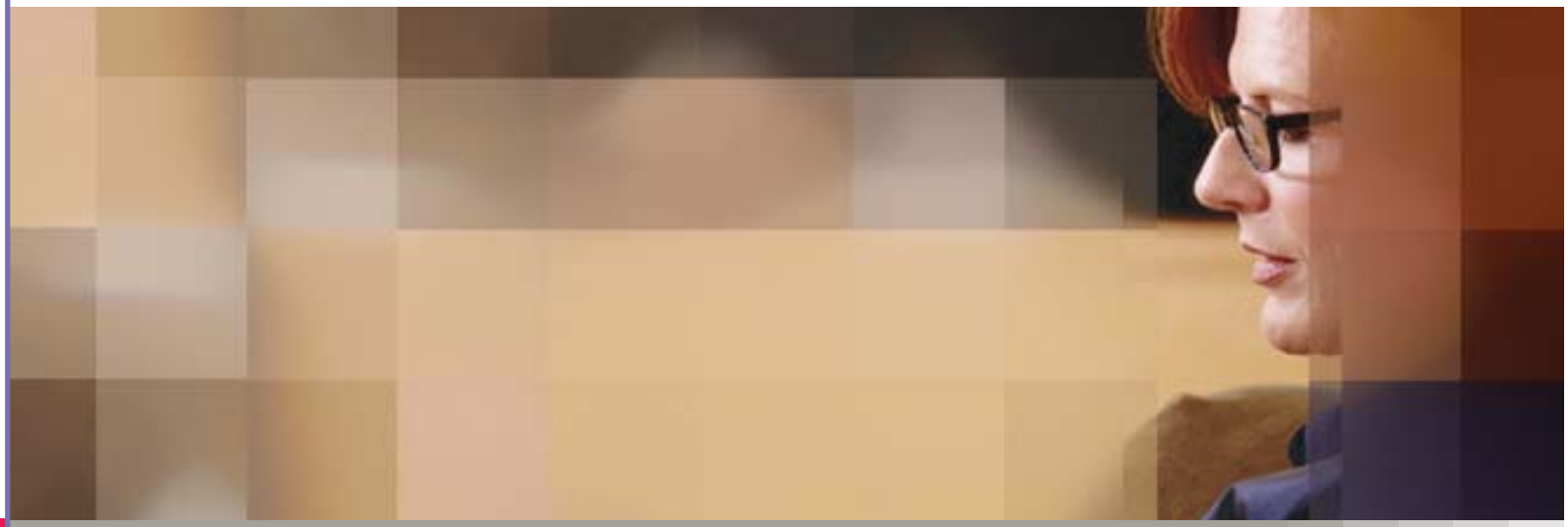

FTTx Trends in APAC

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28 January 2009

Table of Contents

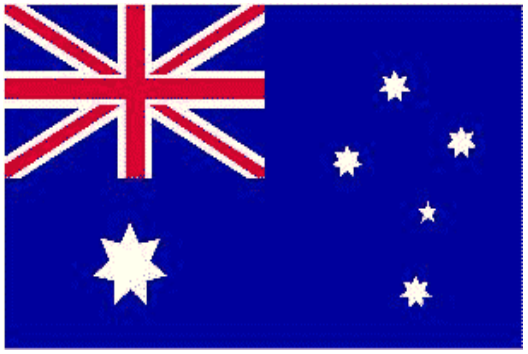
Executive Summary

- Ovum conducted an independent assessment and provided an analysis on broadband deployments and service drivers with specific focus on FTTH/FTTB (as defined by the 3 FTTH councils) activity in the Asia Pacific region focusing on Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam.

- We examined the prospects for FTTP around subscriber growth in the region (focusing on the countries identified above), FTTP deployment activities and deployment variations, regulatory issues impacting FTTP (and broadband growth in general), and service drivers that might necessitate the need for FTTP over other forms of broadband access like DSL, cable modem, or wireless.

- This report is an update of the study performed last year – January 2008

- This report is a subscriber forecast for the years 2006 – 2012, an equipment spending forecast for the years 2006 – 2012 both in excel, and a brief PowerPoint summary of each country.



Australia

Australia Profile

General Information - 2008

- Estimated Population – 21.2 million
  - Urban – 84.8%
- Estimated Households – 8.3 million
  - FTTP Household Penetration – 0.2%
- Estimated Broadband Connections – 6.2 million
  - 69.5% DSL
  - 15.2% Cable Modem
  - 0.3% FTTB/FTTH
  - 15% Wireless
- Broadband Household Penetration –74.7%

Australia Profile

- Growth is dominated by DSL, growth rate of DSL connections is steady
- New government wishes to invest public funds in FTTN (A$4.7 billion)
- Competitive DSLAM investment is slowing as FTTN plans progress
- Industry proposals were lodged in November 2008 to decide which operator will have public funding.
  - These proposals include regulatory reform proposals
  - Most details of proposals are confidential
- Government is scheduled to decide regulatory framework and funding allocation in March 2009
- Deployment is expected to begin in 2009
- Between 2009 – 2014 it is expected that around A$10 billion will be invested in FTTx deployment

FTTx Status

- FTTX deployment is currently limited to some trial sites. Government funding will accelerate FTTN deployment significantly.
- Published commentary suggests that at least six proposals have been lodged.
- Four feature FTTN for 75-90% of households, and wireless and satellite in rural and remote areas.
  - Telstra is seeking assurances of no structural separation
  - They believe that investment in NGN should be subject to a relaxed access requirement, with wholesale prices set by commercial negotiation
    - “We are not going to put something out there that the regulator will force us to open to competitors at less than cost. We will not be forced to or willingly spend shareholder money where we shouldn’t”.
  - SingTel Optus and two other national bidders propose a network subject to current access requirements, and seek protection from a Telstra over-build
- There are also two proposals for networks in small parts of the country, leaving the rest of the country to the national bidders

FTTx Status

- We still think Telstra's proposal is most likely to be accepted.
- Telstra's original 2005 3-year plan was to reach around 50% of households:
  - 450 exchanges will be upgraded over five cities, with 20,000 node deployments
  - Conditioning the network: removing broadband blockers and loading coils, with 500,000 pair gain systems being removed.
  - Fully provisioned, high speed broadband with VoIP and a multi-service access network technology
- Telstra's new proposal is to reach 80-90% with FTTN (if the full government funding were offered as a concessional loan) so these numbers would be larger.

China

China profile

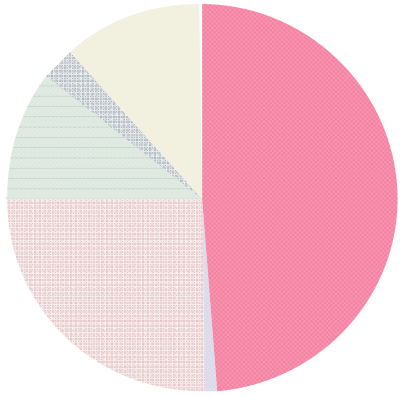
General Information - 2008

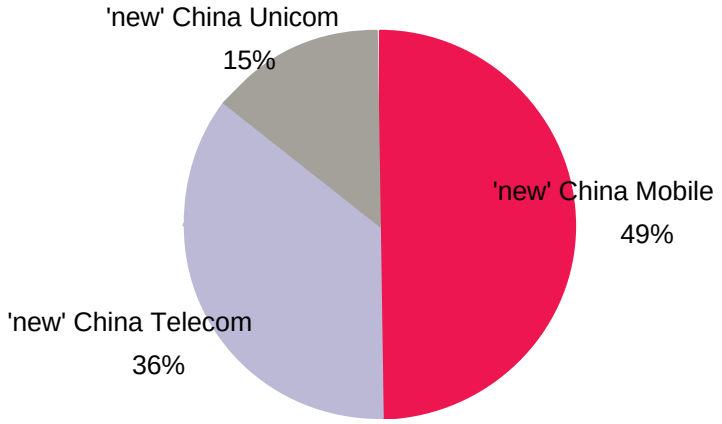
- Population: 1,318 million
  - Urban – 45.7%
- Households – 426.2 million
  - FTTP Household Penetration – 1.4%
- Broadband Subscribers – 78.7 million
  - 91.7 % DSL
  - 0.4% Cable
  - 7.6% FTTH/FTTB
  - 0.3% Wireless
- Broadband Household Penetration – 18.5%

2008 telecom industry shuffle

‘new’ China Telecom	中国电信 CHINA TELECOM	+ China unicom中国联通	CDMA network
‘new’ China Mobile	中国移动通信 CHINA MOBILE	+ 中国铁通	
‘new’ China Unicom	CNC 中国网通	+ China unicom中国联通	GSM network

Revenue share before and after restructuring (*Source: MIIT data*)





2008 telecom industry shuffle cont.

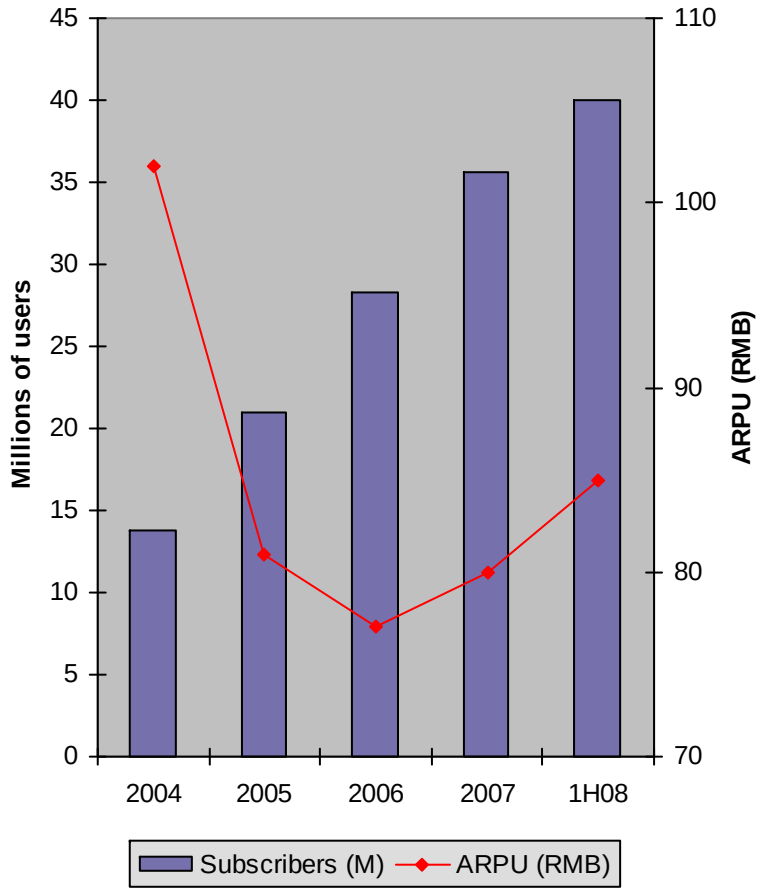
- China's Ministry of Industry and Information Technology (MIIT) was formally launched on June 29, 2008 to replace the old Ministry of Information Industry (MII).
- Post-restructuring, there are now three large national carriers in China: China Mobile, China Telecom and China Unicom. As part of the reorganization, China Mobile has absorbed China Tietong (formerly known as Railcom). China Telecom has taken over Unicom's CDMA business and the communications assets of China Satcom. Netcom merges with Unicom, which has retained its GSM business and a small fixed-line operation.
- All operators can introduce fixed-mobile convergence (FMC) services. It is anticipated that by 2009, the networks will be consolidated and their development will accelerate rapidly with blended services and video offerings.
- Under service convergence, operators can no longer depend only on the network size and industry monopoly to win. More often, it will depend on the customer experience to win the market. This requires an intelligent, large capacity optical network for the backing.
- MIIT suggested 3G licensing will be around year-end with widespread expectation for three types of network licenses: China Mobile will pick up TD-SCDMA, China Telecom CDMA2000, and China Unicom WCDMA.

Market update

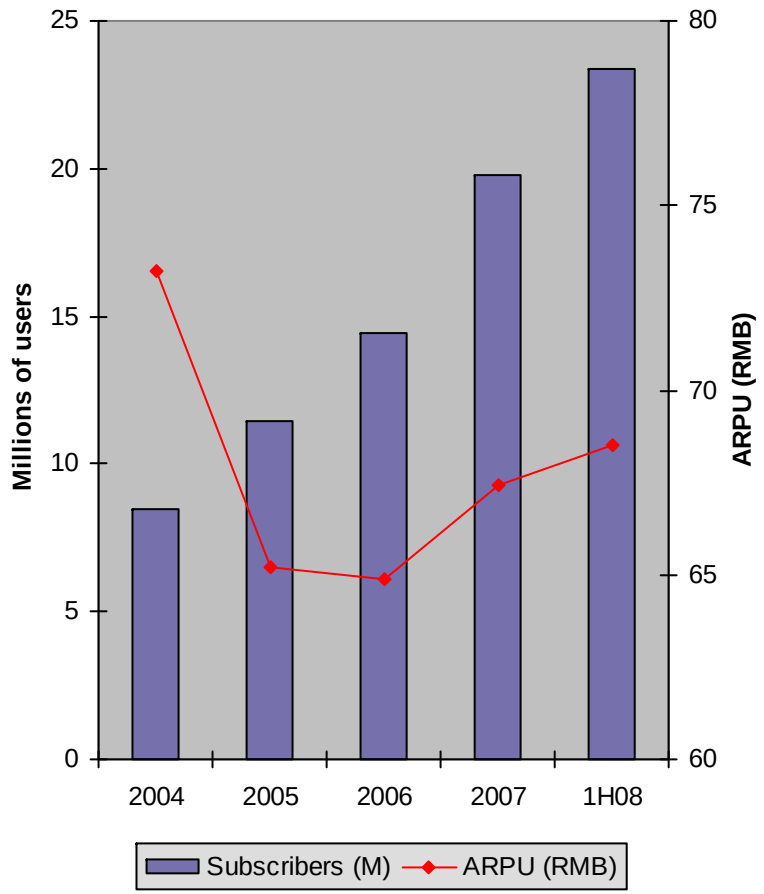
- FTTx (FTTB/H) passed 4 million lines earlier in 2008, likely to reach nearly 6M by 12-08. China Telecom remains the major player, followed by Netcom (now part of Unicom), but China Mobile also probing FTTx.
  - Estimates range from 13 million to 18 million new FTTx subscribers in 2009, with China Telecom and China Unicom installing 70 percent and 30 percent respectively. FTTB will dominate installations, with approximately 90 percent, and the remaining 10 percent will be FTTH.
- According to MIIT's projections, broadband xDSL users could increase by more than 16.2 million in 2008, reaching a total of 68.2 million. From 2008 to 2011, xDSL users will increase by an average of 16.3 million users per year, totaling more than 100 million by 2010. This year there will be approximately 0.6M FTTH users; by 2011, this could grow to 8 million.
- The ASON network offered by China Netcom in the Beijing Olympic Games successfully demonstrated an intelligent optical transmission network with innovative services at the network edge advancing towards the customer premise.
- Effect of international financial crisis
  - Prospects remain good; network investment plans set up pre-downturn so far unchanged. Government fiscal stimulus and attempts to promote domestic consumption are also positive factors.
  - Commercial operation of new generation optical communication technology such as xPON, 40G, PTN will help operators to enhance ARPU, therefore investment in them will continue.
- China FTTx Industry Alliance
  - Formed in Oct, the alliance has over 30 members, including the three Chinese telecom carriers, major telecom equipment vendors, optical electronics vendors, key research labs and top universities.
  - It operates under the China Communications Standards Association and aims to accelerate FTTx growth by building a sound industry chain. Its office is in Hubei Wuhan, the Optics Valley of China.

Scale & competition lowers broadband ARPUs, new services & FTTx speeds reverse trend

China Telecom Broadband



China Netcom Broadband



China Telecom's FTTx strategy

- ADSL2
  - 16Mbps downstream and good interoperability.
  - Large-scale commercial deployment reduces the cost greatly to under $45/user.
  - ADSL2+ now available and VDSL2 ready for 2009.
- VDSL2
  - 20Mbps is achieved by controlling the last mile within 1km.
  - Two rounds of interoperability tests ran smoothly. It will be used mainly for high speed access in urban reconstruction areas. Commercial use is expected to be early 2009.
  - Main challenges – because this technology lacks large-scale commercial deployment, the cost awaits for further reduction to be comparable with ADSL2. However, a higher price is reasonable, because of the higher speed. The technical challenge is developing VDSL2 for household appliances.
- EPON
  - Completed large-scale EPON OLT+ONU vendor interoperability testing at the chipset and system levels, with very satisfactory result. The outcome is used as a reference by Japan, South Korea and Malaysia.
  - "China Telecom EPON Equipment V2.0 Specification" was released and adopted in 20 provinces.
  - The price of EPON dropped quickly within one year; target end-to-end per user pricing is below $100.
  - Completed 40,000 lines centralized purchase order for EPON equipment.
  - Reliable support of TDM services is needed in the future, as 0.5PPM is the criteria for mobile base station to guarantee service quality. Currently, it relies on Ethernet synchronization.
- GPON
  - The results of 2 lab tests are not too ideal; interoperability still a long way to go. Trials likely in 2009.
  - P2P 1km Ethernet is another barrier.
  - The cost needs to reduce further; target price is 20% higher than EPON, i.e. $120/user.
  - Development of high-speed chips and technology equipment lags behind EPON.
  - WDM-PON is under investigation, but product is immature and pricing is too high.

China Telecom's FTTx services strategy

- While voice revenue is dropping, broadband/Internet revenues grew 30% from 1H07 to 1H08, to 22% of total revenues. Broadband ARPU is twice of telephony.
- IPTV is gaining momentum, reaching 600,000 users by end of 2008.
- Currently, the main source of broadband revenue comes from connection fees, whereas those coming from VAS is very little. Majority of the application revenue is taken away by ICP. To the operator, internet access is charged, whereas services are free. It is doubtful whether such pattern of internet connection model can continue for a long time because operators will not have the incentives anymore.
- Generally speaking, broadband access still has very big development potential, with IPTV a strategic growth domain.
  - Next 3 years – China Telecom's high-end user bandwidth demand will consist of IPTV with HDTV (6-10Mbps), 2 SDTV (4-6Mbps), video communication (1-2Mbps), online service (2-6Mbps), network gaming (300-800kbps). In addition, 2 channels of VoIP (200kbps), therefore the overall demand for high-end users is 20Mbps.
  - Next 10 years – Internal research shows 50-100Mbps is required for HDTV, 3 SDTV and even 3D-movie. Tentative plan for 2015 is 50-100Mbps.

China Telecom's deployment strategy

- Apart from the dense population in highly developed economic zones, China has mid- and small-scale cities, as well as outlying countryside. And so, US deployment experience is considered to be more relevant than Japan's as a reference strategy.
- Urban area
  - 2008/09: 38% for copper and 52% for fiber, moving to PON+FTTN/FTTB providing 16Mbps.
  - In 2010, 20Mbps downstream, 4-8Mbps upstream, including 1 IPTV and 2 SDTV channels; high-end customers requires 25Mbps; 32Mbps by 2012 and long-term is 50Mbps to 100Mbps.
  - New sites – FTTB based on PON+LAN; FTTH if construction cost can be reduced effectively.
  - Old sites – copper is replaced by FTTB + VDSL2.
  - Commercial districts and high-end residential areas – FTTN.
  - The emergence of 10G EPON and 10G GPON can provide additional 6Mbps/user without fiber reconstruction. This can satisfy high bandwidth services after 2010.
- Countryside
  - The new optical network should reach the administrative village as far as possible, using FTTN+DSL.
  - Lessons learnt from Wenchuan earthquake – from a technology angle, development based primarily on optical fiber is correct. But dealing with emergency, fiber optics too is insufficient. Mobile is even worse, as both fixed network and mobile base stations were destroyed.
  - The most effective means under emergency condition is by marine satellite handsets. Satellite communication has the superiority, unmatchable with any other technologies. Therefore this kind of unique technology cannot be neglected in a comprehensive environment.

China Netcom

- CNC is the major provider for 10 northern provinces. About 30% of China's broadband market is supplied by CNC.
- Announced US$2B investment in “Copper replacement” projects; testing its FTTH network in Beijing.
- Very much in favor of EPON due to its higher degree of commercialization in chipset and equipment.
- In March 2008, China Netcom released an EPON tender. Huawei, Fiberhome and ZTE captured 85% of the order. This first round included 89,000 lines of subscriber equipment and 3600 sets of fiber optics networks devices (ONUs), far exceeding the 2000 sets originally planned.
- China Telecom and Netcom will submit the EPON OLT+ONU interoperability test results and the related draft standard to MIIT for formulating the national standard.

China Mobile

- China Mobile has large metro, provincial and national backbone fiber optic network resources stemming partly from its original spin-off from China Telecom/MPT. This network provides direct connectivity to many of its 200K+ base stations nationwide, but its access network wireline resources are limited.
- As the industry restructures, China Mobile is in a great financial position: cash reserves exceed debt easily; it has strong profitability metrics; and, a dominant position in mobile. It now wants to enter fixed-line markets as it faces new competition in mobile services.
- It is testing FTTx in China's eastern Jiangsu Province (5 cities) and southern Guangdong Province. Jiangsu has stopped constructing ADSL networks before the end of June and will adopt FTTH networks.
- The FTTx networks employ EPON with 1 Gbps bandwidth, offering video applications, such as IPTV and online games. The networks will be used by China Mobile service centers, and services based on the network will be offered to upscale office buildings and VIP customers with high ARPU.
- Fiberhome is the main supplier. China Mobile requires its FTTx networks to be capable of supporting fixed line voice call services by installing TDM.
- Construction of a national FTTx network may begin in 2009. However, the exact date of large scale rollout will be based on the results of the trials.

Others

- **GreatWall BB**
  - Probably the earliest FTTH PON player in China
  - Deploys EPON for broadband access in Chengdu city, Sichuan Province; Wuhan city, Hubei province; elsewhere.
- **Cable operators**
  - Use EPON to provide bidirectional Internet service over existing cable networks in ShanDong, Jilin and other provinces
- **Enterprises' proprietary Networks or Intranet**
  - Oil field networks in QingHai province

China – WiMAX status

- In China, several operators have already been allocated local 3.5GHz licenses. However, despite the fact that the technology has been tested by several big operators, there are very few rollouts of WiMAX in China. One reason being that the adoption of TD-SCDMA technology has to be favored for mobile broadband. WiMAX licensing, especially in 2.3GHz and 2.5GHz bands, is still in its infancy in China, as the government is cautious about licensing WiMAX frequencies before 3G licenses are awarded. The 2.3GHz band in China has been planned for 3G TDD expansion.

- WiMAX rollouts / plans in China

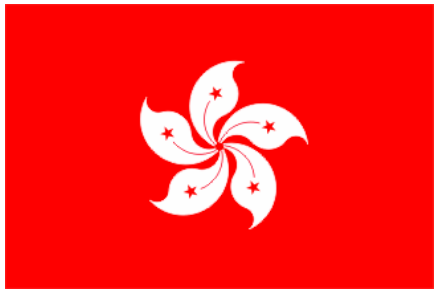
  - China Netcom has conducted trials of Redline RedMAX solution in Chengdu.

  - In May 2006, Guangdong Netcom, a local subsidiary of China Netcom, signed WiMAX equipment purchase contracts with two unnamed equipment suppliers worth a total RMB280 million (USD35 million). Of the total amount, Guangdong Netcom plans to invest up to RMB100 million on WiMAX wireless network equipment. Guangdong Netcom is designated by China Netcom as one of the sites for WiMAX trials.

  - China Telecom has been trialing WiMAX in nine provinces in northern China.

  - In January 2008, FiberHome Mobile announced that its WiMAX-16d solutions have been selected by China Unicom with exclusive construction rights in Shanxi and Heilongjiang provinces. In March 2007, China Unicom announced that “since the beginning of 2006, China Unicom has been testing WiMAX in Guangdong, Shanghai, Dalian and five other cities.”

  - In August 2008, POSDATA signed a commercial contract with Airway Communications. Under the deal, POSDATA will provide 16e-based technology and product to support Airway’s network and service expansion in Shandong Province. Airway's WiMAX network is supporting the government, communities and other vertical applications.



Hong Kong

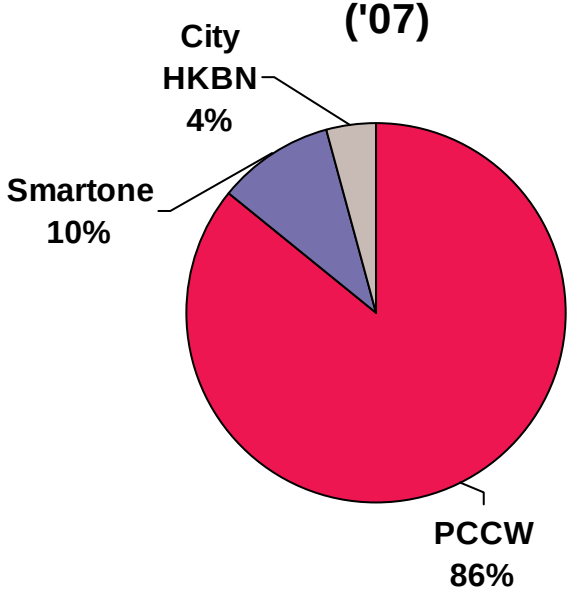
Hong Kong profile

General Information - 2008

- Population: 6.99 million
  - 94.3% Urban
- Households – 2.35 million
  - FTTP Household penetration – 27.7%
- Broadband Subscribers – 2.26 million
  - 56.2% DSL
  - 15% Cable
  - 28.8% FTTH/FTTB
  - 0% Wireless
- Broadband Household Penetration – 96.2%

Spenders & vendors

Hong Kong telco capex: $0.5B ('07)



Source: Ovum

- Major suppliers
  - Large number of vendors with presence in HK and significant network deployments: Huawei, Ericsson, Nortel, Alcatel-Lucent, Cisco, others
  - Huawei sticks out as having momentum in recent years

•Additional spenders not included above: Hutch, i-Cable, Wharf T&T, and large enterprises
•City/HKBN was part of consortium bidding on NetCo project in Singapore
•Diverse, competitive industry has created opportunities for lots of vendors

Spending drivers: Hong Kong

Driver	Remarks
International connectivity	Influx of new undersea cable investment in AP driving terrestrial requirements for city backhaul, bandwidth management, and transport across border to mainland China. Multiple providers are procuring gear to support these needs (PCCW, Pacnet, HGC, etc).
Broadband/ video race	HK's wireline competition is intense. Operators have relatively similar pricing (taking account of both monthly rental and initial set-up costs), and both PCCW and HKBN offer symmetric FTTx (active Ethernet-based) at up to 1Gbps. Aggressive discount offers are often provided to encourage customers to switch from other providers. Content offerings often key to differentiation in VoD/IPTV area; English Premier League football a very popular option, which PCCW offers exclusively. Competition also comes from i-Cable over cable modem and HGC (FTTH/B up to 100Mbps on network with access to over 5500 buildings and 1.3M households). Main business driver for broadband in the future is HDTV. Interactive TV applications have been developed and aggressively marketed by PCCW but market adoption is sluggish.
3G->4G	Coming years will see majority of WCDMA subs migrate to HSPA. YE 2007: 1.6M WCDMA, 0.2M HSPA connections. By 2012 we expect 7.5M HSPA and 0.2M WCDMA subscribers. Local carriers began transition to Ethernet-based backhaul in 2007. Smartone performance in 3.5G market strong.
Ethernet services	Metro Ethernet deployed widely: over $100M in projected revenues in 2008 on nearly 20,000 ports. High international component. Growth continues into more verticals and higher speeds.

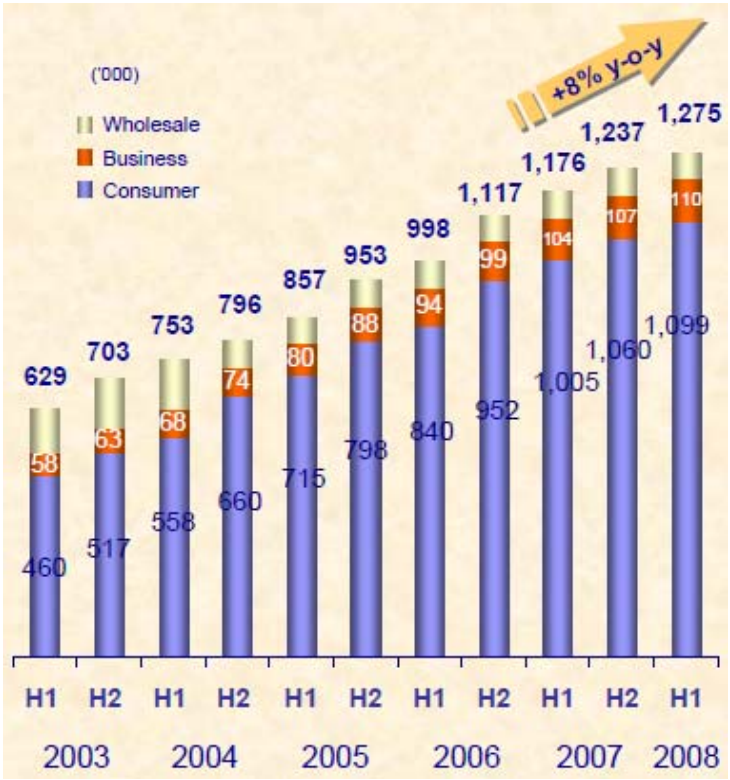
PCCW profile

- Has >50% share in one of world's most saturated broadband markets
  - 1.28 BB lines at 6-08, ~50% are *paying* IPTV customers (unchanged from year ago. Only 108K consumers still on dial-up.
  - Only 9% of BB lines are business: HK is highly developed enterprise Metro Ethernet market
- QuadPlay is central to PCCW's growth strategy

Source: PCCW

PCCW profile

Growth of ‘netvigator’ broadband



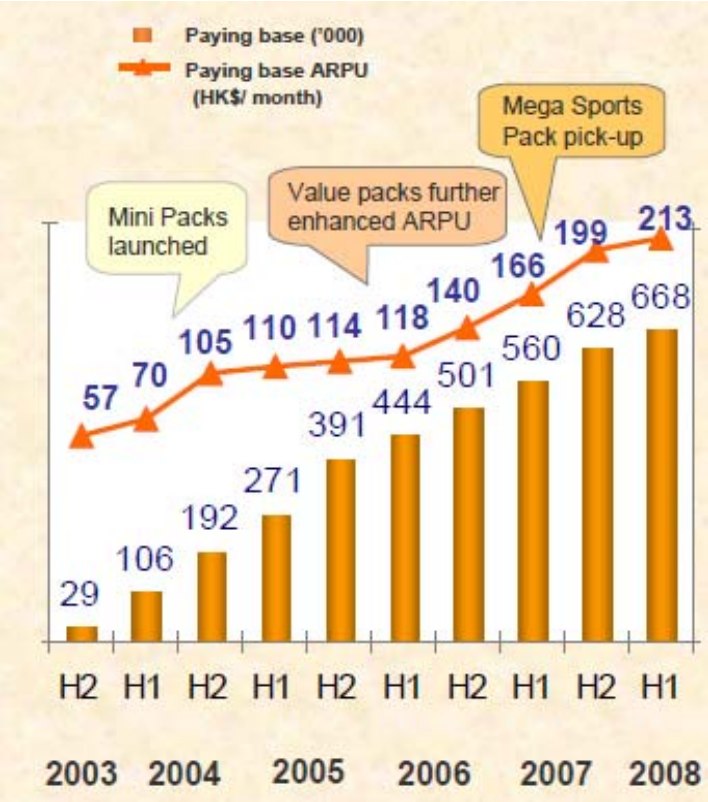
Source: PCCW

- Using exclusive content and innovative applications to attract and retain customers

- Higher-speed and mobility/FMC products aim at keeping ARPU stable to slightly up

PCCW profile

Growth of ‘nowTV’ platform



Source: PCCW

- Heavy investment in IPTV platform paying off locally
- Raising ARPU through market segmentation, adding features to CPE, discounting second set top boxes, pushing ‘all-in-one’ HDTV, growing advertising revenues tied to sporting events, etc.
- Monthly ARPU up 28% from 1H07 to 1H08

PCCW profile

- DSL is main broadband platform
  - Early DSL choices ranged from 1.5 to 6Mbps; next step up now advertised is 30Mbps dedicated.
  - Most of its FTTx is FTTB/FTTC plus VDSL.
  - These options tie into SD-based video available through nowTV
- 11-07 introduced Netvigator Fiber Direct FTTH service
  - Bundled with Netvigator Everwhere wireless access (HSDPA/WiFi)
  - Now aggressively marketing this: latest promotion (12/08) for Fiber Direct 1000M broadband is as follows
    - 24-month contract for 1Gbps unlimited Fiber Direct: monthly fee $2,188 (Original Price $2,688)
    - Waive$6,500 Fiber Direct provision with modem installation fee (in select areas)
    - Waive$530 nowTV HD activation fee
    - Waive$38/mth nowTV HD decoder rental fee
    - Waive$35/mth nowTV HD VOOM channel
    - Waive$488/mth monthly + $12/mth tunnel fee for NETVIGATOR Everywhere service
    - Waive$2,480 Auto Network Selector for NETVIGATOR Everywhere service
    - Free gift:Netgear wireless router + USB Adapter

HKBN/City Telecom profile

- Triple-play/IPTV on its own Ethernet fiber network available to 1.5M HHs and nearly 1K buildings in HK (growing to 2M/1,800)
- Over 50% of subs are on symmetric 25-1000Mbps packages
- 1 Gbps FTTH is future: signed GPON deal with ALU 11-07
- 8-08: 316K BB, 329K VoIP, 156K IPTV subs. Claims price advantage versus incumbent PCCW (see below chart).

Company	Infrastructure	Speed (Download/Upload)	Listed Price per month	Cost per Mbps
HKBN	FTTx	1,000Mbps / 1,000Mbps	HK$1,680	0.84
	FTTx	200Mbps / 200Mbps	HK$688	1.72
	FTTx	100Mbps / 100Mbps	HK$298	1.49
	FTTx	25Mbps / 25Mbps	HK$208	4.16
PCCW	FTTx	1,000Mbps / 1,000Mbps	HK$2,188	1.09
	FTTx	100Mbps / 100Mbps	HK$588	2.94
	ADSL	8 Mbps / 0.8Mbps	HK$398	45.23
	ADSL	3 Mbps / 0.6Mbps	HK$298	82.78

100Mbs

Entry

Notes: Approximate Tariffs only as of 5 May 2008. Prices varies with promotions.

Source: City Telecom interim report FY2007-8

Others

- i-Cable
  - Triple-play/BB service over cable modem connection: 280K subs as of 6-08 down 26K from 1H07. Pay TV subscriber base roughly three times the size of its broadband cable modem user base. Providing substantial discounts in the light of competition and relatively slow speeds.
- HGC
  - FTTH and FTTB services at speeds of 100Mbps
  - Also provides broadband powerline service branded HGC-PowerCom
  - Has extensive global network including multiple links to Shenzhen: Lok Ma Chau, Man Kam To, Lo Wu and (8-08) the Hong Kong-Shenzhen Western Corridor cable system
  - Has access to over 5,500 buildings and 1.3 million households and provides both telephony and broadband services over its fiber network.

WiMAX: license auctions planned for 1/09

- In October 2008, the Hong Kong regulator, the Office of the Telecommunications Authority (OFTA), announced the auction of broadband wireless access (BWA) licenses in January 2009.
- The 2.3GHz and 2.5GHz bands will be released for the provision of BWA services. The available 195MHz is divided into 12 frequency bands, each with bandwidth varying from 5MHz to 30MHz. Bids will be accepted on 15 and 16 December 2008.
- A neutral approach to the auction of the 2.3GHz and 2.5GHz bands is in line with the new Spectrum Policy Framework of 2007. In the absence of restrictions on the types of applications and services, fixed, mobile and converged services can all be provided using the BWA spectrum. Therefore, this auction is taking a fully technology-neutral licensing approach, as prescribed by the framework on new spectrum awards.

India

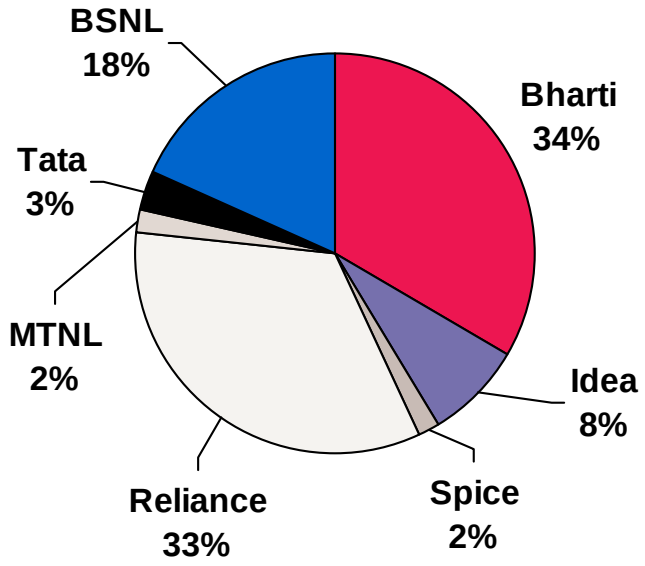
India Profile

General Information - 2008

- Estimated Population – 1.14 billion
  - Urban – 28.5%
- Estimated Households – 236.5 million
  - FTTP Household penetration - .06%
- Estimated Broadband Subscribers – 5.2 million
  - 79.1% DSL
  - 12.5% Cable Modem
  - 2.8% FTTB/FTTH
  - 5.6% Wireless
- Broadband Household Penetration – 2.2%

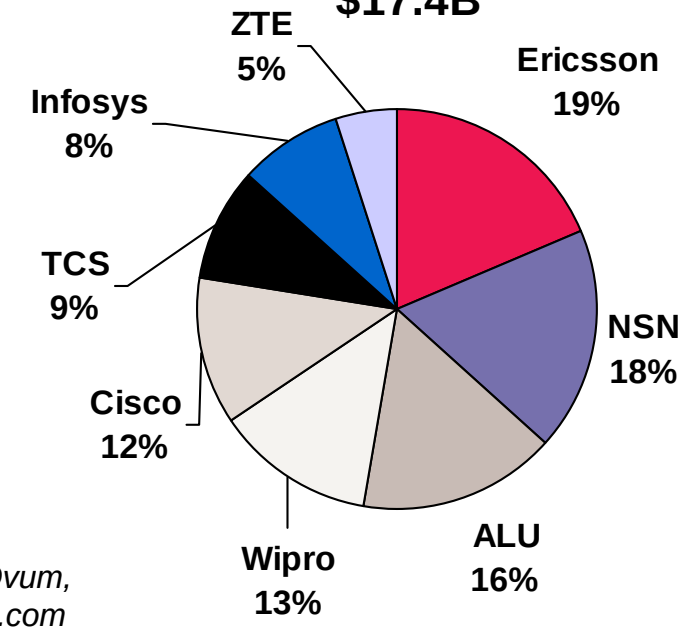
Spenders & vendors

India telco capex: $9.2B ('07)



Sources: Ovum, voicendata.com

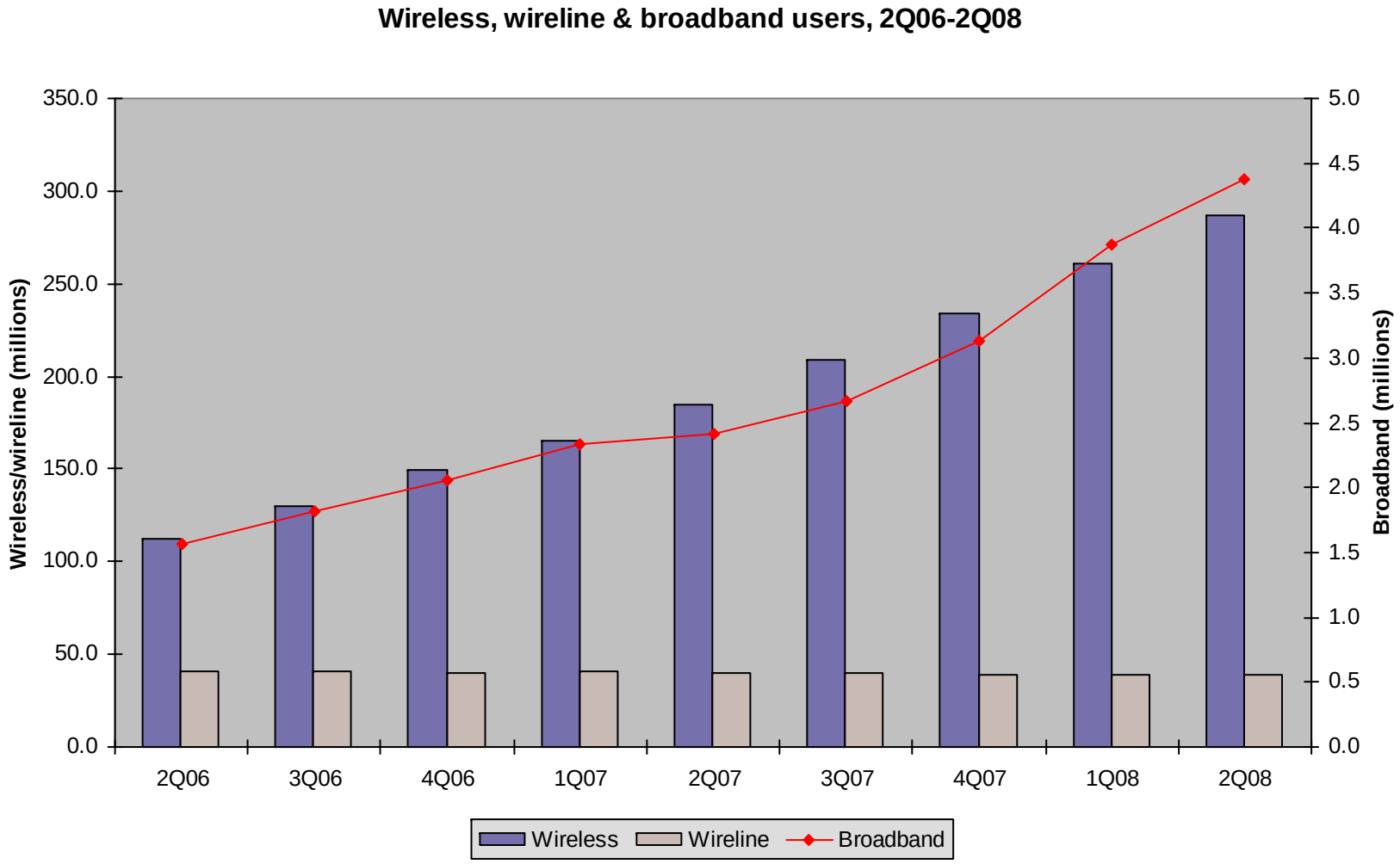
Indian equipment* market: $17.4B



*including software & integration; carrier and enterprise

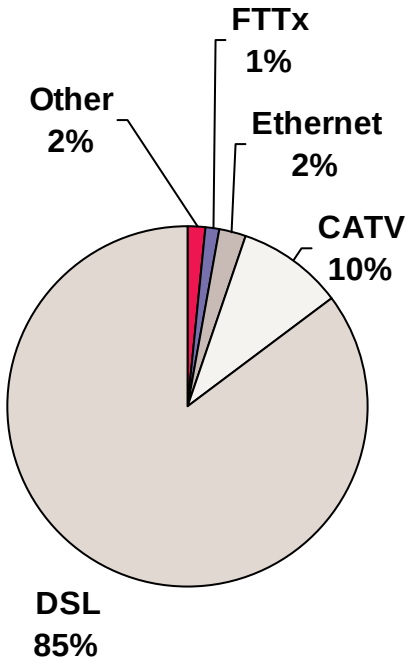
- **Tata group – including former VSNL – is unlisted but much bigger than shown above; similar in capex levels as BSNL, planning significant wireline growth. Vodafone Essar not listed but is big, also buys wireline gear (mainly transport)**
- **Telkom Malaysia and Maxis are investors through Spice and Aircel**
- **BSNL/MTNL are slow moving and still struggle with reform but are main vehicles to meet government broadband targets**

Wireless booming, but not much else

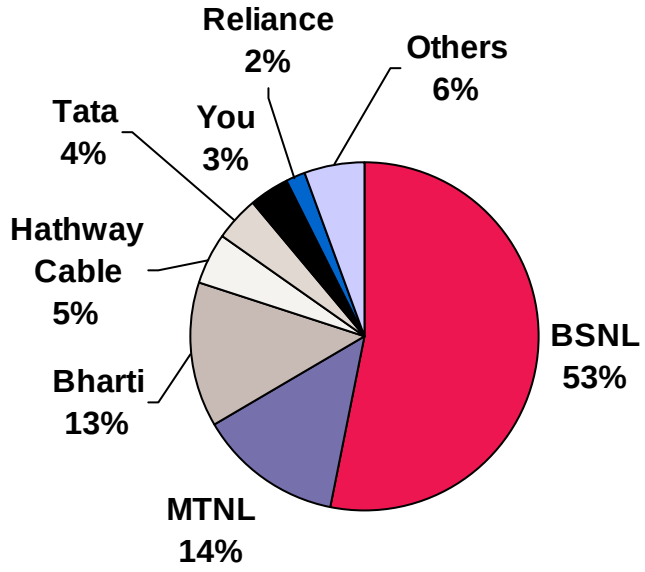


Current broadband landscape

Broadband subs (6-08): 4.38M



Broadband market share (6-08)



Sources: TRAI, Ovum

•Broadband has been slow to take off despite government marketing efforts

Spending drivers: India

Driver	Remarks
NGN	TRAI held inquiry in 2006-7 but NGN transformation remains minor issue relative to wireless spending. BSNL plans full migration to NGN with replacement of PSTN by 2015. Start deploying IMS/SIP-based services in 2009, deploy IP backbones across circles, zones and national level. BSNL's IP core will support 100 nodes each capable of supporting 160Gbps, support IPv6. Core transport will have two layer structure: (1) Primary nodes fully mesh connected at 2.5 Gbps, (2) secondary nodes connected to at least two other nodes with 1 Gbps links; plans to increase the interconnectivity to 10 Gbps
FTTx & video	Broadband market has grown very slowly in India to date for many reasons. Around 16-18M lines are 'broadband capable' but there were 4.4M BB subs in 6-08 despite government's "Year of Broadband" promotion in 2007 (target was 9M lines). By contrast ~8M wireless users signing up monthly. Dominated by ADSL, with 45K FTTx and 419K cable modem users as of 6-08. Upgrades to ADSL2+ as operators look at IPTV, MTNL active in its small area. TRAI recommendations (1-08) aimed at pushing broadband faster, but have been slow to implement. Unbundling not required, cost of leasing fiber remains high. BSNL's roll out plan is to deploy five million additional wireline broadband connections, including two million in rural areas covering about 1,000 cities/towns and over 20,000 villages. BSNL notes that since 2005 investments of Rs 700 crore ($175 million) had been utilized and another Rs 700 crore would be utilized each year for expansion. They were also in the process of launching WiMax in about 1,000 locations, which would be capable of offering wireless broadband services within a radius of about 25 kilometers. At some point India government may pursue a mixed private-public approach to deploying broadband infrastructure similar to Australia/Singapore/Malaysia. Sharing of network resources is being pushed by government in area of cell towers and may will carry over to FTTx deployment policy.

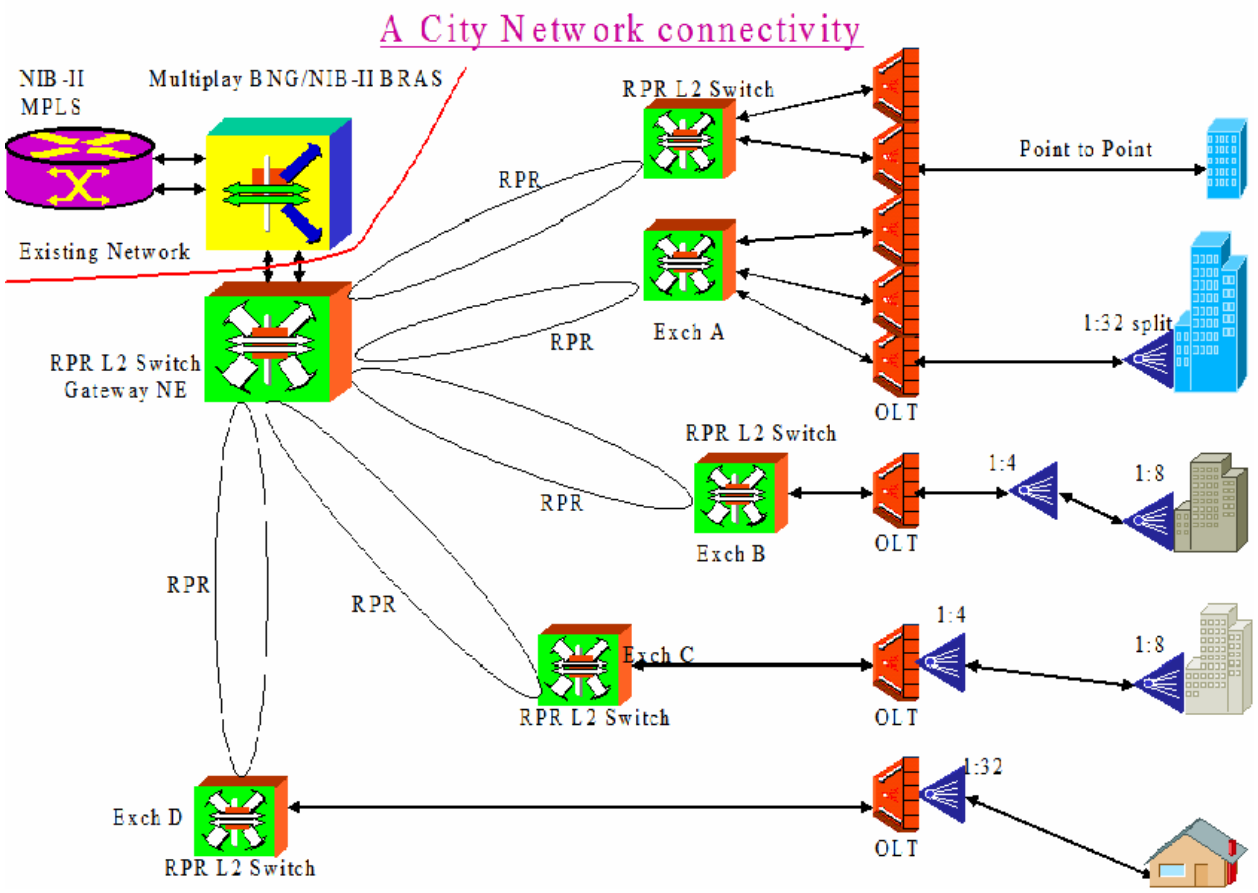
BSNL FTTx Outlook

- Deploys mainly ADSL with significant deployments to rural and government/school locations in line with government targets. UTStarcom, ZTE, and NSN have been main suppliers to date.
- BSNL IPO
  - Planning to go public at some point, likely in 2009 or 2010. 3-year capex plan: US$10B mainly on network expansion. Mostly wireless but government pushing on wireline too.
  - Reviewing bids for 93M line GSM/UMTS (75M/18M) tender worth ~US$6B
- BSNL is expected to place an order for WiMax equipment for two million subscribers and 25,000 villages to be completed within a year. The project value is estimated to be around Rs 2,000 crore ($500 million).
- “Broadband Next Generation Play” network.
  - Triple play, multiple classes of service, broadcast TV with RF overlay.
  - Issued GEPON tender in March 2008. Components: RPR-based L2 aggregation network, GE-PON OLTs, ONTs, and EMS servers, and CPE. 166 systems in total across 25 cities.
  - GPON tender opened 4Q08, estimated at 3-4 times the size of the GE-PON project. Bidders include Alphion, Ericsson, NSN, Huawei, ZTE, Fiberhome, and Wave7Optics. Alphion first vendor to receive TSEC approval for its GPON gear. FTTH (single-family unit) is the target.

BSNL FTTx Outlook

- **Broadband Network Architecture (per GE-PON tender)**:
  - Next Generation Play Subscriber shall be connected to GE-PON OLT.
  - Traffic of OLTs and other access technologies (not covered in this tender) shall be aggregated through aggregation network. One such aggregation unit shall be planned for around 10 thousand users.
  - A total of 25 cities are planned to be covered with GE-PON technology.
  - Traffic of such aggregation units shall be handed over to the backbone MPLS core directly.
  - For establishing the broadband Aggregation Network, RPR based layer 2 switches shall be deployed. The LAN Switch equipment shall also support the IEEE 802.3ad Ethernet Link aggregation technology and RSTP IEEE 802.1s.
  - Both the options consist of multiple aggregation points, which will aggregate the broadband traffic spread over the country. The Aggregation points are likely to be collocated with the MPLS edge connected through multiple GE interfaces.
  - The Aggregation network is planned in all the A ***cities.***
  - The network will be centrally managed from the Network Operation Centre (NOC) deployed under NIB-II and also from the Element Management System client located with in the same city. The main NOC is at Bangalore with provision of DR NOC at Pune. The element Management System (EMS) applications procured in this project shall be integrated with the HP's Network Management System (NMS) application (HP Open View) on standard northbound interface viz SNMP/XML/JAVA. FTP shall be used for bulk file transfer.
  - The Provisioning in Next Generation play solution shall be done both centrally and distributed manner using an ASAP application. The required cartridges for integrating the different elements of Next Generation Play solution viz ONTs, OLTs, RPR based L2 switches etc. This needs to be quoted by the bidder for ensuring end-to-end provisioning in Next Generation play solution. The provisioning in NIB-II MPLS network shall continue to be handled with the existing provisioning system (HPOVSA).
  - The back-office facility (such as AAA, LDAP, Billing and Provisioning and NMS servers) is located in the NOC at Pune and Bangalore procured in NIB-II and the same infrastructure will be leveraged for the Broadband – Next Generation Play.
  - All the network element deployed in this project shall support IPv6 with dual stack.

BSNL FTTx Outlook



•GE-PON project: Triple play last mile network integrated directly into MPLS-based National Internet Backbone II via broadband network gateways/BRAS

MTNL FTTx Outlook

- As with BSNL, ADSL is main technology for broadband delivery
- In November 2008, MTNL launched FTTH services in Delhi (one of its two operating cities), in concert with local fiber cable supplier Aksh Optifibre. Appears to be GEPON-based. ZTE, Huawei, and UTSI were main bidders; winner not clear.
- One driver for FTTx is to better support its existing ADSL-based IPTV service, which offers 100 TV channels in Mumbai and Delhi. Sterlite and UTStarcom were key suppliers in this initial IPTV rollout.
- In September 2008, it issued tender for “IP-MPLS based Converged Network for MTNL Delhi and Mumbai”.
  - Anticipates 2009 spending of 250 crore (~$60M) for turnkey project.
  - One requirement of the tender is that network allow MTNL to introduce additional services such as bandwidth on demand, TV Broadcast Minimum 5000 channels (Both SDTV as well as HDTV), VOIP etc. over the same network.

Other players

Hughes

- Hughes Communications India is targeting 30,000 organizations over the next three years for satellite broadband in terrestrially under served locations. Targeted at organizations with single and multiple locations, Hughes is looking to offer these services to customers who use the Internet to connect to remote locations and run critical applications like ERP (SAP,ORACLE etc.), Intranet applications, Web-based applications, Point of Sale applications.

Bharti Airtel

- Offers broadband DSL (up to 8Mbps) and voice service in 95 cities with focus on multimedia, offering both DTH satellite and IPTV over DSL. As of 9-08 it had 2.5M fixed line customers, of which 37% subscribed to broadband. Only a small (undisclosed) portion of this base uses IPTV. It hopes TV content will help convert all its fixed line users to broadband.

- The strategy of Bharti's Telemedia business is to focus on cities with high revenue potential, except for DTH which is an all-India offering. It launched Airtel digital TV, the DTH (Direct to Home) Satellite TV service, in October 2008. Airtel digital TV is available to customers through 21,000 retail points including Airtel Relationship Centres in 62 cities across the country. Success of DTH in attracting video subscribers may limit Bharti's interest in fixed-line broadband investment for video delivery, impacting FTTx demand negatively.

Other players

- Reliance
  - Focused wireline efforts on using Metro Ethernet platform to penetrate enterprise market; this also drove acquisition of Yipes in 2007. As of 9-08 it offered Metro Ethernet in 44 cities in India with close to 858K buildings connected directly to the network serving close to 1.26 million access lines.
  - In August 2008 it rolled out DTH satellite TV services through wholly owned subsidiary Reliance Big TV Limited. DTH content is encoded using MPEG4, offering over 200 broadcast channels and 30 exclusive movie channels. The service is sold at 100,000 outlets across 6,500 towns in India, leveraging Reliance's existing sales infrastructure from the mobile side of its operation.
  - No indication of interest in FTTx plans as of yet
- Tata Teleservices
  - Broadband strategy is two-fold: (1) for enterprise market, use mix of Metro Ethernet for major customer sites and WiMax for smaller/more remote offices; and (2) for consumer market, use primarily WiMax.
  - Currently does not appear to have plans for FTTx deployments.

India – WiMAX status

- In India, several operators own licenses in the 3.4-3.4GHz band. Licenses in 2.5GHz bands were due to be allocated in 2008 but there are still delays. India wants to allocate the BWA and 3G licenses at the same time. It is now expected to be done in early 2009.

- WiMAX rollouts / plans in India

  - BSNL offers Fixed WiMAX services based on 16d certified products from Aperto and targeting enterprise customers. BSNL also wants to introduce BWA services based on Mobile WiMAX (16e) to address the residential business. It has selected SOMA Networks and a second tender is pending. The 16e network will work in the 2.5GHz band. SOMA was chosen to deploy a Mobile WiMAX network across three circles: Gujarat, Maharashtra and Goa, and Andhra Pradesh. BSNL aims to cover 6,400 villages by March 2009 and another 16,000-18,000 by Q3 2009. For the second project, BSNL aims to provide full mobility in dense urban areas and coverage and cities and highways in the Kerala and Punjab regions. In addition, in August 2008, Intel has signed a memorandum of understanding with BSNL to help its efforts to deliver WiMAX solutions across India. The agreement with BSNL also will involve Cisco, wherein the two companies will "jointly promote the business and technology advantages of WiMAX to corporations and enterprises."

  - MTNL conducted a trial of Mobile WiMAX (16e) technology in the 2.5GHz band.

  - Tata (VSNL) selected Telsima in March 2008 to provide WiMAX for nationwide network. It will invest around USD500 million by the end of 2010, and expects 200,000 WiMAX subscribers by 3-09. The project aims to roll out India's largest WiMAX network, with coverage of 110 cities for the enterprise segment, and 15 for retail with Telsima deploying around 3,000 base stations. The initial phase is to extend wireless broadband internet access, already available in Bangalore since July 2007, to a total of nine cities; Delhi, Mumbai, Pune, Bangalore, Chennai, Hyderabad, Cochin, Chandigarh, and Kolkata, rising to 15 by the end of 2008. In July 2008, Tata announced that it has deployed 1,000 base stations manufactured by Telsima and that it has signed up 10,000 customers since March 2008 on its 3.3GHz wireless broadband network.

India – WiMAX status cont.

- WiMAX rollouts / plans in India
  - Reliance launched a WiMAX-based wireless broadband service in July 2007 in Pune and Bangalore using 3.3GHz spectrum. In March 2008, Reliance announced that it is planning to set up WiMAX networks across 50 countries in the next three years to move into the global telecommunication market.
  - Bharti Airtel has deployed Alvarion's Breezemax 3300 system to build WiMAX networks across India since 2006 using 3.3GHz band. Bharti Airtel is using WiMAX to enhance its broadband, fixed and cellular network infrastructure to offer affordable broadband data services to customers in new markets and has plans to expand this network to more cities throughout India. In June 2008, Alvarion announced that Airtel has signed a contract with Alvarion to expand its WiMAX network for business users across key cities in India.
  - Indian ISP Sify Limited introduced WiMAX services based on 16d technology in association with Proxim in early 2007. Operating in the 5.8GHz band, the network targeted enterprise, residential and cybercafé subscribers. More recently, in July 2008, Sify selected Redline to deploy a WiMAX network using the 3.3GHz band. Redline announced that Sify has selected the WiMAX Forum certified RedMAX products (802.16d) for rollout in five cities to deliver business-class internet services to enterprise users .
  - Aircel Business Solutions (ABS) launched WiMAX services in Chennai in October 2006 and in Bangalore in January 2007 using 3.3GHz band. Aircel switched on its 802.16d WiMAX network in Chennai, offering download speeds of up to 10Mbps with 90% coverage of the city's business districts. In December 2006, Alvarion announced that ABS was expanding its current network and planning to use BreezeMAX 3300 to deploy WiMAX networks across 50 cities in northern and eastern India. At that time, Aircel had deployments in eight cities and was using BreezeMAX to overlay and expand its broadband and cellular network infrastructure to offer broadband data services to SME customers. In February 2007, Aircel also conducted a trial of Mobile WiMAX (16e) technology with Alcatel-Lucent in the 2.5GHz band.

Indonesia

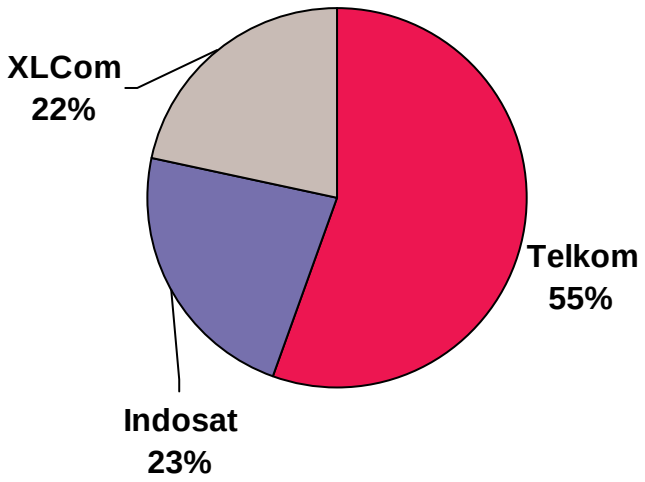
Indonesia profile

General Information - 2008

- Population: 222.0 Million
  - Urban – 45%
- Households – 59.7 million
  - FTTP Household Penetration – 0%
- Broadband Subscribers – 0.66 million
  - 83.4% DSL
  - 1.3% Cable
  - 0% FTTH/FTTB
  - 15.3% Wireless
- Broadband Household Penetration: 1.1%

Spenders & vendors

Indonesia telco capex: $3.6B ('07)



Source: Ovum

- Largest supplier is NSN
  - Nokia primary wireless supplier since 1996, Siemens has historic relationship with Indonesian government
  - Ericsson strong mainly in wireless
  - Chinese suppliers have been aggressive over last few years and improving position in wireline market

•Rapid increase in wireless capex over last few years; wireline relatively flat. Malaysia (XLCom) and Singapore (Indosat & Telkomsel) are investors; Qtel (Qatar) buying Indosat stake.

Spending drivers: Indonesia

Driver	Remarks
Broadband expansion	Local fixed broadband market to date has been very slow to emerge: Telkom (the INO) had just 590K subs at end of September 2008. Hopes for 1.3M by 2009. An affiliate offers cable modem service but penetration is very low. (Kabelvision's MyNet 256/512Kbps). Wireless broadband over HSPA/EVDO cards/dongles are cheap and getting popular but access speeds are slow. To grow fixed broadband Telkom has announced plans to invest US$215M to upgrade the optical network supporting Telkom's Speedy Internet broadband service, in order to improve connection speeds. Speedy is currently available in more than 200 cities, of which 61 have a connection of at least 1Mbps. The upgrade will boost minimum downstream/upstream speeds from 384/64 kbps to 1024k/128bps.
3G->4G	Coming years will see increased adoption of 3G/3.5G services in Indonesia, driving mobile backhaul requirements. As of 2007, 11% of 86M connections were next-gen, we expect this to grow to 55% of 170M by 2012.
NGN	Telkom's strategy: Evolve starting from core with single IP/MPLS backbone network for all services. Most investment will focus on core until 2010. ▪Introduce QoS and carrier grade features to transport different kinds of traffic ▪Migrate legacy services onto IP backbone starting with Class 4 traffic and the Class 5 traffic from the new Flexi/CDMA and the new NGN Class 5 nodes. ▪Evolve the access and metro network to support BB copper and fiber optic-based solutions ▪Introduce new application platforms for BB and convergent services ▪New GbE and IP DSLAM : Metro network and IP DSLAMs in top 44 cities to support (eventual) IPTV rollout. ▪Current capex targeted at basic 2G/3G cellular network expansion and WLL. This is crowding out Telkom's broadband and fiber optic spending.

Telkom Indonesia Profile

- Footprint:
  - Indonesia has >6,000 inhabited islands (of 17,500+ total) which has required extensive use of microwave, satellite and festoon cables for domestic connectivity
  - Lacks universal coverage, but mobile and fixed wireless (WLL) has helped fill gaps
- Main products:
  - As of 9-08, 8.6M **Fixed** and 9.2M **Flexi** WLL subs. Fixed lines not growing due to mobile substitution but WLL grew >60% y-o-y. **Flexi** offered in 321 cities on 3,181 base stations.
  - **IDD** service (duopoly w/ Indosat): 1018M/222M incoming/outgoing mins Jan-Sep '08
  - **Cellular** through **Telkomsel** subsidiary, 60.5M subs and >50% market share.
  - **Data & Internet:** 455K dial-up accounts 9-08; **TelkomSpeedy** broadband grew from 209K DSL subs in 9-07 to 593K in 9-08. Telkom forecasts 1.4M subs in 2010.
  - **TelkomVision** had 140K video subs on various platforms (HFC, DTH, SMATV) as of August 2008, when it announced partnership with PCCW to grow IPTV business.
  - No FTTx plans; but deployments would likely target enterprise/MTU/MNC segment

Telkom Indonesia Profile

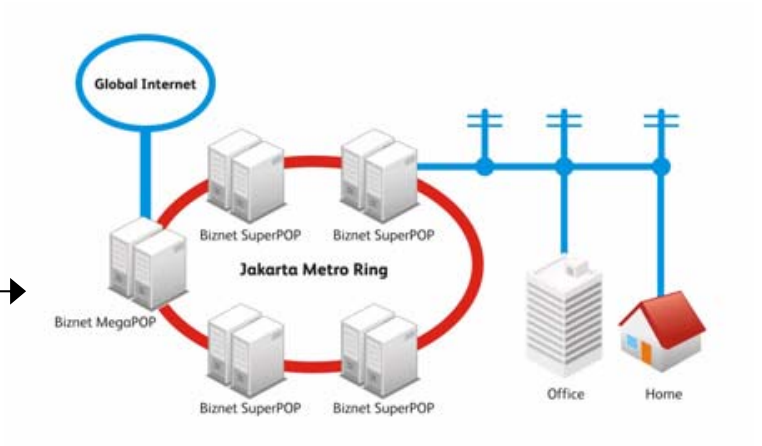
- NGN migration plan
  - Evolve towards NGN starting from the core with a single IP/MPLS homogeneous backbone network for all services
  - Introduce QoS and carrier grade features to transport different kind of traffic (Internet, Voice, Business services, IPTV)
  - Migrate legacy services onto a common IP backbone starting with Class 4 traffic and the Class 5 traffic from the new Flexi/CDMA and the new NGN Class 5 nodes.
  - Evolve the access and metro network to support BB copper and fiber optic-based solutions
  - Introduce new application platforms for BB and convergent services
  - New GbE and IP DSLAM infrastructure: Metro network and IP DSLAMs in top 44 cities to support (eventual) IPTV rollout.
  - Current capex targeted at basic 2G/3G cellular network expansion and WLL. This is crowding out Telkom's broadband and fiber optic spending.

Indosat

- Second largest telco in Indonesia and international incumbent: $1.5B in revenues and $0.7B in capex for 1Q-3Q08, roughly one-third and one-half of Telkom's comparable figures, respectively.
- Fixed data and fixed voice (wireless local loop) account for roughly 15% and 10%, respectively, of revenues.
- Is expanding domestic long-haul and metro transmission networks to carry wireless traffic: cellular subscribers increased from 22.0M (9-07) to 35.5M (9-08). So far has shown no interest in broadband access rollout but investment from Qtel may facilitate a change; currently the INO (Telkom) faces very little competition in broadband market and minimal government push for investment.

Others

- Cyberindo Aditama: Big ISP now deploying Nortel PBB-based Metro Ethernet for enterprise
- Biznet: Started as Ethernet pure play, now also offers GE-PON FTTH to large enterprise and high-end consumer buildings in



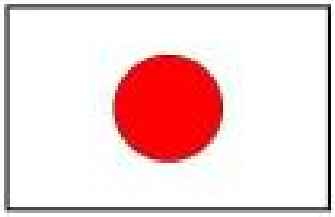
Source: Biznet

- Palapa Ring project: Public-private hybrid to deploy 600K fiber-kms nationwide to improve domestic connectivity.
  - $1.5B project shared by Telkom, Indosat, XLCom, Infokom Elektrindo, Bakrie Telecom, Powertek Utama and Nusantara Ekaprana Teknoguna Kelola.
  - May tender in 2009

Source: Ministry of Communication and Information Tech.

Indonesia – WiMAX status

- There has been lots of debate around the potential allocation of WiMAX licenses, in the 2.3GHz band in particular. Some 3.5GHz spectrum has already been allocated and is suitable for WiMAX rollouts.
  - According to a report in Antara News in May 2008, the Indonesian government plans to put 2.3GHz WiMAX spectrum to tender bid in Q4 2008.
- Identified WiMAX rollouts / plans in Indonesia
  - PT. Citra Sari Makmur (CSM) offers WiMAX services based on 16d standard using WiMAX equipment (PacketMAX) from Aperto in the 3.5GHz band in a dozen of cities. CSM also uses Pre-WiMAX systems from Aperto (e.g. PacketWave). CSM uses Aperto's gear to provide services to Indonesia's financial services and banking sector. CSM also uses Aperto's platform to provide data, voice and multimedia services to hotels, enterprises, and high-end residential customers across various cities in Indonesia.
  - In August 2008, NSN Indonesia was selected by EMTEK for deploying a WiMAX pilot system (Phase 0) in Jakarta. This contract comprises the pilot deployment of NSN's WiMAX systems, including WiMAX base stations, ASN Gateway, Home Agent, DNS server, Nokia Checkpoint firewall security and Flexihopper for microwave backhaul. During the pilot period (till end 2008), NSN will demonstrate the reliability and capabilities of its WiMAX E2E system, including network capacity and coverage performance. The delivery performance will be the basis for the next commercial contract stage scheduled to begin Q1, 2009. This phase will include the deployment of a network with complete coverage of the Greater Jakarta area (with approximately 400 base stations) to provide internet broadband access for business and residential users.



Japan

Japan Profile

General Information – 2008

- Population – 127.9 million
  - Urban – 79.3%
- Households – 49.3 million
  - FTTP Household penetration – 26.8%
- Broadband Subscribers – 33.4 million
  - 48.3% DSL
  - 12.2% Cable
  - 39.5% FTTH/FTTB
  - 0% Wireless
- Broadband Household Penetration – 67.7%

Current Outlook

- NTT East/West dominate FTTH/B market with 73%
- Other FTTH/B Service Providers include power companies (K-Opticom, etc.), KDDI and USEN.
  - Some local and small SPs expanding FTTx offering in their service areas either with their own networks or leasing from NTT East/West.
- NTT downgraded “FTTH” target to 20 million (from 30 million) by fiscal 2010.
  - Quarterly additions slowdown by 27.5% from 2Q08 to 3Q08
- OLT shipment shifting from deploying chassis to adding interface cards

Current outlook – cont.

- Softbank started looking at becoming a reseller for NTT East/West
  - Softbank BB started to lease fiber from NTT East and offer FTTH/B as ISP in some prefectures since December 2008 to assess customer needs.
  - Given the current regulation, leasing optical distribution network (ODN) from NTT East/West is too costly.

Market growth and outlook

FTTx subscriber growth and PON demand will sustain until fiscal 2010 when other variables come into play

- The demand will likely sustain until fiscal 2010, which we expect to be a very important year in Japanese telecom history
  - It is not clear if Japan will reach its target of having 20M FTT*x* subscribers by 2010
  - Discussion on NTT reform will resume
- There are some key variables and assumptions about the future of the market based on historical results.
  - From now until 2010 the PON equipment market in Japan will likely grow gradually.

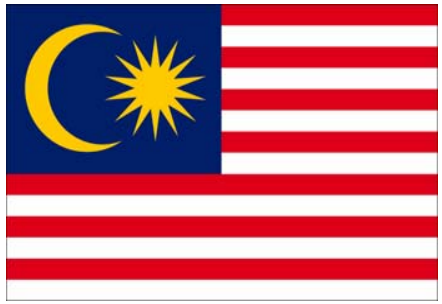
Market growth and outlook

- Key variables to consider in forecasting the Japanese FTT*x* market for 2011 and later

  1. Continuing demand for FTT*x* services
     - High demand for FTT*x* services today.
     - Even after 20M households subscribe to FTT*x*, there will be 10M-20M additional opportunities, since historically there were 60M legacy phone subscribers.
     - We expect many homes to be without FTT*x* even in urban areas, as well as greenfield opportunities in rural areas.
  2. Strong traffic growth
     - MIC study showing data traffic is still growing rapidly.
     - Video as an application may accelerate the traffic growth in the near future.
       - One major and public TV broadcasting organization, Japan Broadcasting Corporation a.k.a. NHK in Japan, launched a video-on-demand service via broadband in December 2008. This new service offering will likely accelerate the demand for FTTx.

Market growth and outlook – cont.

3. NTT's future reform making significant impact on the future of FTTx
   - The competitive landscape may be changed by:
     - Organizational reform of NTT's operating companies, R&D labs, and many other subsidiaries
     - Regulations relating to fiber local loop unbundling and other initiatives
   - Such reforms, if successful, could accelerate FTT*x* market growth further, but if unsuccessful they could slow down demand.
4. Future technologies for optical access
   - 10GE PON is likely to see its first deployment in Japan in the near future
   - WDM-PON using power splitters as well as colorless ONU as the ultimate technology goal as advocated by NTT Labs
   - Also, OCDM-PON has unique features including flexibility in network topology and high security and may be deployed in niche markets like rural areas as well as by some cable operators. DOCSIS-PON may be able to address similar market.
   - Many issues remain to be resolved, however, making it difficult to predict technology outcomes.



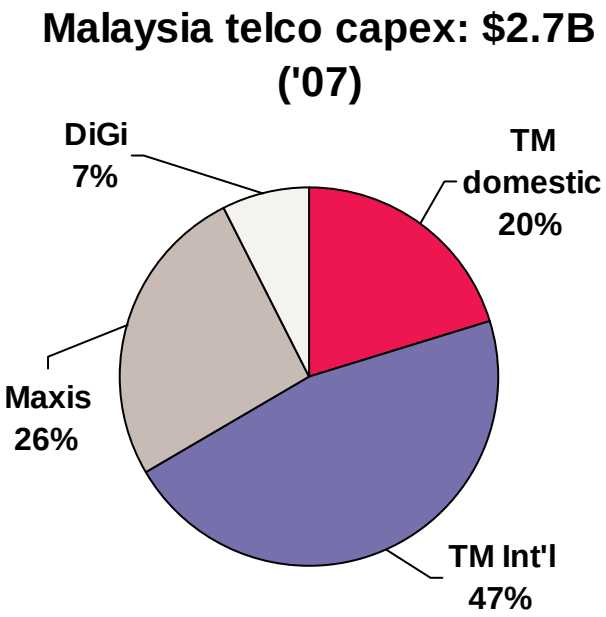
Malaysia

Malaysia profile

General Information - 2008

- Population: 27.5 million
  - Urban – 69%
- Households – 6.3 million
  - FTTP Household penetration – 0.6%
- Broadband Subscribers – 1.5 million
  - 96.8% DSL
  - 0% Cable
  - 2.7% FTTH/FTTB
  - 0.5% Wireless
- Broadband Household Penetration – 23.8%

Spenders & vendors



Source: Ovum

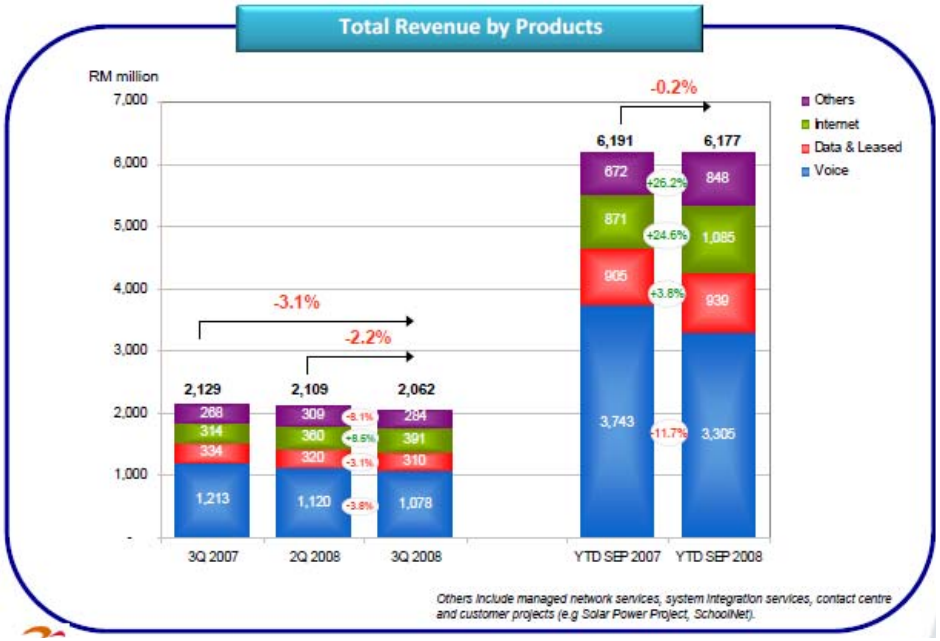
- Major suppliers
  - First tier – Ericsson & NSN
  - Second tier – ALU & Huawei
- Wireline
  - Historically Telekom Malaysia has multivendor strategy in all parts of network resulting in lots of suppliers with modest shares. But Ericsson has been most consistent. NSN, Huawei and Alcatel-Lucent also have projects.

•Maxis is now private; above is estimated
•TM split into two entities and is managed and reports financials separately
•Timedotcom also significant; data N/A

Telekom Malaysia profile

- Accounts for >95% of local wireline market. Incumbent network operator; spun off its international/ wireless division (TMI) early 2008.
- Post-split revenues up just 1-3% per year; data/broadband growth must offset shrinking voice market.
- Broadband user base up 30% y-o-y to 1.55M (9-08), almost entirely DSL. Also offers enterprise Metro Ethernet service in select areas.
- Government-subsidized FTTx rollout will help company enter IPTV/multimedia market and hopefully reverse this trend.

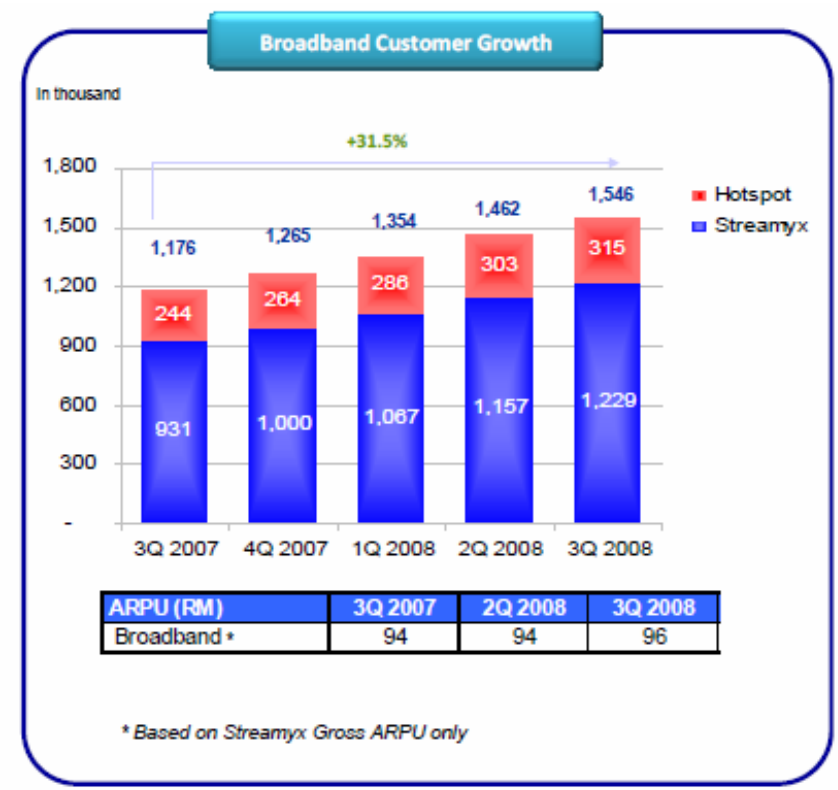
TM's revenue trend: 1Q-3Q08



Source: TM

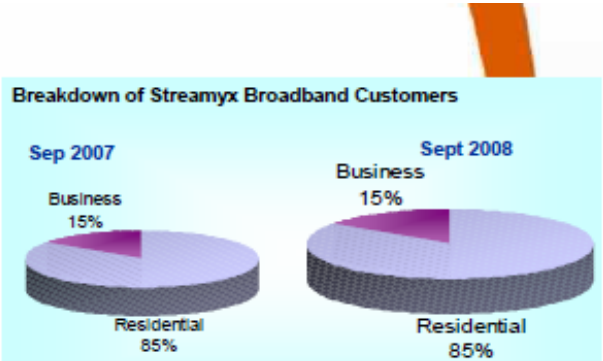
Telekom Malaysia profile

- Aggressive DSL marketing paying off but ARPU flat



ARPU (RM)	3Q 2007	2Q 2008	3Q 2008
Broadband *	94	94	96

** Based on Streamyx Gross ARPU only*



Quarter Review

- Launched the Streamyx Mobility in September
- Combo packages which started in March 2008 remained a hit with 160k cumulative customers by end September

Source: TM 3Q08 investor presentation

High-speed Broadband (HSBB) Project

- Telekom Malaysia awarded this $3.4B FTTH/B project by the government, which will pay roughly 20% of the costs. The first phase of the project is for a ten-year period. The first part of phase one is to connect 1.3 million premises with FTTH or FTTB by the end of 2010. The country is divided into three zones and this first rollout is targeted for zone 1, where population density and average income is higher. The second part of phase 1 will cost another $1.2B and stretch over several years.

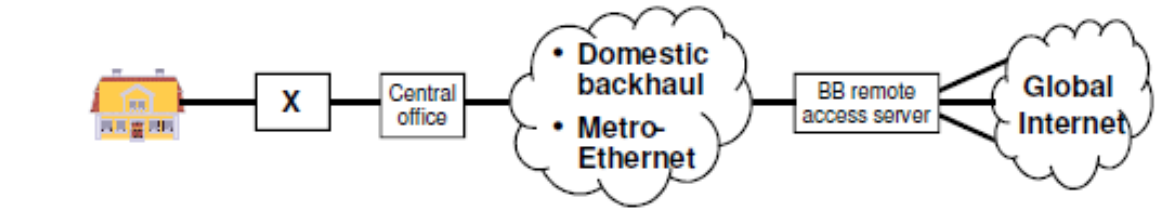
- All subscribers served by the HSBB project awarded to TM will receive a minimum of 20Mbps. Beyond phase 1 the government's focus will shift to "Broadband for the General Public (BBGP)", which will deliver 2Mbps and will consist of both wired and wireless networks (including WiMax).

- Under the award contract, TM will not be forced to provide full open access to other carriers until 2015, but the regulator (MCMC) claims it can monitor TM for anti-competitive behaviour and review the HSBB contract terms every three years.

- Currently TM is training staff to prepare for rollout, prep tenders and network plans, and expects first service rollout by 4Q 2009.

HSBB project's investment focus

HSBB PROJECT INVOLVES UPGRADING ACCESS, CORE, INTERNATIONAL CAPACITY, AND CONTENT PLATFORM PARTS OF THE NETWORK



4 Content eco-system **platform** ⊕ 1 **HSBB access/ last mile** investments ⊕ 2 **NGN core/ backbone** investments ⊕ 3 **International** capacity investments = **A region leading IP hub and domestic BB champion, with regional leading telecom infrastructure**

TM will build a content and application platform to allow smaller and/or local content players can have a role in today's multimedia network	TM will lay fibre to at least within 500m of your home or workplace, to ensure extremely fast connection speed availability.	TM will increase the capacity of the main trunk line that runs the length of Malaysia, while also upgrading it to IP-based technology	TM will upgrade and build new international gateways throughout the county that would enable much faster speeds when using content from overseas.	• TM will enable fast and reliable internet • TM will open the doors to a number of new applications and services

Source: TM (from 2008 FTTH Council AP conference)

Technology choice criteria for HSBB

Current Infra-structure level	Building type	Segment	Preferred technology	Rationale
Greenfield	High-rise	Residential	FTTH	• FTTH from the basement can be regulated to be 'built-in' to high-rises during construction phase
		Commercial	FTTH	
	Landed	Residential	FTTH	• FTTH makes more economic sense when running to greenfield landed properties than initial copper rollout
		Commercial	FTTH	
Brownfield	High-rise	Residential	VDSL2	• Access nodes at multiple floors is necessary to ensure copper distance <500m in order to provide 50Mbps. Can possibly link in with existing copper
		Commercial	ETTH	• Metro-E is necessary to provide sufficient speeds. ETTH will provide commercial QoS service levels
	Landed	Residential	FTTH	• FTTH is not subject to distance from the cabinet, ensuring better quality • FTTH will avoid challenges associated with copper
		Commercial	FTTH	• FTTH is necessary to provide commercial QoS service levels, while still offering up to 100Mbps

Source: TM (from 2008 FTTH Council AP conference)

Malaysia – WiMAX status

- Overview
  - Currently lots of activity around WiMAX network infrastructure rollouts as there are regulatory obligations to be achieved by the licensees of 2.3GHz spectrum.
  - In March 2007, the Malaysian Communications and Multimedia Commission (MCMC) awarded spectrum rights to four companies: Asiaspace Dotcom, Bizsurf, Green Packet and RedTone. Operators were expected to roll out services to 25% of the population in their license areas within a year, with a service offering download speeds of at least 1Mbps. By the end of the third year, it is expected that coverage will be at least 40% of the population. 3.5GHz spectrum is also licensed in Malaysia and can be used for WiMAX. AtlasONE, TTdotCom, NasionCom, Maxis, Telekom Malaysia and eB Technologies own spectrum. There is also 2.5GHz spectrum that has been allocated in Malaysia. Part of the 2.5GHz band was previously allocated to AtlasOne Sdn Bhd and EB Technologies (M) Sdn Bhd for fixed wireless broadband technology and used to provide wireless broadband services in commercial and residential buildings. Atlas One deployed IPWireless' TD-CDMA solution in selected areas in the Klang Valley.

Malaysia – WiMAX status – cont.

- Identified WiMAX rollouts / plans in Malaysia
  - **JARING** has 2.5GHz spectrum which is currently being used for its wireless broadband services (JARING Flite Wireless) in Kuala Lumpur and in Klang Valley. This system, using equipment from Soma Networks, was supposed to be upgraded to mobile WiMAX as soon as the product is certified. In February 2007, Jaring Communications announced plans to expand and upgrade its wireless broadband coverage for a rollout of its first mobile WiMAX operations by the second half of 2007. However it seems that these plans have not yet been achieved.
  - **TimeDotCOM** is offering pre-WiMAX services in the 2.6GHz band using proprietary Navini Ripwave solution.
  - **Maxis** Communications has signed an agreement with Alcatel-Lucent to conduct mobile WiMAX trials in 2.5GHz.
  - In August 2008, **Packet One (P1)** Networks has announced the launch of its WiMAX (802.16e) network using the 2.3GHz band in the Klang Valley. P1 was originally expected to launch services in June, but delayed commercial operations after it opted to extend user trials. Pilots were conducted in the Klang Valley suburbs of Subang, Sentul, Setapak and the Kuala Lumpur City Centre (KLCC) area and covered both business and residential users. Packet One's network is expected to comprise 600 base stations by the end of 2008, covering 25% of the nation's population in major cities along the west coast of Peninsular Malaysia. At launch time, Michael Lai, Packet One's CEO said: "Our plan is to target 100,000 subscribers in the next 12 months." The Mobile WiMAX (16e) network is supplied by Alcatel-Lucent. In May 2008, Intel has invested RM50m (US$15m) into Green Packet, the parent company of Packet One Networks.

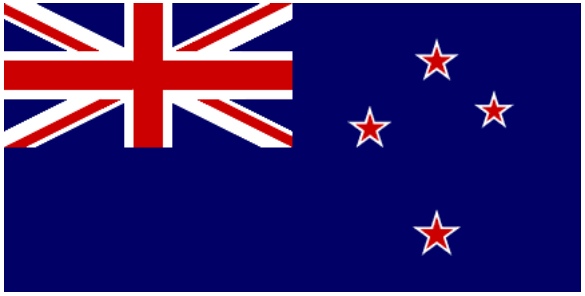
Malaysia – WiMAX status – cont.

- Identified WiMAX rollouts / plans in Malaysia

  - In August 2008, **REDtone** has launched East Malaysia's first WiMAX broadband services, initially covering the Kota Kinabalu business district - and powered by Motorola 16e equipment. Motorola is working with REDtone to supply and deploy WiMAX 2.3GHz equipment at base sites and install CPE to provide broadband services in major business districts in the first phase of the plan. Besides providing broadband services to enterprise customers, REDtone is also planning to work with service providers based in Sabah and Sarawak to provide broadband services to the general public.

  - In March 2007, after being awarded a 2.3GHz license, **Asiaspace** said that it will invest between RM300 million and RM400 million to develop the infrastructure for WiMAX roll-out. The company said that with its 82 towers network infrastructure, it would expedite the roll-out of the service and comply with the MCMC's expectation of covering 25% of the population in Peninsular Malaysia by the end of 2007. Asiaspace will use all the 82 telecommunications towers (42 being located in the Klang Valley) that it has installed in the country to offer wireless broadband access in Peninsular Malaysia by year-end 2007. However Asiaspace finally launched its WiMAX services, marketed under the "amax" brand name, at the end of August 2008. Asiaspace is optimistic of reaching between 50% and 80%of the Malaysian population by 2011. The operator has selected in June 2008 Huawei as its supplier of WiMAX equipment (16e).

  - In August 2008, **Bizsurf** announced that it will launch its WiMAX services to meet the regulator's deadline. Bizsurf is a 50%-associate of YTL e-Solutions. which holds the 2.3GHz license. In addition, Bizsurf entered into a strategic agreement in June 2008 with Xohm, Sprint Nextel’s WiMAX businesss, for assistance in the rollout of services.



New Zealand

New Zealand Profile

General Information - 2008

- Estimated Population – 4.3 million
  - Urban – 86.3%
- Estimated Households – 1.6 million
  - FTTP Household Penetration – 0.3%
- Estimated Broadband Subscribers – 1.02 million
  - 79.4% DSL
  - 7.8% Cable Modem
  - 0.5% FTTB/FTTH
  - 12.3% Wireless
- Broadband Household Penetration – 63.8%

New Zealand Profile

- TNZ is the leading fixed broadband provider and has little infrastructure-based competition
- TelstraClear (wholly owned by Telstra Australia) has operated a small HFC network and a few metropolitan fiber networks for several years
- TNZ's dominance of the wholesale broadband market has encouraged the emergence of several broadband wireless operators such as Whoosh Wireless, but these have had a small impact.
- Major regulatory reform in 2007, including the introduction of ULLS and operational separation of TNZ's access network has led to the launch of ULLS-based competition in 2008.
- TNZ has responded by launching an FTTN project to reach all towns of more than 100 people. Over 500 nodes had been established in Dec 2008.

FTTx Status

- There was a small FTTH installation (<2000 connections) in one housing development in 2007.
- A new Government was elected in November 2008. The new government plans to inject NZ$1.5 billion into fast broadband, and hopes to attract another NZ$2 billion in private investment.
  - Design details are not currently available, but FTTH will play a major role.
  - The network will provide wholesale access, but wholesale products and pricing principles have not been established
  - We think it very likely that Telecom New Zealand will be responsible for the bulk of the build.

Philippines

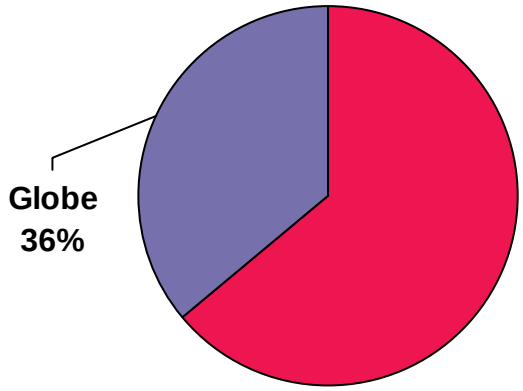
Philippines profile

General Information - 2008

- Population: 85.5 Million
  - Urban – 52.7%
- Households – 18.2 million
  - FTTP Household Penetration – 0.02%
- Broadband Subscribers – 0.92 million
  - 95.5% DSL
  - 0% Cable
  - 0.5% FTTH/FTTB
  - 4% Wireless
- Broadband Household Penetration – 5%

Spenders & vendors

Philippines telco capex: $0.8B ('07)



Source: Ovum

- Biggest vendors include:
  - Ericsson
  - NSN
  - Huawei has momentum
- In wireline ECI and Nortel are both strong and account for bulk of market but Huawei has come on strong over last 2-3 years in all segments. Tellabs is also active in small way, as is ALU.

•Bayantel, Digitel, other regional carriers are relevant, but capex data is N/A
•Most capex has focused on wireless network expansion and applications but broadband is starting to reach critical mass
•Growth of local call center/IT outsourcing businesses becoming important to enterprise connectivity, as well as electronics manufacturing & chips

Spending drivers: Philippines

Driver	Remarks
NGN	The government awarded an NGN broadband project to ZTE in 1H07 worth roughly $330M, but procurement irregularities caused this project to be canceled. At some point when the political turmoil settles the project will likely be rebid.
3G->4G	Penetration high already (60% in 2007) but transition to 3G just beginning. By end 2008, likely about 1.9M WCDMA (0.2M HSPA), by 2012, 10.4M WCDMA (20.6M HSPA). 3G licensees are Smart/PLDT, Globe, Digitel Mobile (Sun Cellular) and Connectivity Unlimited Resources Enterprises (CURE)
Gov't & regulatory	▪No local loop unbundling; major competitors building own infrastructure ▪Low fixed-line teledensity combined with challenging geography and demographics warrant diverse approach to serving consumer market ▪Fragmented fixed-line market makes it hard to gain economies of scale ▪Limited clusters of high willingness to pay consumers and enterprise MTUs/campuses

PLDT profile

- Scope:
  - **Wireless** cellular through Smart & Piltel; wireless BB through Smart Broadband; Wolfpac (content operator); Mabuhay, ACeS Philippines, and Telesat (VSAT)
  - **Fixed** line offered in major metros through PLDT, also through Clark Telecom, Subic Telecom, PLDT-Maratel, Piltel, Bonifacio and PLDT Global.
  - **ICT** services through offered through ePLDT, ePLDT Ventus, Parlance, and Vocativ Systems, SPi Technologies, and a number of other ePLDT companies.
- Operational information:
  - 1.77M fixed-line subs (flat year-over-year). 34.2M mobile subs 3Q08, 28.3M 3Q07
  - Total broadband subs: 0.88M 9-08, 75% up over 9-07
  - Will invest $0.56B on network expansion in 2008: focus on broadband, extend footprint to the hinterlands to SMEs, schools, government and rural users. Also working on an NGN core network project, Nortel is part of this on the LH WDM side.
  - As of 3Q08 1.77M fixed-line subs (flat year-over-year), 0.88M broadband up 75% year-over-year. Niche rollout of FTTH enables 5Mbps for high-income households and small businesses (opting for residential packages). Half of PLDT's broadband user base is served over Motorola Canopy wireless equipment.

Globe profile

- Scope:
  - **Globe** provides wireless services
  - **Innove**, a wholly-owned subsidiary, provides fixed-line services, ICT infrastructure, IP- and multimedia-based solutions. Also offers cellular services under TM brand.
  - **G-Xchange** subsidiary provides mobile commerce services
- Operational information:
  - 23.8M mobile SIMs in service as of 9-08 from 19.2M in 9-07. Wireline user base of ~400K flat year-over-year. Broadband DSL subscribers up 50% year-over-year to 0.18M in 3Q08.
  - Plans US$0.4-5B in capex for 2008: $180 million to expand DSL and wireless broadband, US$130million for core wireless business, $40 for support capex, and US$80-100 million for non-recurring capex (e.g. stake in TGN-Intra Asia Cable).
  - Innove's GlobeQuest offers range of legacy (ATM, leased line, FR, FC) and new data services (DSL and Metro Ethernet)
  - No apparent plans for FTTx; deployments likely to target enterprise/MTU segment (e.g. call centers, business process outsourcing companies, other MNCs)

Others

- Bayantel
  - Regional fixed provider covering roughly 25M population, including parts of metro Manila. Roughly 40K DSL subs 6-07. 1H07 revenues of $54M
  - Offers DSL, leased line, voice, and enterprise data
  - Competes with Globe, PLDT and Digitel
  - Early mover w/ offer of enterprise metro Ethernet service. Main product is EPL, 4-100Mbps
  - Will add VPLS, E-LAN, and grow to 1Gbps service in 2008
  - May target high-end residential market with FTTH in the future
- Digitel
  - Digitel (Sun Cellular) reached 6.5 million subs at the end of June 2008, aiming for 10M by year-end. Sun had a roughly 10% market share by end of June.
  - Allocated US$271M on networks this year, increasing the number of cellsites from 2,300 in December 2007 to 4,000 by end of this year. Starting to move towards 3G, 1M subscriber network to launch soon, will have same coverage as larger 2 players Smart (PLDT) and Globe. Sun awarded wireless backhaul project to Ceragon in July 2008.

WiMAX status

- WiMAX rollouts / plans in the Philippines
  - In late 2005, Innove Communications (part of Globe Telecom) conducted a first WiMAX trial with 100 trial users which were employees from different parts of Intel. The WiMAX infratsructure was deployed in eight villages or subdivisions within a 100km radius in Cavite where the employees reside. The Innove and Intel team up is part of the Asian Broadband Campaign, a pan-regional program aimed at accelerating wireless broadband deployment in Southeast Asian countries. In August 2008, Globe Telecom said that it will launch commercial WiMAX services beginning October 2008. "We were doing trials since the middle of 2007 and concluded the trials in the first quarter 2008. We have tested in densely populated cities," said Lee Han Kheng, Globe's chief operating adviser. He also said that WiMAX will be rolled out in key cities, including Cebu and Metro Manila. Globe will be using 16e CPEs and base stations from Huawei.
  - In March 2008, Prime Communications, formerly Pacific Internet (PacNet), announced plans to roll out a WiMAX network in the Philippines to compete with the country's incumbent operators in the wireless broadband services market. Prime's president and managing director Joji Yap said that the deployment will take place by the end of 2008. The WiMAX rollout will initially cover Metro Manila before being extended to other key cities nationwide, Yap said. Formerly, in April 2007, Pacific Internet Philippines (PI PH). announced that it will invest over US$12 million in building a wireless broadband infrastructure, initially in the Greater Metro-Manila area. PI PH has been assigned 15MHz spectrum in the 2.5-2.7 GHz band.

Singapore

Singapore Country Profile

General Information – 2008

- Estimated Population – 3.7 million
  - Urban – 100%
- Estimated Households – 1.16 million
  - FTTP Household Penetration – 1.8%
- Estimated Broadband Subscribers – 1.1 million
  - 45.9% DSL
  - 37.8% Cable Modem
  - 1.9% FTTB/FTTH
  - 14.5% Wireless
- Broadband Household Penetration – 94.8%

State of the Singapore telecom industry

- The two major players are still fixed line incumbent SingTel and cable provider StarHub. These operators compete head-to-head and the competition is driving some price cuts. Both companies also offer mobile broadband.
- SingTel has about 53% of the broadband market and StarHub has about 46% of the broadband market.
- StarHub offers triple play bundled services for US $88 which includes 10 Mbps downstream, 2 Mbps upstream, cable TV and VOIP.
- SingTel offers unlimited broadband access packages for US$60 with a speed of 10Mbit/s. It offers a range of triple-play bundled services for US$, which includes .
- There are a number of other smaller broadband providers. Pacific Internet offers wireless and DSL. The number three mobile player, M1, also has wireless broadband services.

FTTx status – Intelligent Nation 2015

History

- The Singapore Government's decided in March 2006 to create national high-speed fixed and wireless broadband networks - Next Generation National Broadband Network. This network is to have two components:
  - A wired broadband network that will deliver ultra-high broadband speeds to all homes, offices and schools.
  - A wireless broadband network that will offer connectivity around Singapore.
- The plan is to roll out FTTH to 50 per cent of premises by 2012, and 95% by 2015. IDA envisions that Singapore's new broadband highway will deliver access speeds of 100Mbps, in the near term and 1.0Gbps in the long run.
- Complimentary wireless broadband is offered in strategic locations such as the central business district and major town centres. The project, called 'Wireless@SG', will allow users to surf for free at speeds of up to 512kbps for the next few years.
  - When the fixed network is built, bandwidth will be offered by the wholesaler to service providers. The plan is to have an open access network.

FTTx status - Intelligent Nation 2015

- The IDA decided on a structurally separated model for the fixed network, and tendered funding for the passive (NetCo) and active (OpCo) infrastructure separately. Retail companies will buy wholesale capacity from OpCos.
- The OpenNet consortium led by SingTel defeated a consortium led by StarHub in September 2008 for the passive optical infrastructure (the NetCo). This tender was worth S$750 million.
  - OpenNet will offer wholesale prices of S$15 per month per residential fibre connection and S$50 per month per non-residential fibre connection to the OpCos.
- A shortlist of four bidders for the active switching infrastructure (the “OpCo”) was announced in December 2008. A final decision is due in 1Q2009. This tender is worth S$250 million.
  - Non-selected OpCos will still be allowed to connect the optical network, but will receive no funding and have no universal service obligations.
  - OpCos will not be allowed to offer retail services directly.
- Retail companies will have access to wholesale services from all OpCos.

South Korea

South Korea Profile

General Information - 2008

- Estimated population: 48.5 million
  - Urban – 84.2%
- Estimated Households – 16.2 million
  - FTTP Household penetration – 44.2%
- Estimated Broadband Subscribers – 15.7 million
  - 22% DSL
  - 32.5% Cable Modem
  - 45.5% FTTB/FTTH
  - 0% Wireless.
- Broadband Household Penetration – 96.9%

FTTx Outlook

- Aggressive deployment expected
- KT will aim to increase an invest on network upgrade, simultaneously it aims to reduce costs on maintenance of existing line facilities.
  - KT planed to invest W960 billion($1.02 billion) in network infrastructure in 2008
    - W280 billion ($298 million) in access upgrade
    - W680 billion ($723.4 million) in core network upgrade
  - But, it is expected to invest over W 800 billion in network infrastructure in the end of 2008, due to cost reduction on maintenance of existing line facilities
    - W 250 billion in access network
    - Others in core network
  - KT have 1.1 million FTTH subscribers as of 3Q 2008 and it is expected to reach 1.3 million in the end of 2008.
  - KT have improved its FTTH coverage from 52.5% of national coverage in 3Q 2007 to 68.4% in 3Q 2008.
  - 70% – 80% of upgrade will be FTTH with mostly EPON and maybe some WDM-PON

FTTx Outlook (Continued)

Aggressive deployment expected

- KT plans to invest W 500 billion from 2008 to 2015 for providing 100% nationwide coverage of FTTH.
  - It plans to provide 92% of national coverage in 2010 and to complete 100% coverage in 2015.
  - KT will switch its existing network to All IP basis until 2015 with ensuring optimization of network

KT's investment plans for FTTH

	2009	2010	2011	2012	2013 ~ 2014	2015
Volume of investment (W billion)	60	70	65	62	177	66

* The above table is the data before releasing its FY2009 business plan, thus it may be changed along with its strategic decision

- SK Broadband (prior HTI) deploys ETTH (Ethernet to the Home) to detached homes providing 100 Mbps to each subscriber
  - It acquired its FTTH subscribers of 0.4 million as of 3Q 2008.

Local Initiatives

- BCN (Broadband Convergent Network) Project enters Phase III
  - Launched in 2004, completed Phase II in 2007
  - Phase III (2008~2010) :aims nationwide expansion of advanced networks and applications
  - Aims to deploy 35 million advanced access lines (wired 12 million, wireless 23 million) which support over 50M for wired, over 1M for wireless by 2010
  - Total W18.2 trillion ($19.4B) investment including W360 billion($383M) government' invest in Phase III
- The government plans to introduce "1Giga bps internet pilot service" in December 2008.
  - The government will invest W 3.7 billion in 2009, and it will totally spend W 12.7 billion until 2012 for establishing the foundation of ensuring 1 Giga bps broadband speed.

Local Initiatives (Continued)

- U-City (Ubiquitous City) project
  - U-City is a plan to install the latest IT infrastructure and information services in the urban areas
  - 22 cities are currently developing plans for this project
  - The government has established a three phase program for this initiative which set to begin in 2007
    - Phase I (2007~2008): set up U-city guideline and established a foundation for U-city
    - Phase II (2009~2010): aims to apply service models and to support pilot applications
    - Phase III (2011~2012): aims to launch service applications nationwide and to support upgrade of relevant infrastructure
  - The central government spent W 4.7 billion and W 5.8 billion in 2007 and 2008 respectively, and it will totally invest W 33 billion until 2012.

Regulatory

- Expanded the price discount range in June 2008
  - Regulator imposed strict pricing control over bundling offerings of operators with significant market power (SMP), which hindered proliferation of bundled product
  - Korea Communications Commission (KCC) was eased to its bundling regulation, where Operators with SMP was able to launch bundling products without the government's intervention as long as the range of price discount is within 10%.
  - In June 2008, KCC expanded the range of price discount to 20%.
  - Operators with SMP are providing bundled services including triple and quadruple play services. Thereby, bundled service subscribers are increasing. For example, KT has shown an increase of its bundling subscribers from 0.4 million in 1Q 2008 to 1.3 in 3Q 2008.
- South Korea Assembly approved the IPTV bill (including real-time broadcasting) on December 2007, and the enforcement ordinances was set up in August 2008
  - Delay in regulatory settlement around the convergent IPTV service allowed only VoD offerings.
  - As the law was approved, operators has provided real-time broadcasting services in its IPTV offerings. KT released its linear broadcasting IPTV service in November 2008, and SK Broadband (prior HTI) and LG Dacom are preparing linear broadcasting IPTV services at the moment.
  - KT and SK Broadband acquired 0.8 million and 0.77 million IPTV subscribers as of 3Q 2008 respectively.

Regulatory (Continued)

- Telephone number portability for VoIP was implemented from October 2008
  - It allows fixed line users to switch to VoIP-based packages from alternative operators while retaining their fixed line number.
  - However, free on-net call is not available to VoIP subscribers porting their fixed-line numbers, because call traffic of VoIP subscribers porting their fixed-line number should go through incumbent's switching system.
  - LG Dacom acquired 1 million VoIP subscribers (including LG Powercomm's subscribers) as of 3Q 2008.
  - KT aims to acquire 1 million VoIP subscriber in 2008, by which it aims to cope with an decrease of its fixed-telephony subscribers.

Taiwan

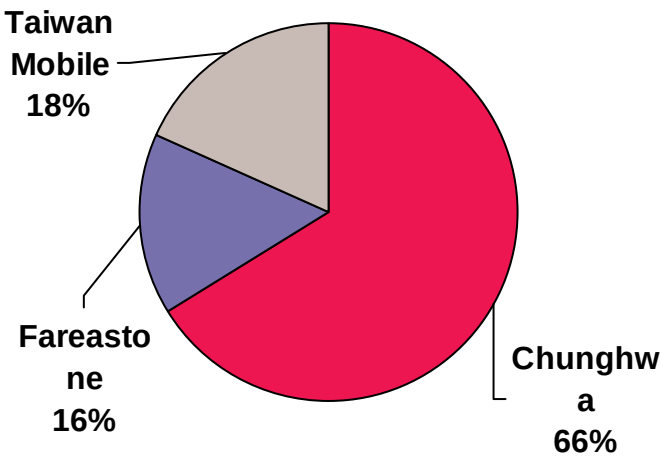
Taiwan profile

General Information - 2008

- Population: 23 million
  - Urban – 94.8%
- Households – 6.9 million
  - FTTP Household penetration – 12.3%
- Broadband Subscribers – 6 million
  - 79.2% DSL
  - 6.2% Cable
  - 14.2% FTTH/FTTB
  - 0.4% Wireless
- Broadband Household Penetration – 87%

Spenders & vendors

Taiwan telco capex: $1.2B ('07)



Source: Ovum

- Major suppliers
  - Alcatel-Lucent and NSN across multiple segments.
  - UTStarcom in BB/IPTV. Ericsson in wireless infrastructure. ALU & Nortel lead in optical; Ericsson with some position. Juniper uniquely strong in IP, Ericsson/Redback also.
  - Mainland PRC vendors mostly irrelevant for political reasons

•Chunghwa (the INO) dominant in broadband/wireline spending, likely 80%.
•Additional spenders not included above: (1) Cable companies: private investment from Taiwan BB (Macquarie), EBT (Carlyle). Upgrade to DOCSIS 3.0 has been slow though. (2) Asia Pacific Broadband Telecom offers DSL, fiber and cable modem services

Spending drivers: Taiwan

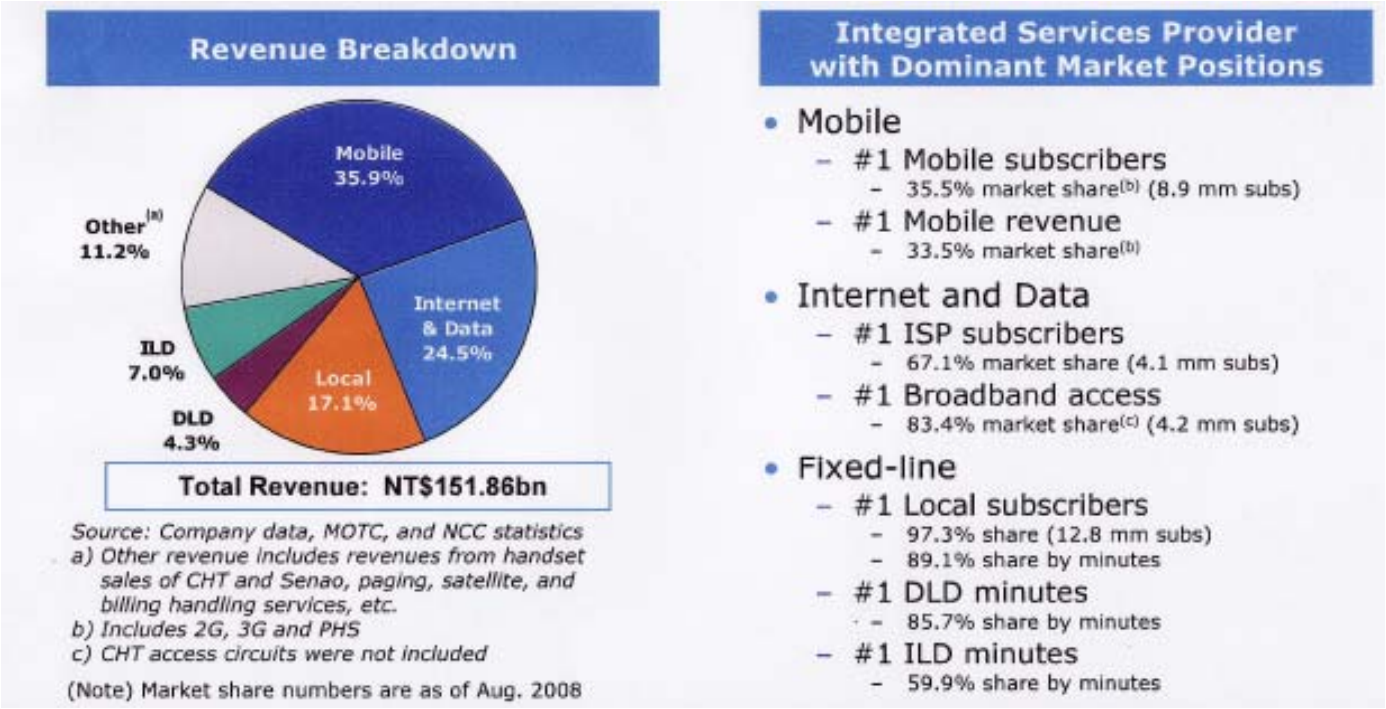
Driver	Remarks
3G->4G	Coming years will see majority of WCDMA subs migrate to HSPA and 1xRTT to EV-DO. YE 2007: 2.0M WCDMA, 0.1M HSPA, 1.1M CDMA2000 1xRTT, and 0.01M EV-DO connections. By 2012 we expect 1.3M EV-DO (0.7M 1xRTT) and 13.8M HSPA and 7.2M WCDMA subscribers; by the same time there should be around 1M Mobile WiMax users, among the higher concentrations in Asia. Local carriers transitioning to Ethernet-based backhaul now.
Ethernet services	Metro Ethernet was ~US$50M market in 2007, nearly 7K ports in service, and market should grow to nearly $200M by 2012. Lack of strong wireline competition has kept growth slow but Chunghwa is getting more aggressive to lower costs and enable higher-bandwidth services. There are some locally produced switches at the low end.
Government & regulatory	Government actively involved in telecom/IT industry (e.g. chips, CPE) development and telecom infrastructure plays a central role in this, both through regulatory requirements, use of government-controlled Chunghwa as an investment vehicle, and subsidies. WiMax is especially important. ▪ICT Joint Project: a Government initiative that might boost network infrastructure. ▪ICF: nonprofit think-tank focused on economic development in the broadband economy. Taipei city project focuses on e-government, bridging divides, mobile apps for public services, and knowledge management. ▪These initiatives aim to build business for the "5C industry" (communication, computer, control, consumer, and content), create a wireless Internet environment, and strengthen the IT infrastructure and service. ▪M-Taiwan: purpose to build a wireless broadband network environment where users can access rich digital content anywhere and anytime and to bridge the digital divide among rural communities. 85 percent of government agencies now have websites, and more than 2,500 government services are provided around-the-clock and year-round. An initial phase completed mid-2007. ▪Local electronics suppliers may have position in global FTTx supply chain, e.g. Accton, which sells FTTB/FTTH home gateways (among other equipment such as Ethernet switches). Government will help them get early experience in the field in domestic market. Similar issue appears in WiMax segment.

Spending drivers: Taiwan

Driver	Remarks
NGN & FTTx	Chunghwa's NGN initiative launched in 2006 and bulk of project will be complete by 2011. CHT has stated its transformation will cost US$4B over 2007-11, or $0.8B per year; CY07 total CHT capex was $0.76B. In the 2009-13 period, total capex will reach roughly US$1B annually. Of total NGN costs, roughly $1.85B will be for national fiber optic build, and $2.15B for mobile upgrades. Chunghwa is a big proponent of Carrier Ethernet-based services and products, and also is aggressively deploying FTTx and a related IPTV ("Multimedia on Demand") platform. By 2011, Chunghwa aims to have 2.5m users, or more than half of its broadband customers, upgraded to FTTx, or 3.3M by 2013. This would include 60 per cent of its corporate customers and 25 per cent of private users. As of September 2008, CHT has 946K FTTx customers. With FTTx rollout the average bandwidth per BB user has increased rapidly, from 2.7Mbps in 3Q07 to 4.2Mbps in 3Q08. Remark: currently Chunghwa is hedging plans a bit stating that the FTTx rollout schedule will depend on regulatory certainty of open access rules
Video	Taiwan's cable TV industry is among the more active in Asia, outside Korea, in part due to external investment from Carlyle and Macquarie. This fact plus high disposable income and rich Chinese language content produced locally or in Hong Kong has stimulated Chunghwa's video investments. As of 9-08 there were 591K subs to MOD video platform, with 700K target for year-end 2008 (initially 800K but downgraded in 3Q08). Still MOD is less than 1% of company revenues.

Chunghwa Telecom profile

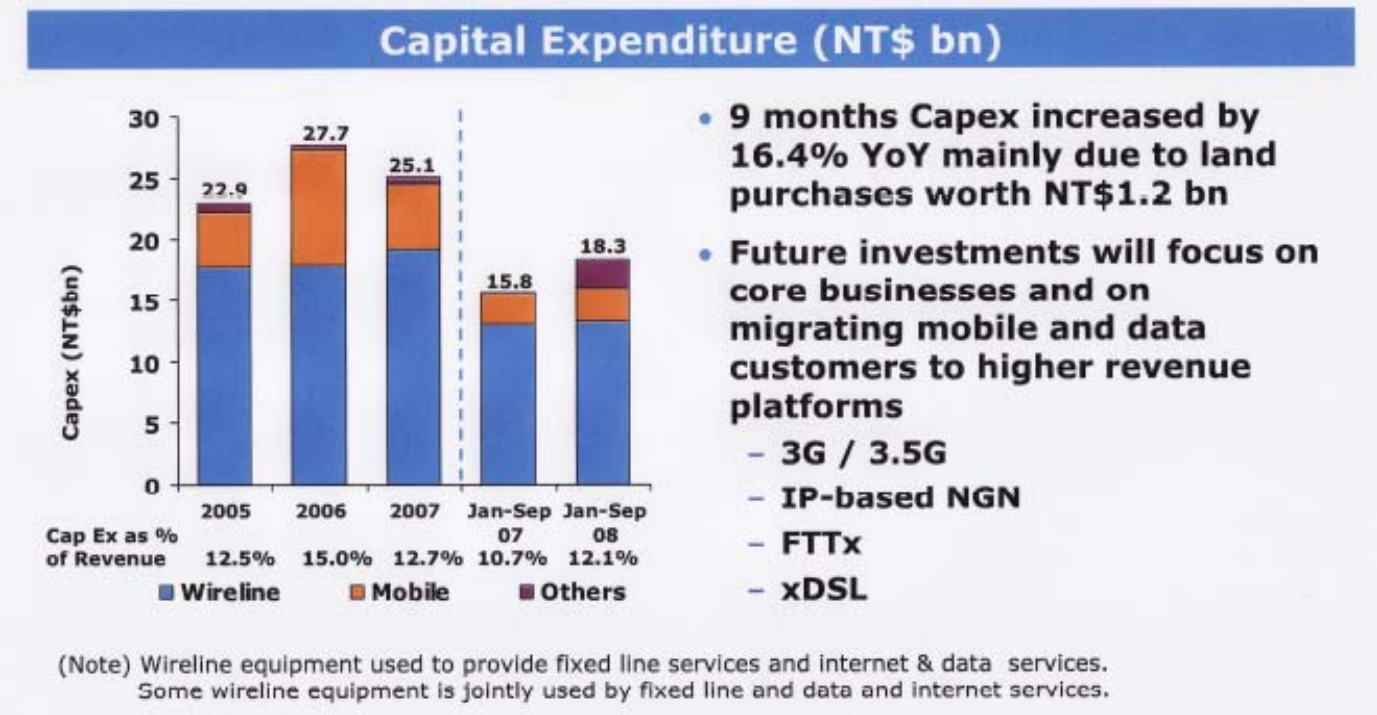
- Chunghwa is dominant local provider in nearly all segments.
- Limited competition offset by government support of advanced service & technology deployment, along with local electronics industry development.



Source: CHT 3Q08 investor presentation

Chunghwa Telecom

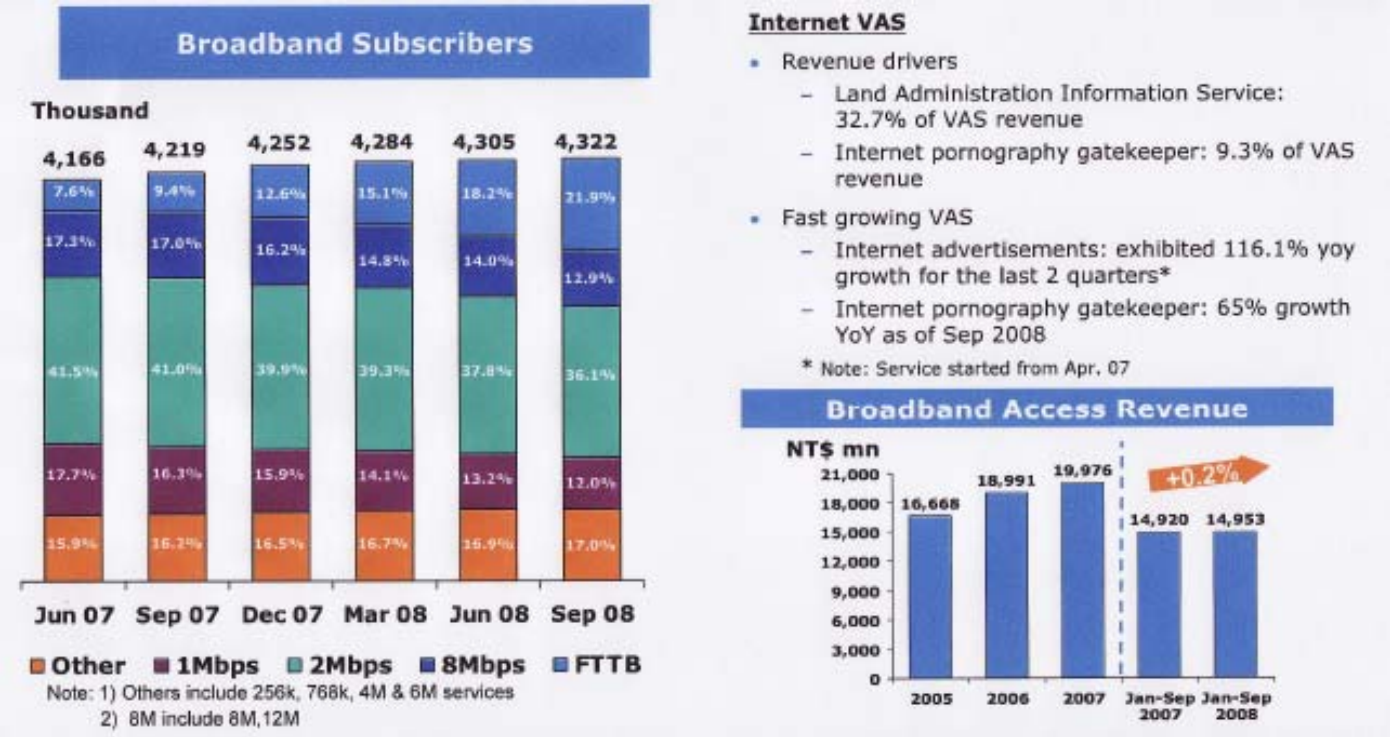
- CHT's capex – though mostly flat overall – is increasingly driven by FTTx and NGN transformation



Source: CHT 3Q08 investor presentation

Chunghwa Telecom profile

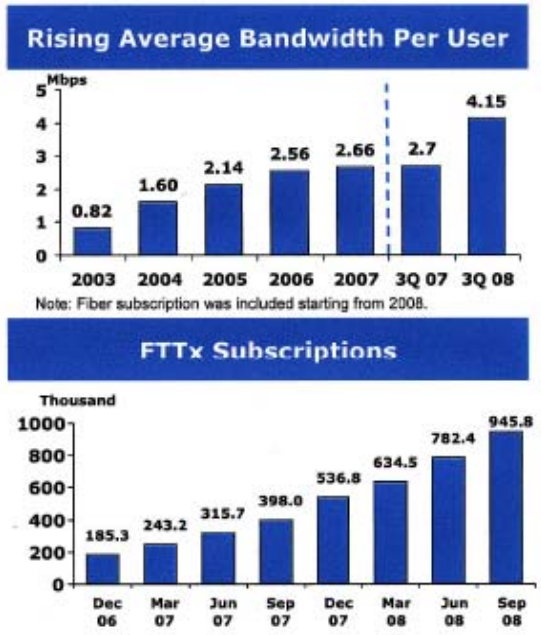
- DSL speeds are rising, Multimedia on Demand (MoD) platform catching on, broadband revenues help offset shrinking voice business: BB accounted for ~10% of 1Q-3Q08 CHT revenues of $4.9B.

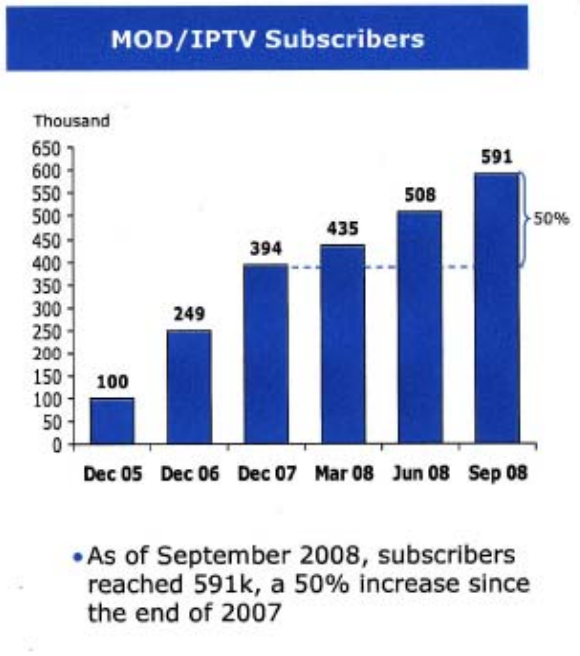


Source: CHT 3Q08 investor presentation

Chunghwa Telecom profile

- Bandwidth consumption and IPTV adoption rising in concert with FTTx subscription rate

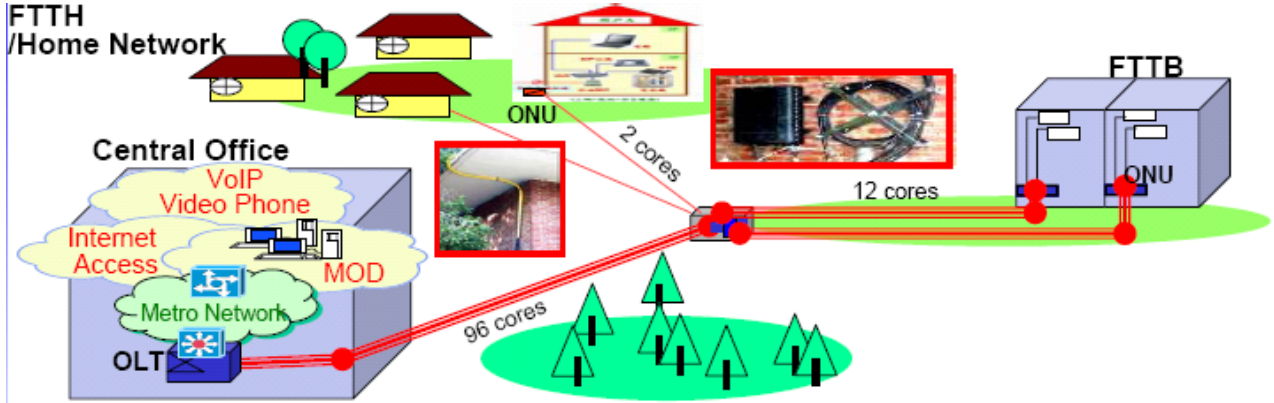




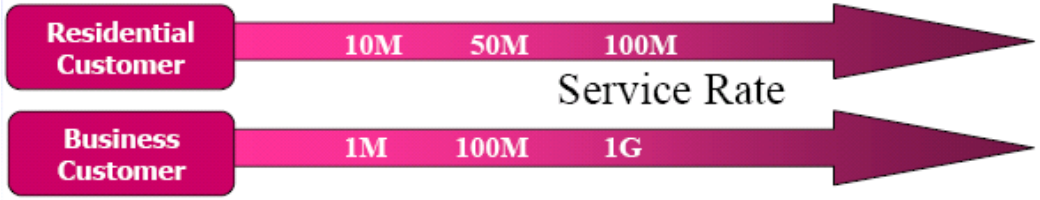
Source: CHT 3Q08 investor presentation

Chunghwa Telecom profile

- FTTx update: 946K subs 9-08, from 398K 9-07. Offered in roughly 17K buildings along with IPTV (MoD), which has 591K subs. FTTx is generally FTTB, from 10 to 50 to 100Mbps per user. Out of 4.3M broadband subs in total, 35% have over 8Mbps.



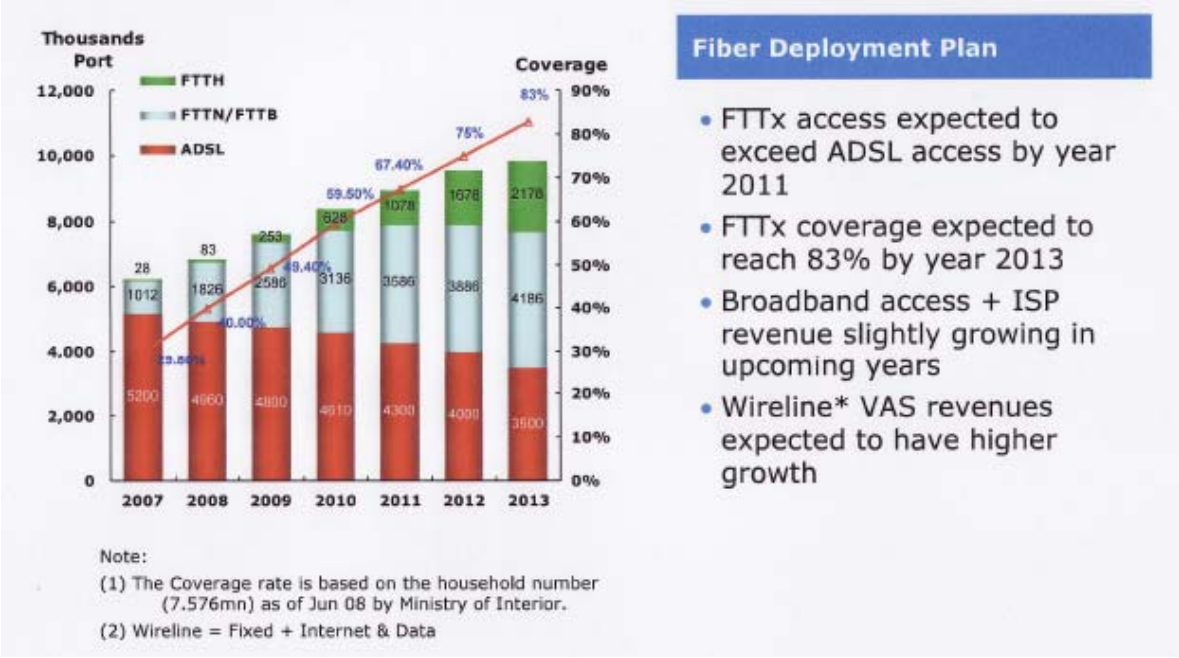
- Using switched Ethernet and PON technologies for broadband access
- Different types of tenants/buildings (condominium, apartment, Science Park...)
- Build FTTH access platform to connect digital home service



Source: CHT TNS-APAC 1-07

Chunghwa Telecom profile

- FTTx to play a big part in Access part of CHT's NGN project. This transformation will cost US$4B 2007-11, or $0.8B per year. Cost breakdown:
  - US$1.85 on national fiber optic build (most of this is FTTx)
  - US$2.15B on mobile upgrade



Fiber Deployment Plan

- FTTx access expected to exceed ADSL access by year 2011
- FTTx coverage expected to reach 83% by year 2013
- Broadband access + ISP revenue slightly growing in upcoming years
- Wireline* VAS revenues expected to have higher growth

Source: CHT 3Q08 investor presentation

Other competitors

- Other providers
  - ISP Seednet, which delivers its service via Chunghwa's network.
  - Taiwan Fixed Network: offers FTTB in major cities. Its 2007 integration with Taiwan Mobile, done through subsidiary TIT and approved by NCC in 3Q07, will allow the combined company to deploy triple play starting 1Q08
  - Asia Pacific Broadband Telecom, which offer a combination of DSL, fiber and cable modem services on optical backbone.
- Cable TV
  - Fragmented but strong cable industry.
  - The Taiwanese government might allow the island's four major cable TV networks to set their own prices and roll out extra services such as digital TV and high speed internet. Generated a lot of investment interest.
  - The Carlyle Group purchased a majority stake in Taiwan's leading TV company, Eastern Multimedia. China Network Systems sold 60 per cent to a private equity fund formed by former Carlyle Group executives. The Australian Macquarie Media Group owns a majority stake in another of the four leading companies, Taiwan Broadband Communications.

Taiwan – WiMAX status

- Taiwan is a key market place for WiMAX as the technology has been identified as a key prospect for the local ODM/OEM industry. The government launched an initiative the M-Taiwan program which includes industrial policy for the support of local chipset and OEM manufacturers behind WiMAX. As a result, numerous Taiwan companies have joined the WiMAX Forum and began to develop products for WiMAX, and CPEs in particular. All the main WiMAX infrastructure vendors have set up relationships with Taiwanese manufacturers and the WiMAX Forum has opened WiMAX Certification Labs in Taiwan. Among the main Taiwanese WiMAX CPE suppliers are Zyxel, Gemtek, AWB (a joint venture between Alvarion and Accton), Tecom and ASUS. On the infrastructure front, Tecom is now manufacturing WiMAX base stations for Samsung and Alvarion.

- On the domestic WiMAX service front, there are still issues. Given the level of involvement of the Taiwanese industry behind WiMAX, people should have expected to see Taiwan at the forefront of WiMAX service developments but it is not the case. Despite the fact that six regional WiMAX licenses in the 2.5GHz band have been allocated in July 2007, the licensees are still cautious about their WiMAX strategies and have postponed their official commercial launch several times. Having been granted 30MHz TDD each, the six licensees are:

  - Northern region: First International Telecom (Fitel), Global On and Wei Mai Si Telecom

  - Southern region: Far EasTone, Tatung and Vestar Cable TV

Taiwan – WiMAX status - cont

- WiMAX rollouts / plans in Taiwan
  - Despite the fact that CHT has no license in 2.5GHz to offer WiMAX services, the incumbent has been involved in the M-Taiwan initiative and has set up various trials with several vendors including Nortel, Alvarion, TAISEL, NSN and Redline.
  - In July 2007, FarEasTone received a 2.5GHz WiMAX license for South Taiwan. In August 2007, Far EasTone Telecommunications announced that it plans to roll out its WiMAX service in Taiwan over the next one to two years and will seek partners to cover the north of the island. in June 2008, Far EasTone Telecommunications (FET) said that it now plans to kick off its WiMAX service in the second half of 2009, according to company chairman Douglas Hsu. Issues related to the interoperability testing of WiMAX devices and the finalization of standards as well as the establishment of the WiMAX infrastructure as causes of the delay, Wu explained. The service provider has selected Alcatel-Lucent, Motorola and Nortel as suppliers of 16e equipment.
  - In July 2007, Fitel won a 2.5GHz license for Northern Taiwan. At this occasion Fitel said that they have plans to set up a WiMAX network in the first half of 2008, and hopes to begin commercial operations in the second half of 2008 at the earliest. However the operator has reviewed its WiMAX plans. In June 2008, Fitel has placed orders for 5,000 WiMAX USB dongles from three Taiwan-based companies – D-Link, Quanta Microsystems and Asustek Computer – in preparation for its WiMAX service rollout, according to company president Charlie Wu. The company plans to offer the USB dongles to its WiMAX subscribers at NT$4,900 (US$161), while allowing access to its WiMAX networks free of charge until the official launch of its commercialized service slated to begin in the second half of 2009, Wu said. As a participant of Taiwan's government initiated Mobile Taiwan (M-Taiwan) program, Fitel is required to solicit a total of 40,000 WiMAX subscribers by mid-2009, Wu noted. Fitel has completed a central hub that can accommodate 200,000 WiMAX users in Hsinchuang, Taipei County as well as the installation of 88 WiMAX base stations that cover 70% of Taipei City, Wu stated, noting that the company will begin to test the base stations soon.

Taiwan – WiMAX status - cont

- WiMAX rollouts / plans in Taiwan
  - In July 2007, Tatung InfoComm received a 2.5GHz WiMAX license for South Taiwan. Tatung InfoComm has selected Alcatel-Lucent and NEC to deploy its commercial WiMAX 802.16e-2005 (Rev-e) network. In September 2008, Tatung InfoComm announced it has completed the installation of 90 out of the 200 WiMAX base stations it purchased from NEC, and the company also confirmed that it is on track to install the remaining 110 base stations before the end of 2008. In addition, as a participant to the Mobile Taiwan (M-Taiwan) Program, Tatung InfoComm has been actively building up its WiMAX networks in Kaohsiung and Pingtong Counties in southern Taiwan as well as in Hualien County in eastern Taiwan. The company is likely to launch its WiMAX service initially in Kaohsiung City and Kaohsiung County with coverage provided by 300-400 base stations.
  - In July 2007, Vastar won a 2.5GHz license to provide WiMAX services in the southern Taiwan region. In August 2007, WiMAX Telecom and Vastar Cable TV System signed a strategic alliance agreement which calls to provide island-wide WiMAX services starting the first half of 2008. As reported by Digitimes in June 2008, Vastar Cable TV System, a WiMAX licensee for the southern region of Taiwan, said that it will begin to establish its WiMAX networks in September 2008 with commercial run of the system slated for the second quarter of 2009, two quarters behind its original schedule, according to company sources.
  - In July 2007, WiMAX Telecom won a 2.5GHz license for Northern Taiwan. In May 2008, WiMAX Telecom said its initial deployment will incorporate 300 base stations in the Taipei area, with the full network eventually including 1,100 base stations and covering the whole of northern Taiwan. Commercial launch is scheduled before the end of 2008.

Taiwan – WiMAX status - cont

- WiMAX rollouts / plans in Taiwan
  - In June 2008, The Taiwan High Speed Rail (THSR) announced that it will cooperate with the Taiwan government-sponsored Industrial Technology Research Institute (ITRI) and a number of companies, including Zyxel Communications, NTT, NTT BP and Corning, to carry out an experimental project for broadband Internet access through WiMAX on high- speed trains, according to plan from THSR and ITRI. The experiment is aiming to reach a data transmission speed of 15Mbps between the terrestrial areas and high speed trains while the trains are moving at speeds of 250-300kmh, ITRI added. While ITRI is responsible for building the experimental environment and integration of all trial processes, Zyxel will help set up the WiMAX base stations. In addition, NTT and NTT BP will support a project to commercialize the Wi-Fi experience, which it has already carried out on the Tsukaba Express railway system. Corning will also assist by offering its fiber-wireless technology for signal delivery, said ITRI. THSR will consider how to commercialize the WiMAX service after the testing is completed by the end of 2008, ITRI indicated.

Thailand

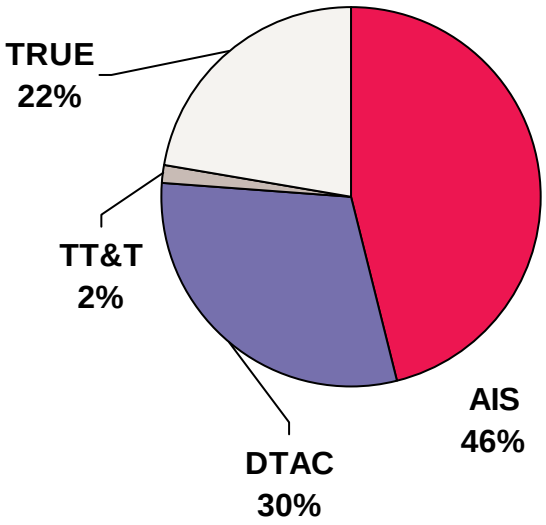
Thailand profile

General Information - 2008

- Population: 65.9 million
  - Urban – 35.4%
- Households – 19 million
  - FTTP Household penetration - .03%
- Broadband Subscribers - 2 million
  - 98.3% DSL
  - 0.2% Cable
  - 0.3% FTTH/FTTB
  - 1.2% Wireless
- Broadband Household Penetration – 10.5%

Spenders & vendors

Thailand telco capex: $1.1B ('07)



Source: Ovum

•TOT and CAT both also spend heavily on networks – mostly wireline gear – but are PTTs and don't report financials

- Major suppliers
  - NSN, Huawei, ALU, and ZTE – roughly in this order
  - Ericsson & Cisco next tier
- In optical and access Huawei has been strong for many years, ZTE has had recent success. ALU and NSN remain important players but have struggled on pricing.

Spending drivers: Thailand

Driver	Remarks
3G service rollouts	3G service rollouts have begun at a very small scale, initially in the 850/900MHz band until 3G licenses are issued (likely 2009) in the 2100 MHz band. AIS, a TOT concession, started already and CAT concessions DTAC and TrueMove will follow soon after getting approval in June 2008. True expects to spend ~$150M on the initial 850MHz-based rollout. Since formal 3G licensing hinges on clarity around concession fees and other messy regulatory issues, there is some risk in the timing, especially if another coup occurs. However, 3G rollouts once begun will span several years and involve billions of dollars of spending. For instance, AIS has budgeted $600M for initial 3G rollout, and TOT has stated its plan to spend nearly $0.9B on wholesale WCDMA network between 2009-12.
Broadband competition	TrueMove (625K subs) continues to push its network coverage, TOT remains competitive across most of the country, and upcountry operator TT&T is expanding more directly into TrueMove's Bangkok territory. Focus remains on broadband data, as TrueMove's DTH video offering has leading market position and achievable speeds over DSL are low so far. However, as basic data penetration rises, IPTV and other video-based traffic (VoD, etc.) will begin to drive traffic nationwide. TT&T's affiliate company Triple T Broadband offers commercial IPTV and has recently deployed WiMax from Cisco to expand its broadband network reach. Datapoint: True's international Internet gateway doubled its traffic load (peak) between 12-07 and 6-08 to 5Gbps.

Spending drivers: Thailand

Driver	Remarks
FTTx, video, and enterprise data	True: ADSL is main consumer platform. VDSL and Metro Ethernet used for enterprise market but user numbers small. FTTx will be deployed to select areas starting 2008. IPTV, HDTV, wholesale carriage, and gaming and storage are drivers. FTTH, FTTC, and FTTB all under review. EPON trial was conducted in 2006. Total FTTH subs expected to reach 100K in 2009. Because of its high margin DTH division True Visions, interest in IPTV is limited and defensive in nature. TOT: in race with True for leading broadband provider, it offers service nationwide, strong in rural areas. Offers MetroLAN service: Metro Ethernet for enterprise in select areas from 2Mbps → 1Gbps. Restructuring to focus on broadband/NGN: Will invest $500M/yr until 2010 to convert core network to NGN, and grow broadband revenues to 70% of total from 30% in 2007. TT&T: runs IPTV service through sister company. FTTB, and FTTH will be launched in 2009-10 – will provide games, triple play, videoconferencing, VOD, etc. Expanding its fiber network steadily: deployed 14K fiber-km of new fiber in 2005, 23k km in 2006.

True profile

- True is the primary fixed-line operator in Bangkok, alternative provider elsewhere, and owns leading DTH satellite TV service.
  - Broadband subs: 625K, added only 20K in 3Q08 but still hope to reach 1M by 2008/9 with expansion outside Bangkok.
  - ADSL main consumer platform. VDSL and Metro Ethernet used for enterprise market but user numbers small.
  - FTTx deployed to select areas starting 2008. IPTV, HDTV, wholesale carriage, and gaming and storage are drivers. FTTH, FTTC, and FTTB all under review. EPON trial was conducted in 2006.
    - Total FTTH subs expected to reach 100K in 2009.
  - Had 1.3M subs (9-08) on high-margin True Visions DTH platform, from 0.9M in 3Q07; ARPU dropping slightly as it pushes low-cost platforms to middle market. This business slows its push towards IPTV. Competes with OTA TV & many local cable companies. Its video revenues remain a big target for other telcos.
  - Over half of its BB subs buy cross-platform quad-play service (mobile, satellite TV, and fixed voice/broadband)

TOT profile

- TOT is the incumbent state-run wireline operator; it operates revenue-sharing based joint ventures with private operators in various sectors.
  - 6.7M fixed lines under control: 2.6M True, 1.5M TT&T, and 2.6M internal
    - By year-end 2008 will have 800-1000K DSL users, out of total 1.6M port capacity installed; this figure includes that of franchisees, so there is some double-counting (TOT does not specify the %).
    - MetroLAN service: Metro Ethernet for enterprise in select areas from 2Mbps → 1Gbps
  - Restructuring to focus on broadband/NGN as PSTN revenues decline
    - Will invest several hundred million US$ per year to convert core network to NGN, and grow broadband revenues to 70% of total from 30% in 2007. Aim is to transform company so it can survive independently. If NTC/NBC pushes broadband, TOT could be at center of implementation given political standing
    - As is TOT sees no incentive to build out FTTH w/o government subsidies. Would likely first deploy FTTH narrowly, with partners in such areas as high-income housing developments.
  - In August 20008, the Thai government approved TOT's plan to have its network operator, ACT Mobile, roll out a 3G network nationwide from 2009-11 at a cost of Bt29 billion (US$0.85B). TOT expects the project to break even within seven years. Of that amount, TOT will contribute Bt2 billion, while the rest will come from loans secured on a government-to-government basis. TOT plans to lease the network to private telecom operators so they can offer retail 3G services. Given the 4Q08 government instability, it is unclear whether TOT’s plans will go forward as planned.

TT&T profile

- TT&T is franchisee of TOT to deploy fixed lines outside of Bangkok.
  - Has ~1.2 million fixed line subs (including residential and enterprise), network capacity of 1.5M. All serving area has BB coverage.
    - Around 400K ADSL subs. Broadband ARPU is 700 Baht/month, versus 200 Baht per month for fixed-line voice user.
    - Triple T Broadband granted nationwide Type III license in 2-06, “MaxNetTV” now up and running in select locations. Country’s first IPTV licensee.
    - FTTB, and FTTH will be launched in 2009-10 – will provide games, triple play, videoconferencing, VOD, etc. No specifics on technology choice or architecture yet.
    - New fiber deployments:14K fiber-km in 2005, 23K fiber-km in 2006.
  - In late November 2008 it canceled its plan to enter Thailand’s 3G market due to the high capital requirement. This will reinforce its focus on fixed broadband.
  - Broadband expansion plan announced 12-08. It will spend roughly half of its 2009 capex on broadband, focusing on Chonburi, Phuket, and Chiang Mai, and hopes to reach 1M subscribers by 2010 and a #1 market share nationwide.

Thailand – WiMAX status

- In Thailand, Shinsat owns 3.5GHz spectrum while True Corp owns some 2.5GHz spectrum while TOT owns 2.4GHz spectrum. In addition, there are currently a dozen of WiMAX trial licenses that have been allocated. NTC issued WiMAX test permits to 12 companies in December 2007. NTC plans to issue additional WiMAX licenses in 2009.

- WiMAX rollouts / plans in Thailand

  - AIS has selected Motorola's equipment for a Mobile WiMAX (16e) trial. In March 2008, AIS announced plans to spend THB1.5 billion (USD48 million) on first phase deployment of a WiMAX network. AIS plans to install 350-450 base stations in suburban areas and major cities, as well as areas where there is no fixed line network. AIS started trials over Motorola's WiMAX Access Point-400 (WAP-400) platform in Bangkok and Lamlukka in 1Q08. The operator is studying performance of real-life applications over mobile WiMAX, and customer usage models in metropolitan, suburban and rural areas. AIS sees WiMAX as complementary to its existing fixed line and wireless offerings. During the trials, WiMAX technology was tested with various applications such as substitution of phone line, content delivery platform and high-speed Internet connection. AIS considers WiMAX an effective replacement for ADSL in providing broadband and various telecom services in cities and suburban areas.

  - In December 2006, NTC approved the application of Shin Satellite to test WiMAX to see if it will jam its Thaicom 5 satellite. ShinSat was planing to share some of the satellite's 3.5GHz spectrum with a WiMAX service.

  - In August 2008, National Electronics and Computer Technology Centre (Nectec) announced that it obtained approval from the NTC to test WiMAX technology in Mae Hong Son for three years and was allocated the 2.5GHz frequency for the pilot project. Three to four base stations will be set up initially, in Muang, Mae Sarieng and Pai districts. In the first phase, connectivity will be provided to 20 WiMAX clients, such as schools and government offices, located within a 10km radius of the first station to be set up in each district. The centre will initially use WiMAX equipment sponsored by Japan International Cooperation Agency, with plans to develop its own equipments at a later stage.

Thailand – WiMAX status – cont.

- WiMAX rollouts / plans in Thailand
  - In February 2008, United Information Highway (UIH), a joint venture between Benchachinda Holding and state-run telco CAT Telecom, held its first trials of 2.5GHz WiMAX wireless broadband services at the Meridien Beach Resort on the island of Phuket. The company holds a trial 2.5GHz license granted by the National Telecommunications Commission (NTC) last year, but has not received the green light to roll out commercial services. UIH plans to invest over USD3 million to bring WiMAX to Phuket, where telephony and broadband services are limited, whilst the company also intends to deploy WiMAX in Bangkok and other cities upon receiving a licence. The target market in Phuket is primarily corporate users, tourists, hotels and resorts, as well as ISPs requiring backhaul for Wi-Fi services. The result of the trial showed that users could connect to the internet at speeds of above 8Mbps. The trial employed tests of both mobile and fixed WiMAX services, with participants including Motorola and Intel.UIH foresees an opportunity in tourism especially the island area; for example Phuket, P.P Island, Koh Samui, Koh Phangan and Koh Toa which have high speed broadband access limitation. UIH hopes that WiMAX technology would be a solution to serve high speed internet users. The trial has been done on sailing boat at Patong beach. The result indicated that users can connect the signal with bandwidth more than 8Mbps and it can use for mobile internet usage. The trial has been supported by Motorola.
  - In June 2008, Alcatel-Lucent announced plans to conduct a trial of wireless broadband services using WiMAX Rev-e technology with True. For the trial Alcatel-Lucent will provide True Corporation with a comprehensive WiMAX solution that operates on the 2.5GHz frequency band, including base stations, wireless access controller, operation and maintenance center, CPE – including WiMAX CPE and wireless cards for laptop computers. Alcatel-Lucent will also provide its WiMAX engineering expertise and integration services for the trial, which will take place in Phatumthanee province on the outskirts of Bangkok. In addition, in March 2008, True also signed a deal with Posdata Flyvo for trialing Mobile WiMAX in Thailand. Non Ingkutanon, deputy director for wireless broadband services at True Corp., said that the firm had obtained consent from the National Telecommunications Commission for testing WiMAX for a period of three months. True Corp. planned to trial the WiMAX system in the 2.3GHz and 2.5GHz bands in Ratchaprasong.

Thailand – WiMAX status – cont.

- WiMAX rollouts / plans in Thailand
  - In July 2008, Triple T Broadband, the wholly owned broadband internet arm of TT&T, is preparing to launch a WiMAX pilot project for e-learning in Chiang Rai in September 2008 as part of a planned two-year THB4 billion (USD120 million) nationwide network rollout plan. Triple T had signed a contract for the supply of WiMAX equipment with Cisco in order to roll out WiMAX-based services in 21 universities. In August 2008, TT&T deployed the first Cisco WiMAX network in Asia Pacific at Mae Fah Luang University. Located in Chiang Rai province in north Thailand, Mae Fah Luang University selected TT&T to deploy the network after it obtained a WiMAX license as part of the Pilot Tele-Center for Rural Area Education and Development Project.
  - In May 2008, Thai communications equipment group Samart has announced that it will apply for a commercial mobile WiMAX network operating concession, once the NTC finalizes regulations and licensing procedures. Samart is conducting WiMAX trials in partnership with the Provincial Electricity Authority (PEA), which has its own telecoms network operating license. President of Samart, Watchai Vilailuck, said that the firm would apply for a WiMAX license through subsidiary Samart Telecoms (Samtel) and planned initial investment of at least THB100 million (USD3 million) in a wireless broadband network supporting applications such as high speed internet access and mobile television.
  - In March 2008, Nortel Networks has joined a unit of Thailand's Loxley PCL to test WiMAX wireless technology (16e). Thongyai Chanthanawan, managing director of Loxley Wireless, said his firm should make a commercial launch of WiMAX by the end of 2008 if it got a license. Loxley operates a wide range of businesses from selling consumer goods and mobile phones to installing telecoms networks.

Vietnam

Vietnam profile

General Information - 2008

- Population: 83.1 million
  - Urban – 27.7%
- Households – 19.1 million
  - FTTP Household penetration - .03%
- Broadband Subscribers – 1 million
  - 96.1% DSL
  - 0% Cable
  - 0.6% FTTH/FTTB
  - 3.3% Wireless
- Broadband Household Penetration – 5.2%

Spenders & vendors

- VNPT owns stakes in many 'competing' carriers, controls 70-80% of the market directly or through partnerships/JVs
  - Operates over 90% of fixed lines. Competitors mainly local, but FPT has national license; EVN a factor.
  - 27M subs by y-e '07, ~75% mobile
  - Over half of 6M+ Internet subs served by VDC affiliate
  - VDC/VNPT subs with broadband: 4-500K y-e '07. Goal:1.5M in '10.
  - Raised backbone capacity 80 → 120Gbps in 2007, building undersea N-S link in 2008. VN landing party for TPE cable.
  - CY07 revenues of roughly $2.5B, around double the CY06 result. Capex in the US$1b/yr range.
- Biggest vendors include:
  - Ericsson
  - Alcatel-Lucent
  - Motorola
- Chinese vendors have progressed slowly due in part to history of conflict, but have won small contracts and are not giving up
- In optical Alcatel-Lucent, ECI and Nortel have had the most success. ZTE and Huawei are actively bidding, with small wins to date.

Spending drivers: Vietnam

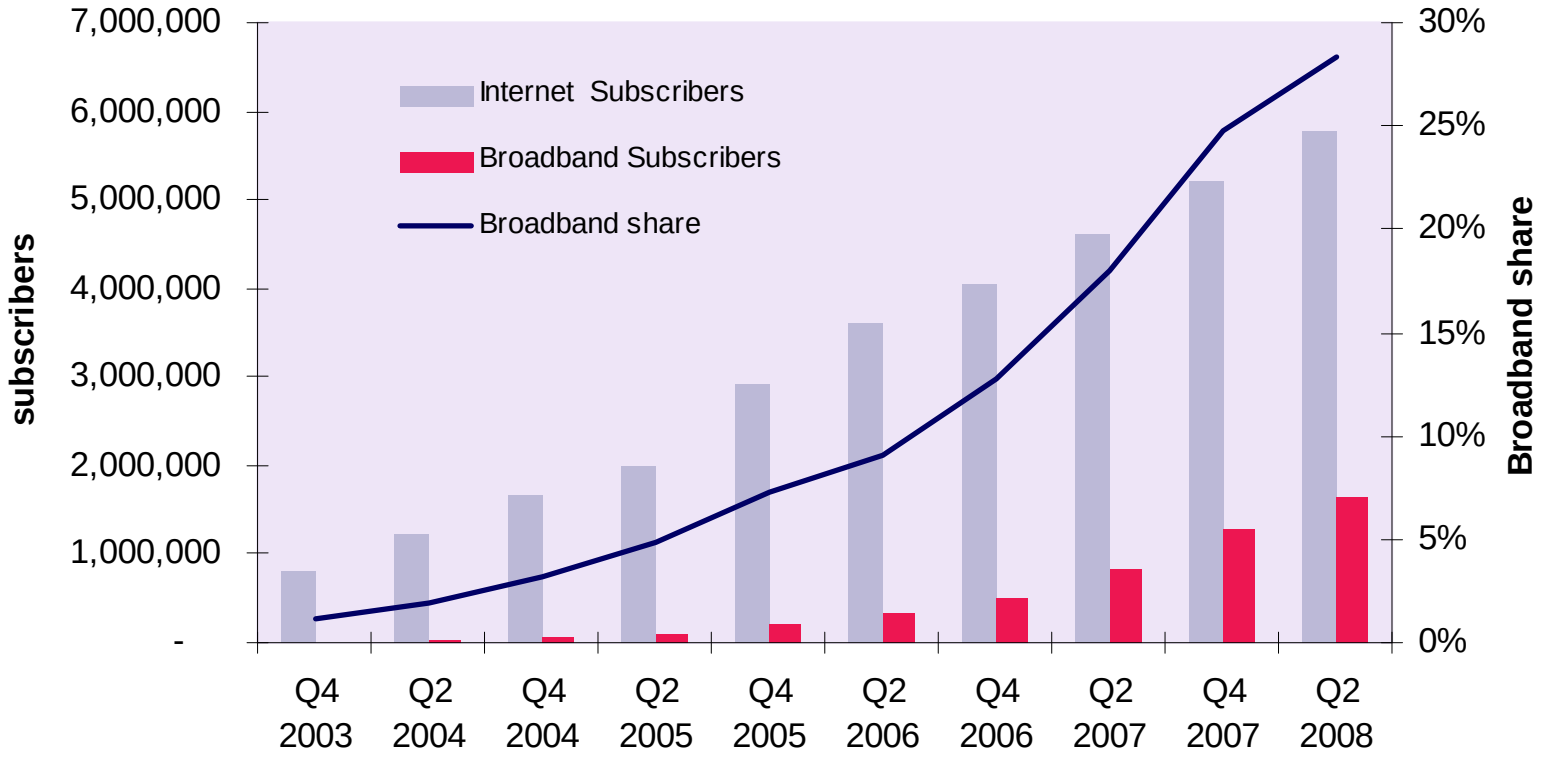
Driver	Remarks
Foreign investment	WTO has enabled foreign capital to flow in, accelerating carriers expansion efforts. Some capital also comes in with management/technical expertise and relationships with vendors and so on that affect deployment strategies, vendor selection, etc. Recent moves: •Vimpelcom paid US$0.27B for 40% stake in GTEL Mobile, a mobile carrier licensed 2-08; Vimpelcom plans to invest nearly $2B in next 5 years in Vietnam. •3G: bidders must show capital availability which will encourage foreign partnerships, which have already been in the works e.g. Viettel-Chunghwa, and Mobifone-France Telecom. SingTel Optus, SK Telecom, and others also looking to invest. •Orange Business Services in 2Q08 renewed a partnership with VDC, this time aimed at deploying MPLS-based IP VPN services in Vietnam. •Mobifone aiming for IPO in 2008. Plan is to sell 15% of stock too the public and 15% to a strategic investor(s), likely foreign, with another 19% for sale to most likely outside investors.
3G	Applications for 4 available 3G concession applications were due 30 September. All 7 2G licensees are likely to bid: Viettel, VinaPhone, MobiFone, S-Fone, EVN Telecom, HT Mobile and GTel. Process is standards neutral, but bidders must pass HR/training, business process, technology/skills, and financial hurdles: regarding the latter, minimum is ability to invest US$1B over 15 years.

Spending drivers: Vietnam

Driver	Remarks
Broadband	No loop unbundling so broadband competition is facilities based and limited. Low PC penetration and ability to pay results in slow take-off. Fixed WiMax being explored as a way around loop bottleneck by SPT and others. FPT and EVN chipping away at VNPT's enterprise market slowly. FTTx deployment envisioned in regulator's "2020 plan": ▪2009-10: Deploy FTTB and FTTC (not FTTH) to residential and commercial areas w/ high bandwidth demand ▪Test and likely deploy optical wireless local loop technology ▪2011-2020: deploy FTTH to support triple play service
Emerging fixed line competition	FPT most significant to date ▪Offers Metro Ethernet, Internet/ADSL, web services, IPTV ▪ADSL main platform but introduced FTTH in 12-06. iTV had roughly 50K subs in 1H08. Offers FTTH at rates of 4, 8, 16, and 20Mbps in limited service area. Viettel ▪Largest mobile carrier, offers broadband in Hanoi & HCMC. Built a national DWDM backbone in 2007. Military origins, politically powerful as rival to VNPT SPT & Hanoi Telecom: offer ADSL in HCMC & Hanoi respectively EVN Telecom ▪Affiliate of power utility, has several million mobile subscribers on CDMA 450MHz platform ▪Better positioned for wireline expansion than others without networks/rights-of-way in place

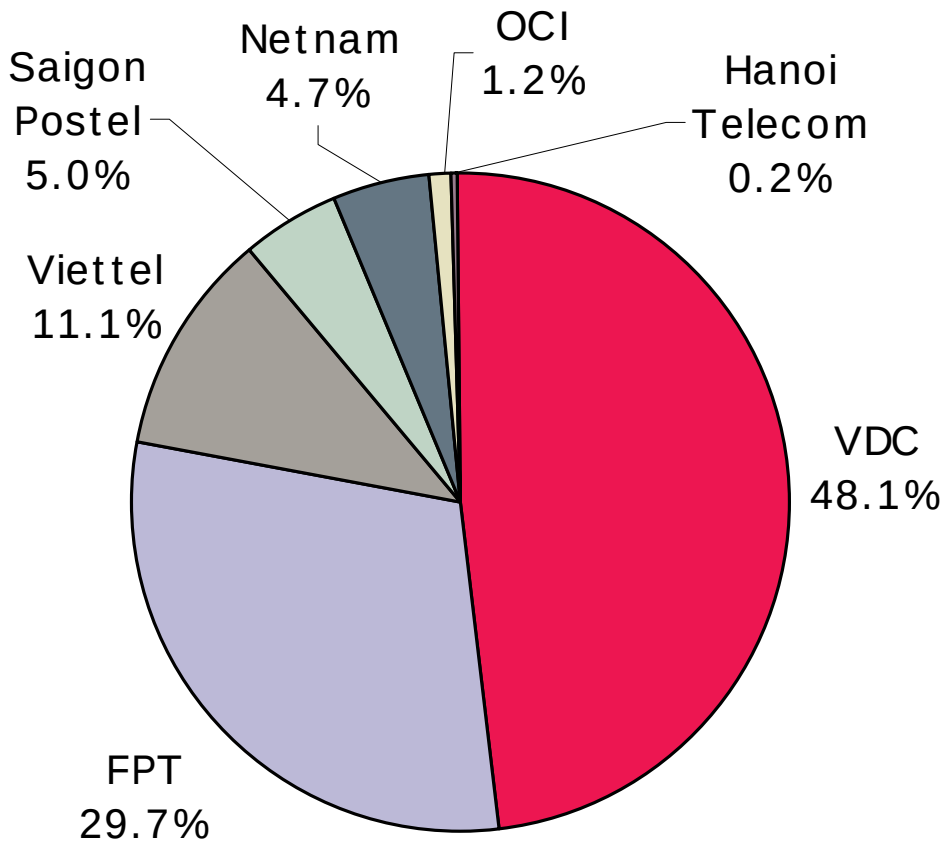
Internet/broadband market growth

- From 1% of Internet users 4 years ago, broadband accounted for 28% of Vietnam's 5.8M Internet subscribers in 2Q08, or 1.6M



Source: VNNIC

Internet user market share (2Q08)



Source: VNNIC

VNPT Profile
Operational

- Footprint:
  - Nationwide, though parts of rural Vietnam not yet covered
  - Directly or through JVs/partnerships, controls >70% of market but this is slipping: share of mobile and Internet/BB subscribers is roughly 50% each (2Q08)
- Operational information:
  - Total households: about half of Vietnam's HHs in coverage area
  - Operates over 90% of Vietnam's fixed lines. Competitors are mainly local, but FPT's nationwide license gives it credibility and EVN is a factor.
  - Had roughly 27M subs by year-end 2007, ~75% mobile
  - 48% of Vietnam's 5.8M Internet subs (2Q08) served by its VDC affiliate
  - VDC/VNPT subs with broadband (ADSL): 7-800K. Aiming for 1.5M total by 2010.
  - Increased north-south backbone capacity from 80 to 120Gbps in 2007, building undersea N-S link in 2008. VN landing party for Transpacific Express cable.
  - CY07 revenues of roughly $2.5B, around double the CY06 result.

Vietnam – WiMAX status

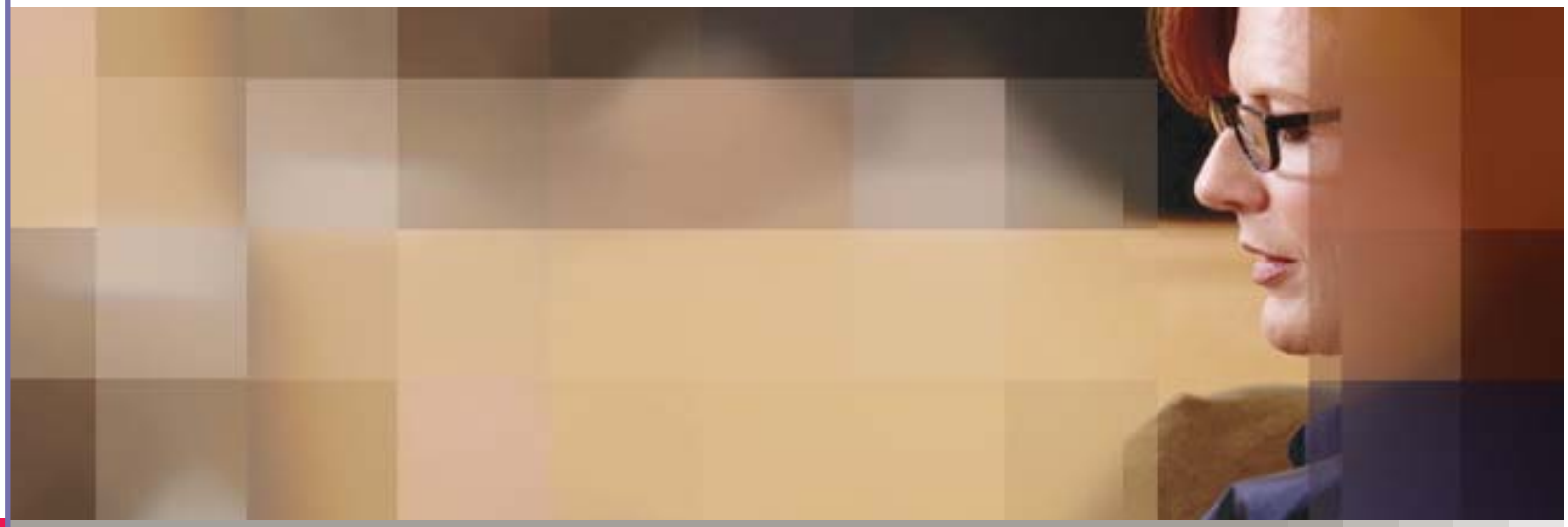
- In Vietnam, the 3.4-3.6GHz is reserved to Vinasat satellite service. So the bands identified for WiMAX services in Vietnam include the 2.3GHz, 2.5GHz and 3.3GHz bands. In 2007, four WiMAX trials were conducted in the 3.3GHz band. In March 2006, the Ministry of Post and Telematics (MPT) allocated a year-long trial WiMAX license to Viettel, VNPT, VTC, and FPT Telecom in 3.3GHz bands. Since than SPT and EVN Telecom were also allowed to conduct WiMAX tests.

- WiMAX rollouts / plans in Vietnam

  - Vietnam Data Communications (VDC), the wholly owned subsidiary of VNPT, has signed an agreement with Intel to begin a WiMAX trial , called Vietnam Bridge, in the mountainous province of Lao Cai. The trial was expected to begin in early July 2006 and finish in December 2006. In September 2007, the project to test WiMAX communications in the remote and mountainous Lao Cai region of Vietnam, carried out by incumbent Vietnam Post and Telecommunications Group (VNPT) in partnership with Intel and the US Agency for International Development (USAID), has reached the end of its first phase to evaluate the wireless technology and the demand for it. The program started on 27 October 2006 in 19 sites; six schools, three public sites, two health stations, five administrative agencies, two small enterprises and one farming family. All were provided with computers and VoIP telephones. Internet access at these points was free of charge for all. The project will enter a second phase, with WiMAX technology installed in the remote Ta Van valley, home to around 700 people. Due to the topography of the valley, there are currently only two fixed phone lines installed there. Ten sites in the valley, including a school, a health station, a guest house and some family homes will be connected to the internet via WiMAX. If phase two is successful, WiMAX technology will be deemed suitable for future rural telecoms rollouts.

Vietnam – WiMAX status – cont.

- WiMAX rollouts / plans in Vietnam
  - Using 3.3GHz band, Viettel announced in December 2006 that it launched a trial offer of WiMAX mobile broadband service in the city of Hanoi. The pilot network of ten BTS will have a capacity of around 3,000 subscribers and will offer speeds of up to 10Mbps within a 32km range of a BTS.
  - In March 2008, Vietnam's Ministry of Information and Communication (MIC) has allowed Saigon Postel Corporation (SPT) to pilot a WiMAX project. SPT, which runs the S-Fone mobile network, will test WiMAX in the 2.3GHz to 2.4GHz band, in Ho Chi Minh City (formerly Saigon) and one of the neighboring provinces of Tay Ninh, Binh Duong, Dong Nai, Ba Ria-Vung Tau or Long An.



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