

Ji-Hoon Park, Byung-Seo Kim, 2014. Reliable beacon transmission based MAC protocol for LR-WPANs over WLAN interferences. *Journal of Zhejiang University-SCIENCE C (Computers & Electronics)*, **15**(6):470-481.  
[doi:[10.1631/jzus.C1300269](https://doi.org/10.1631/jzus.C1300269)]

# Reliable beacon transmission based MAC protocol for LR-WPANs over WLAN interferences

**Key words:** Low rate wireless personal area network (LR-WPAN), Interference, Wireless local area network (WLAN), Beacon

Corresponding author: Byung-Seo Kim  
E-mail: [jsnbs@hongik.ac.kr](mailto:jsnbs@hongik.ac.kr)

# Motivation

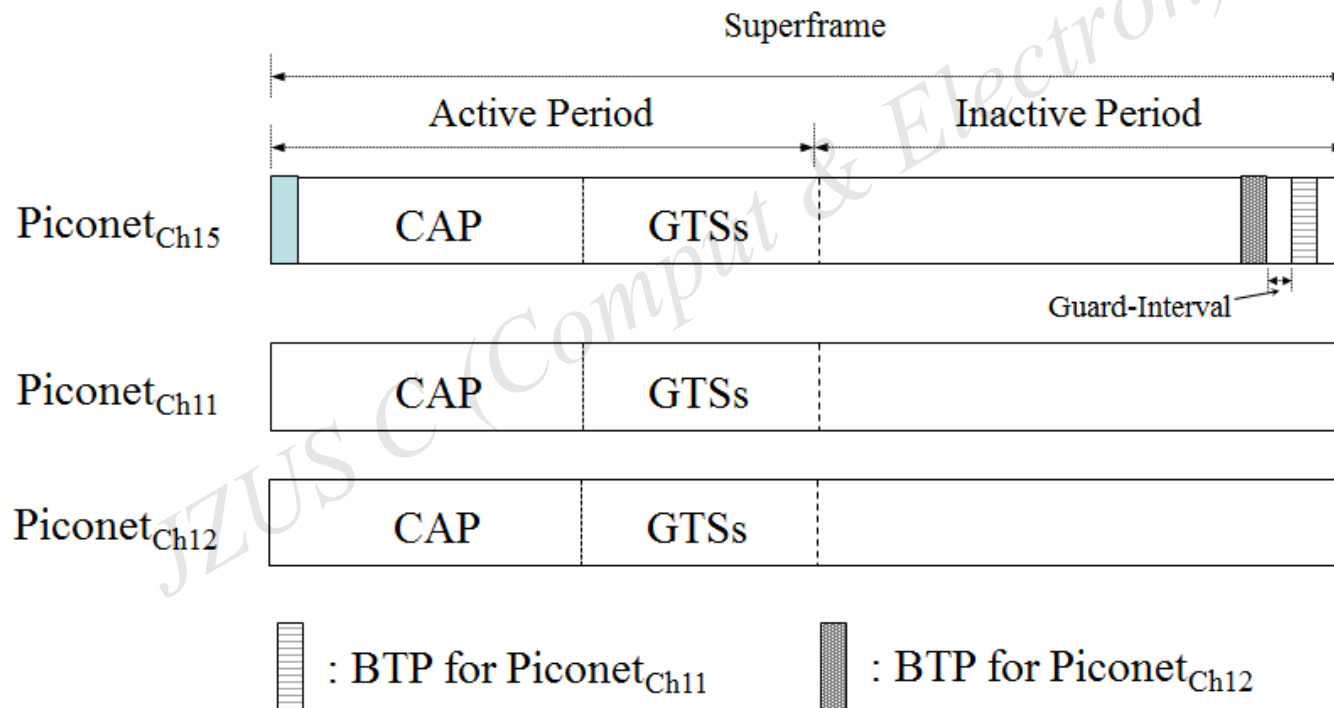
- IEEE 802.15.4 based wireless sensor networks and IEEE 802.11 based wireless local area networks use the same ISM frequency bands, and they interfere each other.
- Performance degradation depends upon the distance between LR-WPANs and WLANs, locations, the channels used by LR-WPANs, and the traffic loads of WLANs.
- Reliability of the beacon frame needs to be guaranteed because the loss of beacon frames causes huge performance degradation.
- After aMaxLostBeacons times, the re-association process is initiated, which requires a long process delay.

# Proposed protocol (1/5)

- We propose a MAC protocol to improve the performance of IEEE802.15.4 based WSNs
- Two types of piconets are considered:
  - Primary-piconet (P-piconet)
  - Secondary-piconet (S-piconet)
- P-piconet uses one of the interference-free channels and S-piconet has to use channels interfered with the WLANs channel
- The interfered channel is used for data transmission and the interference-free channel for beacon frame transmission
- Improve the overall channel utilization and minimize the performance degradation

# Proposed protocol (2/5)

- Example of operations



**An example of constructing superframes using the proposed method**

# Proposed protocol (3/5)

- New frame formats

(a)

Octets:	1	1
MAC header	Command Frame Identifier	Beacon Length

(b)

Octets:	1	1	2	1
MAC header	Command Frame Identifier	Beacon ID	Beacon Tx Time	Max. BTP

(c)

Octets:	1	1
MAC header	Command Frame Identifier	Beacon ID

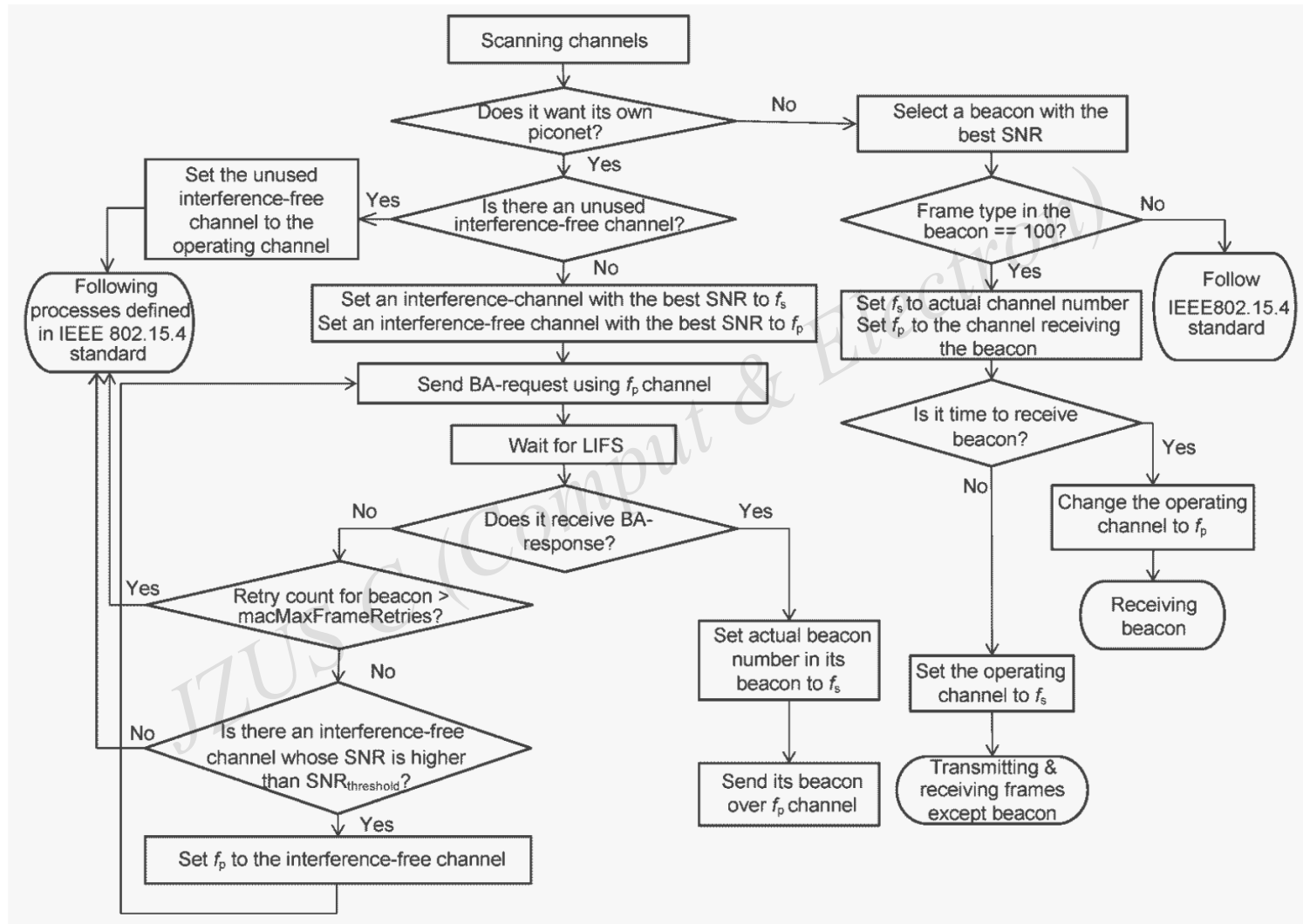
(d)

Octets: 2	1	4/10	0/5/6/10/14	2	variable	variable	variable	2
Frame Control	Sequence Number	Address Field	Auxiliary Security Header	Superframe Specification	GTS Field	Pending Address Fields	Beacon Payload	FCS

**Frame formats of BA-request (a), BA-response (b), BD-request (c), and a beacon frame for RBT-MAC (d)**

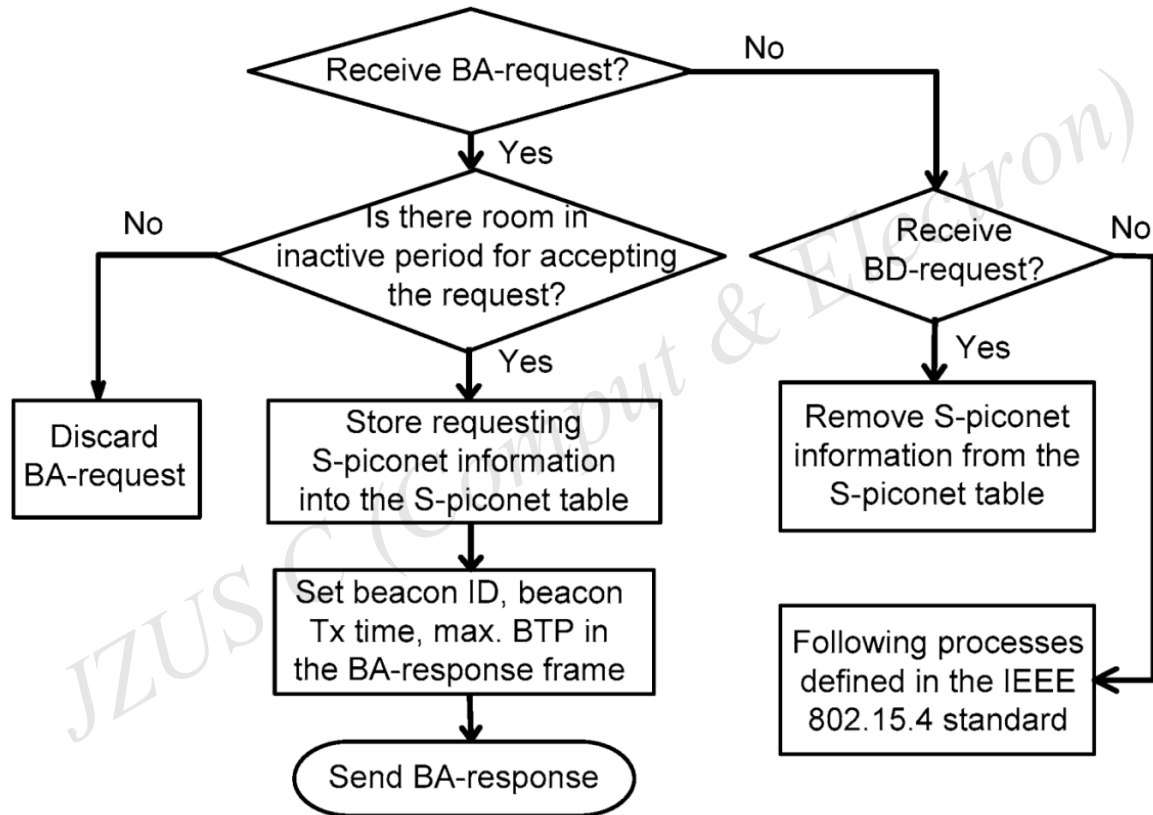
1	variable
Actual Channel Number	Payload

# Proposed protocol (4/5)



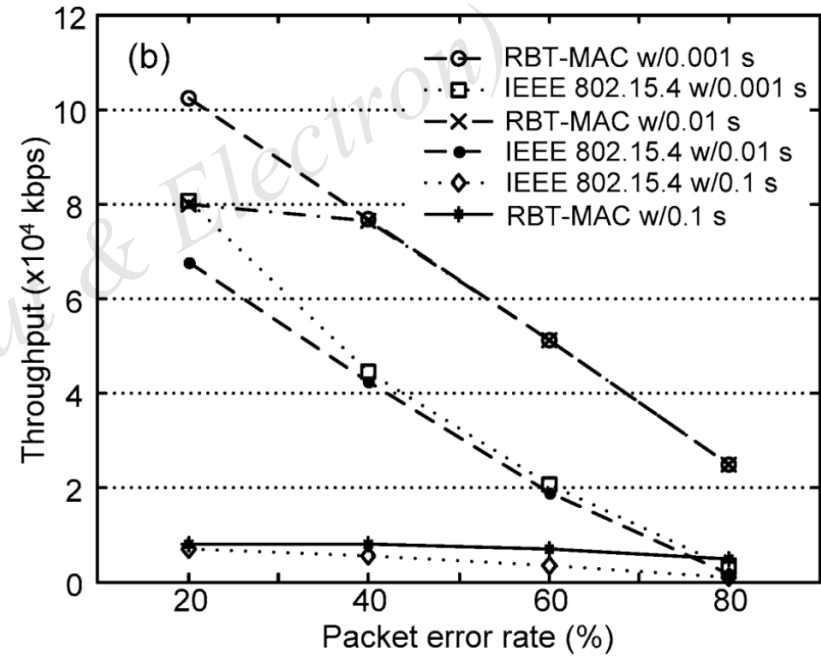
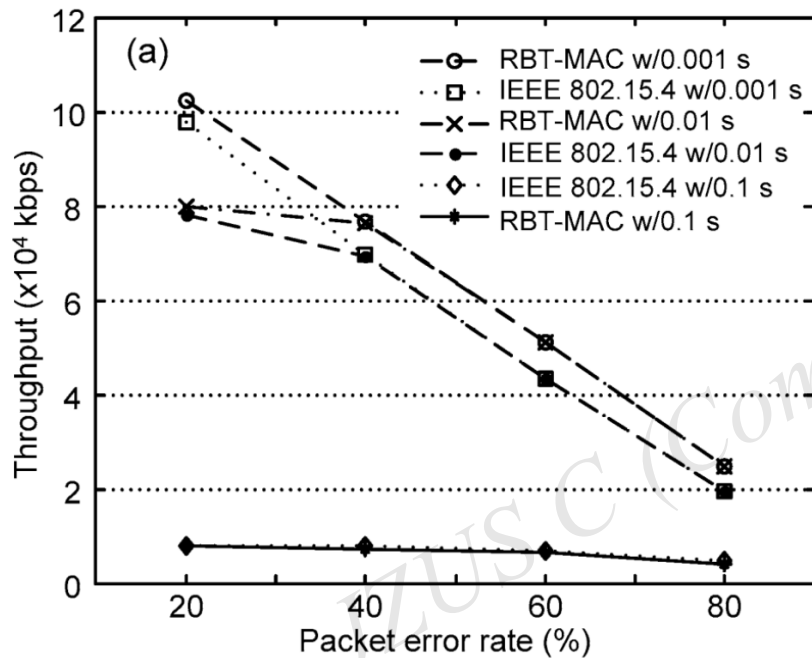
**Flow chart of the process that a device configures and associates with the S-piconet using the RBT-MAC protocol**

# Proposed protocol (5/5)



Flow chart of the process at a PNC of the P-piconet

# Performance evaluations



Throughput as a function of the packet error rate and packet inter-arrival time with a beacon frame length of 14 bytes (a) or 100 bytes (b)