

The 6th Prague Embedded Systems Workshop 2018

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KETCube – the Prototyping and Educational Platform for IoT

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**FACULTY OF ELECTRICAL
ENGINEERING
UNIVERSITY
OF WEST BOHEMIA**

- 1 Short introduction: UWB
- 2 Motivation
 - To be here
 - To create new platform for IoT – KETCube
 - Current Release
- 3 KETCube in Detail
 - Hardware
 - Software
 - Configuration
- Project Life Cycle
- Industry-Standard Tools
- Documentation
- 4 Use Cases
 - Environmental Sensor LPWAN Node
 - Object Presence Sensing Demonstrator
- 5 Conclusions
 - Future Work

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2013 Pilsen European Capital of Culture



City	Pilsen (CZ)
Founded in	1991 (1950)
Number of employees in	2032
Number of students in	14500
Annual sales	79 million €
Core business	University, Research institute

FACULTIES AT THE UNIVERSITY

Faculty of Applied Sciences

Faculty of Design and Art

Faculty of Economics

Faculty of Electrical Engineering (FEE)

Faculty of Philosophy and Arts

Faculty of Education

Faculty of Law

Faculty of Mechanical Engineering

Faculty of Health Care Studies



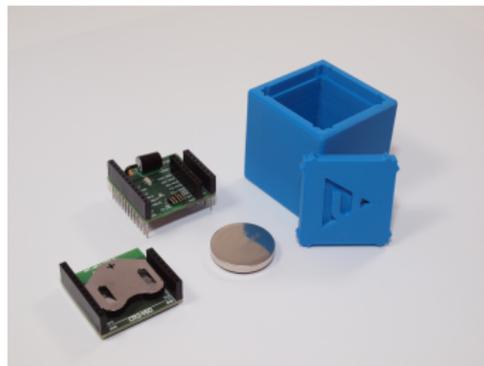
- User-centric testbed using existing Internet of Things (IoT) infrastructure to create a campus-scale “living laboratory”
- We are open to cooperation with external partners, who can test their own technology at a smaller campus-scale before upscaling to larger units (cities, regions, etc.).



www.smartcampus.cz

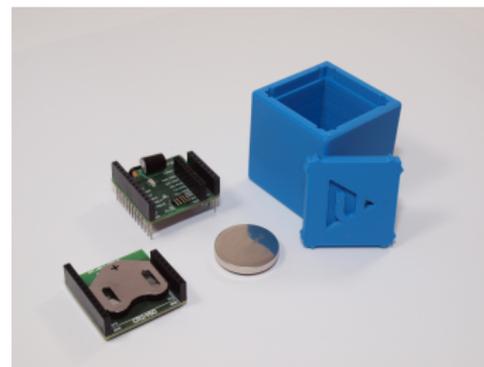
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- **Introduce** an universal **prototyping and educational IoT platform – KETCube**
 - Department of Technologies and Measurement (KET), UWB in Pilsen
 - Non-restrictive BSD-like license¹
- **Attract** new users from industry and academia
- **Ask** for **feedback and contribution**



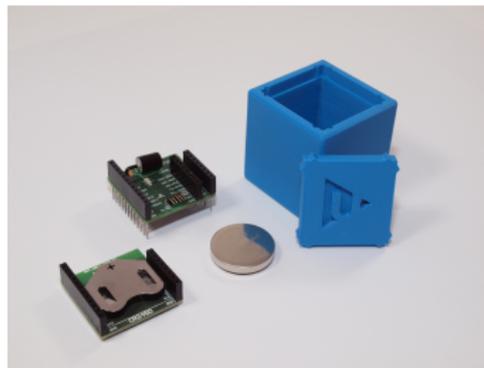
¹University of Illinois/NCSA Open Source License

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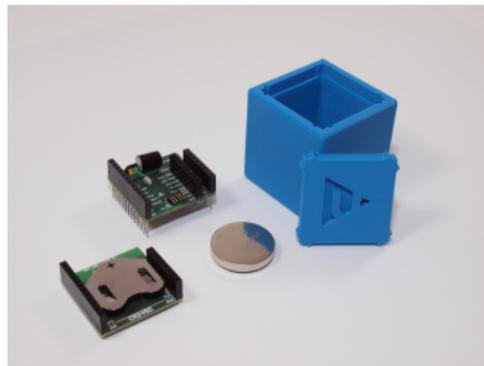


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- Diversity of IoT world brings challenges into our areas of interests:
- Technical – R&D:
 - **point of integration:** simple to (re-)use HW and SW modules
 - deployment to heterogeneous environments
 - **speed-up:** prototyping, validation and test series deployment
- Educational:
 - **mid-complexity:** balance the simplicity and insight (e.g.: Arduino vs. FreeRTOS)
 - industry-standard dev. style and documentation



- Main Board – schematics and manufacturing data
- Battery Board – schematics and manufacturing data
- KETCube Firmware (v0.1) – including project definitions for multiple IDEs and Doxygen-generated documentation
- KETCube Documentation – *Datasheet*, *3 App Notes*
- KETCube Tools – KETCube-related tasks support
- KETCube Box – 3D models and sources for KETCube cube-box



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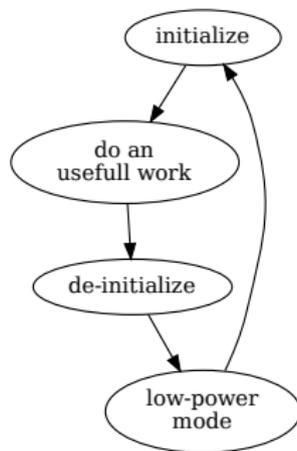
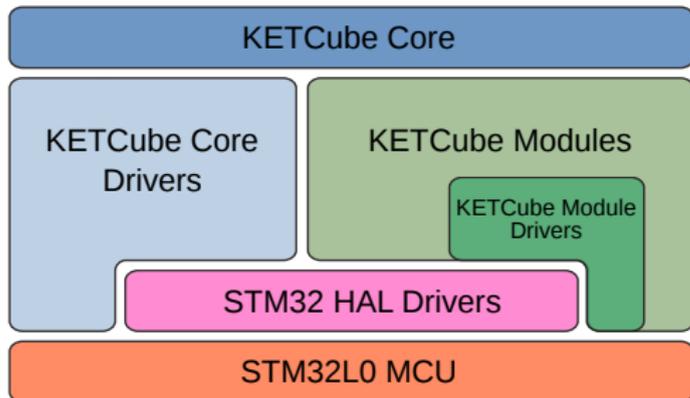
- **Murata Type ABZ:** STM32L0 MCU, SX1276 radio, manufacturer's support for LoRaWAN and Sigfox
- **HDC1080:** Relative Humidity and Temperature sensor (RHT)



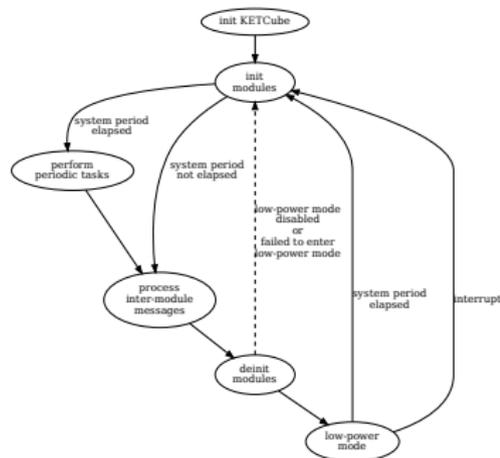
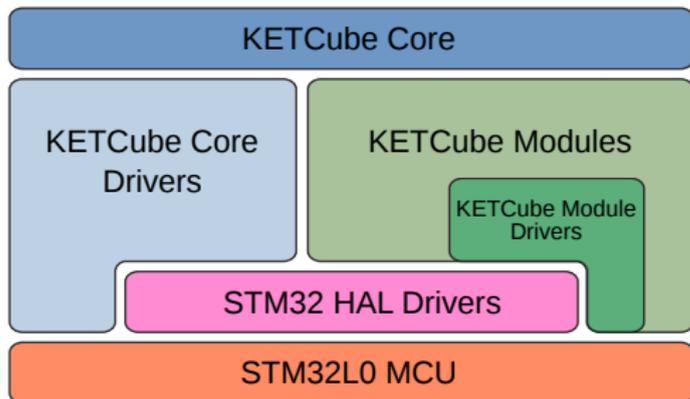
 **LoRa Alliance**



- Simple **architecture reflecting** IoT node **use-case**
- **Easy to re-use** software modules
- Enable/disable software module in compile- and run-time



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- Easy-to-use serial terminal interface:
 - documented in *Datasheet*
 - with built-in help
 - includes command history

```
> enable HDC1080
> enable LoRa
> set LoRa OTAA
> set LoRa appEUI 1122334455667788
> set LoRa appKey 11223344556677881122334455667788
> reload
```

Technical Challenges

KETCube Project Life Cycle

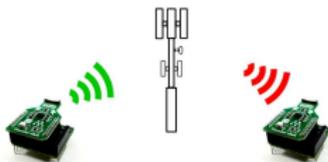
Prototyping - wired connection



Validation - wired connection



Deployment - LPWAN network
(in-field testing, small series)



Wireless demonstrator - p2p, no infrastructure

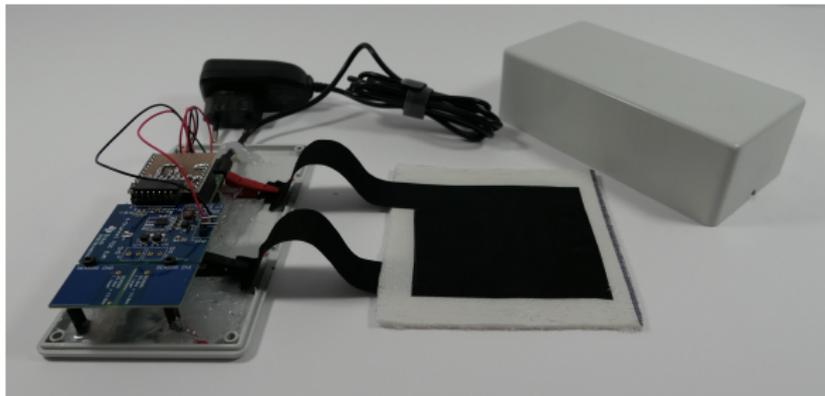


- Firmware:
 - no simplified custom solutions like Arduino IDE
 - any STM32-ready compiler and Keil μ Vision, Eclipse-based Atollic TrueSTUDIO or SW4STM32 or any Makefile-ready IDE (e.g. KDevelop)
 - GNU Indent to enforce coding style
 - Doxygen to generate annotation-based documentation
- PCBs – problems with tools compatibility
 - currently schematics and manufacturing data are released
 - planed: sample extension board projects in particular systems (Altium, KiCAD, Eagle, OrCAD) will be provided

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- Out-of-the-box functionality
- No programming required





- The KETCube extension board as a reduction to TI's FDC2214 dev-board
- Custom KETCube firmware module for FDC2214

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- Incorporating **test methodology** to support both education and R&D process – candidate is Unity
- New communication modules – Sigfox (under development), ...
- **New** sensing and actuating **modules** coming **from running projects** and academia-industry partnership
- Refactoring of parts of code
- Expecting **community feedback and contribution**

- A new Prototyping and Educational Platform for IoT – **KETCube**:
 - **accelerates** the **education and R&D** processes
 - **uses industry-level documentation and tools**
 - **is the point of integration**: speed-up of device validation, in-field testing and deployment

Thank you for your attention!

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