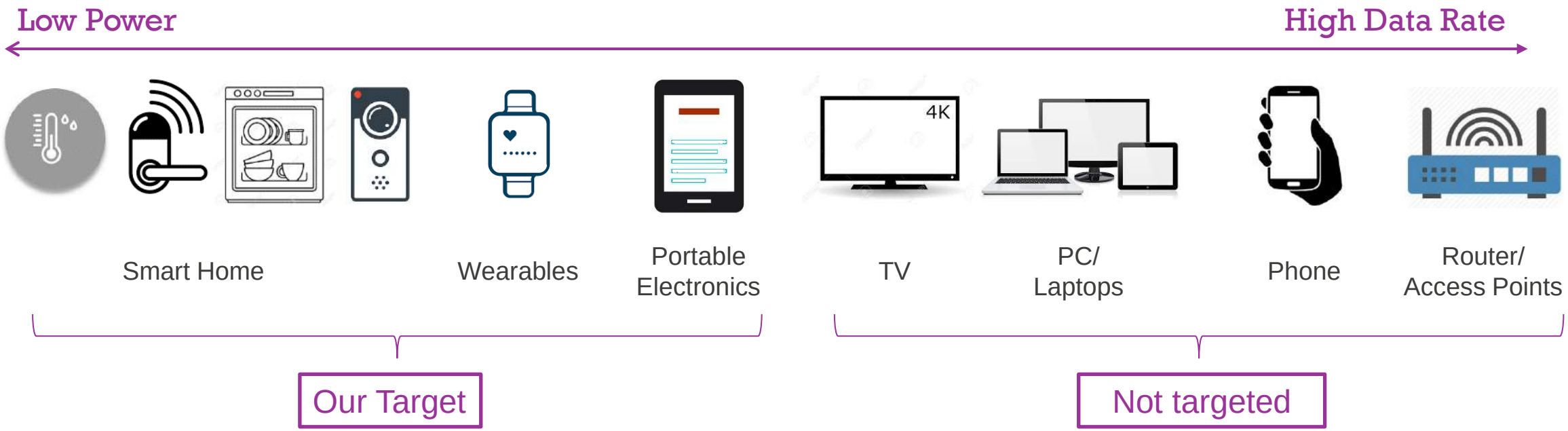
DA16200 INTRODUCTION

PRODUCT POSITIONING

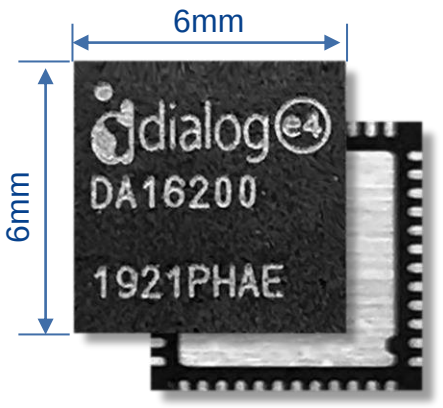


Key Product Features for target applications

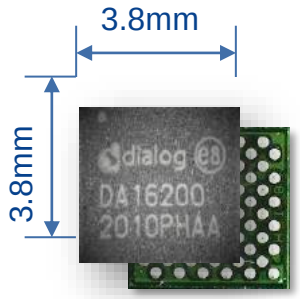
- Focus on reducing power consumption; Ideally battery operated
- Low data rates: less than 25 Mbps
- Premium product: customer focus is quality

DA16200
FEATURES

- **Wi-Fi simplifies the smart home**
  - No additional cost and installation for Gateway / Bridge
- **Very low power** – VirtualZero™ technology
- **More than 1year battery life** for most applications
- **Extended range**
- **Fully integrated** Wi-Fi system on an **SoC, Hostless**
  - All full front-end included Wi-Fi BB/MAC/RF PA, LNA, RF switch
  - 802.11 b/g/n 1x1 2.4 GHz
  - CPU, SRAM, ROM, OTP
  - Dedicated HW encryption security block
  - Extensive I/O
- Package
  - 6x6 QFN, 3.3x3.8 FcCSP



6x6 QFN



3.8 x 3.8 FcCSP

DA16200
FEATURES: LOWEST POWER

Wi-Fi Benchmark Results

- EEMBC IoTMark-Wi-Fi is designed to provide a comprehensive assessment of the entire platform in a **real usage scenario**
- Benchmarking result released in **June 2021**. Dialog's score of 815 is equivalent to about **815 days of battery life** for an IoT sensor running on **two AA batteries**
  - Phase-1 Power (Connected Idle) @ DTIM10
  - Phase-2 Power (Application Communication) @ 60sec MQTT KA
- Participants include Dialog, Silicon Labs (plus Redpine), Infineon (formerly Cypress), Texas Instruments, Altran, and STMicroelectronics.
- At least **50% better** than the closest competitor

Dialog Semiconductor Achieves Industry's Highest Ranking for IoTMark™-Wi-Fi Benchmark | Dialog (dialog-semiconductor.com)

SCORES

This section is only populated after a successful run or reloading a previous session.

Score	815	marks		
Voltage	2999	mV		
Phase 1 Power	195	uW		
Phase 2 Power	408	uW		
Phase 3	n/a	uW	n/a	Mbps

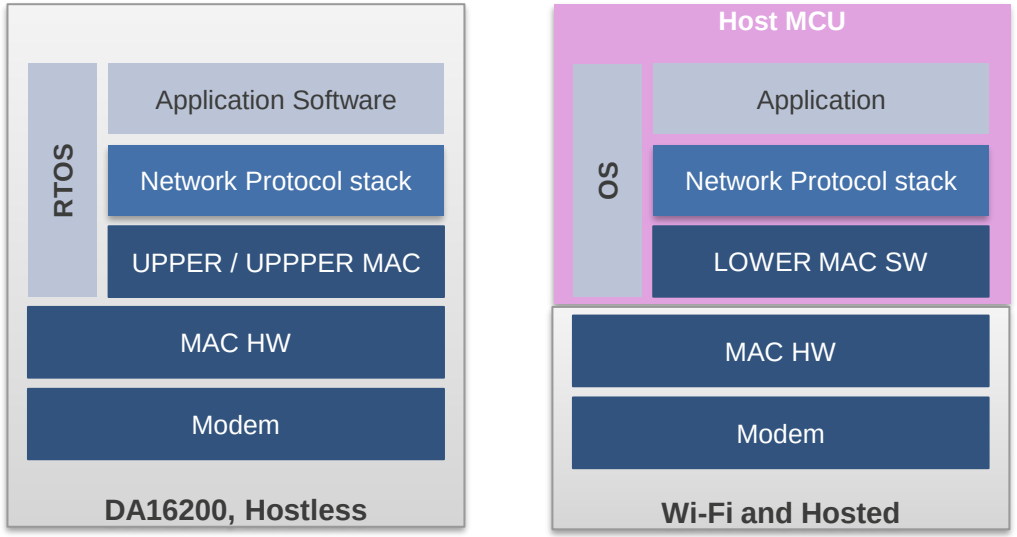
DA16200
FEATURES

Hostless, Runs self-hosted or alternatively with host product's microcontroller

- All software runs on chip
- Fully contained hosted system – full SW and network stack included
  - TCP/IP, UDP, HTTP/s, MQTT, CoAP, and more

Strong security

- Wi-Fi layer – AES, TKIP
- Protocols: WPA/2/3-Personal and Enterprise with EAP types
- Built-in hardware crypto engines for advanced security
  - Elliptic Curve, 256-bit AES keys, digital certificates
  - Upper layer security – TLS, HTTPs, etc.
- Secure boot, secure debugging, secure asset storage



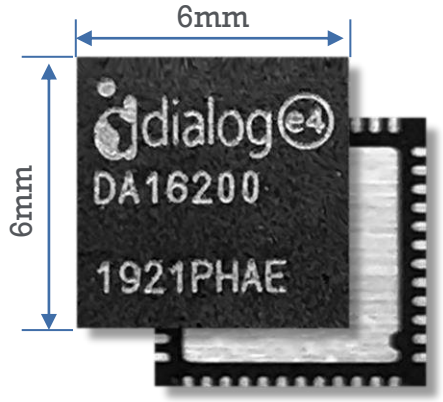
Hostless vs. Hosted

IoT Security is not optional anymore

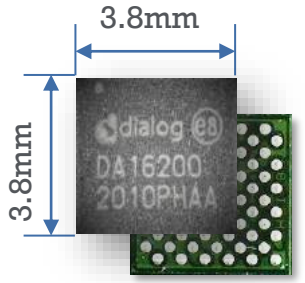
DA16200
CHIPS AND MODULES

SoCs

- Two packages for chip down designs
  - DA16200-00000A32: QFN (6x6mm), Lower Cost
  - DA16200-00000F22: fcCSP (3.8x3.8mm), Smaller Size



DA16200-00000A32



DA16200-00000F22

Modules

DA16200MOD: Low power Wi-Fi System on Module

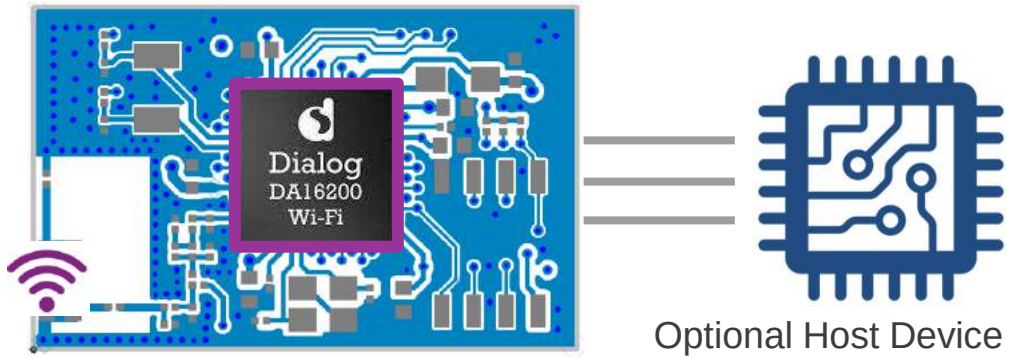
- DA16600MOD: Lowest Power Wi-Fi and Lowest Power BLE module on the market
  - Wi-Fi / BT Co-existence
- Two SKUs each with chip antenna and u.FL connector
- Pre-certified: FCC, IC, CE, Telec, KCC, SRRC, Wi-Fi

DA16200MOD
13.8 x 22.1 x 3.3 mm

DA16600MOD
14.3 x 24.3 x 3.0 mm

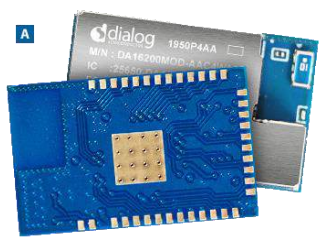
DA16200MOD
LOW POWER WI-FI MODULE

- The fully integrated module consists of:
  - DA16200 SoC
  - 32Mbit (4MB) FLASH onboard
  - Two XTAL integrated; 40MHz / 32.768KHz
- DA16200 module SKUs
  - DA16200MOD-AAC4WA32: with on board chip antenna
  - DA16200MOD-AAE4WA32: with u.FL connector for external Ant.
- Worldwide certifications
- Dimensions: 13.8 x 22.1 x 3.3mm

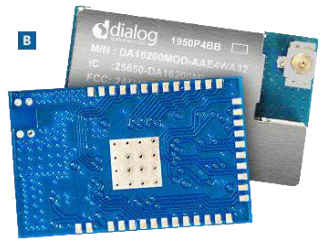


Optional Host Device depending on application

DA16200MOD, all components have integrated



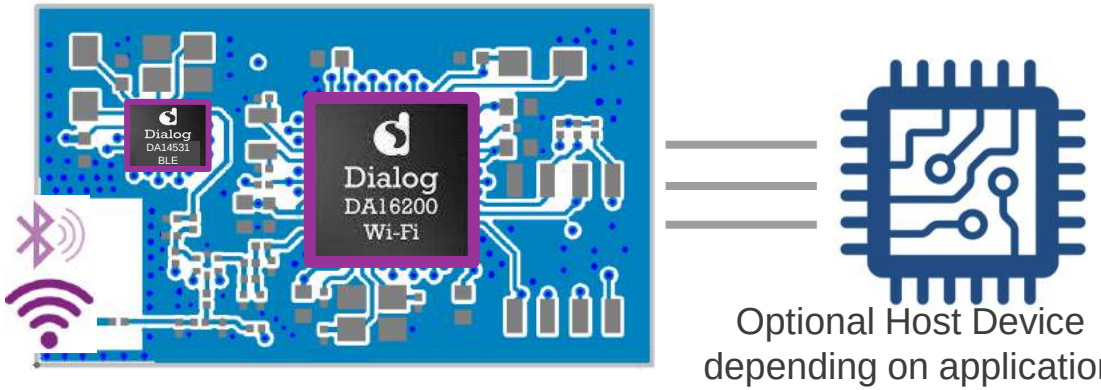
DA16200MOD-AAC4WA32



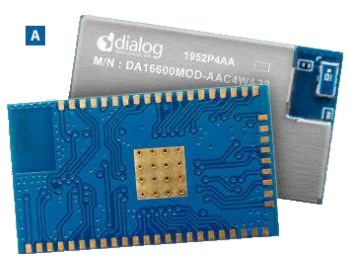
DA16200MOD-AAE4WA32

DA16600MOD
COMBO WI-FI + BLE MODULE

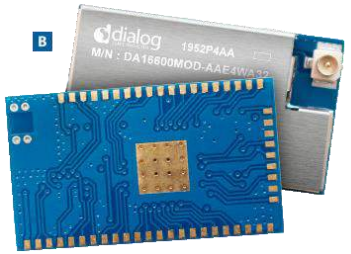
- The module solution for IoT applications featuring lowest power Wi-Fi + BLE
- The fully integrated module consists of:
  - Low Power SoCs: DA16200 (Wi-Fi) and DA14531(BLE)
  - 32Mbit (4MB) Flash memory
  - 3 XTALs for BLE and DA16200
  - All Front-end: SPDT for BLE coexistence and Antenna
- DA16600 module SKUs
  - DA16600MOD-AAC4WA32: with on board chip antenna
  - DA16600MOD-AAE4WA32: with u.FL connector for external Ant.
- Worldwide Certifications:
- Dimensions: 14.3mm x 24.3 mm x 3.0 mm



DA16600MOD, all components have integrated



DA16600MOD-AAC4WA32

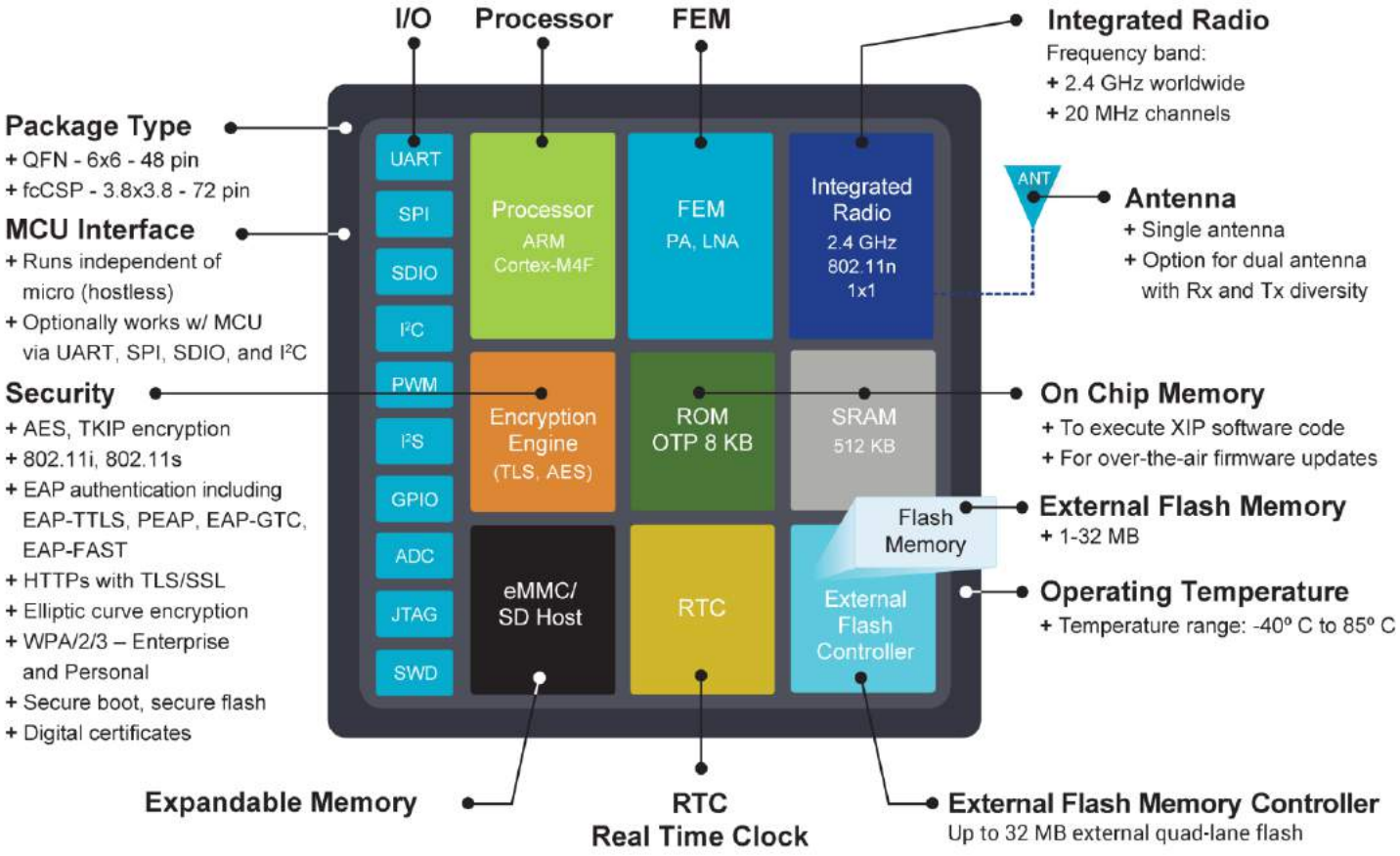


DA16600MOD-AAE4WA32

DA16200 DEVICE DETAILS

HARDWARE BLOCK DIAGRAM

- **Fully integrated** Wi-Fi system on an SoC
  - All full front-end included Wi-Fi BB/MAC/RF PA, LNA, RF switch
  - 802.11 b/g/n 1x1 2.4 GHz
  - CPU, SRAM, ROM, OTP
  - Dedicated HW encryption security block
  - Extensive I/O
- Additional components needed: Flash, Antenna, Xtals (1-2), RLCs
  - 60-90 cents of cost other than SoC

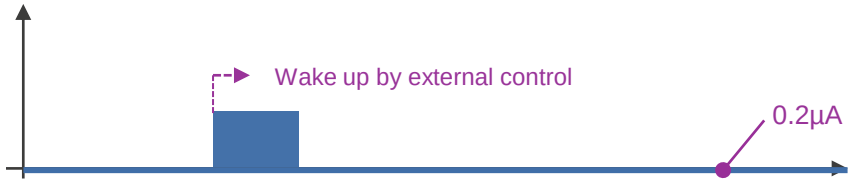
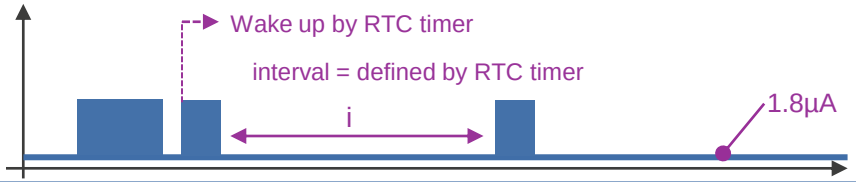
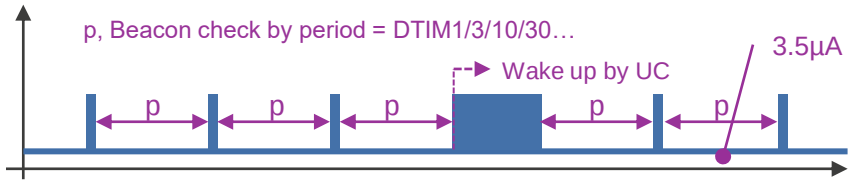


VIRTUALZERO™ TECHNOLOGY

SLEEP MODE

Unique sleep modes to optimize power consumption for each IoT application

- Virtually no power consumption in sleep state
- Validated for 200+ commonly used Legacy Access Points
  - Has interoperability for both lower current and communication success
- Supports 3 sleep modes based on application requirement as below:

Sleep 1	0.2uA	Power on/off	
Sleep 2	1.8uA	RTC enable Keeps network credentials	
Sleep 3	3.5uA	RTC enable Network reloadable	

DELIVERABLE
EV KITS/EVAL BOARDS

Dev kit for DA16200

DA16200MOD-DEVKT	Avnet US	Mouser	Digikey	Farnel
DA16200MOD-DEVKT-P	Avnet US	Mouser	Digikey	Farnel

Dev Kit for DA16600

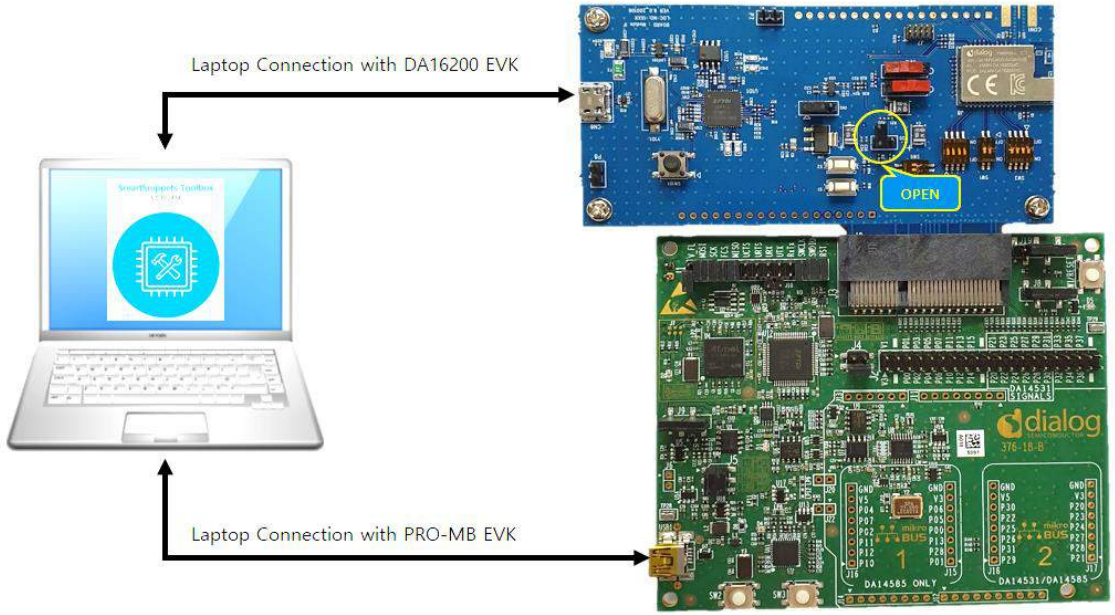
DA16600MOD-DEVKT	Avnet US	Mouser	Digikey	Farnell
DA16600MOD-DEVKT-P	Avnet US	Mouser	Digikey	Farnell

Note: DEVKT-P is the Pro version that includes a power profiling tool

DELIVERABLE
DA16200MOD-DEVKT-P

DA16200MOD-DEVKT-P

- Renesas provides both Hardware and Software for customer evaluation
- No need of current measurement instrument (ex. Keysight N6705)



Board connection

SmartSnippets program

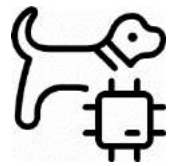
DA16200 TARGET APPLICATIONS

TARGET APPLICATIONS

Wearable Devices

Smart Watches

Fitness Bands



Pet Trackers

Battery operated IoT products

Smart Doorbells

Smart Thermostats

Smart Door Locks

Smart Pens

Zigbee/Z-wave Replacement

Occupancy Sensor

Humidity Sensors

Smoke Alarm

Flow Sensors (Meter)

TARGET APPLICATIONS

MORE THAN 1 YEAR BATTERY LIFE IN MOST APPLICATIONS

Battery operated IoT products

- Wi-Fi security camera
  - 9-10 MB HD video clips
  - 5 events/day
  - 1 second sleep mode
  - 1+ years battery lifetime @4,000mAh
- Door Locks
  - 20 events/day
  - 3 second sleep mode
  - 1+ year battery lifetime with 4AA batteries
- Thermostat
  - 30 events/day
  - 5 second sleep mode
  - 3+ years battery lifetime

TARGET APPLICATIONS

MORE THAN 1 YEAR BATTERY LIFE IN MOST APPLICATIONS

Zigbee/Z-wave Replacement

- Temperature/Humidity Sensor
  - 1,440 events/day (posts every minute)
  - 4+ years battery lifetime with 2AAA
    - 1.2 years lifetime w/FC9000

Wearable Devices

- Smart watch / bands
- Pet tracker

Pet tracker

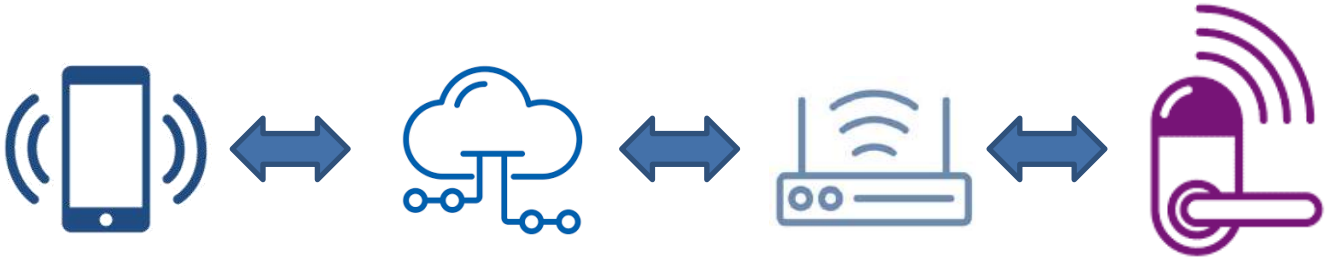
DA16200 TARGET APPLICATIONS

BATTERY OPERATED IOT PRODUCTS

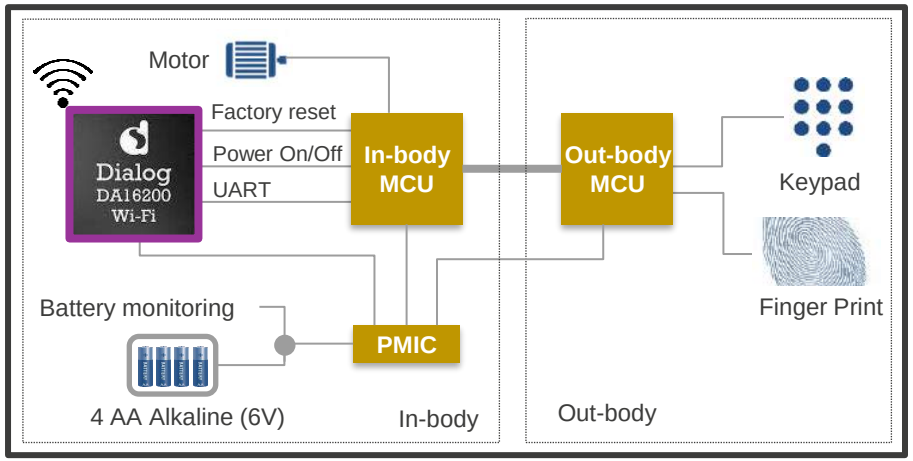
SMART DOOR LOCK

Key Features

- **Always Connected**
  - Open/close the door whenever user wants to wherever they are
  - Check door status remotely in real-time
  - Upload events, logs, and battery status to server in real-time
- OTA support including host firmware update
- Low power consumption/long **battery life: 1+ lifetime**
  - Battery lifetime is dependent on application
  - 20 times/day, check better lifetime on existing door lock performance



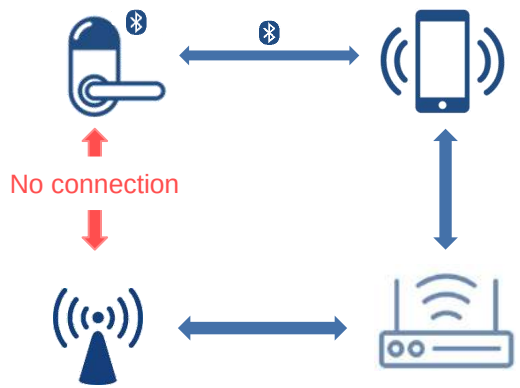
- Example System diagram



SMART DOOR LOCK

DOOR LOCK SUMMARY VS. OTHER IOT STANDARD/WI-FI

Door Lock with BLE



No remote control supporting

Open / Close
- Available with BLE key
- Available at only nearby Door Lock

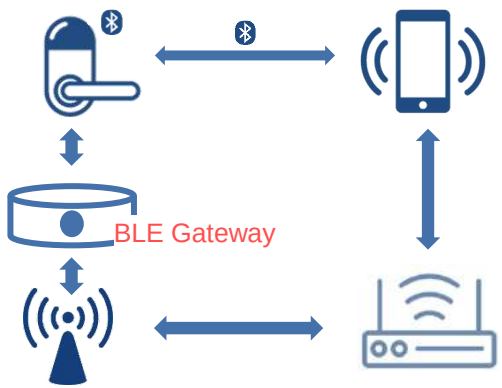
- **Alert when Door Lock status changed**
- Available at only nearby Door Lock

Check Log(Open / Close), Battery status
- Available at only nearby Door Lock

Upload and Download log data
- Available at only nearby Door Lock

OTA System upgrade
- Available at only nearby Door Lock

Door Lock with BLE & Bridge



Bridge device required

Open / Close
- Available nearby Door Lock
- Available from Remote places via Bridge

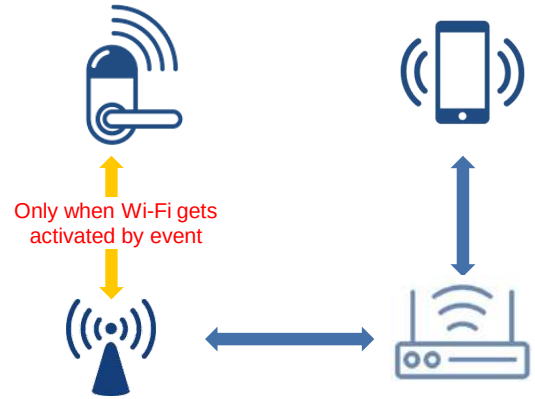
Alert when Door Lock status changed
- Available in real-time from Remote places via Bridge

Check Log(Open / Close), Battery status
- Anytime whenever user wants to check via Bridge

Upload and Download log data
- via phone or using Wi-Fi connection to Cloud via Bridge
- Configure from Remote places via Bridge
- Generate temporary PIN codes for visitors via Bridge

OTA System upgrade
- Available in real-time with phone

Door Lock with Wi-Fi



Wi-Fi consumes high power so it has been turned off at Battery application.

Open / Close
- Available nearby Door Lock only when Wi-Fi gets activated by event((key input, open/close, with long time interval)
- mobile phone from Remote places only when Wi-Fi gets activated by event(key input)

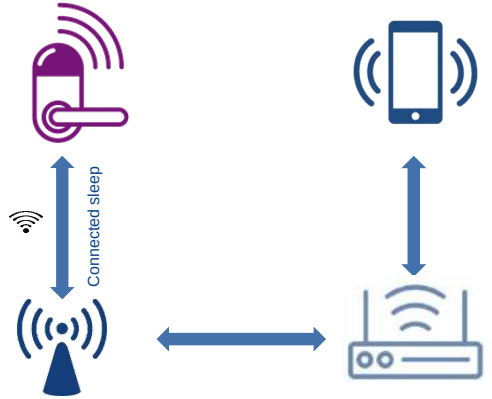
Alert when Door Lock status changed
- Available with delay with phone from Remote places

Check Log(Open / Close), Battery status
- Available at only when Wi-Fi gets activated by event(key input)

Upload and Download log data
- Using Wi-Fi connection to Cloud
- Configure from Remote places only when Wi-Fi gets activated by event(key input)
- Generate temporary PIN codes for visitors from Remote places only when Wi-Fi gets activated by event(key input)

OTA System upgrade
- only when Wi-Fi gets activated by event

Door Lock with DA16200



Low Power connected sleep Supporting

Open / Close
- **Available** from Remote places

Alert when Door Lock status changed
- Available **in real-time** from Remote places

Check Log(Open / Close), Battery status
- **Anytime** whenever user wants to check

Upload and Download log data
- Using Wi-Fi connection to Cloud
- Configure from Remote places
- Generate temporary PIN codes for visitors

OTA System upgrade
- **Available** including Host firmware in real-time

SMART DOOR LOCK
USAGE SCENARIO SUMMARY

DA16200 capabilities vs. the competition

- Get alert **in real-time from remote places** when door lock status has changed
  - Vs. Competitor (Available with delay with phone from remote places)

- Check log(open / close), Battery status **anytime** whenever user wants to check
  - Vs. Competitor (Available only when Wi-Fi gets activated by an event (key input))

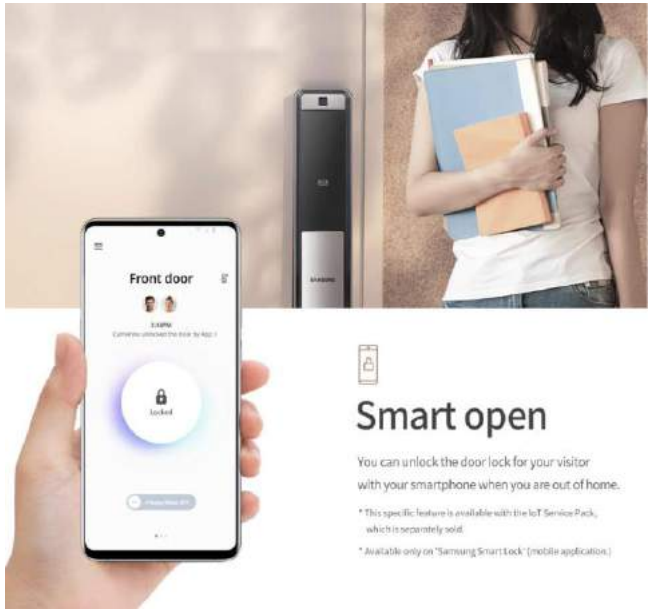
- Set temporary PIN codes **anytime** whenever user wants to set
  - Vs. Competitor (Available only when Wi-Fi gets activated by an event (key input))

- OTA Firmware update via **anytime** whenever user wants to check
  - Vs. Competitor (Available only when Wi-Fi gets activated by an event (key input))

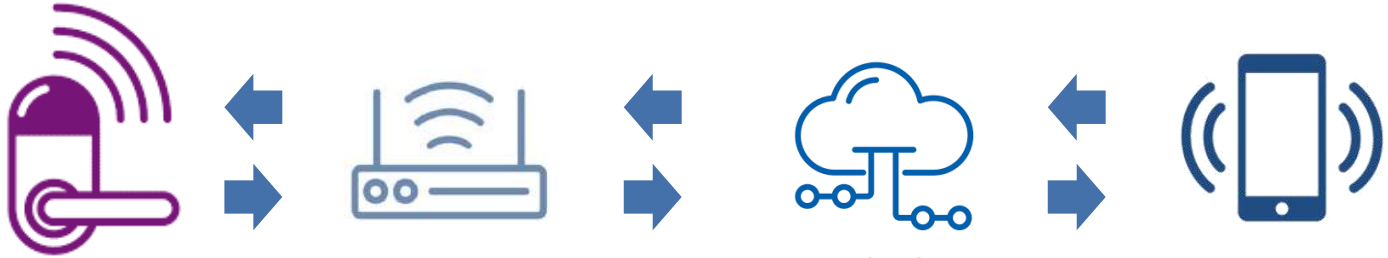
SMART DOOR LOCK

USE SCENARIO: CONTROL IOT DEVICE REMOTELY, OTA, REALTIME STATUS CHECK

Control IoT device, check operation log, Battery status **anytime** whenever user wants to check



Source: Samsung



Legacy AP

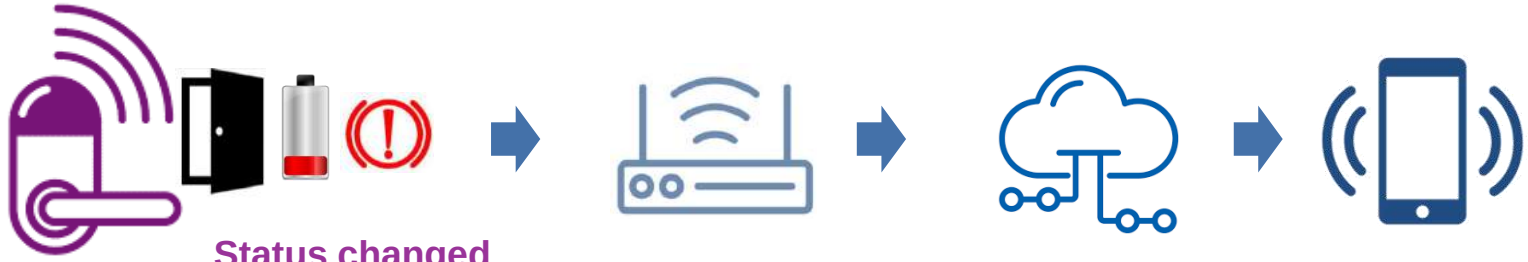
Cloud

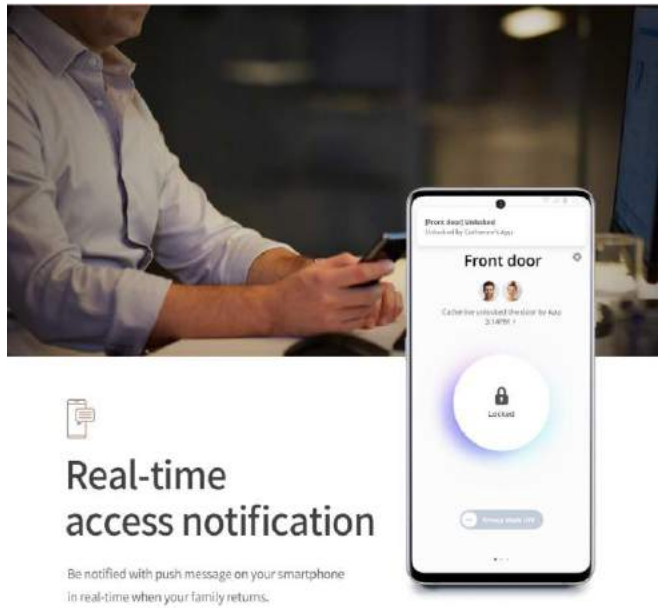
Can check IoT device's status
Can set/control device

SMART DOOR LOCK
USE SCENARIO; GET ALERT IN REAL-TIME

Get alerts in real-time

- **Alerts available in real-time** from remote places **without delay** when IoT device status has changed via always connected function
- **Notify promptly** about low battery and abnormal operation



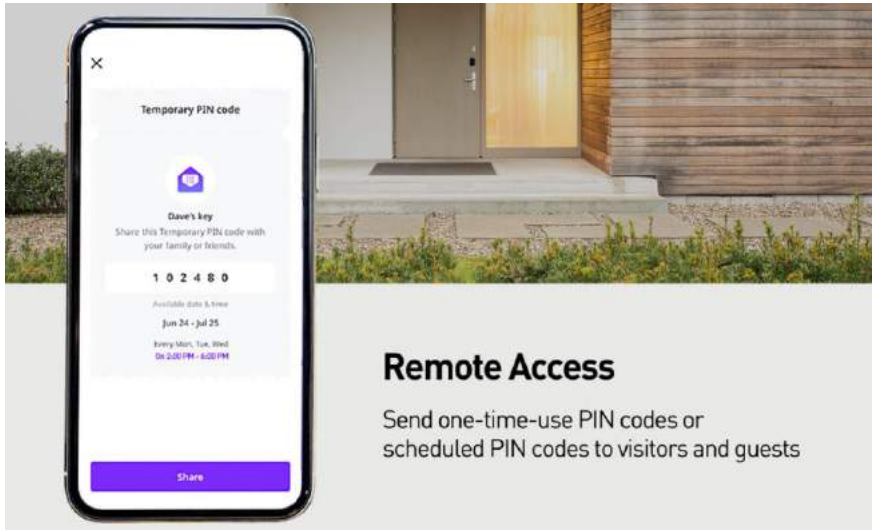


Source: Samsung

SMART DOOR LOCK
USE SCENARIO; SET PIN CODES

Set temporary PIN codes

- Set temporary PIN codes **anytime** whenever user wants to set so that a visitor can open the door with a temporary PIN
- Can **get alert immediately** when visitor opens the door with temporary PIN codes



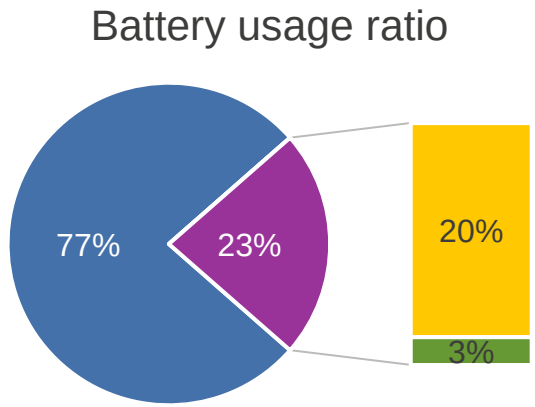
Source: Samsung

SMART DOOR LOCK
BATTERY LIFETIME ESTIMATION

Can estimate battery lifetime by inputting existing door lock's current

			Calculation	DTIM30	Unit	Note
Battery Capacity		AAx8 [2]	a	4,800	mAh	
		efficiency of battery [2]	b	72.92	%	
		Available capacity [2]	**A = a * b**	**3,500**	**mAh**	
Standby	Doorlock system current w/o Wi-Fi		B	194	uA	should be checked with Door Lock maker
	W-Fi Current consumption of DA16200 standby	Sleep average current [3]	c	41	uA	41uA @ DTIM 30, 72uA @ DTIM10
		duration for KA/MQTT Pingpong [1]	d	0.6	s	test data is based on AWS, we need to check it by using Door Lock Cloud
		current for KA/MQTT Pingpong [1]	e	31.4	mA	test data is based on AWS, we need to check it by using Door Lock Cloud
		energy for KA/MQTT Pingpong	f = d * e / 3600 * 1000	5.2	uAh/event	
		KA interval [2]	**g**	**30**	**min**	based on customer server requirement
		total energy for KA hourly	h = f * (60 / g)	10	uA	
		total average current	C = c + g	51	uA	
Operation	Door Lock Current consumption of doorlock event	duration for event [2]	i		s	test data is based on AWS, we need to check it by using Door Lock Cloud
		current for event [2]	j		mA	test data is based on AWS, we need to check it by using Door Lock Cloud
		energy per event	k = i * j / 3600 * 1000		uAh/event	
		number of event per day [2]	**m**		**times**	based on customer usage case
		current by doorlock event (20times) per day	n = k * m		mAh per day	
		energy for event per hour	D = n / 24 * 1000		uA	
	Wi-Fi Current consumption of doorlock event	duration for event [1]	o	0.9	s	test data is based on AWS, we need to check it by using Door Lock Cloud
		current for event [1]	p	31.9	mA	test data is based on AWS, we need to check it by using Door Lock Cloud
		energy per event	q = o * p / 3600 * 1000	*7.98*	uAh/event	
		number of event per day [2]	r	***20***	**times**	based on customer usage case
		current by doorlock event (20times) per day	s = q * r / 1000	*0.16*	mAh per day	
		energy for event per hour	E = s / 24 * 1000	6.65	uA	
total	Door Lock system	hourly	F = B + D	*194.44*	uA	
	Wi-Fi	hourly	G = C + E	*58.11*		
	Total Doorlock current w/V	hourly	H = F + H	*252.56*	uA	
Life Time			**J = A / (G/1000)/24**	***577***	**day**	
			M = J/30	**19.25**	**month**	

Note
1) measured data based on AWS + DA16200, we need to check it by using Door Lock Cloud
2) User defined
3) Measured data based on DA16200 operation for DTIM10, DTIM30

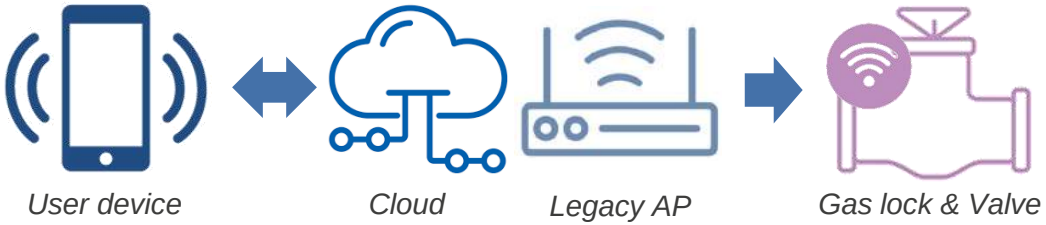


Use Excel file to calculate lifetime

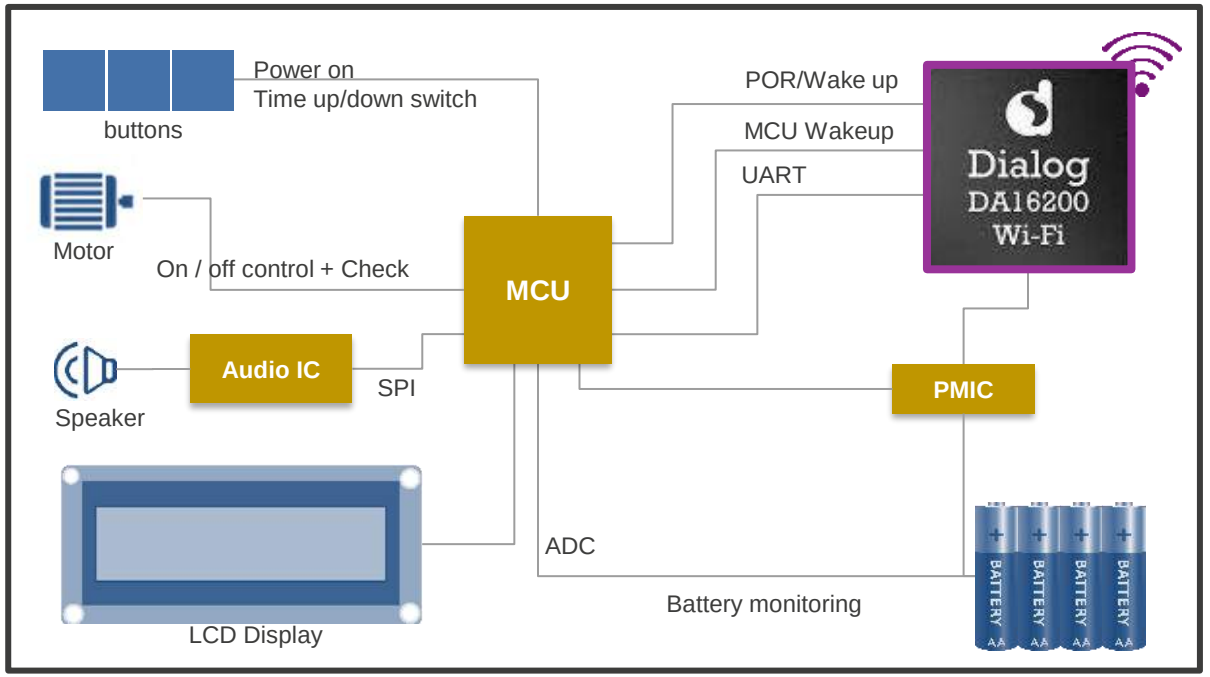
GAS LOCK

Key Features

- **Always Connected**
  - For safety from hazards e.g., accidents cased by gas leakage
  - Smart lock anywhere and anytime (cannot open for safety)
  - Smart monitoring of gas value status in real-time
  - Check access history
- Gateway is not required
- Battery Lifetime : 1+ year @ 4 AA batteries



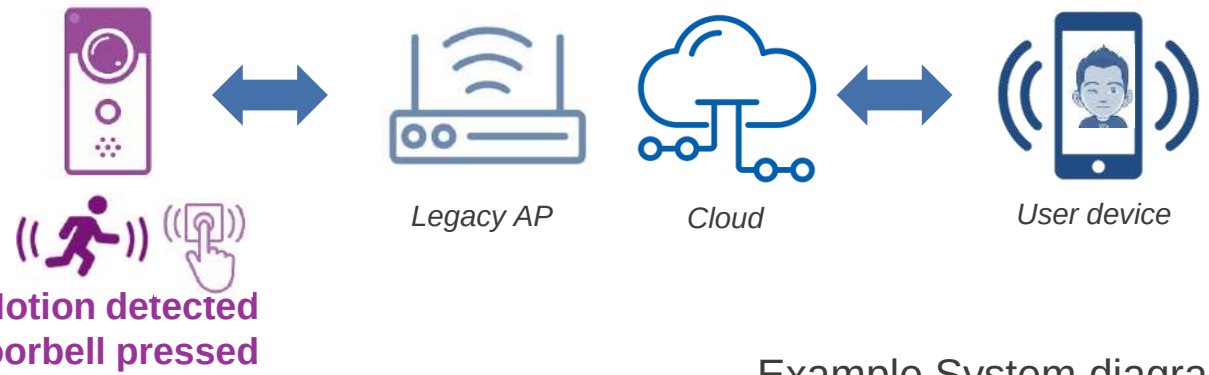
Example System diagram

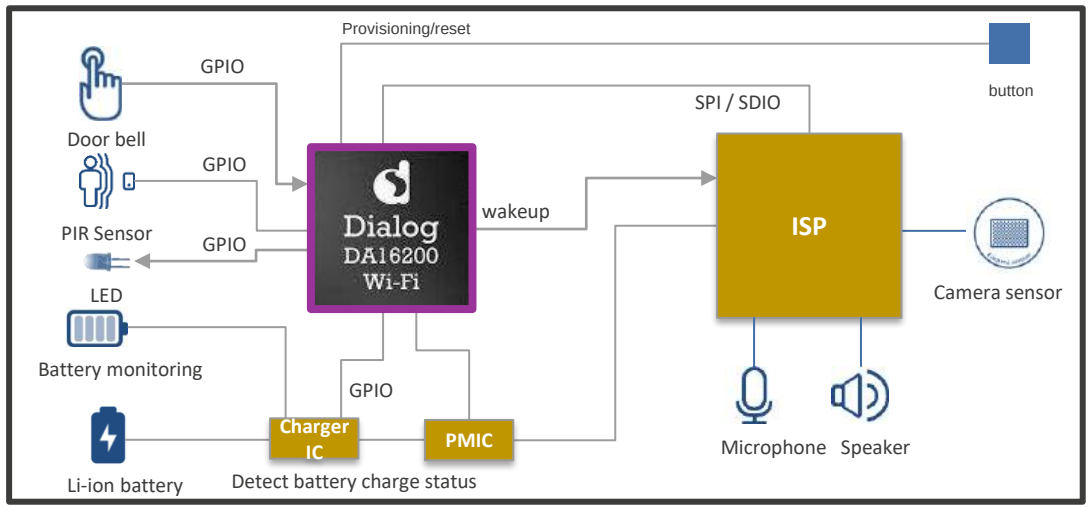


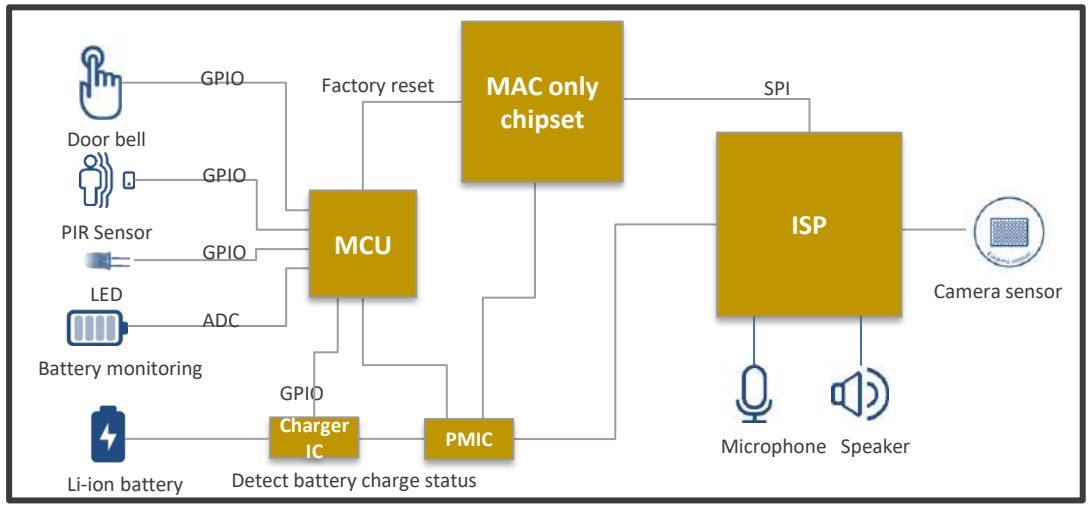
VIDEO DOORBELL

Key Features

- **Always Connected**
  - Take picture / Record video whenever user wants to wherever they are
  - Check Video doorbell status remotely
  - Enable/disable Live video and/or audio through an app
- Upload video / audio events, log, Battery status to Cloud in real-time
- OTA system upgrade
- Operation diagram







Example System diagram

VIDEO DOORBELL
REQUIREMENTS

QoS (Quality of service) for Full HD

- DA16200 MCU can run up to160MHz, SDIO / SPI speed supports up to 50MHz
- From below bitrate requirement depending on resolution and frame rate, DA16200 can cover up to AVC(H.264), 1080p 30fps with enough margins

Standard	Resolution	H.264 & YouTube profile
Full HD	1080p / 30fps	3.4Mbps
HD	720p / 30fps	1.9Mbps
SD	480p	1Mbps

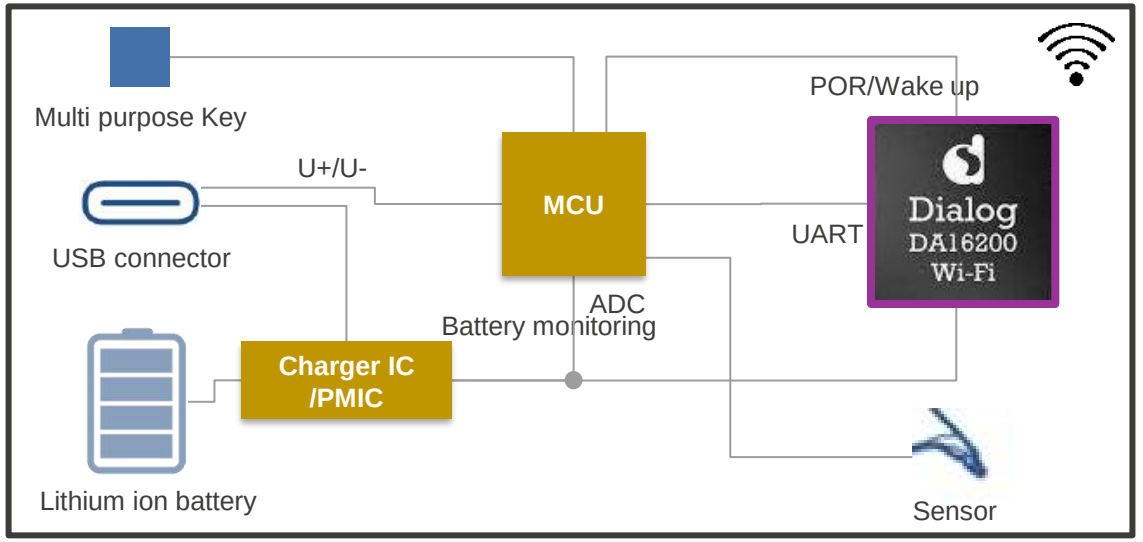
- DA16200 Throughput performance shows UDP Tx 51Mbps @ 160MHz. There is no QoS (Quality of service) issue to transmit video data of Full HD

SMARTPEN

Features

- Can transmit sensor data to cloud
- **Can access cloud without** 4G/Smartphone/Gateway
- Supports **1:N provisioning**
- **RF control to save power** while DA16200 communicates with MCU. Full buffering
- Support OTA upgrade
- Estimated battery lifetime
  - Target is 6 hours on 260mAh battery
  - Wi-Fi consumes only 25mAh while it transmit data to Cloud

Example System diagram



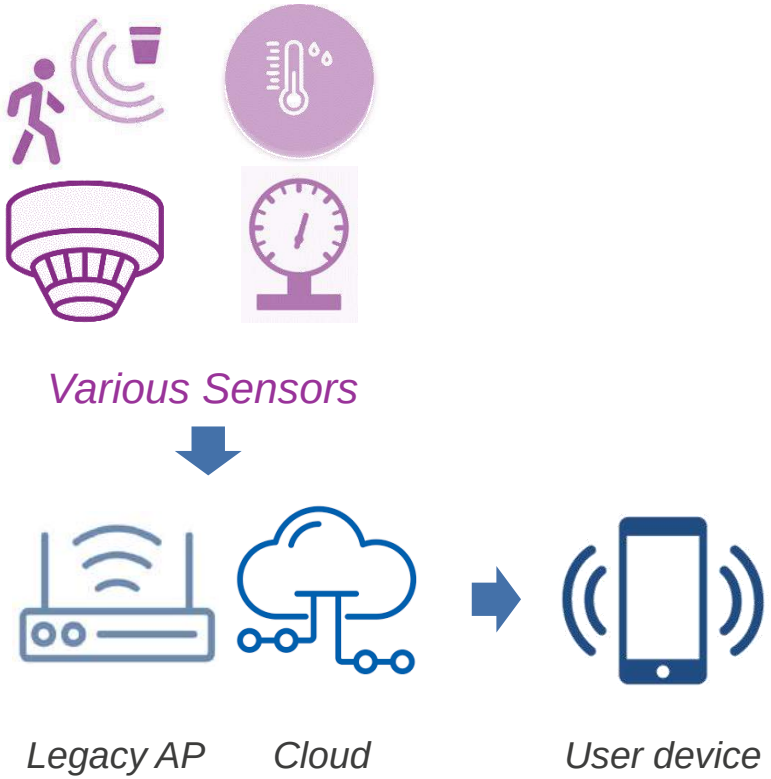
DA16200 TARGET APPLICATIONS

ZIGBEE/Z-WAVE REPLACEMENT

SENSORS

Features

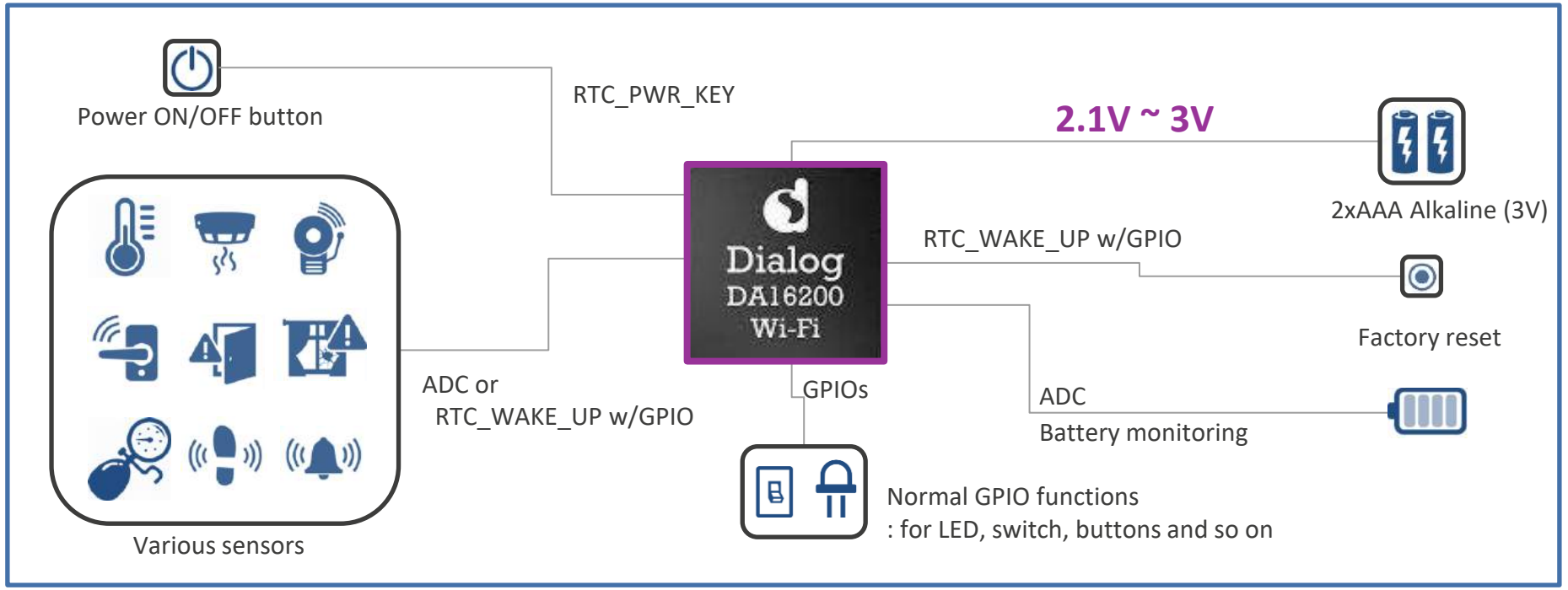
- **Can connect to cloud** without additional device (Gateway)
- **No need of additional MCU** to control Sensor
- Optimizing sensor reporting time to get ultra low avg. current
- **Direct power supply** from Alkaline batteries (AAA 2EA)
- Supports OTA update
- Battery Lifetime estimation
  - 4+ years battery life @ 2 AAA batteries (960mAh, 3V)
    - Tx only
    - 1,440 events/day (posts every minute)



SENSORS

Block diagram

- DA16200 gets sensor data and posts **without Host device**
- Supports **power supply of 2AAA batteries**



DA16200 TARGET APPLICATIONS

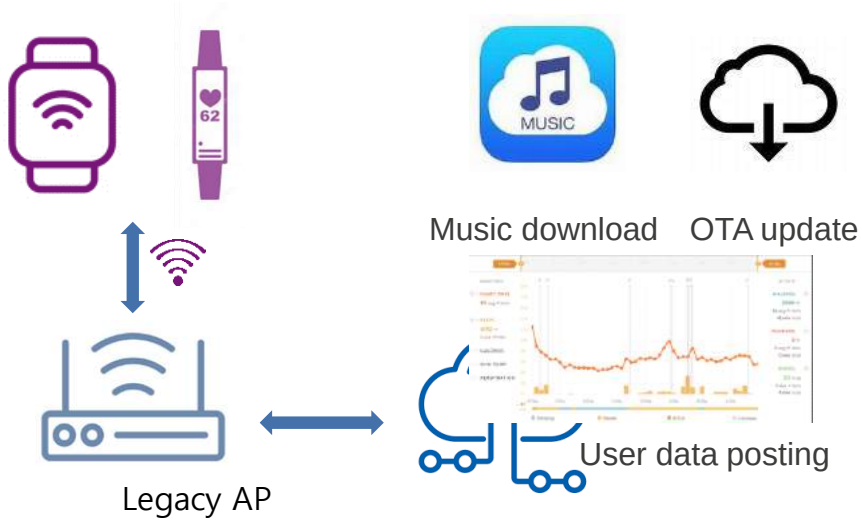
WEARABLE DEVICES; SMART WATCH/BAND, PET TRACKER

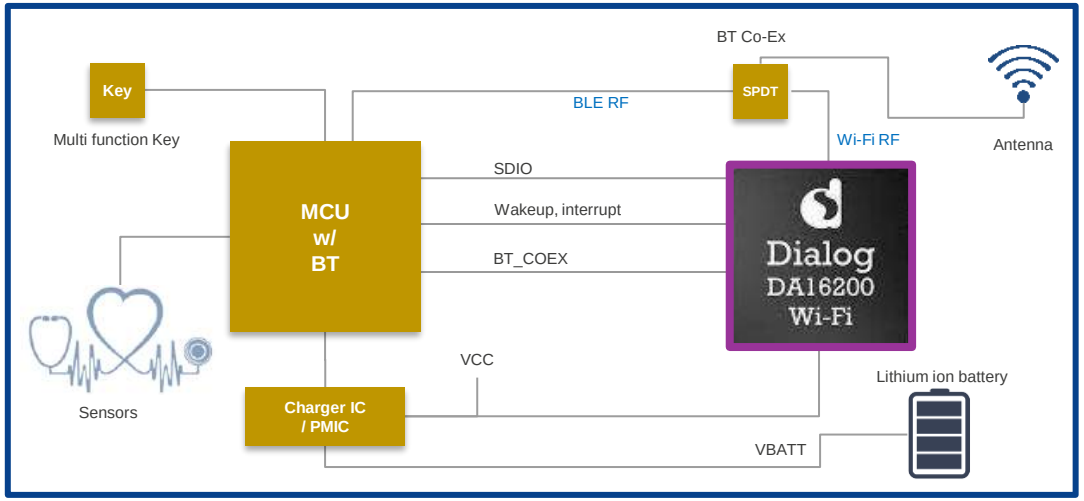
SMART WATCHES/BANDS

Smart Watches/Bands with DA16200

- Can download/upload **large amount of data** from/to Cloud
  - Support 3rd party app to download music files from server not through mobile devices
  - Support higher throughput performance

- Can access Cloud **without going through Smartphone/Gateway**
  - **BLE Coexistence**, OTA including MCU own binary (about 100MB)



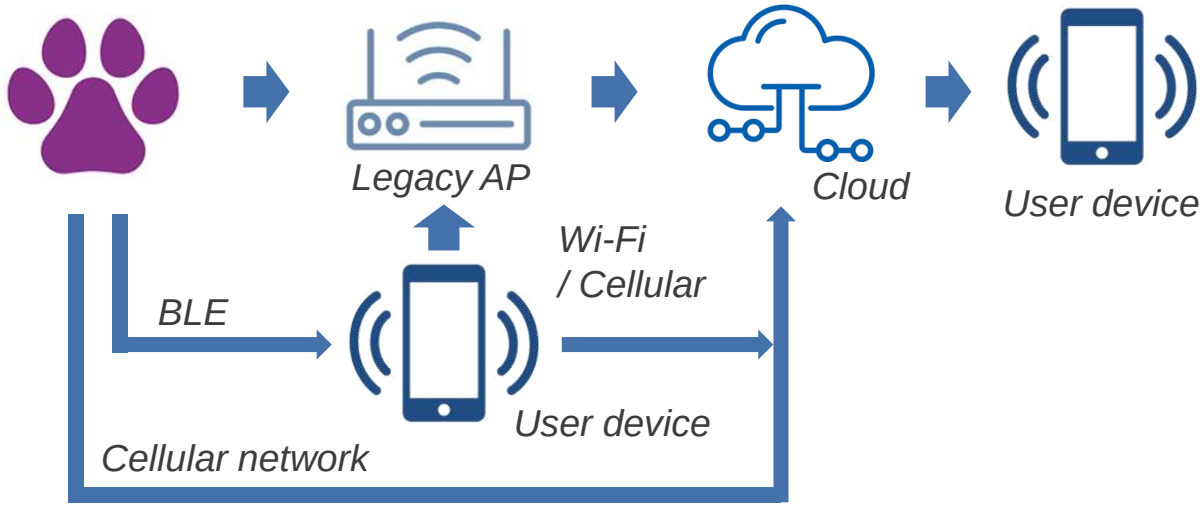


Reference Smart Watch Design

PET TRACKER

Pet tracker with DA16200

- **Directly connects** to your home Wi-Fi network to save battery and improve accuracy
- Uploading all or most of the data over Wi-Fi and use LTE when network is not reachable
- **Quick scan** and **fast reconnection** with network



Operation block diagram

Pet tracker application usage

Renesas.com