Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access <http://grouper.ieee.org/groups/802/20/>**	
Title	**MBTDD 625k-MC Mode (BEST-WINE) Performance Report 1 Presentation**	
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Re:	MBWA Call for Proposal	
Abstract	This document presents the **Technology Performance and Evaluation Criteria Report 1** of the Technology Proposal MBTDD 625k-MC for IEEE 802. 20 MBWA	
Purpose	To discus and Adopt MBTDD 625kHz MC Mode for Draft Specifications of IEEE802.20 MBWA	
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MBTDD 625k-MC Mode (BEST-WINE: Broadband MobilE SpaTial Wireless InterNet AccEss) Performance Report 1 Presentation

IEEE 802.20 Plenary Meeting

Hawaii

January 16-19, 2006

Changes

- The title has been changed to MBTDD 625k-MC
- Slides with the Title underlined and highlighted show the changes in the Evaluation Report 1

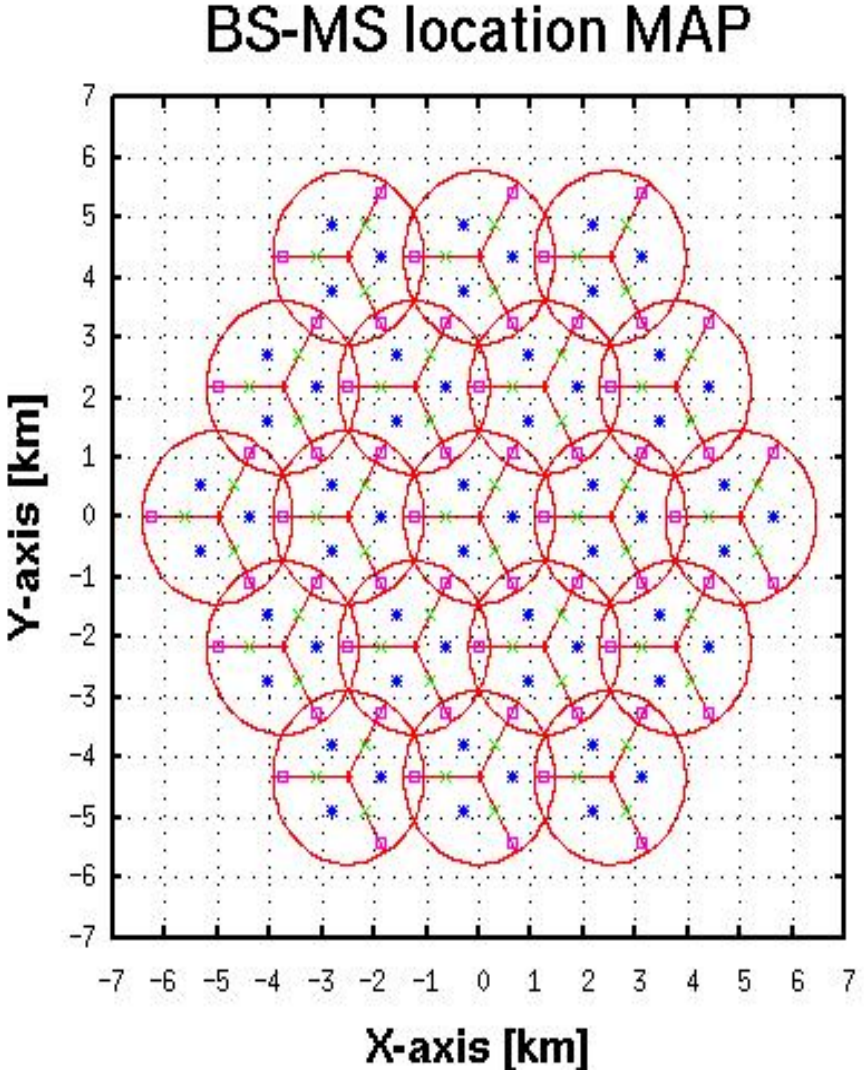
MBTDD 625k-MC Mode (BEST-WINE: Broadband MobilE SpaTial Wireless InterNet AccEss)

- **Proposed Draft Technology Specifications**
  - Enhanced MAC Layer and PHY layer Draft Specifications to the base specifications of HC-SDMA*
  - **AND**
    - Base Technical Specifications "**ATIS-PP-0700004-2005, High Capacity-Spatial Division Multiple Access (HC-SDMA)*".**
    -
    - **** For Electronic Downloads, Paper Copy or CD-ROM please follow the link https://www.atis.org/atis/docstore/doc_display.asp?ID=3617***

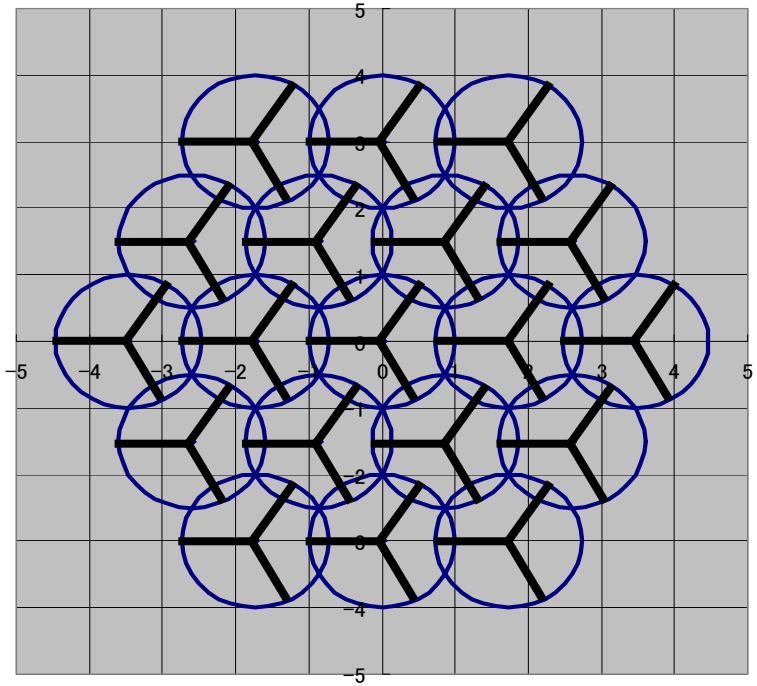
MBTDD 625k-MC (BEST-WINE)
Technology Performance
Outline of Presentation

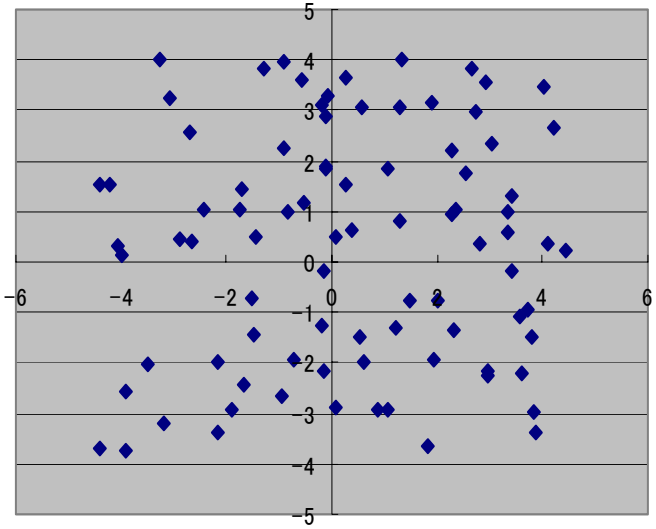
- System Model
- RF Parameters
- Link budget
- Basic PHY layer (link level) information
- Simulation environment
- Simulation Results
  - Link Level
  - System Level
- Conclusion

System Calibration Model



System Lay out and and UT positions





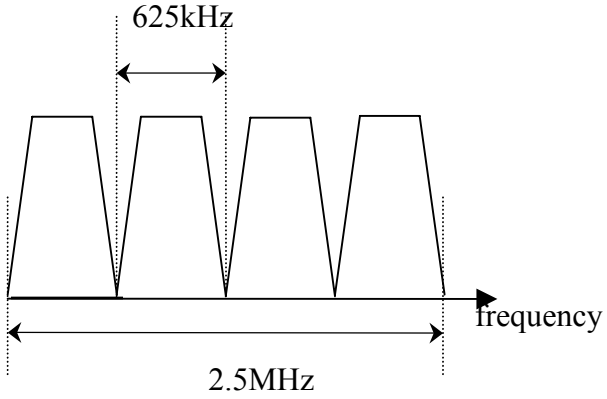
RF Parameters

#	RF Parameter TDD System	Base Value 1 MHz Channel	2.5 MHz TDD - SYSTEM
1	Transmitter Power -- BS	43 dBm/MHz	+44 dBm
2	Transmitter Power -- MS	27 dBm	+27 dBm
3	Out of Band emission limits – BS and MS (emission measured in 1 MHz resolution bandwidth)	Attenuation of the transmit power P by: 43 +10 log(P) dB	-13 dBm
4*	ACLR - Attenuation of emissions into an adjacent channel (same Ch BW) – BS	43 dB	50.2 dB
5*	ACLR - Attenuation of emissions into an adjacent channel (same Ch BW) – MS	36.8 dB	35.4 dB
6	Receiver noise figure -- BS	5 dB	5 dB
7	Receiver noise figure -- MS	10 dB	10 dB
8	Receiver reference sensitivity (to be proposed by each technology)	Specify at BER of 0.1%	See link budget
9*	Receiver Selectivity -- BS	Mod 1 /Mod 10 : 30 dB	30 dB
10*	Receiver Selectivity -- MS	Mod 0 to 6 : 30 dB Mod 7 to 8 : 27 dB Mod 9 to 10 : 25 dB	30 dB 27 dB 25 dB
11[*]	Receiver Blocking – BS (level of same technology blocking signal at frequency offset of 2 times Channel BW)	Mod 0 : -50.8 dBm Mod 7 : -36.8 dBm Mod 10 : -31.4 dBm	-50.8 dBm -36.8 dBm -31.4 dBm
12[*]	Receiver Blocking – MS (level of same technology blocking signal at frequency offset of 2 times Channel BW)	Mod 0 : -58.5 dBm Mod 8 : - 42.6 dBm Mod 10 : - 39.1 dBm	-58.5dBm -42.6dBm -39.1dBm

MBTDD 625k-MC (BEST-WINE) System's PHY and MAC Layer information

- Channel Configuration

Items		Specification
Duplexing		TDD
Mutiple Access		TDMA・SDMA
Carrier space		625 kHz
Frame Lenght		5 ms
symbol duration		2usec
Uplink Time Slot	slots	3
	Length	545 us
	Payload	182 symbols
Downlink Time Slot	slots	3
	Length	1090 us
	Payload	494 symbols
Symbol rate		500 ksps



MBTDD 625k-MC (BEST-WINE) System's PHY and MAC Layer information

- Modulation class

ModClass	Modulation Method	Down Link(Kbps)		Up Link(Kbps)	
		Data Rate /Slot	Data Rate /Carrier	Data Rate /Slot	Data Rate /Carrier
0	BPSK	35	106	6	19
1	BPSK	50	149	13	38
2	QPSK	82	245	26	77
3	QPSK	126	379	43	130
4	8PSK	162	485	58	173
5	8PSK	198	595	72	216
6	12QAM	262	787	98	293
7	16QAM	307	922	115	346
8	24QAM	354	1061	133	398
9	32QAM	378	1133	142	427
10	64QAM	498	1493	190	571

Simulation Channel Environments

- Suburban Macro at 3KMPH – Pedestrian B
- Suburban Macro at 120 KMPH – Vehicular B

Basic PHY layer (link level) information

- Link Level simulation Parameters
  - TDD /TDMA system
  - 3 timeslot structure
  - BS antenna number 12antennas
  - UT antenna numbers
    - Antennas used for transmission :1
    - Antennas used of receiving: 4
  - Adaptive Array Antenna Algorithm : MMSE
  - Receiver equalizer.

Channel models used in Link Level Simulations

Models		case-iii		case-iv	
PDP		Pedestrian-B (Phase I)		Vehicular-B (Phase I)	
Number of Paths		6		6	
Relative Path power (dB)	Delay (ns)	0	0	-2.5	0
		-0.9	200	0	300
		-4.9	800	-12.8	8900
		-8.0	1200	-10.0	12900
		-7.8	2300	-25.2	17100
		-23.9	3700	-16.0	20000
Speed (km/h)		3		120	
Mobile Station	Topology	0.5λ		0.5λ	
	PAS	RMS angle spread of 35 degrees per path with a Laplacian distribution		RMS angle spread of 35 degrees per path with a Laplacian distribution	
	DoT (degrees)	-22.5		22.5	
	AoA (degrees)	67.5 (all paths)		67.5 (all paths)	
Base Station	Topology	0.5λ-spacing			
	PAS	Laplacian distribution with RMS angle spread of 2 degrees per path depending on AoA/AoD			
	AoD/AoA (degrees)	50^o for 2^o RMS angle spread per path 20^o for 5^o RMS angle spread per path			

Sub-path Spatial parameters AoD and AoA offset

- sub-path AoD and AoA offset

Sub-path # (*m*)	Offset for a 2 deg AS at BS (Macrocell) $\Delta_{n,m,AoD}$ (degrees)	Offset for a 35 deg AS at MS $\Delta_{n,m,AoA}$ (degrees)
1, 2	± 0.0894	± 1.5649
3, 4	± 0.2826	± 4.9447
5, 6	± 0.4984	± 8.7224
7, 8	± 0.7431	± 13.0045
9, 10	± 1.0257	± 17.9492
11, 12	± 1.3594	± 23.7899
13, 14	± 1.7688	± 30.9538
15, 16	± 2.2961	± 40.1824
17, 18	± 3.0389	± 53.1816
19, 20	± 4.3101	± 75.4274

System level Simulation environment

- simulation target feature
  - ✓ TDD system
  - ✓ 3 timeslot structure
  - ✓ Spatial Davison multiple Access feature (Max. 4)
  - ✓ Power control
  - ✓ Link adaptation

System level Simulation environment

simulation parameters

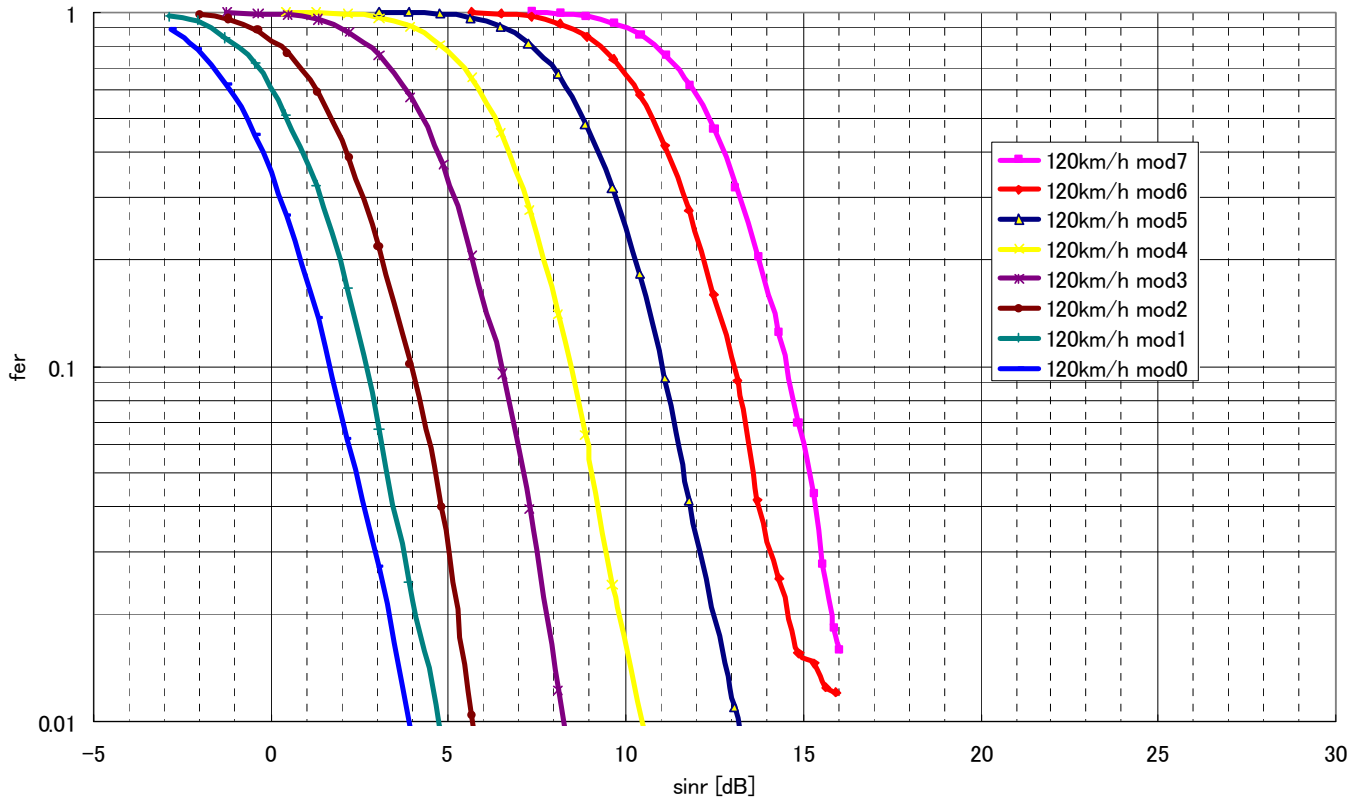
- BS antenna number 12antennas (0.5 λ)
- UT antenna number 4antennas(0.5 λ)
- 19BS 3sector
- BS max Tx power 39dBm/12ant
- UT max Tx power 27dBm
- BS antenna gain 17dBi
- UT antenna gain 0dBi
- BS NF 5dB
- UT NF 10dB
- Temperature 15℃
- BS cable loss 3dB
- UT body loss 3dB
- Simulation (2.5MHz BW= 625kHz ×4carrier)

System level simulation channel model

Channel Scenario	**Suburban Macro**
Number of paths (*N*)	6
Number of sub-paths (*M*) per-path	20
Mean AS at BS	$E[\sigma_{AS}] = 5^0$
AS at BS as a lognormal RV $\sigma_{AS} = 10\wedge(\varepsilon_{AS}x + \mu_{AS}),\ x \sim \eta(0,1)$	$\mu_{AS} = 0.69$ $\varepsilon_{AS} = 0.13$
$r_{AS} = \sigma_{AoD} / \sigma_{AS}$	1.2
Per-path AS at BS (Fixed)	2^0
BS per-path AoD Distribution standard distribution	$\eta(0, \sigma^2_{AoD})$ where $\sigma_{AoD} = r_{AS}\sigma_{AS}$
Mean AS at MS	$E[\sigma_{AS,MS}] = 68^0$
Per-path AS at MS (fixed)	35^0
MS Per-path AoA Distribution	$\eta(0, \sigma^2_{AoA}(\Pr))$
Delay spread as a lognormal RV $\sigma_{DS} = 10\wedge(\varepsilon_{DS}x + \mu_{DS}),\ x \sim \eta(0,1)$	$\mu_{DS} = -6.80$ $\varepsilon_{DS} = 0.288$
Mean total RMS Delay Spread	$E[\sigma_{DS}] = 0.17\ \mu s$
$r_{DS} = \sigma_{delays} / \sigma_{DS}$	1.4
Distribution for path delays	
Lognormal shadowing standard deviation	10dB
Pathloss model (dB), *d* is in meters	$31.5 + 35\log_{10}(d)$

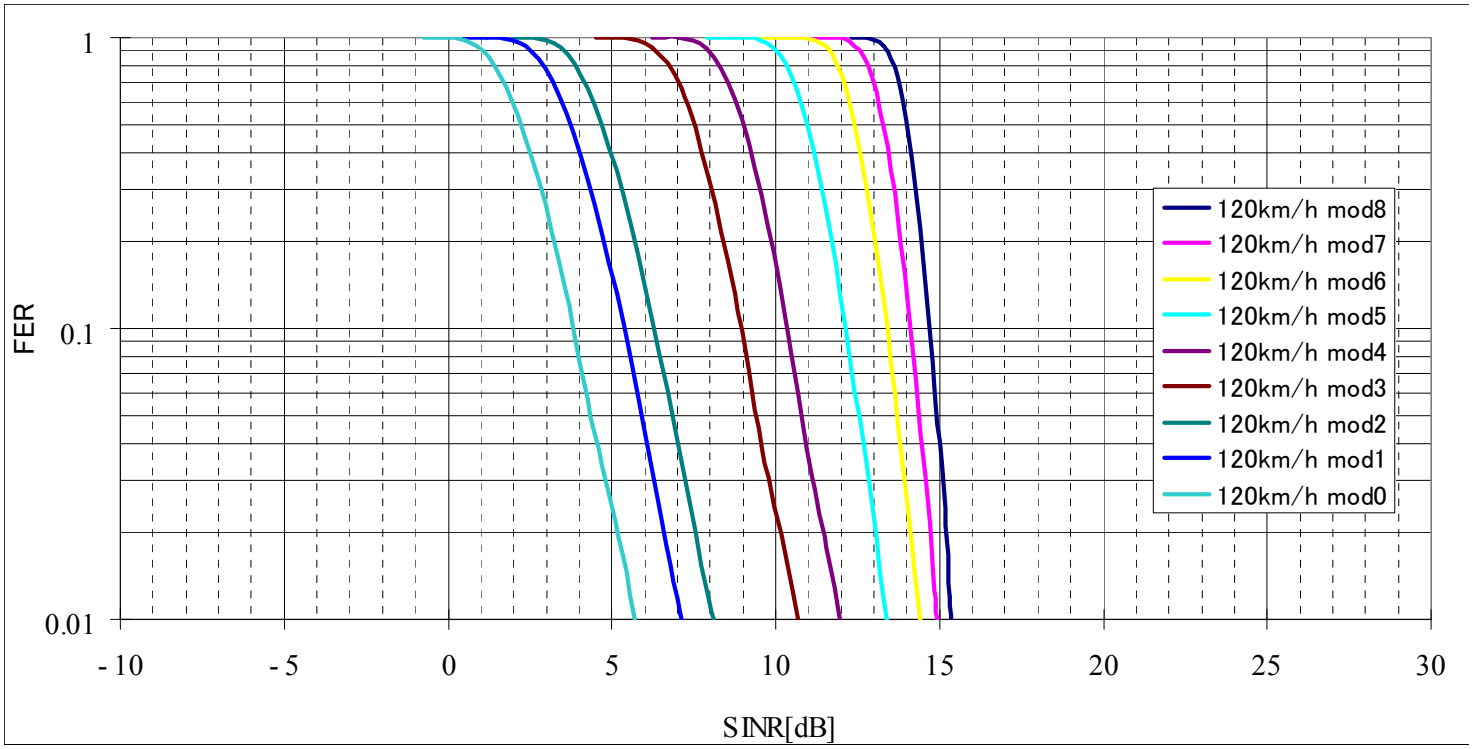
Link level simulation Result

- Uplink (Vehicular B model) FER vs. SINR Performance



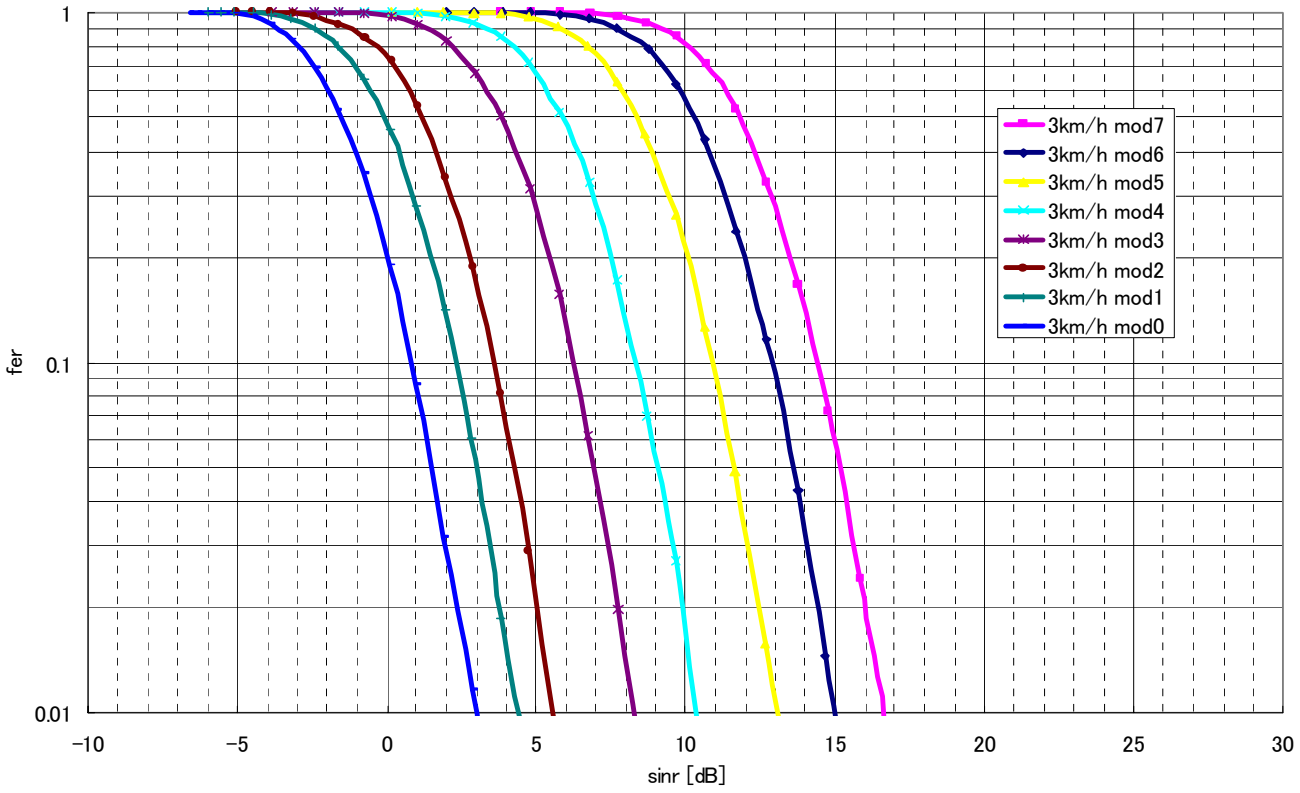
Link level simulation Result

- Downlink (Vehicular B model) FER vs. SINR Performance



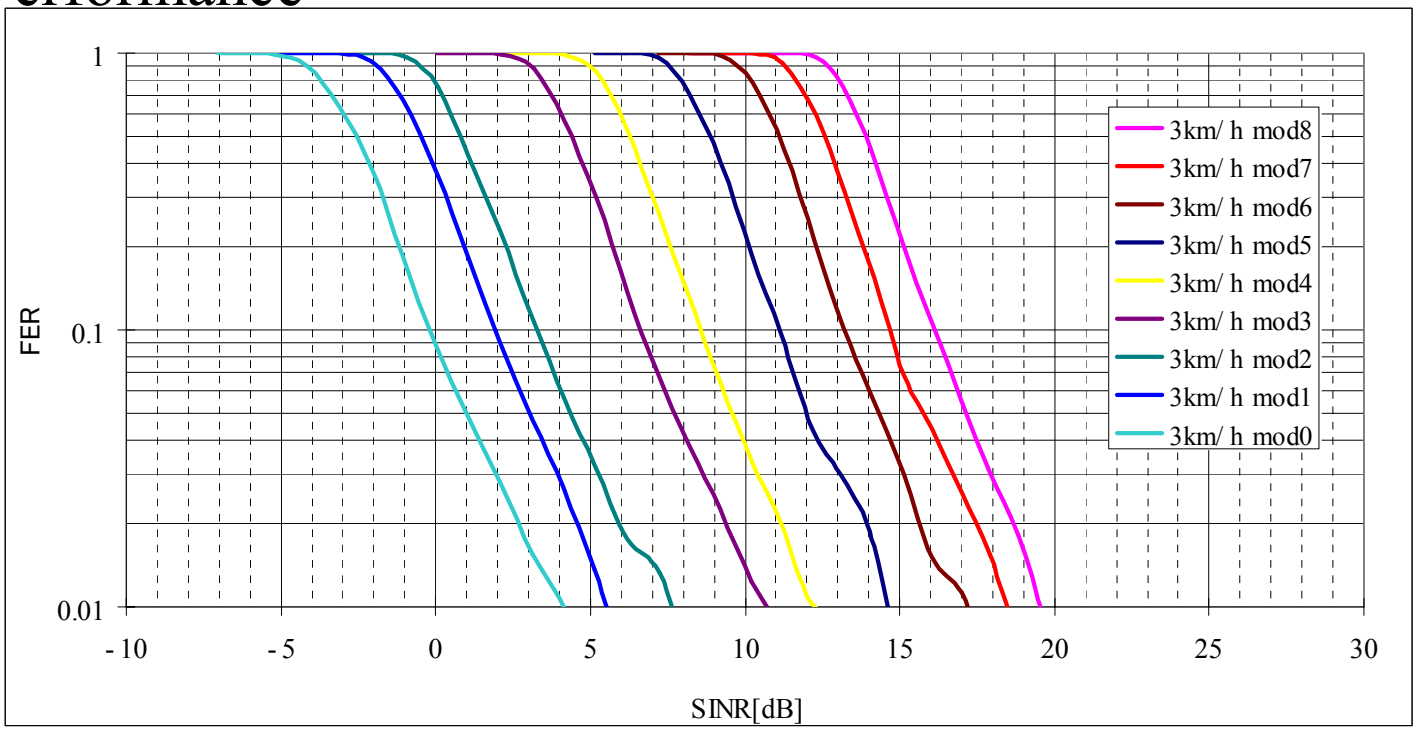
Link level simulation Result

- Uplink (Pedestrian B model) FER vs. SINR Performance



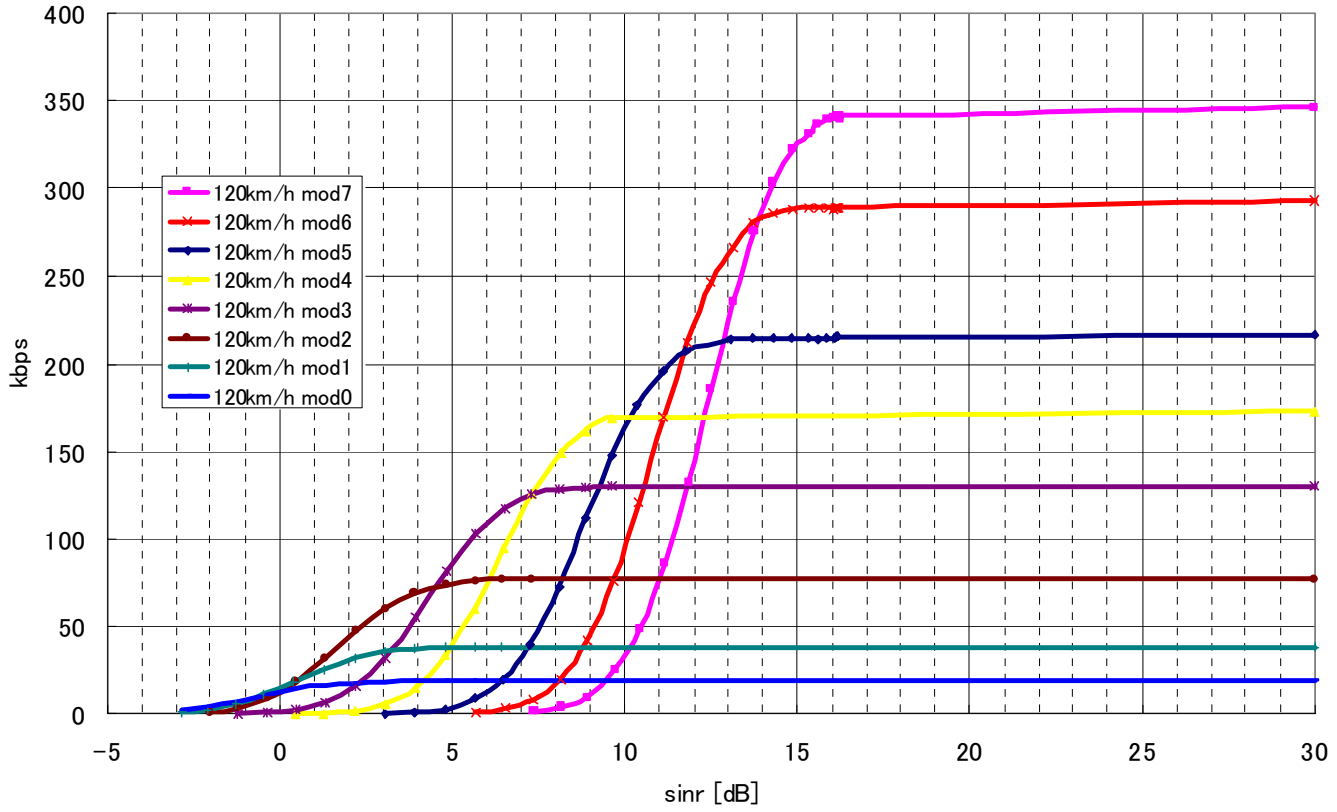
Link level simulation Result

- Downlink (PedestrianB model) FER vs. SINR Performance



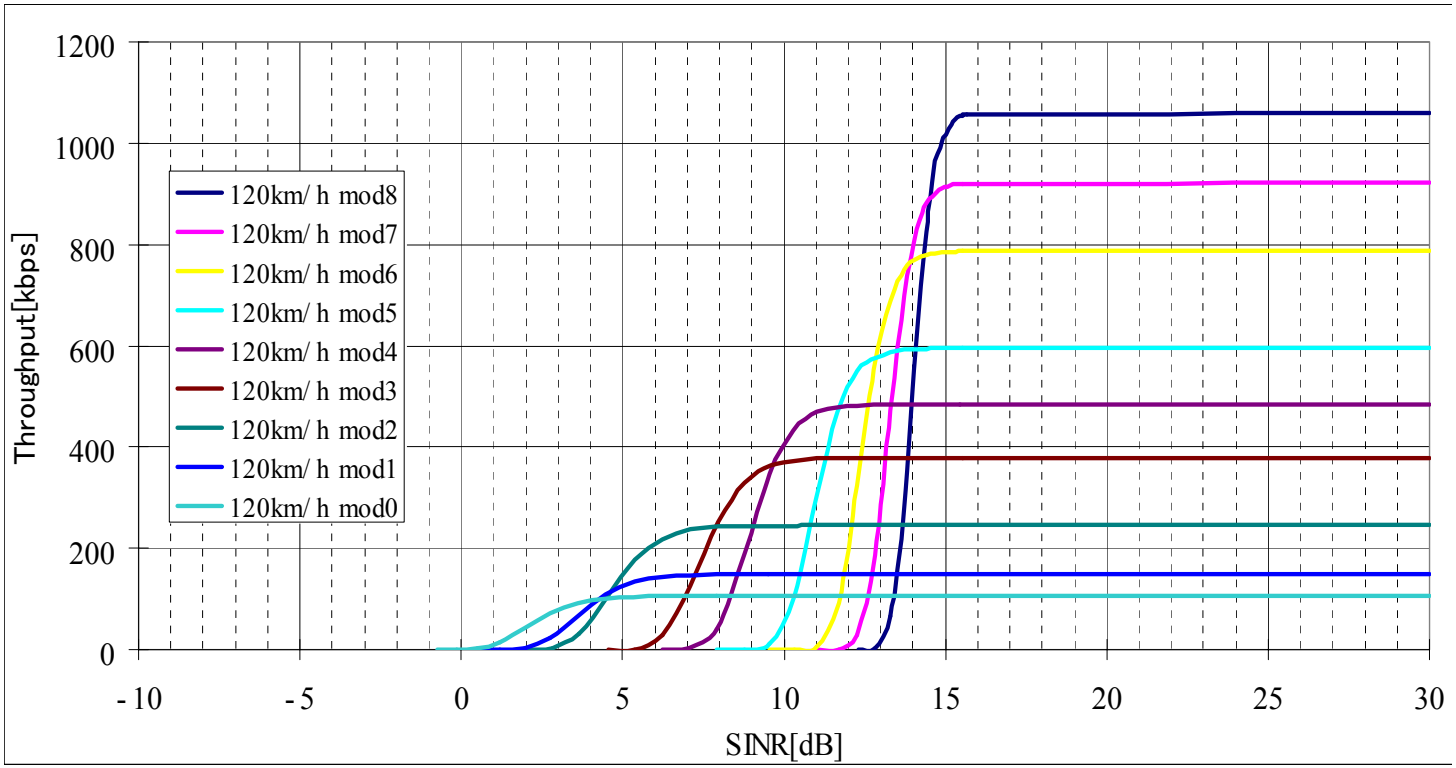
Link level simulation Result

- Uplink (Vehicular B model) Throughput vs. SINR



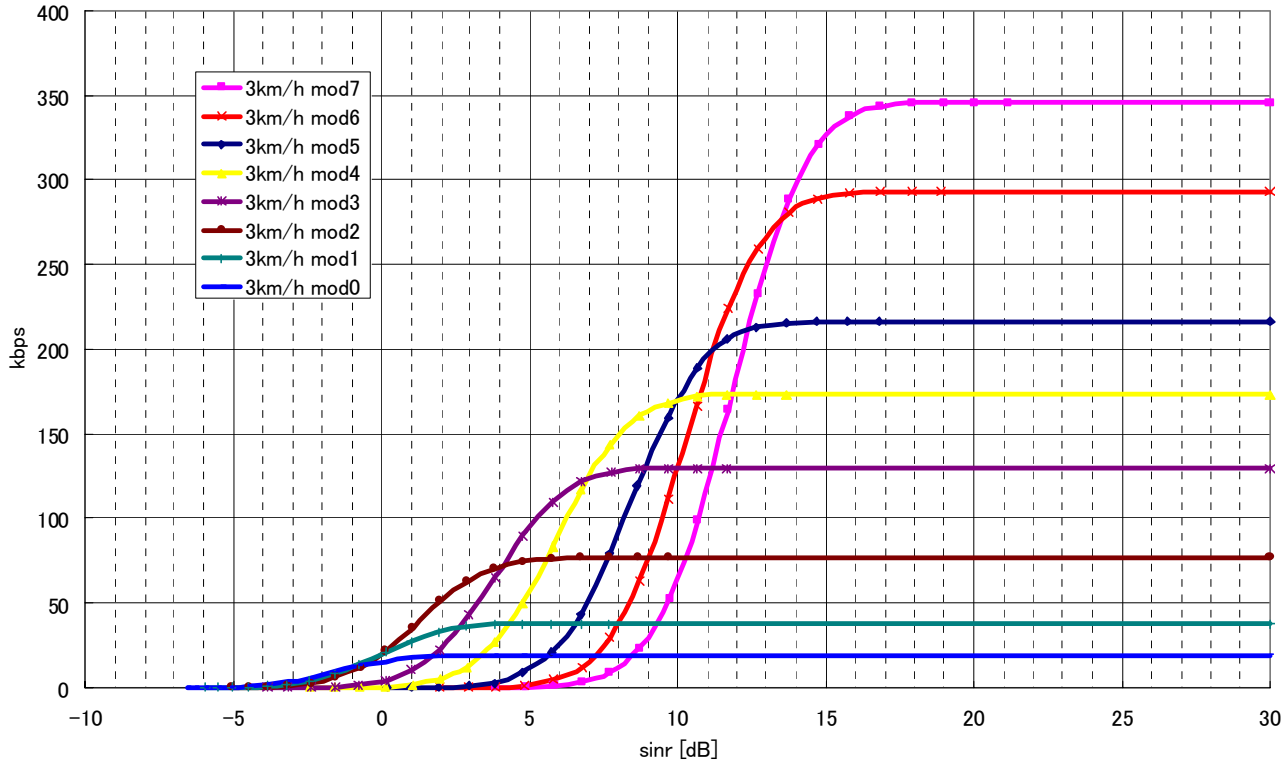
Link level simulation Result

- Downlink (Vehicular B model) Throughput vs. SINR



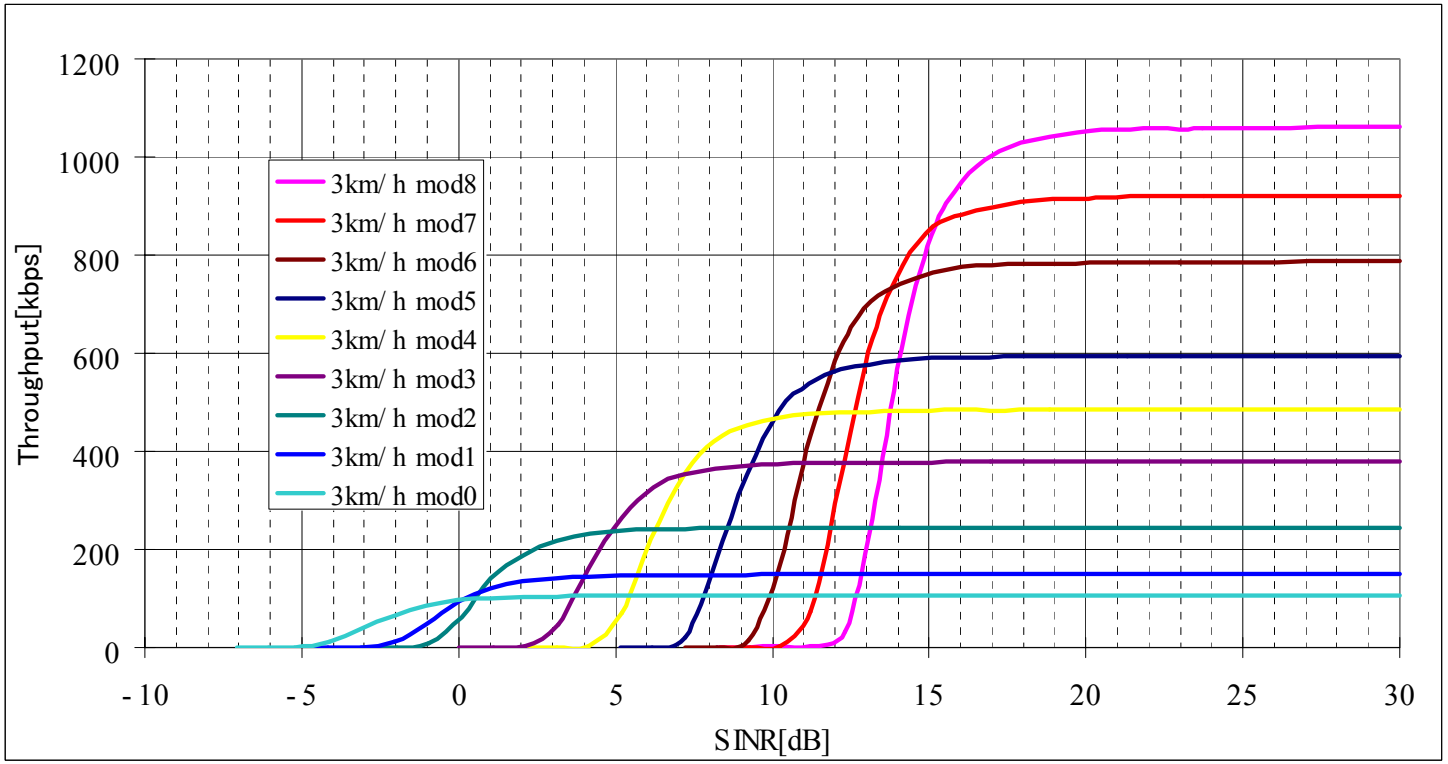
Link level simulation Result

- Uplink (Pedestrian B model) Throughput vs. SINR



Link level simulation Result

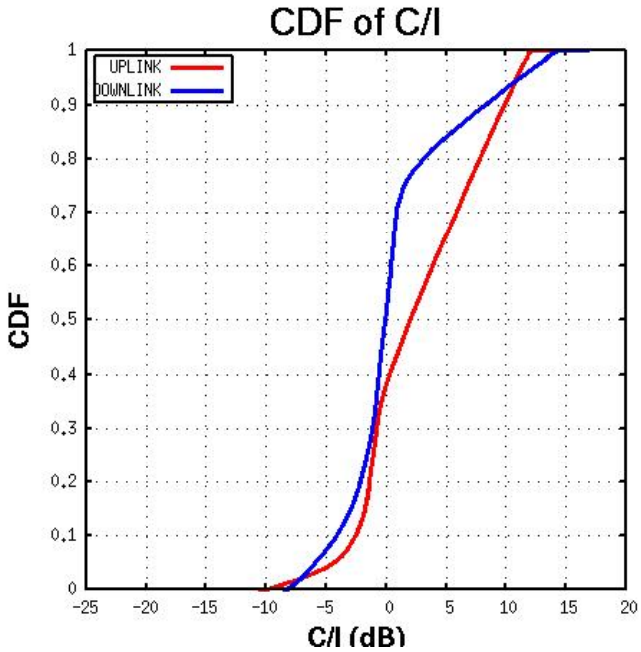
- Downlink (Pedestrian B model) Throughput vs. SINR



System level simulation calibration result

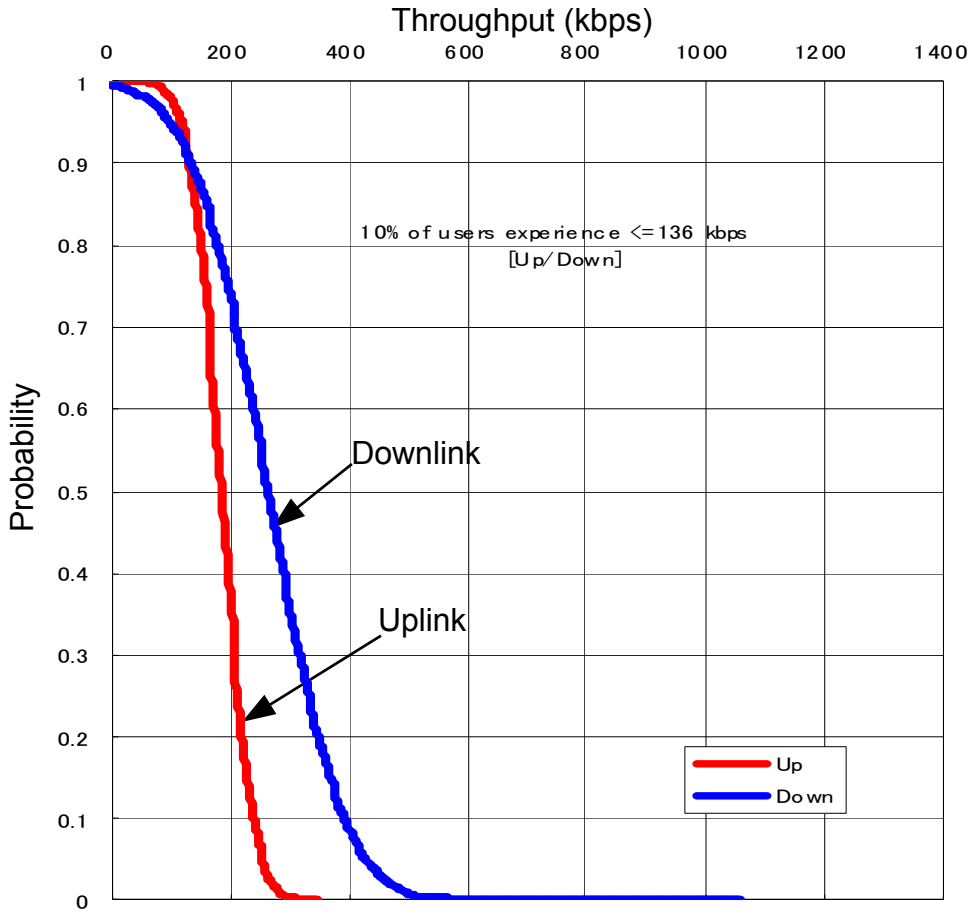
System level simulation calibration condition and parameters

- Number of paths: 1
- Environment: Suburban macro
- Number of BS & MS antenna: 1
- Inter BS separation 2.5km
- Number of carriers: 1(625kHz).
- 1 user/timeslot @sector
  - user1 @ (-60, R/2) intimeslot1
  - user2 @ (0,R/2) in timeslot2
  - user3 @ (60, R) in timeslot3
  - (degree, distance from the BS)



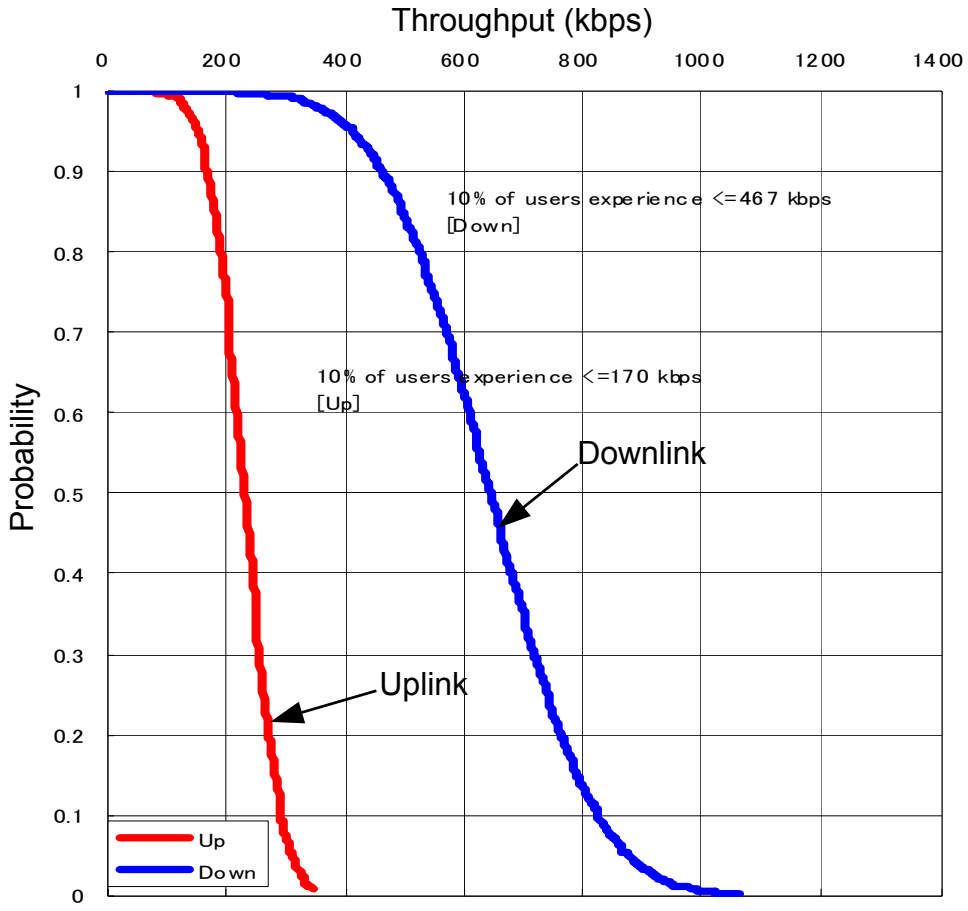
System level simulation result

- 120km/h User Date Rate CDF

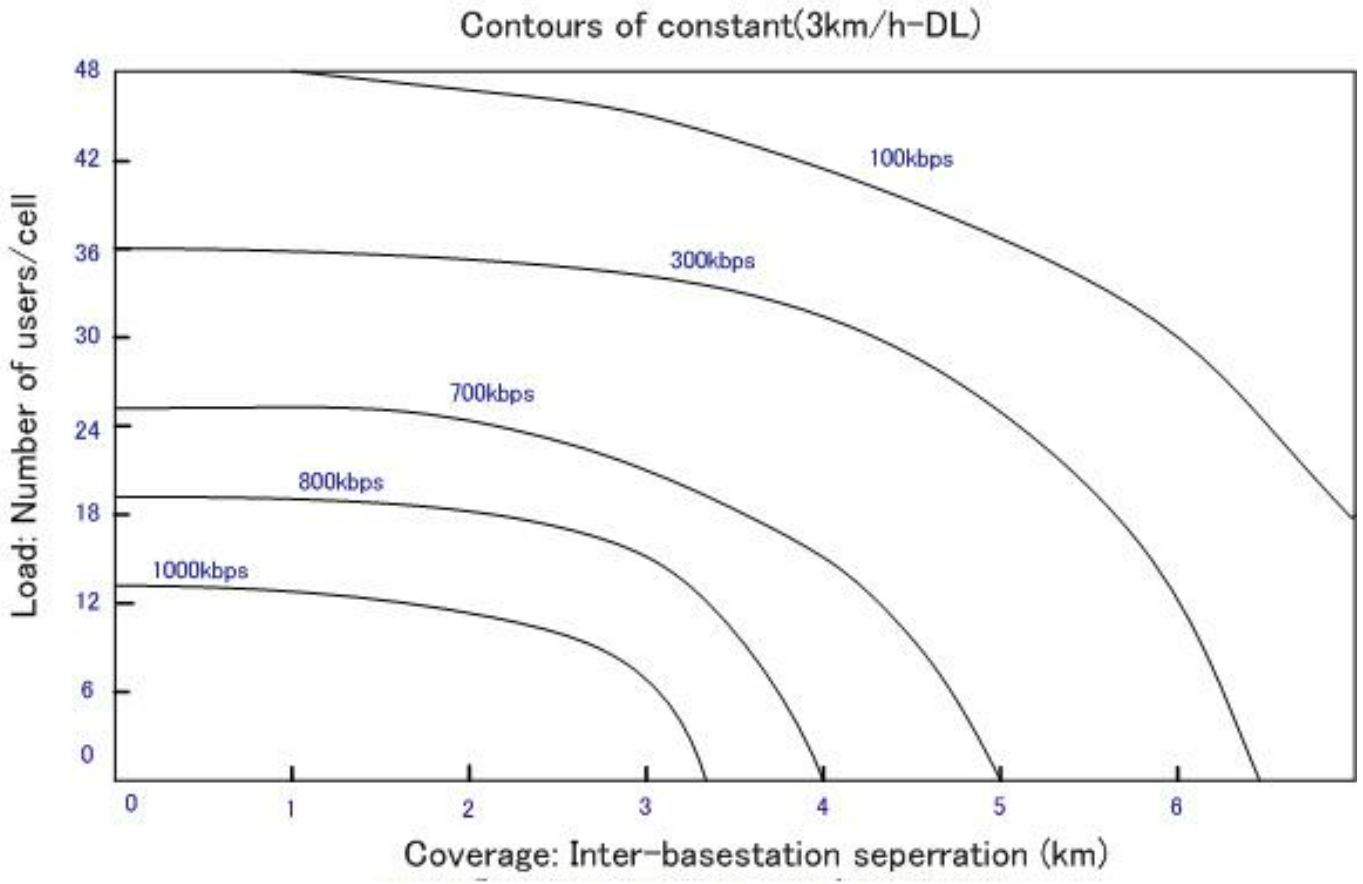


System level simulation result

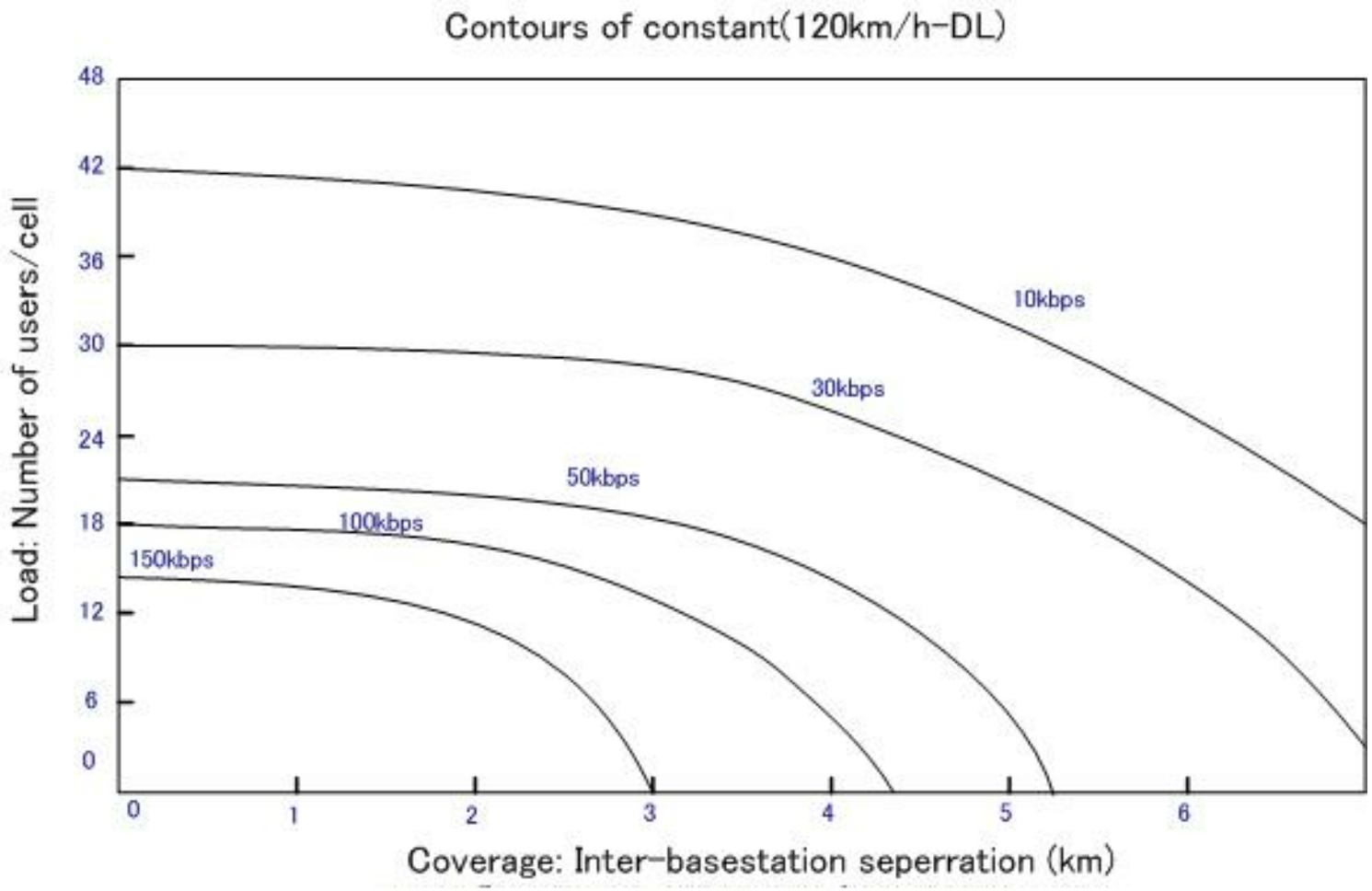
- 3km/h User Date Rate CDF



- Load User vs. Base station Separation
  Downlink -3 Kmph

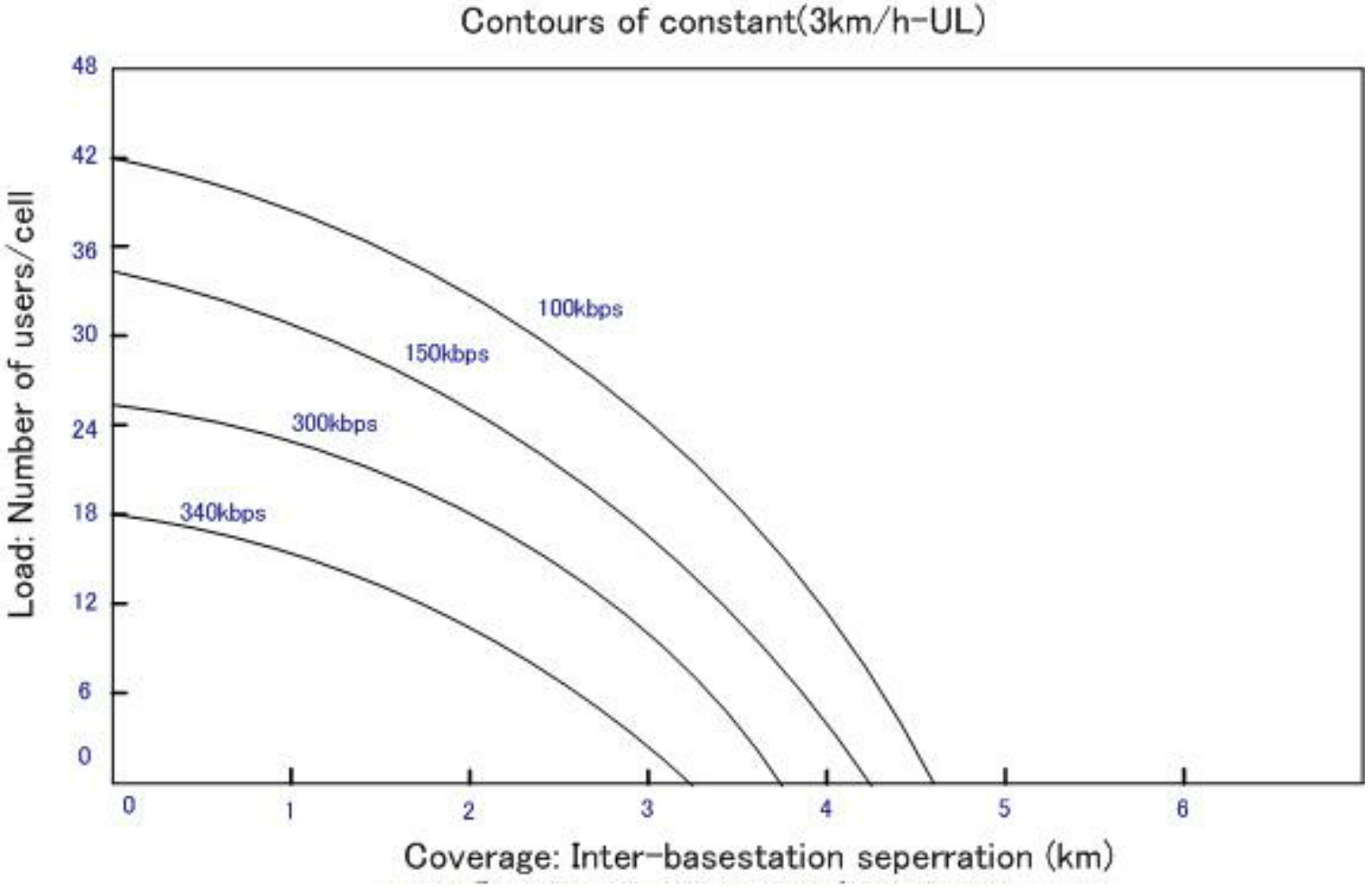


- Load User vs. Base station Separation
  Downlink -120 Kmph



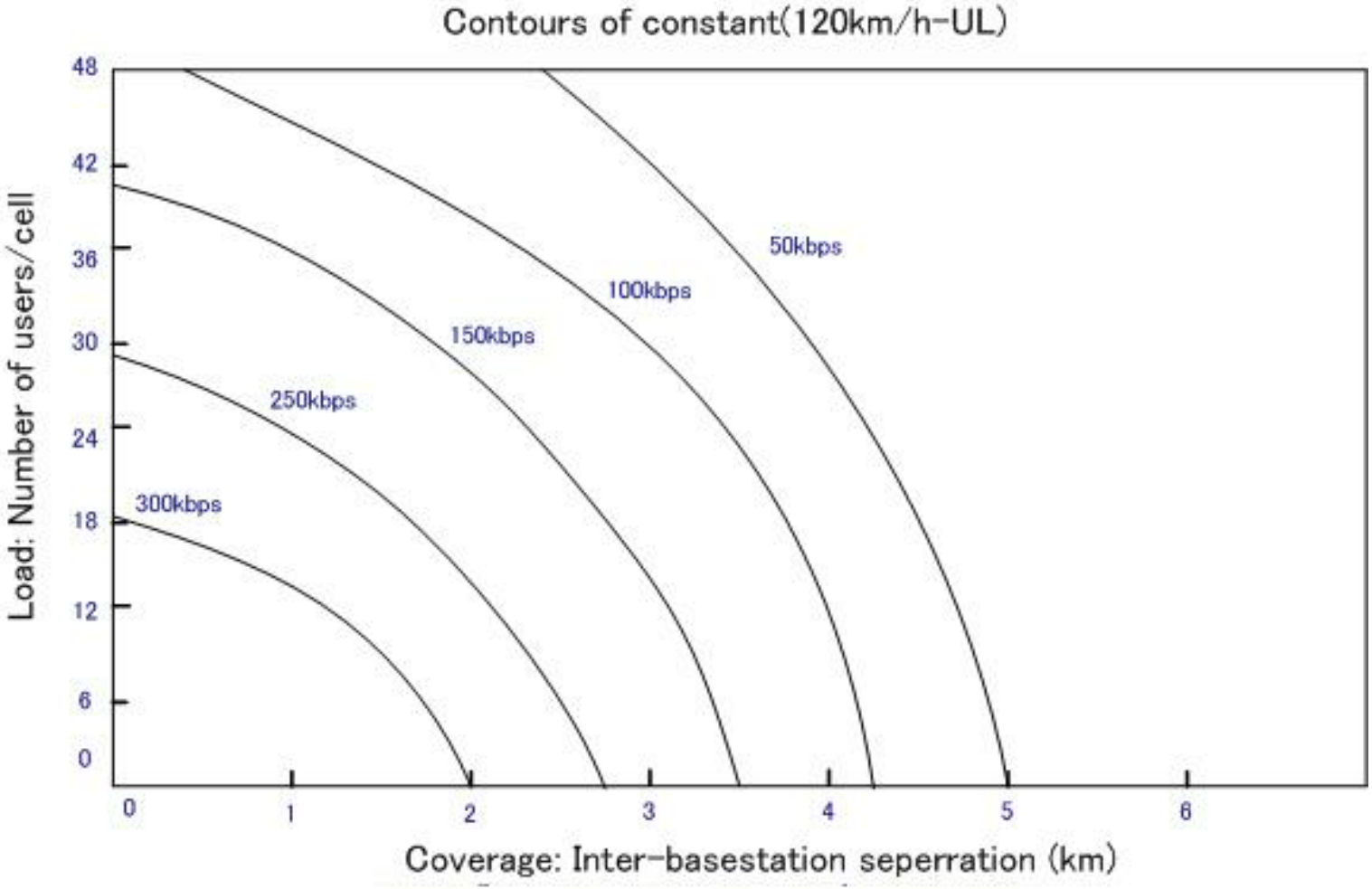
- Load User vs Base station Separation

  Uplink -3 Kmph



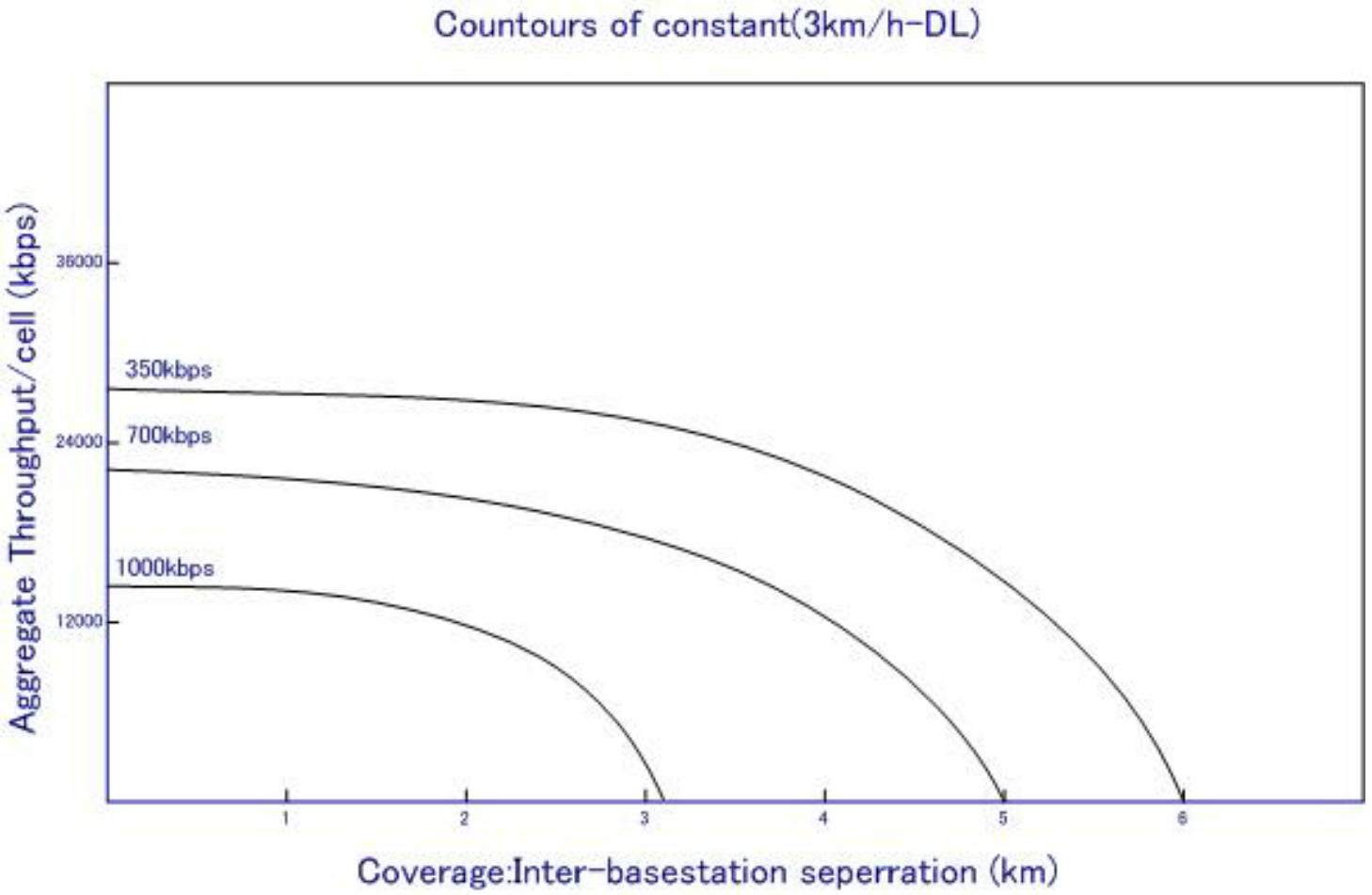
- Load User vs Base station Separation

  Uplink - 120 Kmph



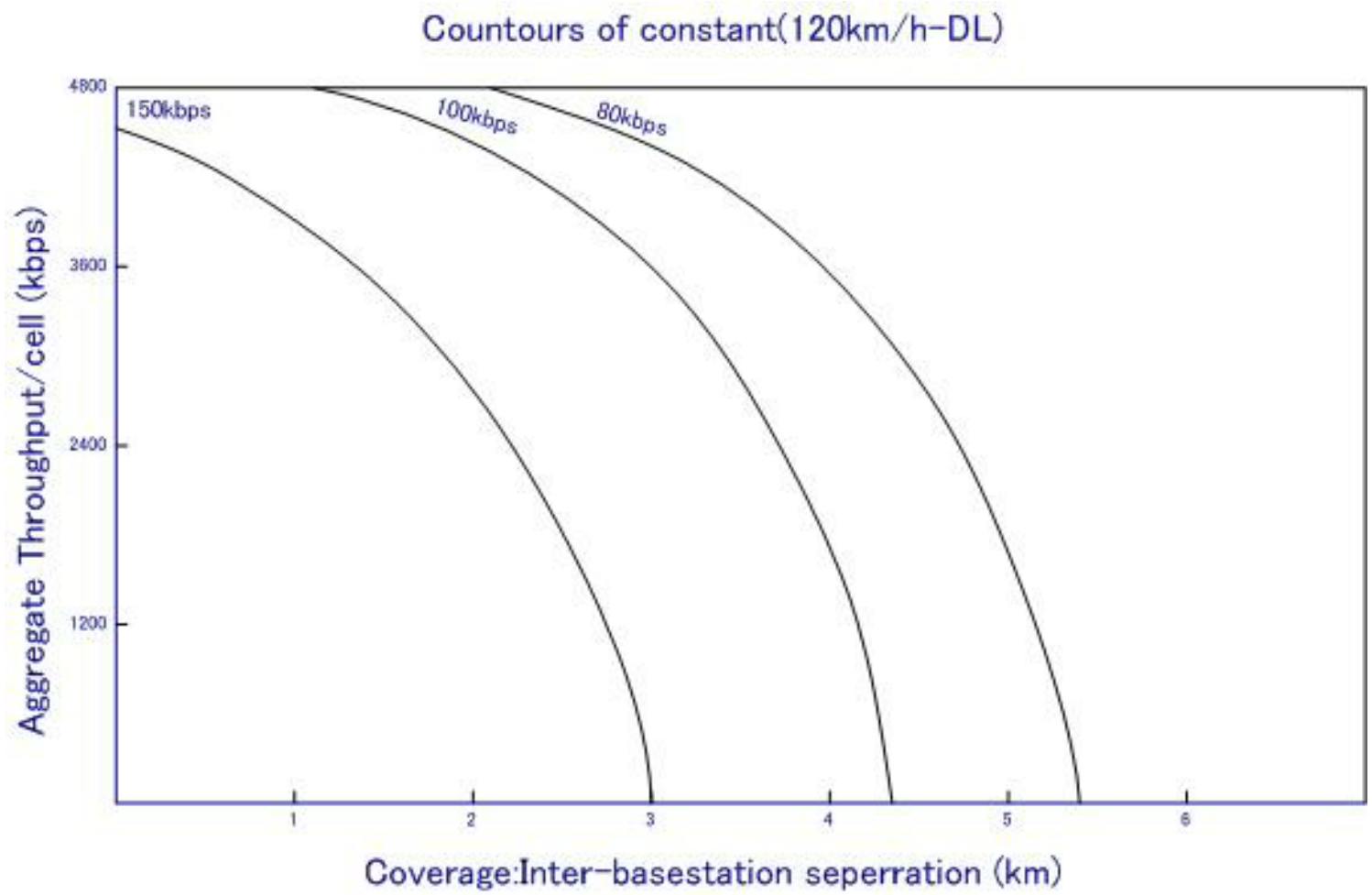
- Aggregate throughput vs Base station Separation

Downlink - 3 Kmph



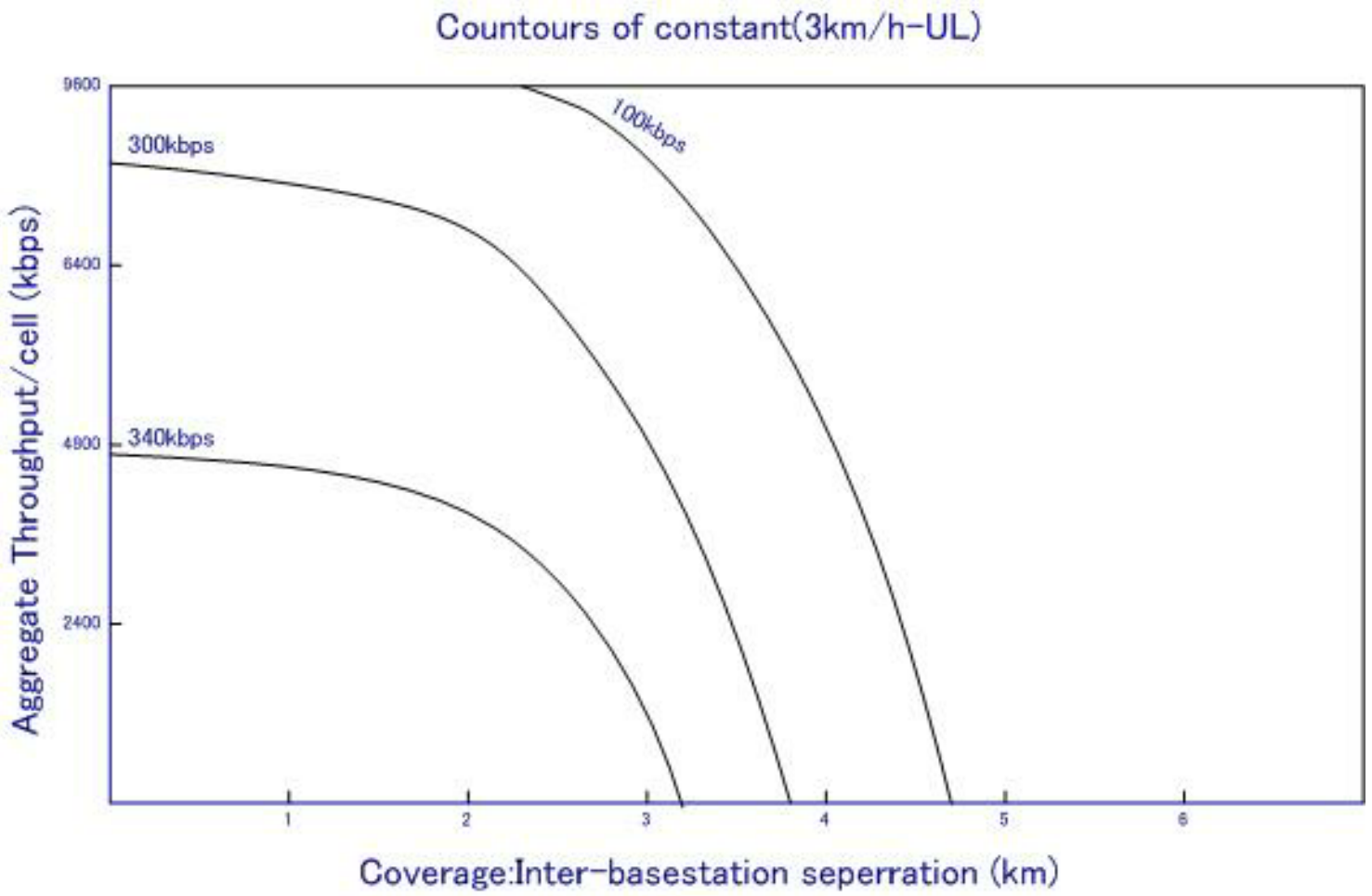
- Aggregate throughput vs Base station Separation

Downlink - 120 Kmph



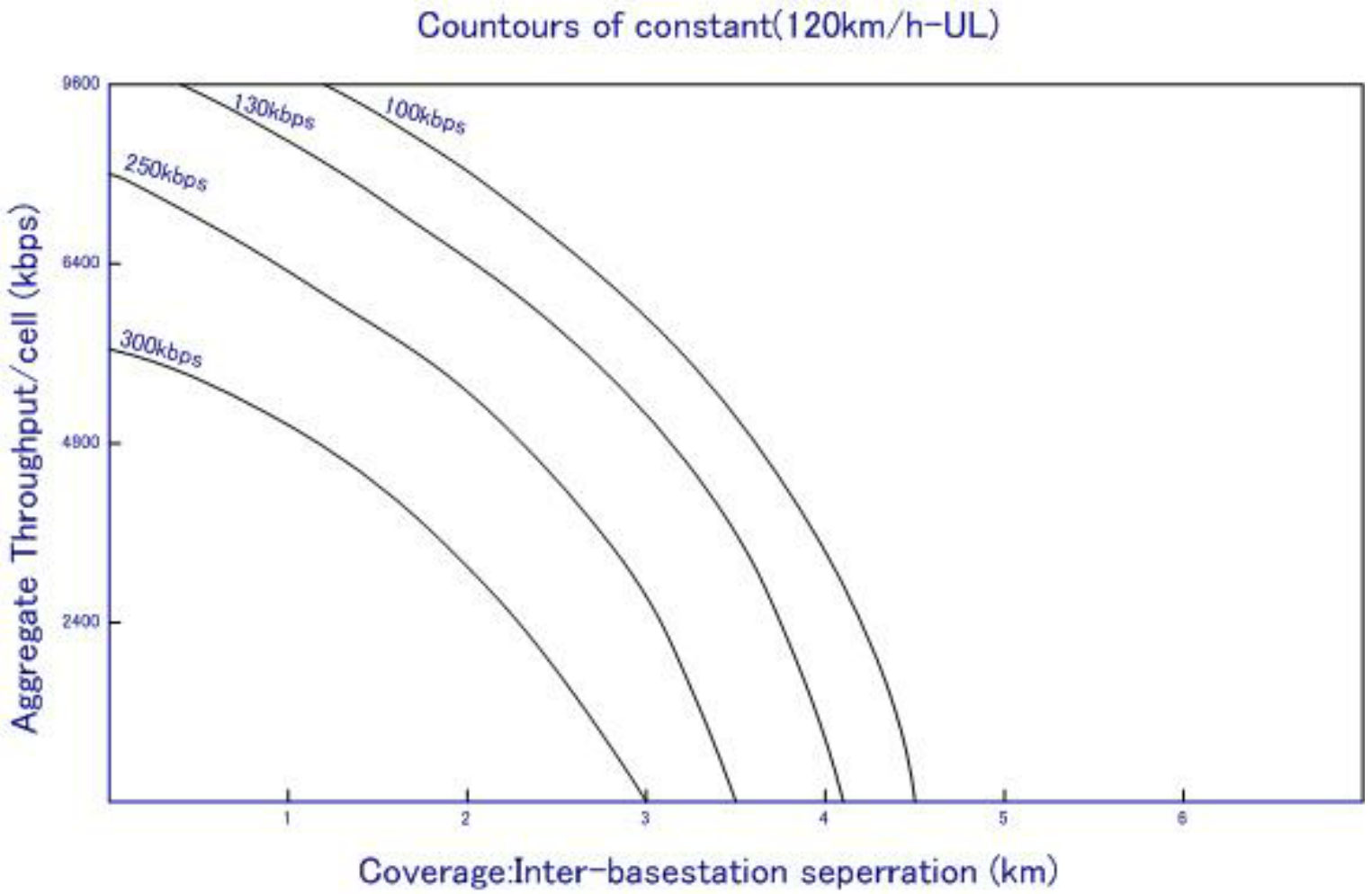
- Aggregate throughput vs Base station Separation

Uplink - 3 Kmph



- Aggregate throughput vs Base station Separation

Uplink - 120 Kmph



- Fairness criteria

The CDF of the Normalized throughput with Respect to average user throughput was determined for Cell radius 1km.

Table 7-1 Suburban Pedestrian B Case

Normalized throughput with Respect to average user throughput	Uplink	Downlink
<0.1	0.001%	0.002%
<0.2	0.006%	0.013%
<0.5	0.823%	1.128%

Table 7−2 Suburban Vehicular B Case

Normalized throughput with Respect to average user throughput	Uplink	Downlink
<0.1	0.003%	0.887%
<0.2	0.017%	1.738%
<0.5	1.257%	9.310%

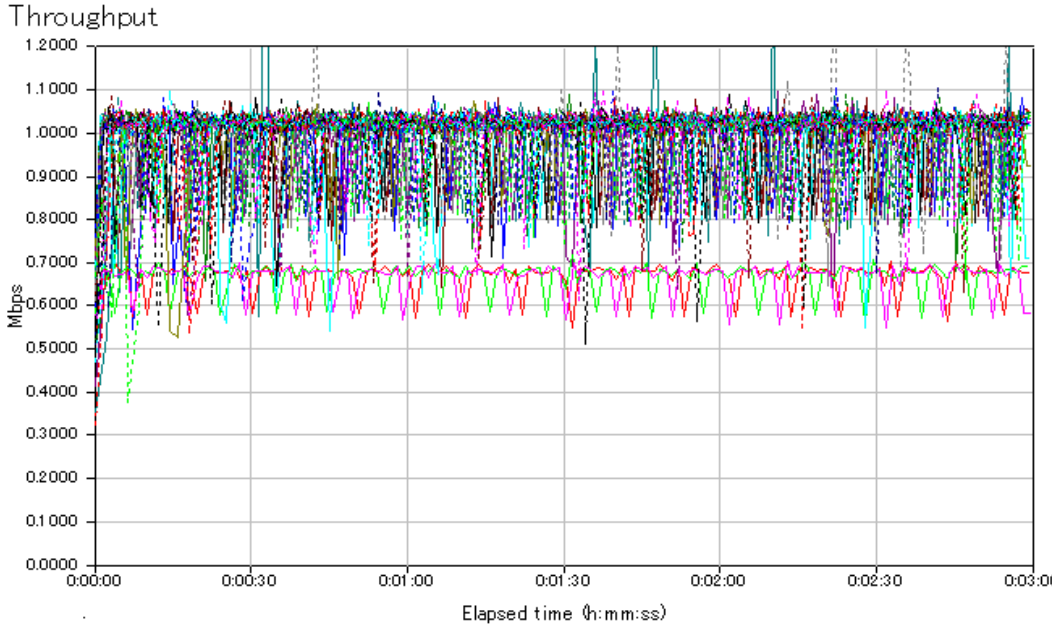
Summary Results-Simulation

	Spectral Efficiency @pedestrian B	Spectral Efficiency @Vehicular B
Uplink	3.018	2.479
Downlink	4.063	1.699

Appendix

Practical System Results

Practical System Results -Sydney



1Mbps 21Users

700Kbps 3Users

Data Flow Direction	Typical/Terminal	Total Data Rates/Basestation	Spectrum Efficiency (bit/sec/Hz/sector)
Downlink	942kbps	22.6Mbps	6.8
Uplink	290kbps	7.0Mbps	4.2
Total	1,232kbps	29.6Mbps	5.9