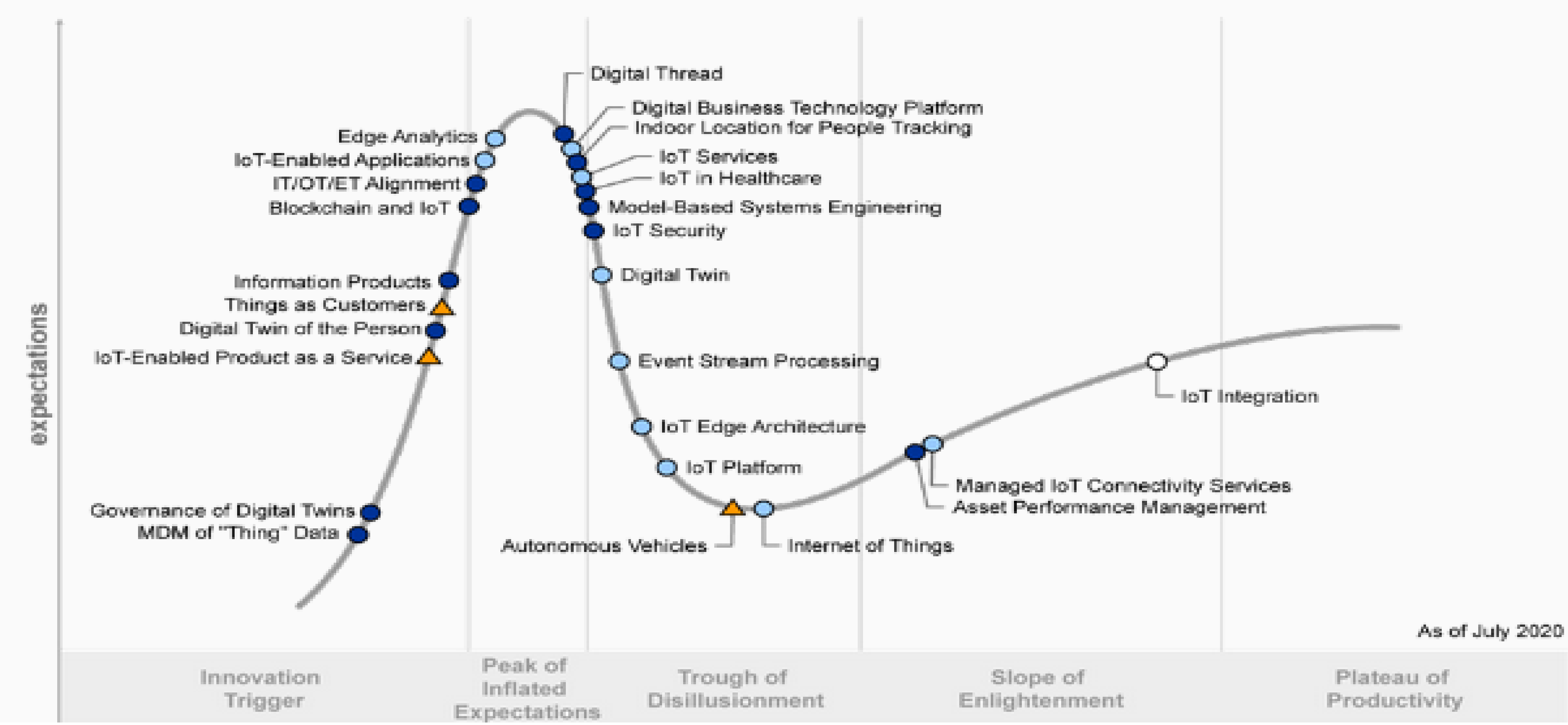
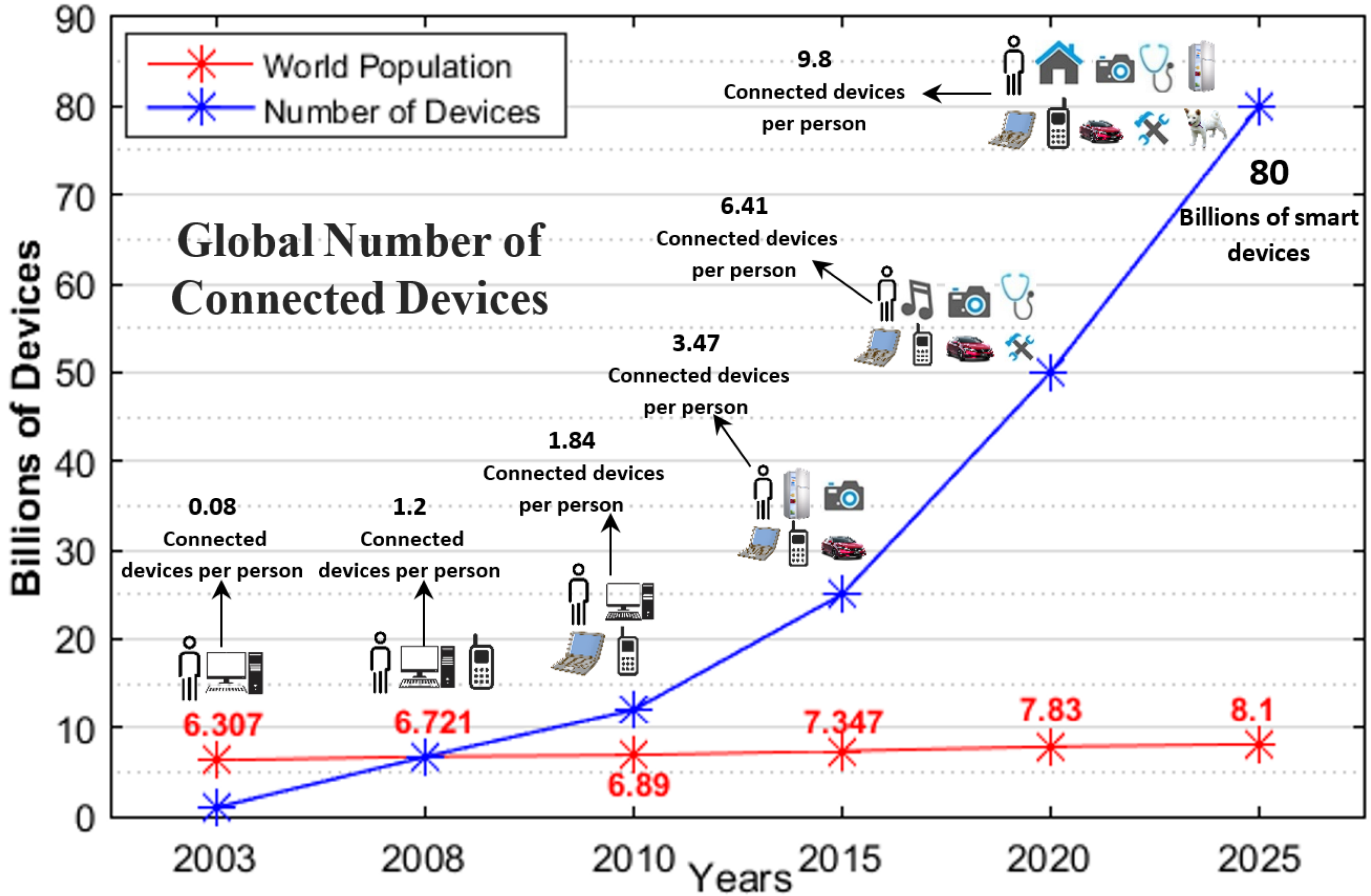
PANEL

MODERN SYSTEMS

IoT (Internet of Things)-based Systems Challenges

Hype Cycle for the Internet of Things, 2020




World Population
Number of Devices
Global Number of Connected Devices
Billions of Devices
Years
0.08 Connected devices per person
1.2 Connected devices per person
1.84 Connected devices per person
3.47 Connected devices per person
6.41 Connected devices per person
9.8 Connected devices per person
80 Billions of smart devices
6.307
6.721
6.89
7.347
7.83
8.1
2003
2008
2010
2015
2020
2025

Topics

Petre Dini, IARIA, EU/USA petre@iaria.org
Chair

- IoT frameworks (push, pull)
- Information gathering (on-path, off-path cashing)
- Volatile, time-sensitive, obsolete, ... collections
- Cooperative data collection (synchronized, selective)
- Monitoring applications (rivers, forest, glaciers, people crowd, crop, irrigation, bird migration, livestock, buildings, waste management)

Panelists

- Alan Martin Redmond, Centre Scientifique et Technique du Bâtiment, France
  Digitalization in the Construction Industry
- Fahim Salim, University of South-Eastern Norway, Norway
  Context; Thinking beyond Binary
- Oliver Michler, TU Dresden, Germany
  Joint Communication, Localization and Sensing Technologies
- Lorena Parra Boronat, Universitat Politècnica de València, Spain
  Sustainable Development; Reliability of gathered data; Energy consumption of IoT-based systems: Green IoT-based Systems

Panellist Position

INTEROPERABILITY 4 CONSTRUCTION INDUSTRY BREAKTHROUGH TECHNOLOGIES

Alan Martin Redmond, PhD, CSEP, PGCert
CSTB – Sophia Antipolis
alan.redmond@cstb.fr

- Common Information Model Infrastructure
- Big Data & Ontologies
- French National Building Database
- Urban Planning
- Common Data Exchange Platform

→ Digitalization in the Construction Industry – Market Readiness

→ Meta Models for Metabuild Platforms

→ Integrated Systems – Interoperability, Standardizations, data matching and data verification

Panellist Position

Moving Beyond Data Dashboards and Traditional Processors, Processing & Storage Solutions

Fahim A. Salim, USN, Norway fahim.a.salim@usn.no

- *Beyond Data Dashboards*
- *Post Binary Processing and Data Storage*
- *Storing Raw Data vs Processed Information*

→ *Context is King*

→ *Thinking Beyond Binary Terms*

→ *Do we need to store all the raw data?*

IARIA

MODERN SYSTEMS Experts Panel

IoT-based Systems Challenges

MODERN SYSTEMS 2022

Panellist Position

Revolution in mobile IoT devices using Joint Communication, Localisation and Sensing Technologies (JCLS)

- **Oliver Michler**, TU Dresden, EU-Germany oliver.michler@tu-dresden.de

- Mobility-as-a-Service -> Highly efficient next Generation Mobility Concepts
- High Datarate with low Latency -> New Radio Communication
- Positioning and Tracking only in Software -> Robust precise Localization
- Passive Environment detection only in Software -> RF based Sensing
- Low energy System design -> Software instead of parallel electronic components
- Multi functional IoT Standards -> Software Defined Radio
- IoT as Multifunctional networked trackable radar-like sensor (transport modes, mobility, production, hospital, agriculture, forest, …)

TECHNISCHE UNIVERSITÄT DRESDEN

→ IoT + JCLS = Hybrid ICT Sensors to replace or integrative complement of 5G and GNSS and Radar systems

Panellist Position

IoT-based Systems as key Enablers of Sustainable Development

Lorena Parra, Universitat Politecnica de Valencia, Spain loparbo@doctor.upv.es

- IoT and data generation
- Necessity of data for sustainable management
- IoT-based systems in cities
- IoT-based systems in rural areas
- Future challenges for reaching a sustainable development based on IoT data

→ Reliability of gathered data

→ Energy consumption of IoT-based systems: Green IoT-based Systems

FULL PANELISTS' POSITIONS

= to be added into the booklet =

OPEN
DISCUSSION

Panellist Position

INTEROPERABILITY 4 CONSTRUCTION INDUSTRY BREAKTHROUGH TECHNOLOGIES

Alan Martin Redmond, PhD, CSEP, PGCert
CSTB – Sophia Antipolis
alan.redmond@cstb.fr

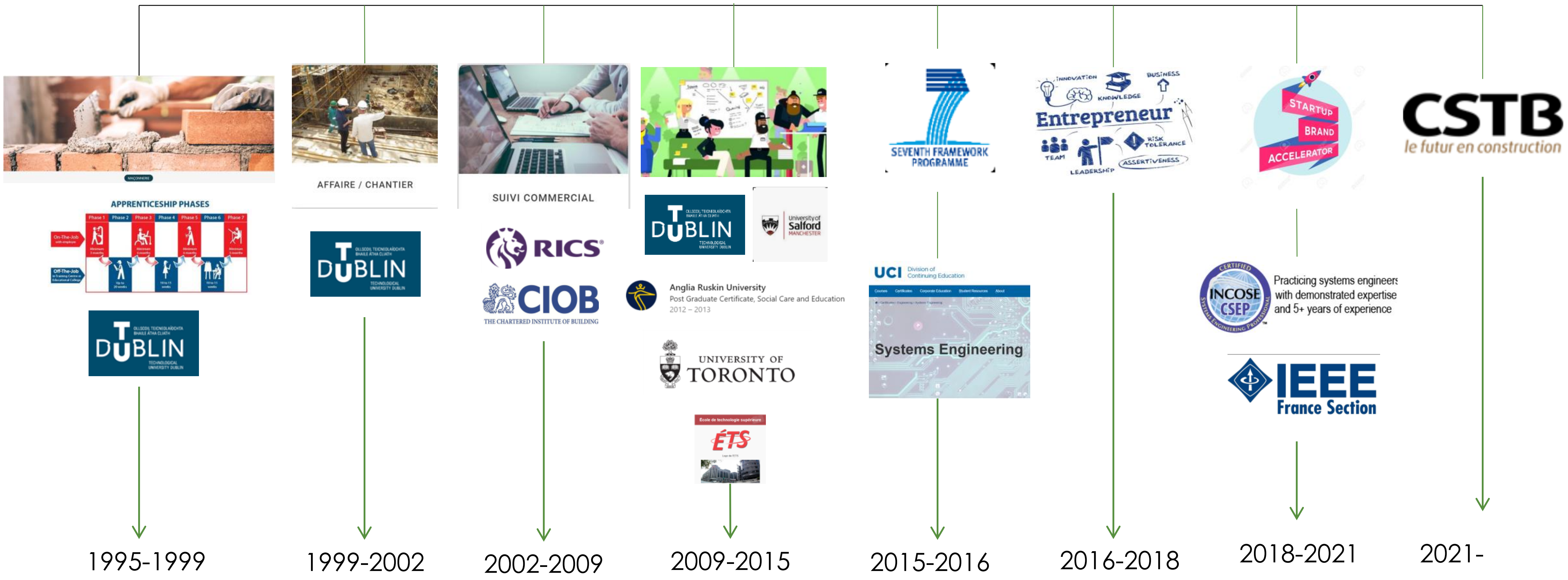
- Common Information Model Infrastructure
- Big Data & Ontologies
- French National Building Database
- Urban Planning
- Common Data Exchange Platform

→ Digitalization in the Construction Industry – Market Readiness

→ Meta Models for Metabuild Platforms

→ Integrated Systems – Interoperability, Standardizations, data matching and data verification

Chronologie



Designing a Framework for Exchanging Partial Sets of BIM Information on a Cloud-Based Service (2013)

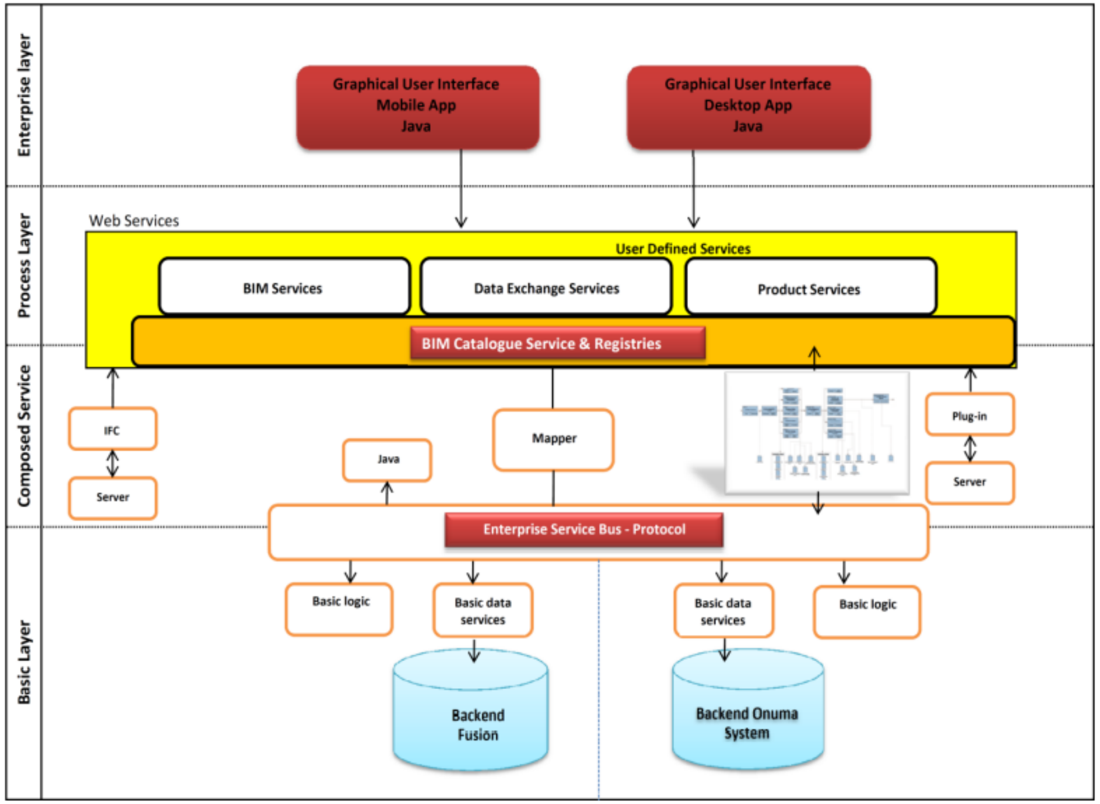


Figure 9.8. Designed solution approach architecture (author)

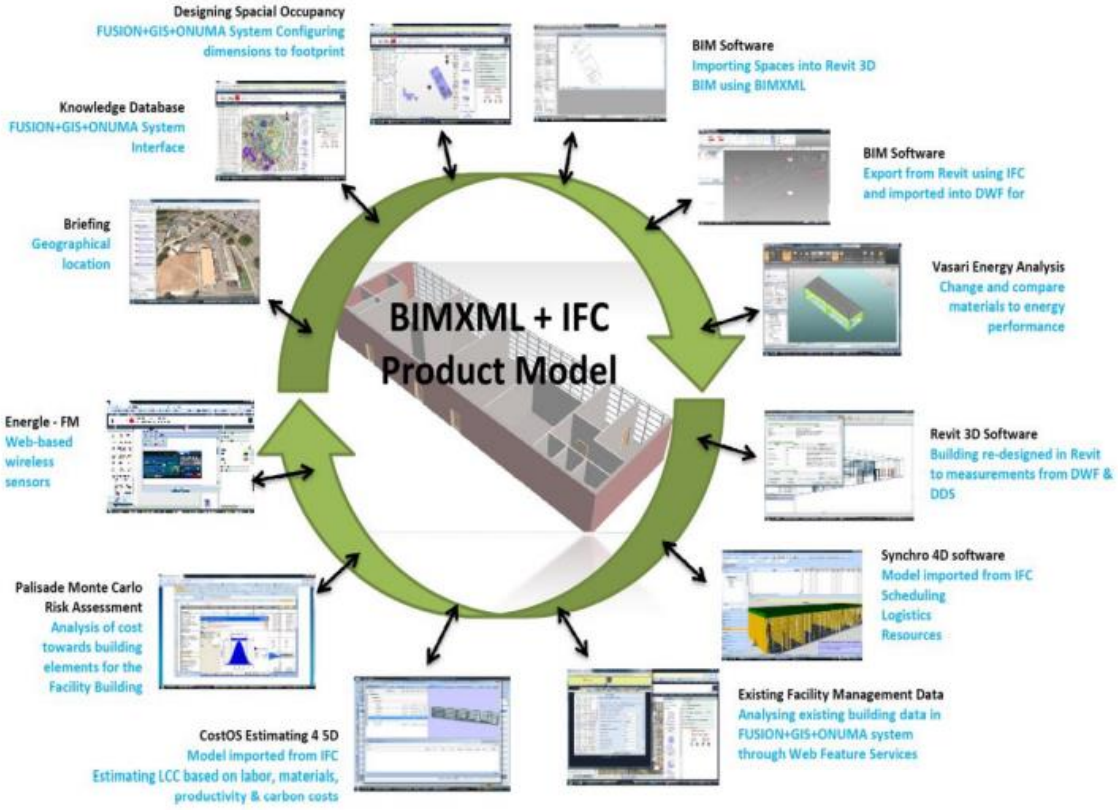
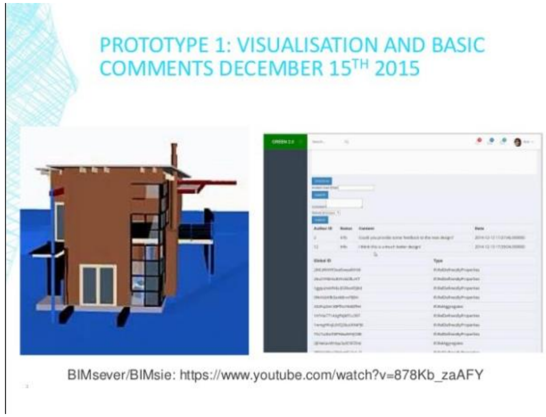


Figure 9.13. BIM XML + IFC product model

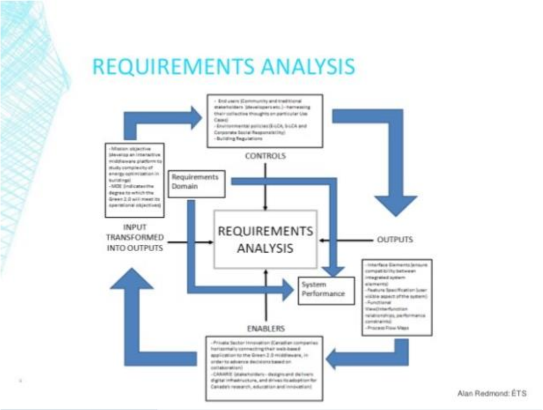

EMPLOYING AN EXPLORATORY RESEARCH STAGE TO EVALUATE GREEN BUILDING TECHNOLOGIES FOR SUSTAINABLE SYSTEMS
Alan Redmond: École de technologie supérieure
Manos Papagelis: University of Toronto
Tamer El-Diraby: University of Toronto
International Conference on Civil, Structural and Transportation Engineering
May 4-5 2015, Ottawa, Canada
ICCSTE15

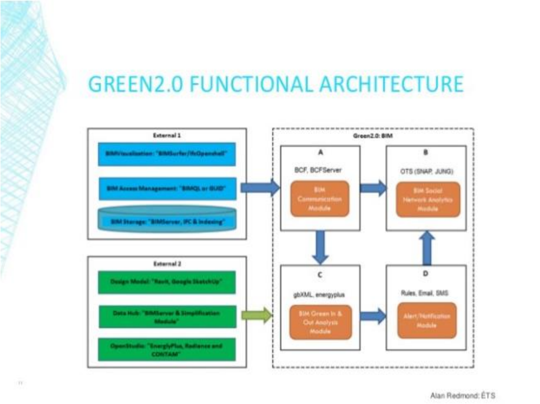

PROTOTYPE 1: VISUALISATION AND BASIC COMMENTS DECEMBER 15TH 2015
BIMsever/BIMsie: https://www.youtube.com/watch?v=878Kb_zaAFY

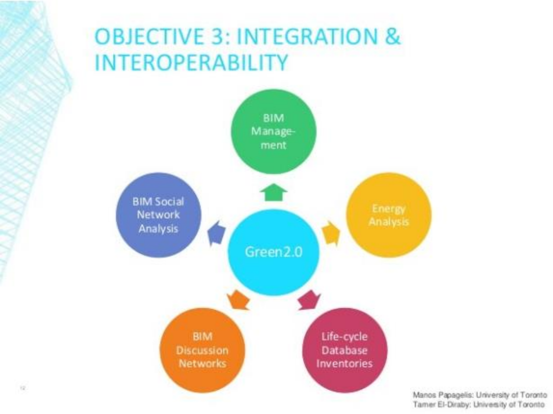

A MIDDLEWARE FOR SOCIO-TECHNICAL ANALYTICS OF GREEN BUILDINGS
Traditional Stakeholders
Community
Conversations
Matter
Building Design
Manos Papagelis: University of Toronto
Tamer El-Diraby: University of Toronto

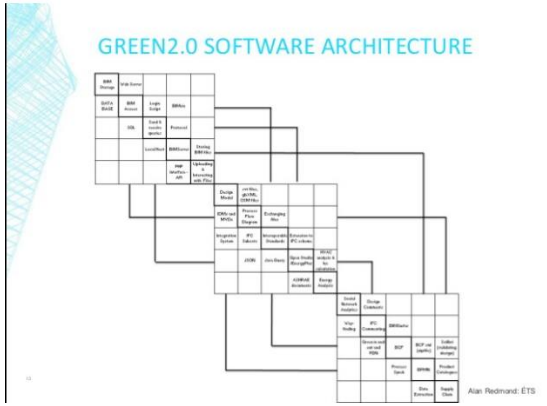

OBJECTIVE 1: RESEARCHER'S SANDBOX
BIM Data Repository
BIM & Life-cycle Data Repository
Communication-rich BIM-enabled Analytics
Large, Complex
Graphical, Physical
Technical, Engineering
Big Data
Sustainability
Socio-technical Analytics
Manos Papagelis: University of Toronto
Tamer El-Diraby: University of Toronto

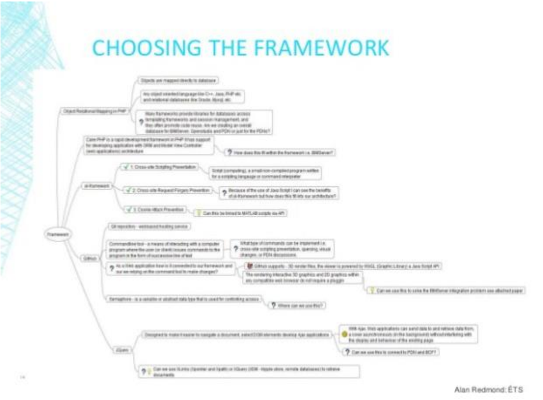

OBJECTIVE 2: SHARE KNOWLEDGE
Goals of Green Buildings
❑ Life cycle assessment (LCA)
❑ Structure design efficiency
❑ Energy efficiency
❑ Water efficiency
❑ Materials efficiency
❑ Indoor air quality
❑ Waste reduction
Share knowledge and educate the end-user through interactive what-if scenarios
Alan Redmond: ÉTS

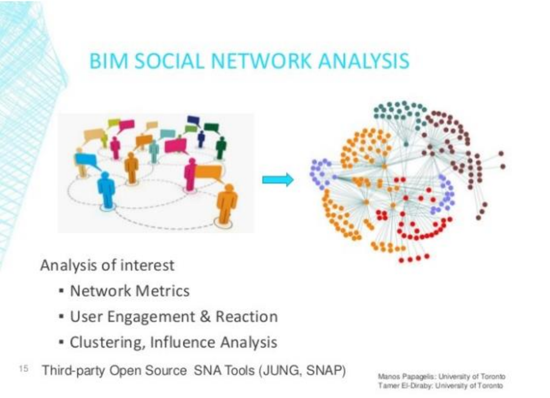

REQUIREMENTS ANALYSIS
CONTROLS
INPUT TRANSFORMED INTO OUTPUTS
REQUIREMENTS ANALYSIS
OUTPUTS
ENABLERS
Requirements Domain
System Performance
Alan Redmond: ÉTS

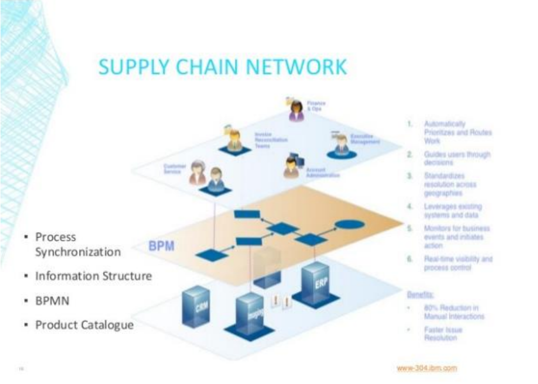

GREEN2.0 FUNCTIONAL ARCHITECTURE
Alan Redmond: ÉTS


OBJECTIVE 3: INTEGRATION & INTEROPERABILITY
BIM Manage-ment
BIM Social Network Analysis
Energy Analysis
Green2.0
BIM Discussion Networks
Life-cycle Database Inventories
Manos Papagelis: University of Toronto
Tamer El-Diraby: University of Toronto


GREEN2.0 SOFTWARE ARCHITECTURE
Alan Redmond: ÉTS


CHOOSING THE FRAMEWORK
Alan Redmond: ÉTS


BIM SOCIAL NETWORK ANALYSIS
Analysis of interest
• Network Metrics
• User Engagement & Reaction
• Clustering, Influence Analysis
Third-party Open Source SNA Tools (JUNG, SNAP)
Manos Papagelis: University of Toronto
Tamer El-Diraby: University of Toronto


SUPPLY CHAIN NETWORK
• Process Synchronization
• Information Structure
• BPMN
• Product Catalogue
BPM

A Total Enterprise Industry 4.0 Integrated R&D Program*
3 Universities – 3 Projects – 20 Professors *(13 Profs. ÉTS in 3 Depts.)*

SIEMENS *Ingenuity for life* · Concordia · ÉTS · McGill

Engineering Design

Digital Multidisciplinary Analysis and Design Optimization "DMADO" Platform for Aero-derivative Gas Turbines (AGT) – *6 Profs (3 ÉTS)*

McGill Lead

Manufacturing · **Development and Repair**

Advanced Manufacturing Automation, Digitization and Optimization "AMADO" – *12 Profs (8 ÉTS)*

ETS lead

Supply Chain

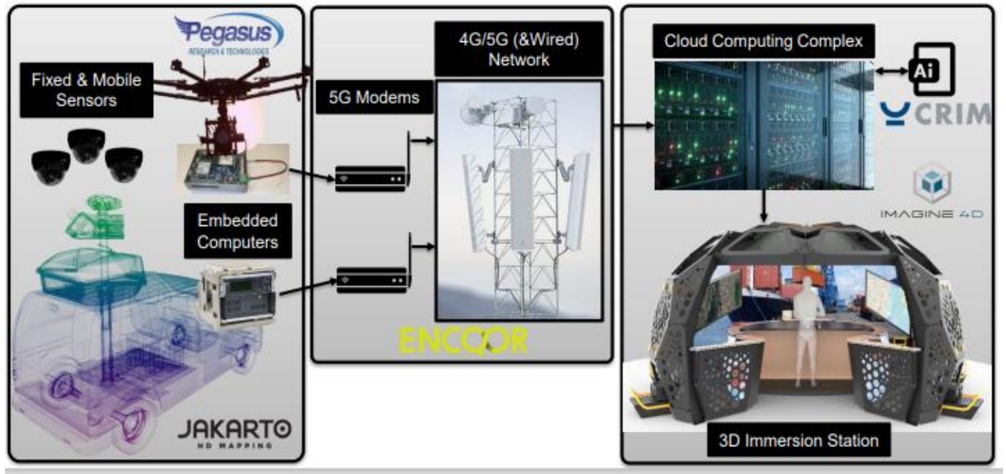
A Digital Technology Platform for Supply Chain "DTPSC" – *7 Profs (4 ÉTS)*

Concordia Lead

Total: $7M/5 years**
(2018-2023)

**A first in Canada*
***Including Siemens In-Kind*

5G Edge-Computing Security Operations Data Collection & Information Sharing Infrastructure



5G Edge-Computing Security Operations Data Collection & Information Sharing Infrastructure

IMAGINE 4D

Imagine-4D is a provider of 3D visualization technologies and simulation content. Station IX, a 3D virtual reality environment uses "Reflected Reality" to offer the most realistic fully immersive environment available today. It offers a 280-degree field of view with an unmatched richness and depth of detail to allow viewers to experience a virtual reality environment as they would in real life.

JAKARTO HD MAPPING

Jakarto uses a mobile platform to capture more than 2 million measures per second and 360 degrees views of street view using High Definition Cameras and LiDARs. By combining these two technologies, **Jakarto** creates a digital twin of a local area, or a city's infrastructure.

Pegasus RESEARCH & TECHNOLOGIES

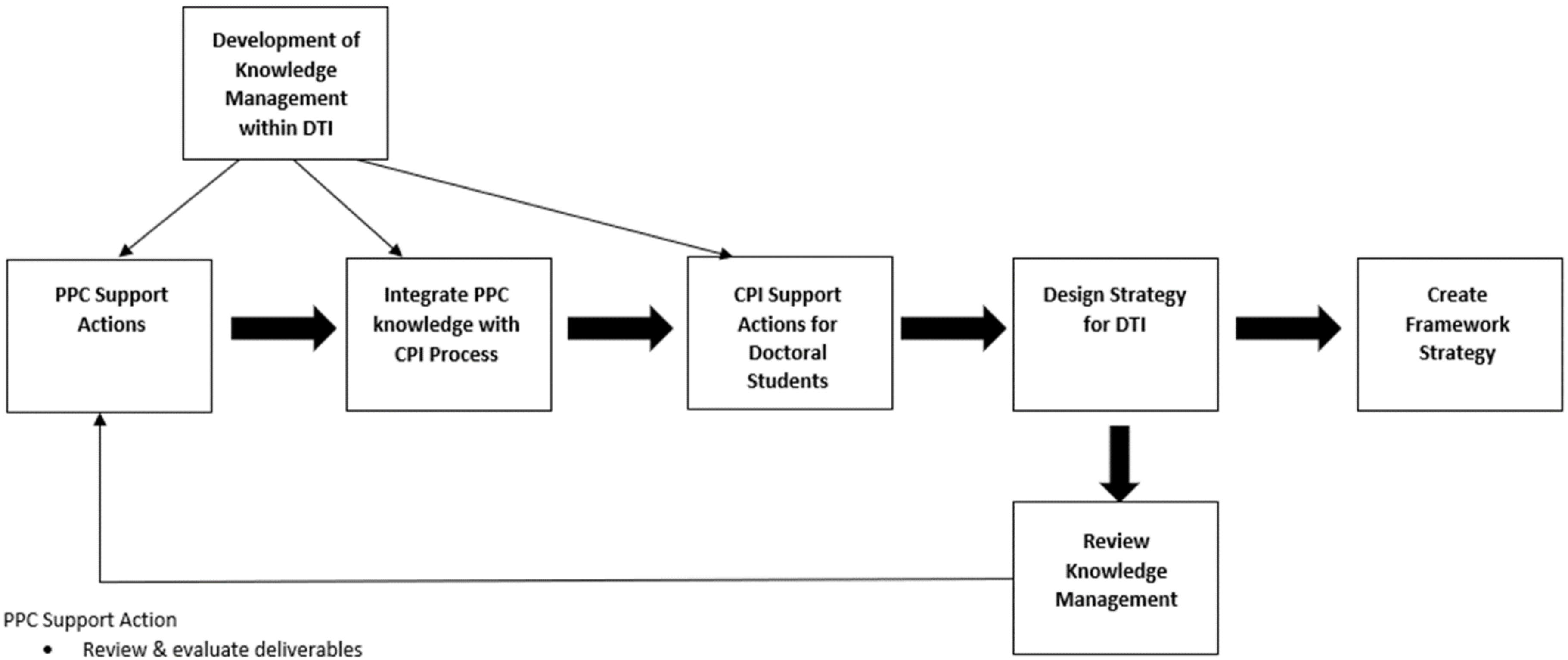
Pegasus Research and Technologies (PRT) provides research and engineering services in the Aerospace and Defence sector, with expertise in Modeling & Simulation, Artificial intelligence & Robotics, and System & Software Engineering. PRT has developed a 4G-enabled intelligent Data Collection Unit (iDCU) for Small Unmanned Aircraft Systems (SUAS).

CRIM

CRIM is an applied research and expertise centre in information technology. **CRIM** focuses on innovation and collaborative development and has expertise in three areas: Data Analytics, Human Machine Interfaces, and Intelligent Systems.

ENCQOR

ENCQOR is a transformational Canada-Québec-Ontario partnership focused on research and innovation in the field of 5G disruptive technologies, on adoption initiatives and system uses. **ENCQOR** establishes the first Canadian pre-commercial corridor of 5G digital infrastructure — the key to making the digital economy a reality.



PPC Support Action
- Review & evaluate deliverables
- Edit & redraft deliverables
- Participate in the drafting of new Horizon Calls

Integrate PPC knowledge with CPI Process
- Analyse & evaluate Horizon Calls for DTI
- Identify & present to DAS potential calls
- Identify, and select potential partners for Horizon Calls Consortiums

CPI Support Actions for Doctoral Students
- Integrate PPC Topics, Horizon Topics, & International Innovated Topics
- Draft Demande de Doctorant-e (2 x formulaires soumis)

Design Strategy
- Review Knowledge Management for Preliminary Strategy
- Investigate commercial markets aspects of Implementing Strategy

PANEL STATEMENT – INTEROPERABILITY 4 CONSTRUCTION INDUSTRY BREAKTHROUGH TECHNOLOGIES

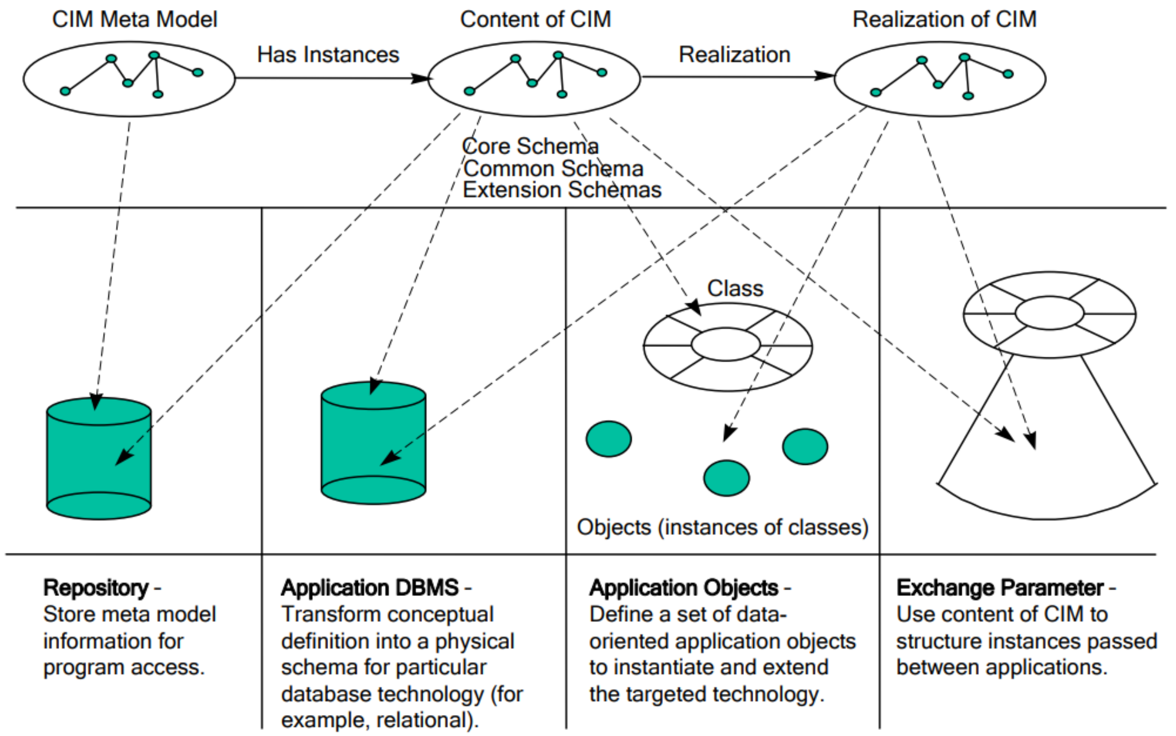


Figure 1 – Four Ways to Use CIM

Common Information Model (CIM) Infrastructure

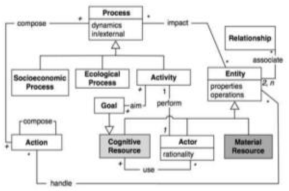
DMTF

Document Identifier: DSP0004

Date: 2014-08-03

Version: 2.8.0

An Entity/Process meta-model for SES Modelling



The Meta-Model of a Social-Ecological System represented as a UML class diagram.

The Meta-Model is represented as a UML class diagram. It uses system-related terms, on the meaning of which scientists from various disciplines may agree [see Terminology]. The model of a SES in conformance with the meta-model (i.e. an instance of this meta-model) is represented by three kinds of diagrams: the Actor-Resource diagram represents the structure of the model; the interaction diagram represents the system dynamics; the own dynamics and actions of each process are described by a process diagram.

Common Information Model (CIM) Infrastructure DSP0004

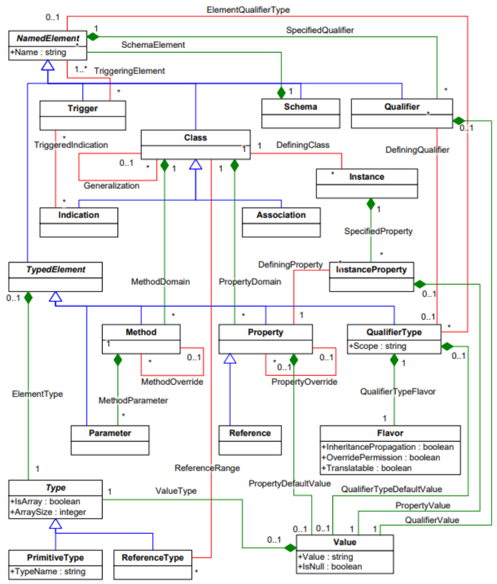
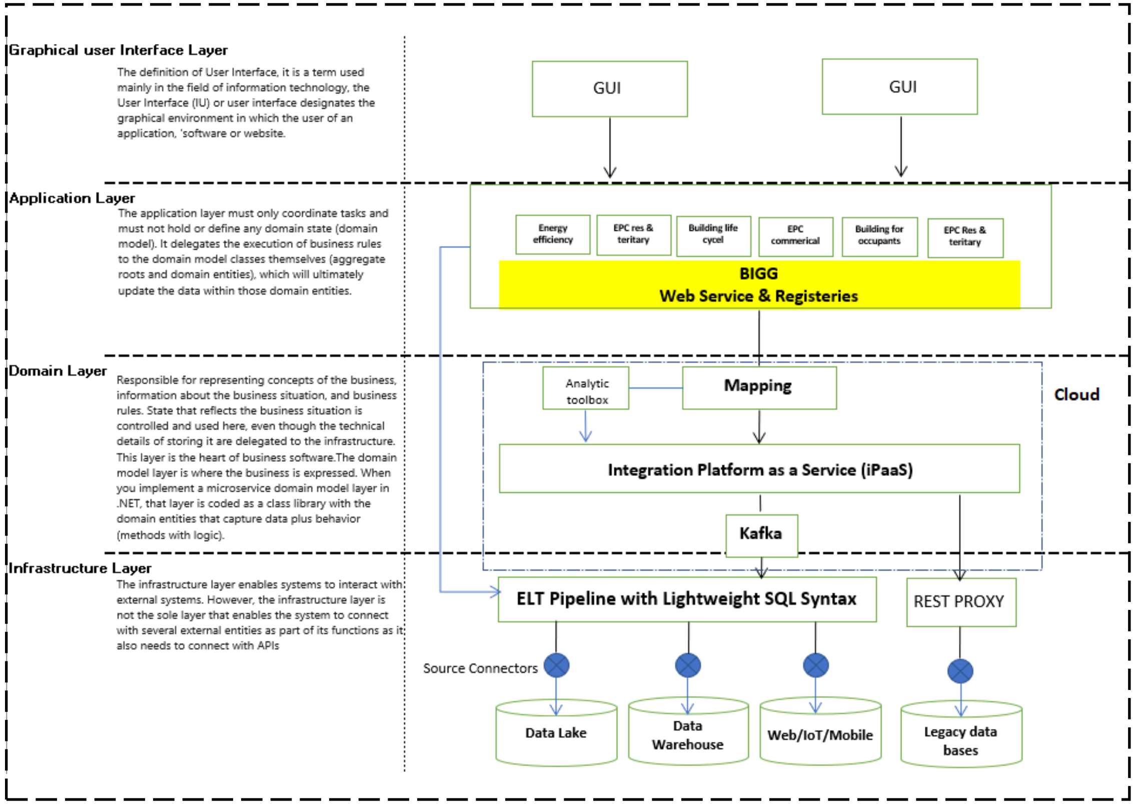


Figure 2 – CIM Meta Schema

Repository



https://doi.org/10.1177/23998083211058798

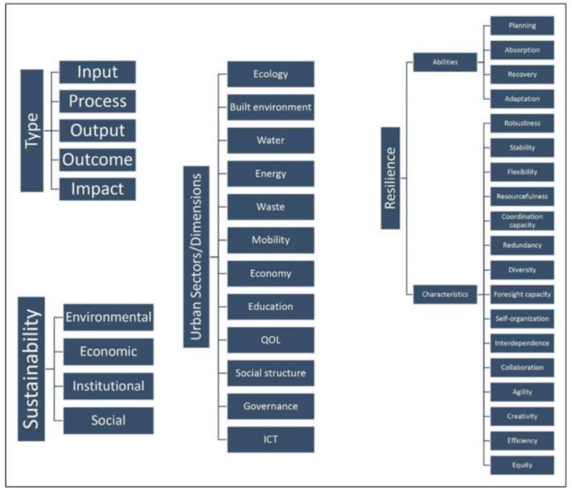
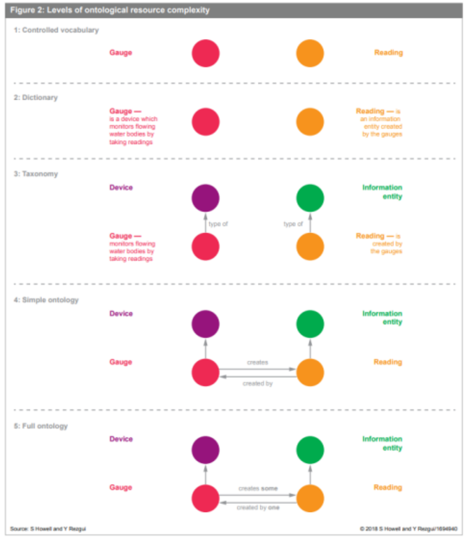


Figure 1. Taxonomy for analysis of indicator sets.



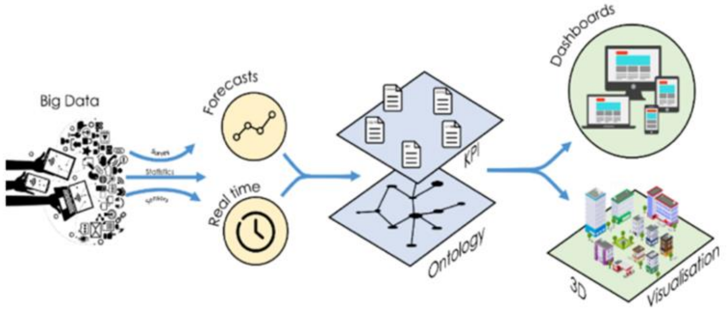
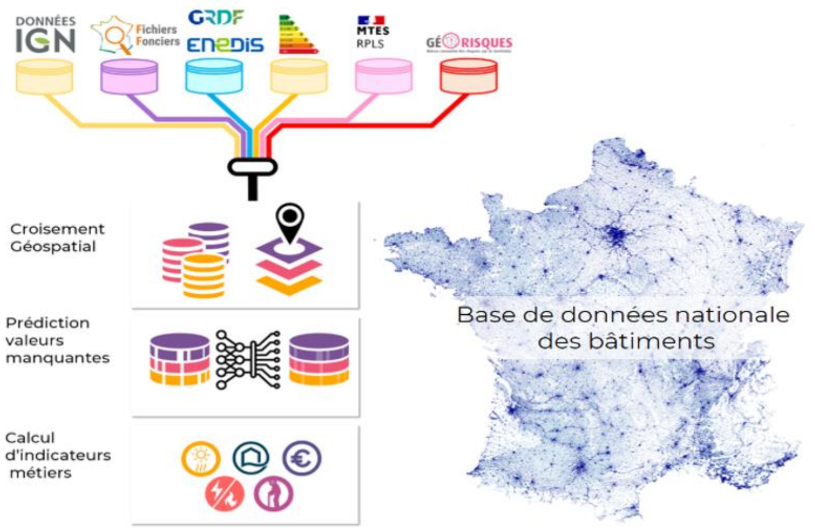


Fig. 1. Real-time UDSA Framework.

https://doi.org/10.1016/j.advengsoft.2019.102731

Application DBMS

Overall description – BDNB



The French national building database (BDNB): a database built by joining multiple national building-databases, including property taxes, energy performance diagnostics, and energy consumption. The comprises more than 20 million localized buildings' geometry with multiple thematic layers, such as and roof material, energy performance, and energy consumption at the scale of single buildings.

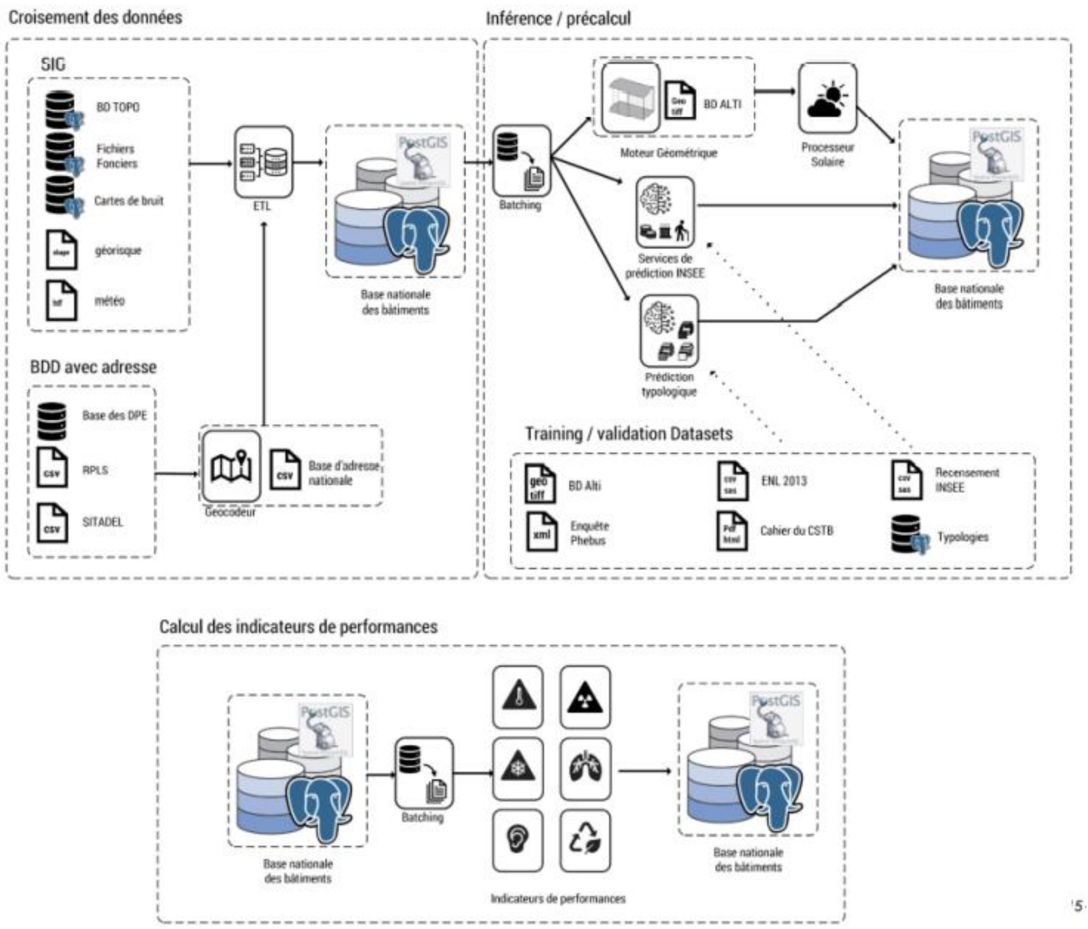


Figure 2. BDNB architecture

En pratique : périmètre de la BDNB open v1

Projet BAT-ID :

- Identifiant concerté

Référentiels nationaux :

- Base d'adresse nationale
- Cadastre
- BD Topo
- Code officiel géographique

Données ouvertes :

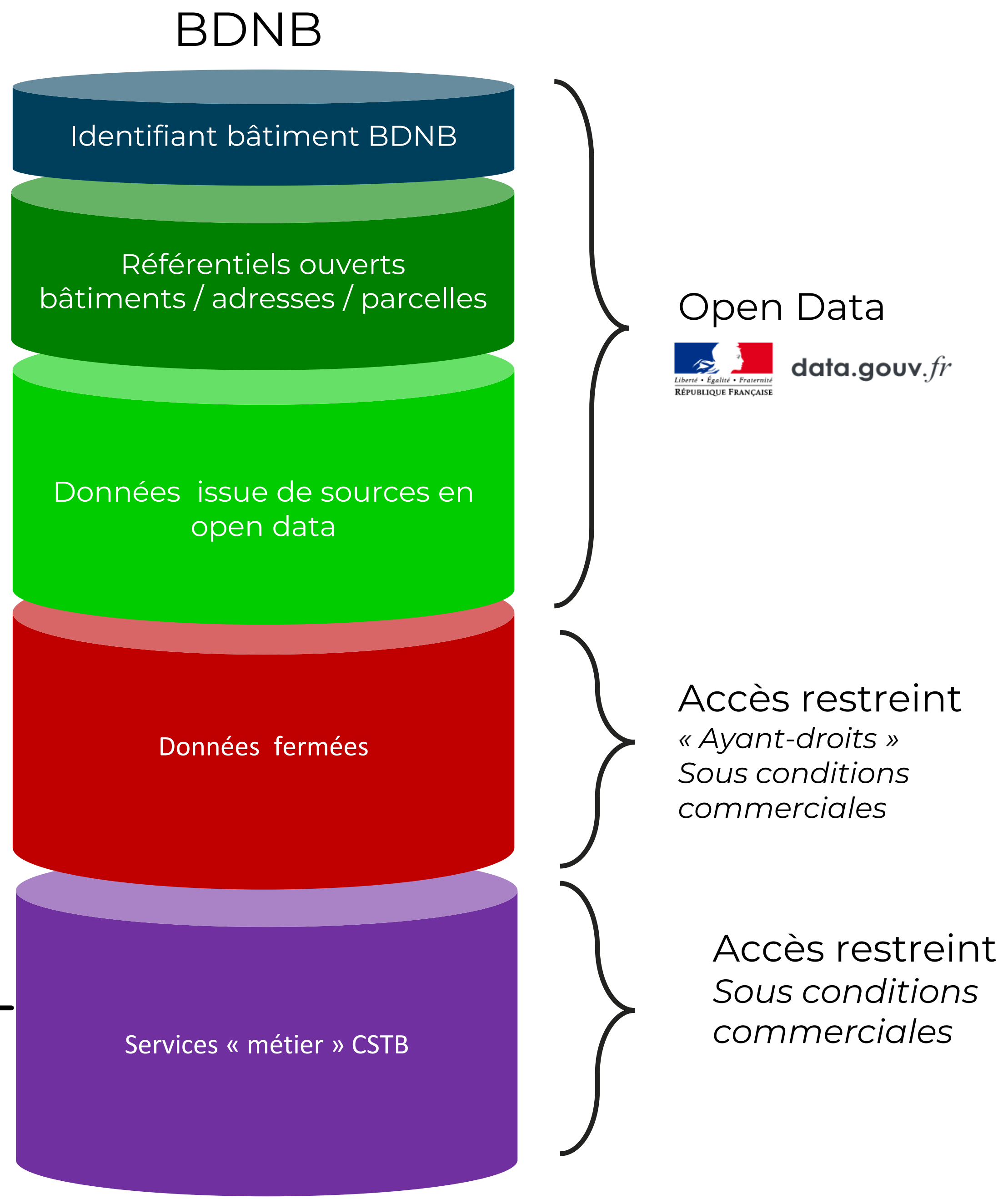
- DPE 2012 (ADEME)
- Données locale de l'énergie (ENEDIS, GrDF)
- Donnée de valeur foncières (CEREMA)
- …

Données fermées :

- Fichier fonciers
- RNIC
- RPLS complet

Services « métier » CSTB :

- Prédiction des données manquantes
- Simulations (DPE 2021, cometh, …)
- Indicateurs décisionnels (Potentiel de rénovation, Valeur foncière,…)
- Métrés
- …

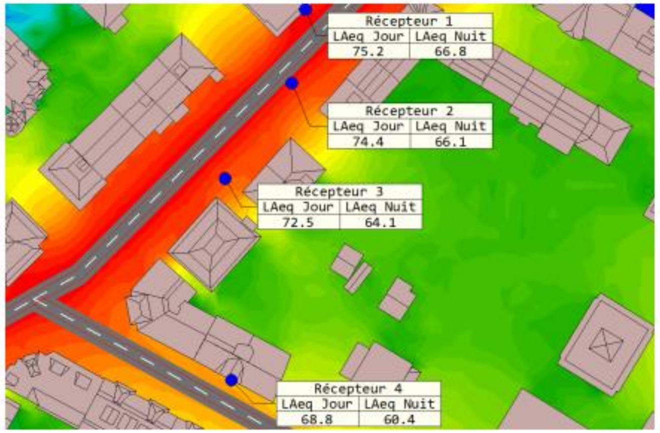


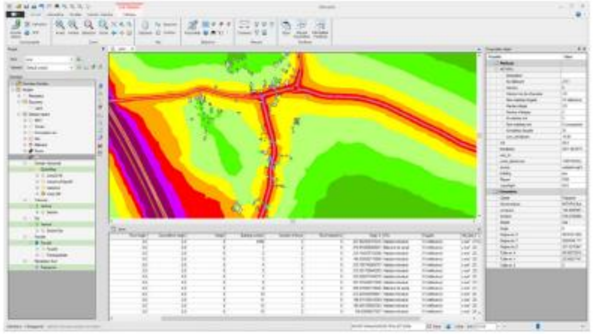
Socio-*economic* ***Scenarios***

CSTB - MithraSIG La cartographie du bruit

Rapidité et précision

MithraSIG allie rapidité et précision par la **simulation de la propagation des ondes acoustiques**. Il utilise des **méthodes asymptotiques** (lancer de rayons/faisceaux) adaptées aussi bien aux **environnements fermés** (centre-ville), **ouverts** (vastes espaces entre constructions) ou aux **sites montagneux** (fort dénivelé). Le moteur de calcul physique implémente les méthodes standardisées et plusieurs modèles d'émission pour les **sources routières, ferroviaires et industrielles.**





Des rendus clairs et complets pour l'aide à la décision et à la communication

4 types de cartographies possibles :

- verticales
- horizontales
- en façade des bâtiments
- récepteurs individuels

Résultats sous forme de tableaux, cartes, coupes, vues 3D et mise à jour dynamique des rendus

- modifications du trafic
- changement d'indice
- activation/désactivation de sources...
- cartes différentielles (avant/après)
- cartes du nombre d'habitants exposés

MithraSIG se distingue par la qualité des documents produits, en particulier les PDF dynamiques (avec calques, schémas et géoréférencement) facilement transférables par courriel.

Il permet aussi la diffusion des cartes sous différents formats :

- KMZ pour la visualisation sous Google Earth™
- Maquettes virtuelles
- Plus de 50 formats vectoriels et raster

LIST & R2M Solution - Manage Urban Spaces Together

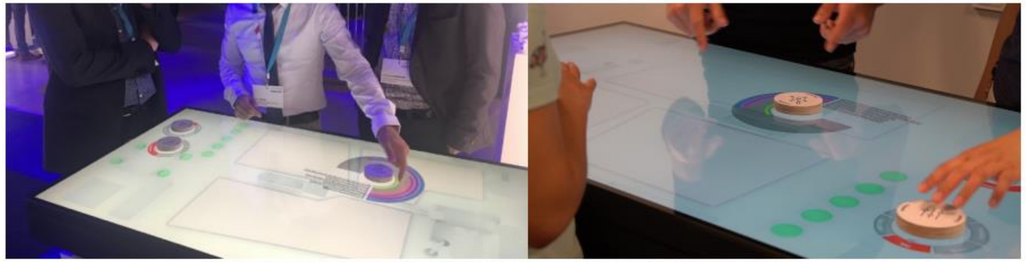


Figure 2: Interaction related to the recommendation platform of MUST

Figure 3: Interaction for the urban space generation using tangible interfaces

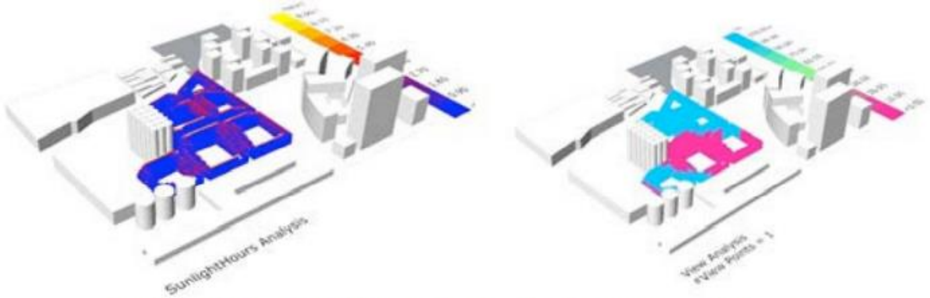
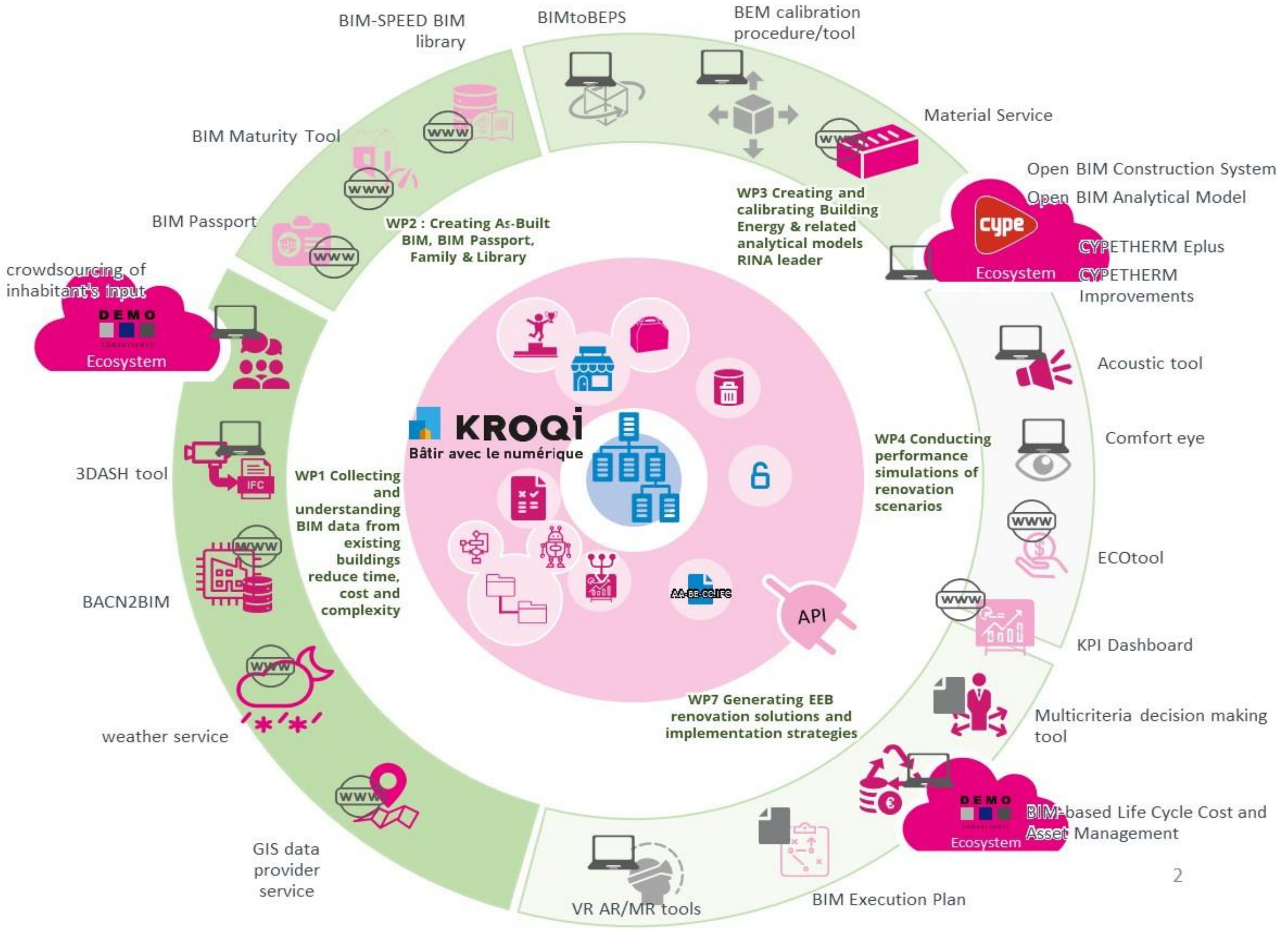


Figure 4: Different types of simulation for the performance indicators

Exchange Parameter - “Address the problem of “data matching” and data verification”



KROQI improved & used as the integration system for the BIM-SPEED project

BREAKTHROUGH TECHNOLOGIES

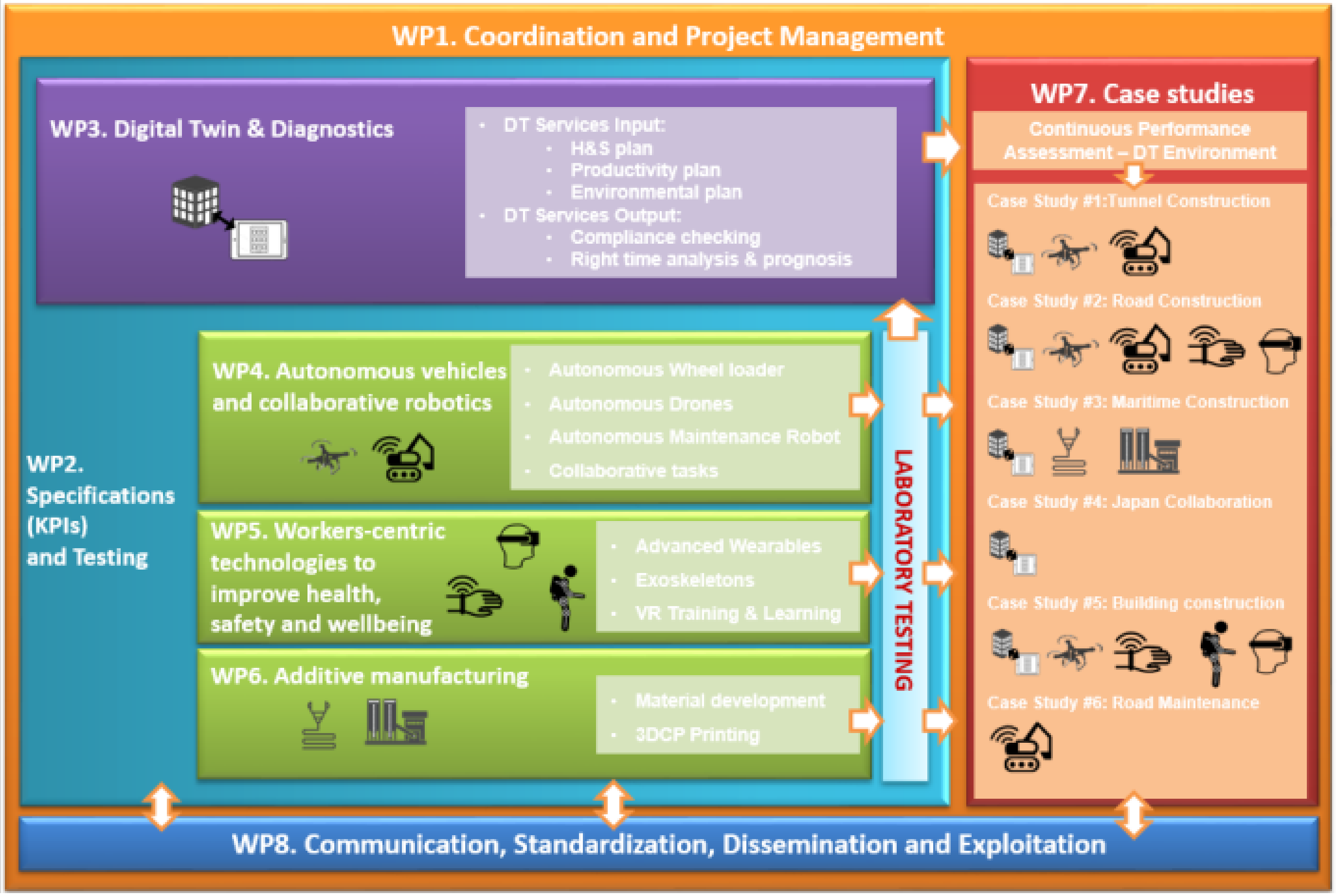


Figure 4. BEEYONDERS WPs relation

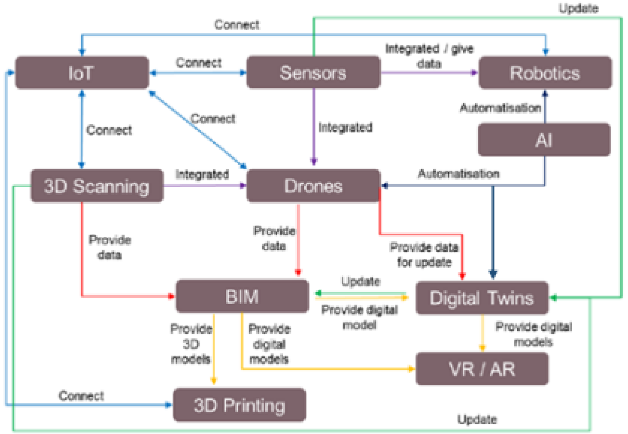
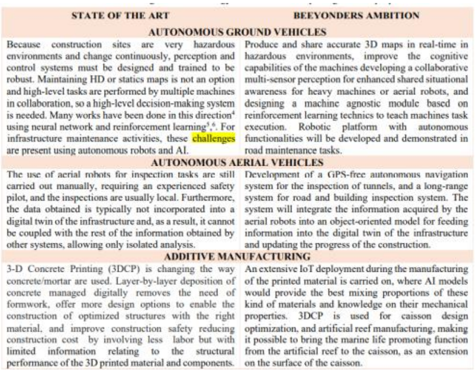
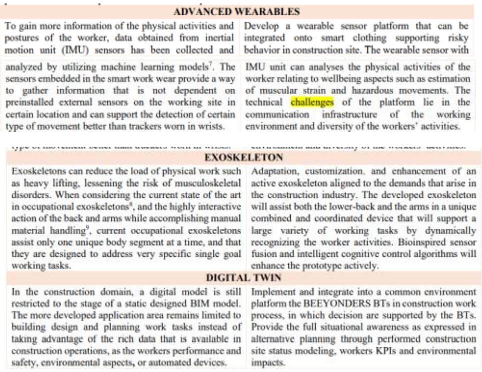


Figure 3. Overview of relation between digital technologies.
Source: Digitalisation in the construction sector, ECSO 2021



STATE OF THE ART	BEEYONDERS AMBITION
AUTONOMOUS GROUND VEHICLES	
Because construction sites are very hazardous environments and change continuously, perception and control systems must be designed and trained to be robust. Maintaining HD or statics maps is not an option and high-level tasks are performed by multiple machines in collaboration, so a high-level decision-making system is needed. Many works have been done in this direction[4] using neural network and reinforcement learning[5],[6]. For infrastructure maintenance activities, these challenges are present using autonomous robots and AI.	Produce and share accurate 3D maps in real-time in hazardous environments, improve the cognitive capabilities of the machines developing a collaborative multi-sensor perception for enhanced shared situational awareness for heavy machines or aerial robots, and designing a machine agnostic module based on reinforcement learning technics to teach machines task execution. Robotic platform with autonomous functionalities will be developed and demonstrated in road maintenance tasks.
AUTONOMOUS AERIAL VEHICLES	
The use of aerial robots for inspection tasks are still carried out manually, requiring an experienced safety pilot, and the inspections are usually local. Furthermore, the data obtained is typically not incorporated into a digital twin of the infrastructure and, as a result, it cannot be coupled with the rest of the information obtained by other systems, allowing only isolated analysis.	Development of a GPS-free autonomous navigation system for the inspection of tunnels, and a long-range system for road and building inspection system. The system will integrate the information acquired by the aerial robots into an object-oriented model for feeding information into the digital twin of the infrastructure and updating the progress of the construction.
ADDITIVE MANUFACTURING	
3-D Concrete Printing (3DCP) is changing the way concrete/mortar are used. Layer-by-layer deposition of concrete managed digitally removes the need of formwork, offer more design options to enable the construction of optimized structures with the right material, and improve construction safety reducing construction cost by involving less labor but with limited information relating to the structural performance of the 3D printed material and components.	An extensive IoT deployment during the manufacturing of the printed material is carried on, where AI models would provide the best mixing proportions of these kind of materials and knowledge on their mechanical properties. 3DCP is used for caisson design optimization, and artificial reef manufacturing, making it possible to bring the marine life promoting function from the artificial reef to the caisson, as an extension on the surface of the caisson.



ADVANCED WEARABLES	
To gain more information of the physical activities and postures of the worker, data obtained from inertial motion unit (IMU) sensors has been collected and analyzed by utilizing machine learning models[7]. The sensors embedded in the smart work wear provide a way to gather information that is not dependent on preinstalled external sensors on the working site in certain location and can support the detection of certain type of movement better than trackers worn in wrists.	Develop a wearable sensor platform that can be integrated onto smart clothing supporting risky behavior in construction site. The wearable sensor with IMU unit can analyses the physical activities of the worker relating to wellbeing aspects such as estimation of muscular strain and hazardous movements. The technical challenges of the platform lie in the communication infrastructure of the working environment and diversity of the workers' activities.
EXOSKELETON	
Exoskeletons can reduce the load of physical work such as heavy lifting, lessening the risk of musculoskeletal disorders. When considering the current state of the art in occupational exoskeletons[8], and the highly interactive action of the back and arms while accomplishing manual material handling[9], current occupational exoskeletons assist only one unique body segment at a time, and that they are designed to address very specific single goal working tasks.	Adaptation, customization, and enhancement of an active exoskeleton aligned to the demands that arise in the construction industry. The developed exoskeleton will assist both the lower-back and the arms in a unique combined and coordinated device that will support a large variety of working tasks by dynamically recognizing the worker activities. Bioinspired sensor fusion and intelligent cognitive control algorithms will enhance the prototype actively.
DIGITAL TWIN	
In the construction domain, a digital model is still restricted to the stage of a static designed BIM model. The more developed application area remains limited to building design and planning work tasks instead of taking advantage of the rich data that is available in construction operations, as the workers performance and safety, environmental aspects, or automated devices.	Implement and integrate into a common environment platform the BEEYONDERS BTs in construction work process, in which decision are supported by the BTs. Provide the full situational awareness as expressed in alternative planning through performed construction site status modeling, workers KPIs and environmental impacts.

Panellist Position

Moving Beyond Data Dashboards and Traditional Processors, Processing & Storage Solutions

Fahim A. Salim, USN, Norway fahim.a.salim@usn.no

- *Beyond Data Dashboards*
- *Post Binary Processing and Data Storage*
- *Storing Raw Data vs Processed Information*

→ *Context is King*

→ *Thinking Beyond Binary Terms*

→ *Do we need to store all the raw data?*

About Fahim

- Research Fellow at Norwegian Industrial Systems Engineering (NISE) Research Group at University of South-Eastern Norway.
  - Harvesting big data in complex engineering environments by human centric AI.
- Formerly Post Doc Researcher at Biomedical Signals and System (BSS) at University of Twente.
  - Using sensors to model player behavior to create new forms of volleyball training.
- PhD in Compute Science, Trinity College Dublin
  - Transforming video streams to allow enhance exploration experience with content.
- Full Stack software engineer.

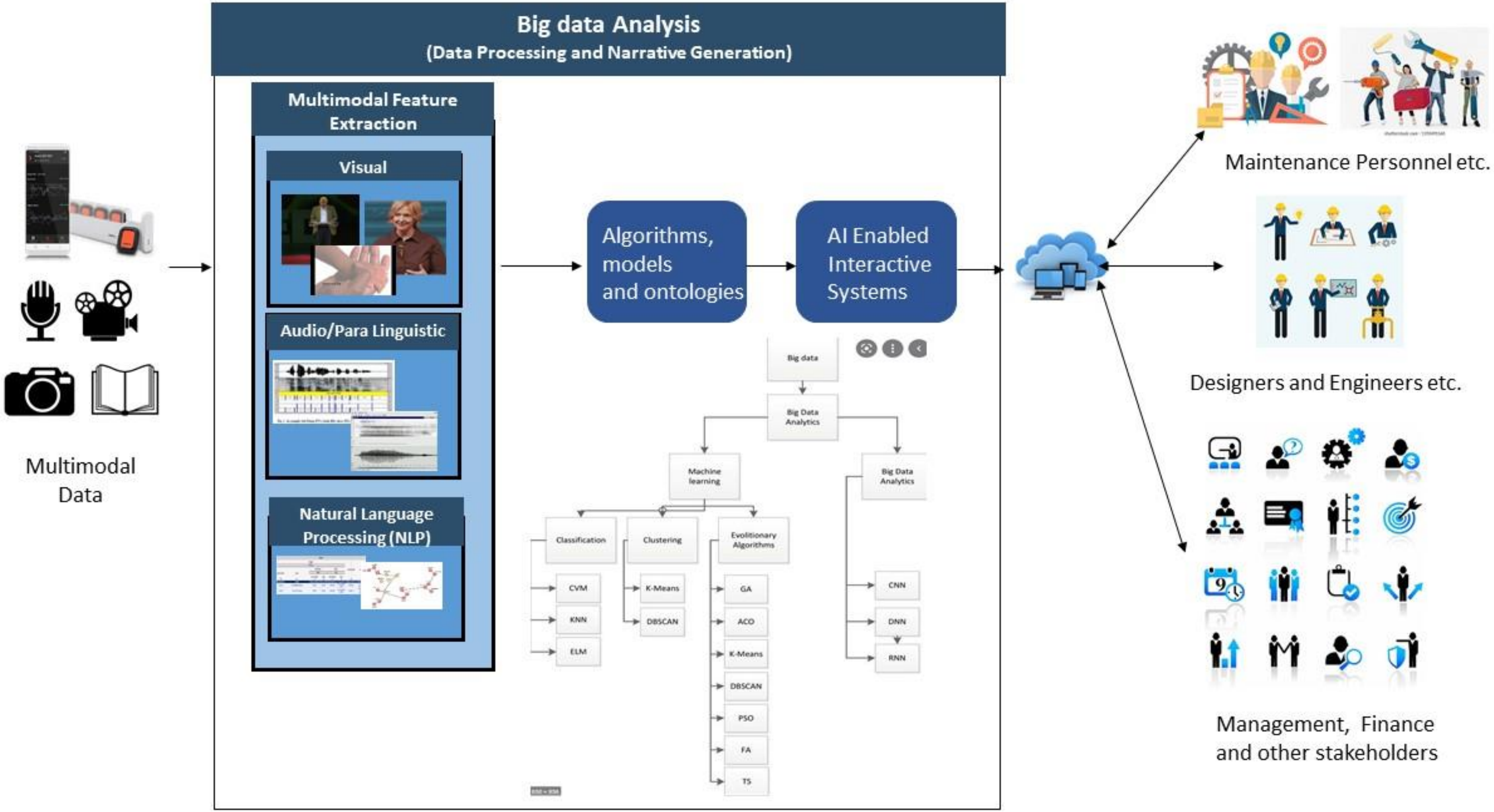
Beyond Data Dashboards

- Organizations perceived a rise in difficulty in terms of utilizing Big Data Analytics (Qlik and Accenture 2020).
- Only 21% of respondents reported to have access to exploration systems suitable for their job roles.
- Systems are designed for the content producer often designed for content producers and not the consumers.

Narrative Generation based on User (Consumer) Context

- User needs:
  - The right content. (both in terms of item and portion)
  - The right manner/modality (device or personal preference)
  - The right expanse i.e., the right amount of detail. (context, device, preference)
- By representing/curating content:
  - In a Non-linear Flow
  - Have Multimodality in the representation.
  - Allow greater User Control (in flow, modality, detail).

Data Processing Framework (Vision)



Energy Consumption in IOT (wearables) devices

- Size and formfactor of wearables.
- Battery life
- Communication protocol and frequency
- Edge computing
- Data Storage
- Solar powered wearables devices (smartwatches)
- Kinetic Energy Harvesting.

Can Post Binary Computing Help?

- Multiple-Valued logic (MVL) and analog computing.
- Less power usage in:
  - Computing
  - Storage
  - Communication.
- Less Hardware complexity:
  - In terms of registers and logic gates and interconnects.

Raw Data vs Processed Information

Developer mode

- Many commercial IOT wearables only grant API access to processed data.
- However, researchers usually preferred access to raw sensor data.
- Clinical research require higher-quality data than most commonly available wearables can provide.
- Security, privacy and ethical concerns.

Thank you!
Questions? comments?

Contact: fahim.a.salim@usn.no

MODERN SYSTEMS Experts Panel
IoT-based Systems Challenges

MODERN SYSTEMS 2022

Panellist Position

Revolution in mobile IoT devices using Joint Communication, Localisation and Sensing Technologies (JCLS)

- **Oliver Michler**, TU Dresden, EU-Germany oliver.michler@tu-dresden.de

Faculty of Transportation and Traffic Sciences

Institute of Traffic Telematics

Chair of Transport Systems Information Technology

- Mobility-as-a-Service -> Highly efficient next Generation Mobility Concepts
- High Datarate with low Latency -> New Radio Communication
- Positioning and Tracking only in Software -> Robust precise Localization
- Passive Environment detection only in Software -> RF based Sensing
- Low energy System design -> Software instead of parallel electronic components
- Multi functional IoT Standards -> Software Defined Radio
- IoT as Multifunctional networked trackable radar-like sensor (transport modes, mobility, production, hospital, agriculture, fores

→ IoT + JCLS = Hybrid ICT Sensors to replace or integrative complement of 5G and GNSS and Radar systems

Everything moves and all is connected

Reference: Stopka, U.: Keynote Speech, ICL-Conference 2021, Germany, Dresden, 2021

IARIA

TECHNISCHE UNIVERSITÄT DRESDEN

MODERN SYSTEMS Experts Panel

IoT-based Systems Challenges

MODERN SYSTEMS 2022

By 2030

Urban population will grow from 3.5 billion to ~5 billion, mainly in developing countries

5 BILLION

By 2025

75% of global GDP growth will be generated by middleweight cities in emerging markets

75 PERCENT

Gross Domestic Product = GDC

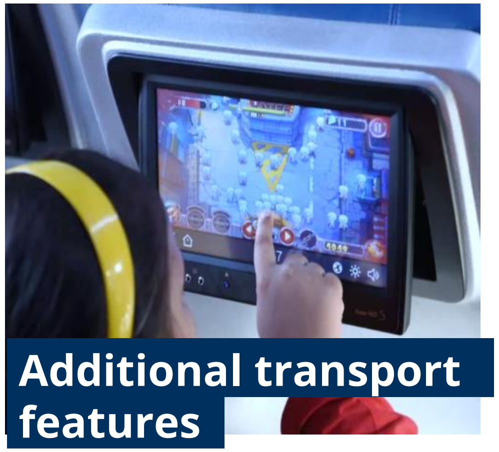
Today

25% of all green house gas emissions come from transportation

25 PERCENT

Reference: Stopka, U.: Keynote Speech, ICL-Conference 2021, Germany, Dresden, 2021

Important Mobility Trends for the Next Decade



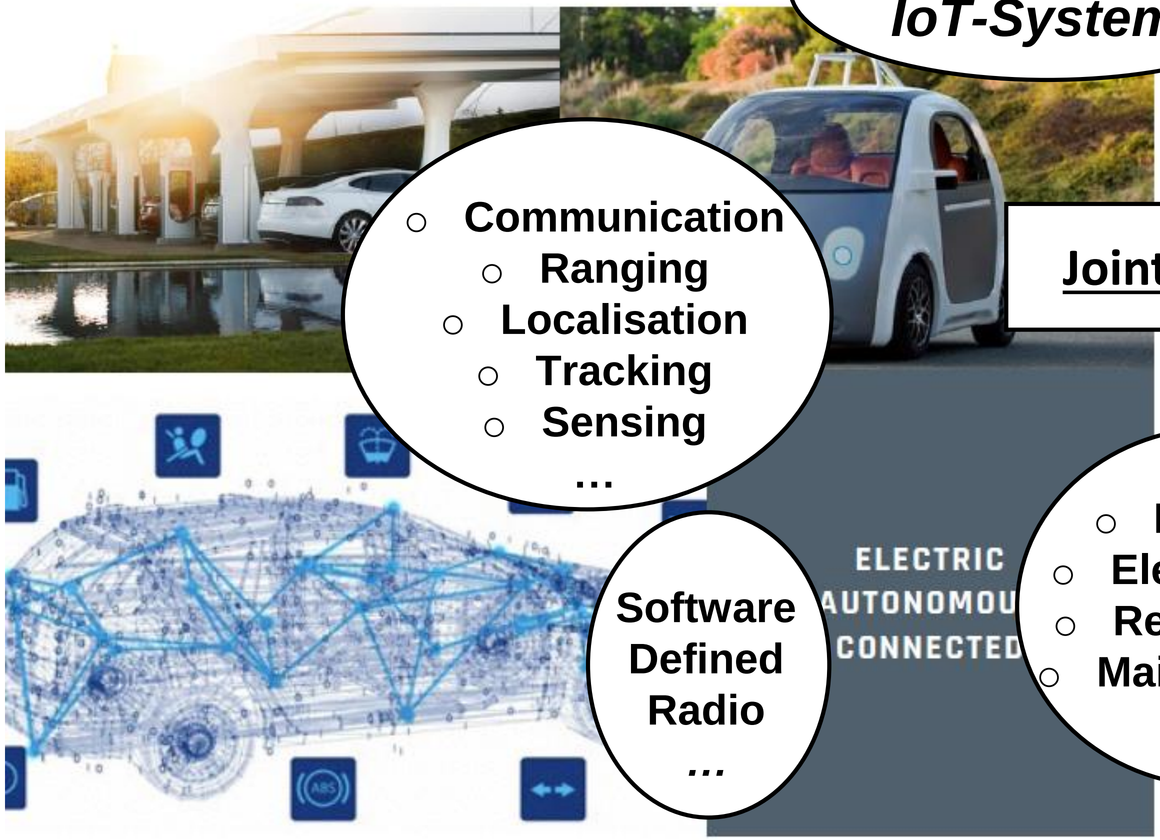
Reference: Stopka, U.: Keynote Speech, ICL-Conference 2021, Germany, Dresden, 2021

Digitisation of Passenger Transport

PRODUCT INNOVATIONS

BUSINESS MODEL INNOVATIONS

Connected IoT-Systems



- Communication
- Ranging
- Localisation
- Tracking
- Sensing

…

Software Defined Radio
…

- Energy ↓
- Electronics ↓
- Realiability ↑
- Maintanance ↑

…

Joint CRLTS

- On Demand Services
- Shared Multimedia Services
- Personalized Vehicle Sharing
- Autonomous Driving Services

…

Reference: https://www.handelsblatt.com/technik/thespark/mobilitaet-ridesharing-dienst-clevershuttle-startet-im-rheinland-weitere-staedte-sollen-folgen/25657984.html?ticket=ST-4096016-tIWQ4WwvaPZAf5zzc5oV-ap5

Reference: Stopka, U.: Keynote Speech, ICL-Conference 2021, Germany, Dresden, 2021

Reference: Dr. Kirschbaum, T.: Utopia ante portas – Der Weg zur autofreien Stadt, Dresden, January 2017.

IARIA TECHNISCHE UNIVERSITÄT DRESDEN

MODERN SYSTEMS Experts Panel

IoT-based Systems Challenges

MODERN SYSTEMS 2022

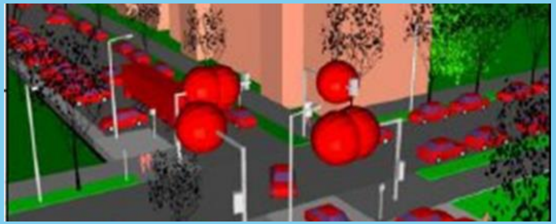
Fields of required competence (TUD)

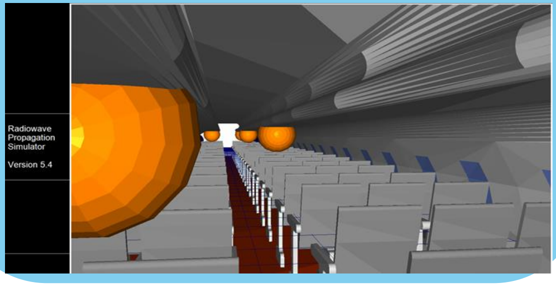
Simulation and radio planning

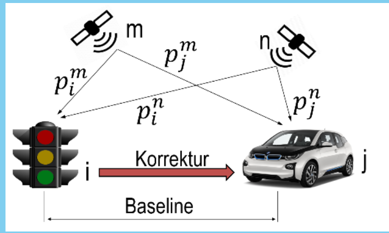
Networking and localisation

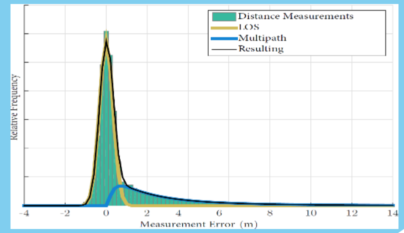
Experimental vehicles and test fields

Methodology and procedures



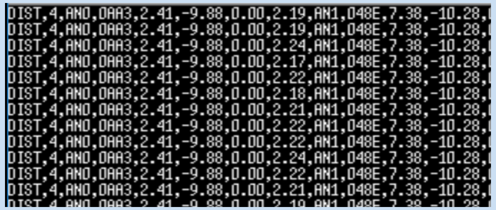




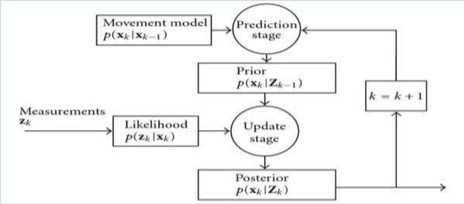


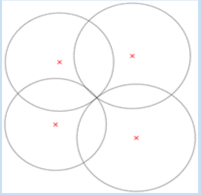
Modular research framework (TUD)

Data input

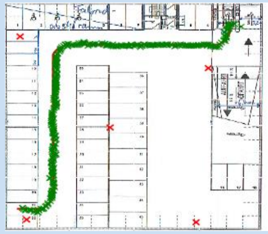


Communication / Ranging / Positioning / Tracking / Sensing





Visualization

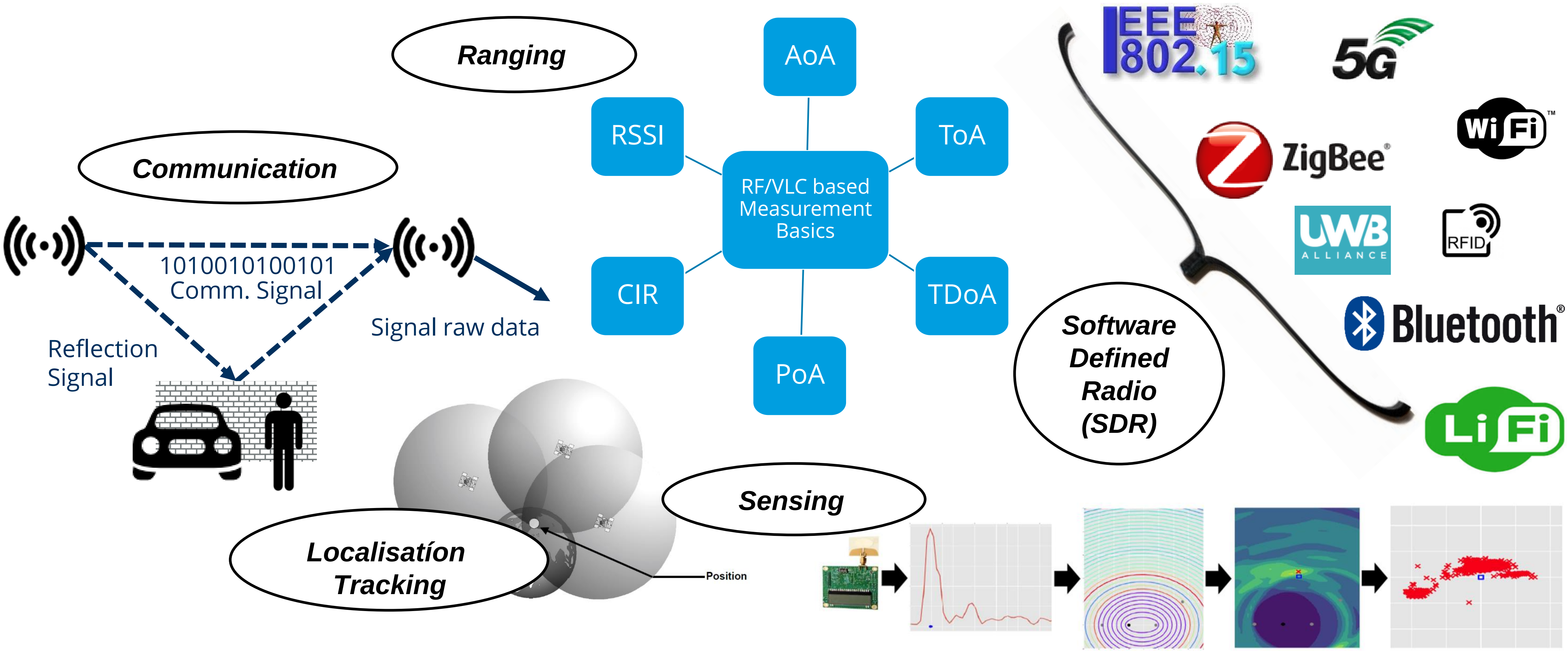


Client/Server ⇒ Database Software ⇒ JCLS - Algorithms / Procedures

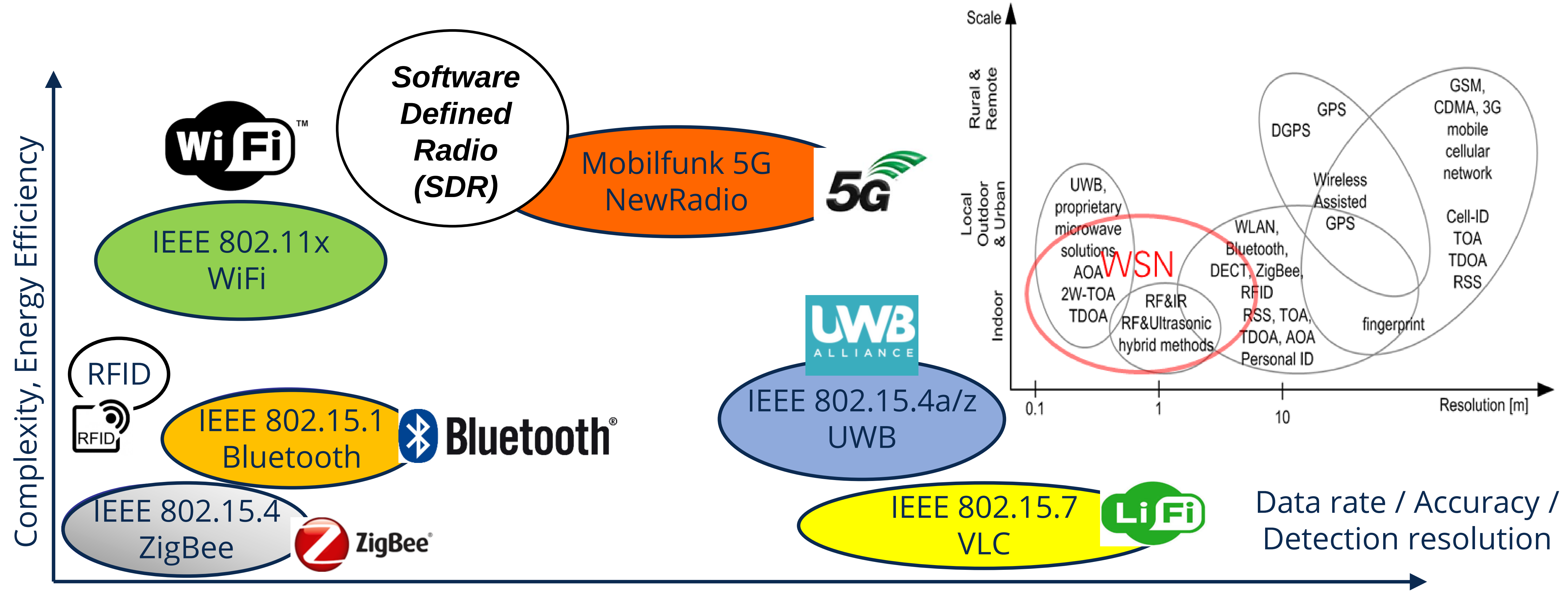
Technology Candidates:

IEEE 802.15.x (BLE, UWB, ZigBee, …), IEEE 802.11.x (WiFi 2,4/5GHz); MobilComm. (5G, 6G)
IEEE 802.15.7 (LiFi)

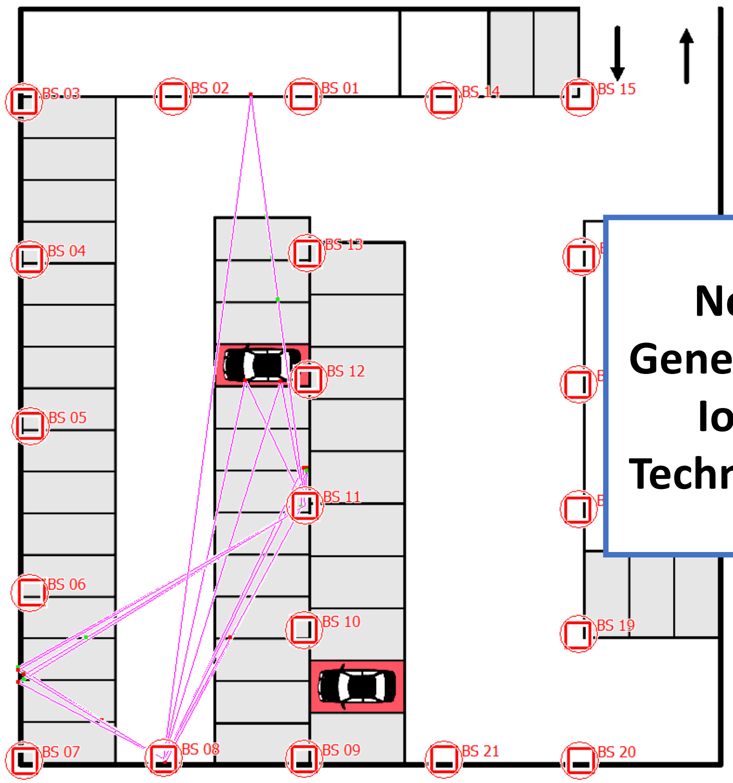
Revolution in mobile IoT devices using JCLS + SDR ⇒ Overview



Revolution in mobile IoT devices using JCLS + SDR ⇒ Cross Technologies

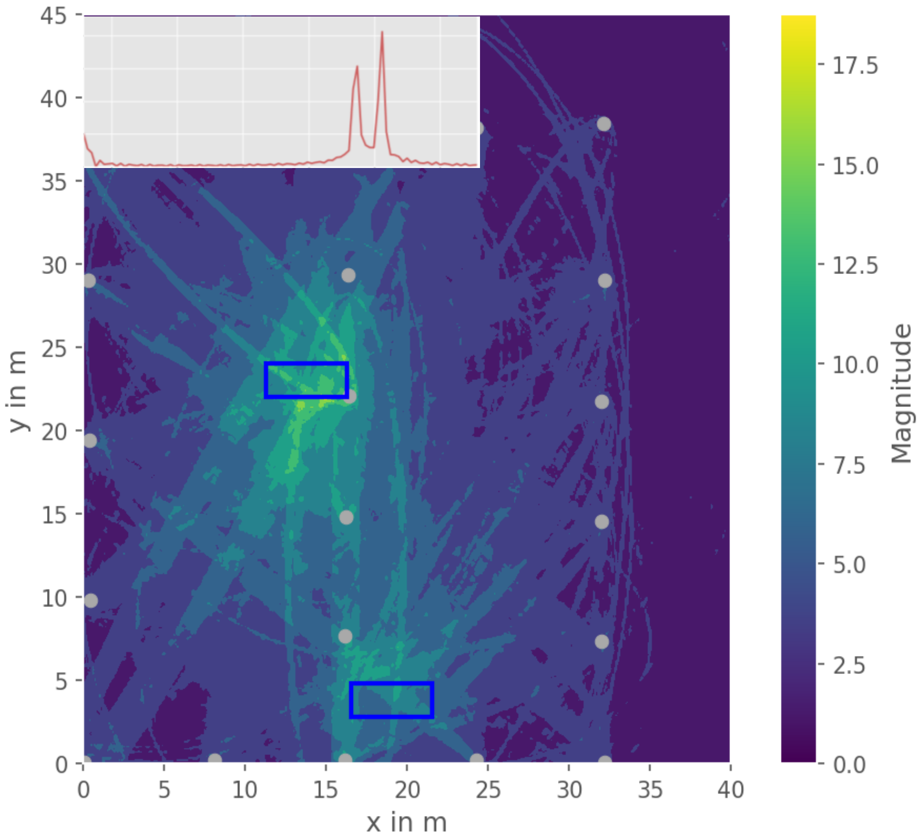


Example: Radio Sensing for Smart Parking Systems (1)

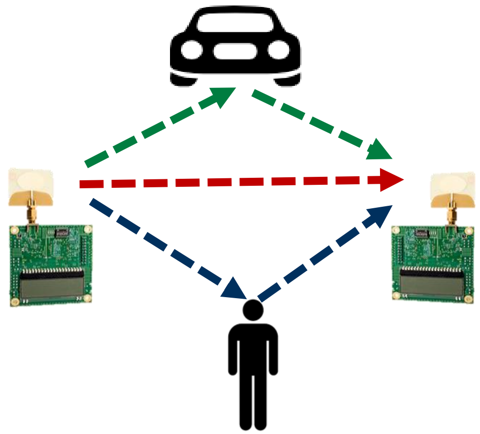


Floorplan and Ray Tracing

Next Generation IoT - Technology

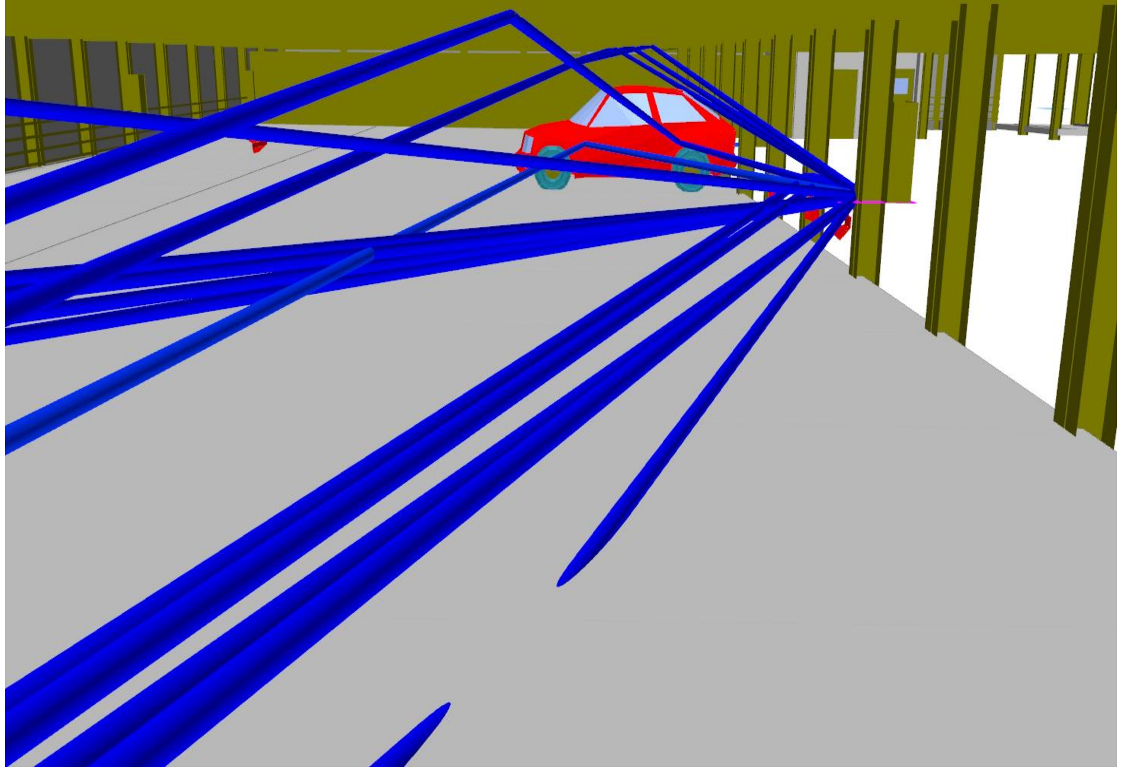


Localization Heatmap

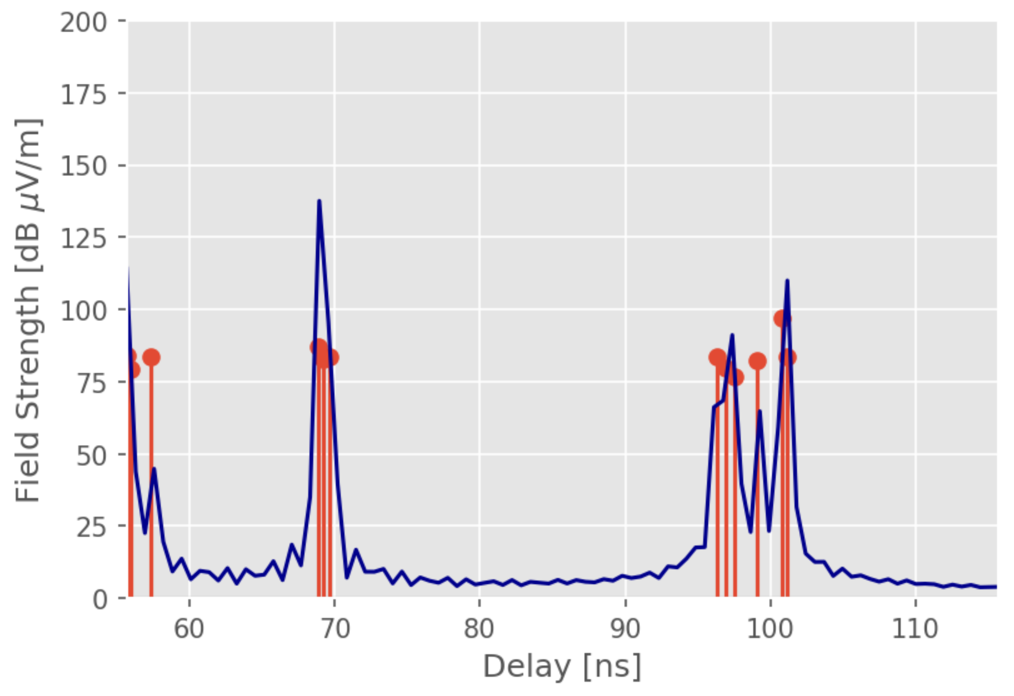


Example: Radio Sensing for Smart Parking Systems (2)

Channel Impulse Response (CIR)



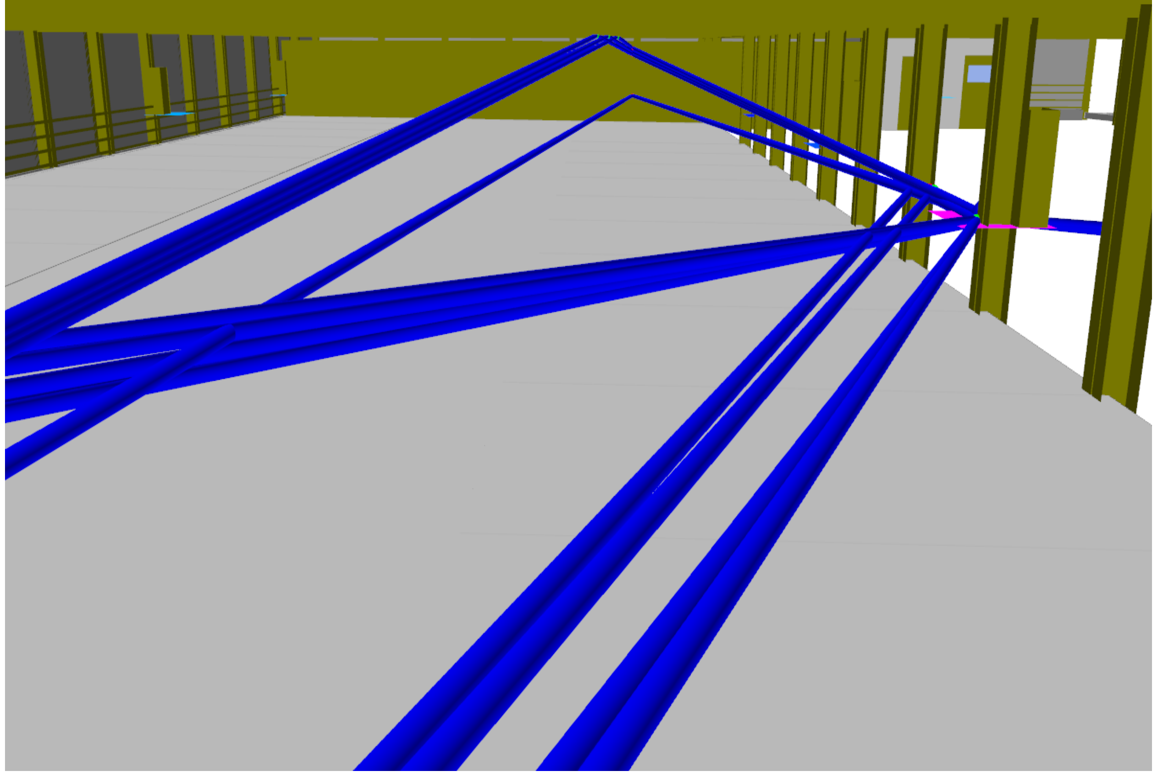
CIR - Subtraction



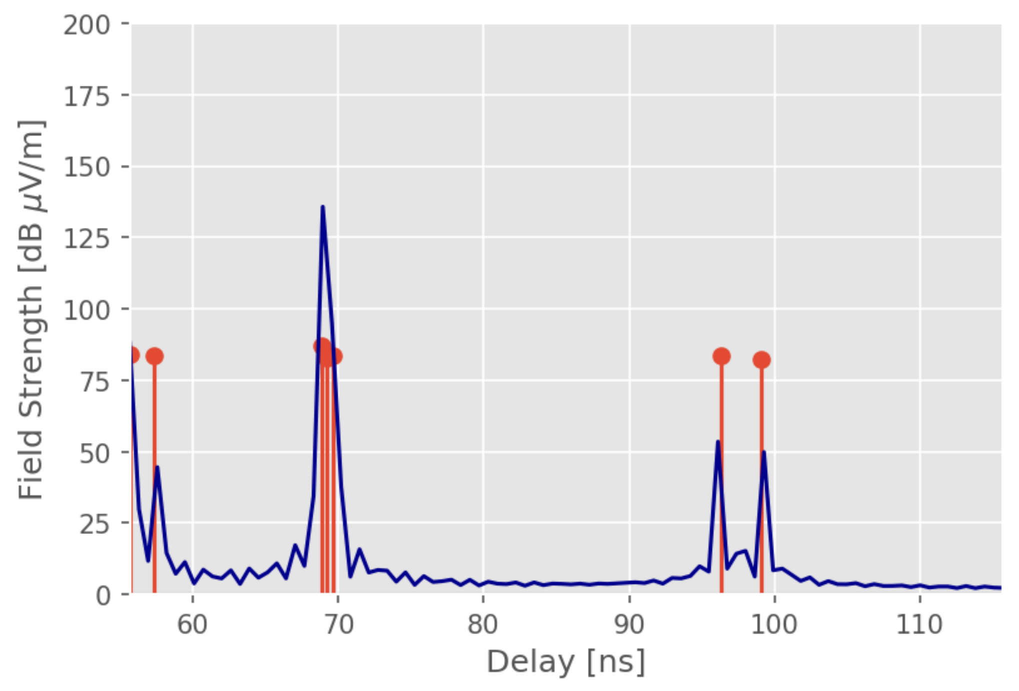
with vehicle

Example: Radio Sensing for Smart Parking Systems (3)

Channel Impulse Response (CIR)

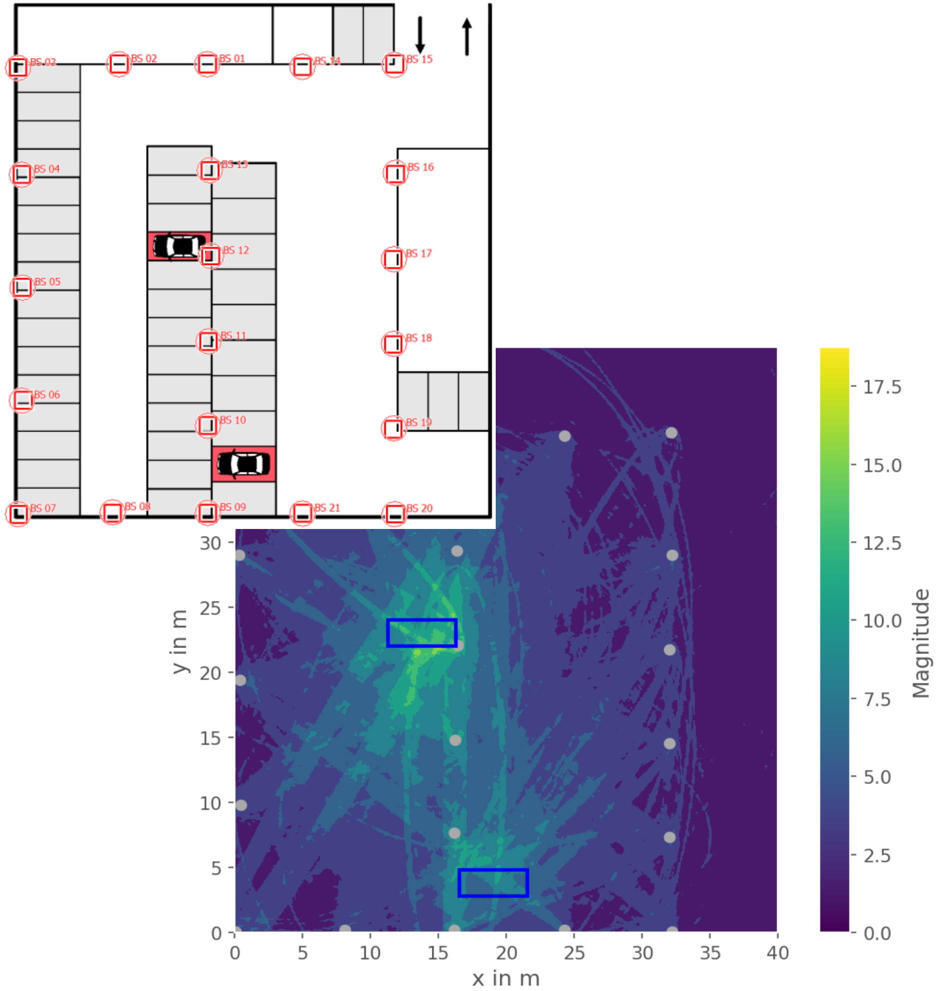


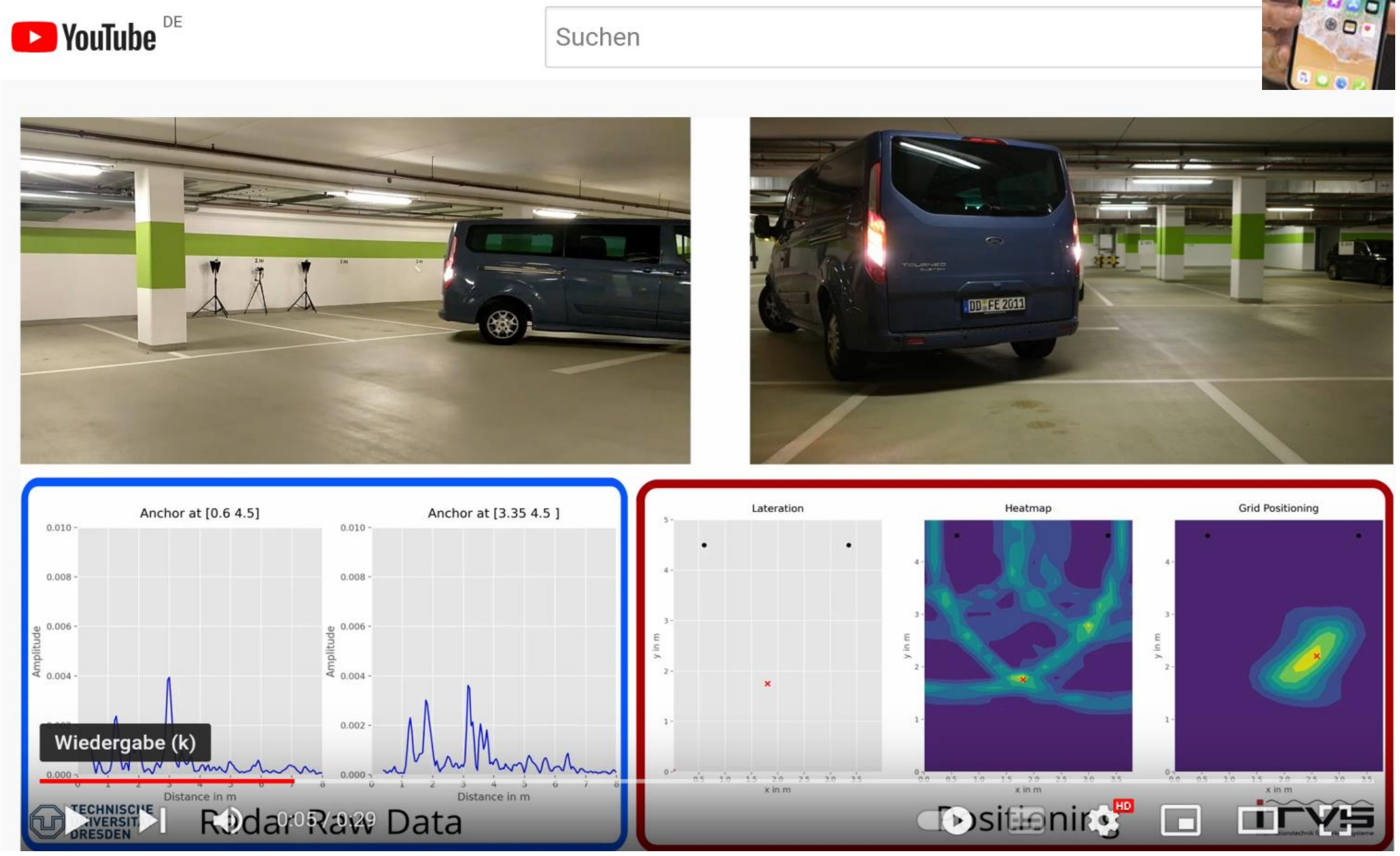
CIR - Subtraction



without vehicle

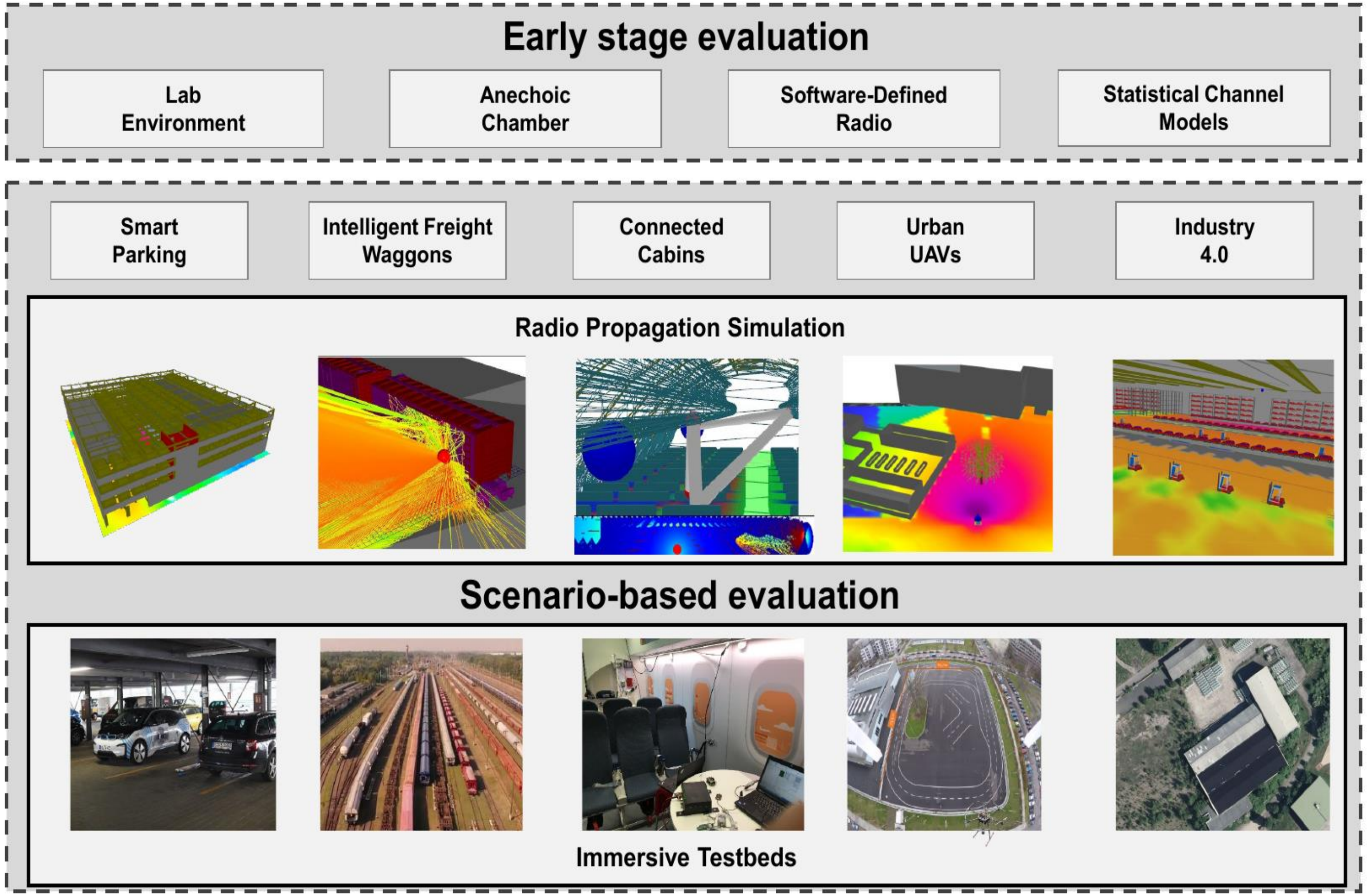
Example: Radio Sensing for Smart Parking Systems (4) ⇒ Result/Service

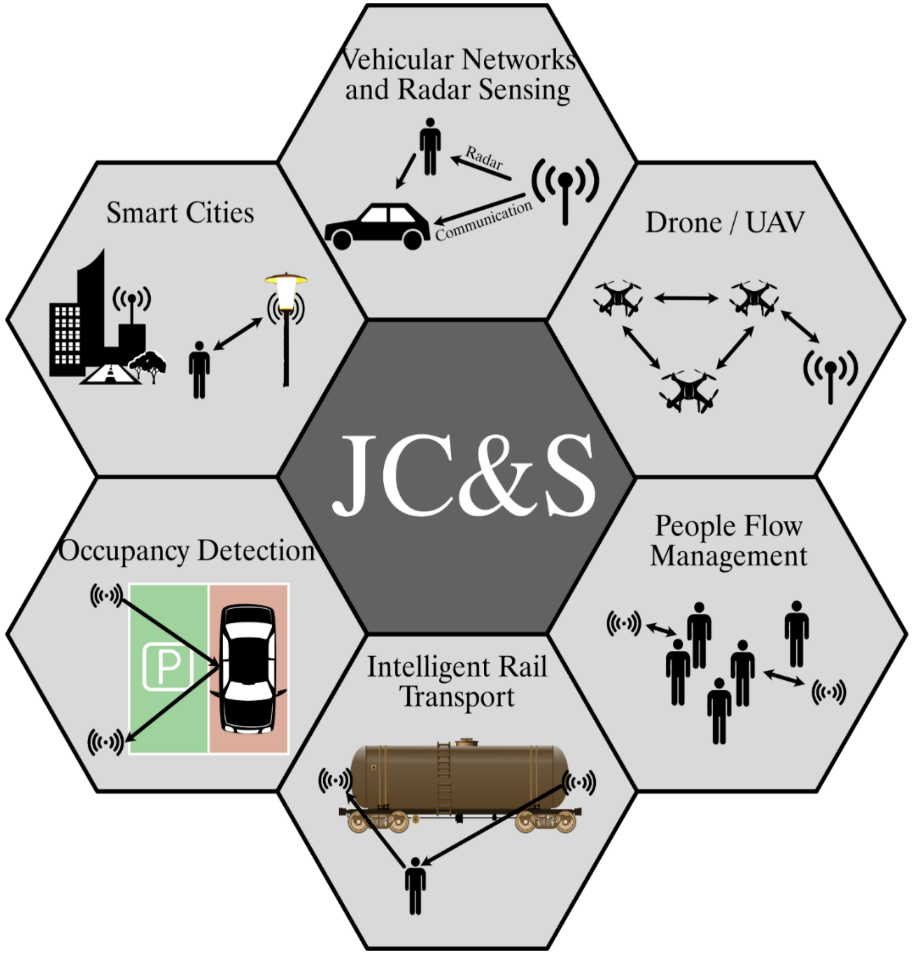




https://www.youtube.com/watch?v=FBv7WuiRKeQ

Mobility Applications ⇒ Extension to everything with IoT given (e.g. health)





TECHNISCHE UNIVERSITÄT DRESDEN

IARIA

MODERN SYSTEMS Experts Panel

IoT-based Systems Challenges

MODERN SYSTEMS 2022

Future Mobility and Transport – What Remains? What is to Come?

Position:

Revolution in mobile IoT devices using Joint Communication, Localisation and Sensing (JCLS)

Reference: pwc & DLR: Digital mobil in Deutschlands Städten, Berlin 2017.

Panellist Position

IoT-based Systems as key Enablers of Sustainable Development

Lorena Parra, Universitat Politecnica de Valencia, Spain loparbo@doctor.upv.es

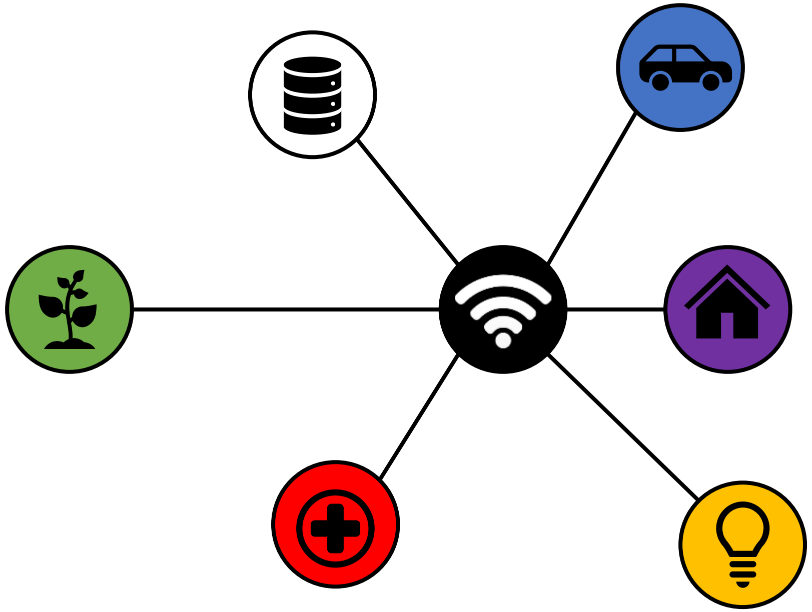
- IoT and data generation
- Necessity of data for sustainable management
- IoT-based systems in cities
- IoT-based systems in rural areas
- Future challenges for reaching a sustainable development based on IoT data

→ Reliability of gathered data

→ Energy consumption of IoT-based systems: Green IoT-based Systems

IoT and data generation

With IoT, almost every single item can generate data, providing thousands of registers every day.



The data can be generated by sensors:

for example, temperature, GPS coordinates.

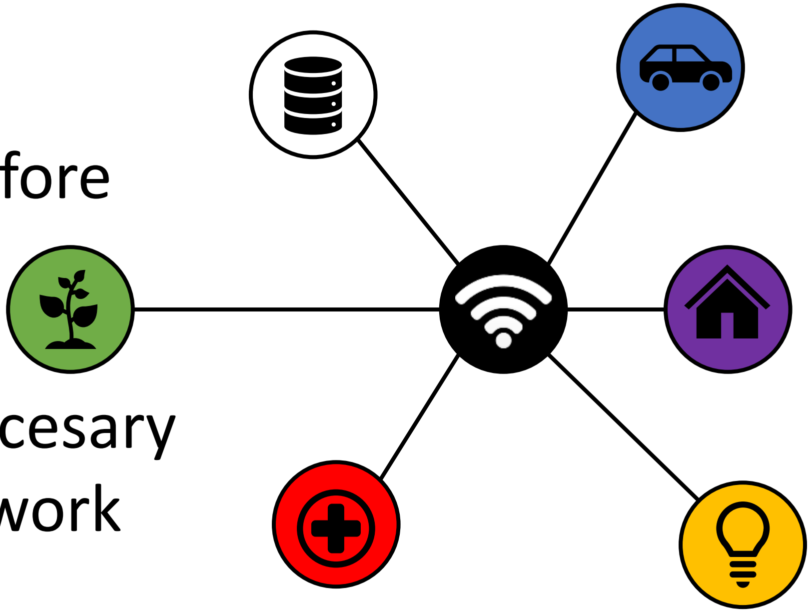
The data can be generated by the use:

for example, bandwidth, remaining energy.

IoT and data generation

With IoT, almost every single item can generate data, providing thousands of registers every day.

The data must be pre-processed, send and stored before they use.
Data gathering must be accurately planned to avoid generating unnecesary data. The generation of unnecesary data impacts on the energy requirements of the network and in its future storage necesities.



Necessity of data for sustainable management

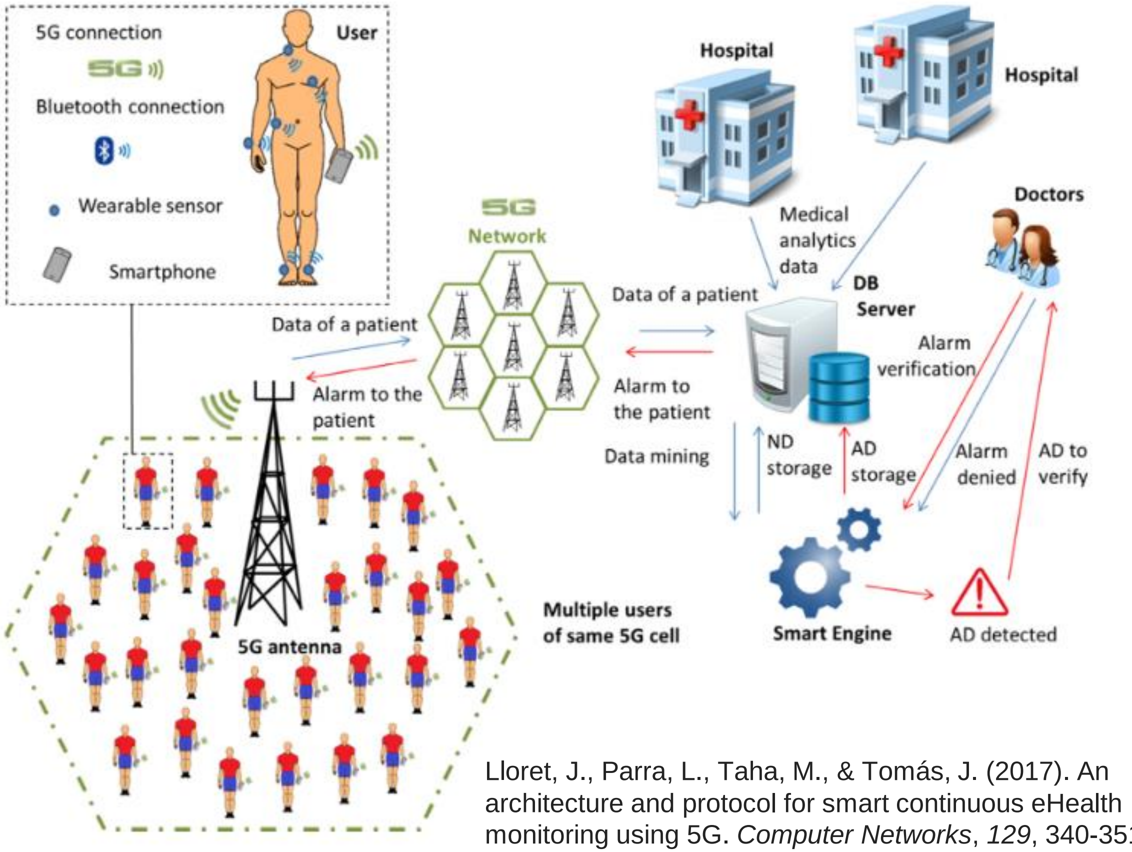
For a sustainable development, real-time (or recent data), historical data, and indicators are necessary.

The IoT systems can be a key element to reach the sustainable development by providing accurate, recent, and reliable data tu nurture the indicators used to measure the SDG.

IoT-based systems in cities

The use of IoT systems for e-health

E-helath can provide access to high quality healthcare especially for communities living in remote areas. It is particularly important for vulnerable people (elderly or disable people and chronic patients).

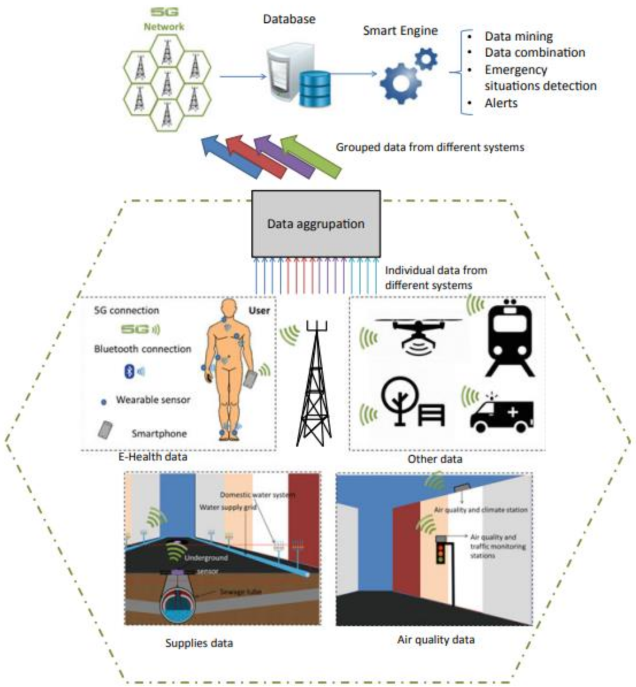


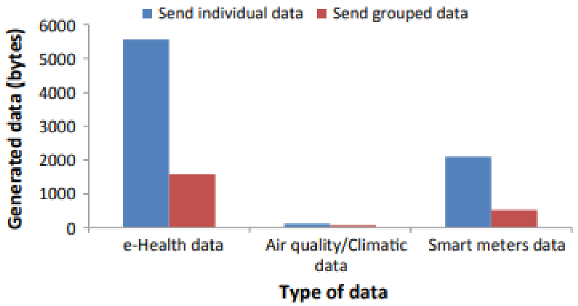
Lloret, J., Parra, L., Taha, M., & Tomás, J. (2017). An architecture and protocol for smart continuous eHealth monitoring using 5G. *Computer Networks*, *129*, 340-351

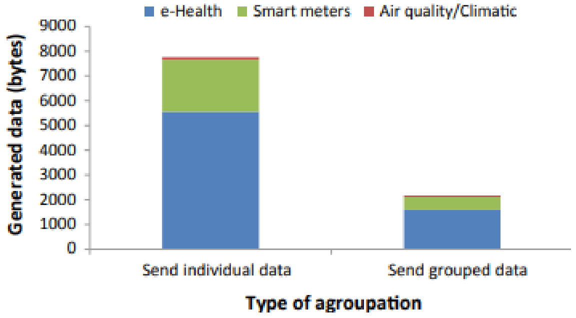
IoT-based systems in cities

The impact of IoT systems
on energy and cities

The IoT systems require form the use of energy. Most of itis used to communicate the data. The smart algorithms can optimize the energy consumption, impacting positively in reducing the use energy in the cities.







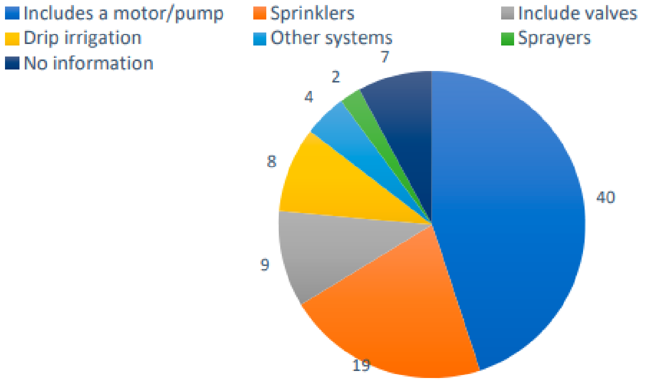
Parra, L., Rocher, J., Sendra, S., & Lloret, J. (2019). An energy-efficient IoT group-based architecture for smart cities. In *Energy Conservation for IoT Devices* (pp. 111-127). Springer, Singapore.

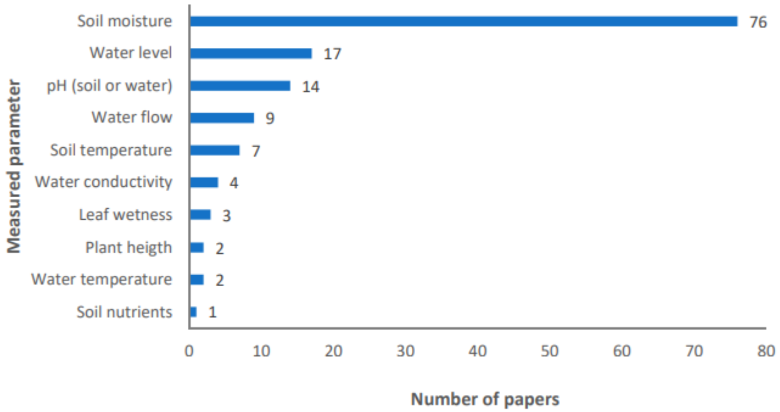
MODERN SYSTEMS Experts Panel
IoT-based Systems Challenges

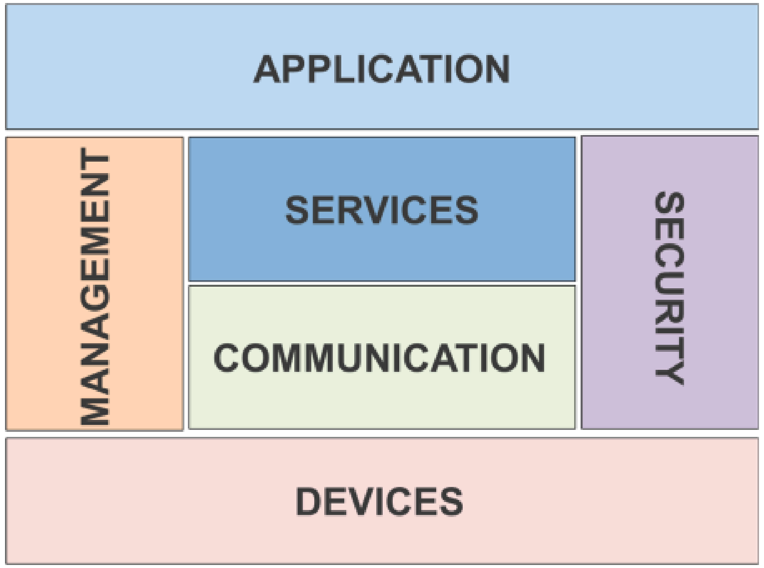
MODERN SYSTEMS 2022

IoT-based systems in rural areas

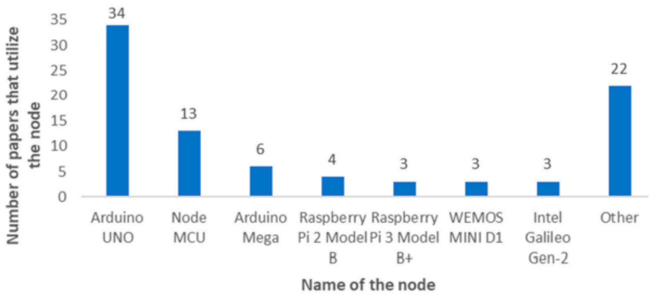
The use of IoT systems for agriculture







Technology	References
Ethernet	[52,62,72,99,117,131,138,139,146,152,164]
GSM	[35,36,44,48,51,57,61,64,72,73,79,85,90–92,103,112,129,153,157,185–189]
Wi-Fi	[28,34,41,43,46,47,50–53,56,59,60,64–66,69–71,77,82,84,88,94,95,111,112,116,117,119,120,123, 125–129,132,134,135,139,143,151–154,156–158,160,163,165,166,168,169,173,182,187,190–194]
ZigBee	[5,32,39,42,63,65–67,93,119–123,128,133,137,144,151,157,175,185,191]
Bluetooth	[46,53,81,118,129,132,134,156,174,181,195,196]
LoRa	[14,31,78,95,142,144,145,149,157,196,197]
GPRS	[44,45,67,73,79,98,101,122,137,157,161,171,179,186,190]
MQTT	[47,75,86,113,114,160,175,176]
4G	[14,45,78,138,141,145,152]
6LoWPAN	[75,147]
IEEE 802.15.4	[73,102]



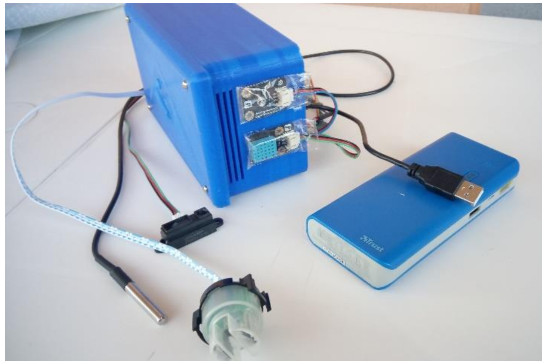
García, L., Parra, L., Jimenez, J. M., Lloret, J., & Lorenz, P. (2020). IoT-based smart irrigation systems: An overview on the recent trends on sensors and IoT systems for irrigation in precision agriculture. *Sensors*, *20*(4), 1042.

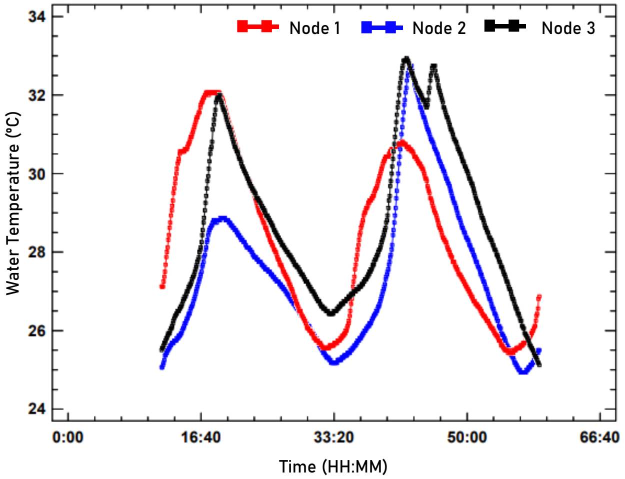
IoT-based systems in rural areas

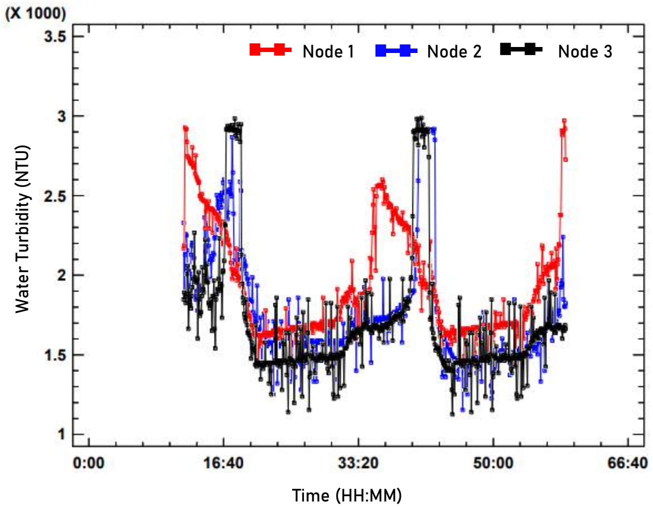
14 LIFE BELOW WATER

CONSERVE AND SUSTAINABLY USE THE OCEANS, SEA AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

The use of IoT systems for oceans







S. Sendra, L. Parra, J. M. Jimenez, L. Garcia, and J. Lloret. LoRa-based Network for Water Quality Monitoring in Coastal Areas. Mobile Networks and Applications, (2022). https://doi.org/10.1007/s11036-022-01994-8

Future challenges for reaching a sustainable development based on IoT data

- Generate, manage, and store data from different variables.
- Increase the acceptability and trustability of public and private institutions in IoT data to maximize sustainable development.
- The high cost of sensors and IoT systems might be a limiting factor.

OPEN
DISCUSSION