

# **Project Development Phase**

## **No. Of Functional Features Included In The Solution**

Team ID	NM2023TMID04427
Project Name	Project – Tracking Public Infrastructure And Toll Payment Using Blockchain

### **I. INTRODUCTION**

BLOCKCHAIN was initially introduced as a distributed ledger of the Bitcoin [1]–[3] system for the purpose of addressing the double-spending problem of the cryptocurrency. One of the key features of blockchain is that, thanks to the immutability of the distributed ledger, it allows transacting parties and stakeholders to establish trust among untrusted entities in a decentralized manner. Due to the huge success of Bitcoin, blockchain has attracted great attention of the research community as an emerging technology. Although blockchain originated as an infrastructure for cryptocurrency, it has become a distributed system technology that inspired and drove a wave of paradigm shift from centralized to decentralized and dynamic system architecture.

- We present a comprehensive survey of the techniques for integration of blockchain and IoV paradigm towards building a future ITS, starting with describing the preliminary background including blockchain technology, edge computing, ITS and IoV.
- We discuss the challenges associated with IoV, highlight the importance as well as motivations of the convergence of blockchain and IoV, and point out the specific challenges which can be addressed by blockchain.
- We present the state-of-art research efforts and in-depth discussion on the adoption of blockchain for IoV scenarios, with a particular focus on vehicular data security, vehicle management, and on-demand transportation services.
- We highlight a number of blockchain-empowered IoV architectures, including the potential integration of blockchain, edge computing, vehicular communication systems, automotive technologies, and privacy preserving techniques.
- We identify and investigate the key challenges associated with blockchain integration with IoV, including security & privacy, performance, IoV-specific & optimized consensus, and incentive mechanisms.

- We outline a number of open issues and challenges as future research opportunities in the area of blockchain, IoV, and vehicular cyber-physical systems.

## 2. PRELIMINARIES OF THIS SURVEY

In this section, we present a brief discussion on the preliminaries of this survey, in where we present the overviews and recent advances. The preliminaries include blockchain technology, edge computing, and Intelligent Transportation System & Internet of Vehicles.

### Blockchain Technology

Blockchain is a collection of blocks, where the blocks stores transactions, records, and scripts, and all blocks are linked together to build a chain based on some cryptographic techniques. The newly generated blocks are continuously affixed to the chain in a digital ledger, and the ledger is maintained by all participants in the network. Hence, blockchain is also called a distributed ledger technology (DLT). As mentioned in introduction, blockchain enables a platform to do trusted tasks and transactions in an untrusted environment without requiring a trusted entity.

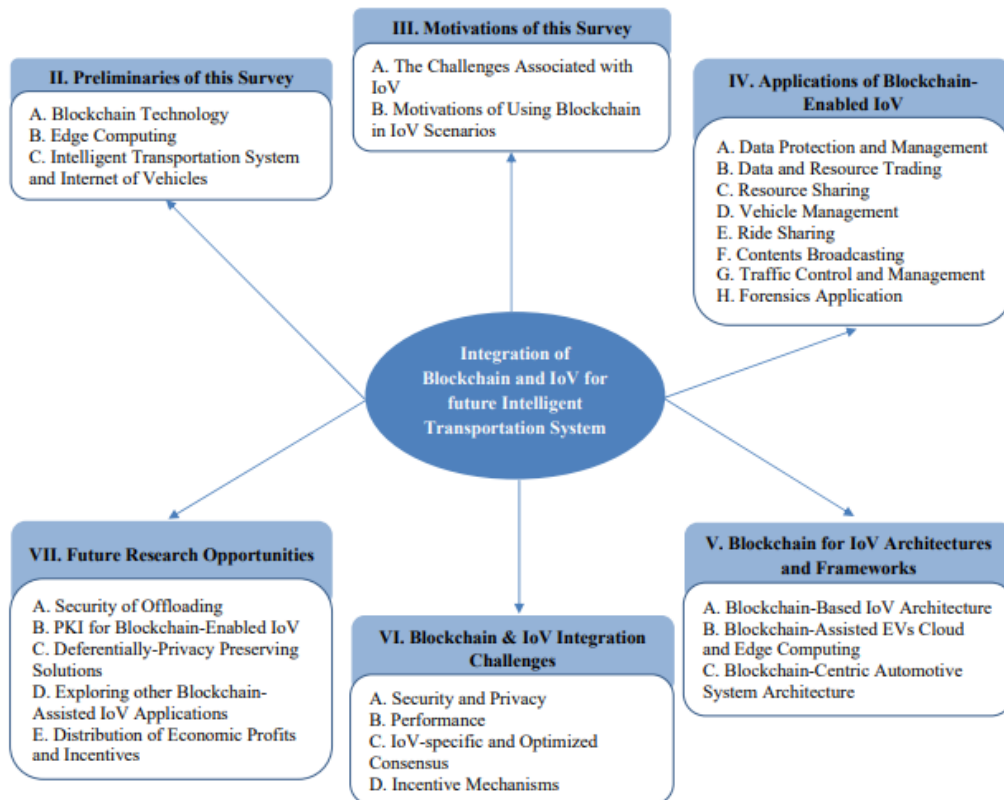


Fig. 1: Outline of the key topics of this paper.

**Smart Contract:** The smart contract are scripts resided in blocks of blockchain. The scripts are able to execute automatically once triggered or some pre-defined rules are met. The smart contract has become popular recently after the introduction of blockchain. The main aim of implementing the smart contract in blockchain is to develop a highly autonomous system which can provide efficient and consistent services without depending on any trusted entity.

## **Edge Computing**

The edge computing concept is introduced as an extension of cloud computing to bring its capability to the edge of the network. Different literatures use different names of edge computing, such as fog computing and cloudlets, but the main aims of this concept are almost similar

Edge computing has become an integral part of IoT and CPS applications [69]–[74], IoV applications [75]–[78], and blockchain [79]–[82], to support a massive number of smart devices by running computational-intensive tasks and storage data at the edge. Specifically, in the context of IoV and ITS, to improve the quality of services while considering the mobility, the edge computing nodes are distributed frequently alongside the roads.

## **Intelligent Transportation System and Internet of Vehicles**

Recently, CPS has become popular and has been widely implemented from all aspects of our lives to industries. The ITS, considered as future transportations, is one of the examples of CPS. The ultimate goal of ITS is to develop more comfortable, safer, dynamic, and efficient transportation as well as urban infrastructures.

At the same time, the automobile industries are developing the technologies behind the smart vehicles, and thus, the vehicles are changing the experience and way of travelling. The smart vehicles as shown in in Fig. 2 (a) are typically equipped with in-vehicle computational & storage units, EDR, control units such as ECUs & OBUs, software & firmware systems, diverse number of sensors, and multiple wireless devices. In this context, to take necessary actions, the control units rely on the data generated from the sensors and cameras, and the communications among all these components are built on different types of wired (CAN bus and LIN bus) and wireless (Bluetooth) technologies. These advanced technologies might incorporate into traditional vehicles soon. Moreover, with these advanced technologies, the vehicles are becoming even autonomous and semi-autonomous, which have the potential to create a revolution in the ITS.