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Sciences et Technologies

UNIDIR - 2019 Innovation Dialogue

Digital Innovations for International Security and Disarmament

Internet of Things *Shelf Life Continuous monitoring*

Dr. Quentin Ladetto - quentin.ladetto@armasuisse.ch





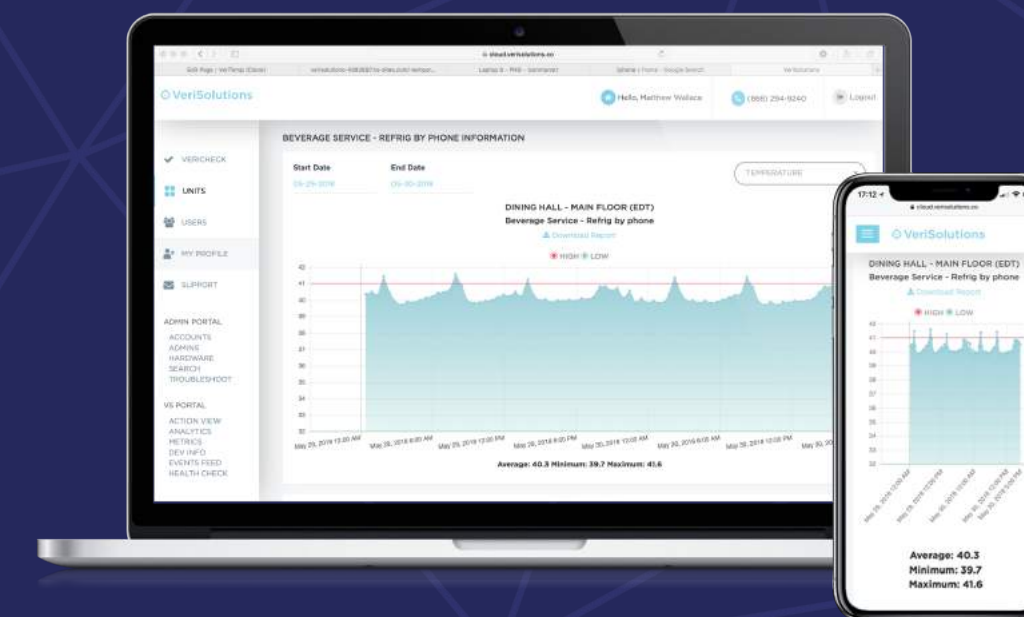
Internet of Things (IoT)



Sensor



Gateway



Server



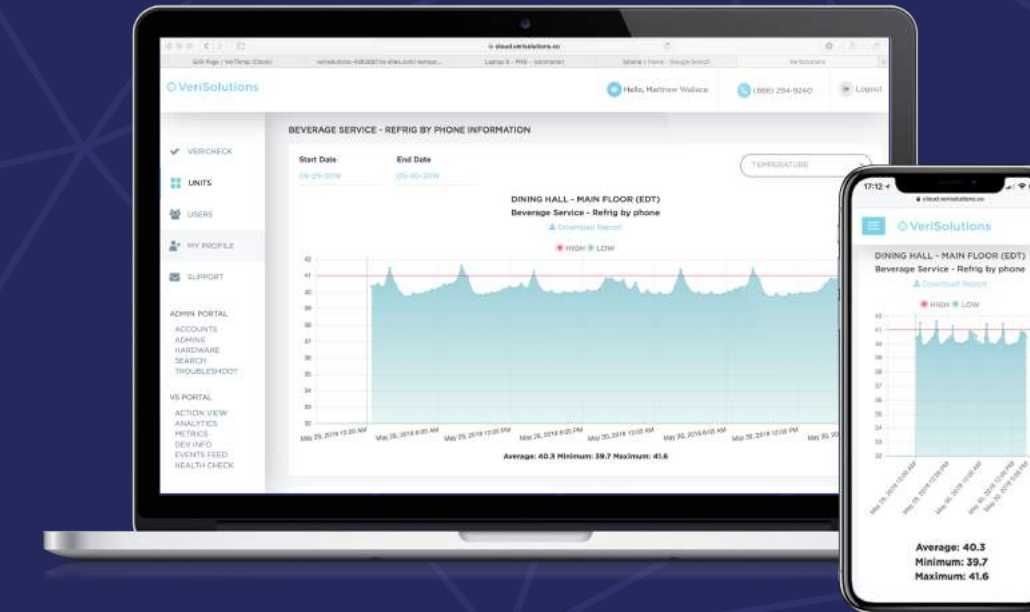
Internet of Things (IoT)



Sensor



Gateway



Server

Yesterday

Sense

Transfer

Store
Analyse
Decide
Act



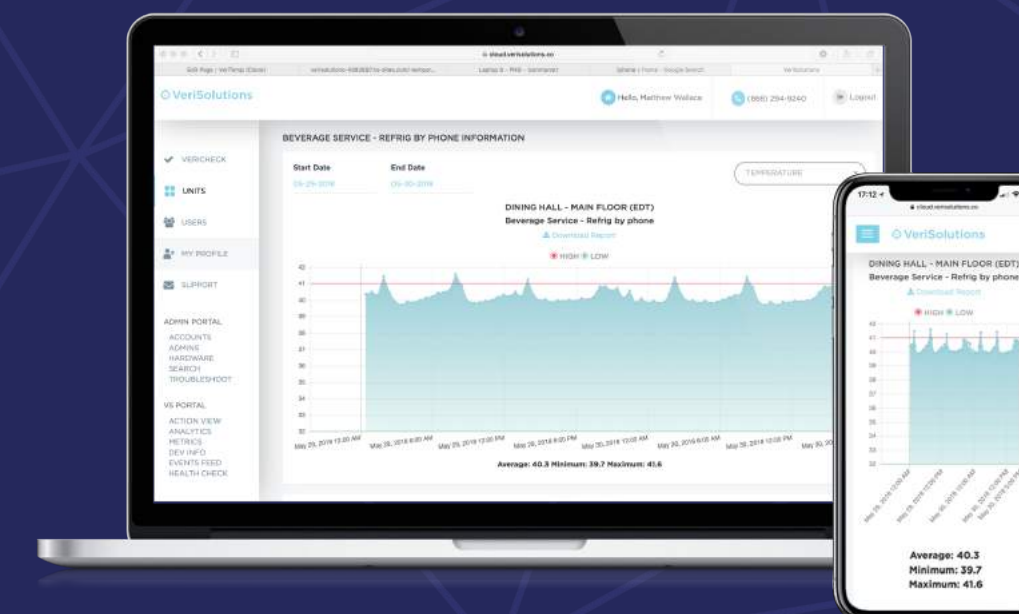
Internet of Things (IoT)



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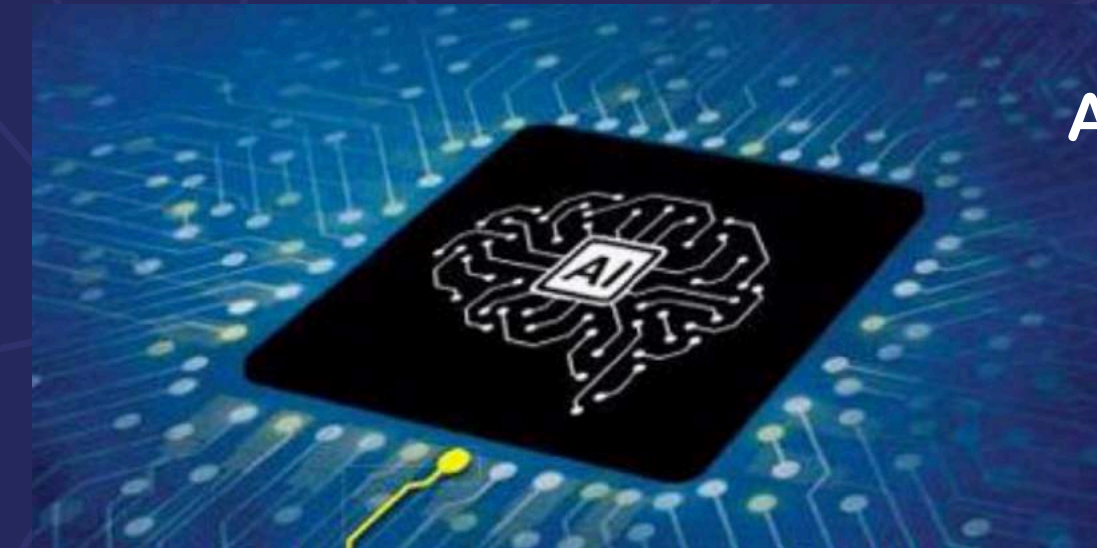
Trend



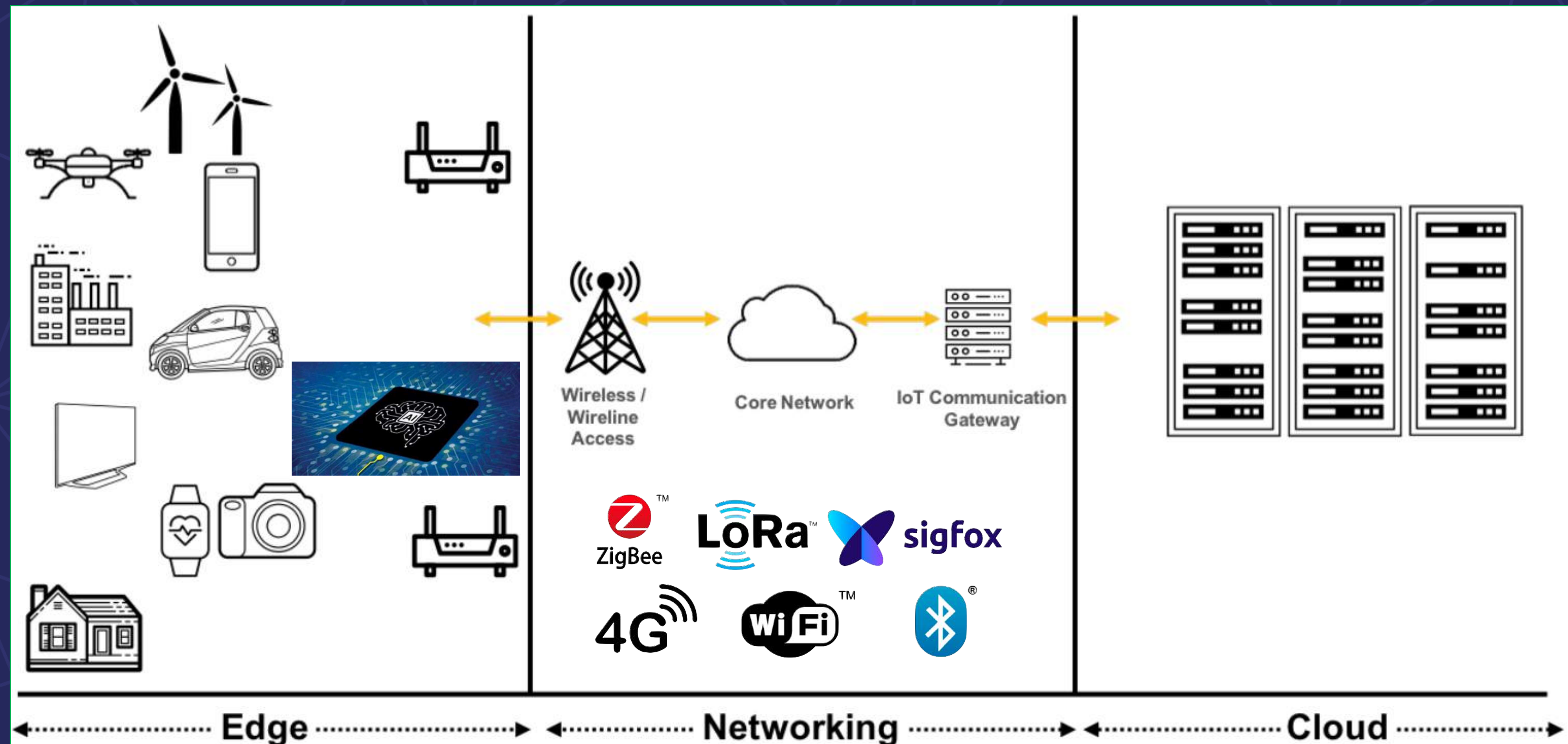
Towards Edge computing

Sense
Analyse
Decide
Act

+ AI



AI on a
chip



Accelerating Implementation of Low Power Artificial Intelligence at the Edge, A Lattice Semiconductor White Paper, November 2018
<http://www.latticesemi.com>



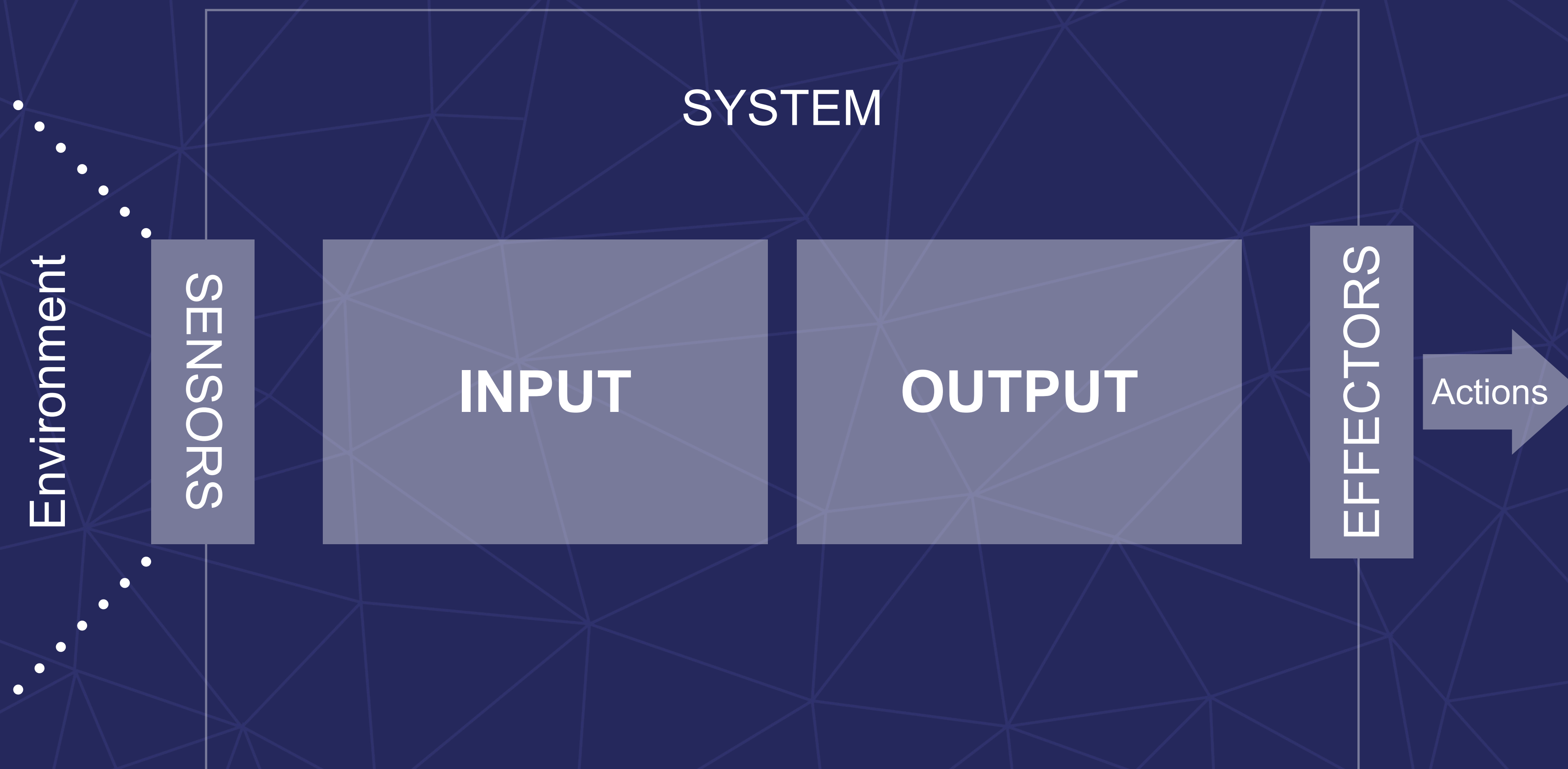
OODA

loop

on a chip



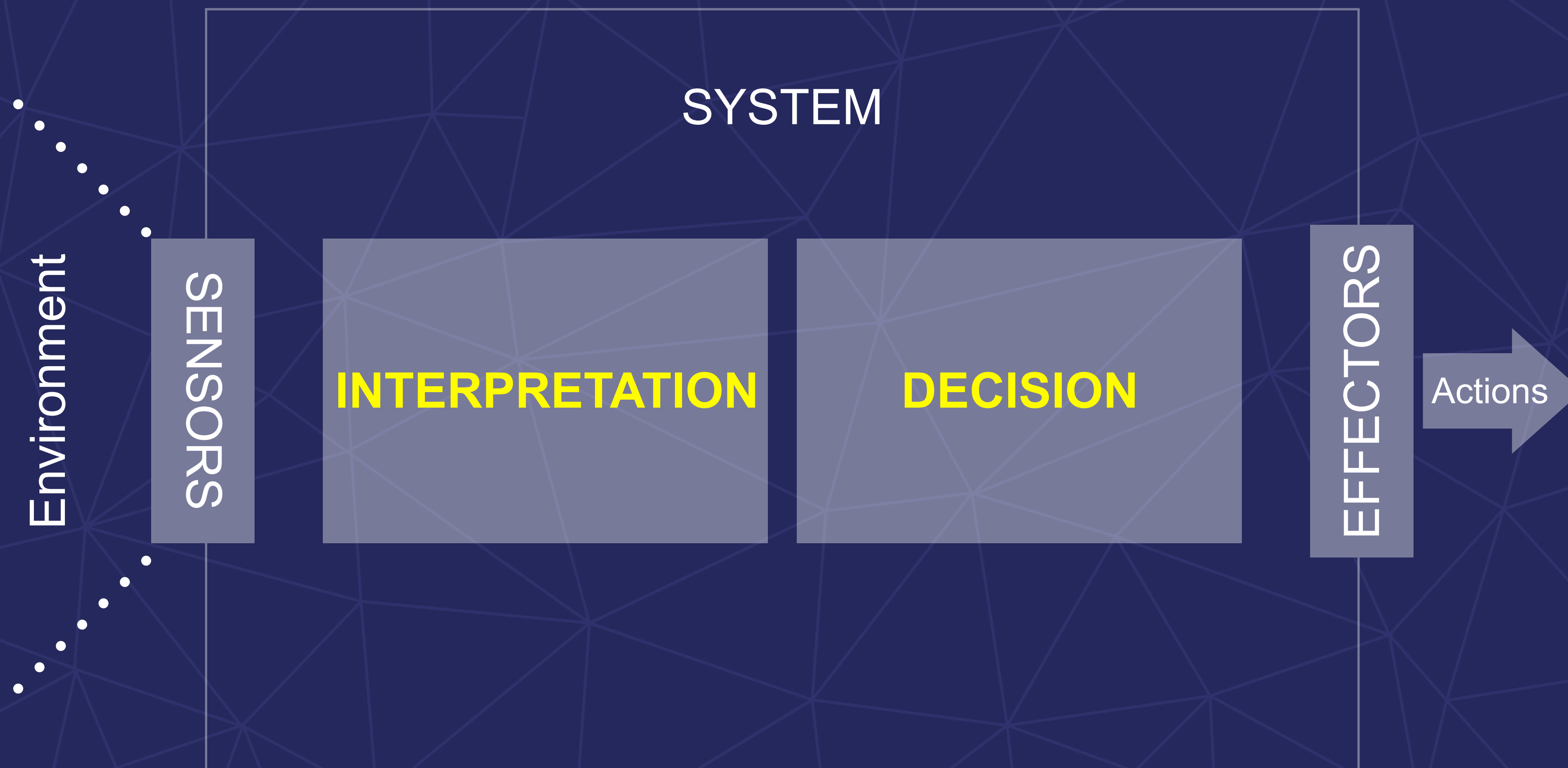
It cannot be... a Black Box



Source: inspired by Agnès DELABORDE, Laboratoire national de métrologie et d'essais (LNE)



It has to be... a White Box



Source: inspired by Agnès DELABORDE, Laboratoire national de métrologie et d'essais (LNE)



Internet of Things in Logistics

- Vehicle diagnosis : optimisation of maintenance
- Delivery management : optimisation of the route
- Legal compliance : location, speed, driving time
- Temperature of cargo : Protection of sensitive goods
- Geofencing and theft prevention

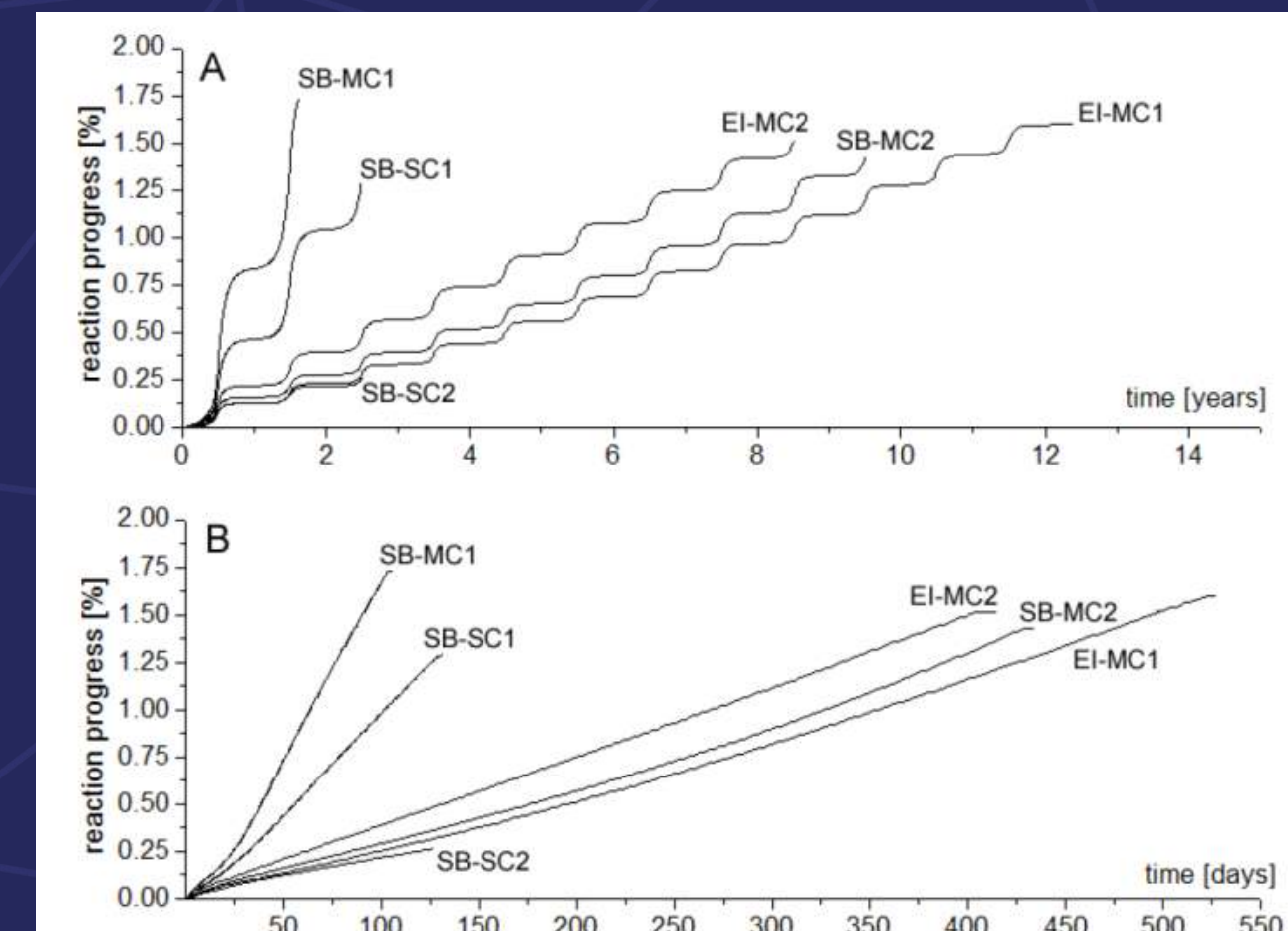
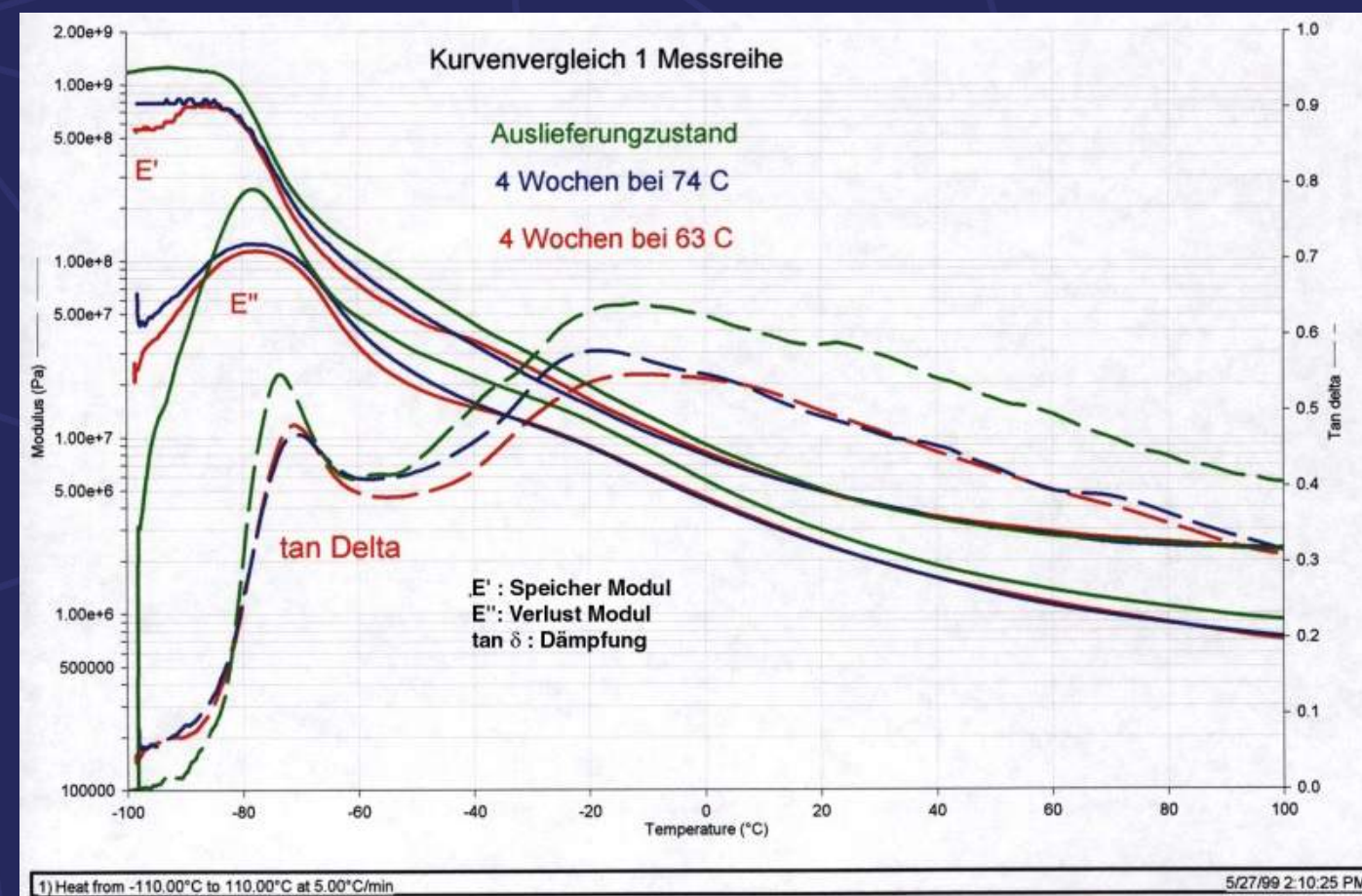




IoT in Ammunition Surveillance

Tracking the environmental conditions allows accurate life-cycle diagnostics

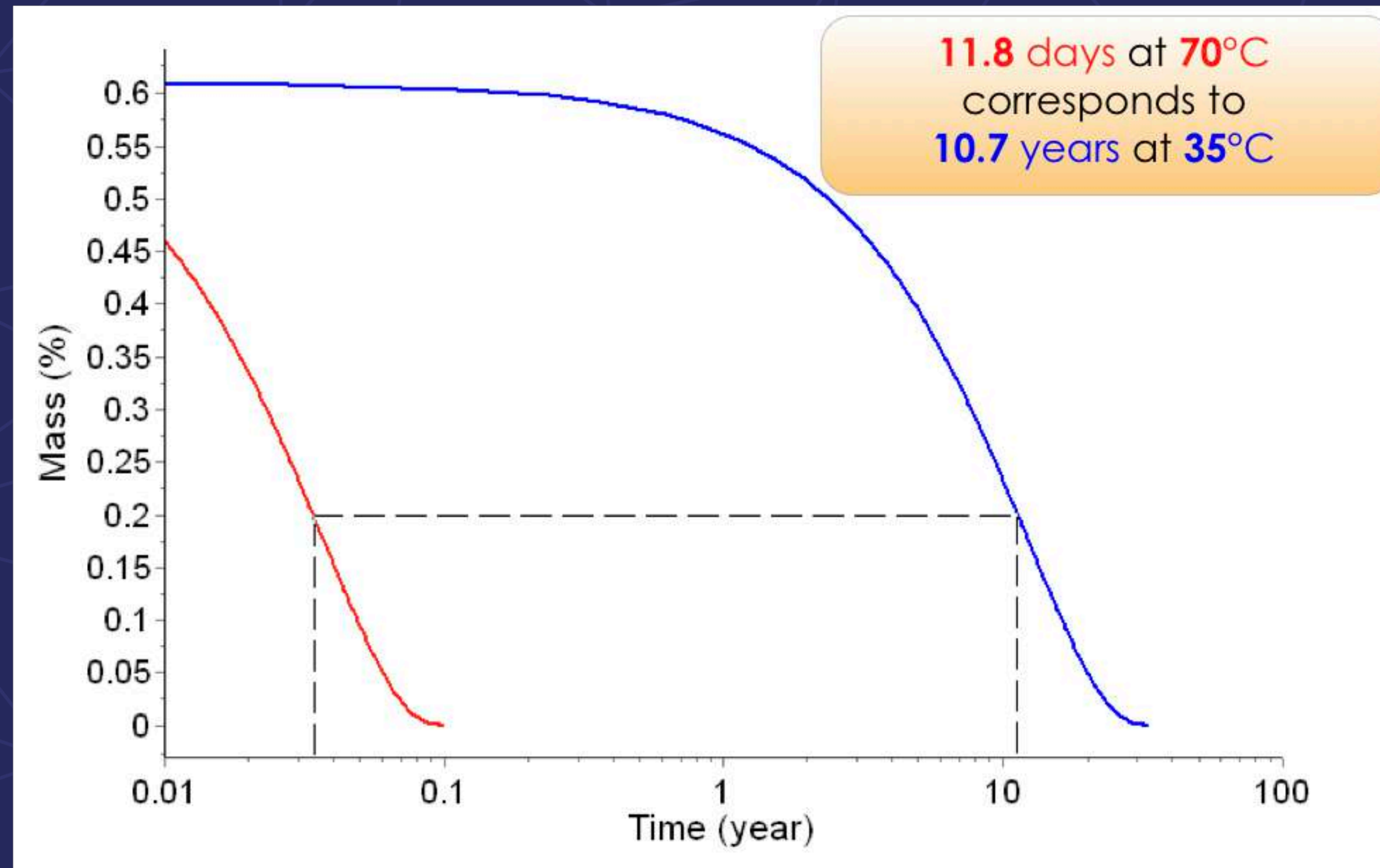
Vibration, Temperature, Humidity





Get the Shelf Life Right!

Simulated change of the stabiliser content at different temperatures
(How long can you store ammunition at a given temperature?)

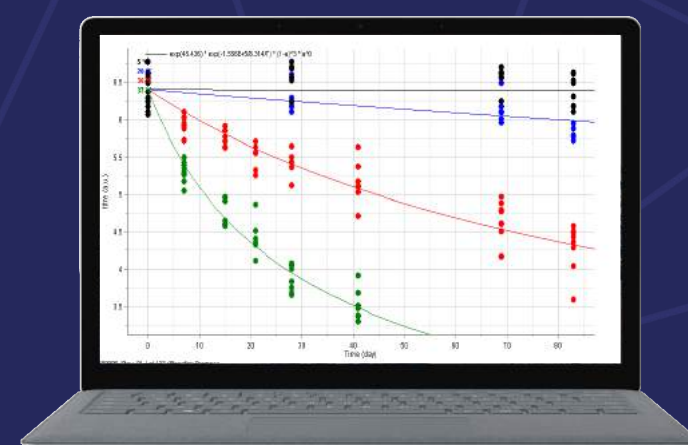




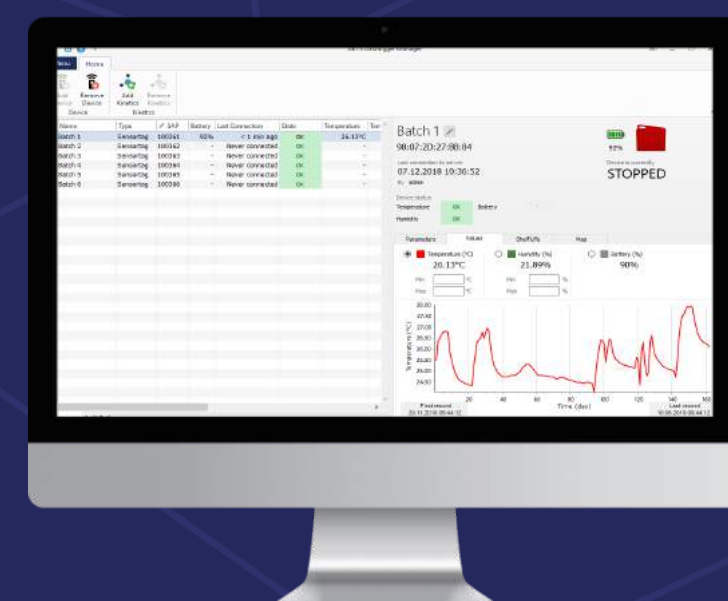
Guarantee the Shelf Lives of Materials

Monitor in real time the **deterioration progress** of a material which is **placed thousands km away**.

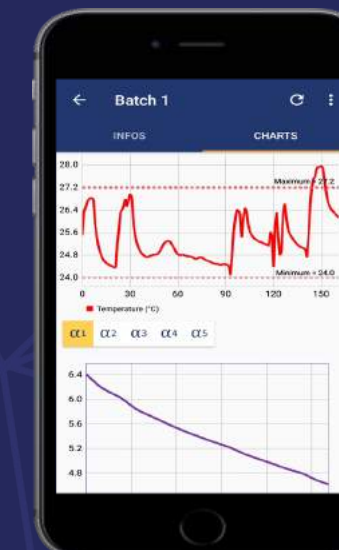
Temperature storage might not be constant!



AKTS
Thermokinetics
Software



AKTS
Datalogger Manager
Software



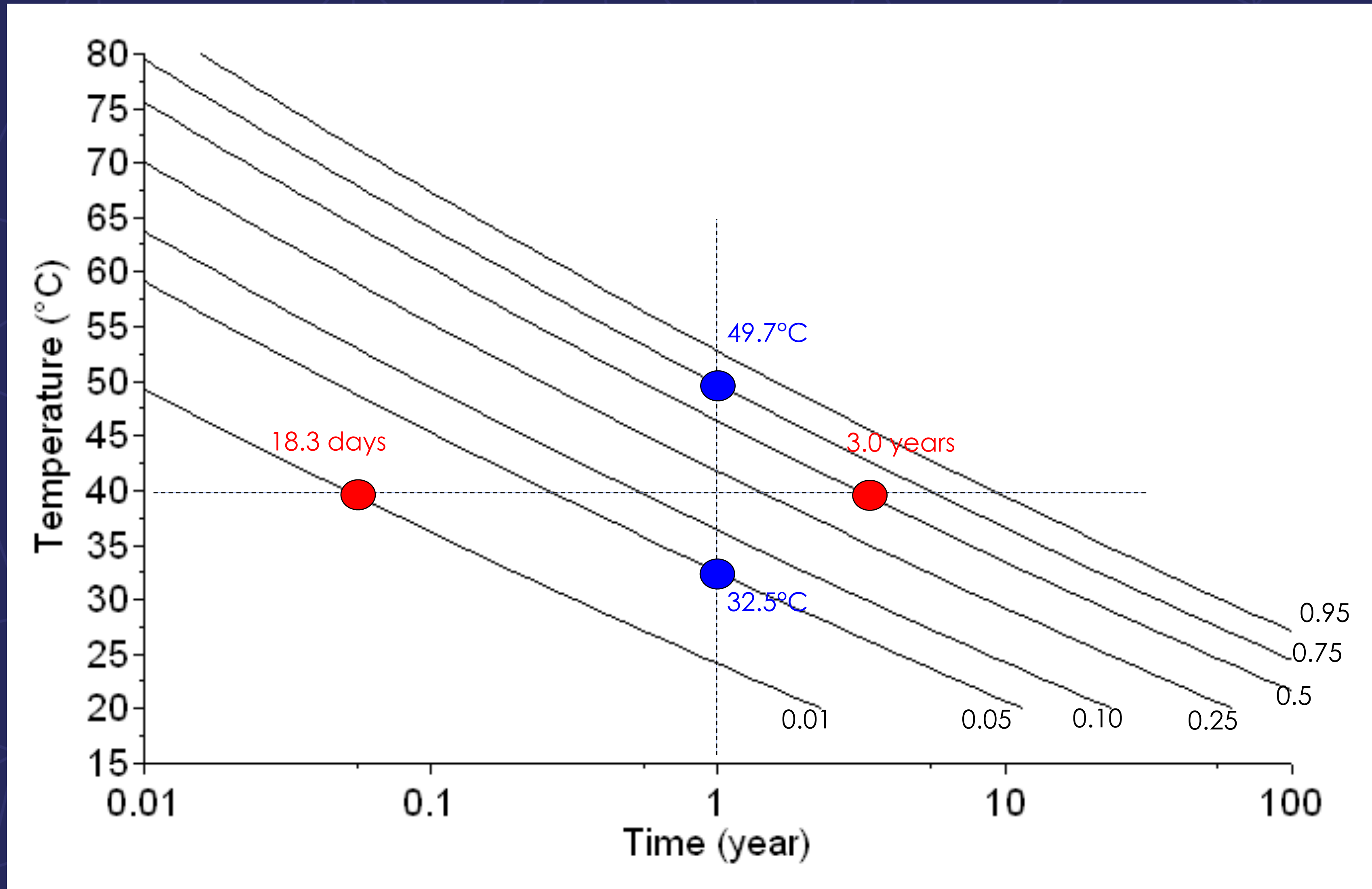
AKTS
On-Chip Kinetics App



AKTS
Datalogger



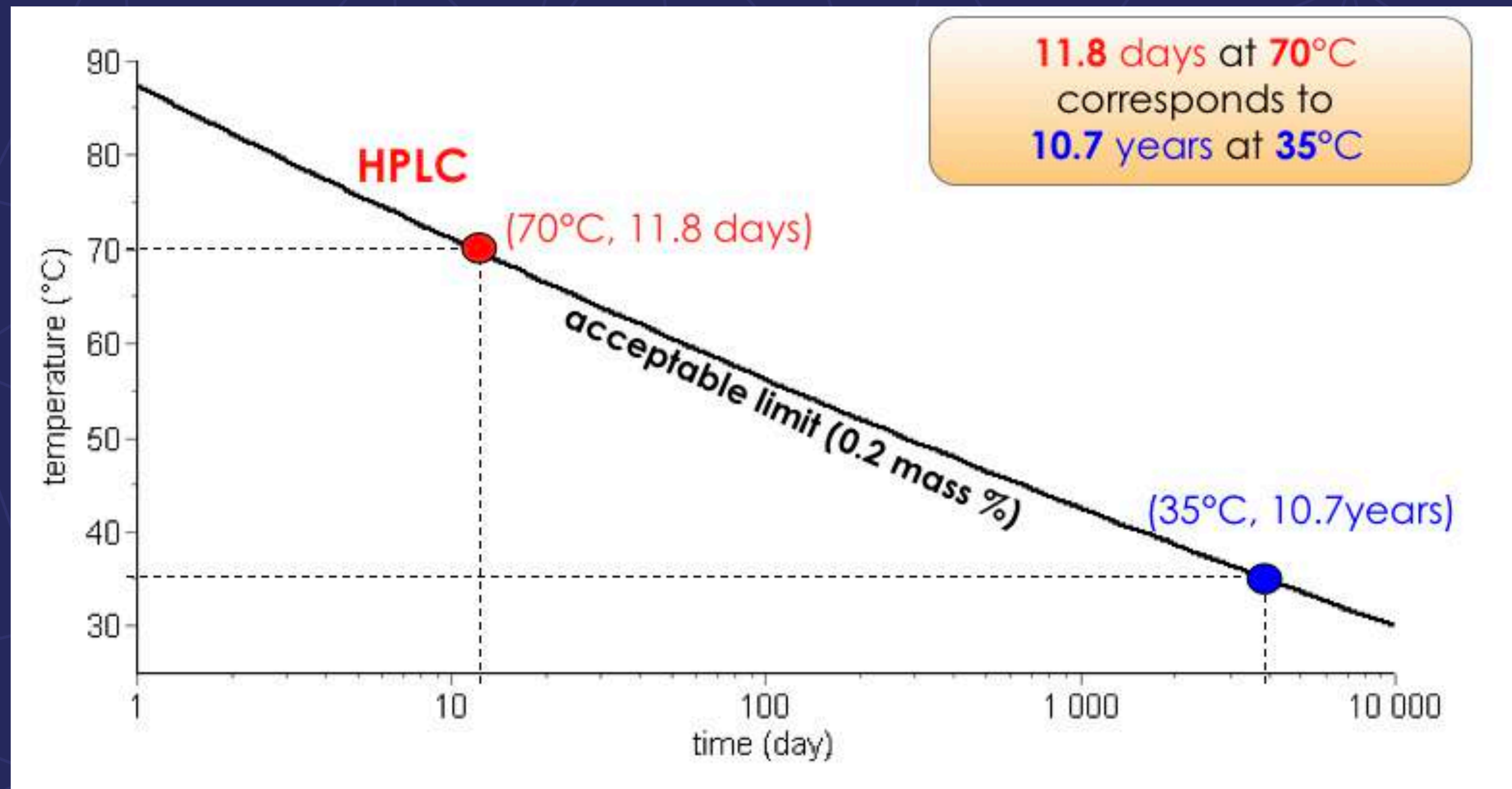
TTT (Transformation Time Temperature) Diagram for HPLC* test



* HPLC : High-performance liquid chromatography



TTT (Transformation Time Temperature) Diagram for HPLC* test



Calculated from the **best** kinetic model applied for the **estimation of the shelf life**

* HPLC : High-performance liquid chromatography



Kinetic Parameters to predict better!

CURRENT REACTION EXTENT	0.5					
SET TEMPERATURE	40	35	30	25	20	°C
REMAINING SL	1.5	3.6	9.3	24.5	67.3	yrs

Set the **temperature** according to the remaining Shelf Life

Set the **remaining Shelf Life** and get the maximal temperature of storage

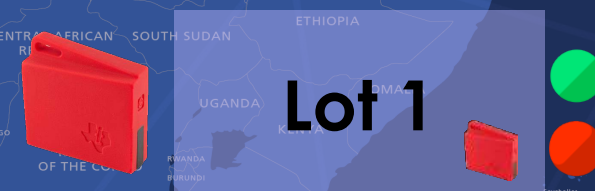
CURRENT REACTION EXTENT	0.5			
MAX TEMPERATURE	33.3	29.7	27.6	°C
SET REMAINING SL	05.0	10.0	15.0	yrs



1st possible use

**Automatic
determination of the
products in real-time.
Displaying a LED
information if product is
safe or not safe.**

Lot 1

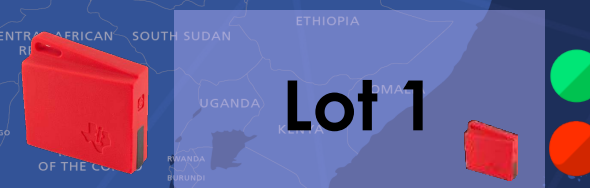




2nd possible use

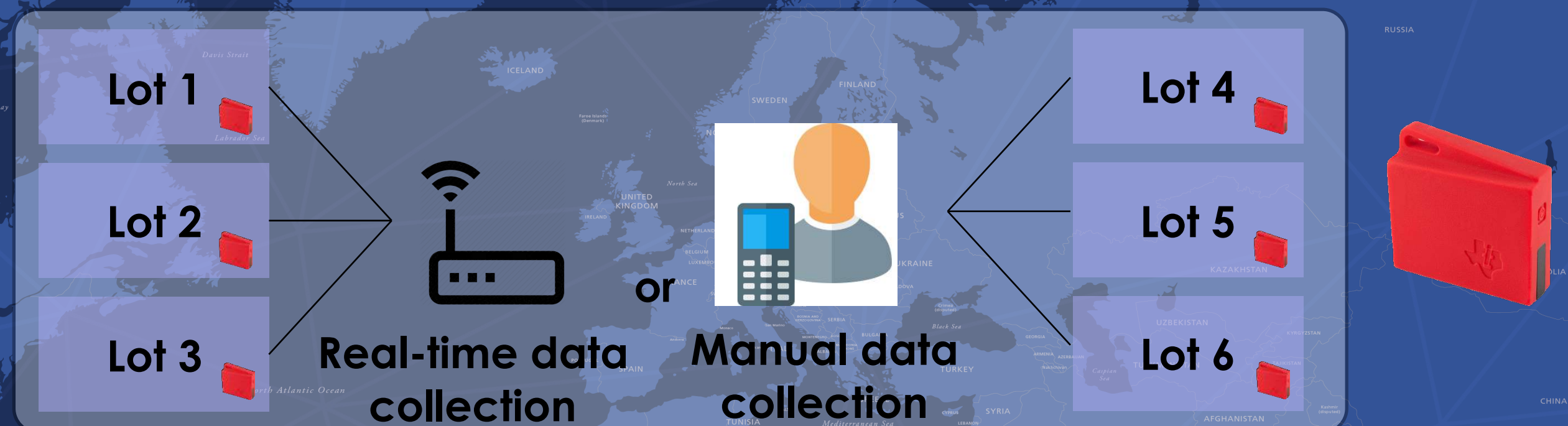


Manual data
collection
and automatic
determination of the
products in real-time

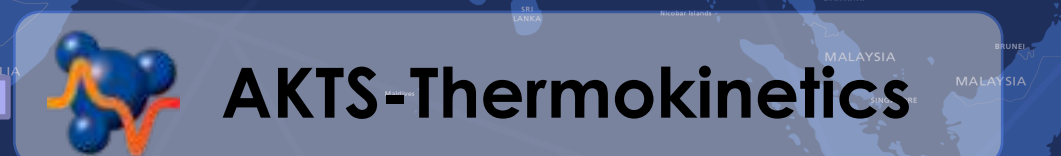
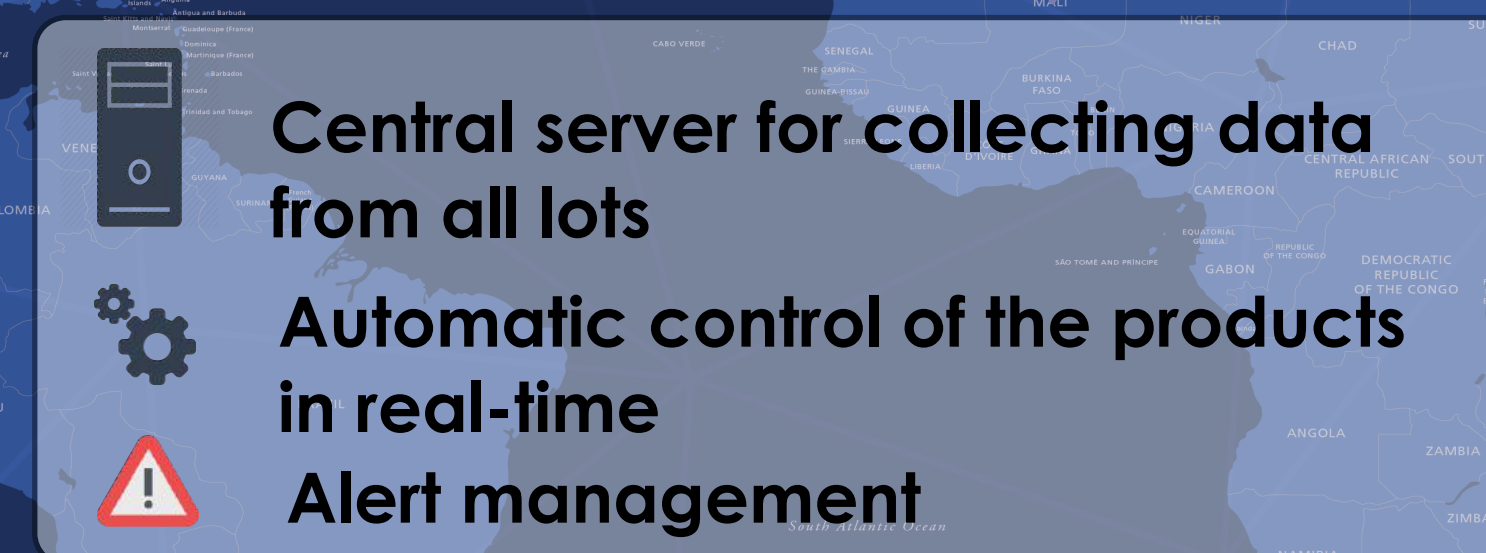




3rd possible use



Secured connection (no cloud storage)



Kinetic computations and comparison of reaction progress with acceptable limits



Worldwide

Real-Time

Unlimited Samples



Pharmaceuticals



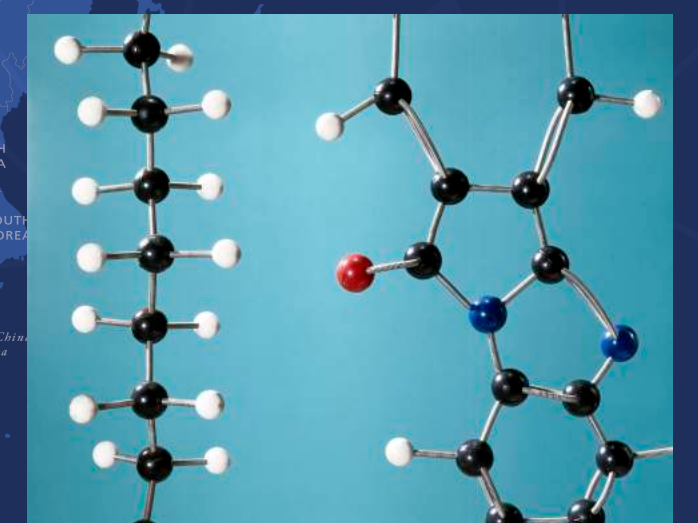
Drugs



Energetic Materials



Food

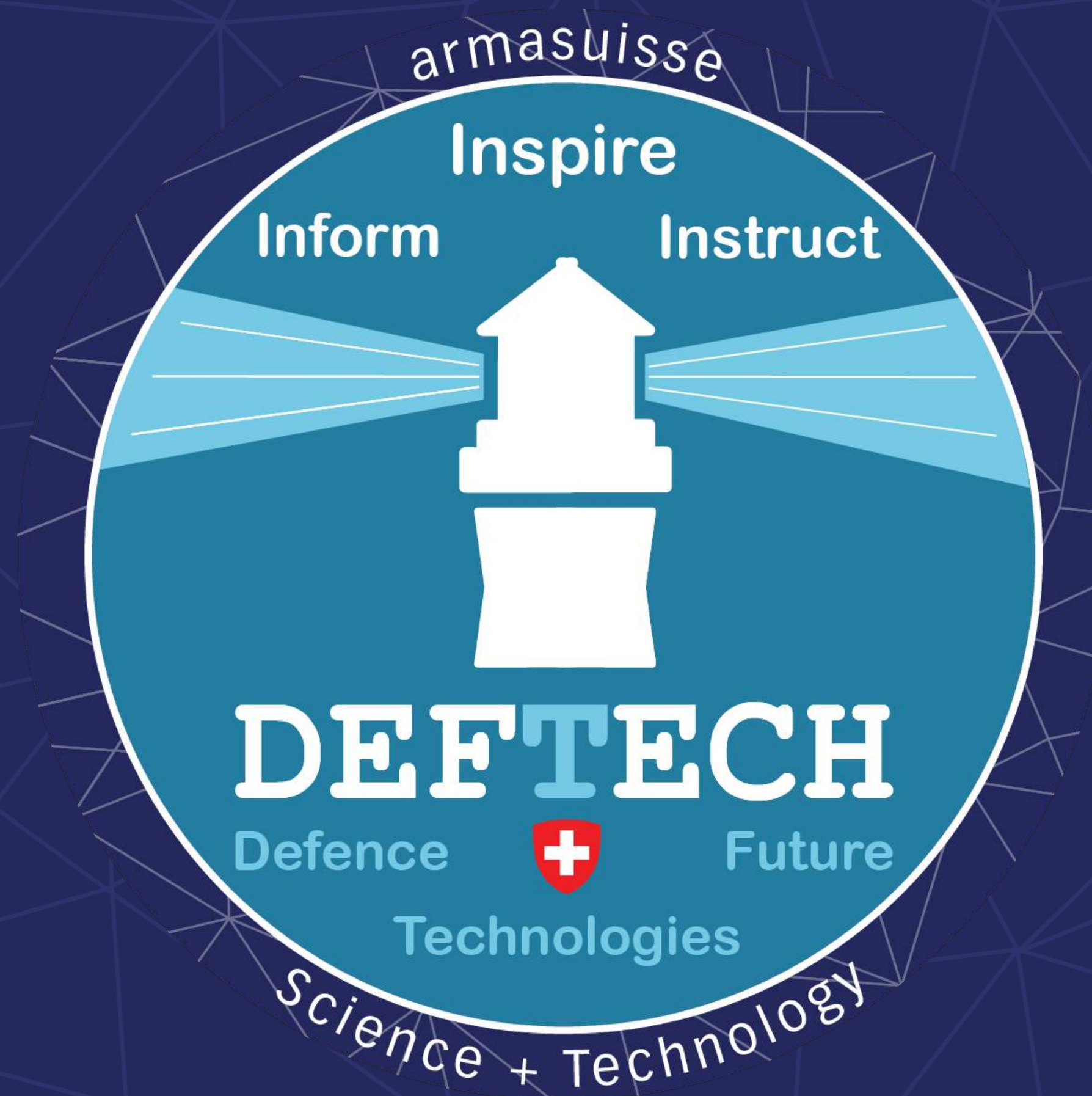


Polymers



<https://akts.com>





<https://deftech.ch>

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