Chirpbox
A Low-Cost LoRa Testbed Solution

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Motivation – Need for a Low-Cost LoRa Testbed Solution

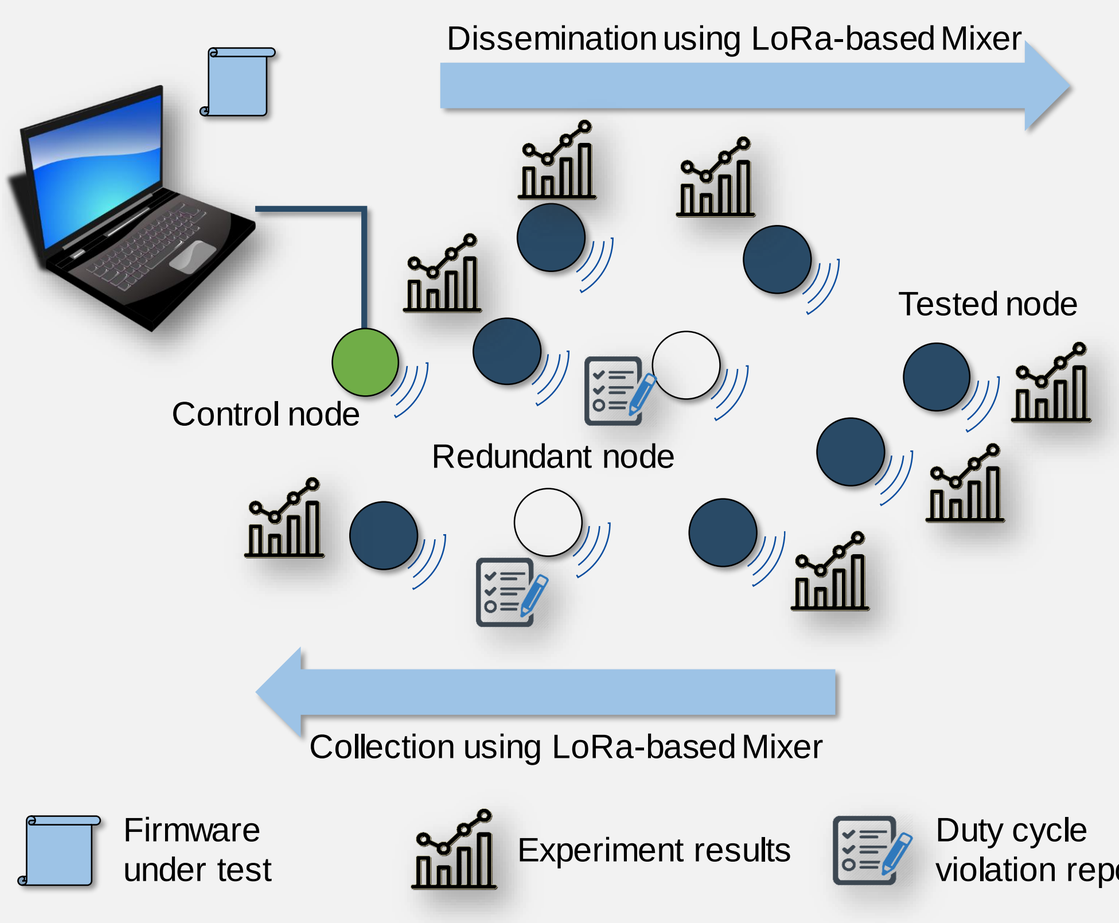
- As nodes are often deployed outdoors over large areas, a key hurdle in designing LoRa testbeds is the absence of a backbone infrastructure (which, instead, is commonly available in indoor facilities).
- Specifically, the lack of infrastructure results in 6 main **challenges**:

C1: How to send back the evaluation results to the user
C2: How to disseminate a firmware under test
C3: How to share a common timescale to compute time-related performance metrics (e.g., end-to-end latency)
C4: How to schedule an experiment remotely
C5: How to ensure long-term availability
C6: How to keep costs low

Solution – Chirpbox

- To address these challenges, we propose Chirpbox, which:
  - Allows to collect the evaluation results and to disseminate the firmware under test using a LoRa-based mixer protocol **(C1, C2)**
  - Ensures clock synchronization with a GPS module **(C3)**
  - Allows to schedule an experiment remotely using a control node (connected to the Internet) located in proximity of the other testbed nodes **(C4)**
  - Does not need an energy-hungry observer for each node, which can hence be equipped with traditional batteries **(C5)**
  - Allows to keep costs below 160 US dollars per node **(C6)**

Chirpbox – System

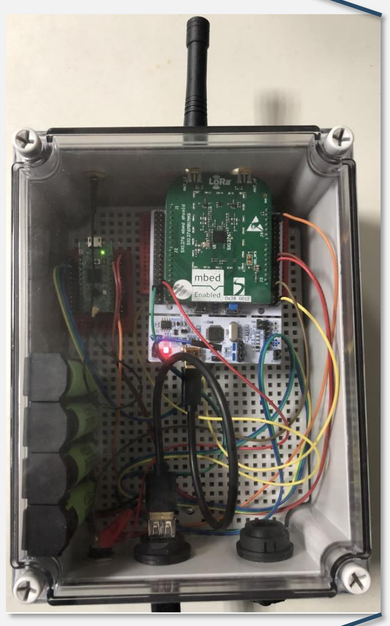


Chirpbox – Hardware

Clock module (GPS and RTC)

Battery module (Nitecore NL1834)

LoRa node (STM32 NUCLEOL476RG with SX1276MB1MAS)



Chirpbox – Workflow

Procedures

Firmware dissemination
1. Receive and write the firmware to bank 2.
2. Configure the experiment duration.
3. Start the firmware under test.

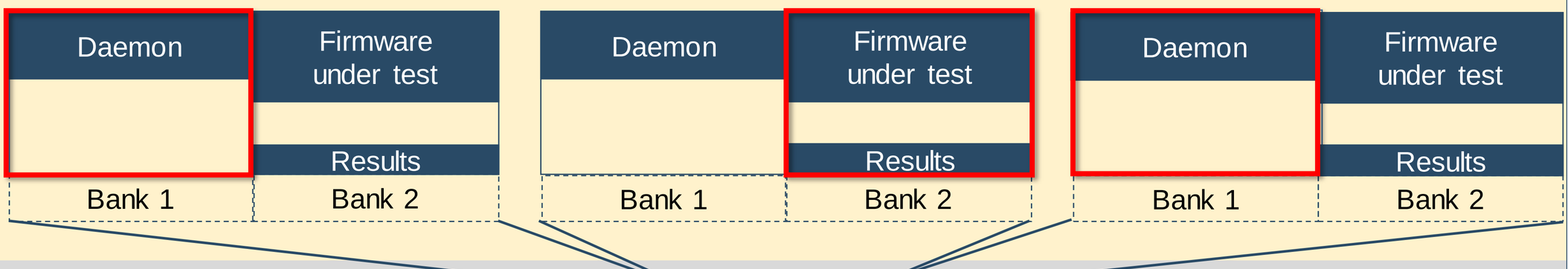
Configuration

Start an experiment

Experiment
1. Record the performance at the assigned address of bank 2.
2. Stop the experiment by the RTC module.

Results collection
1. Check node status.
2. Collect results in bank 2 using LoRa.

Flash of STM32L476RG
Bank1 (0x08000000 - 0x0807ffff)
Bank2 (0x08080000 - 0x080fffff)



Timeline

Firmware located in bank 2

Firmware located in the default bank, bank 1 (to prepare for an experiment)

Firmware located in the default bank, bank 1 (to collect results after an experiment)

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