Suggestion of Mobile Wireless MAN System and Channel Simulation Result

IEEE 802.16 Presentation Submission Template (Rev. 8.21)

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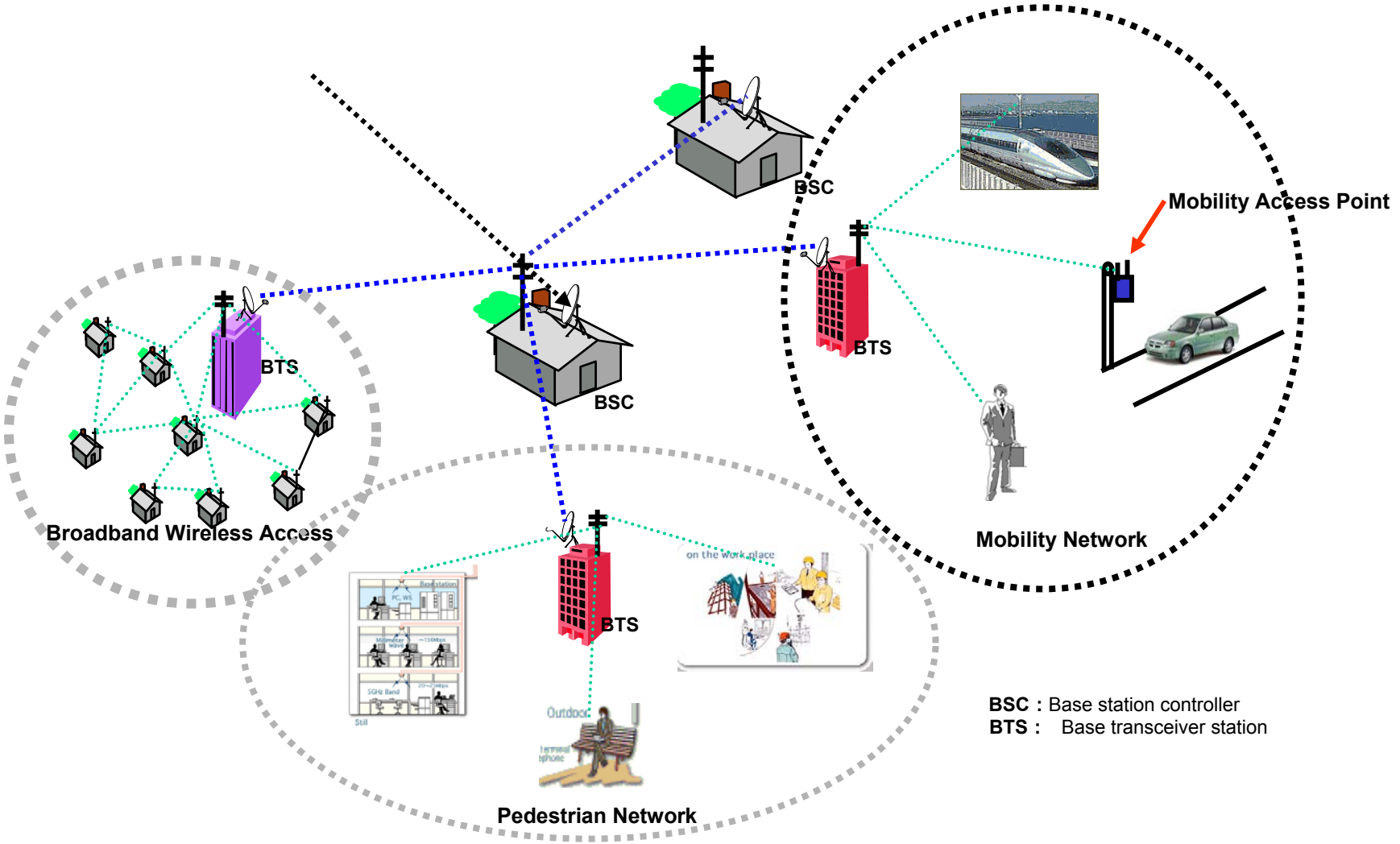
Purpose:

To suggest Mobile Wireless MAN capability and to provide some channel simulation results.

Outline

- **Prospect for MWM feature**
  - ✓ Network deployment
  - ✓ Required capabilities and freq. band
- **How about channel characteristics?**
  - ✓ Path loss
  - ✓ Mobility effect
- **Status of Public Wireless LAN Service in Korea**
- **MWM may need to include services like public WLAN**

MWM Network deployment



Data rate based on application

Application	Required Data rate
AC3 Dolby Digital Audio	384 Kbps
CD audio	1.5 Mbps
MPEG1	1.5 Mbps
MPEG2	4~6 Mbps
DVD	Up to 9.8 Mbps
HDTV	19.280 Mbps

Prospects of MWM Characteristic

- **Frequency band : Licensed band** (Under 3GHz)
  cf) 3GPP2 Freq. band : 1885-2025 MHz(140 MHz), 2110-2200 MHz (90 MHz)
  => Total 230 MHz

- **Data rate : 4~5 bit/sec/Hz** ($\geq$ 20 Mbps at 5 MHz channel band)

- **Only Packet based system**
  (IEEE 802 group main characteristic is packet based system)

- **Mobility : Support up to 250 Km/h**

- **Embrace the Broadband Wireless Access** (IEEE802.16a)

Comparison with 3GPP2

❑ Advantage

- ✓ Higher data rate
- ✓ Simple network(without backward compatibility)
- ✓ Simple system structure (only packet based system)
- ✓ Seamless communication
  (Packet based system is less sensitive in interruption)

❑ Disadvantage

- ✓ Can't support voice
- ✓ Need new Base station, Access point

Channel Simulation Results

❑ Path loss estimation

- ✓ **Modified** Okumura-Hata model
  (Modification : Frequency and Receiver antenna height)
- ✓ Frequency : 2.5GHz
- ✓ Distance from BS : <10km

$$PL_{modified} = PL + \Delta PL_f + \Delta PL_h$$

$$PL = A + 10\gamma \log_{10}(d / d_0)$$

γ : Path loss exponent

ΔPL_f : Frequency correction term

ΔPL_h : Receiver antenna height correction term

Channel Simulation Results

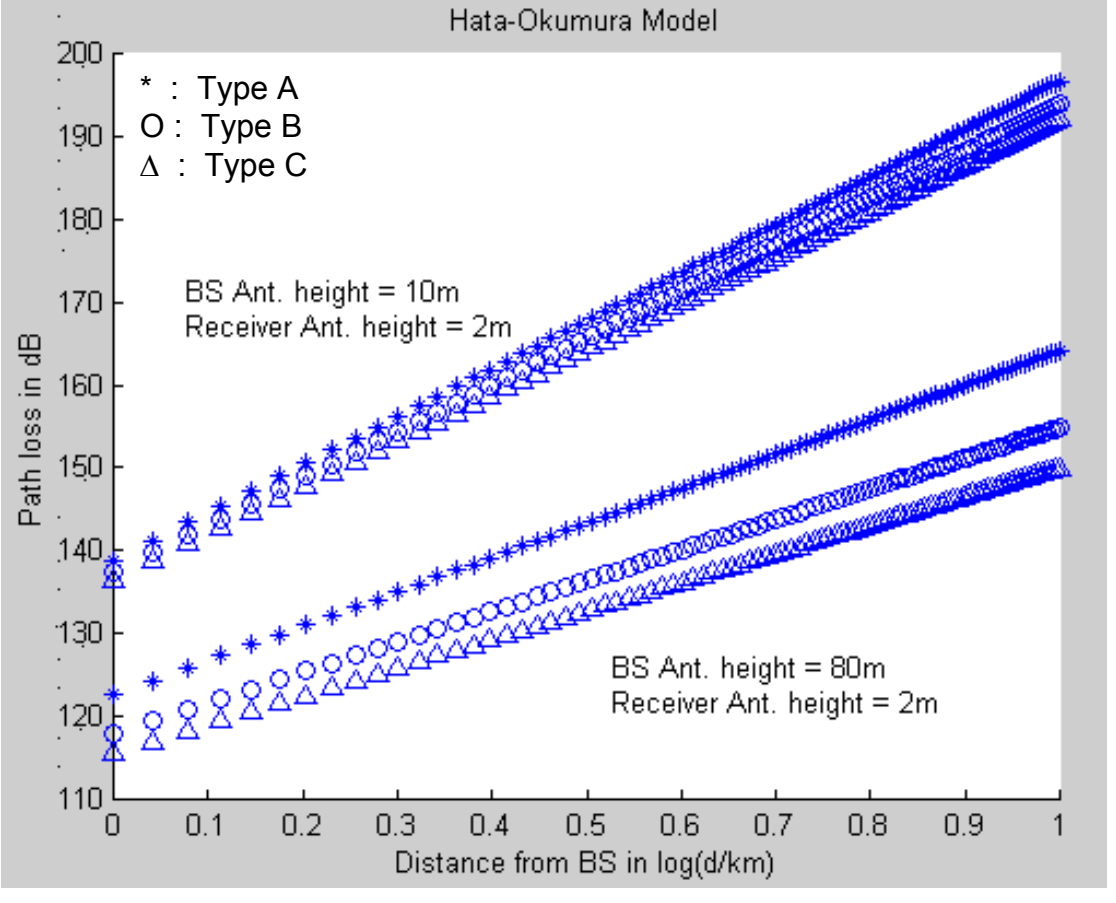
❑ Fading envelope variation

- ✓ Frequency : 2.5GHz
- ✓ Mobile velocity :10Km/h, 120Km/h, 250km/h
- ✓ Max. doppler frequency : 23Hz, 2777Hz, 5787Hz
- ✓ Doppler spectrum : Jake spectrum for mobile characteristics

Jake Power Spectral Density

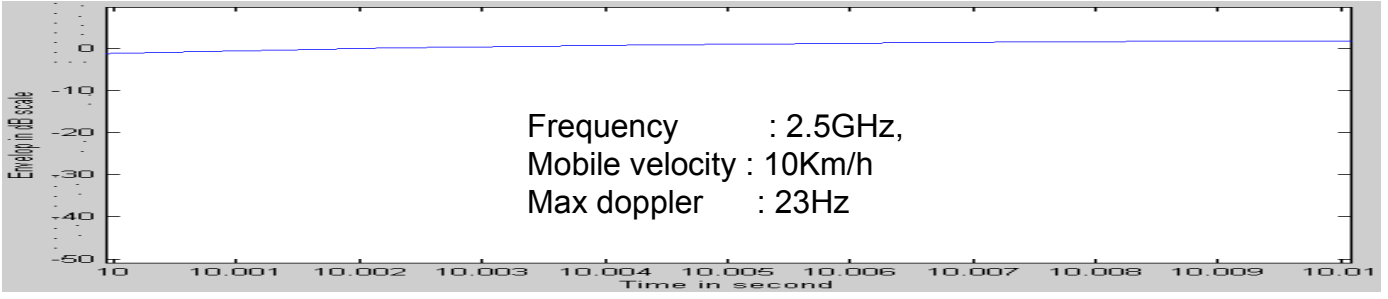
$$S(f) = \begin{cases} \dfrac{2\sigma^2}{\pi f_{\max}\sqrt{1-(f/f_{\max})^2}}, & |f| \le f_{\max} \\ 0, & |f| \ge f_{\max} \end{cases}$$

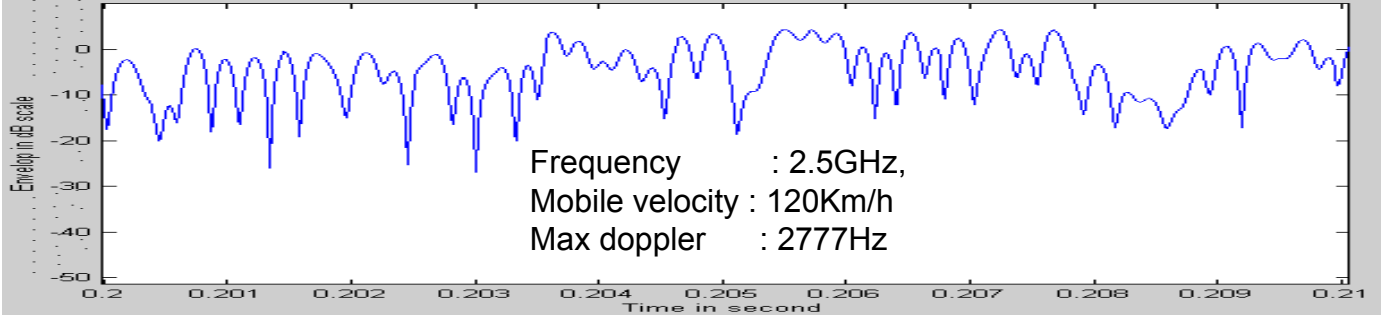
Path Loss Estimation

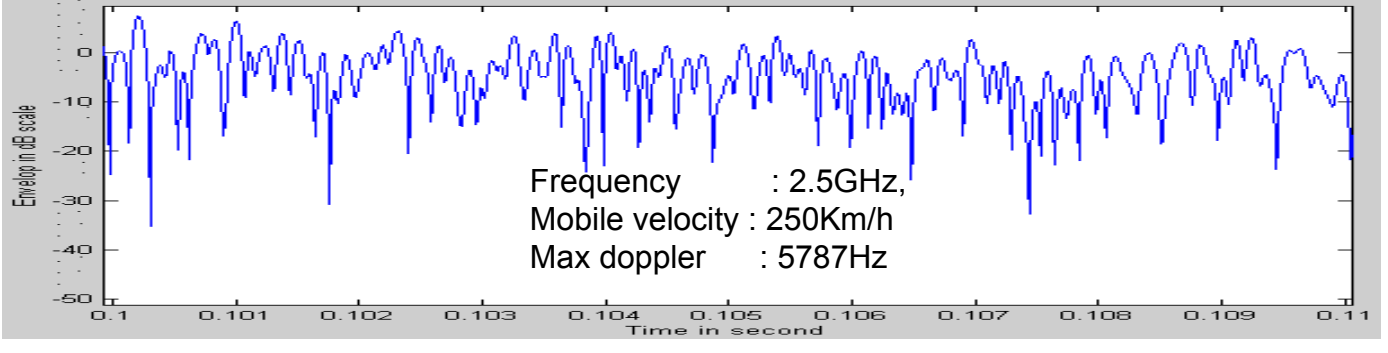


Terrain Type A : Hilly terrain with moderate-to-heavy tree density
Terrain Type B : Intermediate path loss condition
Terrain Type C : Flat terrain with light tree density

Fading Envelop Variation







10msec

Comment about Channel

- **We are in searching and developing appropriate channel model for MWM**

- **Critical problem in MWM based on 802.16aPHY**
  - ✓ Due to mobility, doppler spectrum is quite different from fixed environment
  - ✓ It is expected that fast fluctuation of envelope may cause an serious problem
  - ✓ OFDM : Orthogonality problem
  - ✓ SC : Fast channel equalization problem

- **NO predetermined channel model, NO accurate estimation of MWM Capability**(Date rate, BER, Mobile Speed)

- **Before developing further MWM feature, accurate predefined channel model is inevitable!**

MWM & Public WLAN Service

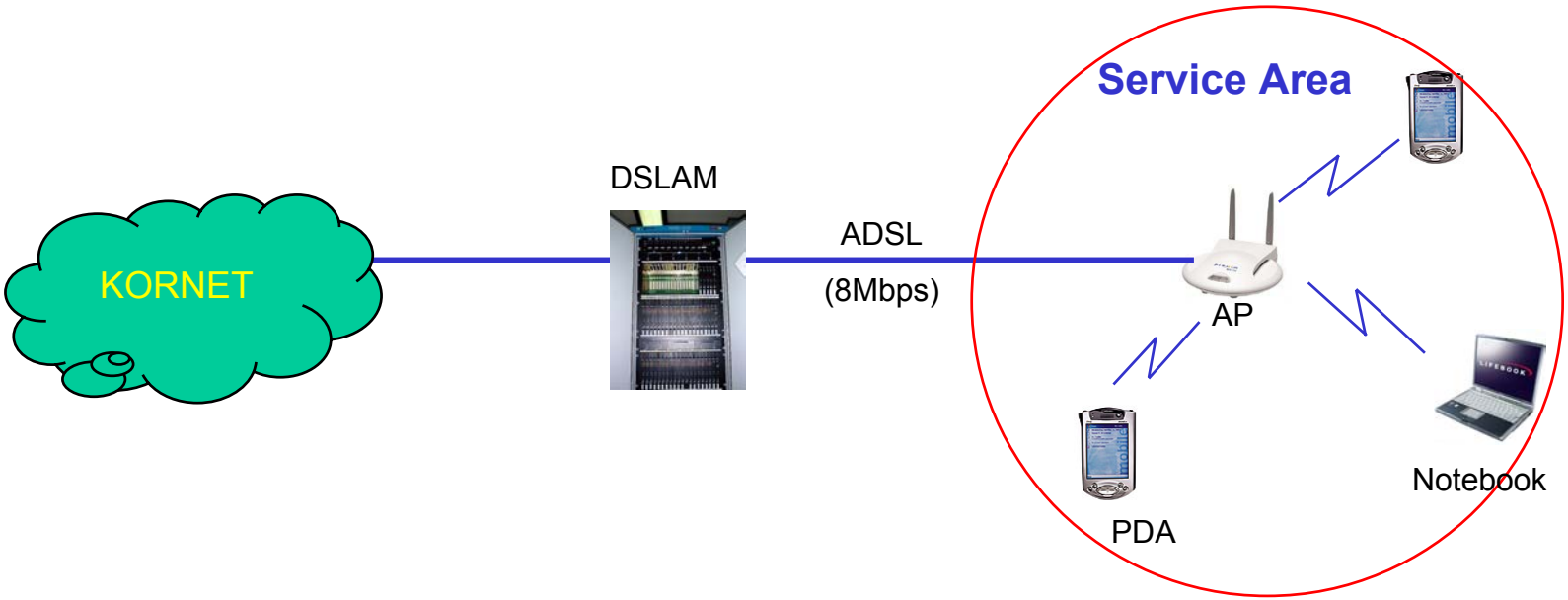
- **Public WLAN service**
  - ✓ An wireless internet service in Hot Spot area (densely populated places) by WLAN techniques
  - ✓ Major Service Area : Office, Residential, Hotel, Public area, Terminal, Airport

- **In Korea, Public WLAN Services Users are increasing (Y2003 : 50,000 users, Y2006 : 3.2milion users)**

- **Our proposal is,**
  Mobile WMAN must include Public WLAN Area

Public WLAN Service in Korea (Korea Telecom)

- **NESPOT** service of A corp. provides wireless high-speed internet environment with portable terminal like notebook, PDA etc. anywhere, anytime
- NESPOT Networking [Using ADSL or T1(1.544Mbps)]



- Service Area : Office, Residential, Hotel, Public area, Terminal, Airport

NESPOT Service Class

- Megapass NESPOT-ID Only
  - ✓ Good for customer using NESPOT above one month and customer occasionally using NESPOT
  - ✓ Billing

Fee level	Fundamental fee	Usage time	Additional fee
A	8.3$	5hours/month	1.7cents/minute
B	20.8$	Unlimited	No

- Megapass NESPOT
  - ✓ Profitable for netizen(internet users) customer usually using multimedia like mpeg or game etc

3years	2years	1year	< 1year	Comment
36.7$	38.3$	40$	41.7$	Flexible IP access

Public WLAN Service in Korea (Hanaro Telecom)

- **HanaFOS AnyWay** is wireless internet service supporting maximum 11Mbps data rate in HanaFOS zone (WLAN internet service places) with PDA, Notebook etc. using wire network of B corp. plus 2.4GHz WLAN network

HanaFOS AnyWay Service Environment

HanaFOS AnyWay Service Class

- AnyWay HomeSpot
  - ✓ Wireless internet service in Hot Spot (high popular places) as well as home
  - ✓ Billing

Media	Speed/Product	Monthly fee			
		< 1year	1year	2years	3years
ADSL	Pro	50$	47.9$	45.8$	42.1$
	Mid	45$	43.1$	41.5$	38$
	Lite	41.7$	39.8$	38.3$	35$

- AnyWay Biz
  - ✓ Business-enterprise wireless internet service targeting for business executives or visiting customers
  - ✓ Billing

Media	Speed/Product	Monthly fee			
		< 1year	1year	2years	3years
ADSL	ADSL-SOHO	41.7$	39.8$	38.3$	35$

Public WLAN Service in Korea (Onse Telecom)

- Shark Air
  - ✓ Wireless internet service in Apartment area's HFC(Hybrid Fiber Copper) network plus WLAN
  - ✓ Billing

Classification	fee
Customer	The Inhabitants in APT
Installation fee	25$
Usage fee	20.8$/ID (Monthly)
WLAN card rental fee	< 1year : 4.2$
	1year : 2.5$
	> 2years : free