DTLS-based Multicast Security for Low-Power and Lossy Networks (LLNs)

draft-keoh-dice-multicast-security

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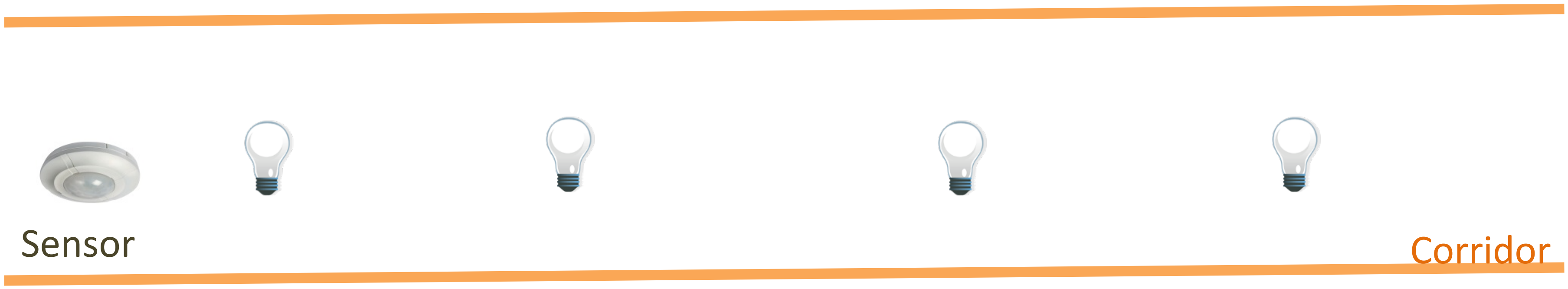
Group Communication Use Case

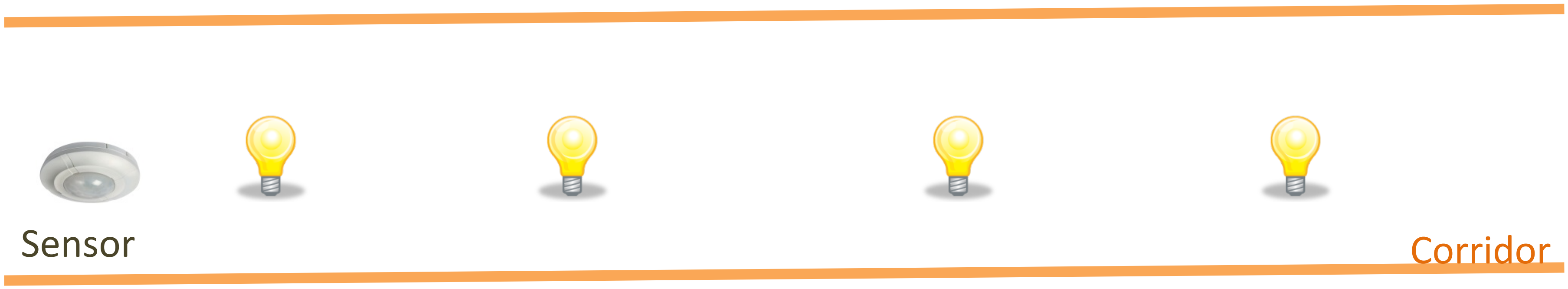
Lighting control



Group Communication Use Case

Lighting control

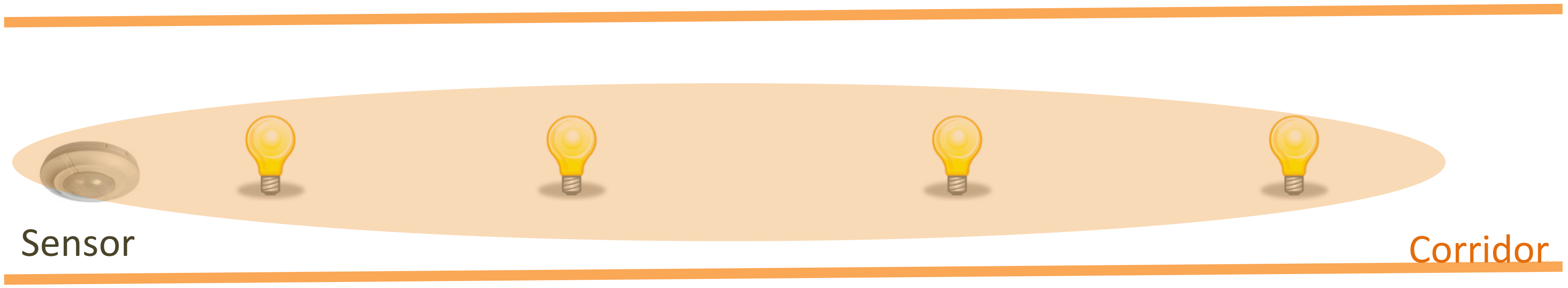
- Visually synchronous change



Group Communication Use Case

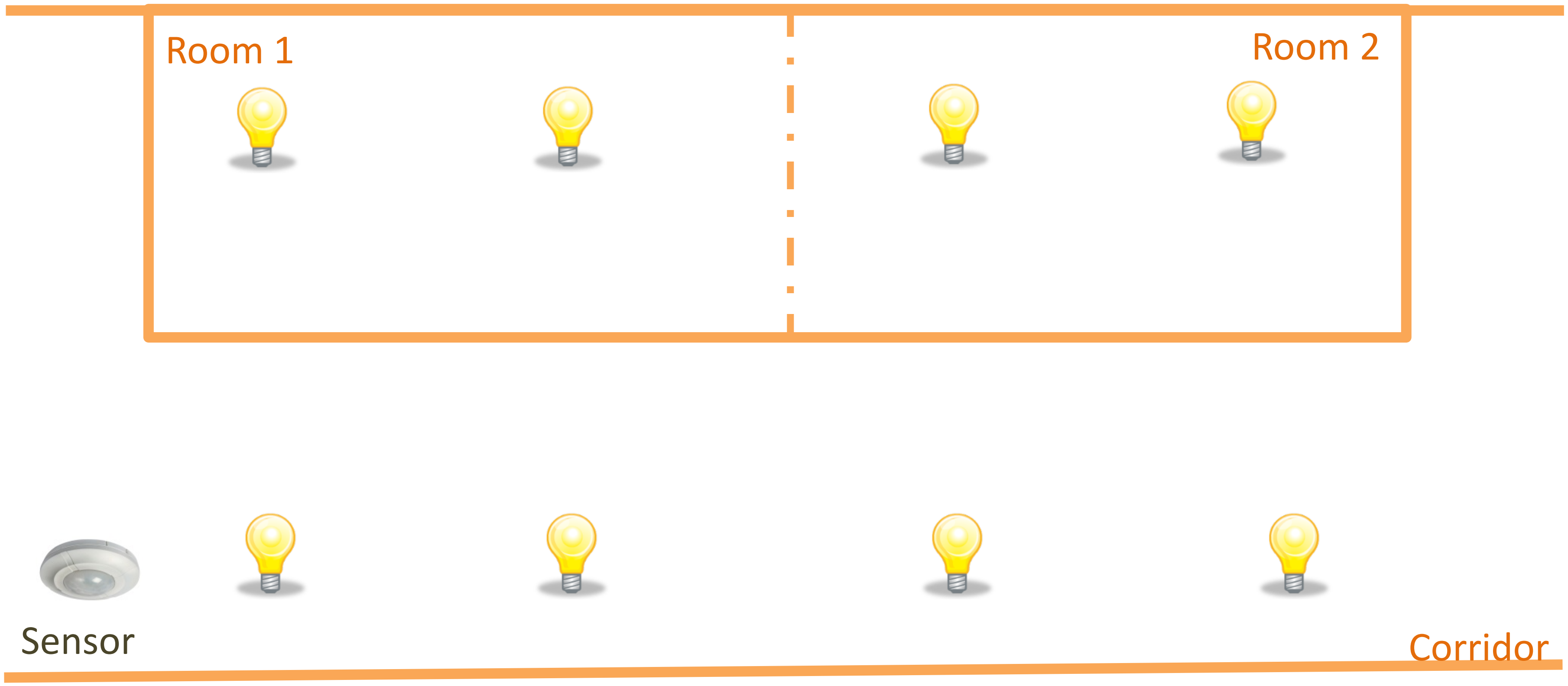
Lighting control

- Visually synchronous change
- Multicast groups -> CoAP group communication



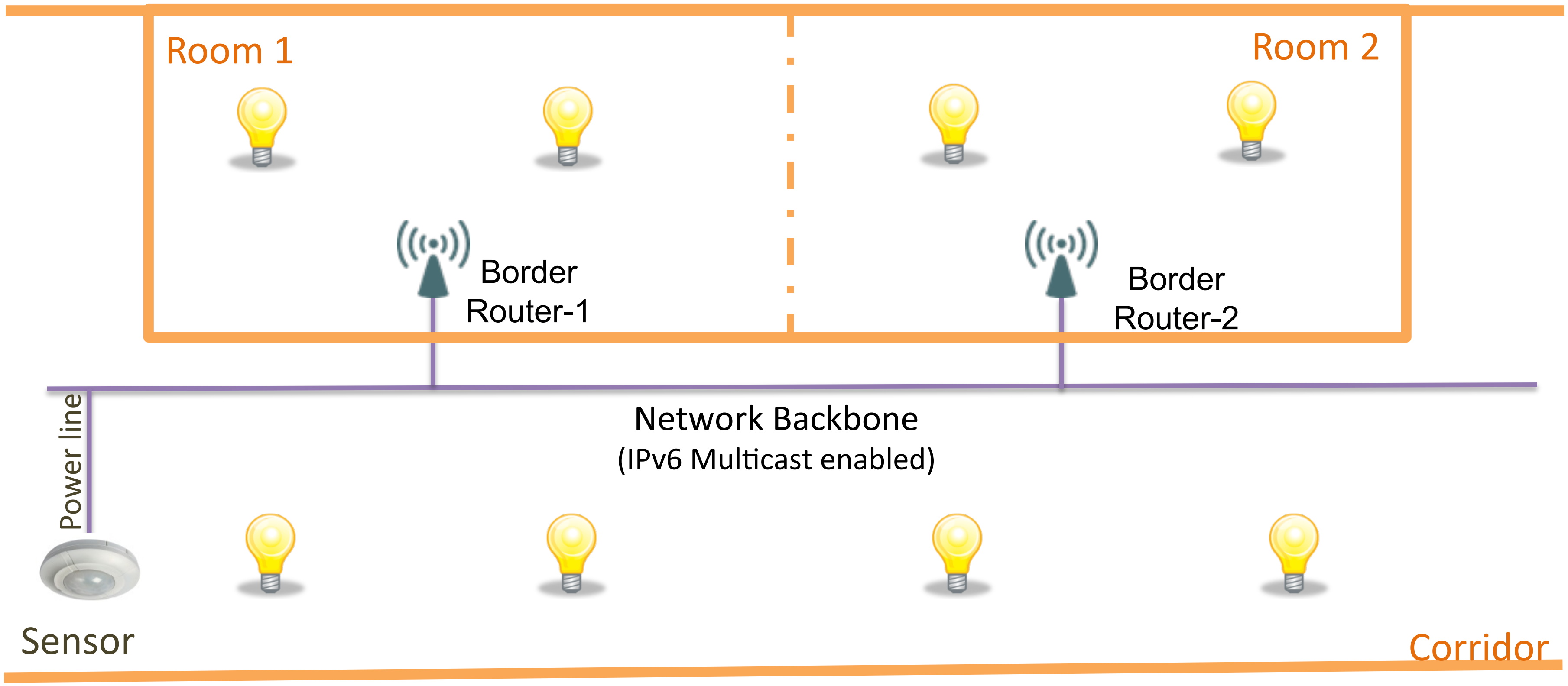
Group Communication Use Case

Lighting control in Office Building



Group Communication Use Case

Lighting control in Office Building



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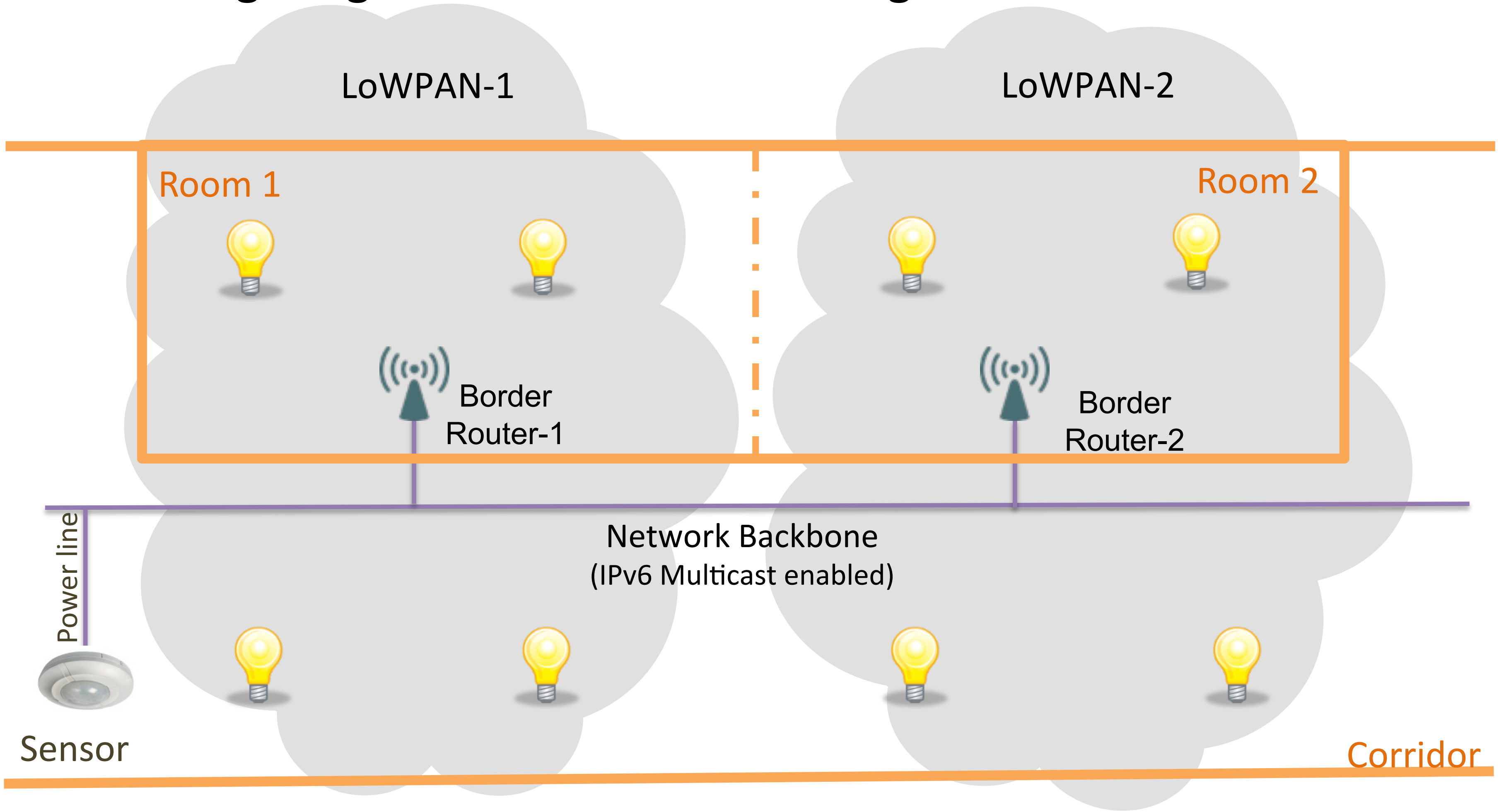

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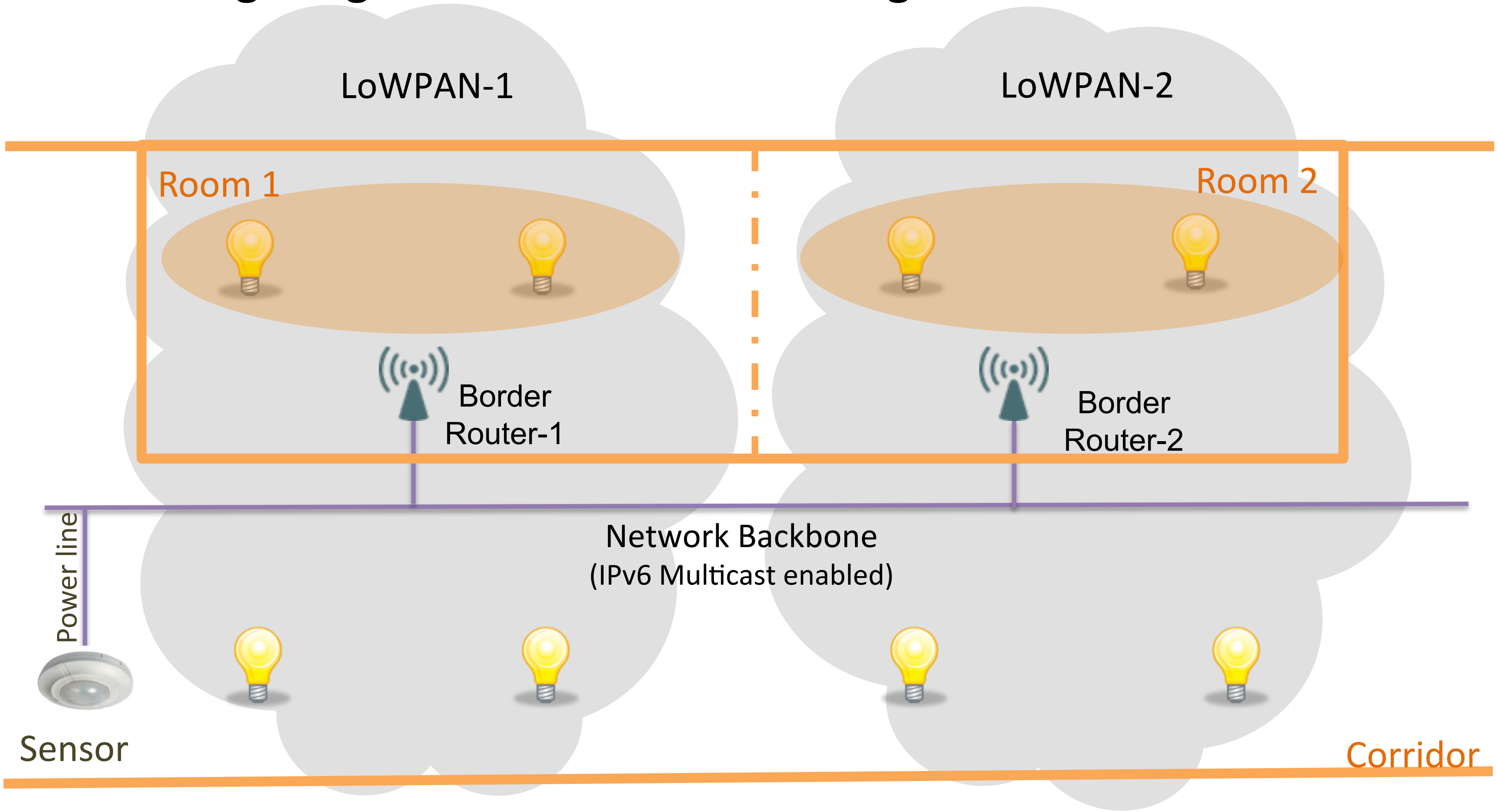
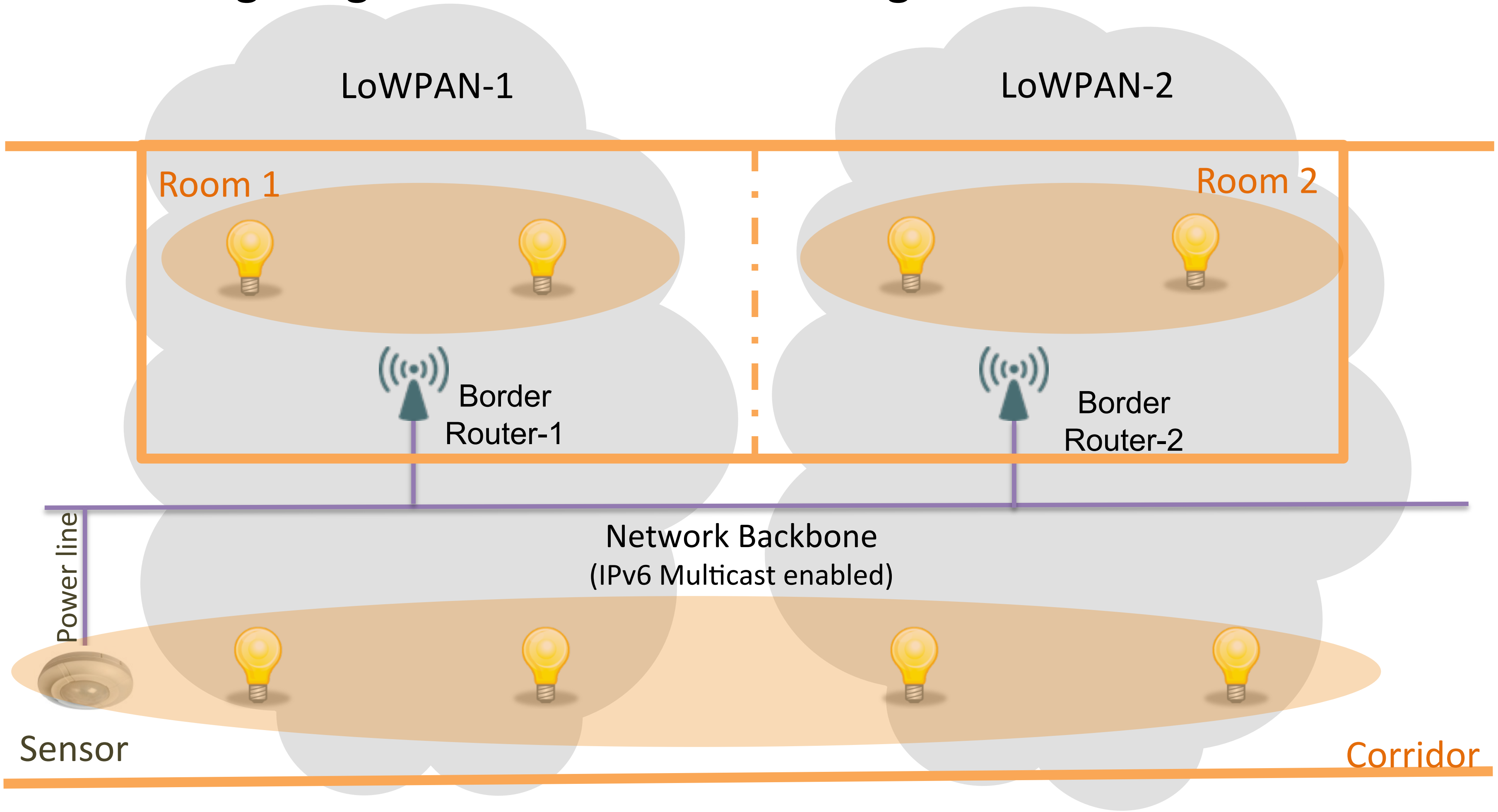
Lighting control in Office Building



Group Communication Use Case

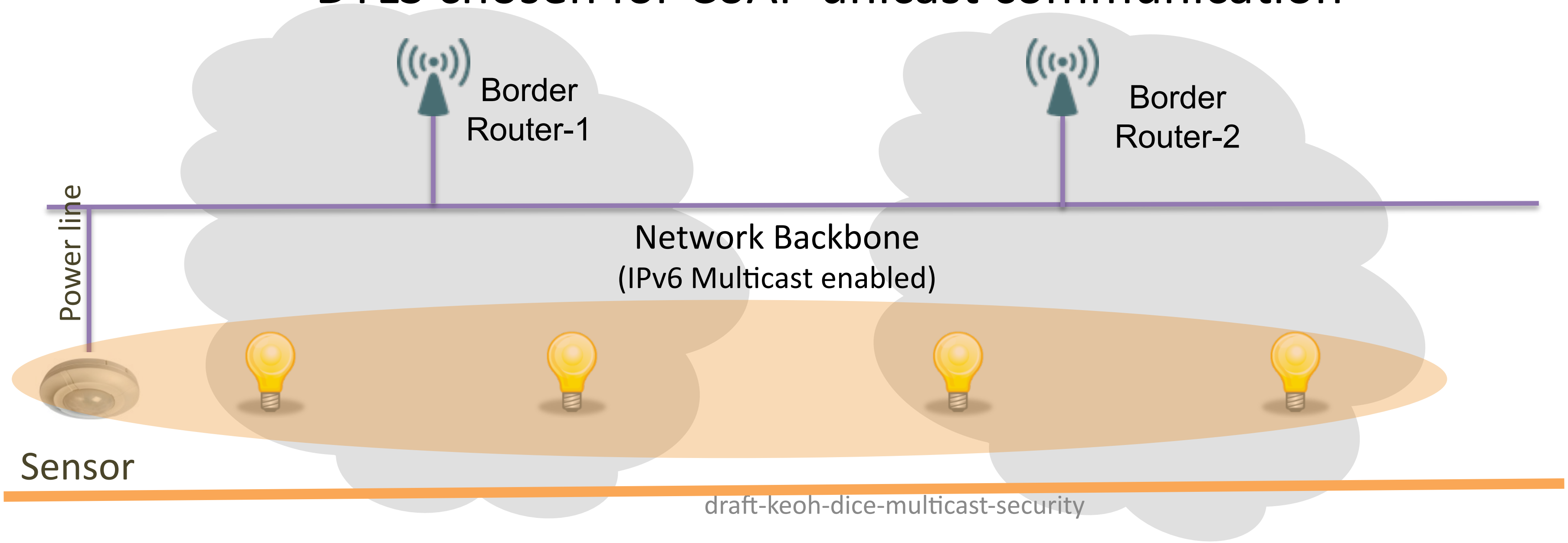
Lighting control in Office Building



Requirement

Security for CoAP group communication messages across multiple LowPANs/PHY-networks

- Same security level as within a single LowPAN
- Groups of <100 nodes
- Group level Confidentiality, Integrity, Replay protection
- Reuse existing protocols on constrained devices
  - DTLS chosen for CoAP unicast communication

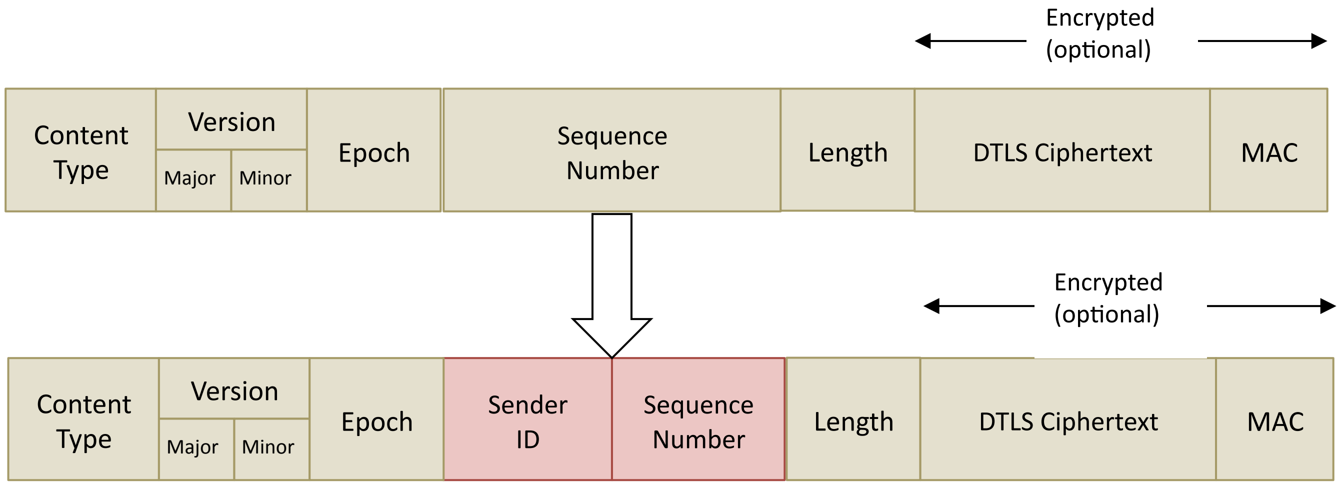


Proposed solution

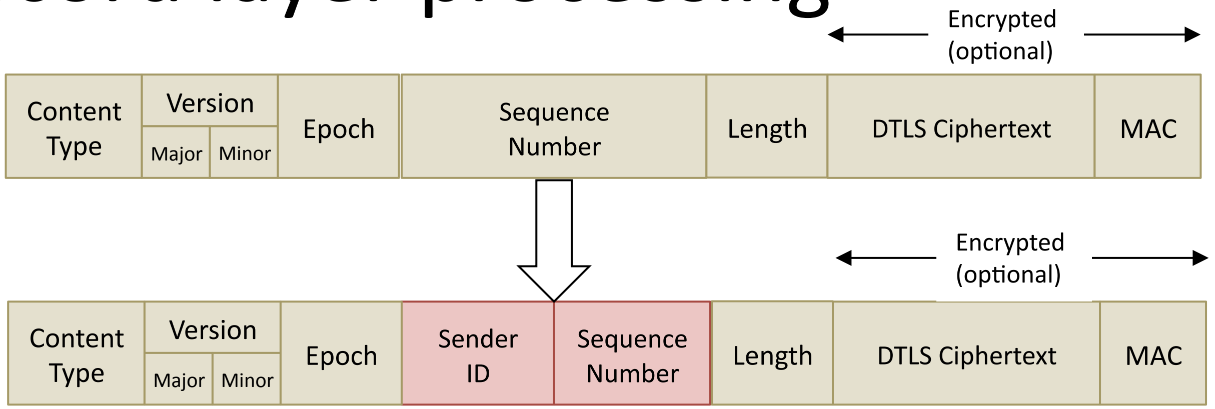
- Use DTLS record layer to also protect CoAP group communication messages (in addition to CoAP unicast)
- Out-of-band setup of Groups Security Association (GSA) for group members
- Support multiple senders in the group
  - Adapt DTLS record layer to avoid reuse of nonce for AEAD cipher suites

DTLS record layer adaptation

- Each sender gets a *unique* ***SenderID (1-byte)*** from the group controller
- In the DTLS Record Layer, split the ***6-byte*** *sequence number* field into:
  - ***1 byte*** *Sender ID* and ***5 bytes*** *"truncated" sequence number*.



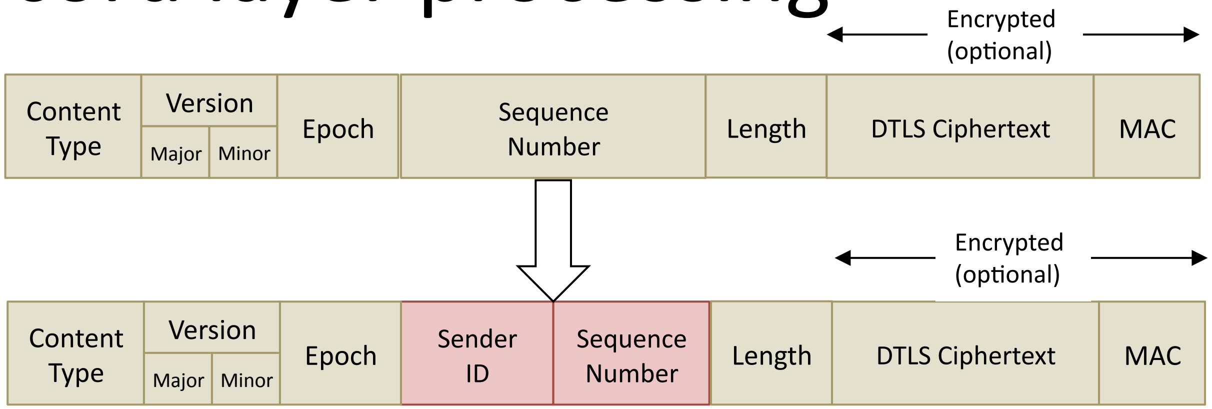
DTLS record layer processing



Senders

- "write state" is instantiated with "server write" parameters.
- Each sender manages its own *epoch* and "truncated" *sequence number*
  - no synchronization is needed with other senders in the group. Initialized to 0.
- The sender include its *Sender ID* in the DTLS Record Layer header and increments the "truncated" sequence number when sending a group message.
- The *epoch* will be increased, and the "trunc." *sequence number* will be reset once the group session key is renewed or updated (*out-of-scope: to be defined as part of key management*)

DTLS record layer processing



Listeners (Receivers)

•Multiple “read states” are instantiated with “server write” parameters for each sender linked by *SenderID*

- Keying material same but the epoch and the "truncated" sequence number of the last received packets needs to be kept different for different senders.

•Listeners use the *multicast destination IP and port address* of the packet to lookup the “server write” key.

•Message is decrypted and the MAC of the message is checked

•Using the *Sender ID* field, receivers retrieve the last used *epoch* and *sequence number* to detect replayed messages.

- If success: last seen seq number from the SenderID in the “read state” is updated

Changes since IETF 88

- More discussion on the group level security
  - Security considerations provide additional guidance on the risks of single group key
- Limit number of group members < 100
  - SenderID field reduced from 2-bytes to 1-byte
- Ensure the solution is crypto-agile
  - Not limited to any particular cryptosuite like AERO
  - Supports DTLS cryptosuites used at record layer
- Other comments
  - Use port address for binding

Summary

- Group communication requires application security in many scenarios

- Preferably re-use existing security protocols on constrained devices in LLNs.

- Proposal to reuse DTLS Record layer to support secure group communication.