

# Suggestion of Mobile Wireless MAN System and Channel Simulation Result

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Purpose:

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

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# Outline

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## **Prospect for MWM feature**

- ✓ Network deployment
- ✓ Required capabilities and freq. band

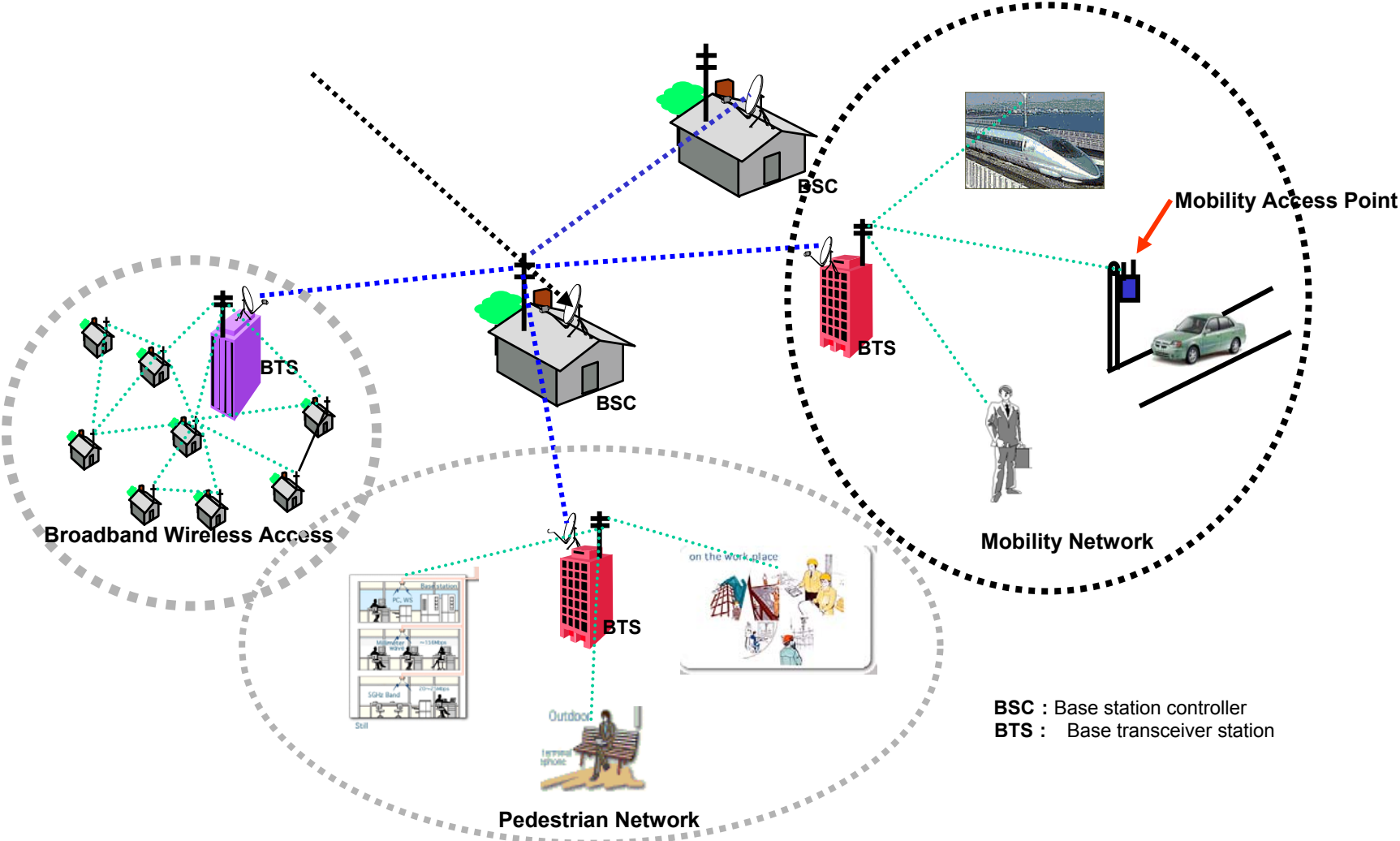
## **How about channel characteristics?**

- ✓ Path loss
- ✓ Mobility effect

## **Status of Public Wireless LAN Service in Korea**

## **MWM may need to include services like public WLAN**

# MWM Network deployment



BSC : Base station controller  
BTS : Base transceiver station

# Data rate based on application

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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

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- ❑ **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

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## ❑ 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

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## □ Path loss estimation

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

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

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

$\gamma$  : Path loss exponent

$\Delta PL_f$  : Frequency correction term

$\Delta PL_h$  : Receiver antenna height correction term

# Channel Simulation Results

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## ❑ Fading envelope variation

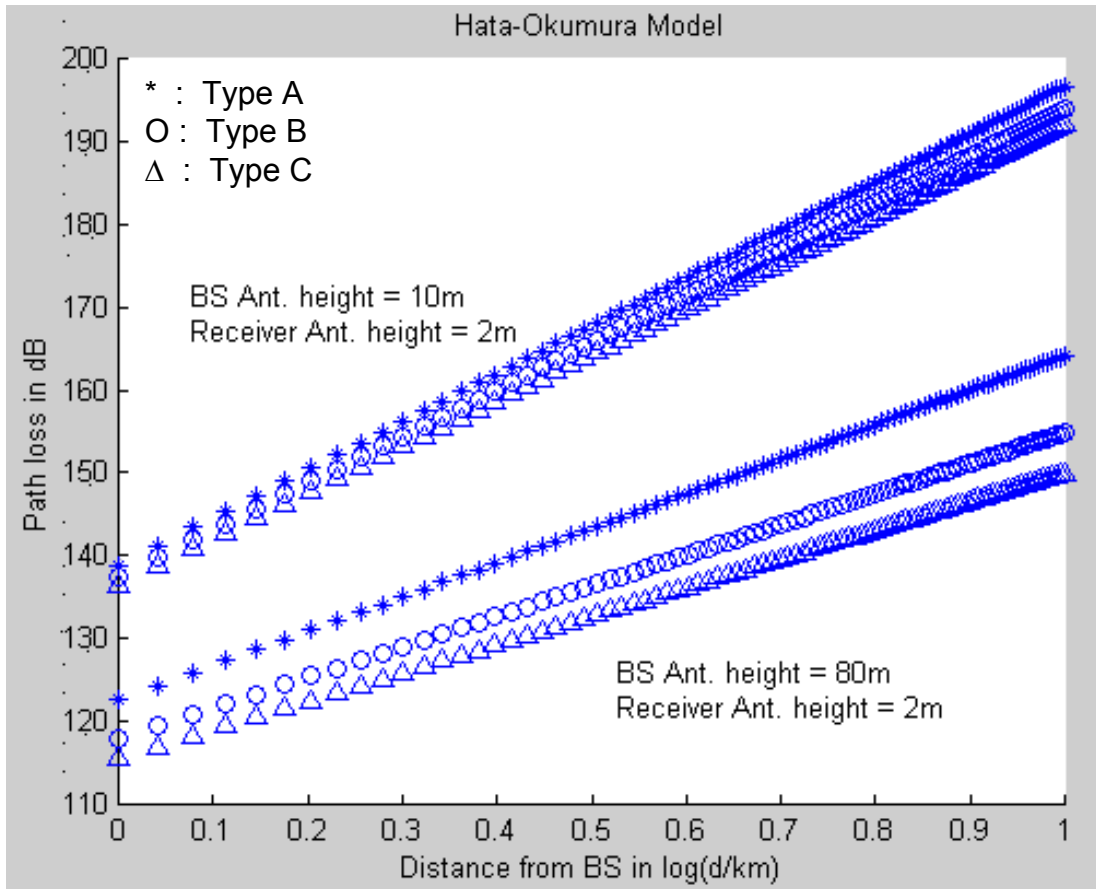
- ✓ Frequency : 2.5GHz
- ✓ Mobile velocity : 10Km/h, 120Km/h, 250km/h
- ✓ Max. doppler frequency : 23Hz, 2777Hz, 5787Hz
- ✓ Doppler spectrum : Jake spectrum for mobile characteristics

Jake Power Spectral Density

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

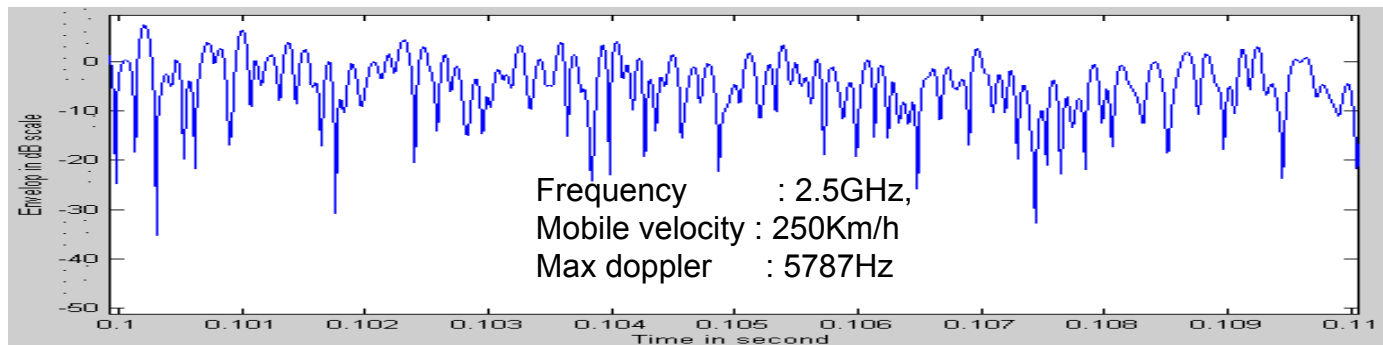
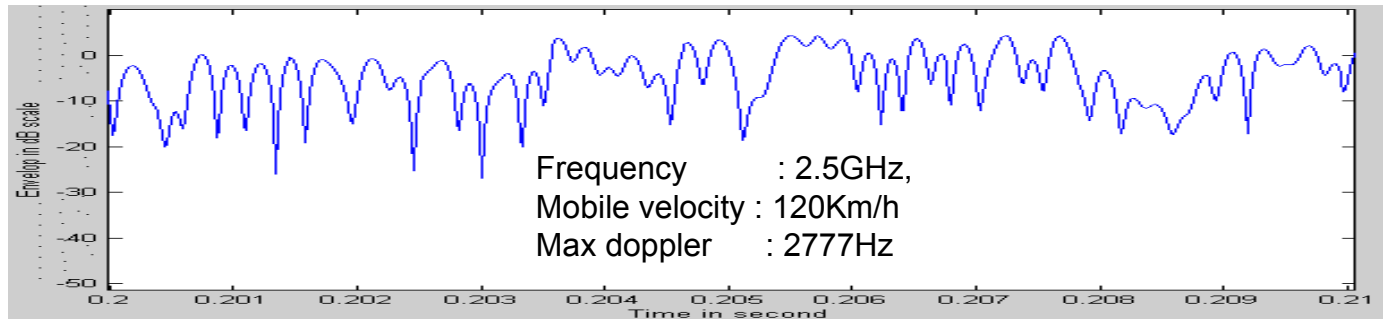
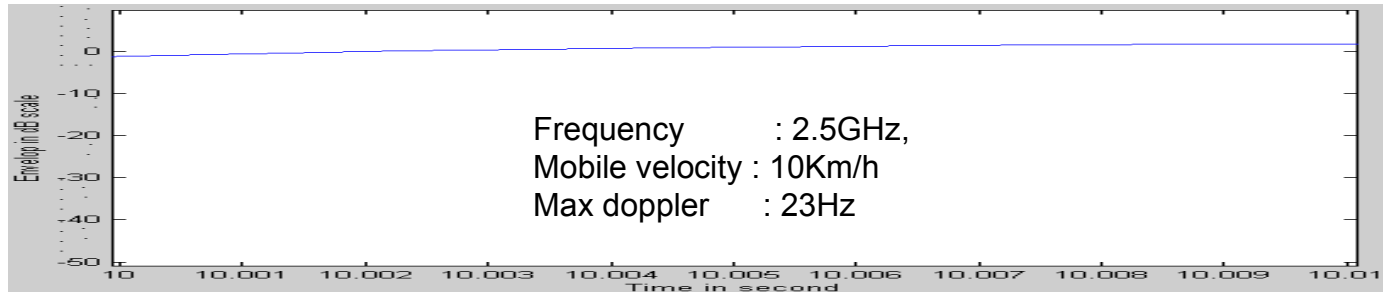


# Path Loss Estimation



- 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

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- ❑ **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

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## **Public WLAN service**

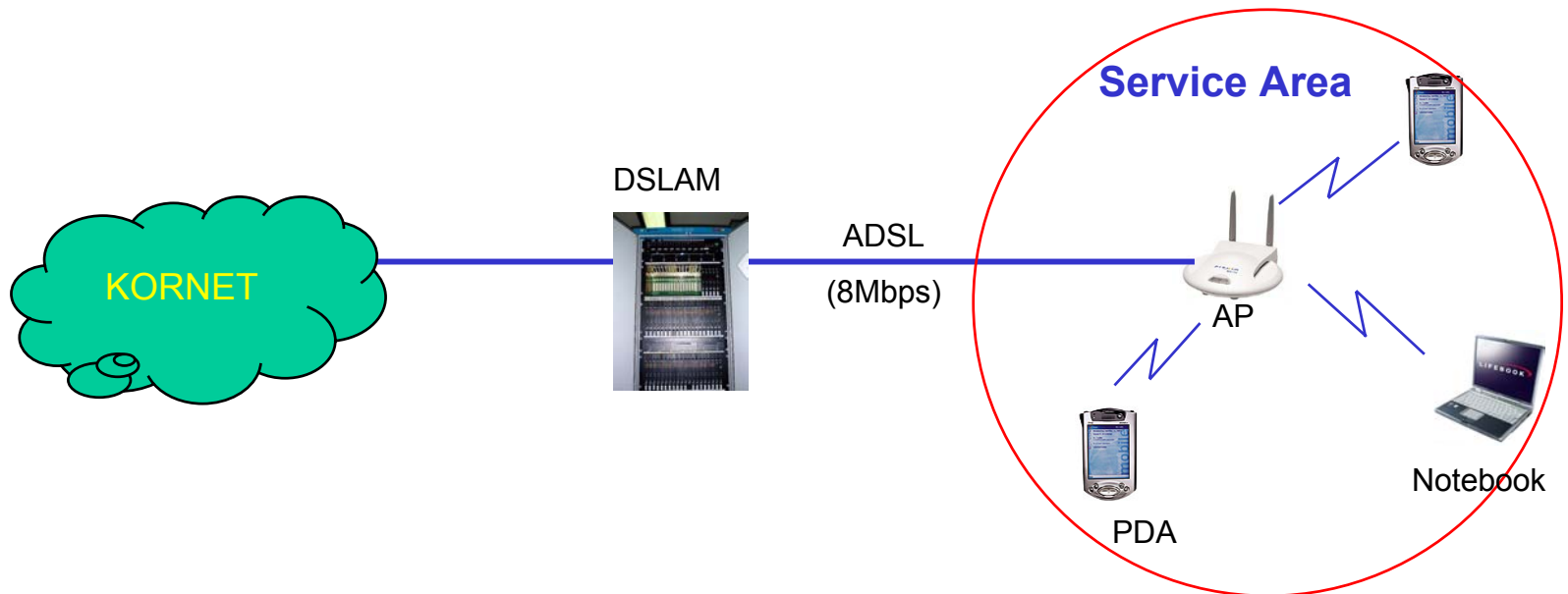
- ✓ An wireless internet service in Hot Spot area (densely populated places) by WLAN techniques
- ✓ Major Service Area : Office, Residential, Hotel, Public area, Terminal, Airport

## **In Korea, Public WLAN Services Users are increasing (Y2003 : 50,000 users, Y2006 : 3.2million 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

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## 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)

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- **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

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## □ 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)

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## ❑ 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