Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access** <http://ieee802.org/20/>	
Title	**QTDD Performance Report 1 Presentation**	
Date Submitted	**2005-10-28**	
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Re:	MBWA Call for Proposals	
Abstract	This contribution (part of the QTDD proposal package for 802.20), contains the QTDD Performance Report 1 Presentation slide set.	
Purpose	For consideration of 802.20 in its efforts to adopt a TDD proposal for MBWA.	
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QTDD Performance Report I Presentation

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Outline

- **Simulation Setups**
- Link level results
- Forward link throughput
- Reverse link throughput

Simulation Numerology

Bandwidth of Operation	10	MHz
FFT Size	1024	points
Chip rate	9.8304	Mcps
Subcarrier spacing	9.6	kHz
Guard carriers	32	subcarriers
Cyclic Prefix	6.51	μs
Windowing Duration	3.26	μs
OFDM Symbol Duration (For 6.51μs CP)	113.93	μs

Channel Models

- Evaluation report I requires the use of Suburban macro correlation model and Ped B/Veh B multipath profile.
- Suburban macro cell:
  - Option I: Laplacian model, simple.
  - Option II: SCM model, multiple cluster scattering is more realistic.
  - Both models are used in link level simulations, and correlation matrices generated from SCM is used for system level simulations.
- Multipath profiles:
  - Ped B (3 km/h), Veh B (120-250 km/h), Veh A (120-250 km/h)

Link-to-System Interface

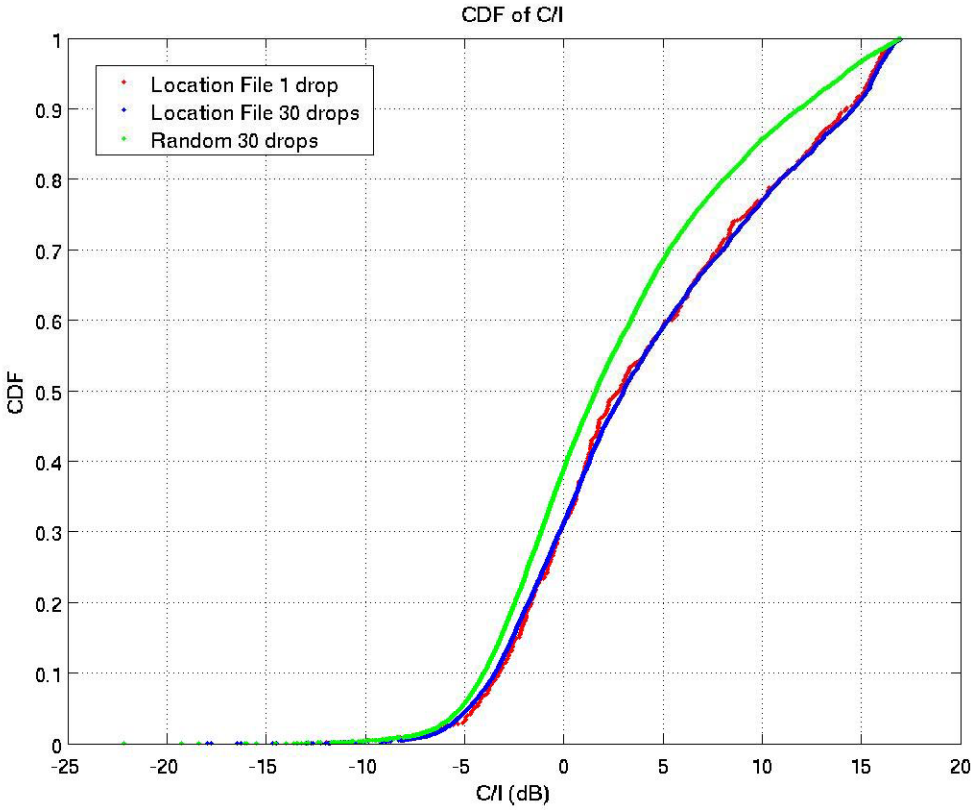
- FER versus effective C/I curves are generated from link simulation, which captures all channel effects and receiver imperfections.
- System simulation computes effective C/I of each packet and looks up the FER link curves.

$$SNR_{eff} = C^{-1}\left(\frac{1}{N}\sum_{i=1}^{N} C(SNR_i)\right)$$

- C(.) denotes the constrained capacity function corresponding to the modulation scheme being used
- When MMSE is used for spatial processing, SNR_i denotes the post MMSE processing SNR.

Location Calibration

- Calibration run is simulated with the exact cell and user locations as specified.
- Observation: highest geometry is 17 dB due to poor antenna pattern with 20 dB front-to-back ratio.



Overhead Channel Modeling

- Overhead
  - FL control overhead 10%.
  - RL control overhead 11%.
- Signaling errors
  - CQI erasure 50%.
  - Power control error 10%.
  - Error events of probability < 1% is not modeled explicitly in system simulation for full buffer simulations.

Outline

- Simulation Setups
- **Link level results**
- Forward link throughput
- Reverse link throughput

FL Packet Formats

Packet Format Index	Spectral efficiency on 1st trans-mission	Max number of trans-missions	Modulation order for each transmission					
			1	2	3	4	5	6
0	0.2	6	2	2	2	2	2	2
1	0.5	6	2	2	2	2	2	2
2	1.0	6	2	2	2	2	2	2
3	1.5	6	3	2	2	2	2	2
4	2.0	6	4	3	3	3	3	3
5	2.5	6	6	4	4	4	4	4
6	3.0	6	6	4	4	4	4	4
7	4.0	6	6	6	4	4	4	4
8	5.0	6	6	6	4	4	4	4
9	6.0	6	6	6	4	4	4	4
10	7.0	6	6	6	4	4	4	4
11	8.0	6	6	6	6	4	4	4
12	9.0	6	6	6	6	4	4	4
13	10.0	6	6	6	6	6	4	4
14	11.0	6	6	6	6	6	4	4
15	NULL							

RL Packet Formats

Packet format index	Spectral efficiency on 1st transmission	Max number of transmissions	Modulation order for each transmission					
			1	2	3	4	5	6
0	0.25	6	2	2	2	2	2	2
1	0.50	6	2	2	2	2	2	2
2	1.0	6	2	2	2	2	2	2
3	1.5	6	3	2	2	2	2	2
4	2.0	6	3	3	2	2	2	2
5	2.67	6	4	4	3	3	3	3
6	4.0	6	4	4	3	3	3	3
7	6.0	6	4	4	4	3	3	3
8	8.0	6	4	4	4	4	4	3

FL and RL Peak Rates

Parameter	Bandwidth 5 MHz	
	Forward Link	Reverse Link
Required Peak Rate	18 Mbps	9 Mbps
QTDD Proposal	64 Mbps	9.2 Mbps

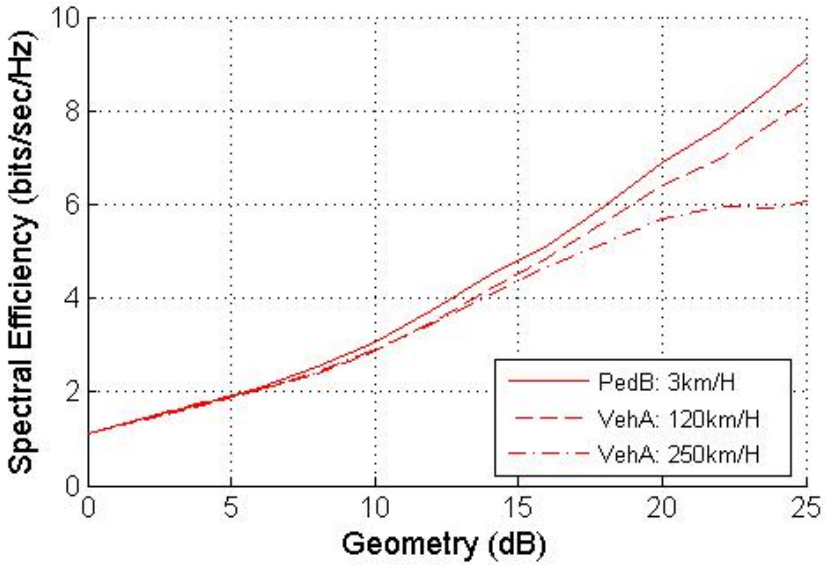
FL Mobility

- MIMO performance is more sensitive to the channel estimation errors due to mobility and multipath delay.
- Experiments assuming 4x4 MIMO SCW with linear MMSE receiver.
- Simulations capture the loss due to channel estimation error, coding, and hybrid ARQ.
- Spectral efficiency takes into account the pilot overhead.
- Correlation models
  - Laplacian AS distribution.
    - BS: AoD 50°, AS 2°, MS: AoA 67.5°, AS 35 °
  - SCM
    - BS: AoD 50 °, AS 2°, MS: average AoA, AS AS 35 °

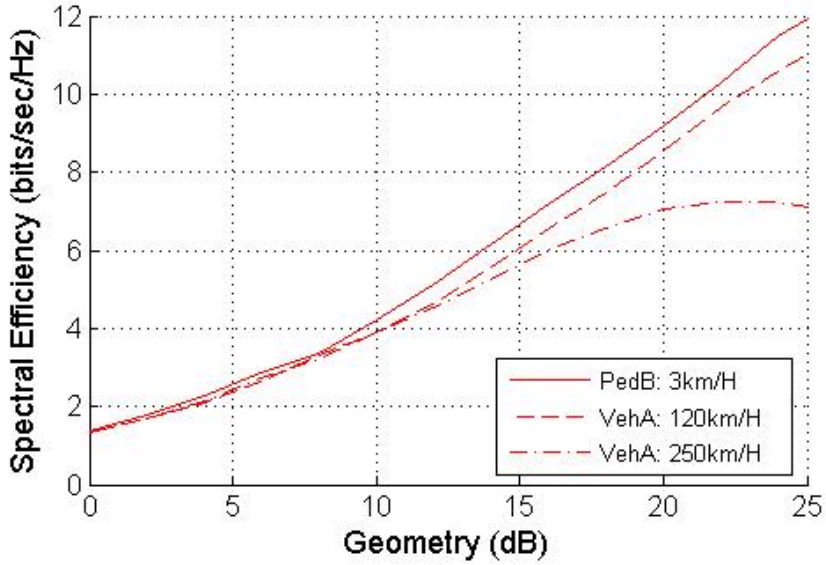
* Spectral efficiency takes into account the pilot overhead.

FL Mobility

- Slight performance degradation up to 120 km/h.
- Support > 6 bps/Hz at 22 dB with vehA 250 km/h.
- Laplacian model results in unrealistic high channel correlation.



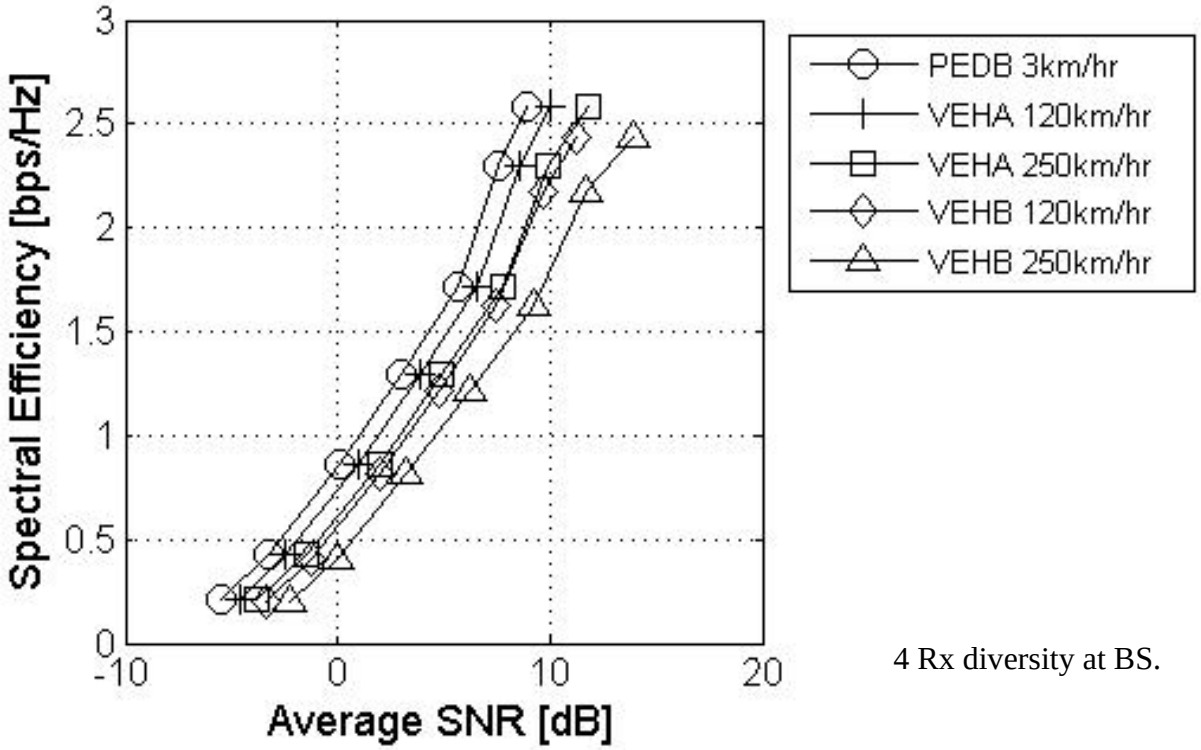
Laplacian Model



SCM Model

RL Mobility

- For each packet format, an average SNR is obtained to meet the 1% FER.
- Spectral efficiency takes into account the pilot overhead and 1% loss in throughput due to packet error.
- Slight performance degradation at 120 km/h.
- Support approximately 2.5 bps/Hz at 250 km/h.



4 Rx diversity at BS.

Forward Link Link Budget

- Mobile station 2 Rx, mobile throughput 1.98 Mbps

CHANNEL	Maximum Pathloss (dB)	Maximum Range (m)
I (ped-A)	138.7	1157
II (veh-A)	142.2	1456
III (ped-B)	141.7	1409
IV (veh-B)	142	1437

Reverse Link Link Budget

- Base station 4 Rx, mobile data rate 64 Kbps

CHANNEL	Maximum Pathloss (dB)	Maximum Range (dB)
I (ped-A)	135.5	936
II (veh-A)	137.6	1078
III (ped-B)	137.3	1057
IV (veh-B)	136.9	1029

Outline

- Simulation Setups
- Link level results
- **Forward link throughput**
- Reverse link throughput

Forward link Spectral Efficiency

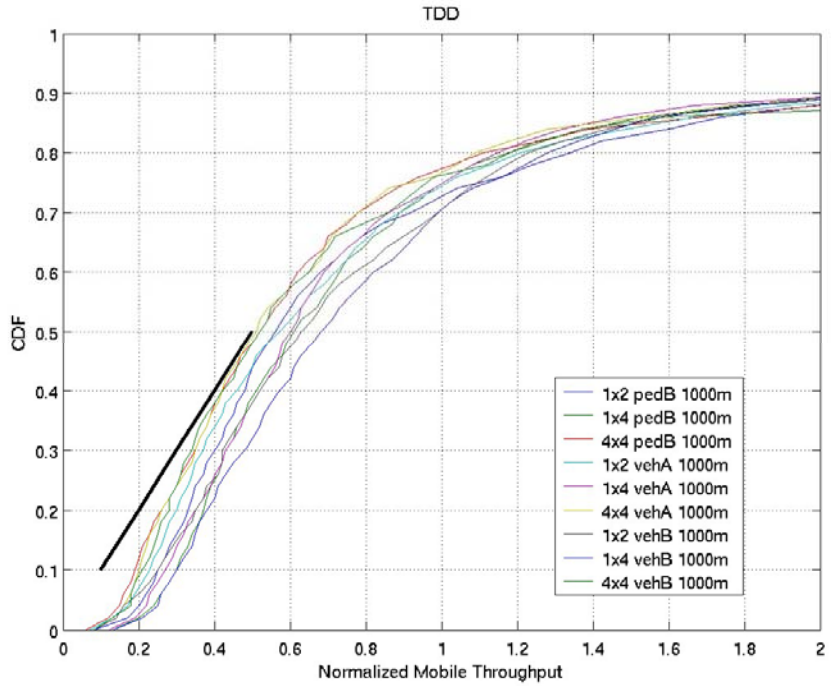
- MIMO 4x4 suburban macro spectral efficiency 1km BS to BS

	PedB 3km/hr	VehA 120km/hr
Required (b/s/Hz/sector)	2.0	1.5
QTDD (b/s/Hz/sector)	2.11	1.85

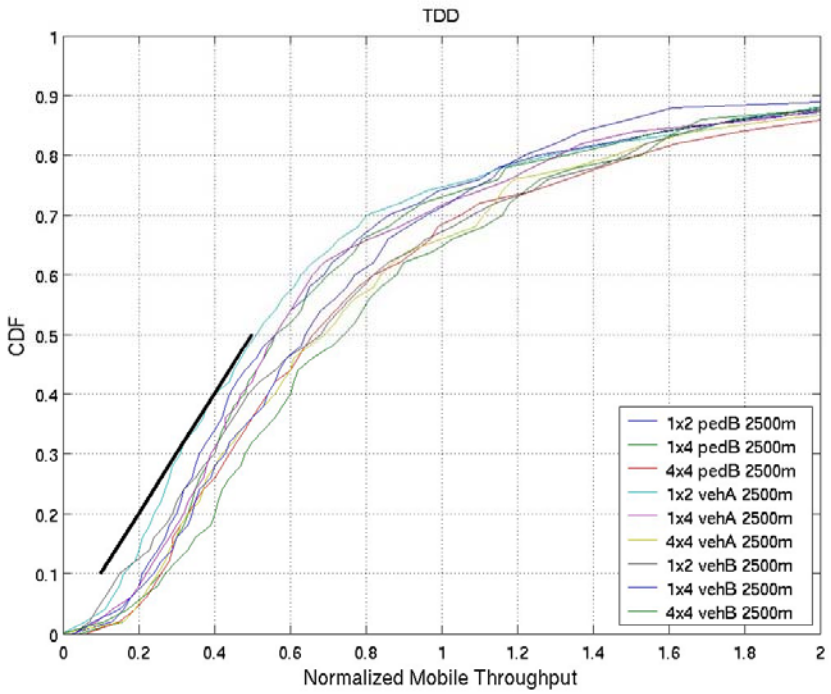
Forward link Data Throughput

Sector Throughput (Kbps)		1x2	1x4	4x4
1km BS to BS	pedB 3km/h	5775	7409	10544
	vehA 120km/h	5366	6801	9262
	vehB 120km/h	3096	4613	6599
2.5km BS to BS	pedB 3km/h	5659	7152	9119
	vehA 120km/h	5048	6765	7784
	vehB 120km/h	2944	4300	5354

Forward Link Fairness

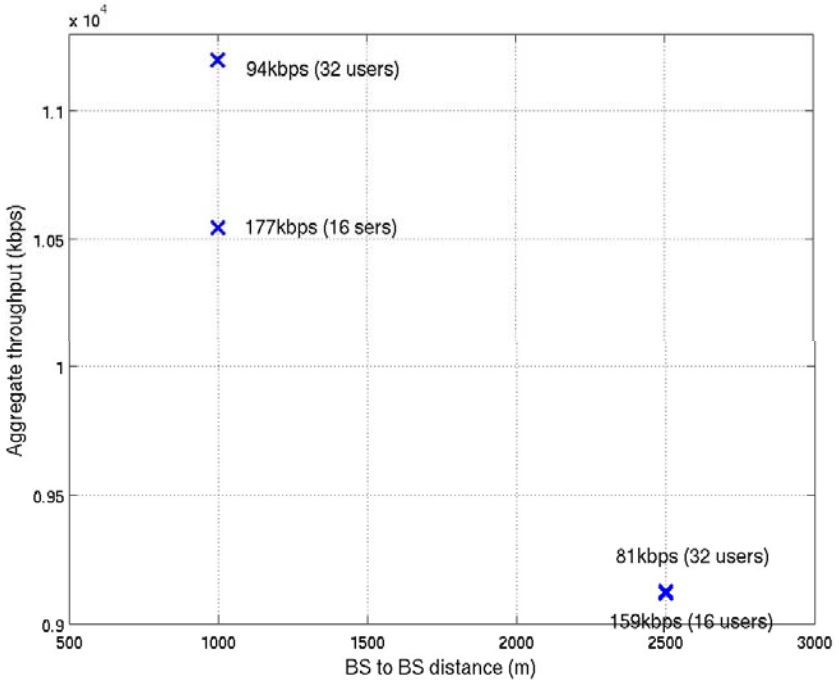


MIMO 4x4, 1000m BS to BS

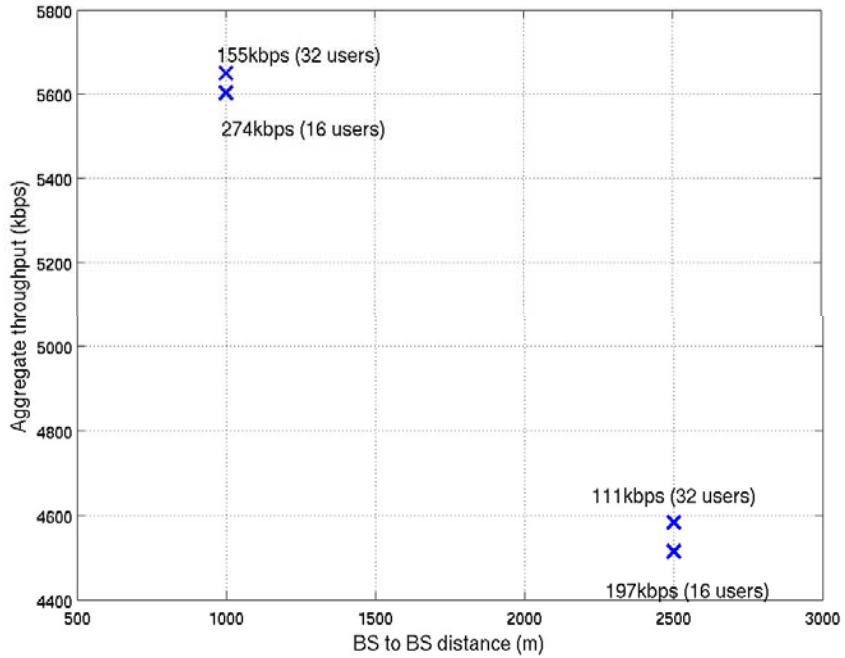


MIMO 4x4, 2500m BS to BS

Forward Link Coverage Tradeoff



802.20 Fariness Scheduling



Equal Grade of Service Scheduling

Minimum service level (80% user data rate) for a 4x4 MIMO system

Outline

- Simulation Setups
- Link level results
- Forward link throughput
- **Reverse link throughput**

Reverse Link Spectral Efficiency

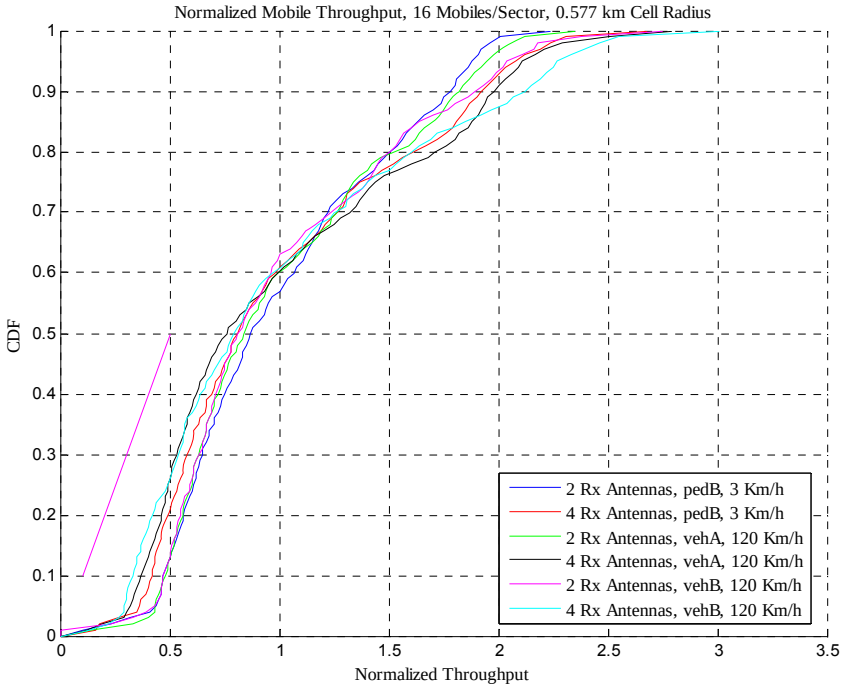
- Suburban macro spectral efficiency with 4 Rx and 1 km BS to BS

Parameter	**PedB 3km/hr**	**VehA 120km/hr**
Required (b/s/Hz/sector)	**1.0**	**0.75**
QTDD (b/s/Hz/sector)	**1.27**	**1.15**

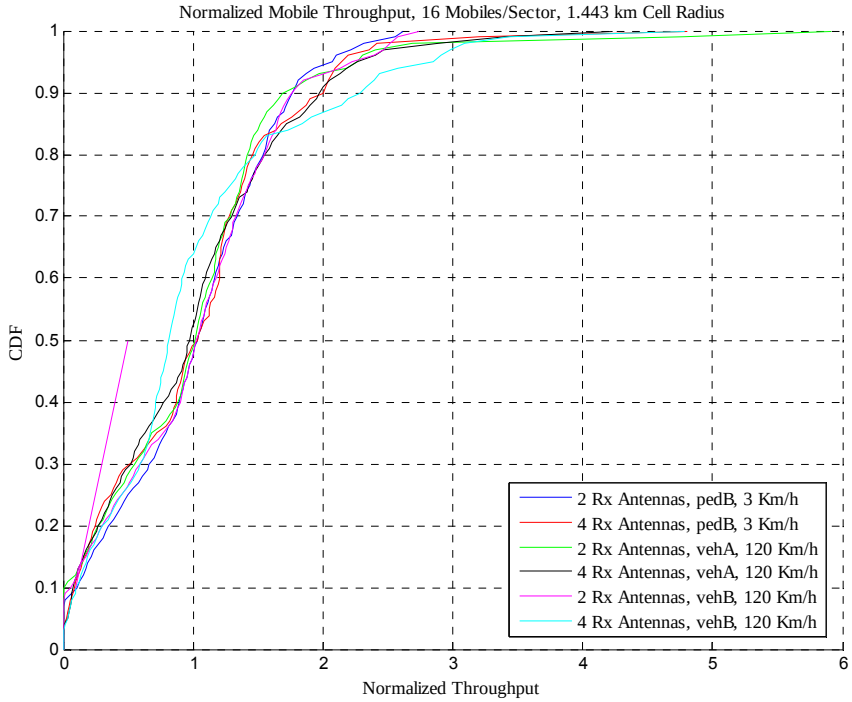
Reverse Link Spectral Efficiency

Sector Throughput (Kbps)		1x2	1x4
1km BS to BS	pedB 3km/h	3938	6341
	vehA 120km/h	3387	5746
	vehB 120km/h	2949	5210
2.5km BS to BS	pedB 3km/h	3140	4900
	vehA 120km/h	2516	4341
	vehB 120km/h	2656	3881

Reverse Link Fairness

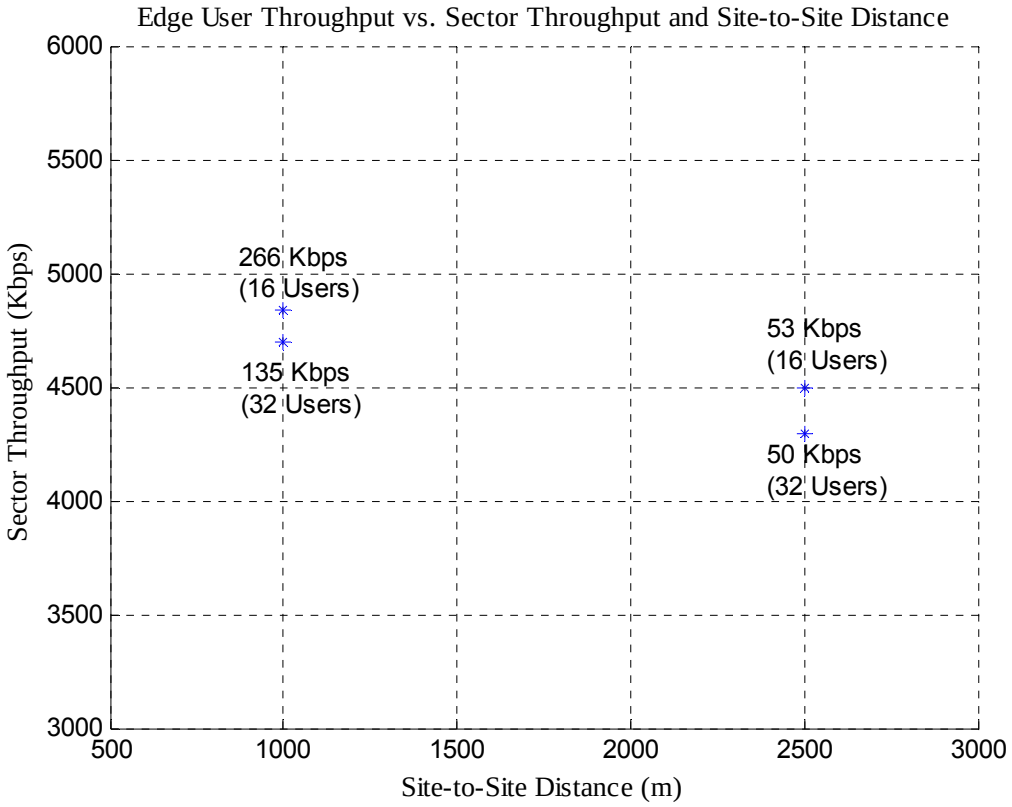


1000m BS to BS



2500m BS to BS

Reverse Link Coverage



Minimum service level (80% user data rate) for a 4 Rx diversity system