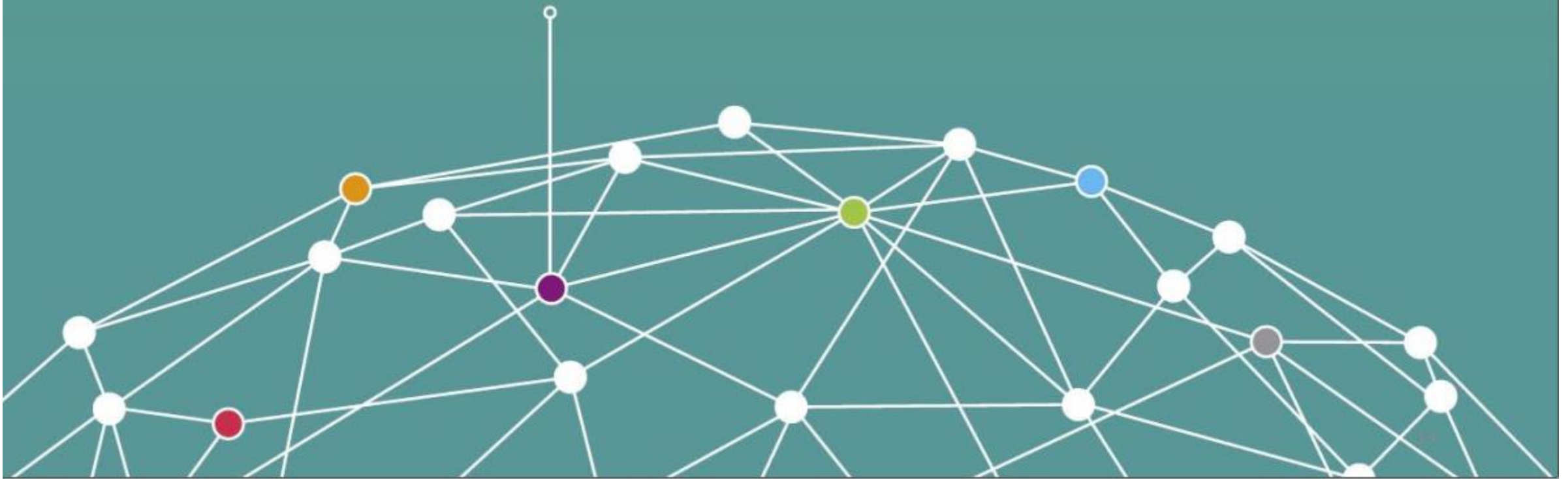# Blockchain Technologies
# CERTH/ITI

Applications in Blockchain

Centre for Research & Technology Hellas (CERTH)

- **Founded in 2000** and is one of the leading R&D centers in Greece

- Includes five (5) institutes:
  - Chemical Process & Energy Resources Institute (CPERI)
  - **Information Technologies Institute (ITI)**
  - Hellenic Institute of Transport (HIT)
  - Institute of Applied Bioscience (INAB)
  - Institute of Bio-Economy and Agri-Technology (IBO)

- >800 employees

- >1500 research projects

- >1500 international partners

- **Annual financing ~ € 25-30M:**
  - 30% industrial research contracts
  - 60% research projects
  - 10% government institutional funding

CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS
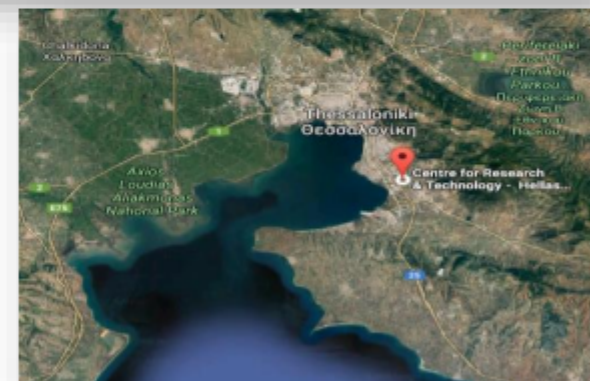
Listed among **TOP-20 E.U. institutions** with the highest participation in competitive research grants in ICT

Background

Established in 1998 in Thessaloniki with an initial start-up capital of €2.3 M for the period 1998-2001.

In 2002 and 2005 ITI was evaluated from selected committees of European experts and placed at the highest percentiles. On this basis, the Institute was awarded grants exceeding €800,000.

In September 2008, ITI relocated to its new premises, a building of 3.500m^2 in the wider area of the CERTH campus.

Since 10/03/2000, ITI is a founding member of the Centre for Research and Technology Hellas (CERTH).

In 2005, the ITI research team was awarded the "European Group Technical Achievement Award" of the European Association for Signal, Speech and Image Processing (EURASIP).

Over the last five years, the ITI has attracted an income of more than €45 M from National and European competitive R&D projects.

ITI is currently ranked 1st in Greece for its participation in competitive research grants.

CERTH-ITI Smart Home Digital innovation Hub

- A **rapid prototyping & novel technologies** demonstration infrastructure
- Resembling a **real domestic building** where occupants can experience **actual living scenarios integrating also Blockchain Technologies**

(HTTPS://SMARTHOME.ITI.GR/)

Current Infrastructure

- **Blockchain Infrastructure (see next slide)**
- **IoT multi-sensorial network** for energy and health related real-time data extraction and equipment control
- **Near-Zero Energy building** equipped with 10kWp PVs and Energy Storage Systems

Blockchain in Healthcare

BaaS system
Healthcare data permission management using Blockchain

- **Example Clinical Platform: MyAirCoach[1]** is an asthma monitoring system based on a Web Clinical Platform.

  - MyAirCoach aims to support asthma patients in controlling their disease through **predictive self-management** and **personalized mHealth**.

- A list of MyAirCoach functionalities can be done via the Blockchain layer

  - This increases trust of the Users to the MyAirCoach clinical Platform

- BaaS enables MyAirCoach Platform users to get **registered/login/logout** to the Platform via our **BaaS** system. Each user action to the Platform is logged in the Blockchain as an immutable **transaction.**

- Each **permission request** to access the Patient Data by Doctors is logged in the Blockchain as an immutable **transaction.** This ensures **traceability** and **accountability**

  - Permissions can be requested to several **assessments** of the myAirCoach system, such as **questionnaire scores** (ACD, ACQ, SNOTT22), inhaler use, spirometry, FeNO, **activity measurements** (heart rate, steps, etc), goals, lung models and **dietary information**.

16/05/18

- Our proposed solution is partially based on the design of **MedRec** Project

Blockchain enabled functionalities in MyAirCoach Clinical Platform

- **User Register**
- **User Login/Logout**
- **Request Permissions**
  - **A Doctor *requests* permissions on a Patient Medical Record**
- **Give Permissions**
  - **A Patient *gives* permission to a Doctor for accessing her/his Medical Record**
- **Update Permissions**
  - **A Patient *changes* the permissions given to a Doctor for accessing her/his Medical Record**

BaaS system

Architecture & Components
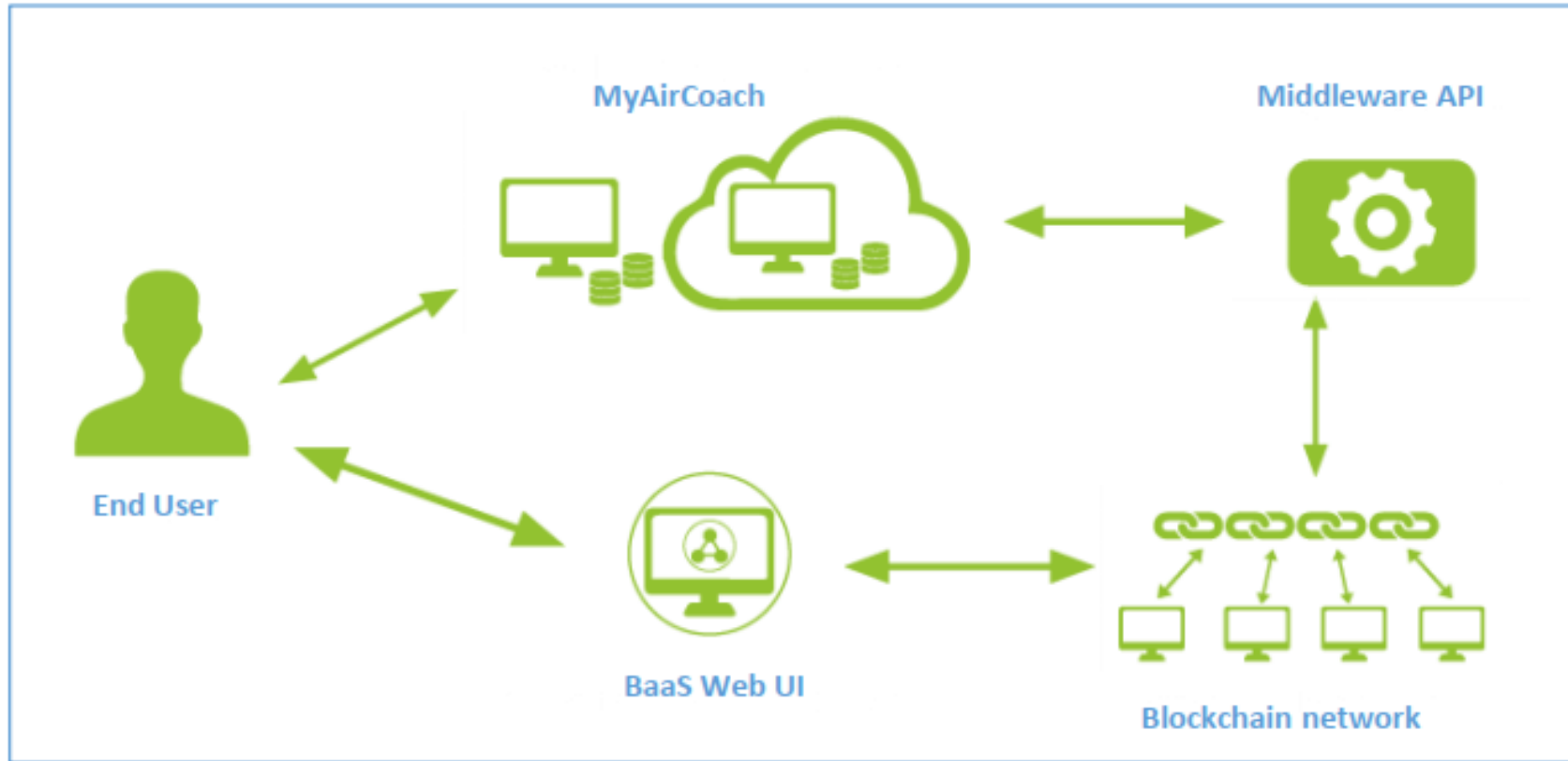
Request Permissions scenario

Entry Point: MyAirCoach
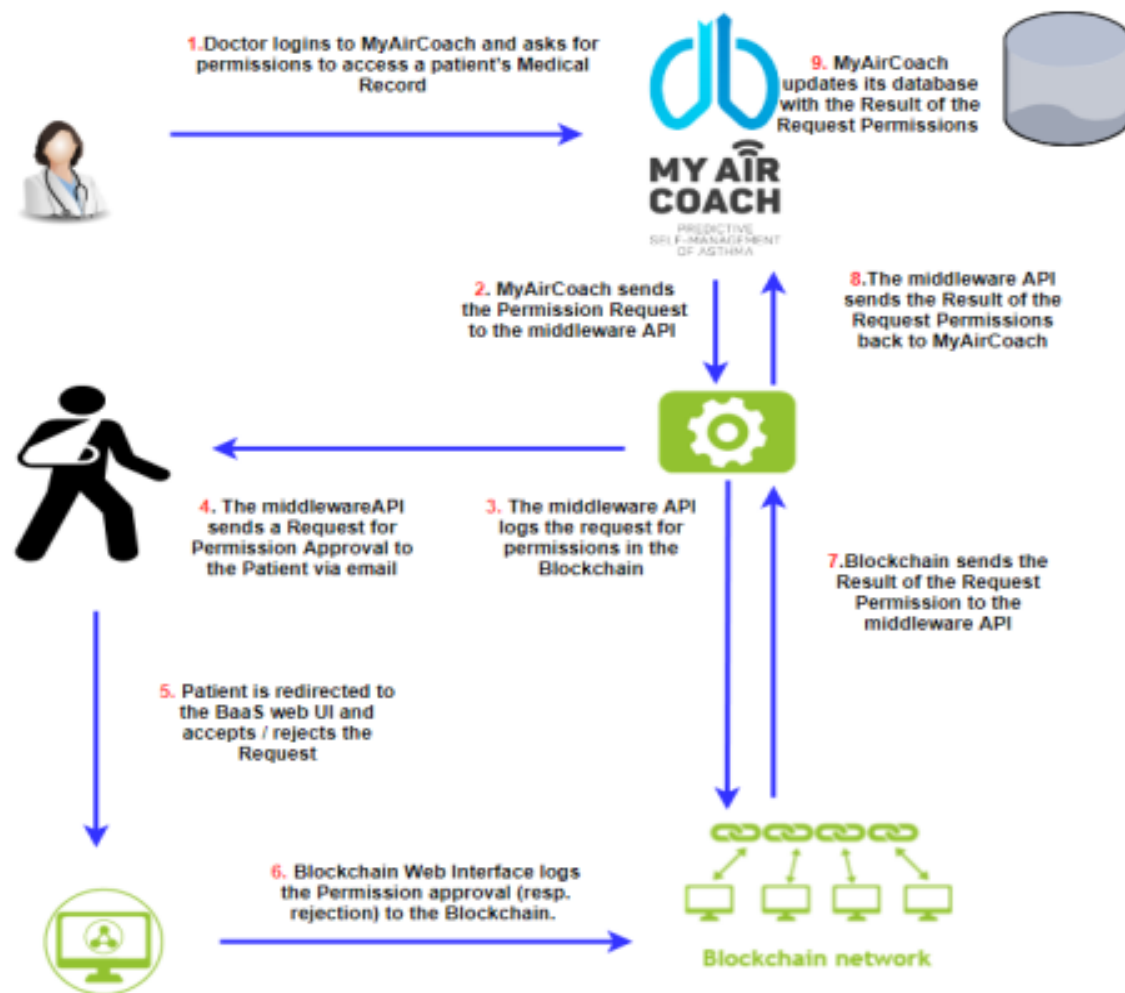
BaaS User/Check Granted Permissions to another User

- In MyAirCoach, a Patient checks Permissions given to Doctors

CERTH BaaS Application Front-end ADMIN View

DASHBOARD
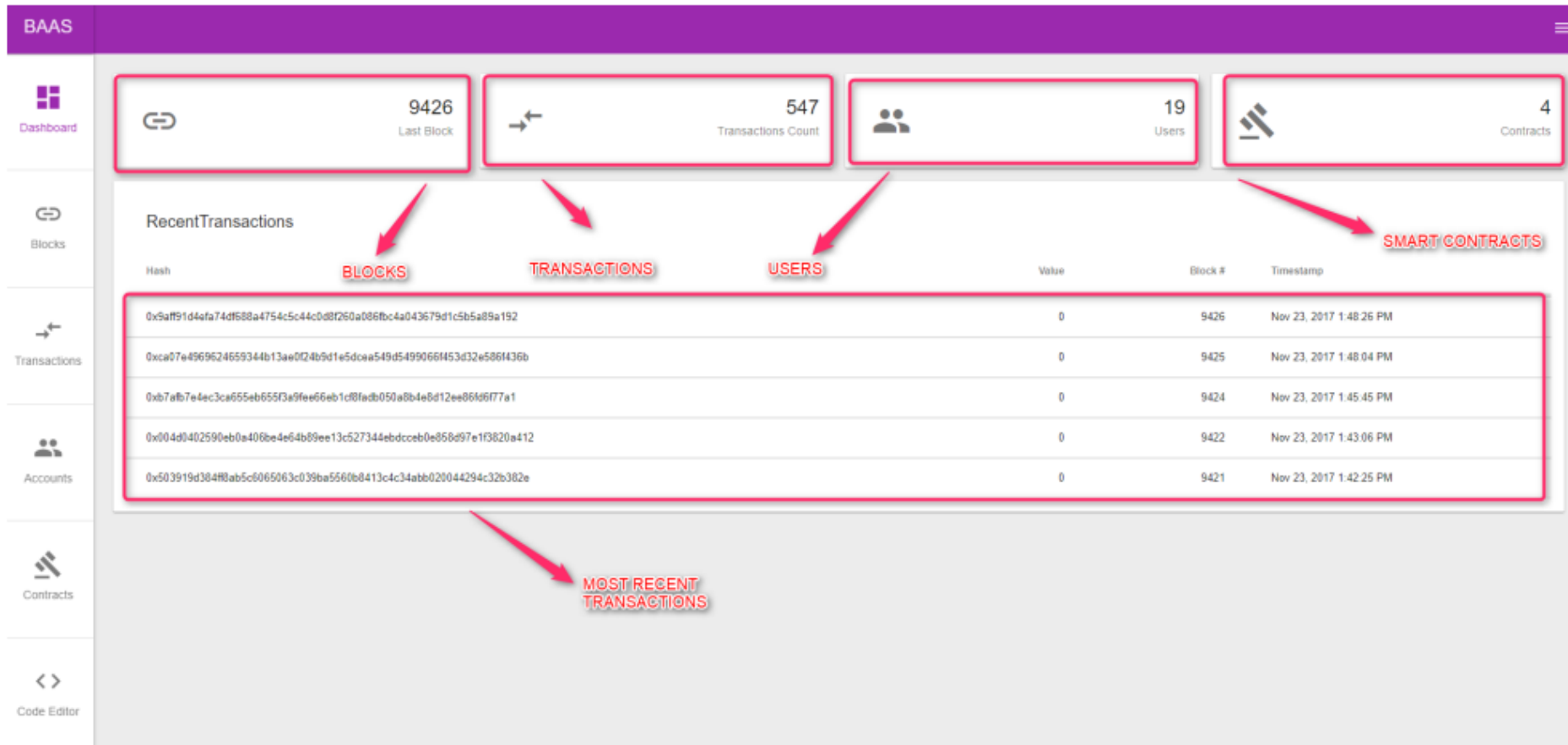
CERTH BaaS Application Front-end USER View
DASHBOARD
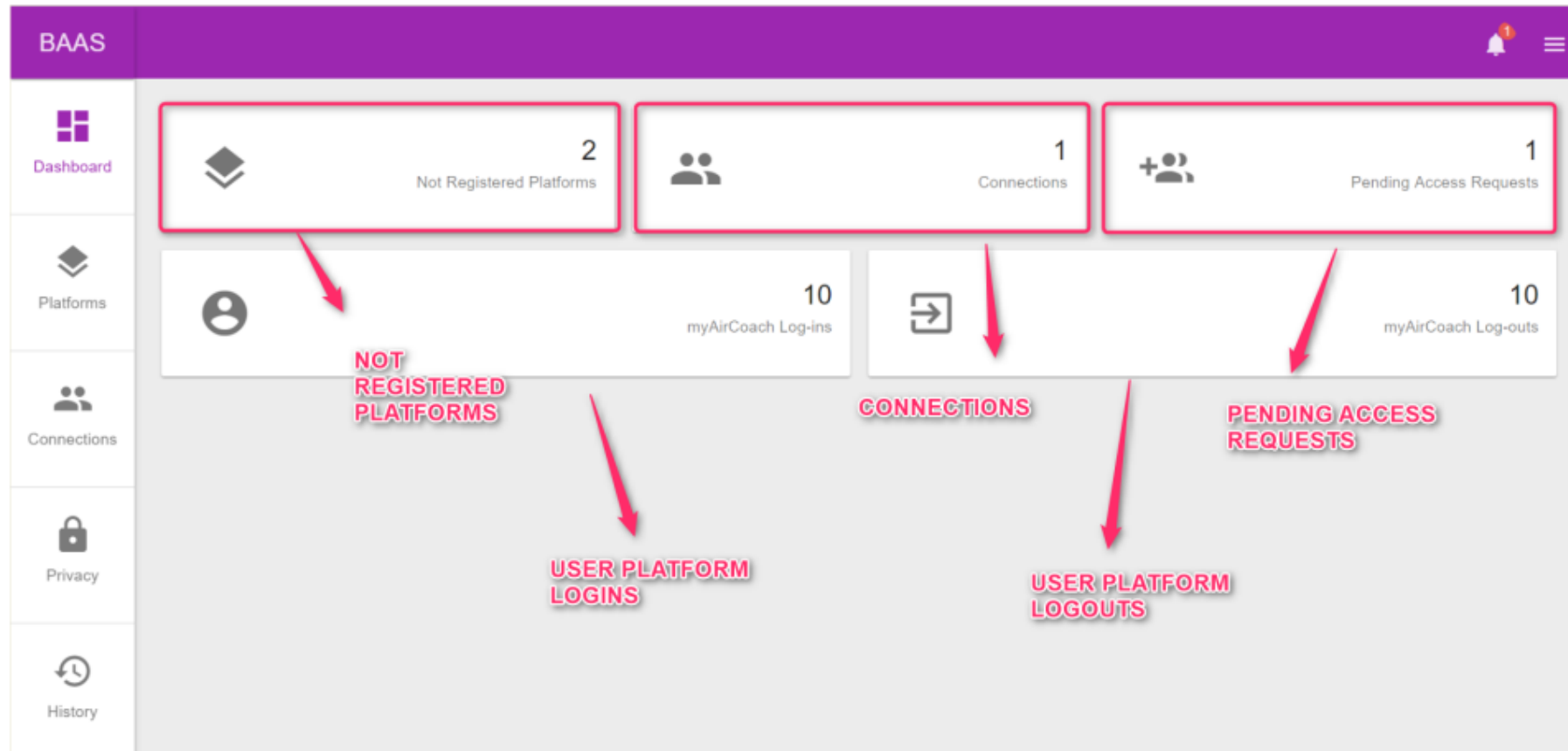
Blockchain in Active and Healthy Ageing

ACTIVAGE Monitoring Platform

- ACTIVAGE is ...
  - a European Multi Centric Large Scale Pilot on Smart Living Environments.
  - about setting the grounds for **Active and Health Aging (AHA)** Digital Transformation that will change the life of 100 million people across Europe.

- ACTIVAGE ...
  - reuses and scales up underlying open and proprietary IoT platforms, technologies and standards
  - integrates new interfaces needed to provide interoperability across these heterogeneous platforms that will enable the deployment and operation at large scale of Active & Healthy Ageing IoT based solutions and services

- ACTIVAGE vision ...
  - support and extend the independent living of older adults in their living environments
  - respond to real needs of caregivers, service providers and public authorities.

ACTIVAGE
PROJECT

PERSONAL CENTERED AHA-IoT ECOSYSTEM

BaaS system

Data permission management using Blockchain

- **Example Platform: ACTIVAGE** Monitoring Platform

- A list of ACTIVAGE monitoring Platform functionalities can be done via the Blockchain layer

  - This increases trust of the Users to the ACTIVAGE monitoring Platform

- BaaS enables ACTIVAGE monitoring Platform users to get registered/login/logout to the Platform via our BaaS system. Each user action to the Platform is logged in the Blockchain as an immutable transaction.

- Each permission request to access the Elderly people Data by Caregivers is logged in the Blockchain as an immutable transaction. This ensures traceability and accountability

Blockchain@CERTH for Interoperable eHealth Services
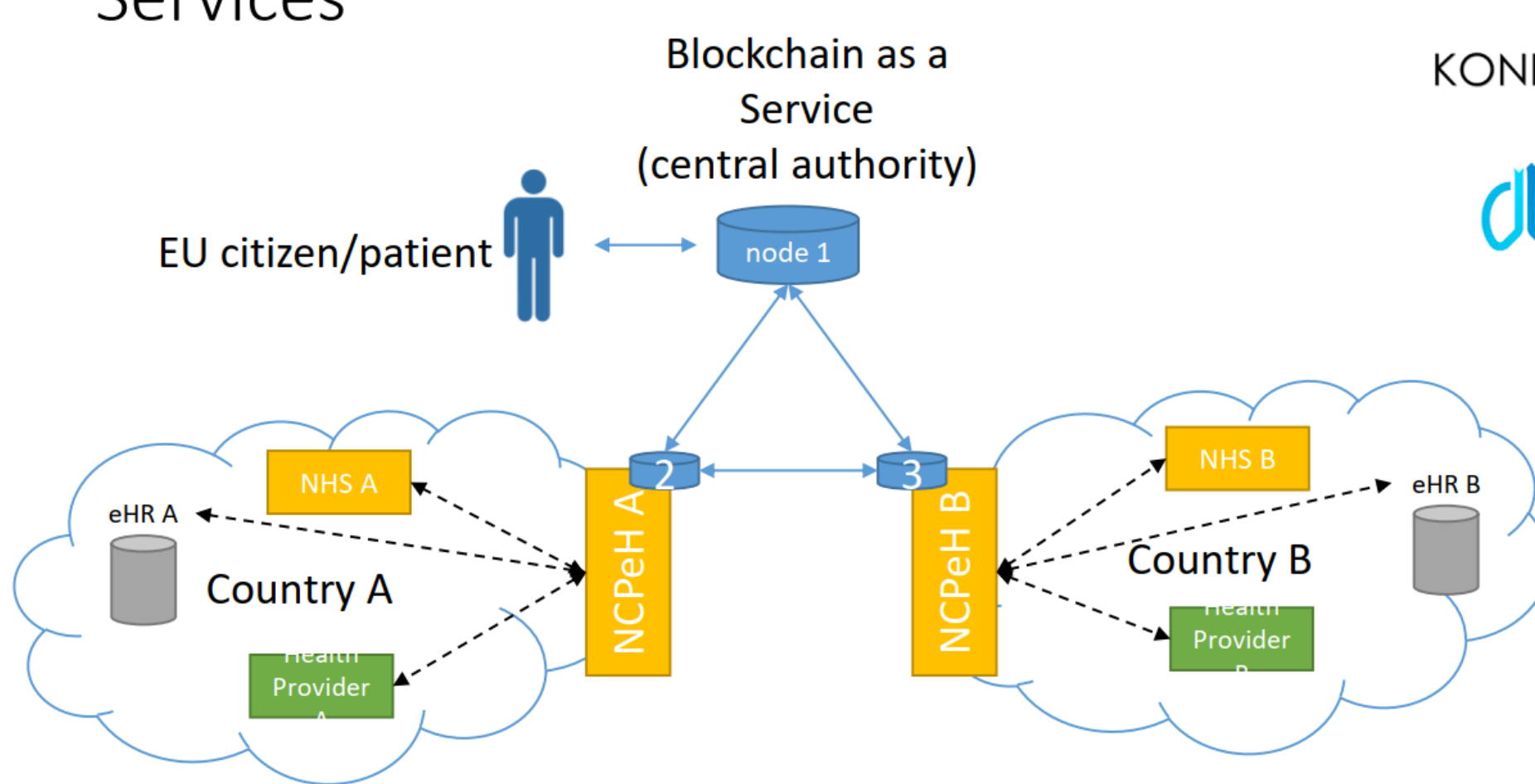
Scenario (1/3)

o New user registers to the Blockchain Service

o Once registered the user enters a personal Health Record ID

o The decentralized NCPeH nodes register an anonymised new user
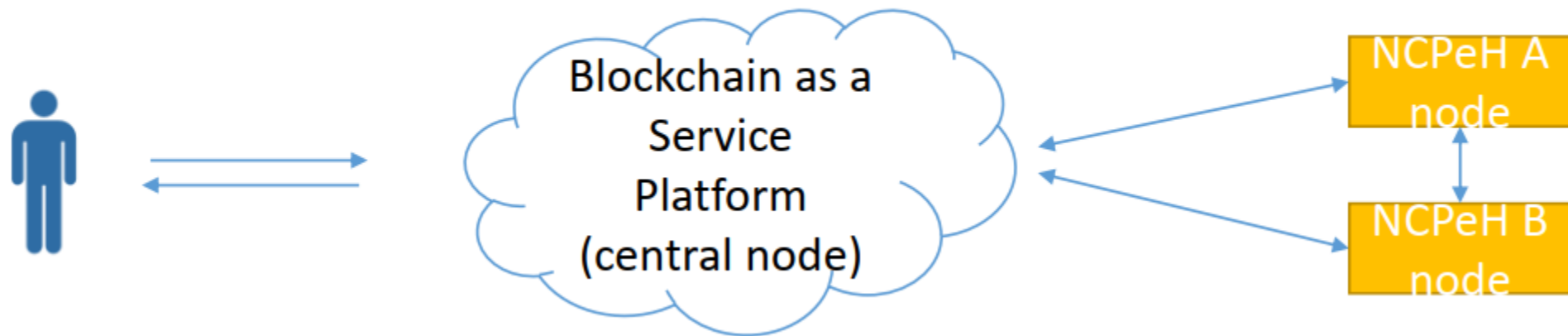
Scenario (2/3)

o User of country A is currently in country B and needs to use the healthcare system

o User permits Healthcare Provider B to access their personal Health Record from country A
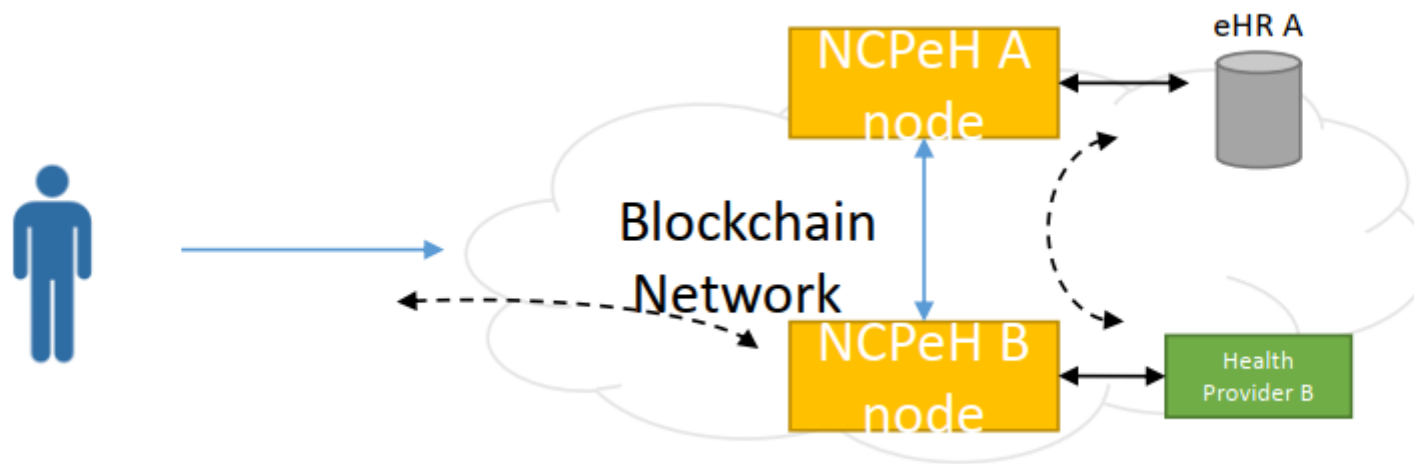
Scenario (3/3)

o Healthcare Provider B "requests" from NHS A to settle transaction (via smart contract)

o Once transaction is settled user permission is revoked automatically
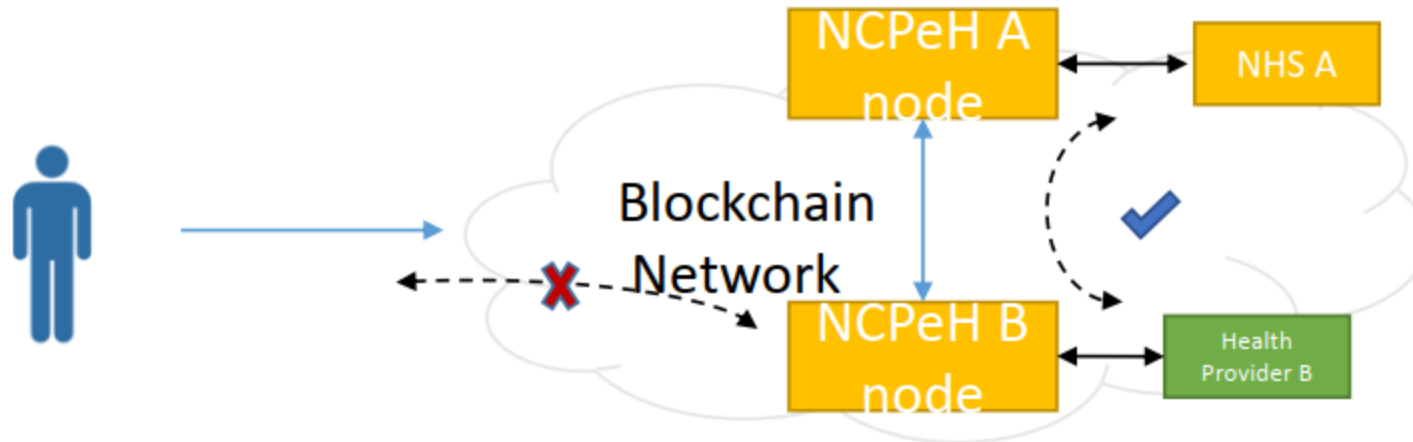
Blockchain in IoT

Pragma. Blockchain Architecture

water agriculture parking lighting energy gas health

Hardware & Identity Protocols

Web Dashboards Mobile Applications

API

pragma. Smart Contracts BAAS Blockchain Middleware

hyperledger ethereum
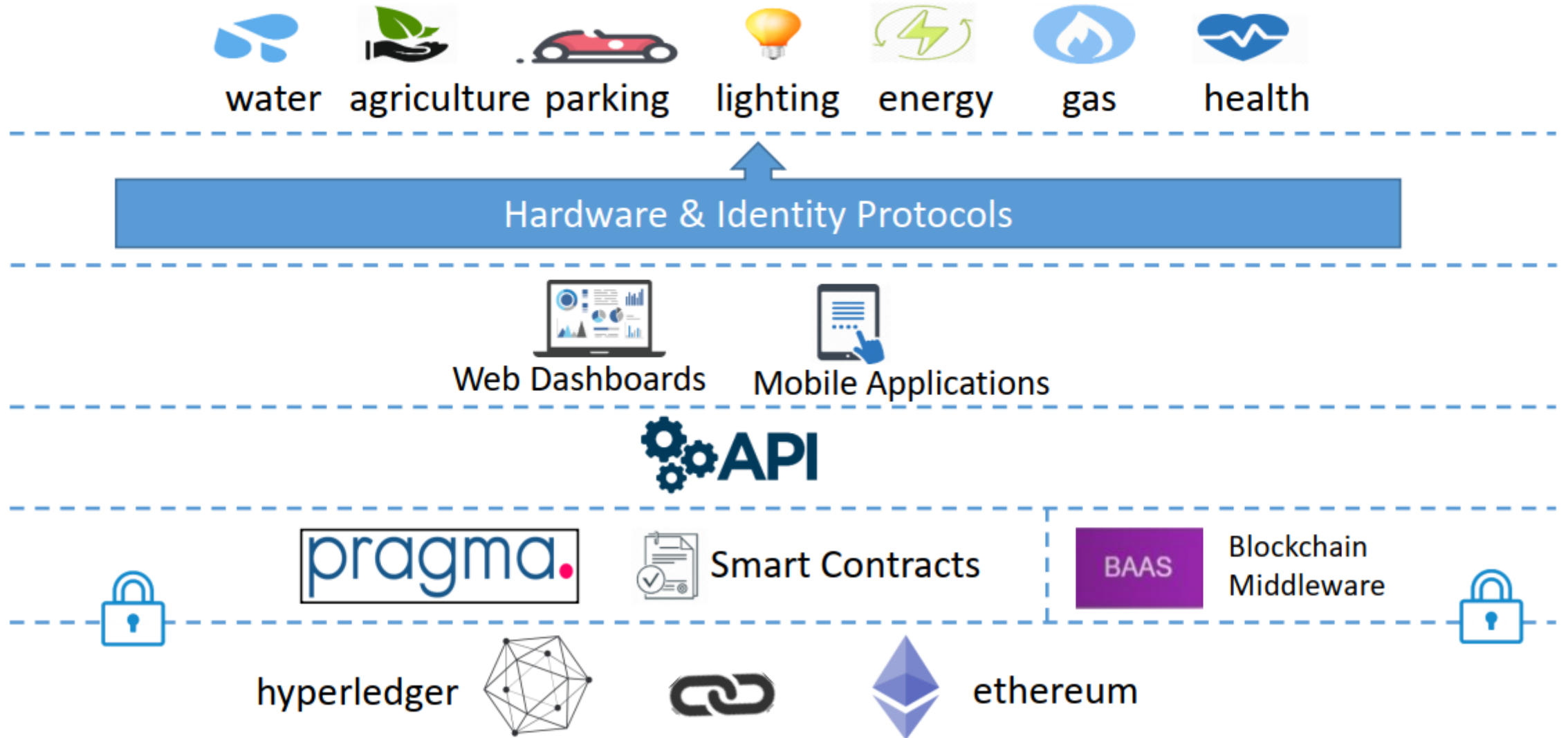
Pragma. Blockchain Agnostic platform
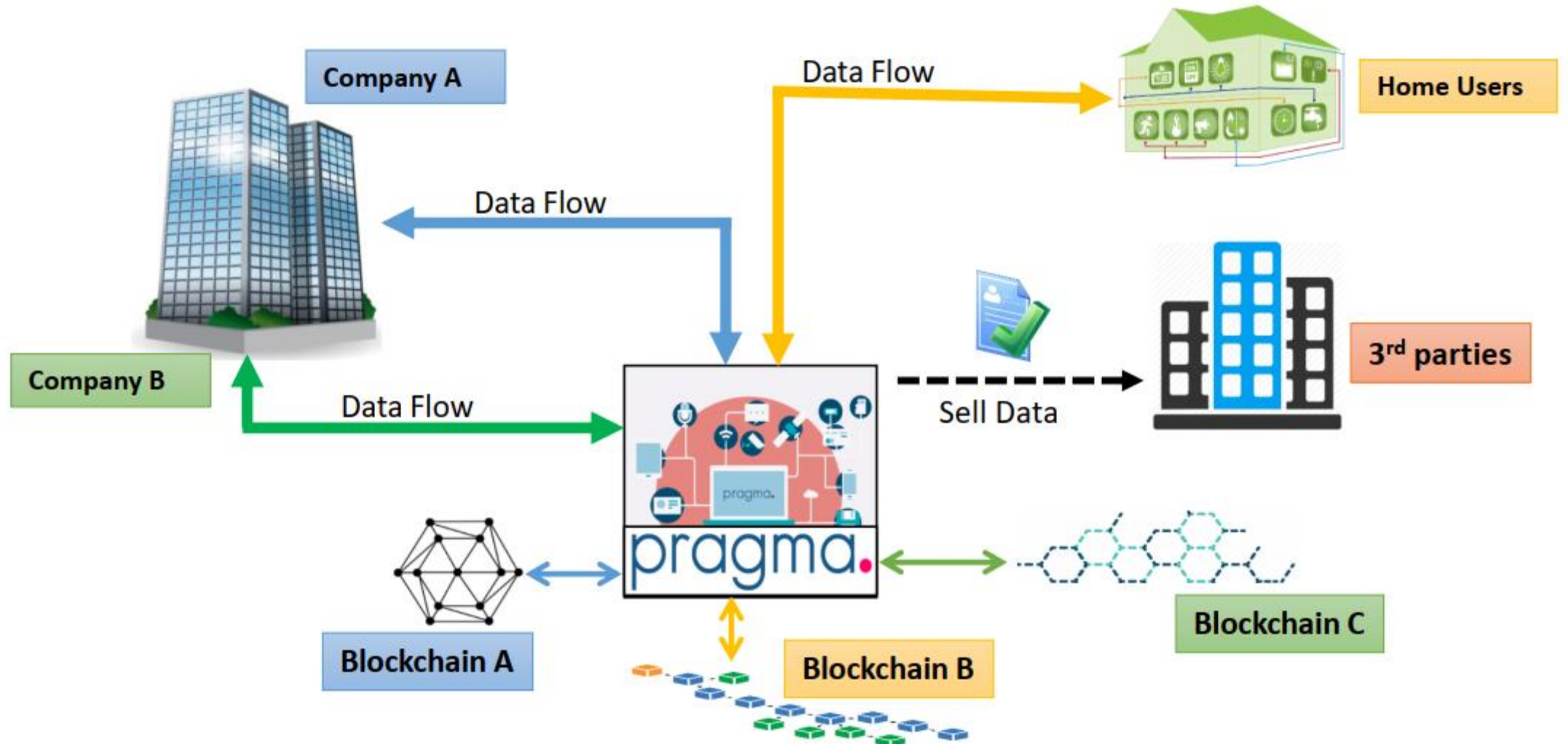
Supported Smart Contracts

❑ **Smart Contracts for Inform Consent**
- Register Users
- Add to portfolio
- Data to 3rd parties

❑ **Smart Contracts for Device/User Management**
- User permissions
- Add devices
- Monitor devices

❑ **Smart Contracts for Intelligence**
- Business-oriented → financial settlements based on smart contracts between Utilities & Prosumers/Consumers Electricity consumption
- End-user oriented → notifications on measurements

Inform consent flow

1. User asks for registration
2. Pragma asks for consent
3. User consents

4. Pragma writes on ledger
   - user's information
   - user's consent
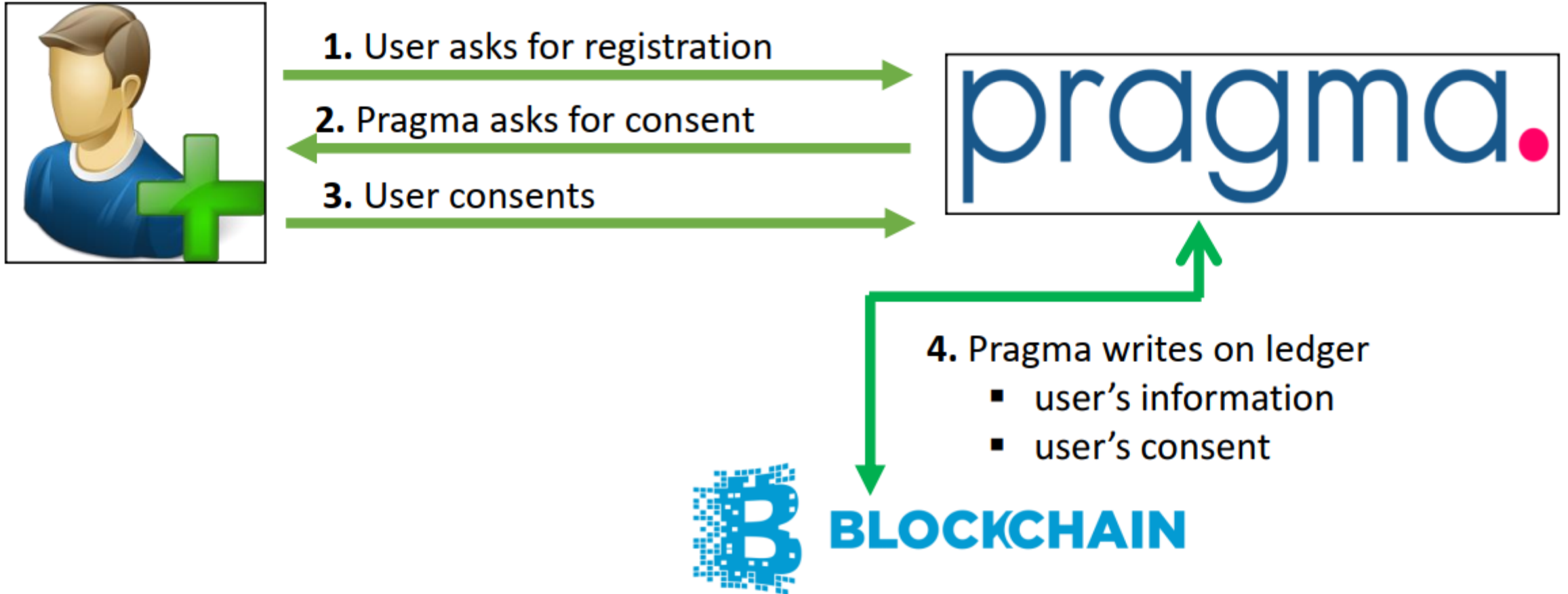
Add-monitor a device flow

1. Admin/reseller adds a device

3. Informs the user for the new Device

4. User starts monitoring the device

5. Pragma writes the device monitored by the user to the ledger

2.1 Pragma writes device on ledger

2.2 Smart contract for monitoring is activated and the user has is notified in order to add the device to their board for monitoring
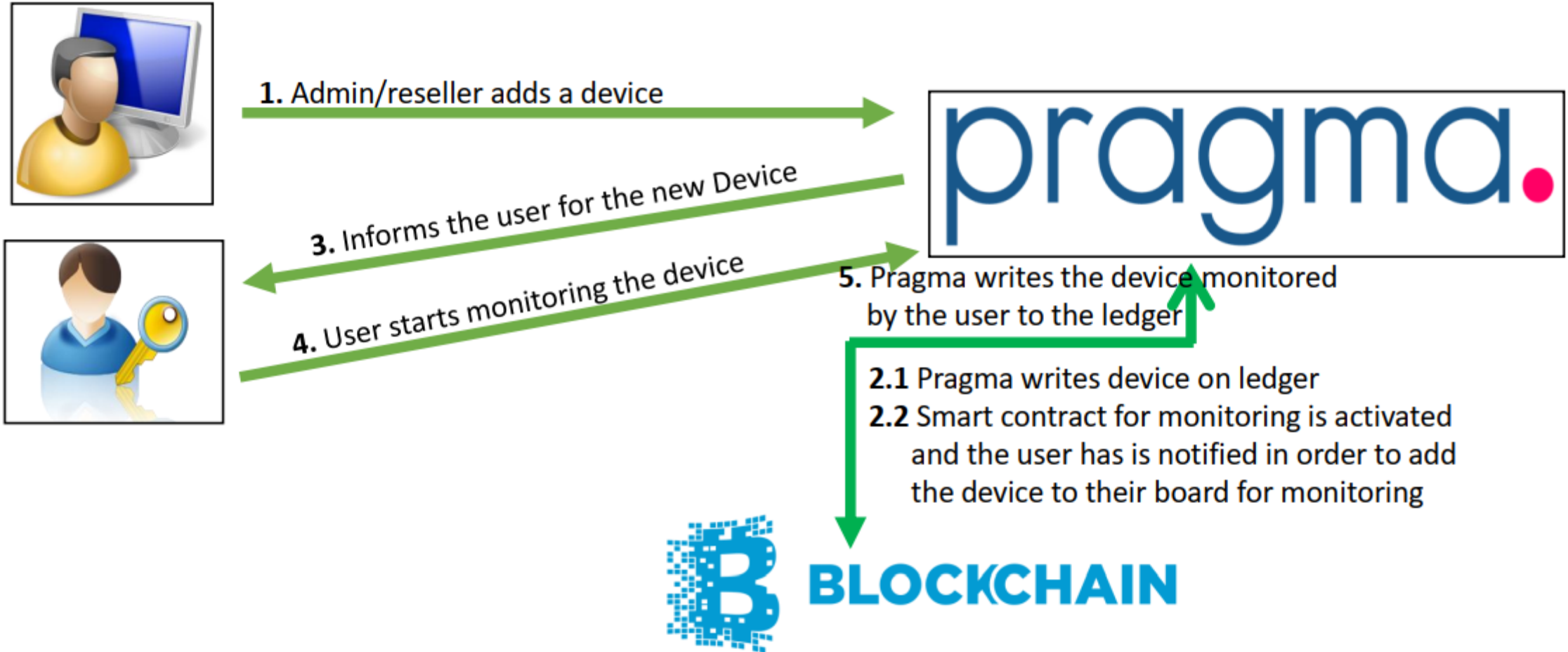
pragma.

BLOCKCHAIN

Electricity daily use flow

Pragma informs the user

User sets
- min/max temperature
- A/C pragma can control

Pragma turns on A/C

Threshold is reached

Pragma writes on ledger
- temperature threshold
- A/C it can control

Smart Contract is activated
- user has to be informed
- A/C has to be turned on
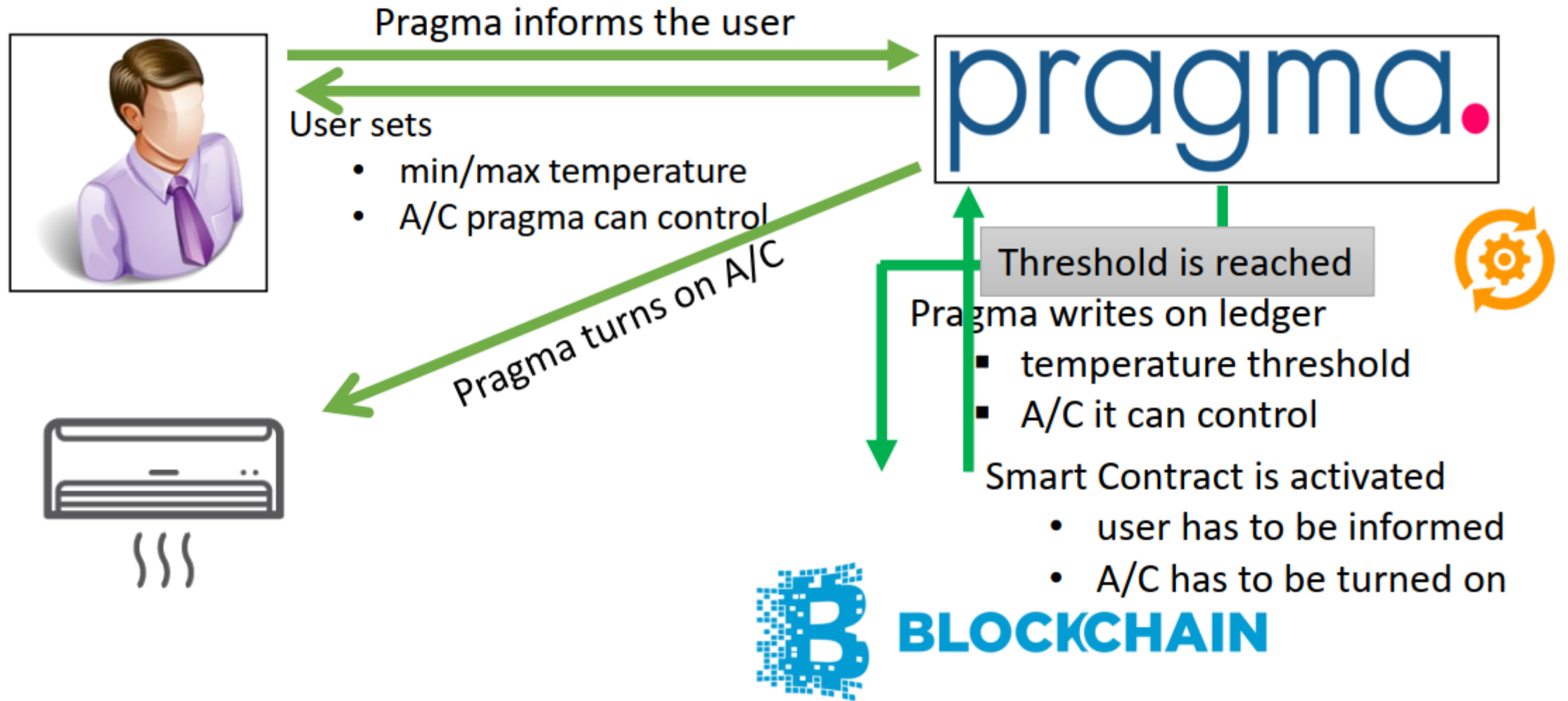
BLOCKCHAIN

Pragma. & Blockchain – Register User

Pragma. & Blockchain - Notifications

Baas & Blockchain - Blocks

Baas Blockchain registered users

Baas Blockchain notifications

Other applications and PoCs

o Blockchain and e-voting

o Blockchain in Energy sector

o Blockchain in Automotive sector

o Blockchain and ICO

Thank you

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