BlueMesh:
Mesh topology for smart home and smart building

Presentation

Speaker

Time

Application scenario

BlueMesh System overview

Mesh protocol

BlueMesh main features

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Application scenario
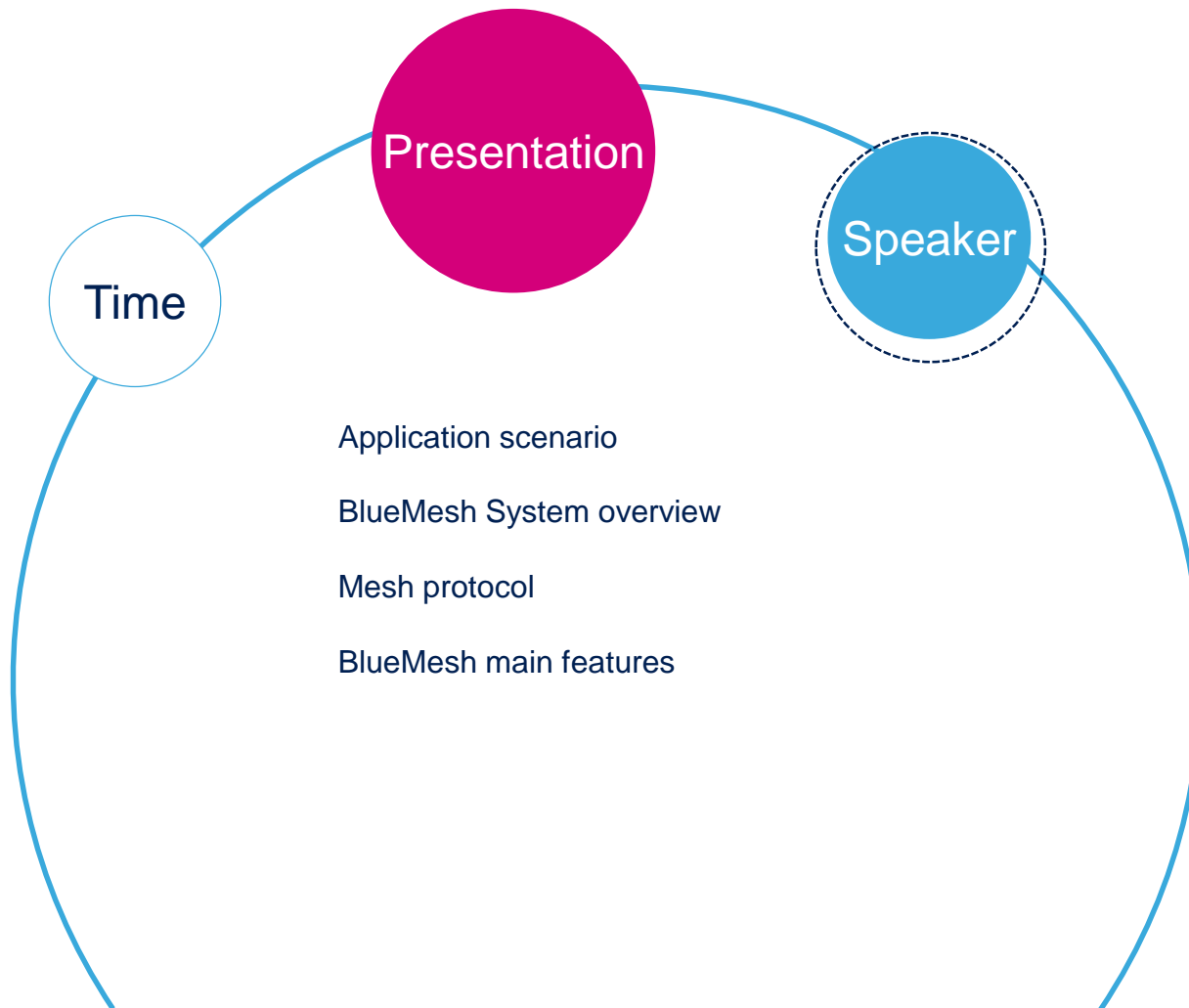
Application scenario

- Home Automation and Smart Lighting are emerging applications within the IoT

- Requirements are both on the HW platforms but also on integrated SW solutions to enable radio control in a network with several nodes

- ST has technical competencies on both domains: smart power and smart radios

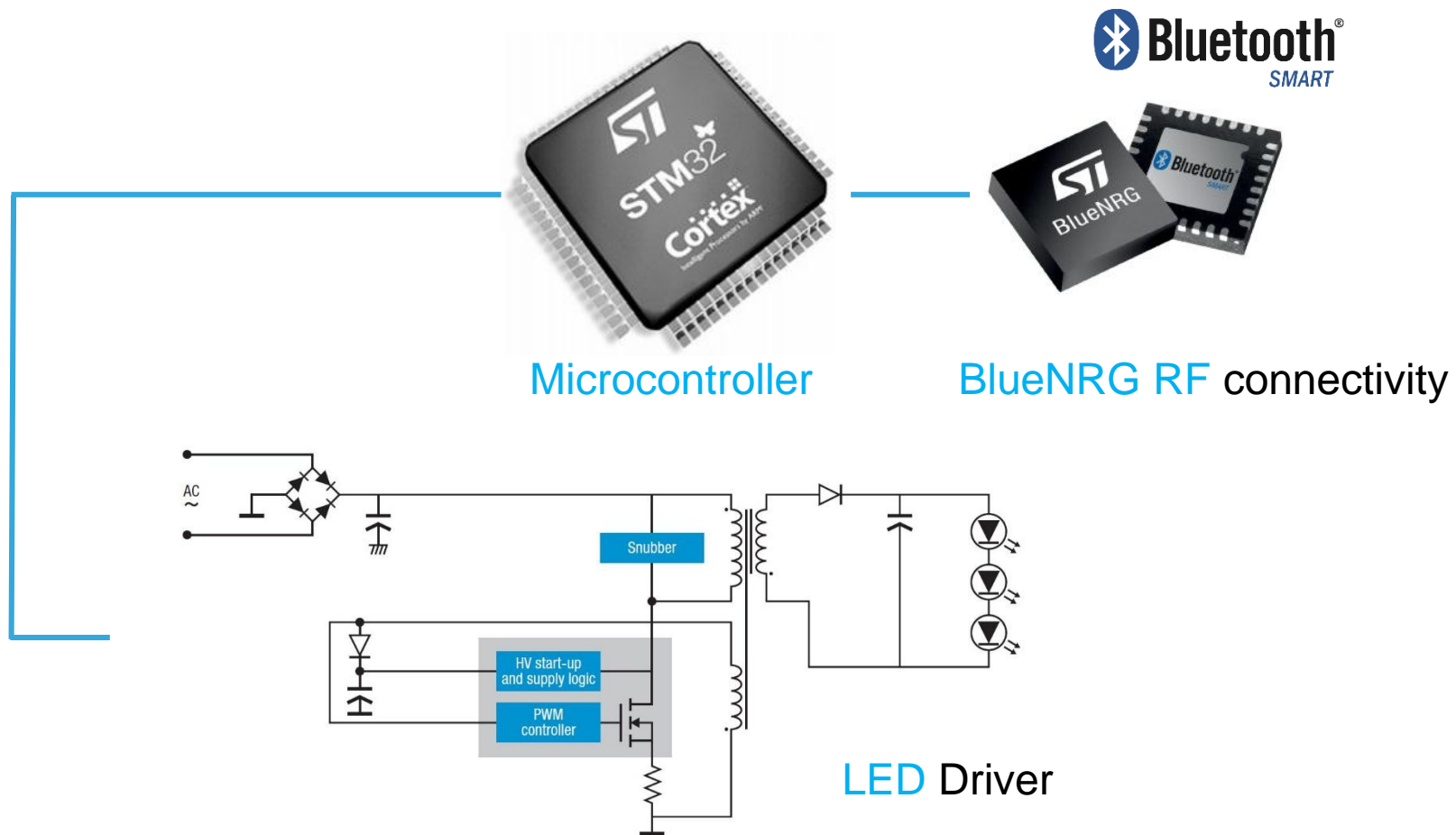- A complete HW platform and SW infrastructure are needed to address this application

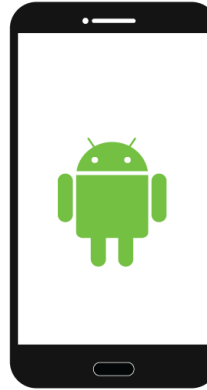**Need for develop and design a complete end to end system solution**

BlueMesh at a glance

Ultra low-power BLE connectivity with Mesh network capability

ST *HW and SW solution* for remote BLE radio-controlled smart light bulbs

Microcontroller   BlueNRG RF connectivity

LED Driver

BlueMesh Scenario

Android device

- Act as remote controller
- BlueTooth Smart connectivity
- Mesh Network controller

Node #i

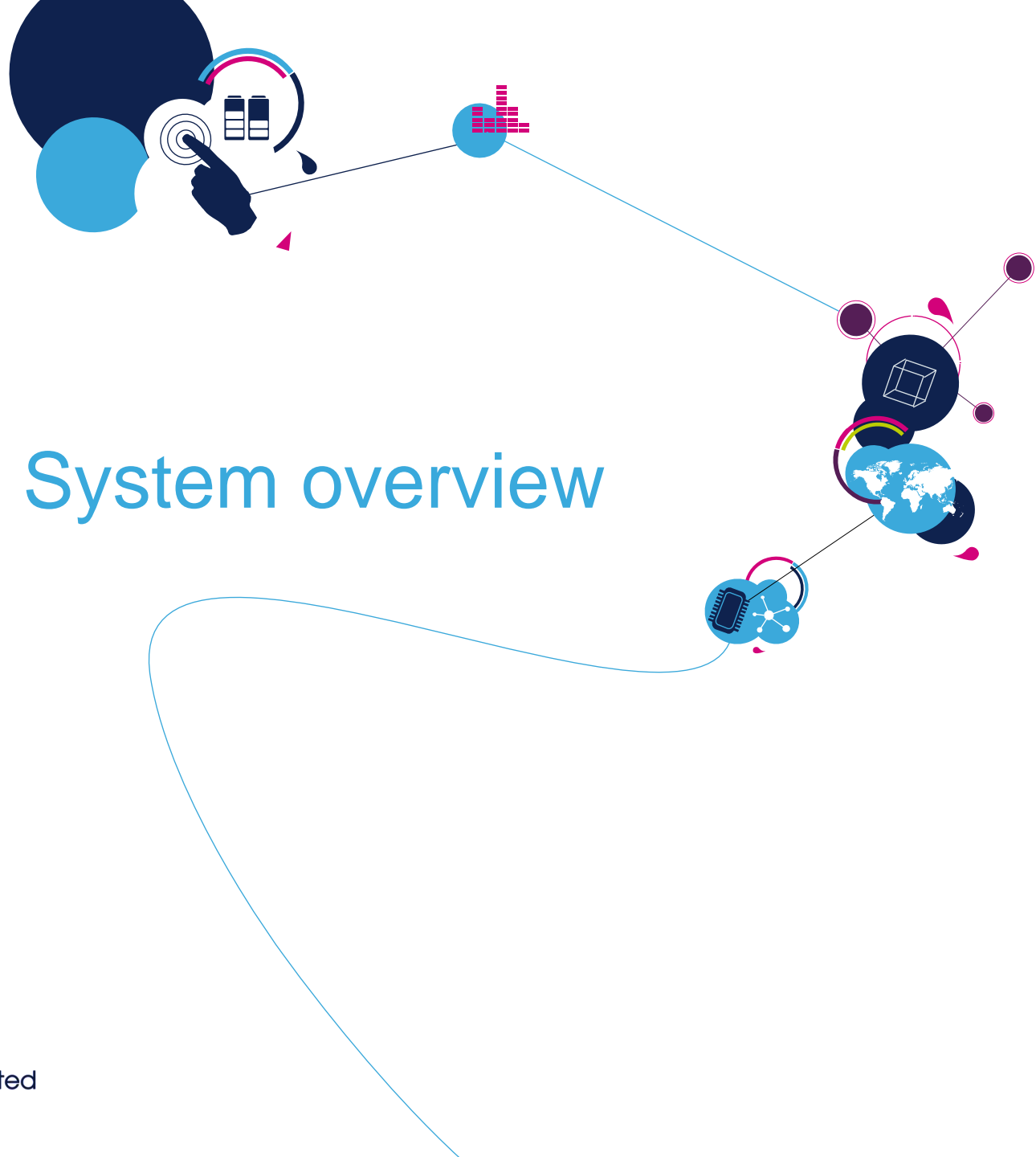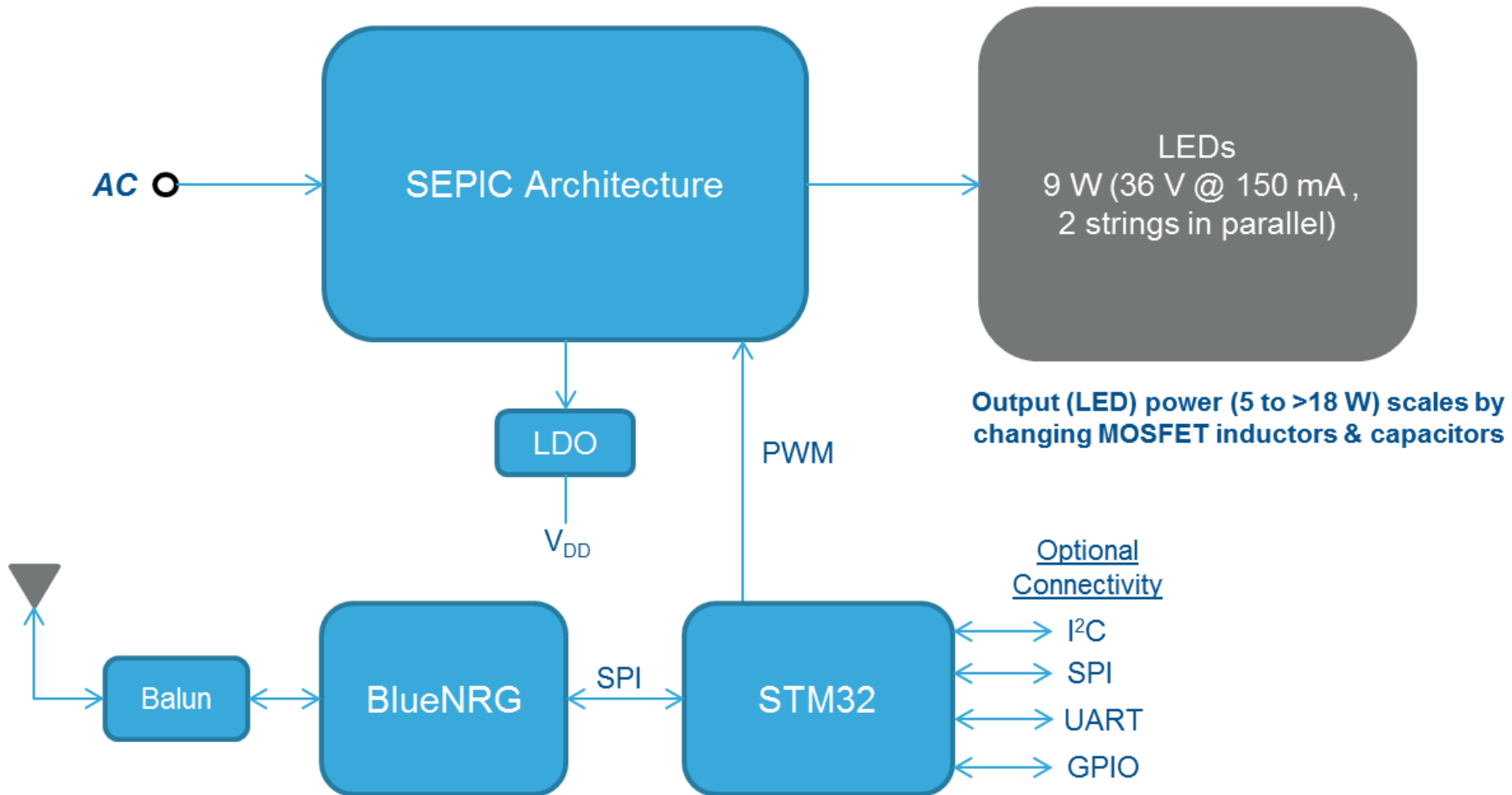- Bluetooth Smart Connectivity
- Mesh capabilities

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BlueMesh System overview

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AC/DC + DC/DC Conversion

AC O → SEPIC Architecture → LEDs
9 W (36 V @ 150 mA,
2 strings in parallel)

Output (LED) power (5 to >18 W) scales by changing MOSFET inductors & capacitors

LDO

PWM

V_{DD}

Optional Connectivity

Balun ↔ BlueNRG ↔ SPI ↔ STM32 ↔ I^2C
SPI
UART
GPIO

Bluetooth Smart System

BlueMesh Architecture overview

Board Demonstrations

STMicrolectronics reference design

Utilities

CMSIS

Applications

Light control

Middleware

Bluetooth 4.0 compliant stack + PROPIETARY mesh FW

Drivers

Hardware Abstraction Layer API

Boards Support Packages

HW Components

STM32

BlueNRG

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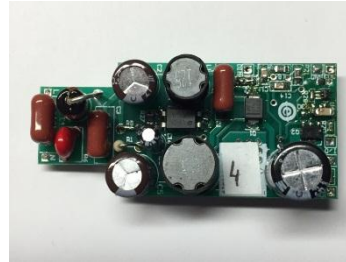# Digital Radio Controller
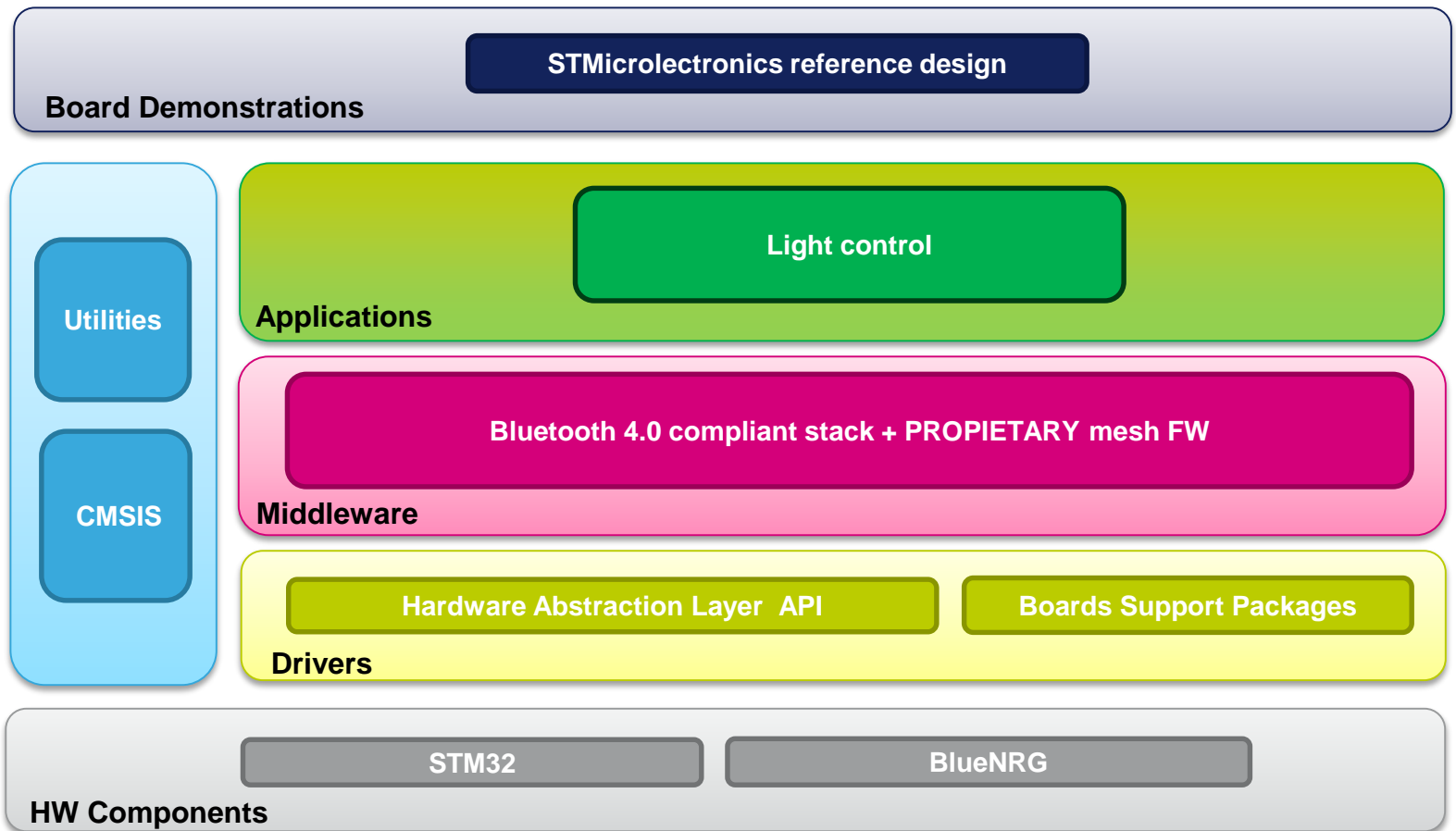
- Digital Radio controller
  - STM32F051 Microcontroller
    - STM32F051C8T6
  - BlueNRG Network Processor
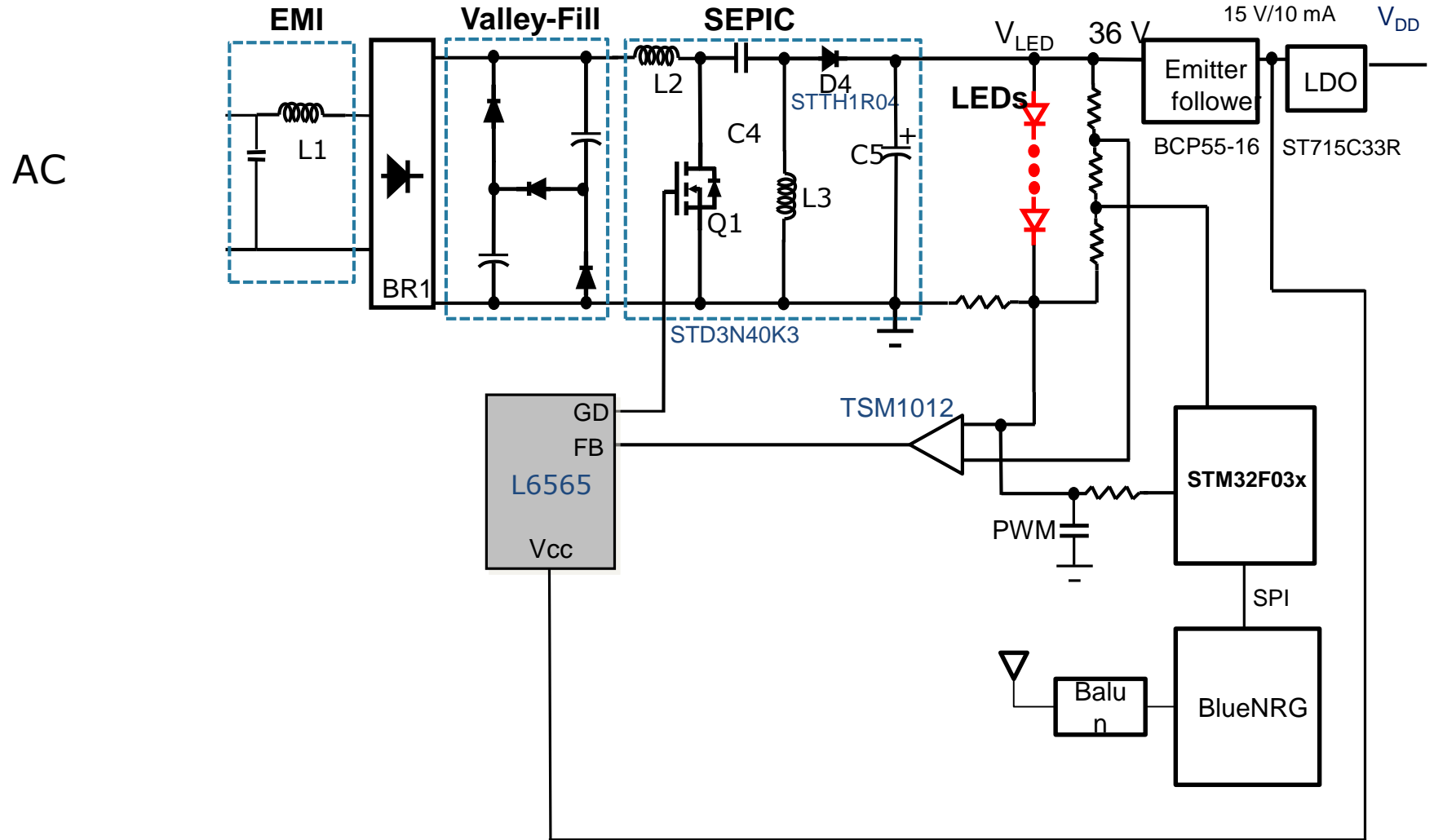   - BlueNRG-xx
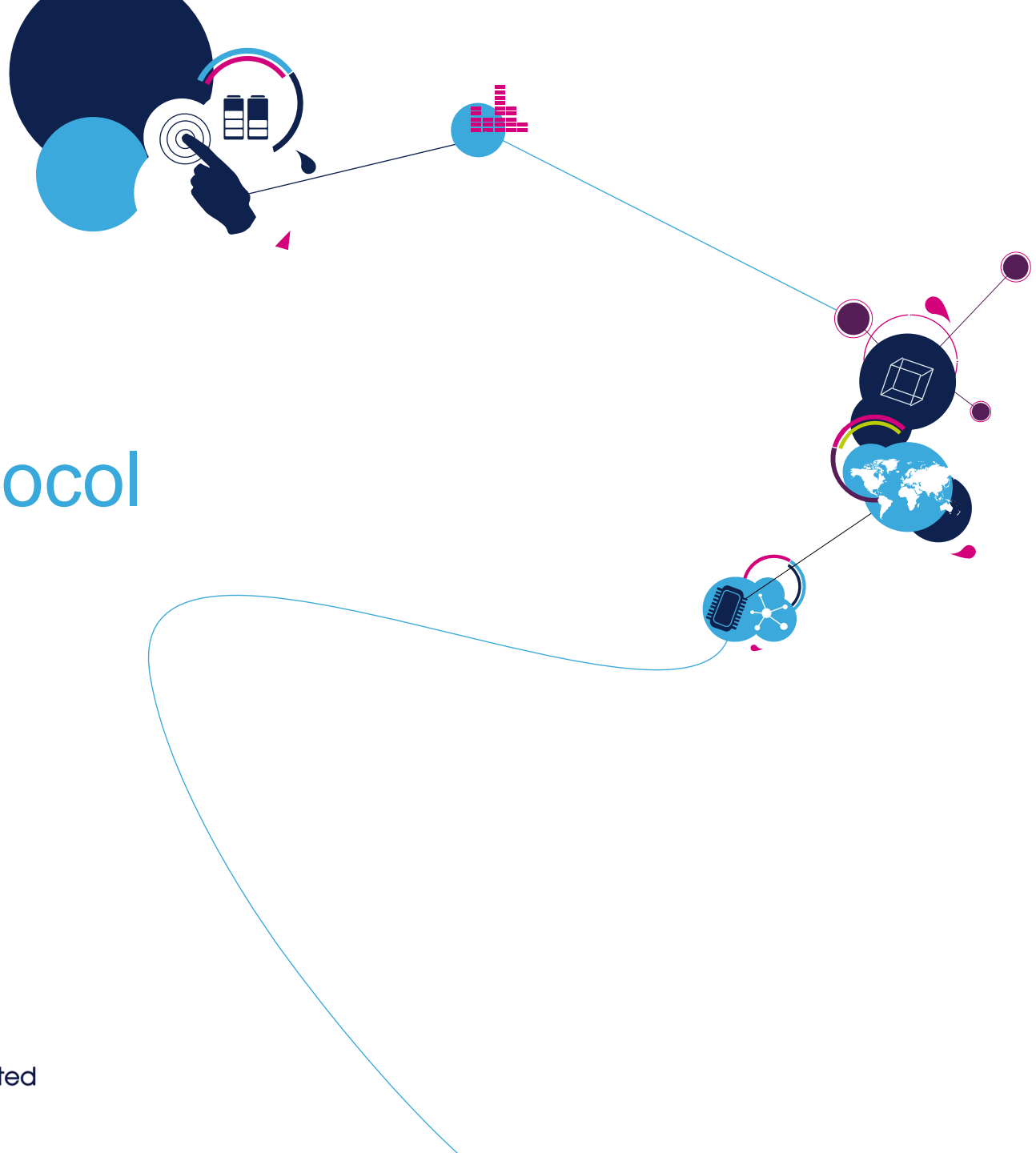 - Integrated Balun
    - BALF-NRG-01D3

LED power Controller

- ## Power System

  - ### Quasi-resonant Controller

    - L6565

  - ### Zener-Protected SuperMESH Power MOSFET

    - STD3NK40K3

  - ### High input voltage - 85 mA LDO linear regulator

    - ST715C33R

  - ### Ultrafast recovery diode

    - STTH1R04

  - ### Voltage and current controller for adaptors

    - TSM1012
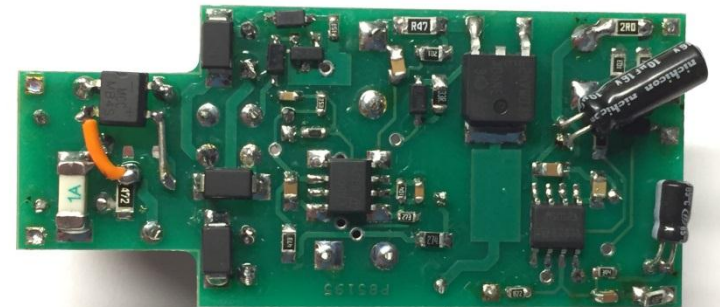
System Schematic / Block Diagram

Mesh protocol

BlueMesh – MoBLE protocol

- MoBLE protocol is the mesh protocol over BlueTooth Smart

- MoBLE protocol has been developed in partnership with Motorola Solution

Mesh controller

Mesh node

MoBLE SDK for Mobile Devices

MoBLE SDK for BlueNRG

BlueNRG BLE hardware with embedded BLE stack

BlueMesh Main components 1/2

- Bluetooth 4.0 master and slave single-mode BLE network processor:
  - Embedded BLE protocol stack: GAP, GATT, SM, L2CAP, LL, RF-PHY
  - Operating supply voltage: from 2.0 to 3.6 V
  - 8.2 mA maximum TX current (@0 dBm, 3.0 V)
  - Down to 1.7 µA current consumption with active BLE stack
  - Integrated linear regulator and DC-DC stepdown converter
  - Up to +8 dBm available output power (at antenna connector)
  - Excellent RF link budget (up to 96 dB)
  - Accurate RSSI to allow power control
  - Proprietary application controller interface (ACI), SPI based, allows interfacing with an external host application microcontroller
  - Full link controller and host security
  - High performance, ultra-low power Cortex-M0
  - 32-bit based architecture core
  - AES security co-processor
  - Low power modes
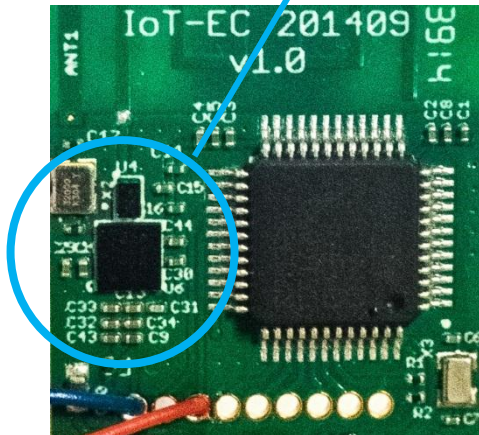
BlueMesh Main components 2/2
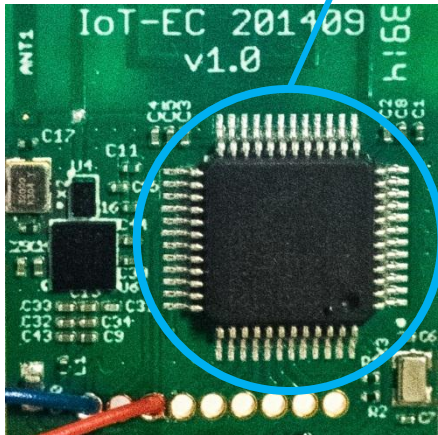
- Mesh over Bluetooth Low Energy stack
  - Control oriented mesh network
  - Fast commands transmission
  - Small-sized data operation

- Key features
  - Runs on top of Bluetooth Low Energy
  - Low power consumption
  - Multi-hop data routing
  - Optimized data path selection
  - Flexible configuration mechanism
  - Cross-platform, highly portable solution for Mesh applications
  - Native C API for embedded
  - Java API for mobile devices
  - Small footprint

Application features

- ## Send-and-forget request
  - turn on/off light individually and broadcasted, dimming individually and broadcasted

- ## Asynchronous notifications
  - get notifications from the mesh network nodes (STEVAL-IDB002V1 dev kit accelerometer) when the controller application is active or running in background

- ## Request/response
  - get light bulb state (automatically)

- ## Add device to network (authentication)
  - Authentication done for each node either one by one or once for all nodes at the same time

- ## Remove device from network
  - Devices can be removed, added later on to the network, and modified while within the network

- ## Notification on add/remove (blinking)

- ## Mesh Network Security
  - basic protection from replay attack (counter), data is encrypted

BlueMesh Main features
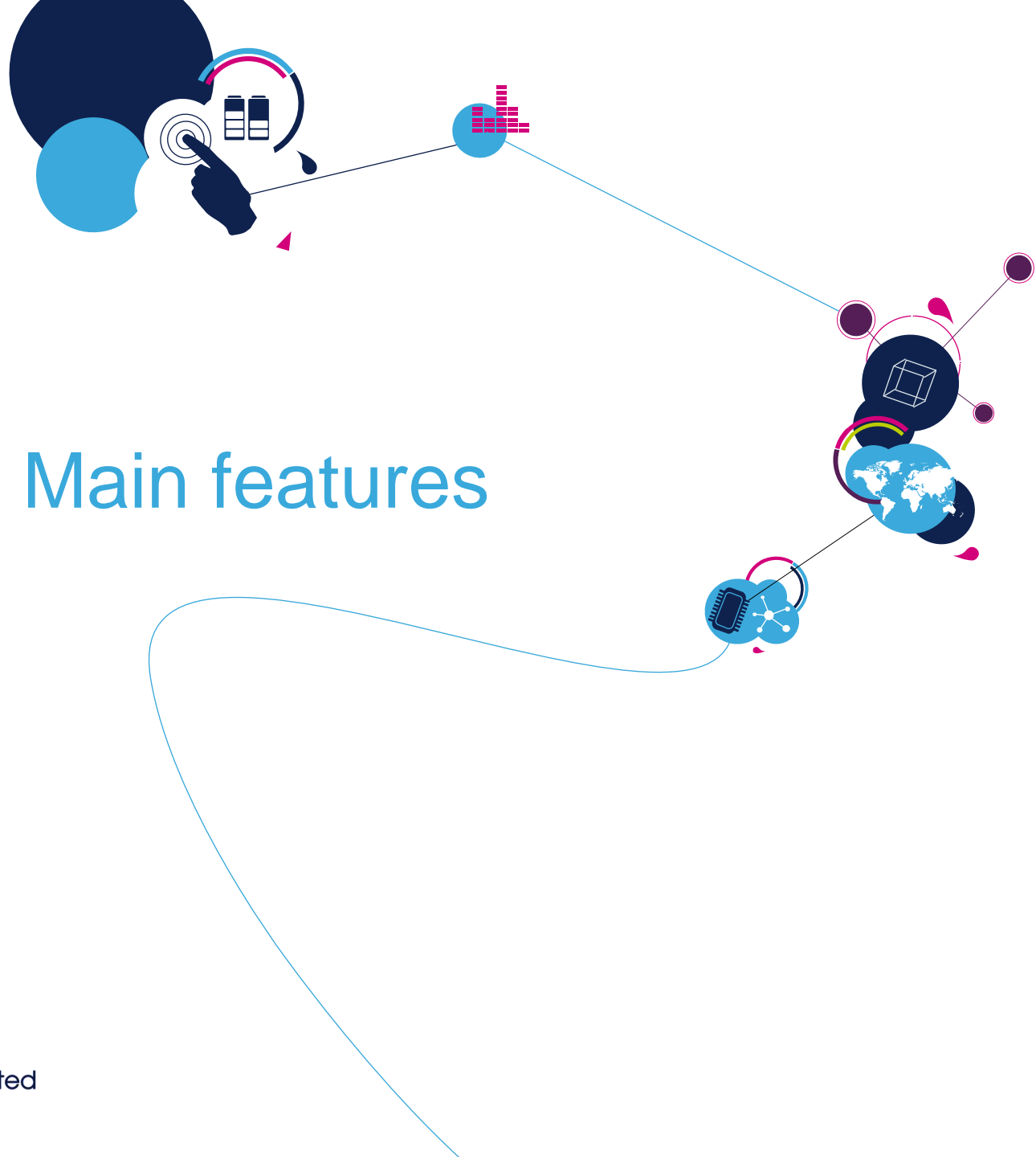
BlueMesh Main features

- Cost down and size reduced solutions
  - Quickly fit your application with all ST building blocks
  - MoBLE Firmware included

- Application customization around the:
  - LED lights
  - Added features
  - Bluetooth Smart profiles

- Flexible and Scalable:
  - p2p compatibility across STM32 family

- Embedded RTC
  - with CR2032 ~15Years autonomy

- +8dBm TX output power
  - longer range achievable