WE MEET @ DIGITAL DAYS

MACHINE DATA MADE ACCESSIBLE THANK BLUETOOTH® AND MOBILE APPS

Jens Ruckes, Senior Software Engineer Wireless Connectivity
Michael Lang, Business Development Wireless Connectivity & Sensors

AGENDA

Machine Data made accessible Thank Bluetooth® and mobile Apps

- Bluetooth – information and important notes
- Machine Data made accessible – an example application
- Mobile App – important to know
- Würth Elektronik – Bluetooth Solutions

BLUETOOTH®

Information and important notes

Bluetooth®

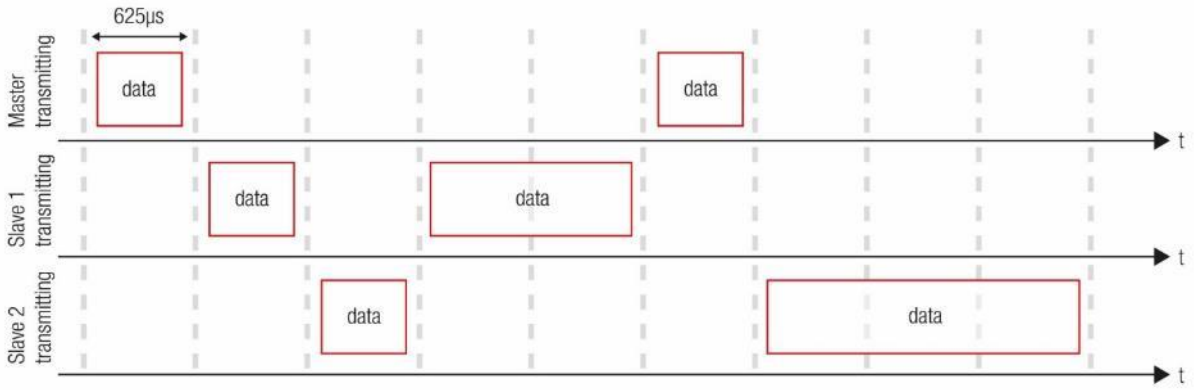
Information and important notes

- Defined 1996 by Intel, Ericsson and Nokia.
- Standardized communication interface
- Used in every Smart Device and lots of other devices
- Consists of different parts
  - Bluetooth Classic
  - Bluetooth Low Energy
  - Bluetooth Mesh
  - Bluetooth LE Audio
- Different parts are not necessarily compatible with each other

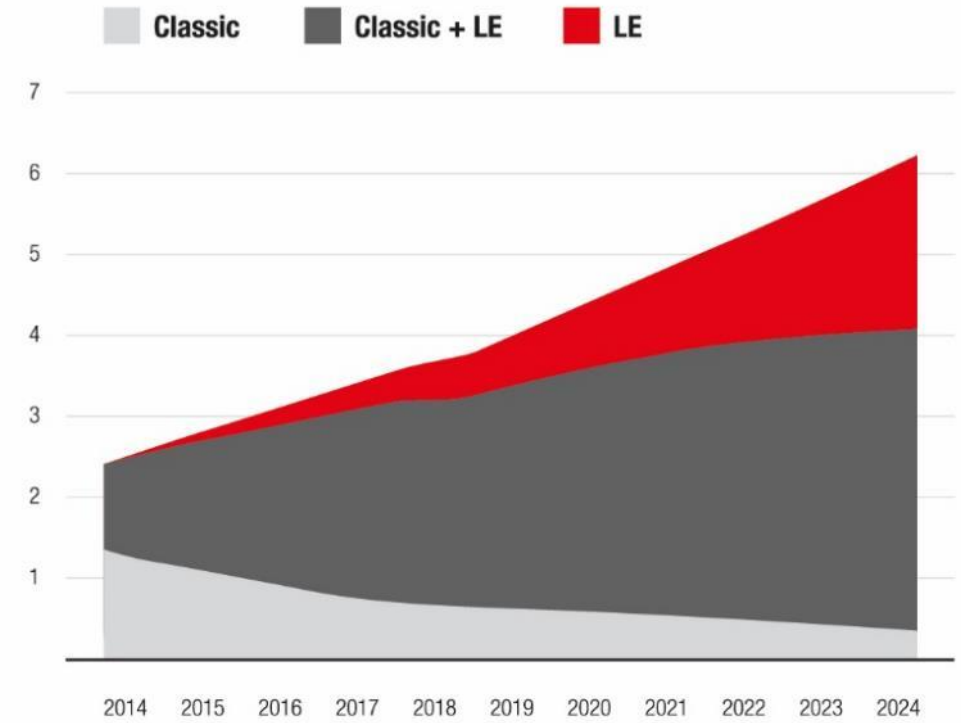
Bluetooth®

Information and important notes

- **Bluetooth Classic**
  - 79 channels with 1MHz bandwidth
  - Higher Power Consumption
  - One Master. Up to 7 slaves
  - SPP Profile
    (transparent date interface, defined by BT SIG)
  - Audio Streaming & Hands free



Annual Bluetooth Device Shipments by Radio Versions

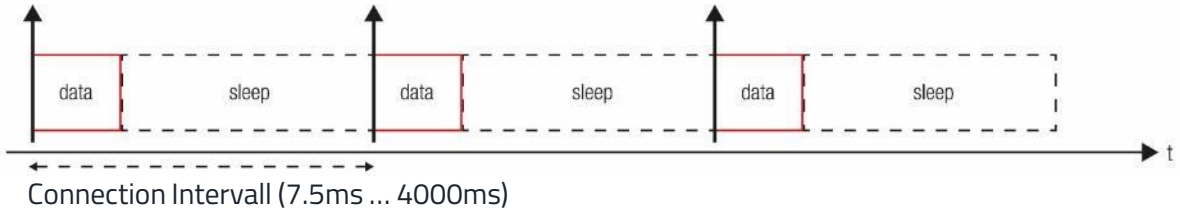


Numbers in billions; Source: ABI Research, 2020

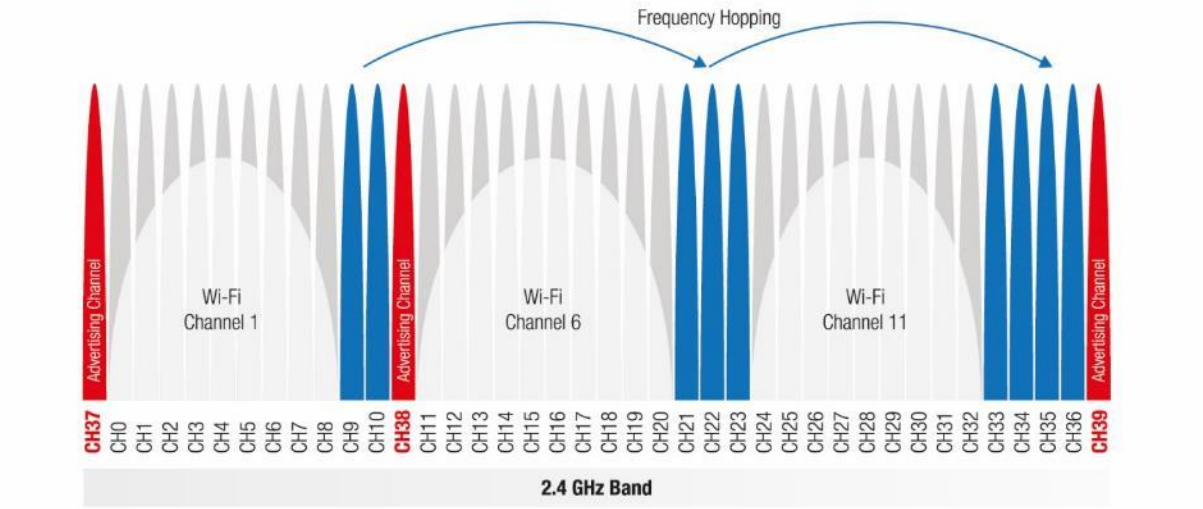
Bluetooth®

Information and important notes

- **Bluetooth Low Energy (Bluetooth LE)**
  - First release with Bluetooth 4.0 in 2010
  - 40 channels with 2MHz bandwidth



Connection Intervall (7.5ms … 4000ms)



- Two modes of operation
  - Non connection oriented Broadcasting = Beacon
    - No security/no encryption – anybody can receive
    - Beacon Size is restricted (to max. 31 Bytes)
    - 3 advertising channels
  - Connection oriented „Point-to-Point“
    - central role (typically your smart device) and peripheral role (a provider of Services and data)
    - negotiation during connection (for optional BLE features like larger radio packets, connection interval, different PHY layers, security, paring, …)
    - Frequency Hopping Spread Spectrum (FHSS) with 37 data channels

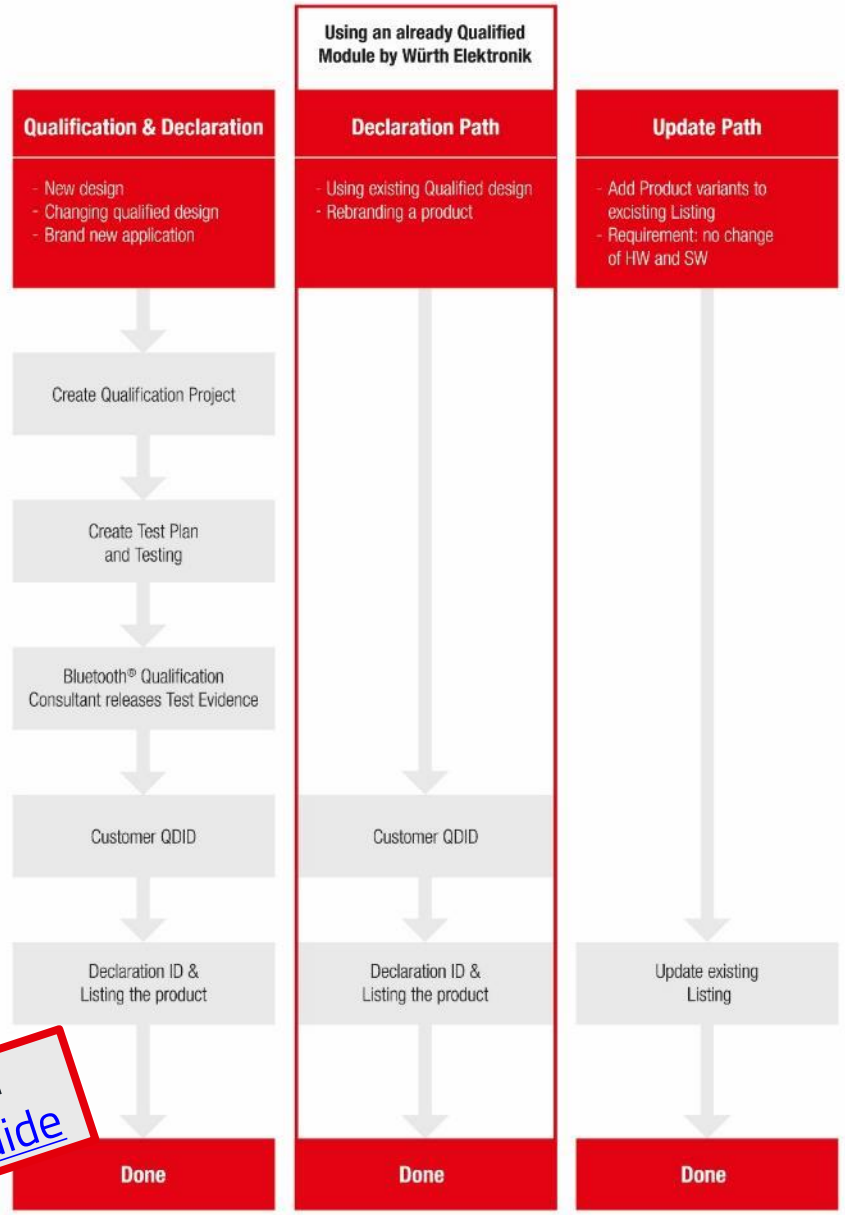
Bluetooth®

Qualification & Listing Process

- consists of qualification and declaration
  - qualification process = interoperability and conformity to specifications (including tests and measurements)
  - Declaration = no measuring or testing effort, only information work to be done (only “paperwork”; and declaration fee of 9600$US)

- Distributor (Inverkehrbringer) is responsible to ensure that the required listing is performed

- Update of existing listing is possible
  - Same Bluetooth HW and SW is used
  - Same distributor
  - No additional Listing Fee has to be payed



Würth Elektronik AppNote:
ANR027 Bluetooth Listing Guide

Bluetooth®

Deprecation policy (updated July 2021)

- Any new Bluetooth Version will be automatically scheduled for deprecation, i.e. 10 years after it's release date
- When the deprecation phase of a Bluetooth Version is reached, no more new products can be listed with the Bluetooth SIG
- Products that are already Listed can still be produced and sold after deprecation

Bluetooth Version	status	deprecation
4.1	deprecated	28 January 2019
4.2	active	February 2025*
5.0	active	February 2027*
5.1	active	February 2029*
5.2	active	February 2030*
5.3 (released July 2021)	active	July 2031*

* Dates are reviewed 36 months before deprecation date an may be changed to a later date

MACHINE DATA MADE ACCESSIBLE

an example application

MACHINE DATA MADE ACCESSIBLE

Example Application - Machinery Access

- Machine parametrization during commisioning
- Service interface, i.e. maintenance information
- control by the machine operator
- Recalibration of the system
- Machine Firmware Update possibility

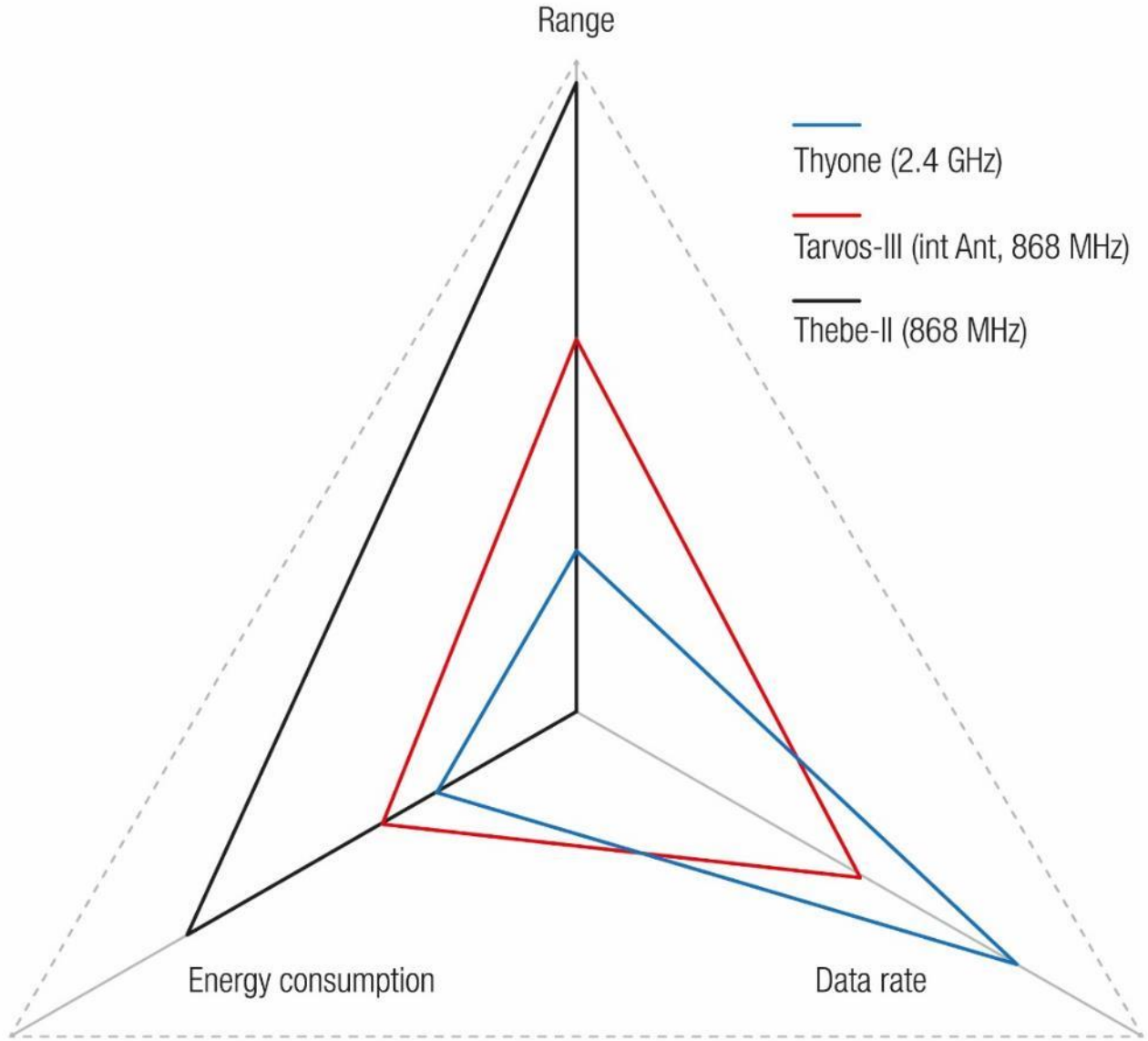
MACHINE DATA MADE ACCESSIBLE

How to do it

- Wireless Connectivity always a trade off between:
  Range - Data Rate - Energy consumption

- Dependence on frequency/wavelength
  - Higher frequency = shorter wavelength
    → higher Data Rate
    → shorter range
  - Lower frequency = longer wavelength
    - → higher Range
    - → lower Data Rate

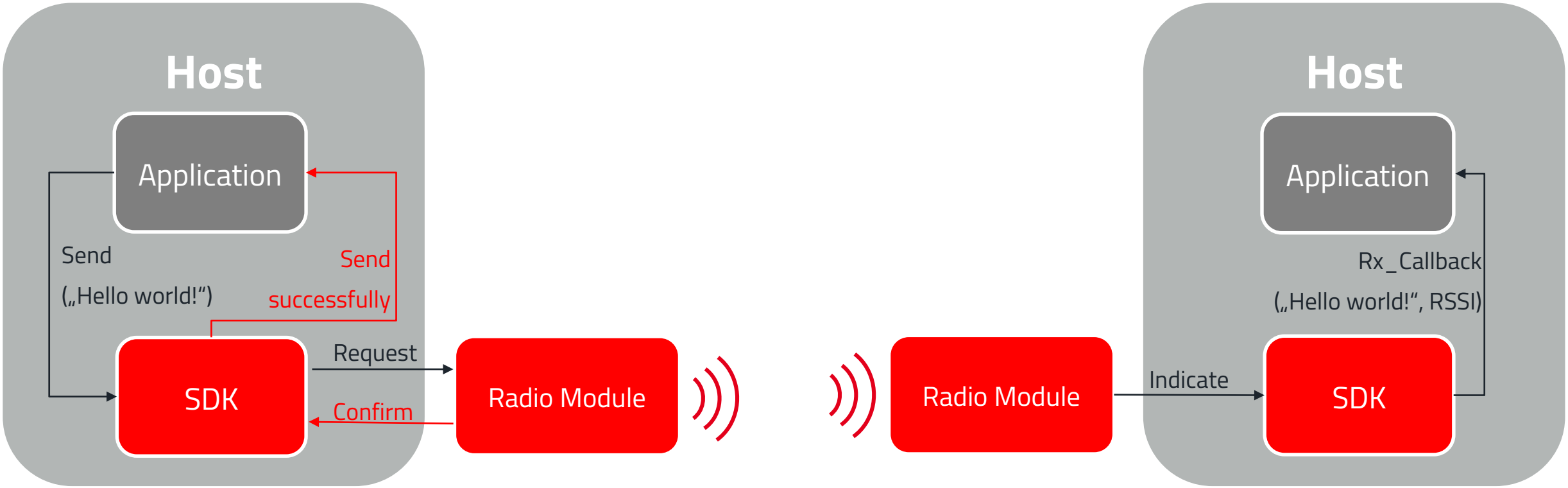
- Dependence on Power Consumption
  - Higher output Power
    → Higher Range
    → Higher Energy consumption
  - Lower output power
    → lower energy consumption
    → shorter range



MACHINE DATA MADE ACCESSIBLE

How to do it

Example Communication



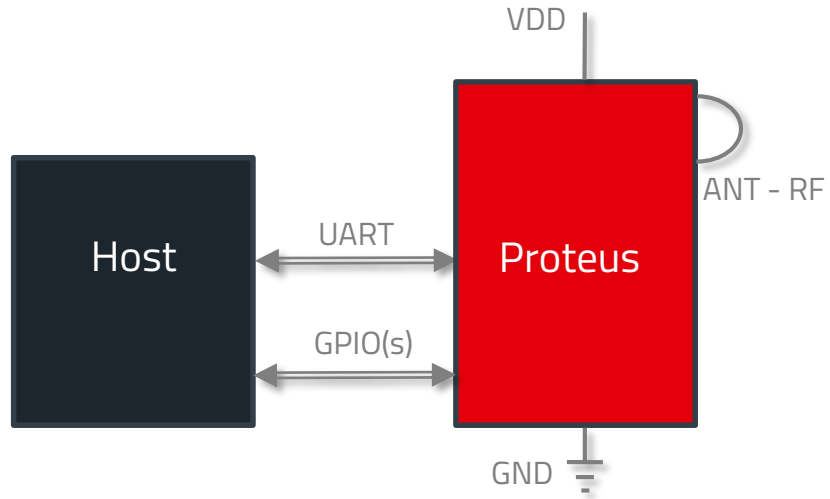
MACHINE DATA MADE ACCESSIBLE

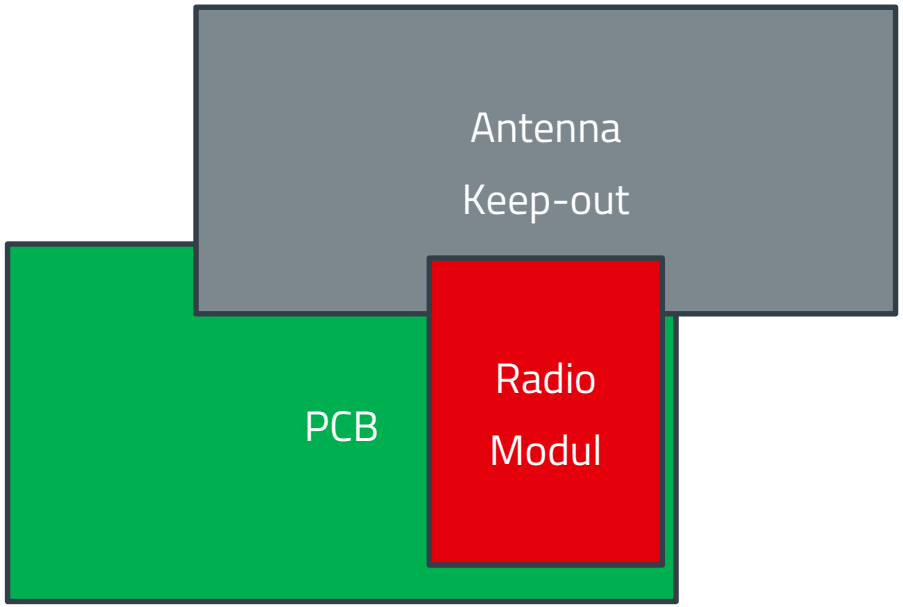
Design-in

- Communication Interface: UART
- Some GPIOs (Reset, Boot, Wake-up,…)
- Smart Antenna Connection (integrated antenna use)
- Stable VCC supply

- Space considerations in a device PCB
- Module size (60 - 100mm²)
- Antenna Ground Plane (~ module size)
- Antenna Keep-out Zone (no metal, ~ 300mm²)

- It's quite easy to have a huge negative impact on radio range

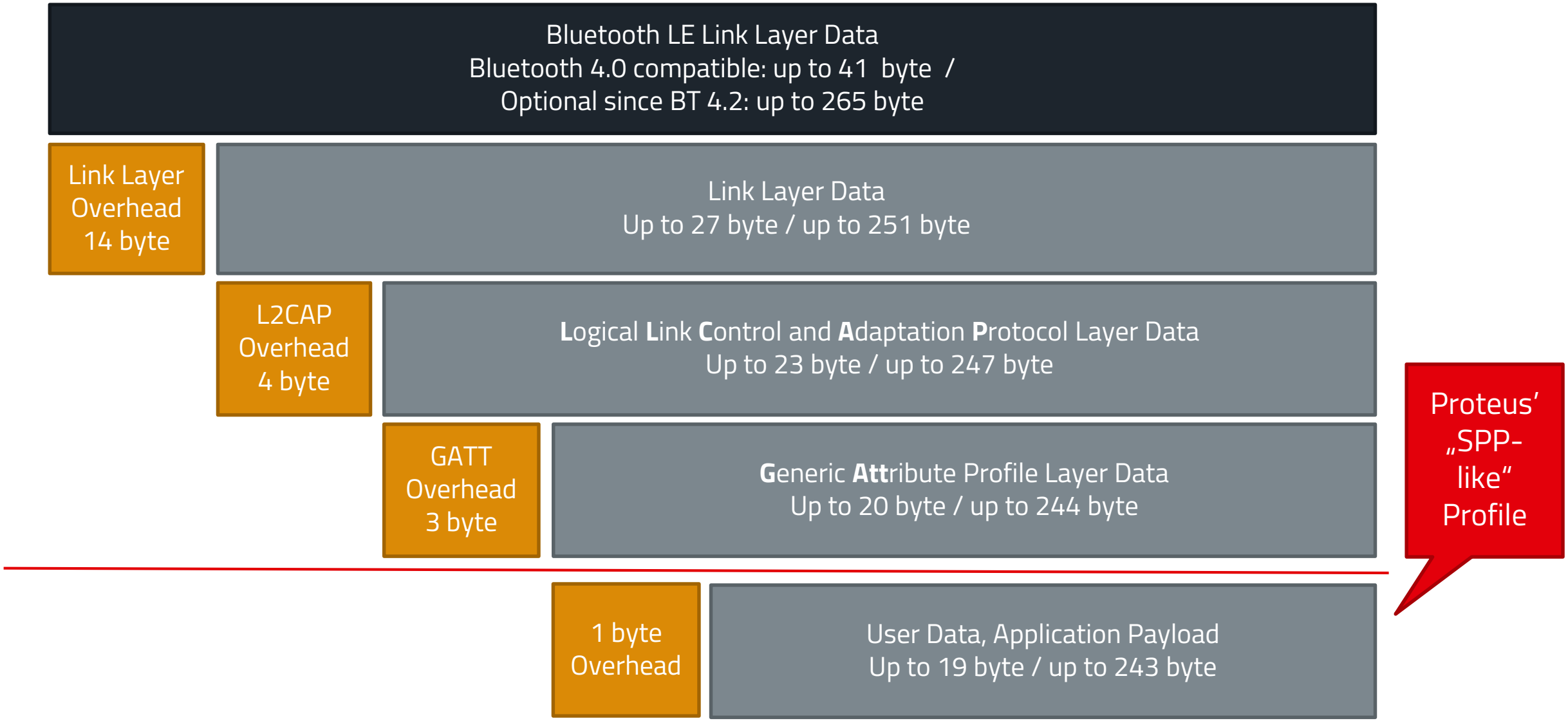




MOBILE APP

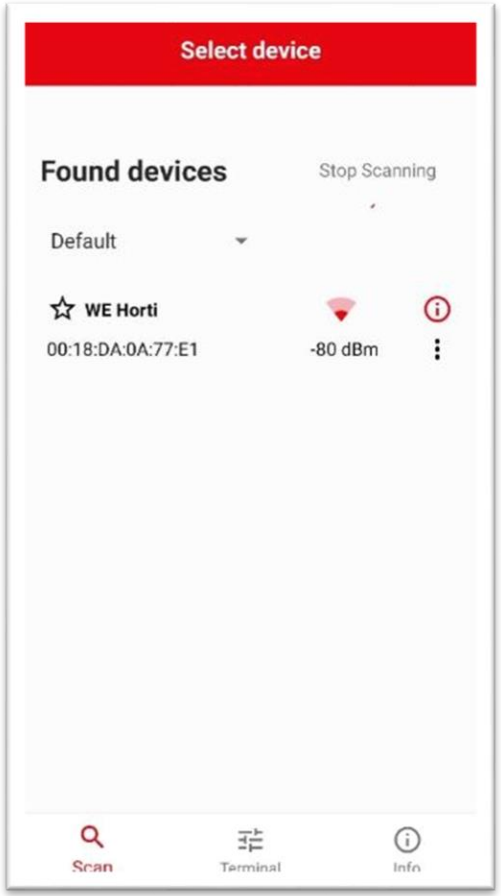
important to know

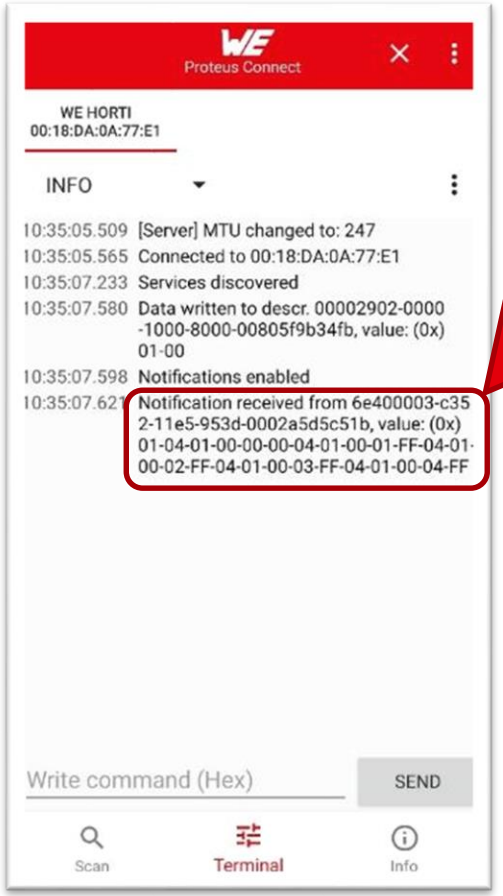
PROTOCOL ENCAPSULATION



APP FUNCTIONS & TASKS

Proteus Connect





GATT Profile = 0x6E400003-C352-11E5-953D-0002A5d5C51B

GATT Profile's Data =

0x01

0x 04 01 00 00 00
04 01 00 01 FF
04 01 00 02 FF
04 01 00 03 FF
04 01 00 04 FF

Proteus Connect Source Code

https://github.com/WurthElektronik/Proteus-Connect-Android

https://github.com/WurthElektronik/Proteus-Connect-iOS

APP DEVELOPMENT

Recommended Resources

- Würth Elektronik eiSos
  - Application Note ANR009 Advanced Developer Guide (SPP-like profile implemented on Proteus modules)

- Bluetooth SIG Core Spec 5.3
  - https://www.bluetooth.com/specifications/specs/core-specification-5-3

- Android
  - https://developer.android.com/guide/topics/connectivity/bluetooth/ble-overview
  - https://developer.android.com/studio (IDE)

- Apple
  - https://developer.apple.com/accessories/Accessory-Design-Guidelines.pdf (Chapter 40 for Bluetooth LE)
  - https://developer.apple.com/xcode (IDE)

WÜRTH ELEKTRONIK – BLUETOOTH® SOLUTIONS

WÜRTH ELEKTRONIK – Bluetooth® SOLUTIONS

More than you expect

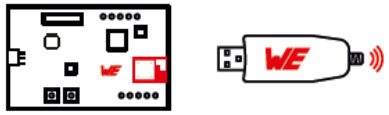
Full Service Products -
Hardware + Firmware

Software Development Kits
and Software-Tools

Software Individualization

Configurable User Settings
with our Firmware WE-ProWare

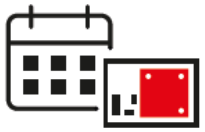
Technical Support –
Talk from Engineer to Engineer



EV-Boards and
USB Radio Sticks

Certification and Conformity -
CE, FCC, IC & ARIB

Small Packing Unit



Long Term Availability

WÜRTH ELEKTRONIK – Bluetooth® SOLUTIONS

Proteus-Series

Proteus-I/-II

- Bluetooth 4.2/5.0
- 11x8mm
- nRF52832
- +3dBm TX / -96dBm RX (conducted)
- 1 Mbps datarate
- Roles: Central, Peripheral, Observer, Broadcaster
- Edge Plating / Castellation
- FOTA update
- CE / FCC / IC / TELEC

Proteus-III/Setebos-I

- Bluetooth 5.1
- 12x8mm
- nRF52840
- +6dBm TX / -92dBm RX (conducted)
- 2, 1, 0.5 & 0.125 Mbps datarate
- Roles: Central, Peripheral, Observer, Broadcaster
- Smart Antenna
- Edge Plating / Castellation
- FOTA update
- 6 remote GPIO useable
- CE / FCC / IC / TELEC

Proteus-e

- Bluetooth 5.1
- 9x7mm
- nRF52805
- +4dBm TX / -93dBm RX (conducted)
- 2, 1 Mbps datarate
- Roles: Peripheral, Broadcaster
- Smart Antenna
- Flex Advertising
- 2 remote GPIO useable
- CE / FCC / IC / TELEC

PRODUCT OVERVIEW

WIRELESS CONNECTIVITY

GNSS

Bluetooth® Low Energy

Wi-Fi

Proprietary

Wirepas

Wireless M-Bus

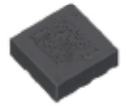
SENSORS

Temperature

Humidity

Absolute Pressure

Differential Pressure



Acceleration