

# Antenna Selection for Mobile Station

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*Zhifeng (Jeff) Tao, Andreas F. Molisch, Philip V. Orlik, Jinyun Zhang  
Chun Nie, Tairan Wang*

**Mitsubishi Electric Research Lab**

201 Broadway, Cambridge, MA 02139, USA

Voice: 617-621-{7557, 7558, 7570, 7595 }

Fax: 617-621-7550

Email:  [{tao, molisch, porlik, jzhang}@merl.com](mailto:{tao, molisch, porlik, jzhang}@merl.com)

*Toshiyuki Kuze,*

**Mitsubishi Electric Corp.**

5-1-1 Ofuna Kamakura, Kanagawa 2478501, JAPAN

Voice: +81-467-41-2885

Fax: +81-467-41-2486

Email: [kuze.toshiyuki@ah.MitsubishiElectric.co.jp](mailto:kuze.toshiyuki@ah.MitsubishiElectric.co.jp)

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Purpose:

*Propose to adopt the mobile station antenna selection technique described herein into IEEE 802.16m SDD.*

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# Antenna Selection for Mobile Station

## Authors:

*Zhifeng (Jeff) Tao, Andreas F. Molisch, Philip V. Orlik, Jinyun Zhang,  
Chun Nie, Tairan Wang*

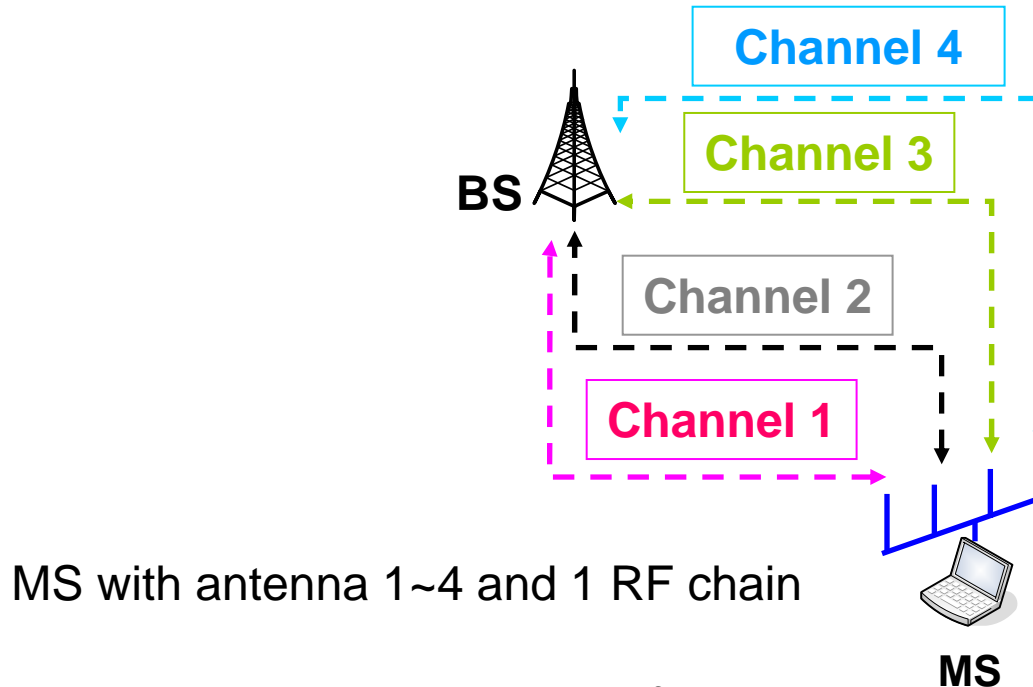
**Mitsubishi Electric Research Lab**

*Toshiyuki Kuze*

**Mitsubishi Electric Corp**

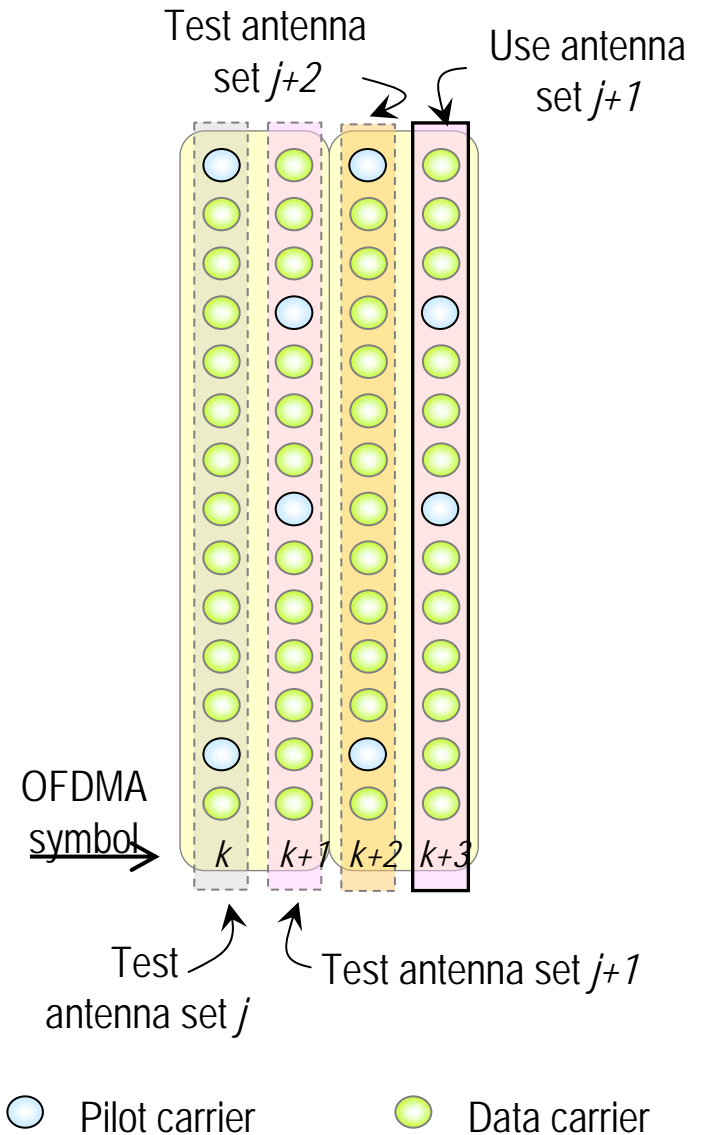
# Motivations

- MIMO system will be mandatory
- For antennas, channel 1~4 is time variant with different gains!
- Less RF chains than antennas will be available at MS (e.g., laptop, etc.) due to cost constraint.
- MS Antenna Selection will be used in other 4G standards (LTE, 11n)
- **Requires only minor changes in standard, but gives large performance improvement**



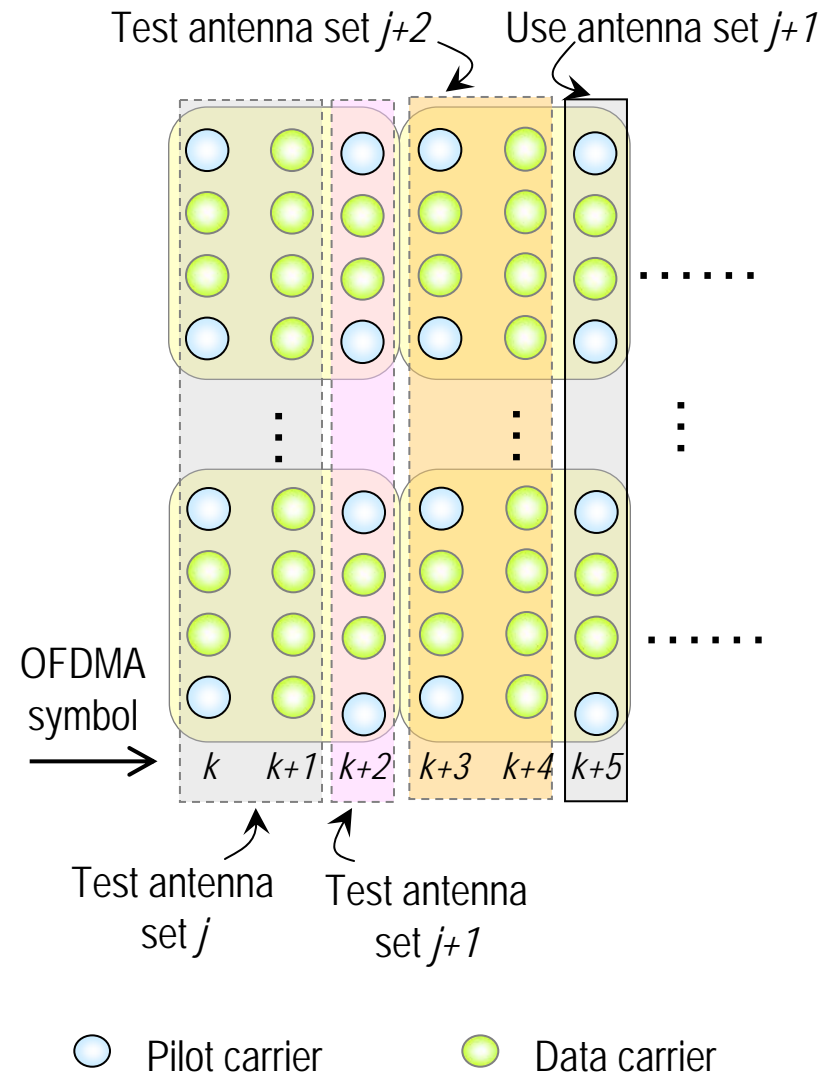
# Receive Antenna Selection

- **Requires no standard change**
- Downlink receive antenna selection at mobile station
- Permutation
  - Partially used subcarrier (PUSC)
- Receiver tests antennas and selects the best one(s)



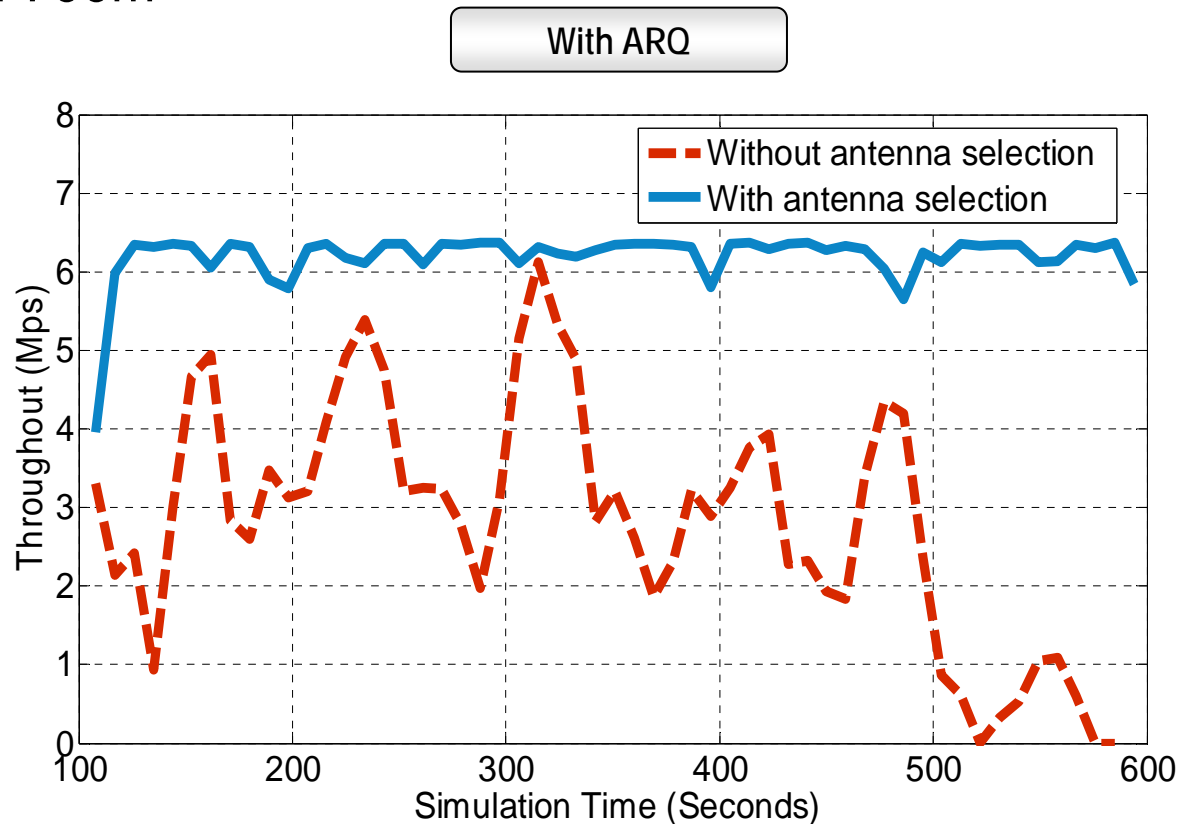
# Transmit Antenna Selection

- *MS and BS agree on sequence in which antennas are trained*
- Uplink transmit antenna selection at mobile station
- MS transmits test signals from different antennas; BS feeds back which ones to use
- Antennas can also be selected based on reciprocity
- Permutation
  - Partially used subcarrier (PUSC)



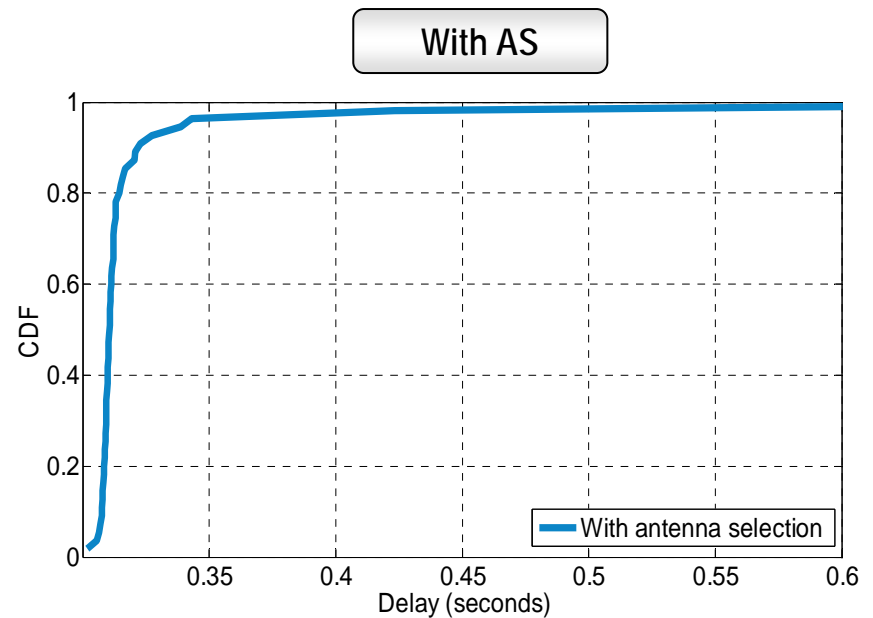
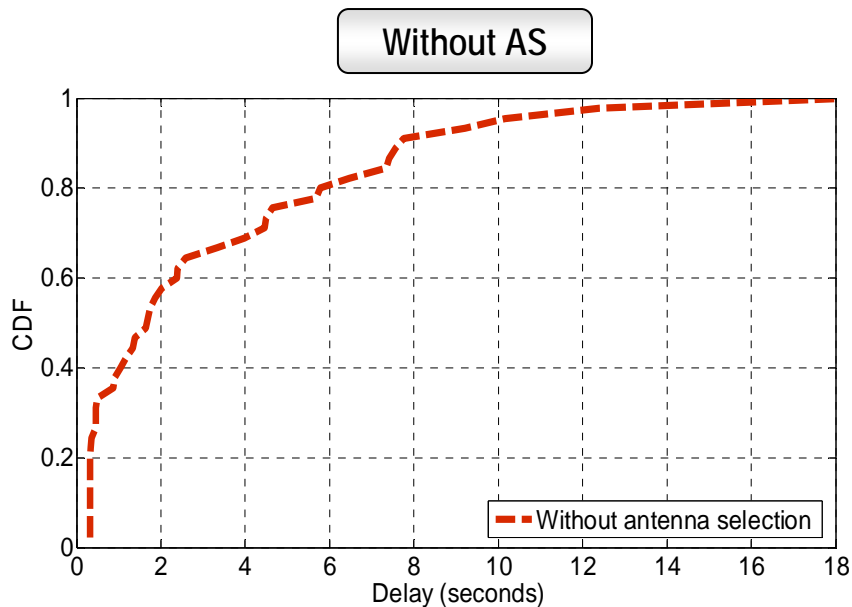
# AS Increases Instantaneous Throughput

- **AS increases instantaneous throughput**
- AMC: 64QAM,  $\frac{1}{2}$  coding rate
- 5 ms frame size
- Uplink traffic only
- Distance: 700m



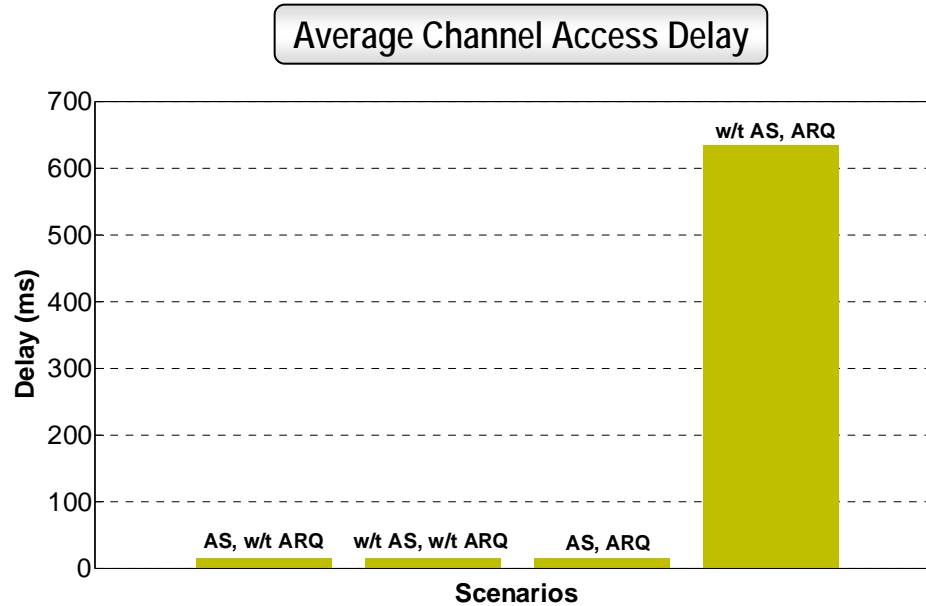
# AS Reduces Delay

- *AS reduces retransmission, and thus lowers delay*
- AMC: 64QAM,  $\frac{1}{2}$  coding rate
- 5 ms frame size
- Uplink traffic only
- ARQ
- Distance: 700m



# AS Reduces Delay

- Average Channel Access Delay



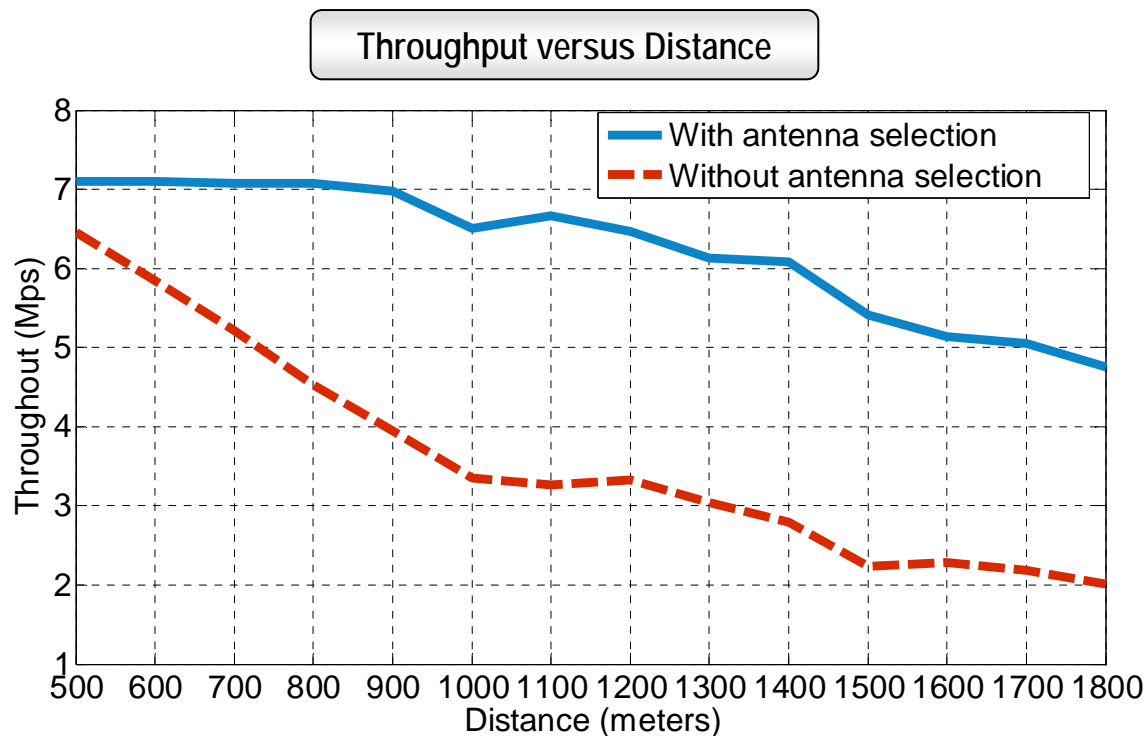
Delay	ARQ	
	Antenna Selection	w/t AS, w/t ARQ
	AS, w/t ARQ	AS, ARQ

Diagram illustrating the relationship between Antenna Selection and ARQ. The table shows four combinations: w/t AS, w/t ARQ; w/t AS, ARQ; AS, w/t ARQ; and AS, ARQ. Red arrows indicate that the delay for w/t AS, ARQ is higher than for w/t AS, w/t ARQ, and that AS, ARQ is higher than AS, w/t ARQ.



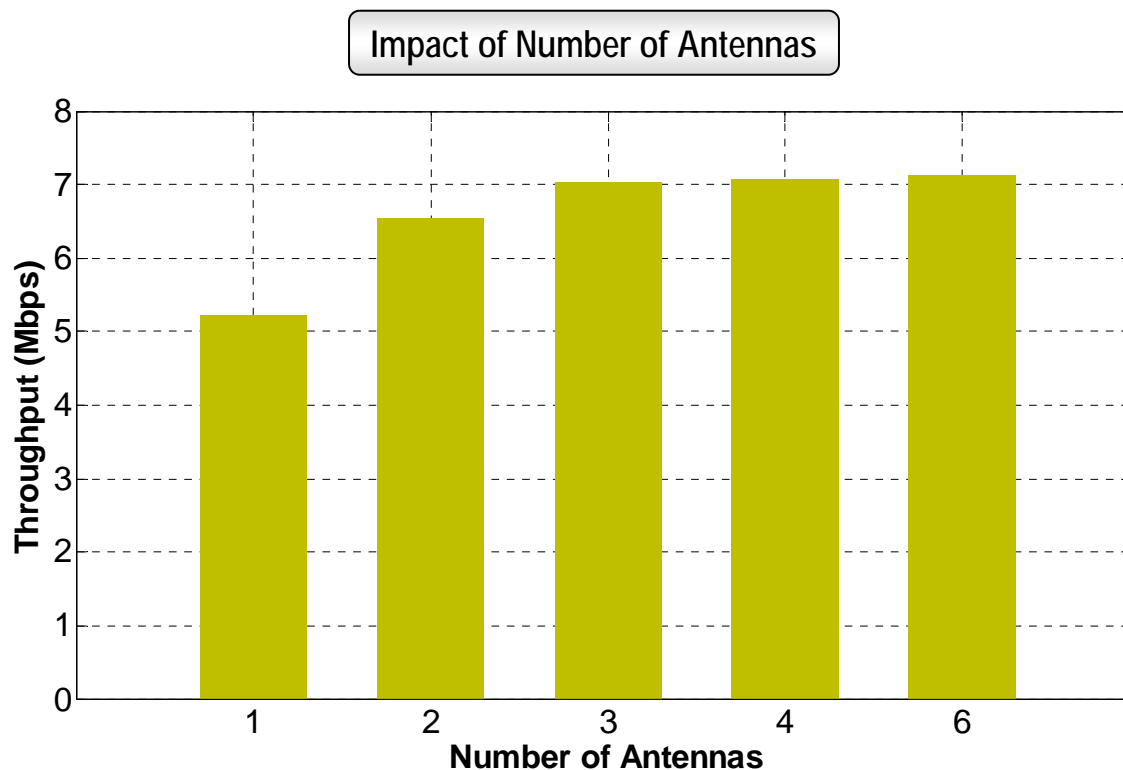
# Throughput versus Distance

- Fixed AMC: 64QAM,  $\frac{1}{2}$  coding rate
- 5 ms frame size
- Uplink traffic only
- Without ARQ



# Throughput versus Number of Antennas

- BS and MS Distance: 700m
- Number of Antenna: {1, 2, 3, 4, 6}
- Without ARQ



# Conclusions

- Antenna selection at MS improves performance
- Easily implemented with current handset technology
- Requires only minimal changes in standard
- Improvement of throughput by up to 30%, decrease in latency by order of magnitude