NEXT GENERATION IoT DEVICES BASED ON RISC-V ARCHITECTURE

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Next Generation IoT Devices based on RISC-V
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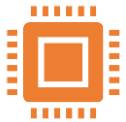

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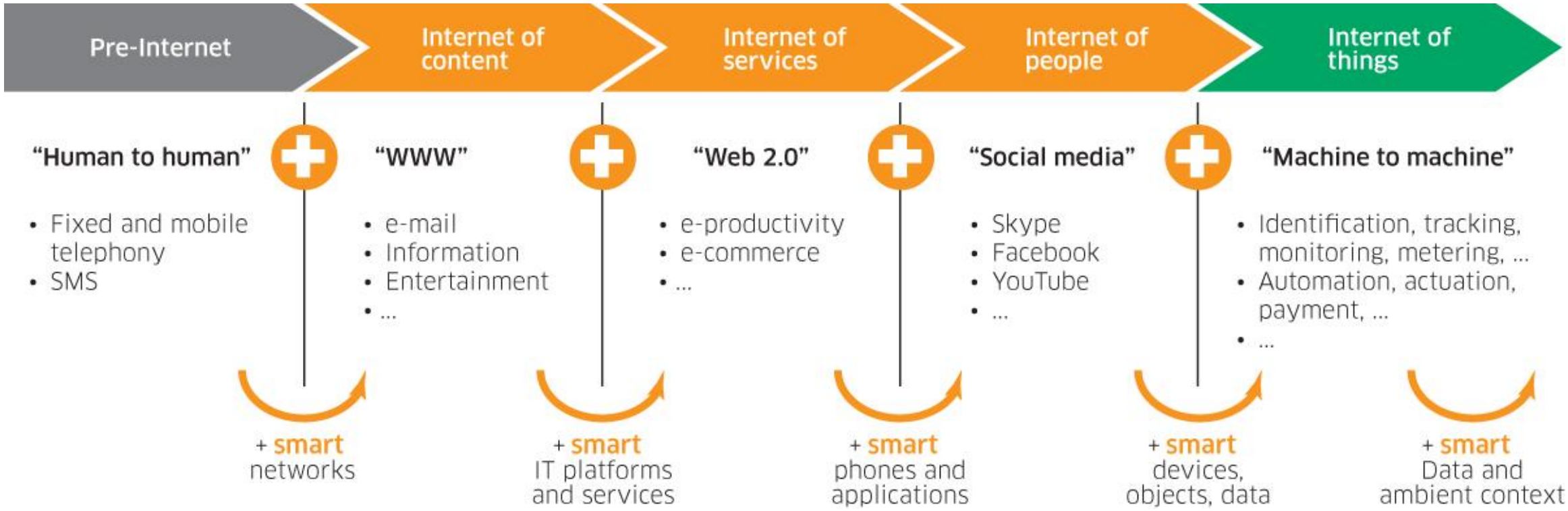
1 – GROUND & STATISTICS

Ground & Statistics
internet evolution



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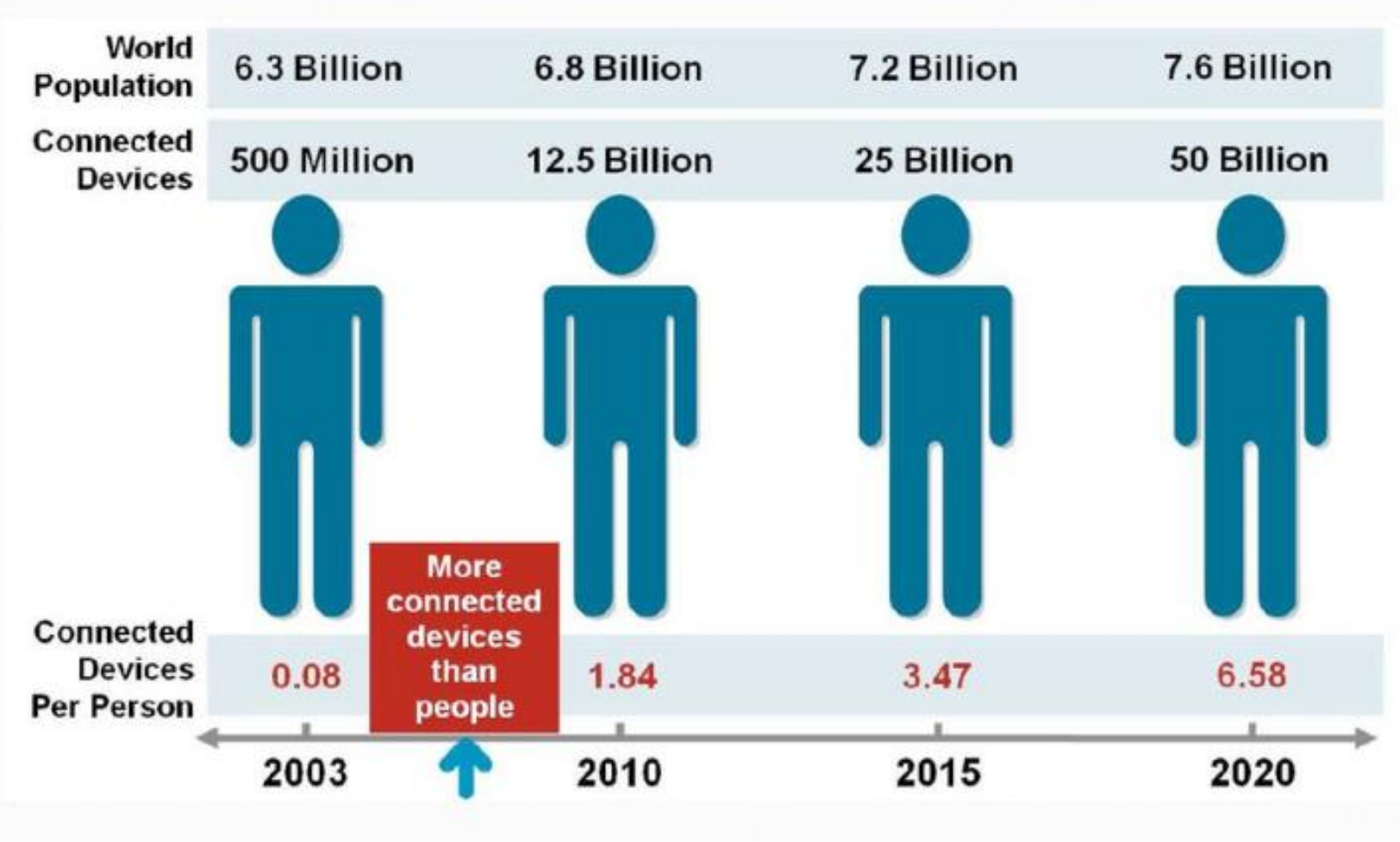
Ground & Statistics
iot devices installed

Source: IBM

Source: Statista

Ground & Statistics
iot devices vs. population



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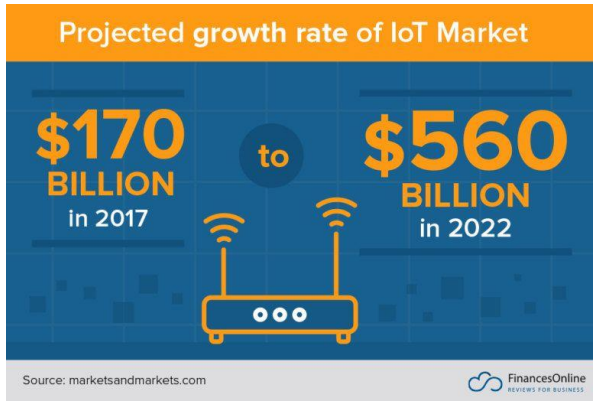
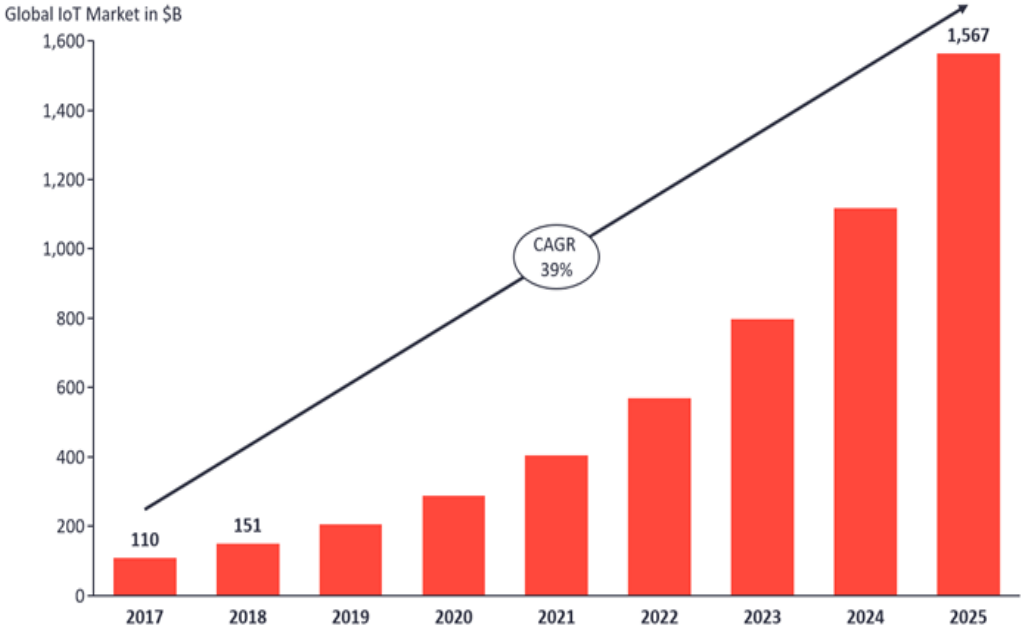
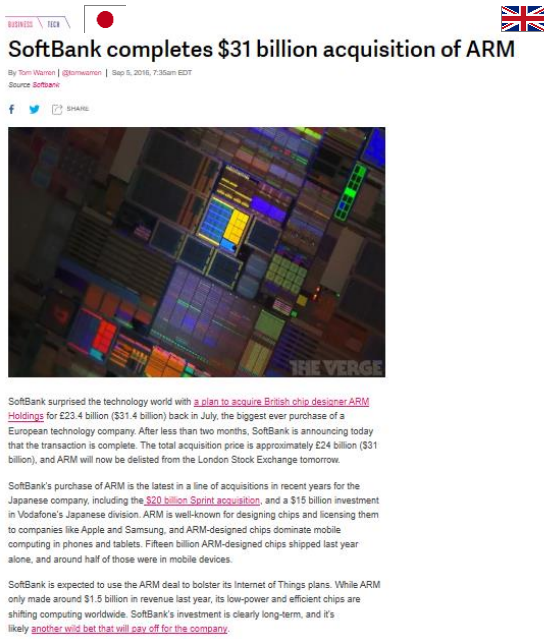
Ground & Statistics
iot market





Source: IoT Analytics Research


SoftBank completes $31 billion acquisition of ARM

By Tom Warren | @tomwarren | Sep 5, 2016, 7:35am EDT

Source Softbank

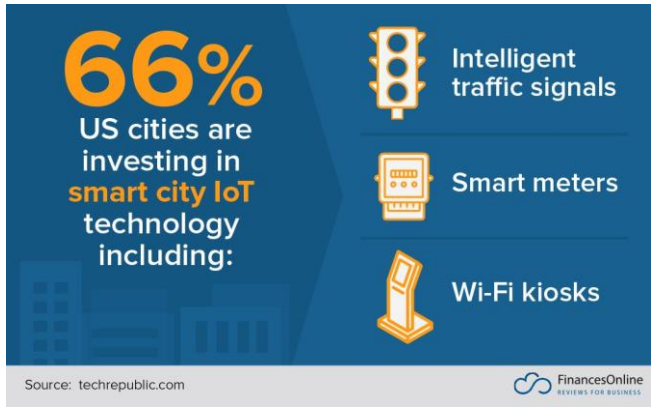
SHARE

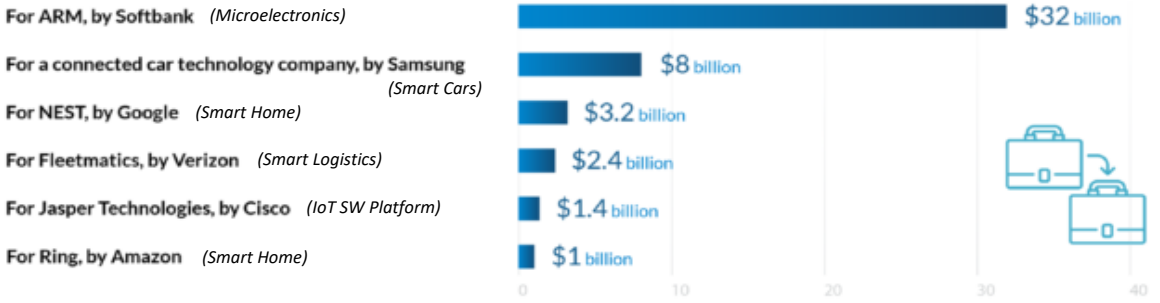
SoftBank surprised the technology world with a plan to acquire British chip designer ARM Holdings for £23.4 billion ($31.4 billion) back in July, the biggest ever purchase of a European technology company. After less than two months, SoftBank is announcing today that the transaction is complete. The total acquisition price is approximately £24 billion ($31 billion), and ARM will now be delisted from the London Stock Exchange tomorrow.

SoftBank's purchase of ARM is the latest in a line of acquisitions in recent years for the Japanese company, including the $20 billion Sprint acquisition, and a $15 billion investment in Vodafone's Japanese division. ARM is well-known for designing chips and licensing them to companies like Apple and Samsung, and ARM-designed chips dominate mobile computing in phones and tablets. Fifteen billion ARM-designed chips shipped last year alone, and around half of those were in mobile devices.

SoftBank is expected to use the ARM deal to bolster its Internet of Things plans. While ARM only made around $1.5 billion in revenue last year, its low-power and efficient chips are shifting computing worldwide. SoftBank's investment is clearly long-term, and it's likely another wild bet that will pay off for the company.

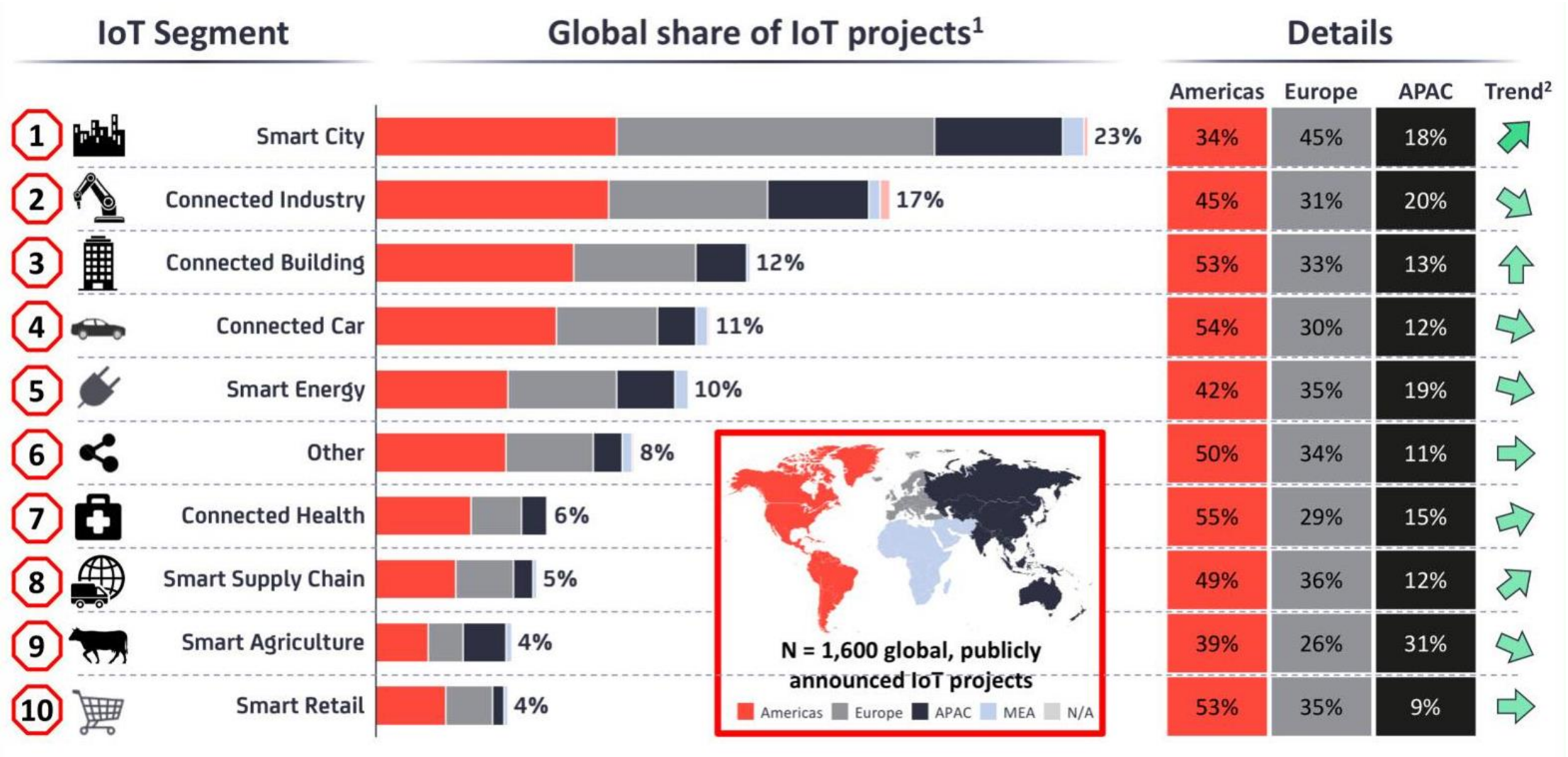
Source: The Verge





Source: SDxCentral, CRN, VCCircle, IoT World Today, Adweek, FinancesOnline

Ground & Statistics
iot applications



Source: IoT Analytics Research

2 – THE COMPANY

The Company purpose

About nvision

- R&D company in IoT founded in 2006 by three entrepreneurs with more than 20 years of experience in multinational companies
- Spin-off company focused on Smart Home and Smart Energy

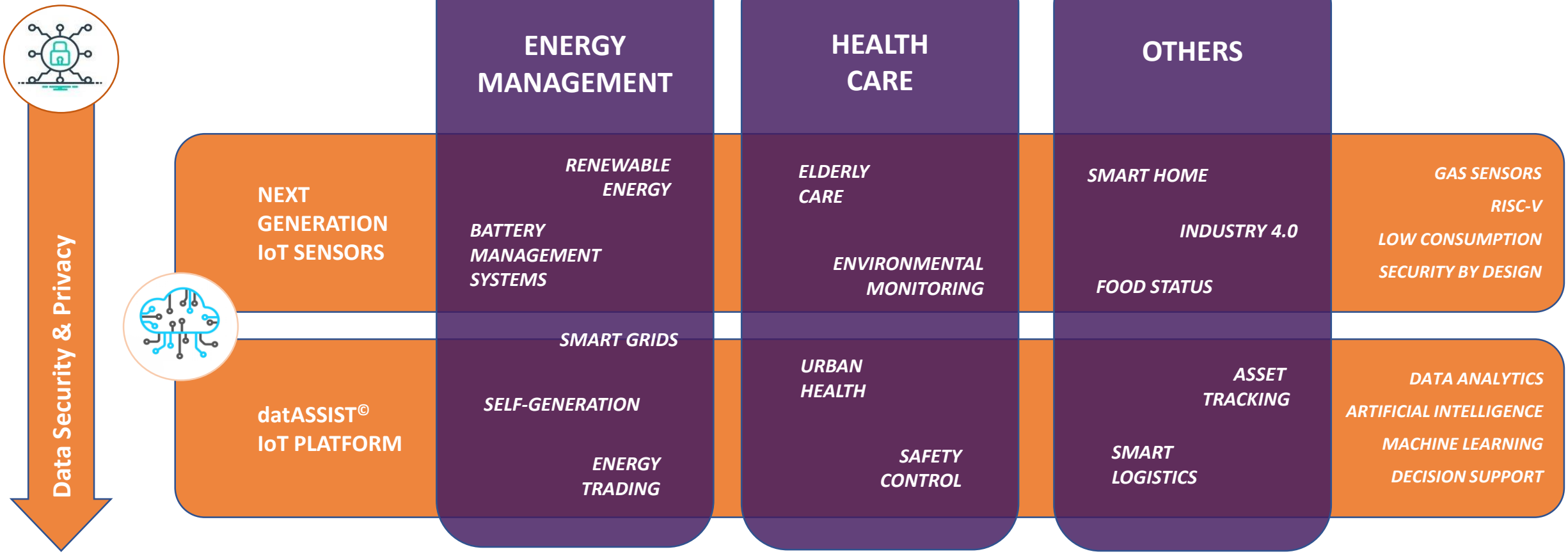
Our mission

Help service providers through a B2B model to launch new services based on innovative business models and combining IoT, Artificial Intelligence, Machine Learning , Decision Support Systems, Data Analytics and Data Privacy & Security among other technologies

What we do

- Develop and operate datAssist©, our “end-to-end” IoT Software Platform
- We work for the Next-Generation IoT Sensors
- We build vertical solutions in areas such as Energy Management and Health Care

The Company
what we do



The Company
R&D interests

Renewable Energy Management and Next Generation Batteries

Research on IoT around Renewable Energy and Batteries management systems, helping to foster new products, services and business models in an evolving and demanding scenario

Applications:

Battery Management Systems
Self-Generation
Smart Grids
SW Services for Energy Trading

Data Analytics for Gas Sensors

Research on Data Analytics and Artificial Intelligence using innovative gas-sensor technologies that bring benefits such as smarter, smaller, more reliable and portable devices that can be applied in different areas and scenarios

Applications:

Air Quality Measurement
Industrial Safety/Process Quality
Elderly Care
Food Status Control

Next Generation IoT Sensors

Develop and advance towards an IoT ecosystem based on open HW/SW strategies based on the RISC-V architecture

Technologies:

Microprocessors
Low Power Consumption
Energy Harvesting
Microbatteries & Supercapacitors
Long-Range Communications
Data Security by Design
Edge and Distributed Computing

Data Security & Privacy in IoT

We work on Cybersecurity at all levels (SW+HW) to overcome the intrinsic insecurity in IoT devices and the Internet, and therefore helping to build a trustable IoT

Technologies:

Cryptography
Authentication & Authorization
Secure Communications
Secure Data Collection & Storage
Security by Design
Blockchain/DLT Architectures

The Company background

Internet of Things (IoT)

IoT Platform, Wireless Sensors, Cloud Computing, Big Data, Data Mining, Artificial Intelligence, Machine Learning, Smart Home, Smart Energy, Secure Societies, Smart Health, Data Security & Privacy

INNCORPORA, TLA, SUPER, nassist, AMOT, preMiA, symbIoTe, INVISUM

Energy Management

Smart Home, Smart Energy, Smart Grid & Microgrids, Energy Services, Energy Trading, Supply & Demand Management

IoT, Predictive Modelling, Machine Learning, Optimization Strategies, Demand Response

ME3gas, GreenCom, SCANERGY, iURBAN, INTUO

Health Care & Wellbeing

Health Monitoring, Ambient Assistive Living, Tracking of Daily Activities, Improvement of Health-Related Quality of Life

IoT, Signal Processing, Graphene Sensors, Data Mining, Predictive Modelling, Artificial Intelligence, Machine Learning

ARMOR, REWARD, RADIO, GRAPHENE FLAGSHIP CORE ONE

Environmental Monitoring

Air Quality Monitoring, Citizens Assessment of Environmental Quality, Children Pollution Exposure, Disease Risk Prediction

IoT, Observatory Web Portal, Graphene Sensors, Predictive Modelling

CITI-SENSE, HELIX, GRASS

The Company
on-going projects

CUBER

All-Copper
Redox Flow Battery

HORIZON 2020

Validation of an all-copper redox flow battery used as a back-up power system in isolated locations and for energy management and grid balancing in renewable power production

EDGE

ADL Monitoring of Elders in Homes using Gas Sensors

SMEs PHDs H2020 SME Innovation Associate

Research on Data Analytics for elderly ADL (Activities of Daily Living) monitoring in homes and applying gas sensors

RISC-V

Microprocessor with a RISC-V Architecture optimized for a Trustable IoT

DOCTORATS INDUSTRIALS

Development of a RISC-V ISA-based microprocessor optimized for IoT, making use of long-range communications and low-consumption technologies, as well as data security & privacy by design

In the pipeline…

BEST
Battery Enhanced Sensing Technologies
HORIZON 2020

PV-AWAKE
Advanced Monitorization of Photovoltaic Plants
HORIZON 2020

URBANSALUT
Citizens' Health due to Environment Exposure
HORIZON 2020

OWL
ADL Monitoring of Elders in Homes using Home Wifi

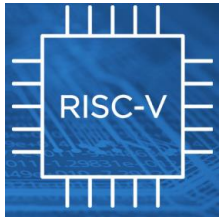
2EMERGE
Design of Graphene-based Gas Sensors for the IoT

3 – RISC-V PROJECT(s)

Industrial PhD thesis (NVISION-CNM)

OPEN RISC-V MICROPROCESSOR ARCHITECTURE OPTIMIZED FOR LOW-POWER AND TRUSTABLE IoT

- Adapt the IoT datAssist platform to standard RISC-V ISA.
- Development of a RISC-V core optimized for IoT applications (spec. telecare systems).



- Most of µP developments based on RISC-V ISA are focused on optimizing the design for **high-performance** computing.
- The case of the IoT requires **simpler**, **cheaper** and more **optimized** architectures.

Industrial PhD thesis (NVISION-CNM)

OPEN RISC-V MICROPROCESSOR ARCHITECTURE OPTIMIZED FOR LOW-POWER AND TRUSTABLE IoT

- The final objective will be the implementation of a robust, low-cost and low-power RISC-V microprocessor version.

<u>REQUIREMENTS:</u>

- In-depth study on the minimum needs in terms of hardware resources.
- Implementation of low-power design strategies and the exploration of technology dependent techniques.

Industrial PhD thesis (NVISION-CNM)

OPEN RISC-V MICROPROCESSOR ARCHITECTURE OPTIMIZED FOR LOW-POWER AND TRUSTABLE IoT

- **Low-cost** → reduce core area
  - 32 bits architecture
  - Fixed-point representation (avoid floating-point representation, use of dynamic fixed-point if required)
  - Single cycle[1] or multiple cycle processor
  - Non-pipelined processor

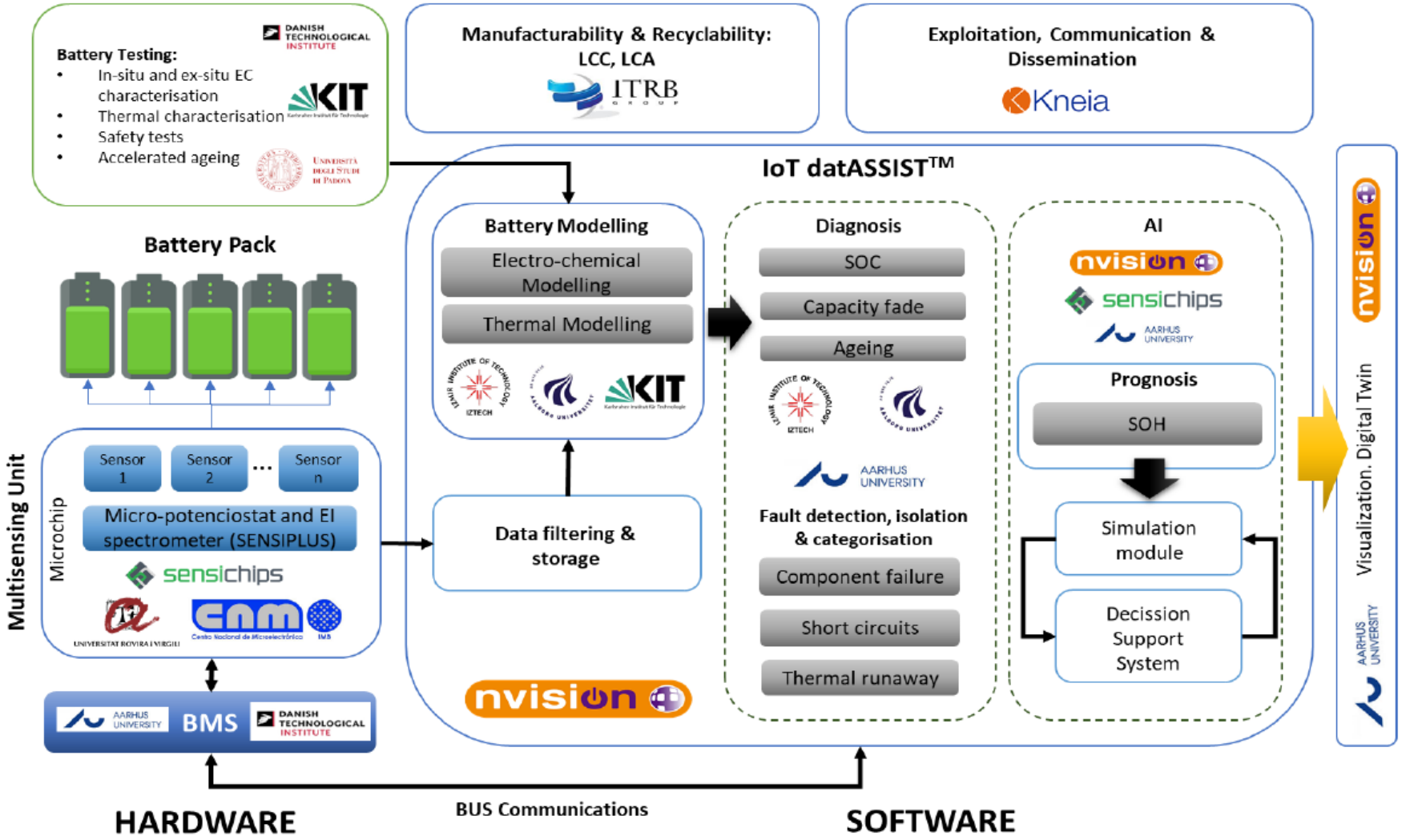
[1] "Single cycle RISC-V micro architecture processor and its FPGA prototype", D.Dennis *et al*, 2017 7th International Symposium on Embedded Computing and System Design (ISED) → Op. freq: **32 MHz**, power = **8 mW**

- **Low power techniques**
  - Clock-gating function
  - Multi-V_{th} (use of multi-threshold voltage gates)
  - DVFS (Dynamic Voltage and Frequency Scaling)

RISC-V Project(s)
more upcoming projects

Project **BEST**
"Battery Enhanced Sensing Technologies"

Development of technologies and procedures to allow a continuous monitoring and health management of large battery modules for Electric Vehicles in order to improve their performance during operation while guaranteeing appropriate safety and extended lifetime

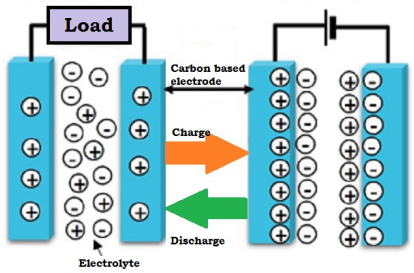


4 – NEXT-GENERATION CHALLENGES

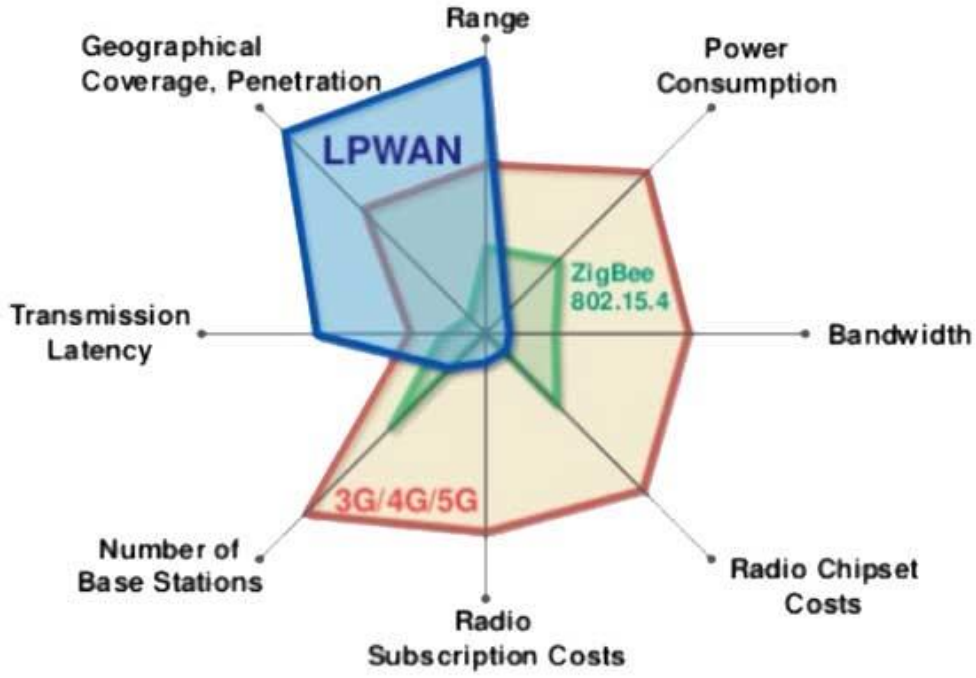
Next Generation IoT Devices
basic iot requirements

- Constrained resources:
  - Simple, cheap, optimized

- Low-power consumption:
  - Energy harvesting
  - Micro-batteries
  - Supercapacitors

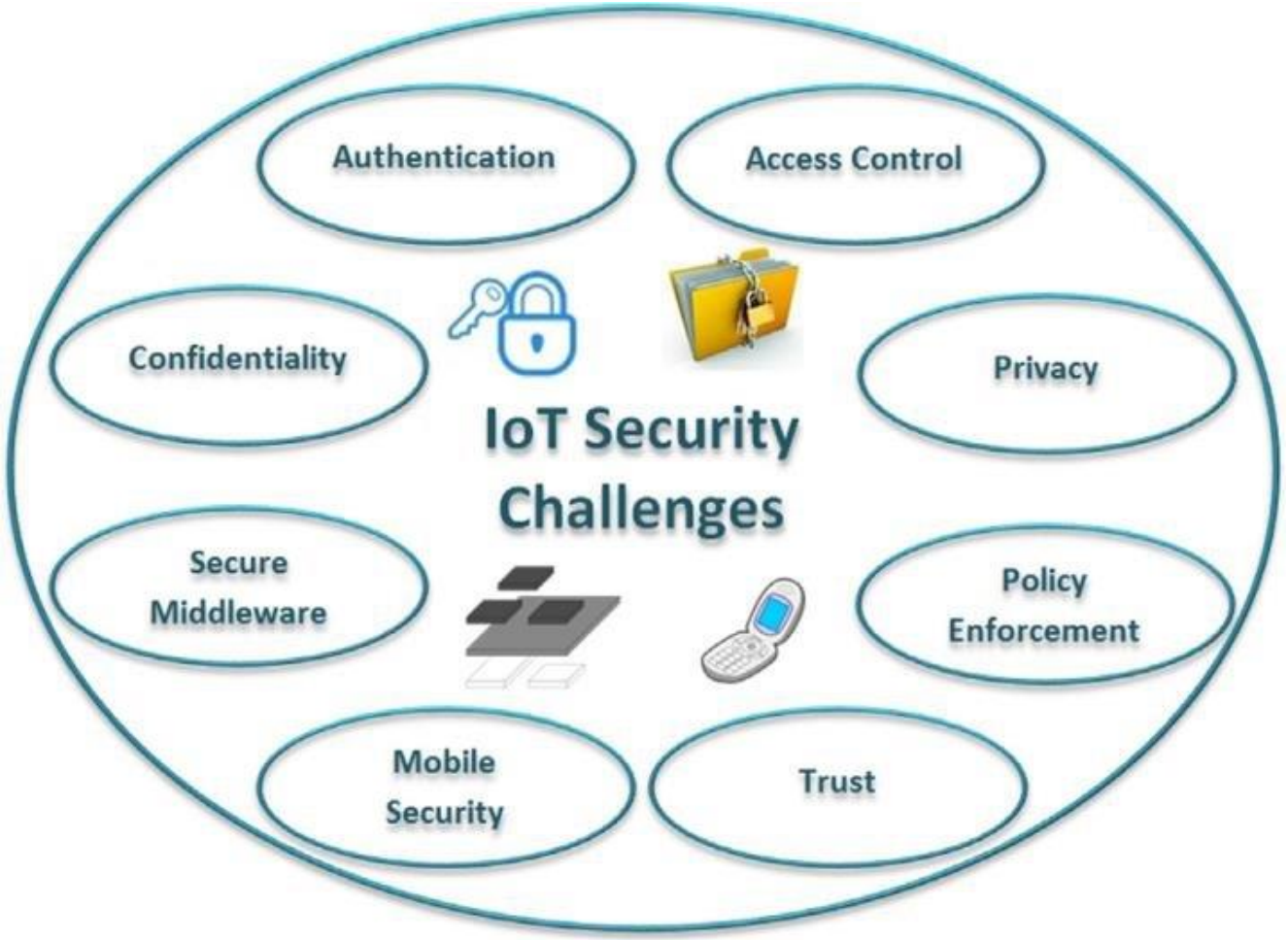


- Communications:
  - LPWAN (low power communications)
    - LORA, Weightless, NB-IoT…
  - 5G



Next Generation IoT Devices
data security & privacy

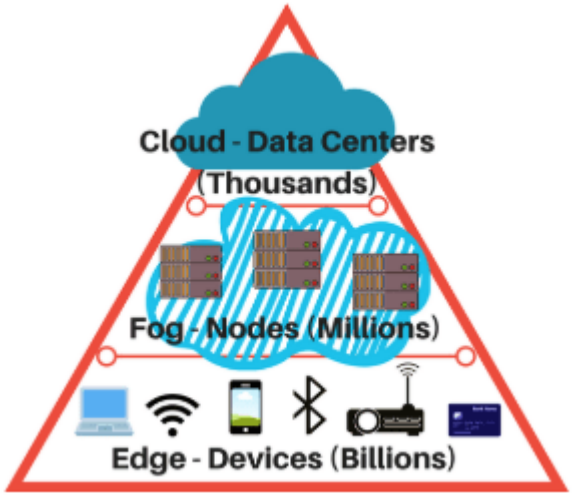
- End-user trust
- Cryptography
- Authentication & Authorization
- Secure Communications
- Secure Data Collection & Storage
- Security by Design
- Blockchain/DLT Architectures



Next Generation IoT Devices
computing challenges

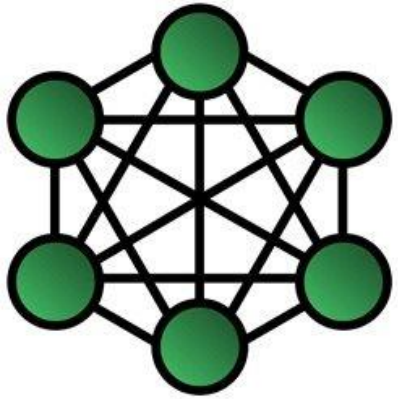
EDGE COMPUTING

- Edge vs. Cloud/Fog computing
- Data streaming and filtering and at the edge
- Real-time analytics at the edge



"An edge-processing system can respond in a few milliseconds, compared with a cloud system, which could take more than 100 milliseconds"

COLLABORATION



- **Distributed and parallel computing** among IoT devices
- **Resource sharing**: computing, networking, data storage
- **Opportunistic computing**

Next Generation IoT Devices
organizational challenges

ROBUSTNESS

- **Decentralized** instead of centralized topologies
- **Dynamic configuration** and reconfiguration upon failures

FLEXIBILITY

- Interoperability and compatibility of devices
- Data standardization or format combination

SELF-SUFFICIENCY

- **Self-configuration** upon connection
- **Autonomous IoT**:
  - Devices consuming information and taking decisions
  - Devices self-coordinating for problem solving
- **Self-aware** and **Self-adaptive** devices:

  IoT devices learning and adapting to a changing reality
- **Distributed Artificial Intelligence/Machine Learning**:
  - Devices collaborating for distributed problem solving
  - Devices incorporating AI/ML for autonomous problem solving

Next Generation IoT Devices
some pplication challenges

- Tactile Internet
- Contextual Internet
- Human-centric sensing/actuating
- Modelling of human behaviour (human in the loop)
- Augmented reality
- Data sharing and monetization
- Contractual arrangements