Energy Efficient Implementation of IETF Constrained Protocol Suite

draft-ietf-lwig-energy-efficient-01

Z. Cao, C. Gomez, M. Kovatsch, H. Tian, X. He

Carles Gomez has been partly supported by the Spanish Government through project TEC2012-32531, and FEDER

IETF 91 – Honolulu, Nov 2014

Outline

- Overview of updates
  - Section 3 (“MAC and Radio Duty Cycling”)
    - Intro text
    - Subsection 3.1 (“Radio Duty Cycling techniques”)
    - Subsection 3.2 (“Latency and buffering”)
    - Subsection 3.3 (“Power save services available in example low-power radios”)
  - Section 5 (“Routing protocols”)
  - Section 6 (“Application Layer”)
  - Minor updates
- 7. Crosslayer optimization
- Further questions to the WG

Section 3 introduction

- Idle listening is the key problem
- Motivation for radio duty cycling
- Mention P1 and P0 devices
  - RFC 7228 (“Terminology for Constrained-Node Networks”)

3.1. Radio duty cycling techniques (I)

- Channel sampling
  - Receiver monitors the channel periodically for very short periods
  - Sender
    - Prepend a preamble
      - Frequently Listening (FL) mode of ITU-T G.9959
      - Coordinated Sampled Listening (CSL) of IEEE 802.15.4e
    - Repeatedly sending data
      - ContikiMAC
- Scheduled transmissions
  - Receiver knows the instants in which it has to be ready for communication
  - Some form of negotiation required
  - Example
    - Bluetooth Low Energy

3.1. Radio duty cycling techniques (II)

- Listen after send
  - Wake up and poll a sender for possible pending transmissions
  - Examples
    - Receiver Initiated Transmission mode of IEEE 802.15.4e
    - Data transmission from coordinator to device in IEEE 802.15.4-2003

3.2. Latency and buffering

- Latency
  - Potentially increases compared with always-on devices
  - Latency increase is a random variable
    - Uniformly distributed if periodical behavior
    - Addition of variance
- Buffering
  - A sender may need to store outgoing packets while waiting for communication opportunity
  - Memory requirements increase
  - Queuing waiting time
  - Buffer overflow probability increase
- Influence on upper layers

5. Routing protocols

- Added text on RFC 6551
  - Node Energy object used by RPL
    - Information related to energy metrics
  - Energy-based routing metrics may help balance energy consumption of network nodes
    - Minimize network partitioning
    - Increase network lifetime

6. Application Layer

- Made explicit that CoAP Observe option allows a server to sleep between notification transmissions
- CoAP proxies provide certain support for sleepy nodes
  - If a cached response is recent enough, the proxy itself may provide the response to a client
  - The proxy may attempt to obtain a response from a sleepy server (when appropriate)
- Proposals for further sleepy node support at the application layer
  - Exploiting proxies, Resource Directory, or signaling when a node is awake
  - Currently not WG documents

7. Cross Layer Optimization

- Almost empty
- The whole document itself deals with cross-layer issues
- Remove the section?

Further questions to the WG

- What should be added?

- What should be removed?