Information Technologies Institute

KONFIDO

CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

On the design of a Blockchain-based system to facilitate Healthcare Data Sharing

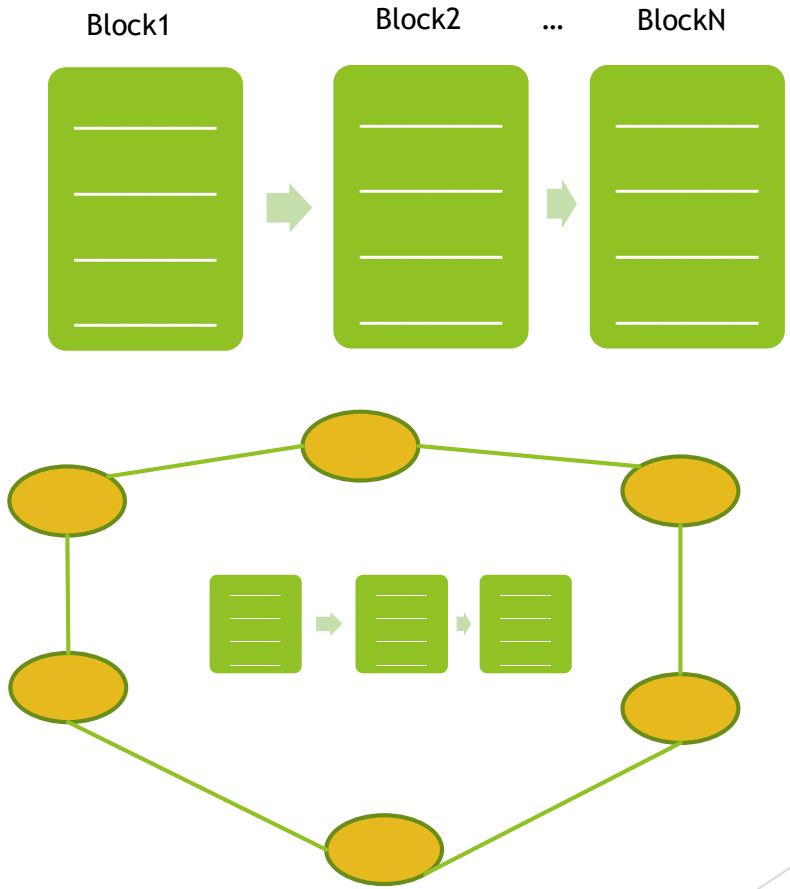
Anastasia Theodouli, Stelios Arakliotis, Konstantinos Moschou, Kostantinos Votis, Dimitrios Tzovaras

Overview

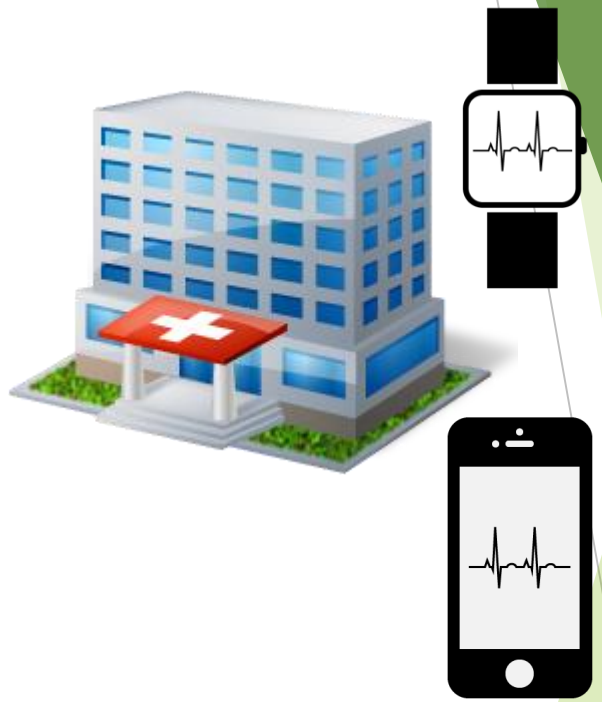
- Blockchain in Healthcare
- Motivation
- Contribution
- Setting
- System architecture
- Smart Contracts
- Use Case Scenarios
- Added value
- Acknowledgment

PRELIMINARIES [1/2] Blockchain

- What is Blockchain ?
  - A continuously growing list of records called blocks.
  - Each block represents a set of transactions and is cryptographically linked to its previous block thus forming a chain.
  - A Blockchain is managed by a peer-to-peer network of nodes that validate new blocks using a consensus algorithm.



PRELIMINARIES [2/2] Blockchain in Healthcare



- How can Blockchain be used in Healthcare ?
  - Healthcare data sharing
  - Facilitate Interoperability between Health Institutions
  - Permission Management of Electronic Health Records (EHRs)
  - Secure Patient Data Storage and Retrieval
  - Pervasive-social-network (PSN) based Healthcare
  - Clinical Trial Authorization (CTA) details governance
  - Enhance transparency and traceability of the Consent given by Patients involved in Clinical Trials

MOTIVATION

- Access of medical research centers to healthcare data stored on Web / Cloud Clinical Platforms via eHealth and mHealth can lead to the creation of a **'distributed pool of data'** of **medical treatments** and **healthcare outcomes**
- Medical Researchers can filter out specific features of the data, and
  - Create **demographic cohorts**
  - Enhance **precision medicine**
- A positive impact on medical research innovation.

- **Healthcare data** are highly **sensitive** and Data Owners (i.e. Patients) may hesitate to share them for research purposes
- Disclosure of Healthcare data have as a consequence:
  - Negative impact on Patients' health
  - Social and financial implications
    - Employers
    - Insurance companies
    - etc.

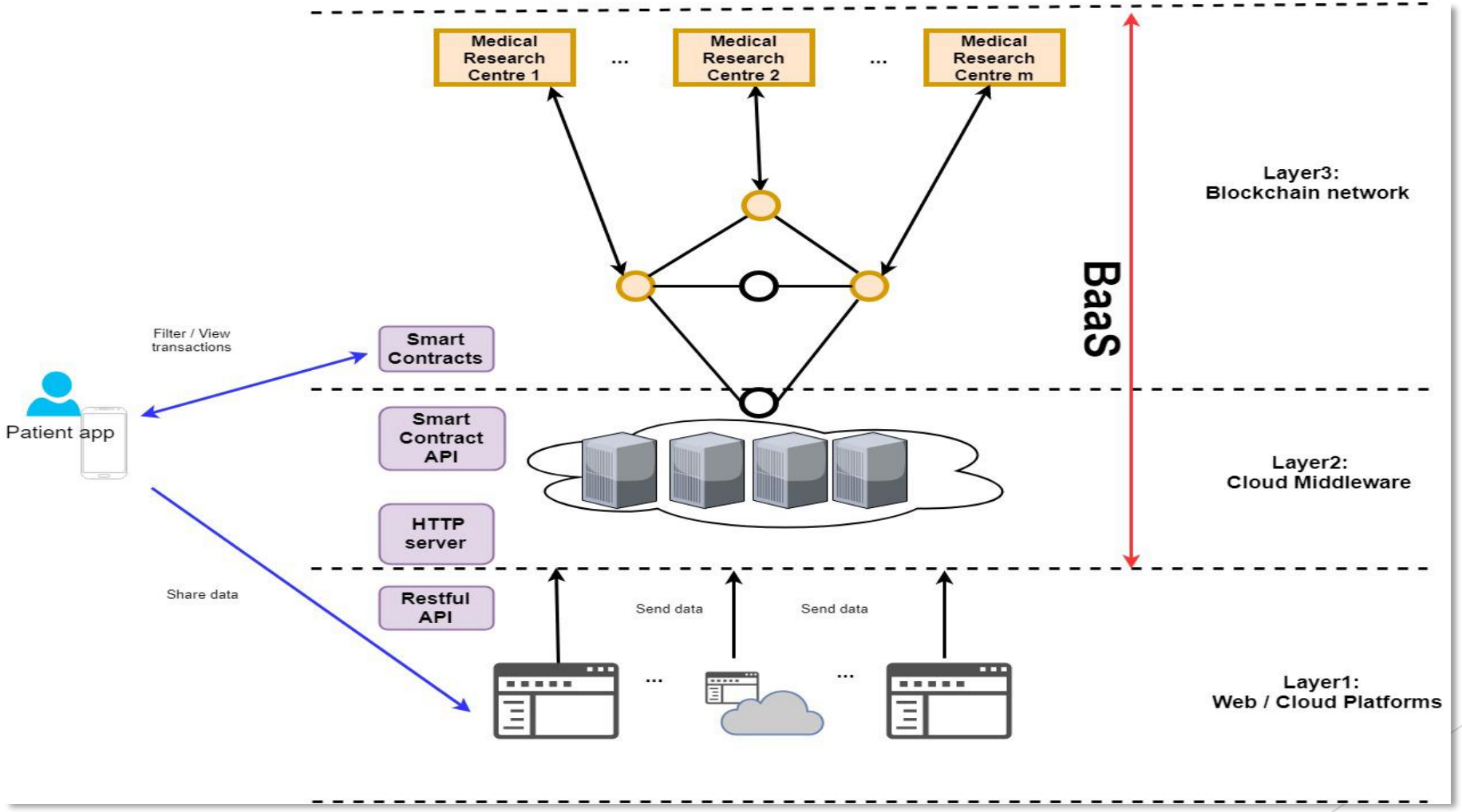
OUR CONTRIBUTION

- To alleviate Patients' above concerns as regards their data sharing, we propose a **Blockchain-centric system architecture design** that facilitates healthcare data sharing and healthcare data permission handling ensuring:
  - **Integrity of shared Data**
  - **Patient pseudonymity**
  - **Auditing and Accountability**
  - **Workflow automation using Smart Contracts**
    - **Transaction-aware State Machine**
    - **Enable (quasi) Turing-complete fully-programmable logic in the way that Blockchain state changes**
    - **Automatically executed upon a pre-defined set of rules**
    - **Tailored to approaches tackling with complex scenarios**

SETTING

- **Involved Entities / Incentives**
  - **Patients:** They want to share their Healthcare Data, preserving privacy and security
  - **Medical Research Centers:** They want access to the Healthcare data stored on Web/Cloud Clinical Platforms for research purposes
  - **Web/Cloud Platforms:** They can export the Data in appropriate format for sharing; no need to be Blockchain nodes
  - **Validators:** subset of Blockchain network nodes who assemble new blocks of valid transactions
- Blockchain model
  - **Consortium Blockchain** with off-chain validation of the Medical Research centers before they become **trusted** nodes of the Blockchain network

SYSTEM ARCHITECTURE



SMART CONTRACTS

Registry Contract (RC)

User Uniquely Identifying field	PDC contract address

Patient Data Contract (PDC)

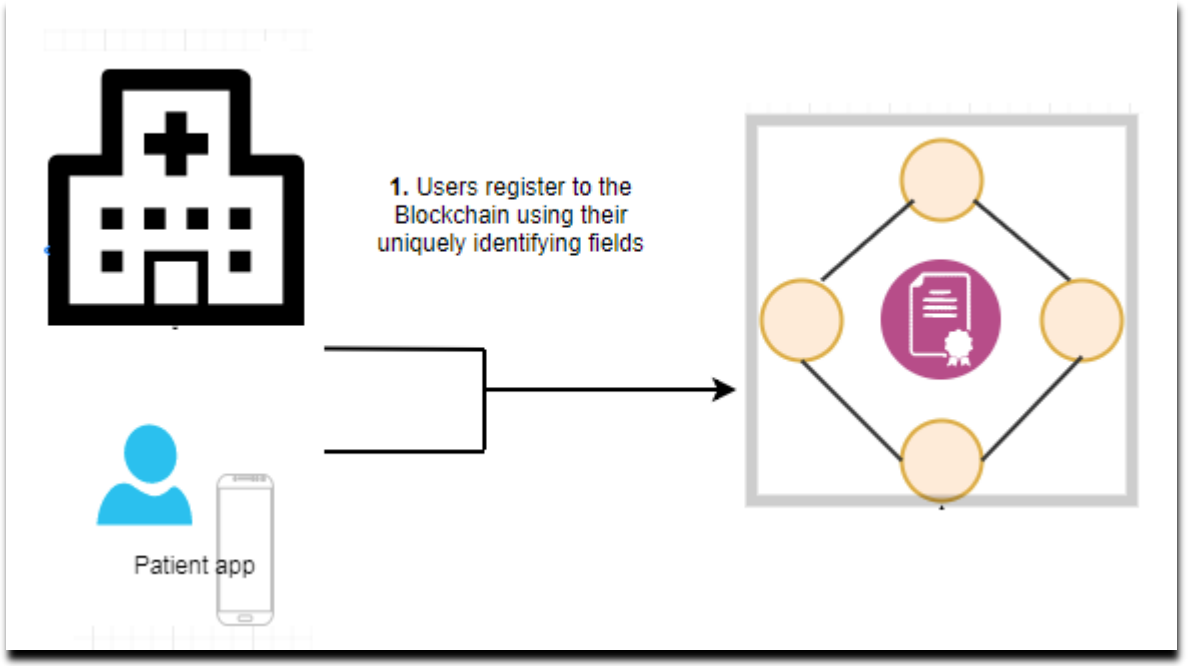
Patient Hashed Healthcare data	Data URL pointer

Permission Contract (PC)

PDC contract address	Medical Research uniquely identifying key	Permissions status

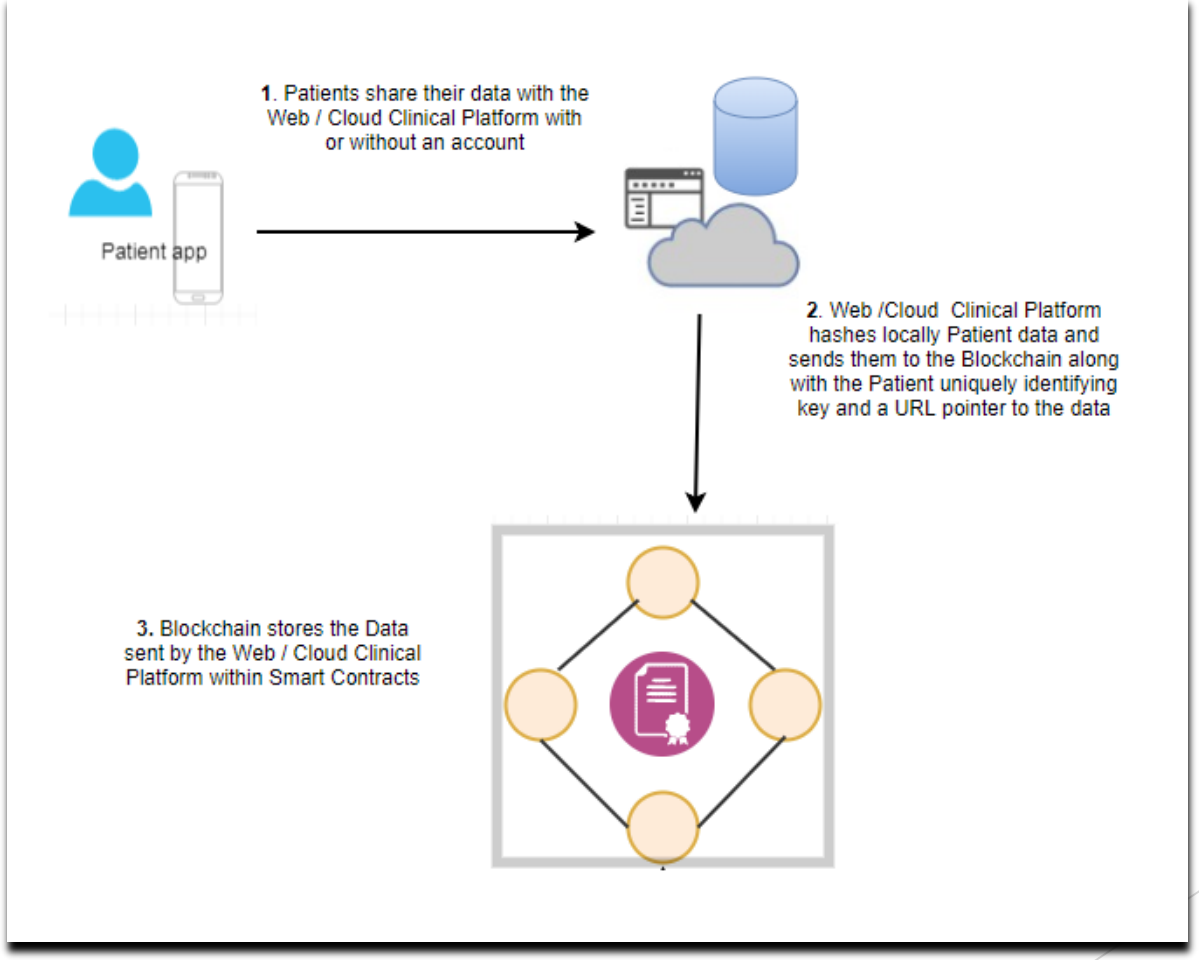
USE CASE SCENARIOS [1/3]

- User Registration
- Patient Data Sharing
- Request Permissions



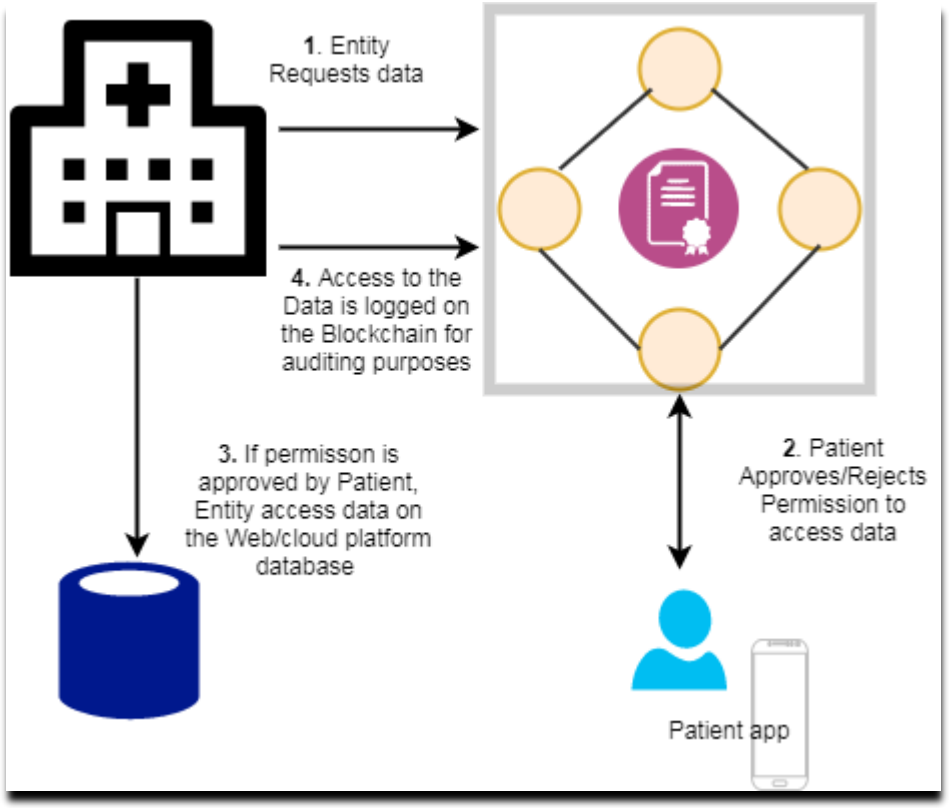
USE CASE SCENARIOS [2/3]

- User Registration
- Patient Data Sharing
- Request Permissions



USE CASE SCENARIOS [3/3]

- User Registration
- Patient Data Sharing
- Request Permissions



SYSTEM VALUE

- **Data Integrity:** the medical research centers can check if the data downloaded from the Web/Cloud clinical platform have not been tampered with.

- **Patient Pseudonymity:** Patients participate in the system only with their uniquely identifying field and not with their personal data.

- **Auditing:** Patients can view their past transactions via an app.

- **Workflow automation:** each time a medical research center wants access to a Patient data, the procedure is executed automatically using smart contracts.

- **Accountability & Immutability of transactions:** Off-chain verified Entities participate to the network as Validators

ACKNOWLEDGMENT

- Authors acknowledge support from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 727528 (KONFIDO- Secure and Trusted Paradigm for Interoperable eHealth Services).**

- Thank you for your attention !
- Any questions ?

Contact:
anastath@iti.gr
kvotis@iti.gr