



DigiFed

# AI & IoT Bootcamp

30 November 2020

Digital Catapult, Ikerlan, University of Ljubljana



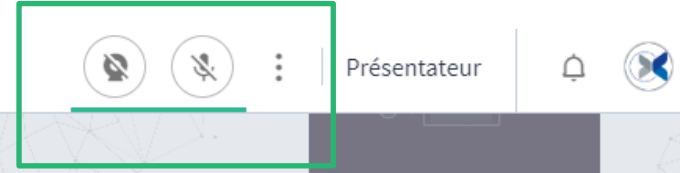
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864266.

# Welcome

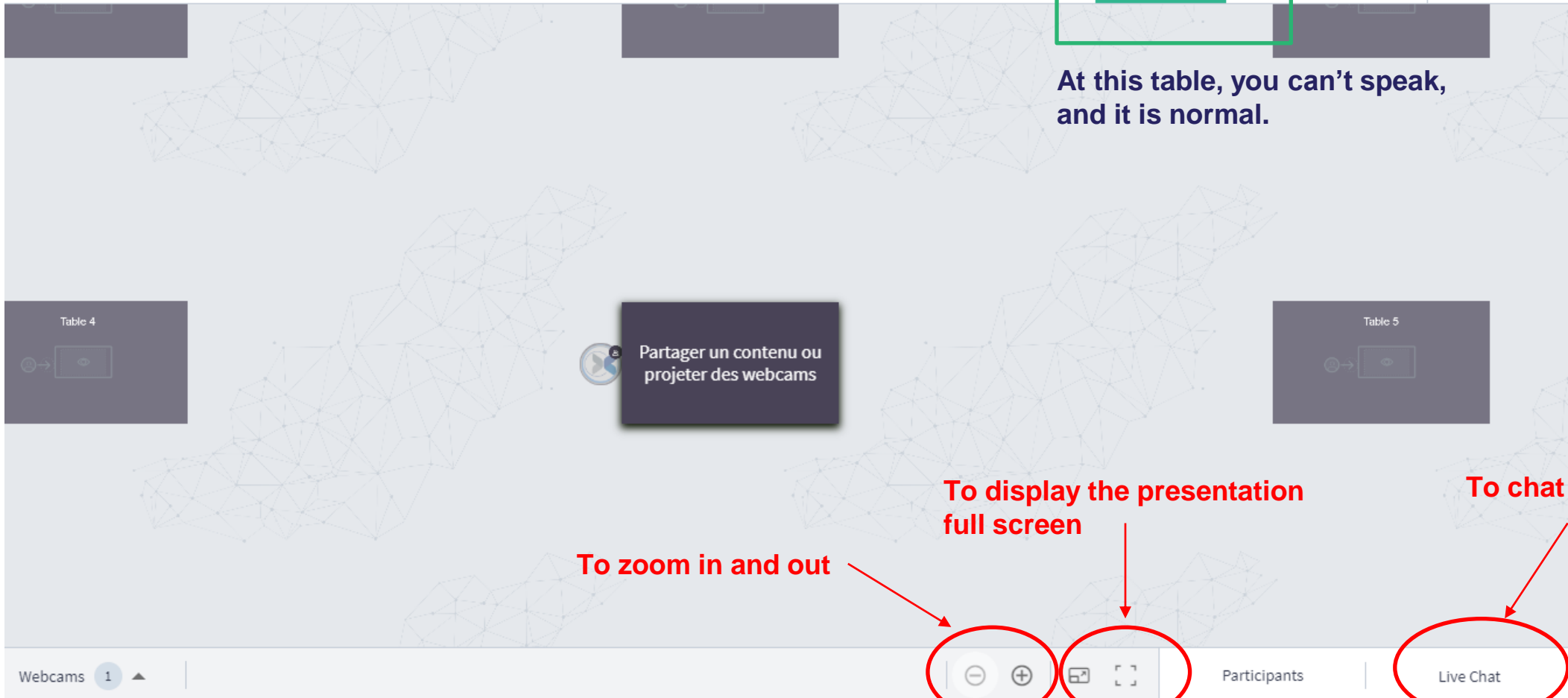
**CATAPULT**  
Digital



# Welcome



At this table, you can't speak, and it is normal.



To zoom in and out

To display the presentation full screen

To chat with us

# Agenda

- **Introduction, objectives and agenda (10 minutes)**
- **Partners' presentations**
  - University of Ljubljana
  - IKERLAN
  - Digital Catapult
- **Open floor discussion with Q&A**



# University of Ljubljana

Jure Trilar

# IoT & AI technology support services from University of Ljubljana

Electrical switch with Ethereum support  
IoT prototyping & service design  
Percipio<BigData> analytics tool

*Prototype supporting interesting use-cases*  
*Open source platform*  
*BigData analytics*



University of Ljubljana  
Faculty of *Electrical Engineering*

# SWETHER - Electrical switch with Ethereum support

- **Function:** IoT-Blockchain Prototyping kit
- **Principle:**
  - End-to-end prototype kit
  - Control electrical switch via blockchain transactions
- **Application cases:**
  - charging of electric vehicles,
  - arbitrary control of IoT devices,
  - device-to-device transactions and interactions.

## Maturity/TRL:

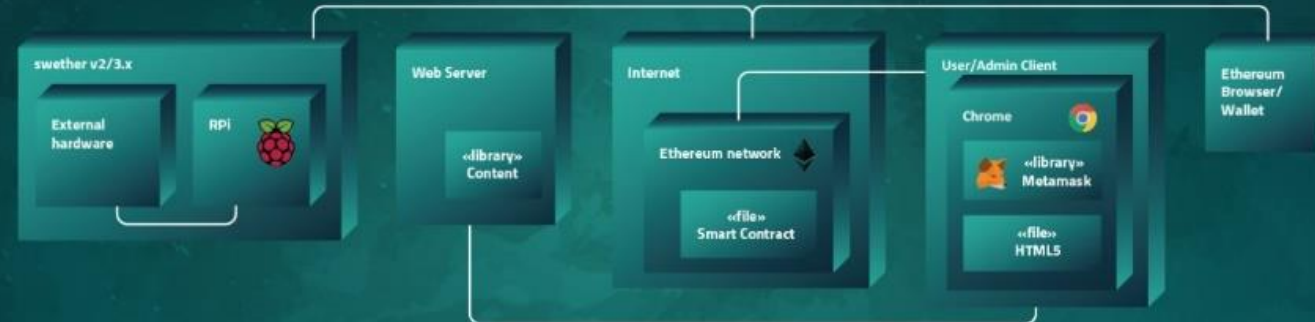
- Technology Readiness Level



swether

electric switch with  
ethereum blockchain support

[www.ltfef.org/swether](http://www.ltfef.org/swether)



# IoT prototyping & service design

- **Function:** Integration of commercial IoT sensors & platform and implementation consultation
- **Principle:**
  - Capacity to developed own IoT boards,
  - due to popular demand we can help develop services on widely available commercial platforms such as:
    - Libelium, Raspberry Pie, Arduino,...
  - Sensors based on context and environment
  - Proper mode of connectivity 4/5G, LPWAN (LoRa, NB)
  - Various modes of computing/databases
- **Cases:**
  - Smart City,
  - Smart Agriculture,
  - Smart Industry...

- **Maturity/TRL:**

- Technology Readiness Level



## IoT Components

Semantics

Services

Computation

Communication

Sensing

Identification





# percipio<BigData> analytics tool

- **Function:** Big Data Analytics Tool: „Find the (un)known unknowns and discover new insights!“
- **Principle:**
  - Context selection
  - Correlation and trends dashboard
- **Key Performances:**
  - Sources
    - 250M tech and sci articles
    - Patents
    - Web and social media

percipio<BigData>

## Maturity/TRL:

- Technology Readiness Level





# Ikerlan

Xabier Iturbe

# IKERLAN in a Nutshell

Since 1974!



350  
HIGH-SKILLED  
PROFESSIONALS > 150  
ICT



24.1 M€  
TURNOVER

13 M€ > TECHNOLOGY  
TRANSFER  
PROJECTS



2 M€  
INVESTMENT IN  
WORLD-CLASS LABS

10 M€ > FUNDAMENTAL  
RESEARCH



45  
PhDs

ikerlan



# Information and Communication Technologies



## IoT & Digital Platforms



## Data Analytics & Artificial Intelligence



- **Short-range IoT connectivity:**
  - BLE, ZigBee, NFC, UWB, WiFi.
- **Long-range connectivity:**
  - *Non-licensed bands:* LoRa, Sigfox.
  - *Licensed bands:* 2G/3G/4G (NB-IoT, LTE-M) and towards 5G.
- **IoT / IIoT protocols and interoperability:**
  - MQTT, CoAP, DDS, LwM2M, AMQP, Websocket, NodeRed, etc.
- **Indoor (UWB, BLE) and outdoor (GPS, GNSS, cellular) location**
- **Intelligence of Things:**
  - IA + ML on edge nodes.

- **Smart Digital Platforms:**
  - Highly scalable.
  - Public, private and hybrid cloud architectures.
- **Artificial Intelligence and Data Analysis:**
  - Predictive maintenance.
  - Data Lakes for Data Analytics.
- **Data interpretability and AI-algorithms:**
  - Smart Digital Platforms
- **Smart Interaction with data platforms :**
  - Natural interaction with data (chatbots, etc.).
- **Development of platforms based on micro-services and “serverless”**

# Dependable Embedded Systems

- **Function:** Development of dependable systems by experts in **safety** and **real-time electronics** engineering
- **Principle:**
  - Embedded Systems development certified up to SIL4
  - Software development and virtualization for real-time control
  - Automated Testing and Validation (HiL)
  - Artificial vision for embedded safety
- **Key Performances:**
  - +20 years experience on electronic and safe embedded systems development
  - Safety Certified methodology (TÜV)
- **Uniqueness:**
  - +10 Functional Safety Engineers
  - 1 Functional Safety Expert (unique in Spain)
  - Referential on the development of advanced and safe functionality executed in complex chips (SoC, multicore, GPUs)

- **Maturity/TRL:**

- Technology Readiness Level



- **Applications:**

- Development of software for control-units on transport (e.g., traction, elevation)
- Development and validation of up to SIL4 certified applications (e.g., railway signaling)
- Virtualization of applications and plants (e.g., an elevation system)



# HW and Communication Systems



## HARDWARE SYSTEMS

- **HW** developments:
  - **Sensorization** solutions
  - **Low consumption electronics**
  - **Signal conditioning**
- **SW** developments
  - **System software** (OS, drivers)
  - **FPGA** and programmable logic
- **Integration** and assembly
  - Electronic cards mounting (**PCB assembly**)
  - **Extreme** conditions / hostile environments
- **Non functional** developments
  - **Standards** compliance
  - **Tests** and troubleshooting (**EMC**, electrical security, environmental)

## COMMUNICATION SYSTEMS

- **Industrial connectivity**
  - **Wireless & Wired** solutions for embedded systems
  - **Wired**
- **Real-time communications**
  - Applied to **industrial** control and sensorization
- **Antennas**
  - Design, simulation and characterization
- **Verification** and **validation**
  - Wireless communication systems
  - In-house designed channel emulator

# Industrial cybersecurity

- **Function:** Protection of embedded electronic systems and digital platforms
- **Principle:**
  - Embedded System Security
  - Security Evaluation
  - Cybersecure IoT, Cloud and User Interfaces
- **Key Performances:**
  - Security Life-Cycle and Certification
  - Trust Technologies based on Distributed Ledger Technologies
- **Uniqueness:**
  - Certified methodologies and addressing compliance with product cybersecurity standards
  - Cybersecurity solutions covering the entire value chain: from the sensor, the electronics, the embedded software, the connectivity solution, the processing and data ingestion platform, to the analytics and its advanced display

- **Maturity/TRL:**

- Technology Readiness Level



- **Applications:**

- Cybersecure Digital platform and IIoT oriented to teleservice.
- Cybersecure Digital platform for fleets of automatic warehouses. Multi-business deployment, multi-warehouse

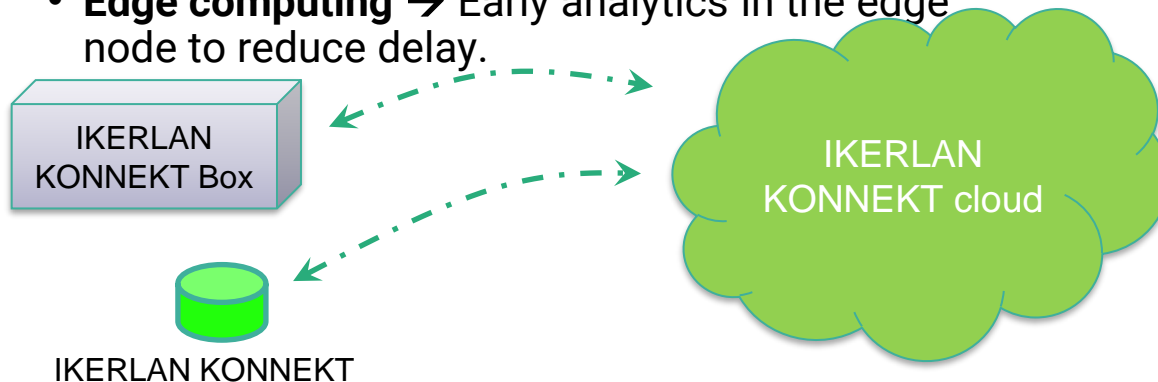
# EXAMPLES

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# AI-powered Digital Platforms

- **Function:** Digital Platform to provide tools to develop AI-powered fog/edge-to-cloud solutions.
- **Principle :**
  - Fog/Edge-to-cloud dynamic architectures.
  - AI-powered Digital platform scenario.
  - Microservices oriented edge devices architecture.
- **Uniqueness:**
  - **Artificial Intelligence** → fog-to-cloud architecture.
  - **Microservices based architecture** → Deployment of AI-models to the edge.
  - **Edge computing** → Early analytics in the edge node to reduce delay.



- **Maturity:**



- Heterogenous cloud architecture (private, public and hybrid).
- Smart Data Lakes provisioning.
- Microservice-oriented service deployment.
- **Key performances:**
  - AI-powered Digital Platform.
  - Data Lake provision for Data analytics.
  - AI-powered predictive techniques.
- **Applications:**
  - Industry 4.0 & Smart Factories.
  - Smart Cities.
  - Smart Living and Ageing Well.
  - Smart Mobility.
  - Smart Buildings.
  - Etc.

# Autonomous Wireless Sensor Node

- **Function:** detect temperature and acceleration events, wireless data transmission, energy-harvesting
- **Principle :**
  - Several transducers for sensing
  - Indoor photovoltaic cells (off-the-shelf)
- **Uniqueness:**
  - **Low power** → sense & harvest at the same time
  - **High processing capabilities**
  - **Robust and synchronized** communications



- **Maturity:**



- Complete prototype (with RF) is working
  - Miniaturization in progress
  - Additional sensing and optimization in progress
- **Key performances:**
    - Sensing data local processing
    - Wireless robust coms (BLE, TDMA based)
    - Up to +-16us accuracy
  - **Applications:**
    - Smart logistics, smart factory: impact and temperature measurements
    - Industrial environment Indoor sensing

# Safety and real-time software on COTS platforms

- **Function:** certification of embedded real-time and non-real time software
- **Principle :**
  - Selection of multicore commercial HW
  - Integration of an embedded hypervisor
  - Software development based on modeling
  - Safety concept based on industrial machinery standard (ISO13489)
- **Uniqueness:**
  - Affordable cutting-edge HW
  - Simplification of complex SW development
  - Safety cognizant

- **Maturity:**



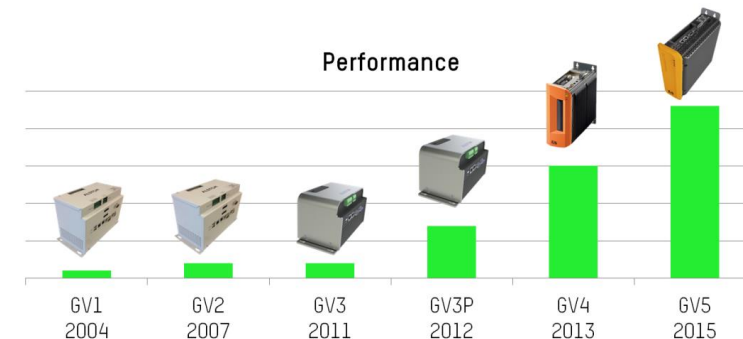
- Integrated in product

- **Key performances:**

- Safety up to PL-D level (SIL-2)
- x1,5 performance

- **Applications:**

- Wind-turbine control
- Operation monitorization
- Local recording of key variables





# Digital Catapult

Dr. Csaba Kiraly | Internet of Things Engineer

# IoT Benchmarking: the Future Networks Lab

*A unique facility that is fast forwarding the adoption of future networks technologies to deliver value to industry*

Infrastructure: LoRaWAN, Sigfox, NB-IoT, 5G



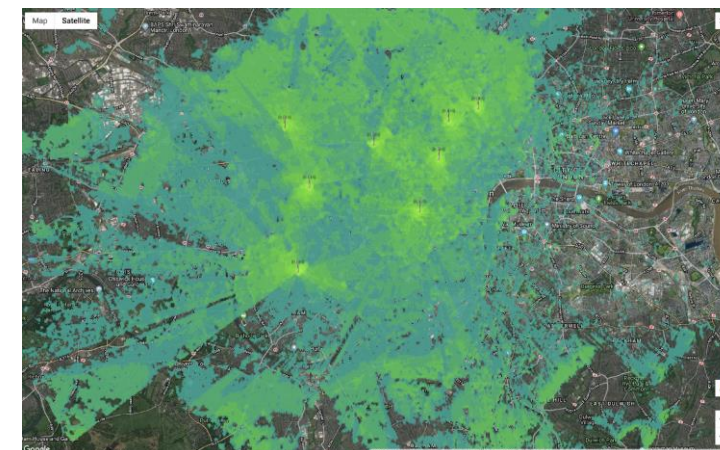
Keysight N6705C DC power analyzer  
 Redwood 5020A LoRaWAN tester  
 RSC Step Attenuator



11 LoRaWAN GWs geolocation testbed in London

## Expertise

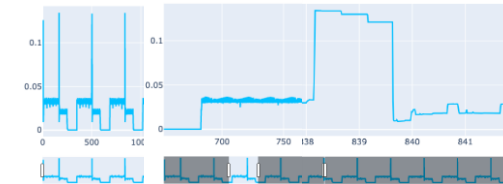
- short-range: 802.15.4, BLE, RFID, NFC, UWB, WuR
- long-range: LoRa (LoRa2.4), LoRaWAN, Sigfox, NB-IoT
- multi-radio platforms
- testing and benchmarking methodology
- test plans and reports



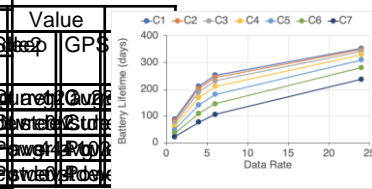
# IoT Benchmarking: tests

## Power consumption laboratory tests

- Current/power consumption measurements
- Active/inactive states of a device
- Report: peak current, current/power per state
- Battery lifetime estimation for specific application/use-case



Global Data	Value	Unit
Current avg	34.25	mA
Current max	133.4	mA
Power avg	126.7	mW
Power max	493.5	mW
Battery lifetime	272	Days

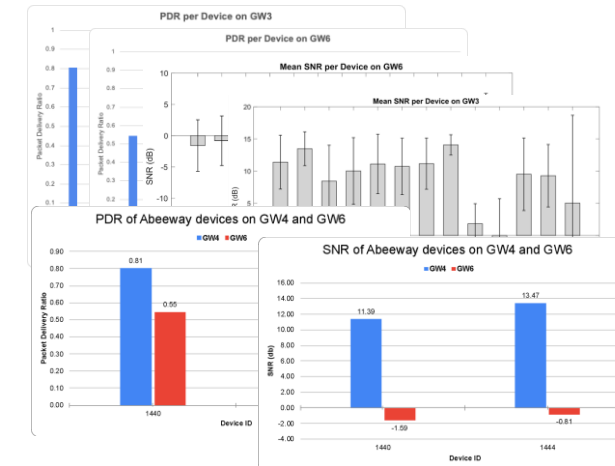


## Communication performance tests

- Connectivity assessment indoor/outdoor
- Test different antenna orientations, heights from ground, communication and application parameters
- Report reliability, accuracy, and others (e.g., RSSI, SNR)

## Device characterization

- Configurability, programmability
- I/O capabilities, built in sensing capabilities
- Mechanical properties
- Usability



# From electrons to Edge and Cloud

We can provide advice and support wrt:

## Hardware

- Local buses: I2C vs SPI
- Modules, SiP, SOC
- Sensors
- Low power modes and sequencing
- AI processors
- Crypto ICs

## Communications

- L1/L2/L3/messaging protocols
- LoraWAN gateways
- FUOTA
- Industrial legacy protocols (e.g. Modbus)
- Heterogeneous networks
- Platform integration: e.g. getting data from TTN

## Software

- low-power AI: TinyML and Tensorflow Lite for Micro
- embedded OSES, embedded Linux
- IoT gateway SW stacks

## // Other success factors

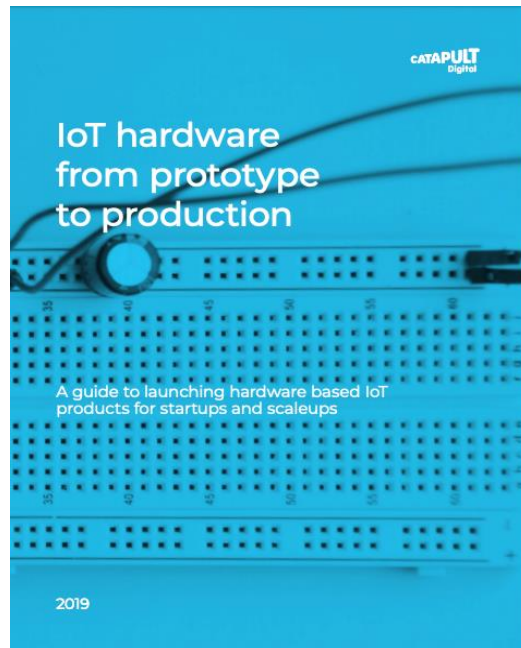
- UI/UX
- Dashboard design
- Adding intelligence
- Partnerships
- Hardware as a Service business model

# Getting from TRL3 to pre-production

Report making your journey to production faster and less risky.

Download it here:

<https://bit.ly/3avHmZg>



**Why are connected products different and more difficult?**

- Asking the right questions at the different stages of your project
- Realistic budgets
- Design to cost – Design for manufacturing
- IP protection

**A tangible IoT solution with measurable innovation-based ROI**

**A roadmap for the route to scale deployment to address your business needs**



# Writing convincing IoT project proposals

Read Section 5.3 Evaluation and score carefully !

EXCELLENCE

IMPACT

QUALITY

BUSINESS CASE

- Remember that projects are for up to 12 months only, add **Gantt charts** , make sure you plan for prototype building (component lead times...), measurements against initial objectives/metrics during pilot and **second version based on pilot results**.
- Show **progression through TRL levels** over time. Might include plan for BOM optimisation, design to cost, pre-certification for example.
- Add a **risk mitigation** table. Pilots rarely go without hiccups (to setup and to run), so be realistic and think about what might cause deviations from original plan, e.g., network/communications, Cloud setup, etc.
- Be realistic about **timeframes** (Add **contingency** factor) and remember that it will also take time/manpower to get familiar with platforms and more importantly write the deliverables.



# Digital Catapult

Nathan Coulson | AI&ML Technologist

# AI/ML at the Digital Catapult

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**Accelerating AI  
startups**



**MACHINE  
INTELLIGENCE  
GARAGE**

**Increasing AI  
adoption in Industry**

**SIEMENS**

**Leading on  
applied AI Ethics**



**NEURAL INFORMATION  
PROCESSING SYSTEMS**

# AI Compute, Machine Learning & AI Ethics Capability

- **Function:** We are able to offer a specialised acceleration programme, that addresses the challenges that today's artificial intelligence (AI) and machine learning (ML) startups face.
- **Principle:**
  - Time and support on internal infrastructure (access to two DGX-1 servers)
  - Ethics Support
  - Combined AI/IoT Technical support
  - Access to cloud credits/vouchers
- **Uniqueness:**
  - We have already supported over 90 startups across multiple industries (raising £38m in equity investment over 2 years)
  - Access to resources provided by Google, Nvidia, AWS, EPCC, Graphcore and more
  - Industry leading AI Ethics expertise through our Ethics Steering and Advisory boards

- **Maturity/TRL:**

- Technology Readiness Level



- **Applications:**

- Support early stage AI startups to bring new products to market in an ethical and efficient way
- Access to compute for resource constrained startups/smaller SMEs
- AI ethics advice for startups, smaller and larger SMEs



# Technology partners and collaborators



# Examples of tailored support for AI startups

## Tailored MI Garage support activities

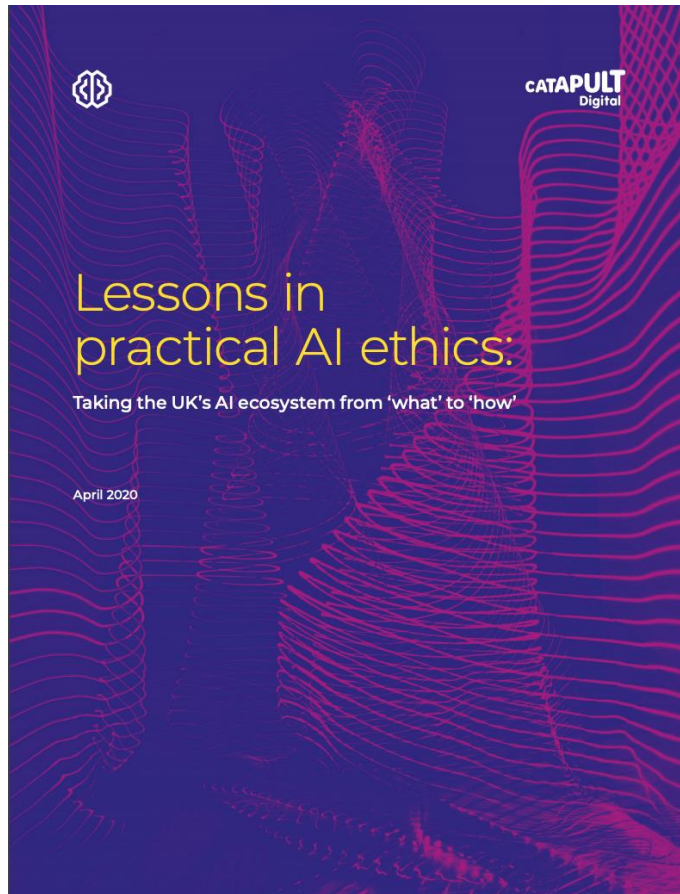
- Technical Office hours with the AI/ML team to design a support plan
- Supported onboarded to compute infrastructure (cloud or on-premise)
- AI Ethics consultation with members of our expert AI Ethics advisory board to discuss and mitigate potential ethical issues



## Technical, business and ethics workshops

- Design tools for AI: Human Centred Design for AI startups
- AI & IoT Workshop: Deploying AI at the edge
- AI Platforms and Architecture workshop: Building for scale

# Recent publications



<https://bit.ly/2SwtMOQ>



<https://bit.ly/2W1WI3K>



# Introduction to the Q&A session



# Q&A session

The screenshot shows a virtual meeting interface. At the top left, there is a menu icon, the BLUMORPHO logo, and the text "Bootcamps DIGIFED". At the top right, there is a "Présentateur" label, a bell icon, and a globe icon. In the center, there is a large grey area with a geometric pattern. On the left and right sides, there are smaller grey areas labeled "Table 4" and "Table 5" respectively. At the bottom, there is a "Webcams" section with a "1" icon and a "Participants" section with a "Live Chat" button. Three red annotations are present: 1. A red circle around the camera and microphone icons in the top right, with arrows pointing to the text "Activate your camera" and "Activate your microphone". 2. A red circle around a bubble icon in the center, with an arrow pointing to the text "Grab your bubble and move around the room to meet the experts". 3. A red circle around a bubble icon in the center, with an arrow pointing to the text "Partager un contenu ou projeter des webcams".

# Q&A session

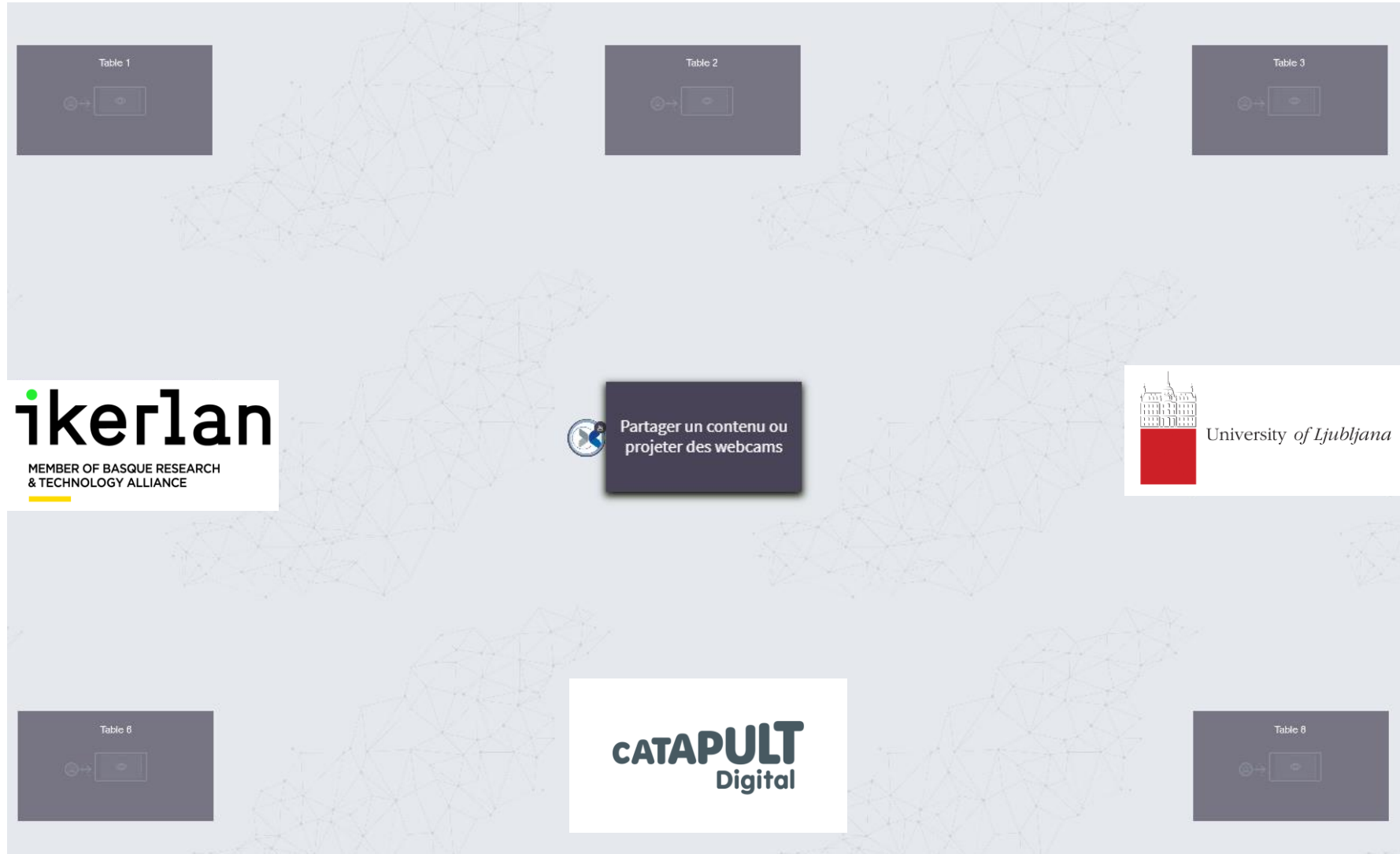



Table 1

Table 2

Table 3

**ikerlan**  
MEMBER OF BASQUE RESEARCH  
& TECHNOLOGY ALLIANCE

 Partager un contenu ou  
projeter des webcams


 University of Ljubljana

Table 6

**CATAPULT**  
Digital

Table 8