Power Saving Mode and nRF9160

What is PSM?

Power Saving Mode (PSM) is an LTE feature that allows a device to go into sleep mode for an extended period of time while staying registered to the network.

IoT devices tend to send or receive data intermittently. This means that they don't need to stay fully connected to the network the entire time. By going into a sleep mode the device saves energy. Additionally, while in sleep mode the device stays registered in the network, which means it won't have to go through the registration process again when it needs to send data and thus it saves power.

How does it work?

First of all, both the network and the device must allow PSM. Then the device can request PSM and propose values for periodic TAU (Extended Timer) and Active Timer. The network can accept them or reject them and set new values. *The network will reject the PSM request if it does not support this feature.*

Once PSM is enabled, the device can send data (modem energy consumption is high), when it finishes it goes into idle mode (energy consumption is reduced, but it is still significant). The device stays in idle mode for a period defined by the Active Timer. During this time the device can receive commands from the network.
When the Active Timer is up the device enters sleep mode (consumes minimum energy). During this time the device can't be reached by the network.
It will stay sleeping until the TAU timer is up (the Tracking Area Update is initialized by the device to let the network know it's still available and to stay registered). The sleeping time can also be interrupted whenever the device needs to send data over the network.

Implementing PSM on nRF9160

In the **proj.conf** file we can configure the values for periodic TAU and Active Timer that we want to request from the network. The values of the timers are represented as explained in the next tables:

String. 1 byte in 8-bit format.

Bits 5 to 1 represent the binary coded timer value.

Bits 8 to 6 define the timer value unit for the *General Packet Radio Services (GPRS)* timer as follows:

Bits
8 7 6
0 0 0 – Value is incremented in multiples of 2 seconds
0 0 1 – Value is incremented in multiples of 1 minute
0 1 0 – Value is incremented in multiples of 6 minutes
1 1 1 – Value indicates that the timer is deactivated

Table 2. Coding and value range for Active Timer

String. 1 byte in 8-bit format. Bits 5 to 1 represent the binary coded timer value. Bits 8 to 6 defines the timer value unit for the GPRS timer as follows: **Bits** **8 7 6** 0 0 0 – Value is incremented in multiples of 10 minutes 0 0 1 – Value is incremented in multiples of 1 hour 0 1 0 – Value is incremented in multiples of 10 hours 0 1 1 – Value is incremented in multiples of 2 seconds 1 0 0 – Value is incremented in multiples of 30 seconds 1 0 1 – Value is incremented in multiples of 1 minute 1 1 0 – Value is incremented in multiples of 320 hours 1 1 1 – Value indicates that the timer is deactivated

Table 1. Coding and value range for Periodic-TAU

We assign the next configurations with the binary value in string.

- `CONFIG_LTE_PSM_REQ_RPTAU`
- `CONFIG_LTE_REG_RAT`

In our application code we request PSM by calling the next API: **lte_lc_psm_req(true);**
It's recommended that we enable this feature before establishing an LTE connection to request timer values during ATACH.

The **%XMONITOR** command reads modem parameters; Active Time and Periodic-TAU are among these parameters. With this command we can verify if the network accepted or overrode our timer values.

Finally to verify that our modem is going into sleep mode Nordic recommends to enable modem sleep and TAU prewarning notifications by setting the following options:

- `CONFIG_LTE_LC_MODEM_SLEEP_NOTIFICATIONS`
- `CONFIG_LTE_LC_TAU_PRE_WARNING_NOTIFICATIONS`

REFERENCES

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QUESTIONS

1. What happens when we send data before the periodic TAU timer is up? Will the TAU timer restart or will it continue with the remaining time from the previous cycle?
2. We've come up with an indirect way to detect modem transition into PSM. First we subscribe to RSRP notifications. Next, we query the signal connection status (CSCON). And if the connection state is IDLE, then we judge sudden signal values of 255 as modem entering deep sleep.
   Do you think our method detects PSM accurately?
3. In one of your replies you said: *"If the network doesn't assign a valid <Active-Time> to the UE, PSM is not allowed."*
   We understand that receiving either invalid TAU or Active timer means that PSM is not allowed. Is there another way to verify that network doesn't support PSM? If we receive valid timer values, should we assume PSM is supported? If not, is there a way to verify PSM is supported?