FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITY OF WEST BOHEMIA

RICE

Faculty of Electrical Engineering
University of West Bohemia
Pilsen, Czech Republic
Department of Technologies and Measurement

SmartCAMPUS

IQRF Summit 2018

Ing. et Ing. **Petr KAŠPAR**, Ph.D.
Head of SmartCity & IoT group

www.rice.zcu.cz

University of West Bohemia

City	Pilsen (CZ)
Founded in year	1991 (1950)
Number of employees	2032 (year 2014)
Number of students	14 500
Annual sales	79 million €
Core business	University, Research institute

FACULTIES AT THE UNIVERSITY
Faculty of Applied Sciences
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
Faculty of Art and Design

University of West Bohemia

FACULTY STAFF AND STUDENTS	
Ph.D. students	184
B.Sc. and M.Sc. students	1 761

DEPARTMENTS AT THE FACULTY

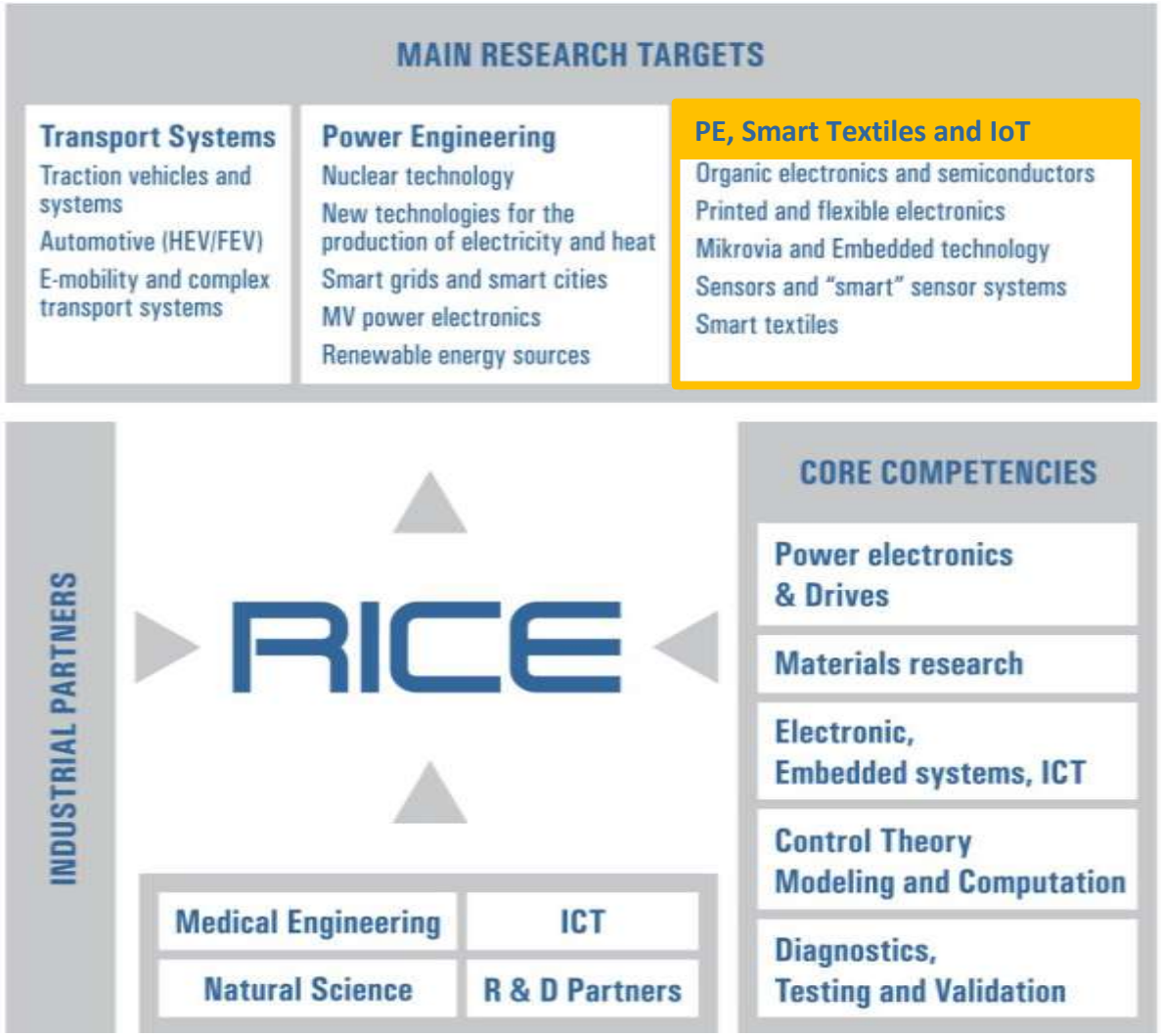
- Department of Applied Electronics and Telecommunications
- Department of Electrical Power Engineering and Environmental Engineering
- **Department of Technologies and Measurement (KET)**
- Department of Electromechanics and Power Electronics
- Department of Theory of Electrical Engineering
- **Regional Innovation Centre for Electrical engineering (RICE)**

FACULTY STAFF	
Professors	18
Associate Professors	37
Assistants	67
Research workers	38

RICE - Regional Innovation Centre for Electrical engineering

- RICE was funded from the European Regional Development Fund (ERDF) with budget of ≈ 25 mil. EUR (infrastructure + equipment).
- RICE is able to secure the whole research chain – from basic research, through development, testing, up to functional samples/prototypes.
- Main activities
  - material and technology diagnostics
  - applied research / partnership
  - advanced systems development
- **One section of the RICE is devoted to smart textiles, printed electronics and IoT** – KET research team.

RICE - Competence Roadmap



Head of group	Assoc. Prof. Ales Hamáček
Members	2 Professors 4 Assoc. Prof. 12 Ph.D. 11 Ph.D. stud.
Member-ship	OE-A, IPC, IEEE

R&D Areas

R&D activities connected with IoT and I 4.0

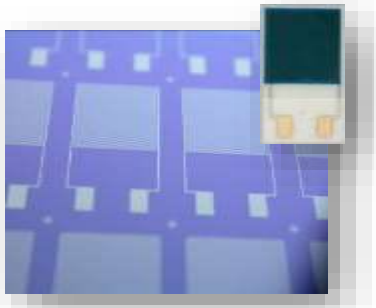
Printed and Flexible electronics – Passives, sensors, transistors.

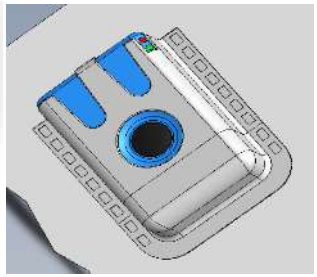
Smart Textiles – Interconnection systems, Functional blocks integration, RF communication, Sensor evaluation circuits, smart firefighter protective suit, smart textiles for healthcare.

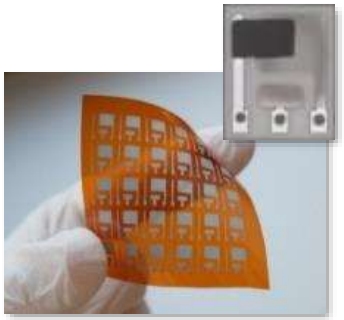
Vapour and Gas Sensors – Chemoresistive, Electrochemical.

Industrial deposition technologies – Aerosol Jet Printing (OPTOMEC 300), Screen printing (EKRA E2)

Flexible Systems - Hybrid integration of printed and conventional components on foils and textiles.







FACULTY OF ELECTRICAL ENGINEERING
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Running projects – Printed Electronics, Smart Textiles and Sensors

INTERNATIONAL PROJECTS
ADVANTEX - Advanced Functional Blocks and Technologies for Smart Textile Products
ASES - Smart High Efficient Alternative Solar Energy Source
NATIONAL PROJECTS - Technology agency of the Czech Republic / MPO
SYMOD - System for monitoring and detection
SOFTSTOP - Safety traffic barrier of road tunnels
SENIORTEX - Smart Modular clothing and textile products with integrated electronic microsystems for improving the health care of the aging population
ELTEX - Smart textiles with integrated electronic functional blocks of new generation for health protection enhancement
UNAS - Carbon nanostructures for sensor applications
DETEKO - Innovative printed sensor for detection of heavy metals in liquids
SuBaTex - Flexible autonomous energy harvesting systems for smart textiles
GLOVETECH - A unique test system and advanced semi-automatic production technology to increase the comfort and protection gloves against thermal risks.
LONG-TERM PROJECT
FLEXPRINT – Centre of Competence - Flexible printed microelectronics based on organic or hybrid materials
NETESIS - New Technologies and Concepts for Smart Industrial Systems

Smart firefighter suit

- RICE is the winner of the tender Smart@fire for 10 000 smart protective firefighter suits for Belgium, France and English firefighters.

smart@fire

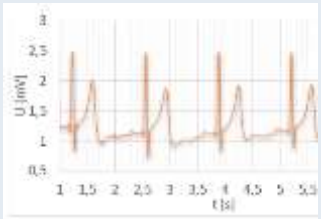
Smart textiles

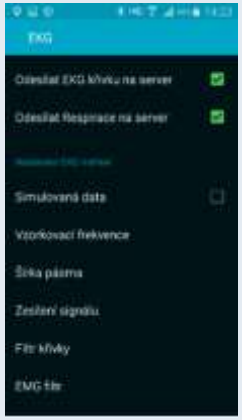
Target applications:

Home care and health care

Smart bed sheet including evaluation electronics for patient monitoring (in 2 zones integrated presence sensors, motion detection and humidity sensors).

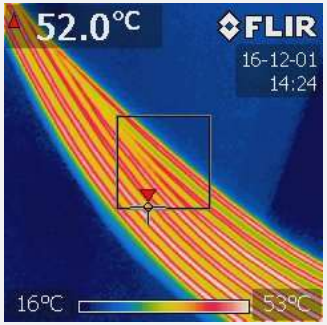
Sport and fitness





Sport top and functional T-shirts with integrated knitted or embroidered textrodes for HR and ECG monitoring.

Well-being, IoT



Washable knitted heating textiles for well-being and automotive applications.

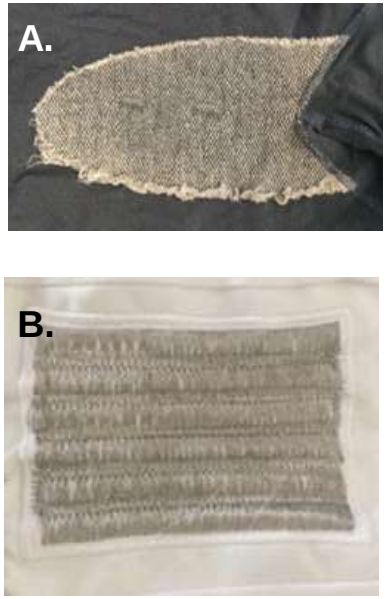
Printed and embroidered antennas for IoT applications.

Smart textiles

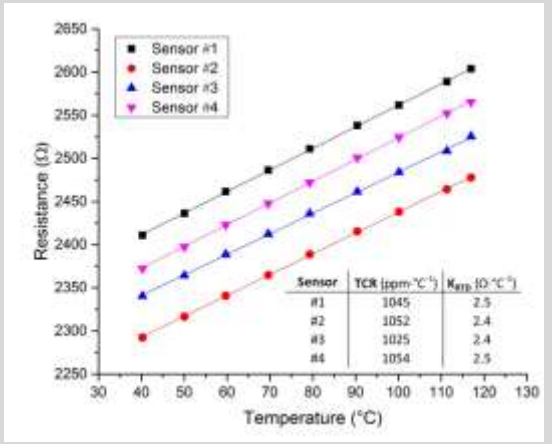
R&D in smart textiles:

- Hybrid resistive and conductive threads.
- Textile electrodes for HR and ECG monitoring.
- Large area embroidered temperature sensor.

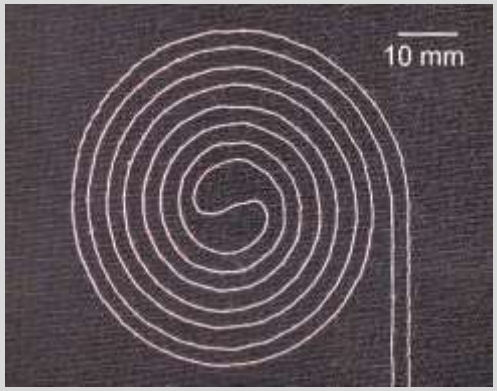
Hybrid conductive sewing threads based on metal microwires.
(Linear resistance down to 6 $\Omega \cdot m^{-1}$)



Textile electrode
(A. – knitted, B. - embroidered).



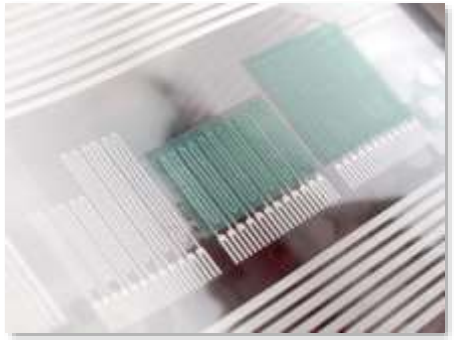
Temperature calibration curves.

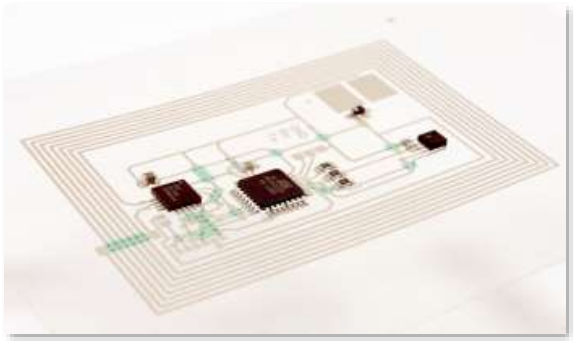


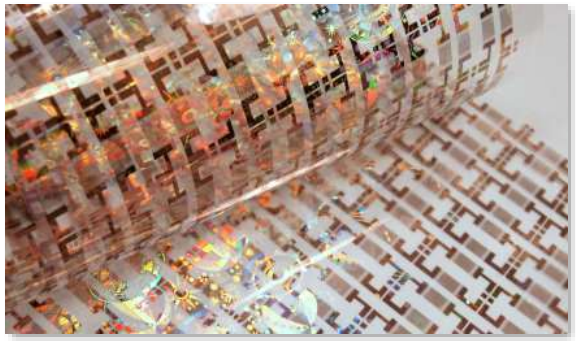
A novel large area embroidered temperature sensor. (Washable large area sensor with fast time response to sudden changes)

Printed electronics

- **Printed electronics applications:**
  - Components
    - Passives – R, L, C
    - Active - transistors
    - Antennas – HF, UHF
    - Sensors – T, RH, chemical
  - System-on-Foil
    - Hybrid T+RH labels
    - ID system on metal holograms







Printed electronics

Hybrid system printed on foil

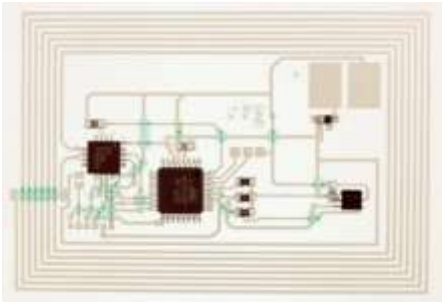
- Flexible RFID sensor tags for smart labels, smart packaging, logistics and IoT.
- Including data logging and android application for data visualization.
- Smart labels for:

a) V1 - temperature logging

b) V2 - temperature and relative humidity logging.

Smart label V1 (Temp. log.)

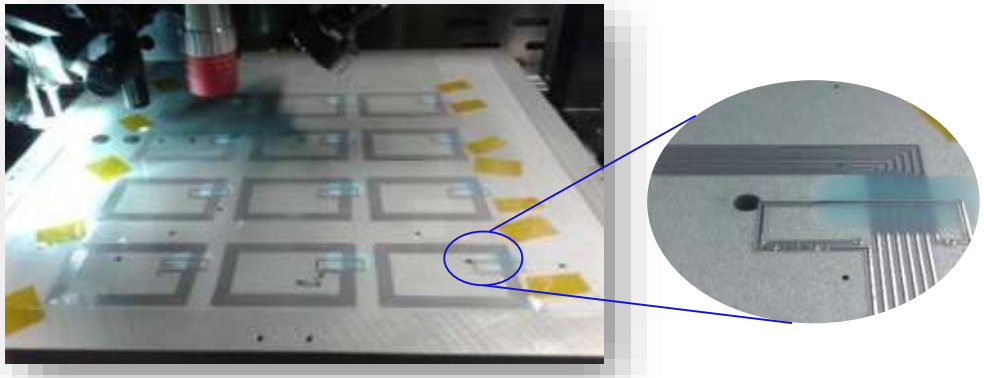
Smart label V1 android application.



Smart label (Temp. + RH log.)

Smart label V2 android application (data history).

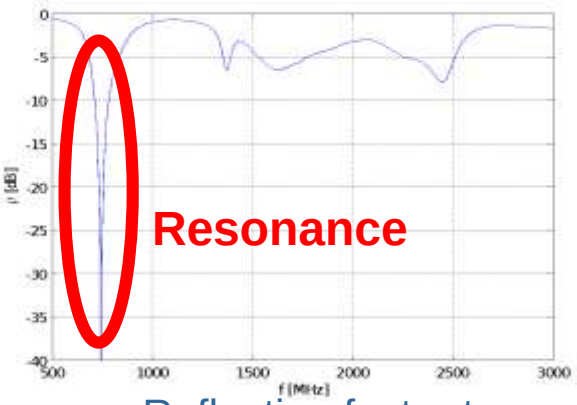
Printed electronics – antennas for IoT



Aerosol Jet printed inductive antenna.

Antennas printed on R2R flexo printing machine Gallus EM 410 S.

868 MHz printed antenna on textile substrate.



Reflection factor to frequency characteristics.

Embroidered antennas.

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Smart City & Internet of Things Group

SmartCAMPUS UWB | Future Concept

01. Parking
02. Parking
03. Caffeteria
04. Bibliobox
05. Scooters
06. Benches
07. Lecture Halls
08. Café
09. Informational Panel
10. Smart Bin
11. Weather Station
12. Sport Field
13. Sport Hall
14. Charging Station
15. Charging Kiosk
16. LoRaWAN Gateway

smart CAMPUS

- microcosm of a city
- living laboratory
- test polygon

Smart Campus UWB

SmartCAMPUS UWB | Opportunities For All

University of West Bohemia

Cities

Companies

smart CAMPUS

Smart Campus

Tasks progress

1) Organisation structure across the UWB

- 1st level: University
- 2nd level: Faculties
- 3rd level: Departments

2) COMMUNICATION INFRASTRUCTURE

- ICT and Smart Campus Cloud
- IoT network LoRaWAN
- web pages, Facebook, Twitter, …

3) SMART TECHNOLOGIES IMPLEMENTATION and INTEGRATION

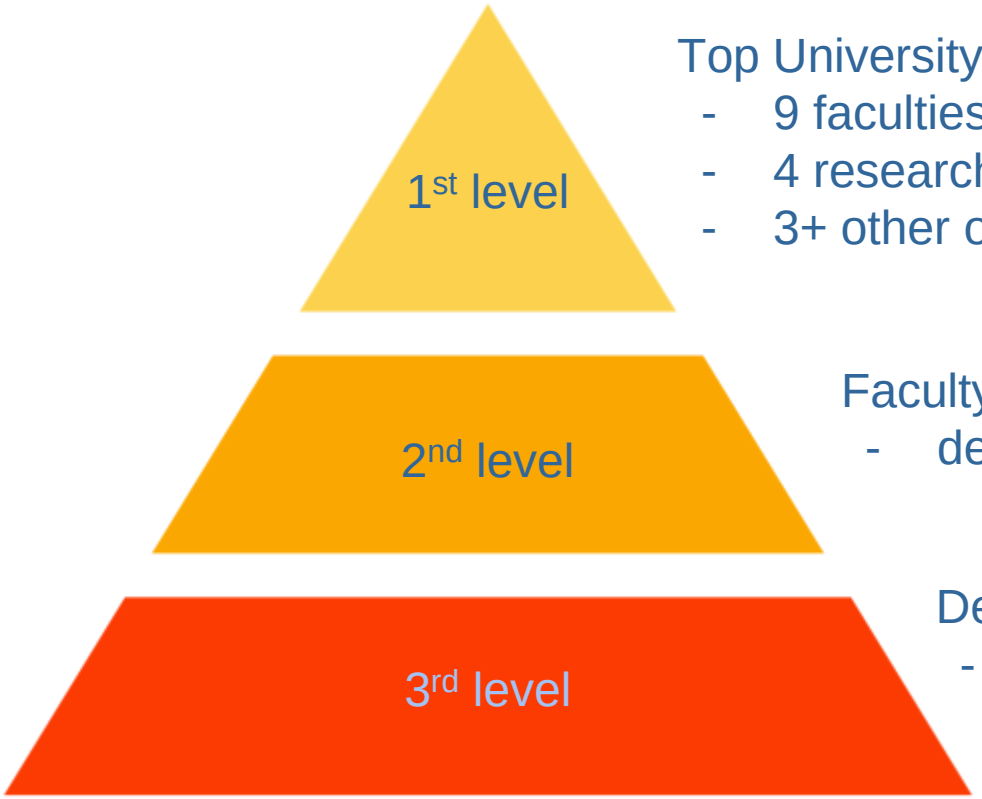
- different smart parking solutions
- smart streetlights
- smart sensors …

4) PARTNERS CONTRACTING

- cooperation agreement
- searching of new partners

Smart Campus UWB

Ad 1) Organisation structure across the UWB



Top University Organisation Level
- 9 faculties
- 4 research institutes
- 3+ other organizational units

Faculty Organisation Level
- departments at each faculty

Department Organisation Level
- workgroups under departments

Smart Campus UWB

Ad 2) Communication infrastructure - IoT technologies

Sigfox Network

- SimpleCell – the only one Sigfox operator in CZ

LoRa Network

- České Radiokomunikace a.s.
- RVTech s.r.o.
- Pilsen City (SITMP)
- ST Microelectronics
- The Things Network

NB-IoT Network

- Vodafone Czech Republic a.s.

IQRF Network

- MICRORISC s.r.o.

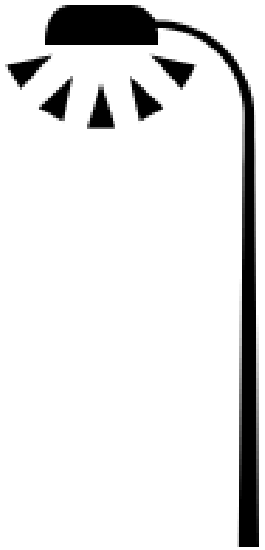
Smart Campus UWB

Ad 2) Communication infrastructure (in progress)

Campus street lights infrastructure

- upgrading to “power-supplied 24/7”

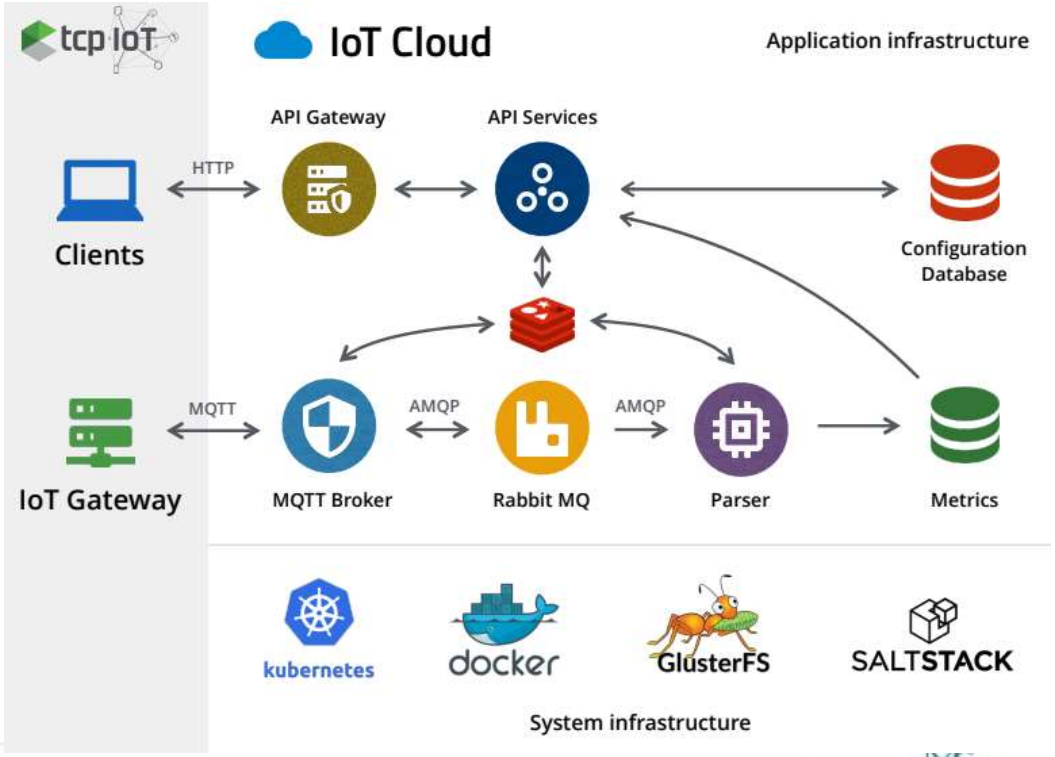
- power supply for new smart lights
- power supply for Wi-Fi hotspots
- power supply for IoT sensors



Ad 2) Communication infrastructure (done)

Smart Campus Cloud

- made by workgroup from 2 faculties and company TC Písek s.r.o.
- used technologies: by TC Písek s.r.o.



Ad 3) SMART TECHNOLOGIES IMPLEMENTATION and INTEGRATION

Smart Parking (in progress)

- smart parking sensors (Sigfox / LoRa) by partner ČD Telematika a.s.

ČD-Telematika

- smart parking sensors (IQRF) by partners ILC FACTORY a.s. and Radek Pechman

INDUSTRYLIGHT

RADEK PECHMAN

- smart parking system by partner CertiCon a.s.

CERTICON

Ad 3) SMART TECHNOLOGIES IMPLEMENTATION and INTEGRATION

Street lights and sensors (in progress)

- smart street lights by partner
  ILC FACTORY a.s. and Radek Pechman

INDUSTRYLIGHT

RADEK PECHMAN

- SmartCity sensor by partner Tesla Blatná, a.s.

TESLA BLATNÁ, a.s.

Ad 3) SMART TECHNOLOGIES IMPLEMENTATION and INTEGRATION

Sensors - example: LORATECH multinode (done)

- Design and development of LoRaWAN sensor node exclusively for RVTech s.r.o. for measuring environmental parameters.

Main features:

- Relative humidity range: 0-100 % RH
- Temperature range: -40 to 85 °C
- Pressure range: 300 – 1100 hPa
- Communication: LoRaWAN
- Idle current consumption: < 70 nA (!)
- Configurable via uSD card

Ad 3) SMART TECHNOLOGIES IMPLEMENTATION and INTEGRATION

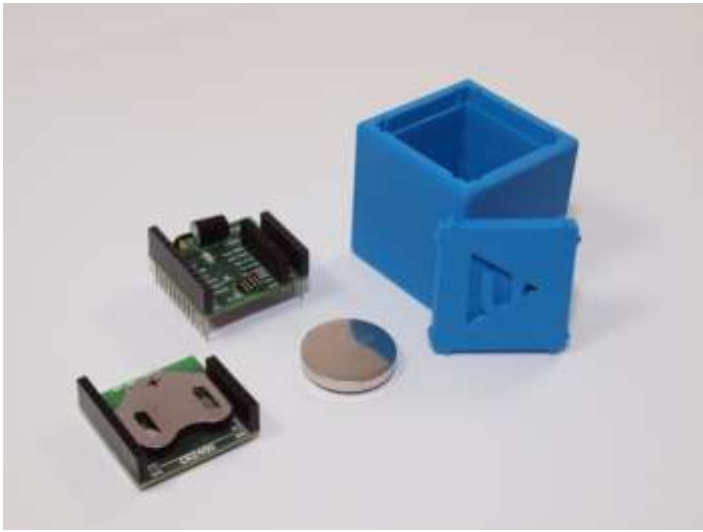
Sensors - new IoT platform KETCube (done)

- New and open prototyping and demo IoT platform developed at the Department of Technologies and Measurement (KET), University of West Bohemia in Pilsen.

ZÁPADOČESKÁ UNIVERZITA V PLZNI

Main features:

- Supported Frequencies: 868MHz, 915MHz
- Radio: LoRaWAN, planed: Sigfox, Proprietary P2P
- Interfaces: UART, SPI, I2C, ADC, DAC, PWM, GPIO
- mikroBUS compatible pinout, custom KETCube pinout
- Key circuits: Murata ABZ..., TI HDC1080 (T, RH)
- Battery: Panasonic CR-2450/BN (620 mAh)
- Recommended Antenna: ANT-868-JJB-RA



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Ad 4) PARTNERS CONTRACTING (in progress)

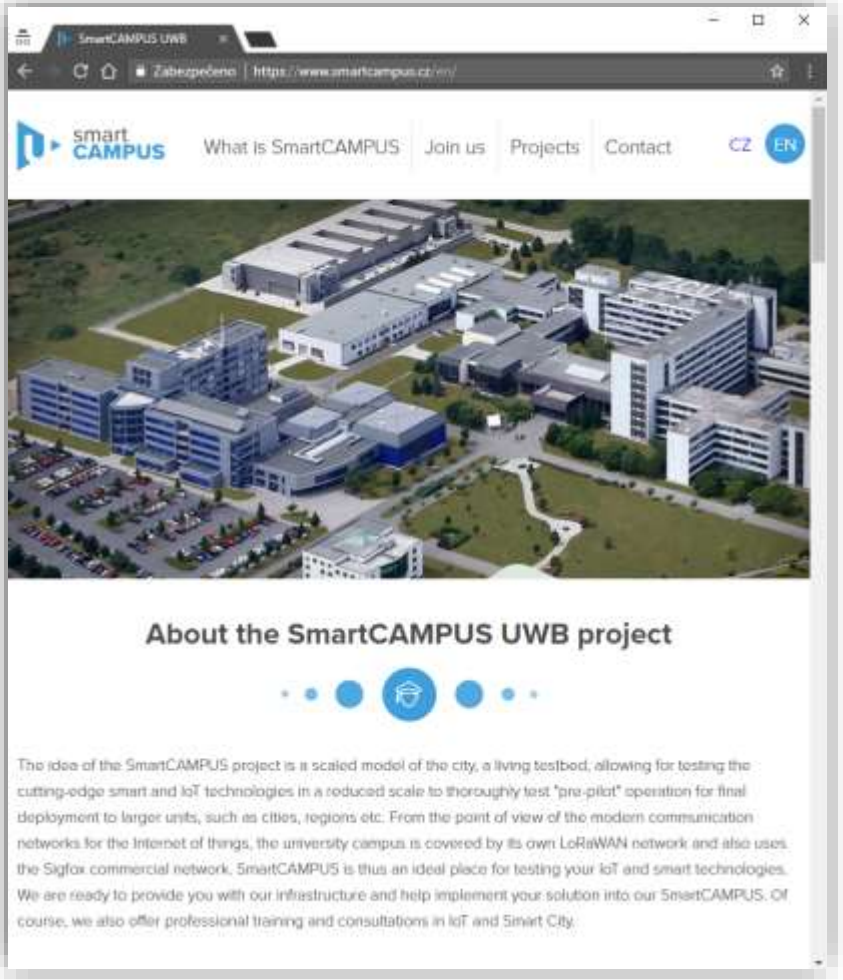
Are you interested in Smart Campus?

JOIN US NOW !

www.smartcampus.cz

Smart City & Internet of Things Group

SmartCAMPUS UWB



smart CAMPUS

https://www.smartcampus.cz/en

#smartcampuszcu

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