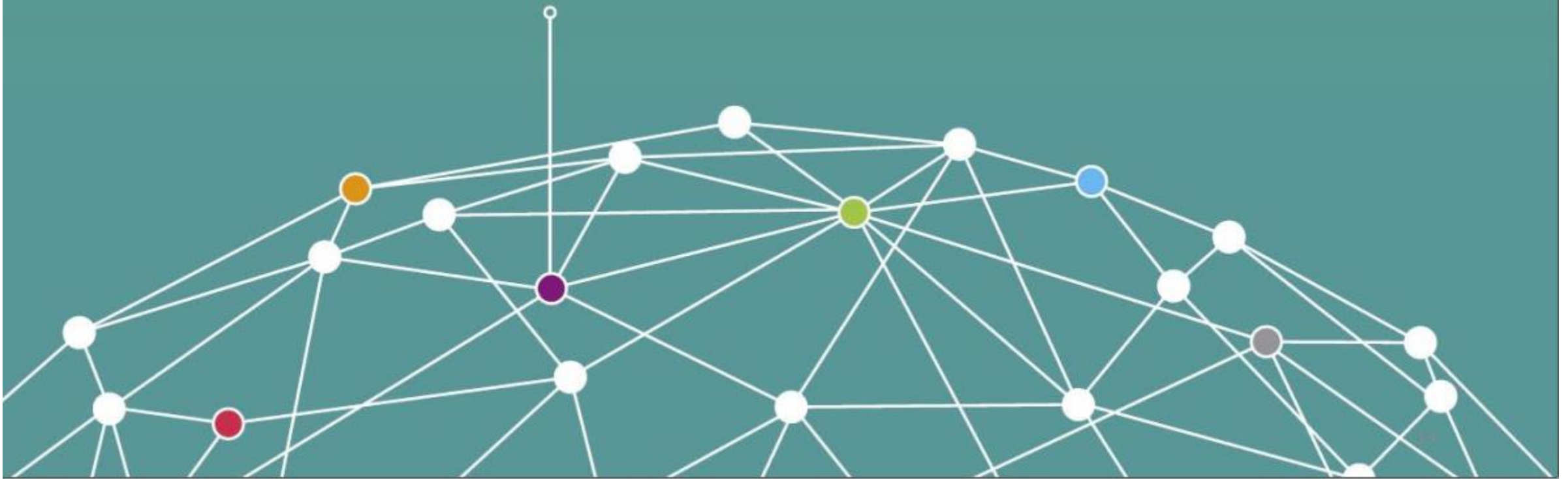


Blockchain Technologies

CERTH/ITI

Applications in Blockchain

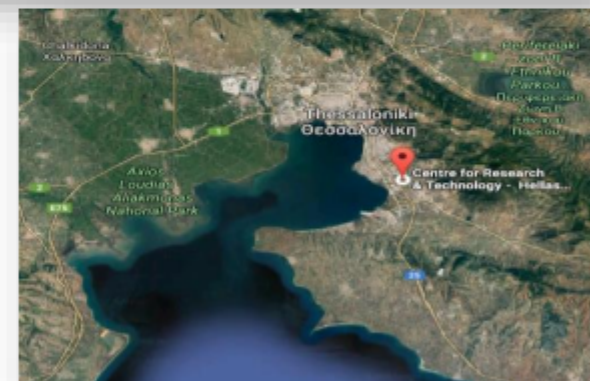


Centre for Research & Technology Hellas (CERTH)

- **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.



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

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



In September 2008, ITI relocated to its new premises, a building of 3.500m² in the wider area of the CERTH campus.



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**

[\(HTTPS://SMARTHOME.ITI.GR/\)](https://smarthome.itl.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: MyAirCoach¹** 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**.
- Our proposed solution is partially based on the design of **MedRec** Project

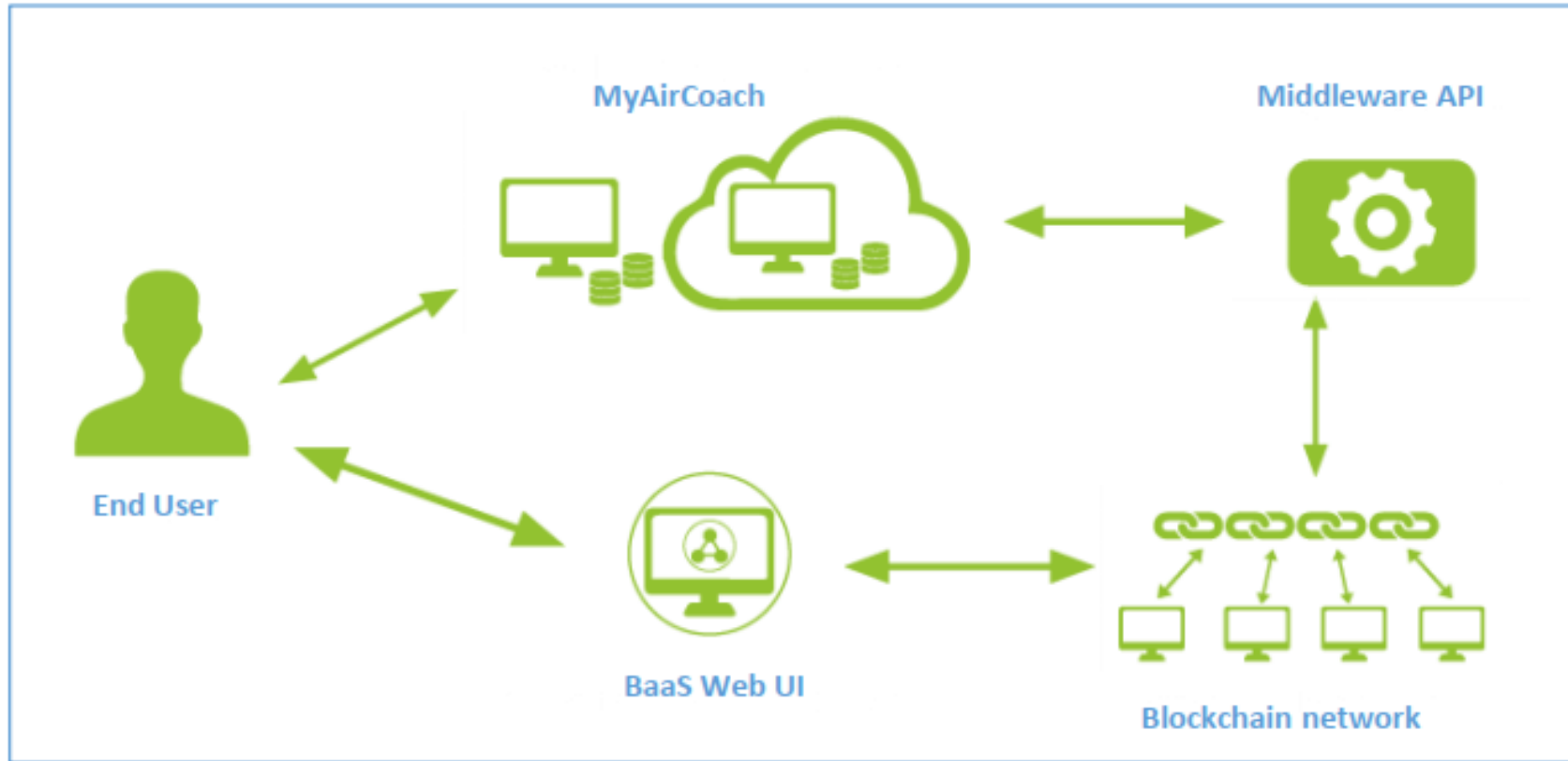


Blockchain enabled functionalities in MyAirCoach Clinical Platform

- **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

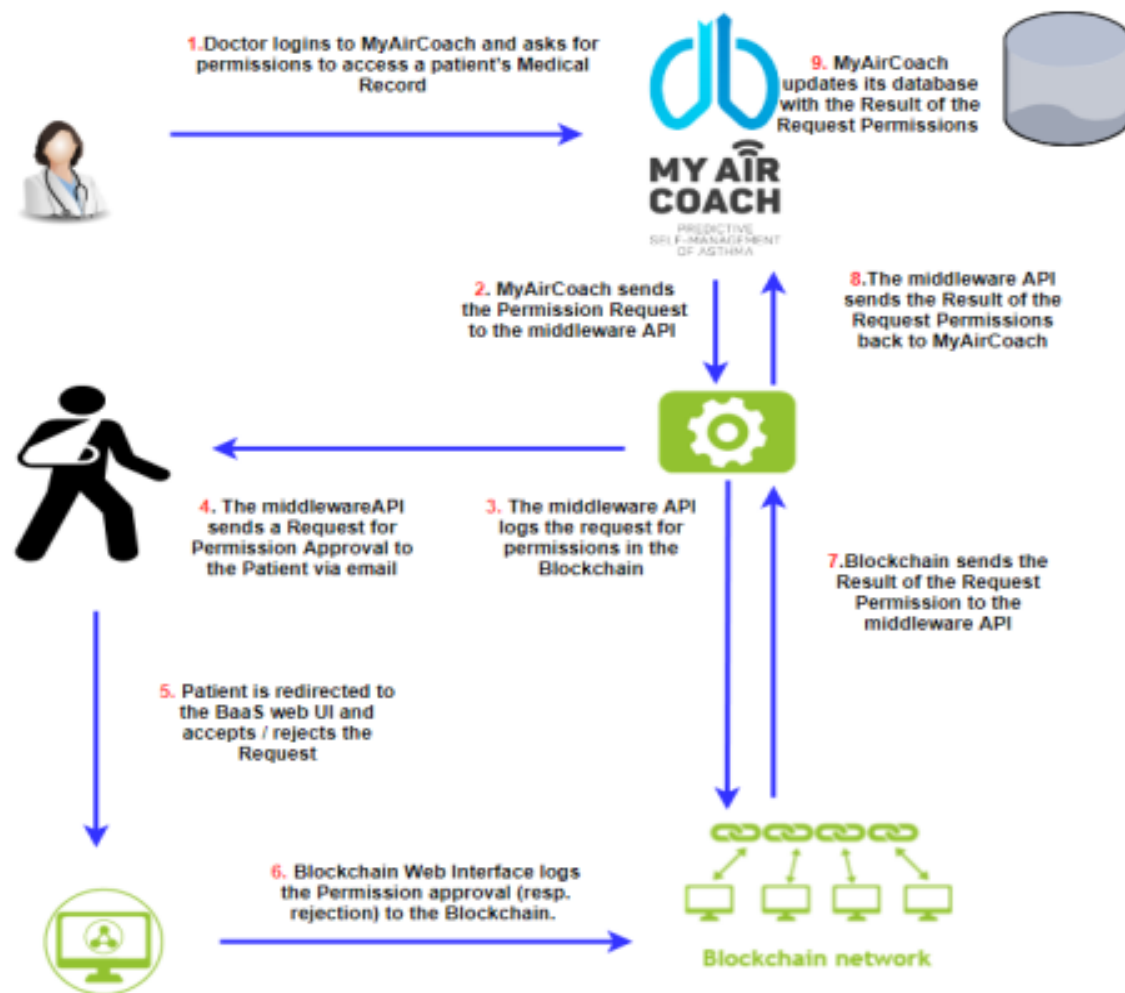
BaaS system

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

The screenshot displays the MyAirCoach BaaS interface. On the left, a sidebar contains navigation links: Dashboard, Platforms, Connections, Privacy, and History. The main area shows two user cards for 'myAirCoach' with email addresses 'johndoe@iti.gr' and 'kou@iti.gr', each with a 'VIEW CONTRACT' button. A red arrow labeled 'Doctors' points to these cards. A modal window titled 'Contract' is open, showing an address and a 'Permissions' table. A red arrow labeled 'Permissions' points to this modal.

Contract

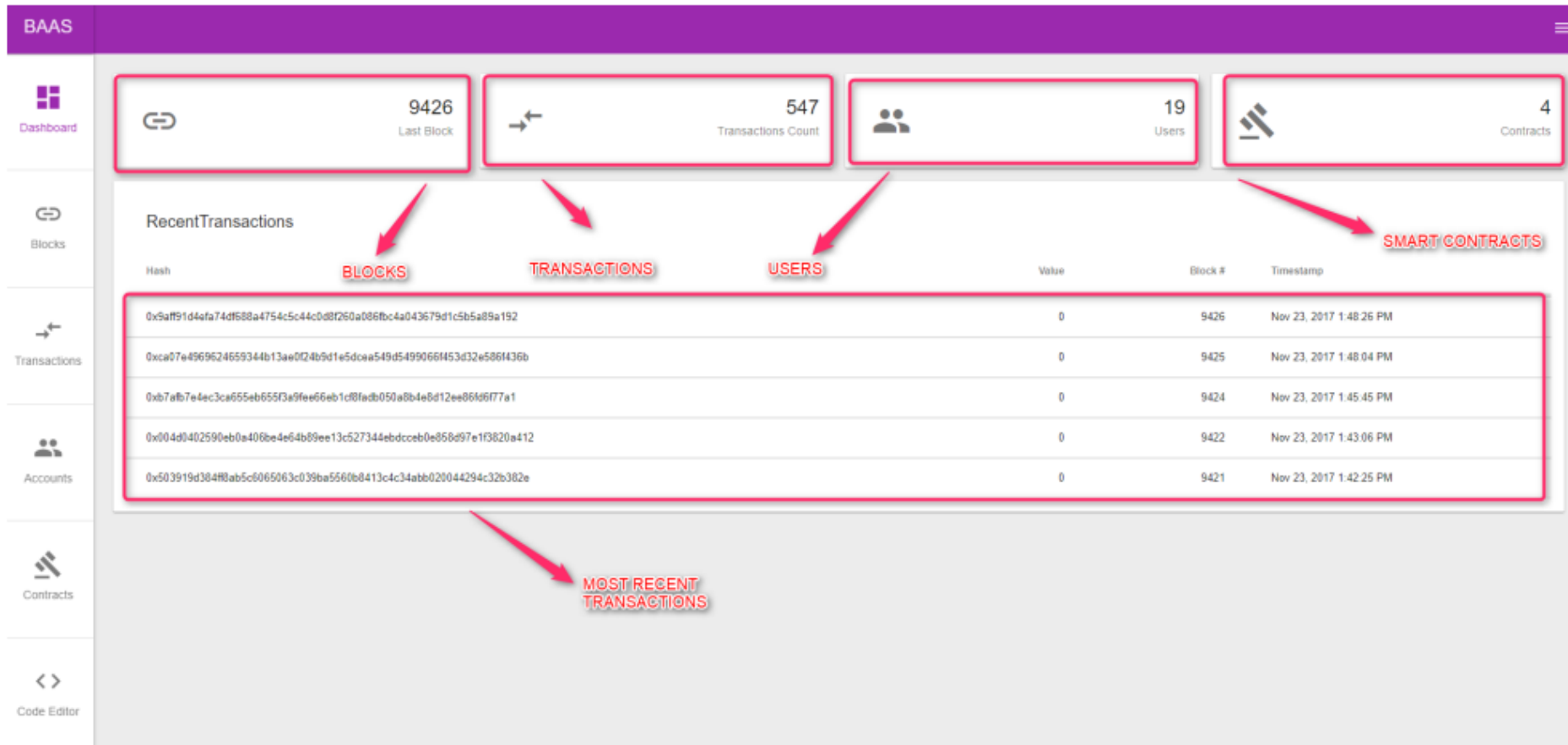
Address: 0xc7dad4b265884f835b0edfa1759e5456671d7902

Permissions:

Fields	[Write]	[Read]	[Update]	[Delete]	
*** Asthma Control Questionnaire (ACQ)	✓	✓	✓	✓	🔒
*** Socioeconomics	✗	✓	✓	✓	🔒
*** Asthma Quality of Life Questionnaire (AQLQ)	✓	✓	✓	✓	🔒
*** Diet	✗	✓	✓	✓	🔒
*** Spirometry	✗	✓	✓	✓	🔒
*** Pulse	✓	✓	✓	✓	🔒
*** Inhaler Use	✗	✓	✓	✓	🔒
*** ACD Score	✓	✓	✓	✓	🔒
*** Temperature	✓	✓	✓	✓	🔒
*** Lung Model	✓	✓	✓	✓	🔒

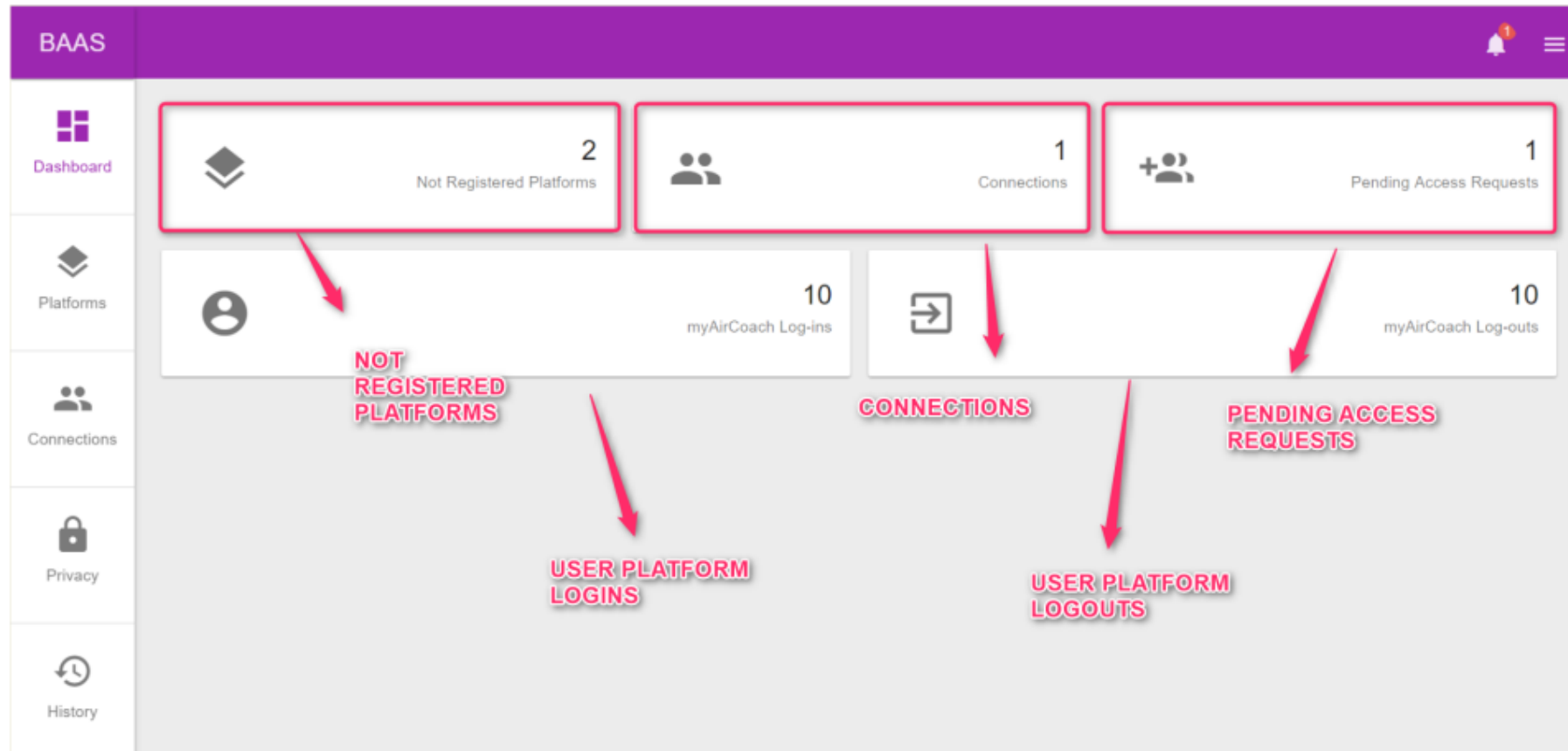
CERTH BaaS Application Front-end ADMIN View

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

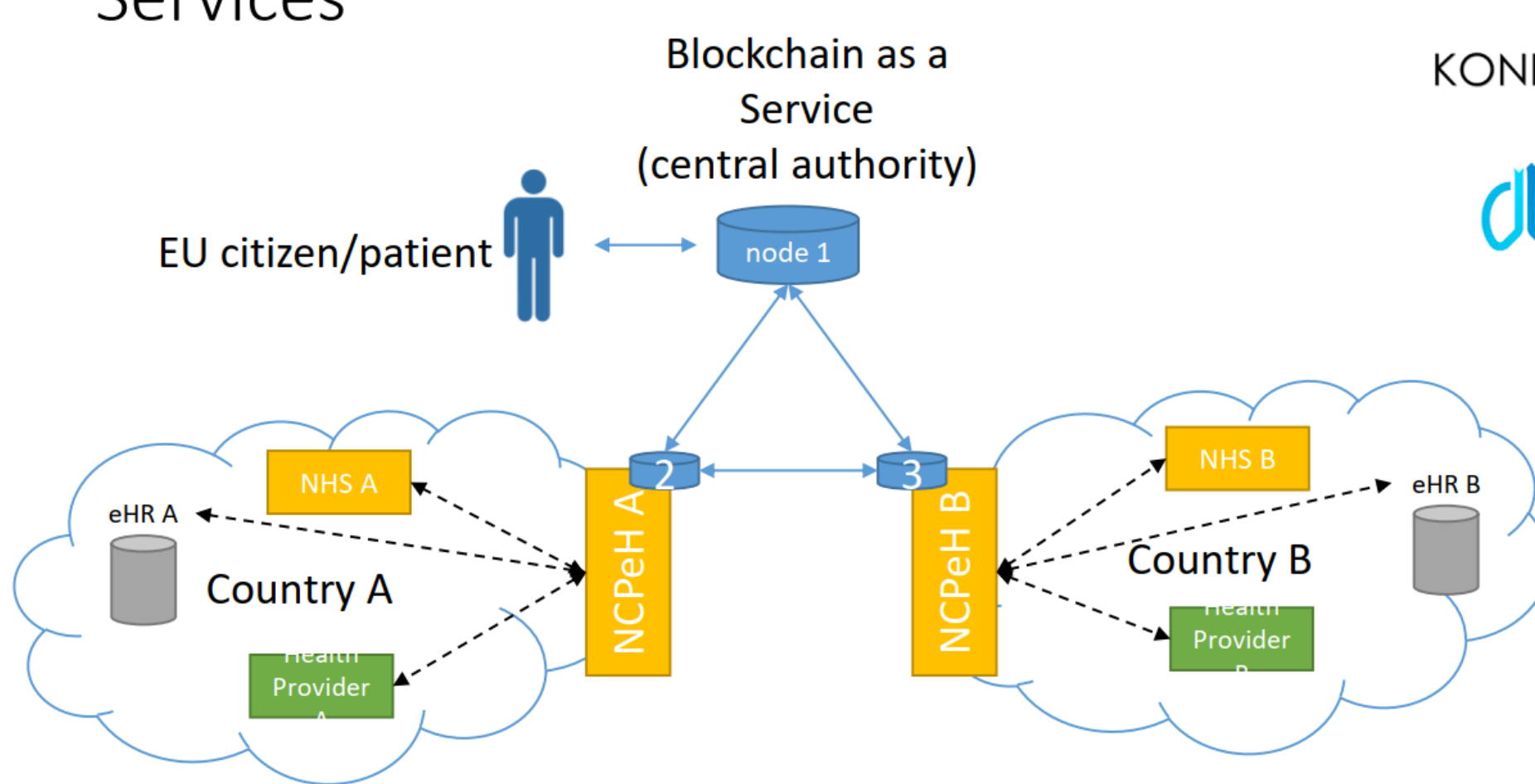
BaaS system

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**

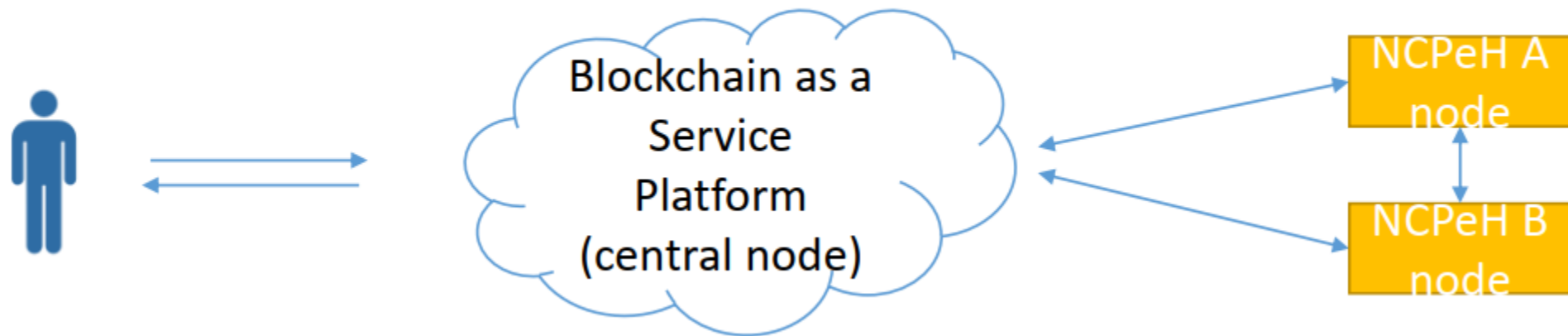
ACTIVAGE
PROJECT

Blockchain@CERTH for Interoperable eHealth Services



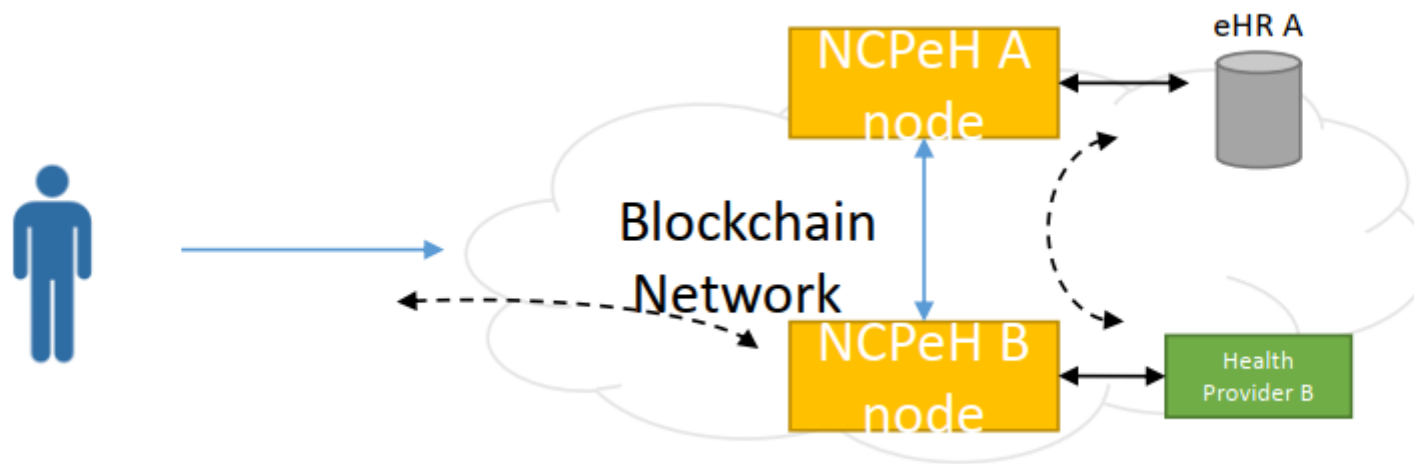
Scenario (1/3)

- New user registers to the Blockchain Service
- Once registered the user enters a personal Health Record ID
- The decentralized NCPeH nodes register an anonymised new user



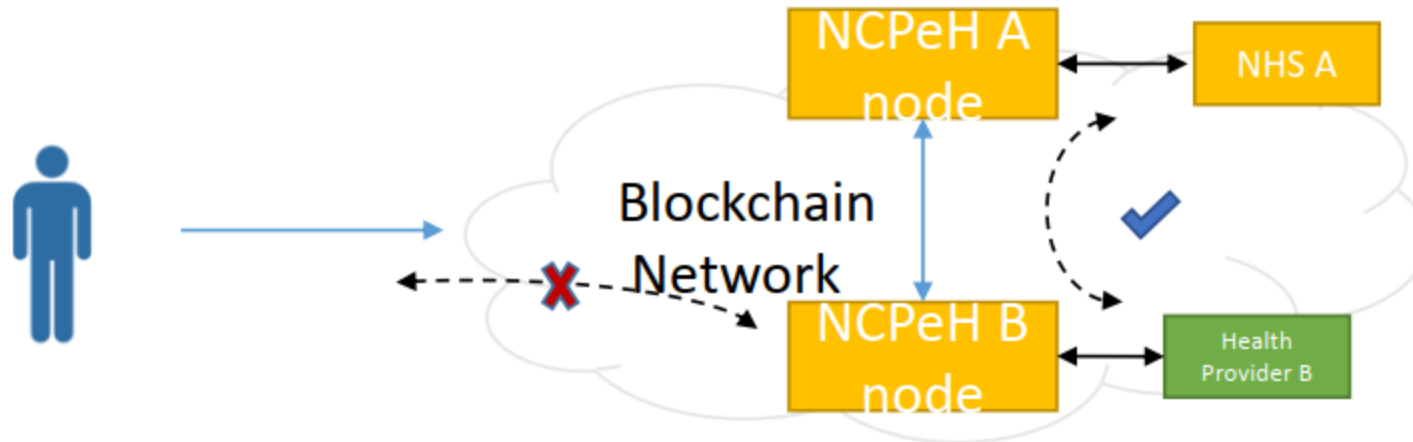
Scenario (2/3)

- User of country A is currently in country B and needs to use the healthcare system
- User permits Healthcare Provider B to access their personal Health Record from country A



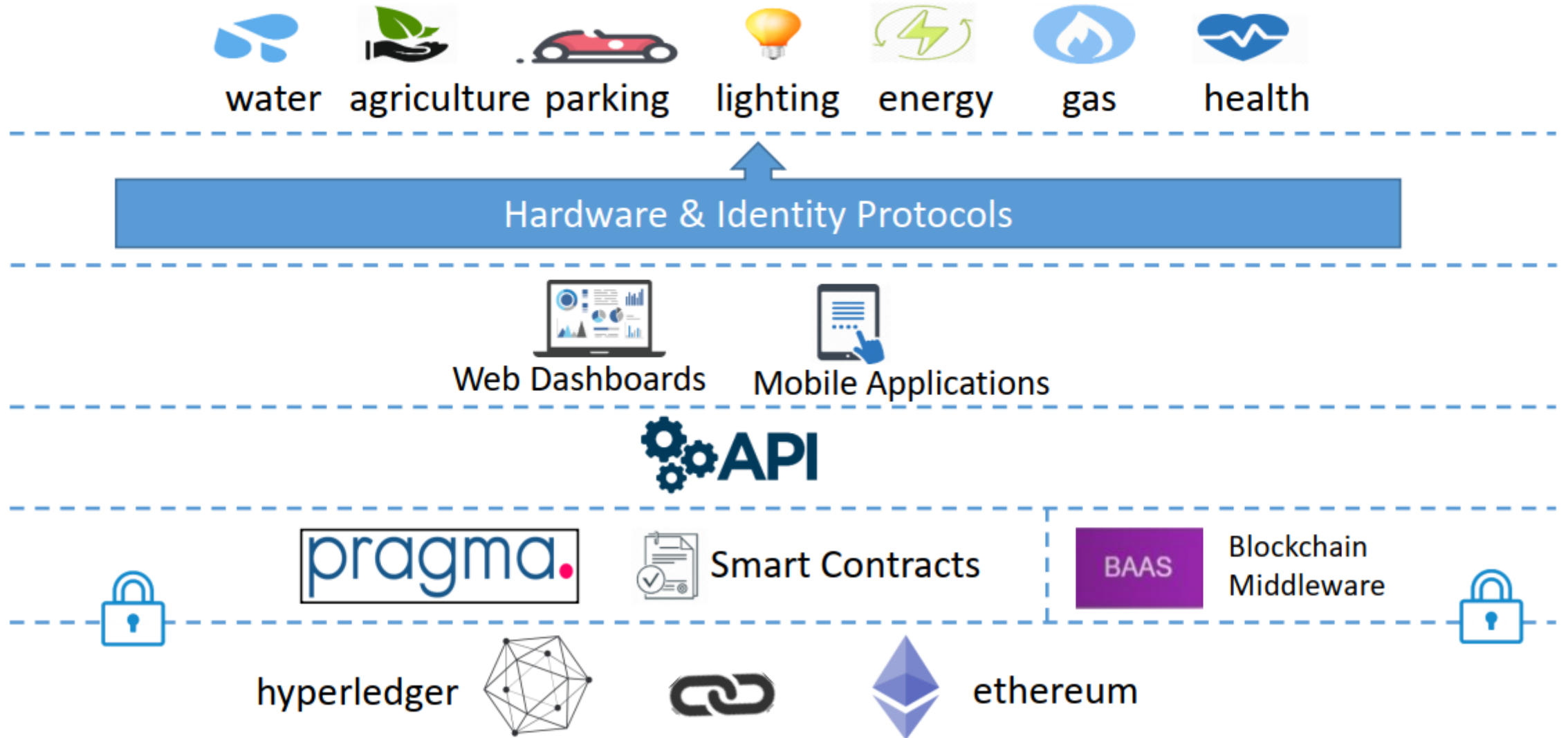
Scenario (3/3)

- Healthcare Provider B “requests” from NHS A to settle transaction (via smart contract)
- Once transaction is settled user permission is revoked automatically

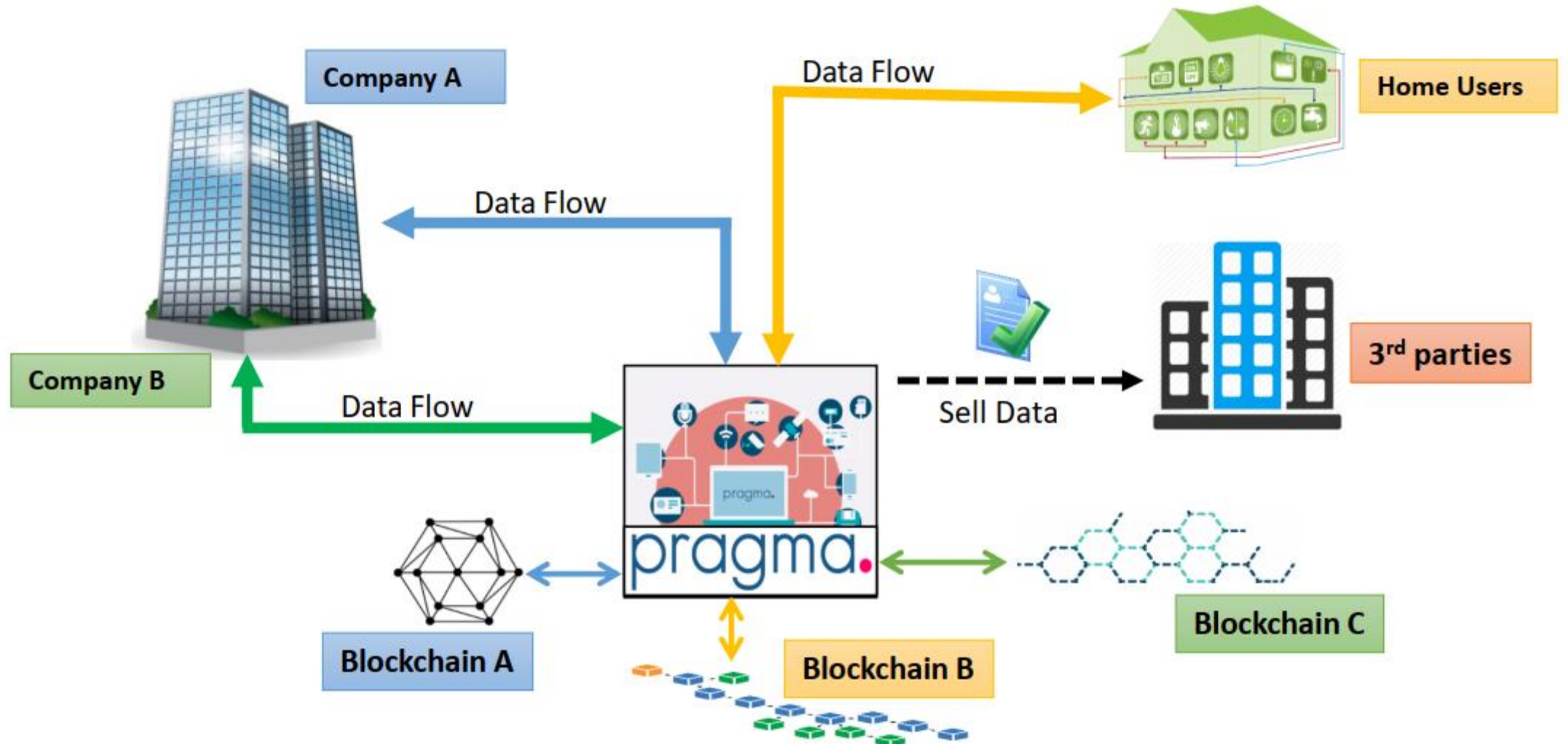


Blockchain in IoT

Pragma. Blockchain Architecture



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

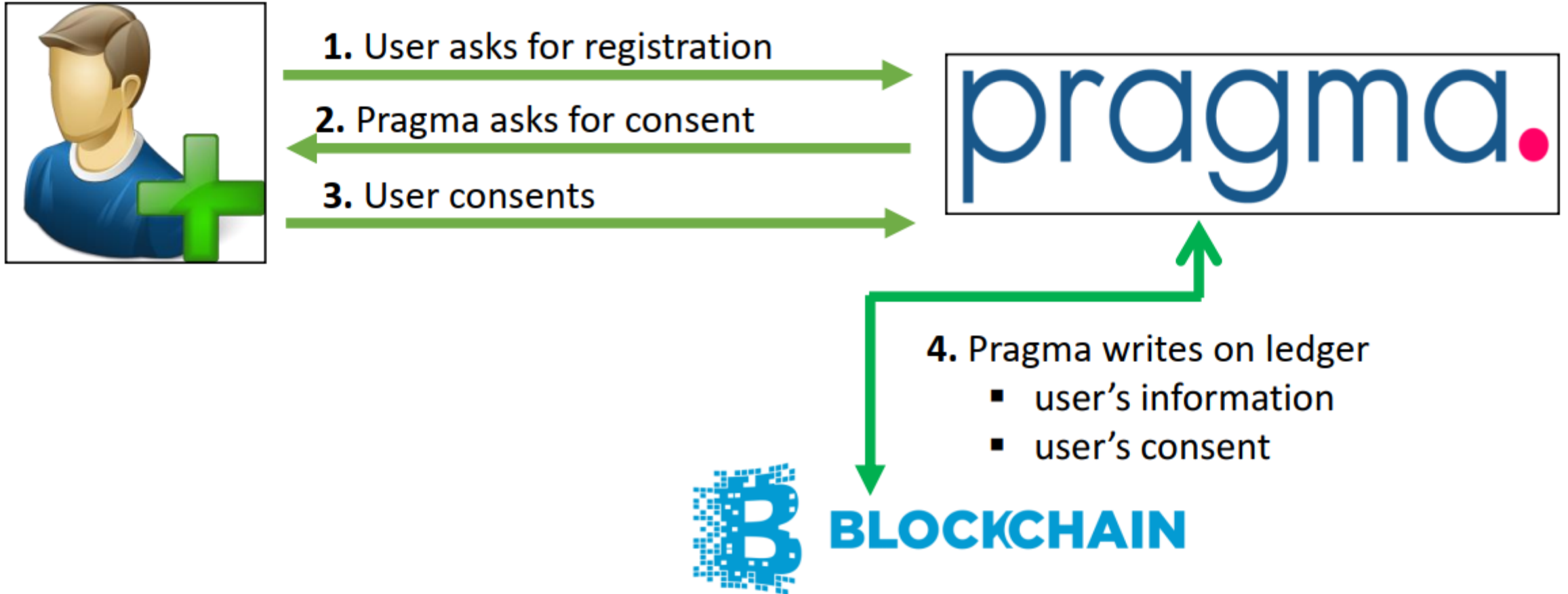
- User permissions
- Add devices
- Monitor devices

☐ Smart Contracts for Intelligence

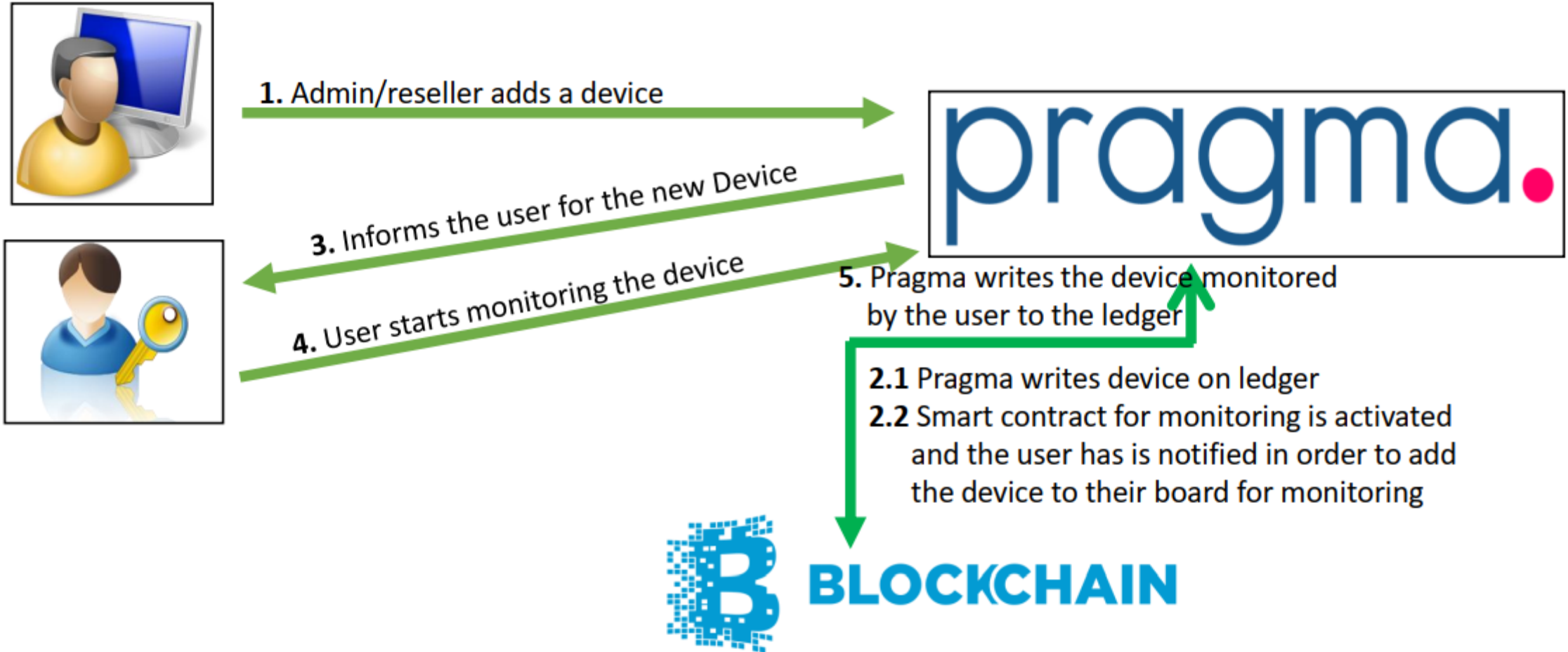
- Business-oriented → financial settlements based on smart contracts between Utilities & Prosumers/Consumers Electricity consumption
- End-user oriented → notifications on measurements



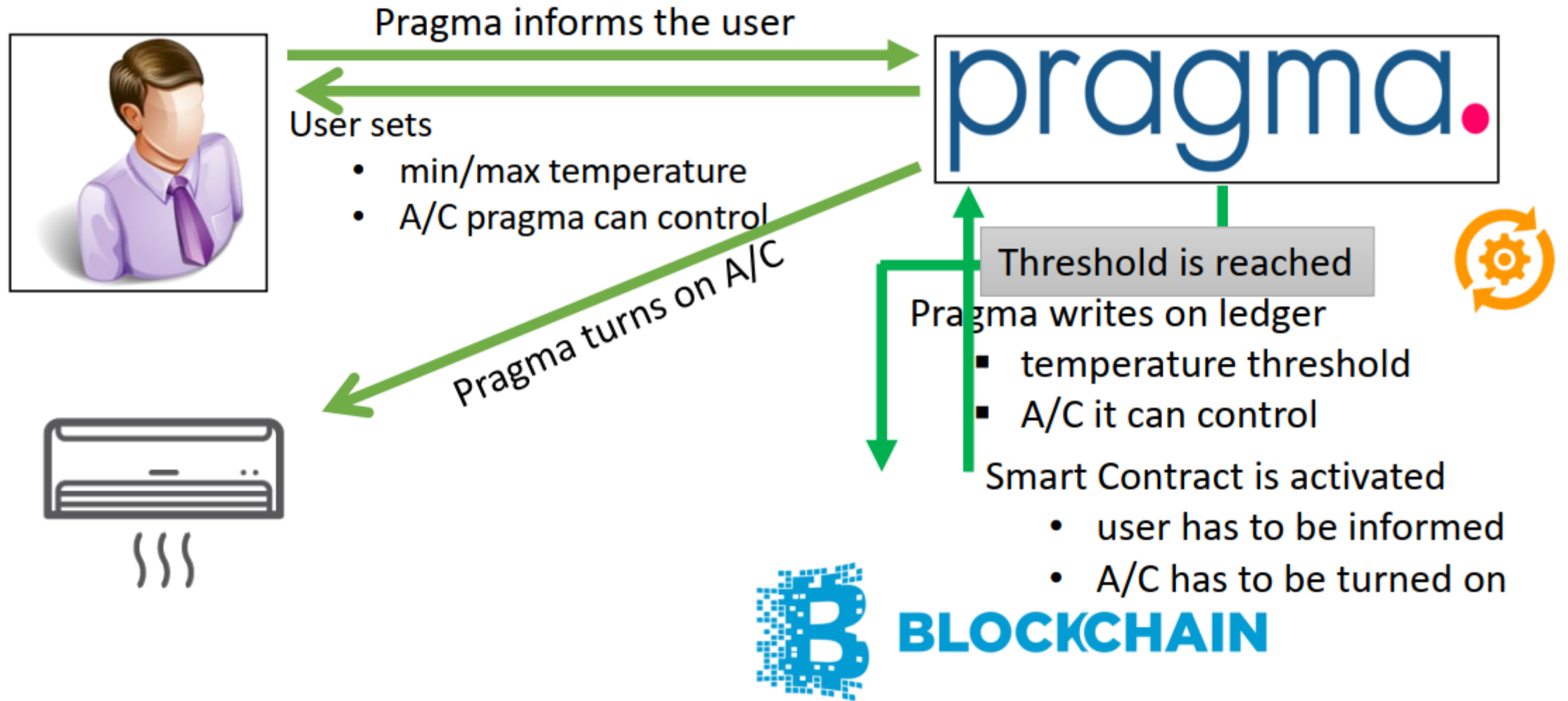
Inform consent flow



Add-monitor a device flow



Electricity daily use flow



Pragma. & Blockchain – Register User

The screenshot displays the Pragma. User Administration interface. A 'New User' modal is open, showing fields for login details (User type, User status, Username, Password) and contact details (First Name, Last Name, Email, Phone number). A red box highlights the 'Connected via Blockchain?' checkbox, which is checked. A red callout box labeled 'Connected to Blockchain' points to this checkbox. The background shows a table of users with columns for User Name, First Name, and Actions. The user 'blockchain-user' is listed with a status of 'Blockchain'.

pragma.

HOME BREAKDOWN COMPARE EXPLORE EVENTS PREDICTION REPORTS RULES ADMINISTRATION

Users Clients Portfolios Sites Costs Devices Device Groups Notifications Blockchain

User Administration
Create, edit and delete users. Select user roles to apply special permissions. Disable existing users and manage accounts. Upload user images. Edit contact details.

Search Users

Rows per page: 10 1 - 1 of 1

Connected via Blockchain?

Actions

blockchain-user Blockchain

New User

Login details

User type * Site User User status * Active

Username * Password *

Image

Contact details

First Name * Last Name *

Email * Phone number

SAVE

Pragma. & Blockchain - Notifications

The screenshot displays the Pragma. web application interface. The top navigation bar includes the 'pragma.' logo, a 'HOME' link, and a 'BREAKDOWN' link. A left sidebar contains a 'Monitored Points' section with a search bar and a location pin icon for 'Building 1. Grevena'. The main content area shows a timeline of notifications. Two orange boxes represent notifications: one dated '14/05/2018 10:30' and another dated '13/05/2018 15:45'. Both notifications are titled 'Building 1 - Grevena Out of bounds electricity measurements' and provide details: 'Site: Building 1, Grevena | Device: Electricity Meter | Measurement: Electricity | Value: 1.1 kWh' and 'Site: Building 1, Grevena | Device: Electricity Meter | Measurement: Electricity | Value: 0.9 kWh'. A red box highlights a notification details panel on the right, which includes a 'MARK ALL AS READ' button, a list of the two notifications with yellow warning icons, and a 'VIEW ALL NOTIFICATIONS' link. A second red box, containing the text 'Blockchain Notifications', is positioned below the highlighted panel.

pragma.

HOME BREAKDOWN

Monitored Points

Search Tree

Building 1. Grevena

Building 1 - Grevena Out of bounds electricity measurements

Site: Building 1, Grevena | Device: Electricity Meter | Measurement: Electricity | Value: 1.1 kWh

14/05/2018 10:30

Building 1 - Grevena Out of bounds electricity measurements

Site: Building 1, Grevena | Device: Electricity Meter | Measurement: Electricity | Value: 0.9 kWh

13/05/2018 15:45

MARK ALL AS READ

Building 1 - Grevena Out of bounds electricity measurements

Site: Building 1, Grevena | Device: Electricity Meter | Measurement: Electricity | Value: 1.1 kWh

Building 1 - Grevena Out of bounds electricity measurements

Site: Building 1, Grevena | Device: Electricity Meter | Measurement: Electricity | Value: 0.9 kWh

VIEW ALL NOTIFICATIONS

Blockchain Notifications

Baas & Blockchain - Blocks

BAAS

Administrator

Dashboard

Blocks

Transactions-I

Accounts

Contracts

Code Editor





Blocks

Blocks

Block #	Transaction id	Transactions Number	Family Version	Family Name
30	1d0417af244f34234d1b19e8b75e5526f6803469b5872fede2564cc113cd488642e2bdd15141486e48dd2ba9d9ec8aea76c43df1dd2db638fdc5b7b23ceae84b	1	1.0	notify-loT
29	3a2897a0b1133a8c66e7fa7713917965512f83c6dad9cef28253405777cb1dd070098c1ef1a2c1855d77a3c7235386a0c6be62e6bef583db8502d620e668136d	1	1.0	notify-loT
28	63a512465c3aa838d3f1f20000c353dc70b6289c085077f5e150de59e#fa6310746593f01e8d3d38d234d68686010e8755940f2373f023dfa700dc87cf11d3	1	1.0	notify-loT
27	7a8e022aab4282430871662f0d632cd81d977def40a0cd1b12a2533197cbda3942cb9a84fe4c9627e7cb66d91b4da36083ebfe07fd10c1dfd9342178f939a84c	1	1.0	notify-loT
26	3f5be38272b393c4dd6d17882495326f87a1076fccc23dbdb861127c0e68bf2d3e442a951deed4d1e12c411e573c21b913612b6f03845370cd59c736a464b443	1	1.0	notify-loT
25	e6cb8974820d942eae533475138d256c7736104b5db111f732b9ae0c34ef17967ffe0faa38f1a2a02bd088bbdb160f31f8b9e49186f736bd83df70164b70ab68	1	1.0	notify-loT
24	262af375e5a60e2482ddc005322c9c2e8d68fc124ba60776c577f56c7da7e7033a07c3a8d05ae04e6492be3790a4f0fd03cea5d954dac98a9c0f48b592069add	1	1.0	notify-loT
23	9b94f322459c7903bc40dac8d65c70e7f6d3f445d8bac7c8f05e6b9c301faae0fe11170f69c35fc3ed86311bf8d8c0d339b7f14d45fedea02738d9094913f9	1	2.0	pragma-loT
22	373f860cb383fabb14b075c898d12ea3061b2504e7bb742c7284e68f9e578692888f2eb5f5c158daea9a7318f81c701be519fa6869b8e08ad0e5f6666eb9036	1	2.0	pragma-loT
21	aa481caaeabc2384595f7668d61c27b17e49747a25f6e9f7b90411f75e934c7f3314f903930c45c1be87e067eaa8e0b8841becc0b5d3a89ad045a489cab6838	1	1.0	notify-loT

Page: 1 Rows per page: 10 1 - 10 of 30


Baas Blockchain registered users


BAAS Administrator		
 Dashboard	Accounts	
	Username	Account
	maria pappa	level03
	nikos karatasos	level03
	blockchain-user	level05
 Blocks	panagiota geraki	level04
 Notifications	sofia terzi	level01
	Page: 1 Rows per page: 10 1 - 5 of 5	
 Accounts		


Baas Blockchain notifications


BAAS

Administrator


Dashboard


Blocks


Notifications


Accounts

Notifications List

Username	Title	Type	Message	Timestamp
maria pappa	Building 2 - Volos Out of bounds electricity measurements	Warning	Site: Building 2, Volos Device: Electricity Meter Measurement: Electricity Value: 1.0 kWh	May 14, 2018 2:15:00 PM
blockchain-user	Building 1 - Grevena Out of bounds electricity measurements	Warning	Site: Building 1, Grevena Device: Electricity Meter Measurement: Electricity Value: 1.3 kWh	May 14, 2018 10:30:00 AM
panagiota geraki	Building 1 - Thessaloniki Out of bounds electricity measurements	Warning	Site: Building 2, Thessaloniki Device: Electricity Meter Measurement: Electricity Value: 0.9 kWh	May 15, 2018 3:30:00 PM
sofia terzi	Building 1 - Thessaloniki Out of bounds electricity measurements	Warning	Site: Building 2, Thessaloniki Device: Electricity Meter Measurement: Electricity Value: 0.9 kWh	May 13, 2018 8:45:00 PM

Page: 1 Rows per page: 10 1 - 4 of 4

Other applications and PoCs

- Blockchain and e-voting
- Blockchain in Energy sector
- Blockchain in Automotive sector
- Blockchain and ICO

Thank you

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Linkedin: <https://www.linkedin.com/in/sophiaterzi/>

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Information Technologies Institute, Centre for Research & Technology - Hellas

