

Some Overview Justifications

- ❑ In the “higher end” NB-IoT is in many markets replacing GSM/GPRS for IoT usage. In general the traffic models of IoT applications are different, and with varying packet sizes. So far, NB-IoT is mostly optimized towards sparse small packets. There are cases also with larger packet sizes, file downloads, file uploads etc. A natural requirement is that NB-IoT should provide good spectrum efficiency, and good power consumption at least in comparison to GSM/GPRS also in the mixed IoT applications scenario.
- ❑ When NB-IoT is deployed on a LTE grid with High Power per PRB in the DL cmp to LTE and with capability of high numbers of repetition, the result is that NB-IoT cells may have very significant overlap, also at the cell edge the radio quality is good, and an outdoors UE can be connected to another cell while at the cell center of a neighbor cell.
- ❑ UEs in deep indoor coverage generally experience very long transmission times, which is natural. However GSM/GPRS and now NB-IoT applications are now targeting also non-basement users with interactive use, e.g. purchase/payment terminal, automatic purchase machines, which has some real time requirements. It would be beneficial if there was support to keep UEs in deep coverage on different carriers to UEs in normal coverage.

Efficiency: Higher Order Modulation

❑ Specify support for higher order modulation for PDSCH and PUSCH, 16QAM

❑ Motivation

- Use cases for embedded Ues (IoT UEs) are very diverse, the typical amount of data in a transmission varies from application to application.
- Higher order modulation would be less resource consuming for UEs in good/normal coverage.
- NB-IoT is used as a replacer of GERAN. For Cells where Deep coverage is not needed, the spectral efficiency should be at least as good as EDGE.

❑ Expected Benefit

- Increased Spectral Efficiency, for cells with UEs in Normal Coverage.
- A likely secondary outcome: Higher bitrate for UEs in Normal Coverage

❑ Evolution perspective

- This kind of change would result in a new UE category Cat NB3
- It is expected that the additional hardware complexity is not significant to the cost of the NB-IoT UE, and that this enhancement can be included in the hardware evolution of all vendors.

Efficiency and Latency: NB-IoT Carrier per Coverage Level

- ❑ Specify Support for different coverage level support per carrier.
 - Paging need to be adapted for this.
- ❑ Motivation
 - R_{max} also for paging can be set low on carriers for normal coverage, leading to low power consumption for PDCCH decoding for UEs in normal coverage (without the additional overhead of WUS).
 - If carriers could be dedicated for normal coverage vs deep coverage, normal coverage UEs can have better latency without risk for Head of line blocking by UEs in deep coverage that need many repetitions.
 - Better deployment tailoring: UEs that need deep coverage could use stand-alone carriers, while UEs in good coverage could also use in-band carriers.
- ❑ Expected Benefit
 - Better handling of coverage and interference.
 - Avoid that bad coverage UEs blocks good coverage UEs.

Mobility During Data Transmission

- ❑ Specify Support for Mobility during data transmission.
 - Mobility trigger other than Radio Link Failure, based on measurements.
- ❑ Motivation
 - The relatively low data rates of NB-IoT involves significant transmissions times for e.g. file transfers, configuration files, report files, media files, software upgrade files etc.
 - The interruption at current cell change by RLF and subsequent search for suitable cell causes long interruption.
 - With current deployments overlap between cells can be very significant for outdoor UEs, thus a moving UE that cannot change cell due to long transmission may cause significant interference in neighbor cells. The traditional approach is to keep the UE connected to the best cell, by a mobility mechanism.
- ❑ Solution approaches
 - Details for further study.
 - E.g. Cell reselection with RRC reestablishment in connected mode.
 - Measurements in Gaps
 - The hardware requirements of the UE shall not be extended by this feature.
 - E.g. DRX gaps, or extended DL UL transmission Gaps.
- ❑ Expected Benefit
 - Less Interference, with overall enhanced performance.
 - Less interruption at connected mode cell change.



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