Opportunistic Strategies for Keeping Push Notification Channels Alive on Smart Devices

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Problem Definition

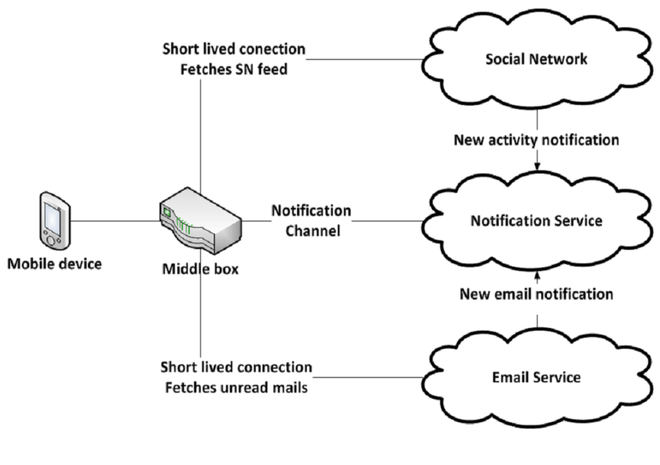


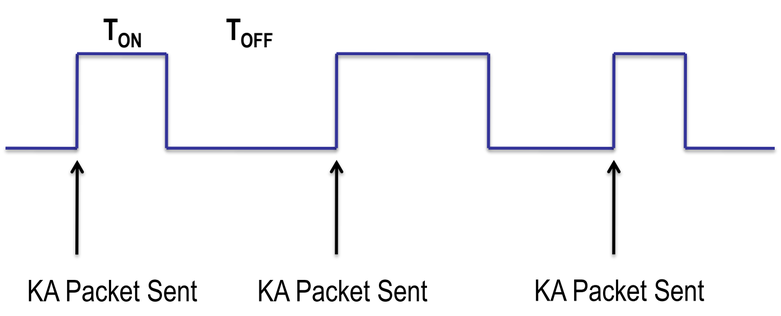
Fig : A model of notification service

- There is a binding timeout for middle boxes
- Keep Alive packets are needed to be sent periodically

Objective

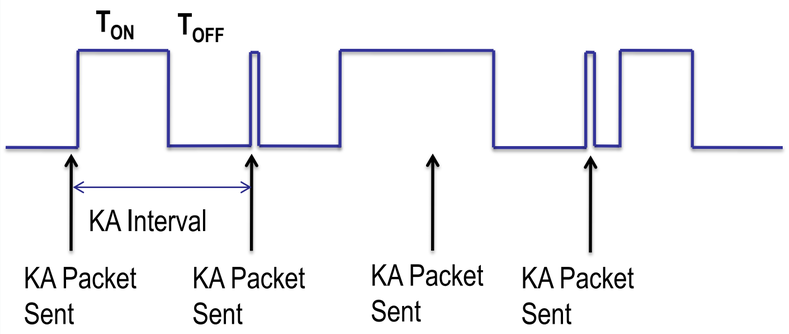
- Optimizing the process of sending keep alive packets to reduce power consumption.
- Sending keep alive packets without powering up the CPU and the radio module.

Strategy 1: Whenever ON



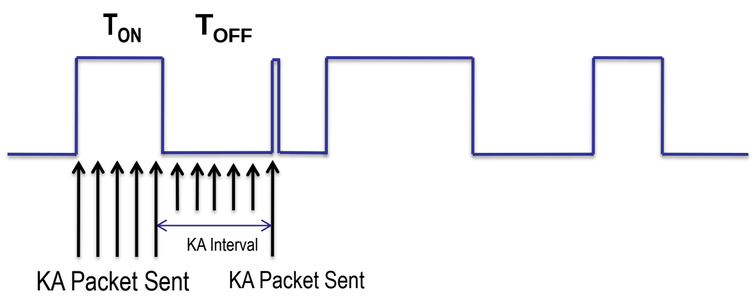
- Radio module is not turned on just to send keep alive packets
- Power consumption is reduced
- TCP connection may go down for larger period of time

Strategy 2 : At Each KA Interval



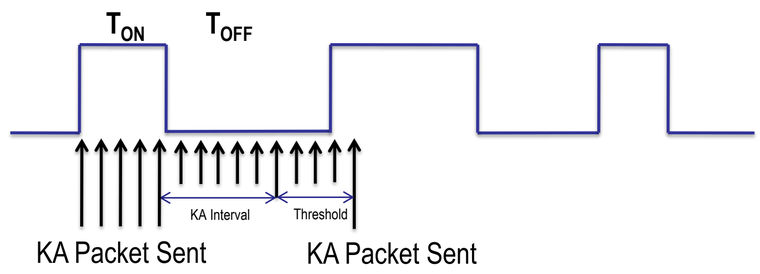
- Packets are sent in every keep alive interval whether the radio module is ON or OFF
- The Push Notification channel or TCP connection never goes down
- Cost increases to turn on the radio module and the CPU

Strategy 3: Repeated Probing



- Repeatedly checking if radio module is ON or OFF
- If ON packet is sent otherwise wait till KA interval
- No disconnection happens here
- Extra cost for repeated probing
- Number of packets sent in OFF period decreases

Strategy 4: Repeated Probing with Threshold



- Just like previous approach
- Here we are allowing a small disconnection time which is called “threshold”
- Instead of sending at KA interval in OFF state, we’re waiting for an extra threshold time
- Rate of packets sent in OFF state further decreases

Simulation Strategy

To calculate time period for ON and OFF event we have considered exponentially distributed random variable T.

$$T_{ON} = -\frac{1}{\lambda_{ON}} \ln(U)$$

$$T_{OFF} = -\frac{1}{\lambda_{OFF}} \ln(U)$$

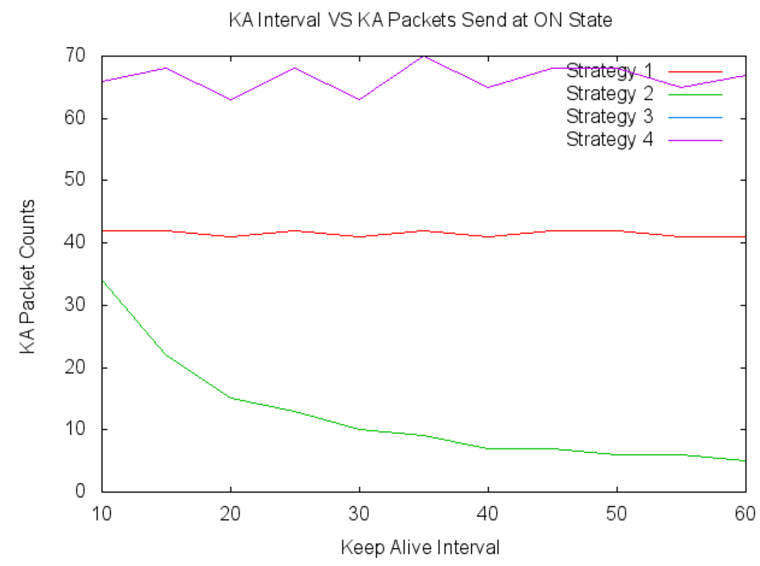
Here U is an uniform distribution on the interval (0,1).

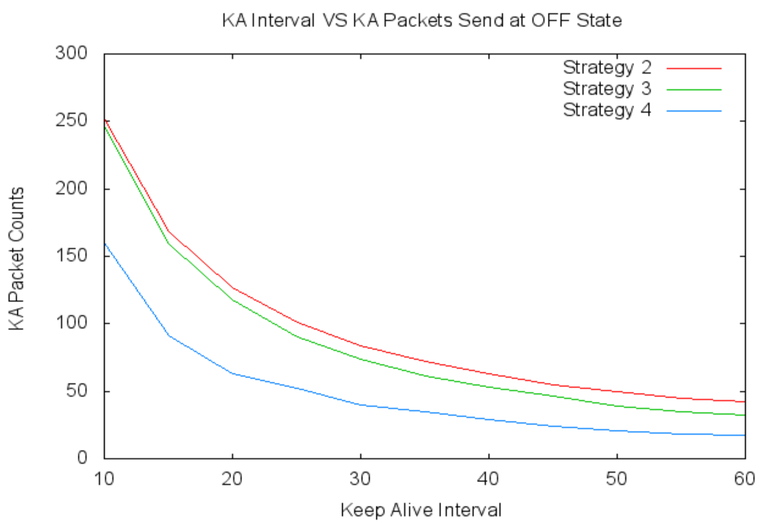
Parameters	Values
λ_{ON}	1/15 (8:00 am to 6:00 pm) 1/2 (6:00 pm to 8:00 am)
λ_{OFF}	1/45 (8:00 am to 6:00 pm) 1/80 (6:00 pm to 8:00 am)
KA Interval	10 min to 60 min
Threshold	5 min to 35 min
Simulation Period	48 hours

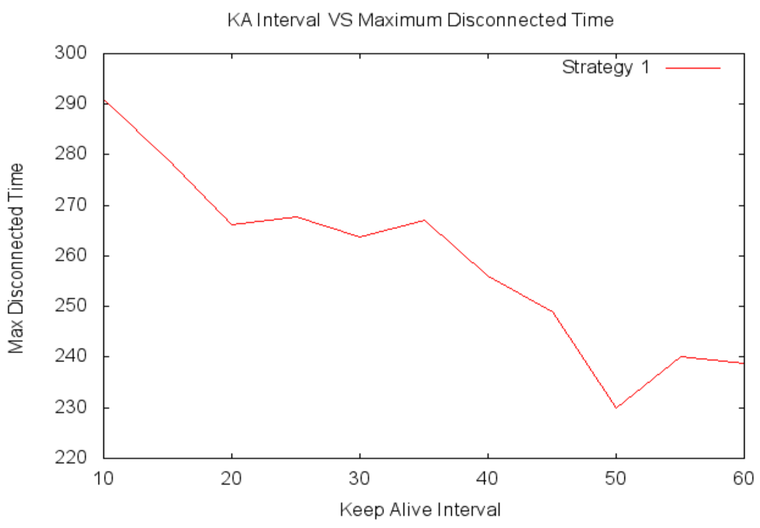
For a fixed KA interval we have run the simulation for 100 times and taken the average value of each of the following-

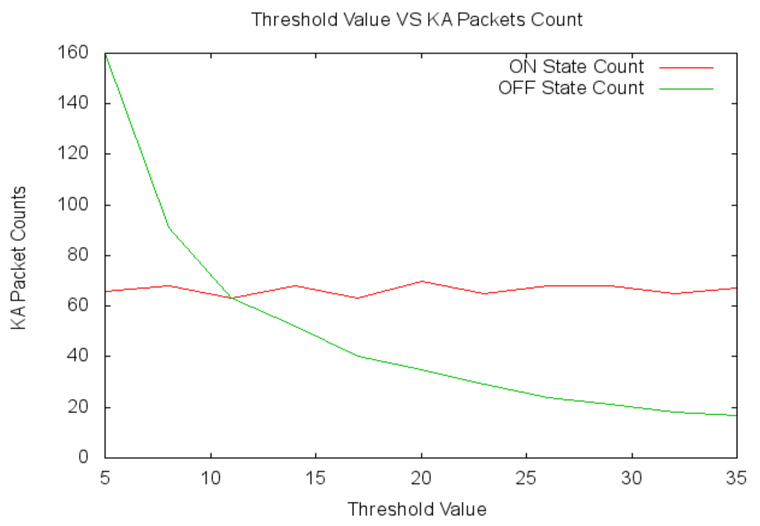
- Packets sent in radio ON state
- Packets sent in radio OFF state
- Maximum disconnected time

Simulation Findings









Future Target

Develop an adaptive strategy that learns from a user’s past data, updates radio module ON, OFF time and thus creates more chance for reducing the number of packets sent in OFF period

References

[1] H. Haverinen, J. Siren, and P. Eronen. Energy consumption of always-on applications in WCDMA networks.

[2] S. Herzog, R. Qureshi, J. Raastroem, X. Bao, R. Bansal, Q. Zhang, and S. M. Bragg. Determining an efficient keep-alive interval for a network connection

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