

Project	IEEE 802.20 Working Group on Mobile Broadband Wireless Access < http://ieee802.org/20/ >	
Title	MBFDD Performance Report 1 Presentation	
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Re:	MBWA Call for Proposals	
Abstract	This contribution (part of the MBFDD proposal package for 802.20), contains the MBFDD Performance Report 1 Presentation slide set.	
Purpose	For consideration of 802.20 in its efforts to adopt an FDD proposal for MBWA.	
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MBFDD 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	2x5	MHz
FFT Size	512	points
Chip rate	4.9152	Mcps
Subcarrier spacing	9.6	kHz
Guard carriers	32	subcarriers
Cyclic Prefix	6.51	μ s
Windowing Duration	3.26	μ s
OFDM Symbol Duration (For 6.51 μ s CP)	113.93	μ s

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)

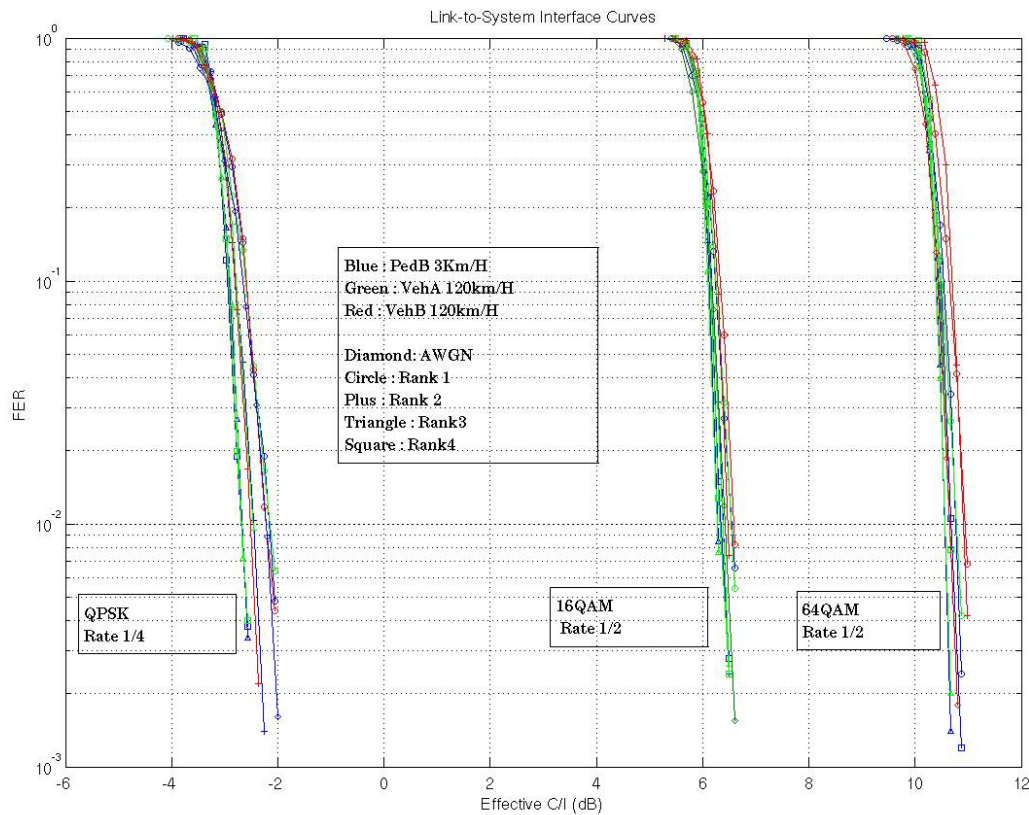
Link-to-System Interface

- 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.

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

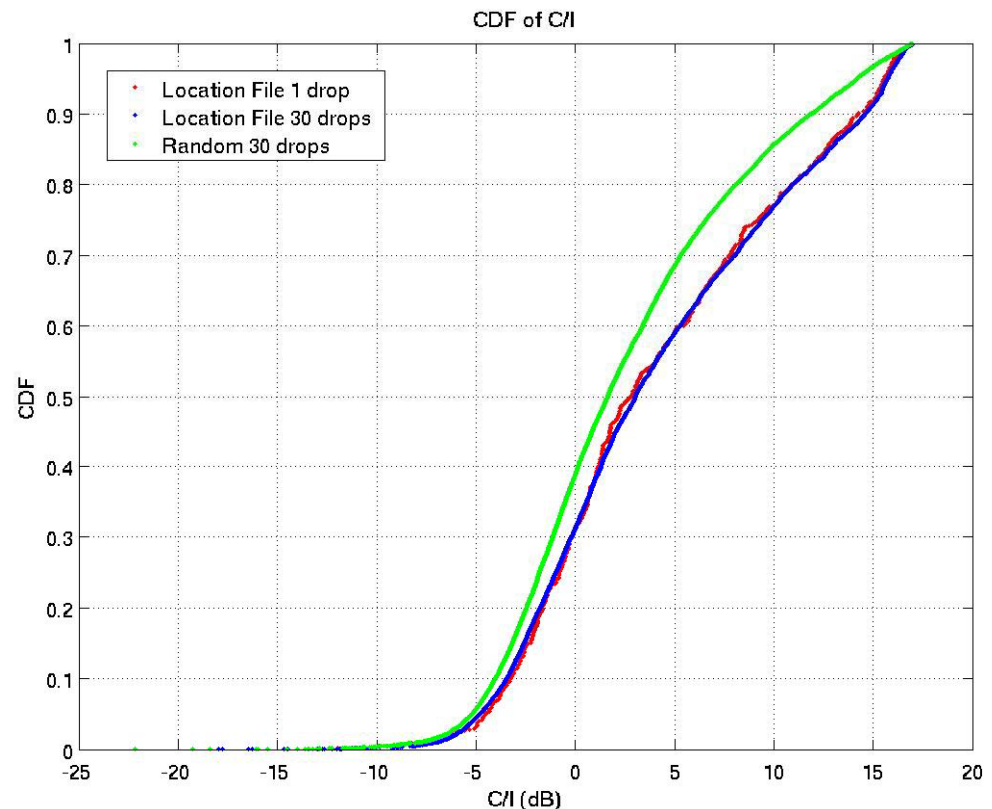
- $C(\cdot)$ denotes the constrained capacity function corresponding to the modulation scheme being used
- When MMSE is used for spatial processing, SNR_i denotes the post MMSE processing SNR.

Link to System Interface Calibration Data



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 $< 1\%$ are 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 1 st transmission	Max number of transmissions	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 1 st 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
9	4.0	6	6	6	4	4	4	4
10	5.0	6	6	6	4	4	4	4
11	6.0	6	6	6	4	4	4	4
12	7.0	6	6	6	4	4	4	4
13	8.0	6	6	6	6	4	4	4
14	9.0	6	6	6	6	4	4	4

FL and RL Peak Rates

Parameter	Bandwidth 5 MHz	
	Forward Link	Reverse Link
Required Peak Rate	18 Mbps	9 Mbps
MBFDD Proposal	65 Mbps	16 Mbps

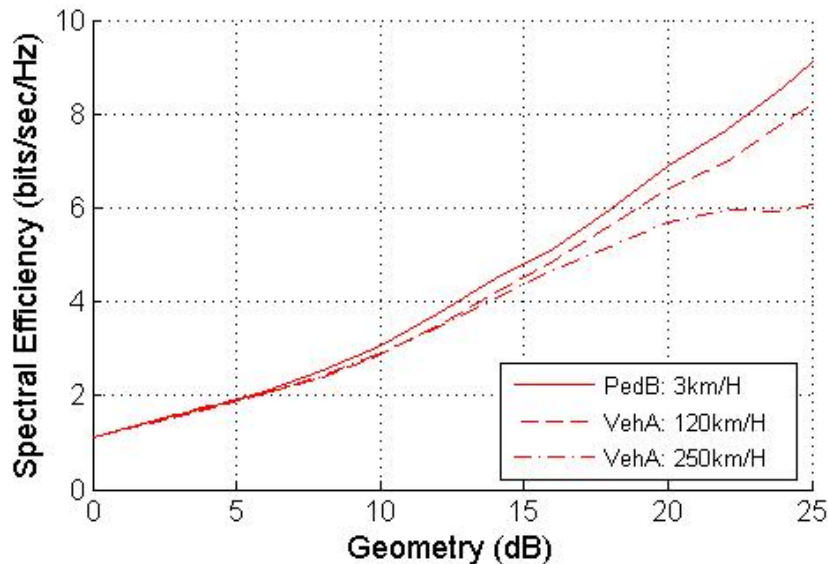
FL Mobility

- 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 °

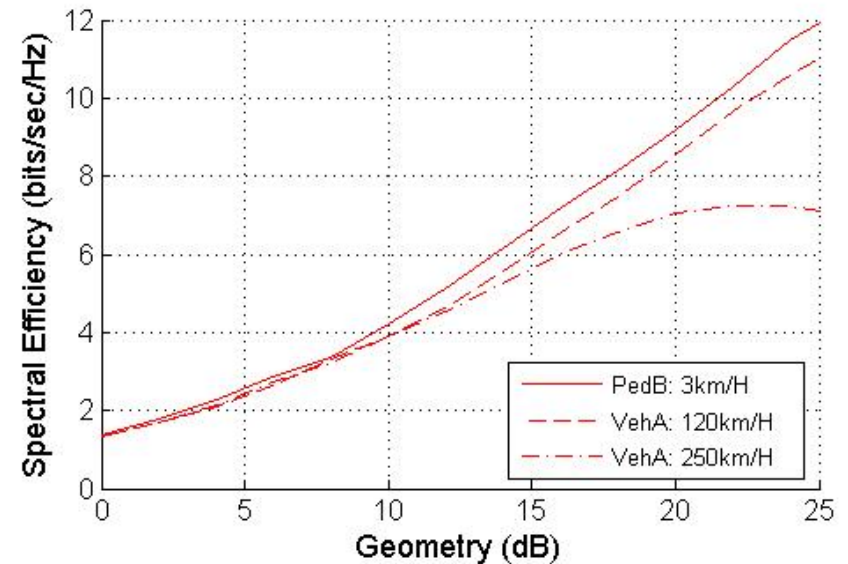
* Spectral efficiency takes into account the pilot overhead.

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.



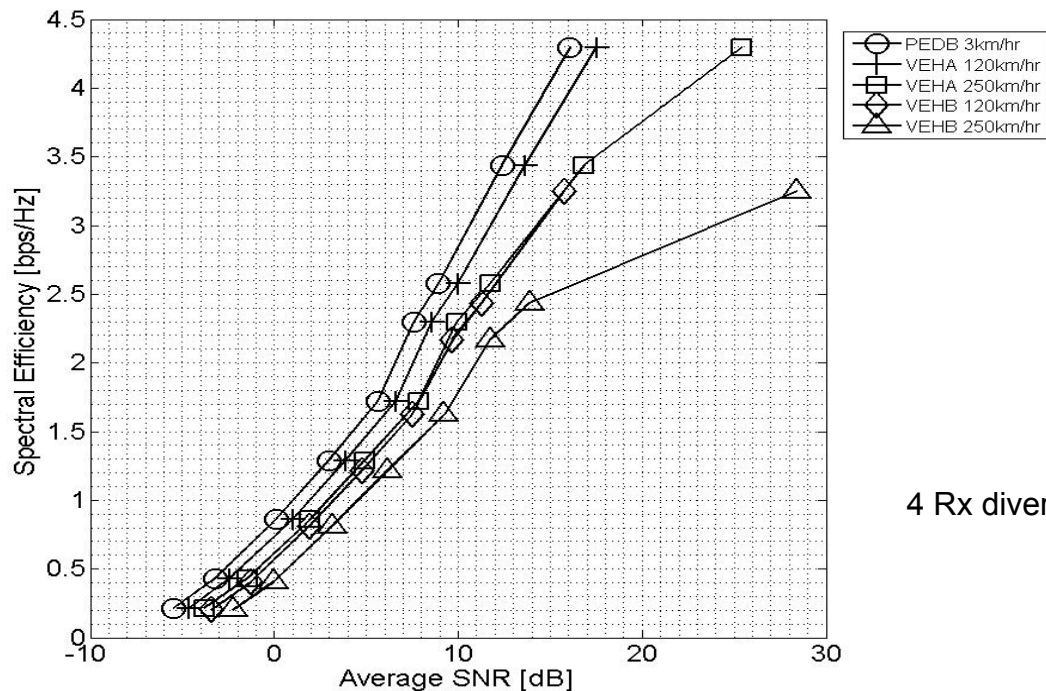
Laplacian Model



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 over 2.5 bps/Hz at 250 km/h.



4 Rx diversity at BS.

Forward Link Budget

- Mobile station 2 Rx, mobile throughput 1.92 Mbps.
Assuming 10dB penetration loss

CHANNEL	Maximum pathloss (dB)	Maximum range (meters)
I (ped-A)	145	1749
II (veh-A)	146.5	1931
III (ped-B)	146.3	1906
IV (veh-B)	145.8	1844

Reverse Link Budget

- Base station 4 Rx, mobile data rate 64 Kbps.
Assuming 10dB penetration loss

CHANNEL	Maximum pathloss (dB)	Maximum range (m)
I (ped-A)	142.7	1508
II (veh-A)	143.8	1617
III (ped-B)	144.0	1638
IV (veh-B)	142.8	1514

Outline

- Simulation Setups
- Link Level Results
- **Forward Link Throughput**
- Reverse Link Throughput

Forward Link Spectral Efficiency

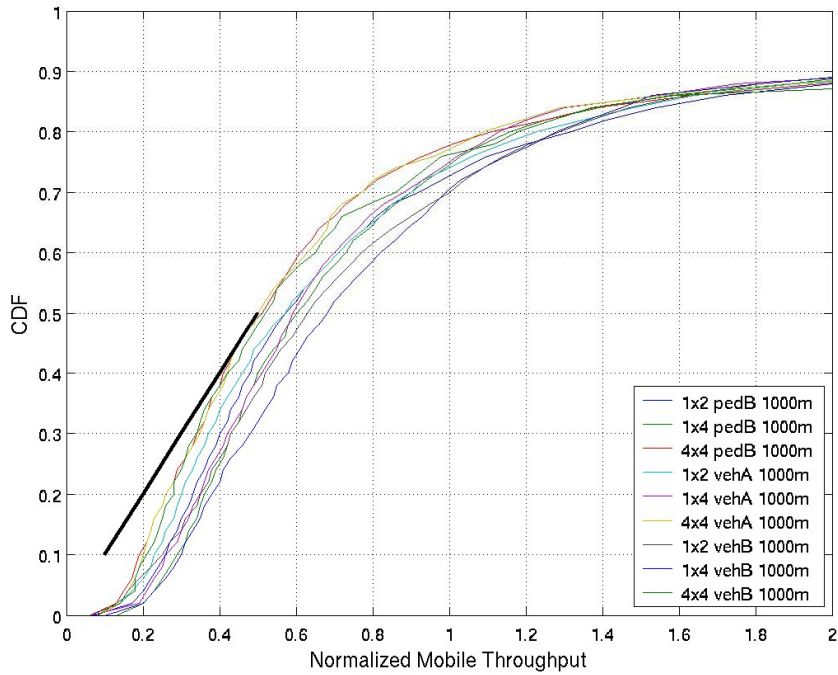
- MIMO 4x4 suburban macro spectral efficiency 1km BS to BS

	PedB 3km/hr	VehA 120km/hr
Required (b/s/Hz/sector)	2.0	1.5
MBFDD (b/s/Hz/sector)	2.20	1.92

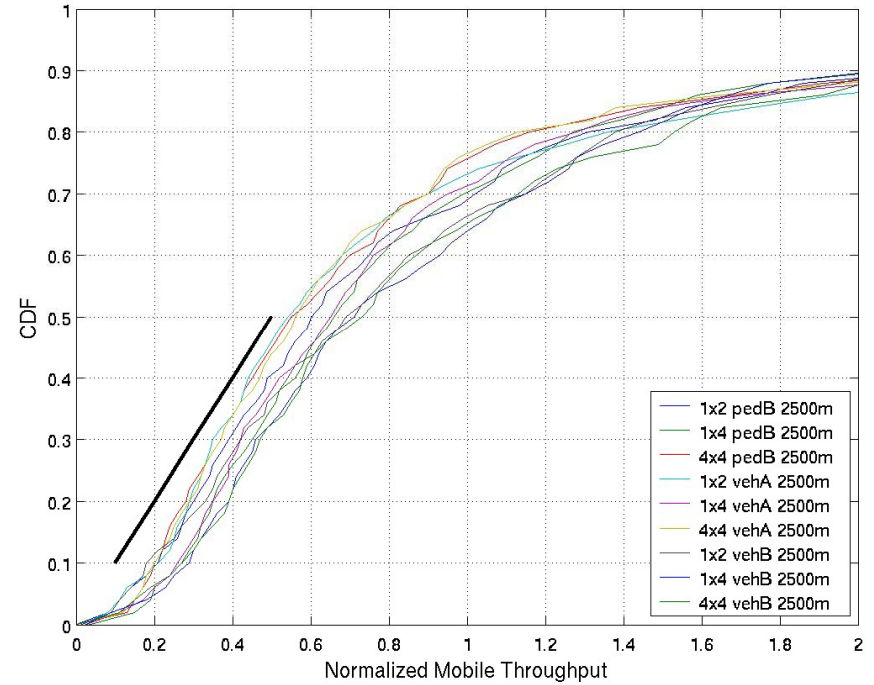
Forward Link Data Throughput

Sector Throughput (Kbps)		1x2	1x4	4x4
1km BS to BS	pedB 3km/h	5912	7740	10857
	vehA 120km/h	5366	7072	9580
	vehB 120km/h	3103	4751	6751
2.5km BS to BS	pedB 3km/h	5110	7000	9084
	vehA 120km/h	4640	6233	7707
	vehB 120km/h	2756	4299	5695

Forward Link Fairness

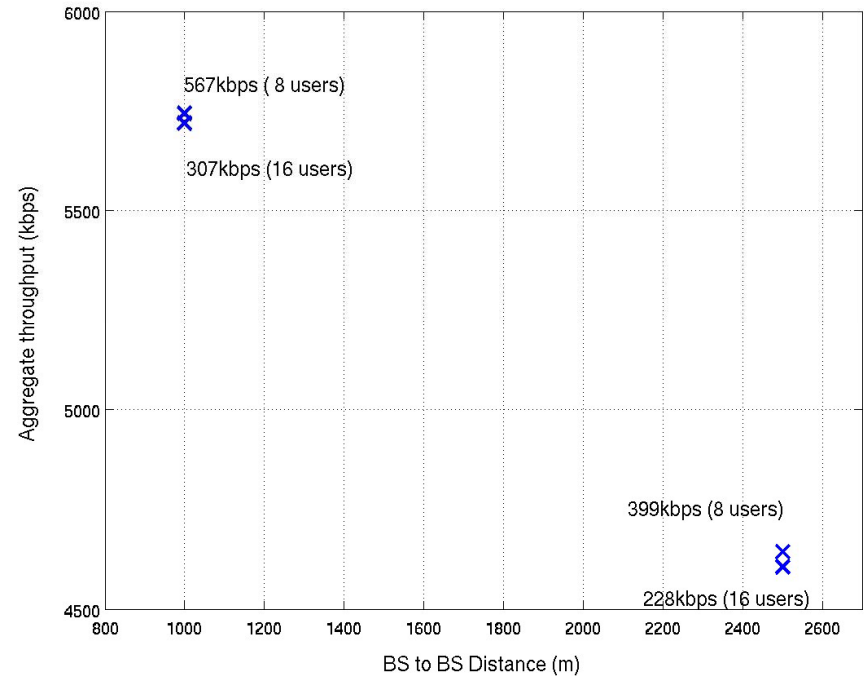
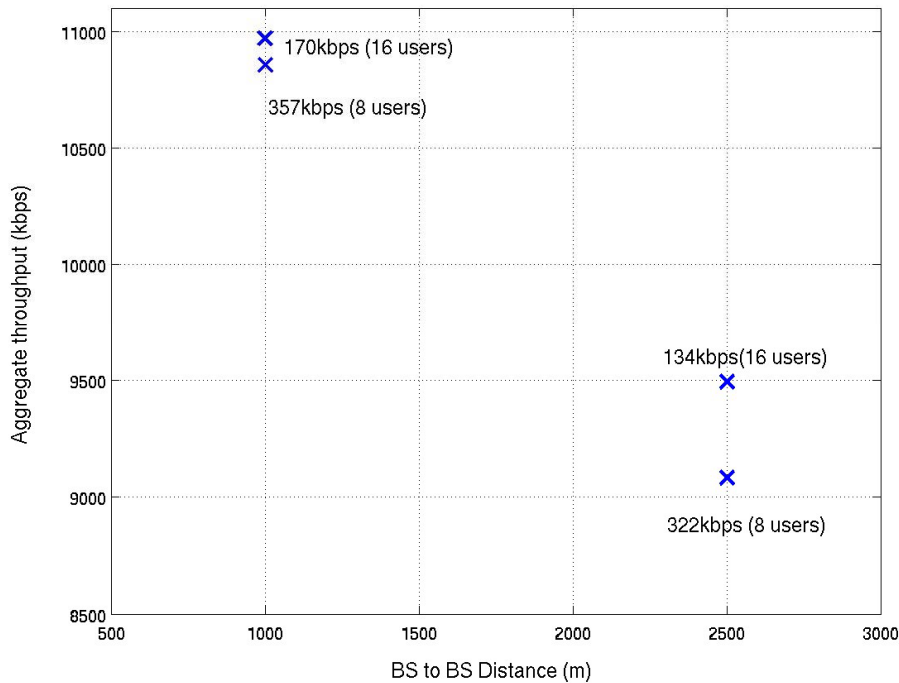


MIMO 4x4, 1000m BS to BS



MIMO 4x4, 2500m BS to BS

Forward Link Coverage Tradeoff



802.20 Fairness 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

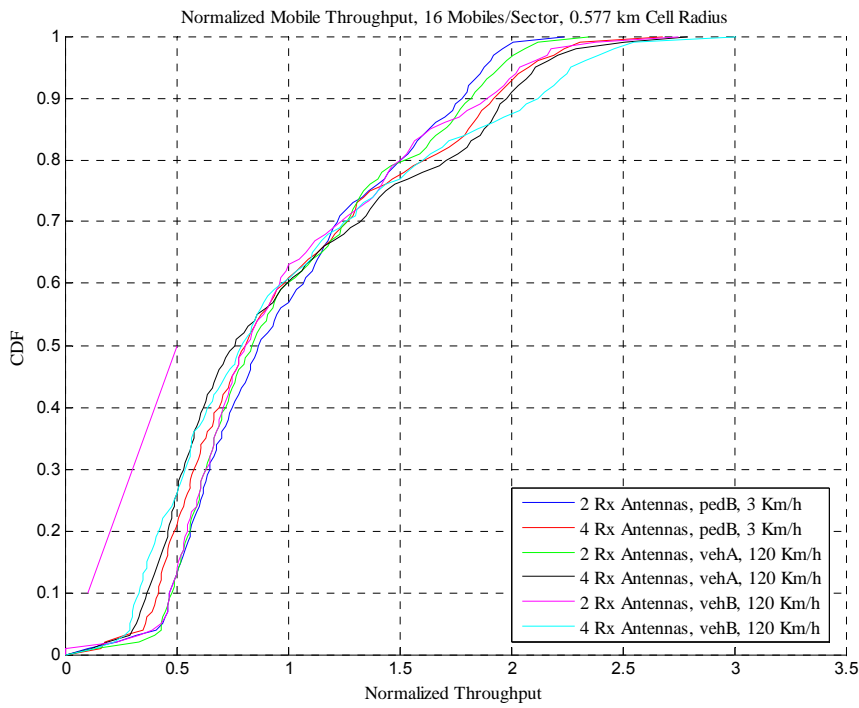
- Suburban macro spectral efficiency with 4 Rx and 1 km BS to BS

Parameter	PedB 3km/hr	VehA 120km/hr
Required (b/s/Hz/sector)	1.0	0.75
MBFDD (b/s/Hz/sector)	1.38	1.18

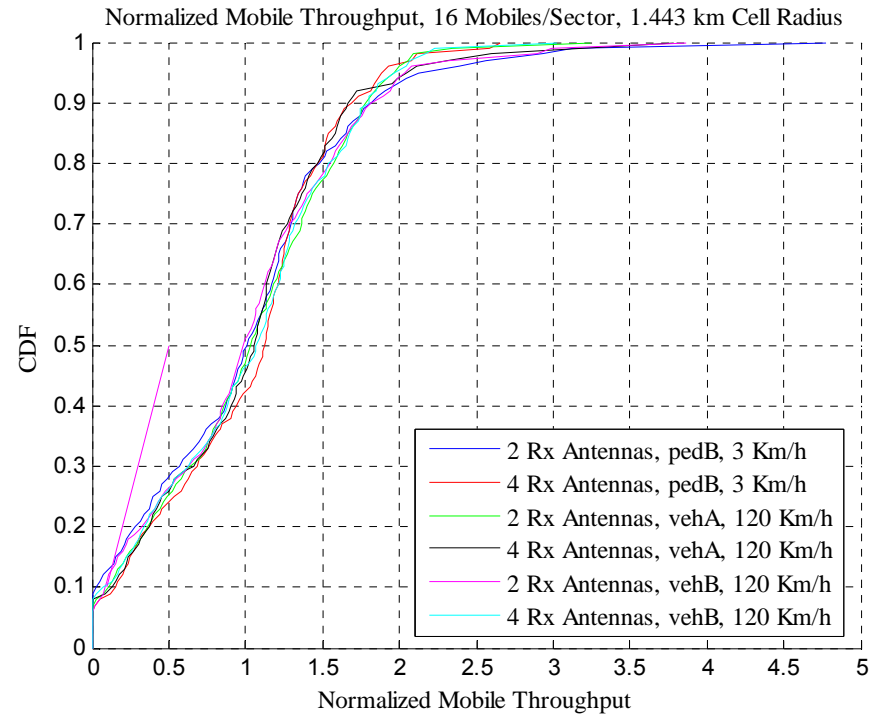
Reverse Link Data Throughput

Sector Throughput (Kbps)		1x2	1x4
1km BS to BS	pedB 3km/h	4109	6921
	vehA 120km/h	3853	5883
	vehB 120km/h	3055	5063
2.5km BS to BS 8 users/sector	pedB 3km/h	3449	5109
	vehA 120km/h	3058	4919
	vehB 120km/h	2566	4223
2.5km BS to BS 16 users/sector	pedB 3km/h	2753	4462
	vehA 120km/h	2420	4316
	vehB 120km/h	2057	3477

Reverse Link Fairness

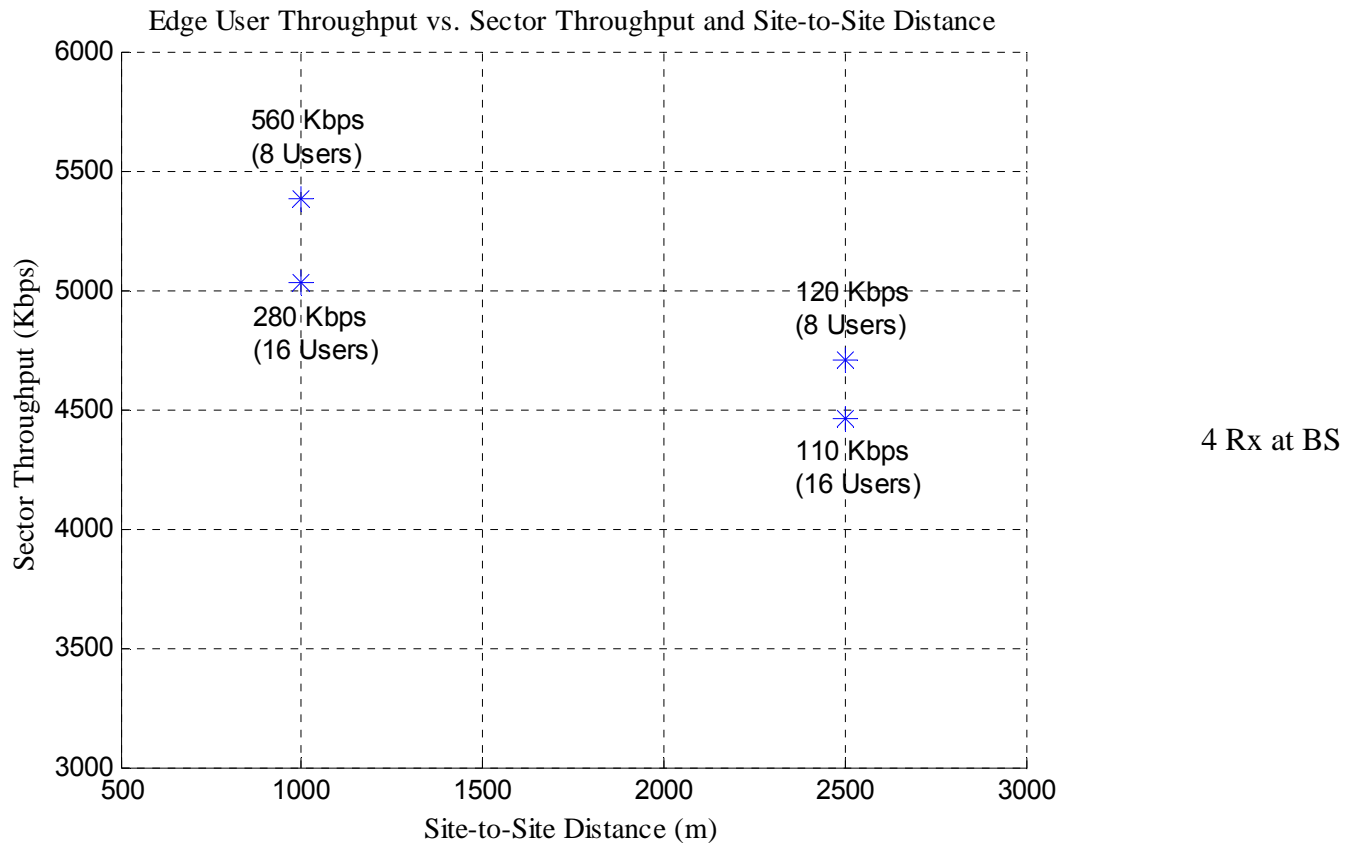


1000m BS to BS



2500m BS to BS (16 users)

Reverse Link Coverage



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