IT in AEC Industry 4.0
IOT-NIMBUS

n-Blocks & nBlocksStudio
A Modular Low-Power Low-Code IoT Platform

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Content

- IoT Hardware development in Nimbus
- n-Blocks Hardware Platform
  - Motivation
  - Concepts
  - Modularity
  - Some use cases
- nBlocksStudio Firmware Development Platform
  - Concepts
  - Workflow
  - Examples
- Summary

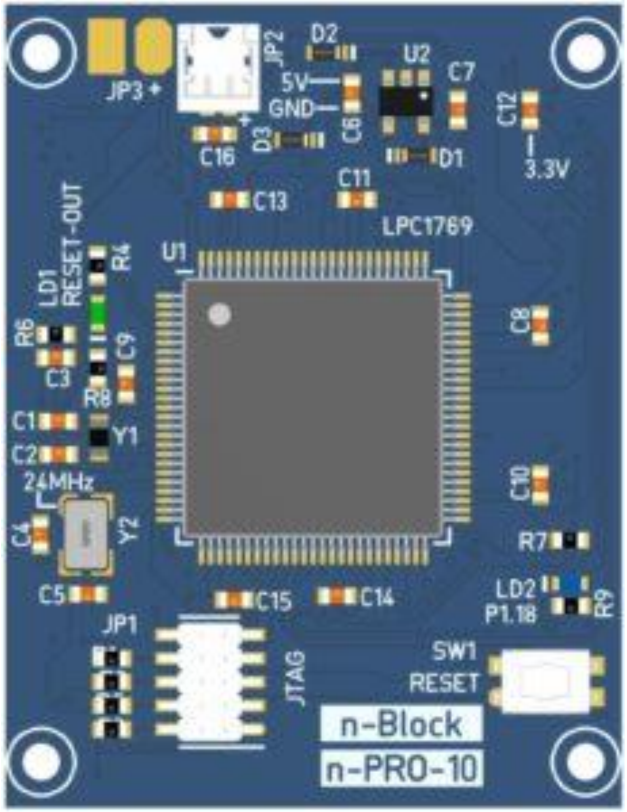
IoT hardware development in Nimbus

Embedded Hardware

PCB schematic and layout for rapid prototyping, proof of concept, pre-production prototypes

Simulation

Assembly, testing and verification.



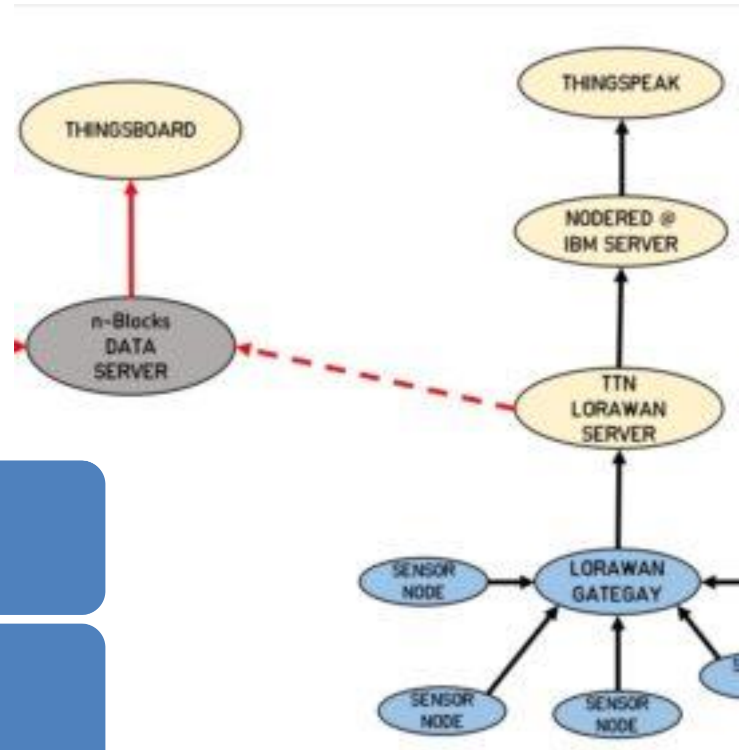
IoT hardware development in Nimbus

Firmware

- Communication protocols
- Interface modules (SPI, UART, I2C, Smart GPIO...)
- RF, Sensors, Remote Monitoring and Telemetry
- Proximity, based on GPS, BLE and Wi-Fi.
- Non-Blocking and Real time

IoT hardware development in Nimbus

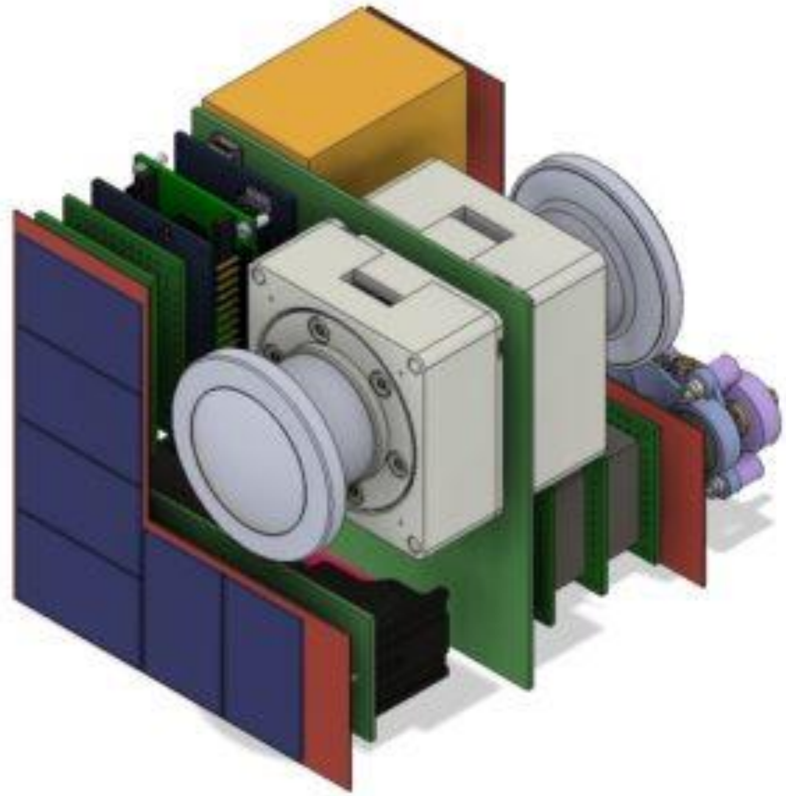
System Integration



- Interfacing the hardware and software components
- System testing strategy
- Validation of system-level functions throughout the integration process
- Collaboration with Nimbus/CIT Software and Mechanical-design groups

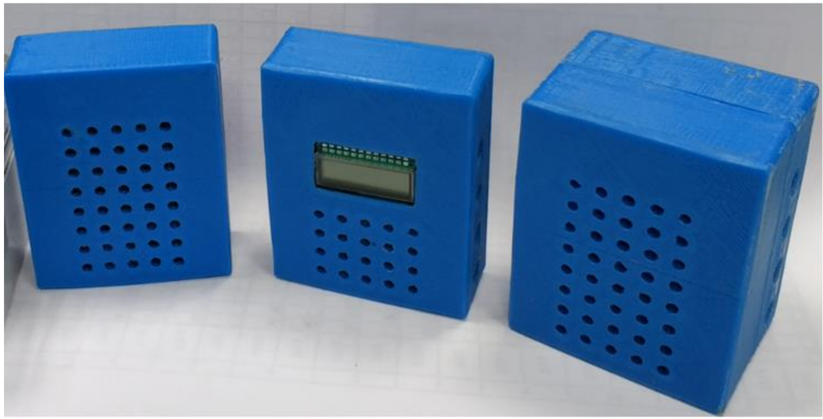
IoT hardware development in Nimbus

Product Design



Overall system Architecture

Mechanical enclosure designs



Small form factor designs

www.n-Blocks.net

n-Blocks

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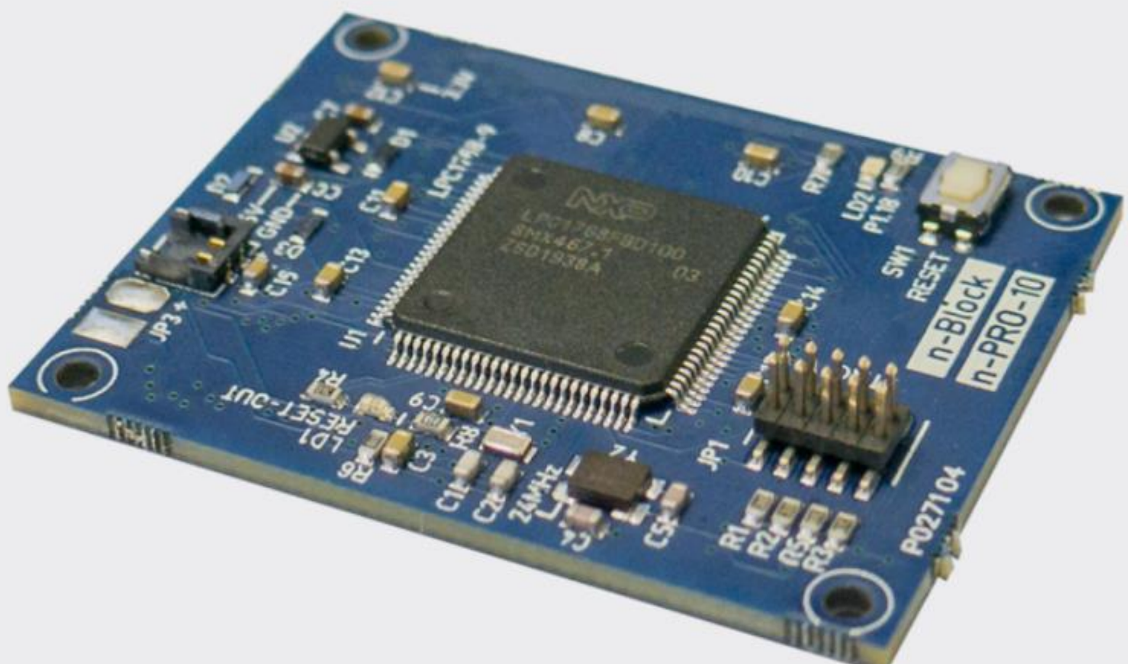
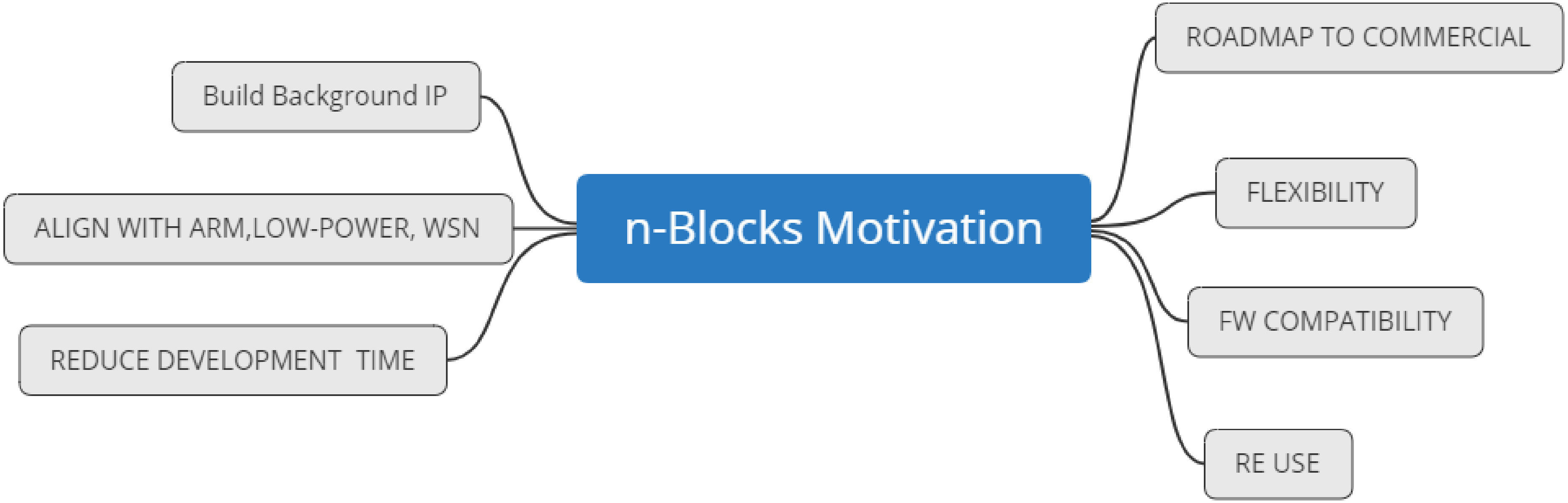
n-Blocks
Modular Platform for IoT Devices



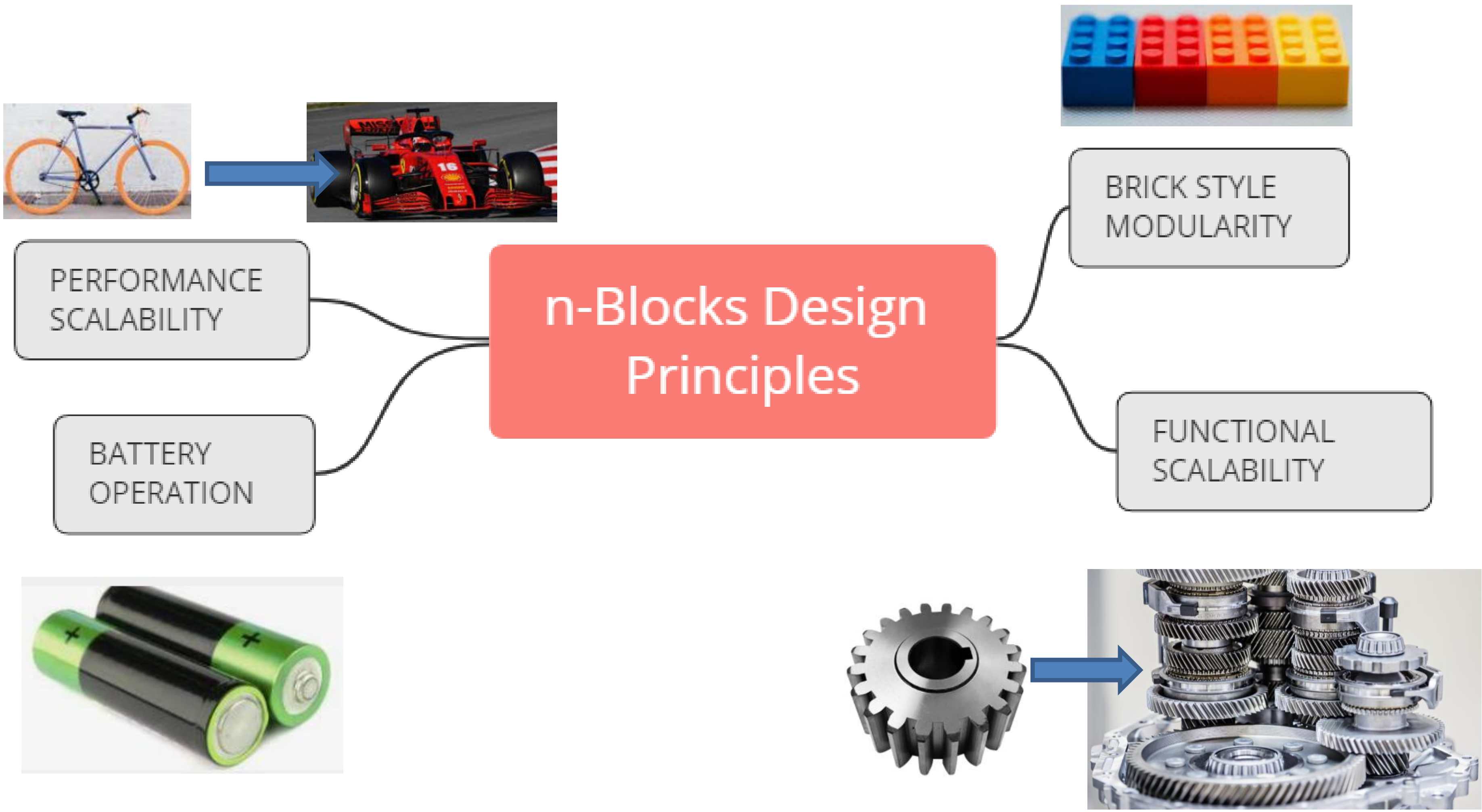
n-Blocks: Motivation



1. Provide an IoT proof of concept platform that offers an easy roadmap towards
    1. Commercial products
    2. Nimbus client's projects
2. Provide more flexibility than off-the-shelf technology
3. Compatibility with mainstream firmware development platforms
4. Re-use hardware/firmware
5. Reduce development time
6. Align development with ARM Cortex, Low Power & WSN
7. Build Background IP on hardware and firmware via standardization.....OR.......

HOW TO AVOID THE FUTURE DEVELOPERS TO TREAT OUR CURRENT WORK LIKE THIS
HOW TO TRANSFORM OUR DAILY DEVELOPMENT TO BACKGROUND-IP

n-Blocks: Modular IoT Design Principles

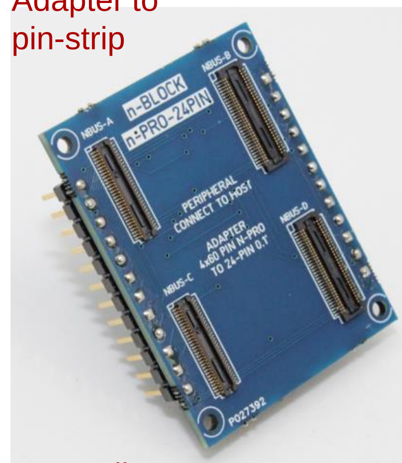


n-Blocks: HW Modularity

NXP Cortex M3
LPC1768

TI Cortex A8
OSD3358
Linux

Adapter to
pin-strip

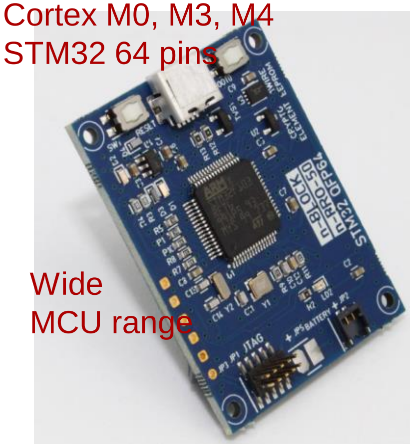


LoRa STM32L072
SX1276 &
Sensors

WIFI/BLT Espressif
WROOM32
& Sensors

BLE Nordic ARM
Cortex M4 BLE
& Sensors

Cortex M0, M3, M4
STM32 64 pins

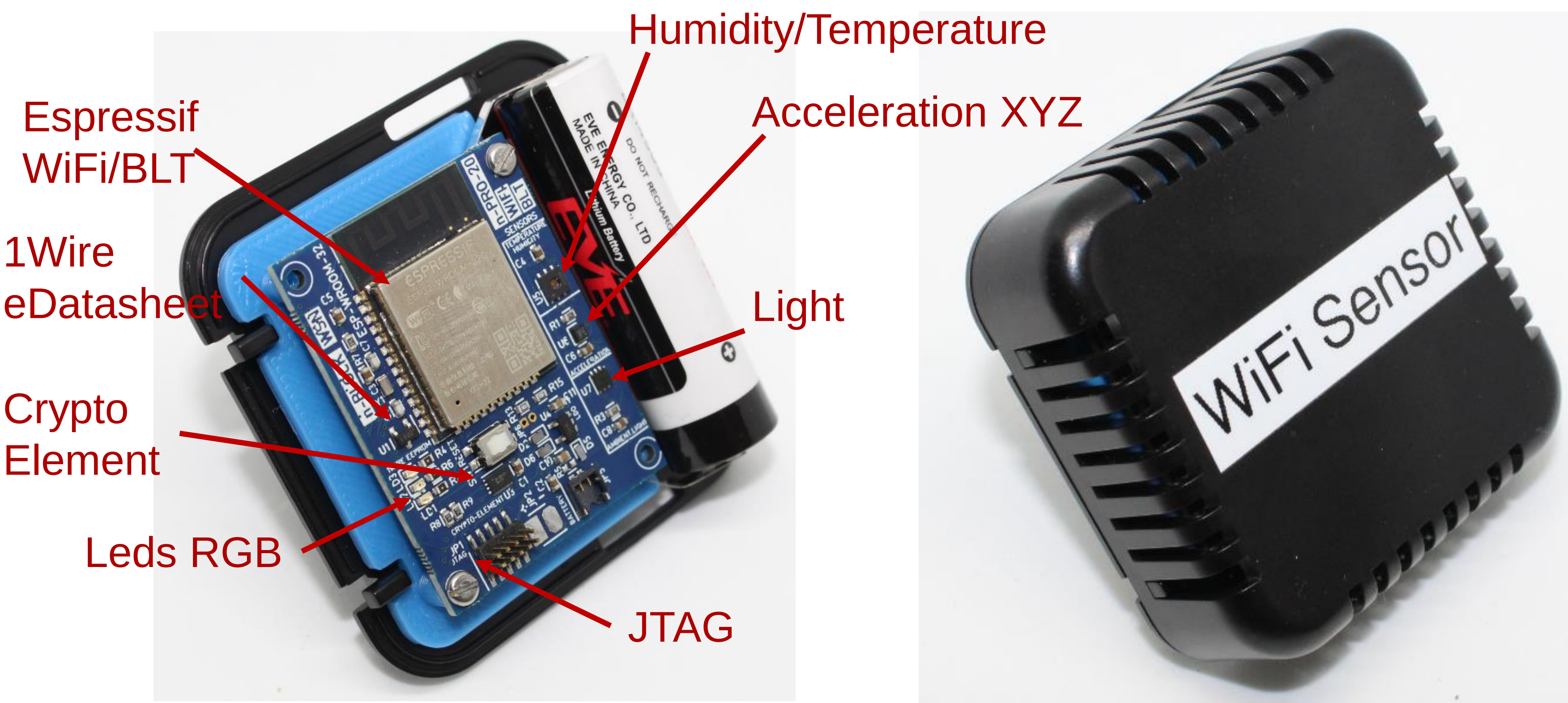


Wide
MCU range

Standalone Host Board : Wireless with sensors

Example: n-PRO-20 WiFi / Host Sensor board

- Running on a 3 year battery life setup, on a low cost off-the-shelf indoor sensor enclosure

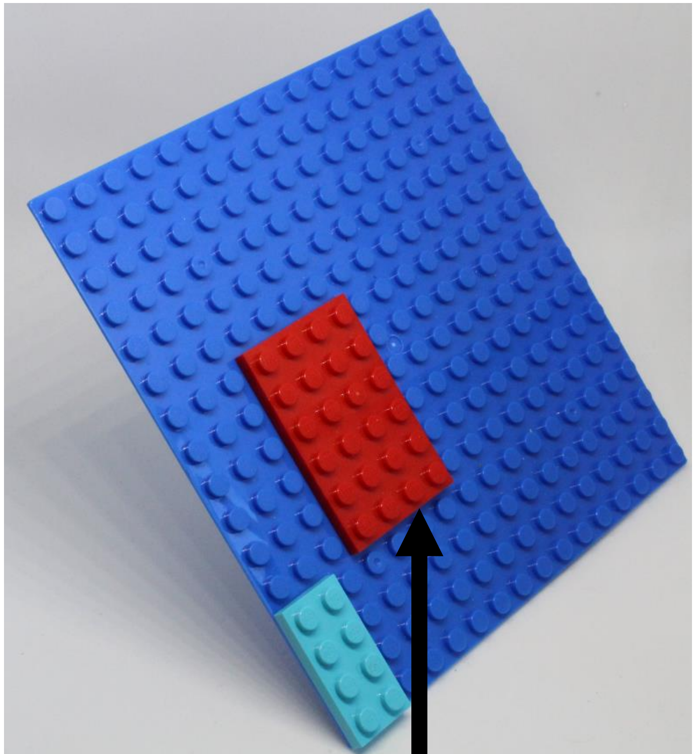


Standalone Host Board: Wireless with Sensors

Example: LoRa Sensor

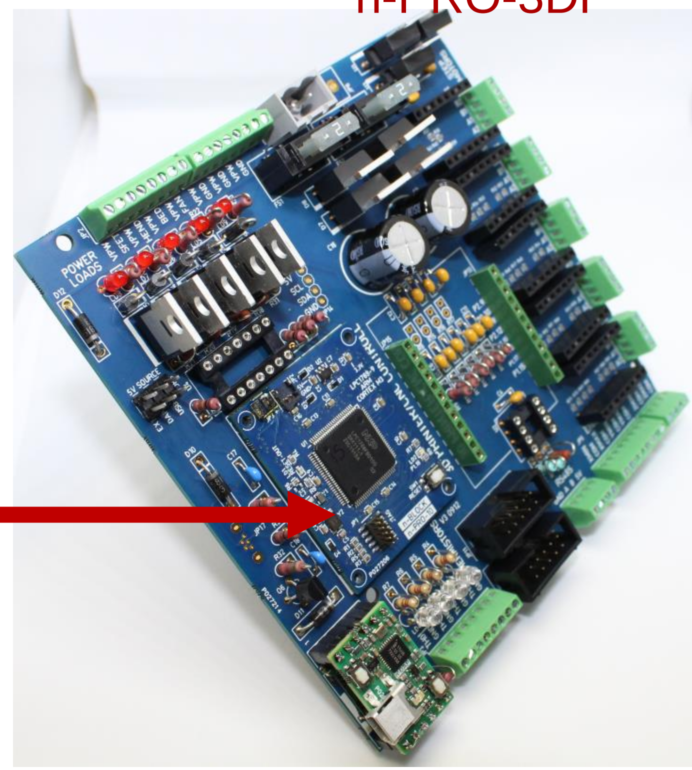
- Running LoRaWAN on a 10 year battery life setup, on a low cost off-the-shelf indoor sensor enclosure

Application Board + Host Board

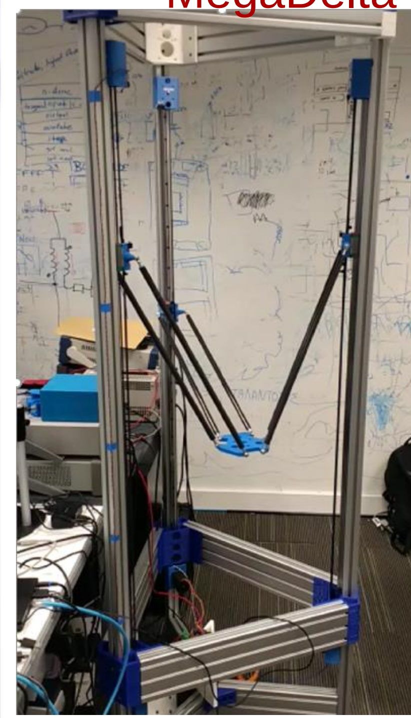


- Example: 3D printer / CNC / Robot controller
- Application board, with Host MCU board, tested on a MegaDelta Robot

n-PRO-3DP



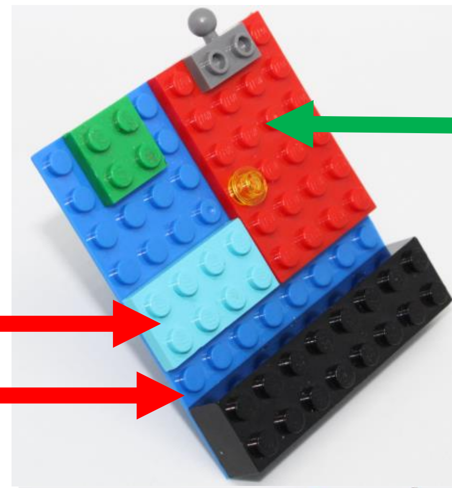
MegaDelta

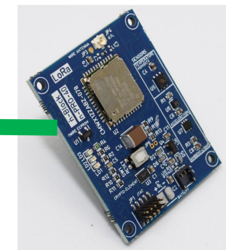


n-PRO-10

n-Blocks: Wireless Sensor modularity

- Example: Feature-rich LoRa sensor
  - n-PRO-MBSEN Peripheral board VOC sensing, Magnetic contact, NFC, PIR motion, Sounder, expansion socket (120 pin) and AAA battery holder with low cost wall-mount indoors-sensor enclosure
  - n-PRO-40 LoRaWAN/sensors board
  - n-PRO-SEN1 peripheral board with ultra-low-power-I2C environmental sensors to expand sensing capabilities of a host node





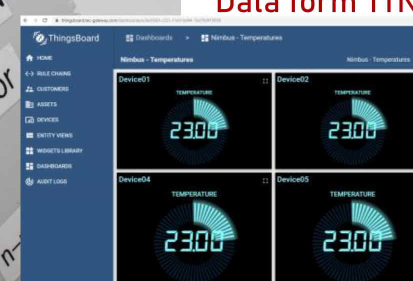
n-PRO-40
LoRa n-Block
- LoRaWAN
- Crypto element
- 1 wire eeprom
- RGB leds
- JTAG
- On Board sensors

n-PRO-SEN1
Ultra Low Power Sensors
- LIGHT
- PRESSURE
- VOC
- HUMIDITY
- ACCELERATION 3D

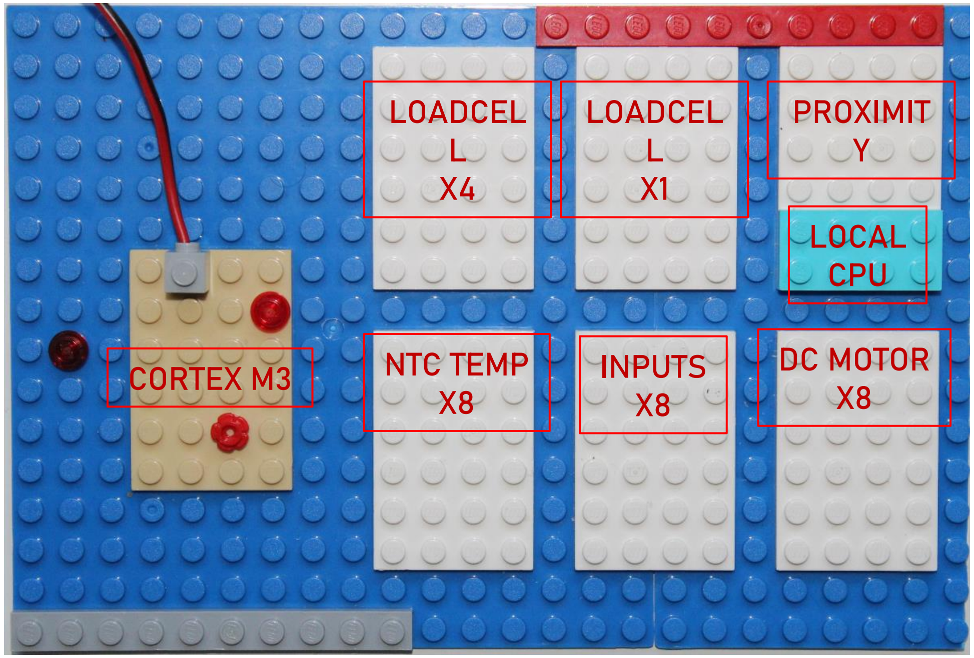
n-PRO-MBSEN
Wireless Sensor Motherboard
- PIR
- SOUNDER
- MAGNETIC CONTACT
- VOC
- HUMIDITY
- NFC
- SOUNDER

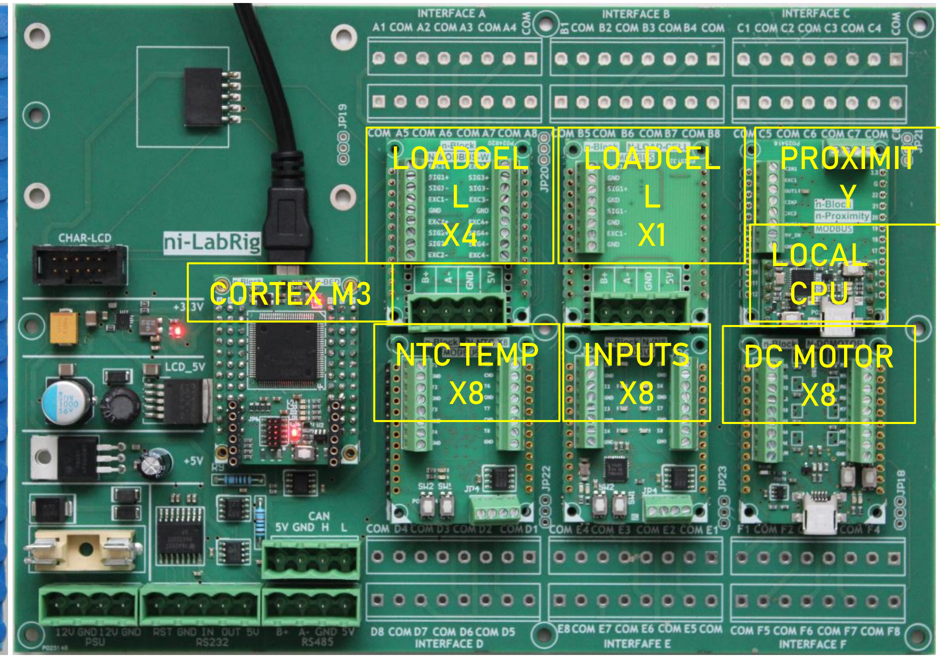
ENCLOSURE
COTS BMS Wall mount Sensor

Cloud
Dashboard
Getting MQTT
Data form TTN



n-Blocks: Modular Lab Rig





Use Case – Fats, Oils and Grease Monitor

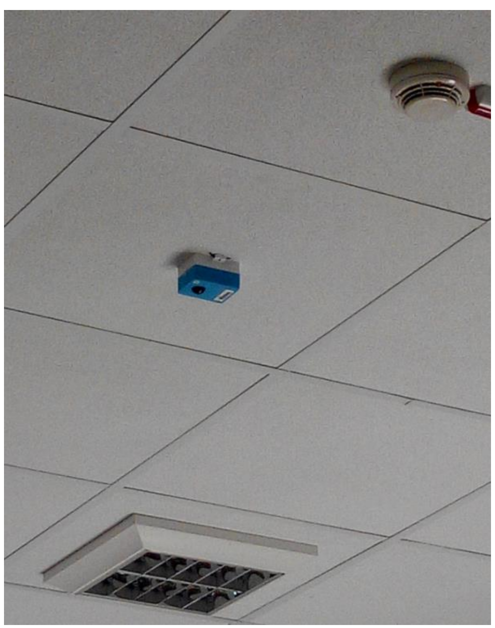
- Blockages of waste pipes big problem in urban areas
- Monitoring system can help to detect blockages early
- Preventative maintenance of pipes

Sensors:
Custom Capacitive
IR light,
RGB,
Temperature

Coms:
3G, WiFi, Ethernet

Use Case – Wireless Building Management

- Deployment of wireless sensors in Kalvino library in Torino, Italy
- Prototype development as part of FP7 Tribute project



Sensors:
CO2
VOC
Light
Temperature

Coms:
802.15.4, USB, Ethernet

Use Case – Environmental Monitoring

- Demonstrate deployment in the wild
  - Multiple sensors, processing, wireless communications with backup
  - Energy harvesting

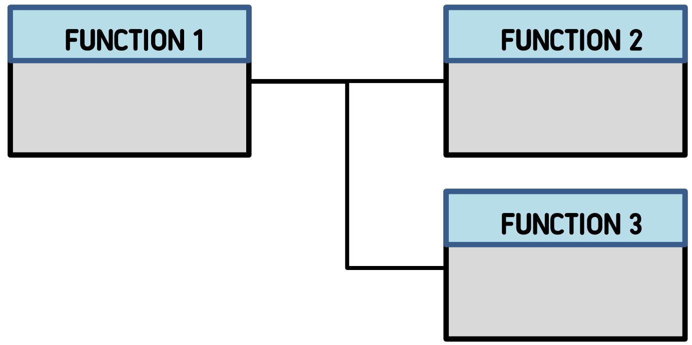
Environmental
Monitoring

River Liffey
Deployment

Sensors:
Depth
Turbidity Water-
Temp
Air Temp
Humidity Tilt
Vibrations Light
Position Flow
Compass

Comms: 3G, LoRa

nBlocksStudio: Introduction

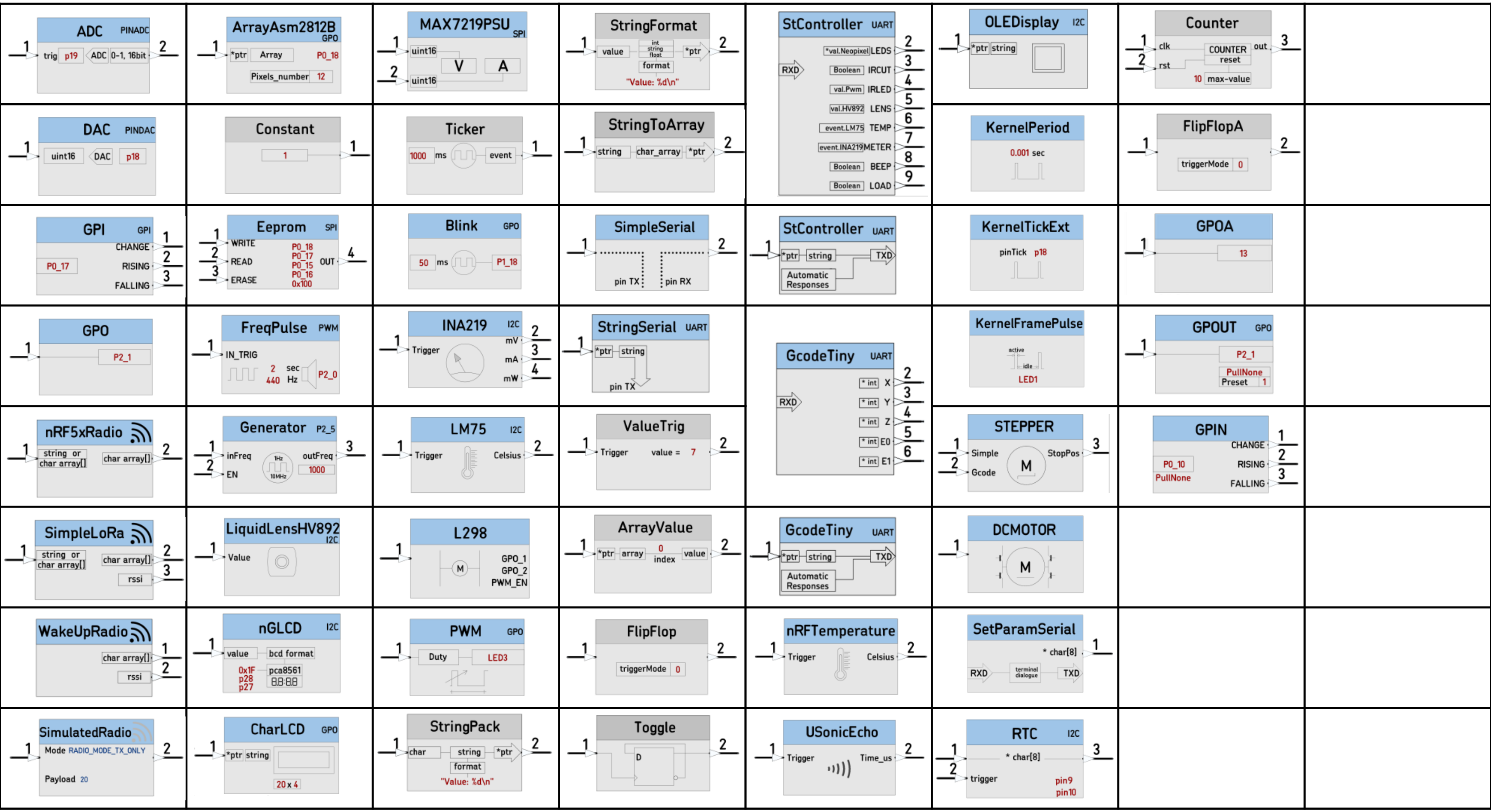


nBlocksStudio
- Graphical-Diagrammatic programming environment
- Aim – allow users to develop applications without writing code
- Uses the Flow Based Design paradigm
- Function-Nodes connected with Wires

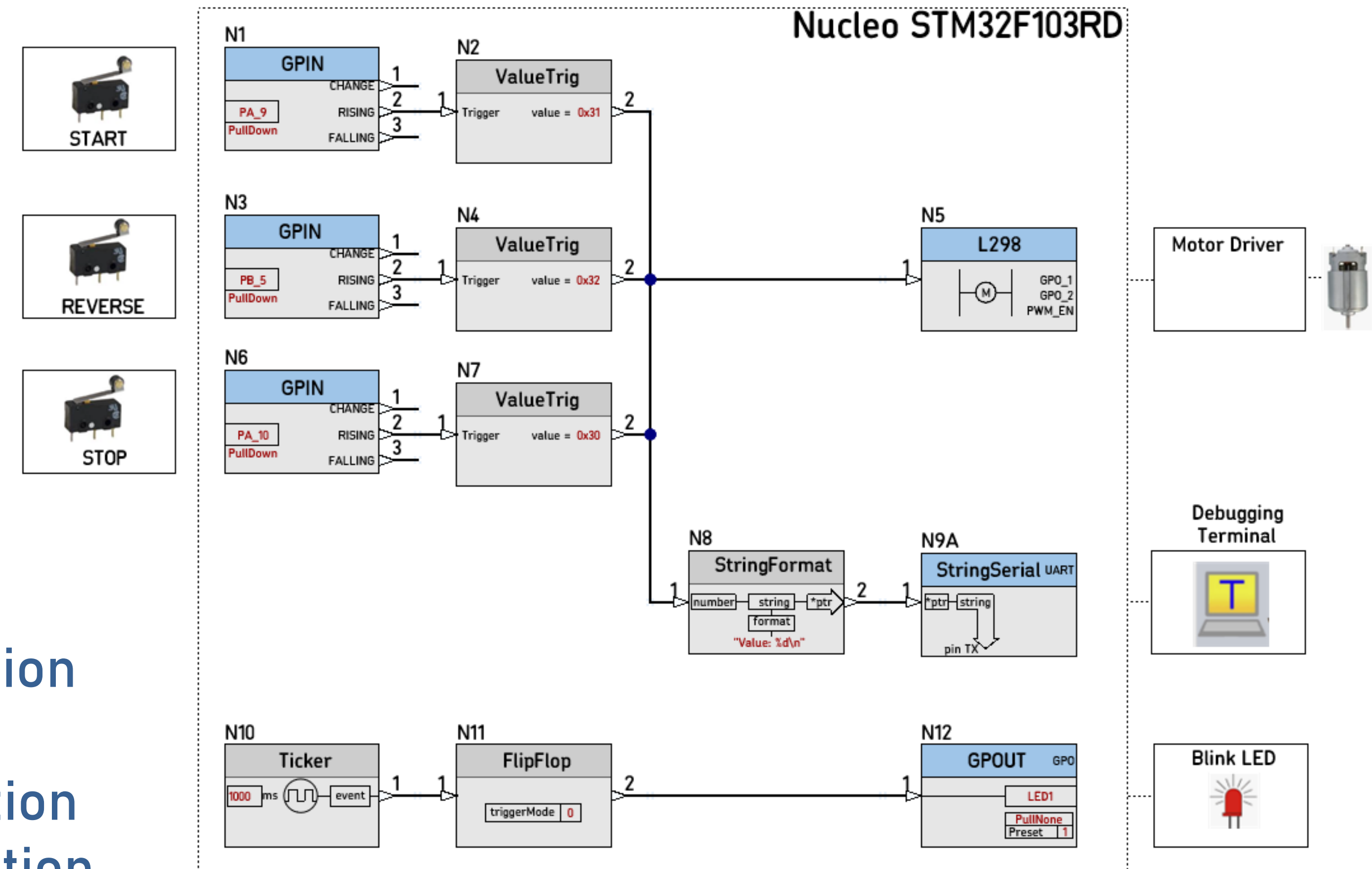
Code
- Autogenerated code runs in a soft-real-time system
- Underlying layer: Kernel and Event driven tasks

- Contribution server

Function Blocks



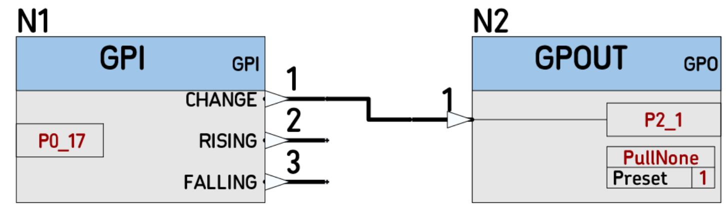
Concepts

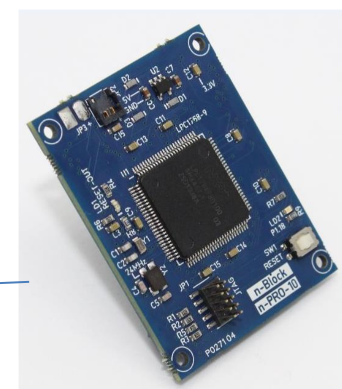


1. Node
2. Flow
3. Connection
4. Design
5. Translation
6. Compilation

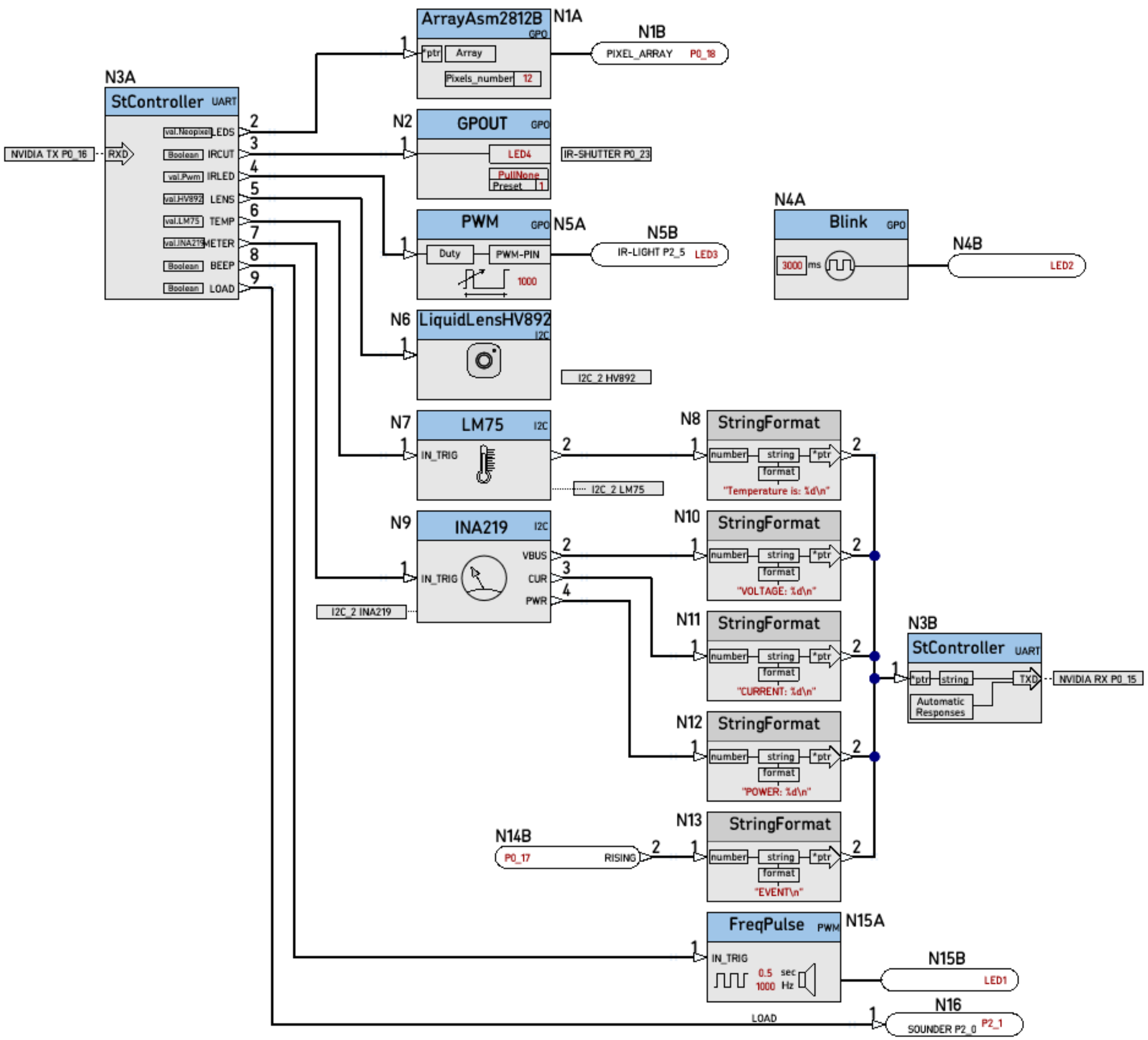
Workflow

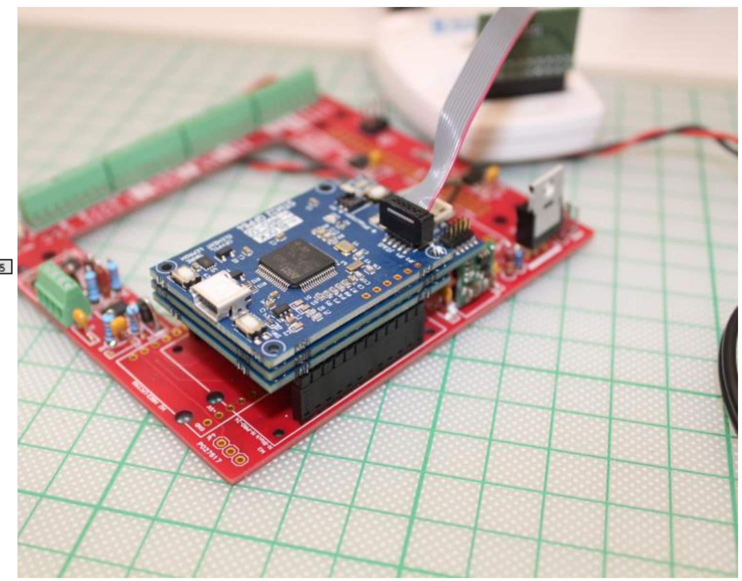
1. SELECT NODES
2. CREATE THE DESIGN
3. AUTO-GENERATE CODE
4. COMPILE
5. UPLOAD TO BOARD



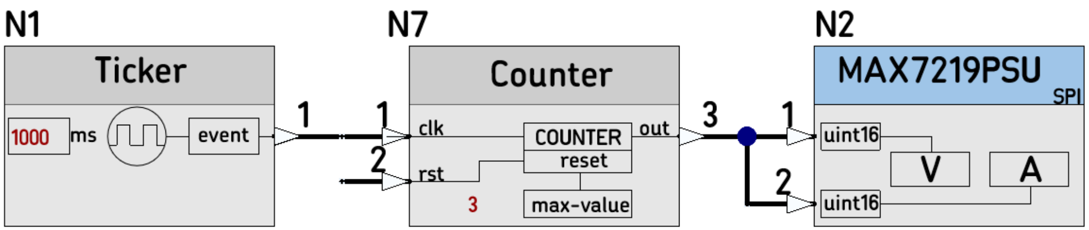


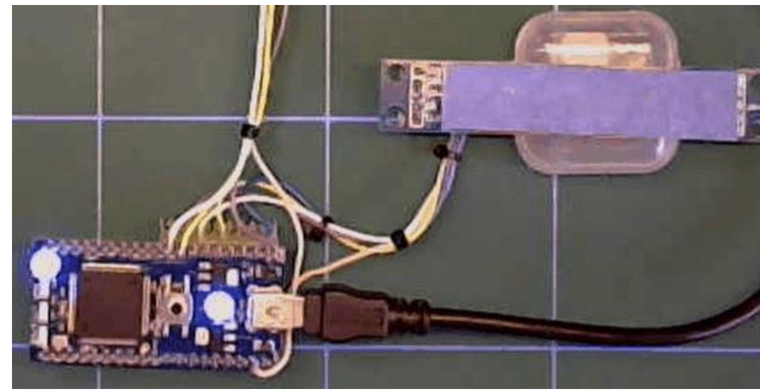
Example: Optical Scanner Controller

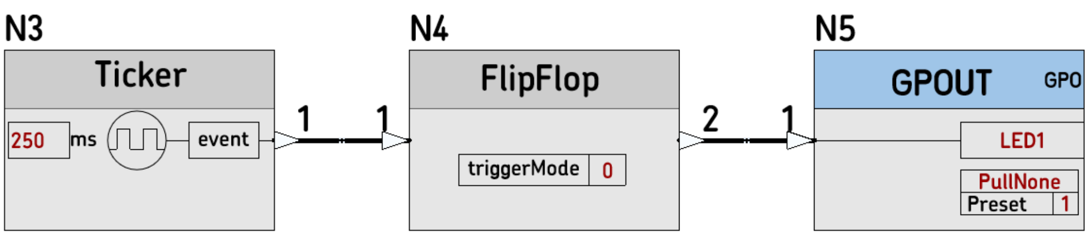


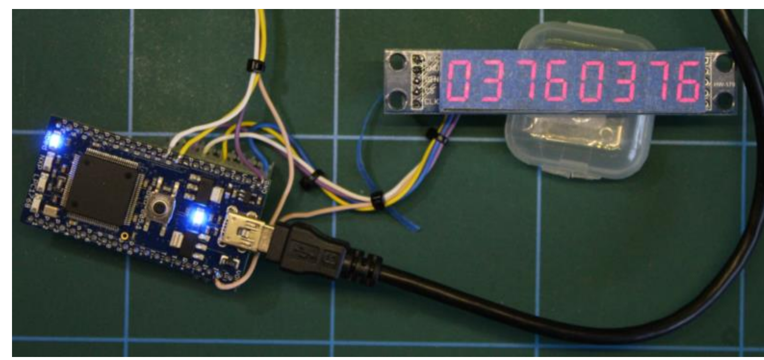


Example: seven-segment Display

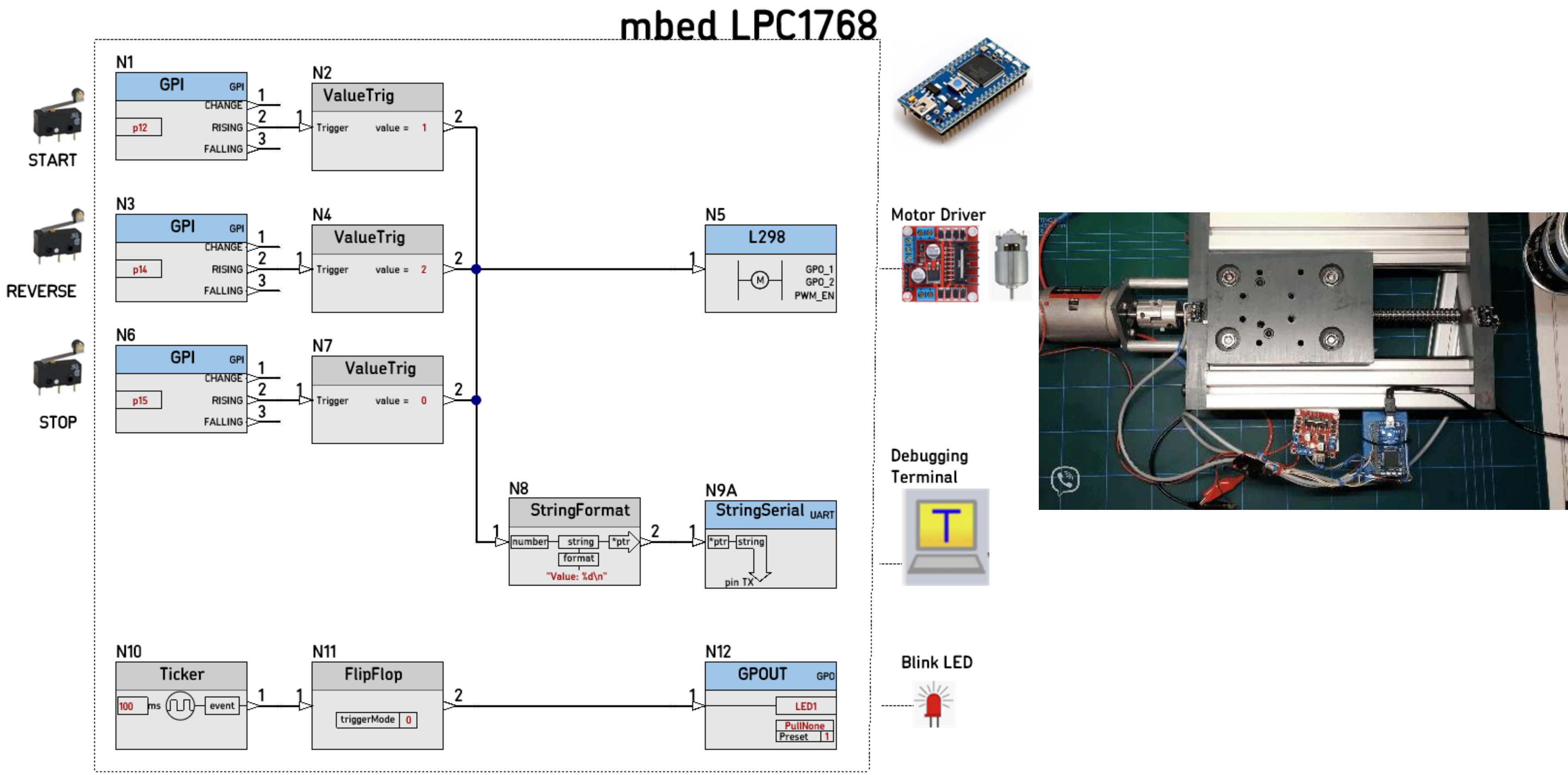




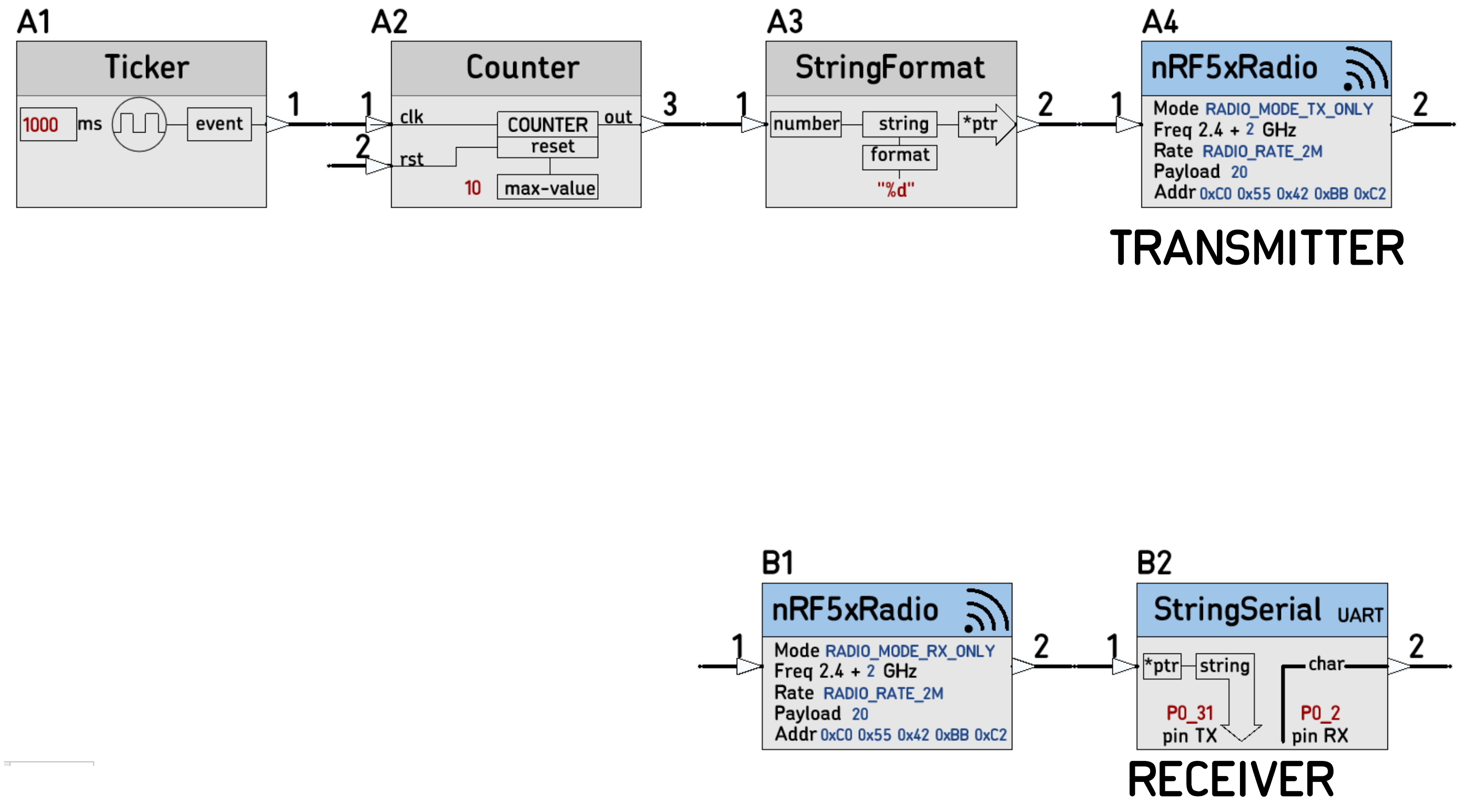


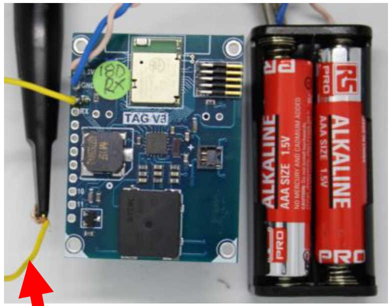


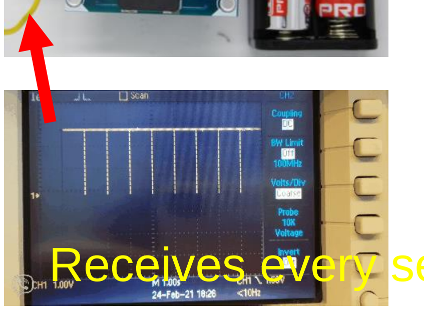
Example: Simple motion automation



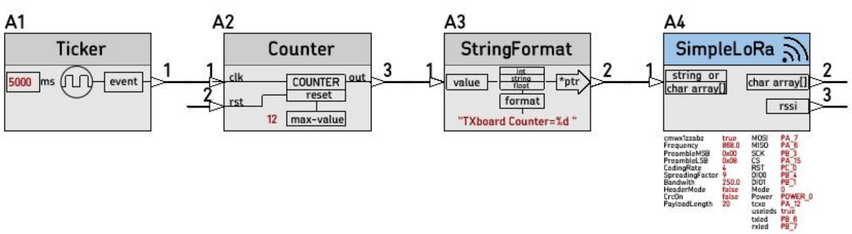
Example: Simple 2.4GHz Link



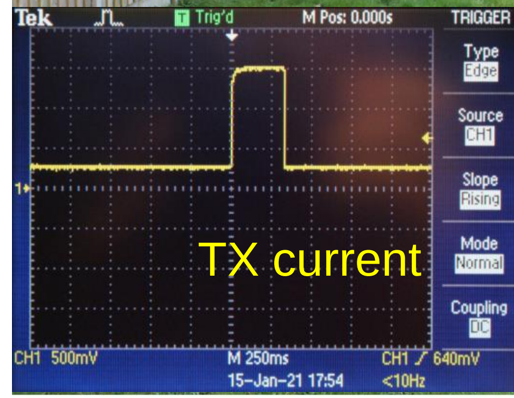




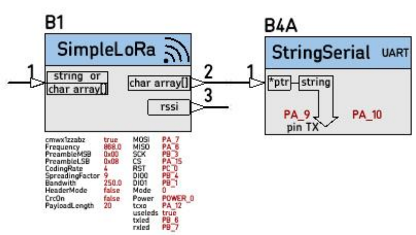
Example: Simple LoRa Link



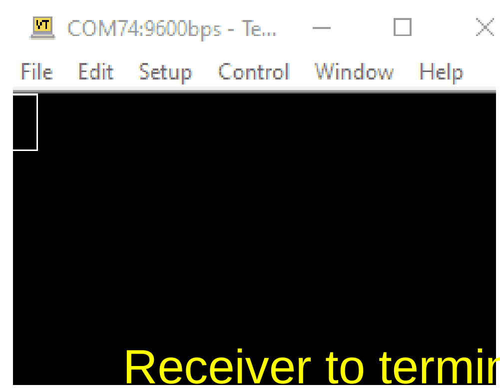
TRANSMITTER

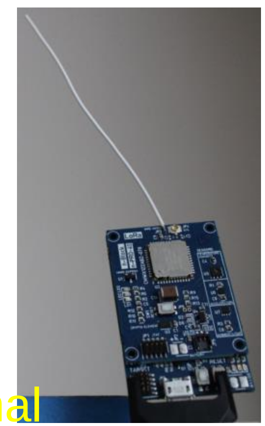


TX current



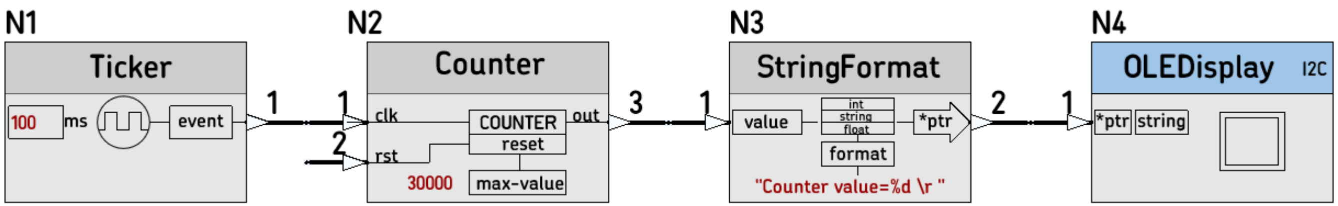
RECEIVER



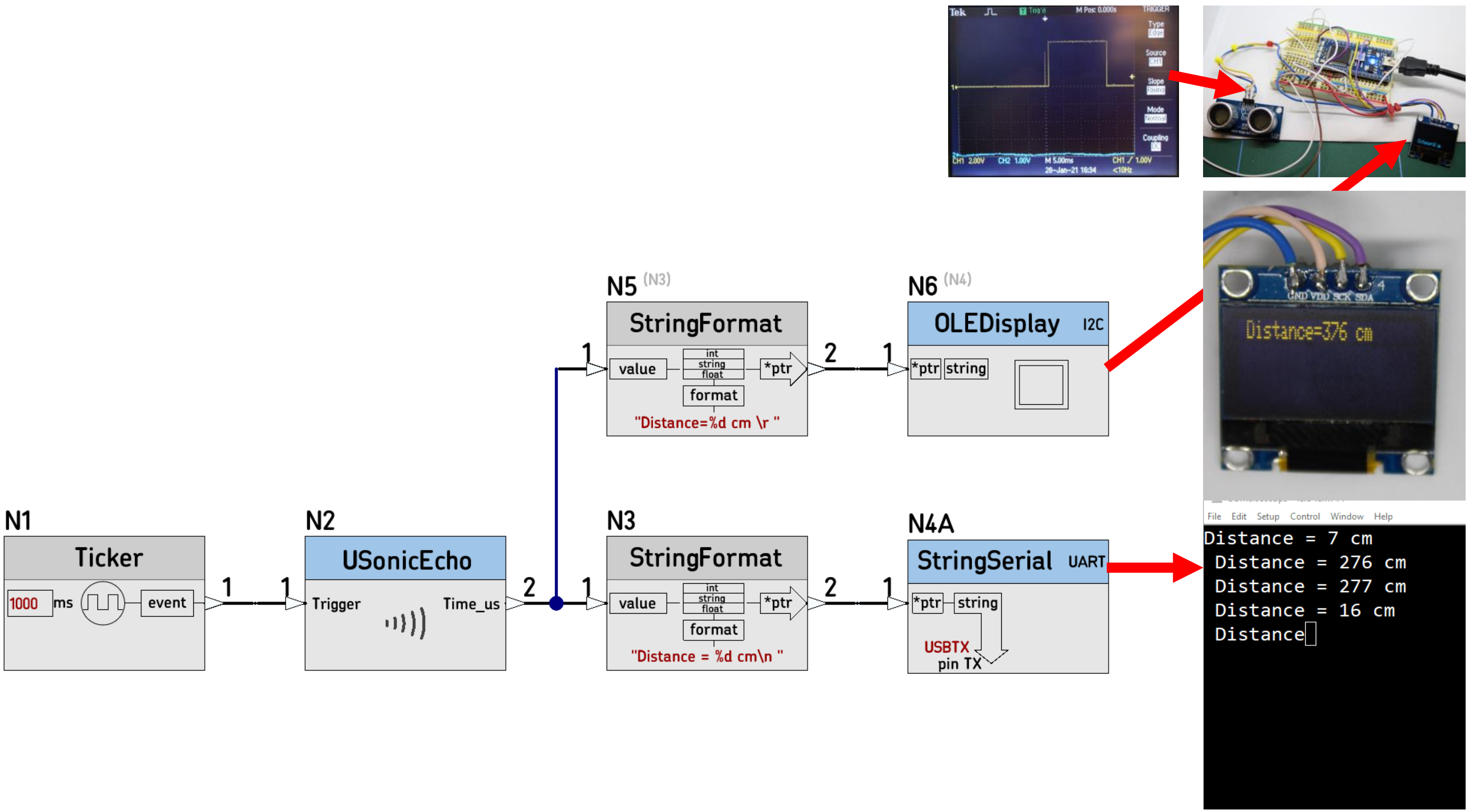


Receiver to terminal

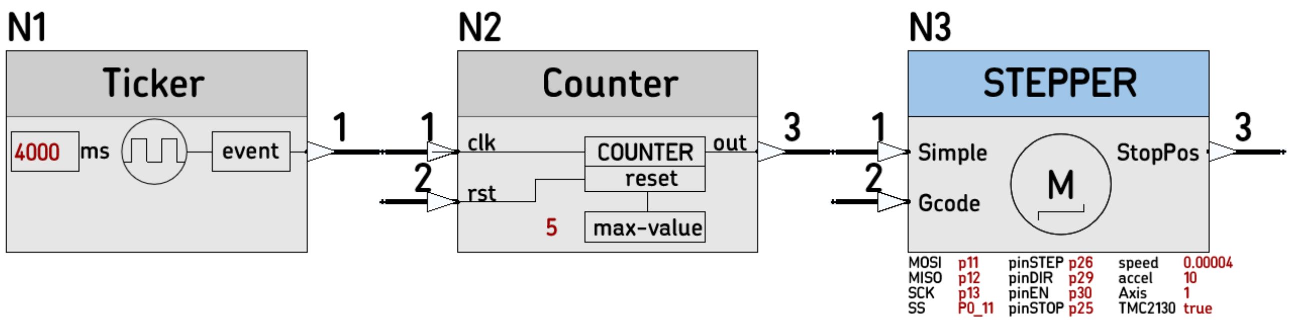
Example: Counter to OLED display

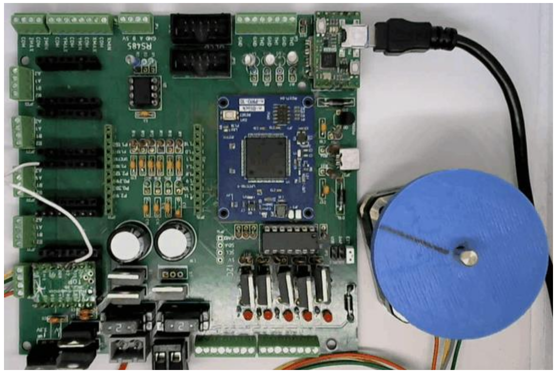


Example: Ultrasonic Range finder



Example: Simple Stepping-Motor





Summary

- n-Blocks: A modular low power IoT Hardware platform
  - Uses Standardized Form-factor, Connectors, Interfaces
  - Design driven, Powered by ARM Cortex Microcontrollers
  - Applied to real Projects and reference designs:
  - No Cables: Reduces drastically development time

- nBlocksStudio: A flow-based / function-blocks programming environment, for microcontrollers.
  - Uses Function Blocks. Driven by events and messages
  - Design driven, Powered by C++ classes and abstractions
  - Applied to real Projects and reference designs:
  - No Code: Reduces drastically development time