Enabling technologies for Wireless Sensor Networks

VTT Technical Research Centre of Finland Ltd
VTT Tiny Node V3.0

- Miniature euro coin size
- On-board antenna
- Bluetooth Smart 4.0 radio (short range)
- Integrated sensors including
  - Accelerometer, 3D
  - Pressure sensor
  - Temperature sensor
  - Humidity sensor
- Data-flash memory 64MBit
- Coin cell battery operated
- Waterproof enclosure

Application domains
- Building Automation
- Wellness and Healthcare
- Industrial Automation Systems
- Smart Lighting
TinyNode V4.0 board

- Miniature euro coin size (charger cut-off part)
- On-board antenna
- Bluetooth Smart 4.0 radio (short range)
- Integrated sensors including
  - Accelerometer, 3D
  - Magnetometer, 3D
  - Inclinometer, 3D
  - Air pressure sensor
  - Temperature sensor
  - Humidity sensor
- Data-flash memory 64MBit
- Coin cell or rechargeable battery operated
- NFC wakeup for communication and recharge
FlexNode V1.0

- Wireless charging (NFC)
- On-board antenna
- Bluetooth Smart 4.0 radio
- Integrated sensors including
  - Accelerometer, 3D
  - Temperature sensor
  - Humidity sensor
- Perforation for breathability
- Data-flash memory
- Li-Po battery operated
- Size: 90 x 20mm
- 25um flex PCB available
LoRa-Node

- Miniature size
- On-board chip antenna or external antenna
- Long range, low bandwidth, LoRa 868 / 915 MHz radio
- Integrated sensors including
  - Temperature sensor
  - Humidity sensor
  - Air pressure sensor
- Data-flash memory 64MBit (add-on options)
- Bluetooth Smart 4.0 radio (add-on options)
  - Hybrid radio systems feasible
  - 2.4GHz local sub-network and 868MHz gateway connectivity
LoRa installation at VTT Office building Oulu
Embedded BLE Gateway

Beaglebone

- Commercially available
- 1GHz ARM Cortex A8
- 4GB on-board flash
- Ethernet and WiFi (optional)
- USB, HDMI,
- 2x46 headers (4xUART)
- Several add-on boards available
  - CAN, IO, Display
- BLE 4.0 connectivity with USB
- Linux Debian
VTT Little Node + Board Extensions

- 2.4 GHz transceiver
- GFSK modulation
- 250 kbps, 1 Mbps, 2 Mbps data rates
- TX output Power +4dBm
- Bluetooth Smart 4.0 compatible
- ARM M0 32 bit processor
- 256 kB flash program memory

**AD-Board specifications**
- 4.8 kHz, Ultra low noise, 24-Bit Sigma-Delta ADC with PGA
- Programmable gain 1 to 128
- Two digital filter options. The choice of filter affects the r.m.s noise/noise-free resolution at the programmed output data rate 4.7 Hz to 4.8 kHz.

**Power Board Specifications**
- Continuous Energy Harvesting From Low voltage Input Sources: VIN ≥ 80 mV
- Integrated Dynamic Maximum Power Point Tracking for Optimal Energy Extraction From a Variety of Energy Generation sources
- Integrated Battery manager for storage elements between 2.2-5.25V
- Secondary Buck-Boost converter to regulate battery voltage with input range:1.8-5.5V and output 2V to 5V.
- Holder for backup coin-battery in case of harvested power shortage
Sensor integration options

- Integration of commercial available separate digitally I2C, SPI or UART and analogue interfaced devices
- **PCB tailoring with add-on sensors feasible**

**AD-board**
- 4.8 kHz, 24-Bit Sigma-Delta ADC with PGA
- Programmable gain 1 to 128, Digital filters
- Integration of strain gauge transducers

**CO2-sensor**
- Digitally interfaced commercial carbon dioxide-sensor
- 0-2000 ppm
- Low-noise and low-power

**Pressure difference sensor**
- Digital I2C-interfaced
- High accuracy
- Range +/- 500 Pa
## VTT IoT application for gateway based solutions

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Intelligent indoor conditions monitoring HW

- Temperature (wireless, battery powered)
- Relative humidity (wireless, battery powered)
- Air pressure (wireless, battery powered)
- CO2 (wireless, separate sensor)
- Pressure difference (wireless, separate sensor)

- The sensors can be assembled into a building with a gateway unit. The unit will collect and send all data to a cloud server which can be proprietary for the client.
- Sensor units use BLE or LoRa for communication, Gateway is using WLAN or operator based network (LTE) for communication to the cloud servers.
VTT IoT application for mobile based solutions

TinyNode(s)
- Wireless sensor nodes
- Temperature, Pressure
- Humidity, CO2 (add-on)
- Pressure difference (add-on)
- Bluetooth LE 4.0

Mobile data Collection app
- Android App for data collection from TinyNode(s)
- Real-time or logging data collection

Data Cloud Backend
- Cloud backend for data storage and basic visualization
- Data-file download for advanced analysis
Additional information

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