LTE-A CoMP Technology And Field Test

Hui Song, Ranplan Wireless Design Co. Ltd.

4G, Bell Labs Shanghai/R&I Shanghai

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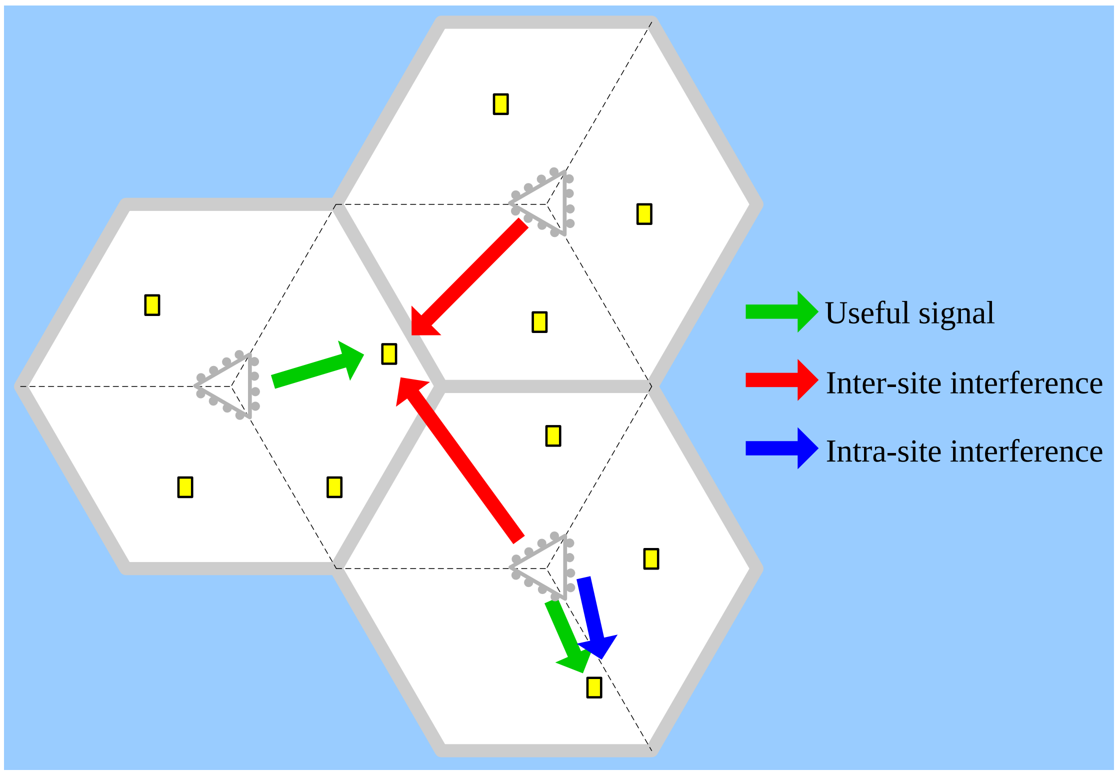
Interference: the bottleneck for next generation radio



LTE-A target

improved Spectral Efficiency & Fairness

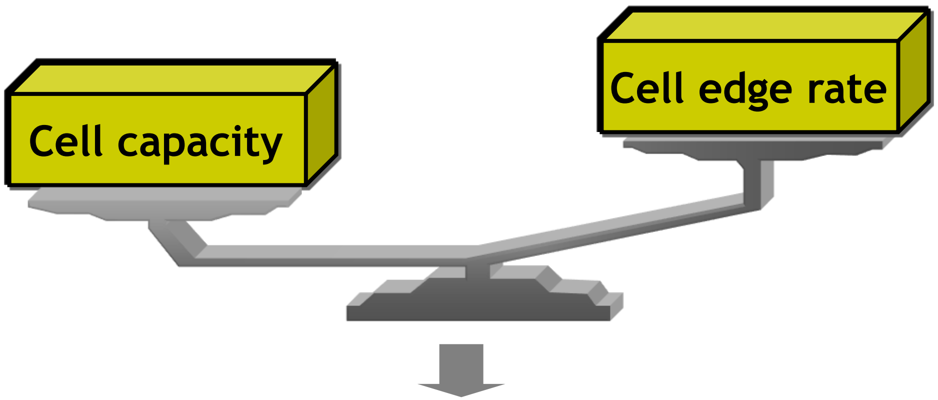
Interference Management

Robust network deployment

Coordinated Multi-Point Tx

Conventional techniques for interference mitigation

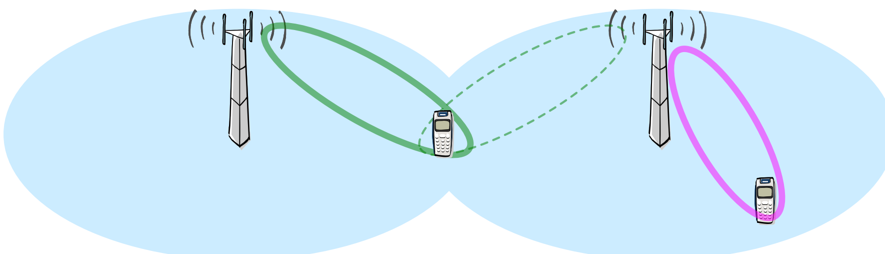
- Conventional techniques for interference mitigation
  - Power control: reduce power to meet SINR target
  - Soft handoff: user is simultaneously communicating with two or more base station
  - Scheduling: assign time/frequency channels on adjacent cells to mitigate interference e.g., soft frequency reuse.
  - Multiuser detection: Jointly detect desired and interfering signals



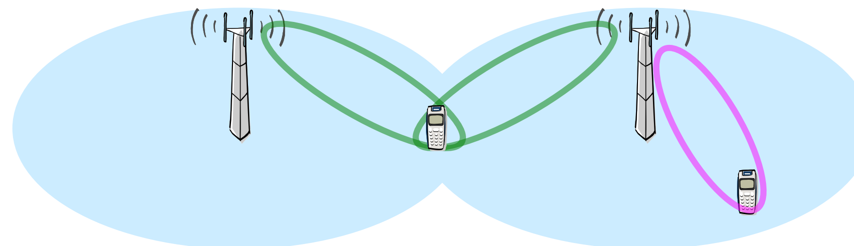
More efficient techniques are needed to achieve the IMT-A requirements on cell edge user throughputs and average spectral efficiency

Coordinated Multipoint (CoMP) transmission

Coordinated Multipoint (CoMP) transmission techniques are considered as promising candidates for efficient interference management to improve cell edge and/or system throughput



Coordinated Scheduling/Beamforming
(Co-Sch/BF) CoMP



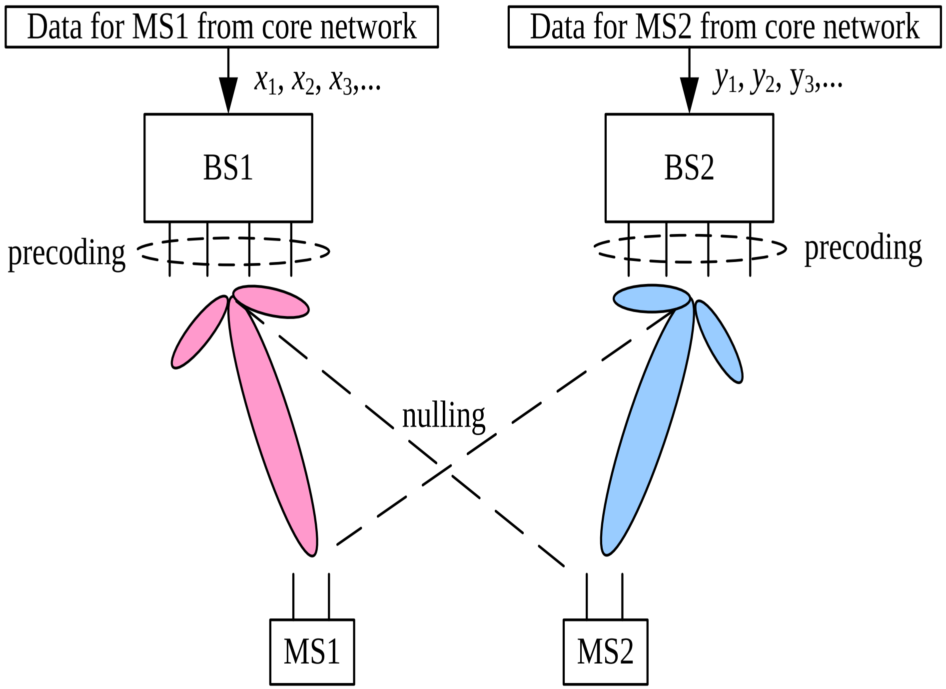
Joint Processing/Transmission
(JP/T) CoMP

Data sharing not needed
Smaller performance gain
Lower system requirement

→

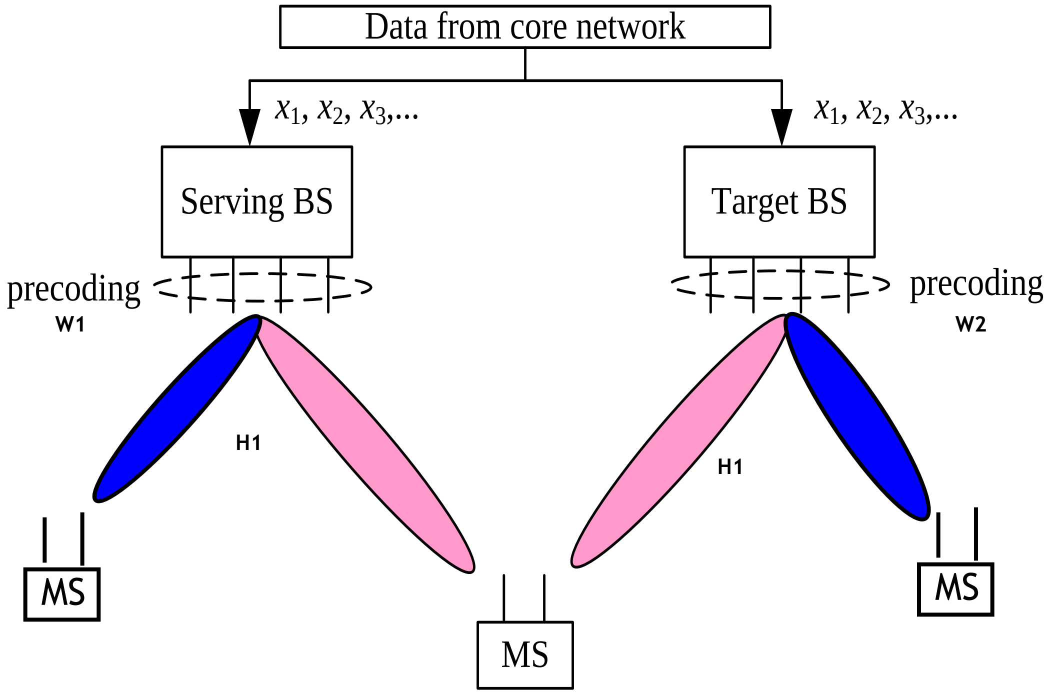
Data sharing needed
Larger performance gain
Higher system requirement

Interference nulling based coordinated beamforming



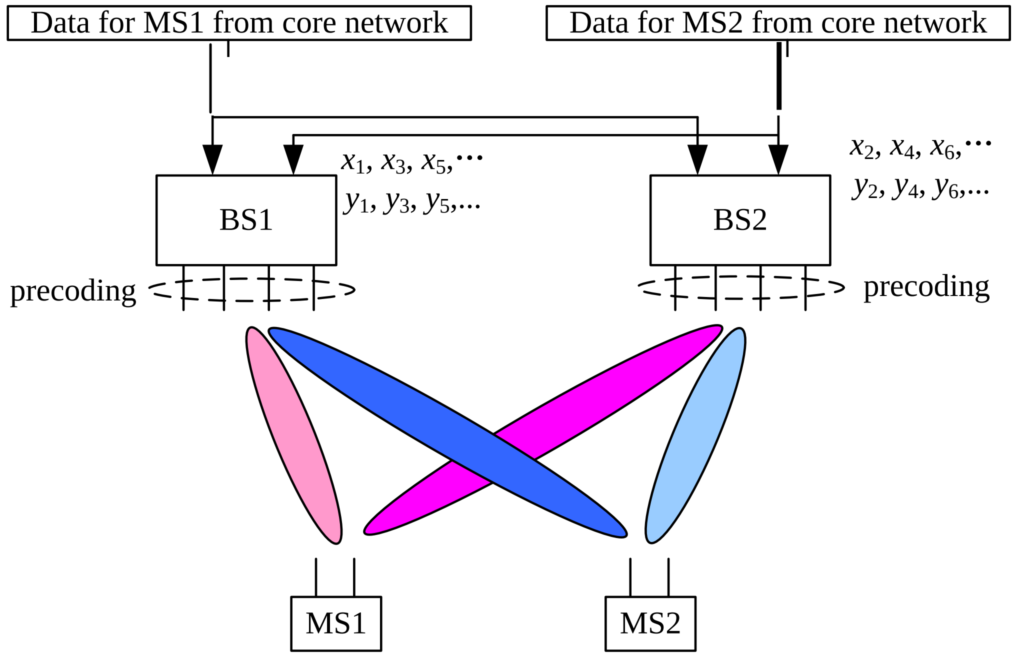
- While transmitting to its own terminal, a BS exploits the redundant spatial degrees of freedom to null/reduce the interference to neighboring cells
- Low requirement on the backhaul
  - No user data exchange between BS
  - Partial CSI exchange in FDD and no CSI exchange in sounding-based TDD

Non-coherent Joint Transmission



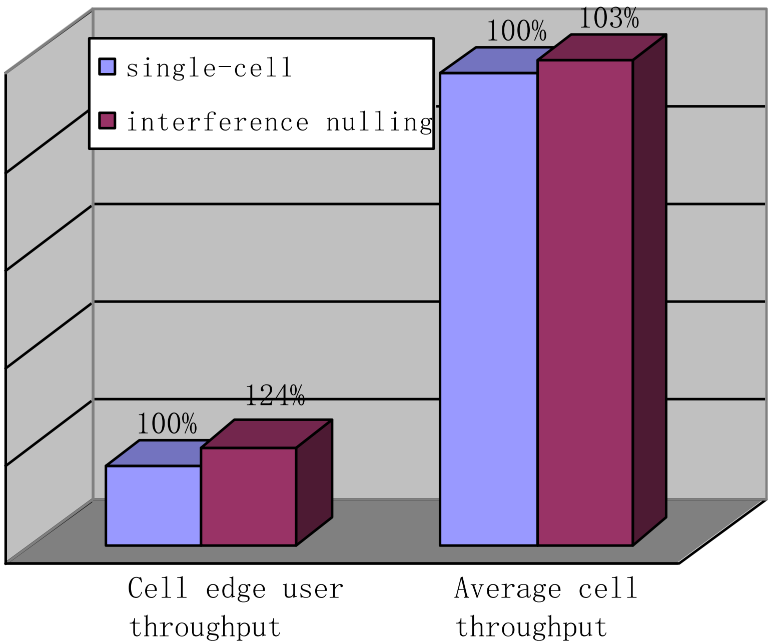
- Precoder from each base station is independently calculated based on the local MIMO channel information between the BS and the UE
- The same or different data stream is transmitted from neighboring BSs individually
- Medium requirement on the backhaul
  - User data sharing between BSs
  - No CSI exchange between BSs

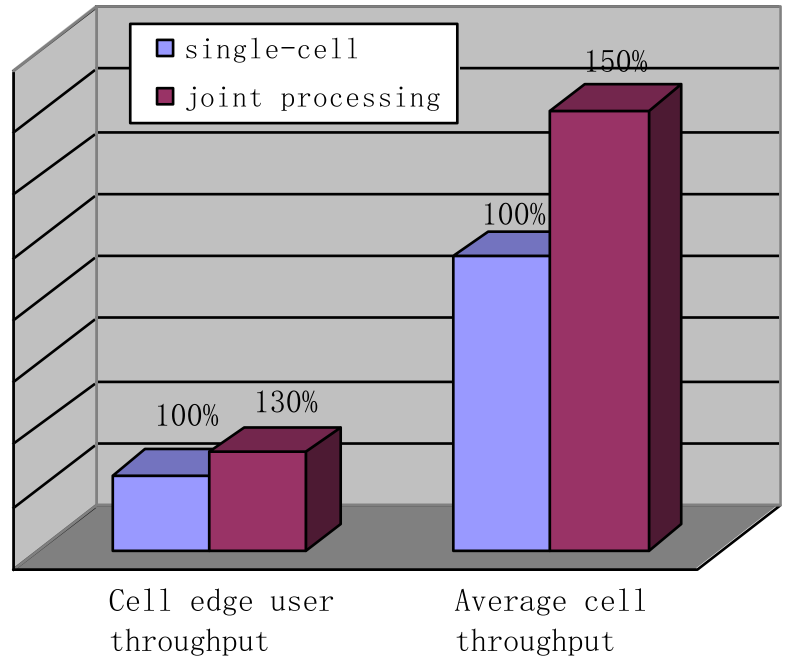
Coherent Joint Transmission



- Multiple BSs within a cluster perform joint MIMO transmission to multiple MSs located in different cells
  - Coherent joint MIMO processing: multiple BSs act like a single virtual BS
- High requirement on the backhaul
  - Both data and CSI exchange between BSs

System level evaluation





Coordinated beamforming

- A cell edge throughput gain of 24%
- No average cell throughput gain

Joint Transmission

- A cell edge throughput gain of 30%
- An average cell throughput gain of 50%

LTE-A Downlink CoMP Demo - *Overview*

Objective

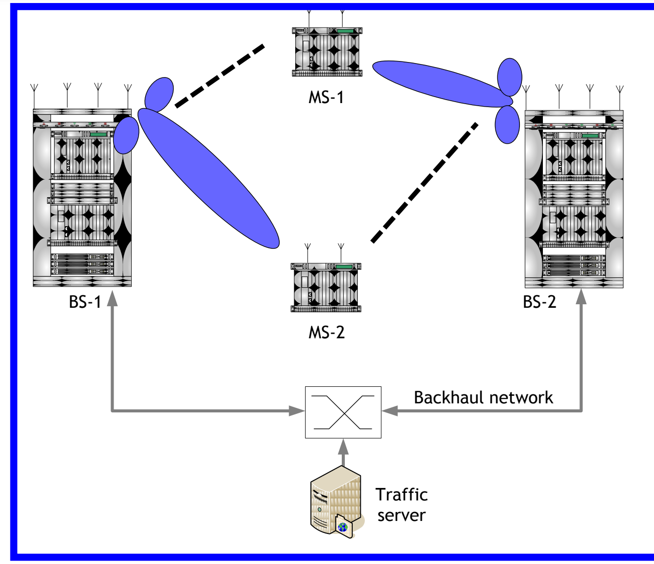
- Evaluate the typical CoMP algorithms in real interference-limited environment
- Evaluate the impact of current system implementation constraint and impairment
- Evaluate implementation complexity of critical algorithms in DSP/FPGA

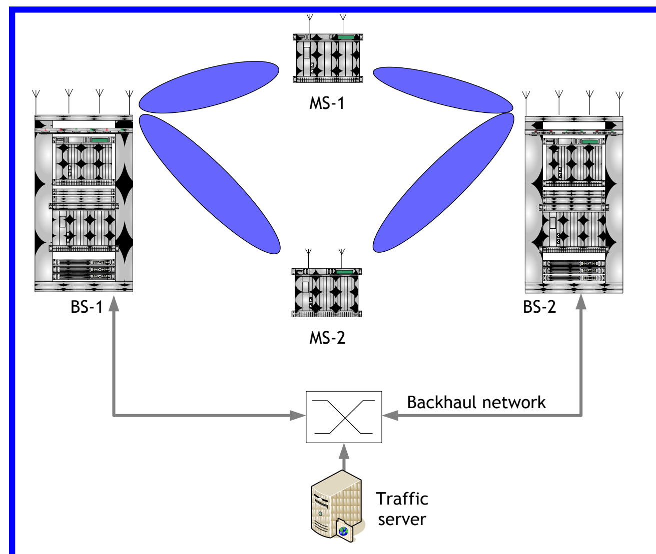
System configuration

- 2 BSs, each with 4 antennas
  - Gigabit Ethernet connection among BSs
  - GPS assisted time/frequency synchronization
- 2 MSs, each with 2 antennas
  - Single stream per MS

Transmission format

- Bandwidth: 20MHz
- LTE TDD frame structure with 2:2 DL:UL ratio
- Modulation and coding
  - 16QAM+1/2 turbo coding



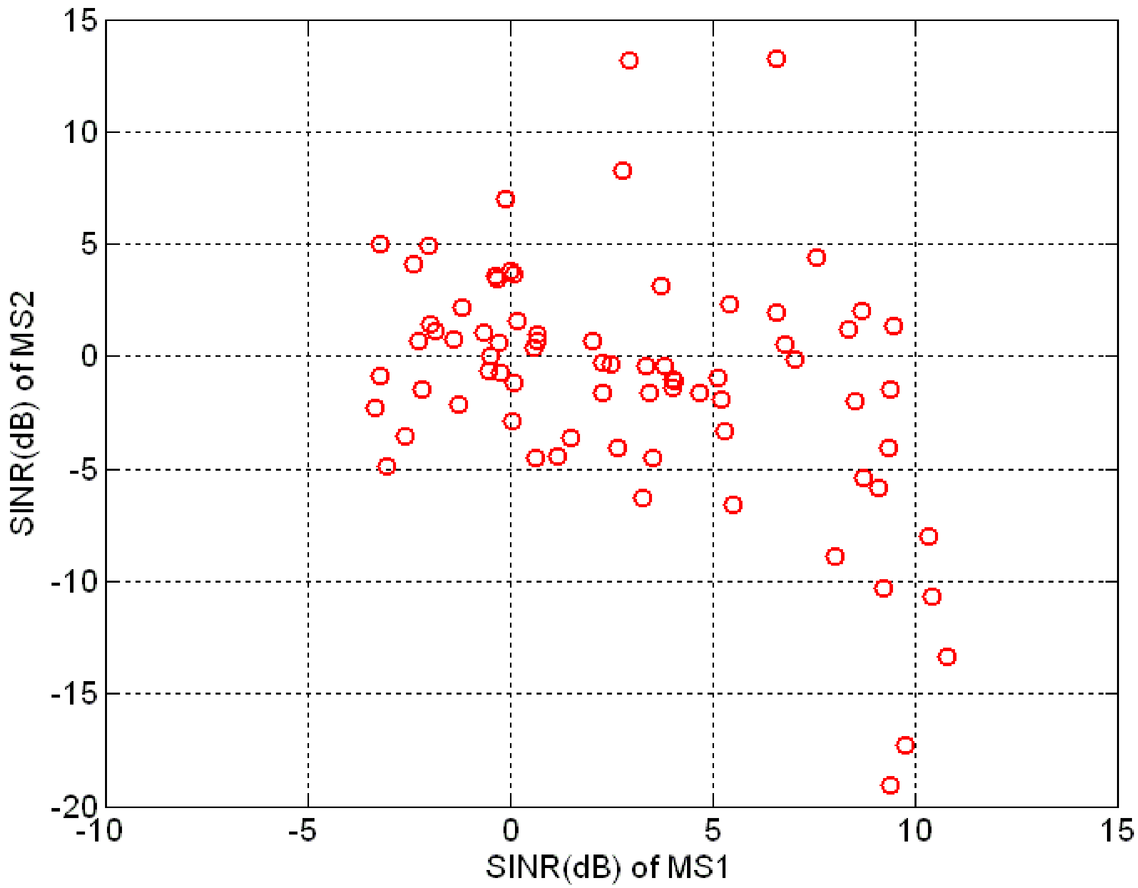


LTE-A Downlink CoMP Demo - Indoor Field Trial

5 transmission modes tested

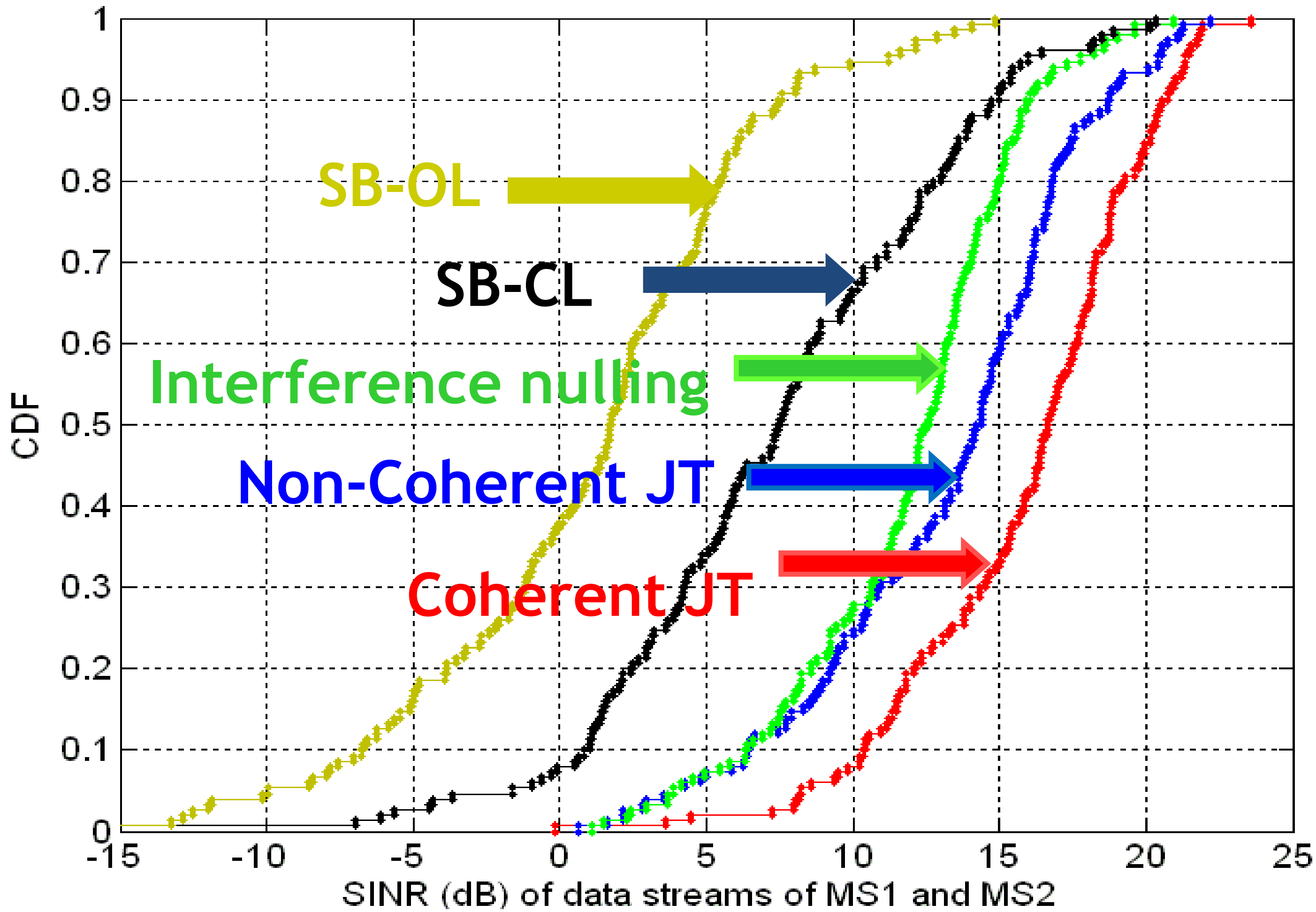
- Coherent JT
- Non-coherent JT
- Coordinated beamforming
- Single BS closed –loop (SB-CL)
- Single BS open-loop(SB-OL)

LTE-A Downlink CoMP Demo - Indoor Field Test Results



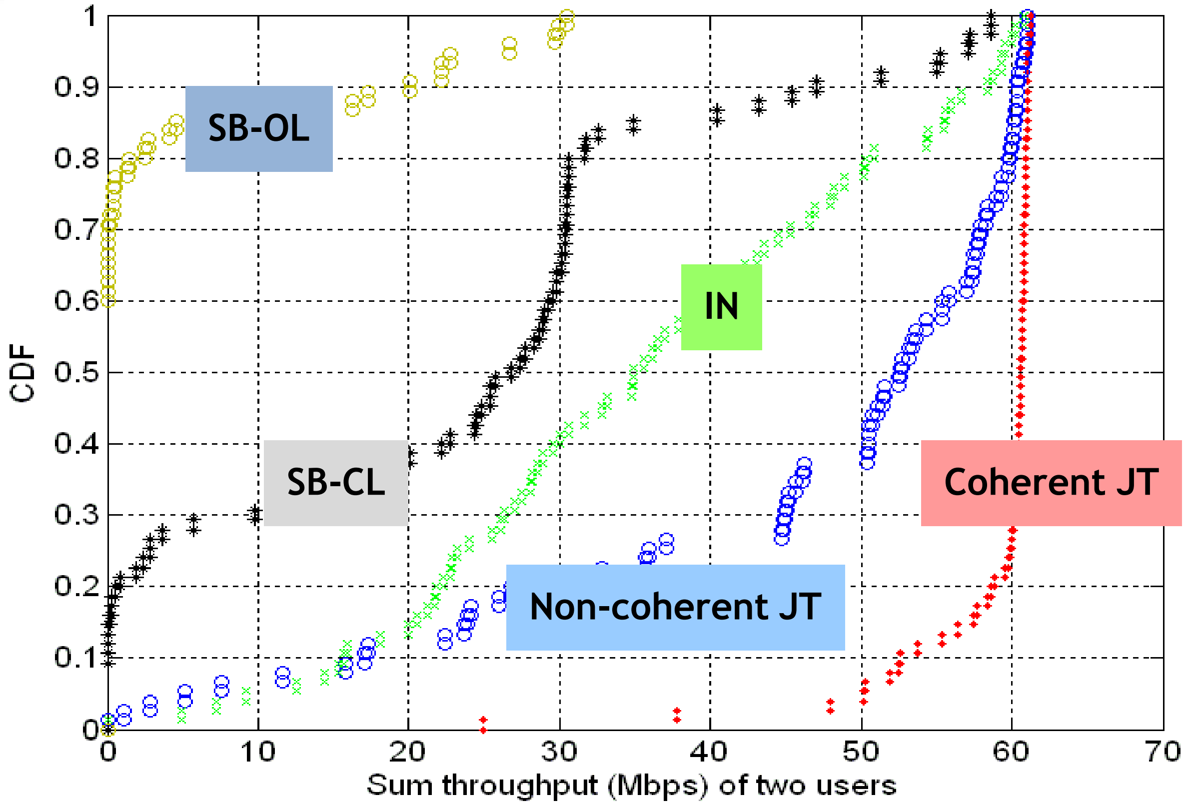
SINR measured from common pilot (CSI-RS)

LTE-A Downlink CoMP Demo - Indoor Field Test Results



SINR measured from dedicated pilot (DM-RS)

LTE-A Downlink CoMP Demo - Indoor Field Test Results



Operation Modes	coherent JT	noncoherent JT	interference nulling	SB-CL
Sum-rate(Mbps)	58.72	45.68	35.68	22.67

28% ← 28% ← 50% ←

Averaged sum throughput in field measurement

Conclusion

Release 10	Release 11	Release 11
Single-BS transmission	**Coordinated beamforming**	**Joint Transmission**
• 8Tx SU-MIMO for higher peak rate • MU-MIMO enhancement for higher cell capacity	•Attractive performance gain mainly on cell edge users • Easy implementation • Short-to-medium-term application	•Significant performance gain in both cell average and cell edge rate • High requirement on backhaul and feedback overhead in air interface • Long-term evolution

Thank You !