4G TDD GROUP CELL (MU-COMP) Trial Network

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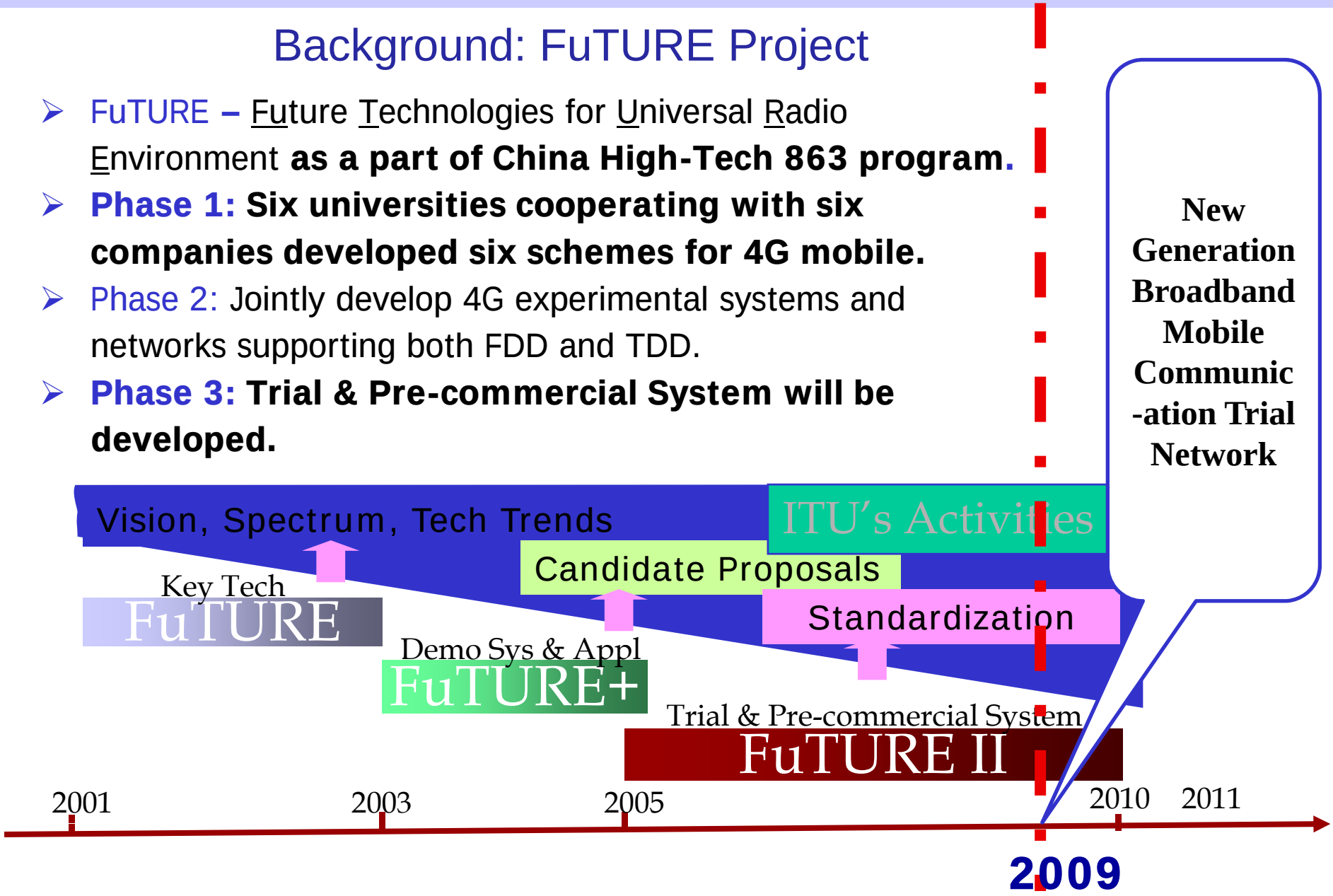
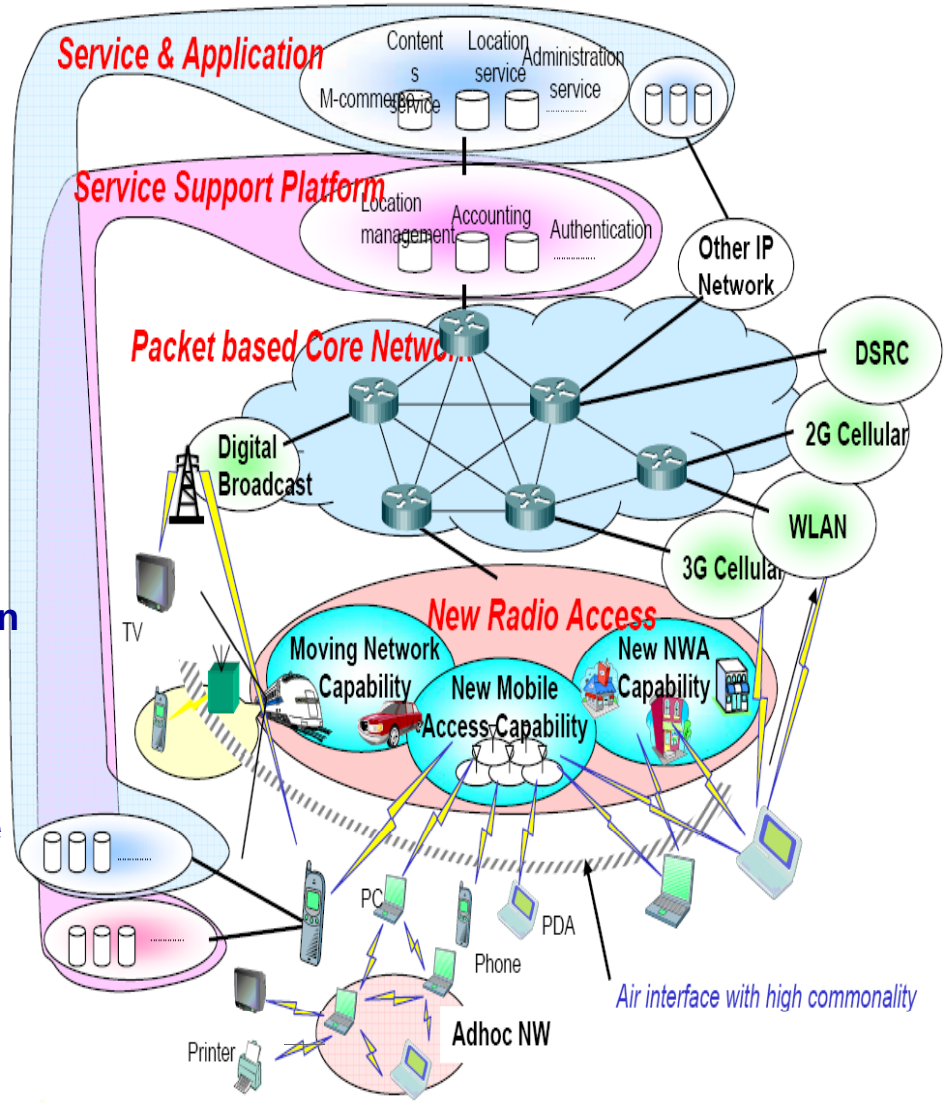
Background: FuTURE Project

- FuTURE – Future Technologies for Universal Radio Environment **as a part of China High-Tech 863 program.**
- **Phase 1: Six universities cooperating with six companies developed six schemes for 4G mobile.**
- Phase 2: Jointly develop 4G experimental systems and networks supporting both FDD and TDD.
- **Phase 3: Trial & Pre-commercial System will be developed.**



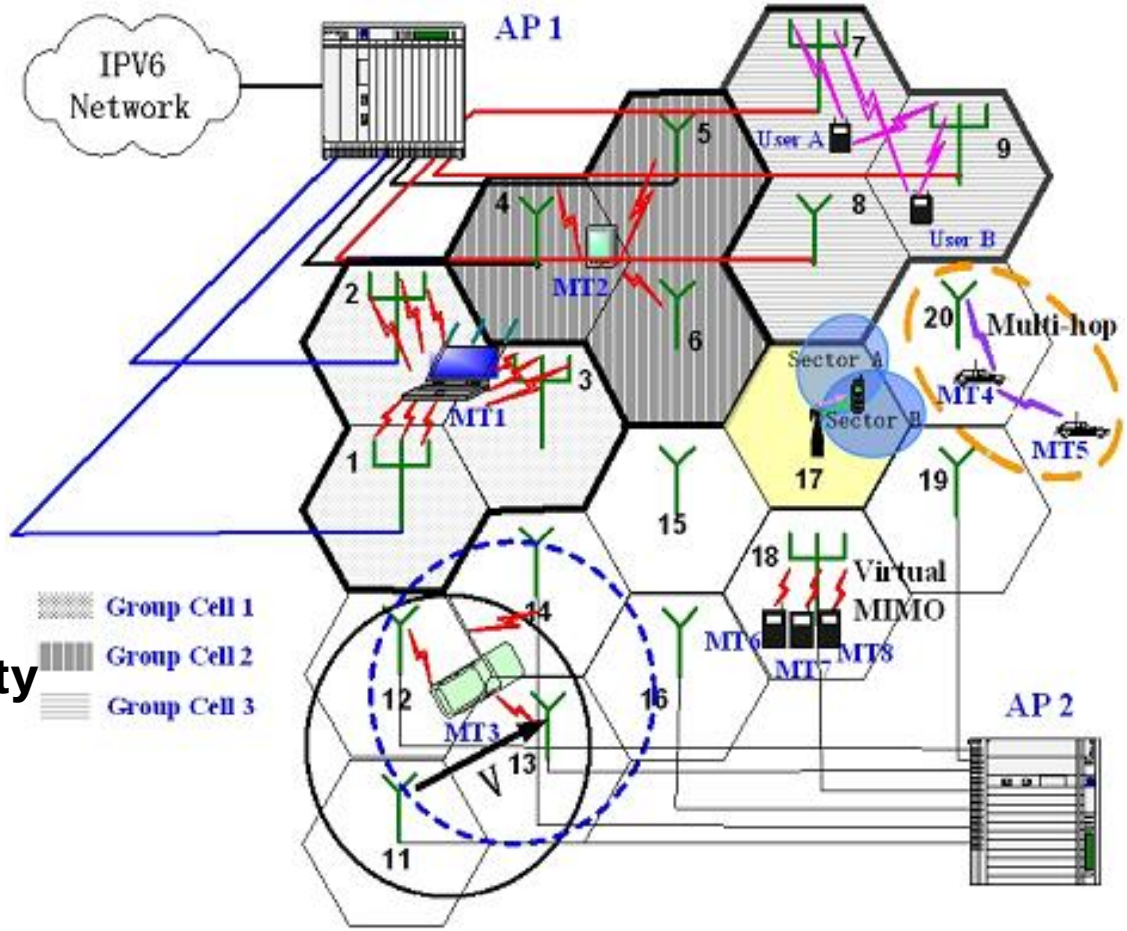
Vision of 4G Wireless Communication System(2002)

- **Higher Data Rate（100M～1Gbps）**
  - 3GPP TR 25.913 “Requirements for Evolved UTRA and Evolved UTRAN”
- **Higher Mobile Mobility（250km/h）**
  - ITU-R M.1645: “Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000”
- **All-IP Architecture, Function Split of Control Plane and User Plane**
  - ITU-T SG13 FGNGN
  - 3GPP TS 22.258 "Service requirements for an All-IP Network"
- **Ubiquitous Services, Convergence of different Network Architecture**
  - 3GPP TR 23.882 “ 3GPP system architecture evolution (SAE)”
- **Versatile Multimedia Packet Service**
  - WWRF（MUSE）



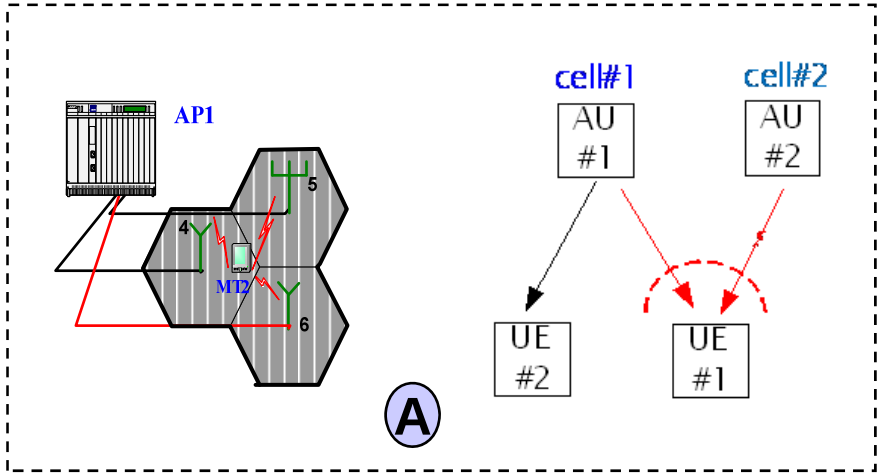
4G TDD Network Architecture（2001-2003）

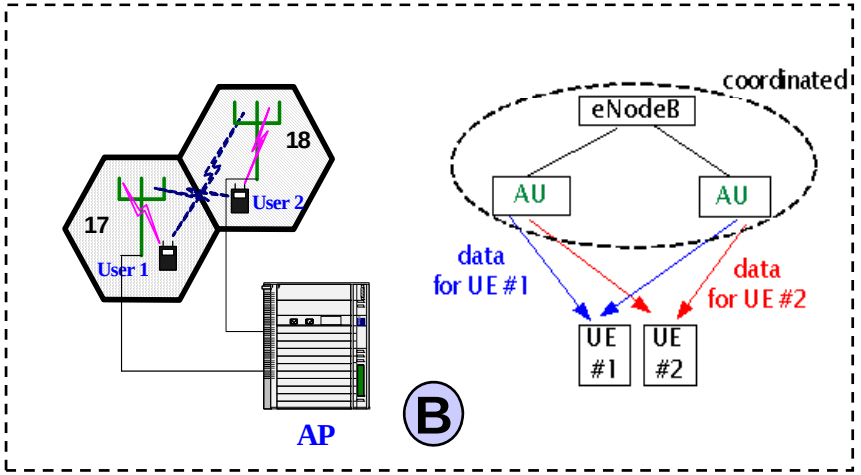
- ☐ **Flat Radio Access Network**
  - – All-IP based architecture
  - – Short latency
- ☐ **Novel Cellular Architecture**
  - – Group Cell
  - – Slide Handover
  - – User always in cell center
  - – Solve “smaller cell” problem
  - – Avoid “cell edge” effect
  - – Avoid frequent handover
  - – Enlarge coverage area
- ☐ **Fully Explore Space Diversity**
  - – Distributed Antenna Array
  - – Virtual MIMO
  - – Multi-hop, Relay

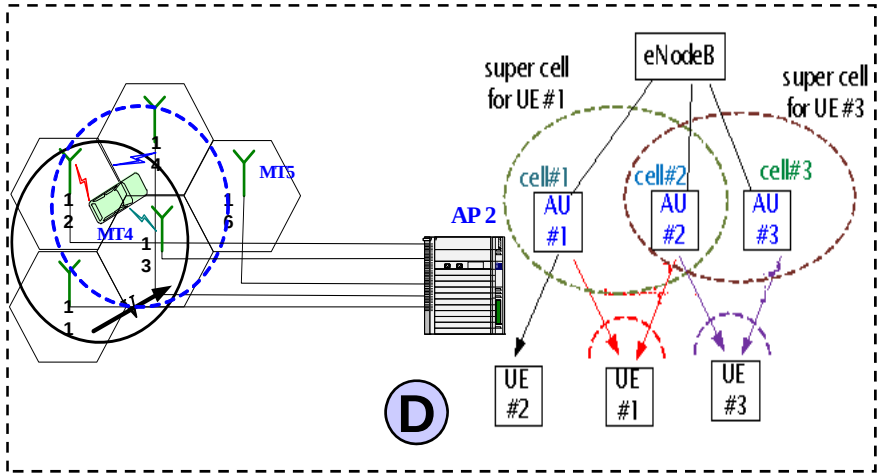


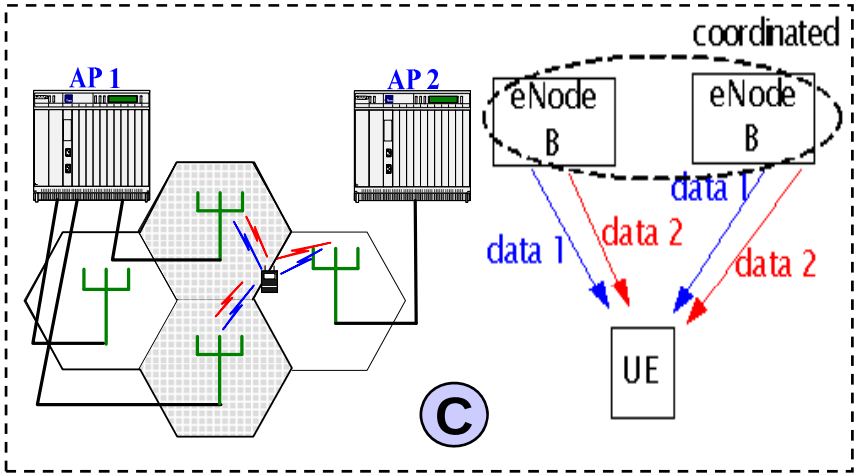
Scene for Outdoor Demonstration
Group Cell (CoMP) 2006.4-2006.10

Group Cell (2001) vs 3GPP LTE-A CoMP（2008.9）

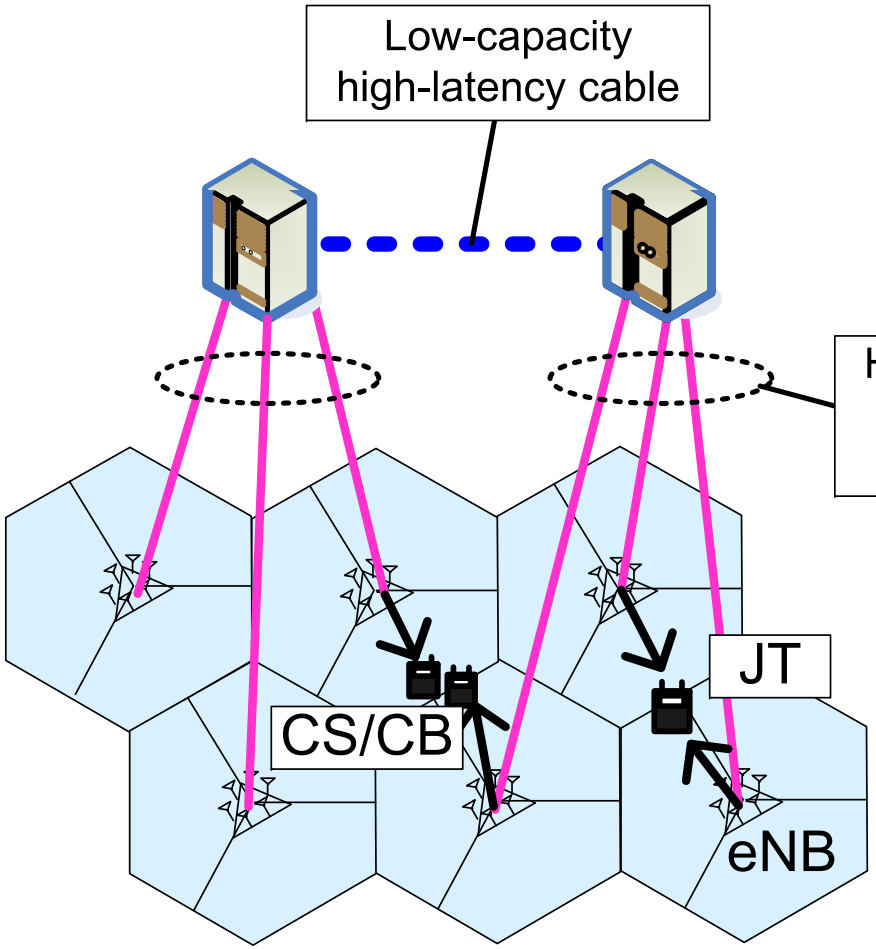








- Coordinated Scheduling/Beamforming (CS/CB) **CoMP**
- Joint Transmission (JT)



	CSI/scheduling information exchange	Data exchange
CS/CB	YES	NO
JT	YES	YES

- CS/CB can be applied in inter-eNodeB scenario with weak backhaul.
- JT can be applied in intra-eNodeB scenario with powerful backhaul.

Table 2 Parameters of Group Cell simulation, and trial networks

Parameters	LTE-CoMP simulation	FuTURE TDD Trial	New Generation Broadband Mobile Communication Trial Network
Carrier frequency	3.5GHz	3.5GHz	3.5GHz , 5.8GHz(for Relay)
System Bandwidth	20MHz	20MHz	20-100MHz
Duplex mode		TDD	TDD
Peak Data rate	100Mbps	100 - 122Mbps	100M - 1Gbps
Transmission power	27dBm	27dBm	27dBm
Active Subcarrier /FFT point	880	884/1024	1664/2048
Subcarrier interval	15kHz	19.5kHz	60kHz
Symbol period		62us	18.75us
Block size		4400 bits	3776 bits
Modulation		16QAM	16QAM
Channel Coding	Turbo code	Turbo code / LDPC	LDPC
Antenna Configuration(UE, BS)	(2, 4)	(1,1), (1,4), (2,4), (4,8)	(4,6)
Antenna separation(UE, BS) (in times of wavelength)	(10, 10)	(10, 10)	(10, 10)

Table 2 Parameters of Group Cell simulation, and trial networks

Distance of adjacent AUs	200m	200m	200m
Channel model	SCM, Urban macro, high spread	/	/
UE speed	5km/h	3km/h ~ 100km/h	3km/h ~ 100km/h
Distance-dependent path-loss	L=128.1+37.6log10(R),R in km	/	/
Shadow fading deviation	8 dB	/	/
Penetration loss	20dB	/	/
Noise figure at UE	7dB	7dB	7dB
Antenna gain	17dBi for sector antenna	12 dBi for sector antenna	12 dBi for sector antenna
Traffic model	Full buffer	Full buffer, VoIP	Full buffer, VoIP
Link-to-system level mapping	Exponential Effective SIR Mapping (EESM)	/	/
BLER target	10%	/	/
Receiver algorithm	Zero Forcing (ZF)	Zero Forcing (ZF)	Zero Forcing (ZF)
Number of BS\AU\UE\Relay	19\57\570\0 (wrap-around, Uniform in entire network)	3\6\2\0	3\4\3\1
Scenarios support	JT, CS/CB	BS1: non-JT; BS2: JT (named as adaptive MIMO in 2006)	JT, CS/CB, Cooperative Relay

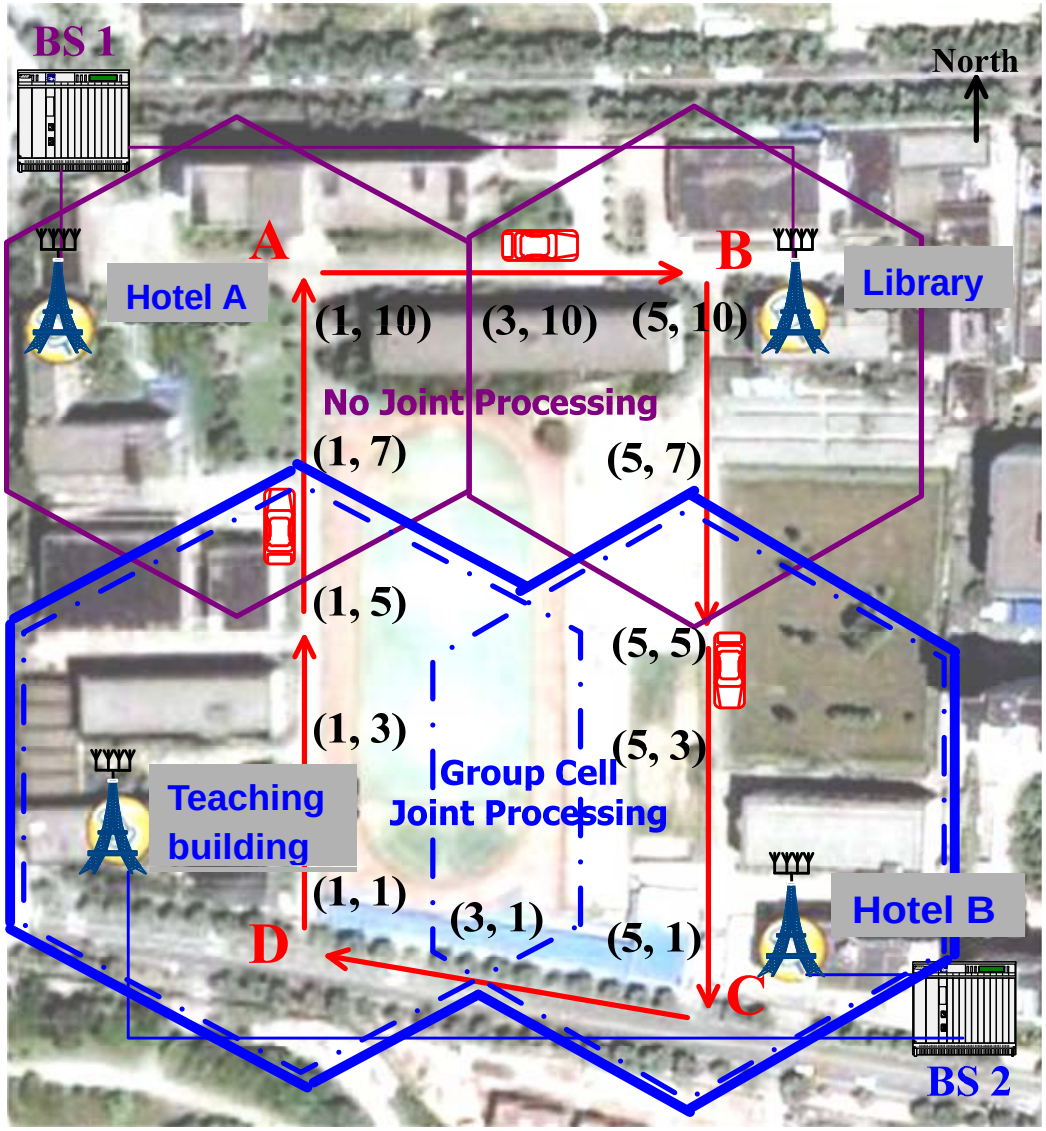
Numerical simulation: results

- Spectral efficiency (SE) performance

Schemes	Cell average SE		5% cell edge SE	
	Value (bps/Hz/cell)	Gain over non-CoMP	Value (bps/Hz/cell)	Gain over non-CoMP
Non-CoMP	2.4867	0	0.1011	0
MU-JT	3.7301	50.00%	0.1524	50.74%

- MU-JT, which combines MU and JT, achieves **obvious performance gains** in terms of both cell average and cell edge spectral efficiency.
- As the **tx power is fixed**, MU-JT can significantly improve system spectral efficiency per dBm.

Field test

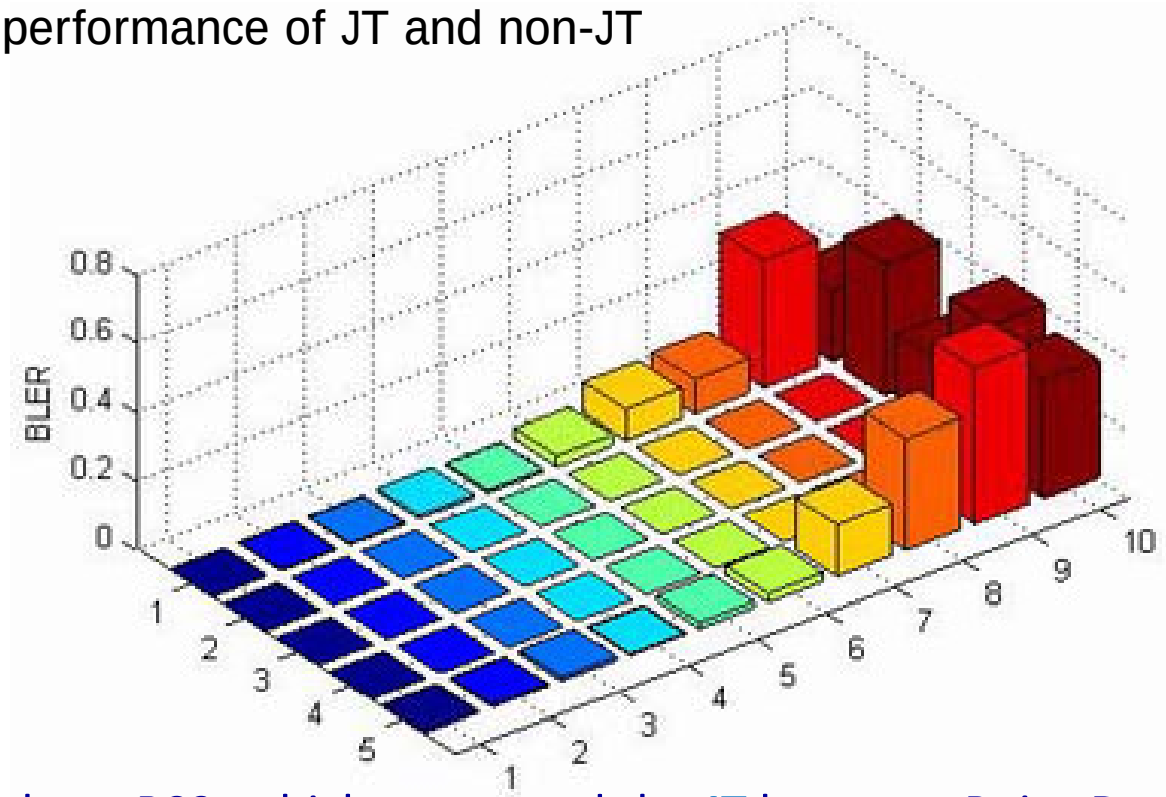


Two comparative trials are conducted:

- The first northern BS1: was composed by two remote four-antenna AUs established on Hotel A and Library, **without JT**.
- The other southern BS2: **established one Group Cell** which was composed by two remote four-antenna AUs located on the Teaching building and Hotel B, which **supports JT scenario inside of the Group Cell**.

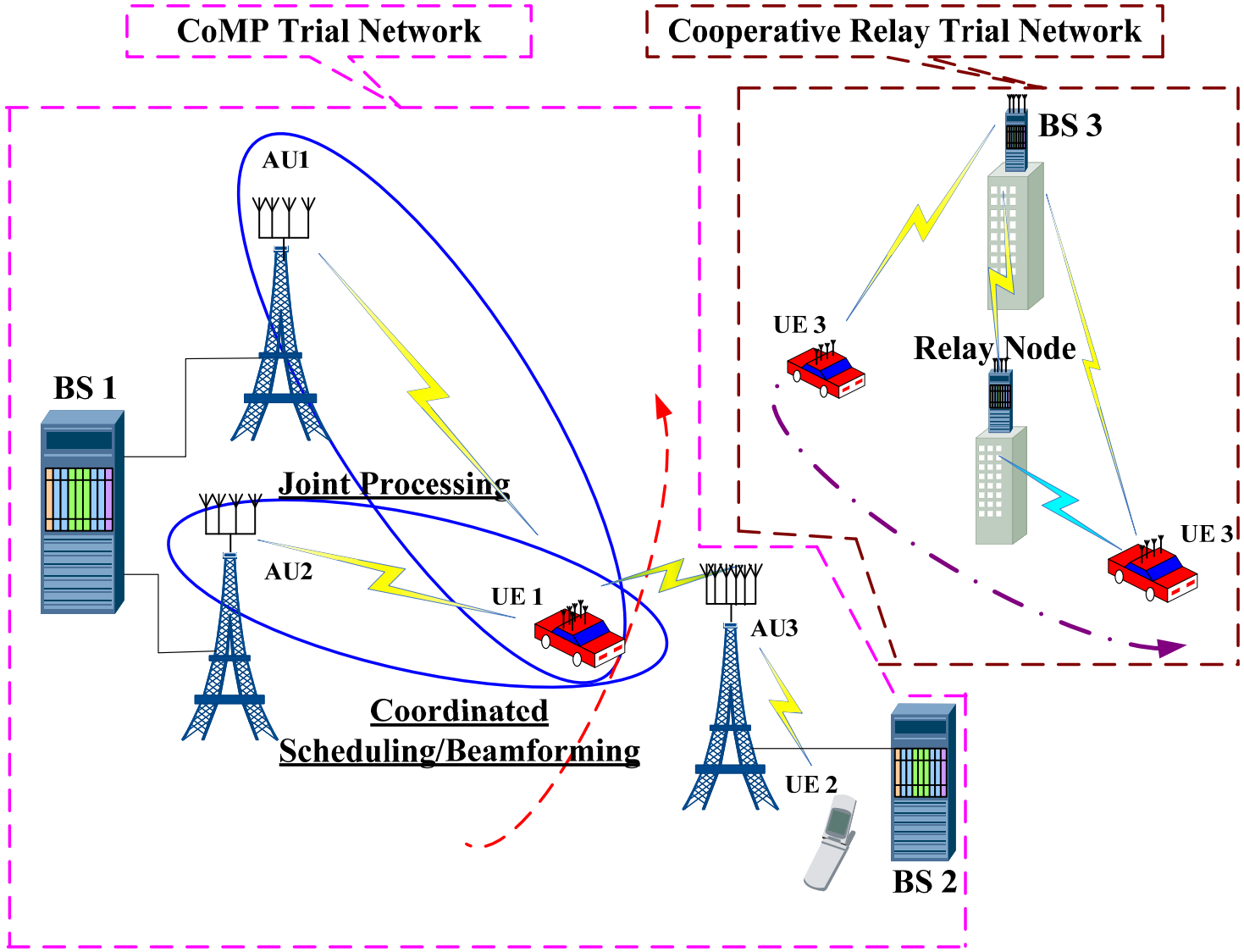
Field test: results

- BLER performance of JT and non-JT



- The southern BS2, which supported the **JT** between Point D and Point C, has good BLER performances inside of all the Group Cell coverage as about **0.1%.**
- Whereas, the northern BS1 **without JT** has bad performance as about **20% BLER** between Point A and Point B, especially in the crossover area of two cells' edge.
- **The advantage of JT can be found obviously**.

From 2009-2011



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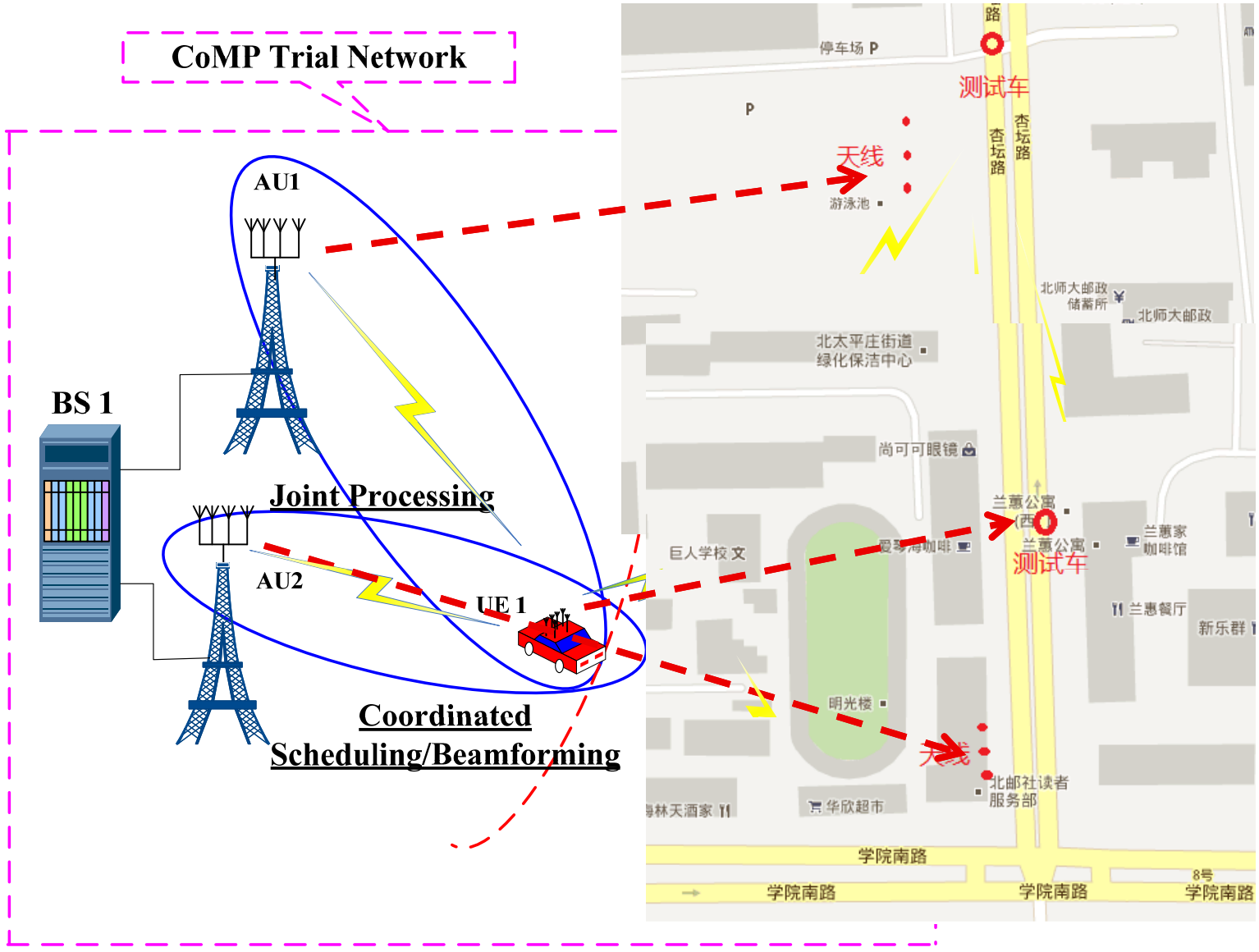

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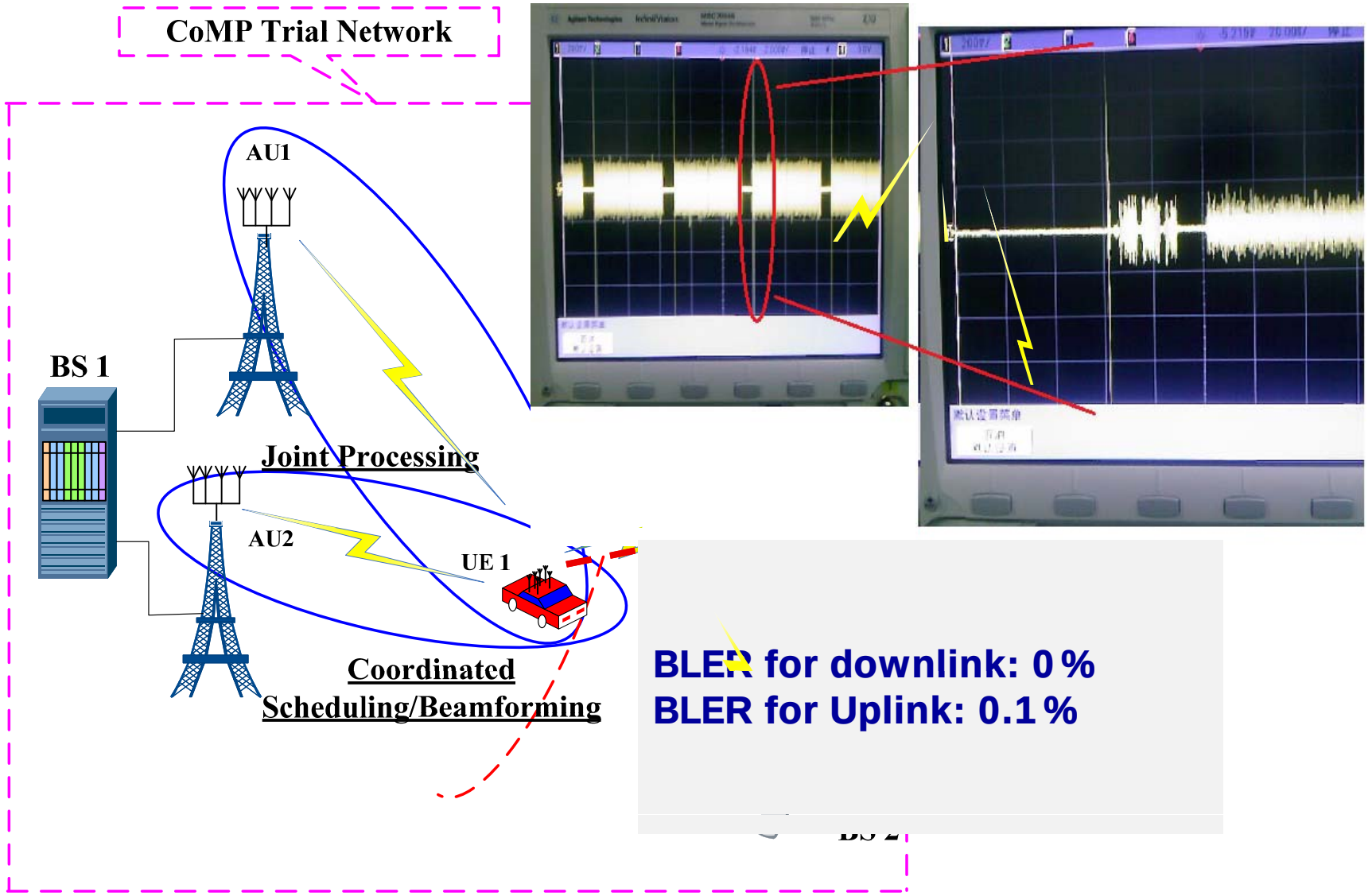
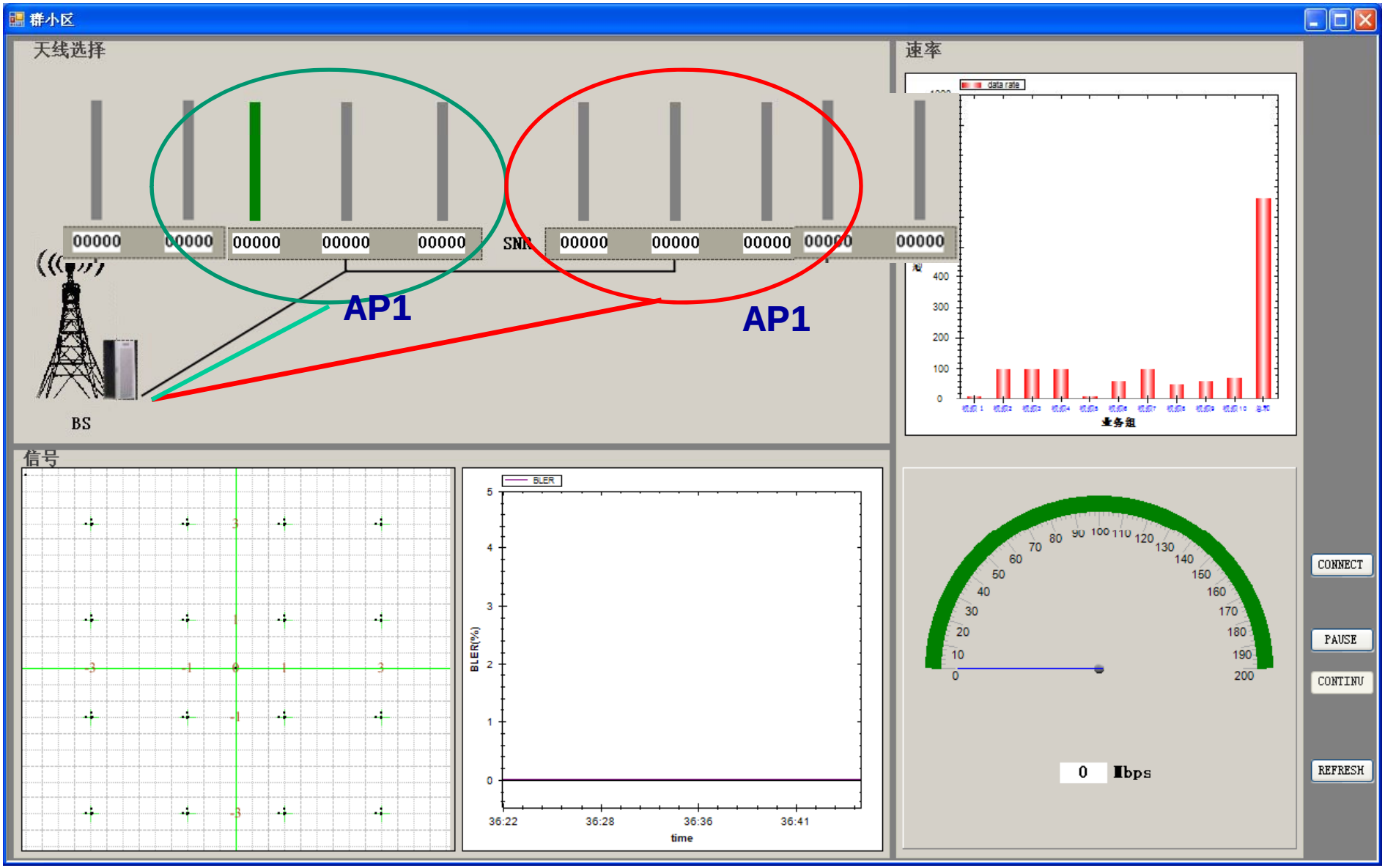


New CoMP trial network



Thanks!