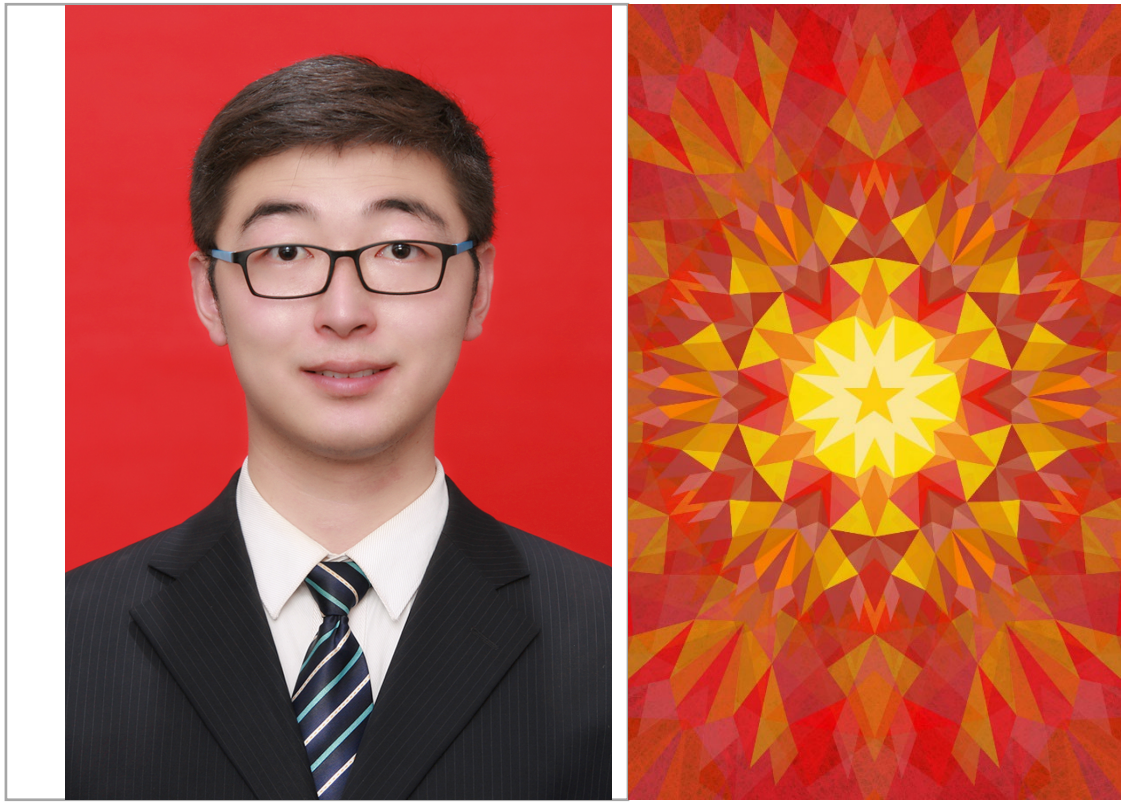
ITU KALEIDOSCOPE
ONLINE2020

7-11 December 2020

Flexible multiplexing mechanism for coexistence of URLLC and eMBB services in 5G Networks

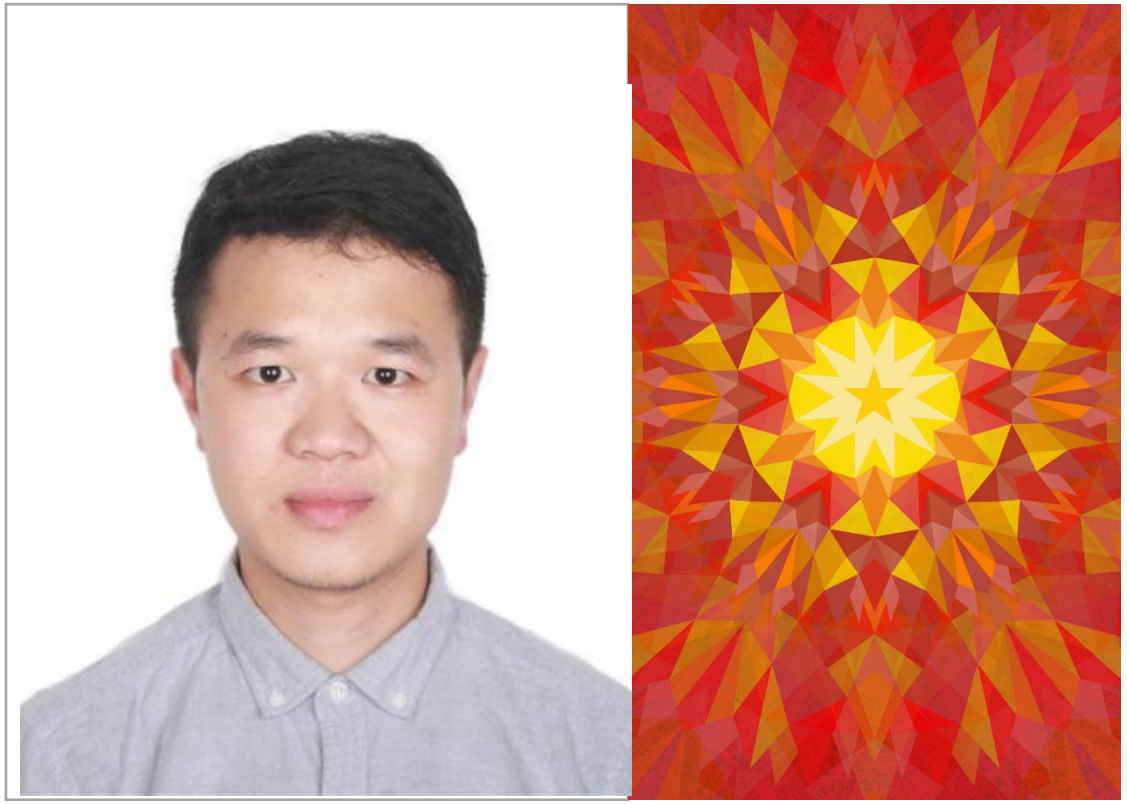
Kai Xiao
Affiliation:
ZTE Corporation &
State Key Laboratory of Mobile Network and Mobile Multimedia
Contact information:
M: +86 15702989526
E: xiao.kai@zte.com.cn



Session 3: Wireless infrastructure and digital transformation

Paper S3.2

Xingguang Wei
Affiliation:
ZTE Corporation
Contact information:
M: +86 18810562759
E: wei.xingguang@zte.com.cn

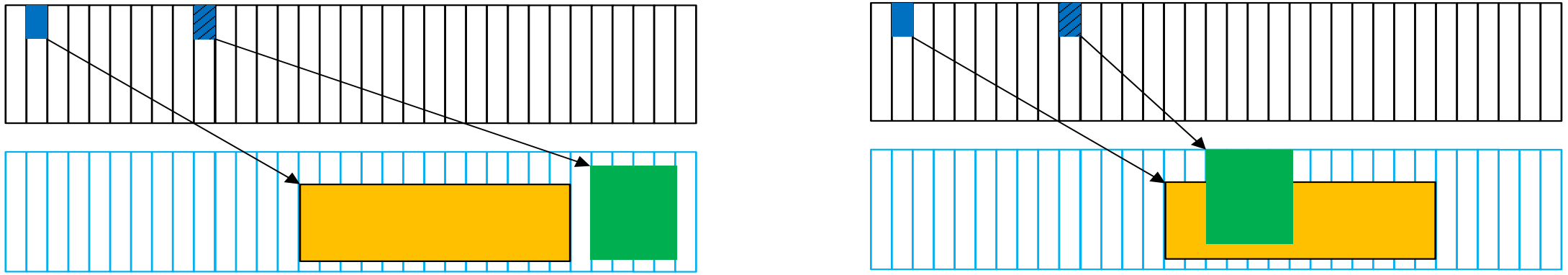


- Background
- Dynamic Pattern Cancelation Indication（DPCI）
- Resource Occupancy based Power Control（ROPC）
- Dynamic selection of DPCI and ROPC
- Simulation results and conclusion

1 Background

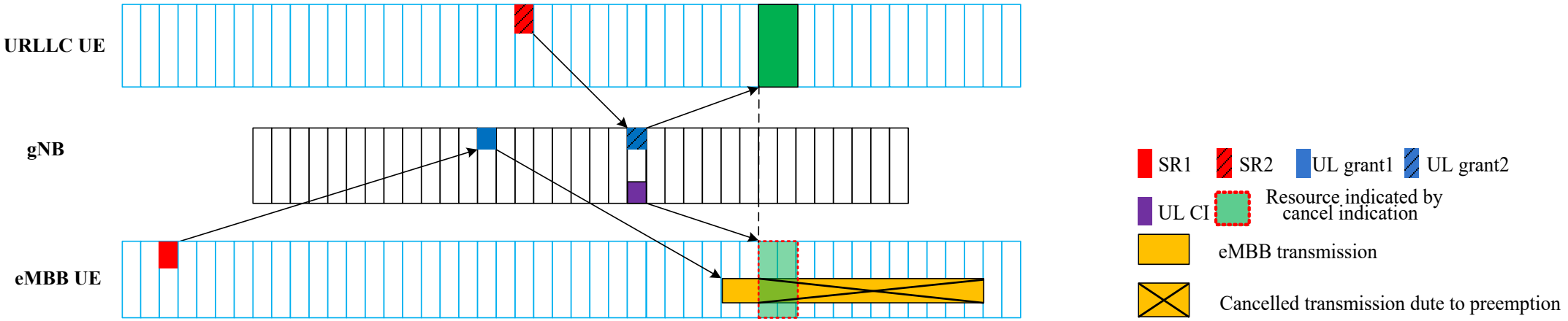
ZTE中兴

- Three types of sevices are summaried for supporting major scenarios in 5G,
  - enhanced mobile broadband (eMBB): ultra-high definition video, 3D video, etc.
  - ultra-reliable and low latency communication (URLLC): Driverless, industrial automation, etc.
  - massive machine type of communication (mMTC): ...
  - Standardization during 3GPP Rel-15 and Rel-16 focused on the first two types of services.
- Inter-UE multiplexing
  - eMBB and URLLC will be taken as an example of services with low and high priority, respectively

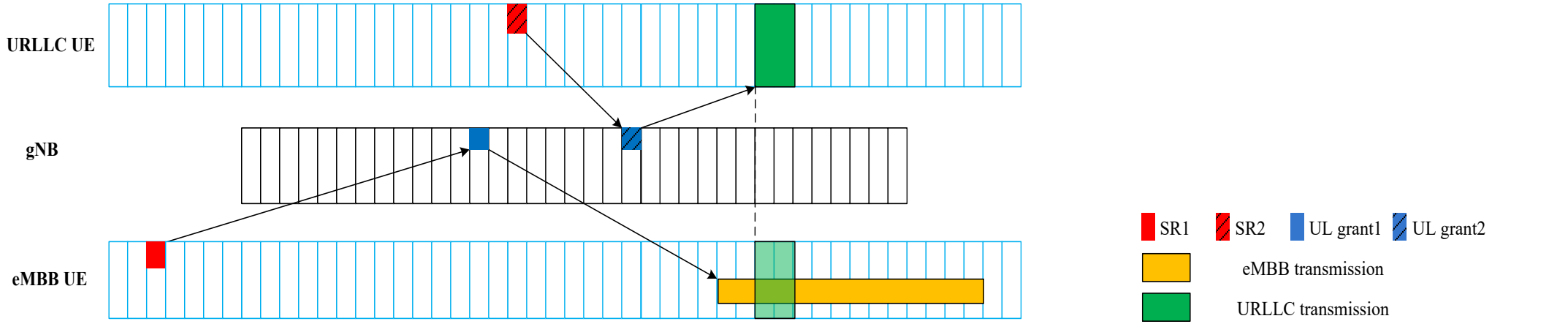


1 Background

Uplink cancellation indication(ULCI)

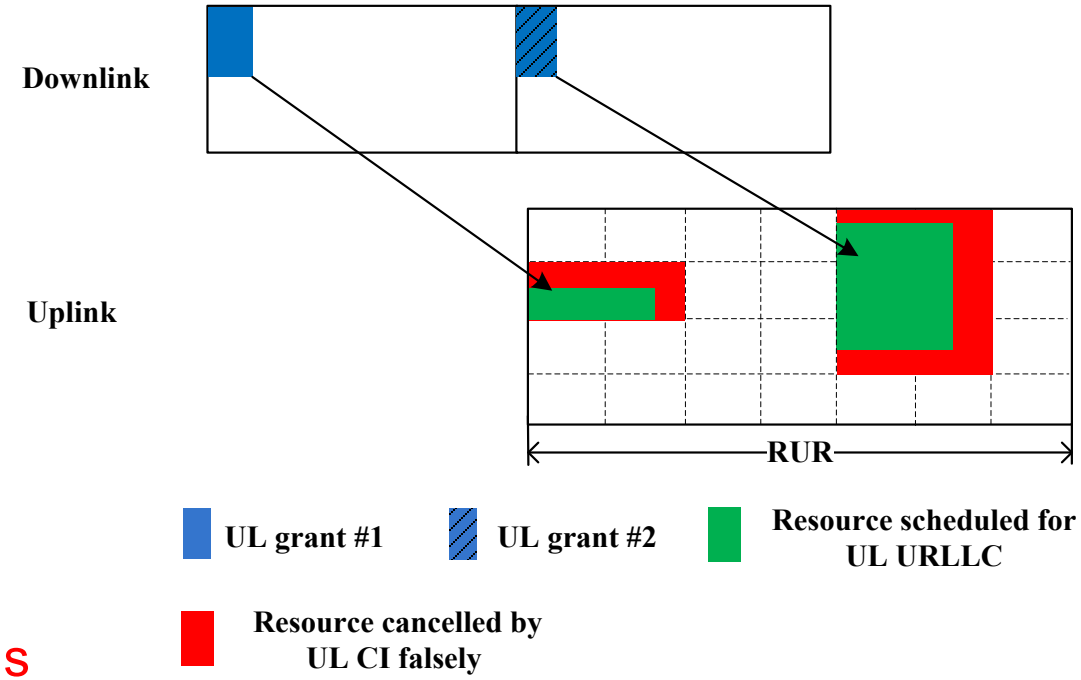


Power control (PC)



2 Dynamic Pattern Cancelation Indication

☐ Semi-static 2-D bitmap in ULCI



0	0	0	0	1	1	0
1	1	0	0	1	1	0
0	0	0	0	1	1	0
0	0	0	0	0	0	0
O1	O2	O3	O4	O5	O6	O7

F

T

Time-Frequency domain indication granularity 7×4 is configured via RRC signaling semi-statically

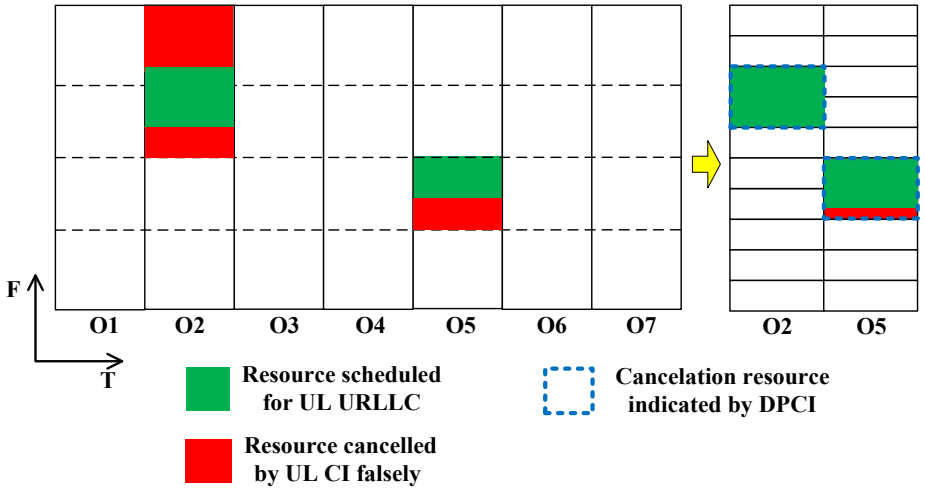
Cons

- ✓ The semi-static 2-D bitmap pattern indication is difficult to meet the dynamic changing resource requirements of the service
- ✓ eMBB in the red box will be canceled falsely by ULCI with limited indication accuracy

2 Dynamic Pattern Cancelation Indication

☐ Dynamic 2-D bitmap in DPCI

- *Q* bits are used for indicating which time occasions is occupied, where '*Q*' equals to the number of time occasions.
- $C_{a\times b}$ is 2-D bitmap for frequency domain indication, each portion is indicated by a bit in the 2-D bitmap, wherein *a* represents the number of occupied time occasions and *b* represents frequency domain granularity.

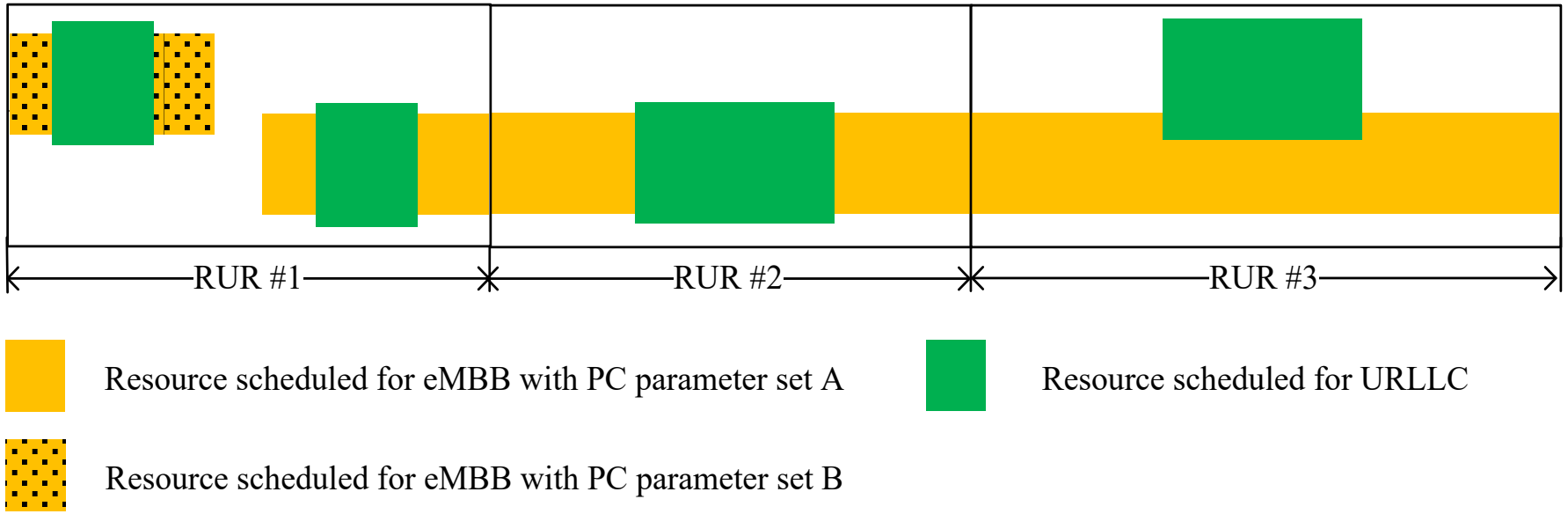


ULCI	occupied time domain occasions number	1~7						
	frequency domain indication granularity	$\frac{1}{4}$						
DPCI	occupied time domain occasions number	1	2	3	4	5	6	7
	frequency domain indication granularity	$\frac{1}{21}$	$\leq \frac{1}{10}$	$\frac{1}{7}$	$\leq \frac{1}{5}$	$\leq \frac{1}{4}$	$\leq \frac{1}{3}$	$\frac{1}{3}$

3 Resource Occupancy based Power Control

ZTE中兴

PC



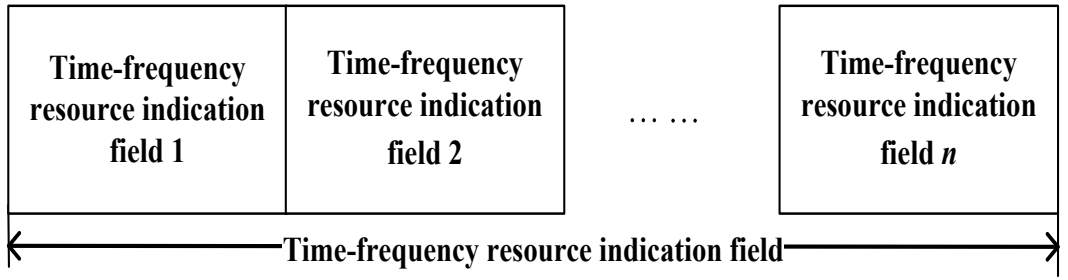
Cons

- ✓ Different interference levels caused by different combinations of the interference source and the interfered device
- ✓ One single PC parameter set can hardly not mattch with power boosting requirement under different interference levels, which means power waste of URLLC and degrade the eMBB performance

3 Resource Occupancy based Power Control

☐ Different PC parameter sets for different URLLC TB

The different power control parameter sets for different group of time-frequency resources will be configured via RRC signaling.

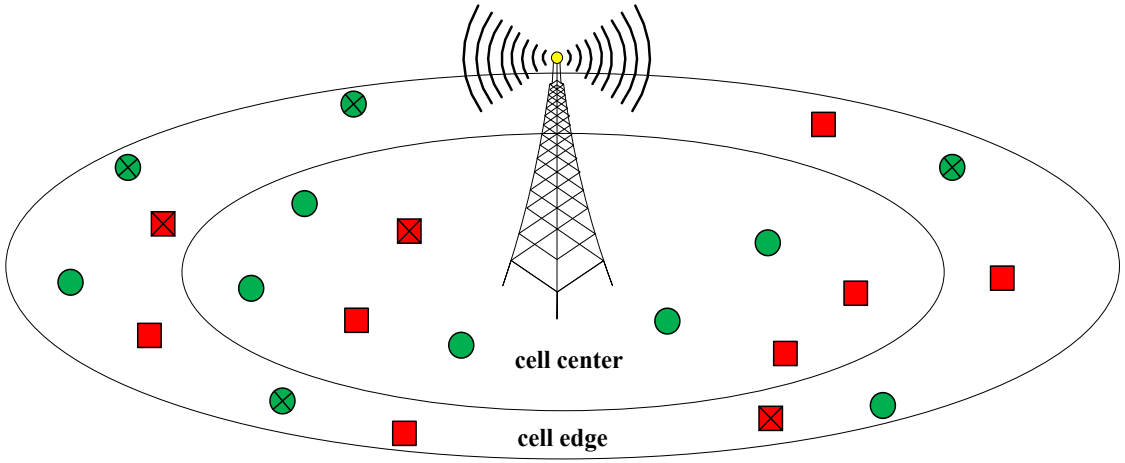


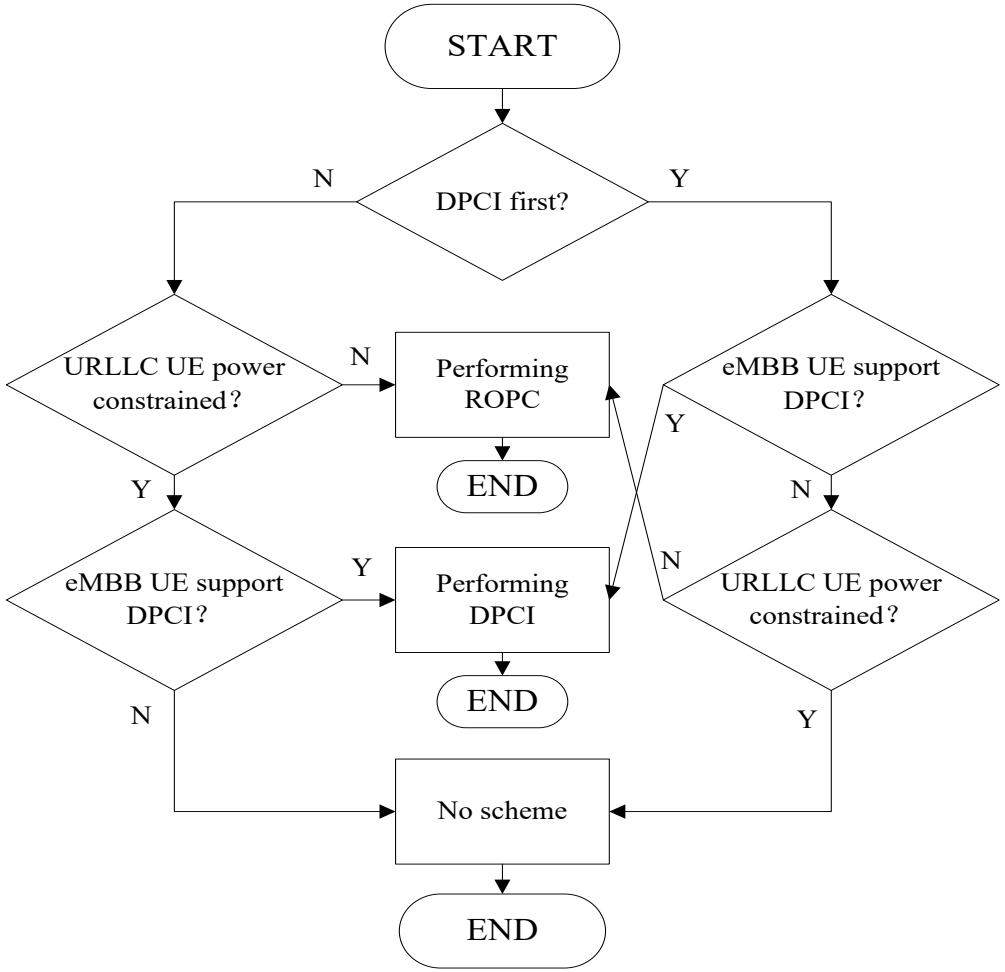
☐ Boosting power based on overlapping resource proportion

1. Computes the overlap proportion between each group of URLLC time-frequency resource and the time-frequency resource of the eMBB (gNB)
2. Sends a control information carrying the index of power control parameters to the calculation result (gNB)
3. Decodes the control information of ROPC (UE)
4. Determines the power value to be enhanced for each group time-frequency resource according to the index in the time-frequency resource indication field (UE)

Index	Actual overlapping resource proportion *x*	Power boosting(dB)
0	$x \le 10\%$	0
1	$10\% < x \le 40\%$	3
2	$40\% < x \le 80\%$	6
3	$x > 80\%$	9

4 Dynamic selection of DPCI and ROPC



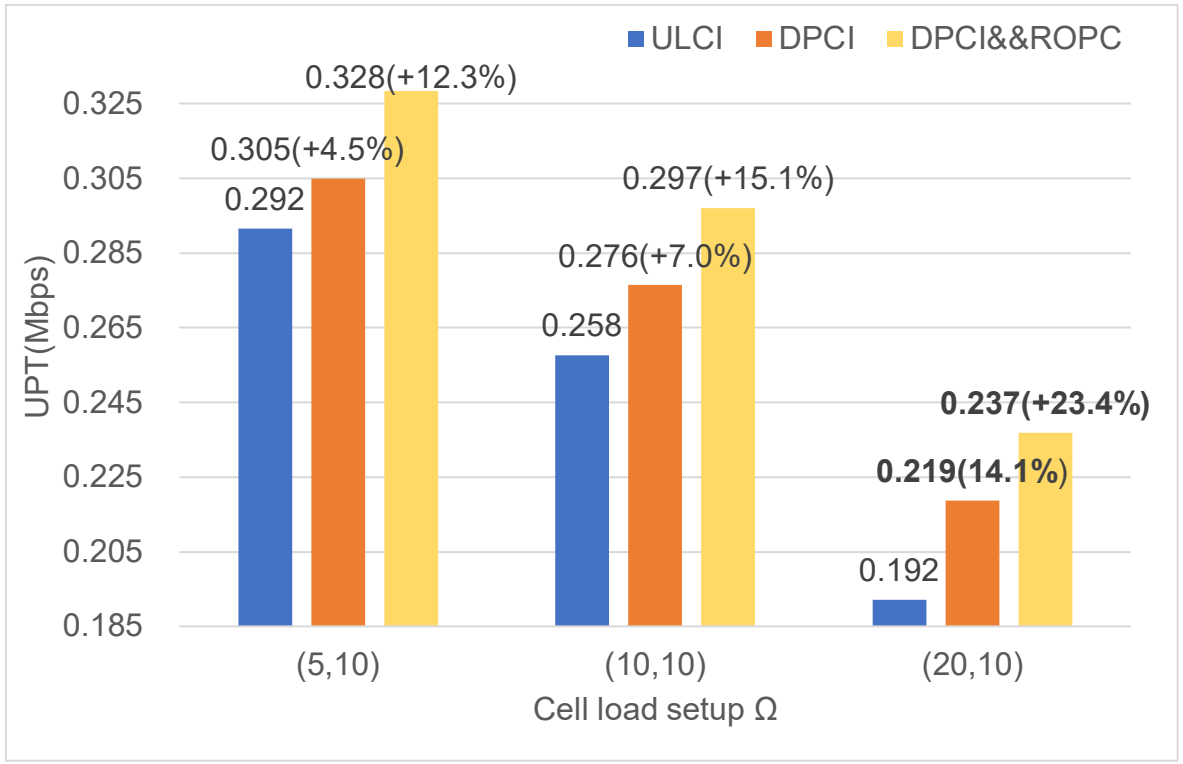


Three options for multiplexing scheduling:

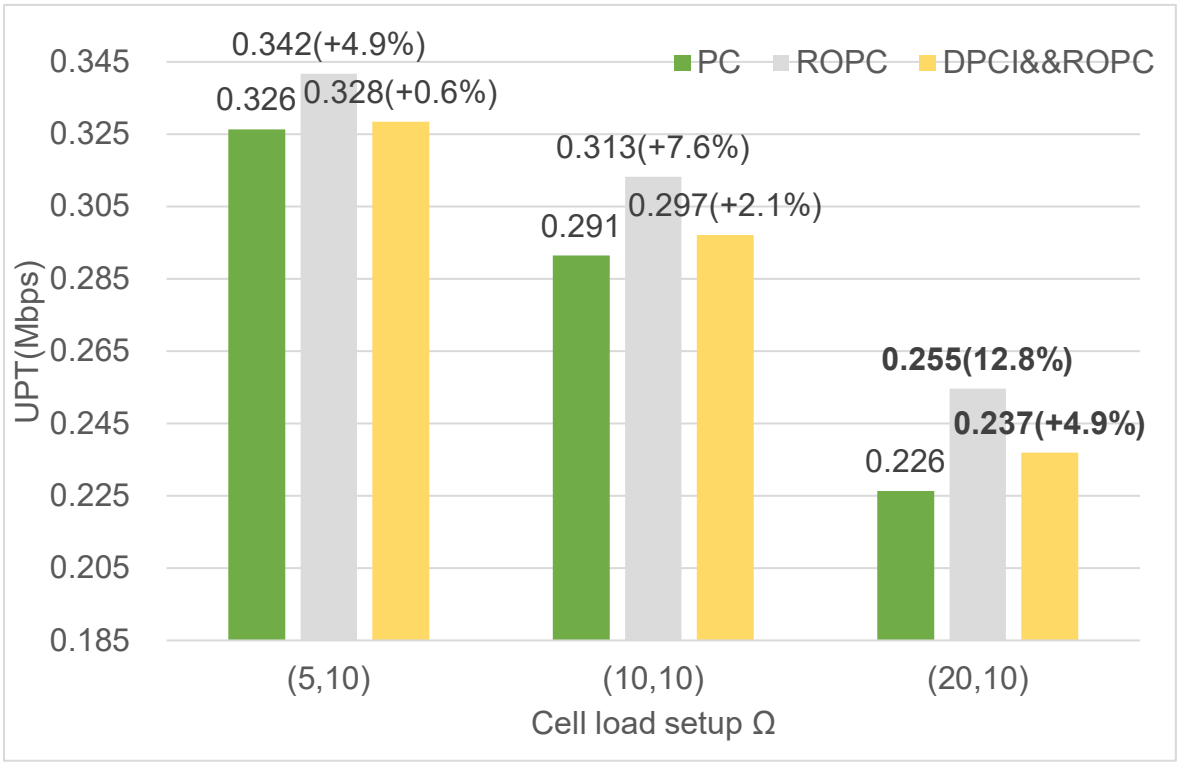
ROPC, DPCI and no scheme.

5 Simulation results and conclusion

☐ Throughput simulation for eMBB UEs



Throughput simulation for eMBB UEs of different schemes using ULCI as baseline



Throughput simulation for eMBB UEs of different schemes using PC as baseline

5 Simulation results and conclusion

ZTE中兴

☐ Performace requirement simulation for URLLC UEs

Multiplexing Schemes		$\Omega=(5,10)$	$\Omega=(10,10)$	$\Omega=(20,10)$
No scheme (%)		84.37	78.64	66.71
Existing schemes	ULCI (%)	93.33(+8.9%)	89.87(+11.2%)	80.64(+13.9%)
	PC (%)	87.78(+3.4%)	83.97(+5.3%)	73.84(+7.1%)
Proposed schemes	DPCI(%)	93.07(+8.7%)	89.34(+10.7%)	80.32(+13.6%)
	ROPC(%)	88.34(+4.0%)	86.47(+7.8%)	76.77(+10.1%)
	DPCI&&ROPC (%)	96.14(+11.8%)	92.99(+14.4%)	**84.38(+17.8%)**

Performace requirement simulation for URLLC UEs using No scheme as baseline

5 Simulation results and conclusion

Conclusion

- Compared with ULCI, DPCI enhances the protection of low-priority services, and the throughput of eMBB UEs increases by 14.1% at the maximum ratio.
- Compared with PC, ROPC enhances the performance both of high-priority and low-priority services, and the throughput of eMBB UEs increases by 12.8% when max 3 more percentage of URLLC UEs satisfies the requirements.
- Joint enabling of two types schemes such as DPCI and ROPC is realized for the first time. Compared with no scheme, extensive system level simulations results show that max 17.8% more percentage of URLLC UEs satisfies the requirements, and the throughput of eMBB UEs is increased by 23.4% at the maximum ratio.

ITU KALEIDOSCOPE ONLINE2020

Thank you!