3GPP RAN #65
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RP-141403

Motivation for RAN2 Rel-13 WID Proposal Extended DRX for Idle mode

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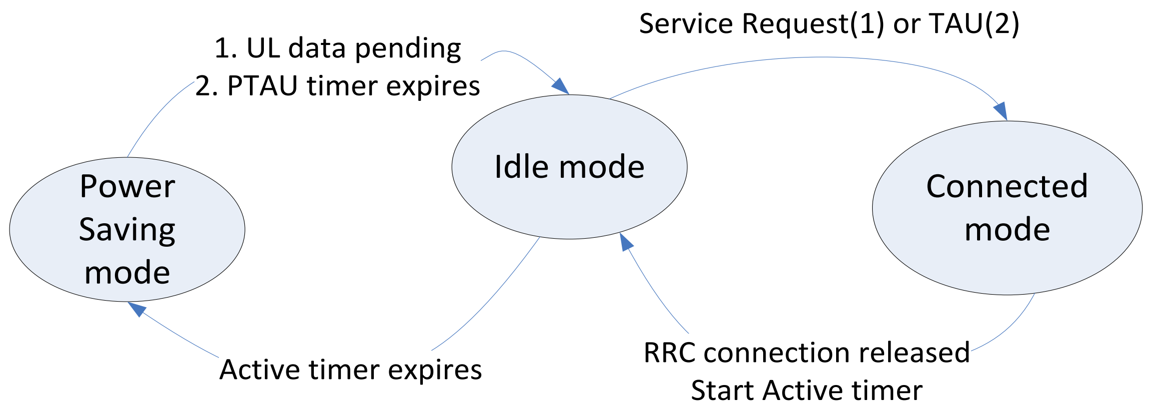
Rel-12 MTC Power consumption optimization (MTCe-UEPCOP)

What was accomplished:

- Introduction of Power Saving Mode
  - UE becomes unreachable for paging during PSM, it stops access stratum activities.
  - How to enter PSM:
    - UE negotiates Active time with MME (and optionally periodic TAU timer)
    - UE starts active timer when it enters idle mode.
    - When Active time expires it enters PSM.
  - How to exit PSM:
    - Trigger: MO data, Periodic TAU timer expires
    - Action: Service request or TAU, respectively.



Limitations of Power Saving Mode

PSM has limited applicability for unscheduled Mobile Terminated data with some requirement on MT data delay tolerance

- What can be done today with PSM for MT data:
  - Negotiate Periodic TAU timer equal (or slightly shorter) to maximum allowed delay tolerance for MT data.
  - UE needs to perform periodic TAU procedure to become available after entering PSM.
  - Store & Forward functionality is required in the network:
    - E.g.: SMS, SMS based triggering
  - UE needs to negotiate an Active Timer large enough to allow the network to send the MT packet once UE updates registration:
    - E.g.: SMS infrastructure is notified once UE performs periodic TAU
    - Therefore Active timer should be 2min+

Drawbacks:

- Increased signaling due to unnecessary periodic TAUs
  - Example: Delay tolerance = 30min, but only one MT data per day, there could be 47 unnecessary periodic TAUs per day per UE (if no MO data).
- Increased Power consumption due to unnecessary periodic TAUs

The Importance of MT data scenarios

Many use cases for MTC are being developed or considered with different requirements for MTC device reachability delay for MT data

MTC Application	Density (/sq. km)		Uplink				Downlink			
	Urban	Suburban	Use case	Messaging interval	Data per transaction (bytes)	Transactions per day	Use case	Data per transaction (bytes)	Transactions per day	Wake up interval
Electric Meter	5792	1158	Meter read	Scheduled	584	24	Utility service msg.	160	1	15 sec
Water Meter	5792	1158	Meter read	Scheduled	200	12	s/w update	400000	0.01	15 min
Security Panel	5792	1158	Ack or sensor state change	Ad hoc	584	10	Remote interaction	160	10	1 sec
HVAC - Residential	1158	232	Ack	Ad hoc	200	0.08	DR instructions	160	0.08	15 sec
Outdoor Street Light	579	116	Ack	Scheduled	200	2	On/Off state change	160	2	60 sec
Off Street Parking Meter	5598	1120	Payment transaction	Ad Hoc	360	6	Payment transaction confirmation	100	12	1 Sec
Parking Space Sensor	11197	2239	State change	Ad Hoc	60	12	Diag test	160	0.07	5 min
Water Assets	5792	1158	Asset health, alerts	Scheduled	320	80	Payment transaction confirmation	320	80	1 sec

Delay tolerance

Proposal for Release-13

Open a new Rel-13 WID to adopt a solution that is effective for MTC power consumption reduction in scenarios requiring mobile terminated data

Proposed solution: Extended idle mode DRX

- Benefit for MT data:
  - Does not introduce additional signaling load
  - DRX cycle can be set depending on the requirements on delay tolerance for MT data
  - Has better power consumption than PSM for scenarios requiring mobile terminated data (see next slides for comparison)
- Proposal is to address the impact of extending the Idle DRX cycle beyond the current System Frame Number range (10.24s)
  - Target at least 5-10 minutes
  - A companion Work Item has been proposed in SA (S2-142586).

PSM vs Extended DRX – Battery Life Comparison (1)

Model for MO data:

- Device warm-up from deep sleep = 40ms
- Service request delay = 220ms
- X=4 MO data communications per day
- Time in connected mode for data transmission/reception = 400ms
  - After 400ms of transmission UE is moved to I-DRX

Model for MT data:

- Non-scheduled Y=1 MT data per day, variable delay tolerance=60, 30, 15, 5 min.
- MT data communication lasts 1 second
- For PSM:
  - It is assumed that MT data is SMS message.
  - Periodic TAU timer = MT delay tolerance
  - Active timer = 2min.
  - MT data arrives 1 minute after periodic TAU
    - UE performs TAU, stays in I-DRX with 2.56s DRX cycle for 1 minute.
    - UE is paged, performs SR, stays connected with data transmission/reception for 2.56s, and goes back to I-DRX
    - UE stays in I-DRX for 2min before going back to PSM.

PSM vs Extended DRX – Battery Life Comparison (2)

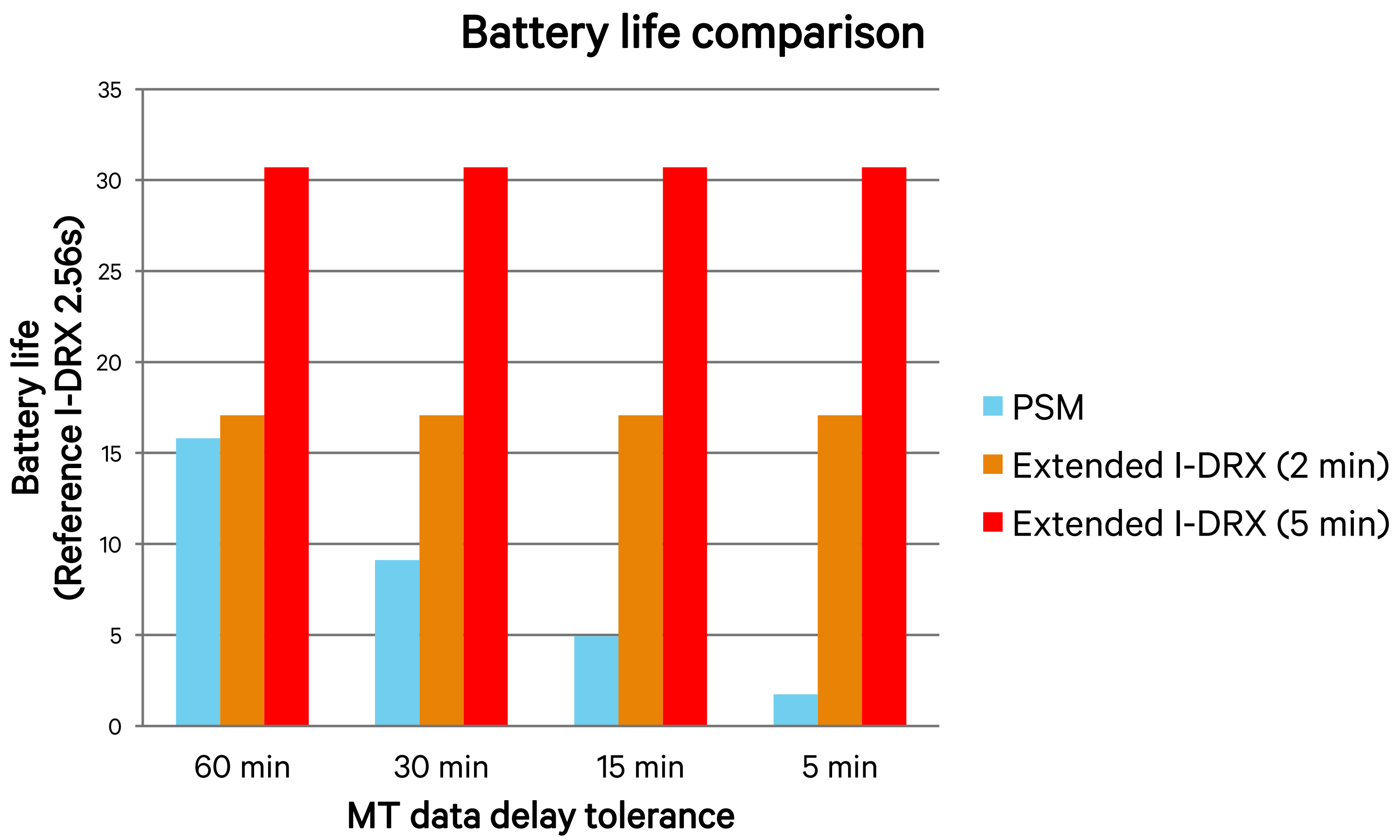
Power values assumed (based on values used in RAN2 discussion in Rel-12 UEPCOP, see R2-132560)

Parameter	Value	Comments
P_{rx}	1 unit/ms	Power consumed for RX.
P_{tx}	2 unit/ms	Average power consumed for TX
P_{sleep}	0.01 unit/ms	Power consumed during sleep mode, including power consumed for low accuracy clock and memory maintaining, leakage current (e.g. caused by power management unit), etc.
P_{Deep_sleep}	0.0001 unit/ms	Optimized sleep state

PSM vs Extended DRX – Battery Life Comparison (3)

Observations:

- Even for 1hr delay tolerance, PSM has slightly worse power performance than extended I-DRX with DRX cycle of 2 minutes.
- For delay tolerance of 5 minutes, performance of PSM is similar to current I-DRX with DRX cycle of 2.56



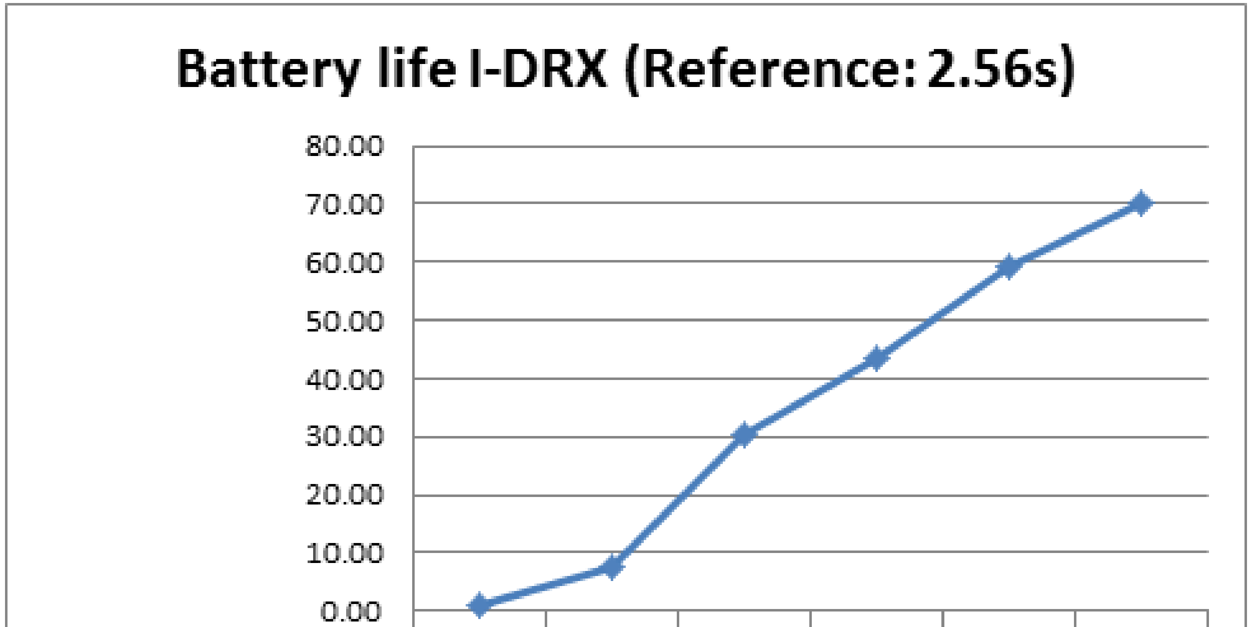
Why large DRX values?

We propose to extend DRX cycle length in idle mode to values in the order of minutes

- Exact maximum value may be studied further in RAN2 but our target is at least around 5 minutes, beyond 10.24s.

As shown in R2-132560 during RAN2 UEPCOP study phase:

- A DRX cycle of 2 min can increase battery life by around 6 times the battery life for DRX=10.24s. A DRX cycle of 5 minutes can increase it by almost 9 times.
  - (Comparative performance depends on traffic characteristic)



	2.56s	10.24s	1min	2min	5min	15min
Battery life I-DRX (Reference: 2.56s)	1.00	7.68	30.37	43.66	59.19	70.31

Thank you

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