



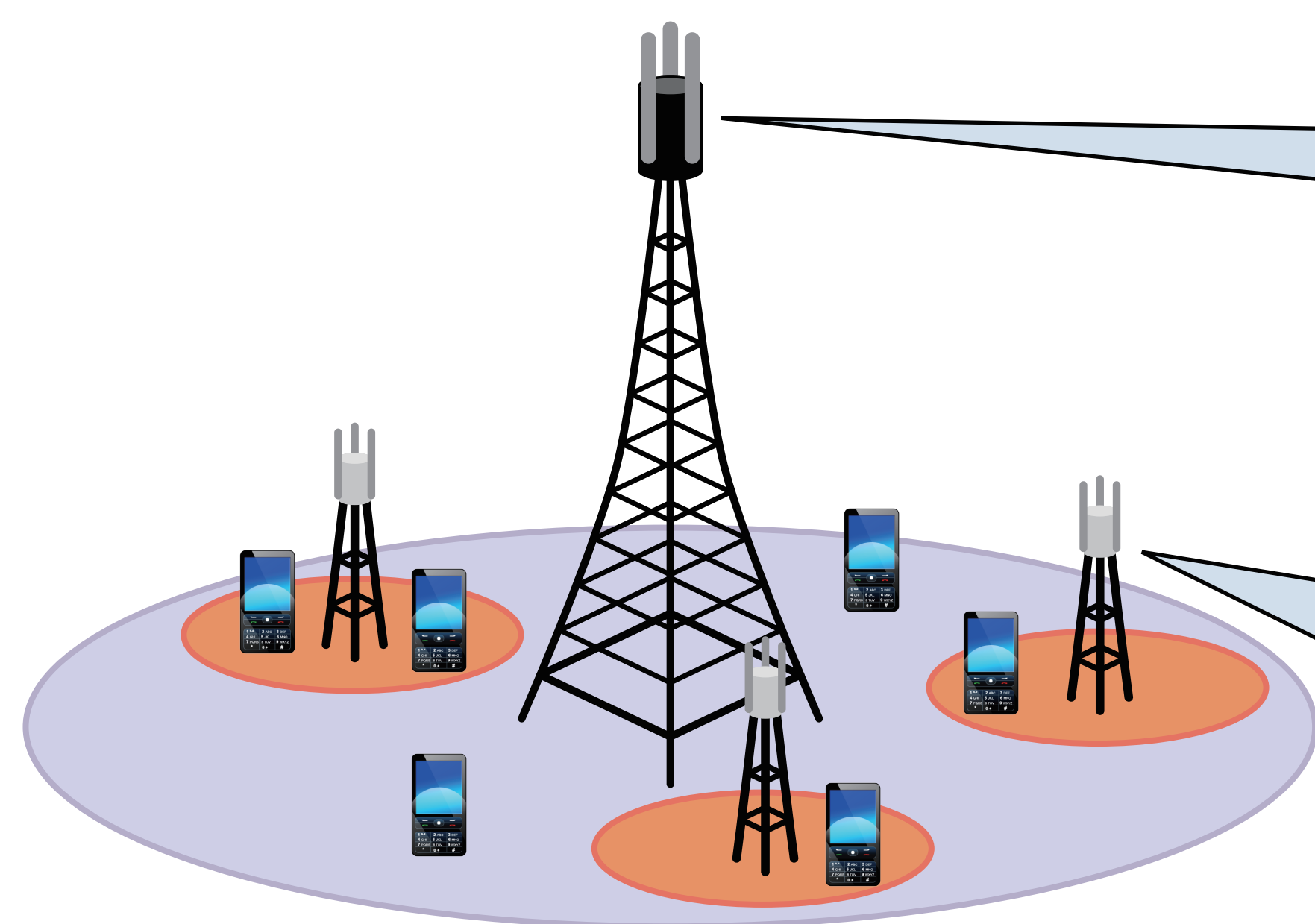
System Level Analysis of Millimeter-wave Overlaid HetNet

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Project website: <http://www.miweba.eu/>

System model

Two types of multiband heterogeneous cellular network is considered in this simulator, **2GHz/3.5GHz** multiband system and **2GHz/60GHz** multiband system.



2GHz macro BS

Center frequency: 2GHz
Bandwidth: 10MHz

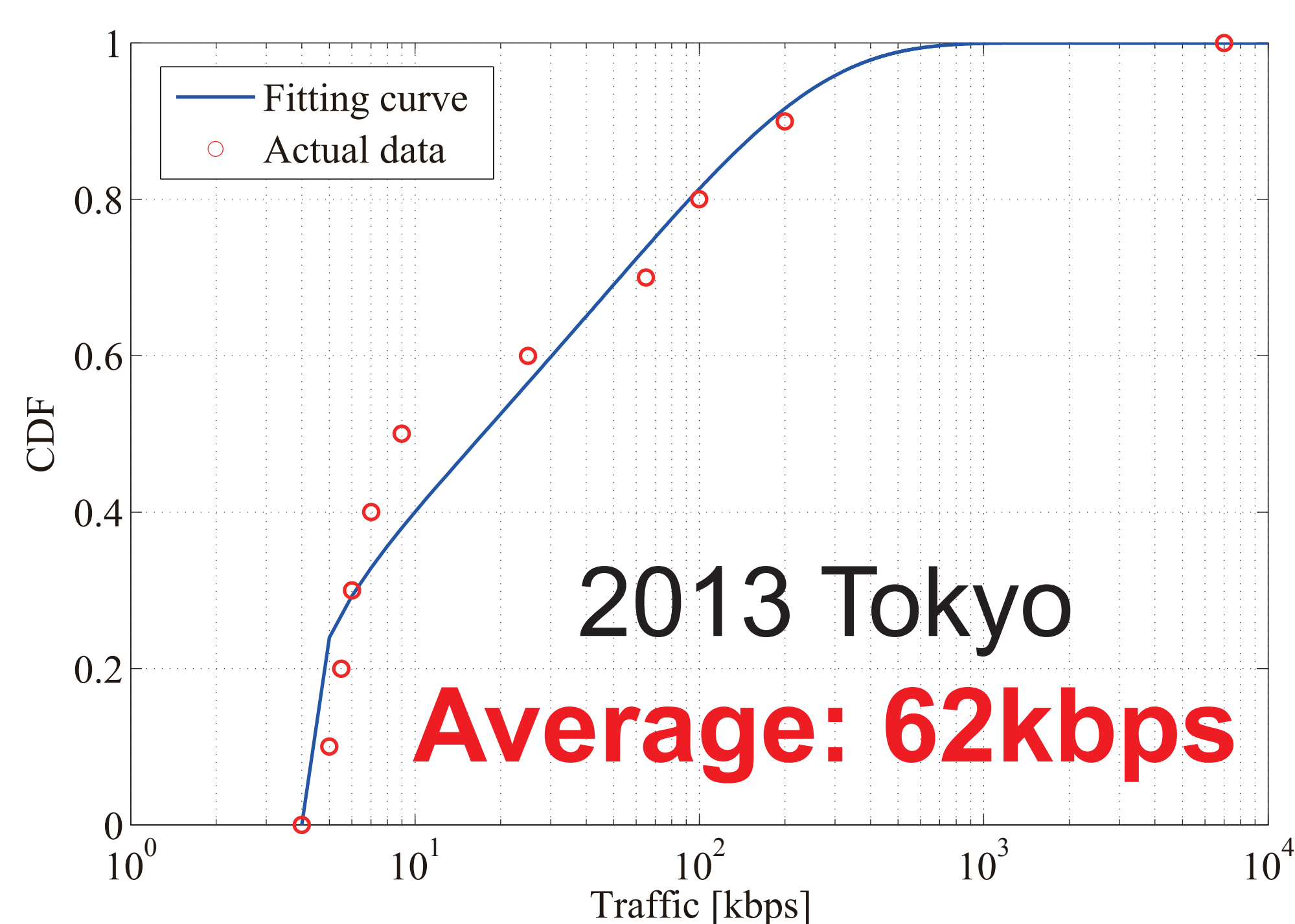
3.5GHz/60GHz smallcell BS

Center frequency: 3.5GHz/60GHz
Bandwidth: **100MHz/2GHz**

Parameter	Value
Bandwidth (Macro / 3.5GHz / 60GHz)	10MHz / 100MHz / 2GHz
Number of evaluation cells (Macro / Smallcell)	1 / 0-200
Antenna height (Macro / 3.5GHz / 60GHz)	25m / 10m / 3m
Number of UEs/site	5000
Number of antennas (Macro, 3.5GHz / 60GHz / UE)	4 / 1 / 2
Tx power (Macro / 3.5GHz / 60GHz)	46dBm / 30dBm / 10dBm
Noise power	-174dBm/Hz
Average traffic demand	62kbps / 62Mbps
Antenna gain (Macro / 3.5GHz / 60GHz)	17dBi / 5dBi / 25dBi
Antenna directivity (Macro / 3.5GHz / 60GHz)	3GPP sector antenna / Omni / WiGig compliant

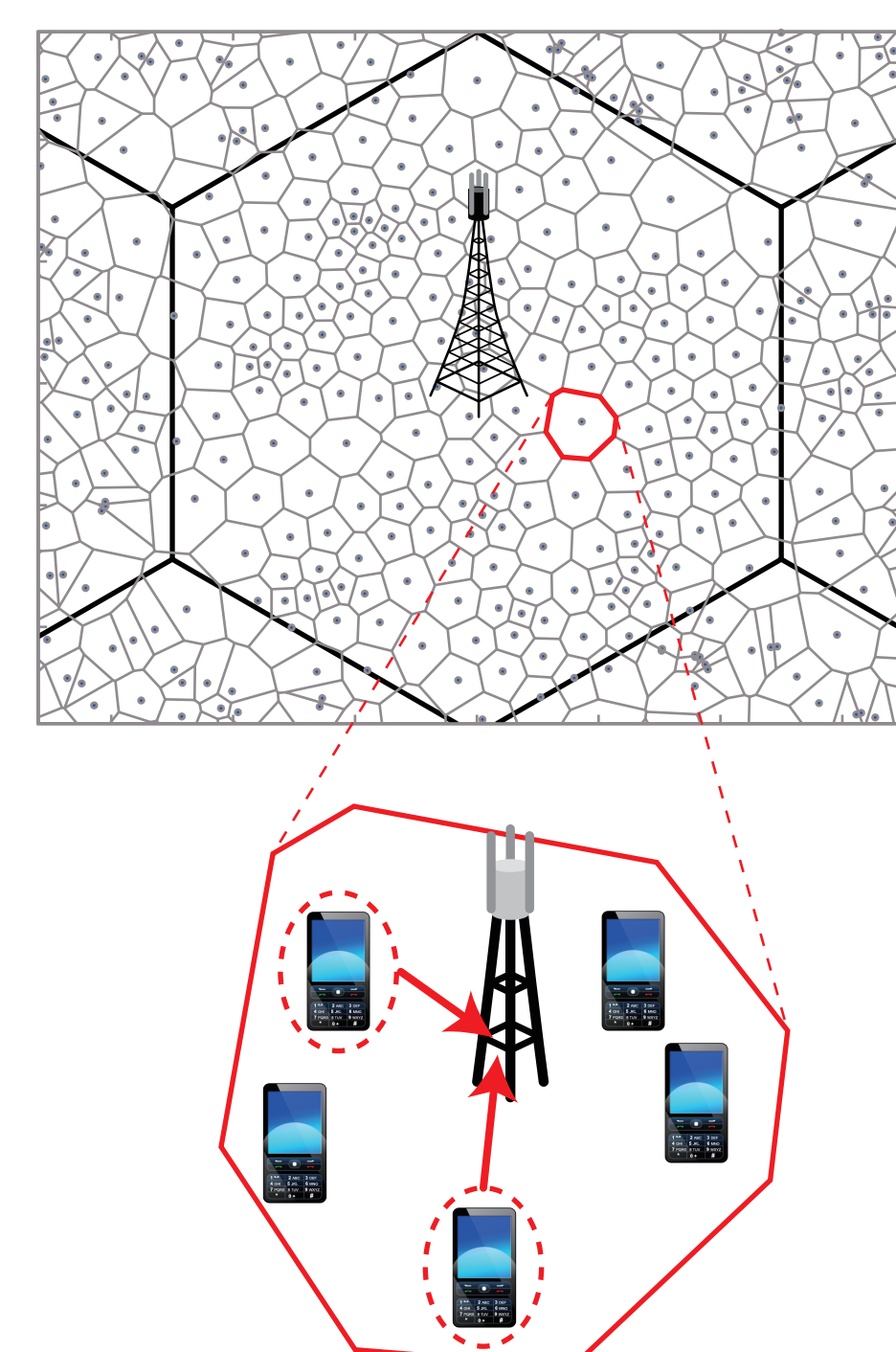
Traffic model

The user traffic model reflecting actual environment is introduced. This user traffic data was **measured in the 23 wards, Tokyo, Japan in 2013**.



Cell association method

Combinatorial optimization based cell association method is employed to find the optimal users of each BSs who can maximize the system rate.



$$\underset{x_u}{\text{maximize}} \left[\sum_{u=1}^U \left\{ \min \left(\frac{\alpha_s W_M C_{u,M}}{|\mathcal{M}_s|}, L_u \right) x_u + \min \left(\frac{W_s C_{u,s}}{|\mathcal{S}_s|}, L_u \right) (1-x_u) \right\} \right]$$

W_M : Macro BS bandwidth
 W_s : Smallcell BS bandwidth
 $C_{u,M}$: Received link capacity from macro
 x_u : User association index
 $C_{u,s}$: Received link capacity from s -th smallcell BS
 L_u : Traffic demand
 $|\mathcal{M}_s|$: # of macro users within the area of s -th smallcell
 $|\mathcal{S}_s|$: # of s -th smallcell users

Combinatorial optimization of 0/1 knapsack problem

$x_u = 0$ **User u connects to smallcell BS**

$x_u = 1$ **User u connects to macro BS**

Simulator GUI and preliminary result

Our developed simulator can calculate RSRP, SINR, throughput, and system rate. Preliminary simulation evaluate instantaneous system rate and it shows that mm-wave overlay HetNet can achieve 1000 times higher system rate than macro only network in high traffic scenario.

