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An Introduction to National Mobile Communications Research Laboratory

Southeast University

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Professor & Director

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移动通信国家重点实验室

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- Founded in 1989
- Approved by the State Planning Commission and the Ministry of Education (MOE)
- Received 1.2M USD financial support from World Bank loan
- Specially supported by the “211” and “985” projects of the MOE – the national key discipline development projects
- Equipped with modern R&D facilities, including EDA tools and mobile communication specific measurement instruments

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The Laboratory's Mission

- to promote the basic knowledge for mobile & wireless communications
- to provide up-to-date training for university graduates and professional visitors
- to transfer the know-how to the industries

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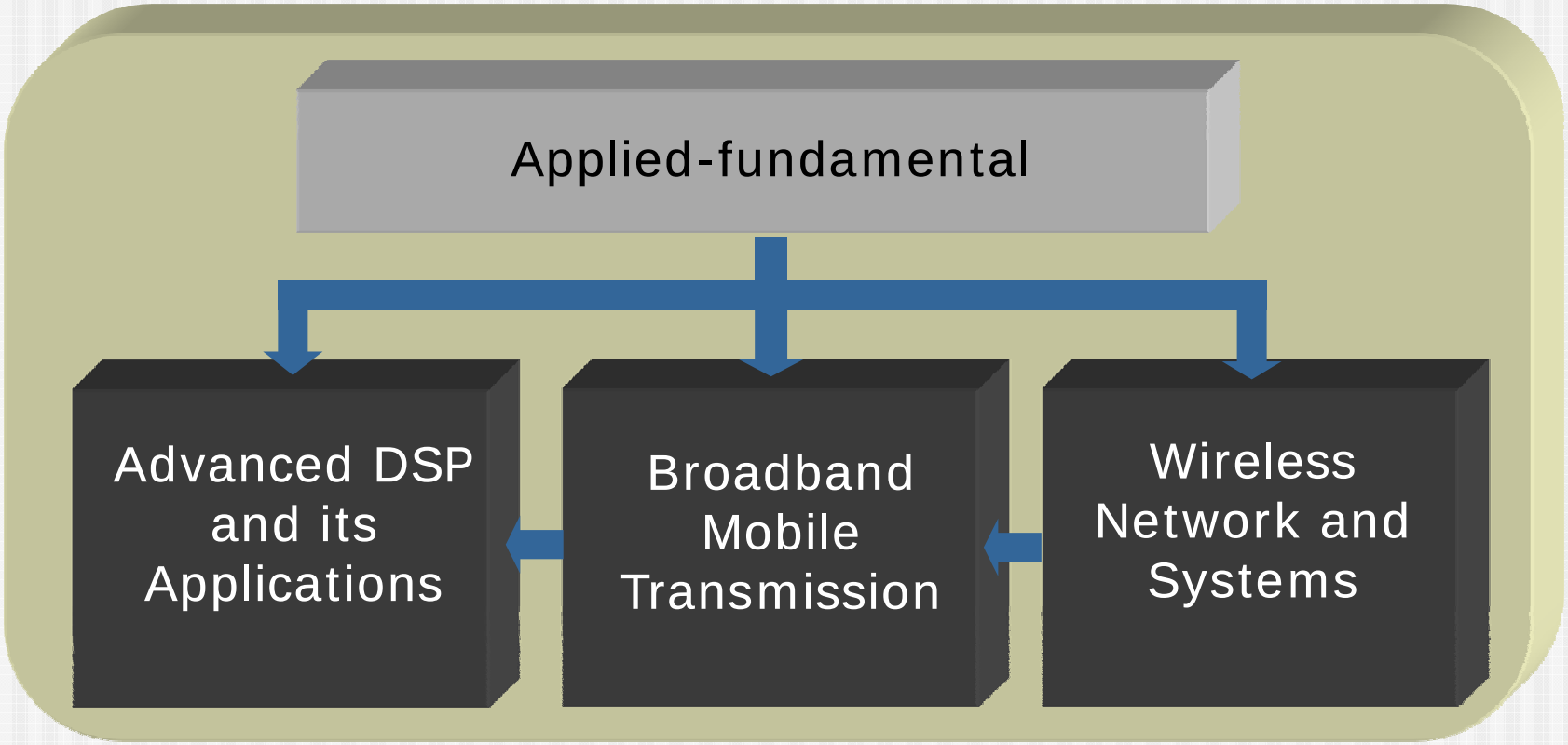
Main Research Areas



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Current Human Power Resource

- 17 professors
- 58 faculty members
- 12 post doctors
- 18 visiting scholars and guest researchers
- 380 graduate students, including 80 Ph.D. students.

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Project Funding in 2007

Source	Contracts		Research funds	Percentage	
“863”project	6	27	32.90m	73.34%	89.77%
NSFC	6		1.59m	3.54%	
Other Gov. Funding	11		3.15m	7.02%	
Provincial	4		2.63m	5.86%	
Intl. cooperation	7		1.19m	2.65%	
Domestic Co.	11		3.40m	7.58%	
Total	45		44.86m in RMB	100%	

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Publications & Patents in 2007

- 102 journal papers, including IEEE Trans. IT/Comm/WCom/JSAC/……
- 59 conference papers, including ICC, Globalcom/VTC/……
- 10 patents granted, including 3 US patents
- 21 patents newly pending
- 2 books

Two Spin-off Companies

SeuComm:

- **Dedicated to development of core technology in 3G and beyond, including protocol stacks and ASICs**

SEMIT:

- **Dedicated to development of short-range wireless communication systems, including bluetooth and WLAN**

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Some Important Achievements

- A key player of the 1st GSM trial system in China, with the core techniques transferred to manufacturers in 1995 and 1996
- 11 reports submitted to ITU for 3G/TD-SCDMA standardization work
- Completion of the 1st CDMA trial system in cooperation with Datang and others in 1998
- Completion of the 1st China's 3G (C3G) trial system, as a leader university in 2000
- Completion of the 1st ASIC chip for cdma-2000 handy in 2002
- The leader university of China's 863 beyond 3G R&D project- named FuTURE project, with completion of the 1st China's B3G trial system.

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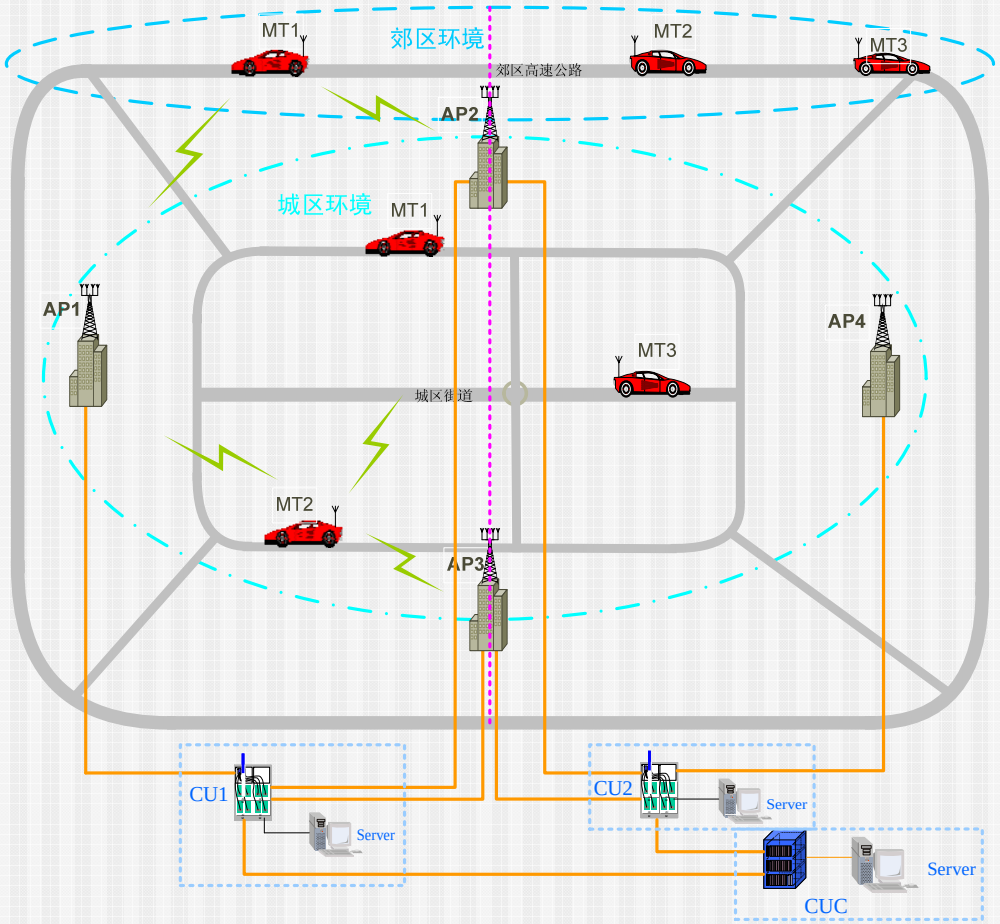
FuTURE Demonstrator

Key features

- combined FDD/TDD;
- distributed radio architecture based on RoF;
- MIMO GMC/OFDM links;
- environmental adaptation;
- 40-100Mbps full coverage for high mobility
- high speed local area hot-spot applications
- higher spectrum efficiency up to 2-10bps/Hz
- lower transmission power and better EMC performance



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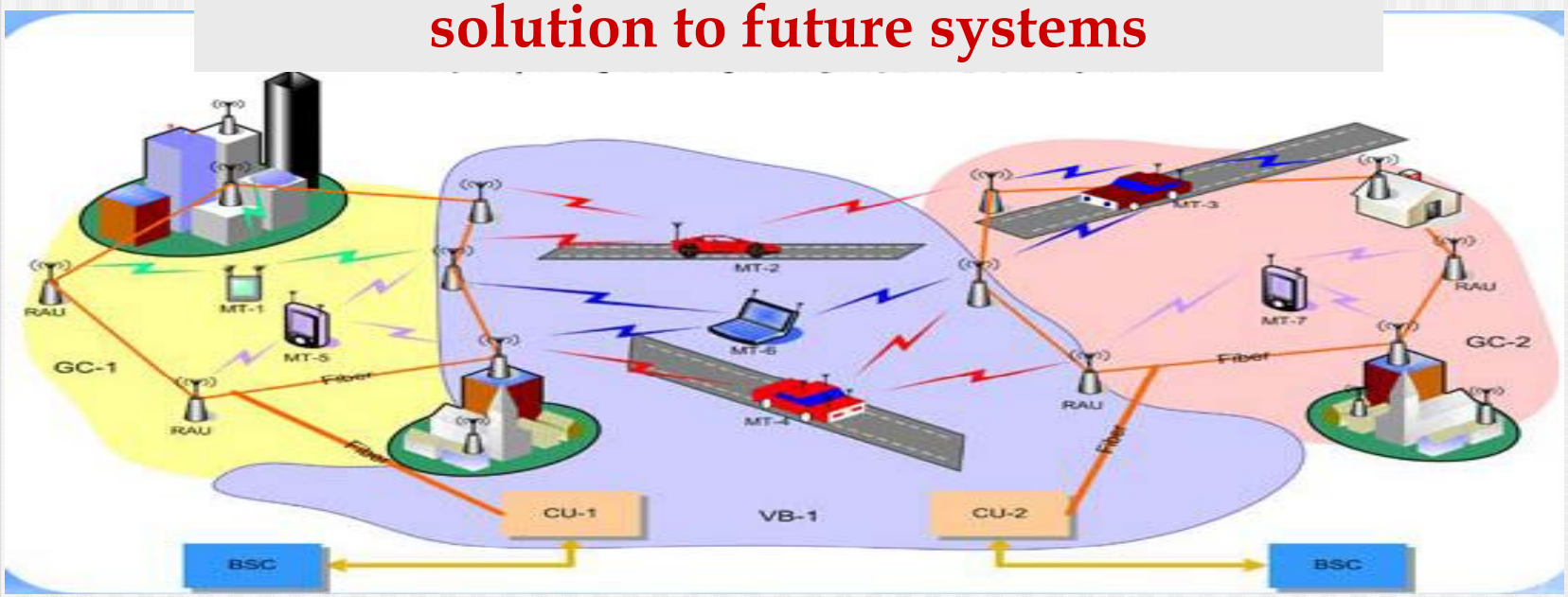
Distributed Antenna System: A possible solution to future systems



- Antennas of infrastructure is located as nearly as possible to the users to reduce the transmission power;
- Antennas of infrastructure consist of user-centric MIMO to improve the spectrum efficiency

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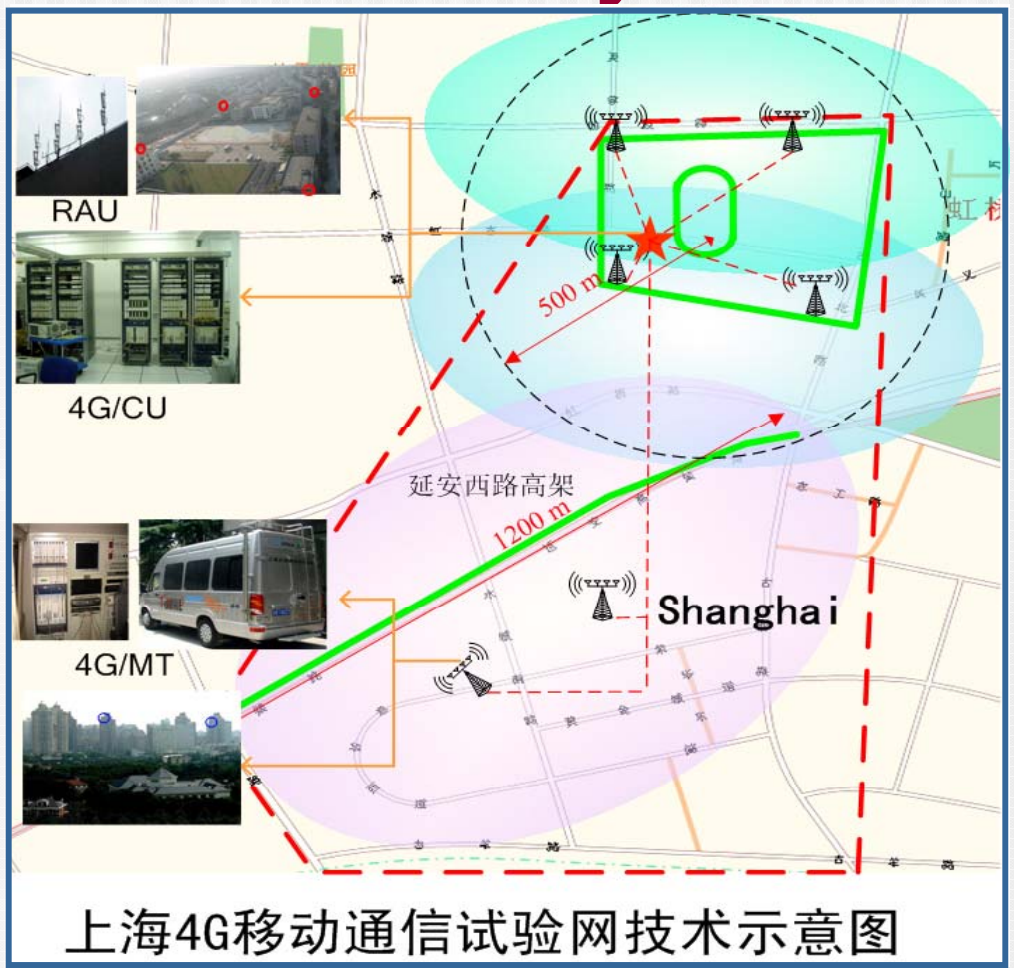
FuTURE outfield trial system

FuTURE outfield deployment:

- Frequency Carrier: 3.5GHz
- Bandwidth: 20MHz
- RoF distributed antenna networks: 6 APs/3 cells
- 6 mobile stations
- GMC/OFDM modulation
- 8x4/4x4 MIMO
- >100Mbps data rate
- Antenna coverage: 0.5-1km
- Power for single antenna: 27dBm
- radio environment: from 0 to 120km



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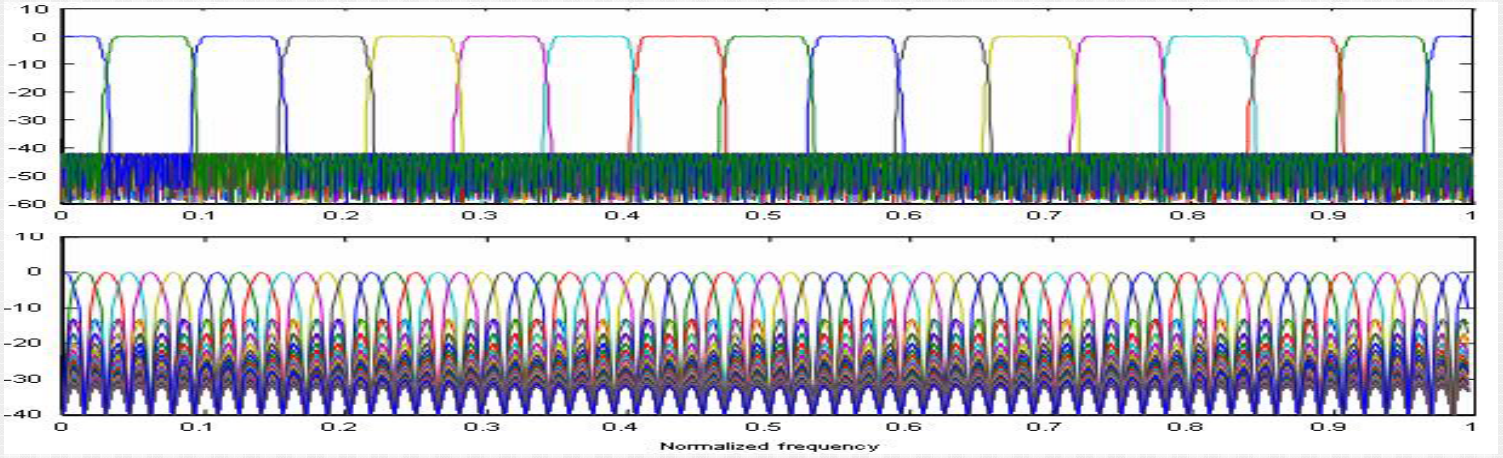
GMC/OFDM Link



X.Q. Gao & X.H. You et al, IEEE JSAC, vol.24, No.6, 2006

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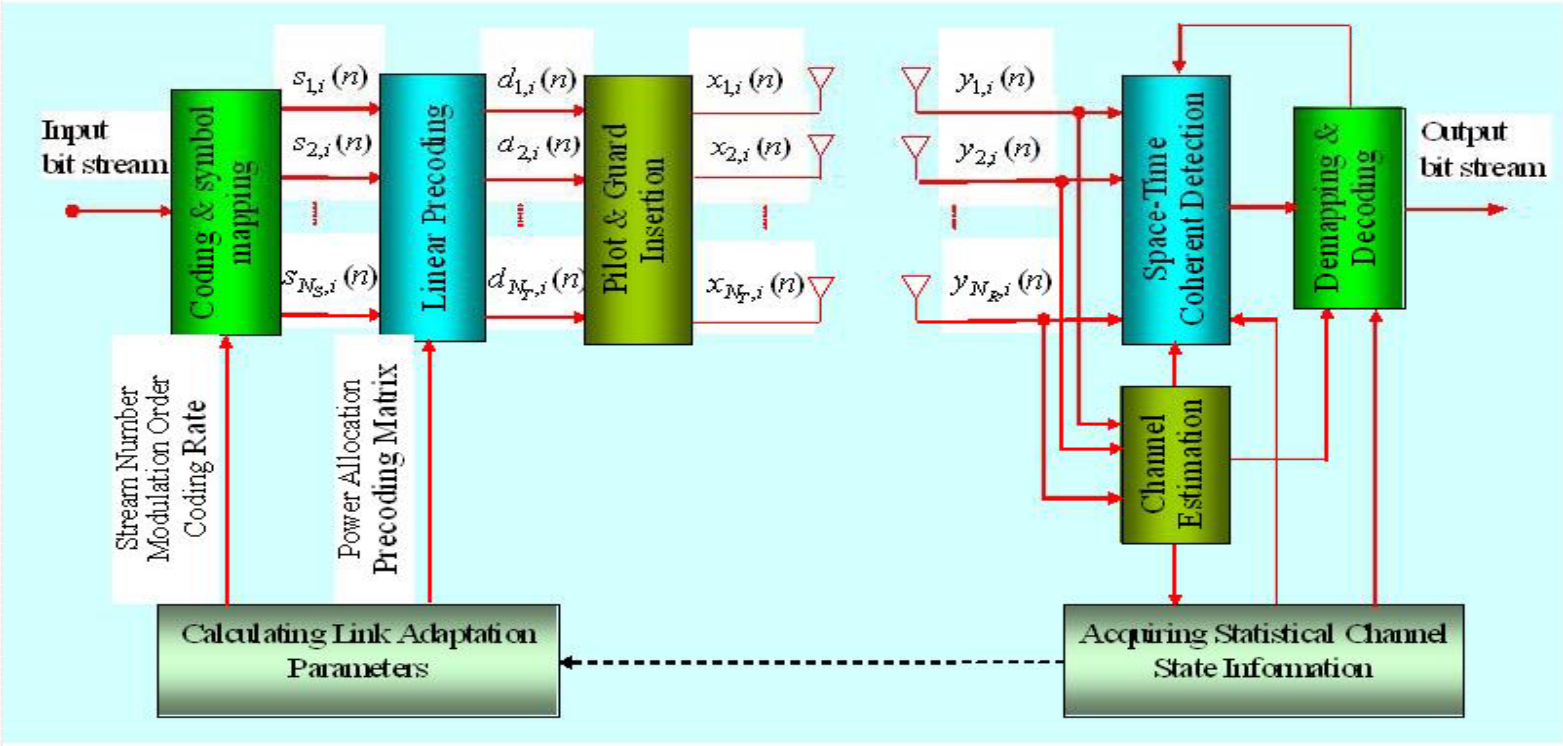
Illustration of Unifying MIMO Transmission



X.Q. Gao et al, IEEE Trans. on IT, to appear

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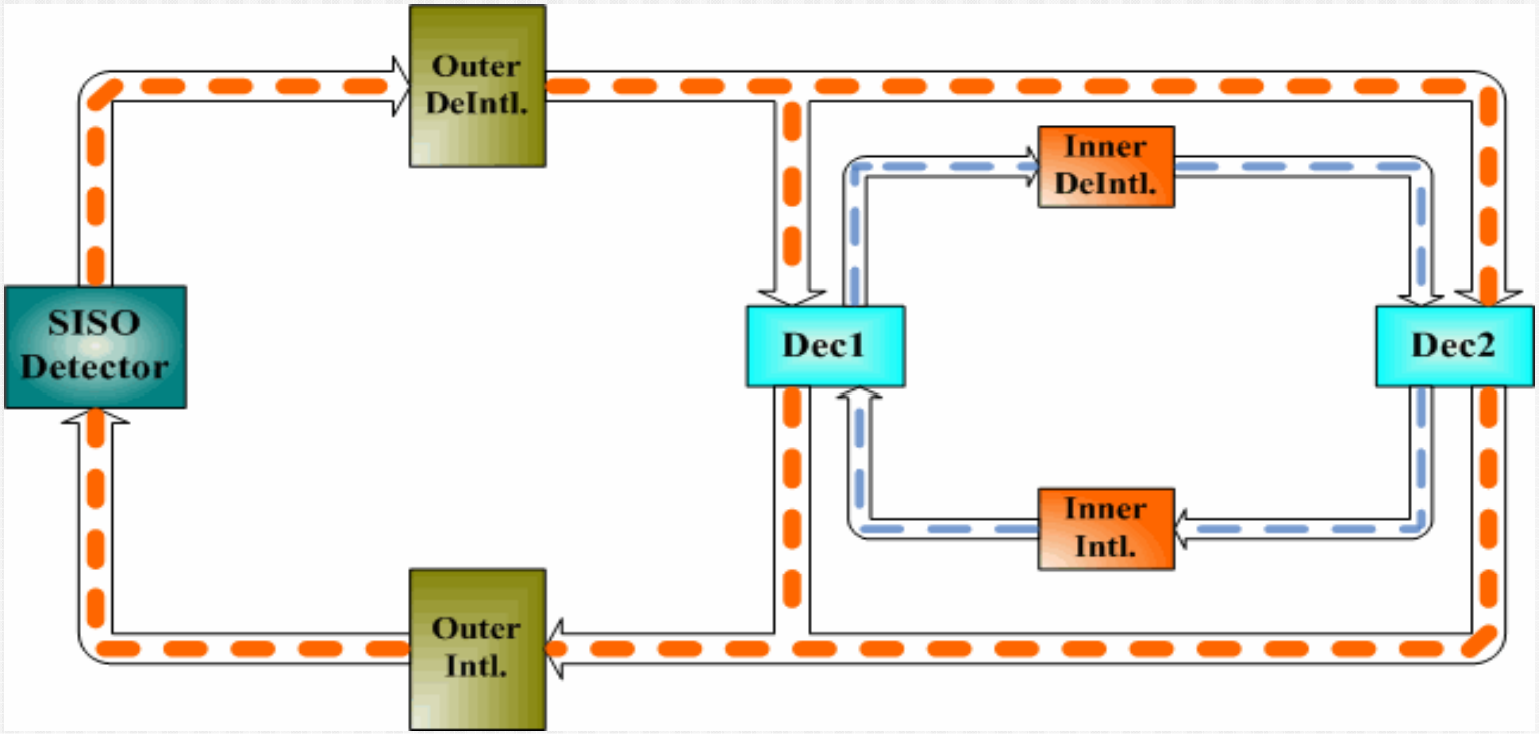
Dual-Turbo Receiver



B. Jiang & X.Q. Gao et al., ICC'09 & IEEE Trans. on Wcom, to appear

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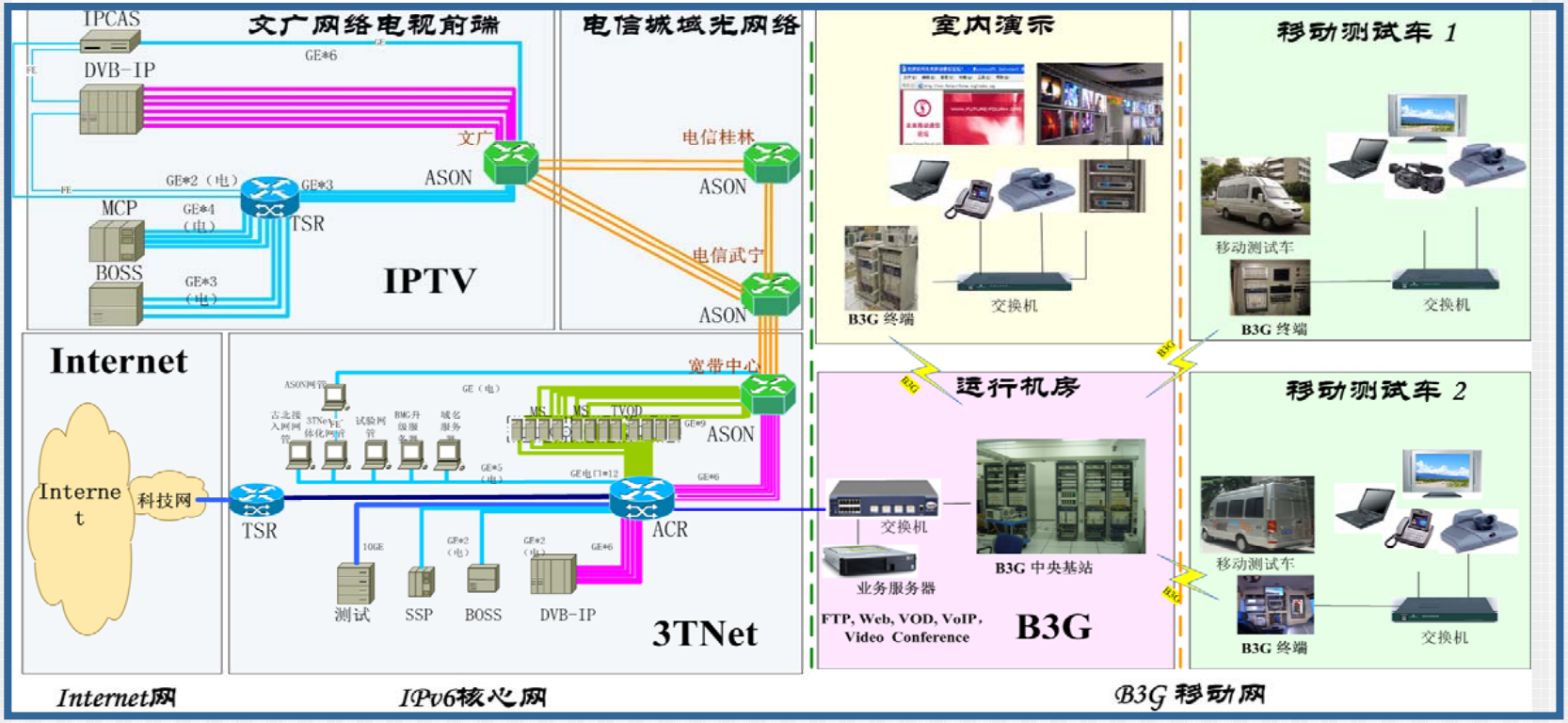
FuTURE outfield trial system – Shanghai

Network deployment for trial system



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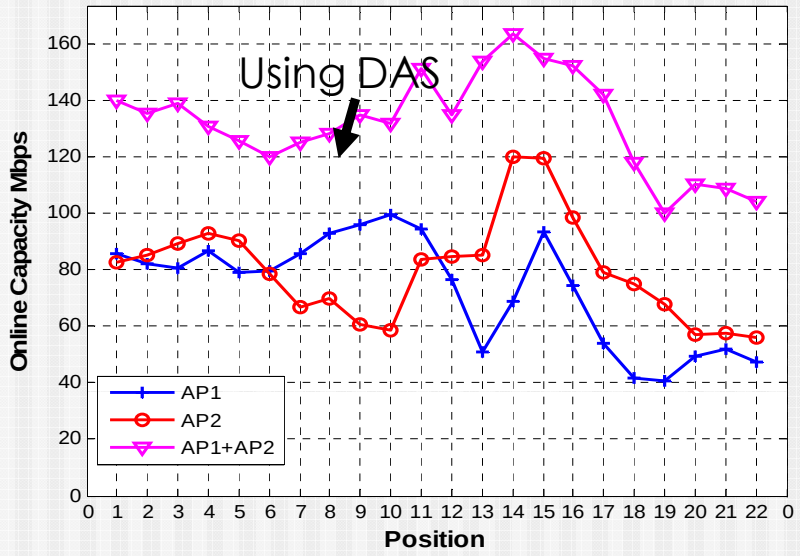
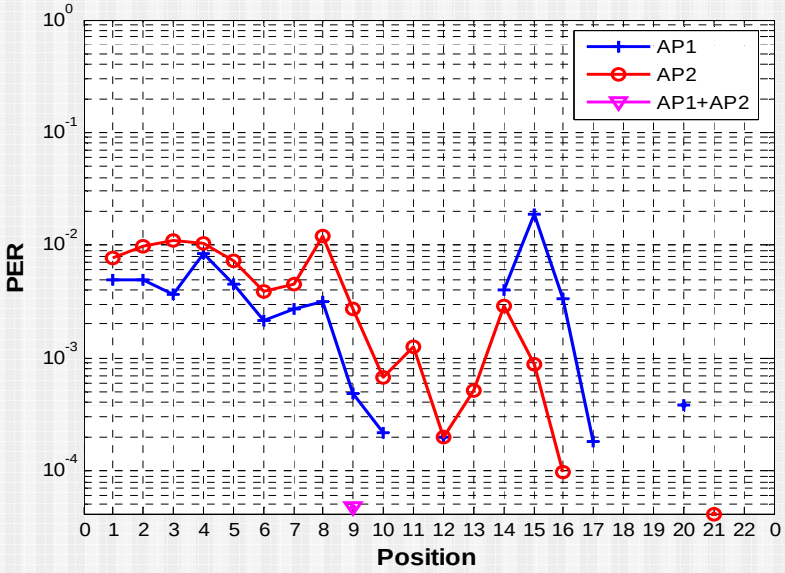
Test results for distributed MIMO

Online Capacity



BER Performance



System Model of Cooperative DAS

The capacities of cooperative DAS, conditioned on mobile user's position, have been given by Wang & You, IEEE Trans. on SP, vol. 56, May, 2008, pp. 2165-2170 and IEEE Wireless Comm. Mag., to appear.

Uplink:

$$I_{\mathrm{UL}} = \log_2 \det\left[\boldsymbol{I}_M + \frac{P}{M\sigma^2}\sum_{n=1}^{N} \rho_n \boldsymbol{U}_n^H \boldsymbol{U}_n\right]$$

Downlink:

$$I_{\mathrm{DL}} = \log_2 \det\left[\boldsymbol{I}_L + \frac{1}{Lc^2}\sum_{n=1}^{N} p_n \lambda_n \boldsymbol{D}_n^H \boldsymbol{D}_n\right]$$

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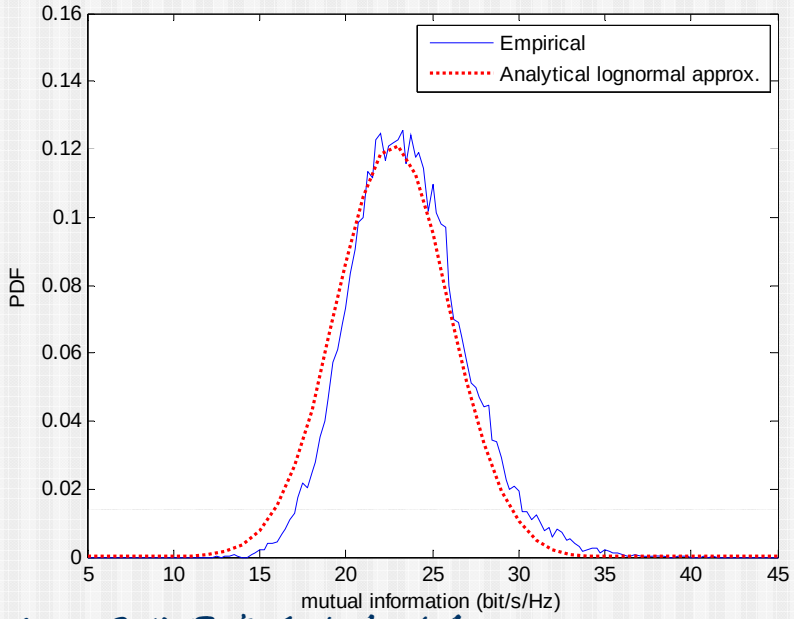
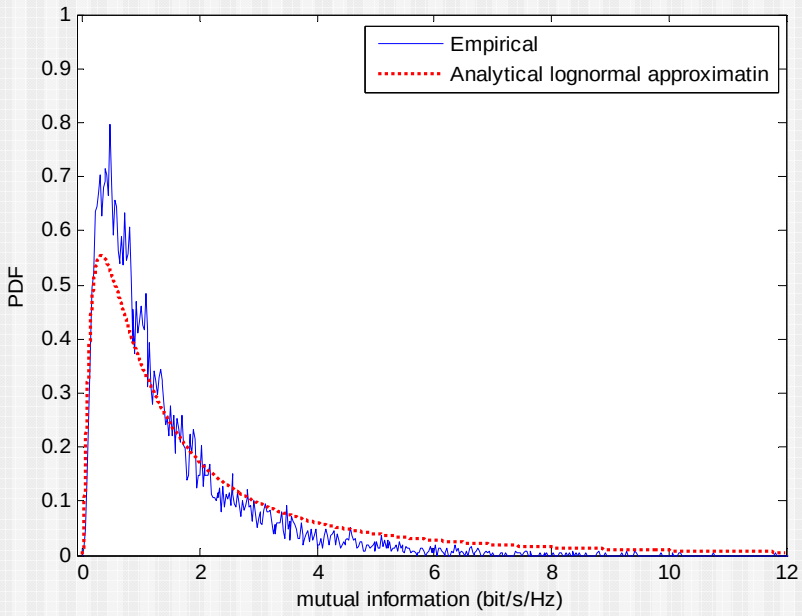
We have also shown that for a given user's position, the above capacities can be approximated as a Gaussian random variable at large SNR and a log-normal random variable at small SNR, respectively.

Based on this approximation, the capacity over the entire cell can be thus obtained in an analytical way.





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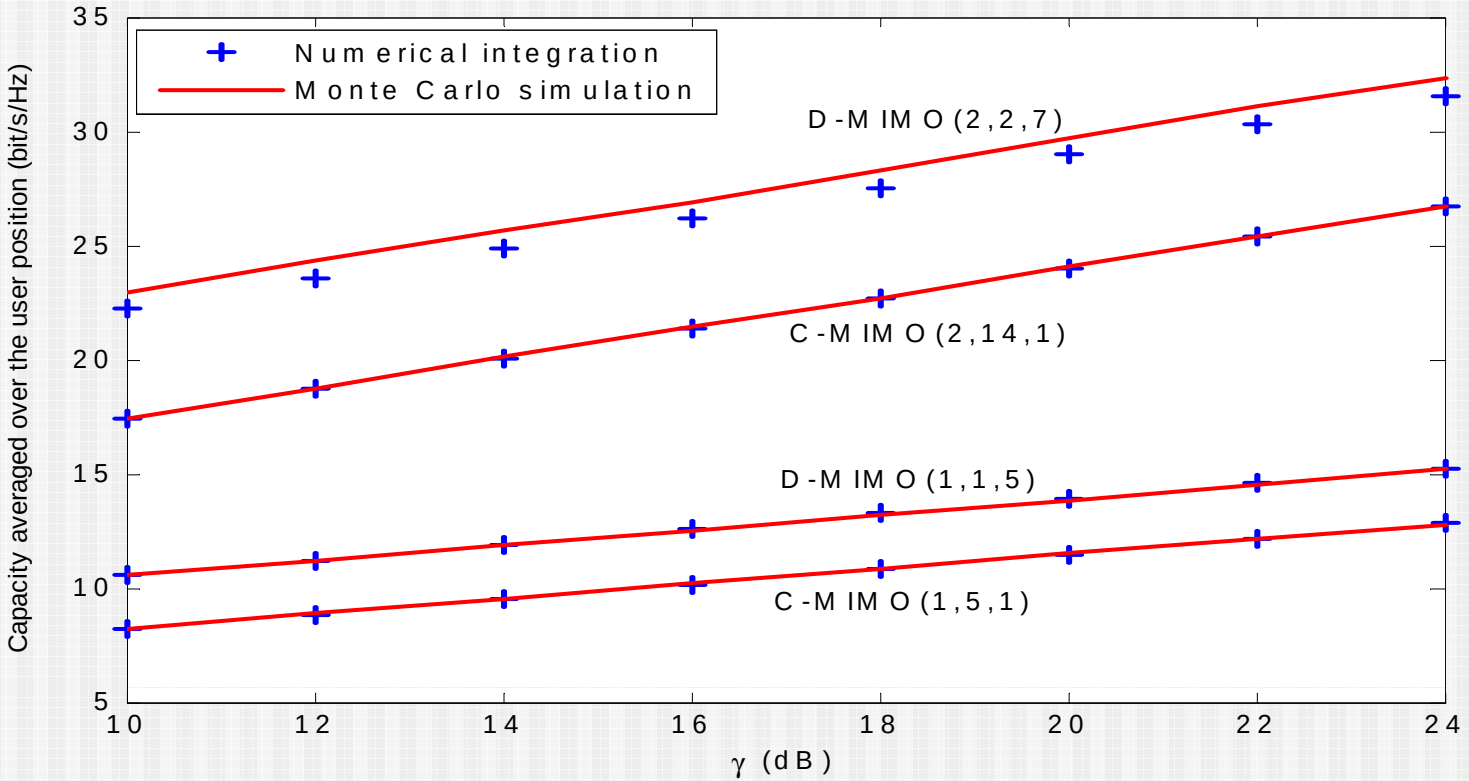
Uplink Capacity Averaged Over the Cell:
Comparison between distributed MIMO and Co-located MIMO



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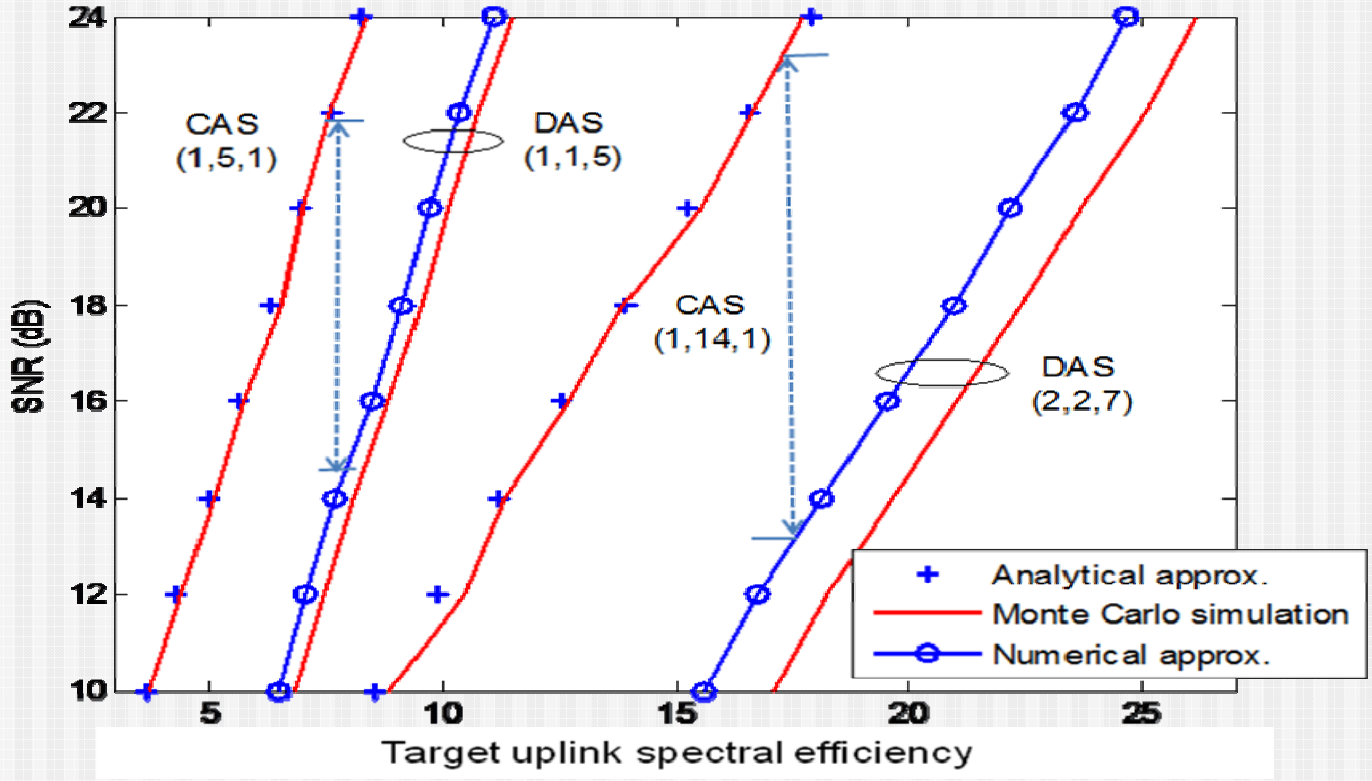
Comparison of transmit power efficiency in uplink



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Thank You for Attention!