

工程與生活

Wireless Technologies



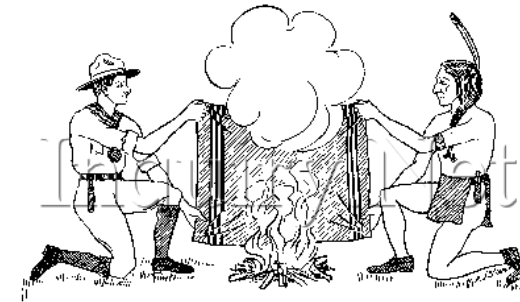
James Clerk Maxwell



電子系暨電信所
洪萬鏞



Wireless Communication ?



SMOKE SIGNALS

Transportation

Critical Infrastructure

Global Networking: Ready for Future Roles?

Telecommunications Banking & Finance

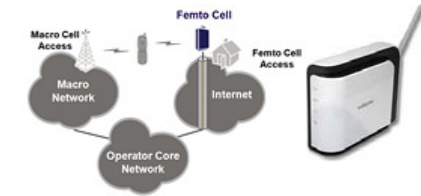
GOVERNMENT SERVICES
FEDERAL
STATE
LOCAL

The Latest Buzz

Open Access:
Google's Android Phone



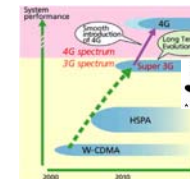
ANDROID



Femtocells



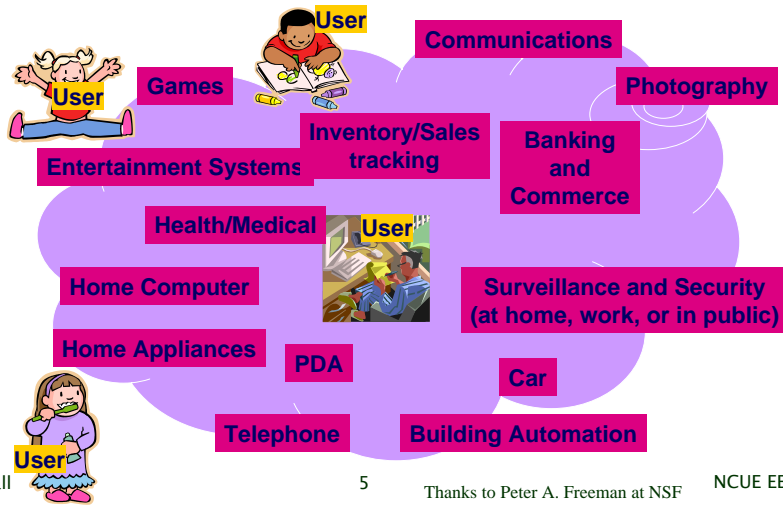
WiMAX versus LTE



700 MHz FCC Auction: Open Access

Digital Living 2010

Tomorrow's users will be surrounded by pervasive devices, embedded sensors and systems... all connected to the Internet.



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Thanks to Peter A. Freeman at NSF NCUE EE & CM

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

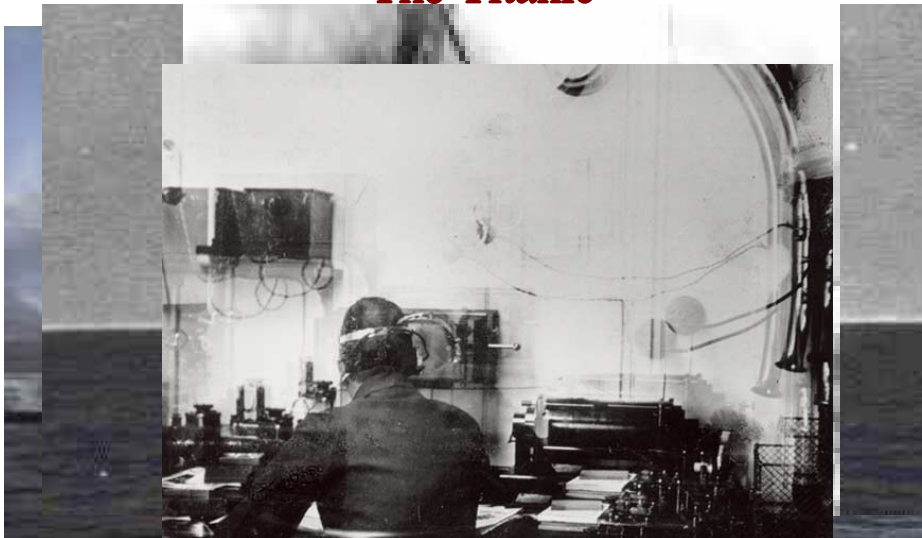
- Voice transmission over radio 1906

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The Titanic



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First Mobile Radio Telephone 1924

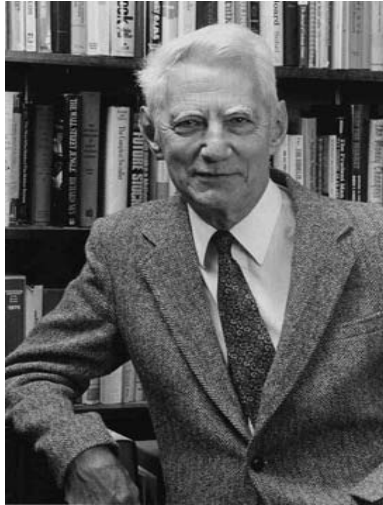


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Claude Elwood Shannon



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

Broadband Applications – Endless Opportunities

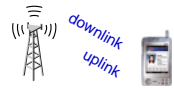
- Mapping/Location Based Services – Automatic Vehicle Location, critical infrastructure protection
- Push-to-talk
- Video Streaming – incident scenes, security
- Digital Image transfer – disaster scene, photos
- Large files transfer- records, on-line manuals, emergency protocol
- Biometrics – facial recognition
- Bioterrorism detection and response – sample analysis, plume tracking

<p>Biometric Services</p> <p>Facial Scan Retinal Scanners Mobile Fingerprint</p>	<p>Video Services</p> <p>Real-time Car Video Disaster Surveillance Dispatch Centers</p>
<p>Multimedia Data Collection/Retrieval</p> <p>Images from site Image from Crime Databases Patient Monitoring</p>	<p>GPS/GIS Location Based Services</p> <p>Route Navigation First Responder Tracking Incident Mapping</p>

Mobile Broadband

It's already happening

Responding to Crisis -- Performance Matters



Mugshot Download



352x375 pixels
jpeg
20 kbytes

Cellular Digital Packet Data	CDMA2000 1x EV-DO Rev 0	CDMA2000 1x EV-DO Rev A
12.1 kbps down 9 kbps up	2.4 Mbps down 153.6 kbps up	3.1 Mbps down 1.8 Mbps up
13 secs	0.067 secs	0.051 secs



287x308 pixels
gif
47.2 kbytes

31 secs	0.157 secs	0.121 secs
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High Resolution Incident Still Photo



1400x1050 pixels
jpeg
140 kbytes

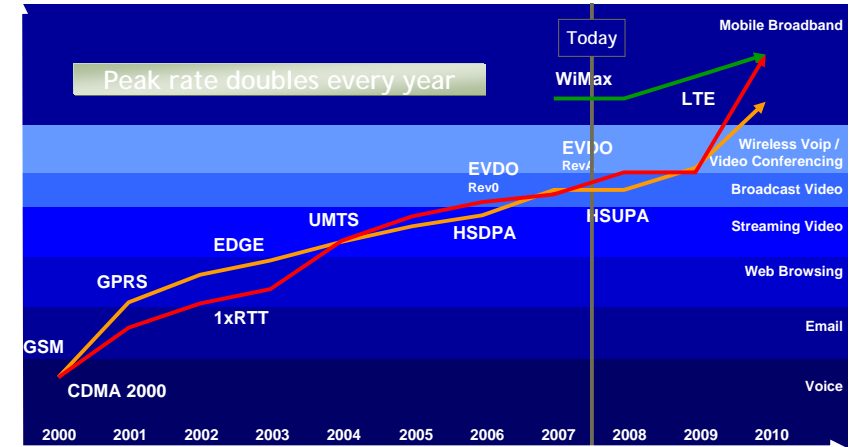
Download:	CDMA2000 1x EV-DO Rev 0	CDMA2000 1x EV-DO Rev A
93 secs	0.467 secs	0.361 secs
Upload:	7 secs	0.623 secs
124 secs		

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Broadband Wireless Technologies



As bandwidth becomes ever faster and cheaper, ubiquitous broadband coverage becomes a reality creating real change for all...

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Communications are Increasingly Complex and Critical



- Securing personnel and assets against operational incidents and terrorism
- Preventing ecological disasters through secure, reliable SCADA
- Enabling rural doctors to save lives with real-time specialist consultation
- Providing interoperable communications between emergency services

Business critical communications solutions address a complex customer environment: Growing mobile workforces; need for reliable, redundant secure connectivity; integration of new and legacy applications

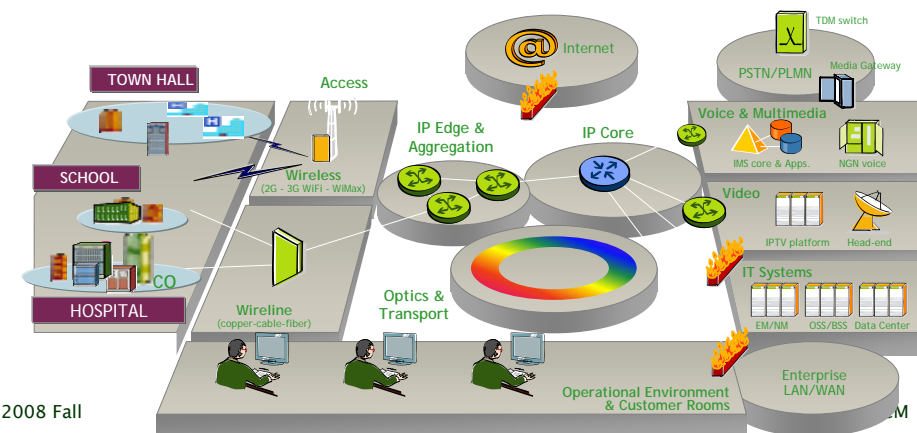
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End to End Business Critical Network

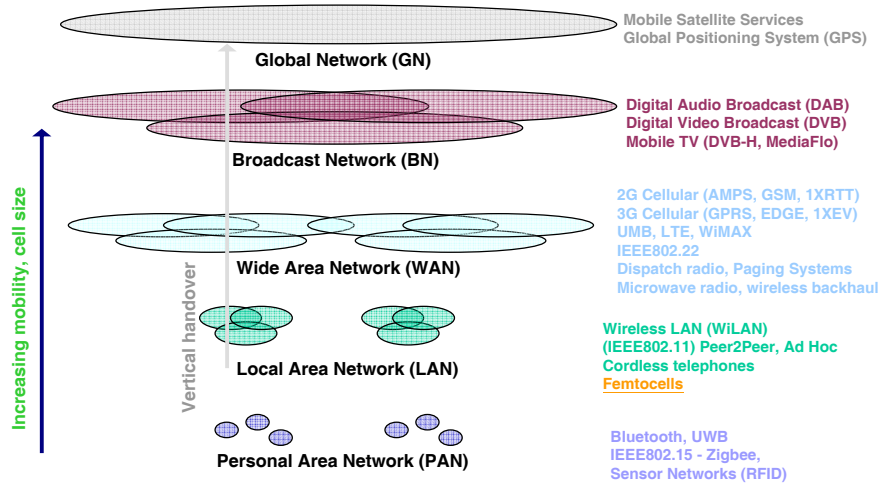
- Local authorities are changing from traditional voice and basic interoffice communications to high-bandwidth services with extensive use of video and data
- Unprecedented amounts of bandwidth are required to support this new scenario
- Existing networks are built on legacy technologies that are difficult to scale or adapt to changing needs



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Wireless Systems



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Mobile

Computing/Entertainment/Commns



iPod: impact of disk size/cost



Samsung Cameraphone w/ camcorder



Blackberry: phone + PDA

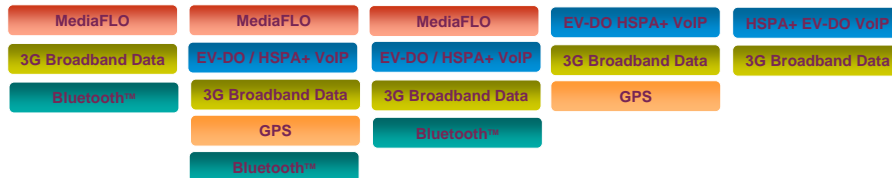
SONY PSP: mobile gaming

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- Computing: smaller, faster
- Disks: larger size, small form
- Communications: wireless voice, data
- Multimedia integration: voice, data, video, games

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A Day in the Life of a World Cup Fan

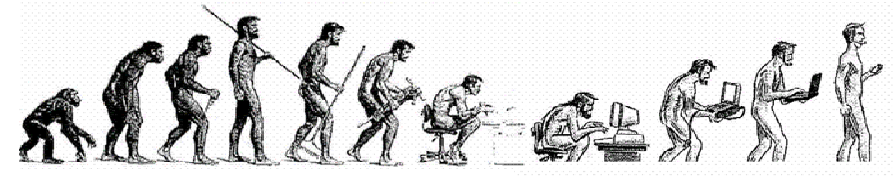


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Evolution of Wireless Communication



Laptop: Mobile computer

Necktop: Brains

Pockettop: Mobile phone

Servers, Databases

Bluetooth
Wi-Fi, WiMax, 3G, 2G
Informal & Formal networks
2G, 3G, Wi-Fi, WiMax

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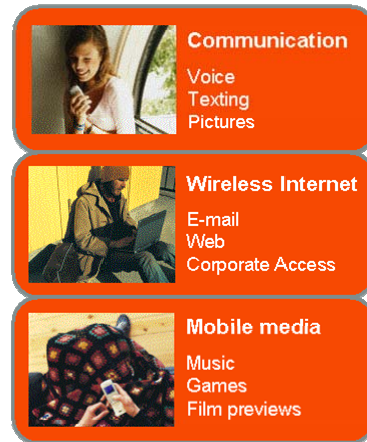
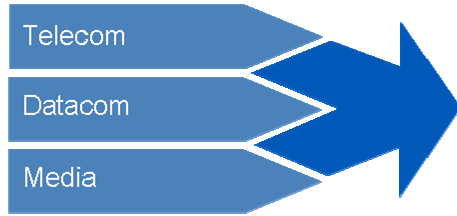
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EVOLUTION

New Service Paradigm

3 origins – 3 trends

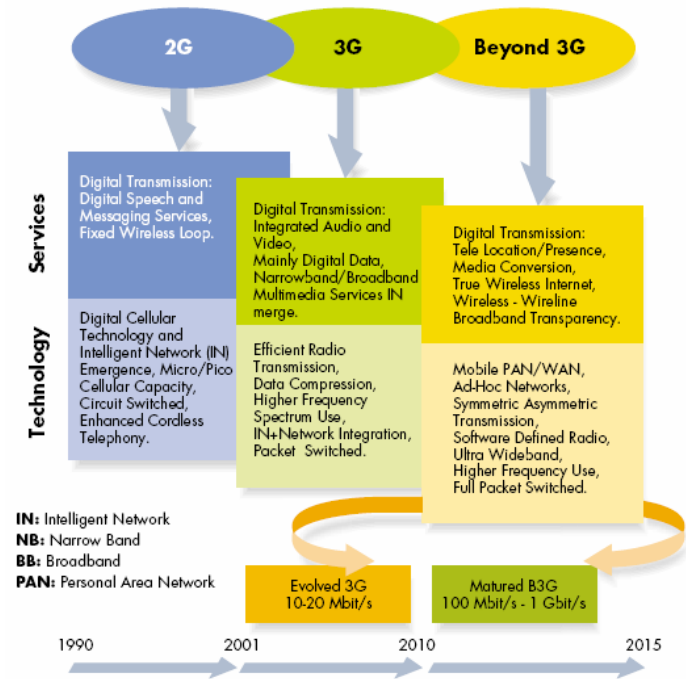


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EVOLUTION



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Wireless Broadband Evolution



Network Evolution	Mobile Device Evolution	Service Evolution
<ul style="list-style-type: none"> All-IP Network For Fixed-Mobile Convergence (VoIP & data) Co-existence of Different Access Networks for Various Needs <ul style="list-style-type: none"> Coverage, Mobility, Capacity, QoS, Data Rates ... 	<ul style="list-style-type: none"> Convergence of Communication, Computing & CE Platforms Multi-mode Devices Connect to Various Access Networks <ul style="list-style-type: none"> Service Requirements, Availability, Cost ... 	<ul style="list-style-type: none"> User Behaviors Trend from Wired to Wireless Same Rich IP Apps and Services in all Environments <ul style="list-style-type: none"> Ubiquitous & Consistent Experience Desired

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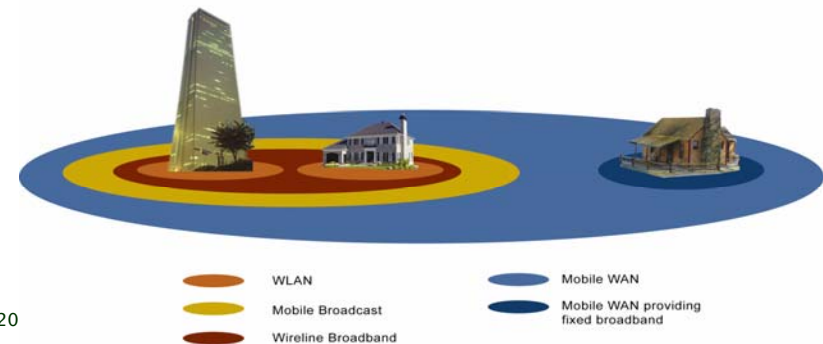
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Multiple air interfaces supported with a common all-IP based core network

Network Evolution: The Right Technology for the Right Service

- Selection of access based on service requirements, availability, cost
- Full range of devices access the same content across different IP networks



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: EE & CM

Device Evolution: Convergence of Communication, Computing & CE Platforms

- Multimode devices supporting several air interfaces
 - PP, PP2, GPS, FLO/DVB-H, 802.11
 - Embedded WAN in CEs
 - Handset acts as WAN gateway to CEs (via 802.11, UWB or Bluetooth)
- Continued advances of device capabilities
 - New class of computers -- Ultra Mobile PCs
 - Mobile microprocessors
 - Dual CPU - Up to 1 GHz
 - Multimedia
 - 3D Graphics, camera, video, display, gaming, mp3 players
 - Large storage capacity for personal media library
 - Video, pictures and music
- Integration at silicon level for lower cost, improved form factor and increased battery life



Ultra Mobile PC

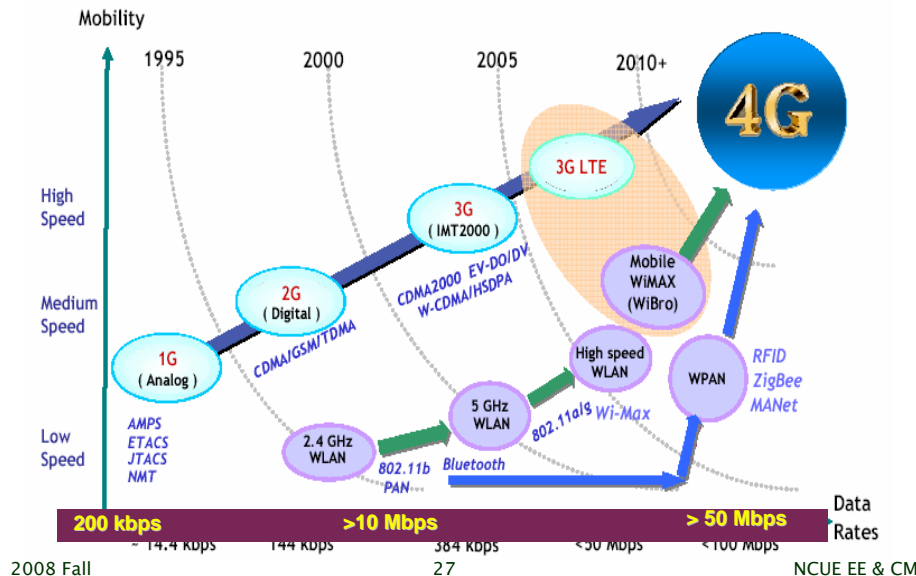
Service Evolution: Same Rich IP Apps and Services in all Environments

- User Trends Shift from Wired to Wireless
 - Ever increased demand for more and higher quality video
 - Users sharing content within a traditional fixed environment (wireless through the home)
 - Place-shifting of content now accessible at all times and places with wireless
 - Introduction of mobile real-time TV services via multicast technology
- Individuals becoming content creators
 - Handsets now becoming media generation and storage devices
 - Wireless connection to social networks allows users to express themselves anytime, anywhere

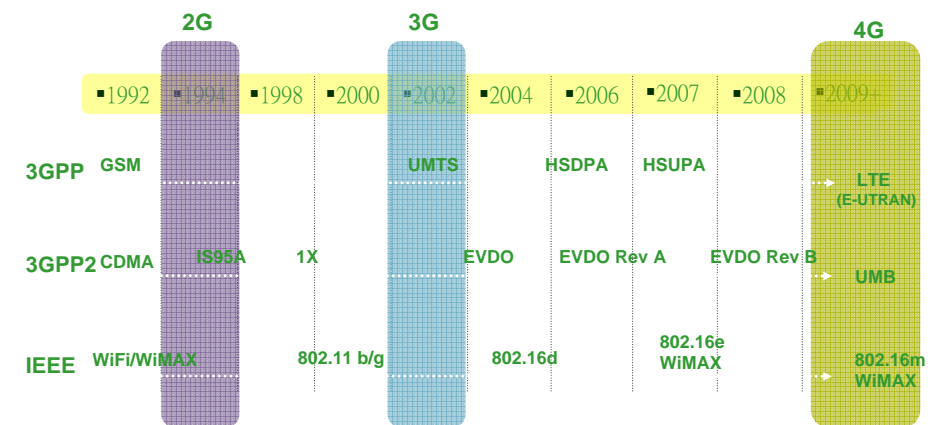


User Generated Content on Social Networks

All Roads Lead to 4G (Eventually)

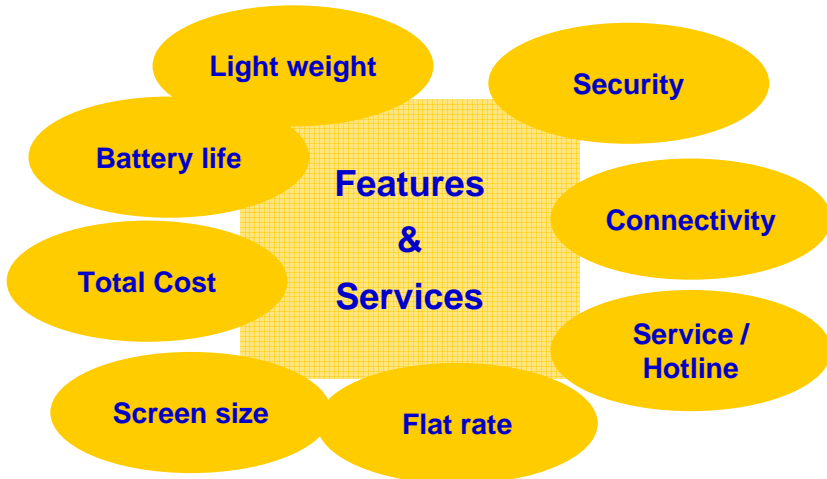


Wireless Broadband Wide Area Standards Landscape



Effects of Device Portability

One size does not fit all anymore...



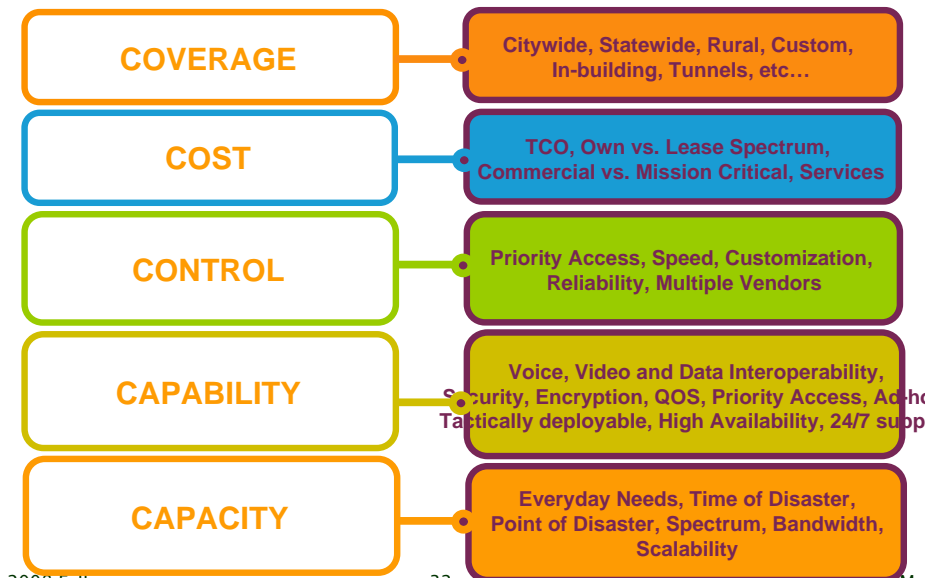
Vehicle Accident

- Video increases emergency room doctor's knowledge of the mechanism of injury, enabling quicker and possibly more accurate treatment
- Biometry data from Incident Scenes enable real time monitoring of Patients on the way to the Hospitals

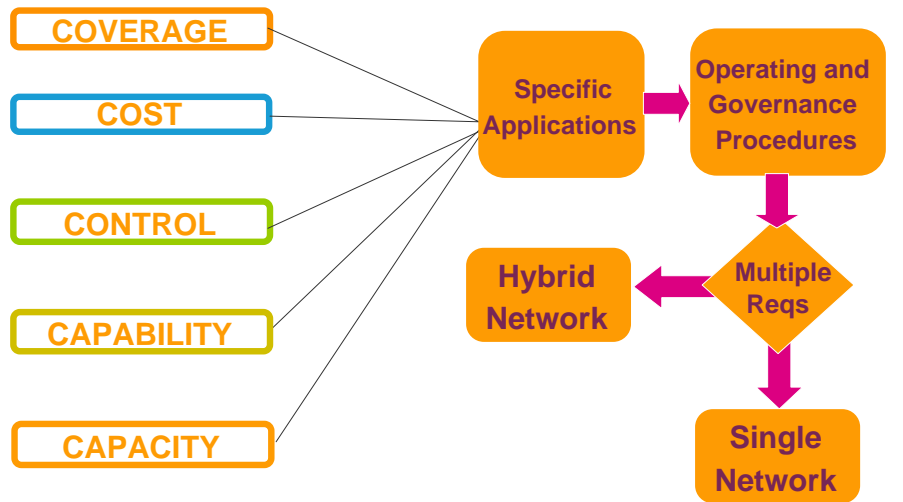
Remote Medical Diagnosis

- Remote diagnosis can shorten the time before treatment which can potentially save lives and shorten recovery time

Wireless Network Design Variables: 5 C's

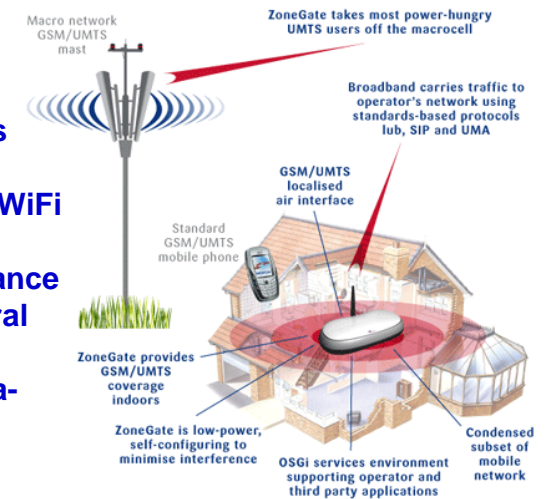


Wireless Technology Solutions Vary from One Country to the Next



Femtocells

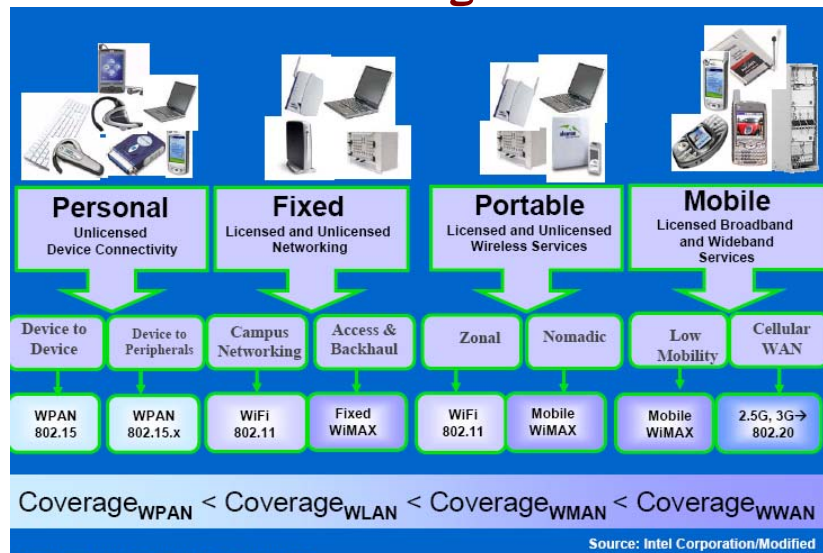
- Femtocell
 - In-home wireless access point
 - Competing with WiFi
 - Improve cellular system performance
 - Ubiquisys, several large vendors (Samsung, Nokia-Seimens, etc)



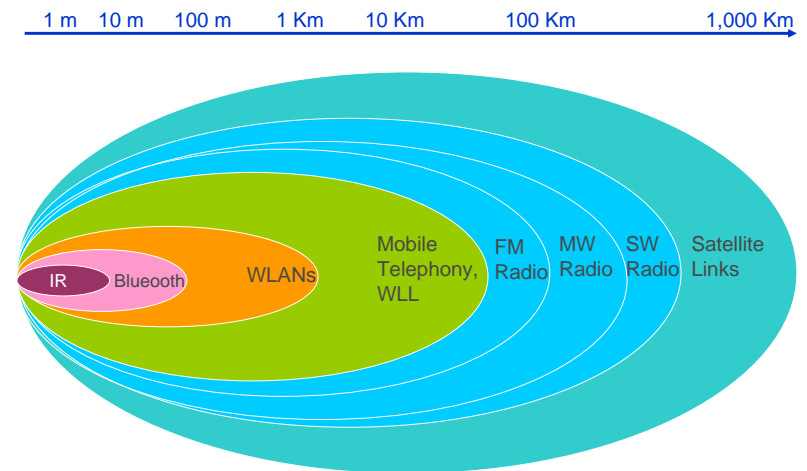
Source: Alcatel 2006

Source: www.3g.co.uk/PR/Feb2007/ZoneGateInHome.gif

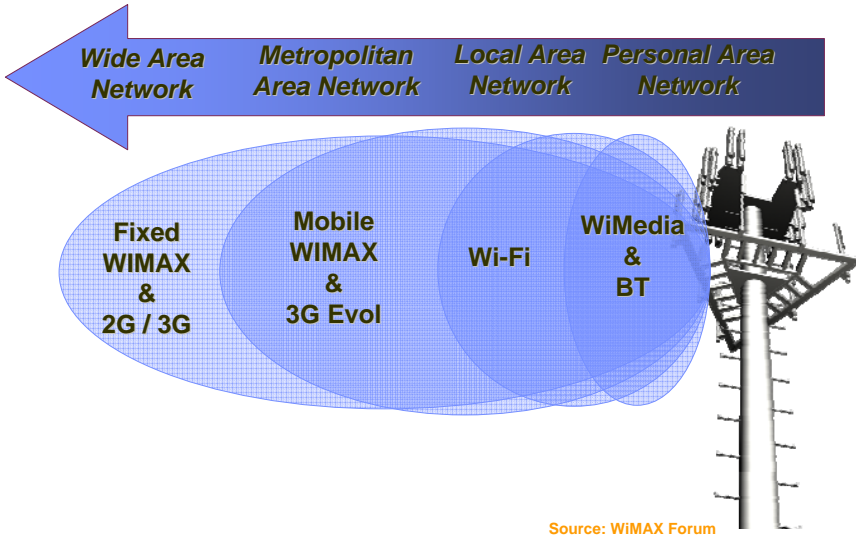
Wireless: The Big Picture...



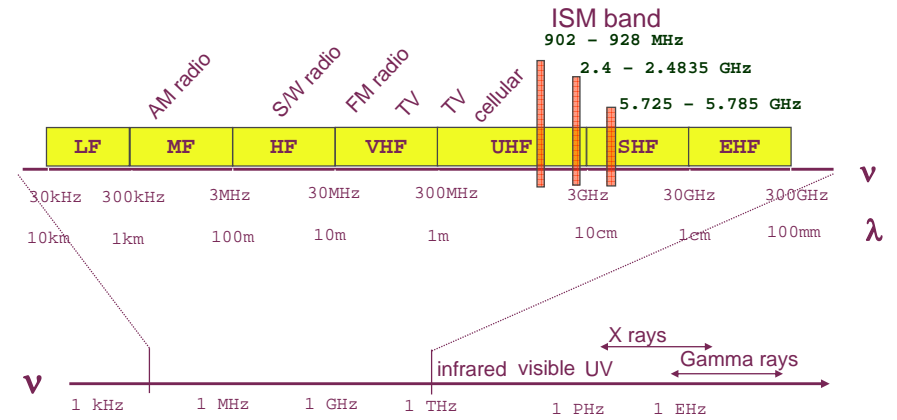
Wireless Systems : Range Comparison



Broadband Wireless Technologies

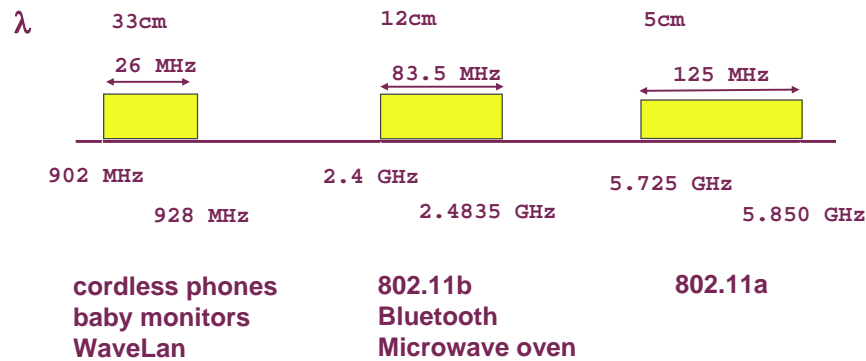


EM Spectrum



Propagation characteristics are different in each frequency band

ISM Radio Spectrum (In Use)



Spectrum Regulation

- Spectral Allocation in US controlled by FCC (commercial) or OSM (defense)
- FCC auctions spectral blocks for set applications.
- Some spectrum set aside for universal use
- Worldwide spectrum controlled by ITU-R

Regulation can stunt innovation, cause economic disasters, and delay system rollout

ITU-R: International Telecommunication Union-Radio Communication Section

FCC: Federal Communications Commission

OSM: Office of Surface Mining

Interplay among Alternative Technologies

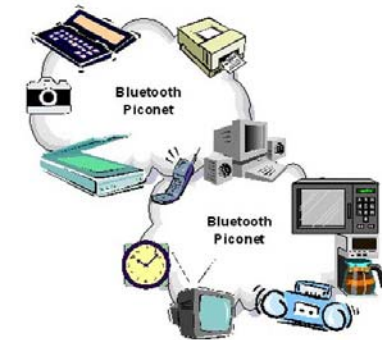
- The Game
- The hunter has the power to decide who wins



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

Bluetooth

- Cable replacement RF technology (low cost)
- Short range (10m, extendable to 100m)
- 2.4 GHz band (crowded)
- 1 Data (700 Kbps) and 3 voice channels
- Widely supported by telecommunications, PC, and consumer electronics companies
- Few applications beyond cable replacement



Broadband Over Power Lines: The Third Wire

- Based on additional analyses, NTIA recommended several supplements to the FCC proposed BPL rules to reduce risk of BPL interference (June 2004)
- The FCC adopted rules incorporating most NTIA recommendations on October 14, 2004.
- Today, many utilities, hotel operators and others are deploying experimental and operational BPL systems.



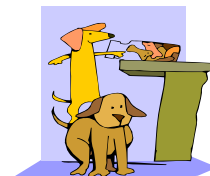
HomePlug Modem
can turn an electrical outlet into an Internet connection.

Cognitive Radio

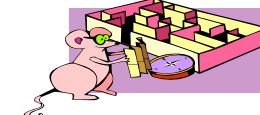
Fixed radios
are set by their operators



Adaptive radios
can adjust themselves to accommodate anticipated events



Cognitive radios
are aware of their environment and learn how to adapt



BBC News

“... Doctors at a Welsh hospital are leading the way in using modern technology to help speed up a patient's treatment ...”



University Hospital of North Staffordshire, UK:
“ Mobile telephones affect the safe operation of sensitive medical equipment we use to treat patients for example, syringe pumps, ventilator equipment or



pacemakers and because of this the use of mobile telephones is not permitted in hospital buildings and within 3 meters of the exterior of any building. The use of mobile telephones in hospitals can also disturb other patients. When you come into hospital please leave your mobile telephone at home and please ask your relatives and friends to remember to turn off their mobile telephones before entering hospital buildings. “

