This project aims to revolutionize water management in Greek smart cities through a permissioned blockchain network based on Hyperledger Fabric. The initiative addresses key challenges in traditional water management systems, such as inefficiency, lack of security, and limited data transparency.

By integrating blockchain technology with IoT infrastructure, the project enhances the capabilities of Water Management Authorities, offering a secure, transparent, and efficient solution for monitoring, analyzing, and managing water resources.

Main Contributions:
- Implement a secure, blockchain-based IoT network for water management using encrypted communication technologies.
- Deploy a network with trusted entities and roles, ensuring a highly specific architecture and business logic.
- Deploying Chaincodes that are necessary to implement the functionalities.
- Develop Ricardian contracts for automated decision-making agreements.
- Develop a Hyperledger Fabric blockchain automated framework for initial monitoring and management the network.

Implementation:

The project has successfully established a blockchain network encompassing five distinct organizations, each playing a crucial role. The cities of Zagori and Zitsa represent regional entities, while DOTSOF: Technologies acts as a controller, monitoring the role of the government. For research purposes, ATHENA RC and CERTH are integral participants. This network is structured around two primary channels: a shared communication channel for inter-organizational interaction and individual channels dedicated to each organization for handling private data.

Integration of IoT Technology:

In the regions of Zitsa and Zagori, a total of 147 IoT water meters have been used, along with the necessary gateways. These devices meticulously discover water usage data, which is then securely transmitted to their respective blockchains. The project has achieved an integration of blockchain technology with IoT data.

User Interface and Contract Management:
A dedicated website has been developed for users, offering functionalities such as contract creation, consultation, and regional statistics viewing.

Organization, Channel, and Policies Architecture and Network Deployment:

The SUSANNA ecosystem is designed to revolutionize water utility management through its transformation into a permissioned blockchain network. This sophisticated architecture enables secure and efficient communication via a "firewalled" gateway, where transactions are authenticated using private keys.

At the core of this system are the participating organizations within the Hyperledger network, categorized into three distinct levels based on their authorization and function:

- Water Management Organizations: Includes Zagori and Zitsa municipalities in Greece. These entities manage private channels for IoT water meter data, user information, database analytics, and smart contracts.
- Control Level Entities: Comprising governmental or independent authorities, which plays a pivotal role in governance and oversight.
- Research Entities: A group consisting of NGOs, research centers, and universities such as ATHENA RC and CERTH, focusing on statistical analysis.

The architecture employs a hierarchical model, allowing each organization to access multiple channels tailored to their specific needs. DEYAs, for instance, not only handle their private channels but also collaborate with government agencies through dedicated channels for state inspections and regulatory compliance. A unique feature of the framework is that it allows all DEYAs and government public agencies, facilitating the integration and encrypted storage of user information.

Chainscodes:

Chainscodes, central to the project's functionality, were meticulously developed and deployed. These smart contracts, categorized into:
- Data Contracts: responsible for receiving and providing all the information needed (Asset, Info, Readings, Readings Bridge).
- Trigger Contract: responsible for automated or semi-automated actions and events like possible water leakages, warning if the water consumption exceeds, issuing bills, terminate the contract.
- Ricardian Contract: incorporates functionalities to initialize Ricardian contracts, templates and instances within the Hyperledger Fabric, and to subsequently trigger them as required.

Chainscodes played a pivotal role in managing water meter data, automating responses to specific triggers, and ensuring legal compliance within the blockchain ecosystem. This implementation not only streamlined water utility data management but also fortified the system against unauthorized access and manipulation.

Smart Ricardian Contract:

In our blockchain ecosystem, Ricardian contracts are crucial for embedding legal terms into Chaincodes, ensuring legal integrity and digital efficiency. These contracts, crafted in collaboration with the Water Management Organizations, are deployed and implemented using the Accord Project's tools. The contracts that each customer signs are converted into computer-readable language, verified by the blockchain, and automatically activated for specific operations like managing water leaks, faulty meters, consumption limits, billing services, and termination processes.

Blockchain Automated Framework and Management System:

A fully automated framework has been developed, which not only initiates and monitors each node within the network but also offers scalability. This capability is evident in its capacity to integrate new organizations or contracts, ensuring the system's adaptability and future growth potential.

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References: