Assignment #4
Subject:Computer Networks
Section:C
Assignment Members:20L-0941, 20L-0984

Blockchain based Intelligent Transportation Systems

Abstract:

Block chain is one of the lead technologies with everyone curious as to how it works or provides services.Block chain has been the answer by many to the fact that due to rapid advances of technology a lot of personal data is no longer safe and sold to companies or worse used by hackers to extort people financially.Block chain tackles this by providing a decentralised system to store data.This is achieved by a decentralised network consisting of large amount of unreliable nodes and the data is permanently and irreversibly stored in a tamper proof manner.So in this assignment we will look into how block chain can be implemented in intelligent transport systems. Here the main user for blockchain in the intelligent transport system is assumed to be people who are interested in traffic information and to ensure that this data is validated we will use a user rating system to ensure integrity of data.

Introduction:

With the ever increasing advancement in technology it has become plausible for vehicles and mobile phones to provide up to date traffic data. The reason for such a system to exist is once again within the advancement of technology with more people now being

able to afford cars it becoming more and more difficult to manage the increasing amount of traffic. This high amount of traffic results in cost increase as cars are left stuck running in traffic for longer and longer periods of time. This is compounded by the fact that increasing the number of vehicles increases the probability of accidents. It is becoming more and more necessary to somehow automate transportation while also preserving the users anonymity and data.Thus it is imperative that an intelligent transport system is implemented which also is immune to data leaks or loss.So basically after implementation of a ITS(intelligent transport system) automobiles will be able to communicate with each other about their direction of travel relative velocity and traffic conditions in the road up ahead.Due to this information being provided to the autonomous automobiles it is estimated that around [1] 79% of crashes will be avoided.. By exchanging messages regarding traffic conditions and information on safety and accidents, global traffic control can reduce environmental pollution, accident rates, and traffic jams [2], [3] while enhancing convenience, comfort, and safety.Along with this pedestrian and public transport will also be improved greatly with there being a rapid increase in implementation of ITS initiatives such as s ERTICOITS Europe [4] and CityVerve Manchester [5], that can contribute to the development of smart cities.Now having each device having transmitting data is necessary for a successful ITS but the issue is that the data exchange required to pull this off will be enormous and considerable network traffic.Moreover the complex exchange of data between multiple IOV(internet of vehicles) on multiple networks is paramount for its success.For example bitcoin [6] has revolutionised the digital currencies since its introduction such as bitcoin.This technology represents a distributed ledger which contains an immutable log of transaction occurring within a network.Although the primary research focus is on the use of Blockchain in the financial sector, recently, the scientific communities have shifted their attention to the Internet of Things (IoT) [7] and adopted it to generate a decentralised, trustworthy, and secure environment. The work we have done is to read multiple papers to ascertain the feasibility of blockchain being implemented in IOV(internet of vehicles).

Methodology:

The process of our research would be first to invent a hybrid blockchain that will compile anonymity with sharing of data.
After that we will conduct surveys to find out how much information are people comfortable with being shared even with the assurance of no leakage of data.
After which testing will be done with packet sizes on multiple networks to find which packet size is best suited for transmission of data over multiple networks.
Finally a method for achieving the reputation of users that can be trusted will be pursued.

Related Work:

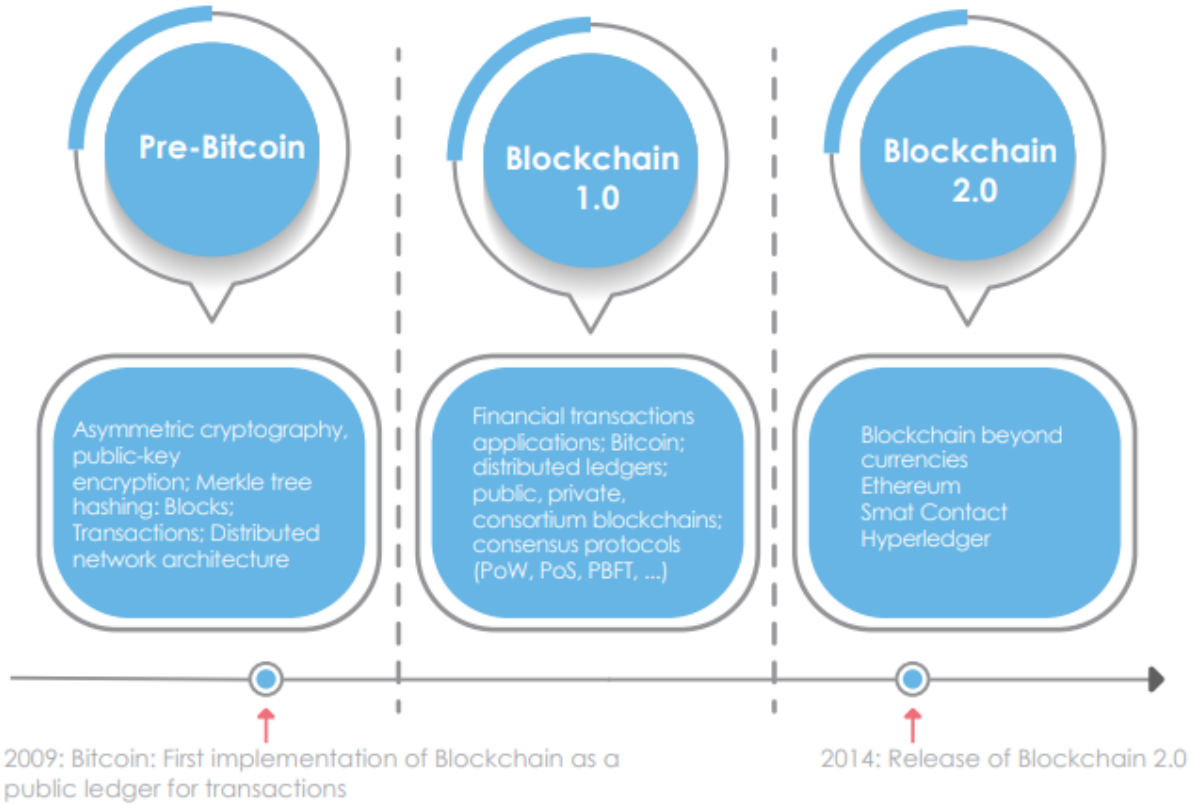
Paper#1:

Blockchain Technology for Intelligent Transportation Systems: A Systematic Literature Review Rateb Jabbar, Eya Dhib, Ahmed Ben Said, Moez Krichen, Noora Fetais, Esmat Zaidan, Kamel Barkaoui

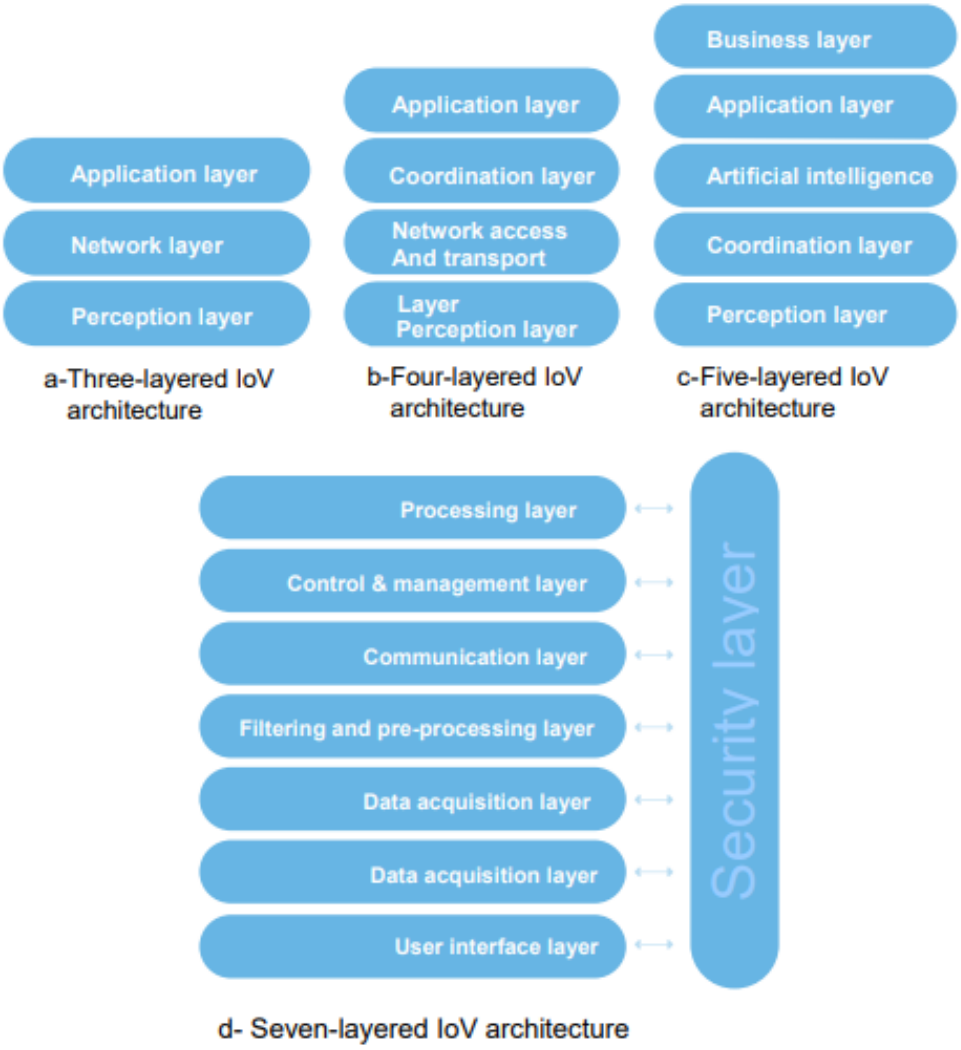
The paper talks about 3 types of blockchain [1](private, public, and consortium) and then goes on to explain the private Blockchain, also called permissioned Blockchain, is a closed and access-restricted system where only pre-verified persons who satisfy certain requirements are allowed to perform certain actions on the Blockchain. Most small-range organisations and business Blockchains favour this Blockchain type; however, it is not suitable for trading scenarios. In contrast, the public Blockchain presents a wide-open permissionless system where anyone can join and have full rights to use it. The auditability and transparency of information are more appreciated because no access limitation is imposed. However, the cost of related mining operations, delay,

and synchronisation among all participating nodes are high. Public Blockchains are not recommended for long delays or energy-sensitive domains. These two Blockchain types are considerably self-explanatory. The third type, consortium Blockchain, is between the two aforementioned types; it is a semi-private and semi-open Blockchain system where only organisations or participants with the same goals could join the group. It ensures scalability, acceptable delay, and reasonable costs.Then it discusses the over complexity of blockchain and how it manages to keep the data safe and secure from all possible threats mainly by decentralisation of information and each system containing blocks of information that ven if one block is compromised the other remain intact while also preserving the data integrity.It also discusses about hash chains and how hash pointer are used for pointers and add a next level of security.

We also discuss the history of the block chain as shown in the diagram below.



Then it goes on to discuss IOV architecture which includes 3-7 layers of architecture as mentioned below in image.



Paper#2:

Blockchain-based Reputation for Intelligent Transportation Systems By

Liviu-Adrian Hîrţan ,Ciprian Dobre, Horacio González-Vélez

In this paper the discussion i s primarily regarding how to calculate multiple reputations.This will be achieved by users and central servers with central servers having information about which users are transmitting what and will adjust the reputation of the user based on how accurate their intel is so central server will have update information of every user and how much weight is to be assigned to their information.

Paper#3:

Blockchain-Based Intelligent Transportation: A Sustainable GCU Application System By

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The purpose of this study was to explore how to apply blockchain technology to intelligent transportation, create a hierarchical theoretical framework of intelligent transportation, and explore a sustainable application system of intelligent transportation under the blockchain.

Paper#4:

Blockchain Based Intelligent Vehicle Data sharing Framework

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In this paper, they have proposed Intelligent Vehicle data sharing.They are proposing a trust environment based Intelligent Vehicle framework. In the proposed framework, they have used the blockchain technology as the backbone of the IV data sharing environment. The blockchain technology provides the trust environment between the vehicles based on proof of driving. They basically discuss VANET which is primarily vehicle to vehicle communication while driving .

Paper#5:

A Blockchain-Based Authentication Scheme and Secure Architecture for IoT-Enabled Maritime Transportation Systems

Zhang, Peiying and Wang, Yaqi and Aujla, Gagangeet Singh and Jindal, Anish and Al-Otaibi, Yasser D. (2022) 'A Blockchain-Based Authentication Scheme and Secure Architecture for IoT-Enabled Maritime Transportation Systems.', *IEEE Transactions on Intelligent Transportation Systems* .

This paper primarily focuses on using blockchain to implement maritime travel especially in areas with heavy ship lane traffic to better manage said traffic and also decrease the risk of accidents and increase efficiency and reduce fuel consumption.The model presented by them is quite similar to models previously discussed.

Paper#6

Blockchain Technology for Intelligent Transportation Systems: A Systematic Literature Review

Here in the journal https://ieeexplore.ieee.org/abstract/document/9706476 they are proposing that to provide a systematic review of Blockchain application to intelligent transportation systems in general and the Internet of Vehicles (IoV) in particular there are 4 phases.

First, the Blockchain technology including its opportunities, relative taxonomies, and applications is introduced; basic cryptography is also discussed.

Secondly, the Blockchain 1.0 phase, (characterised by Bitcoin implementation and common consensus protocols)

Thirdly, the Blockchain 2.0 phase (characterised by the implementation of smart contracts, Ethereum, and Hyperledger).

Finally, the state of the art of Blockchain-based IoV solutions (BIoV) is explored by referring to a large and trusted source database from the Scopus data bank.

Author Ahmed Ben Said

Paper#7

Blockchain For Intelligent Transport System

Here in journal https://www.tandfonline.com/doi/abs/10.1080/02564602.2020.1766385 they are

proposing that to resolve fetching relevant information and removing other facts and figure that are not required to describe certain situations such as an accident. We have to analyse road accident data and reduce various dimensions with Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Non-negative Matrix Factorization (NMF). We conduct comparative analysis with three datasets where error rate for PCA is 32% with Dataset1. Likewise, error rates for LDA and NMF are 36% and 35%, receptively. While keeping in mind that such reduced data is helpful in many legal processes, we introduce Blockchain in the framework.

Authors Anandkumar Balasubramaniam, Malik Junaid Jami GulORCID Icon, Varun G. Menon & Anand Paul

Here in the journal https://ieeexplore.ieee.org/abstract/document/9156237 they are proposing that The Transportation System and the data generated from the vehicles can be intercepted, manipulated and corrupted with coordinated attacks. Moreover, every system might have bad actors who want to manipulate the system or data to his or her favour by exploiting the system. In order to guarantee data integrity, immutability, and availability for the ITS, we propose Blockchain based architecture with outlier detection to prevent malicious activity by the vehicles while preserving integrity in sharing information.

Authors

- Shirshak Raja Maskey
- Shahriar Badsha
- Shamik Sengupta
- Ibrahim Khalil

Paper#8

BITS: Blockchain based Intelligent Transportation System with Outlier Detection for Smart City

Here in the journal https://ieeexplore.ieee.org/abstract/document/9156237 they are proposing that security is still a main concern in vehicular communication systems (VCSs). This can be addressed through secured group broadcasts. Therefore, secure key management schemes are considered as a critical technique for network security. Here they are proposing a framework for providing secure key management within the heterogeneous network. The security managers (SMs) play a key role in the framework by capturing the vehicle departure information, encapsulating blocks to transport keys and then executing rekeying to vehicles within the same security domain.

Authors

- Shirshak Raja Maskey
- Shahriar Badsha
- Shamik Sengupta
- Ibrahim Khalil

Paper#9

Blockchain-based Reputation for Intelligent Transportation Systems

Here in the journal https://www.mdpi.com/1424-8220/20/3/791 they are proposing Blockchain is a disruptive technology that is frequently used in the financial, Internet of Things (IoT), and healthcare industries. It can reach consensus within a decentralised network, which may be made up of many unreliable nodes, and it can permanently and

irreversibly store data in a way that is tamper-proof. We describe a reputation system for intelligent transportation systems in this research (ITS). It views users who are interested in traffic information as the architecture's primary actors. They safely exchange data that other users utilise to validate it collectively. To travel between two sites, users can opt to use either such crowd-sourced certified data or data supplied by the system. Based on the reputation of the suppliers, the data saved is accurate and unchangeable. With a simulation, we offer findings for three cities: Rome and San Francisco

Authors

- Liviu-Adrian Hîrţan
- Ciprian Dobre
- Horacio González-Vélez

Paper#10

Using Blockchain to Enhance and Optimize IoT-based Intelligent Traffic System

Here in the journal https://ieeexplore.ieee.org/abstract/document/8669412 they are proposing data transmission and request for lane property right under the domain of an intelligent traffic system. IoT devices are usually deployed in a heterogeneous environment, with the natural gene of decentralization.Data transmission between vehicles uses a peer-to-peer network in which every node communicates directly with every other node, verified by their relevant end-point nodes; lane's acquisition right is approved by all relevant vehicle nodes, as well as with consensus agreed upon via smart contract.

Authors

- Qilei Ren
- Ka Lok Man
- Muqing Li
- Bingjie Gao

Challenges:

The challenges faced by us will be :

- Creating a reliant reputation system.
- Creating a hybrid blockchain.
- Understanding the limits to which users are comfortable with sharing information.
- Maintaining reliable communication between multiple networks.

Conclusion:

Overall it is the best solution to implement blockchain based transport as it provides us with safe and efficient travel while also preserving our data.

References:

[1] Rateb Jabbar, Eya Dhib, Ahmed Ben Said, Moez Krichen, Noora Fetais, et al.. Blockchain Technology for Intelligent Transportation Systems: A Systematic Literature Review. IEEE Access, 2022, pp.1-1. ff10.1109/ACCESS.2022.3149958ff. Ffhal-03570962f

[2] Kan Zheng, Qiang Zheng, Periklis Chatzimisios, Wei Xiang, and Yiqing Zhou. Heterogeneous vehicular networking: A survey on architecture, challenges, and solutions. IEEE communications surveys & tutorials, 17(4):2377–2396, 2015.

[3] Georgios Karagiannis, Onur Altintas, Eylem Ekici, Geert Heijenk, Boangoat Jarupan, Kenneth Lin, and Timothy Weil. Vehicular networking: A survey and tutorial on requirements, architectures, challenges, standards and solutions. IEEE communications surveys & tutorials, 13(4):584–616, 2011.

[4] ERTICO – ITS Europe. https://ertico.com/, 2021. [Online; Available].

[5] cityverve. https://www.smartsustainablecities.uk/cityverve, 2021. [Online; Available].

[6] Michael Nofer, Peter Gomber, Oliver Hinz, and Dirk Schiereck. Blockchain. Business & Information Systems Engineering, 59(3):183– 187, 2017

[7] Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, and Manuel Díaz. On blockchain and its integration with iot. challenges and opportunities. Future generation computer systems, 88:173–190, 2018.

Contribution:

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Papers 6-10

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Papers 1-5