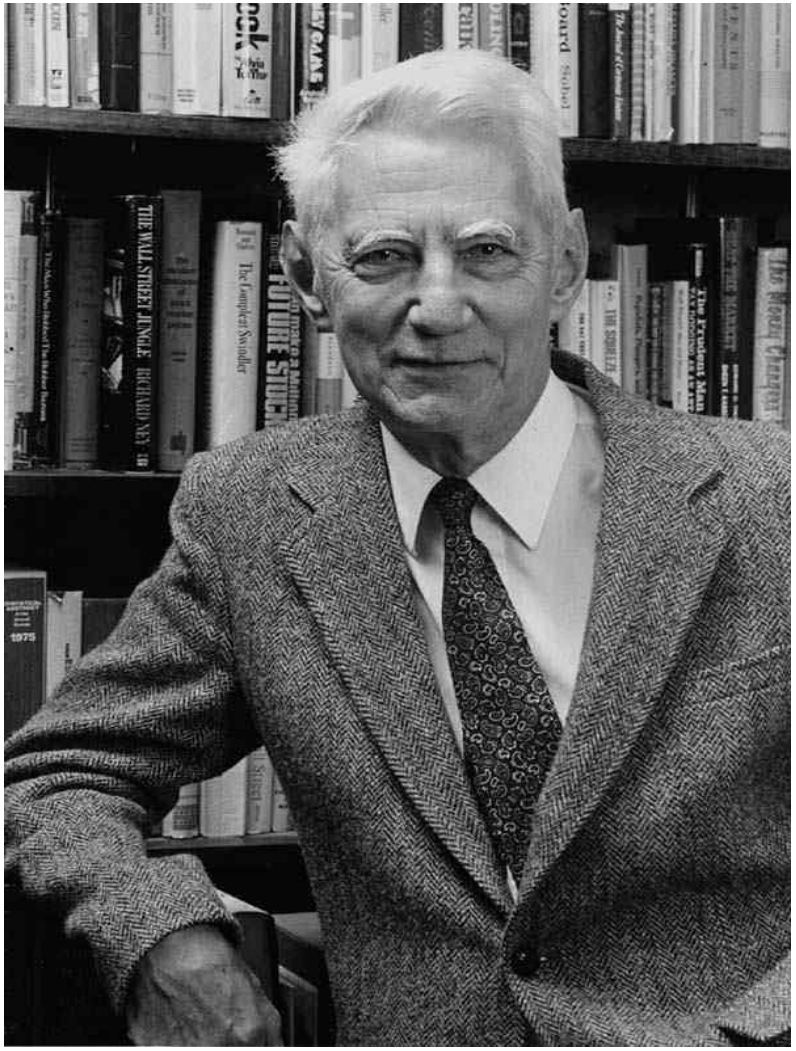
- Voice transmission over radio 1906

The Titanic



First Mobile Radio Telephone 1924

Claude Elwood Shannon



Claude Elwood Shannon

(1916 - 2001)

Father of Information Theory

Electrical engineer, mathematician, and native son of Gaylord. His creation of information theory, the mathematical theory of communication, in the 1940s and 1950s inspired the revolutionary advances in digital communications and information storage that have shaped the modern world.

This statue was donated by the Information Theory Society of the Institute of Electrical and Electronics Engineers, whose members follow gratefully in his footsteps.

Dedicated October 6, 2000
Eugene Daub, Sculptor

Winners of the 2010 Reader's Choice Awards

Best Smartphone:
HTC Hero
from Sprint

Apple Smartphone iPhone 4

第四代iPhone的供應鏈

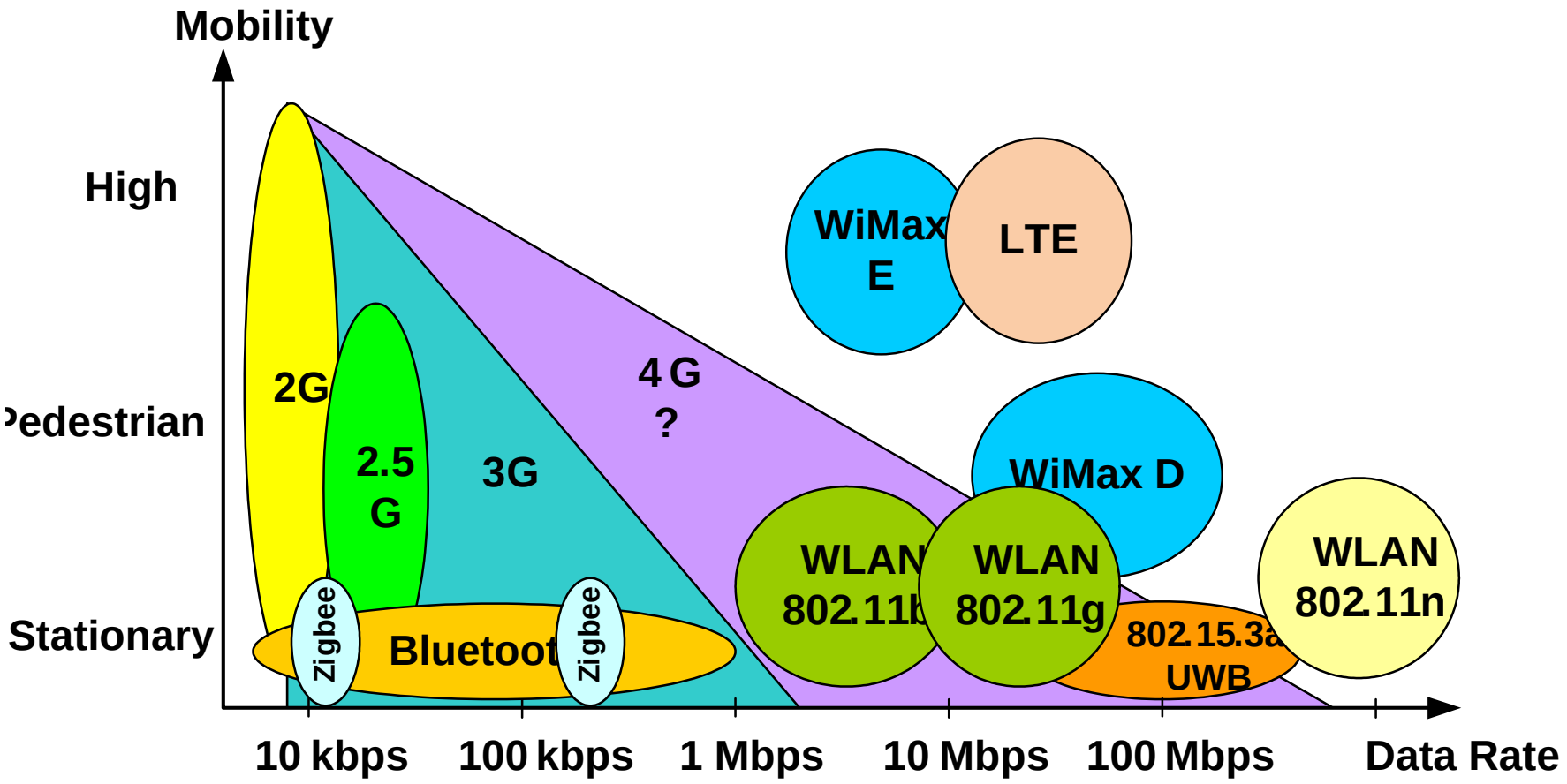
產品項目	廠商	占比(%)	與之前供貨比較
組裝	鴻海	100	未變動
觸控面板模組	宸鴻、勝華、新奇美	45、40、15	新增新奇美(原群創)
石英元件	晶技	45	原本15%，提高到45%
IC載板	景碩	100	未變動
鏡頭模組	大立光、玉晶光	80、20	新增玉晶光(僅視訊鏡頭，非500萬畫素鏡頭)
軟性銅箔基板	台虹	65	原本20%，提高到65%
檢測X-Ray機台	德律	100	未變動

資料來源：各公司　　鄧馨儀／製表

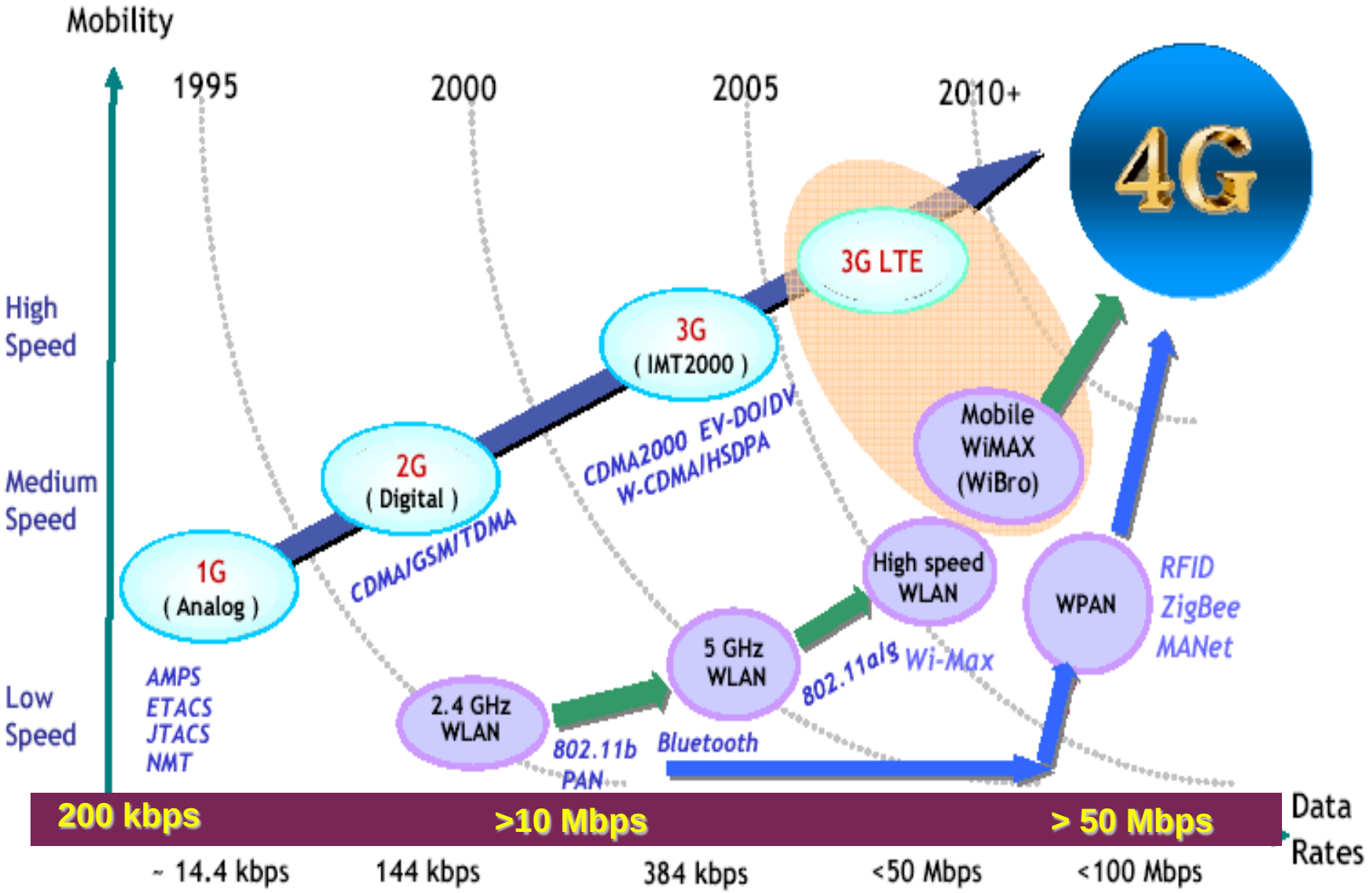
Wireless World Map

System	Application	Distance	Mobility	Data rate
ZigBee	Industrial	Short	Low	Low (< 1 Mbps)
Bluetooth	PC, Cell phone	Short	Low	Medium (~ 1 Mbps)
UWB	Home appliances	Short	Low	High (> 50 Mbps)
WiFi	PC network	Medium	Low	High (> 100 Mbps)
WiMAX fixed	Internet Service	Long	Low	Medium
2/2.5 G Cellular	Voice + low rate data	Long	Medium	Low
3/3.5G Cellular	Voice + Internet	Long	High	Medium
4G Cellular WiMAX & LTE	Voice + ??	Long	High	High
4G Advanced	Voice + ?? + ??	Long	High	Very high (> 200 Mbps)

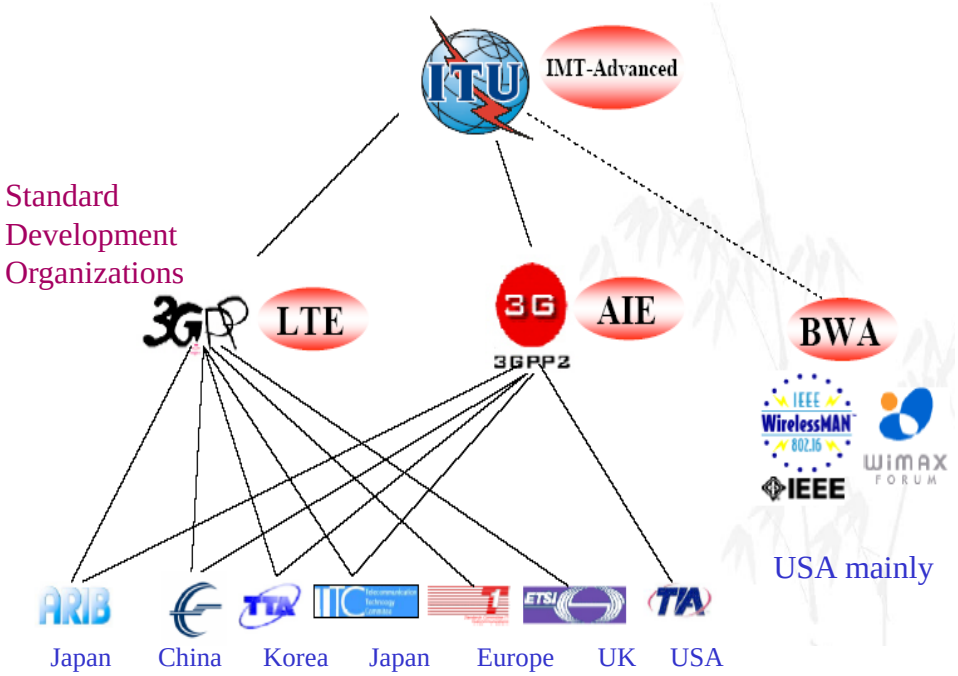
Wireless Map



All Roads Lead to 4G (Eventually)



What is 4G? ITU-Rs' Perspective



- **A high degree of commonality of functionality worldwide while retaining the flexibility to support a wide rage of services and applications.**
- **Capability of inter-working with other radio access systems.**
- **Capability of services within IMT and with fixed networks.**
- **Enhanced peak data rates 100Mbps for high mobility and 1Gbps for low mobility**

Players in the 4G Battle

- WiMax (802.16e)
- LTE (3GPP)

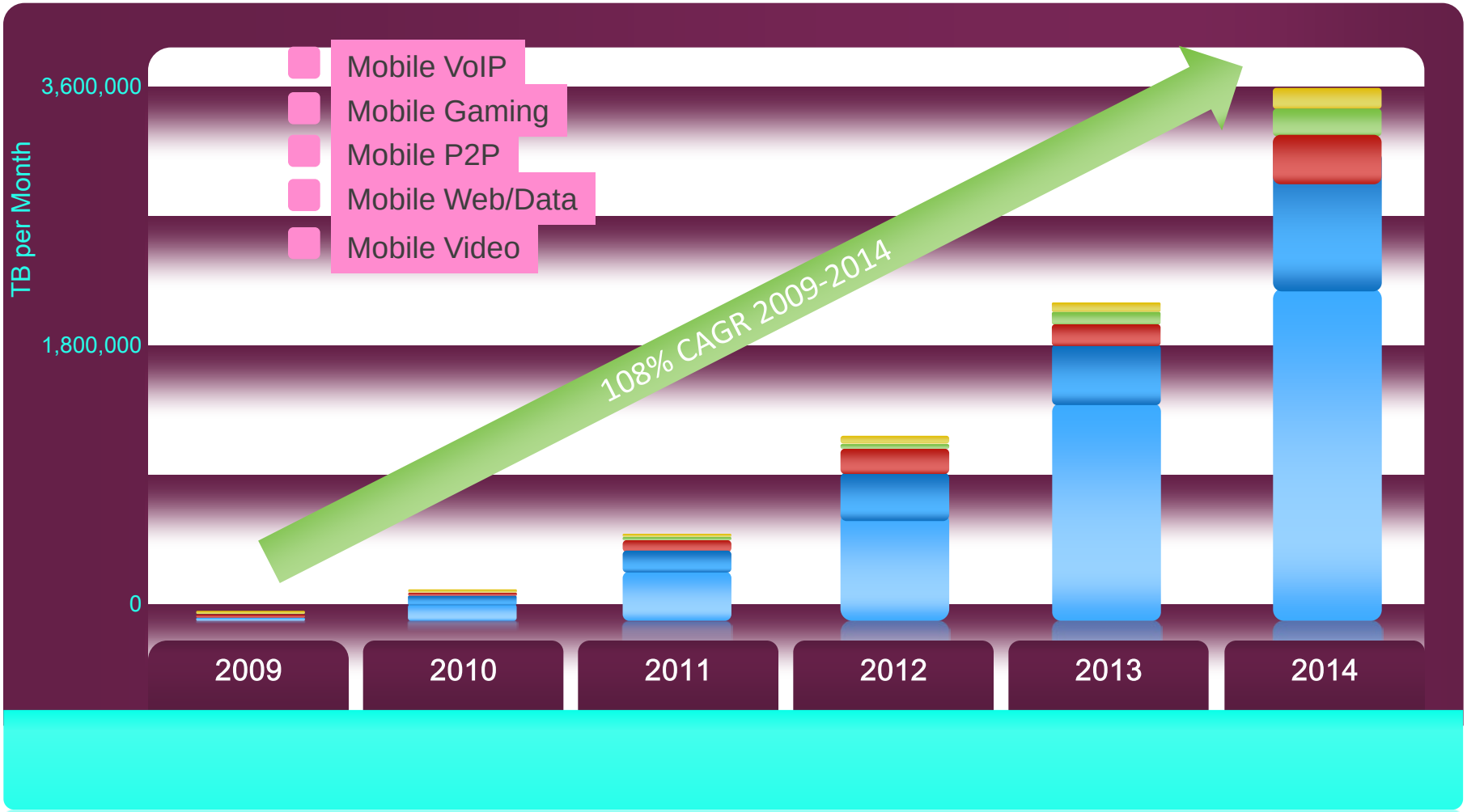
22 Billion Internet-Connected Things

The number of devices connected to the Internet is expected to hit 5 billion this month, says IMS Research, and will reach 22 billion by 2020.

Killer 4G Application: Cloud Computing Goes Mobile

- All their stuff in the palm of their hands 24x7.
- Open ecosystem of applications, content and devices.
- User generated content.
- Business content.
- Demands true broadband connectivity.

Mobile Growth by Traffic Type

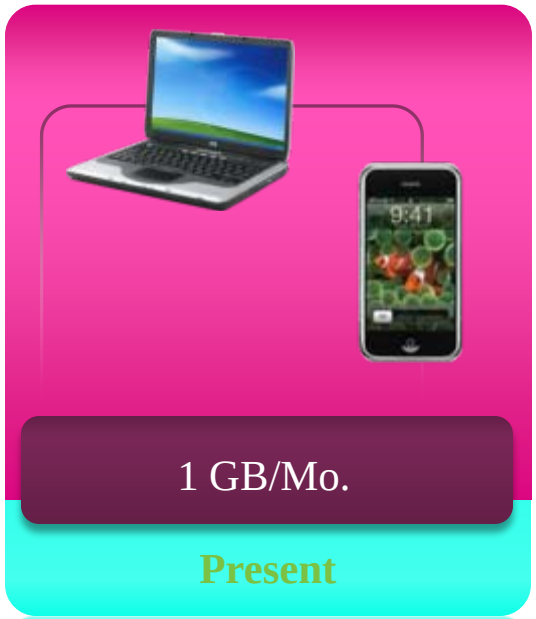


Source: Cisco VNI Mobile, 2010

The World in the Palm of Your Hand

30 MB/Mo.

Past



1 GB/Mo.

Present

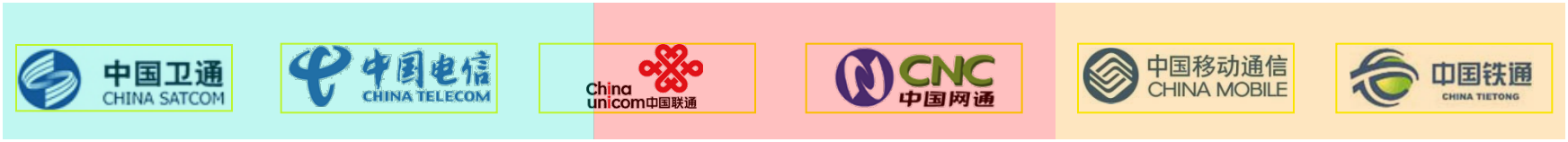
14 GB/Mo.

Future

Smartphones will outship the global notebook + netbook market in 2010 and the global PC market (desktop + notebook + netbook) in 2012.

Morgan Stanley Mobile Internet Report

配合趨勢電信業者版圖整合 範例: China



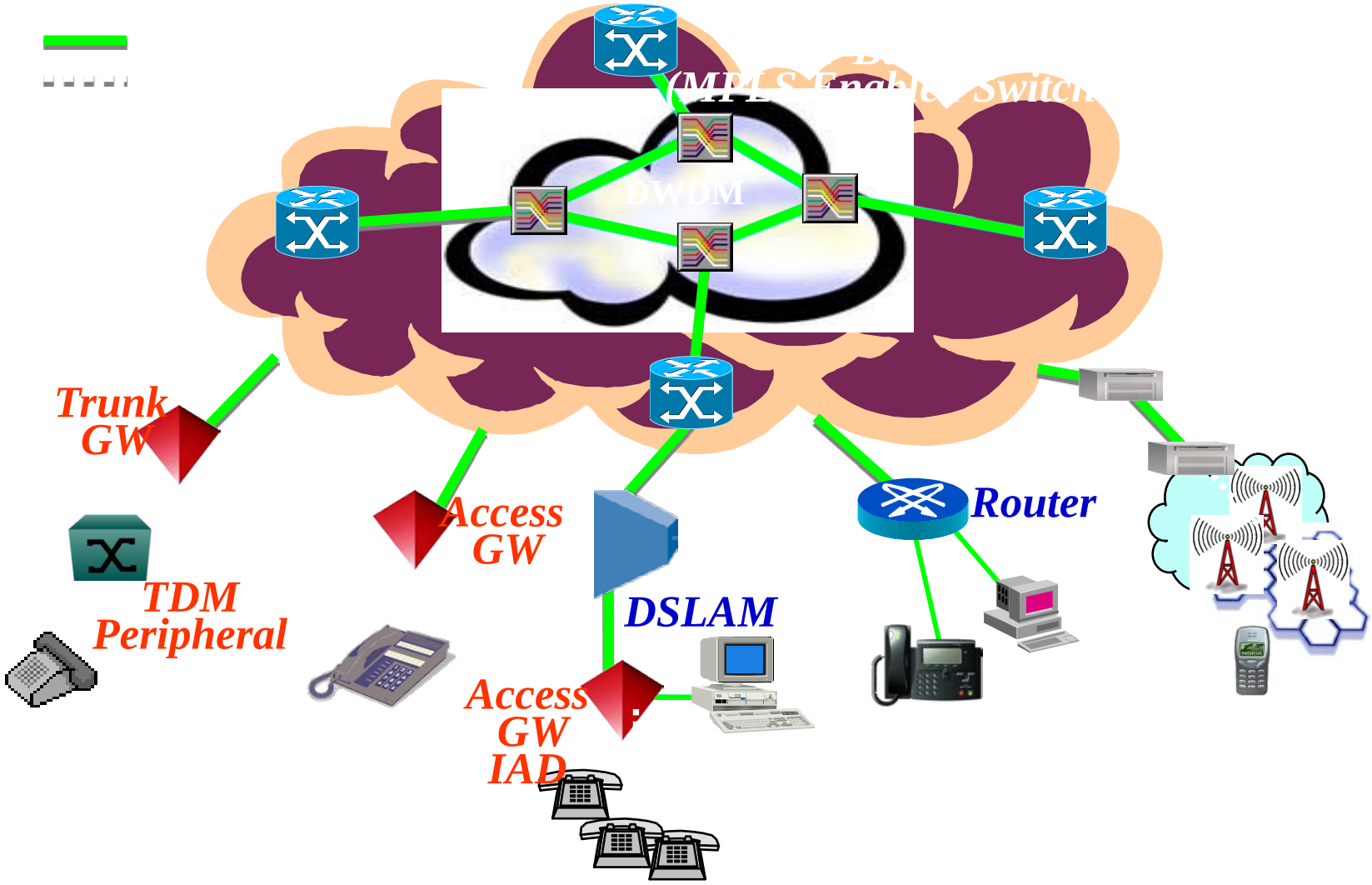
中国电信 CHINA TELECOM	
Wireless	43.81 M
Phone	196.17 M
Internet	50.56 M
2G: CDMA	
3G: CDMA2000	
4G: LTE	

China unicom中国联通	
Wireless	142 M
Phone	107.6 M
Internet	36.6 M
2G: GSM	
3G: WCDMA	
4G: LTE	

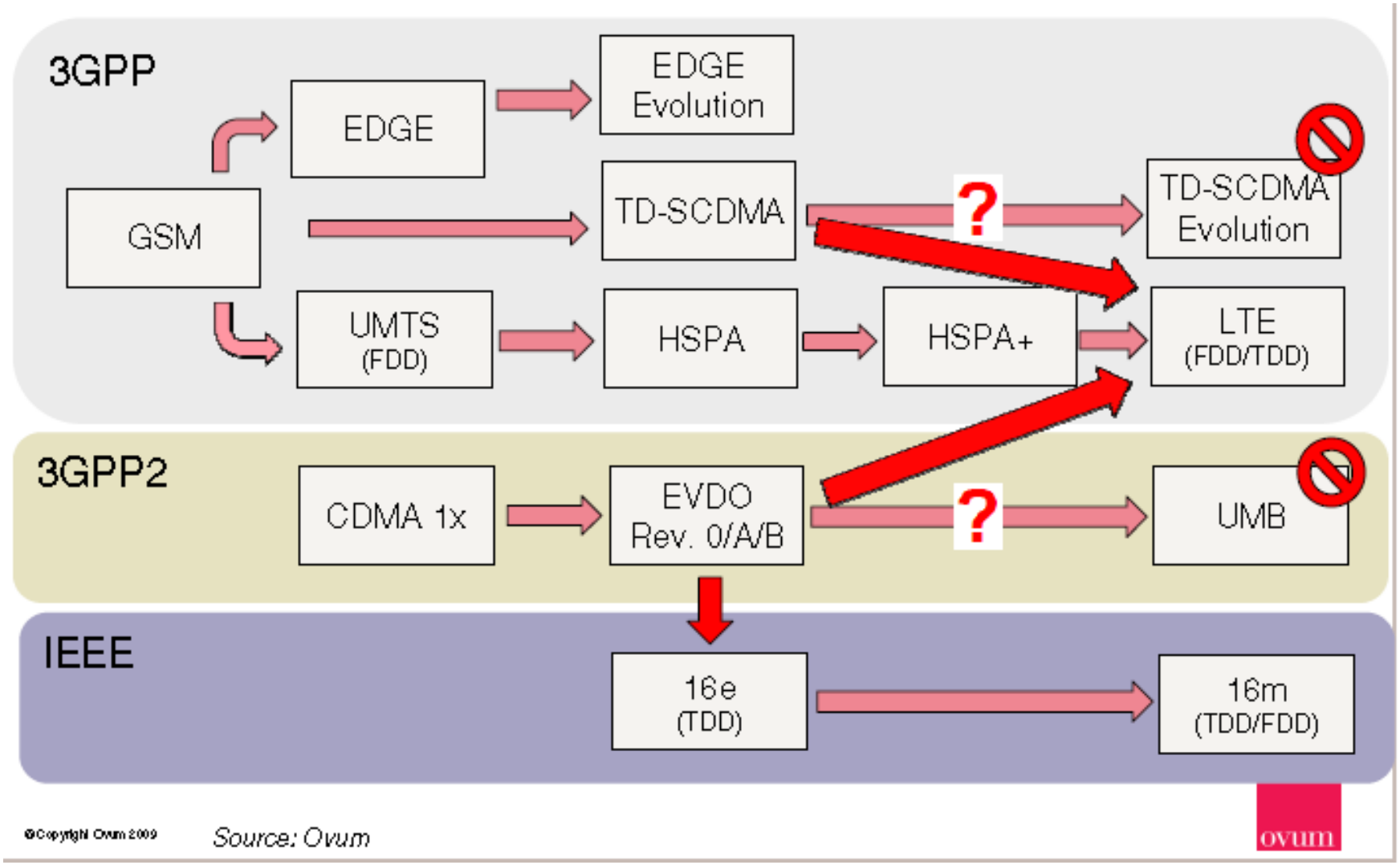
中国移动通信 CHINA MOBILE	
Wireless	502.9M
Phone	in millions*
Internet	in millions*
2G: GSM	
3G: TDS-CDMA	
4G: LTE	

* Till Aug 2009

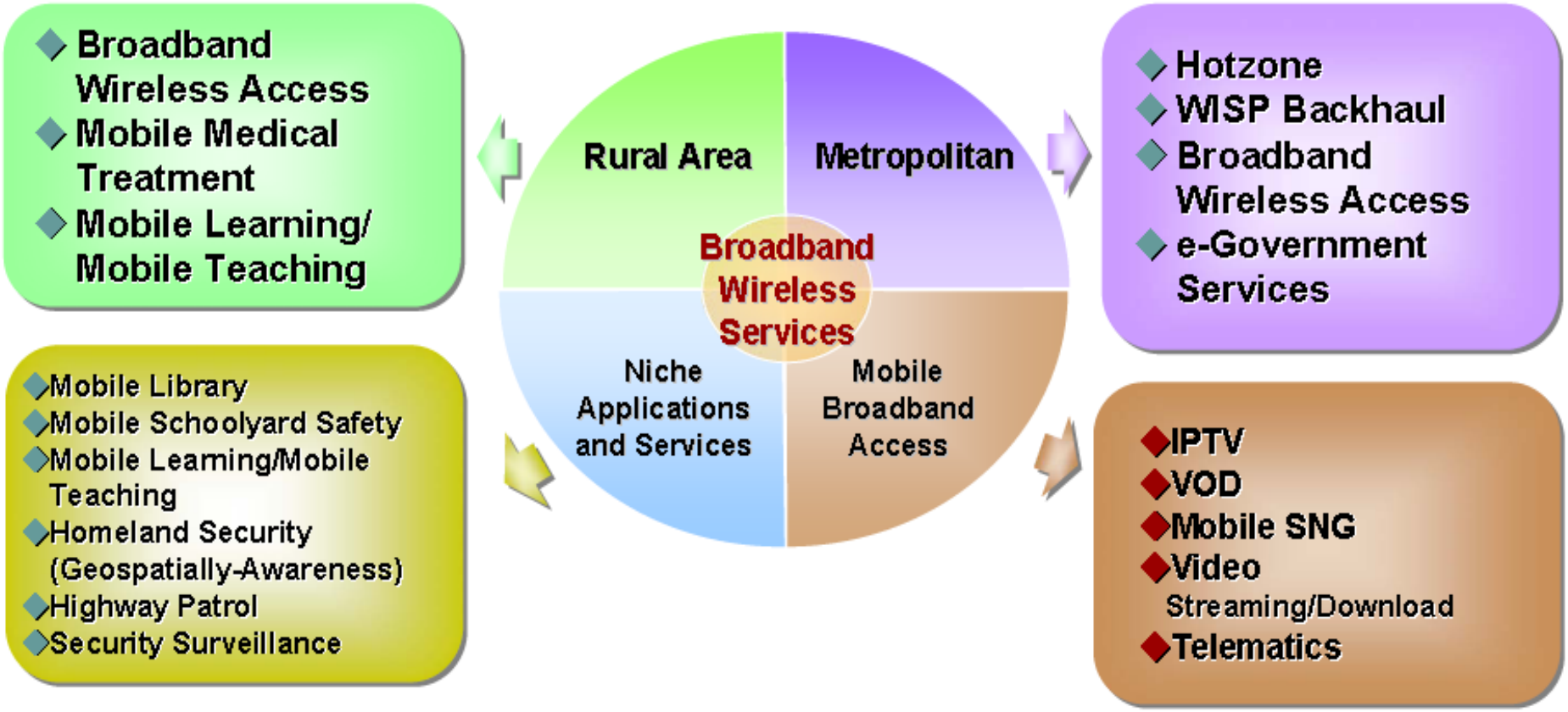
有線、無線電話網路骨幹IP化參考模式



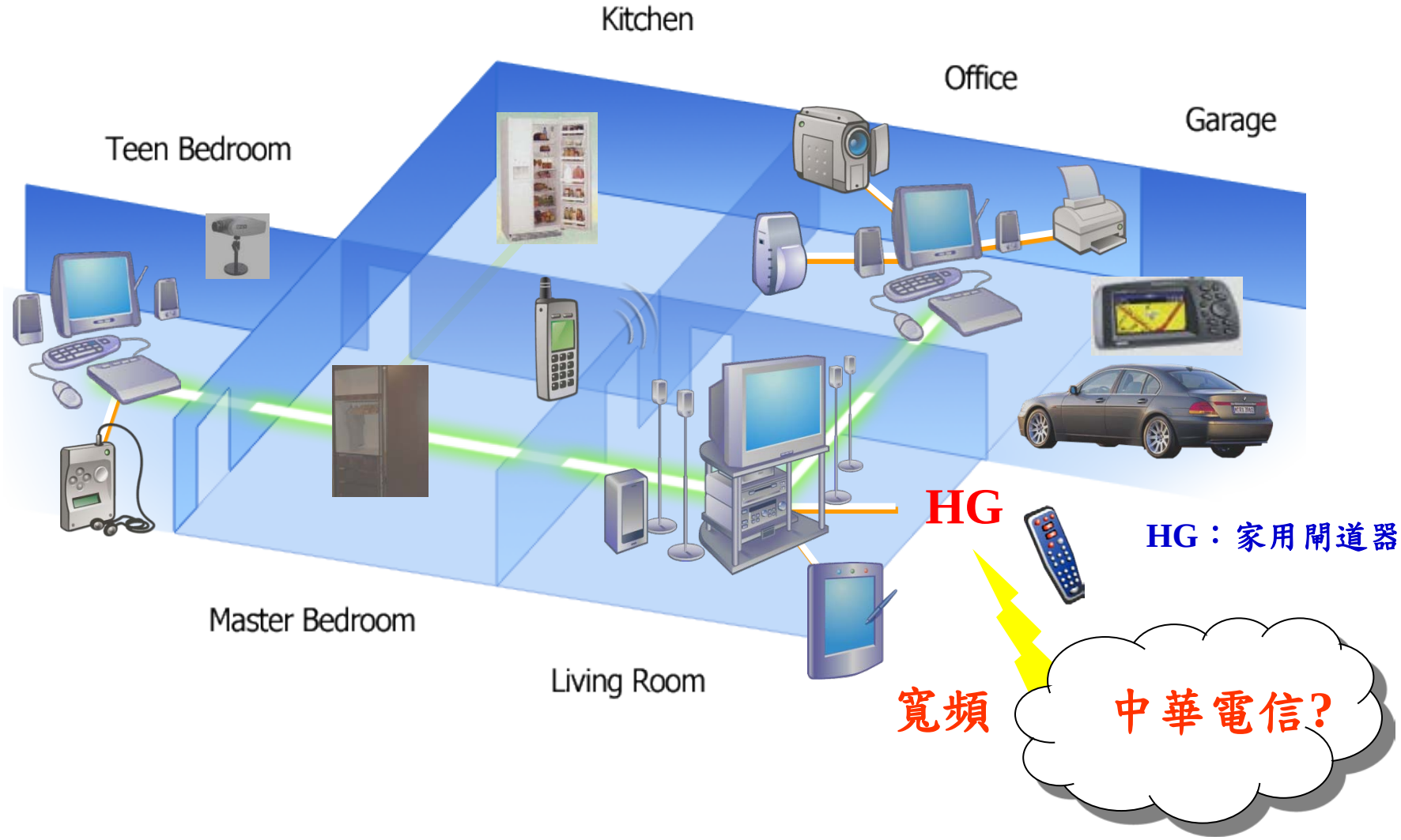
無線網路(個人行動)戰場：LTE v.s. WiMAX



寬頻無線上網服務應用


Broadband Wireless Access
Mobile Medical Treatment
Mobile Learning/ Mobile Teaching
Mobile Library
Mobile Schoolyard Safety
Mobile Learning/Mobile Teaching
Homeland Security (Geospatially-Awareness)
Highway Patrol
Security Surveillance
Rural Area
Metropolitan
Broadband Wireless Services
Niche Applications and Services
Mobile Broadband Access
Hotzone
WISP Backhaul
Broadband Wireless Access
e-Government Services
IPTV
VOD
Mobile SNG
Video Streaming/Download
Telematics

未來的戰場：家庭網路


Kitchen
Office
Garage
Teen Bedroom
Master Bedroom
Living Room
HG
HG：家用閘道器
寬頻
中華電信?

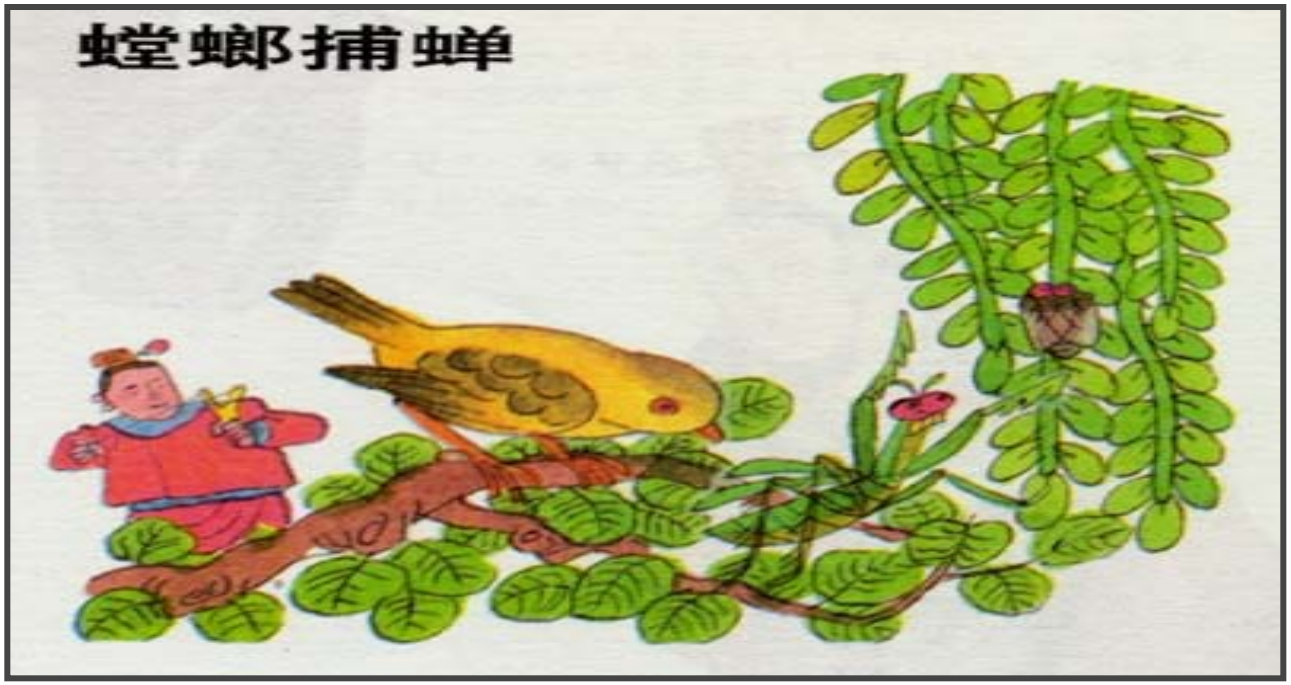
Wireless Health

The wireless future of medicine

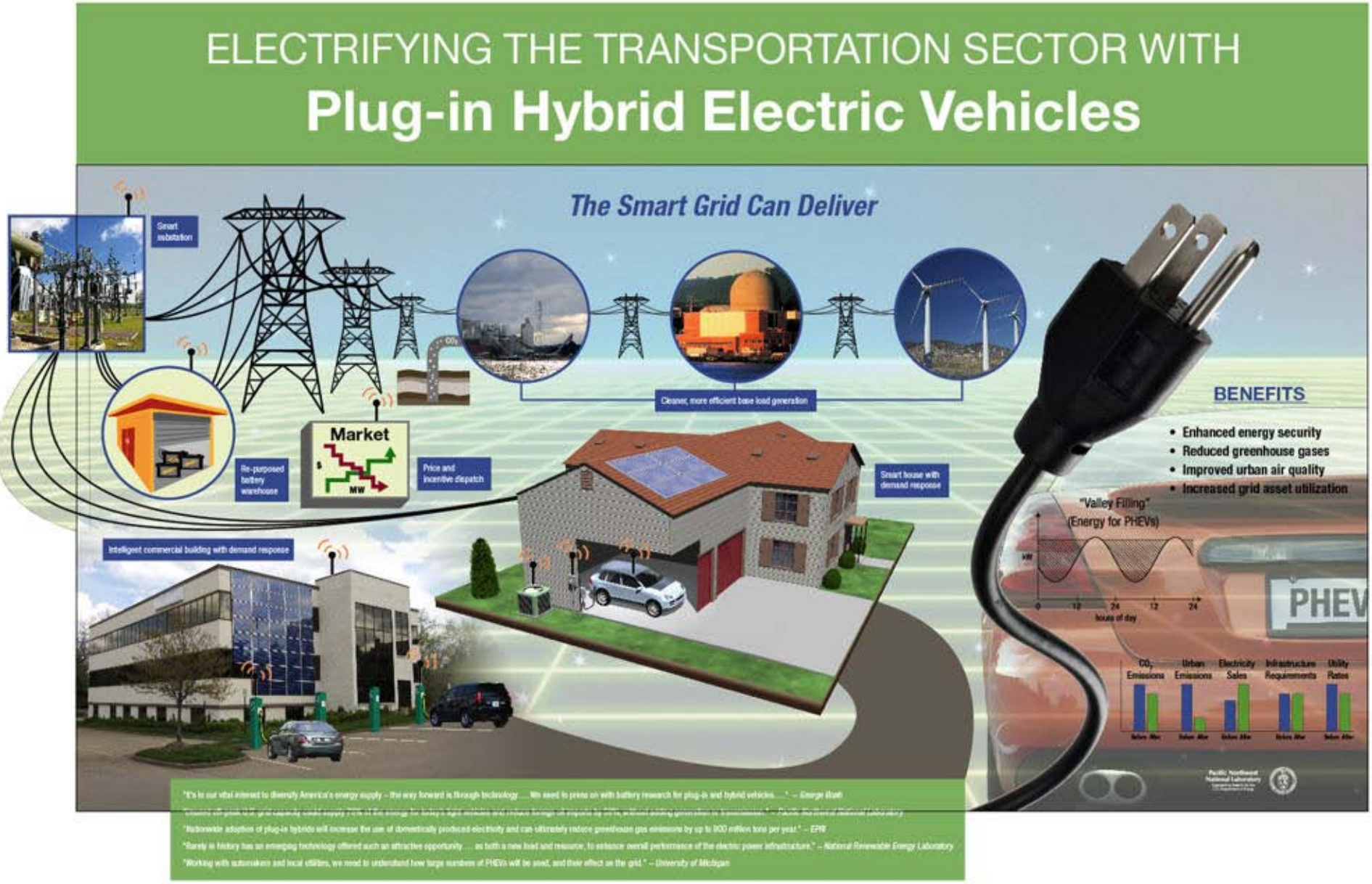
Qualcomm

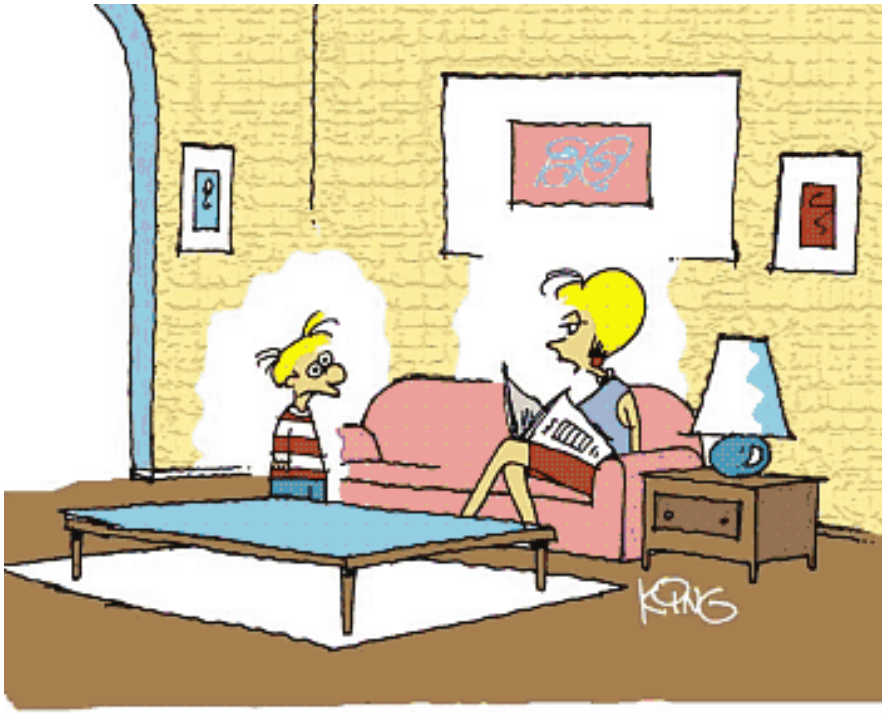
Interplay among Alternative Technologies

- The Game
- The hunter has the power to decide who wins



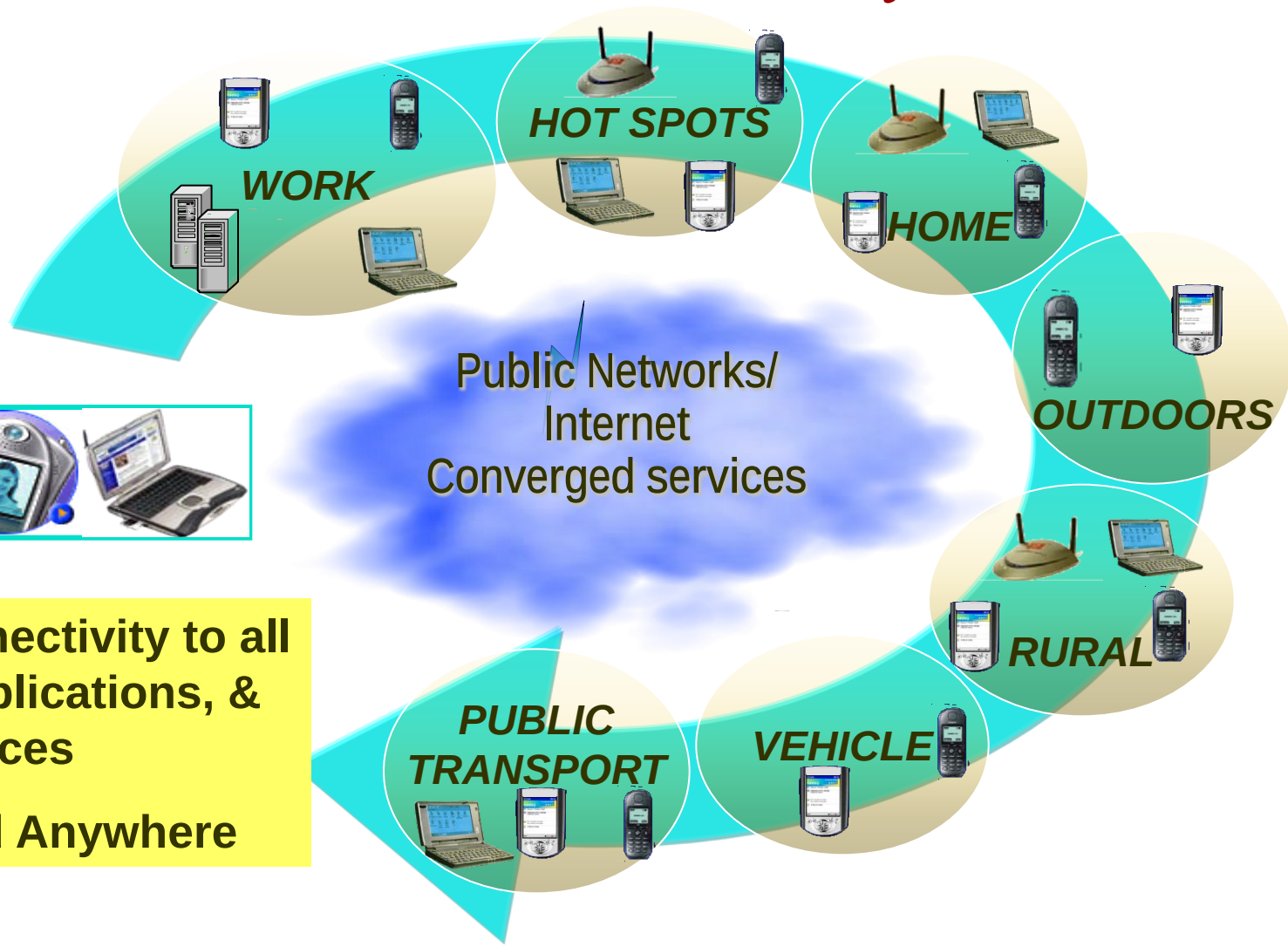
From Dr. C.K. Mao: Telecom Regulation (APEC Workshop)


ELECTRIFYING THE TRANSPORTATION SECTOR WITH
Plug-in Hybrid Electric Vehicles
The Smart Grid Can Deliver
Smart substation
Re-purposed battery warehouse
Market
MW
Price and incentive dispatch
Cleaner, more efficient base load generation
Smart house with demand response
Intelligent commercial building with demand response
BENEFITS
• Enhanced energy security
• Reduced greenhouse gases
• Improved urban air quality
• Increased grid asset utilization
"Valley Filling"
(Energy for PHEVs)
kW
Hours of day
PHEV
CO2 Emissions
Urban Emissions
Electricity Sales
Infrastructure Requirements
Utility Rates
Before After
"It's is our vital interest to diversify America's energy supply – the way forward is through technology.... We need to press on with battery research for plug-in and hybrid vehicles...." – Energy Sec
"Nationwide adoption of plug-in hybrids will increase the use of domestically produced electricity and can ultimately reduce greenhouse gas emissions by up to 900 million tons per year." – EPRI
"Rarely in history has an emerging technology offered such an attractive opportunity .... as both a new load and resource, to enhance overall performance of the electric power infrastructure." – National Renewable Energy Laboratory
"Working with automakers and local utilities, we need to understand how large numbers of PHEVs will be used, and their effect on the grid." – University of Michigan



"No, you weren't downloaded.
Your were born."

Wireless Future : A Seamless Mobile Lifestyle



Seamless connectivity to all networks, applications, & services

Anytime and Anywhere

Challenges

- Social (e.g. children's use)
- Political (e.g. posting false info)
- Policy (e.g. access)
- Legal (e.g. copyright)
- Technical (e.g. security)

These fundamental issues are closely intertwined and must be addressed if we are to realize the opportunities before us.

Questions?
Comments?