BLE 5.0 and the Smart Home
Future Electronics-Grand Rapids, MI

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Relays & Connectors · Capacitors · Circuit Protection · Electromechanical · Sensors · Industrial Automation · Resistors & Inductors · Semiconductors · Wireless Connectivity

na.industrial.panasonic.com   1-800-344-2112

Agenda

- The Smart Home

- Smart Doorbell: BLE Basics
  - PAN1762 overview & hands-on demo

- Smart Lighting: Thread Mesh Network
  - PAN4620 overview & presenter demo

Panasonic Industrial Devices-Table of Products

Resistors
Thin Film Resistor
Low Resistance Chip Resistor
Small & High Power Chip Resistor
Anti-Sulfur Resistor
Common Mode Noise Filters EXC24xx EXC28xx Series

Capacitors
Aluminum Electrolytic Capacitors
Hybrid Capacitors
Specialty Polymer Capacitors
"Gold-Cap" Electric Double Layer Electrolytic Capacitors
Leaded Film Capacitors

Inductor Products
Power Choke Coils

Circuit Protection
ESD Suppressor
MLCV (Multi Layer Ceramic Varistors)
ZNR/MOV
Thermistors

Thermal Management
PGS/Pyrolytic Graphite Sheet
NASBIS

Electromechanical
Light Touch/Tactile Switches
Detector Switches
Snap Action & Stroke Switch
Rotary Encoders

Relays
Power
Signal
Photo MOS
Solid State
Automotive
High Frequency

Connectors
Narrow Pitch
FPC Connectors
Active Optical
Stacking For High Current

Sensors
Passive Infrared
Infrared Array: Grid Eye
Pressure Sensor

Wireless Connectivity
Bluetooth RF Modules
WiFi, WiFi + BT RF Modules

Storage Media
Industrial SD cards
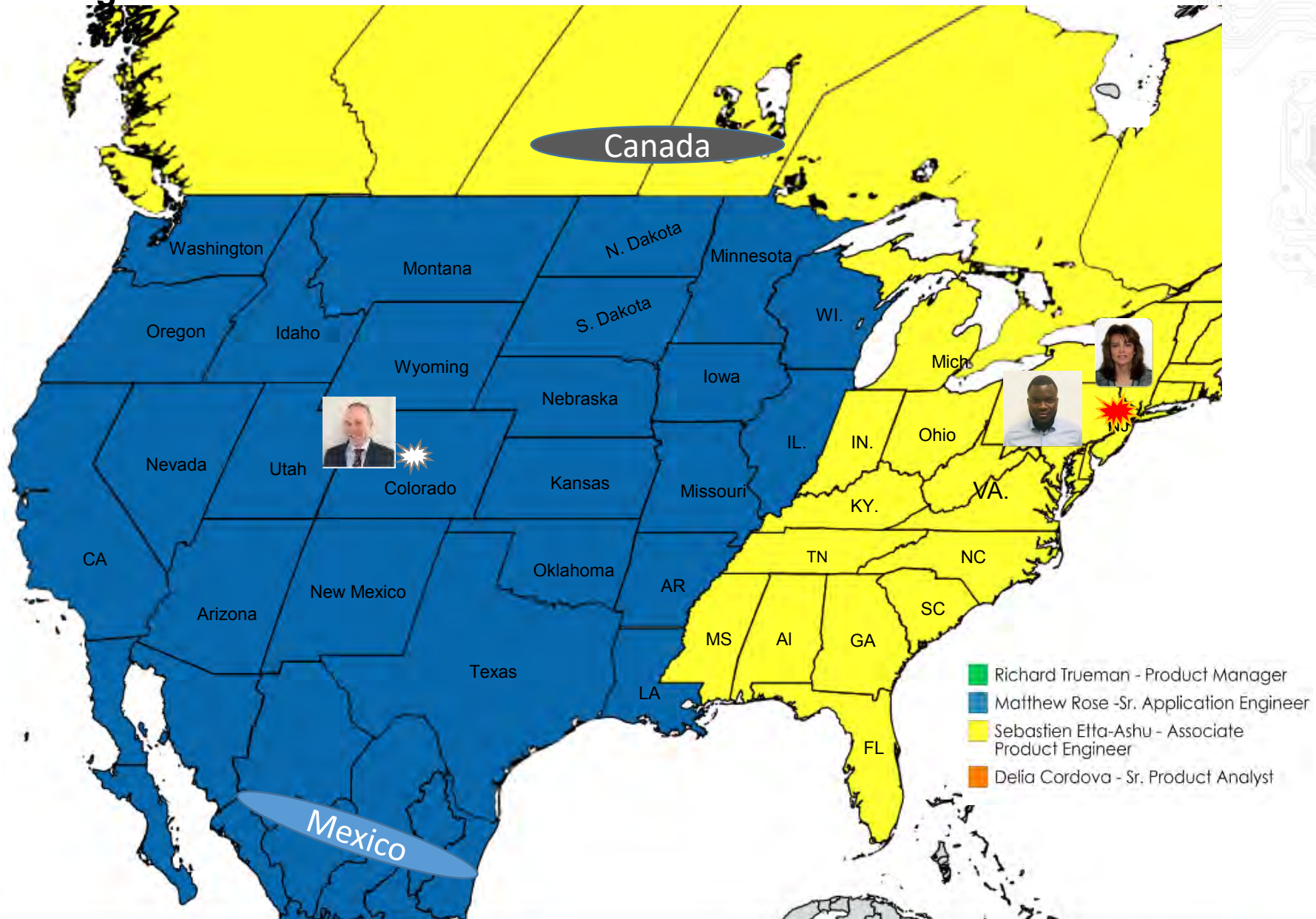Consumer & Plus SD cards
eMMC

Semiconductors
CSP MOSFET & Diode
NFC TAG LSI & Module

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RF Organization

Panasonic RF Team-Europe

RF Design Team, Luneberg, Germany

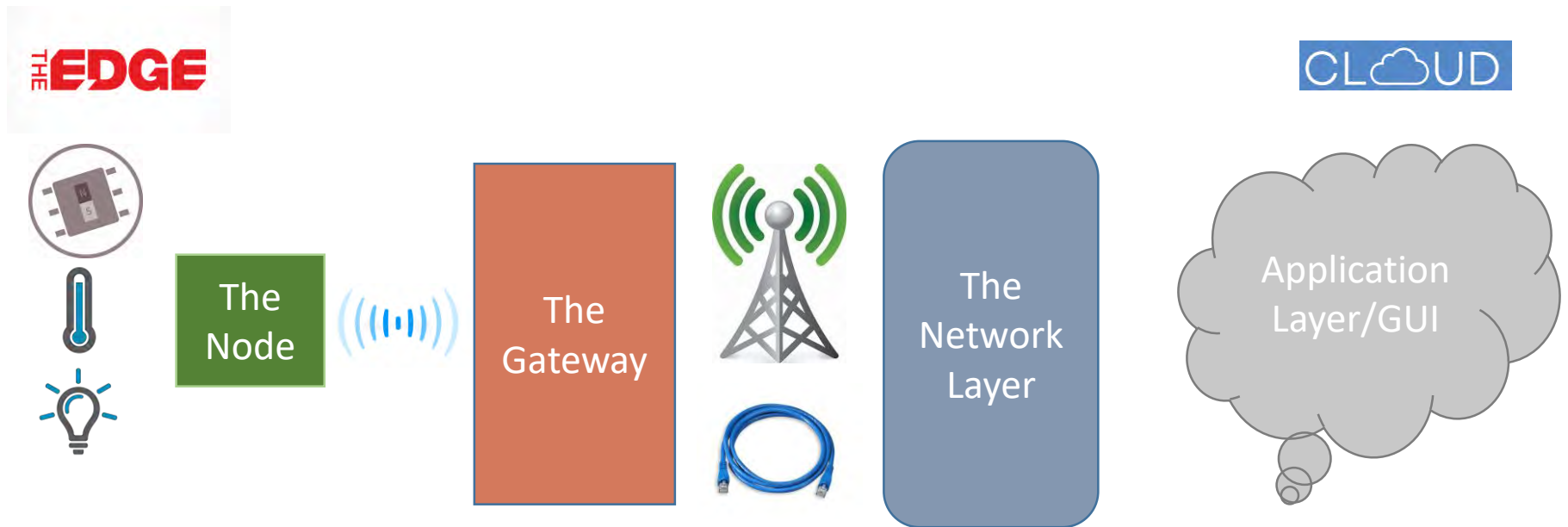**The Factory, Stara Lubovna, Slovakia**

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Panasonic North America-PIDSA

- 257,000 Employees
- Company was founded by Ko-nos-uke Ma-tsush-ita in 1918 as a producer of lightbulb sockets
- Made his money selling bicycle lamps in 1920s
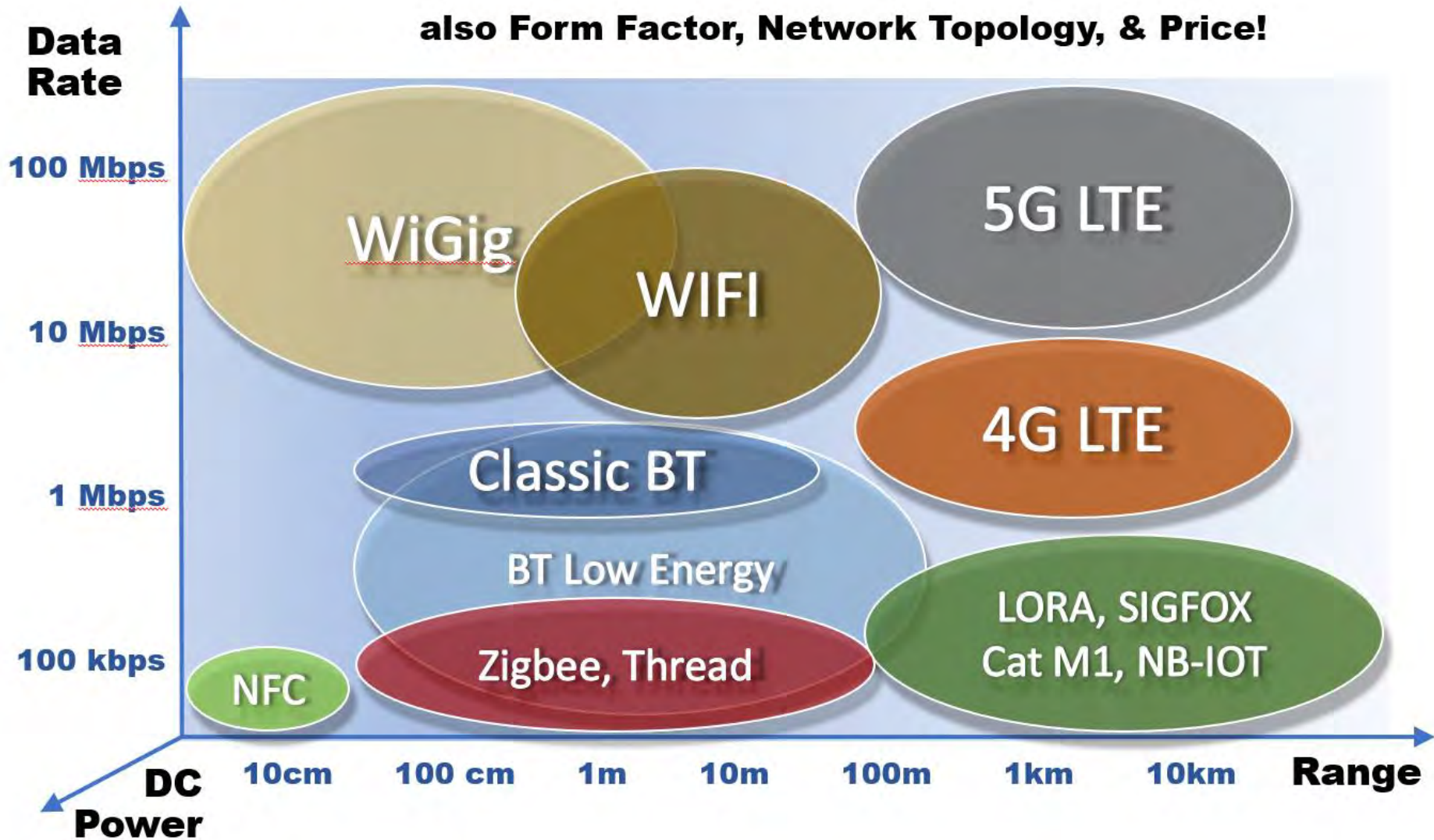- 2018 commemorates 100th Anniversary of founding

Everybody has its own way. Only the courage and persistence of each person will help him discover the true path

~ Konosuke Matsushita ~

www.StatusMind.com

1918

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What is the IOT?

The Internet of Things is the network of physical devices embedded with electronics, software, sensors, actuators and connectivity which enables these things to connect and exchange data.

THE EDGE

The Node

The Gateway

The Network Layer

CLOUD

Application Layer/GUI

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The Six Parameters

Air Protocols

also Form Factor, Network Topology, & Price!

Data Rate axis: 100 Mbps, 10 Mbps, 1 Mbps, 100 kbps

Protocols: WiGig, WIFI, 5G LTE, 4G LTE, Classic BT, BT Low Energy, LORA, SIGFOX, Cat M1, NB-IOT, NFC, Zigbee, Thread

Range axis: 10cm, 100 cm, 1m, 10m, 100m, 1km, 10km

DC Power

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Protocols in Your Cell Phone

1. Cellular (4G/5G LTE)
2. Wifi
3. Classic Bluetooth
4. Bluetooth Low Energy
5. Near Field Communications
6. GPS
7. Wireless Charging

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Architecture Nomenclature
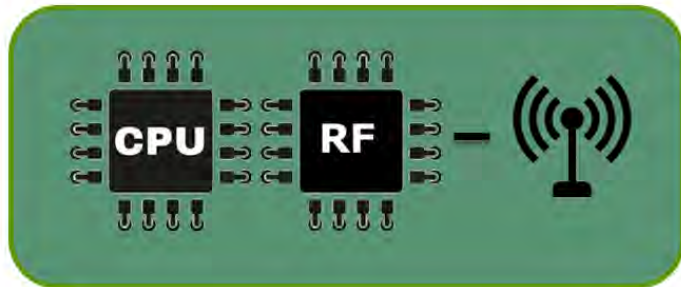
Chip-on-Board design
- CPU does both application and wireless code
- Antenna needs to be certified
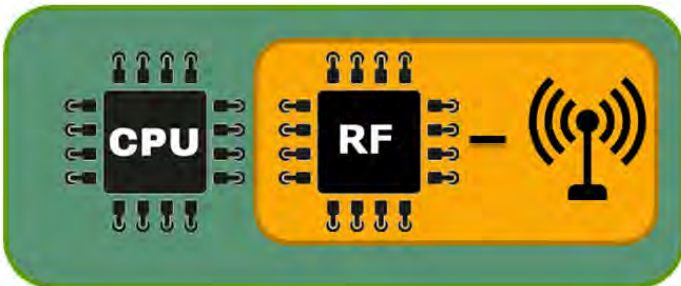
Module design (Host mode)
- CPU still does both application and wireless code
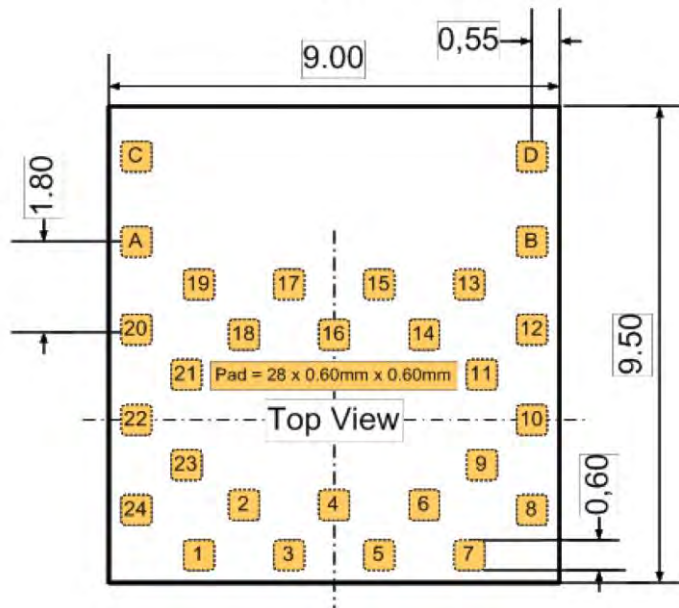- Antenna on module is pre-certified
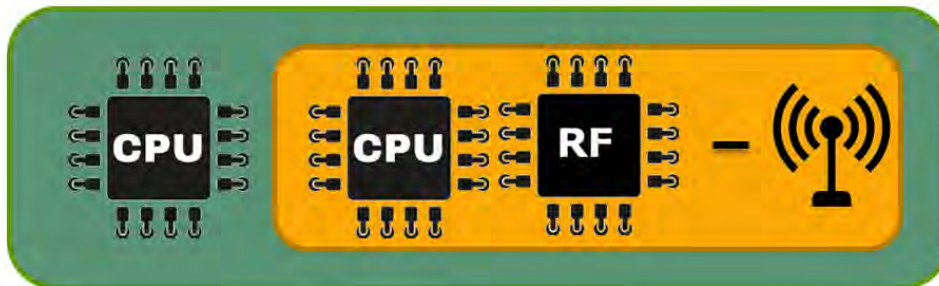
Fully-embedded module design (SA mode)
- CPU does application code
- Separate CPU does wireless code
- Antenna on module is pre-certified

What is a module?

Top View

Top View

Pad = 28 x 0.60mm x 0.60mm

Block Diagram

Vcc 3.3 V

UART/SPI/I2C

GPIOs

Quad Decoder

ADC/Wake-up

Reset

Slow Clock 32 KHz

Dialog DA14580

Crystal 16 MHz

DC-DC Conversion

Chip Antenna

PAN1740 Bluetooth 4.1 Module

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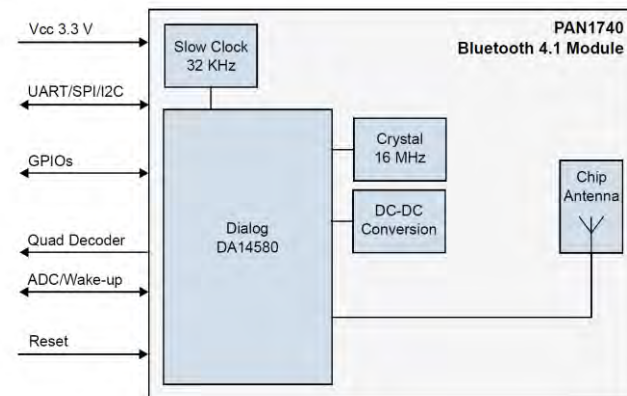
Modules vs. Chip: Why Consider a Module?

Time-to-revenue!

- **Initial Development / RF Certification & Testing --$200k+**
  - Hardware Engineering
  - Firmware
  - RF Layout
  - RF Test Equipment
  - Testing & Verification
  - Re-spin
  - Certification
- **TOC = BOM + Mfg & Packaging**
- **Other Considerations**
  - Time to market
  - Product Life

Breakeven?

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Smart Home

Smart Doorbell

Smart Lighting

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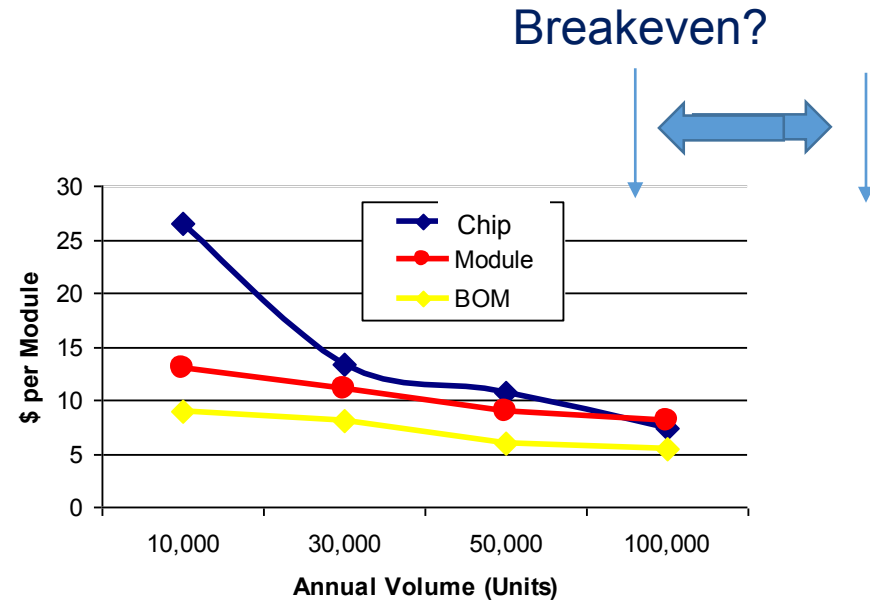
The Smart Home
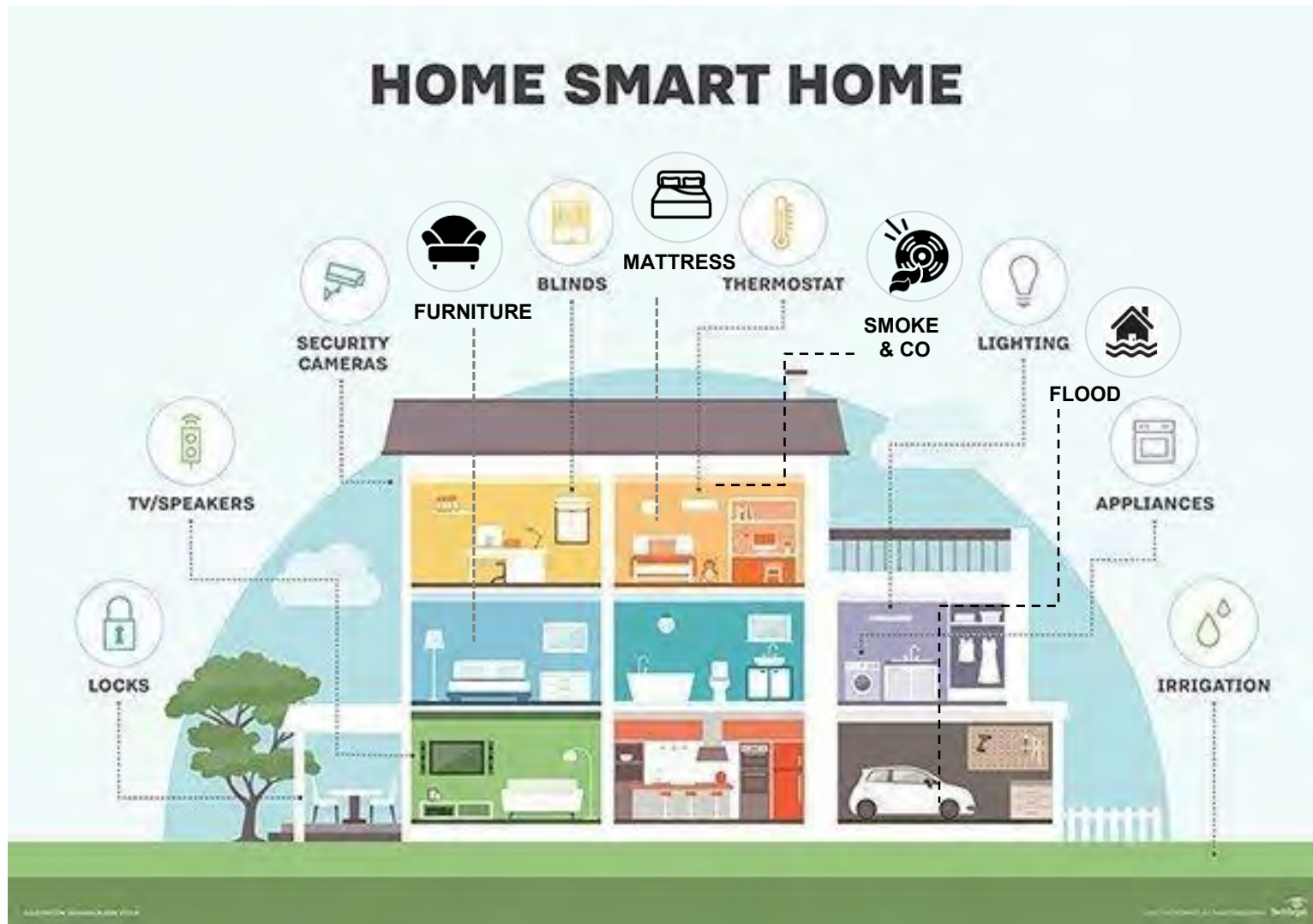
The Free Refrigerator

- I bought a home on Halloween 2018 that came with a free fridge (1)-$1200
- The front of the fridge had a ding in it so it was replaced (2)
- Fridge didn't work so I called the builder in mid Nov. who said call the mfg
- I called the mfg. After waiting for 41 minutes they said call repairman
- Repairman came after Thanksgiving. Fridge worked for one day.
- Repairman came again. Worked for two days. Food spoiled.
- Repairman came again in early Dec. Called the mfg.
- Said he couldn't repair it so mfg authorized replacement.
- Missed mfg call. Called back & waited on hold for 32 min.
- New fridge will be delivered by shipping company Jan 3.
- New fridge (3) arrived Jan 3 but they wouldn't install it.
- Hauled old fridge (2) into the garage, installed new fridge (3)
- Another phone call from third party. New fridge due Jan 15.
- Second new fridge (4) goes into the garage. They take # 2.

Would the addition of a wireless module have created a better experience?

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A visit to Lowe's Appliance Aisle

"We're not supposed to talk to people doing research" Associate Mike

Washers & Dryers lead the IOT revolution

W/D Brand	MSRP	Wifi
LG	$799-$1499	SmartDiagnosis/SmartThinq
SAMSUNG	$799-$2099	Smartcare
SAMSUNG	$699-$799	no
WHIRLPOOL	$599-$1299	no models
MAYTAG	$699-$1299	no models
GE	$599-1049	no models
ROPER	$499	no

High and medium priced must have STEAM! VIBE! And MOISTURE SENSOR!

Bacteria Heater & Wrinkle Shield also touted & Vent sensor on high end!

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High-end Fridges are following

SAMSUNG

GE APPLIANCES

LG

Stoves, Microwaves and Dishwashers lag…

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A visit to Home Depot Appliance Aisle

Chef Connect/BLE

- Chef Connect uses Bluetooth technology to pair compatible ranges, hoods, and over-the-range microwaves.

- When paired with a Chef Connect range, the over-the-range microwave clock will sync to the range clock, so you only have to set one clock. Additionally, you can set the microwave surface light and vent fan to come on automatically when the range burners are used. When the device is paired, the light and fan will turn ON upon receiving a command from the range or cooktop.

Carl "Customers mainly buy on price and features, some like the wifi."

High End Smart Ovens

GE APPLIANCES

$3000

JENN-AIR®

BOSCH

LG

dacor
The Life of the Kitchen.®

Bluetooth®

"Wirelessly control oven functions from your smartphone"

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Smart Microwaves

$800

$60

- Scan-to-cook technology — Take the guesswork out of microwaving frozen foods and prepare your favorites exactly how the manufacturer intended with just the scan of a barcode

- Wi-Fi Connect — Works with Alexa, so you can use your voice to operate your microwave from any room in the house

High End Smart Dishwashers

GE APPLIANCES

BOSCH

$800
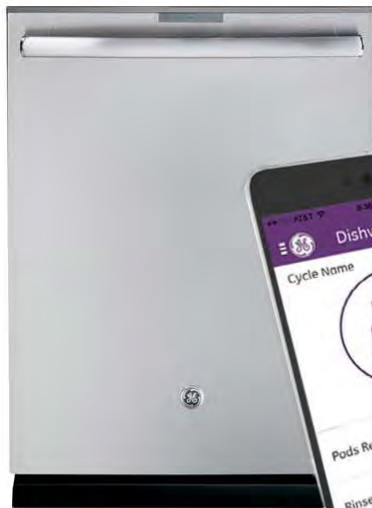
What does connectivity get the consumer?

Maintenance

Troubleshoot quickly with SmartDiagnosis™

Consumable status
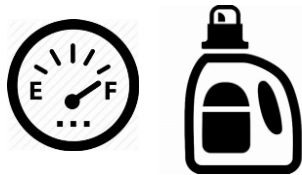
Assistant Interaction

WIFI CONNECT
Connect to WiFi for real-time feedback, optimized performance, alerts and more.

WORKS WITH

WORKS WITH amazon alexa

amazon dash Replenishment

IFTTT

works with the Google Assistant

An Expanded Experience
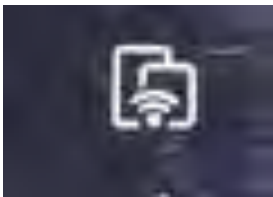
Wifi connectivity allows you to download customizable programs and stay connected

The Cool Factor

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IOT's Value to Stakeholders

- Consumers
  - Ease of use
  - Perception of quality
  - Expanded experience
- Suppliers
  - Reliability
  - Customer use cases
  - Improved customer experience
  - Improved brand loyalty
- Service entities
  - More efficient repair
  - Improved customer experience
- Other entities in the Ecosystem
  - Attaching to the home network/asst.
  - Consumable suppliers

A Warranty Anecdote:
- Four repair trips
- 30-40 minutes hold times
- Two months down time
- Three fridges delivered

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Paths to connectivity

- The big question: Can low- and medium-priced appliances gain from connectivity?
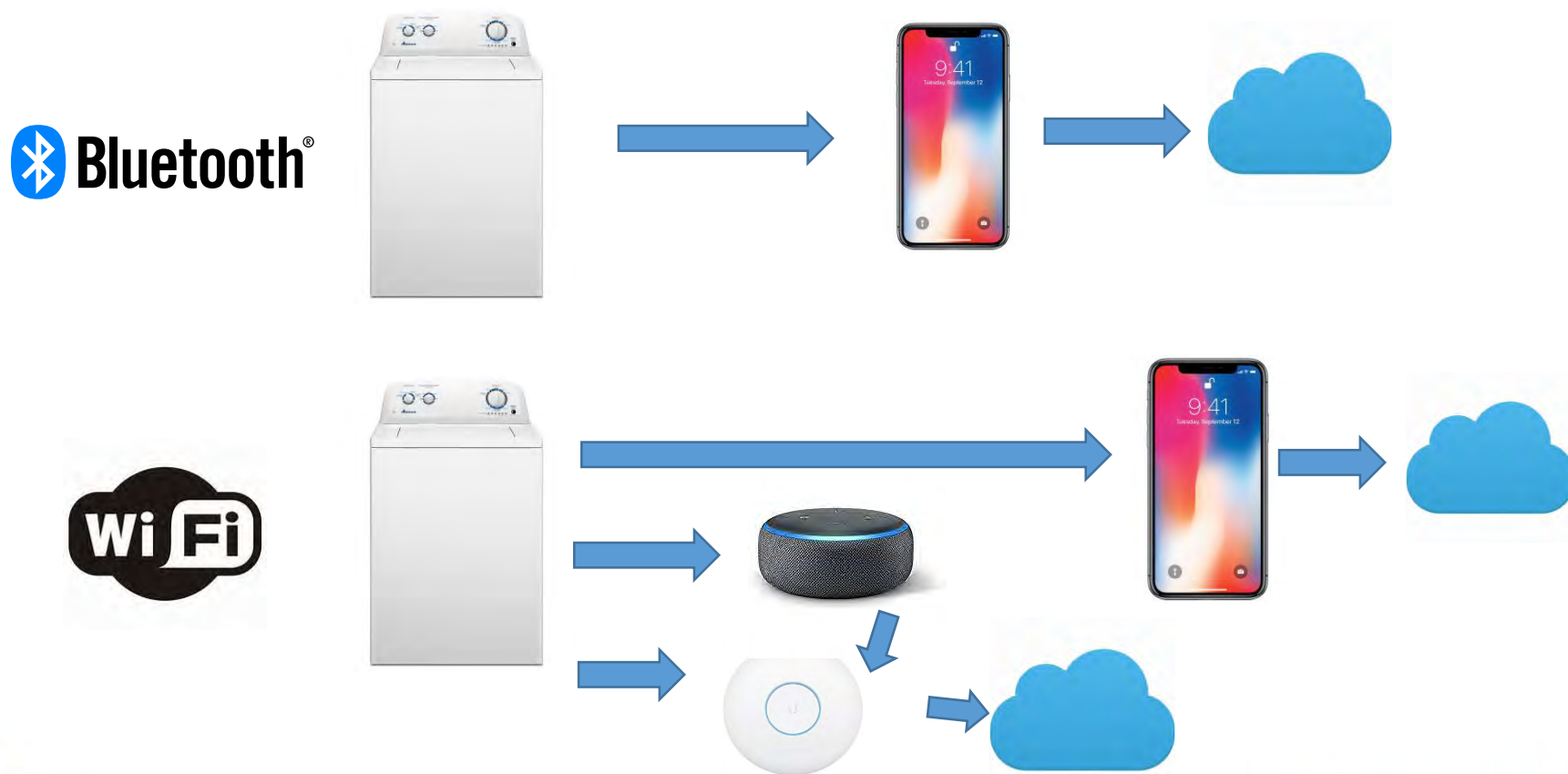
Home Depot's Connectivity Aisle

A visit to Home Depot-cont.

Ring™ Alarm Indoor Security Kit

RING ALARM MOTION ALERT KIT 5PC

$199.00

Safety

RING PRO HARDWIRED VIDEO DOORBELL

Nest® Hello Video Doorbell

Auto-Away saves energy when you're out.

REBATE AVAILA...

Nest Learning Thermostat
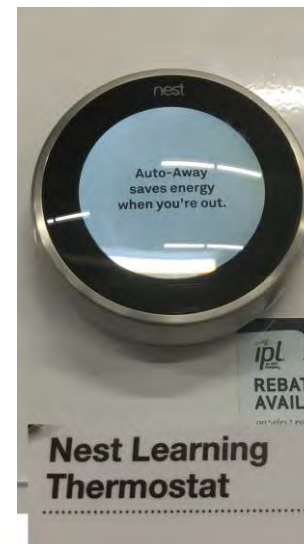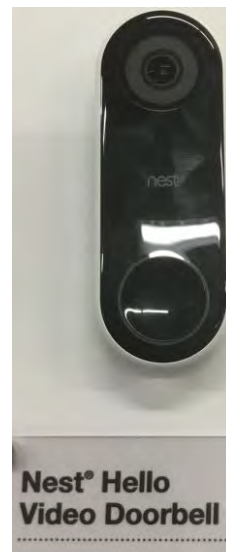
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The Delta Allentown LED Smart Faucets

80°F — 95°F — 110°F

Indicator Changes Color as Water Temperature Changes
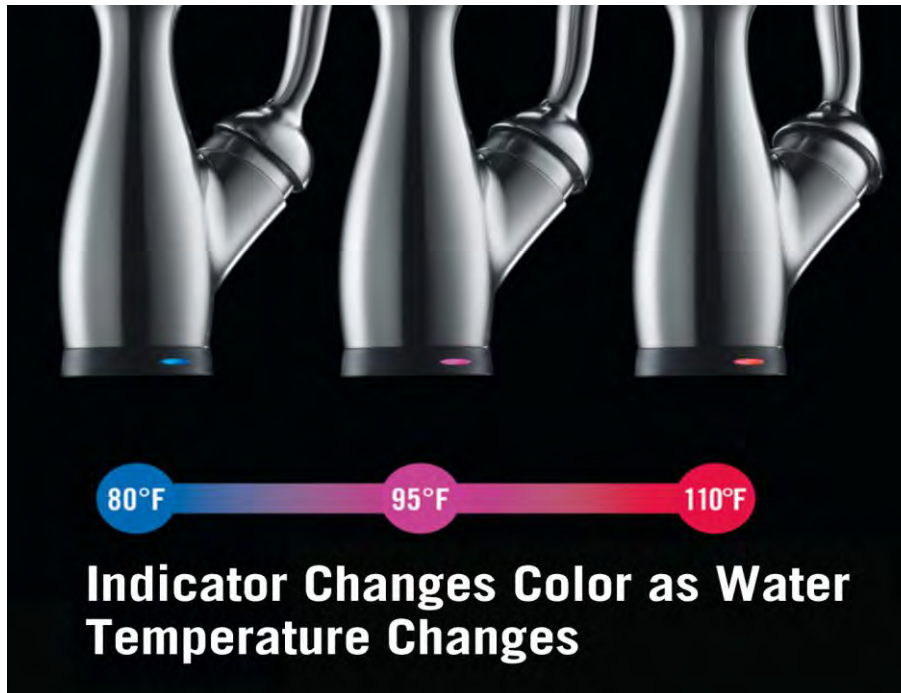
- **Water-powered**
- **Helps to save water by indicating temperature instead of allowing the water to run**
- **Helps to avoid temperature surprises**

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Smart Home

Smart Doorbell

Smart Lighting

History of Bluetooth
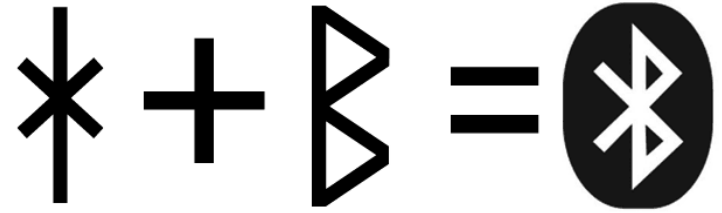
**Nickname of
King Harald "Blåtand" Gormsson
King of Denmark ca. 958-986AD**

Succeeded by his son, Sweyn Forkbeard

In 1997, Intel engineer Jim Kardach suggested the name "Bluetooth" as King Harald had brought together warring tribes and the protocol would be uniting various consumer devices through a common wireless link.

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The Bluetooth Special Interest Group

- Started in 1998 with five companies
- Now consists of 33,000 companies
- Working groups hash out standards
- All products that use Bluetooth must complete the Bluetooth Qualification Process   www.Bluetooth.com

Fees	Explanation	Associate Member	Adopter Member
Declaration / Listing Fees			
Declaration Fee	A Declaration fee must be paid for any new, changed, used or branded Bluetooth product	$4,000	$8,000
Innovation Incentive Program (IIP)	Start-up companies commercializing their first Bluetooth product can qualify for up to two declarations at a reduced price. The company must have annual revenue of less than USD $1 million and no prior QDLs, EPLs or Declarations.	$2,500	$2,500
GATT-based Profile Client (app)	Applications that support the client role only and implement one or more Bluetooth SIG adopted GATT-based Profiles are qualified as a Profile Subsystem product type.	$100	$100

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FCC Part 15B Testing (Unintentional radiation)

Regulation Title 47 CFR part 15 Compliance Testing

FCC testing for Product Certification can be broken into two parts: General Emissions testing and Intentional Radiation testing.

Virtually every electronic product needs to undergo General Emissions testing.
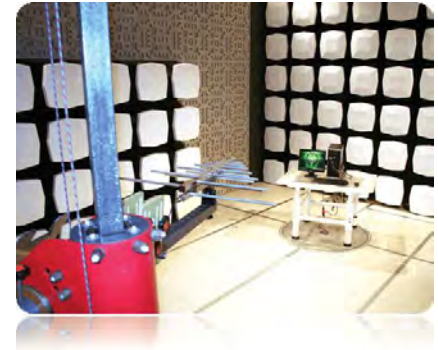
- The FCC has mandatory requirements before a product can be used, sold, or even marketed in some cases.
- Depending on the type of equipment, manufacturers are required to meet the FCC requirements for Certification and Supplier's Declaration of Conformity (SDoC)
- FCC Part 15 Subpart B is for unintentional radiators that use IC chips, oscillators, clocks, or one of any other numerous active electronic components
- FCC Part 15 Subpart B lists the emissions limits and requirements. Testing to the appropriate test methods is typically the only way to prove the requirements are met.
- Anecdotally cost is $1500-$2500 and takes a day or two of testing

FCC 15B is a self-declaration process, not a certification
2019 brings changes to the process-TBD

Panasonic modules are certified for Intentional Radiation in many territories. Certified countries are listed in individual datasheets.

IC

FC

CE

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Bluetooth Versions

CLASSIC	**1.0**	**1997**	**Introduction of Bluetooth "Classic"**
	2.0	**2004**	**Introduction of Enhanced Data Rate**
	2.1	**2007**	**Addition of Secure Simple Pairing**
	3.0	**2009**	**Addition of Alternative MAC/PHY**
BLE	**4.0**	**2010**	**Introduction of BLE**
	4.1	**2014**	**Increased packet size**
	4.2	**2016**	**Increased security with ECC**
	-	**2017**	**Ratification of Mesh 1.0 spec**
	5.0	**2018**	**Long distance, 2.0 Mbps PHY**
	5.1	**2019**	**Angle of arrival/Angle of departure**
	6.0	**2020**	**Audio over BLE**

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The Generic Access Profile

Device role: Central

Client

X ?	Y ?	Z ?
T		

Server

Time 5:30:04		

Device Role: Peripheral

Server

X 1	Y 0	Z 0
T 25.5		

Client
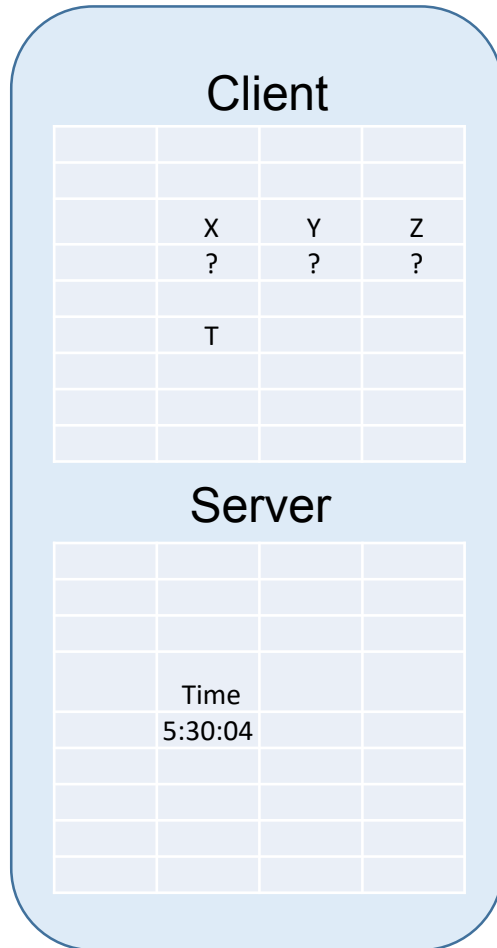
Time ?		

Sensor Data

Current Time

Sensors

CLOCK

05:30

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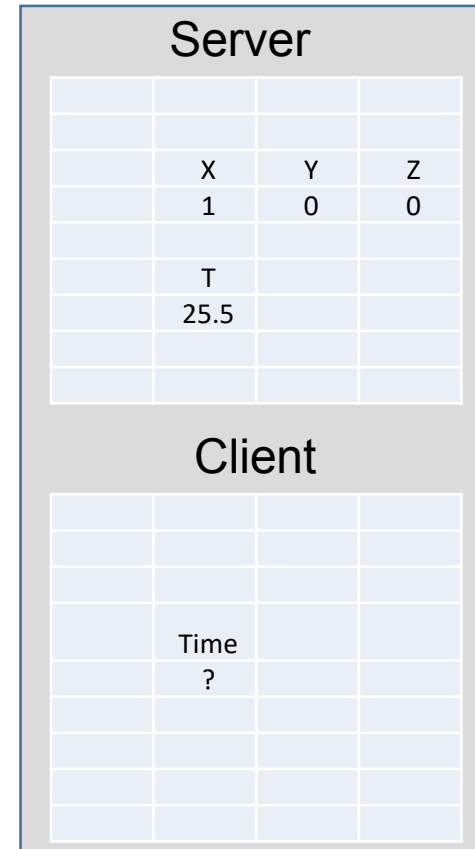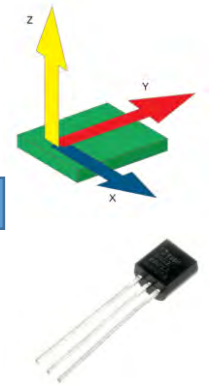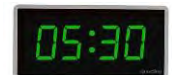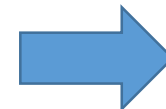
BLE Generic Access Profile Modes and Roles
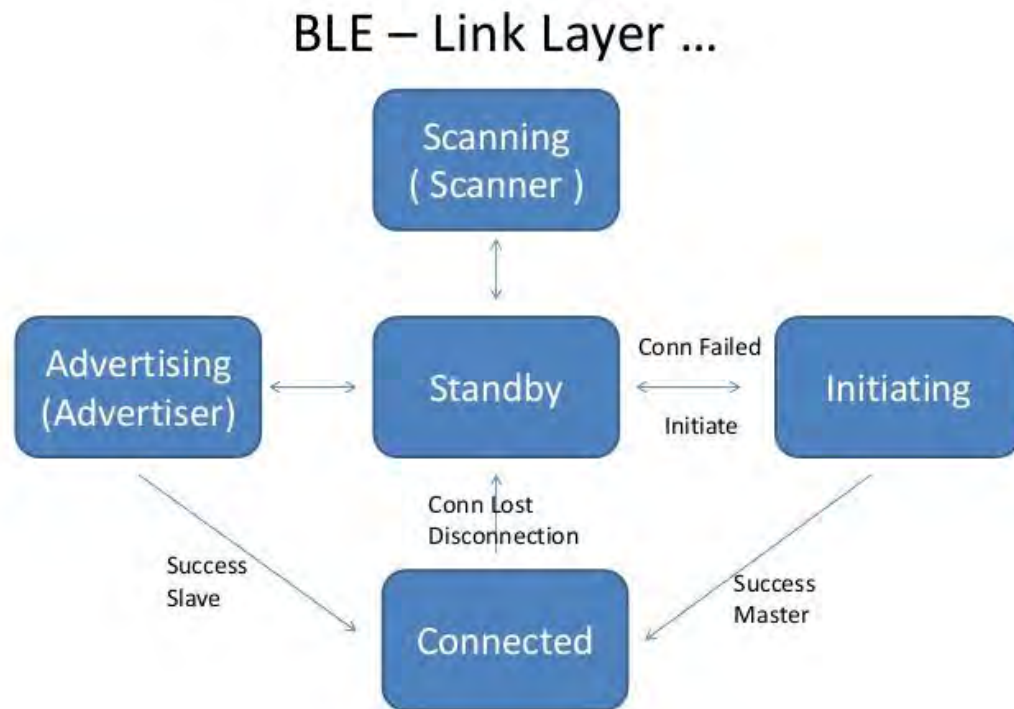
BLE – Link Layer ...

1. Advertising
   A. Broadcaster: sends ADV packets with data, Link Layer Advertiser
   B. Observer: scans for advertisements, Link Layer Scanner
2. Connected
   A. Peripheral: Advertises, Link Layer Slave
   B. Central: establishes and manages connection, Link Layer Master

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Modes and the Whitelist

Bluetooth Low Energy Sensor Nodes

Bluetooth

1. Discovery Modes
    A. Non-Discoverable
    B. Limited-Discoverable
    C. General-Discoverable

2. Connection Modes
    A. Non-Connectable
    B. Directed-Connectable
    C. Undirected-Connectable

Smartphones / Tablets
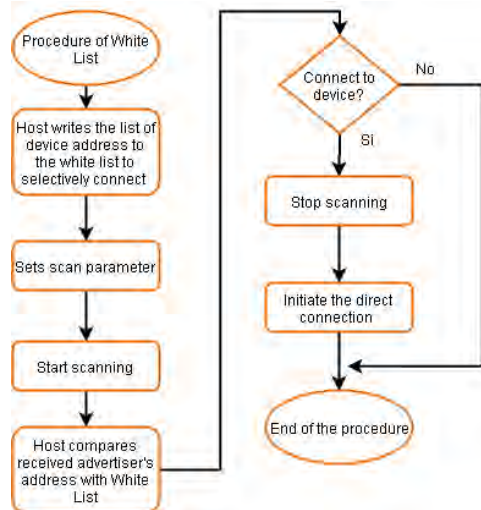
- The device to connect is saved on the white list located in the Link Layer.
- This enumerates the remote devices that are allowed to communicate with the local device.
- Since device filtering occurs in the LL it can have a significant impact on power consumption by filtering (or ignoring) advertising packets, scan requests or connection requests from being sent to the higher layers for handling.
- The White List can restrict which device are allowed to connect to other device. If is not, is not going to connect.

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BLE Advertising and Connected Channels
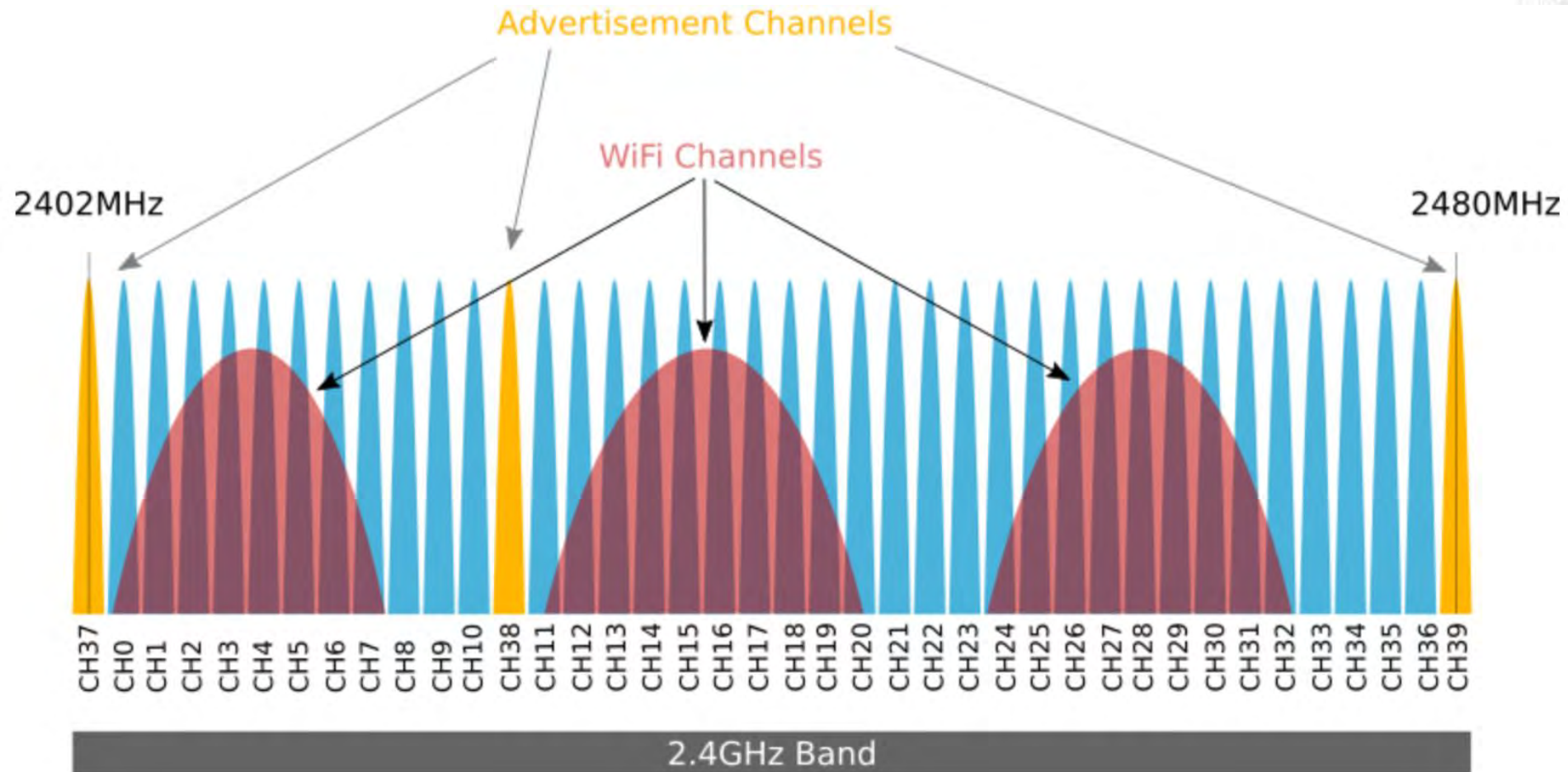
Time-based graph of advertising
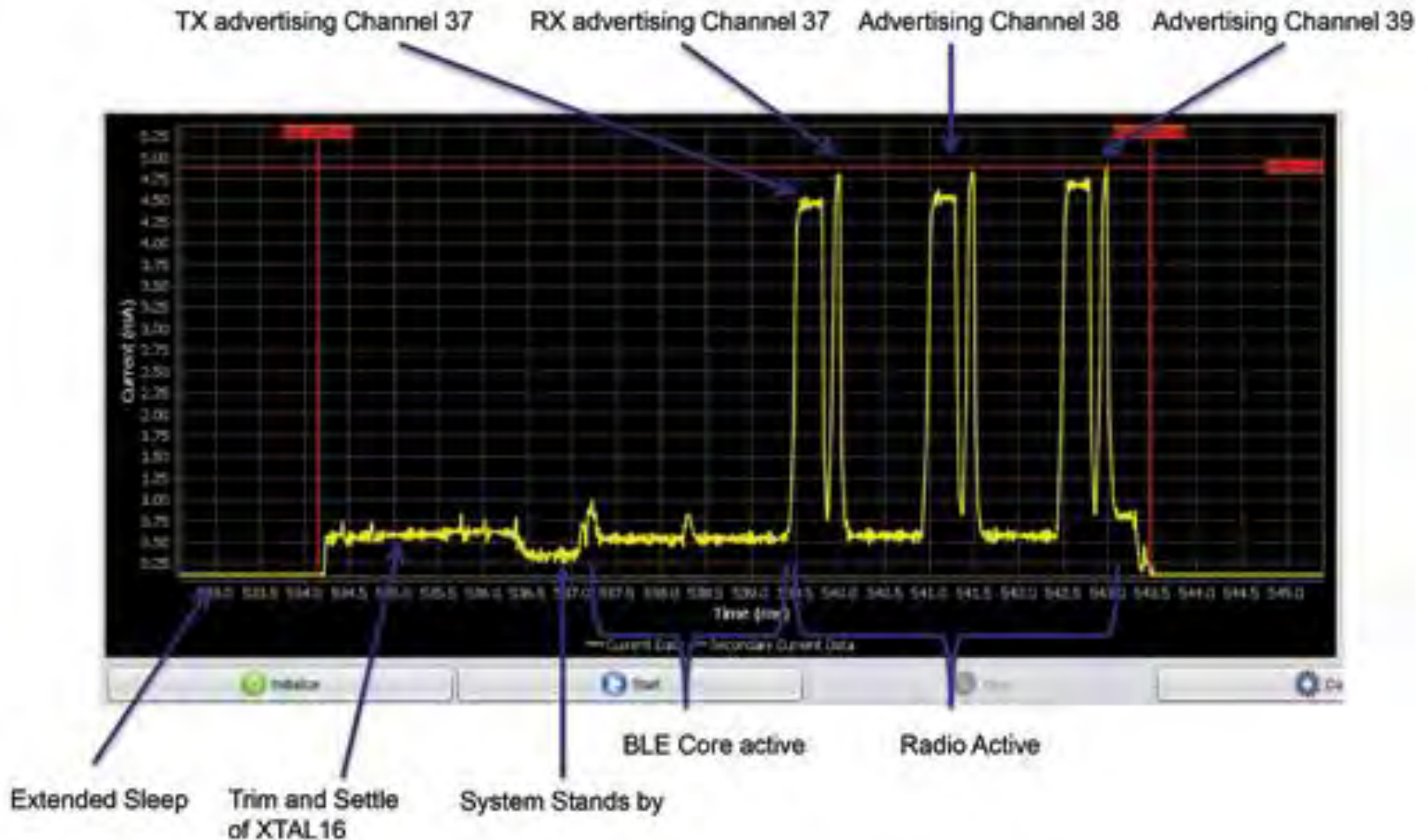
Dialog DA14580/PAN1740 using Smart Snippets app

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Advertising and Connection Establishment
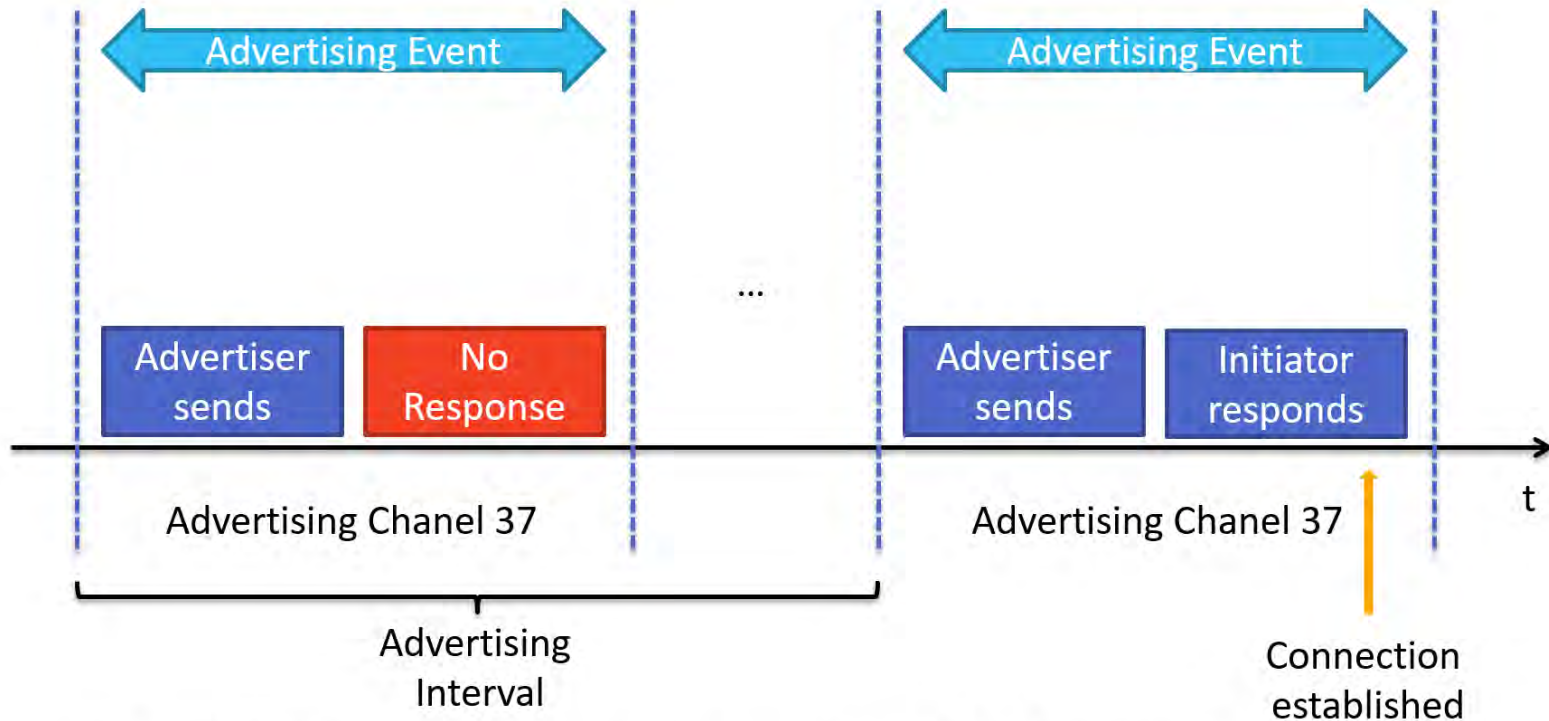
- Central device scans advertising channels 37, 38, 39 for advertising messages
- Peripheral device waits for response after sending advertising message
- Central device initiates connection by responding to advertising event
- Central dictates all connection parameters used for connection

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Connection Events
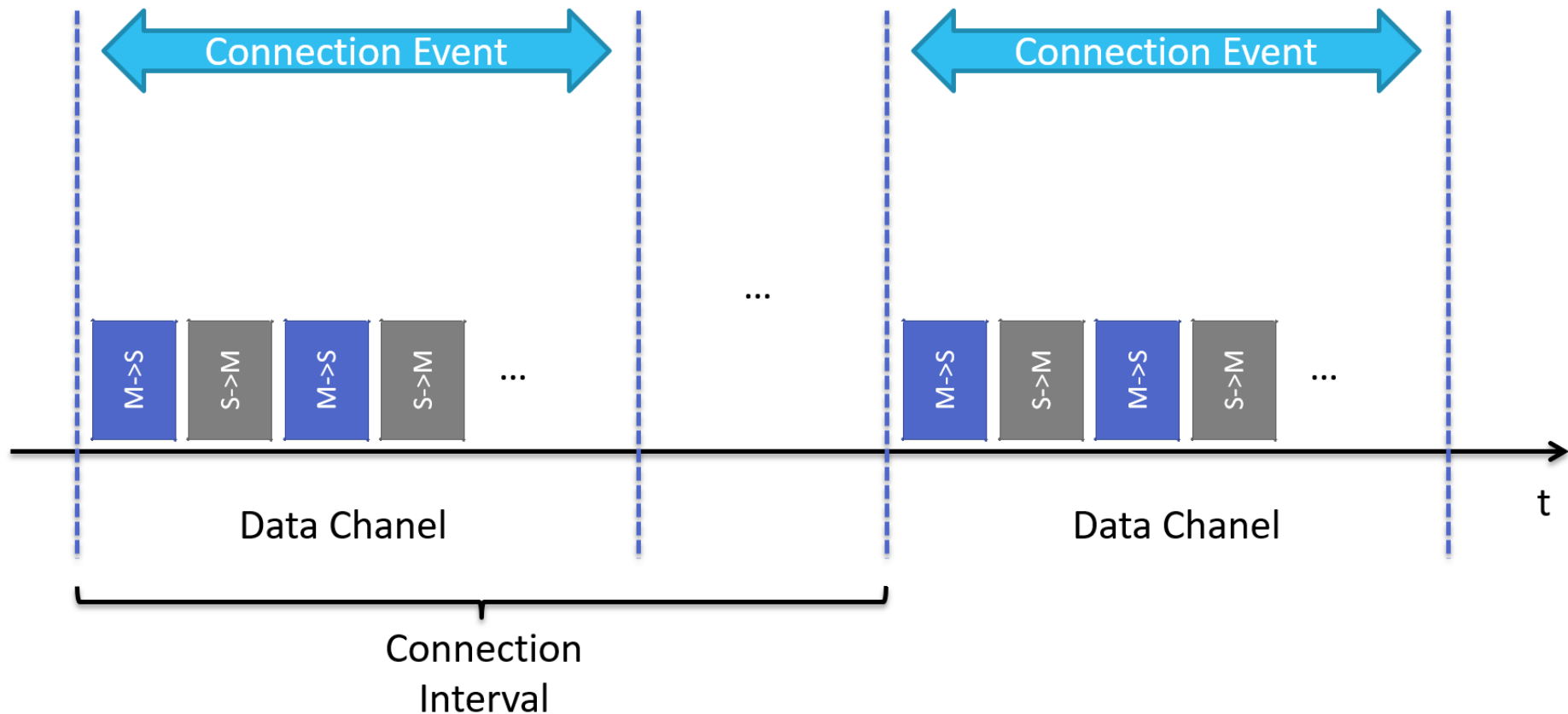
- Connection interval can only be changed by master
- Slave may request master to change connection interval
- Multiple packets are exchanged between master and slave
- Max. number of packets is hardware-dependent

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Piconet-Scatternet

A **scatternet** is a type of ad hoc computer network consisting of two or more piconets. The terms "scatternet" and "piconet" are typically applied to Bluetooth wireless technology.
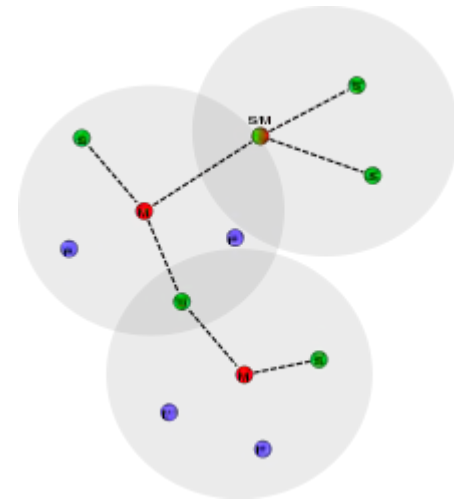
A *piconet* is the type of connection that is formed between two or more Bluetooth-enabled devices. The devices are "peer units" in that they are able to act as either master or slave. However, when a piconet is formed between two or more devices, one device takes the role of the 'master', and all other devices assume a 'slave' role for synchronization reasons. Piconets have a 7 member address space (3 bits, with zero reserved for broadcast), which limits the maximum size of a piconet to 8 devices, i.e. 1 master and 7 slaves.

A *scatternet* is a number of interconnected piconets that supports communication between more than 8 devices. Scatternets can be formed when a member of one piconet (either the master or one of the slaves) elects to participate as a slave in a second, separate piconet.

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Generic ATTribute Profile - Data structure

- How data is organized and exchanged
- Some specific profiles are standardized by the SIG (Public profiles)
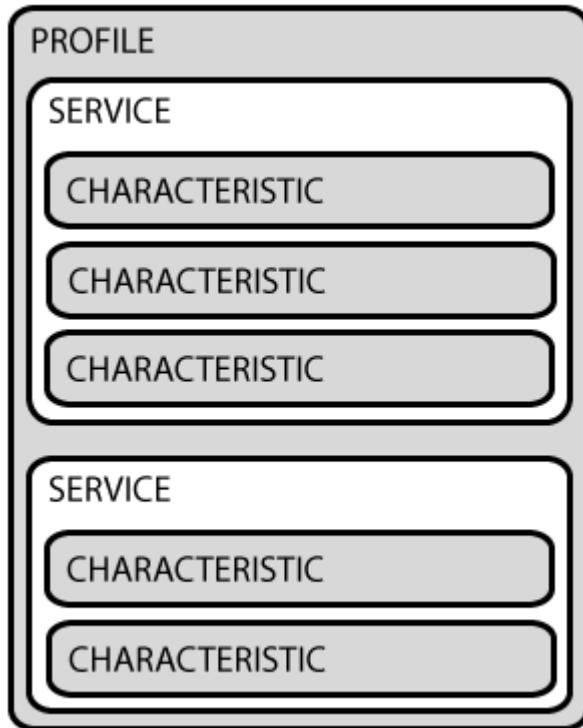
Profile:
    Heart Rate Profile

Services:
    A. Heart Rate Service (16-bit UUID 0x180D)
    B. Device Information Service

Characteristics
    A1. Heart Rate Measurement (0x2A37)
    A2. Body Sensor Location
    A3. Heart Rate Control Point
    B1.
    B2.

Attributes/Data

PROFILE

  SERVICE
    CHARACTERISTIC
    CHARACTERISTIC
    CHARACTERISTIC

  SERVICE
    CHARACTERISTIC
    CHARACTERISTIC

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List of Public Profiles and Services

Mesh profiles
- MESH (Mesh Profile) - for base mesh networking.
- MMDL (Mesh models) – for application layer definitions.

Health care profiles
- BLP (Blood Pressure Profile) — for blood pressure measurement.
- HTP (Health Thermometer Profile) — for medical temperature measurement devices.
- GLP (Glucose Profile) — for blood glucose monitors.
- CGMP (Continuous Glucose Monitor Profile)

Sports and fitness profiles
- BCS (Body Composition Service)
- CSCP (Cycling Speed and Cadence Profile) — for sensors attached to a bicycle
- CPP (Cycling Power Profile)
- HRP (Heart Rate Profile) — for devices which measure heart rate
- LNP (Location and Navigation Profile)
- RSCP (Running Speed and Cadence Profile)
- WSP (Weight Scale Profile)

Internet connectivity
- IPSP (Internet Protocol Support Profile)

Generic sensors
- ESP (Environmental Sensing Profile)
- UDS (User Data Service)

HID connectivity
- HOGP (HID over GATT Profile)

Proximity sensing
- FMP — the "find me" profile
- PXP — the proximity profile

Alerts and time profiles
- The phone alert status profile
- The time profile

Battery
- The Battery Service exposes the Battery State and Battery Level

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Bluetooth 5.0

1. Up to 2x bandwidth
   - 2Mbps PHY

2. Up to 4x range of Bluetooth 4.2 with low energy
   - Coded PHY (125 kbps mode and 500 kbps mode)

3. Up to 8x the broadcasting capacity on the RF layer
   - Larger data packets: 31-octet to 255-octet packets

4. Offload advertising data
   - from 3 ADV channels to up to 37 broadcasting channels

v5.0 Throughput Comparisons

	BLE 4.2	BLE 5	BLE 5 Long Range (S=2)	BLE 5 Long Range (S=8)
Connection speed	1 Mbps	2 Mbps	1 Mbps	1 Mbps
Network data rate	1 Mbps	2 Mbps	500 Kbps	125 Kbps
Data throughput	800 Kbps	1400 Kbps	380 Kbps	109 Kbps
Error Correction	None	None	FEC	FEC
Bluetooth 5 Requirement	Mandatory	Optional	Optional	Optional

Note: v4.0- 72 kbps, v4.1- 220 kbps, both at about 25 feet

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Does my phone have 5.0?

- Using nRFConnect
- Need ANDROID 8 (Oreo) and Galaxy S8, iPhone 8 or X
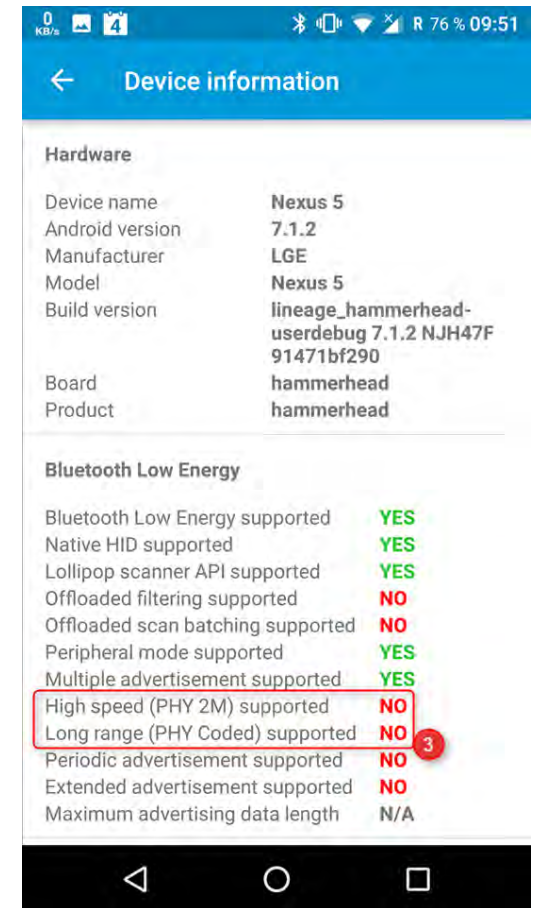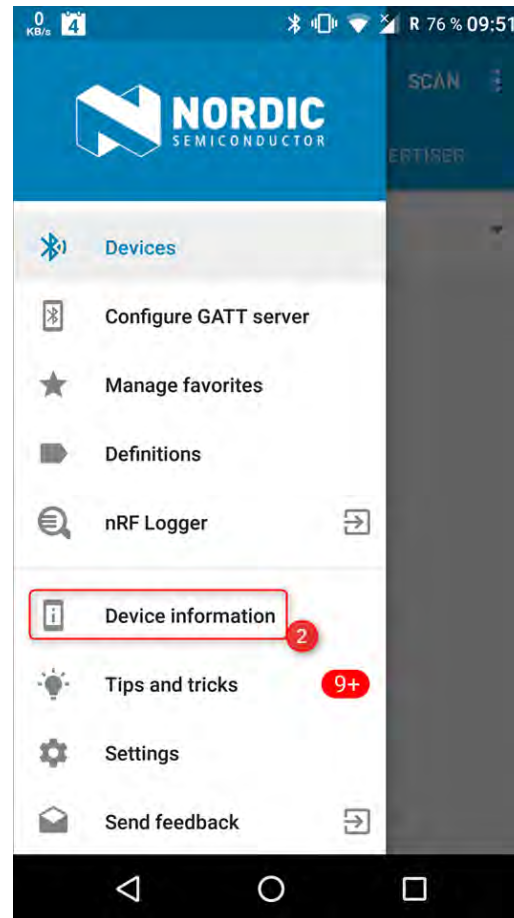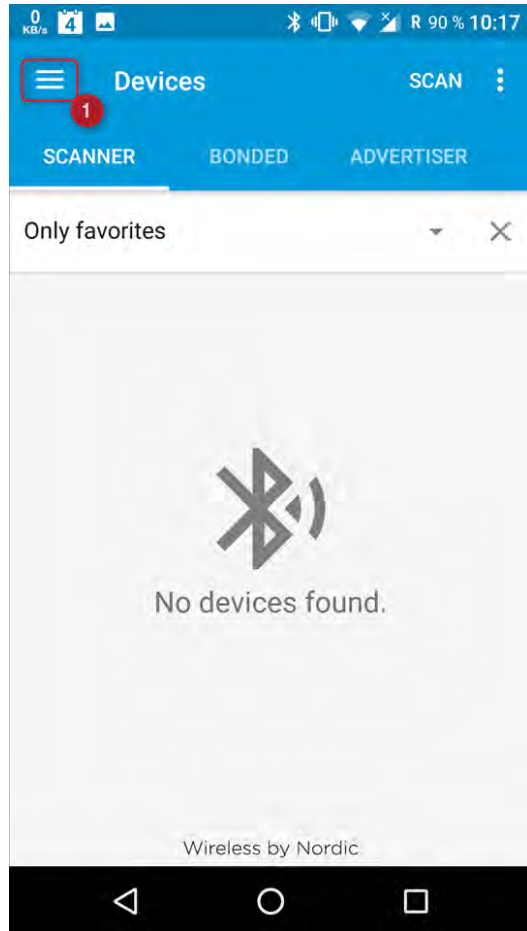
Android Version History
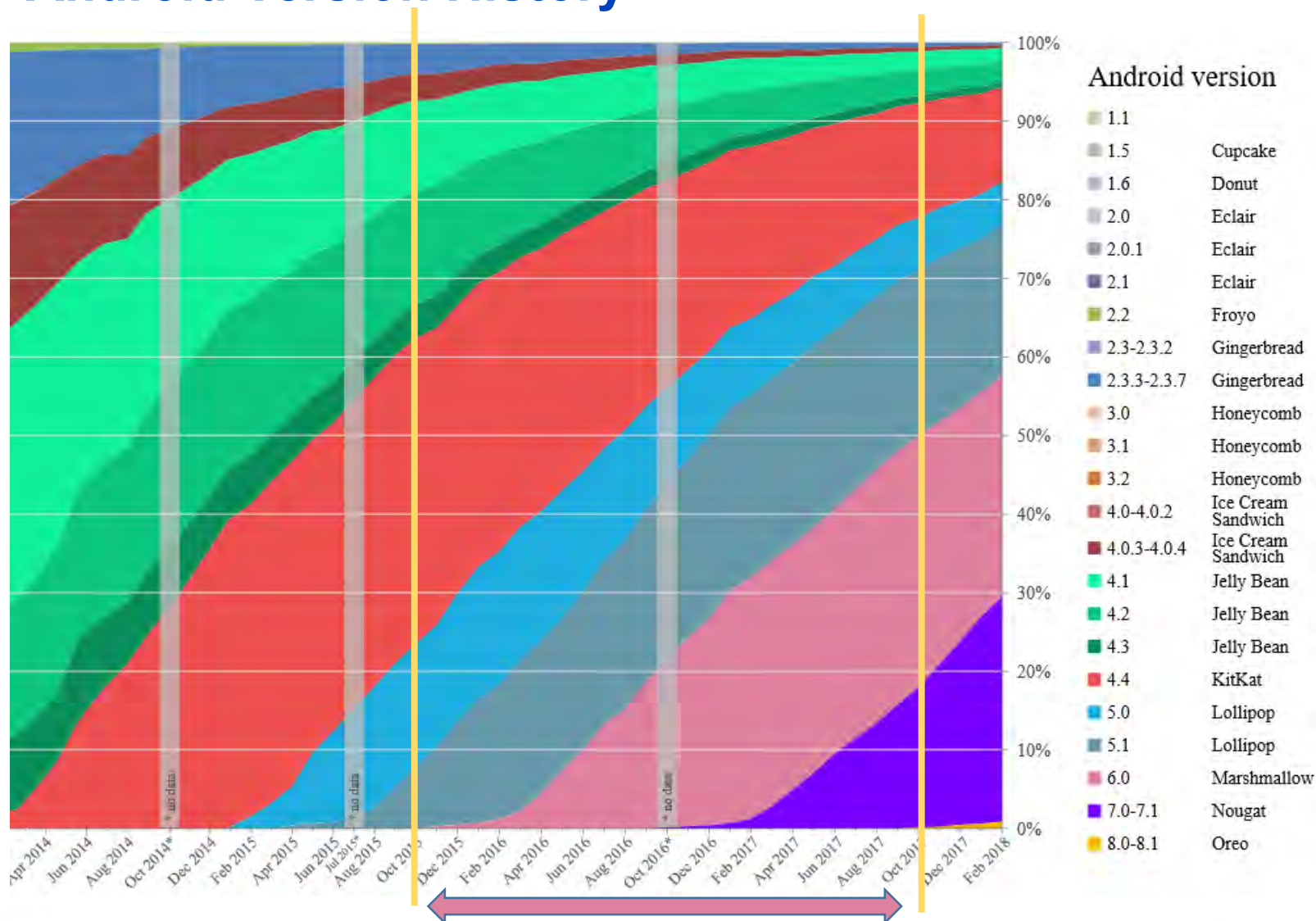
Took about 2 years for Marshmallow to hit 50% market

BLE 5 Smartphones

Device	LE 2M	LE Coded	Extended Advertising
Samsung Galaxy S10+ (Snapdragon)	Yes	Yes	Yes
Xiaomi Mi 9	Yes	Yes	Yes
OnePlus 6T	Yes	Yes	Yes
Huawei Mate 20 Pro	Yes	Yes	Yes
Huawei Mate 20 X	Yes	No	No
Google Pixel 3	Yes	No	Yes
Nokia 7 Plus	Yes	No	No
Razer Phone 2	Yes	No	Yes
Pocophone F1	Yes	Yes	Yes
Samsung Galaxy Note 9 (Snapdragon)	Yes	No	No

Bluetooth Low Energy

Bluetooth Low Energy supported	YES
Native HID supported	YES
Lollipop scanner API supported	YES
Offloaded filtering supported	YES
Offloaded scan batching supported	YES
Peripheral mode supported	YES
Multiple advertisement supported	YES
High speed (PHY 2M) supported	YES
Long range (PHY Coded) supported	YES
Periodic advertisement supported	YES
Extended advertisement supported	YES
Maximum advertising data length	1650

Panasonic

Toshiba TC35680 Range Testing

Distance Measurement of TC35680

600m communication distance has been demonstrated.

Baylands Park
999 E Caribbean Dr, Sunnyvale, CA 94089

Saratoga Creek

500.00 m   600.80 m

Measure distance
Click on the map to add to your path

Total distance: 600.80 m (1,971.12 ft)

Map data ©2018 Google

Panasonic
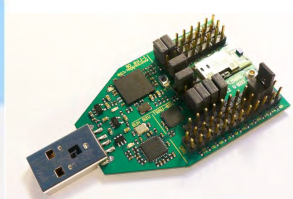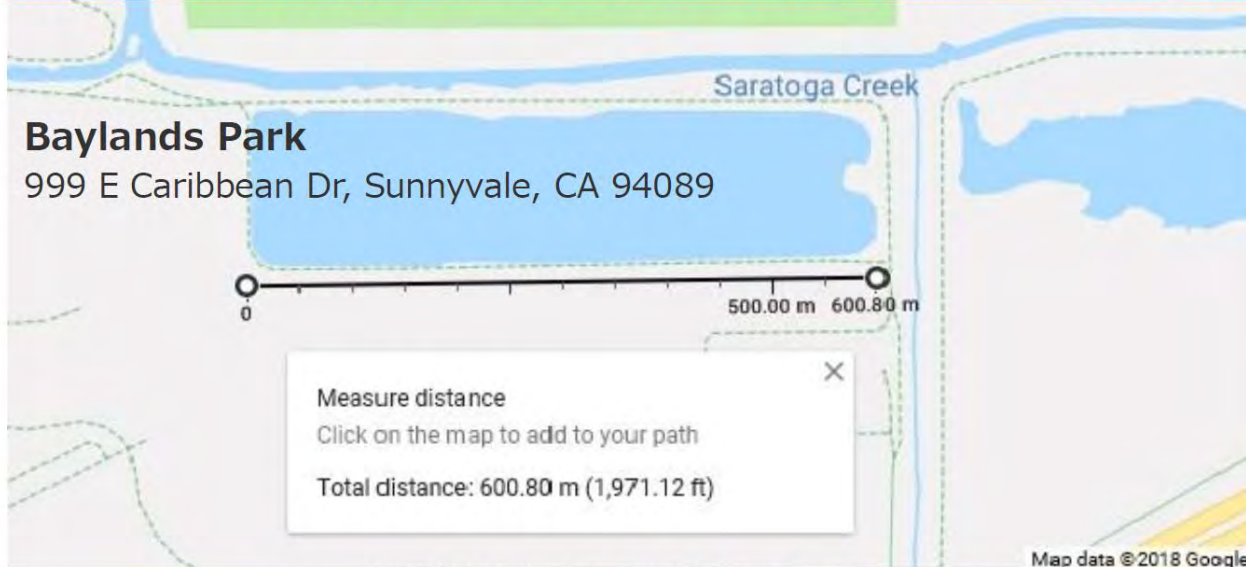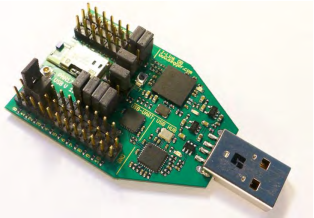
Coded PHY results

Distance Measurement of TC35680

600m communication distance has been demonstrated.

Test date: April 25th, 2018
Test condition: Coded_PHY(125kbps) and TX Power +8dBm, Link budget 113dB
Test results:

Antenna height	Connection	Advertise
1.5m	400m(1312feet)	450m(1476feet)
2.5m	500m(1640feet)	600m(1868feet)

■ Connection criteria:
Maintain connection over 10 seconds and be able to read firmware characteristics.
Connection Interval 46.25ms, SVTO 1600ms

■ Advertising criteria:
To receive advertise report at least once per 10sec.
Advertise interval 40ms

Advertising device   Coded-PHY   Scan device   PC
                             125kbps   GUI tool

TC35680-001   TC35680-001
Evaluation   Evaluation
board   board

Standalone   Complete mode

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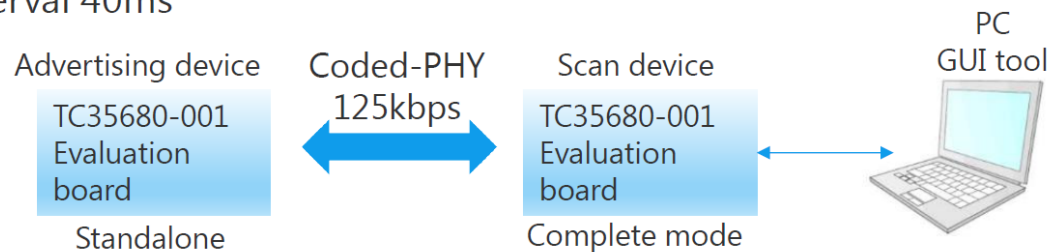
More BLE Resources

Mohammad Afaneh | Novel Bits <mohammad@novelbits.io>

https://www.bluetooth.com/
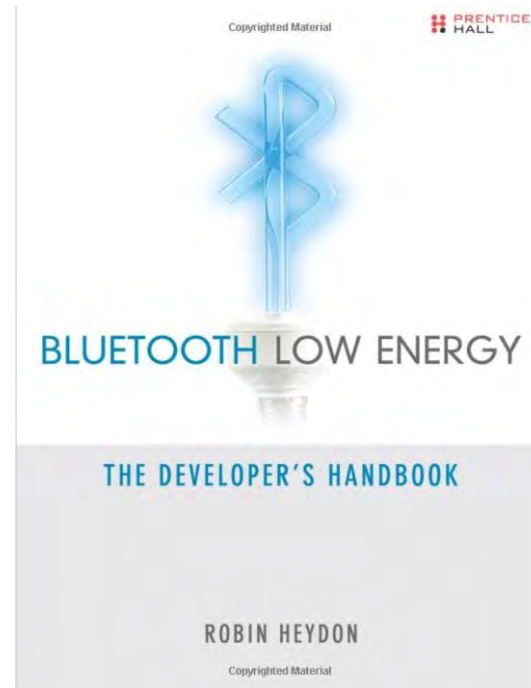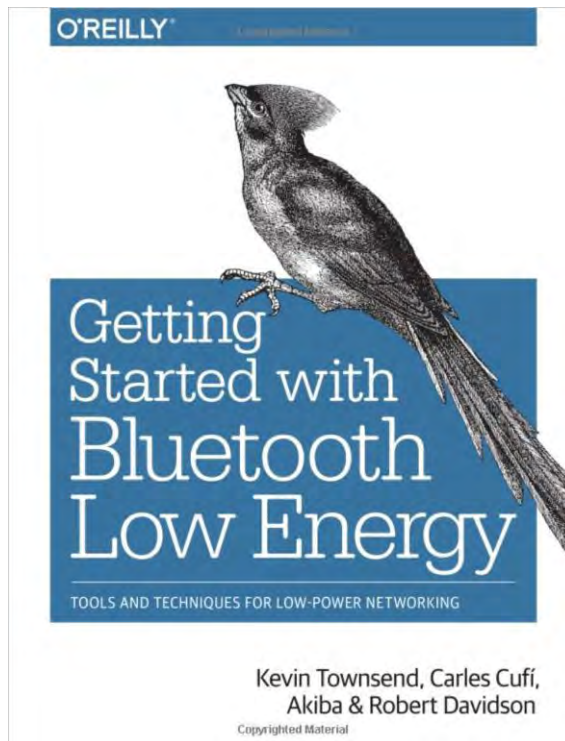
BLE Architecture Modes
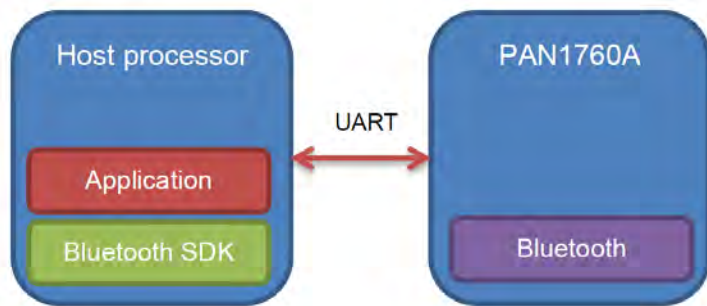
Host and Standalone Modes

Host mode
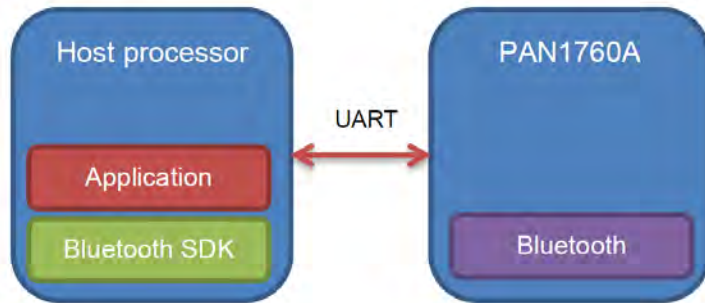
Standalone Mode
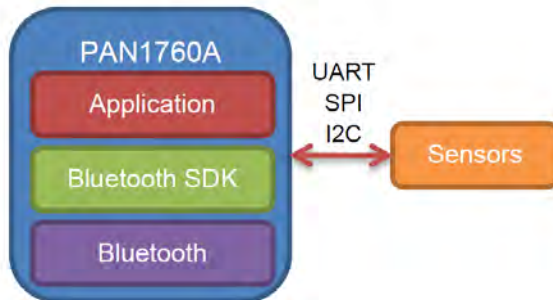
Mode Selection

The operating mode of the PAN1760A module is determined by 2 GPIO jumpers in the PIN header breakout section.

Reset

Host Mode

Standalone Mode

Panasonic
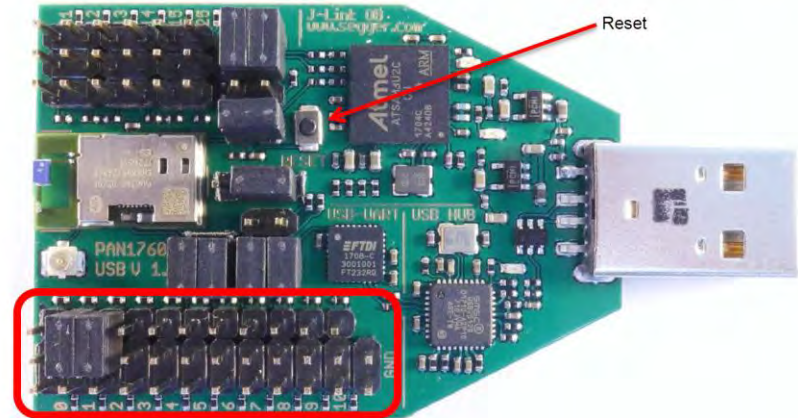
AT Command Mode

- Runs in standalone mode, acts like host mode
- In two commands start SPP over BLE peripheral device
- Device is programmed with AT command FW using EasyStandalone app
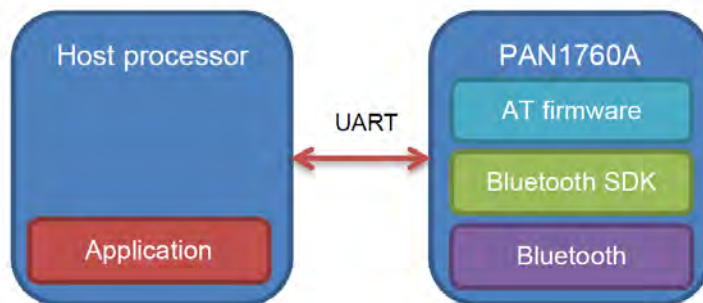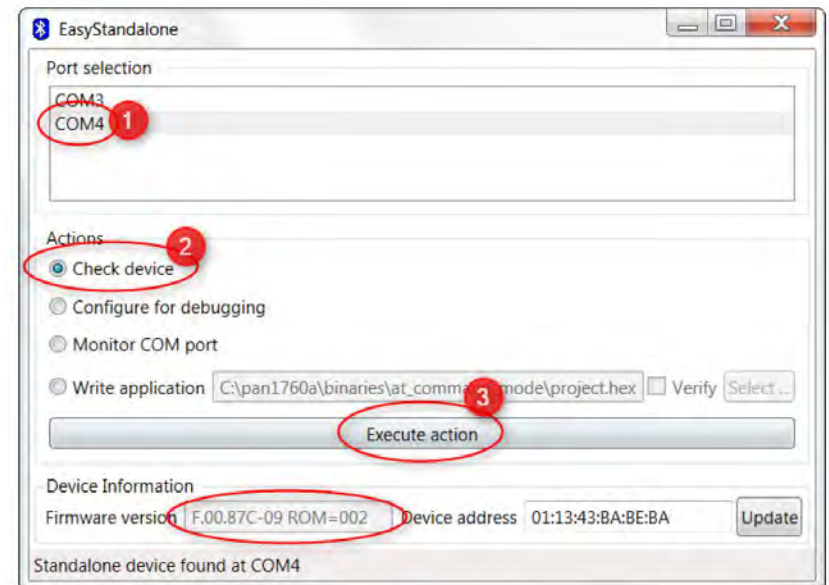
Application-SPPoverBLE & Demo

- Classic Bluetooth Profile: Serial Port Profile
- It emulates a serial cable to provide a simple substitute for RS-232
- SPPoverBLE is not a public profile as it goes against the spirit of BLE
- Demo code for SPPoverBLE is available on the Toshiba BLE website

Panasonic
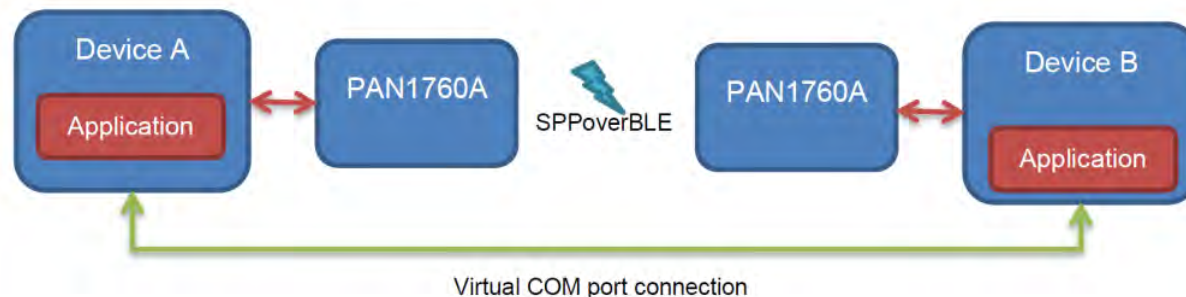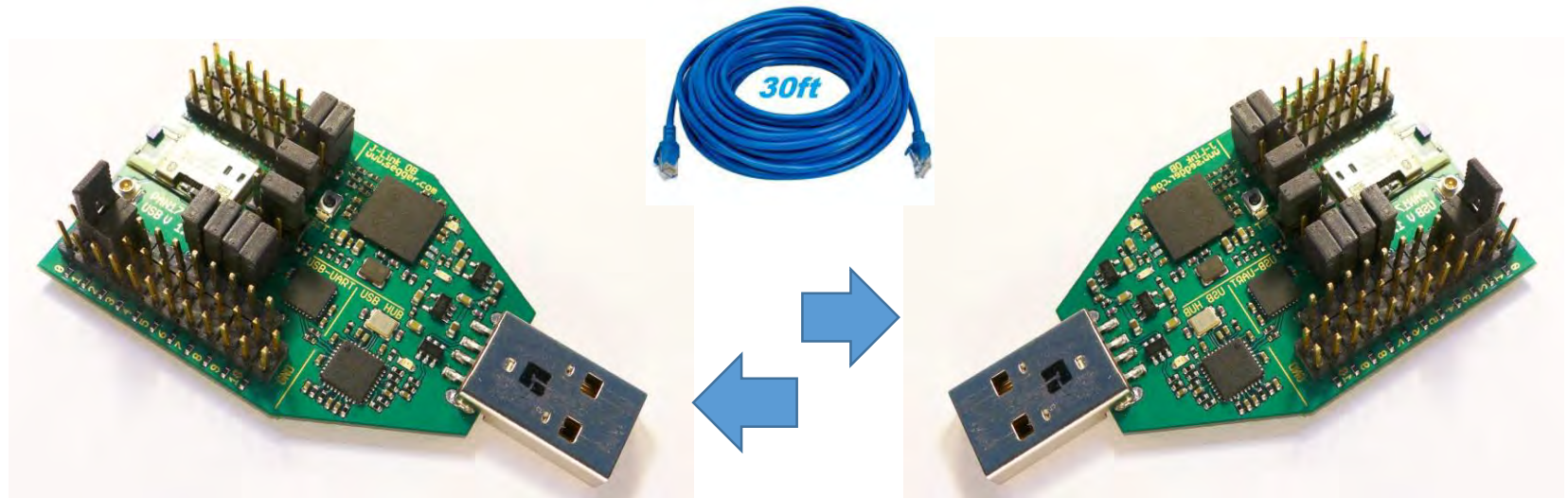
BLE Door Bell Demo using the Toshiba PAN1762A

- Utilizes SPPoverBLE StandAlone demo
- On Central device the Button sends the "R" character for "Ring"
- Peripheral device recognizes the "R" and uses PWM to drive a Piezo buzzer
- Utilizes the PAN1762A ETU dev kit for rapid prototyping

Panasonic

PAN1762 (BLE 5.0)

Toshiba TC35680

Bluetooth® Core spec V5.0 (high speed & long range)

- 15.6 mm x 8.7 mm x 1.9 mm
- Host mode, AT command mode or stand-alone operation mode
- +8 dBm maximum output power
- 18 General Purpose IOs
- 2·SPI, 2·I²C, UART, PWM, Wake-up inputs, general purpose ADC
- ARM® Cortex®-M0
- 128 kB flash memory and 128 kB internal RAM for application code and data patches
- 10/12 bit ADC @ 1MS/s

Bluetooth® SMART

TOSHIBA
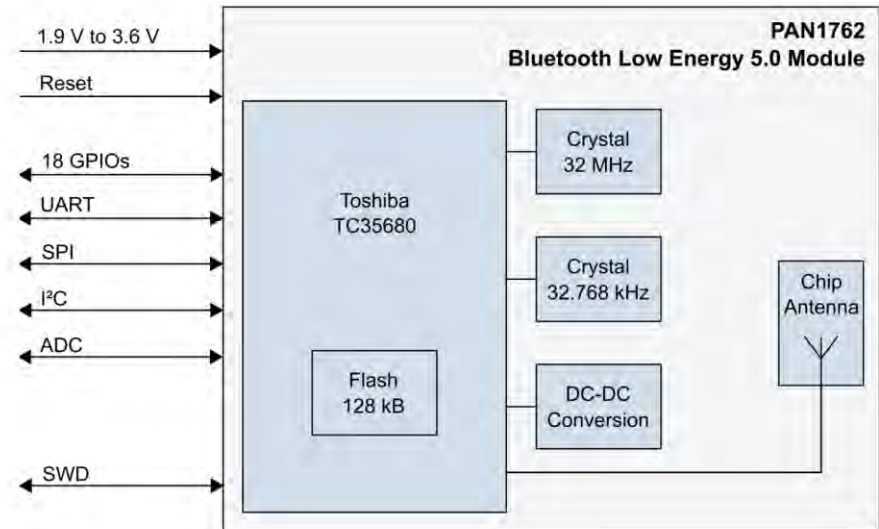
Panasonic

Your Doorbell Dev Kit

Your Doorbell Dev kit will include:
- Panasonic PAN1762 dev kit with two dev boards
- Two LEDS
- One button
- One buzzer
- Two replacement jumpers

Hardware Setup

PAN1762 – Peripheral Side

- Install the LED – observe orientation!
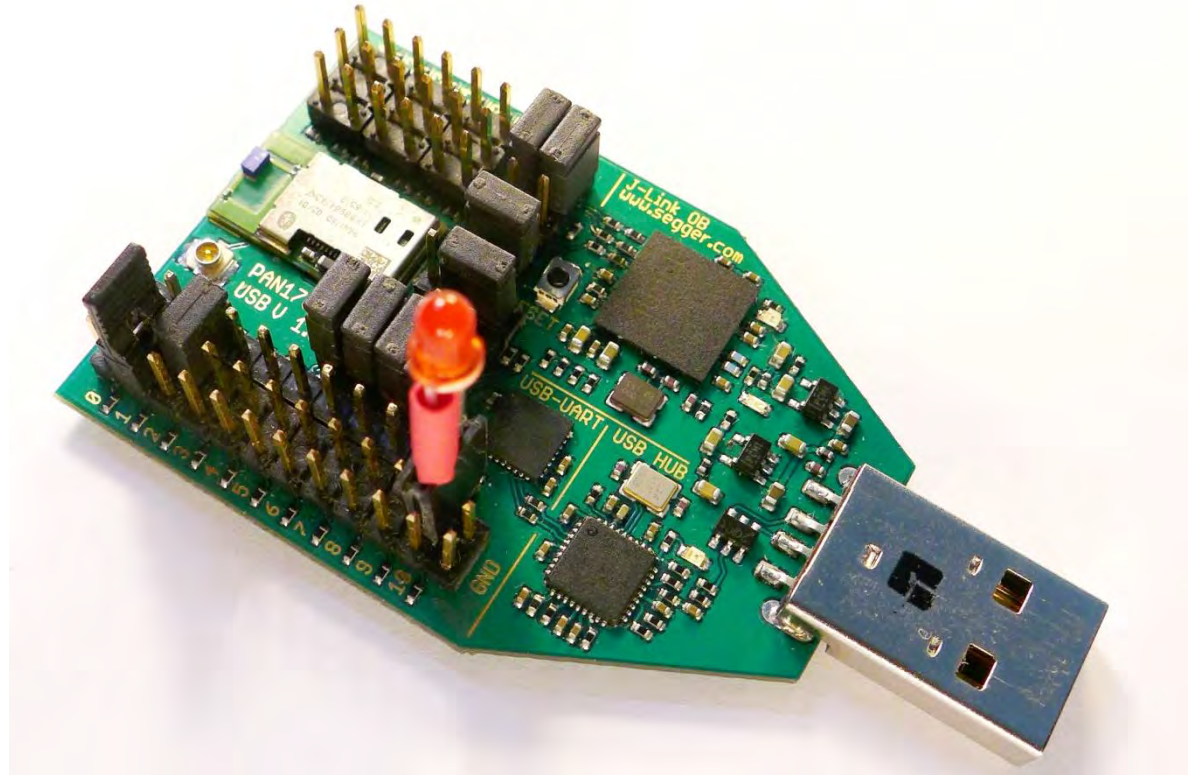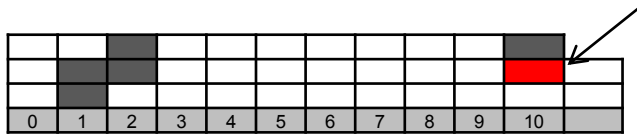
Hardware Setup

PAN1762 – Peripheral Side

- Install buzzer – orientation does not matter
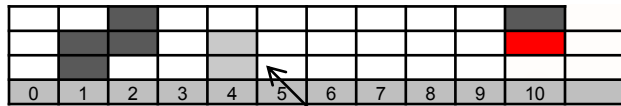
buzzer
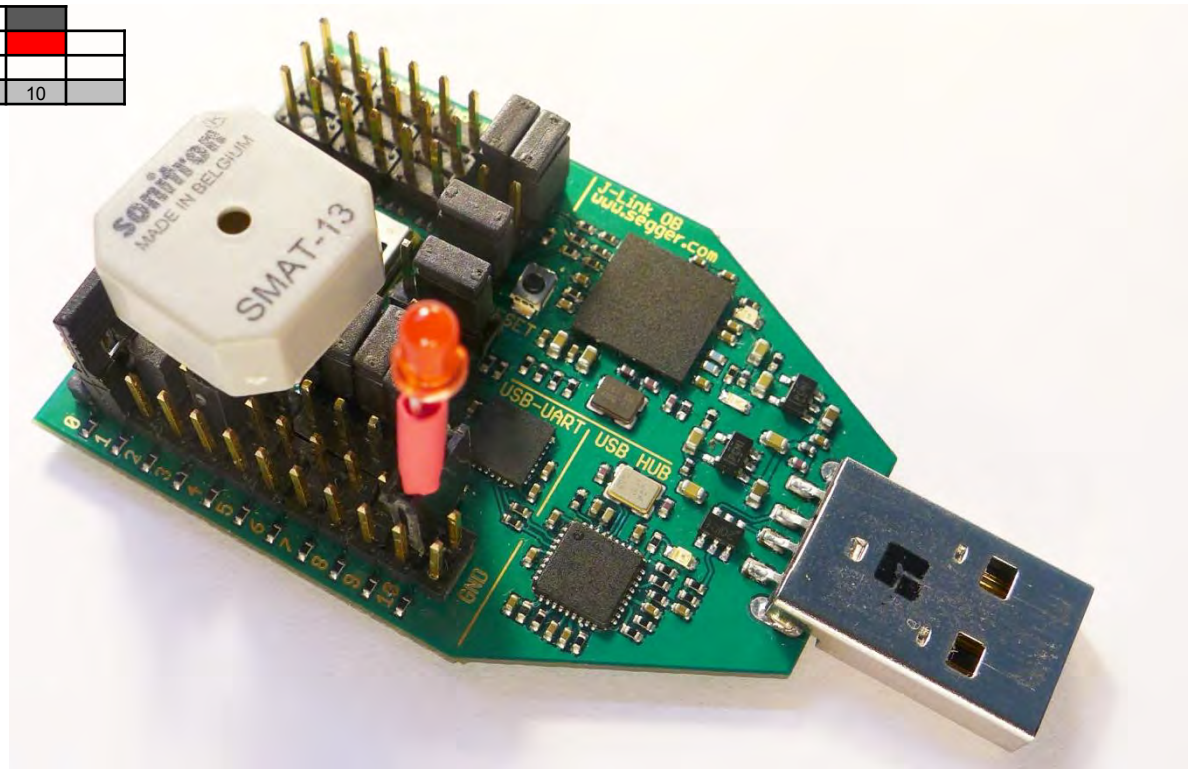
PAN1762 – Central Side

- Install LED – observe orientation!
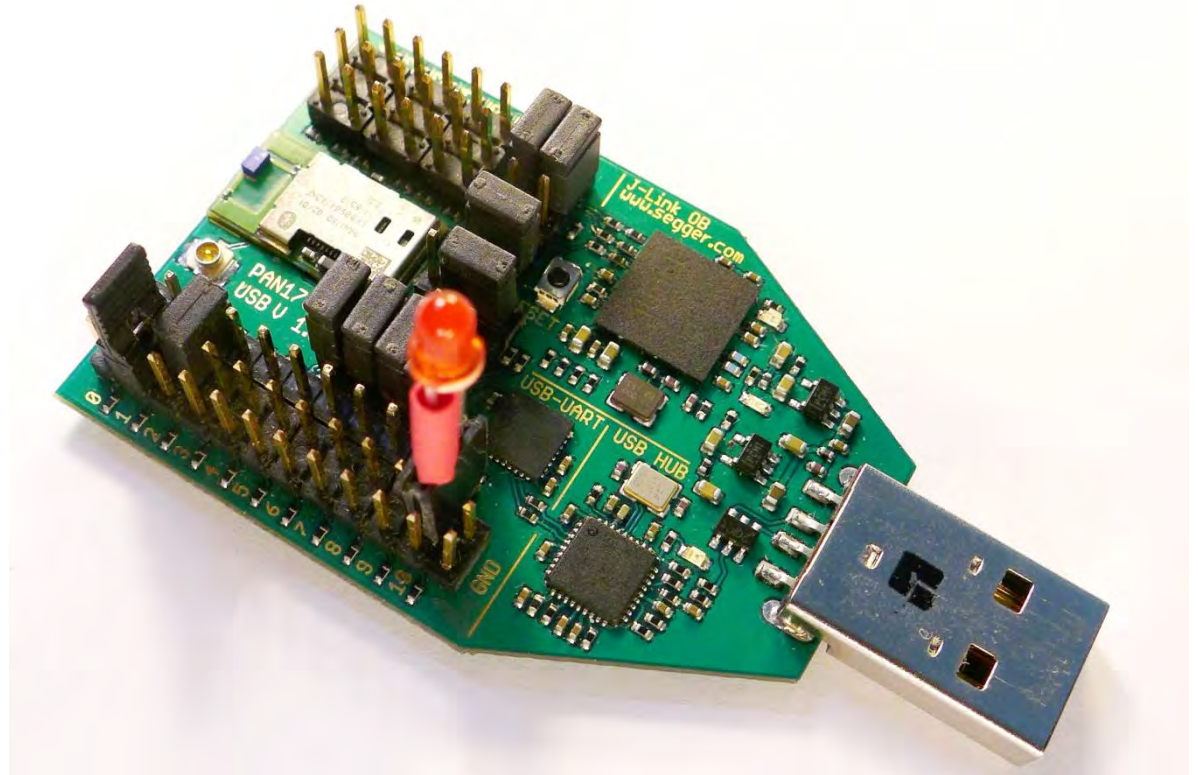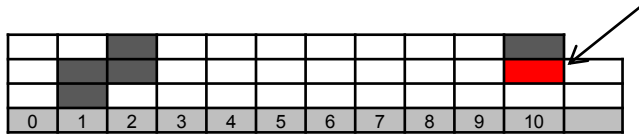
PAN1762 – Central Side

- Install button – orientation does not matter
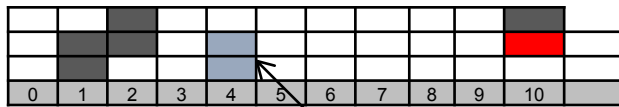
button
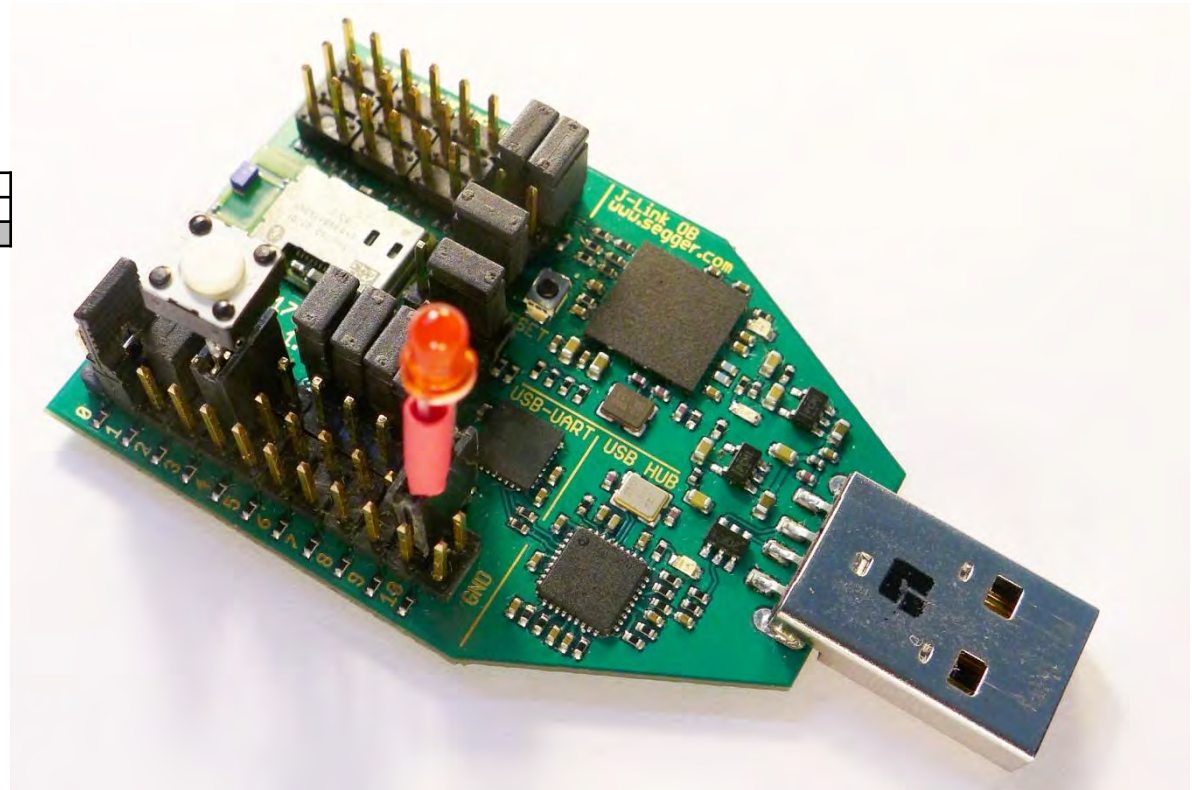
Demo time with two dev boards!

PAN1762

- Power up both units by plugging into outlet or USB

- Peripheral advertises with selected name written on box

- Central scans then recognizes, then connects

- Lit LED indicates a successful connection

- Press button to send the character "R" through SPPoverBLE

- Peripheral parses input, recognizes "R" then drives buzzer with PWM

Central
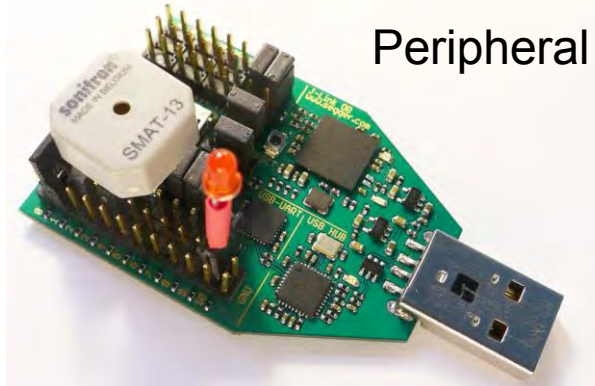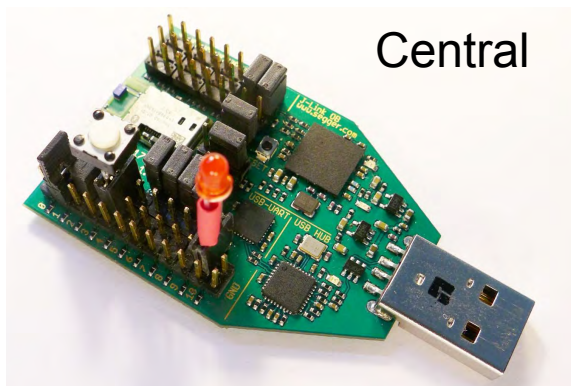
Peripheral

Note: if LEDs don't light, verify ADV name is correct on both units

Demo time with dev board and smart phone!

PAN1762-phone 1

- Remove central device with button from power

- Peripheral re-advertises with selected name, LED turns off

- Download "nRFConnect" from App Store or Play Store

- Open app and (1) start scanning, (2) Wait for your device to appear then (3) press CONNECT, peripheral LED turns on
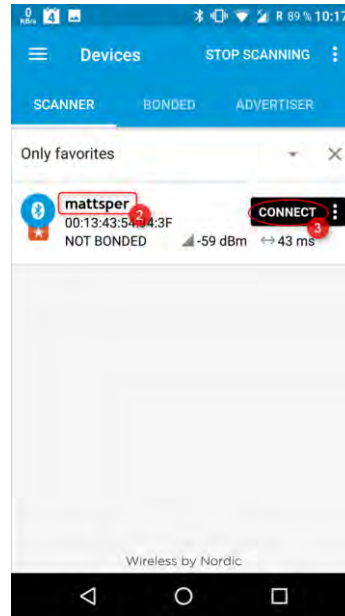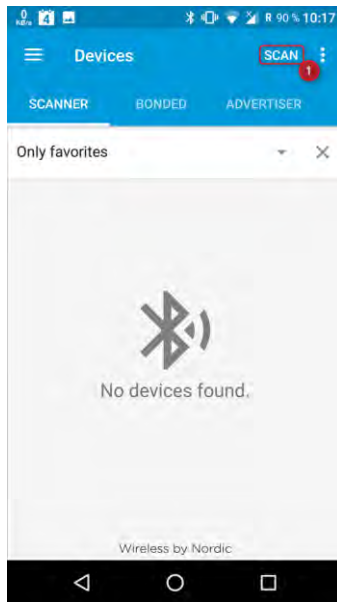
Peripheral
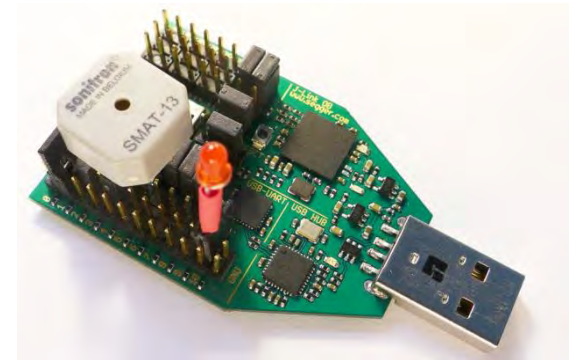
Demo time with dev board and smart phone!

PAN1762-phone 2

- (4) Select UNKNOWN SERVICE, (5) press "up arrow" icon

- (6,7) Select TEXT as format from pull-down menu, initially says BYTE

- (8) Enter "R" in text field then (9) press SEND

- Peripheral parses input, recognizes "R" then drives buzzer with PWM
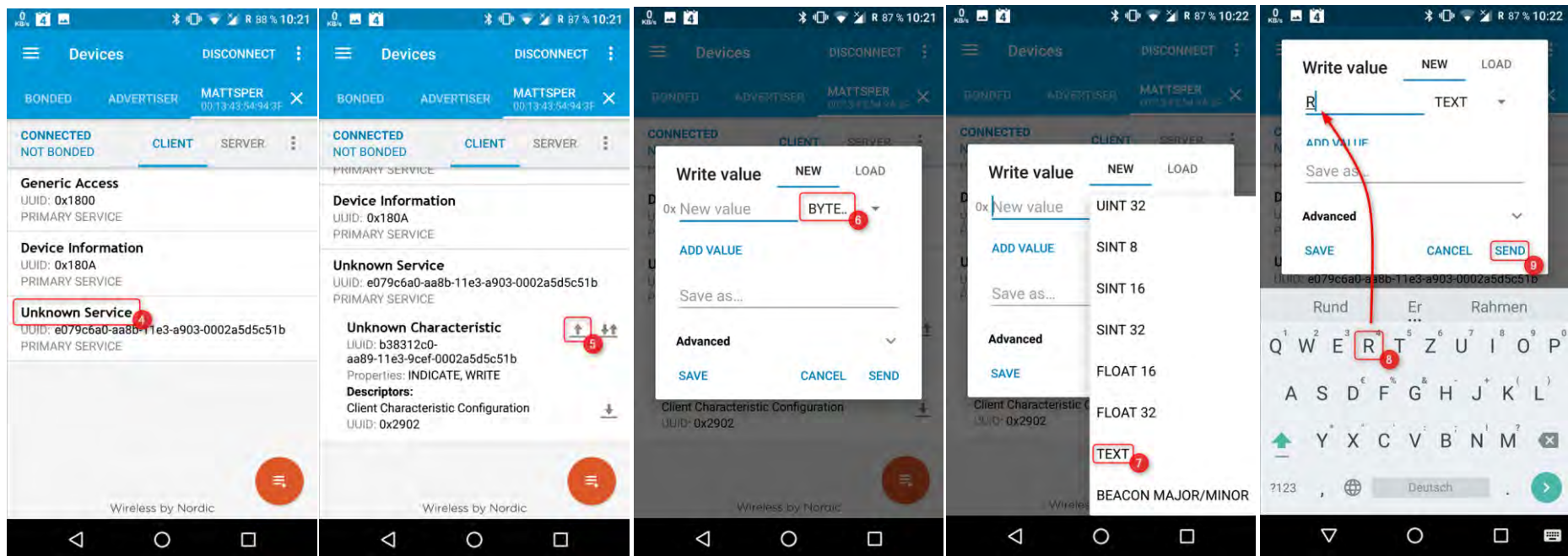
Roadmap: PAN1740A & PAN1780

- PAN1740A
  - Dialog DA14585
  - 5.0 core & Mesh
  - Integrated mike
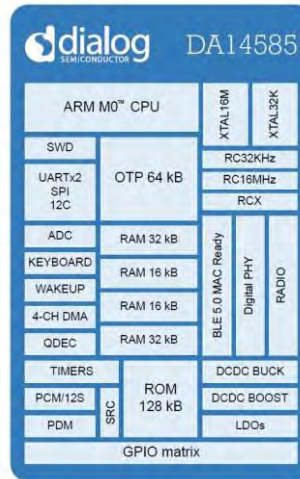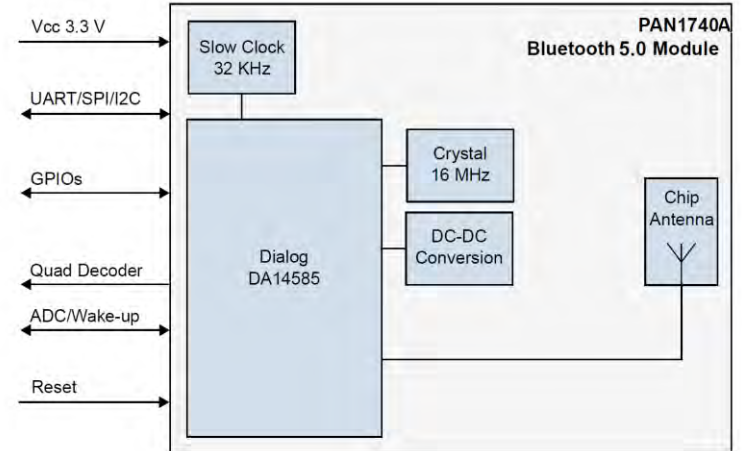
- PAN1780
  - Nordic nRF52840
  - 5/Thread/802.15.4/ANT
  - BLE Mesh

Block Diagram

PAN1740A Bluetooth 5.0 Module

Block Diagram

PAN1781 Bluetooth 5.0 Module
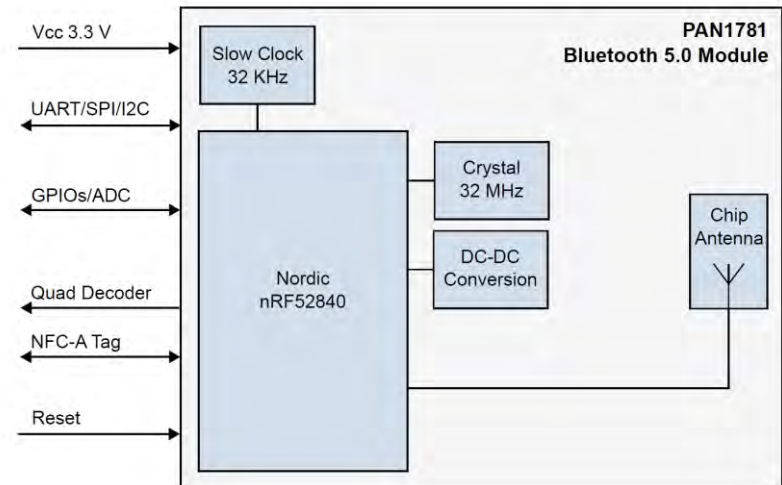
Smart Home
Smart Doorbell
Smart Lighting

What is Thread?
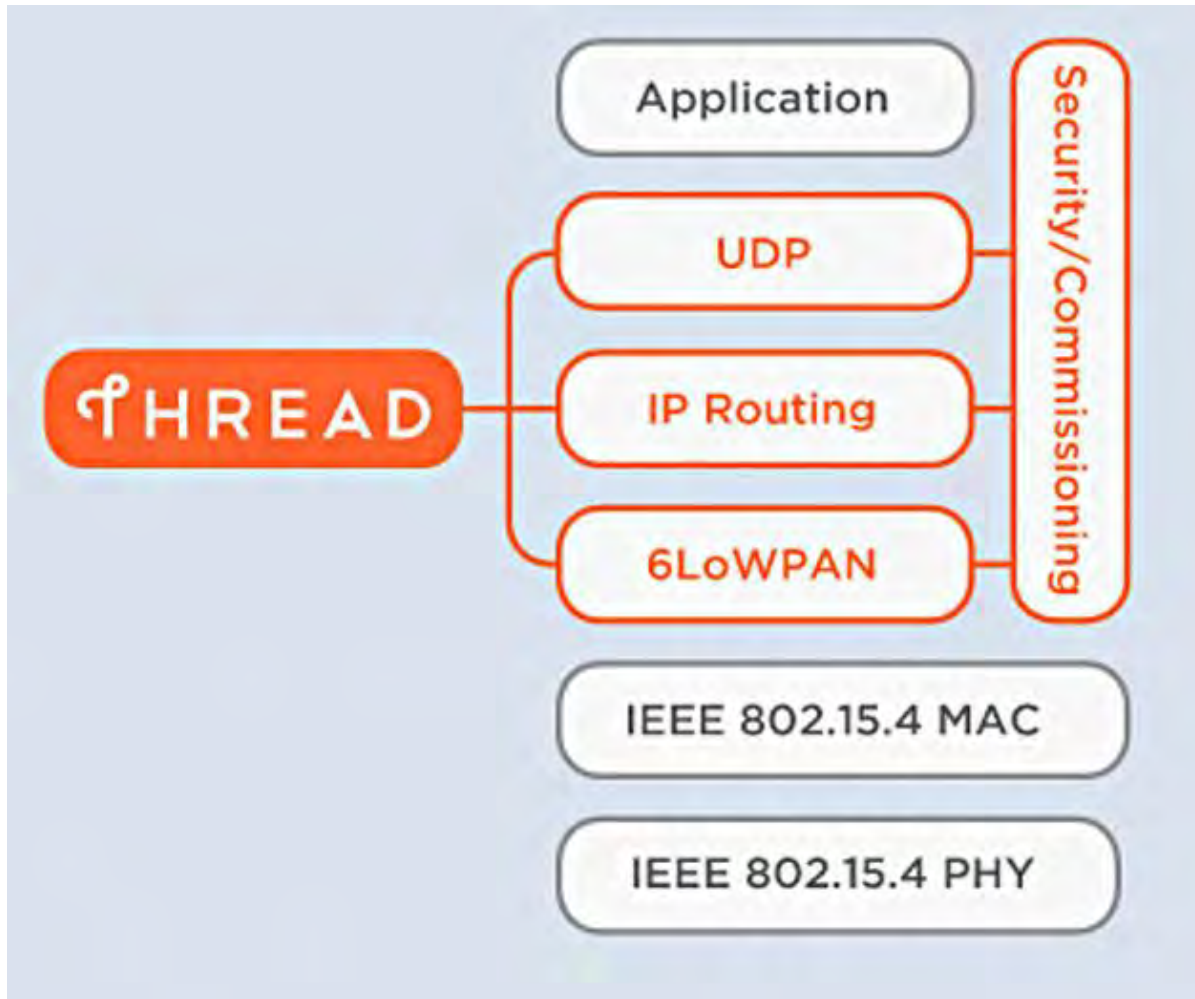
MESH
• Topology: Flood vs Routed
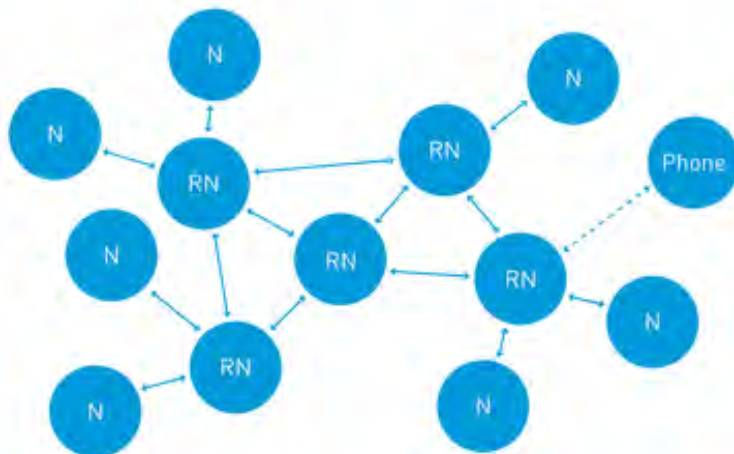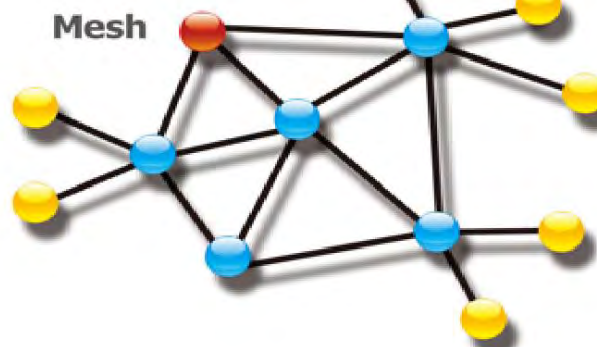
Thread Network Architecture
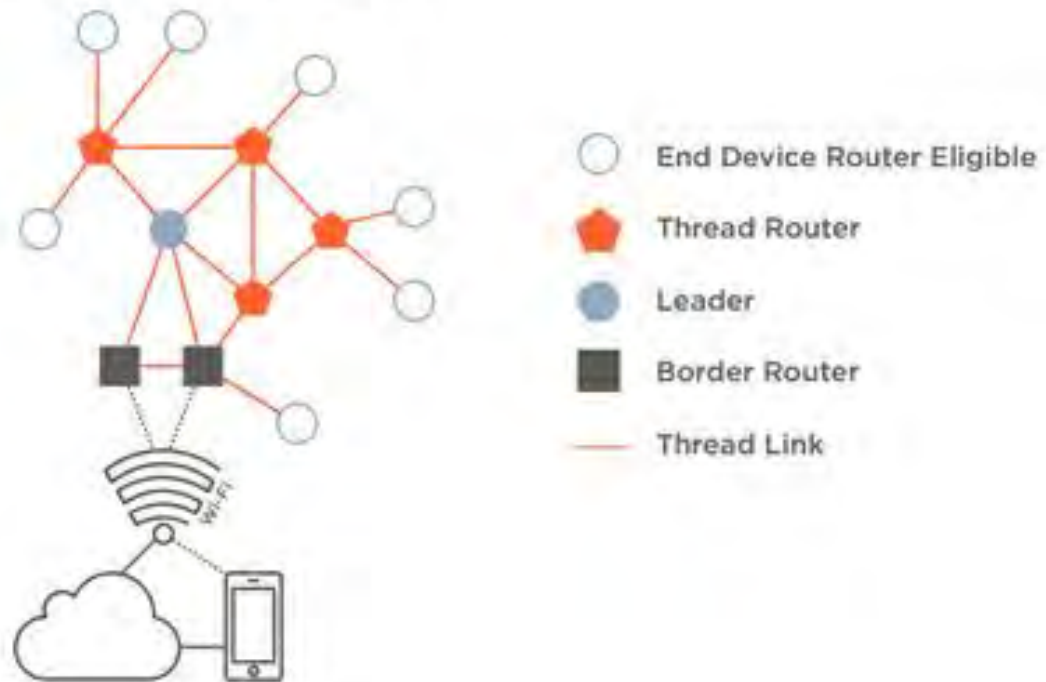
BLE Flood Mesh 1.0
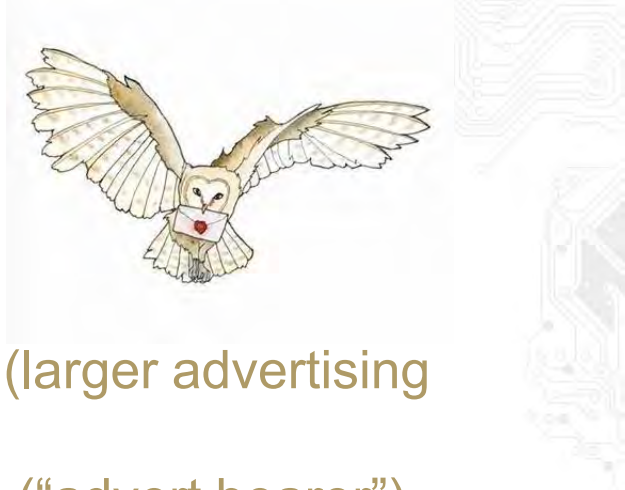
- Version 1.0 adopted in 07/2017
- Based upon Bluetooth Low Energy
  - Works with 4.2 already, but 5.0 is more fun (larger advertising data)
- Data transmission via advertising and scanning ("advert bearer")
  - Connection-oriented ("GATT bearer") will be removed in the future
- Encryption and authentication is mandatory
  - Network encryption (Who can participate?)
  - Application authentication (Who talks to whom?)
- Flood network
  - No (directed) routing
  - Nodes relay and forward messages until they reach all nodes
  - Less efficient in comparison to directed routing
- Network must be setup and configured ("provisioning")
  - Install network encryption and application authentication keys
  - Configure unique mesh device address and device key

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IPV4 VS IPV6

- **Internet Protocol Version 4 Identifies devices on a network through an addressing system   eg. 1.160.10.240**

- **2^32=4 billion addresses**

- **IPV6 will coexist; more addresses**
  - No more Network Address Translation
  - Auto-configuration
  - No more private address collisions
  - Better multicast routing
  - Simpler header format
  - Simplified, more efficient routing
  - True quality of service,
  - Built-in authentication & privacy support
  - Easier administration
  - Say good-bye to DHCP

- **128-bit**

- **3ffe:1900:4545:3:200:f8ff:fe21:67cf**

- **3.4×10^{38} addresses-that's a lot**

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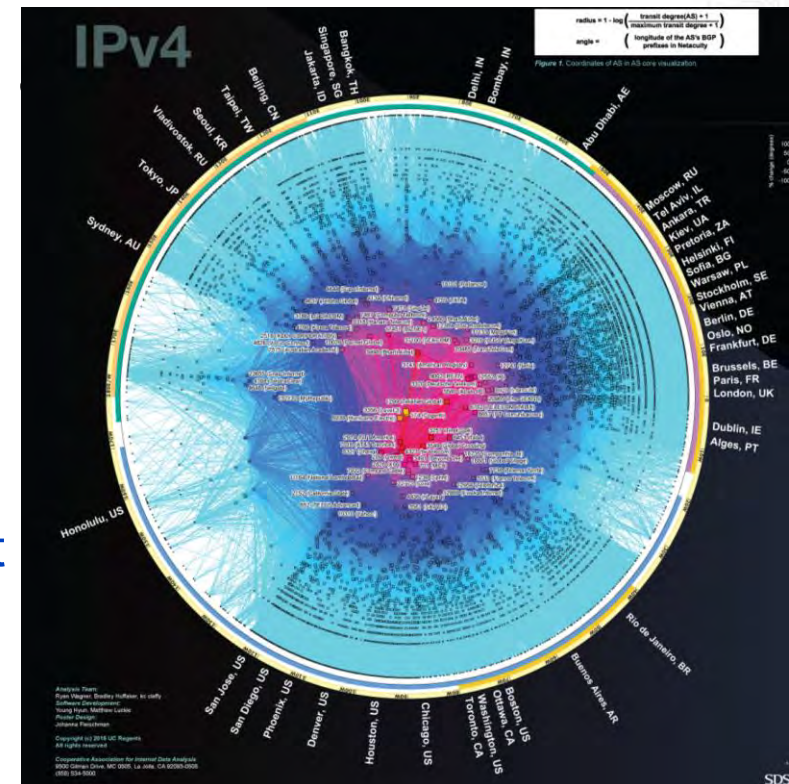
PAN4620 (802.15.4 & BLE 4.2)

- Based on NXP KW41 SoC
- Single and concurrent operation of Thread® and BLE
- Open to various known application layers or proprietary solutions
- **802.15.4**
- IEEE® standard 802.15.4 compliant
- Supporting software consisting of 802.15.4 MAC/PHY implementation, Simple Media Access Controller (SMAC), and certified Thread® stack

- **Bluetooth Low Energy**
- ☐ Bluetooth® LE 4.2 compliant implementation certified by BT SIG
- ☐ Supporting software consisting of BLE host stack and profiles, BLE Mesh, and IPv6 6LoBLE

15.6 mm x 8.7 mm x 1.9 mm
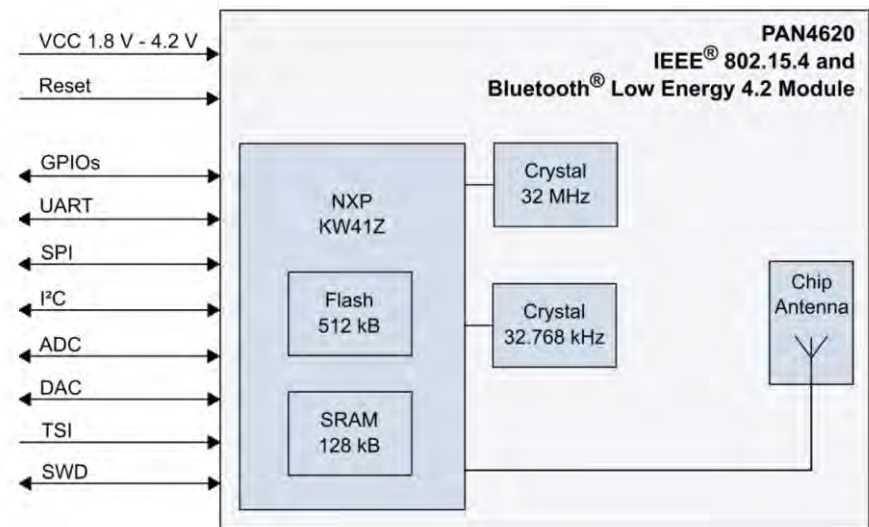
Panasonic

Make your own Smart Home

- **Dev kits**
- **Production Programming**
- **The RF Support Team, FAEs & Reps**
- **The RF Module Support Forum**
- **Why Panasonic?**

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Dev Kits

PAN1762
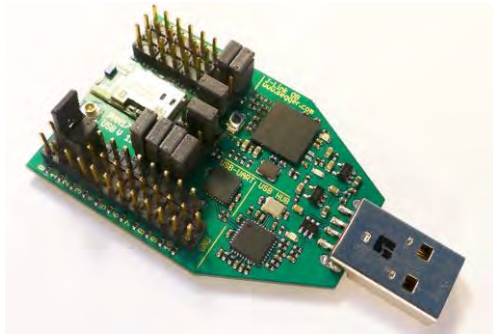
ENW89853AWKF

PAN1760A

ENW89847AWKF

PAN9420

ENW49C01AYKF

PAN9026 (Wandboard w/ 9026)

ENWF9201AXEF

PAN9026 Only
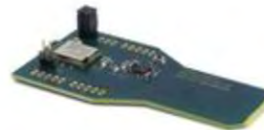
ENWF9201AZEF
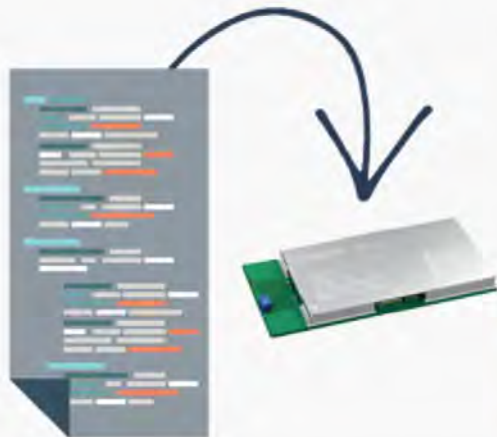
PAN4620

ENWC9B01AQEF

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2 Send Panasonic The Application Software

3 Panasonic Uploads The Application Software

4 Panasonic Tests Samples And Requests Approval

5 Software Is Uploaded To Entire Order And Ships

Panasonic's *Software Preprogramming Service* eliminates a step in manufacturing, providing a leaner production process. With modest minimum order quantities*, this Service is completely FREE.

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Panasonic RF Rep Network

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RF Module Support Forum
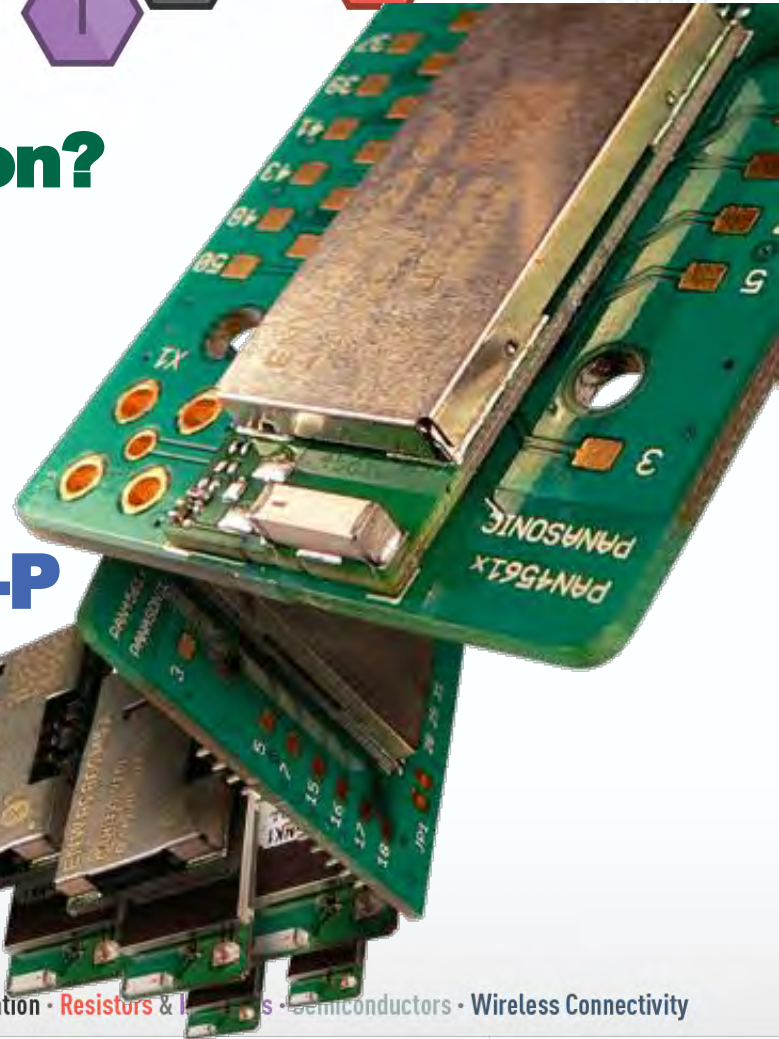

forum.na.industrial.panasonic.com

Panasonic

What impacts a customer's buying decision? (The value proposition)

1. Technical specs
2. Relationship & Support
3. Production Lifetime & P-2-P
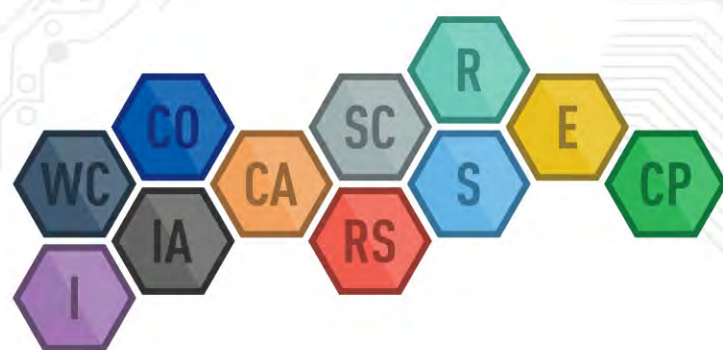4. Quality & Reliability
5. Price

Relays & Connectors · Capacitors · Circuit Protection · Electro... ...omation · Resistors & I...s · Semiconductors · Wireless Connectivity

na.industrial.panasonic.com   1-800-344-2112

Thank you
Matthew Rose