Performance Comparison among Various OLPC schemes and Proposed Remedy

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Venue:

Category: AWD-DG comments / Area: Power control/Link adaptation DG

"AWD-DG comment"

Base Contribution:

None

Purpose:

Discussion and Approval

Notice:

Release:

Patent Policy:

Motivation

- Contributions have different views on Open Loop Power Control
  - See the next page for contributions submitted in March Meeting
- OLPC would result in different system performance
- Performance evaluation is necessary
  - To tell the algorithm which shows best system performance
  - To see the pros and cons of each algorithm

Contribution List

FILENAME	TITLE	AUTHORS	AFFILIATION
C80216m-09_0545.doc	Proposed Text on Power Control Section in A mendment Text	Peter Wang, Adrian Boariu, Joon Ch un, Xiaoyi Wang, Zexian Li	NSN and Nokia
C80216m-09_0546.doc	Proposed text for the 802.16m amendment (8 02.16m-09/0010) for section 11.1 on Power Control	Ali T. Koc, Yang Rongzhen, Shilpa Talwar, Hujun Yin, Nageen Himaya t, Guan, Wei, Papathanassiou, Apost olos; Choi, Yang-seok	Intel Corp.
C80216m-09_0557.pdf	Open loop uplink power control for 802.16m i n TDD	Eldad Zeira, Ron Murias	InterDigital
C80216m-09_0587.doc	Proposed Text on Power Control Section in A mendment Text	Xiaoyi Wang, Zexian Li	NSN Nokia
C80216m-09_0589.pdf	Proposed Text of Power Control for the IEEE 802.16m Amendment	Fan Wang, Bishwarup Mondal, Mar k Cudak, Fred Vook, Amitava Ghosh	Motorola
C80216m-09_0612.pdf	Proposed Text of Power Control Section for th e IEEE 802.16m Amendment Working Document	Jeongho Park, Jaehee Cho, Heewon Kang, Hokyu Choi	Samsung Electronics and ETRI
C80216m-09_0634.doc	Proposed Text on Power Control Section for t he IEEE 802.16m Amendment	Dongcheol Kim,Wookbong Lee, Jin Sam Kwak, Yeong-Hyeon Kwon, S ungho Moon, Jong Young Han, Han Gyu Cho	LG Electronics

Assumptions

List	Notes
Antenna configuration	Single transmit antenna at MS Two receive antenna with 4 lambda spacing uniform linear array at BS
MIMO Scheme	SIMO (mandatory)
Channel Model	Modified Ped-B 3km/h (mandatory)
Channel correlation Scenario	Uncorrelated Channel : Zero Correlation
Cellular Layout	Hexagonal grid, 19 cell sites, wrap-around, 3 sectors per site
Distance-dependent path loss	L=130.19 + 37.6$\log_{10}$(.R), R in kilometers
Inter site distance/Penetration loss	1.5km/10dB (optional) for Mix Channel Model 0.5km/20dB (mandatory) for Ped-B 3km/h
Shadowing standard deviation	8 dB
Antenna pattern (horizontal) (For 3-sector cell sites with fixed antenna patterns)	$A(\theta) = -\min\left[12\left(\frac{\theta}{\theta_{3dB}}\right)^2, A_m\right]$ θ_{3dB} = 70 degrees, A_m = 20 dB
Users per sector	10 (EMD)
Scheduling Criterion	Proportional Fair (PF for all the scheduled users)
Mean IoT	Less than [10] dB

Parameters

List	Notes
OFDM parameters	10 MHz (1024 subcarriers)
OFDM symbols per subframe/ UL subframe	6 / 3
Overhead	Pilot OH (11.1% for SIMO, 22.2% for CSM)
Permutation	Distributed: IEEE 802.16m DRU in full bandwidth (mandatory)
Number of total LRU in one subframe	48
Channel State Information	Delay 1 frame (5ms)
Link Adaptation	QPSK 1/2 with repetition 1/2/4/6, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 2/3, 64QAM 3/4, 64QAM 5/6
HARQ	Chase combining, non-adaptive, synchronous. HARQ with maximum 4 retransmissions, 3 subframes ACK/NACK delay, no error on ACK/NACK. HARQ retransmission shall occur no earlier than the eighth subframe after the previous transmission.
Scheduling	No control overhead, latency timescale 1.5s, 8 LRUs per each MS
MIMO receiver	Linear Minimum Mean Squared Error (LMMSE)
PHY Abstract	RBIR
Data Channel Estimation	Perfect data channel estimation
Feedback Channel Measurement	Perfect feedback channel measurement
Mobile Max Power	23dBm
FFR	Full bandwidth using FR=1 (Mandatory), 4 FPs (optional)
Scheduling periodicity	Frame

Samsung

- OLPC Equation

$$P_{Tx,tone}[dBm] = NI[dBm] + L\ [dB] + C/N_{mcs}[dB] + Offset_{MS} + Offset_{BS}$$

  - NI is Noise and Interference Level broadcasted by serving BS
  - L is estimated average pathloss between serving BS and MS
  - C/N_{mcs} is target SINR for mcs MCS level
  - $Offset_{MS}$ is compensation factor controlled by MS
- IoT Control
  - BS can control MCS and subchannel size
  - One example can be found in IEEE C802.16m-09/0612r1
- Features
  - BS can change overall IoT and fairness etc without any signaling
  - Therefore just one OLPC equation is enough
  - Can minimize the necessary signaling

Intel

- OLPC Equation

$$P_{Tx,tone}[dBm] = NI[dBm] + L\ [dB] + SINR_{opt}$$

  - NI is Noise and Interference Level broadcasted by serving BS
  - L is estimated average pathloss between serving BS and MS
  - SINRopt is target SINR value for IoT control and fairness control defined as

$$SINR_{opt} = 10\log10\left(\max\left(10\wedge\left(SINR\min[dB]/10\right), \gamma \cdot SIR_{DL} - \frac{1}{N_r}\right)\right)$$

    - SINRmin and γ are parameters broadcasted by serving BS

- Features
  - SINRmin forces cell edge MS to transmit signal with tone power at lest SINRmin
  - Gamma γ controls the tradeoff between sector and cell edge performance

LGE

- OLPC Equation

$$P_{Tx,data} = \min(P_{Tx,1}, IoT_{\max} + N_0 + SIR + PL_S - 10\log 10(MT_T))$$

  - IoT_{max} is broadcasted parameter
  - PLi is pathloss between MS and strongest interfering BS

$$P_{Tx,1} = PL_s + NI + SINR_{Target} + Offset_{perAMS} + Offset_{perABS}\ [dBm]$$

  - NI is Noise and Interference Level broadcasted by serving BS
  - PL_S is estimated average pathloss between serving BS and MS
  - $SINR_{Target}$ is target SINR for mcs MCS level (same to C/N_{mcs} in Samsung)

- Features
  - MS chooses the smaller one to satisfy the IoT level

Performance Results

- Sector and Cell Edge Performance according to IoT levels

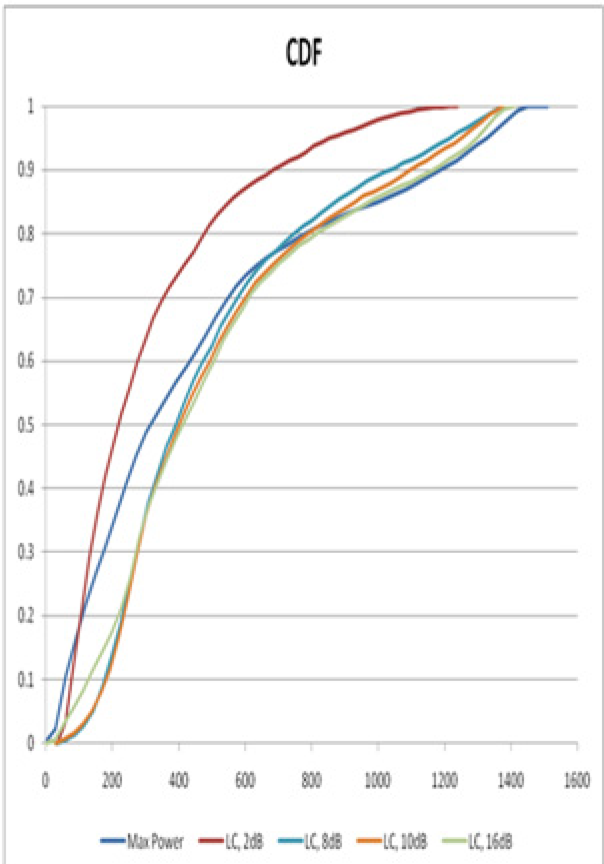
	Samsung 1*			Intel			LGE			Note
	IoT result(dB)	Edge Tput(kbps)	Sector Tput(Mbps)	IoT result(dB)	Edge Tput(kbps)	Sector Tput(Mbps)	IoT result(dB)	Edge Tput(kbps)	Sector Tput(Mbps)	
Max power	22.4566	39.63	4.5680	22.4566	39.63	4.5680	22.4566	39.63	4.5680	Reference
Target IoT 2dB or gamma 0.2	2.0000	64.07	3.0365	4.3424	240.00	2.6289	2.0005	68.19	2.7506	
Target IoT 4dB or gamma 0.4	4.0005	101.26	4.0533	4.5968	238.91	3.1242	4.0000	105.46	3.6605	
Target IoT 6dB or gamma 0.6	6.0002	122.04	4.6127	5.4016	238.35	3.7014	6.0003	127.88	4.3310	
Target IoT 8dB or gamma 0.8	8.0006	140.15	4.9298	6.8449	236.01	4.2809	8.0011	136.67	4.6828	
Target IoT 10dB or gamma 1.0	10.0003	138.61	**5.1078**	9.4260	**232.65**	4.6623	9.9998	119.59	4.7329	IoT 10dB
Target IoT 12dB or gamma 1.2	12.0005	122.53	5.2967	11.2517	186.11	4.8367	11.9995	113.91	4.9643	
Target IoT 14dB or gamma 1.4	13.9999	96.63	5.1974	12.5827	129.68	5.0317	13.9994	90.91	5.0771	
Target IoT 16dB or gamma 1.6	15.9994	77.71	5.1513	14.4938	106.10	5.0685	15.9997	83.20	5.1073	

- OffsetMS is applied to Samsung 1 only
  - * Samsung 1 represents the case that BS uses load control algorithm for scheduling
- SINRmin is set to 0 dB

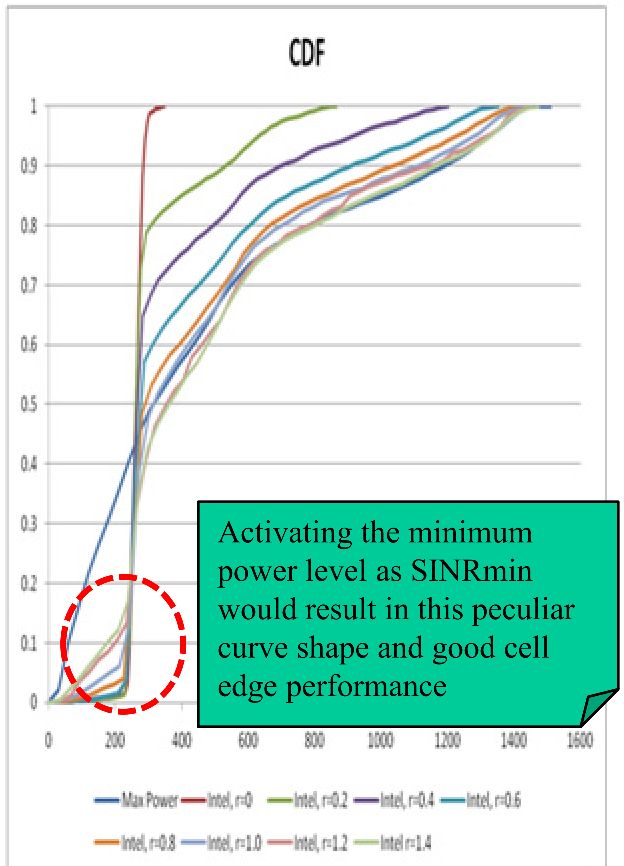
Performance Results

- Why Intel's OLPC shows Best Cell Edge Performance ?

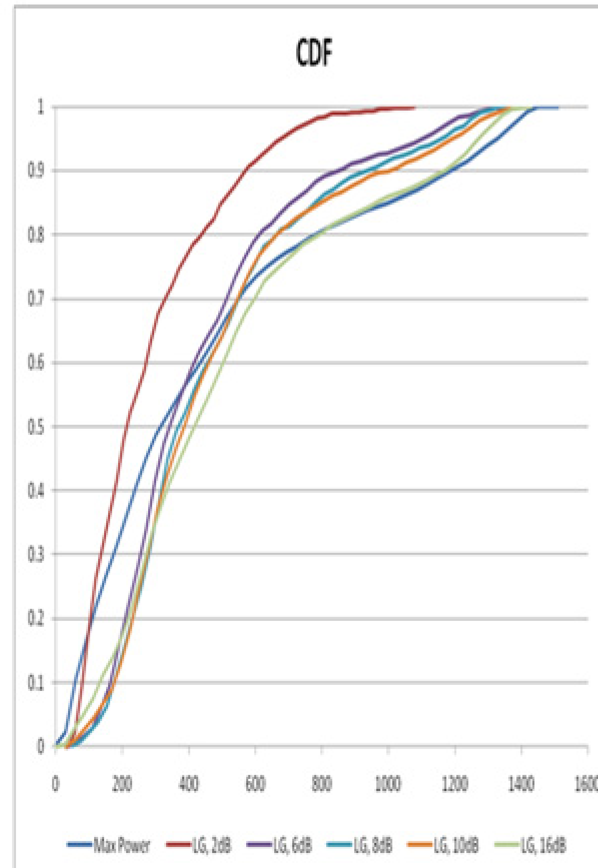
Samsung1



Intel



LGE



Revisit of Samsung's OLPC

- In Samsung's OLPC
  - BS determines MCS
  - MS just set tone power according to MCS
  - This is very generic form, which also means it is very flexible
- Therefore Samsung's can give SAME EFFECT as Intel's or LG's
- For example
  - Let us assume BS knows all MS's SIR_DL
    - In practical, BS can calculate by averaging reported CQI, or Ms can report it
  - Then, BS CAN EXPECT the received SINR as SINRopt

$$SINR_{opt} = 10\log 10\left(\max\left(10\wedge\left(SINR\min[dB]/10\right), \gamma \cdot SIR_{DL} - \frac{1}{N_r} \right) \right)$$

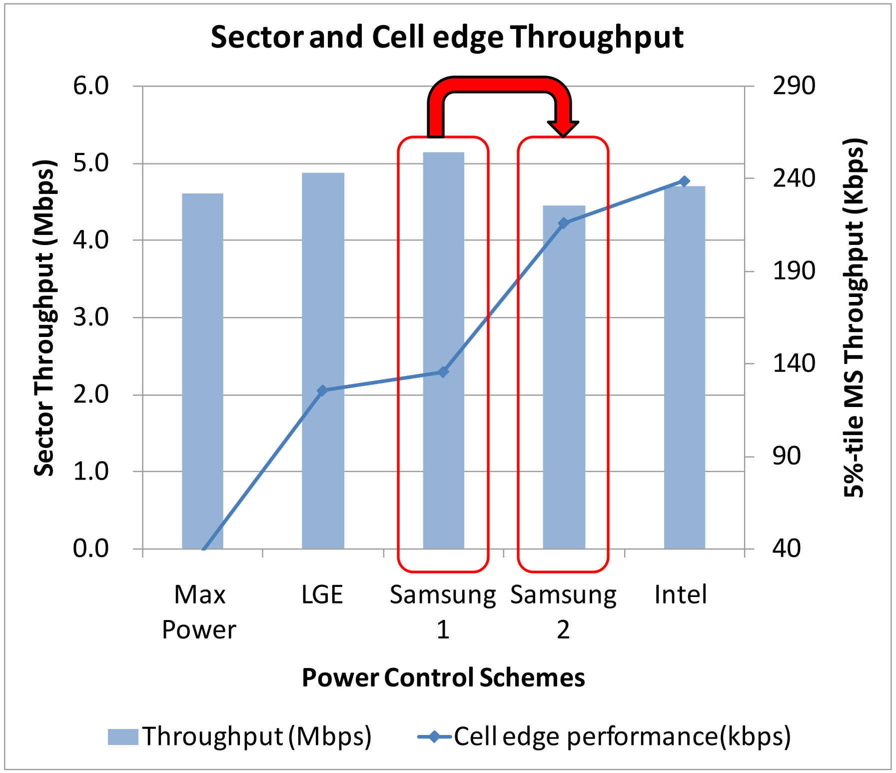
  - Once BS figures it out, then BS can decide MCS level
  - MS just follows Power Control Schemes below

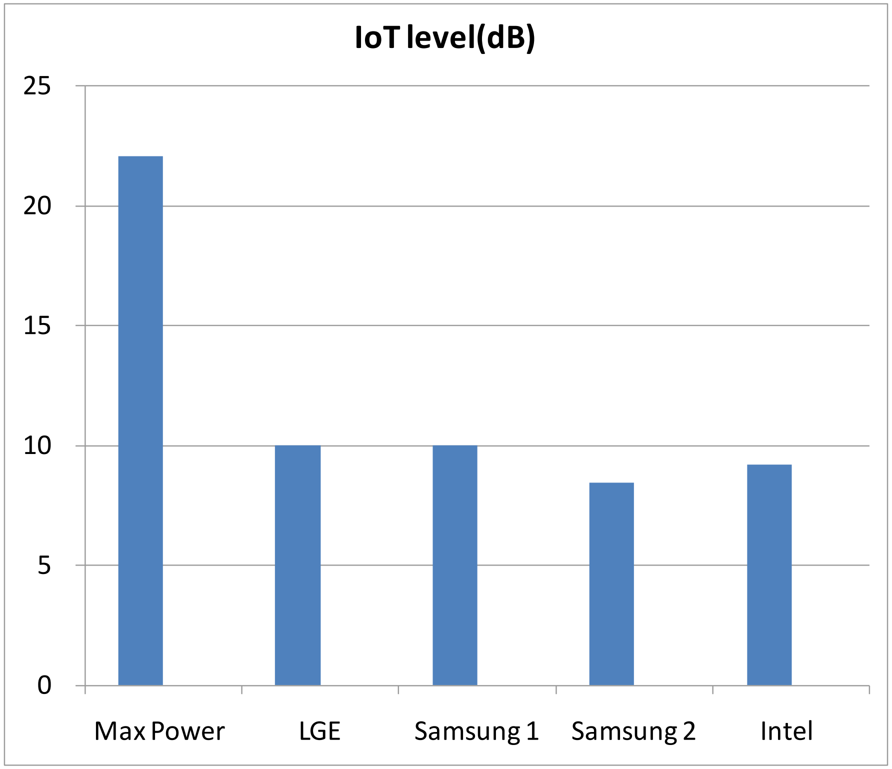
$$P_{Tx,tone}[dBm] = NI[dBm] + L\ [dB] + C/N_{mcs}[dB]$$

→ Samsung 2

Revisit of Samsung's OLPC

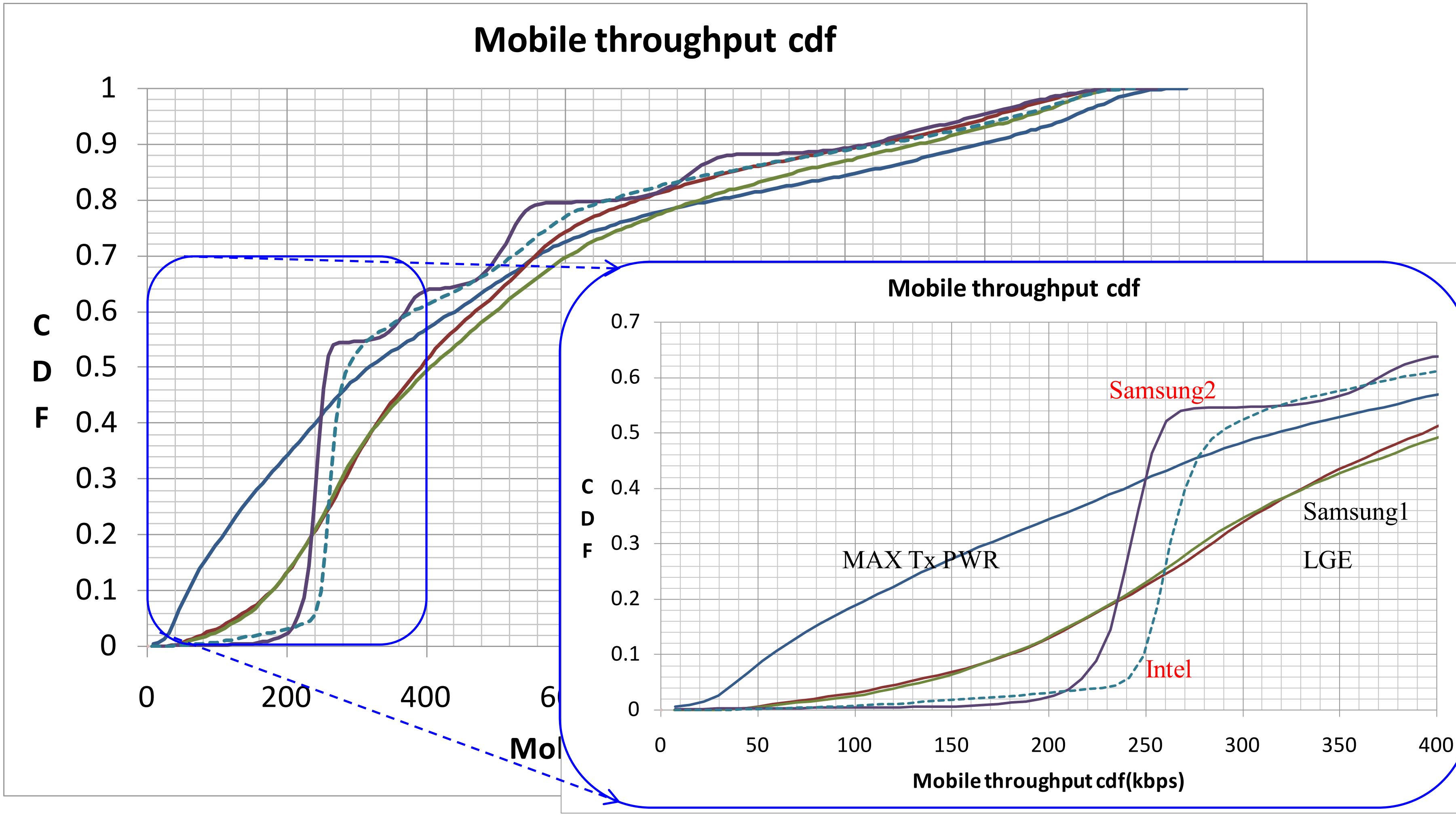
- Sector and Cell Edge Performance with IoT





Revisit of Samsung's OLPC

- MS Throughput CDF



→ **Samsung's OLPC has very high degree of freedom and can give same effect as other power control**

Requirements

- Performance
  - High sector throughput and edge throughput
  - Easy tradeoff between them
- Signaling Overhead
  - Downlink overhead should be minimized
- Support for Persistent Allocation
  - OLPC should be matched well even with P.A
- BS Scheduler Constraint
  - High degree of freedom for BS scheduling, the better in practical situation

- Taking all requirements into consideration
  - Samsung’s OLPC is recommended
- Purely in terms of Performance
  - Intel’s OLPC is recommended

Proposed Remedy

- Adopt C80216m-09/0844 or latest version for Open Loop Power Control Scheme