Qshine
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Primary Component Carrier Assignment in LTE-A

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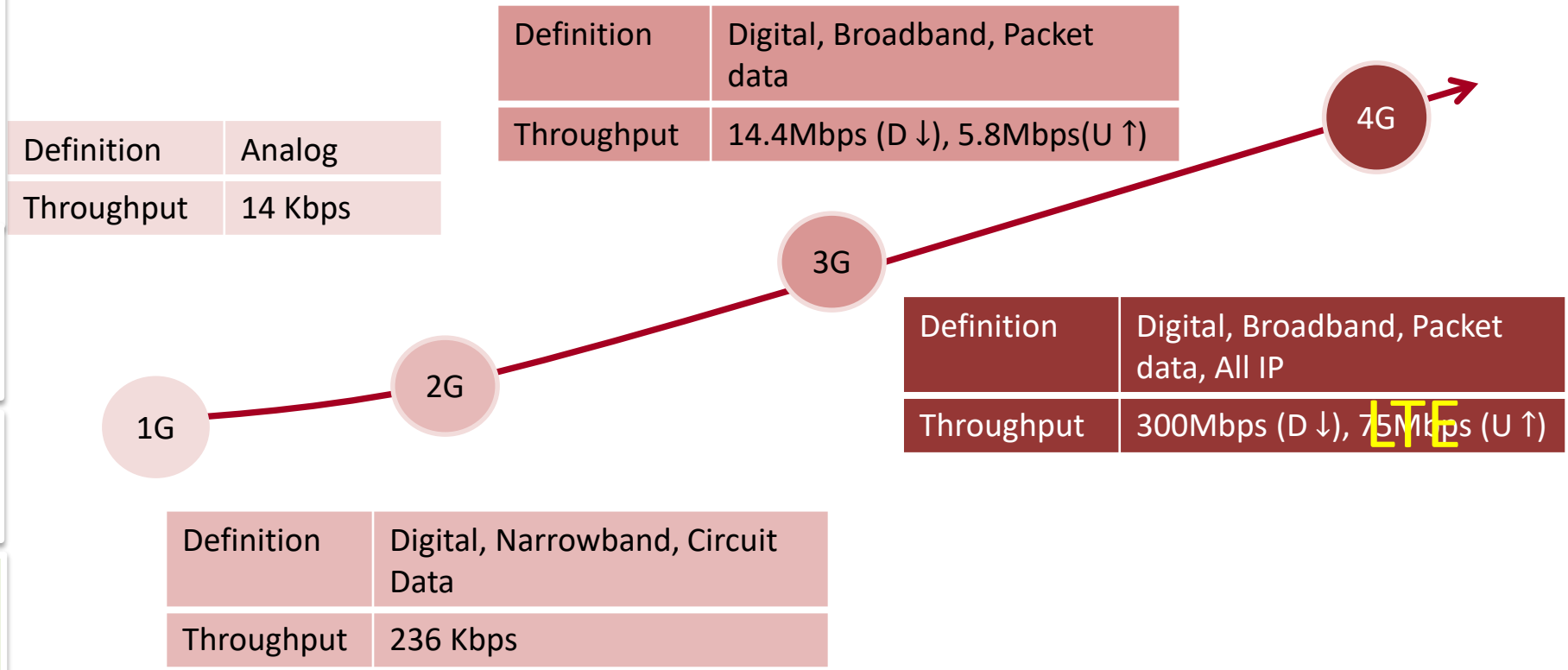
Outlines

- Introduction
- Primary Component Carrier Assignment
- Analysis
- Results
- Conclusion

Communication Speed Over Generation



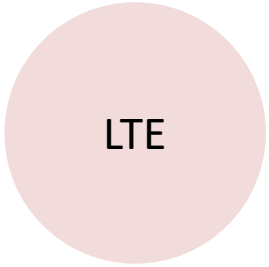
Definition	Analog
Throughput	14 Kbps

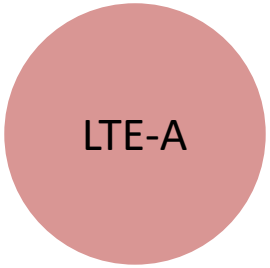
Definition	Digital, Narrowband, Circuit Data
Throughput	236 Kbps

Definition	Digital, Broadband, Packet data
Throughput	14.4Mbps (D ↓), 5.8Mbps(U ↑)

Definition	Digital, Broadband, Packet data, All IP
Throughput	300Mbps (D ↓), 75Mbps (U ↑)

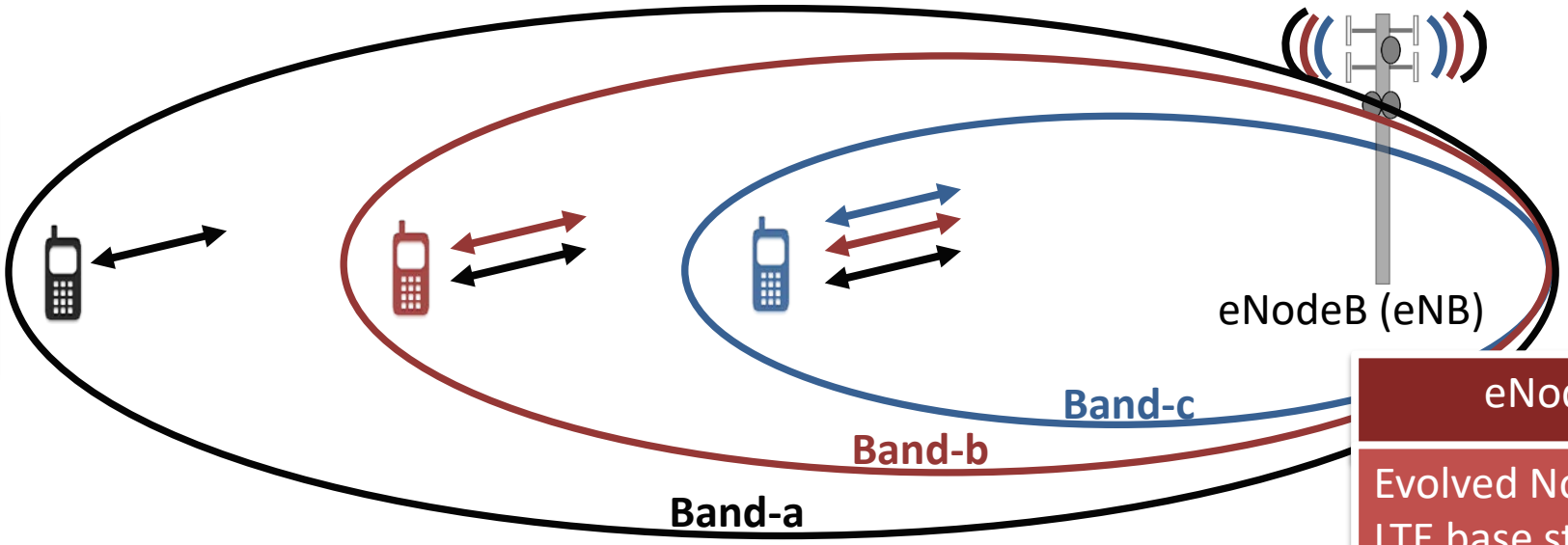
LTE and LTE-A





Theoretical Throughput	300Mbps (D ↓) - 75Mbps (U ↑)	3Gbps (D ↓) - 1.5Gbps (U ↑)
Experienced Throughput	13Mbps (D ↓) crowded area	
Technology	OFDMA (D ↓), SC-FDMA (U ↑)	OFDMA, CA, RN, MIMO

Carrier Aggregation (CA)



eNodeB

Evolved Node B:
LTE base station

Secondary Component Carriers

Primary Component Carrier

Up to 5 Carrier Components (CC) for downlink and uplink

Objective

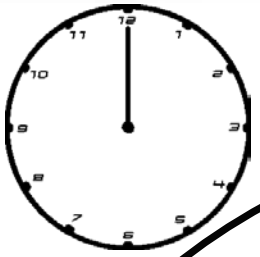
Analyzing the impact of packet drops and delay experienced by users during the primary component carrier assignment operations.

Component Carrier Assignment

- Case 1: *PCC needs to be updated, therefore all SCCs need to be updated.*
- Case 2: All SCCs need to be updated but PCC does not need to be updated.
- *Case 3:* Some SCCs need to be updated but PCC does not need to be updated.

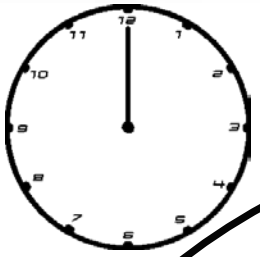
PCC and SCCs

Can performance of reassignment of primary component carrier be improved if one of SCCs is used as PCC?



$t = 21$

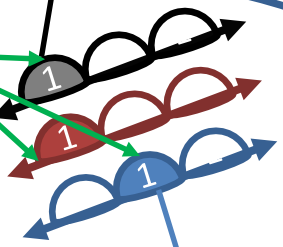
PCC Granting from a SCC



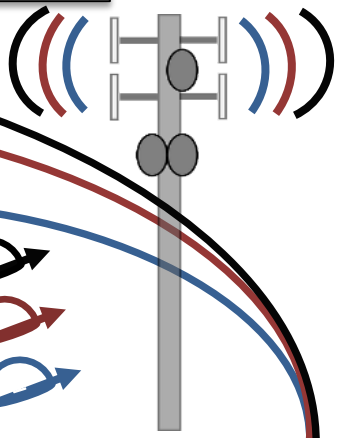
$t = 21$

Black can be PCC, so
PCC is now black not blue

CCs can be updated now.



Blue is PCC



eNB

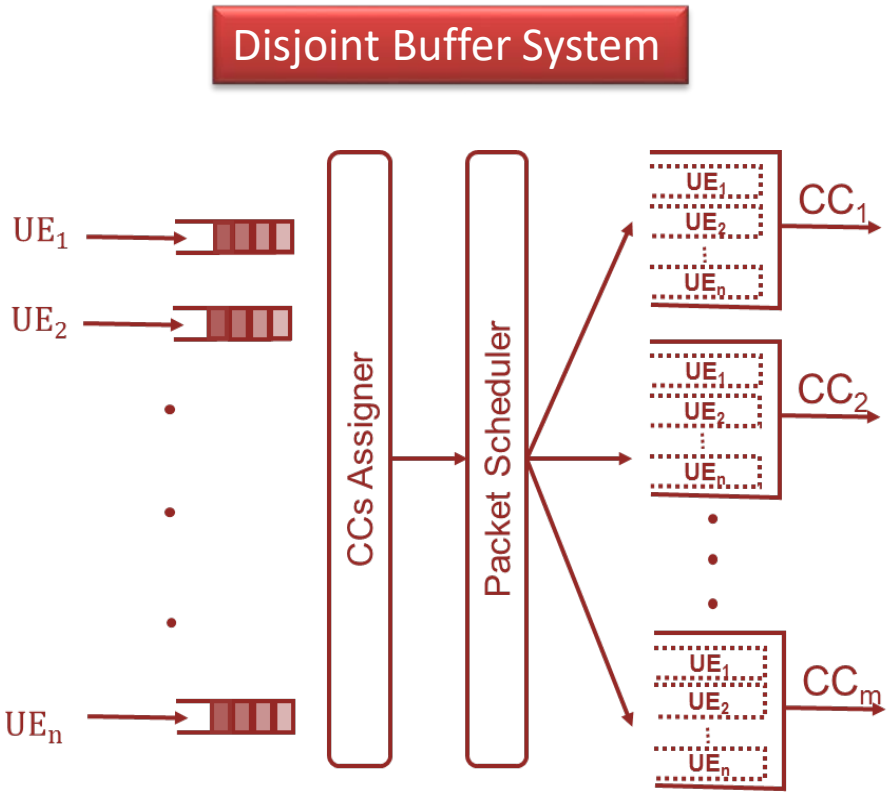
Band-c

Band-b

Band-a

The new CCs are assigned.
PCC needs to be updated,
so the others CCs.

Queuing Analysis



Simulation parameters

Scenario [21]	b
Number of eNB	1
Used Bands	800MHz, 1.8GHz, 2.6GHz
Number of CCs in Each Band	4
Total Number of CCs	12
Queue Length of Each Queue	50 packets
Bandwidth of CCs	10MHz
Modulations	BPSK, QPSK, 16QAM, and 64QAM
CQI	3, 5, 7, and 11
Transmission Time Interval	10ms (10ms is average, it can be more or less)
Time for CCA	20ms (at most 20ms)
CQI Threshold	The highest possible
Simulation Model	Finite buffer [22]

- LTE (1 CC), LTE-A (4 CCs)
- 1/2 of users are LTE-A.
- Users are freely move around of eNB
- Min-delay packet scheduling is used.

Results

- Discrete event simulation for downlink process with carrier assignment methods.
  - 4 CCs assignment to LTE-A type users and 1 CC assignment to LTE type users
- We compare four methods by considering with/out PCC granting
  - RA (Random)
  - LL (Least Loaded) according to user loads on carriers
  - CQ (Channel Quality) according to channel quality
  - LR (Least Load and Rate) user loads and channel quality for rate function

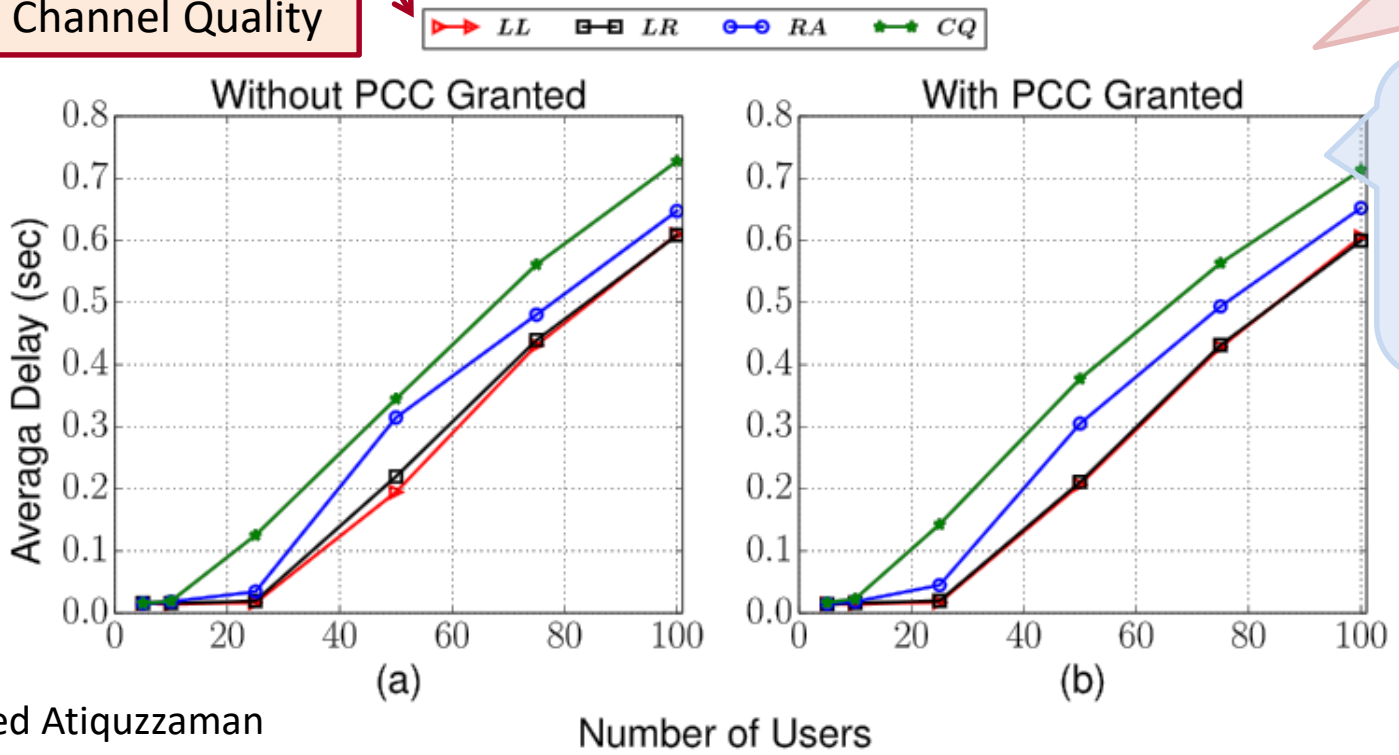
Delay: With/out PCC Granting

Objective

Observing effects of number of users on delay.

LL = Least Load
LR=Least Load Rate
RA = Random
CQ= Channel Quality

Not much delay differences between with/out PCC granting.



CQ is the worst in with/out PCC granting.

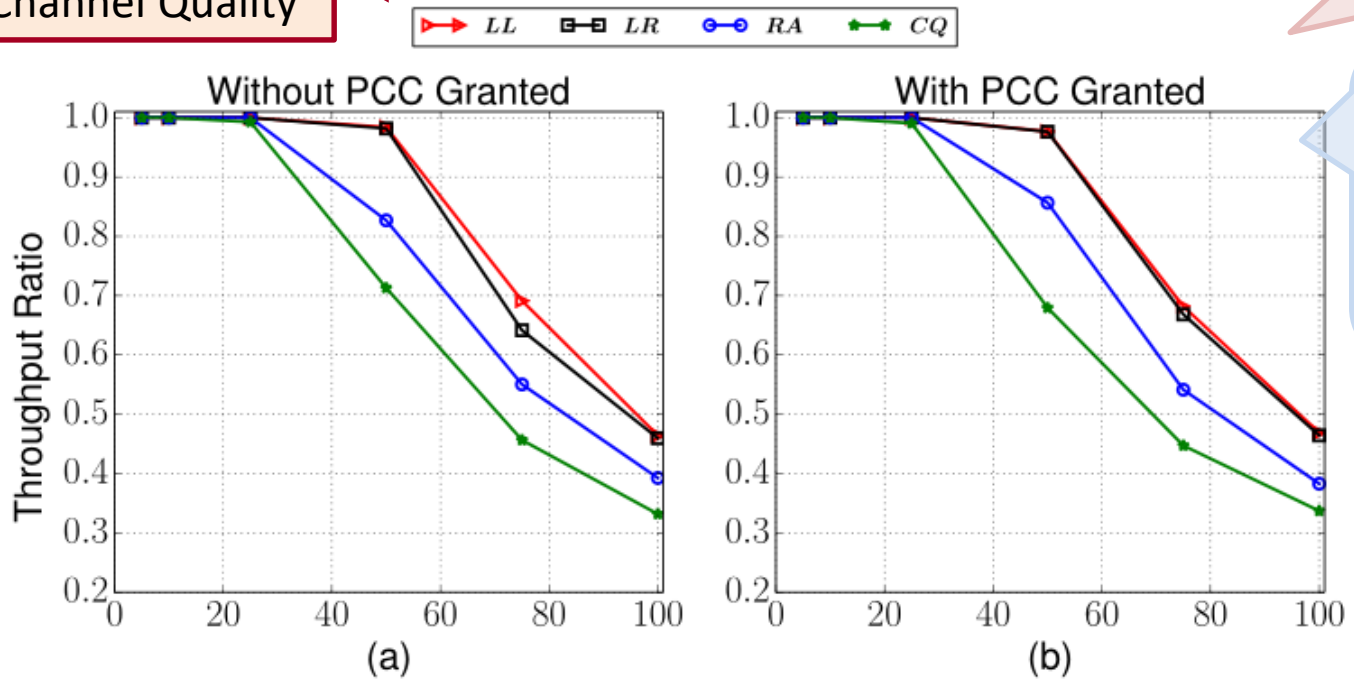
Throughput: With/out PCC Granting

Objective

Observing effects of number of users on throughput.

LL = Least Load
LR=Least Load Rate
RA = Random
CQ= Channel Quality

Slightly higher throughput with PCC granting.



CQ is the worst in with/out PCC granting.

Conclusion

Thank You

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