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Innovations for Digital Inclusion

Innovative Broadband Models for Digital Inclusion

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Agenda

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- -WiMAX
- -CDMA 2000 1x at 470 MHz

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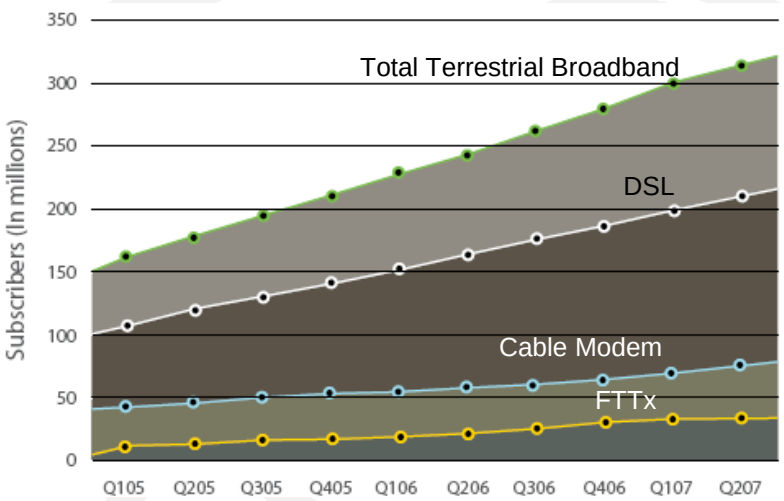
I. Introduction



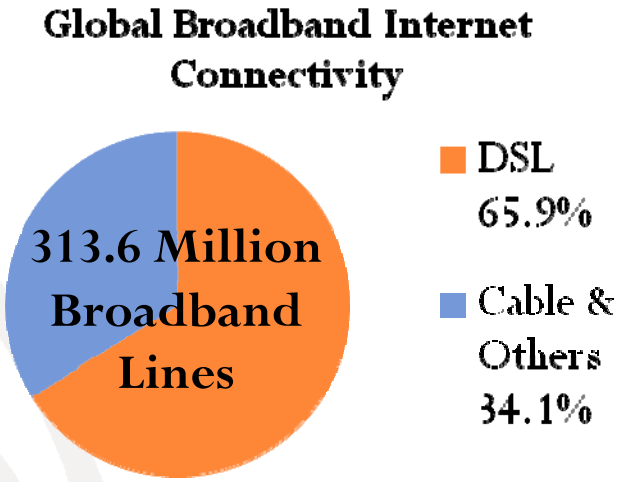


Figure 1 World broadband lines pass 313.6 million

Despite the substantial growth in the broadband internet connectivity, there is still a large gap in the ability to access information between rural and urban areas or a **digital divide**.

I. Introduction (Cont.)

- "Innovative Broadband Models for Digital Inclusion" have been deployed in Thailand using Broadband Satellite, WiMAX & CDMA 2000 (470MHz) for providing telecom access to villages, schools and health centers in remote areas of Thailand through the use of the capacity demand sharing IP-based broadband communication technique.

II. Enabling Broadband Satellite Technology and Ground System

Broadband Satellite

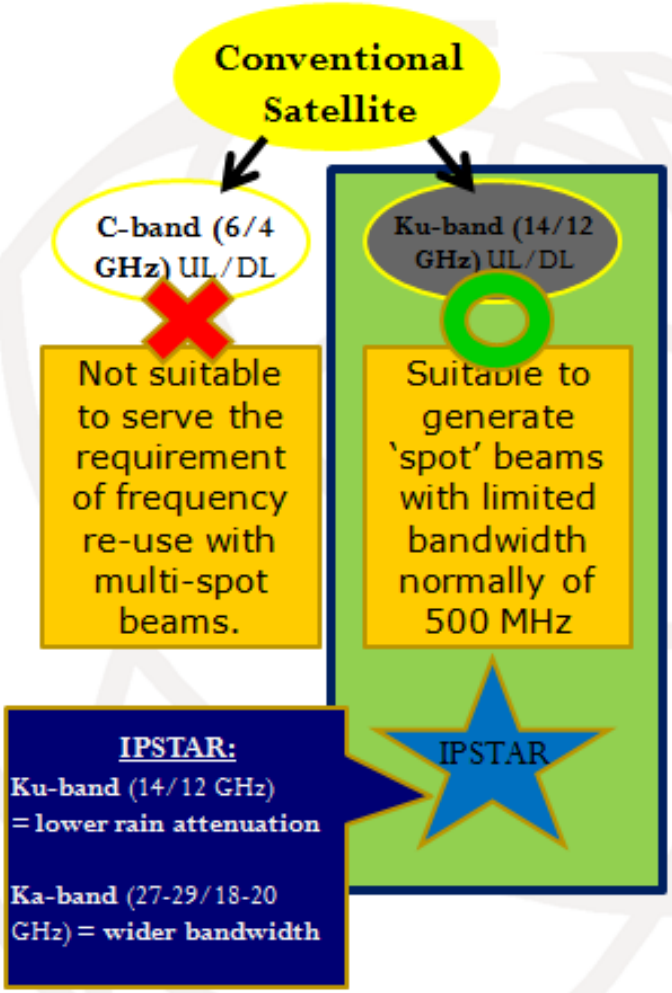
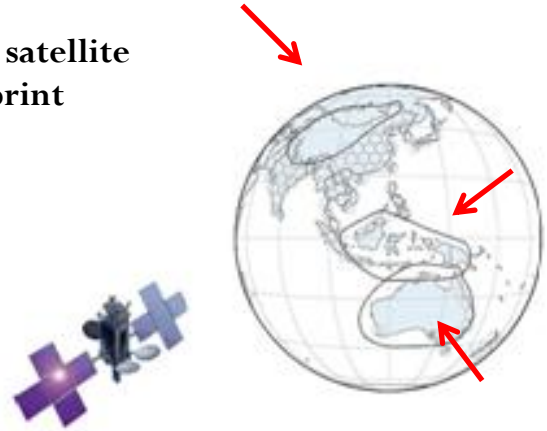
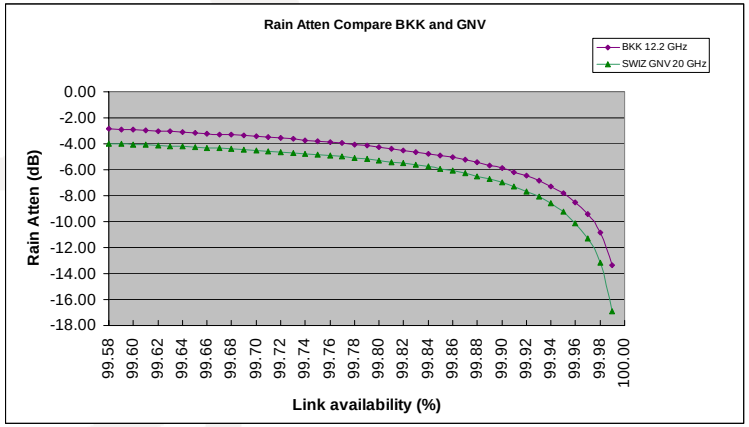


Fig. 2 IPSTAR satellite and footprint



ITU-R Rain Attenuation compare between BKK at 12.2 Ghz and GNV at 20 GHz



Rain attenuation of BKK with Freq 12.2GHz (Ku band downlink) is higher than GNV with Freq 20 GHz (Ka Band downlink) ~ 1-2 dB

Fig. 3

II. Enabling Broadband Satellite Technology and Ground System
Broadband Satellite

- Development of technology for ground equipment has enabled to increase power and spectrum is to achieve efficiency by
  - incorporating in head-end modem at the set-top box with turbo product codes (TPCs)
  - and/or Low Density Parity Check (LDPC) together with Adaptive Coding and Modulation (ACM) technique in Forward Error Correction (FEC)
- This is not only increase the amount of spectrum by frequency re-use in IPSTAR, but also the increase of the efficient use of spectrum by IPSTAR ground system.

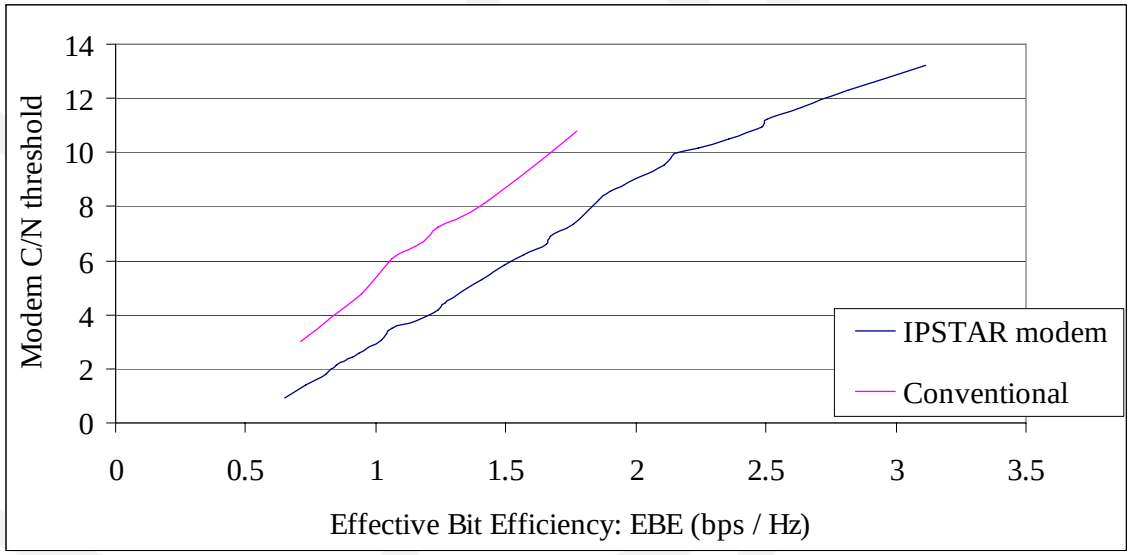


Figure 4 The IPSTAR modem and conventional modem efficiency comparison

II. Enabling Broadband Satellite Technology and Ground System
Broadband Satellite

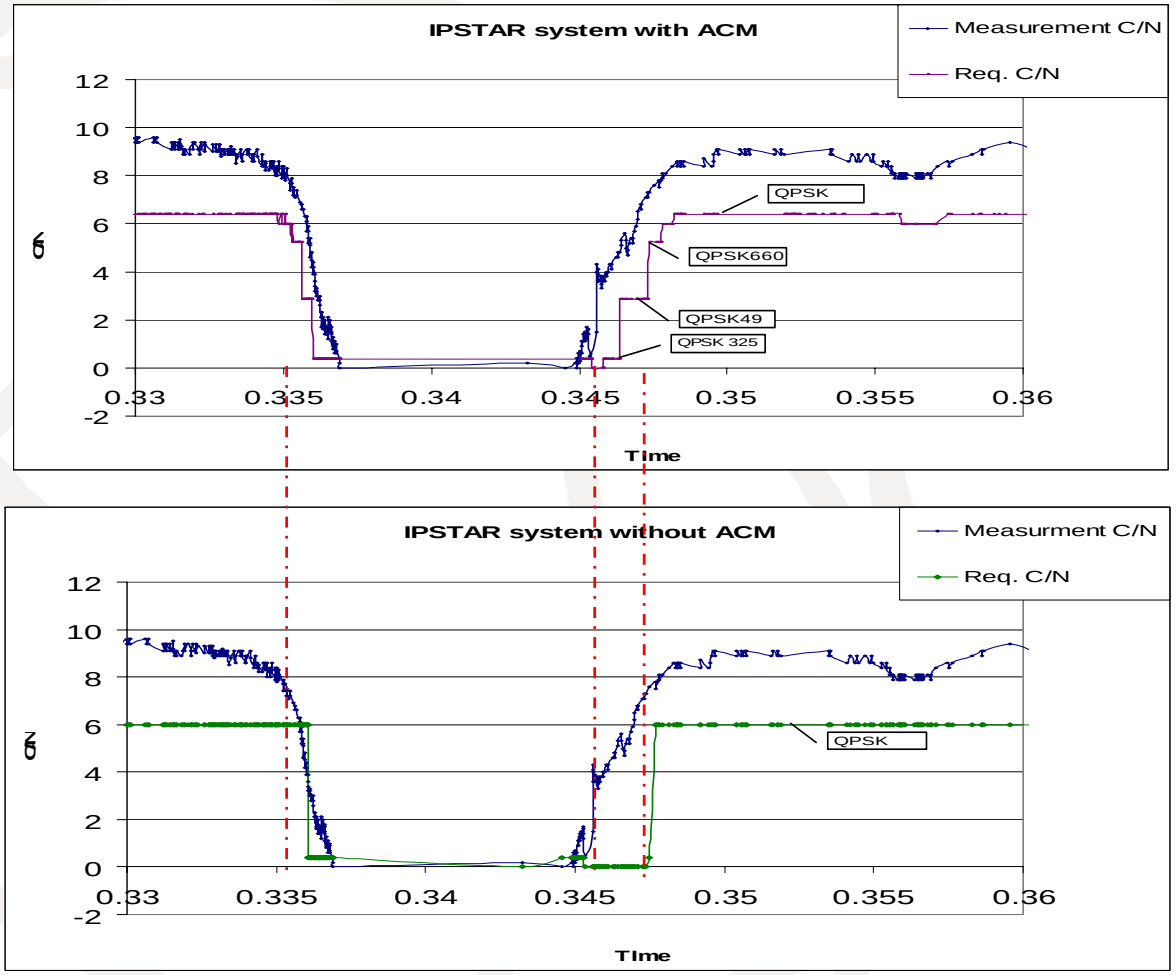


Figure 5 The measured C/N data and required threshold C/N with ACM and without ACM

II. Enabling Broadband Satellite Technology and Ground System

Broadband Satellite

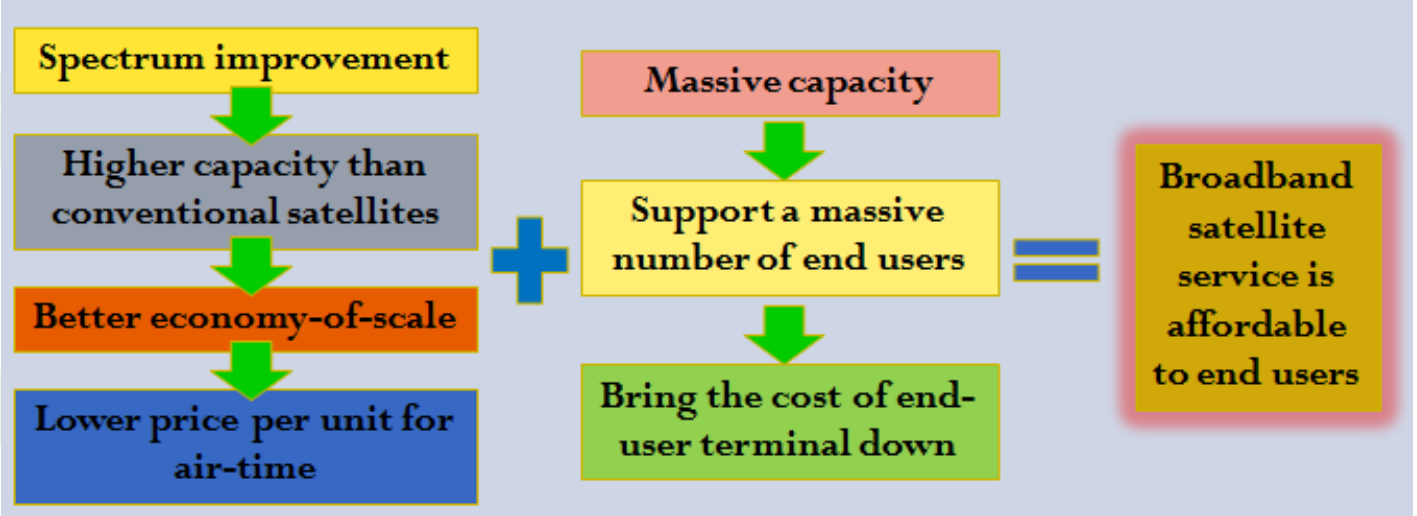


Table 1 Compares the capacity of various satellites in service

Satellite Broadband Technology Category	Representative Offerings	Capacity (per system)
Ku-band (FSS)	DirecPC / DirecWay, StarBand, SkyBridge	500 Mbps
Ka-band (bent pipe)	iPStar, WildBlue, Astra-Net	30 Gbps
Ka-band (on-board processing)	Astrolink, SpaceWay, Teledesic	30 Gbps
Mobile (3G MSS) (L-band) Airplane (Ku-FSS)	Inmarsat's B-GAN, New ICO Connexion	100 Mbps 500 Mbps

III. Comparison with WiMAX and CDMA 470
WiMAX: Policy & Backgrounds

- Based on the availability of spectrum for telecommunication services for the WiMAX frequency bands, the National Telecommunications Commission (NTC) using technology neutrality approach has a policy to assign the 2.5 GHz and 2.6 GHz bands for IMT 2000 and beyond including WiMAX after refarming 2.5 and 2.6 GHz.

- For the provision, 2.3 GHz and 2.4 GHz which is still available will be assigned for WiMAX for three licenses each with 30 MHz for a license period of minimum 5 years

III. Comparison with WiMAX and CDMA 470
WiMAX: Field Testing

Field testing of WiMAX initiated by NTC:

- **Objective:** To ensure the Mobile WiMAX technology's workability in various locations and environments with various frequency bands and various applications.
- **Date:** Between March – November 2008
- **Participants Granted testing Licenses:** 14 telecom operators with 7 different WiMAX suppliers
- **Frequency bands:** 2.3 GHz, 2.4 GHz & 2.5 GHz
- **Bandwidth:** 3.3 MHz/sector, 5 MHz/sector,
  8.75MHz/sector to 10 MHz/sector.
- **Limitation:** TDD only
- **Testing Scope:** LOS, NLOS, based on fixed, nomadic, portability and simple mobility circumstances.
- **Tested Applications:** VoIP, Web Browsing, video streaming video conferencing, interactive gaming and file transfer protocol.

III. Comparison with WiMAX and CDMA 470(Cont.)
WiMAX: Other Projects

- Other projects where WiMAX were deployed:

Telehealth

Picture 1.Telehealth check up in Phang Nga, Southern Thailand

Teleeducation & E-Learning

Picture 2. Teleeducation and E-Learning through WiMAX, Mae Fah Luang University

III. Comparison with WiMAX and CDMA 470(Cont.)

CDMA 2000 1x at 470 MHz

- CDMA 2000 1x at 470 MHz has been developed by TOT Corporation to cover remote villages at a distance of about 10 kms with maximum power within 60 watts and channel bandwidth of 1.23 MHz.
  - Not new approach, since other countries had also deployed similar technologies.
- Currently CDMA 2000 1x at 470 MHz has been deployed based on Universal Service Obligation scheme to provide 2 public phone lines and one 256 kbps internet access for the remote villages in Thailand.
- In addition, the use of EV-DO technology has been instrumental in providing easier and faster access to medical facilities and enhancing rural and underserved communities' economic and social development by providing them with medical and educational resources.

IV. Performance Analysis
Satellite

- In Thailand, the deployment of IPSTAR has been instrumental in providing rural connectivity for the USO project since 2006.
- In Australia, programs such as HiBIS & Australian Broadband Guarantee Program subsidize cost of providing broadband service to consumers in regional, rural and remote locations through the use of IPSTAR.
- A satellite platform, like IPSTAR, is the simplest, most economical solution for swift deployment a telecommunication backbone and to link rural communities to the world.
  - IPSTAR deployment in Thailand: 69K users
  - IPSTAR deployment in Australia: 68K users

IV. Performance Analysis (Cont.)
Sustainability of Broadband Satellite

Table 2 Option for Service Objectives

USER/ SERVICES	Public Community	Institute Enterprise	Private (Household, Individual)
Voice Telephone (Fixed or Mobile)	Pay phone public call cent	Institutional fixed telephone service (or GSM or CDMA)	Individual mobile phone, HH fixed line
Data/ Internet (dial-up or broadband)	Community telecentre, cyber café, WiFi/WiMAX	Institutional Internet, Intranet; LAN/WAN	Private dial-up, broadband
Voice/ Data/ Internet (Broadband Satellite)	Community Telephone/Telecentre	Community Internet connecting with District Administration	Private/ broadband Satellite

IV. Performance Analysis(Cont.)
WiMAX: Test Results

- **NLOS Coverage**: 1.5 km to 7.3 km
- **LOS Coverage**: 20 km
- **Spectrum efficiency**: Varied from 0.647 bps/Hz to 2.15 bps/Hz
- **Interference**:
  - Detected between WiMAX signal and MMDS
  - No interference between WiMAX themselves.
- **Max UL**: 5.5 Mbps
- **Max DL**: 15 Mbps
- **Ratio of DL/UL**: 2/1 to 29/18
- **Video streaming quality**: Very for single channel, but degraded as more channels were added.

IV. Performance Analysis(Cont.)
CDMA 2000 1x at 470 MHz

- CDMA 2000 1x at 470 MHz has similar performance as compared to CDMA 2000 at 850/1800 MHz
- The main difference is the farther distance coverage by using 470 MHz
  - Hence it tends invest less and cover larger area.

V. Conclusion and Recommendations (Cont.) Satellite

- IPSTAR is a suitable technology to provide broadband internet and vertical applications

- However, extendable and sustainable broadband satellite services mandatory need government support in term of policy
  - provides funding to end-users in rural area to be accessible to broadband internet.
  - Likewise, supporting geographical area, population distribution

V. Conclusion and Recommendations (Cont.) WiMAX

- Fixed WiMAX
  - Test results confirmed the readiness and robustness of technology for service
- Mobile WiMAX
  - NLOS testing showed it is not suitable to use in the dense high-rise building areas
    - Signal attenuation and multi-path fading results in poor indoor QoS
  - However, mobility test yields good results for vehicle speed moving at 60 km/hr
    - Full mobility over vehicle speed over 60 km/hr has not been tested yet
- Recommendation for Thailand case
  - In Thailand, Fixed WiMAX can be deployed to connect remote villages up to 20 kms distance and relaying signal to nearby villages by Mobile WiMAX NLOS

V. Conclusion and Recommendations (Cont.)
CDMA 2000 1x at 470 MHz

- Efficient use of the already allocated 470 MHz band
- Cost effective for rural telecommunications in remote villages
  - Farther coverage and lower infrastructure investment
- However it is not promising in long term due to more expensive operation cost

V. Conclusion and Recommendations (Cont.)

- IPSTAR Broadband Satellite system, WiMAX and CDMA 470MHz are technologies that could serve digital inclusion missions

- The regulators and operators of each country/region will have to evaluate and select choices of technologies that are suitable for their requirements and obligations

- A good balance of suitable technologies, required applications, investment, time-to-service, and end-user affordability are needed to achieve digital inclusion

Thank you for your kind attention

More information

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