B3G/4G Research

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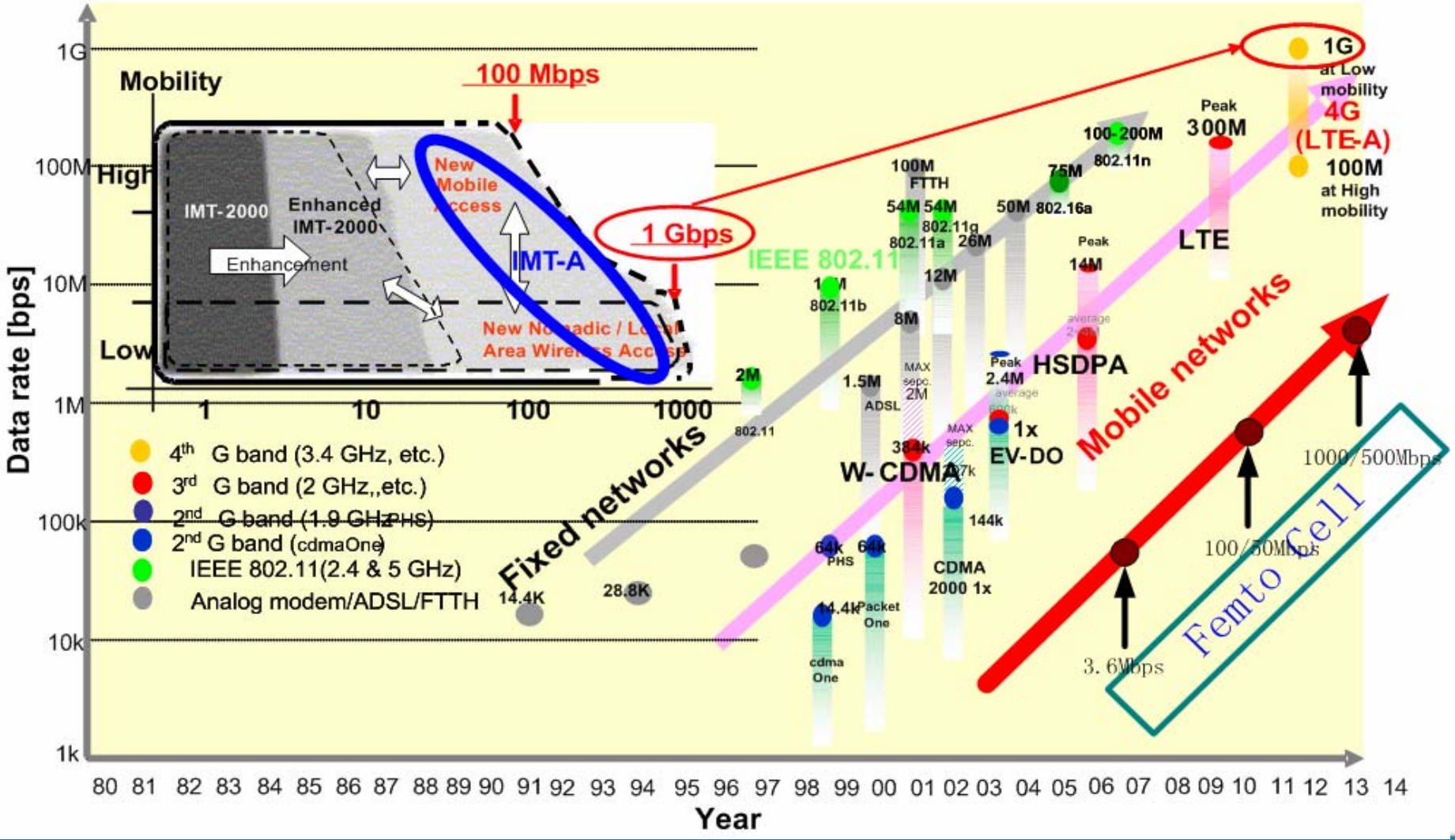
Outline

- Introduction
- Technical Solutions for communication

Introduction

- **User Requirement**
  - ✓ Ubiquitous access
  - ✓ High Power efficiency (always on line)
  - ✓ Low bit cost
  - ✓ Audience to Player
  - ✓ Security
- **Operator Requirement**
  - ✓ High Revenue: Hot Spot or Local Area
  - ✓ Wireless Network Operator to Content(Service) Provider
- **Technical Solution**
  - ✓ Fixed access: Wi-Fi, IEEE 802.16d, xDSL
  - ✓ Mobile access: 3GPP,3GPP2

Technical Solution/1



Technical Solution/2

- Relay
- Device-to-Device (D2D) Communications
- Home (e)NB or Femto-cell

Relay/1

- **Improve System Performance**
  - Cell edge spectrum efficiency
  - System spectrum efficiency
- **Increase network deployment flexibility**
  - Fast network deployment
  - Reduce the deployment cost

$A(\theta) = 0$ dB

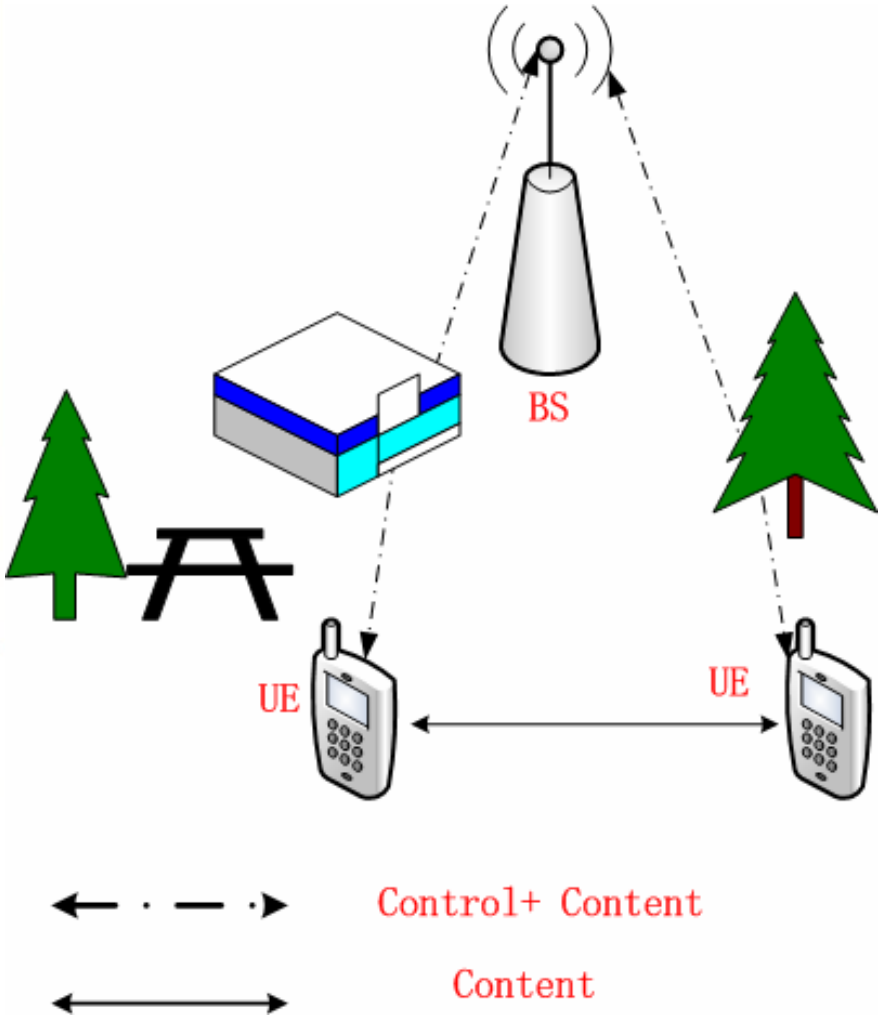
Simulation Specification

		MACRO-CELL
General	Carrier Frequency f_c	3.5GHz DL UL
	Channel Bandwidth	20MHz (Start-point)
	Deployment	Hexagonal grid, 19 cell sites, Three sector per cell,FR number: 0~3, One FRN per sector [Fig-1],Three FRN per sector [Fig-2](full coverage)
	Duplex	BS: TDD,UE: TDD,FRN: TDD
	MAC Frame Structure	Fig-3
	Power Mask	Flat (Start-point)
Base Station	Location/height	Above rooftop,
	Max. transmit power per sector	46dBm=39.81W
	Inter-site distance (only BS layout)	
	Number of antennas per sector	4 (start-point)
	Antenna configuration (per sector)	Linear array (only for BS-FR)
	Antenna element spacing	0.5λ=fc (fc =DL carrier frequency, c=speed of light)
	Azimuth antenna element pattern	
		A_m= 20, θ_{3dB}= 70°
	Elevation antenna gain	14dBi
User Terminal	transmit power	24dBm
	number of antennas	1 (Start-point)
	receiver noise figure	9dB (reference from LTE)
Fixed Relay Node	location height	Below rooftop,
	Max. transmit power per sector	37dBm=5W
	number of antennas per FRN	1
	antenna configuration (per sector)	Omni-directional pattern
	azimuth antenna element pattern	Omni-directional
	elevation antenna gain	9 dBi (only for FR receiver)
	receiver noise figure	5 dB

System simulation results

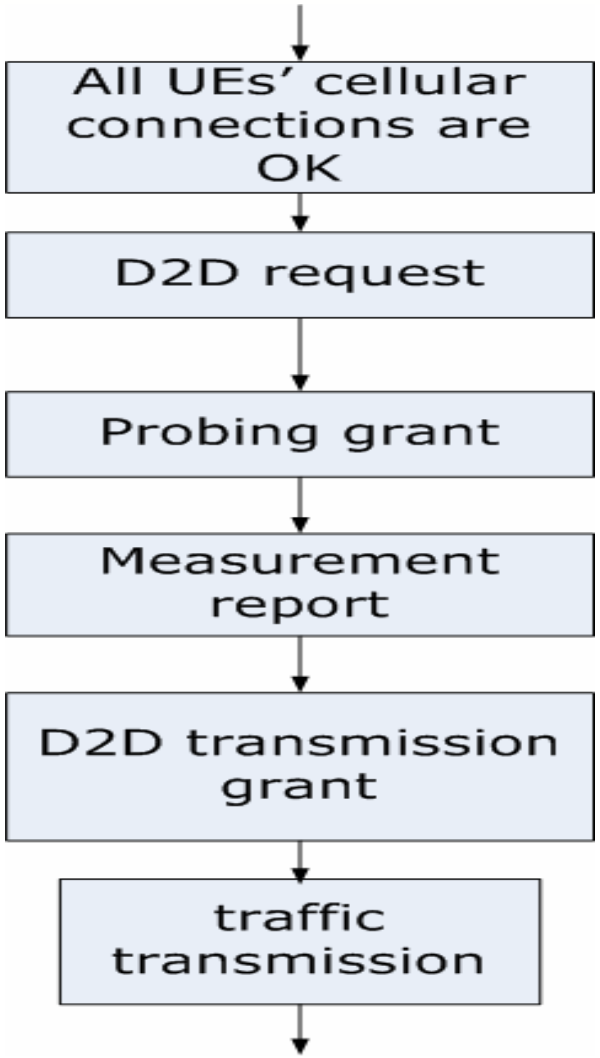
	FR_NUM = 0	FR_NUM = 1	FR_NUM = 2	FR_NUM = 3
Sector LUE throughput (Mbps)	17.5752	14.3515	16.3921	18.6504
Sector RUE throughput (Mbps)	0	5.4463	7.9381	9.5522
Sector throughput (Mbps)	17.5752(100%)	19.7978(112.7%)	24.3303(138.4%)	28.2026(160.5%)
5% UE throughput (Kbps)	93.6(100%)	94.5(101.0%)	114.5(122.3%)	130.8(139.7%)

D2D communications/1: scenarios



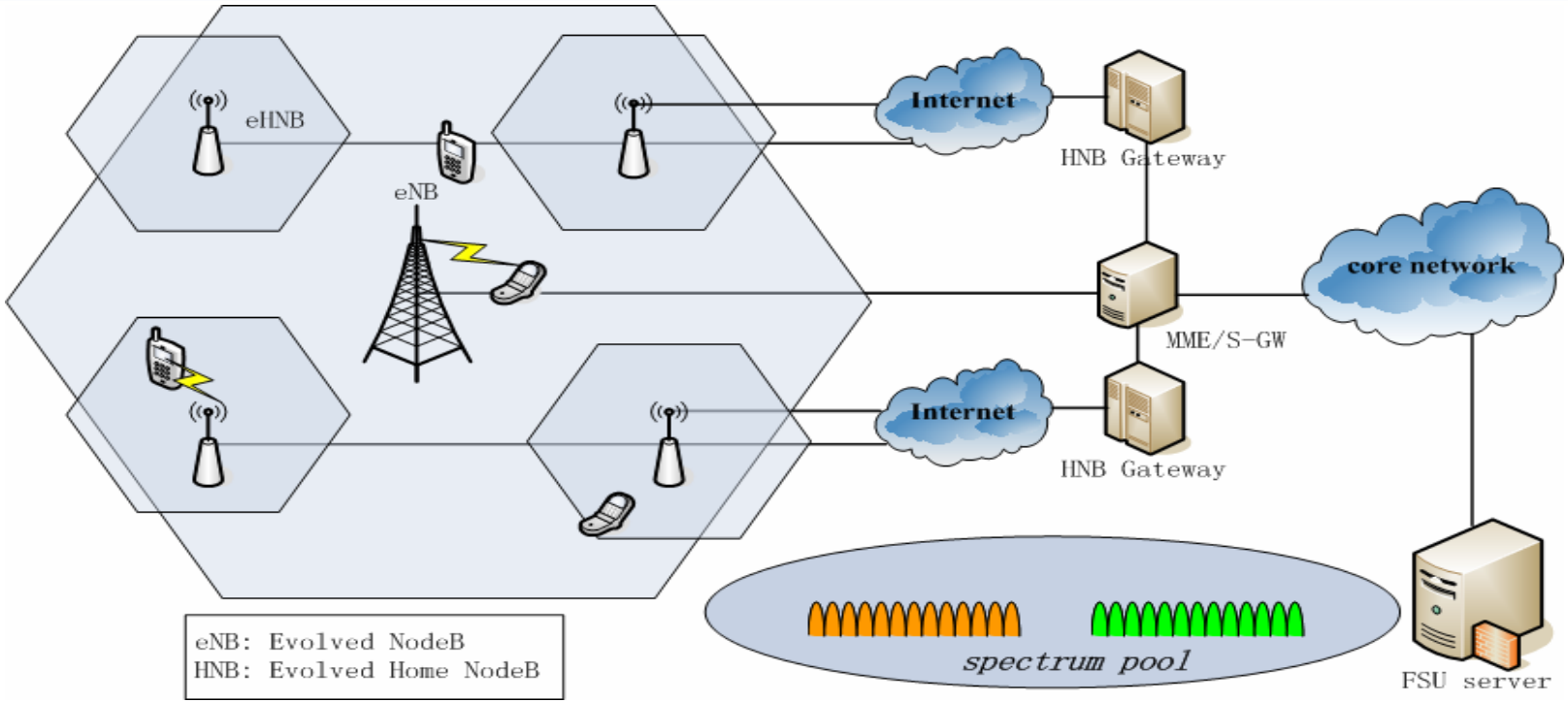
- Based on cellular environment
- TDD
- Centralized control, authorization, resource provision, charging…
- Not excluding semi-distributed scheduling (D2D has limited scheduling ability under BS's supervision)
- Radio interface of D2D: Homogeneous with cellular system
- Synchronization of D2D link and cellular link are assumed
- No resource reuse between cellular and D2D, not excluding soft reuse between D2D

D2D communications/2: Research Topic



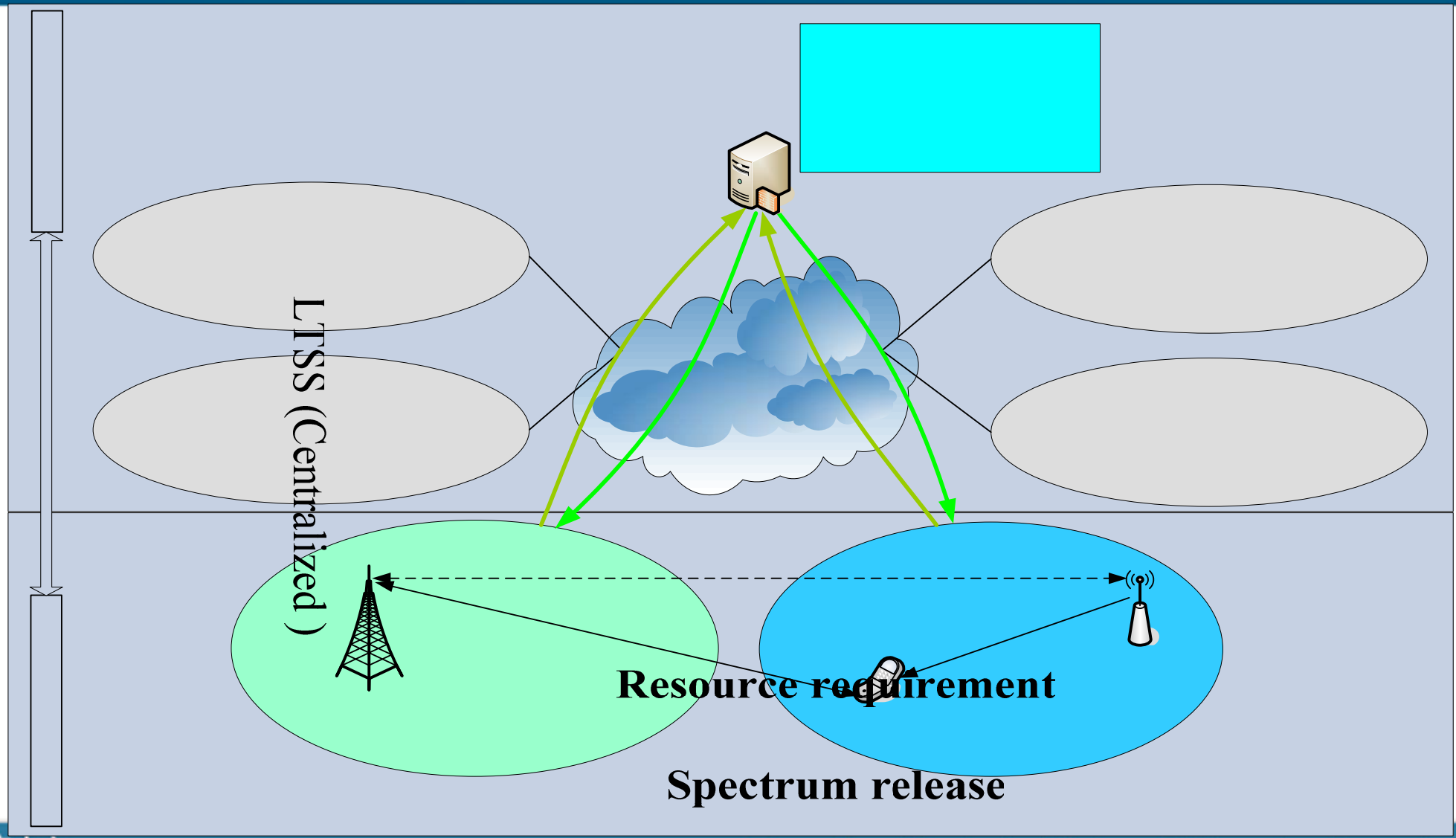
- **Signaling design**
- **Resource allocation schem design**
- **Power Control on D2D link**

Home (e)NB/1



- Home eNB uses the same spectrum as Macro(Micro) eNB
- No interface between Home eNB and Macro(Micro) eNB
- Home eNBs may be freely deployed by subscribers

Home (e)NB/2:Functional Description



Home (e)NB/2:Research Topic

- Information exchange between Macro eNB and Home eNB over air-interface
- (Semi)-distributed dynamic spectrum allocation mechanism and algorithm design
- Interference analysis for WA/LA co-existing system based on static system level simulation

Nokia-WiCo Joint Research Lab

Thank you!