

GSMA EXECUTIVE SUMMARY

Impact of Wireless Broadband Penetration on Taiwanese Economy

13 July 2011



Contents

Executive Summary

Overview of broadband services in Taiwan

Wireless broadband value chain

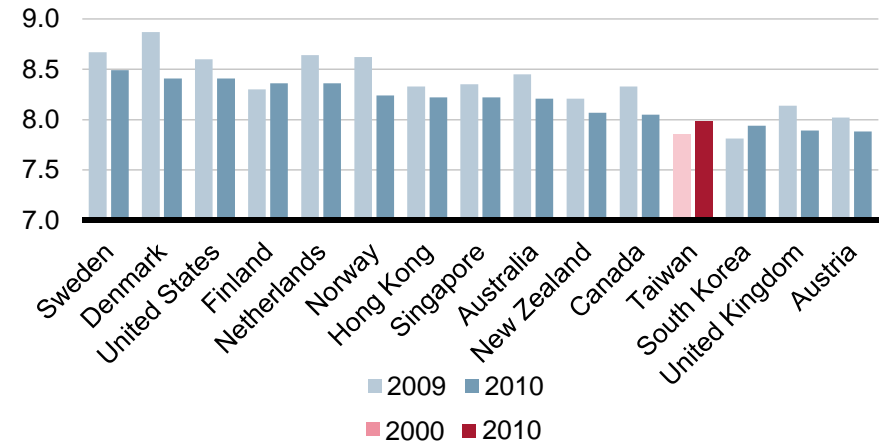
Socio-economic impact of wireless broadband

Stakeholder imperatives

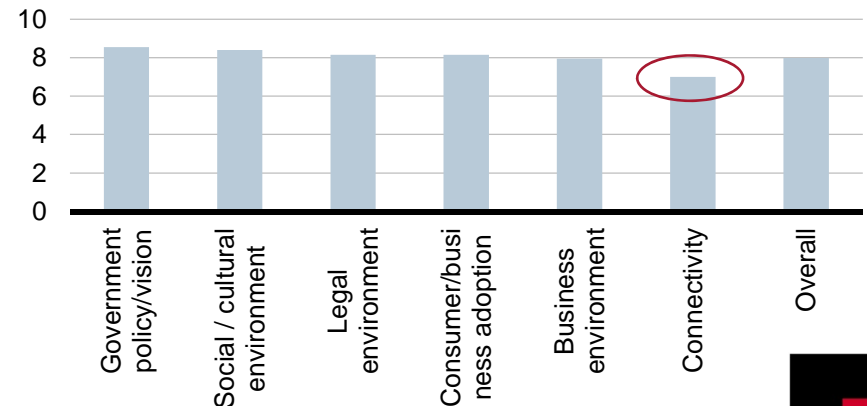
The GSMA has assessed the impact of wireless broadband in Taiwan, an important part of the country's digital economy

- The primary focus of the assessment was to:
 - evaluate the direct impact of wireless broadband services
 - estimate the impact of wireless broadband services on related economic sectors within the ecosystem
 - estimate the second-order impact of wireless broadband services in terms of productivity gains
- While Taiwan ranked highly in terms of digital economy, it cannot afford to rest on its laurels:
 - it is still behind Singapore and Hong Kong overall
 - Taiwan scores quite low in terms of connectivity, scoring only 7 compared to other indicators, most of which score more than 8 (e.g. government policy/vision)
- The Taiwanese government should therefore push forward its digital initiatives, particularly with regard to connectivity, in order to drive its competitive advantage and sustain or improve its digital ranking

EIU score of e-readiness (2009) and digital economy (2010)



Breakdown of digital economy score for Taiwan (2010)

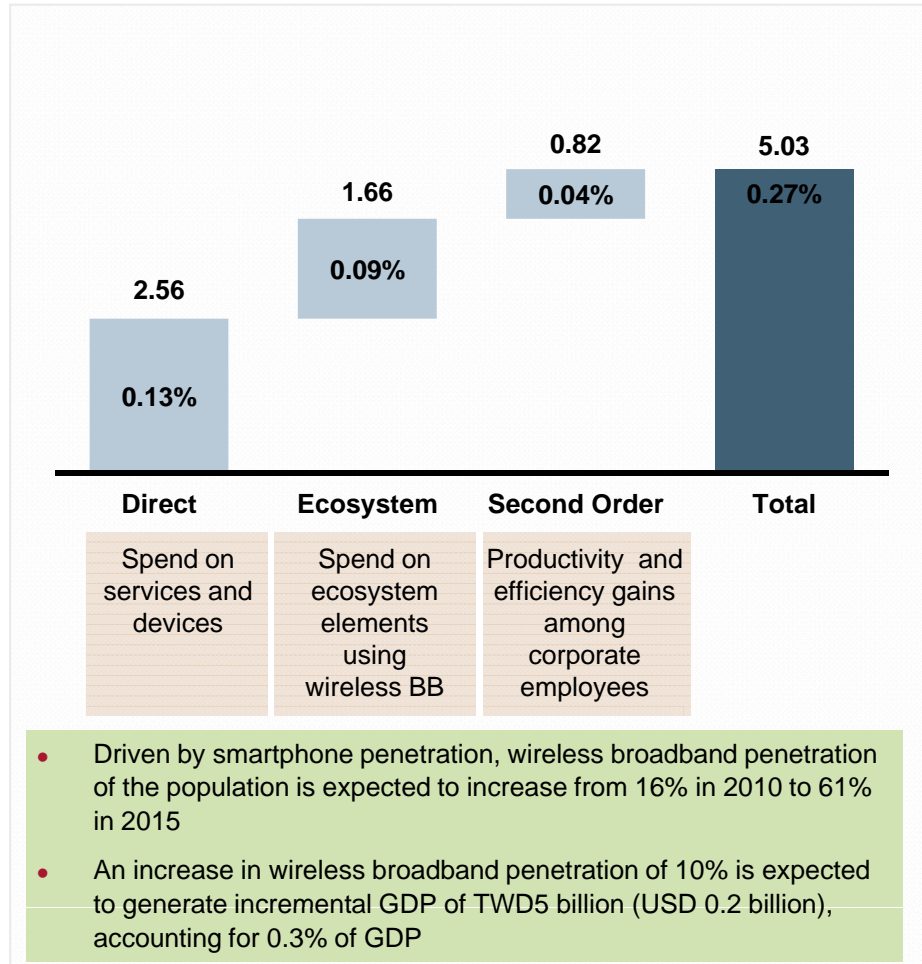


The development of wireless broadband can bring significant benefits for the Taiwanese economy

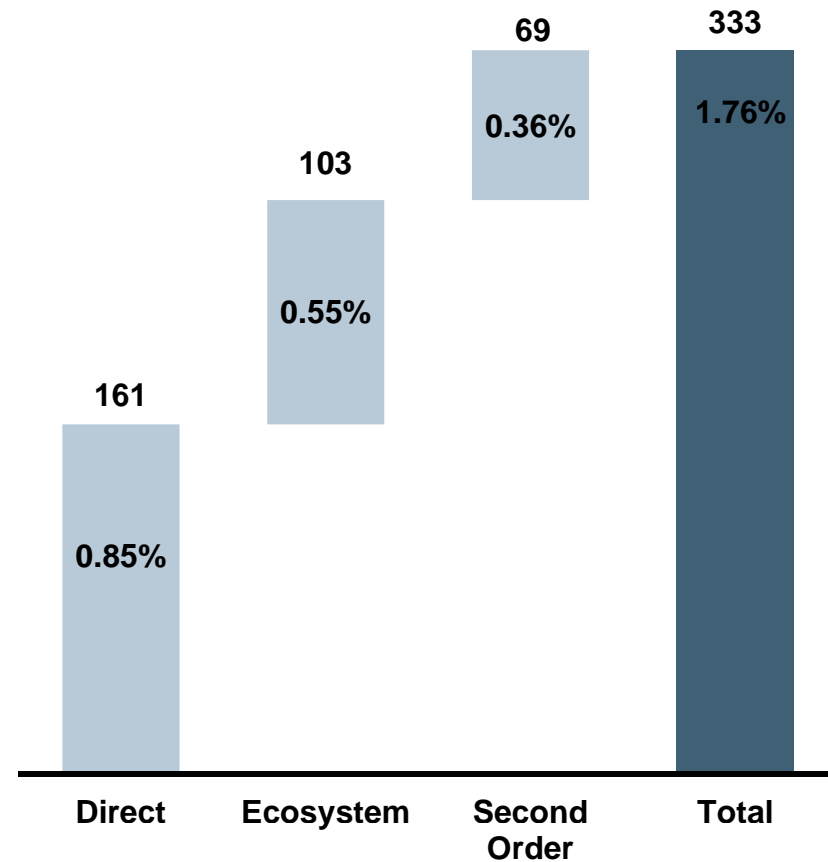
- An increase in broadband penetration of 10% will contribute TWD 5 billion (USD 0.2 billion) or 0.27% to Taiwan's GDP
- We expect growth in wireless broadband penetration to largely be driven by a rise in smartphone penetration
- Apart from the direct effects of wireless broadband penetration on service providers, Taiwan will see benefits elsewhere in the ecosystem
- Manufacturing will benefit from the increased adoption of wireless broadband services:
 - the importance of 3G equipment and devices will be the main driver of growth, with LTE representing an increasing role in later years as it develops its ecosystem
 - due to the lack of global WiMAX demand, it is more likely that manufacturing revenues will be generated from LTE versus WiMAX technologies in years to come
- The Taiwanese Government should actively take initiatives to promote the development of HSPA as well as LTE, particularly in the 700MHz and 2600MHz bands:
 - the NCC should facilitate WiMAX operators using the 2.6GHz spectrum to change their licence conditions from the deployment of WiMAX to LTE
 - the reallocation of spectrum in the 700MHz band should be done as efficiently as possible so that mobile operators can use this band for LTE
 - delays in the reallocation of the 700MHz spectrum means that less ideal alternatives may have to be considered by operators
- An increase in wireless broadband is likely to see a significant benefit for the consumers/retail sector through more vibrant online commerce, entertainment and advertising
- Social services and corporate sectors could also scale up with increasing wireless broadband adoption
- Second-order productivity gains in Taiwan are likely to be lower than those seen in developing countries

An increase of 10% in wireless broadband penetration will contribute 0.3% to Taiwanese GDP

Impact on GDP by 10% Increase in Wireless Broadband Penetration (TWD billion, 2010-2015)

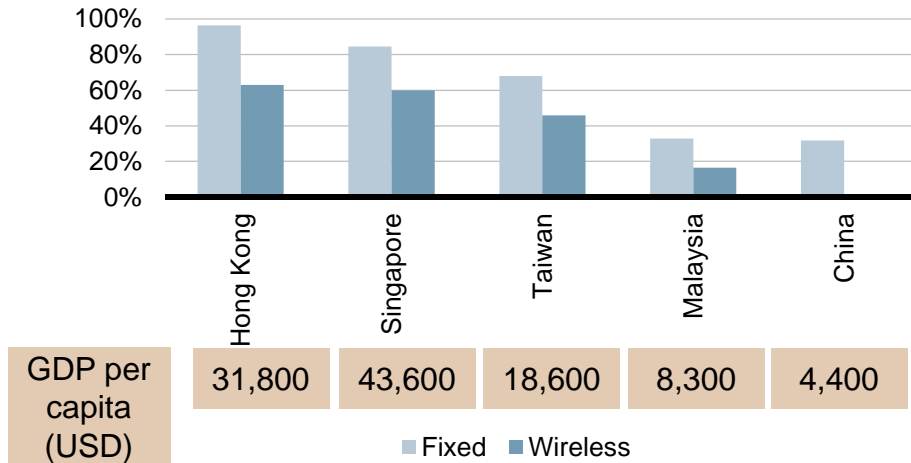


Total impact on GDP by wireless broadband in 2015 (TWD billion, 2015)



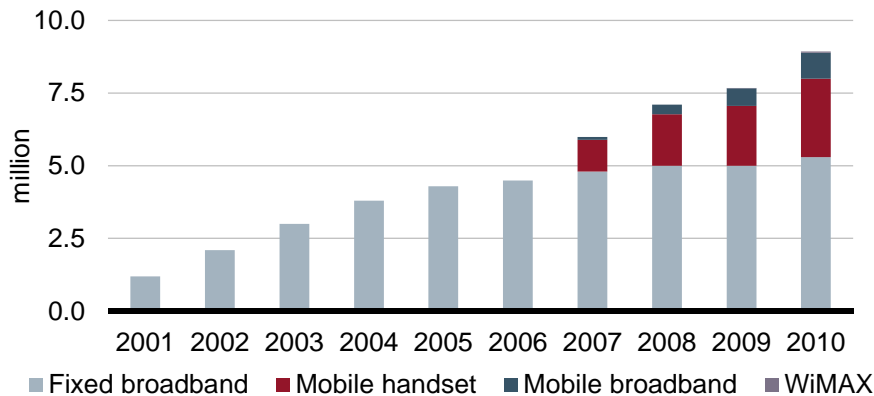
Growing wireless broadband is expected to drive total broadband penetration in Taiwan

Broadband household penetration by access technology (2010)*



- Broadband household penetration in Taiwan is high, at 114%:
 - despite being slightly behind, it is not far from broadband penetration levels in other developed Asian economies such as Hong Kong and Singapore
 - driven by fixed broadband connections, wireless broadband is becoming increasingly important, with fixed broadband growth showing stagnation in recent years
- Broadband penetration is expected to grow, in line with sustained economic growth
- An increase in broadband penetration is likely to be driven by growth in wireless broadband:
 - it tends to be taken up as a complement to fixed broadband in Taiwan
 - rural areas where there is limited fixed-line infrastructure are likely to see more growth in wireless broadband compared to urban areas

Evolution of broadband subscriptions in Taiwan

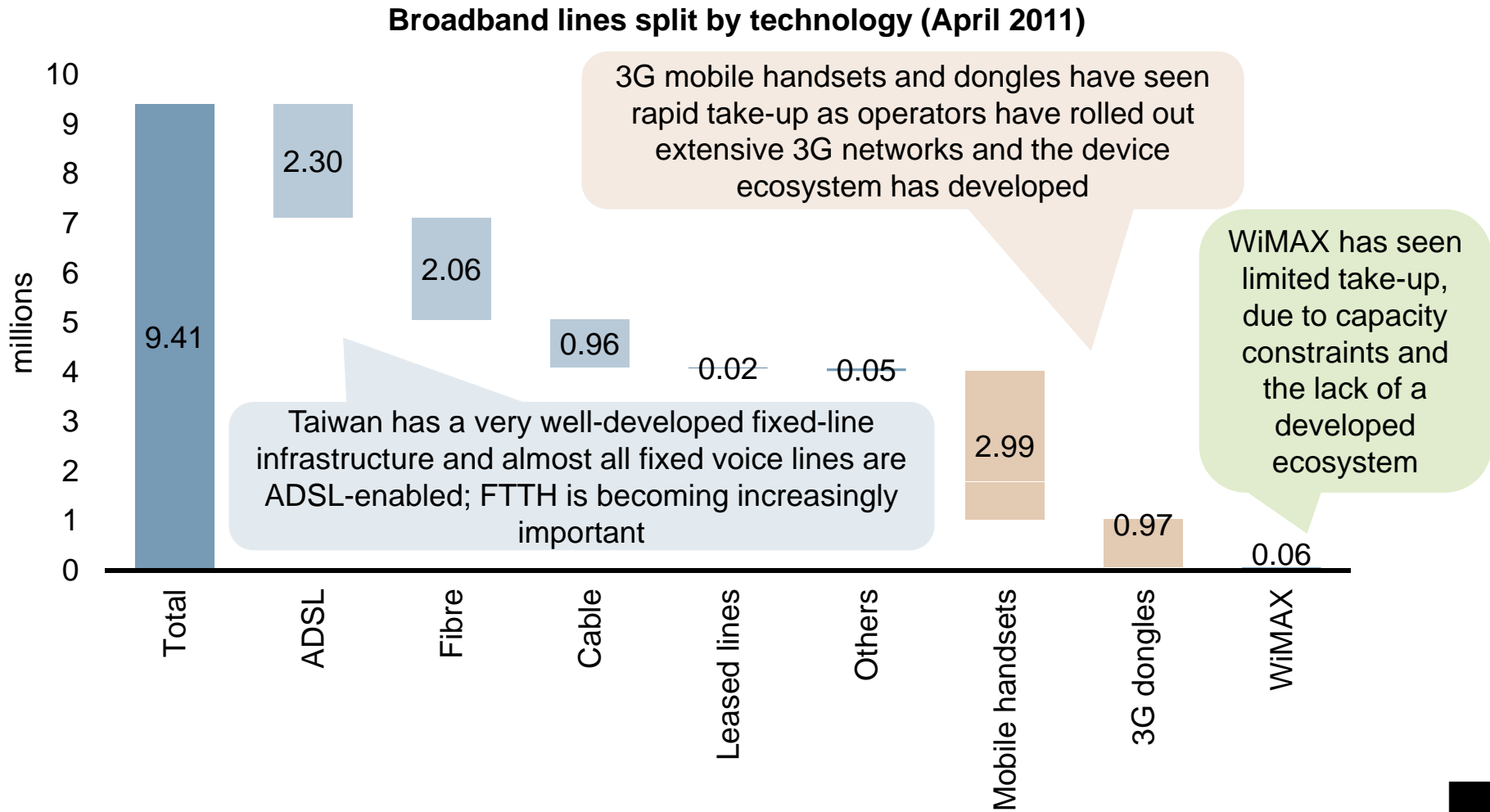


Source: Telegeography, NCC, Analysys Mason, GSMA, regulator websites

Note: * Fixed broadband excludes WiMAX; wireless broadband refers to dongles and data cards and, in some cases, includes broadband access from smartphones

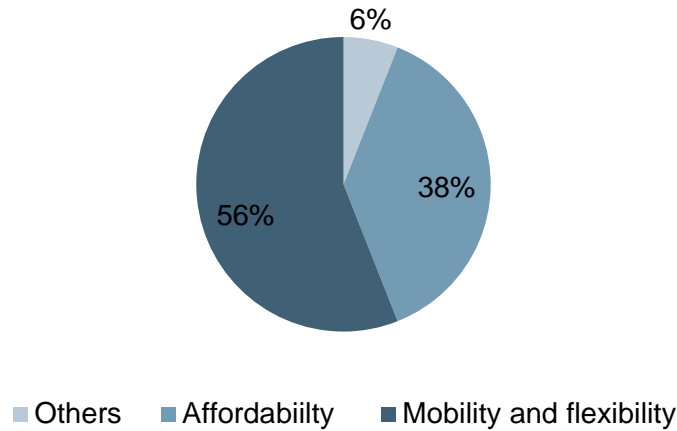


Wireless broadband take-up is driven by the roll-out of 3G networks and a developed ecosystem



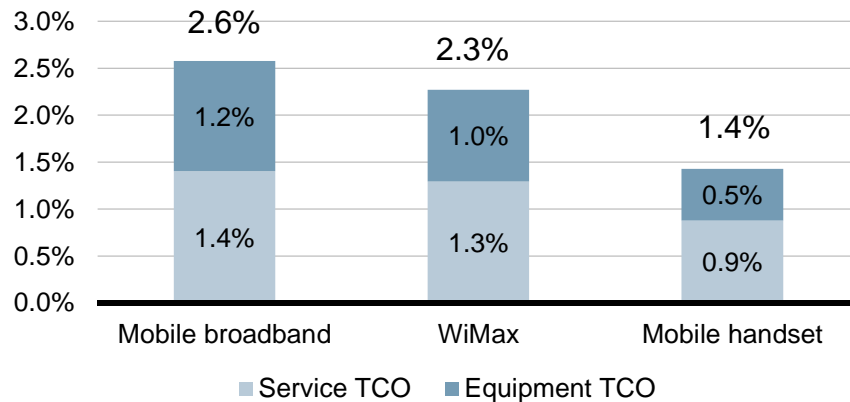
The stage is ready for mobile handsets to drive broadband usage

Reasons for using wireless Internet access in Taiwan (2010)



- Flexibility and mobility are key reasons for wireless Internet usage in Taiwan
- Affordability of mobile Internet equipment is also an important driver for wireless broadband usage, particularly with regard to wireless broadband access via mobile handsets:
 - mobile handsets provide the cheapest option in the market, and are likely to be a popular means of wireless broadband adoption
 - recent growth in smartphone usage is evident; in Q1 2011, 44% of total handset sales in Taiwan were smartphones, a quarterly and annual increase of 18% and 150% respectively
 - sustained future growth of smartphones is likely to drive usage further as consumers begin to use the features and functionalities of their devices

Entry-level TCO as a percentage of private consumption (2010)*

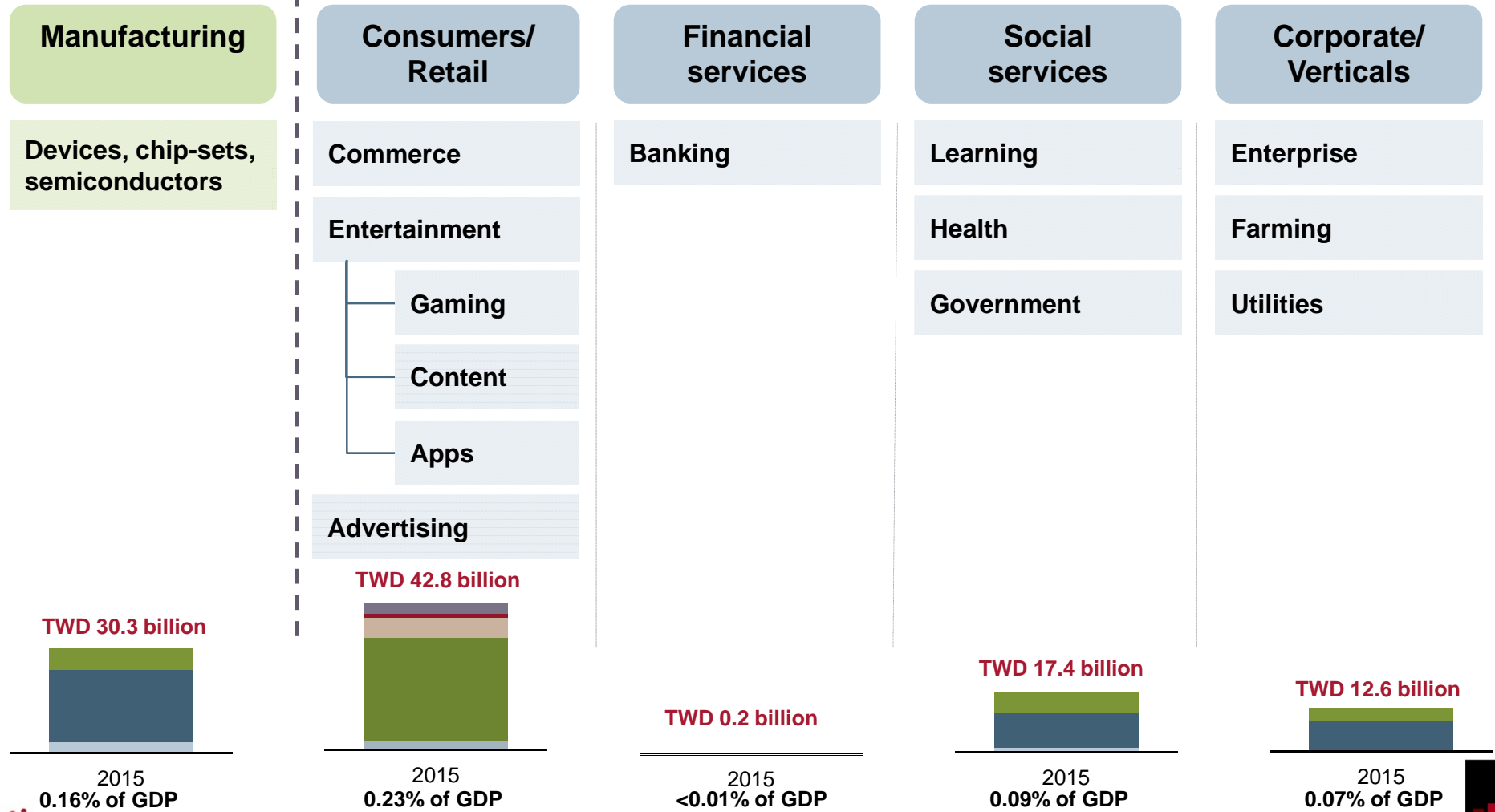


Taiwanese operators themselves want to deploy LTE, as indicated by recent trials

WiMAX	Cellular mobile
Rationale	
<p>1 Standardisation: a growing global LTE subscriber base and operator investment in the technology will see LTE achieve greater support and a more robust ecosystem vis-à-vis WiMAX</p>	<p>1 Future capacity constraints: growing demand for data may cause spectrum constraints; the allocation of additional spectrum and subsequent deployment of LTE allows operators to complement existing networks</p>
<p>2 Backward compatibility of devices: compatibility of LTE devices with existing technologies means there is likely to be a smooth transition to the production and take-up of LTE devices</p>	<p>2 Competition: the likely launch of LTE by other players means mobile operators are likely to deploy LTE in order to retain their competitive advantage</p>
<p>3 Harmonisation: operating TD-LTE in the 2.6GHz will enable interoperability and roaming, reliable vendor support, and economies of scale</p>	
Strategy	
<p>Likely to deploy TD-LTE versus FD-LTE, driven by the:</p> <ol style="list-style-type: none"> 1) likely launch of the technology by China Mobile 2) current allocation of the standard LTE band 2.6GHz 3) lack of WiMAX take-up around the world 	<p>Likely to continue offering HSPA+ 3G services in the short-term, moving to FD-LTE in later years; this strategy is driven by:</p> <ol style="list-style-type: none"> 1) comparability of HSPA+ and LTE supporting short-run data demand; backward compatibility of HSPA+ and LTE devices 2) delayed reallocation of 700MHz spectrum which is currently utilised by the military
<p>Although there may be delays in gaining approval from the NCC deployment is still likely to be faster than mobile operators</p>	
Examples of trials	
<p>WiMAX: Global Mobile and First International; Mobile: Chunghwa Telecom; WiMAX/mobile: FarEastTone</p>	

The development of a wireless broadband ecosystem will have a significant direct revenue impact

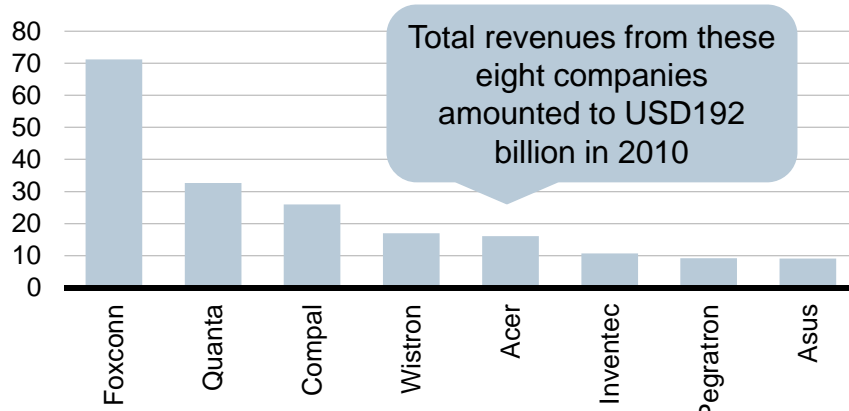
Wireless broadband ecosystem*



Note: *Wireless broadband ecosystem does not include mobile service delivery

Local device manufacturing will be significantly influenced by the global demand for wireless broadband access

2010 revenues of Taiwan's top 8 ICT manufacturing companies (USD billion)



Shipments of app-enabled smartphones and tablets are expected to reach 377 million in 2011 and 462 million in 2012 – overtaking traditional PCs

“Leading computer brands all have adjusted downward their PC shipments this year as they expect part of the PC market to be eaten away by tablets,” says Kakuangelo Kuo, a product manager of AsusTek's Eee Pad Business Unit

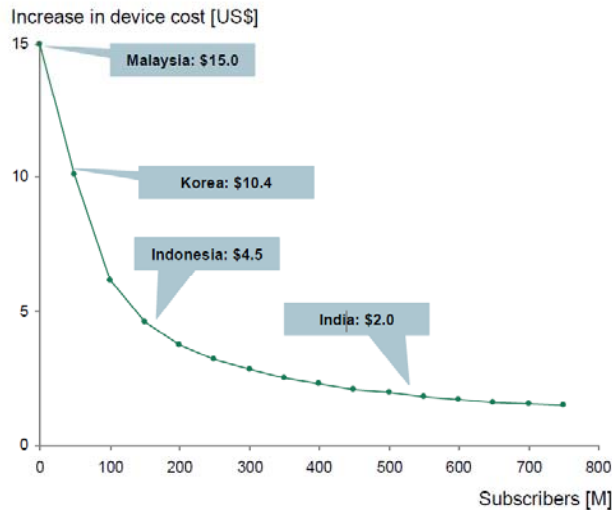
- ICT manufacturing and the consequent exports of high-tech products are significant elements of the Taiwanese economy:
 - the top eight ICT manufacturing companies accounted for approximately 86% of 2010 industry revenues
 - Taiwan ranks third in the world in terms of high-tech products as a percentage of total exports, and is ranked as the world's leading producer of notebook computers
 - global notebook shipments in the first half of 2011 are expected to reach 98.02 million units; Taiwan shipments were estimated to reach 85 million units in the first half of 2011, representing approximately 87% of the global market

While previously focused on the production of computers the future of Taiwan's device manufacturing will be driven by the demand for smartphones and tablet computers

The standardisation of technologies and spectrum bands will drive economies of scale

- Taiwan should harmonise technologies in the standard LTE band, particularly in the 700MHz band given China's expected launch over this spectrum in the next few years
- Device manufacturers have the potential to manufacture increasingly popular multi-band devices to achieve economies of scale
- Taiwan should then harmonise spectrum in the relevant bands according to the economies of scale achieved in the device market
- Driven by China Mobile's plans, the NCC has announced it is considering the allocation of spectrum in the 700MHz band for the future roll-out of LTE
- This spectrum is currently used by military/police organisations; it may take up to three years to be allocated for LTE and a further four years to finalise the licensing process and deploy commercial LTE networks
- Operators may be forced to look at less desirable alternative options for LTE deployment in other bands

Illustration of possible economies of scale of handsets as the subscriber base increases



Spectrum band	Current use	Future use for wireless broadband in Taiwan
470 – 862MHz	Analogue TV	<ul style="list-style-type: none"> • A portion of the spectrum released from the anticipated switch-off of analogue TV in June 2012 could be used for wireless broadband
850MHz	APT-CDMA	<ul style="list-style-type: none"> • Possible adoption given substantial ecosystem development
1800MHz	2G operators	<ul style="list-style-type: none"> • The renewal of 1800MHz 2G spectrum to the original licence holders may allow 2G operators to launch WBB* in this band • Spectrum refarming may allow both 2G and 3G operators to use this band to provide WBB* services, creating a more competitive environment
2600MHz	WiMAX operators	<ul style="list-style-type: none"> • Technically can be used for LTE deployment

Supporting platform services and content will also see benefits from wireless broadband

Consumers/ Retail

Commerce: focus on the development of NFC payment applications

Entertainment: focus on trying to leverage the large-scale Chinese VAS market by entering partnerships with Chinese operators

Advertising:
a) adopt strategies such as those seen in Japan to develop rich mobile Internet advertising b) use NFC as a way to better target consumers in the mobile internet advertising space

Financial services

Banking: operators and financial institutions should look to enter partnerships to provide non-traditional banking services such as chore-management applications

Social services

Learning: focus on language learning as a way to develop m-learning

Health: if higher bandwidth is made available to operators, they should further develop m-health applications

Government: the government should focus on extending the variety of its m-applications

Corporate/ Verticals

Enterprise: profit from growth of the private enterprise cloud computing market, particularly with regard to mobility apps arising from the increase in wireless broadband penetration

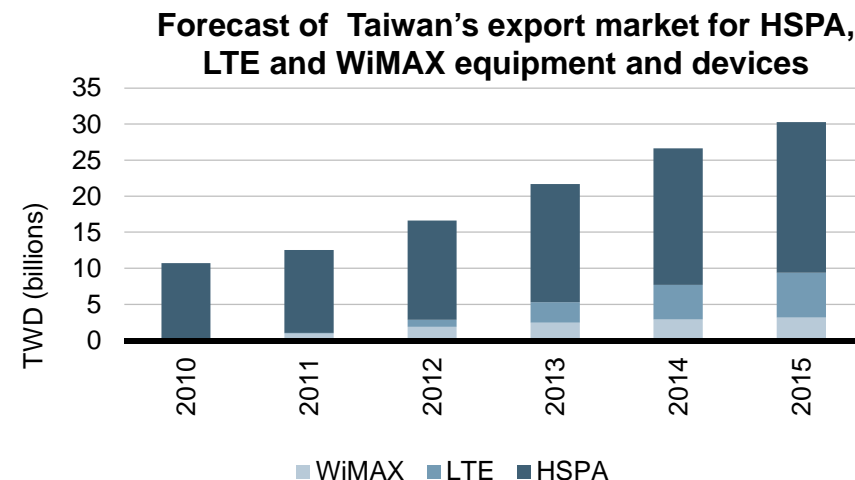
Farming: focus on the development of e-agriculture and m-agriculture

Utilities: continue the development of the M2M market

To reap the full benefits of broadband will require support of the Government in driving the export market

- The Government's WiMAX development plan aimed to leverage local Taiwanese production in order to become the world's largest exporter of WiMAX products
- However, low levels of worldwide WiMAX demand means that no global WiMAX hub was developed
- Despite government bodies still pushing for the adoption of WiMAX for various applications in Taiwan, the lack of scale means WiMAX devices are likely to cost more than LTE devices in the medium term
- Given the similar functionality of the two technologies, the government should consider the development of HSPA+ and LTE
- HSPA equipment will continue to be the main driver of Taiwan's export market of equipment/devices for the foreseeable future
- Although the launch of LTE is not expected until at least 2014, Taiwan's LTE export market is likely to be more significant than that for WiMAX:
 - despite a lower market share for the exports of LTE vis-à-vis WiMAX equipment ...
 - ...the potential scale of global LTE take-up and lack of WiMAX standardisation means the value of Taiwanese LTE exports is expected to be driven by demand for LTE equipment/devices
 - future deployment of LTE in Taiwan could further enhance the competitiveness of local manufacturers

Although local demand will drive the country's WiMAX export market, given the smaller market size in terms of lower demand, it is in Taiwan's best interest to focus on the manufacturing of HSPA and LTE equipment rather than WiMAX equipment



LTE supports many spectrum bands and Taiwan's key imperative is to release spectrum in the 700MHz band

- LTE is supported by many bands around the world, resulting in quite a fragmented market
- There is a clear distinction between the use of different bands, with Asian and European countries harmonising in the 700MHz and 800MHz bands respectively
- Harmonisation within prevailing LTE bands enables operators to gain many benefits including:
 - interoperability and roaming
 - fast and reliable vendor support
 - economies of scale in the production of handsets and network equipment
- Local and global market dynamics means Taiwan should significantly focus on the deployment of LTE in the 700MHz and 2.6GHz bands:
 - a) 2.6GHz spectrum is already allocated to WiMAX operators
 - b) China Mobile and Asian operators are focused on the deployment of LTE in the 700MHz band

LTE deployments worldwide by spectrum band

Bands	Deployments and plans
700MHz	Verizon (USA), with growing momentum in Asia (inc. China, Indonesia, Vietnam, Australia) for harmonisation on this band
800MHz	Vodafone (Germany), with plans in the EU for harmonisation on this band, T-Mobile (Germany), Telefonica (Germany)
850MHz	No deployments; potential trial by SK Telecom
1.5GHz	NTT DoCoMo (Japan)
1.8GHz	CSL (HK), Elisa (Finland), CenterNet (Poland), MobileOne (Singapore), Omnitel (Lithuania), TeliaSonera (Latvia)
2.1GHz	Glo (Nigeria), Metro PCS (USA)
2.6GHz	TeliaSonera (Denmark, Finland, Norway, Sweden, Uzbekistan), CSL (HK), Net4Mobility (Sweden), Telekom Austria (Austria), T-Mobile (Austria), VivaCell (Armenia), EMT (Estonia), Elisa (Finland)

The NCC's most important task is to ensure that the reallocation of spectrum in the 700MHz band is as efficient as possible. The regulator must also facilitate changes in WiMAX operators' licence conditions to deploy LTE

The NCC will need to define a clear roadmap to allow wireless broadband to realise its true potential

Frequency	Status	HSPA/CDMA	LTE	Rationale for wireless broadband	Government/regulatory imperative
2600MHz	Existing allocation to WiMAX operators	✓	✓	Lack of global WiMAX standardisation	<ul style="list-style-type: none"> • Issue technology-neutral licences for operators with current WiMAX-specific concessions • Ensure less stringent approval of applications to move to LTE • Consider competition effects in mobile market
2100MHz	Likely future capacity constraint for 3G data from ~2013 onwards	✓	✗	-	<ul style="list-style-type: none"> • Release and allocate spectrum in other bands in order to make up for future data capacity constraints
1800MHz	Spare capacity/ future roadmap	✓	✓	2100MHz: capacity constrained in future; 1800MHz: spare capacity	<ul style="list-style-type: none"> • Issue technology-neutral licences for spectrum in this band to allow refarming and consequent use of this band for LTE and HSPA data services
900MHz	Likely capacity constraint for 2G voice and data	✓	✗	-	<ul style="list-style-type: none"> • Issue technology-neutral licences for spectrum in this band to allow refarming and consequent use of this spectrum for HSPA data services
850MHz	Existing allocation to APT-CDMA	✓	✓	To retain competitiveness	<ul style="list-style-type: none"> • Facilitate move for APT-CDMA to launch faster WBB* services by issuing technology-neutral licences according to market demand
700-800MHz	Future roadmap	✗	✓	Better propagation characteristics for rural coverage	<ul style="list-style-type: none"> • Reallocate the 700MHz for LTE and realise the digital switchover as efficiently as possible

Spectrum harmonisation is a key regulatory development after the standardisation of technologies and the related development of a multi-band device ecosystem of and achievement of economies of scale

Definitions of key terms used in this presentation

Terms	Definitions
Wireline	Lines of copper / cable / fiber deployed underground or overhead for voice / internet services
Fixed Broadband – Wireline	Data connection (\geq 256 Kbps download or upload speed) over wireline infrastructure
Fixed Broadband – Wireless	Data connection (\geq 256 Kbps download or upload speed) over wireless transmission accessed from a fixed location, primarily using WiMAX 802.16-2004 / 802.16.d technology
Wireless Broadband	Data connection (\geq 256 Kbps download or upload speed) over wireless transmission primarily using WCDMA, HSPA, LTE, CDMA EV-DO, TD-SCDMA and WiMAX 802.16.e technologies; includes mobile broadband dongles/data cards, smartphone devices and tablets
Internet Users	Unique users accessing internet from private / shared / corporate connection
Wireless Broadband Users	Unique users accessing wireless broadband services from private / shared / corporate connection
Consumers	Individuals accessing broadband services from residential premises or SOHO (Small Office, Home Office) & unorganized sector (whose activities / data collection is not regulated under any legal provision) businesses
Enterprises	Includes large businesses and SMEs in the organized sector (for which statistics are available from budget documents or reports, or whose activities or data collection are regulated under a legal provision)
Direct Impact	Consumer and enterprise spend from telecoms service providers on devices and services for accessing wireless broadband
Ecosystem Impact	Revenues generated by the telecom and adjacent industries from value added services / other services enabled by wireless broadband access
Second Order Impact	Increase in economic productivity of the work force as a result of access to wireless broadband services
e-commerce/m-commerce*	e-commerce refers to any online commerce/payment activity (wireless broadband is an element of e-commerce); m-commerce refers to mobile-specific applications for commerce/payment activity (i.e. specific to tablets and smartphones)