

3GPP TSG RAN Meeting #75

Dubrovnik, Croatia, March 6 - 9, 2017

Agenda item: 10.1.1

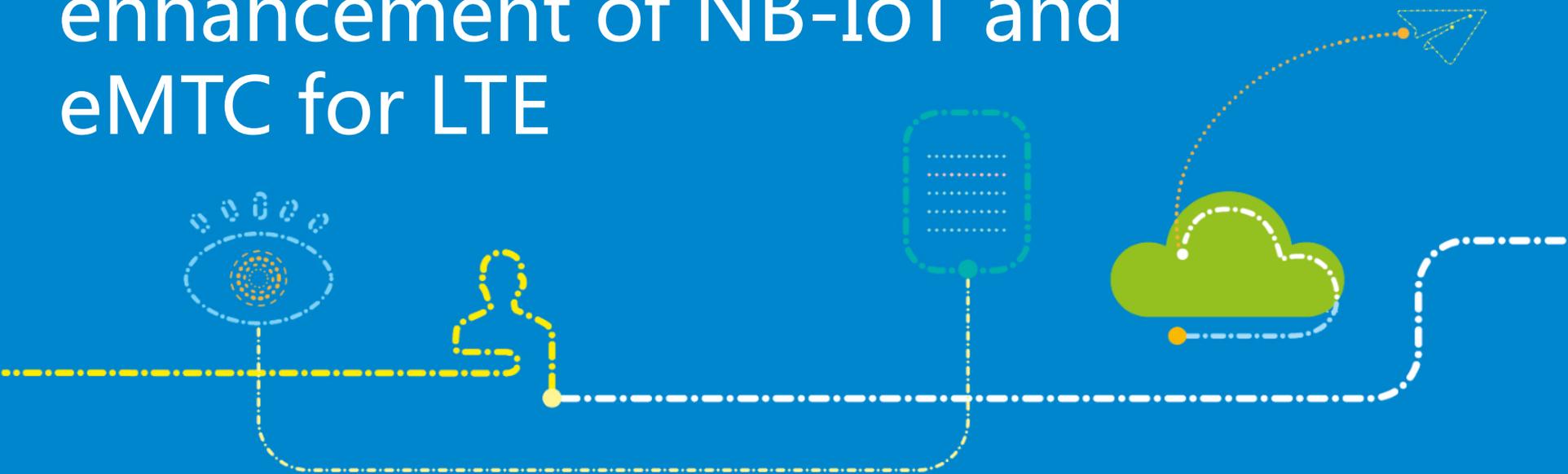
Document for: Discussion

RP-170372

ZTE

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# Motivation for further enhancement of NB-IoT and eMTC for LTE



# Justification

- In Rel-14, two work items, eMTC and NB-IoT, were approved to address the requirements of cellular internet of things.
- However , the scope of WID was reduced during the WID discussion as a result of limited TU time available.
- Some features were further delayed in WG discussion
- As the actual network deployment started, it is important to ensure that IoT devices and IoT traffic can be handled efficiently in the networks ,and that new service requirements can be satisfied



# Objectives

- Power consumption and latency reduction enhancement
- Spectrum efficiency and coverage enhancement
- Positioning enhancement



# Power consumption and latency reduction enhancement

- Device power consumption is of paramount importance for NB-IoT success. Currently, feedback from field deployment and actual comparison with competing technologies shows room for improvement and calls for immediate attention.



## Power consumption enhancement

- For IoT applications, lots of the traffic is characterized by small packet data transmission. Improving access and transmission efficiency for small data transmission is important.

Status	Ave power consumption (mA)	Ave time %	Ave usage
Actual TX period	400	17%	43%
Non TX RRC connected period	180	50%	56%
IDLE period	3	33%	1%

Objective:

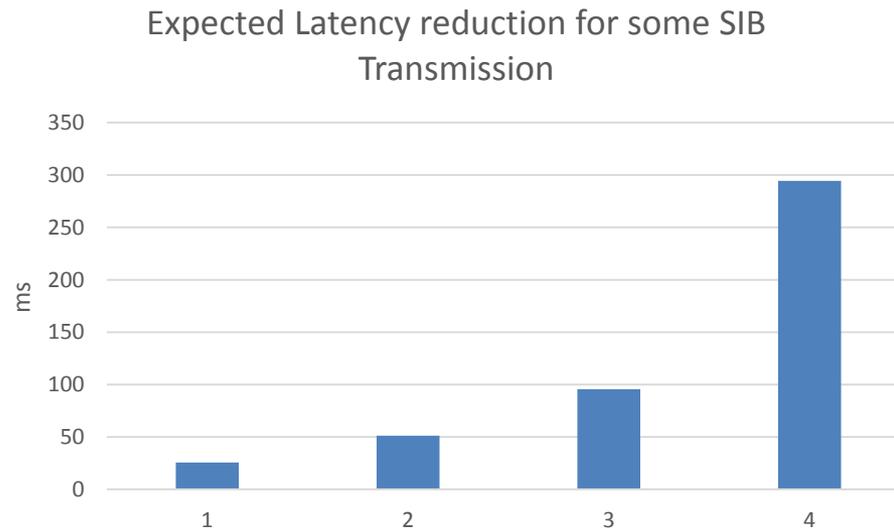


Specify enhancement to improve UE power consumption and efficiency of small packet transmission [RAN1, RAN2]

# Power consumption and latency reduction enhancement

## SI latency enhancement [RAN1, RAN2]

- SI transmission enhancement via IoT specific SIB to reduced UE monitoring requirement and network access latency



- Control channel enhancement in connected mode [eMTC only][RAN1]

- Reduce power consumption in NPDCCH detection.

# PRACH enhancement

Study and specify enhancement for PRACH performance and capacity [RAN1, RAN2][NB-IoT only]

Coupling loss	UE Mean arrival rate (/s)	Num of unit allocated (/s)	Need Unit Num per PRACH opportunities	Num of PRACH opportunities (/s)	<u>PCollision</u>
<144 dB	5.43	105	1	105	5.1%
[144 dB, 154 dB]	0.54	88	8	11	4.8%
>154 dB	0.17	52	16	3.25	5.1%
Total resource	PRACH	245	PRACH Resource %	26.1%	

Coupling loss	UE Mean arrival rate (/s)	Num of unit allocated (/s)	Need Unit Num per PRACH opportunities	Num of PRACH opportunities (/s)	<u>PCollision</u>
<144 dB	5.43	376	1	376	1.4%
[144 dB, 154 dB]	0.54	400	8	50	1.1%
>154 dB	0.17	256	16	16	1.1%
Total PRACH		1032	PRACH resource %	110%	

Parameter	PRACH Format		
	Format 0	Format 1	Format 2
Percentage of users	88.5%	8.9%	2.8%
PRACH overhead	1.7%	2.7%	3.1%
Number of PRACH opportunities (per sec)	12	2	1
Mean arrival rate (per sec) at 52547 devices per cell	5.43	0.54	0.17



# Spectrum efficiency and coverage enhancement

- With deployment of multiple PRBs , it is desirable for some terminals to better utilize the bandwidth .
  - Resource allocation on subcarriers level will increase both spectrum efficiency and coverage ;
  - More bandwidth for increased data rate , for example , two PRBs at the same time to increase data rates,
    - Benefit some high data rate IoT applications if configured in the network.
- Multiple HARQ processes can be considered to further increase the data rates.
- Standalone eMTC deployment scenario could be enhanced, for example, resource utilization.



# Spectrum efficiency and coverage enhancement

- OFDM subcarriers level resource allocation for uplink [eMTC only]
- Paging enhancement [RAN1, RAN2]
  - Paging transmission enhancement via common PO to reduce resource utilization
  - Potential paging reduction

Pagingcycle	128	256	256
PO reduction	512	512	512



# Spectrum efficiency and coverage enhancement

- Signaling support for multi-carrier operation enhancement [RAN2, RAN4]
  - Support of NB-IoT multi-carrier operation for standalone mode with either guard-band and/or in-band mode of operation
- Specify support of multiple HARQ process to further improve UE data throughput [NT-IoT only ][RAN1,RAN2]
- Enhancement of standalone eMTC operation mode [eMTC only]
  - Utilization of all DL OFDM symbols [RAN1, RAN2]

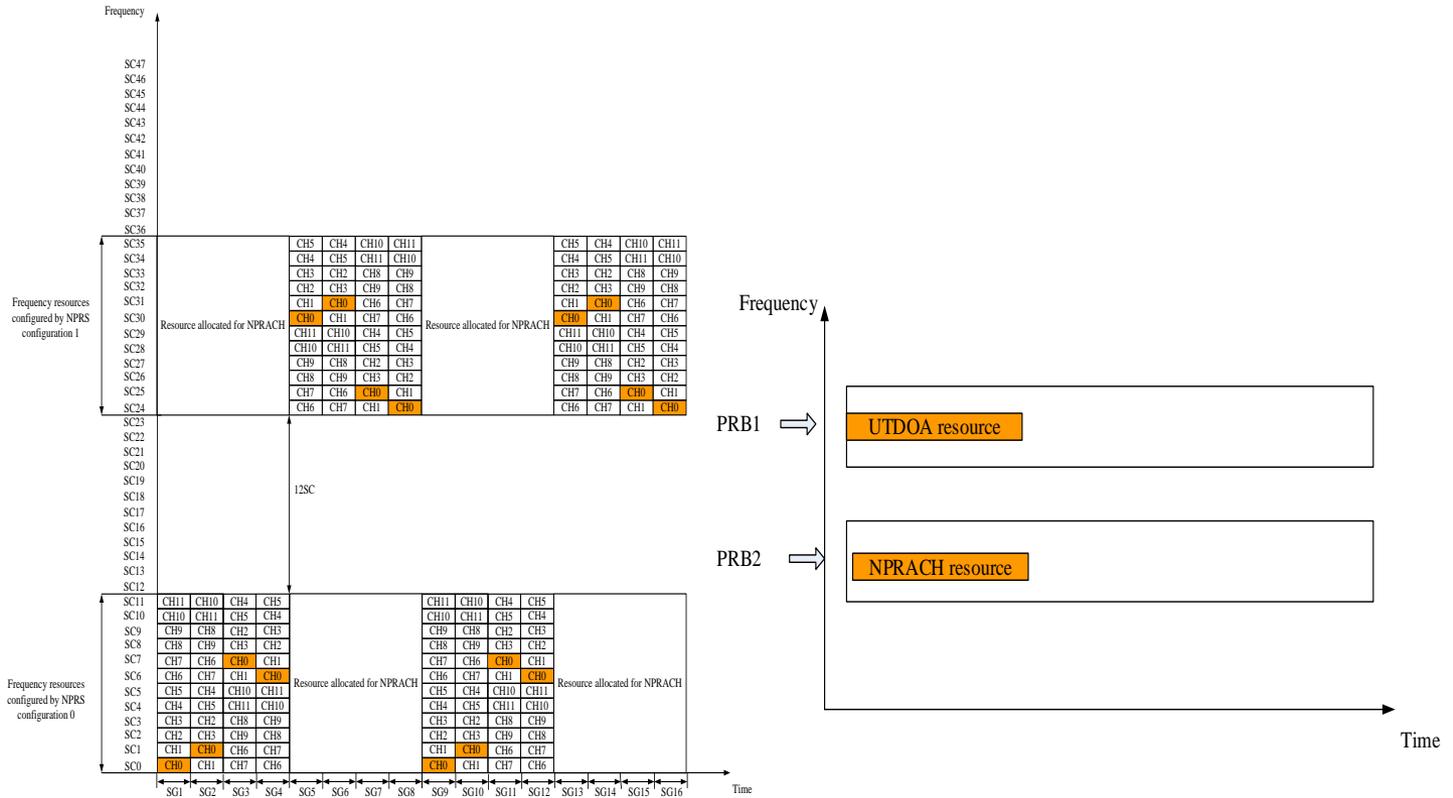


# Positioning support

- UTDOA were studied in Rel-14 but not finished.
- Compare with OTDOA, UTDOA has the significant advantage of lowering UE complexity and UE power consumption.
  - In OTDOA, UE implementation of RSTD measurement increases UE complexity
  - In OTDOA , UE measurement feedback increase UE power consumption , particularly for UE in extreme coverage scenario
- However, UTDOA was blocked in the study due to some concern of potential interference of NPRACH



# Example of UTDOA Configuration



## UTDOA agreement in Rel-14

- Rel-13 NPRACH preamble is the best candidate and can be used as a signal for NB-IoT UTDOA in some scenarios.
  - Whether it is feasible in a given network deployment depends on issues including network coordination, interference handling, power control, in-band emissions, capacity impacts, etc.
- Companies are encouraged to identify in RAN1#87 scenarios where it is and is not feasible



## UTDOA Objective in Rel-15

- Based on Rel-14 study phase result, identify feasible deployment scenario and specify support for UTDOA based positioning
  - Candidate reference signal is based on Rel-14 NPRACH with minimal necessary enhancement, considering multiple PRB deployment scenario
  - Evaluate the impact for NPRACH performance with existence of NPRACH based reference signal and identify potential mitigation/coordination schemes if needed
  - Study and specify enhancements on control plane overhead reduction and UE power consumption reduction. UEs in both RRC-connected/idle mode should be considered [RAN2]



# Thank you



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