ITU Regional Workshop on IMT

Da Nang, VietNam; 7-8 June 2010

Thailand's Experience and Development of IMT

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Chairman

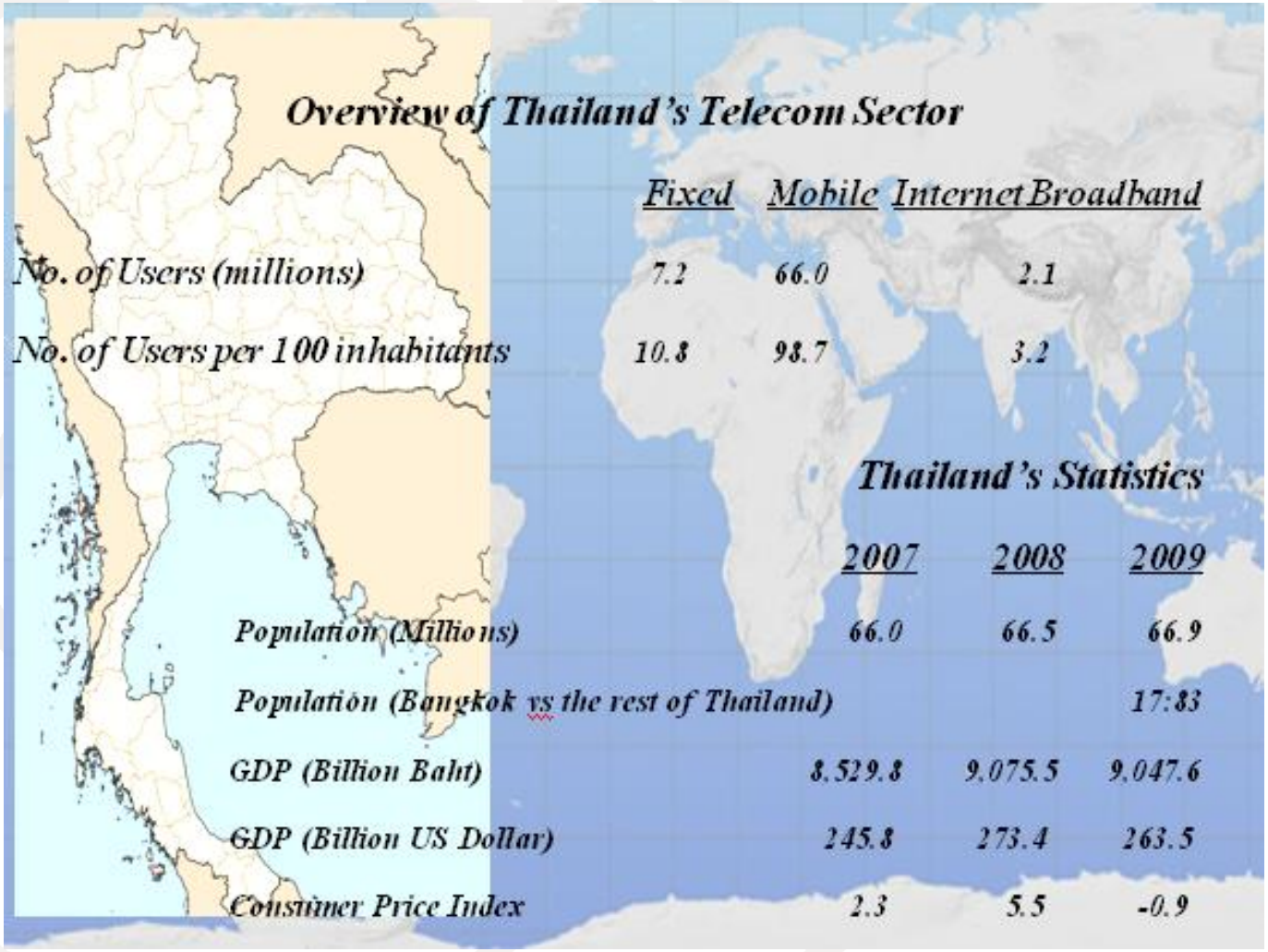
The National Telecommunications Commission

Thailand

Contents:

i. Overview of Thailand's Telecom Sector and ICT Competitiveness
ii. RF Spectrum Allocation for IMT
iii. 3G/WiMAX: Past, Present and Future
iv. Status of 3G Licensing in Thailand
v. 3G Deployment in Thailand
vi. WiMAX Testing
vii. Experience in Deployment of 3G/WiMAX in Tele-Education, Telehealth etc.
viii. Conclusion

I. Overview of Thailand's Telecom Sector and ICT Competitiveness

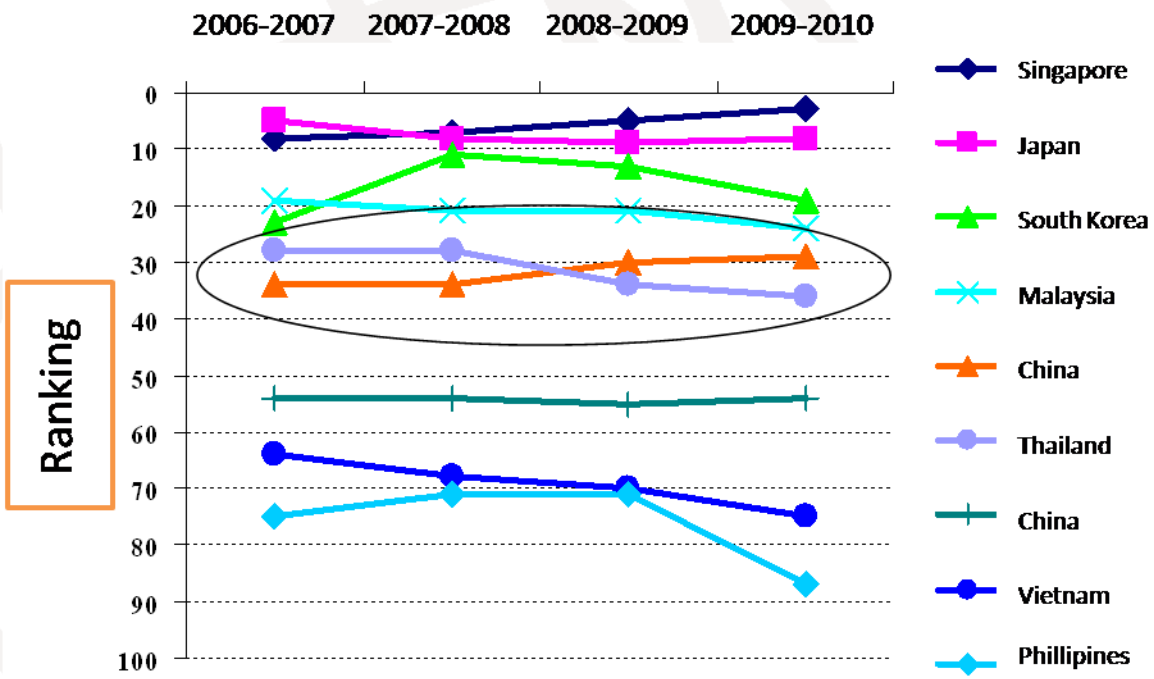


Competitive Index Comparison

Stage of Development	Country	Global Competitiveness Index			
		2006-2007	2007-2008	2008-2009	2009-2010
No. of Countries Evaluated		*122*	*131*	*134*	*133*
Group3: Innovation-Driven	Singapore	8	7	5	3
	Japan	5	8	9	8
	South Korea	23	11	13	19
Group2: Efficiency-Driven	Malaysia	19	21	21	24
	China	34	34	30	29
	Thailand	28	28	34	36
Group1: Factor-Driven	Indonesia	54	54	55	54
	Vietnam	64	68	70	75
	Phillipines	75	71	71	87

Source: The Global Competitiveness Report

Global Competitiveness Index Ranking



Source: The Global Competitiveness Report

Infrastucture & Technological Readiness

	Singapore	Japan	South Korea	Malaysia	Thailand	Vietnam
Global Competitiveness Index	**3**	**8**	**19**	**24**	**36**	**75**
1. Infrastucture	**4**	**13**	**17**	**26**	**40**	**94**
- Telephone lines	27	30	23	72	84	36
2. Technological Readiness	**6**	**25**	**15**	**37**	**63**	**73**
- Mobile telephone subscriptions	10	72	61	51	21	79
- Internet users	15	16	9	22	75	76
- Personal computers	8	18	17	41	78	62
- Broadband Internet subscribers	22	20	7	55	78	77

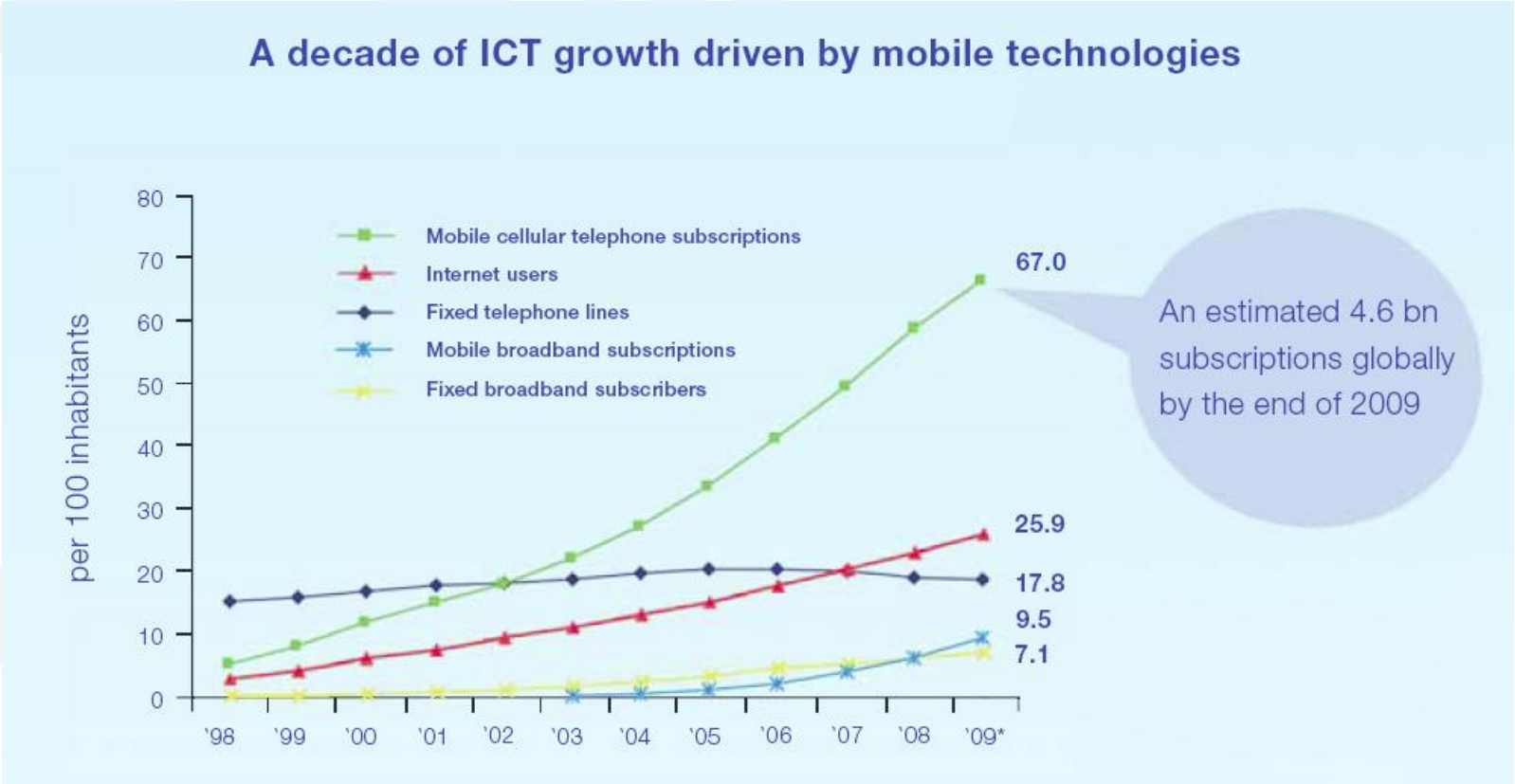
Source: The Global Competitiveness Report

Network Readiness Index

Network Readiness Index	2006-2007	2007-2008	2008-2009
Singapore	3	5	4
Japan	14	19	17
South Korea	19	9	11
Malaysia	26	26	28
Thailand	37	40	47
China	59	57	46
Indonesia	62	76	83
Vietnam	82	73	70
Phillipines	69	81	85

Source: The Global Competitiveness Report

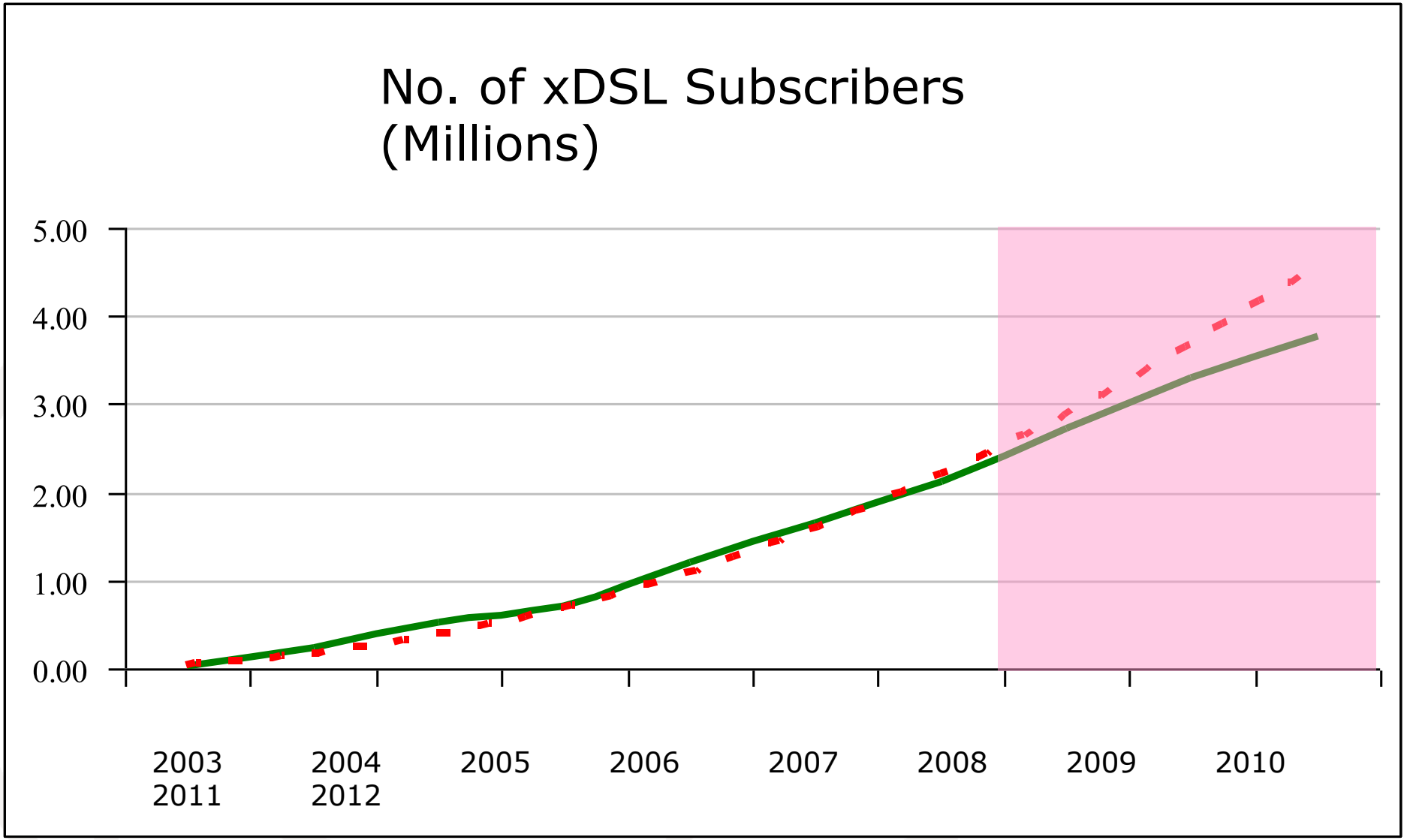
World's ICT Growth



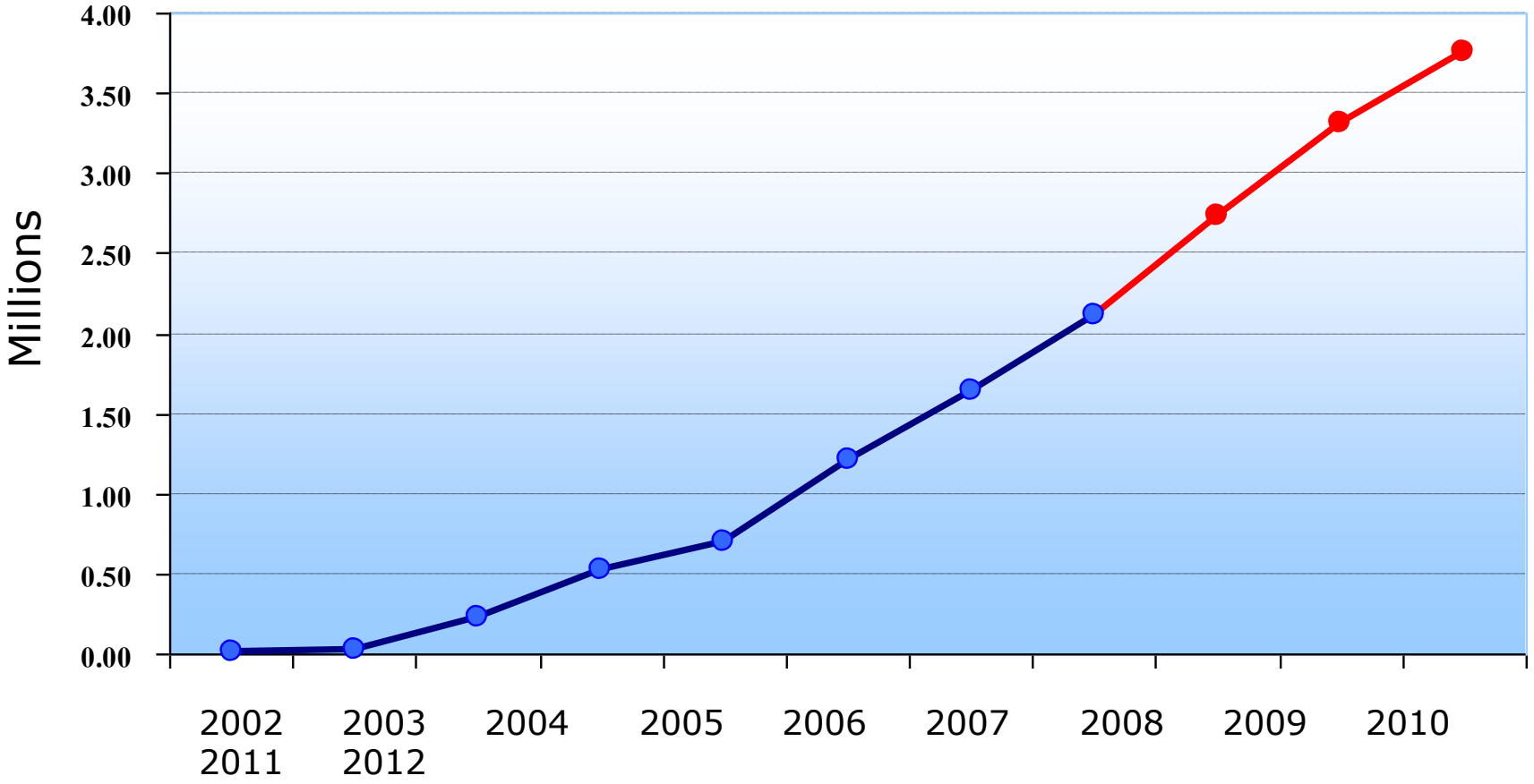
Source: ITU. The World in 2009 – ICT Facts and Figures

Forecast of Broadband Internet Subscribers

Year	Ratio between Broadband Subscribers/ Fixed line Subscribers	No. of Fixed line (Millions)	No. Broadband Subscribers (Millions)	No. of Broadband Subscribers per 100 inhabitants
2005	0.07	7.293	0.524	0.81
2006	0.1	7.22	0.705	1.08
2007	0.16	7.563	1.212	1.83
2008	0.22	7.394	1.647	2.48
2009	0.29	7.213	2.114	3.16
Forecasting				
2010	0.38	7.175	2.727	4.05
2011	0.466	7.096	3.307	4.89
2012	0.538	6.993	3.762	5.54


No. of xDSL Subscribers
(Millions)
5.00
4.00
3.00
2.00
1.00
0.00
2003
2011
2004
2012
2005
2006
2007
2008
2009
2010

No. of Broadband Subscribers



II. RF Spectrum Allocation for IMT

Spectrum Allocation for IMT

Frequency Band	Specific Band Pairing (MHz)	Common Names	IMT Spectrum In Thailand
450 MHz	450 - 470	450 MHz	WRC-07
700 MHz	698 – 960 (varies)	Varies	Digital Dividend Not defined yet
800 MHz	824 - 849 / 869 - 894	800 MHz or cellular band	✓
900 MHz	890 - 915 / 935 - 960	900 MHz or GSM 900	✓
1700 MHz	1750 - 1780 / 1840 - 1870	Korean PCS band	No in Thailand
1800 MHz or 1.8 GHz	1710 - 1785 / 1805 - 1880	DCS 1800 band	✓
1900 MHz or 1.9 GHz	1850 - 1910 / 1930 - 1990	PCS band or PCS 1900	✓
2.1 GHz	1920 - 1980 / 2110 - 2170	UMTS band	✓
1.7 GHz / 2.1 GHz	1710 - 1770 / 2110 - 2170	AWS Band	No in Thailand
2.5 GHz	2500 - 2 570 / 2620 - 2690	MMDS band, IMT band	Wimax
3.4 GHz	3400 – 3600 (vary)	WiMAX band	Reserved for C Band Satellite

III. 3G/WiMAX: Past, Present and Future

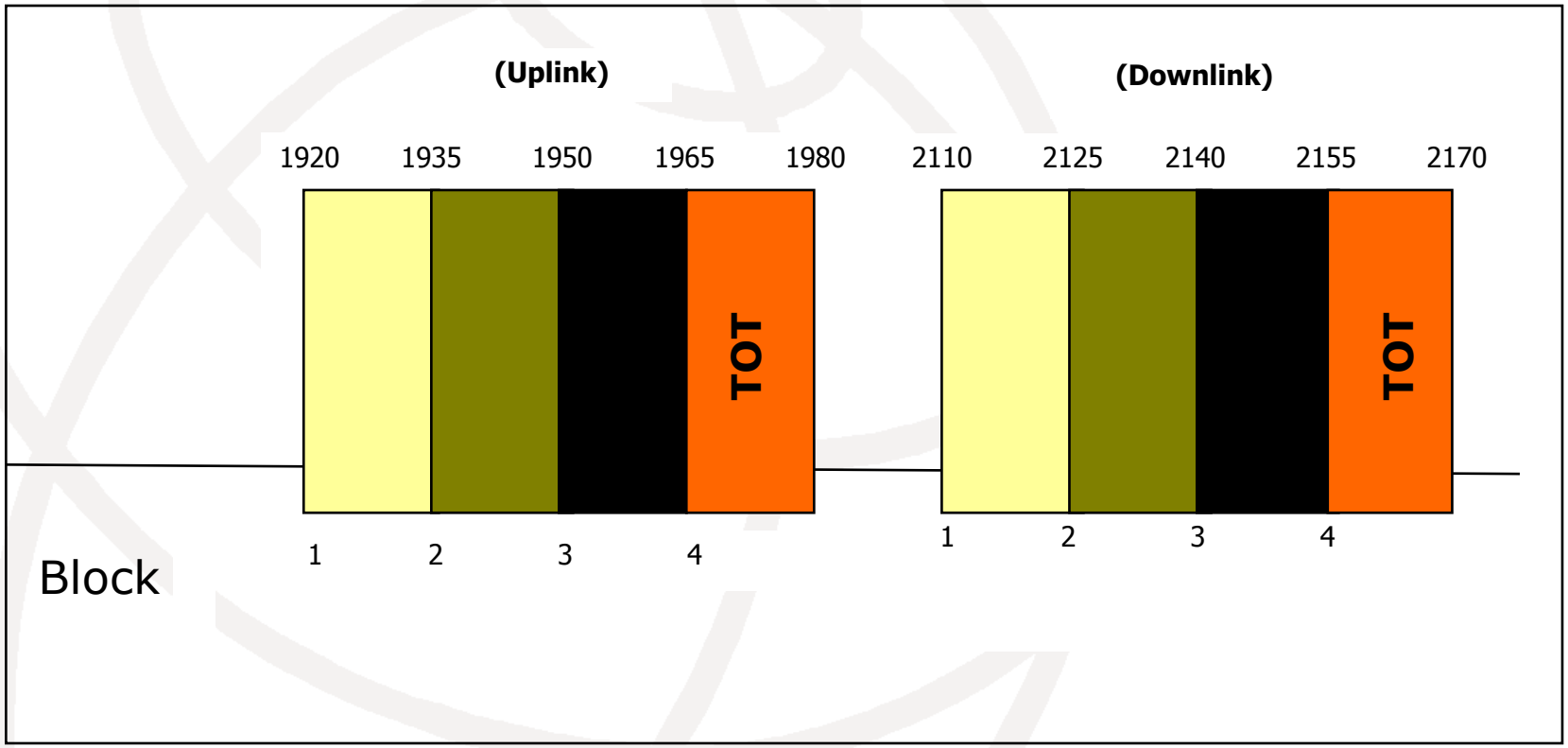
- Assignment for Mobile Phone for mobile phone service provider

	Assignment Frequency		System / Standard	Frequency License	Service Provider
	Transmitted Frequency (MHz)	Received Frequency (MHz)			
1	479.0-483.5	489.0-493.5	NMT	TOT	TOT
2	824.0-835.0	869.0-880.0	AMPS - 800 (BAND A) / CDMA	CAT Telecom	CAT Telecom
3	845.0-846.5	890.0-891.5			
4	835.0-845.0	880.0-890.0	AMPS - 800 BAND B	CAT Telecom	Dtac
5	846.5-849.0	891.5-894.0			
6	897.5-905.0	942.5-950.0	GSM 900	CAT Telecom	AIS
7	905.0-915.0	950.0-960.0			
8	1710.0-1722.6	1805.0-1817.6	PCN 1800	CAT Telecom	True Move
9	1722.6-1747.9	1817.6-1842.9	PCN 1800	CAT Telecom	Dtac
10	1760.5-1785.0	1855.5-1880.0			
11	1747.9-1760.5	1842.9-1855.5	PCN 1800	CAT Telecom	DPC
12	1885.0-1900.00	1965.0-1980.0	GSM 1900	TOT and CAT Telecom	Thai Mobile
13	1965.0-1980.0	2155.0-2170.0	IMT - 2000	TOT and CAT Telecom	Thai Mobile

- Frequency Allocation for IMT-2000

	Frequency		System	Frequency License	Service Provider
	Transmitted Frequency (MHz)	Received Frequency (MHz)			
1	1920.0-1965.0	2110.0-2155.0.	IMT - 2000	Not allocated yet	-
2	2010.0-2025.0				

- Current Spectrum



There are three spectral bands to be allocated:

1) 2.3, 2.4, 2.5, 2.6 GHz for WiMAX
2) 3.5 GHz reserved for C Band satellite at WRC 2007 by Thailand
3) 5.7, 5.8 GHz

- Possible allocation of NTC is 2500-2520 and 2670-2690 MHz = 40MHz

- Spectrum Allocated of 2500-2690 MHz

<table>
<tr><th colspan="2">2500-2520
(20 MHz)</th><th colspan="2">2520-2670
(150 MHz)</th><th>2670-2690
(20 MHz)</th></tr>
<tr><td colspan="2" rowspan="2">Telecommunication</td><td colspan="2">Telecommunication</td><td rowspan="2">Telecommunication</td></tr>
<tr><td colspan="2">Broadcasting</td></tr>
<tr><td>empty</td><td>The Government Public Relations Department MMDS</td><td>Guard</td><td>1. MCOT = MMDS (Bangkok and Surrounding Area) 2593.25/2598.75 MHz (video/audio)
2. Fixed link (Other Provinces)</td><td>empty</td></tr>
</table>

IV. Status of 3G Licensing in Thailand

1) 3G in band migration

Principles
- Technology neutral and service neutral

Spectrum Use
- Efficient Use
- Co-use or Shared use

Recent Status

AIS	900 MHz	Obtained approval from NTC to have 3G / HSPA In-Band Migration on 6 May 2008 and 13-14 August 2008 respectively.
dtac	850 MHz	
true move	1800 MHz	Is expected to deploy 3G/HSPA as a marketing and investment partner on co-branding with CAT Telecom

2) CDMA 1xEv-DO

CAT Telecom has acquired Hutch network in 25 provinces, making it an integrated 3G network nationwide. There are about 5,000 base stations in service to date.

3. TOT

NTC has granted a 3G licence which enables the transfer of right from CAT Telecom (one of the two partners) over 3G already allocated spectrum to ACT mobile

4. 3G Licensing in the Core Band (1.9 -2.1 GHz)

NTC has decided to select Auction for 3G spectrum allocation.

Possible number of licences

- 3 licences for paired band (FDD), 15 MHz each

For the time being, no licences will be granted for unpaired spectrum (TDD) for 3G

Auction will be most likely Simultaneous-Multi-Round-Ascending Auction (SMRA)

Area Coverage – national licence

Roll out condition and Universal Service Obligation included.

Preparation for auction

NTC has employed Nera for making a preparation and auction design of 3G. Auction Mastering will be most likely the staff of NTC under the supervision of outside dignitaries to witness the smooth and fair auction of 3G.

V 3G Deployment in Thailand

Spectrum Holder	Assigned Frequency Uplink (MHz)	Assigned Frequency Downlink (MHz)	Technology/ Speed	Service Provider
TOT	479-483.5	489-493.5	CDMA 2000-1x (153.6 kbps)	TOT
CAT	824-834.2	869-879.2	CDMA 2000-1x CDMA 20001x-EVDO (in 25 provinces and 51	CAT
CAT	834.2-839	879.2-884	HSPA 800 (UL: 3.6 Mbps DL: 14.4 Mbps)	CAT (True Move)
CAT	839-849	884-894	HSPA 800 (UL: 3.6 Mbps DL: 14.4 Mbps)	CAT (DTAC)
TOT	897.5-905 905-915	942.5-950 950-960	GSM 900 และ HSPA 900 (UL: 5.76 Mbps DL: 14.0 Mbps)	AIS
CAT	1710-1722.6	1805-1817.6	GSM 1800	True Move
CAT	1722.6-1747.9 1760.5-1785	1817.6-1842.9 1855.5-1880	GSM 1800	DTAC
CAT	1747.9-1760.5	1842.9-1855.5	GSM 1800	DPC
TOT	1885-1900	1965-1980	GSM 1900	THAI MOBILE
TOT	1965-1980	2155-2170	HSPA 2100	TOT

Service Provider	Technology	Base Station	NO. of Base Stations Installed	NO. of Base Stations In-Service
TOT	CDMA 470	565	128	5
DTAC	HSPA 800	1220	54	54
TRUE	HSPA 800	656	193	193
AIS	HSPA 900	1884	184	107
TOT	HSPA 2100	533	533	533

VI. WiMAX Testing

Trial Use Testing

- AIS
- UIH
- Loxley
- TT&T
- CAT Telecom
- TOT and OEA
- True Move
- PEA and Samart Telecom
- Trans Pacific Telecom
- Triple T Broadband
- CS Loxinfo
- True Universal

	Frequency			Equipment							
	granted for trial	used for trial	Bandwidth	Base Station			CPF			Technology used	
				Brand/ Model	Tx Power	Antenna height	Brand/ Model	Tx Power	CPE Type		
True Universal Convergence Co., Ltd. (Huawai, China)	2.5 GHz	2.505 GHz, 2.515 GHz	10 MHz/ sector	Huawei BTS3707	40 dBm	35 m	SEOWON SWU-1100	23dBm	USB Dongle	801.16e	TDD
True Universal Convergence Co., Ltd . (Motorola, USA)	2.5 GHz	2.675 GHz, 2.685 GHz	10 MHz/ sector	Motorola WAP400	30 dBm	35 m	Motorola CPEi300, Winema	27 dBm, 23dBm	Router Type, PCMCIA	801.16e	TDD
United Information Highway Co., Ltd.	2.3 GHz, 2.5 GHz	2.675 GHz, 2.685 GHz	10 MHz /sector	Motorola SG1702	44.6 dBm	30 m	Motorola PCCW, CPEi25600, CPEi25300	-	Router type, PCMCIA	801.16e	TDD
CS LoxInfo Public Co.,Ltd	2.3 GHz, 2.5 GHz	2.500 MHz, 2.600 MHz	5 MHz/ sector	SOMA รุ่น NPM 2500	57 dBm	30 m	SOMA รุ่น SOMA port 300	30 dBm	Router type, PCMCIA	801.16e	FDD
True Move Co.,Ltd (from Alcatel Lucent, France)	2.3 GHz, 2.5 GHz	2.515 GHz, 2.685 GHz	10 MHz/ sector	Alcatel Lucent C-WBS9710	35 dBm	35 m	Zyxel Max 100, Max 200	23 dBm, 27 dBm	PCMCIA card, Router type	801.16e	TDD
True Move Co.,Ltd (from PSADATA, Korea)	2.3 GHz, 2.5 GHz	2.3135 GHz	8.75 MHz/ sector	POSDATA RAS3000	47 dBm	45 m	POSDATA FLYVO U100	-	USB Dongle	801.16e	TDD
Samart Telcoms Public Co.,Ltd.	2.5 GHz	2.5175 GHz	5 MHz/ sector	Alvarion Breeze MAX 2500	-	20 m	Alvarion Pro Outdoor	Fixed Outdoor type	-	801.16e	TDD
Loxley Public Company Limited	2.3 GHz 2.5 GHz	2.325 GHz, 2.335 GHz	10 MHz/ sector	Nortel BTS 5000 series	40 dBm	-	Zyxel PCMCIA Indoor type	23 dBm	PCMCIA Indoor Type	801.16e	TDD
CAT TELECOM PUBLIC COMPANY LIMITED	2.5 GHz	2.515 GHz	3.33 MHz/ sector	ZTE WiMAX	-	24m (Chiangmai U) and 33m (Khuangsingha , Chiang Mai)	GCT	-	USB Dongle	802.16e with Wave I	TDD
TT&T Public Co.,Ltd (from POSDATA, Korea)	2.3 GHz 2.5 GHz	2.3045 GHz, 2.3135 GHz	8.75 MHz/ sector	POSDATA RAS3000	43 dBm	~35m	POSDATA R100, U100	23dBm	Router type, USB Dongle	801.16e	TDD
TT&T Public Co.,Ltd (from CISCO NAVINI, USA)	2.3 GHz 2.5 GHz	2.516 GHz	5 MHz/ sector	CISCO Navini BTS-MX8	46 dBm	~35m	CISCO Navini Surfer 1252	31 dBm	Router type	802.16e with Wave II	TDD
Triple T Broadband Public Company Limited	2.3 GHz 2.5 GHz	2.5 GHz	10 MHz/ sector	Alcatel Lucent 9710 C-WBS	35 dBm	20m	Zyxel Max200, Zyxel Max100	-	Router type, PCMCIA	801.16e	TDD
Advanced Info Service, PLC. (from Motorola, USA)	2.3 GHz, 2.5 GHz	2.675, 2.685 GHz	10 MHz/ sector	Motorola	30 dBm	40m	Motorola/ CPEi 300, Winema	-	Router type, PCMCIA	801.16e	TDD
Advanced Info Service, PLC. (from Huawei, China)	2.3 GHz, 2.5 GHz	2.505 GHz, 2.515 GHz	10 MHz/ sector	Huawei	40 dBm	34m (Chonburi) 42m (Chiang Rai)	SEOWON /SWU-1100	23 dBm (1.75W)	USB Dongle	801.16e	TDD
Super Broadband Network Co.,Ltd	2.3 GHz, 2.5 GHz	2.384 GHz	10 MHz/ sector	POSDATA / Flyvo RAS 6000	40 dBm	50 m (Phayatai, BKK) 35 m (Chonburi)	POSDATA / Flyvo U100	200 mW	USB Dongle	801.16e	TDD
TOT Public Company Limited / **Planet Communication Asia Co.,Ltd**	2.3 GHz, 2.5 GHz	2.496 – 2.690 GHz	6 MHz /sector	Motorola / Expedience	49 dBm	18-40m	Motorola / Expedience	< 3 W (PC Card) 10 W (RSU) 15 W (OSU) 10 W (MSU)	PCMCIA, Router Type, Outdoor Unit and Mobile Unit	Pre-WiMAX	TDD
Total Access Communication Public Company Limited	2.3 GHz, 2.5 GHz	2.505 GHz, 2.515 GHz	10 MHz/ sector	Huawei BTS3703	40 dBm	30 m	SEOWON SWU-1100	23dBm	USB Dongle	801.16e	TDD
CAT Telecom Public Co.,Ltd. for support CCTV System	2.3 GHz, 2.5 GHz	2.503 GHz	6 MHz/ sector	Motorola / Expedience	33 dBm	18-35m	Motorola / Expedience	< 3 W (PC Card) 10 W (RSU) 15 W (OSU) 10 W (MSU)	PCMCIA, Router Type, Outdoor Unit and Mobile Unit	Pre-WiMAX	TDD

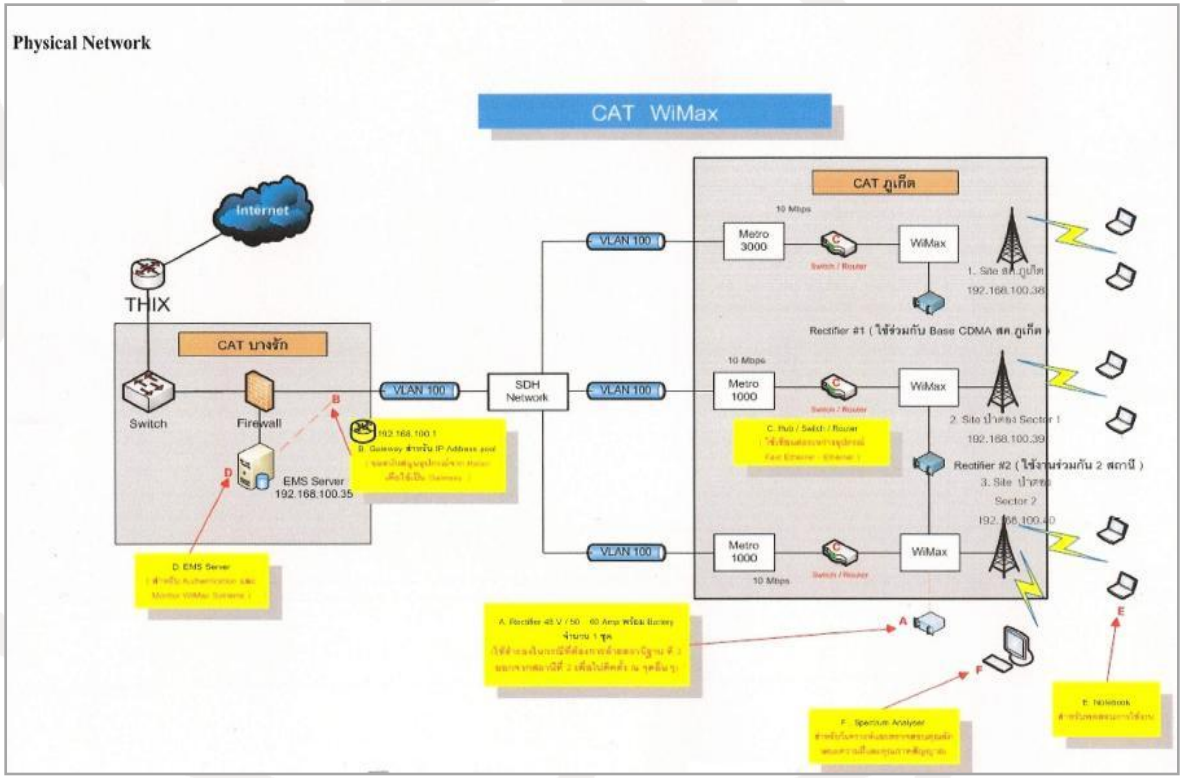
	Summarized test result												
	Coverage Area (distance)	Max. Download Thoughput	Max. Upload Thoughput	Delay	Max. Spectrum Efficiency	LOS/NLOS capability		Mobility	Application test				
						LOS	NLOS		Video streaming	VoIP	FTP	Vedio Conference	Web Browsing
True Universal Convergence Co., Ltd. (Huawai, China)	-	10.04 Mbps	4.11 Mbps	-	2.157 bps/Hz	Good	Poor	Simple Mobility, Inter-sector handoff capable	Good	Good	-	-	Good
True Universal Convergence Co., Ltd . (Motorola, USA)	2 km	12.76 Mbps	4.48 Mbps	-	1.8275 bps/Hz	Good	Poor	Simple Mobility, Inter-sector handoff capable	Good	Good	-	-	Good
United Information Highway Co., Ltd.	7 km (Outdoor LOS) 3 km (Outdoor NLOS) 500 m (Indoor)	14.98 Mbps	4.59 Mbps	1.957 bps/Hz	-	Good	Poor	Simple Mobility, inter-sector handoff capable	Good	Good	-	Good	Good
CS LoxInfo Public Co.,Ltd	4.6 km	7.6 Mbps	300 kbps	150 msec	1.58 bps/Hz	Good	Poor	Nomadic	Good	Good	-	Good	Good
True Move Co.,Ltd (from Alcatel Lucent, France)	1.4 km	6.84 Mbps	3.02 Mbps	-	0.986 bps/Hz	Good	Poor	Simple Mobility	Good	Good	-	Good	Good
True Move Co.,Ltd (from PSADATA, Korea)	1.5 km	11.5 Mbps	2.756 Mbps	-	1.629 bps/Hz	Good	Poor	Simple Mobility	Good	Good	-	-	Good
Samart Telcoms Public Co.,Ltd.	19 km with LOS	6.3 Mbps	5.2 Mbps		2.3 bps/Hz	Good	Poor	Nomadic	Good	Good	-	Good	Good
Loxley Public Company Limited	-	7.27 Mbps	3.1 Mbps	126 msec roundtrip	1.037 bps/Hz	Good	Poor	Portable 30-60 km/h, no handoff	Good	Good	-	-	Good
CAT TELECOM PUBLIC COMPANY LIMITED	2 km with LOS	5.63 Mbps	1.37 Mbps	23 msec roundtrip	2.1 bps/Hz	Good	Poor	Portable 30 km/h, inter-sector handoff capable	Good	Good	-	-	Good
TT&T Public Co.,Ltd (from POSDATA, Korea)	5 km with LOS	12.3 Mbps	3.9 Mbps	65 msec roundtrip	1.85 bps/Hz	Good	Poor	Full mobility ~60 km/h, inter-sector handoff capable	Good	Good	-	-	Good
TT&T Public Co.,Ltd (from CISCO NAVINI, USA)	7.3 km with LOS	4.3 Mbps	89 kbps	103 msec roundtrip	0.8778 bps/Hz	Good	Good	Portable	Good	Good	-	-	Good
Triple T Broadband Public Company Limited	Coverage area (distance) 2 km with LOS	11 Mbps	4.3 Mbps	Delay 90 msec roundtrip	1.53 bps/Hz	Good	Poor	Simple mobility ~30km/h, inter-sector handoff capable	Good	Good	-	Good	Good
Advanced Info Service, PLC. (from Motorola, USA)	1.2 km (Silom, BKK) 1.5 km (Lam LUK Ka, Patumthani)	9.73 Mbps	3.57 Mbps	-	1.33 bps/Hz	Good	Poor	Simple mobility, inter-sector handoff capable	Good	Good	-	Good	Good
Advanced Info Service, PLC. (from Huawei, China)	2.4 km (Chonburi) 3.1 km (Chiang Rai)	9.3 Mbps	4.1 Mbps	-	1.34 bps/Hz	Good	Bad	Simple mobility, inter-sector handoff capable	Good	-	Good	-	Good
Super Broadband Network Co.,Ltd	6 km (ชลบุรี)	10.40 Mbps	5.00 Mbps	-	1.54 bps/Hz	Good	N/A	Spot test	Good	-	Good	Good	Good
TOT Public Company Limited **Planet Communication Asia Co.,Ltd**	9.11 km	5.33 Mbps	1.22 Mbps	18 – 60 ms	1.092 bps/Hz	Good	Good	Simple Mobility, Spot test	Good	Good (VOIP with SIP Protocal)	-	Good	Good
Total Access Communication Public Company Limited	4.1 Km	10 Mbps	4 Mbps	63 ms (Handoff) 28 ms (E2E latency)	1.4 bps/Hz	Good	Poor	High speed Mobility (more than 60 Km/h), Intra-BTS	Good	Good	-	-	Good
CAT Telecom Public Co.,Ltd. for support CCTV System	5.5 km	3.4 Mbps	0.480 Mbps	-	0.647 bps/Hz	Good	Poor	Simple Mobility	Good	-	-	-	-

VII. Experience in Deployment of 3G/WiMAX in Tele-Education, Telehealth etc.

Telehealth check-up in Phang Nga, Southern Thailand Telecommunication Applications using CDMA 1xEVDO

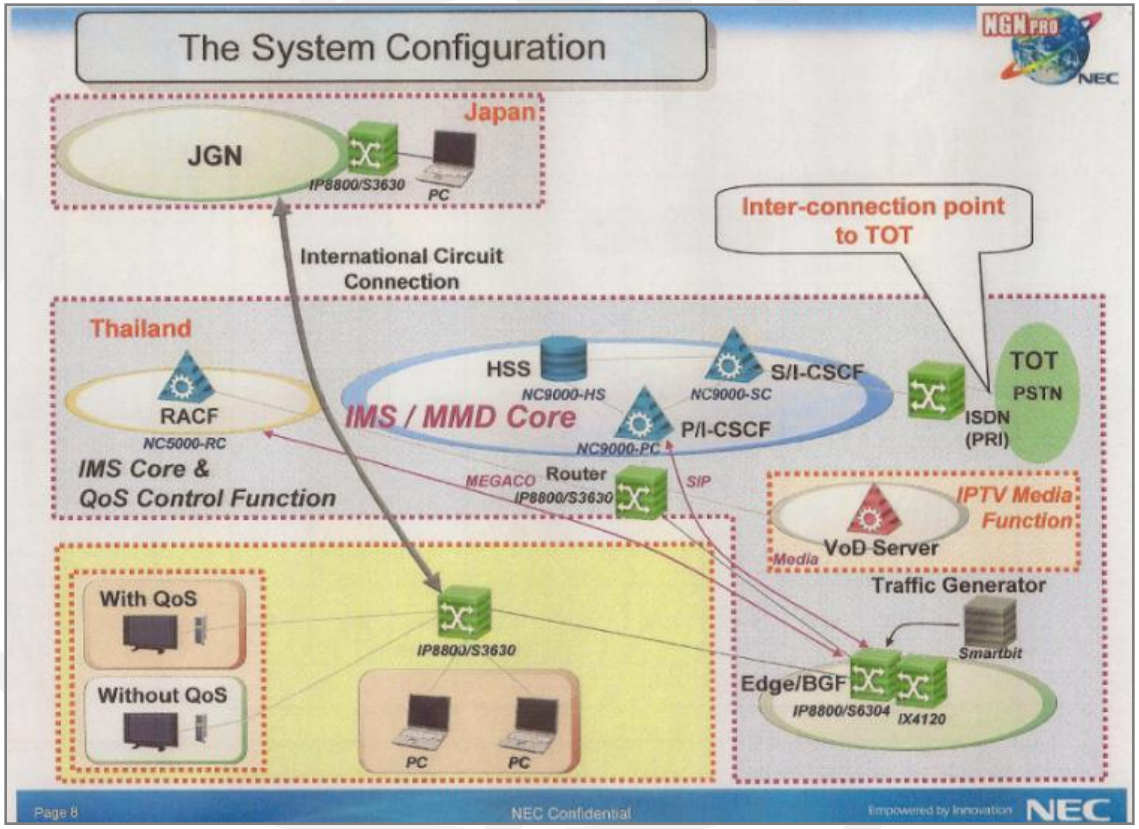
Teleeducation and E-Learning Application using WiMAX at Mae Fah Luang University

NGN Test Site and Network Configuration in Phuket



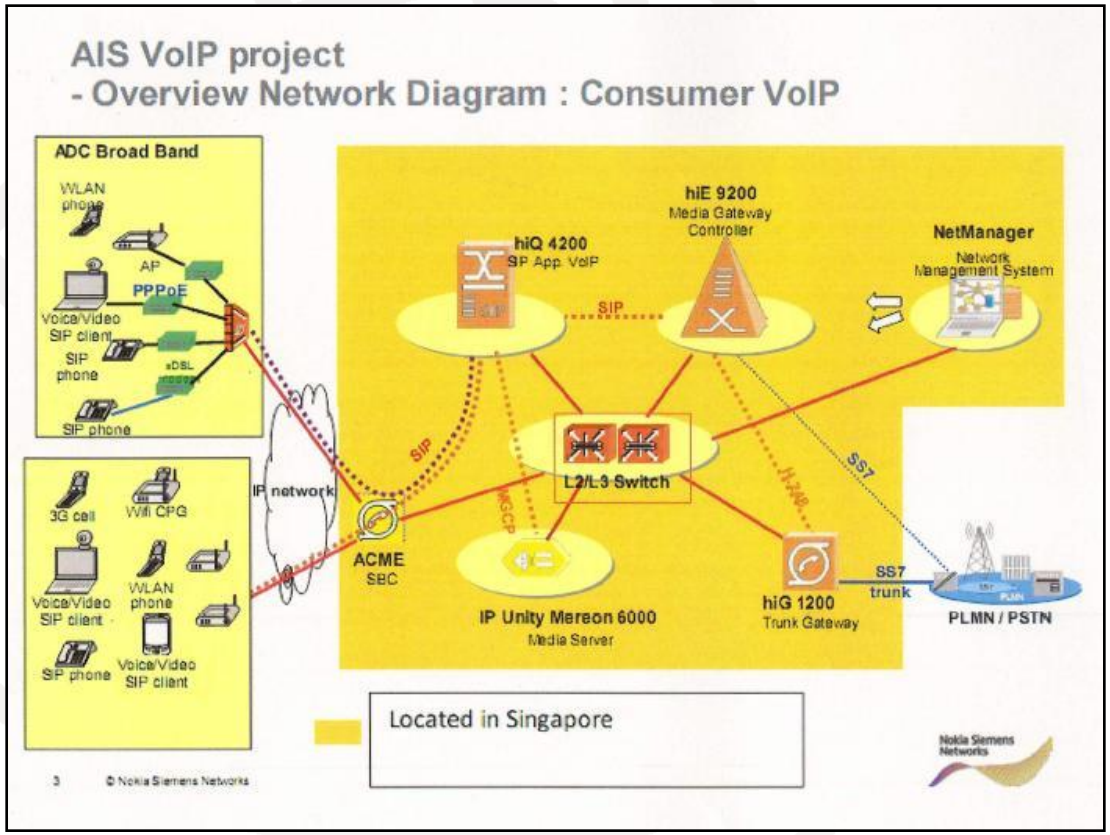
WiMAX Interoperability and Mobility Testing by CAT Telecom at NTC NGN Test Site in Phuket

NGN Test Site and Network Configuration in Phuket



NEC VoIP Testing Configuration

NGN Test Site and Network Configuration in Phuket



AIS VoIP Testing Configuration

VIII. Conclusions

- 3G Licensing, its regulations and auction method is:
  - Expected to be announced in the third quarter of 2010
  - WiMAX tender will be announced in the fourth quarter of 2010
  - NTC needs to conduct intensive study of future telecommunications trend, for example, cognitive radio/dynamic spectrum allocation etc.
  - NTC is now expediting the drafting of regulations on 3G, WiMAX, NGN and future telecommunications system.

Thank You
for Your Kind Attention