How Blockchain Technologies can Promote the Creation of Smart Services in Smart Shires

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1. Introduction

In recent years, advances in the ICT domain were focused mainly on "smart cities", offering a set of strategies aiming at improving and optimizing services offered to citizens. All these services have been mainly devoted to dense metropolitan areas. In the long-term, these efforts will have two relevant social effects: on one hand, they improve the life of the citizen. On the other hand, they will strengthen the differences among different areas of the same country or region. The problem is not just a matter of "digital divide", and it is not possible to trivially replicate smart cities services, or ask to deploy the same technological infrastructures, in a decentralized area. Indeed, the different economic circumstances make smart cities related solutions not feasible in the considered contexts.

The PRIN "Smart Shires" project aims at devising a software architecture promoting the development of sustainable, secure and opportunistic solutions for the deployment of smart services in decentralized areas. These solutions must be cheap and not strictly dependent on the presence of classic ICT infrastructures. Digital resource scarcity must be overcome through sharing and adequate organization of data, computation and communication resources. This is accomplished by integrating legacy access network infrastructures with alternative cooperative approaches, based on opportunistic and community-based mesh networks. Similarly, based on the specific service to host, computation might be performed either on the cloud, on an edge cloud, or on completely decentralized architectures, by guaranteeing the desired level of privacy. Even decentralized storage is a potential solution that allows storing data without relying on centralized data silos. The overall sharing of network, computing and storage resources must be securely traced and rewarded.

To this extent, scalable blockchain based techniques can be of help to provide accountability and incentives management, since they offer proof of cooperation, which can be automatically

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awarded via smart contracts and the distribution of crypto-tokens to be employed in the smart services ecosystem. Indeed, the fewer the resources the more the cooperation needed. In a "Smart Shires" scenario, more than ever there is a need to incentivize users' collaboration and discourage selfish free-rider behaviors. A goal of the project is to create an environment where all users (or better prosumers) are interested in keeping the system operational and healthy. Trust and incentive-based schemes can be devised that resort to blockchain technologies. The aim is to enact a sharing economy, where operational decisions and rewards inside a blockchain are orchestrated as a Decentralized Autonomous Organization (DAO). Through the proper design of a smart contract-based architecture, a decentralized layer will provide token-based rewards and decentralized voting capabilities. Smart contracts will allow implementing token-based rewarding schemes, without the need for a third party [1]. Depending on the applications, tokens can be fungible (i.e. they can be earned, like bonus points, and spent, like cryptocurrencies, e.g., ERC-20 [2]), non-fungible (NFT, i.e. each earned token is different from others and has its own value, e.g., ERC-721 [3]), or even of different types (e.g., royalty tokens, composable tokens). At the same time, Smart Shires services could rely on traceability and anti-tampering properties provided by blockchains. Some specific aspects of collaboration between the participants in the smart architecture (as well as the interactions between the components of the distributed architecture) could be enhanced using specific machine learning techniques.

This oral communication will be devoted to present the project and highlight how a blockchain based software architecture can promote its effective deployment. Focus will be given to a possible use case related to eHealth monitoring, based on the need to securely handling transmission of sensitive data, in absence of Internet connectivity, through trusted data mules.

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