# Evolution of Mobile Technologies in the next 3-5 Years
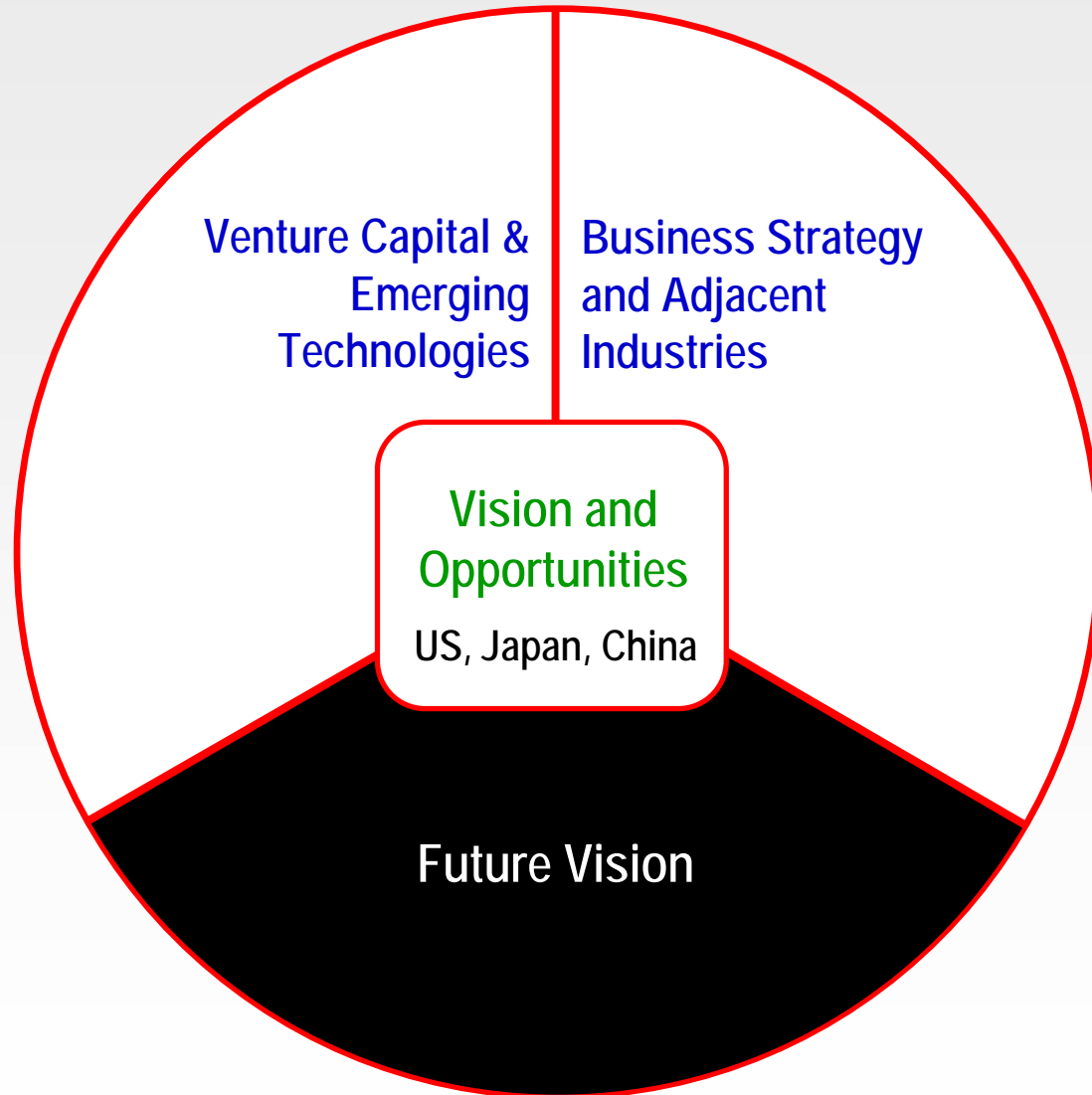
Stanley Chia

Group R&D

# Agenda

- <span style="color:red">About us</span>
- Where is mobile wireless industry going?
- What is driving the changes in this space?
- What new products will we likely see?
- How will the service offerings change?
- How will China be a key influencer on these changes?
- What to do?

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# Mobile Usage in the Next 3-5 Years

- WCDMA/GSM will lead the subscription followed by CDMA2000 by 2008 – total subscription will exceed 2+ billion
- China, W Europe, C Europe & Mid east & Africa will lead in the number of subscriptions by 2008
- Asia PAC, North America and West Europe will lead in total minutes by 2008
- North America will lead in personal usage by 2008 of the order 700+ minutes

# Worldwide Data Service Revenue

By 2008 the worldwide value of data service is about $400,000 million

# Global Handset Volume Forecast

- Asia Pacific will lead in handset volume opportunity

- China handset revenue will increase to $16b by 2008 ($9b in 2003)

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# The Next Billion Customers

- According to Forrester [05], there are 1.5 billion mobile users - a quarter of the world's population

- A further 3.5 billion people live within the coverage area of cellular networks

- In order for handset manufacturers and mobile operators to expand their base by a further 1.5 billion mobile users, they need to turn to emerging nations and provide cheap phones and services for low-income consumers

# The Changing Tech Industry

## How the technology industry is changing for the next billion customers

### Design

- Products have to simpler and more durable
- All-in-one
- Operate with icons
- Tolerate harsher environment, e.g. heat and dust

### Innovation

- Innovate for peculiarities of emerging markets
- Take care of the unreliability and unavailability of electricity
- Make use of alternative energy source such as solar power

### Pricing

- There is pressure on price
- Pay-as-you-go model is one of the answers

### Business

- Revise strategies to meet local needs
- Supply technology to local companies for producing market specific products

### Competition

- Companies dominating the developed world will be challenged by new comers who can leverage low labour cost and intimate knowledge of local markets

# Emerging Social Challenges

- **Customer is a big uncertainty**

- **The mobile is altering the fabric of society!**
  - The "Affective Mobile"
  - This is why some people don't like the mobile

- **Mobile behaviour often challenges existing social rules** ...
  - Talking loudly on a train was simply not done
  - Let alone discussing one's personal problems

- ... **and it may confront established social practices**
  - camera phones banned from workspace, clubs, etc
  - Putting a camera onto a phone has reduced its ubiquity!

# Important Features and Functions

Considering mobile wireless data devices, how important are the following features / functions to your organization?

- Wireless in the enterprise still hindered by security concerns
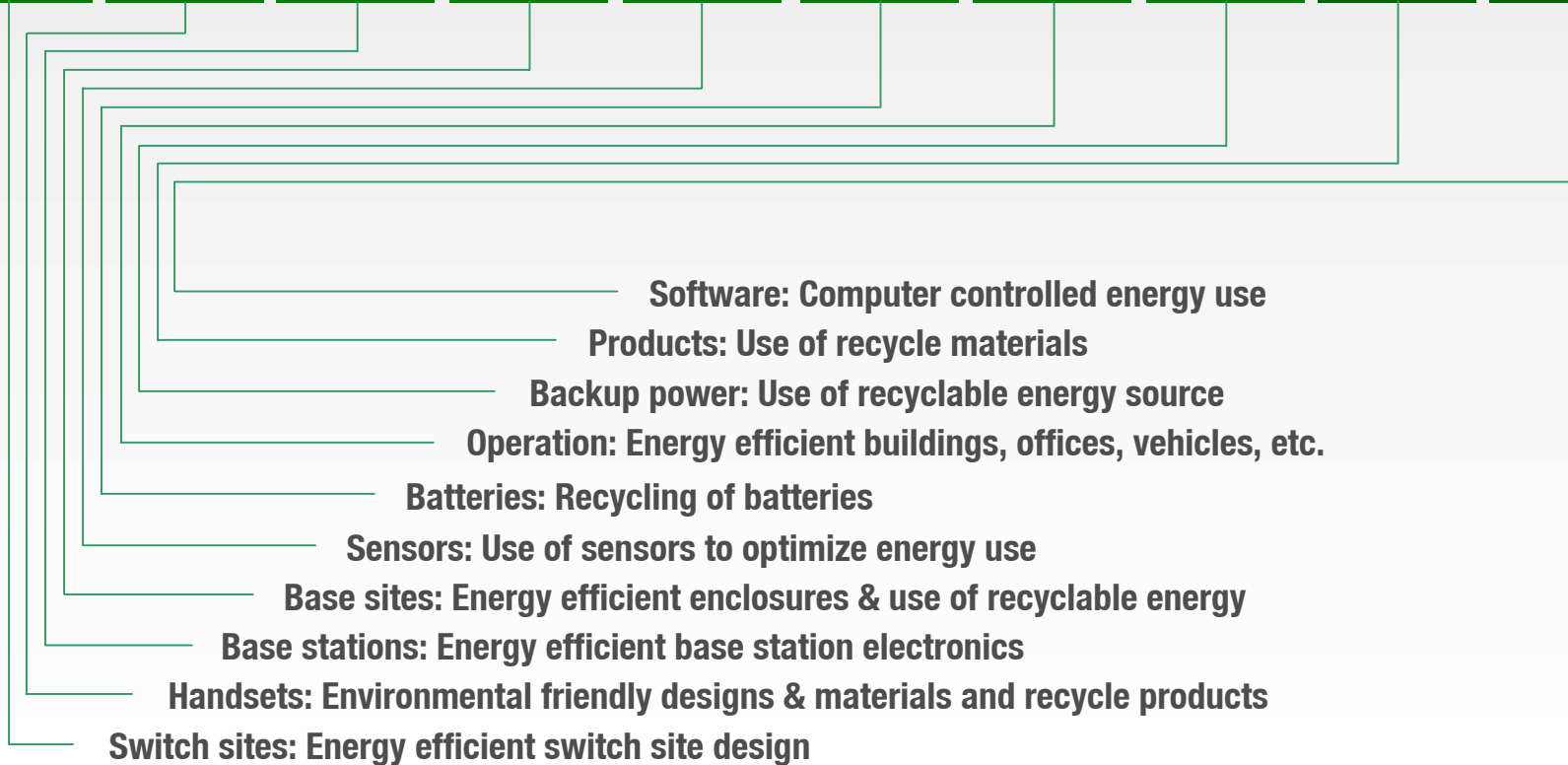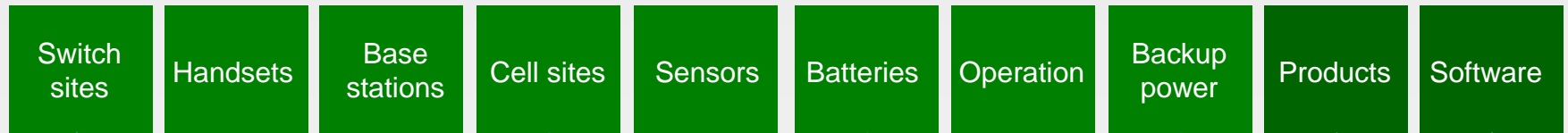- A less than secure mobile system can be worse than no system at all

# Youth Mobile Feature Preference

# Music beats games in teen desires in US

# Health Risks and Safety

- The health risks of using mobile phones remain a source of media attention even though there has been no successful lawsuits against the industry so far

- The UK National Radiological Protection Board recently reiterated that there is no solid evidence mobile phones pose health risks

- NRPB, however, recommended cell-phone use be minimized and urged the public to take a precautionary approach to wireless calling

- The US Food and Drug Administration agreed with the NRPB that there is "no hard evidence of adverse health effects on the general public from exposure to radio frequency energy while using wireless communication devices"

- The NRPB advocates higher fines for drivers caught using mobile phones while operating motor vehicles

# Environmental Consciousness

| Switch sites | Handsets | Base stations | Cell sites | Sensors | Batteries | Operation | Backup power | Products | Software |
|---|---|---|---|---|---|---|---|---|---|

**Software: Computer controlled energy use**

**Products: Use of recycle materials**

**Backup power: Use of recyclable energy source**

**Operation: Energy efficient buildings, offices, vehicles, etc.**

**Batteries: Recycling of batteries**

**Sensors: Use of sensors to optimize energy use**

**Base sites: Energy efficient enclosures & use of recyclable energy**

**Base stations: Energy efficient base station electronics**

**Handsets: Environmental friendly designs & materials and recycle products**

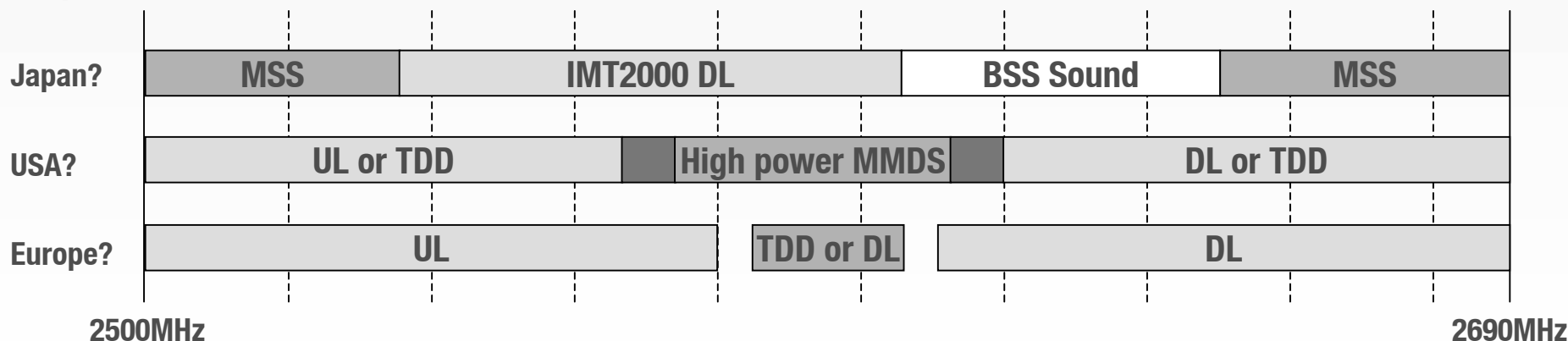**Switch sites: Energy efficient switch site design**

# New Mobile Spectrum

- 3G is currently utilizing the paired band (FDD) with the unpaired spectrum not being utilized

- By 2008, it is expected more unpaired spectrum is utilized with TDD based access technologies

| 2003 | 2004 | 2005 | 2006 | 2007 |
|------|------|------|------|------|

▲ WRC'03      ▲ WRC'07

**Proposed allocations for the UMTS extension band**

**Japan?** | MSS | IMT2000 DL | BSS Sound | MSS

**USA?** | UL or TDD | High power MMDS | DL or TDD

**Europe?** | UL | TDD or DL | DL

**2500MHz**      **2690MHz**

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# Product Directions - Trade Shows

**CeBIT**
- RFID
- IT security
- High definition visual
- Convergence

**3GSM Congress**
- Entertainment
- HSDPA
- IMS
- Convergence

**CTIA**
- Applications
- Cool phones
- High speed radio
- Convergence

**CONSUMER ELECTRONICS SHOW**
- Mobile TV
- VoIP
- WLAN in home
- Convergence

# CeBIT 2005

| Digital lifestyle | IT security | High definition | Convergence |
|---|---|---|---|
| • Notebook continue to gain in ascendancy over PCs<br>• VoIP is increasingly attractive to private users<br>• Multimode phones capable of cellular and alternative access were on offer | • Interest is turning to issues like spyware, phishing, and protection of mobile networks and terminal devices | • High definition video material processing from shooting and editing to playback capabilities were strongly featured among the exhibits | • The convergence between information and telecommunications technology and consumer electronics has been a key theme |

# 3GSM World Congress 2005

| Entertainment | 3G/HSDPA | IMS | Convergence |
|---|---|---|---|
| • Music download applications are proliferating<br>• Mobile TV streaming was featured with a number of terminals with some also support DVB-H broadcast | • 3G terminals are clearly maturing with more smaller & cheaper terminals available<br>• HSDPA infrastructure were demonstrated by most suppliers and equipment is ready for shipment | • Most suppliers were featuring IMS infrastructure equipment<br>• IMS products around the theme of rich voice were pushed by suppliers. | • Convergence is becoming a buzzword but everyone has a different interpretation<br>• UMA, FMC, multi-access, multi-function devices, internet-video-voice triple play were some of the advocated themes |

# CTIA Wireless 2005

| Music & home | Better phones | High speed | Convergence |
|---|---|---|---|
| • Mobile music is coming to the center stage with many more phones double as MP3 players<br>• Wireless home has been a main theme with many of the wireless devices finding applications in the home environment | • More capable camera phones with higher power zoom lens are appearing at the stands<br>• Bluetooth headsets are getting ever smaller and more stylish | • HSDPA handsets are leading the way in high speed mobile<br>• Broadband technologies such as WiBRO continued to make their presence | • IMS is featured by infrastructure suppliers as the key to convergence of multiple access technologies including the fixed<br>• There are more UMA products to drive FMC / FMS |

# Consumer Electronics Leads 2005

| Mobile TV | VoIP | WLAN in Home | Convergence |
|---|---|---|---|
| • Technology companies are confident about future demand for mobile TV<br>• Innovations with display technologies could make full-length programme and movies more appealing | • Many companies are introducing VoIP products and VoIP is going mainstream<br>• More WLAN / 3G phones appear in the market that can support voice | • Home entertainment devices are increasingly supported by 802.11b/g<br>• WLAN technology offers consumers much control over when, where, and how they watch movies, listen to music, view digital photos, etc. | • Convergence between PC technology and consumer electronics is happening on a large scale<br>• The Intel – Microsoft foresight seems to be coming true finally |

# Triple Play – Integrate to Differentiate

Merging the world of content and communication and transform them into a social experience can provide an enhanced user experience
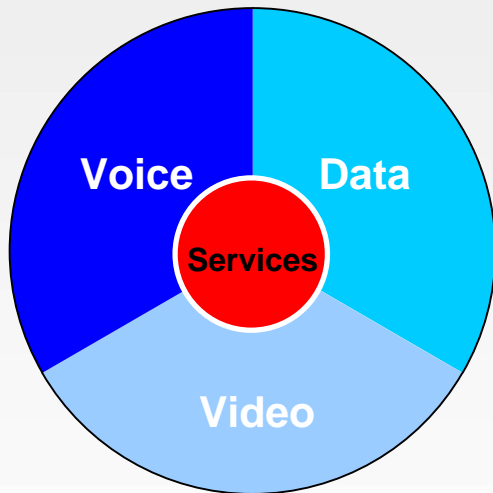


Services
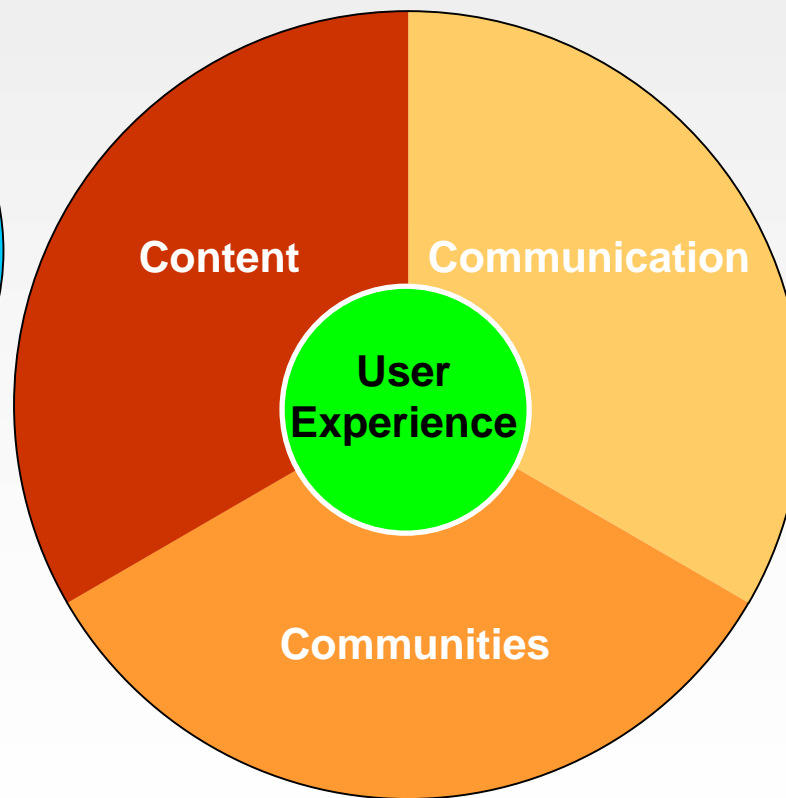
Experience
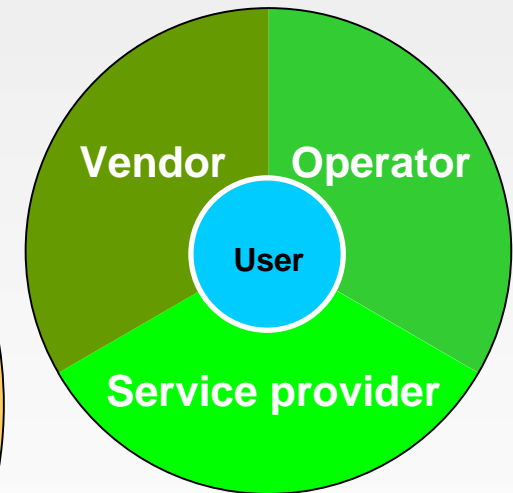
Stakeholders

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# Mobile Broadcasting is Here

| Digital TV | Mobile TV | Multicasting | Interactive TV |
|---|---|---|---|
| • Digital TV is gaining momentum | • DVB-H / FLO are leading mobile TV technologies | • MBMS is the native 3GPP multicast technology | • The future is evolving from reactive to interactive TV |

**Low cost devices are important and multiple technologies are emerging**

# Access is Proliferating Rapidly

| TD-SCDMA | 3G | Fixed wireless | Broadband | Mesh |
|---|---|---|---|---|
| • TD-SCDMA will be first deployed in China prior to spreading afar | • WCDMA / CDMA2000 are core 3G technologies for most operators | • Fixed wireless and mobile are on the path of convergence | • WiMax is positioned to address broadband and fixed wireless | • Radio relay mesh network may reduce backhaul cost |

**Wireless technologies are being optimized for both mobile & fixed access**

# Core Network is Trended to Go IP

| 3GPP Core | IPv6 | Best connected | Architecture |
|---|---|---|---|
| • The 3GPP core is evolving to R5 IMS and migrating to all-IP | • IPv6 will be embedded in the China core and elsewhere | • Always best connected can add value to multi-access | • Backhual cost remains a barrier for a centralized core & data rate |

**The target is an access independent core, aiming at improving flexibility**

# Services Remain the King

| Voice | Messaging | Online games | Video | MM Library | Web Service | Wi-Fi |
|---|---|---|---|---|---|---|
| • Voice will remain as the most dominant service | • Messaging will migrate to include video clips | • Online games are spreading rapidly in China and beyond | • Video will be embedded in most non-voice services | • Community portals will find applications with mobile | • Web service becomes a driver for network service | • WLAN based service will extend to support voice |

**Online gaming is emerging as a dominant service among many others**

## Voice

- Traditional voice will still be the dominant service revenue by 2008

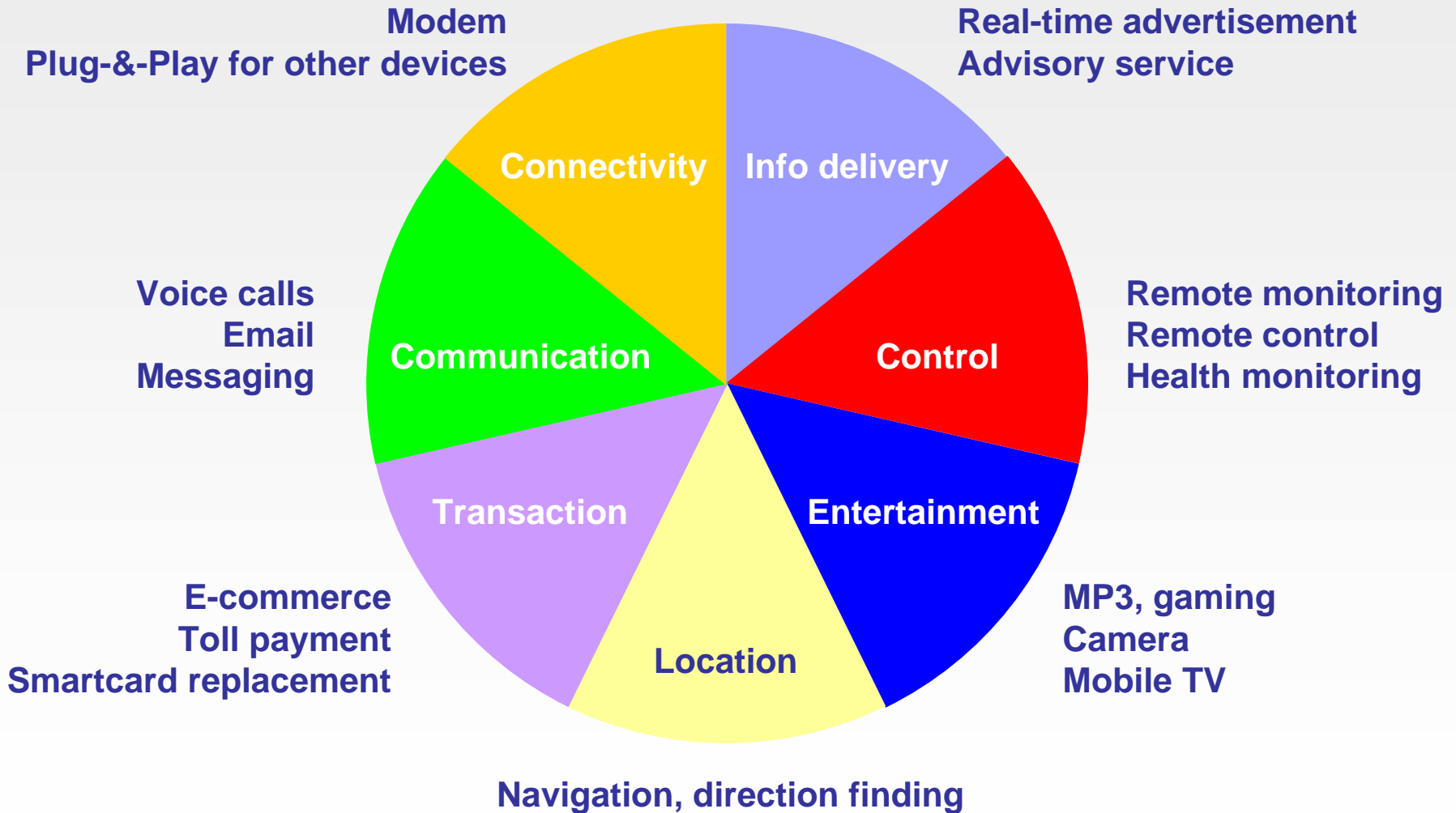- VoIP is on the increase but mainly in the fixed

# Voice over WLAN Trends

- WLAN might help address some shortcomings of mobile networks:

  - Functionality: improve latency / bandwidth needs for data applications

  - Cost: lowering cost of provisioning of voice within buildings / campuses

  - Provide higher data rates for uplink path to complement 3G

- WLANs might help operators address some under-served markets:

  - Fixed calls made from home

  - Voice and PBX services at the enterprise

  - Specific high-usage environments such as a campus and public transport (planes / trains)

# Downloadable Games Market

- Downloadable game market grows to $6.5b by 2008

- Global wireless gaming revenue for thick-client games = games that can be downloaded onto and then played / executed on the users'

- Both services and transport charges are included

# Multi-function Handsets

**Modem**
**Plug-&-Play for other devices**

**Real-time advertisement**
**Advisory service**

Connectivity | Info delivery

**Voice calls**
**Email**
**Messaging**

Communication | Control

**Remote monitoring**
**Remote control**
**Health monitoring**

Transaction | Entertainment

**E-commerce**
**Toll payment**
**Smartcard replacement**

Location

**MP3, gaming**
**Camera**
**Mobile TV**

**Navigation, direction finding**

Copyright Vodafone 2005

# Handset Technology Evolution 1/2

- Integrated storage
  - 1.8" drives with 40 GB and pico hard drive

- Removable storage
  - Flash capacity already reached 4 GB

- Battery and power management
  - Micro fuel cell reaching maturity with high power density in 2+ years
  - Polymer and organic LED displays eliminates the need for a backlight in 2+ years
  - Energy management algorithm will reduce power consumption

# Handset Technology Evolution 2/2

- Processing
  - Performance increase to cope with 3D graphics
  - NEC predicts 150x the number of transistor per cm$^2$ of chip that of today (in next five years?)
  - Reduction in power consumption to increase talk-time (from 2 hours to 60 hours in five?? years)

- Camera phones
  - Performance rivaling mass market digital still cameras with auto-focus, panorama mode, pre-defined shooting modes, etc.

- Mobile devices are absorbing a range of consumer electronic functionalities

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# The Rise of Asia

## KOREA
- Land area: 98,190 km$^2$
- Climate: temperate
- Population: 48m
- Life expectancy: 75.6
- Cellular subscribers: 36m
- Cellular penetration: 73%

## JAPAN
- Land area: 374,744 km$^2$
- Climate: tropical in south to cool temperate in north
- Population: 127.3m
- Life expectancy: 81.04
- Cellular subscribers: 86m
- Cellular penetration: 67%

## INDIA
- Land area: 2.9m km$^2$
- Climate: tropical monsoon in South to temperate in North
- Population: 1.07b
- Life expectancy: 64
- Cellular subscribers: 50.7m
- Cellular penetration: 4.8%

## CHINA
- Land area: 9.3m km$^2$
- Climate: tropical in south to subarctic in north
- Population: 1.3b
- Life expectancy: 72
- Cellular subscribers: 340m
- Cellular penetration: 25%

# China is an emerging giant

- China is already undergoing a major digital and information technology transformation in the past few years

- China is picking up momentum to narrow its technology and socio-economic gap with developed countries

- "The China Price" become the three scariest words in the manufacturing world – a massive shift in economic power is underway [Business Week '04]

# Scale of China

- China has an area of 9.6m km$^2$ (land 9.3 km$^2$) – world's 4$^{th}$ largest country after Russia, Canada and U.S.

- With a population of nearly 1.3bn and a growth rate of 0.57%, one in five persons in this world lives in China

- If each person in China is allocated one IP address one would need 72 Class A IP address groups to fulfill the demand

- One hour online (28.8 kbps modem) per person per day would generate 1.6 Tb of traffic

- A 1MB home page per person would mean 1,300 TB of storage capacity -

# The China Challenge

| SPEED | BREADTH | COMPETITION |
|---|---|---|
| • Earlier competitors took years to build up an international presence<br>• Chinese competition often arrives en masse and seizes share rapidly with unbeatable price, leaving little time for competitors to adjust | • Other Asian nations shed labour-intensive work as they industrialized<br>• China is gaining share in low-end work and simple assembly at the same time it is advancing into higher-value areas such as digital electronics | • Japan and Korea are limited players in many industries<br>• In China dozens of manufacturers battle for share in domestic market appliances, keeping everyone lean |
| • Unlike Japan and Korea, China welcomes foreign investment in key industries<br>• Foreign ventures account for 60% of exports and a big share of local sales | • China is both an export power and is itself becoming the world's biggest market<br>• That gives China unparallel economies of scale | • Retail giants that import directly help Chinese electronics makers build global market share without the need to spend as much on distribution and advertising |
| ALLIANCES | SIZE | ACCESS |

# China's Global Champions

| | |
|---|---|
| **Huawei** **Telecoms** **equipment** | **CHINA'S TOP** **COMPANIES** |
| **Lenovo** **Personal** **computers** | **TCL** **Electronics** **Televisions** |

**China's most dynamic and ambitious companies**

# Consumer Electronics in China

- China would have a huge consumer electronics market
  - $100b by 2008 [IDC]
  - $94b by 2007 [Global Resource Ltd]
- Manufacturers are shifting to high-end digital products
  - LCD and plasma TV, digital TV
  - PC, laptop and PDA
  - Family multimedia centers, MP3 and DVD players
  - Digital cameras
  - Household appliances
- China is the world's 4th largest market for luxury goods accounting for 12% of global demand [Goldman Sachs]

# China Semiconductor Consumption

- As the third largest country for semiconductor consumption in the world, China's total demand will increase significantly in the next 3-5 years
- The growth is due to enormous demand from the computer, communications and consumer electronics segments

# China Semiconductor Productivity

- There are over 468 fabless companies in China
    - Work in processes ranging from bipolar metal gate to 0.13$\mu$m CMOS
- Around 120 of the design houses are working from 0.35$\mu$m to 0.18$\mu$m
    - Many have shipped at 0.25$\mu$m
    - Three have started work at 0.13$\mu$m
- China accounted for 4% of worldwide chip manufacturing capacity in 2003, rising to 9% by 2007

# Mobile Usage in China

- China's mobile users topped 344.07m in Feb 2005
  - An addition of 5.5m users per month
  - 24.8 mobile phones per 100 Chinese
  - Reinforces China as the largest mobile market by users
  - All users belong to China Mobile and China Unicom
  - Expected to exceed 400m in 2005
- China has 310 million fixed-line subscribers
  - 24.5 fixed subscribers per 100 Chinese
- Total fixed and mobile subscribers is 639m

# Messaging in China

- Text messaging has been a strong growth area in China along side the intensive growth of voice subscriptions
- Mobile phone users in China are expected to send 217.75b text messages in 2004
  - Up 58.8% from 2003
- By 2006 mobile users are likely to send 1.4 trillion short messages, equivalent to $1.7b in charges
- Analysys International predicted the value of China's SMS market will hit CNY37b with some 360m users
- In 2005, China will have 270m SMS users with a market value of CNY33b, up from 237m user and a market value of CNY28b in 2004

# Broadband and Internet in China

- Aggressive dial-up migration to broadband

- Broadband Internet Account will exceed dial-up in 2004

- With 380m household, the penetration is just 10+% by 2008

# China's Ambition Beyond 3G

- China has launched a research project called Future Technologies for a Universal Radio Environment (FuTURE) under the National 863 Program in 2001
  - The goal is to support theoretical research and technology evaluation through experimental platforms
- Five envisaged key challenges
  - Individualization of IP addresses
  - Data services become predominant to over 80% of services with BER $<10^{-3}$ for voice and $<10^{-6}$ for data services; 10 kbps to 100 Mbps per user with QoS similar to fixed system
  - Peak data rate will be 40-100 Mbps for high speed and >100 Mbps for low speed
  - High spectrum efficiency of 2-5 b/s/Hz for high speed and 5-10 b/s/Hz for low speed; Bandwidth per user is 20-30MHz at the 3-5 GHz band
  - Peak transmit power to decrease by 10dB (relative to the same condition as 3G) to preserve battery life; peak to average of the radio transmission to be <10dB
- Key technologies
  - A generalized cell structure with radio over fiber, together with MIMO, link adaptation and OFDM / generalized multi-carrier access

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# Problems and issues we face

## Supply force

- Suppliers are driving the proliferation of technology solutions
- Suppliers are tailoring solutions to facilitate for multi-technology adoption

## Industry trends

- A rising tide of converged play / triple or quad play
- Converged technology solutions are maturing

## Competition

- Attacked by contagious parasites and aggressive predators in mobility space
- Competition leveraging technologies and engaging in land grab to utilize unlicensed spectrum

## Regulator

- Supportive to market competition and new entrants using innovative technologies and disruptive business models
- Facilitate unlicensed spectrum to lower the barrier of entry

## Customers

- Cheaper calls
- Increased convenience
- More choices of services
- Increase productivity
- Reduce overall cost
- Better experience (ease of use, responsive, faster)
- Avoid being locked-in

## Shrinking base

- Revenue from traditional business is on the decline
- Traditional technologies are not adequate to deliver new services cost effectively or not efficient to evolve and operate

# We Live in an Ever Evolving World

**Transistors replaced vacuum tubes**

**Integrated circuits replaced transistors**

**Personal computers replaced minicomputers**

**Digital mobiles replaced analogue mobiles**

**Electronic mail replaced facsimile**

**Digital cameras replaced wet film cameras**

**DVD replaced LP**

**Future success will rely on foresight and insight**

# Charting the right course isn't easy

The "Titanic Disaster" – the closer you are, the better visibility you have with the problem, but there is less chance to maneuver out of the situation – take the hint early

| **1** That Sunday at 1:45 p.m., a message from the steamer *Amerika* warned that large icebergs lie in *Titanic's* path | **2** Later that evening, another report of numerous, large icebergs, this time from the *Mesaba* | **3** At 11:40pm, a collision with an iceberg turned out to be inevitable |
|---|---|---|