



... in the Internet of Things

Bachelor Project (PO)
Scenario Description
Hamburg 08.04.2024

Kevin “Tom” Weiss
Leandro Lanzieri

kevin.weiss@haw-hamburg.de
leandro.lanzieri@haw-hamburg.de

Prof. Dr. Thomas C. Schmidt

INET AG, Dept. Informatik HAW Hamburg

t.schmidt@haw-hamburg.de

A bit about us: Kevin Weiss



- Received his B.Sc in Electrical Engineering at the Lakehead University.
- Since 2018 works as a Research Assistant at the Hamburg University of Applied Sciences where he focuses on Hardware-in-the-Loop testing and got involved as a RIOT maintainer.
- He is currently working both in academia and industry in the embedded engineering field, with projects ranging from fiber optic temperature sensor design at Accelovant Technologies to IoT wireless metering at Lobar GmbH.

A bit about us: Leandro Lanzieri



- Studied Electrical Engineering, then he obtained his Master's degree in Embedded Systems at the University of Buenos Aires, with a thesis in collaboration with the Hamburg University of Applied Sciences.
- He has worked at the INET group of HAW Hamburg since 2018 as a research assistant where he focused on secure IoT protocols and got involved in RIOT OS as a maintainer.
- He is currently pursuing his PhD in collaboration with DESY on a research project, which aims to analyse data from operational records, environmental measurements and experiments, in order to find early indicators of hardware deterioration of the embedded sensor systems at the European XFEL.

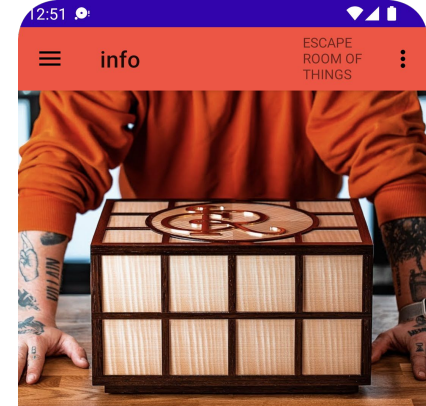
Previous projects

Escape Room of Things

A secure plug-n-play Escape Room

Escape Room of Things

- Multiple wireless puzzle nodes.
- Encrypted and authenticated node communication:
 - Credentials installed on flash.
 - QR code for on-boarding.
 - CoAPs (DTLS).
- Central control tracking status of all puzzles.
- Mobile app:
 - Users get instructions and tips.
 - Admins can add new nodes and configure the rooms.



WELCOME TO
ESCAPE ROOM
OF THINGS

Solve riddles to open the
box and escape the room.

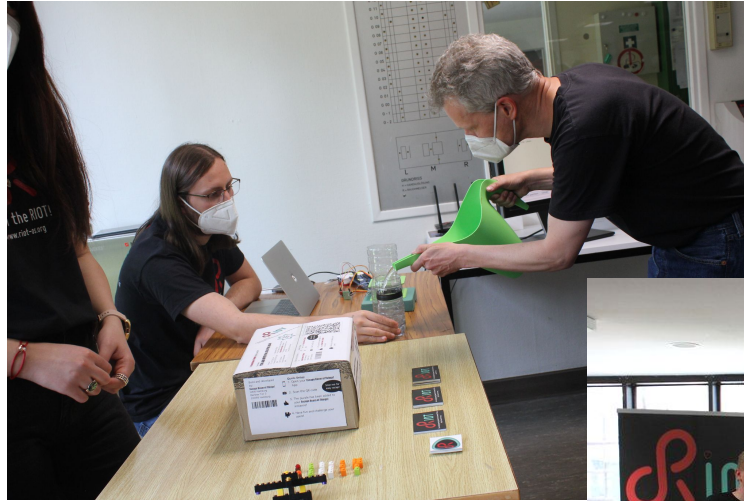
Escape Room of Things



Riddle 1.

You have a 0.5l bottle of water and a 0.3l bottle. You have to fill the 0.5l bottle with exactly 0.4l of water.

TAKE A TIP



SyncBlink

Touch base daily, reassure seamlessly.

SyncBlink Concept

Ensure activity of others with a device that requires daily interaction and reflects the interaction across nodes.

For example, an elderly parent interacting with a node so their children can be reassured that no accidents happen.

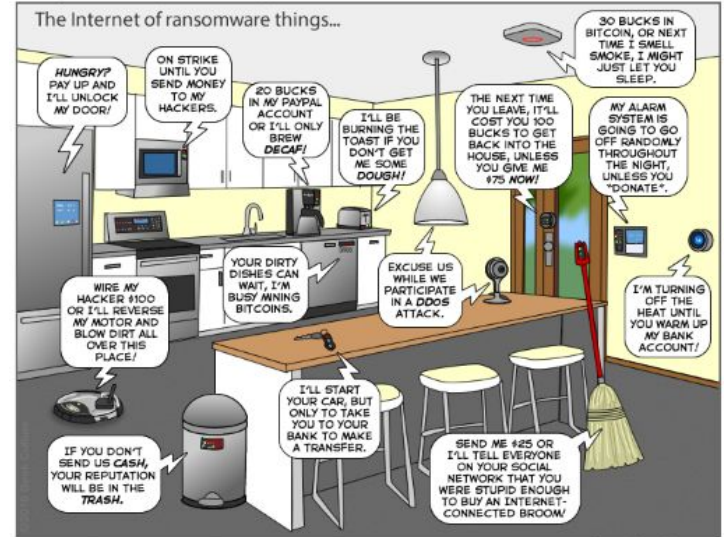


Motivation

+30 billion devices by 2029

- **Security**
 - Rise of cybercrime.
 - We need: **C**onfidentiality, **I**ntegrity, **A**uthentication.
- **Interoperability**
 - Increasing number of vendors with custom solutions, results in incompatibility silos.
 - Open standards help foster better communication between devices from different vendors.
- **Open implementations**
 - Reduce development costs.
 - Accelerate innovation.
 - Open review process enhances security.

The Joy of Tech - by Nitrozac & Snoggy

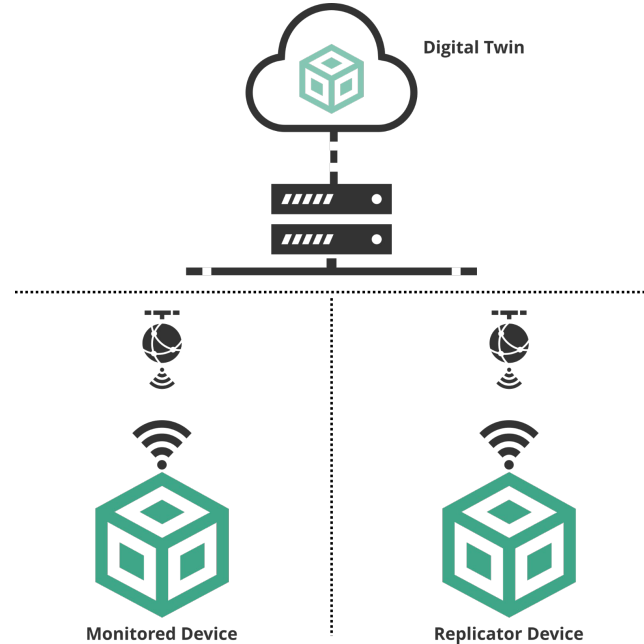


You can help us keep the comics coming by becoming a patron!
www.patreon.com/joyoftech

joyoftech.com

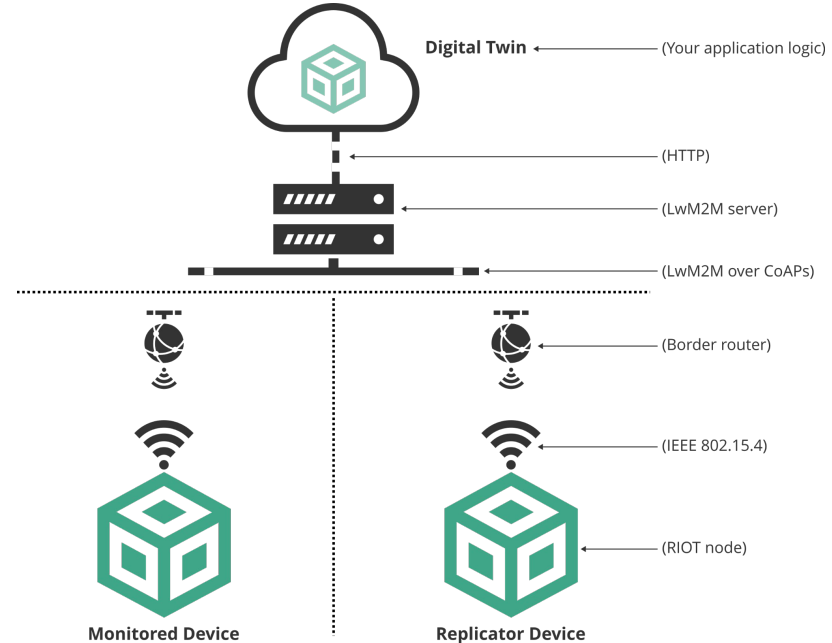
Project High-Level Requirements

- There must be at least two devices **synchronized by means of a digital twin**.
- The application logic shall communicate with node via standard **IoT application protocols**.
- The devices should have at least one actuator and one sensor, be battery powered, and use wireless communication.



Project Technical Recommendations

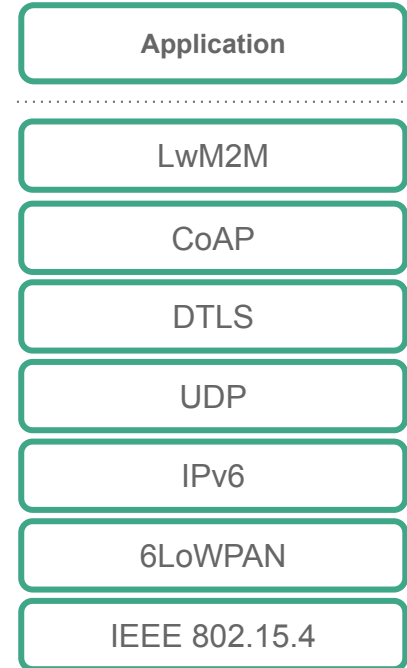
- Locally all devices communicate with a border router over **IEEE 802.15.4**.
- The **border router** interfaces the wireless local network with the Internet.
- The devices communicate with a **LwM2M Server** to report their sensor and actuator values.
- Your application logic gets the devices values from the LwM2M Server via its **HTTP API**.
- The application creates a **digital twin** (representation) of the monitored device and **synchronize** it in the replicator.



Technologies

We will utilize open standards to ensure security and interoperability

- Resource discovery: **LwM2M**
- Application: **CoAP, Link Format**
- Transport: **UDP + DTLS**
- Network: **IPv6 + 6LoWPAN**
- Radio + MAC Layer (local): **IEEE 802.15.4**



Example of IoT networking stack

Proposed Teams

The following team organisation **is a suggestion**:

- **Sensor nodes**
 - Device sensing and actuation.
 - Wireless communication.
 - LwM2M object representation.
 - Device enclosures.
- **Web application**
 - Backend and communication with LwM2M server.
 - Device registration.
 - Frontend UI.

Formalities

- **Attendance on site is required**
- **Milestone presentations**
 - Mandatory and on site
 - Slides and documented source code checked-in
 - Every member of the teams should present a part
- **Final documentation**
 - Project documentation and description linked to GitHub repository
 - <https://www.hackster.io/riot-os>

Tools

- **MS Teams (code 0zy0hq7)**

- <https://teams.microsoft.com/l/team/19%3aw4wtNy73YMTvOTEIYOaEYBgzMrt45QaNgUHxIDitp4w1%40thread.tacv2/conversations?groupId=355104ec-2606-43f0-a2af-a0049898a650&tenantId=2c6cac8d-ab61-47b3-8209-4df2e46aefbc>

- **GitHub**

- Everyone should send to MS Teams
 - Name
 - GitHub username
 - HAW email address
- Project code will be in <https://github.com/smartuni>

Material

- Calendar and slides
 - <https://inet.haw-hamburg.de/teaching/ss-2024/riot-im-internet-of-things>
- RIOT Tutorial
 - <https://github.com/inetrg/exercises>

How to access lab PCs

1. On multi-boot menu, choose **BRV-Special**
2. First login:
 - a. Choose **Networker** user
 - b. Enter password **praktikum**
 - c. Repeat password **praktikum**
 - d. Enter new password **riot2024**
 - e. Repeat password **riot2024**
3. Second login:
 - a. Enter your user (e.g., **infwuf123**)
 - b. Enter your password
 - c. For people without “inf” account:
 - i. User: **testuserti**
 - ii. Pass: **278Z-TIUS-37TI**

Information for Task 8 - CoAP

- On task 4 the IP for the sensor node is:
 - **2001:db8:8000:0:e838:ffb2:e668:7e94**
- On task 5, the IP for the resource directory is:
 - **fd00:dead:beef::1**

Questions?