



An Introduction to Bluetooth Mesh

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Bluetooth now comes in three delicious flavours

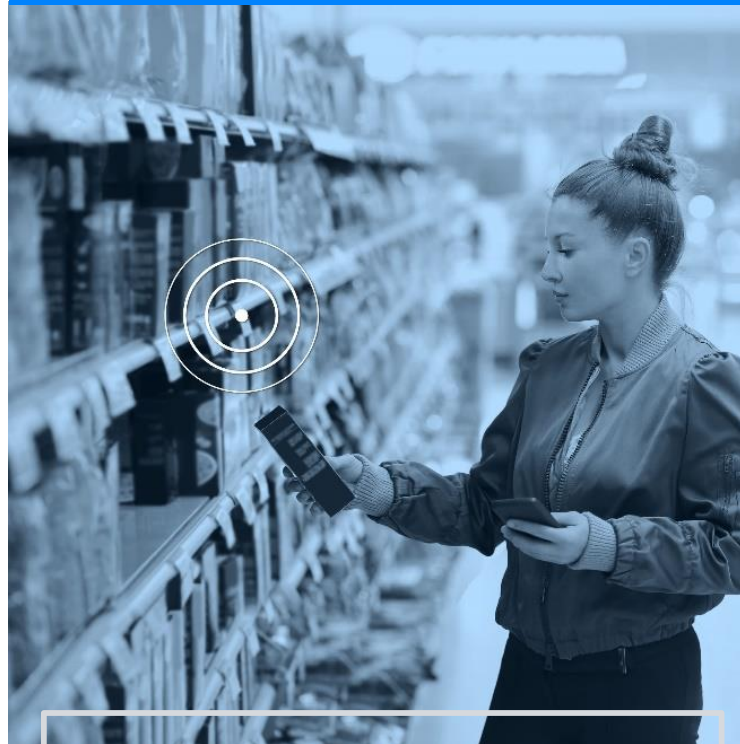
BR/EDR



point-to-point

1:1

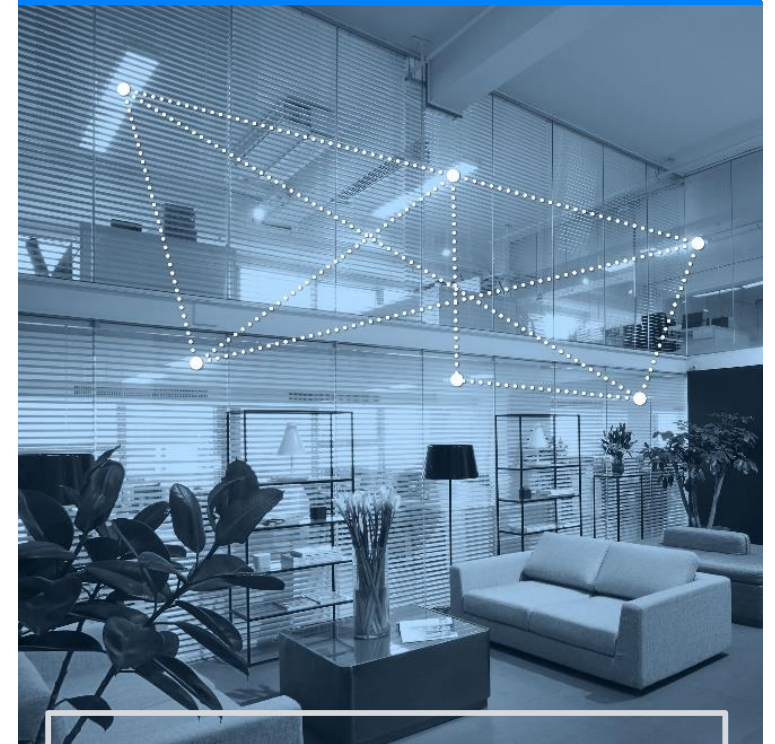
Low Energy (LE)



broadcast

1:m

Mesh



many to many

m:m



relationship between Bluetooth technologies

NETWORKING

Bluetooth mesh networking



RADIO

Bluetooth BR/EDR

Bluetooth Low Energy



Bluetooth Mesh

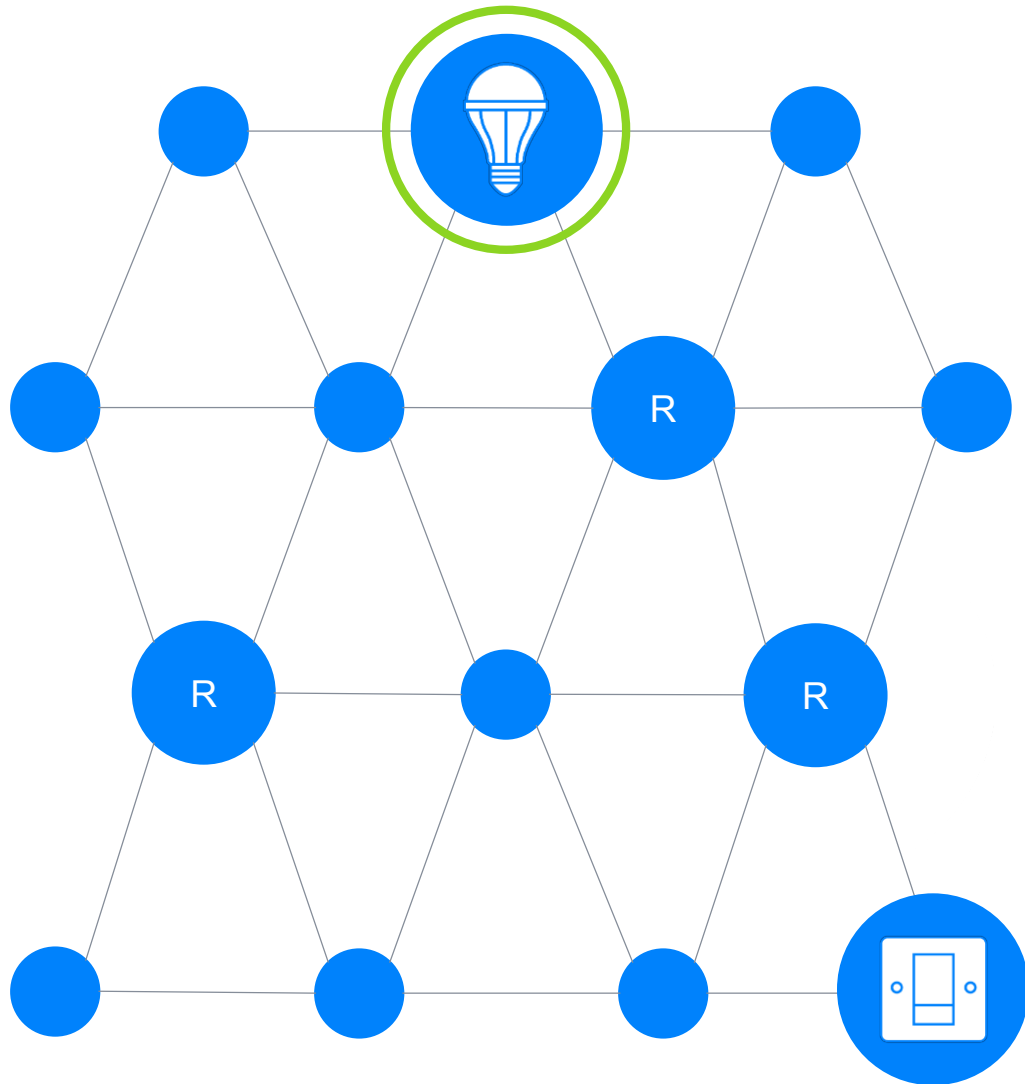
Networks

multi-hop, multi-path, multicast



Bluetooth Mesh

Node Network Roles



R = Relay function on

relay nodes

Messages get sent to other nodes that are in direct radio range of the publishing node

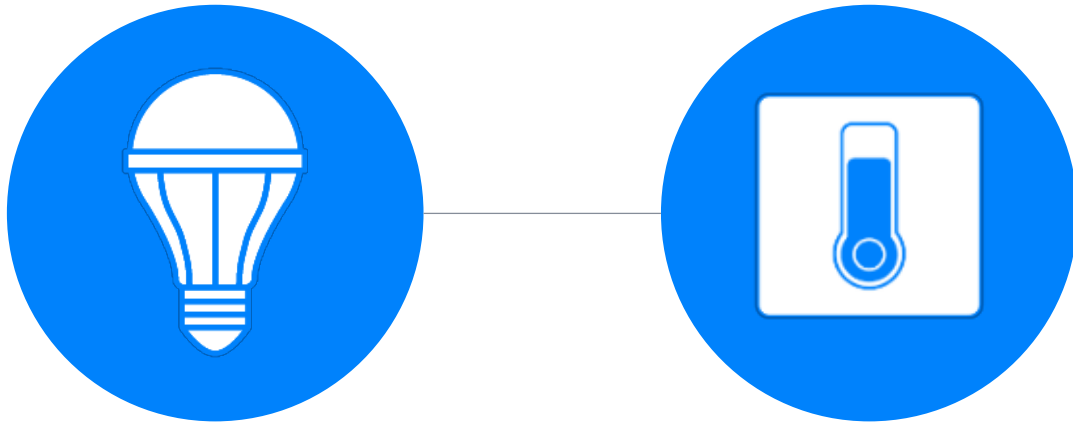
Some nodes can act as “relays” however

Relays retransmit messages so that they can travel further, in a number of “hops”



Friend

Low Power Node
(sensor)



friend nodes and low power nodes

Low power nodes (LPNs) are highly power constrained

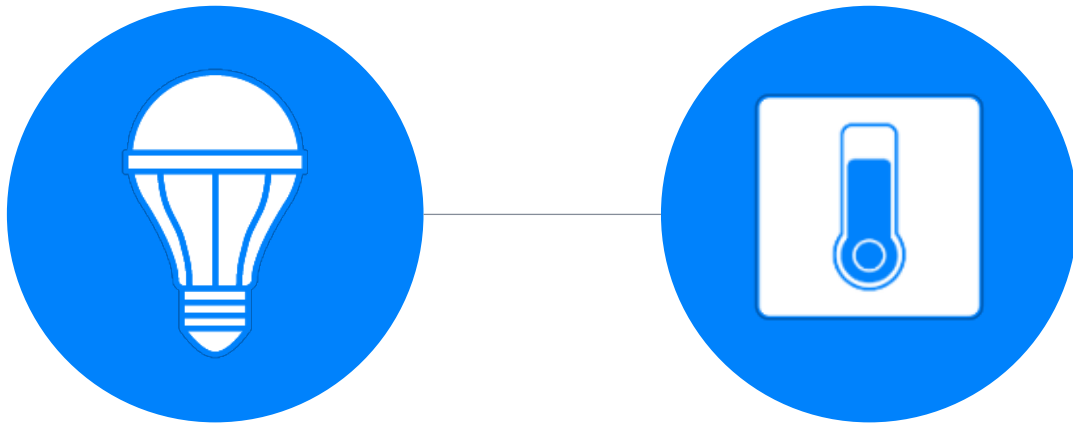
To avoid the need to operate at a high(er) duty cycle to receive messages from the mesh, an LPN works with a Friend

Friend nodes store messages addressed to LPNs they are friends with and forward them when the LPN occasionally polls



Friend

Low Power Node
(sensor)



To: Sensor
“set temperature thresholds”

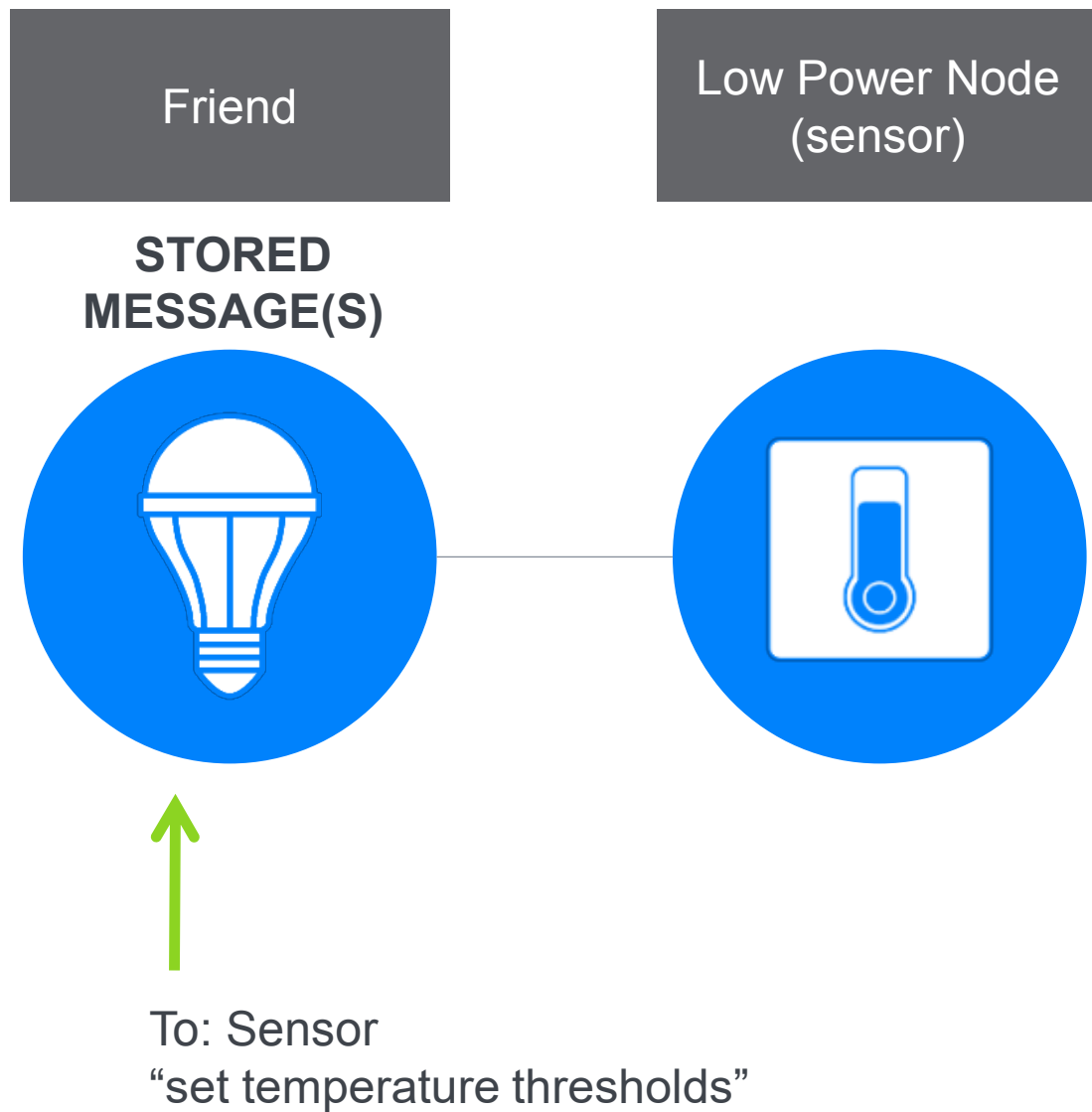
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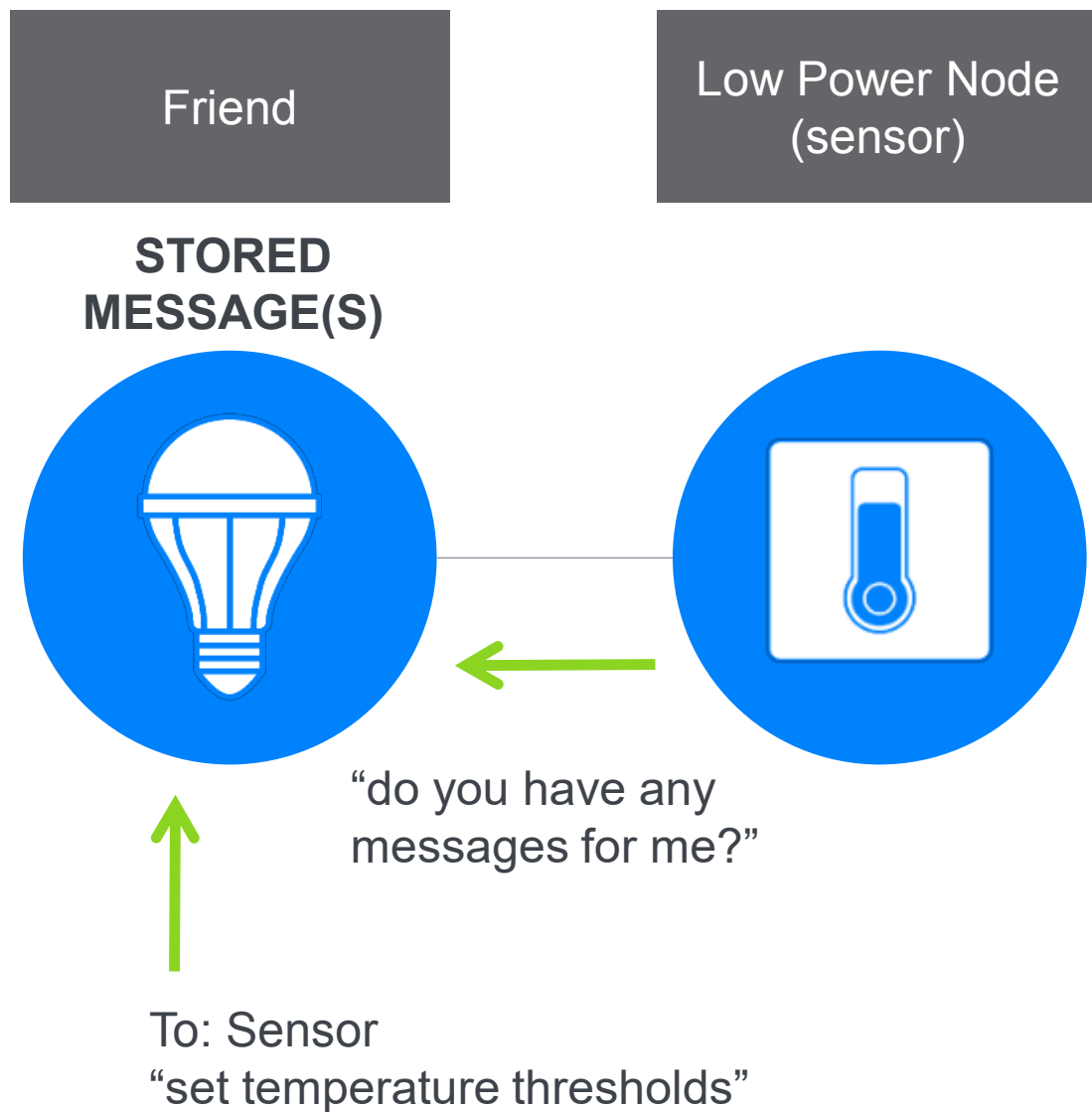
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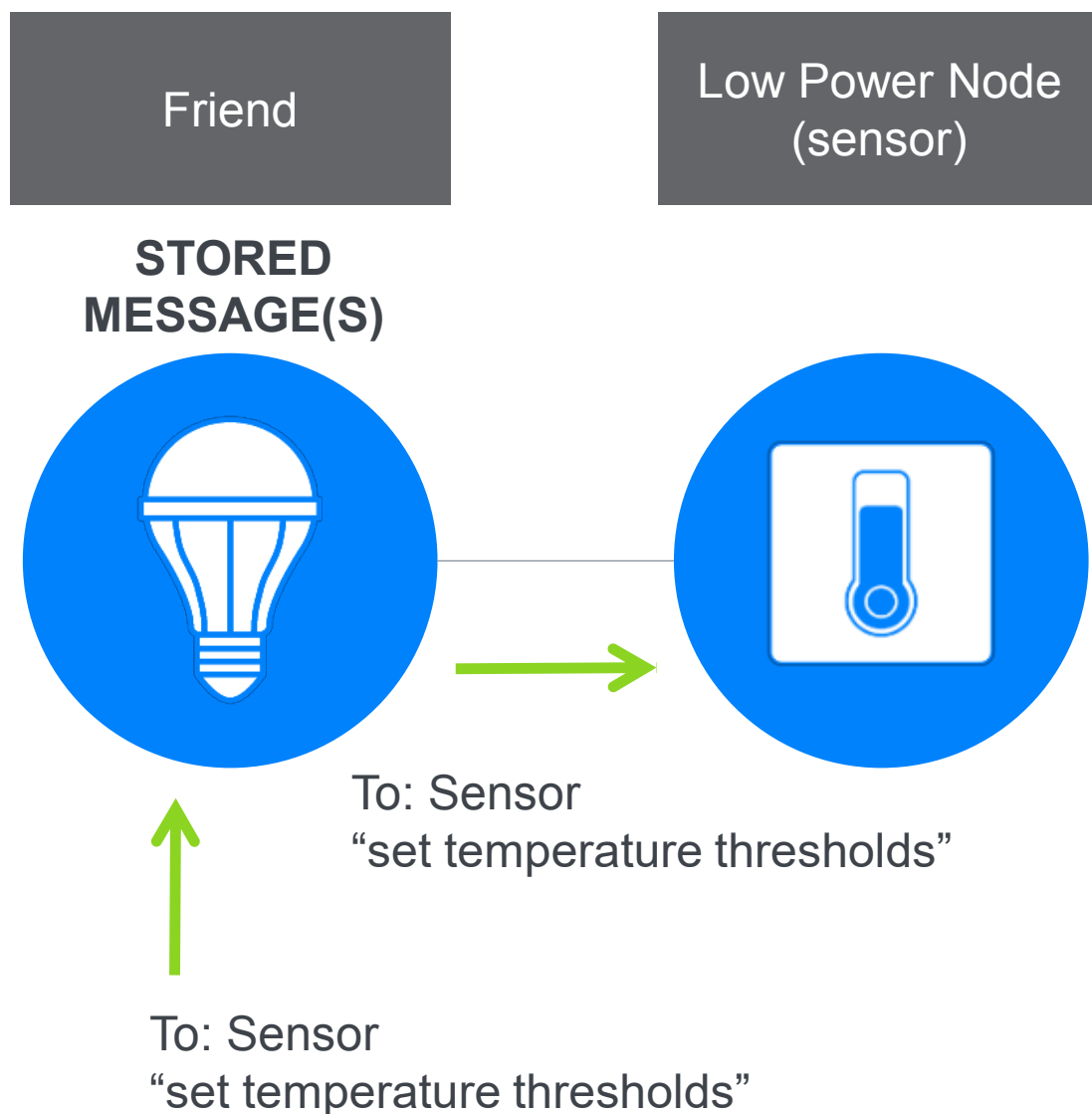
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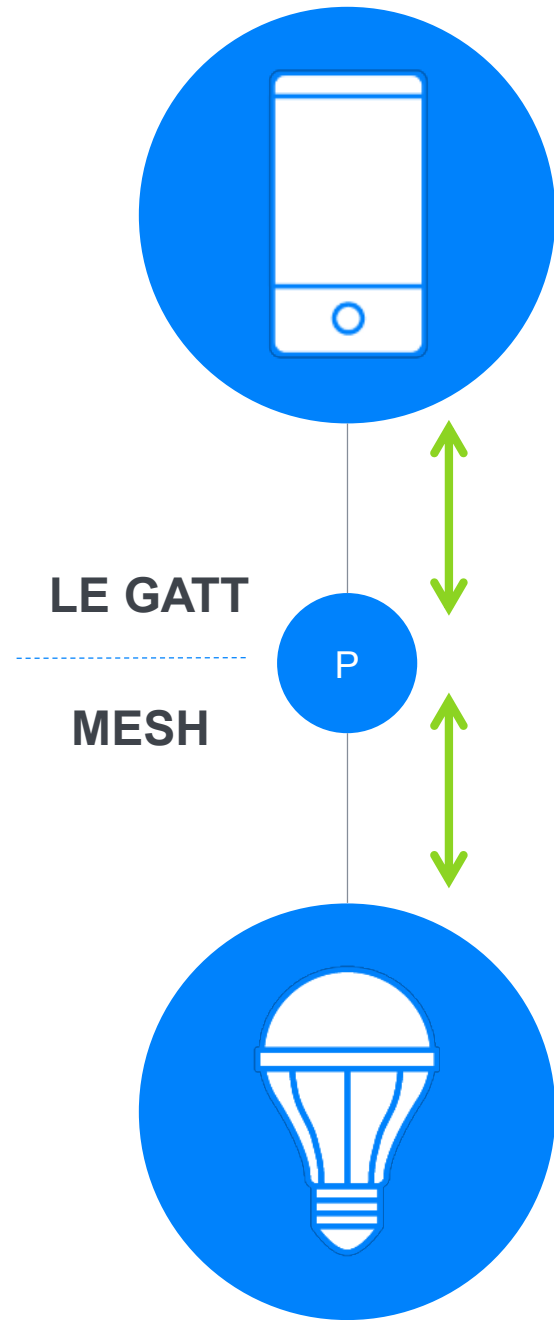
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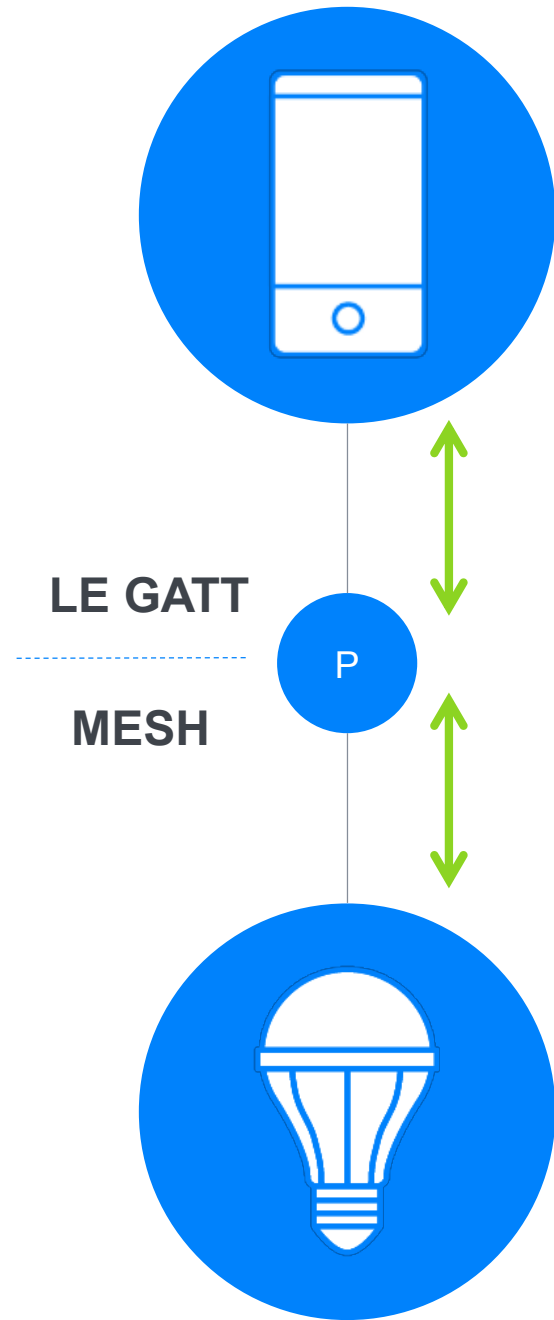




proxy nodes

Bluetooth low energy devices like smartphones can communicate with a mesh network via a proxy node





proxy nodes

Bluetooth low energy devices like smartphones can communicate with a mesh network via a proxy node

mesh monitoring and control applications

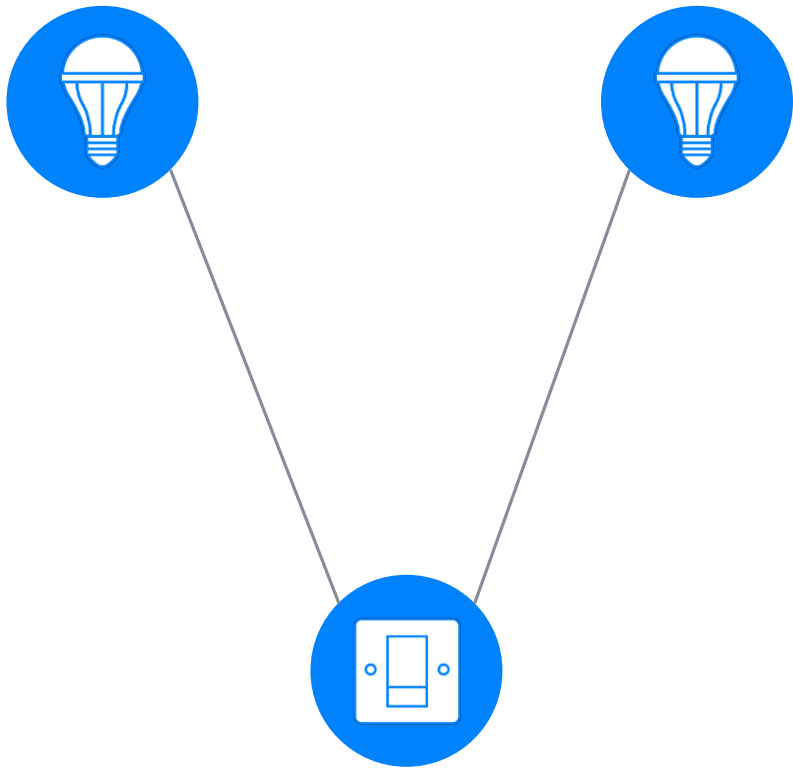


Bluetooth Mesh

Communication and Interaction

State: OnOff = Off

State: OnOff = Off



State: OnOff = Off

messages and state

nodes communicate with each other by sending messages

nodes have state values which reflect their condition (e.g. ON or OFF)

access messages operate on state values

SET - change of **state**

GET - retrieve **state** value

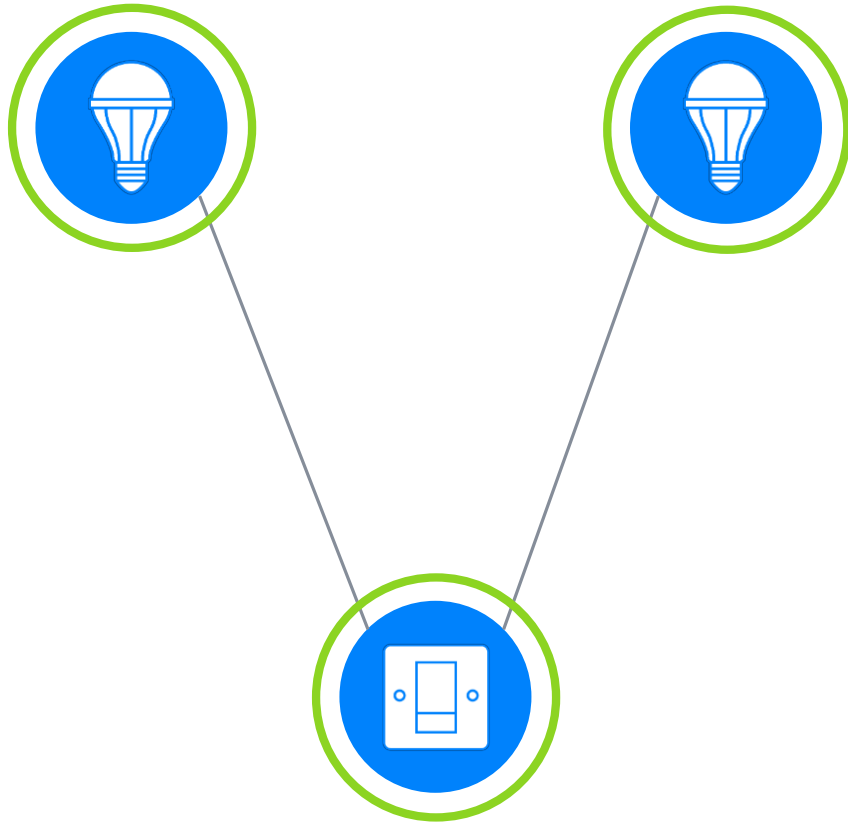
STATUS - notify current **state**

ACK vs UNACK



State: OnOff = On

State: OnOff = On



State: OnOff = On

messages and state

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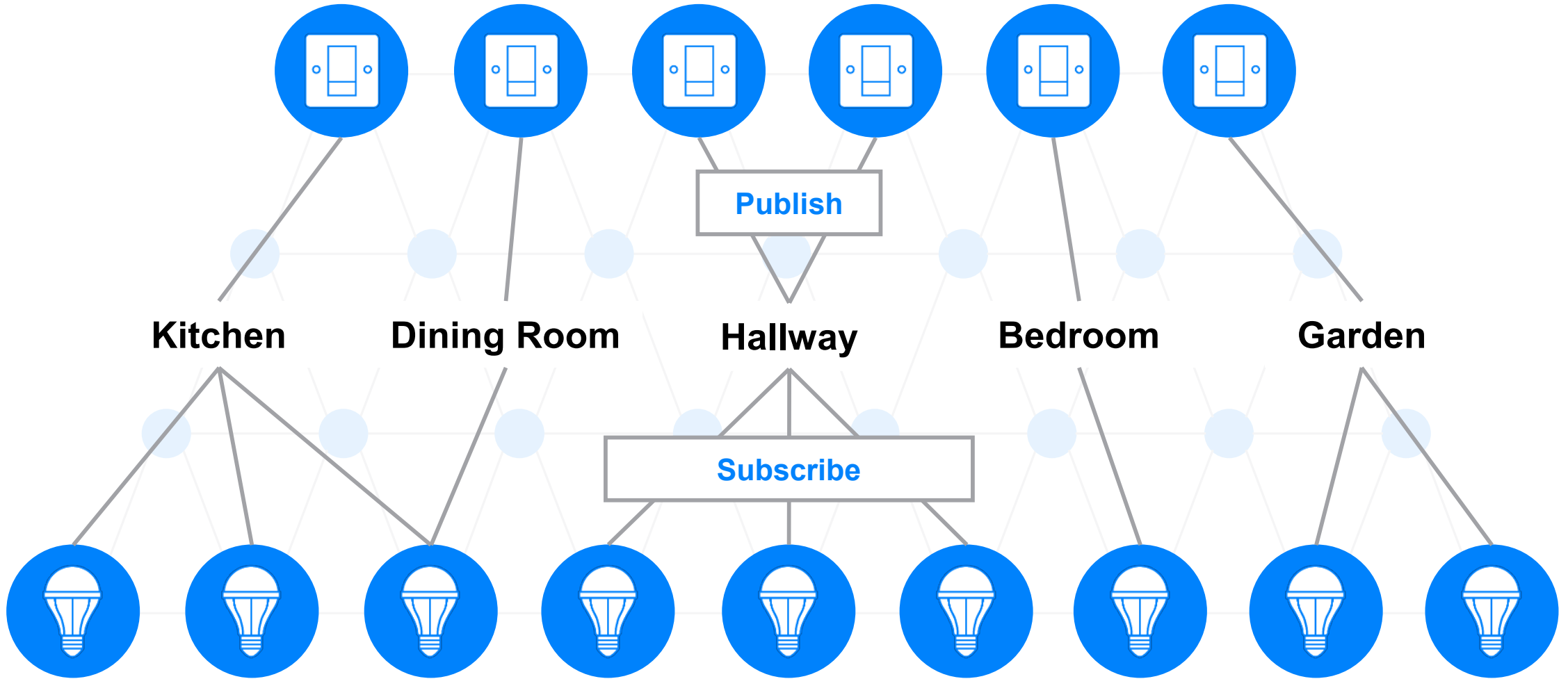
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ACK vs UNACK



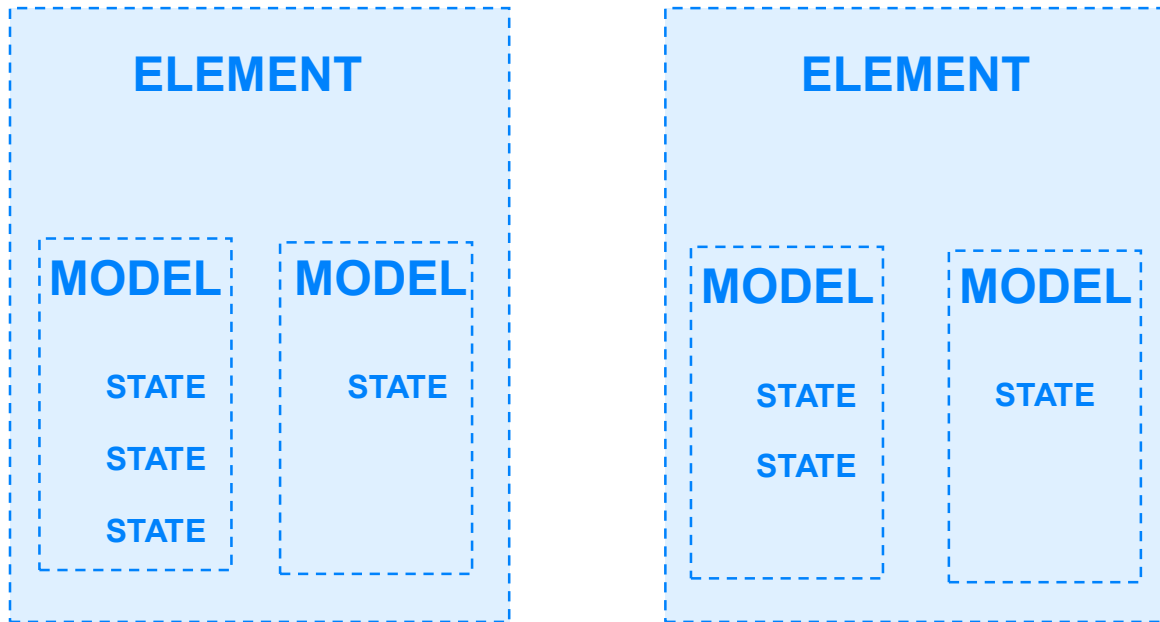
the publish/subscribe communication model



Bluetooth Mesh

Node Composition

NODE



note: a model is sometimes owned by multiple elements

node composition

a node consists of an arrangement of

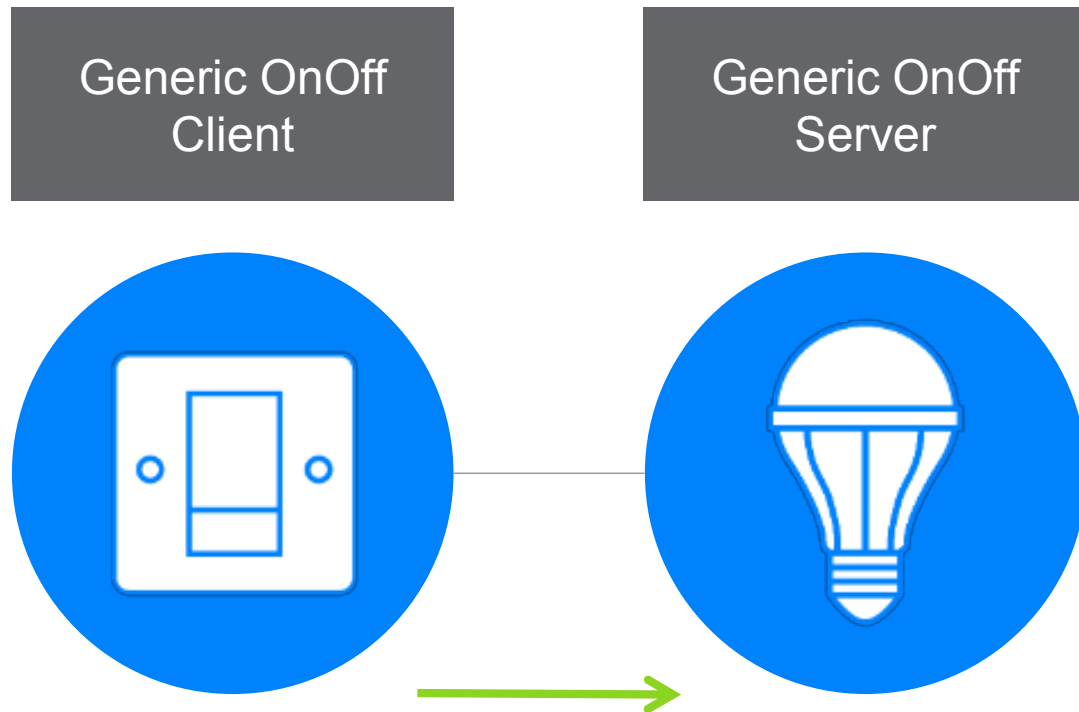
elements

models

states

each element has its own address





models

define node functionality

define states, messages, state transitions and behaviors

client, server and control types

generics such as onoff client and server

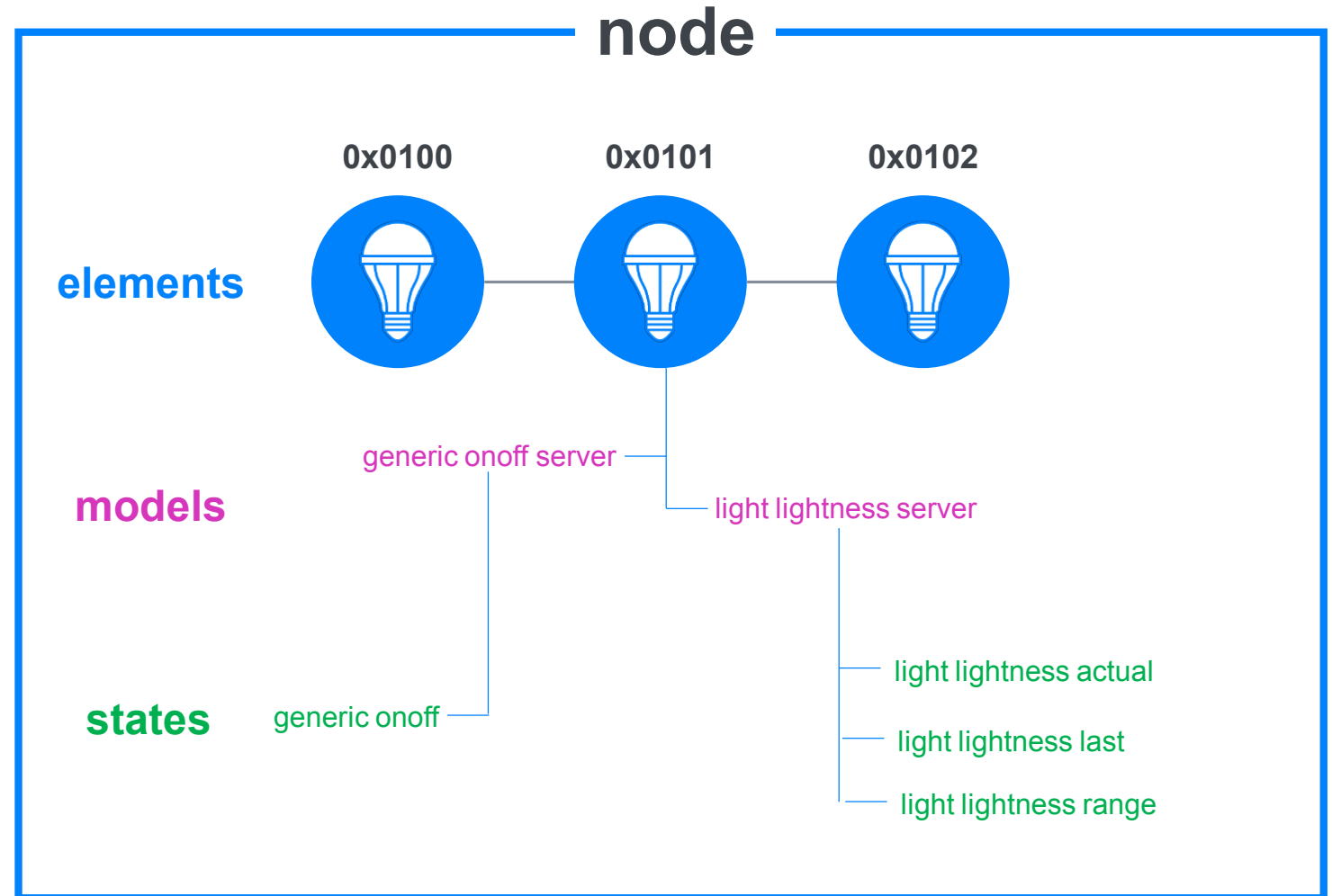
lighting, sensors, scenes & time



node composition

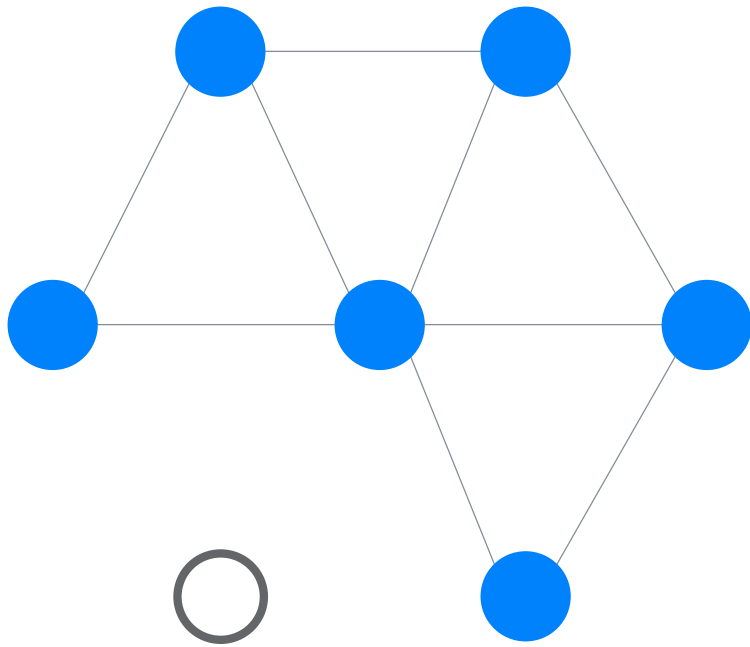


single node
3 elements
multiple models and states



Bluetooth Mesh

Security



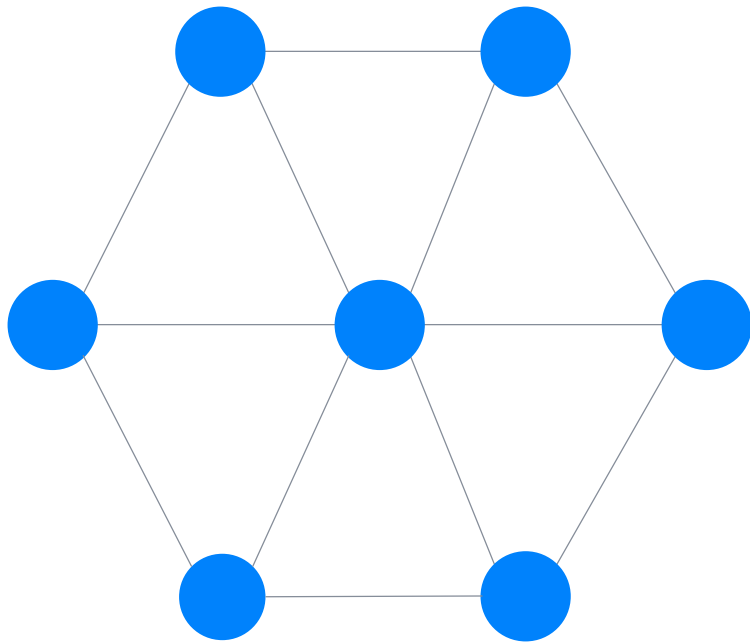
devices and network membership

Bluetooth mesh networks are secure

only members of the same network can talk to each other

a security process called **provisioning** makes a device a member of a network





Device is now a
node on the network

devices and network membership

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talk to each other

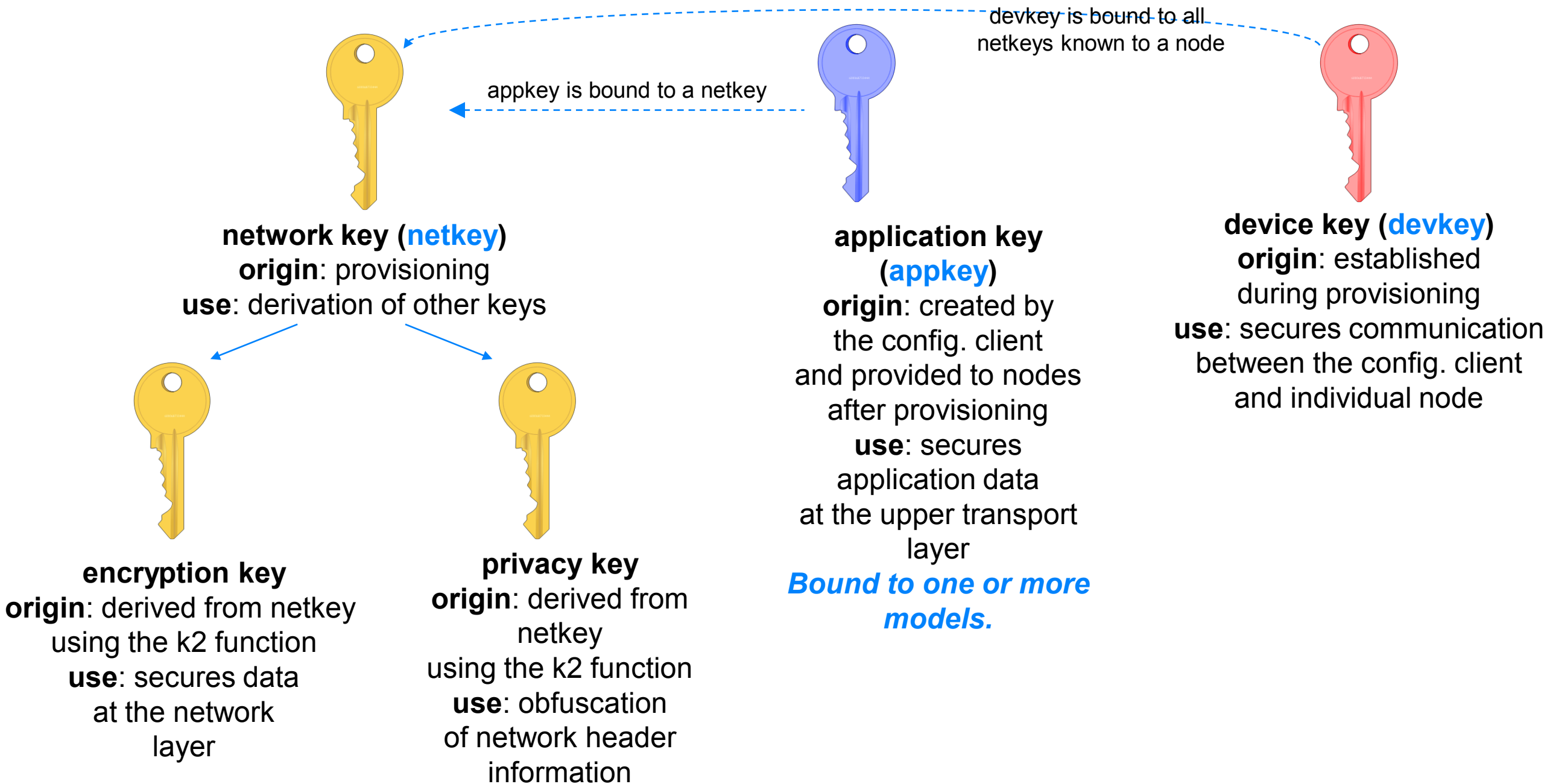
a security process called **provisioning**
makes a device a member of a network



Bluetooth mesh: Security



- Mandatory, cannot be reduced
- Encryption and authentication
- Separate security for network and each application
- Area isolation
- Message obfuscation
- Protection from replay and trashcan attacks
- Secure device provisioning



Bluetooth mesh

Anatomy of a smart lighting system





Switch Models



Light Models



Sensor Models



Switch Models



Light Models

Generic On/Off Server



Sensor Models



Switch Models

Generic On/Off Client



Light Models

Generic On/Off Server



Sensor Models



Switch Models

Generic On/Off Client



Light Models

Generic On/Off Server

Light Lightness Server

Light HSL Server



Sensor Models



Switch Models

Generic On/Off Client



Light Models

Generic On/Off Server

Light Lightness Server

Light HSL Server

Light LC Server



Sensor Models

Sensor Server





Switch Models

Generic On/Off Client



Light Models

Generic On/Off Server

Light Lightness Server

Light HSL Server

Light LC Server



Sensor Models

Sensor Server

State Binding



Bluetooth Mesh

Video Demonstration

Bluetooth Mesh

What next?

Bluetooth SIG Resources - Reading Material

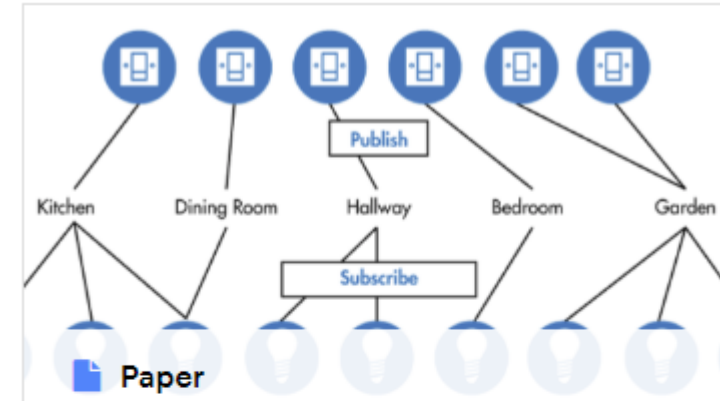



 Paper

Bluetooth Mesh Networking - An Introduction for Developers

This in-depth introduction for developers examines Bluetooth mesh's system architecture, security mechanisms, and unique message publication and delivery.

[LEARN MORE ↗](#)



 Paper

Bluetooth Mesh Models - A Technical Overview

In this detailed technical paper, Martin Woolley provides a guided tour of the Bluetooth...

[LEARN MORE ↗](#)

<https://www.bluetooth.com/bluetooth-resources/?types=paper&categories=&tags=mesh>



Bluetooth SIG Resources - hands-on education




 **Study Guide**

An Introduction to Bluetooth Mesh Networking

Learn the theory and practice of Bluetooth mesh device firmware development, and develop a working mesh network.

[LEARN MORE ↗](#)



Status

CONNECTED 14b:27:ad:b3:xx:xx

Maximum Transmission Unit

MTU: 12


Provisioning Data

Node ID	0x0000000000000000
Node Name	0x0000000000000000
Node Role	0x00000000
Encryption Key	0x0000000000000000
Primary Key	0x00000000
Network ID	0x0000000000000000

The proxy can wait to use will advertise this network ID.

Proxy PDU

Use: 0x0000000000000000

 **Study Guide**

Network PDU

An Introduction to the Bluetooth Mesh Proxy Function

Learn how to create applications for smartphones and other platforms which can monitor and control nodes in a Bluetooth mesh network.

[LEARN MORE ↗](#)

<https://www.bluetooth.com/bluetooth-resources/?tags=mesh&keyword&types=study-guide>



questions?

Twitter: @bluetooth_mdw



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