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A BRIEF REVIEW: MOBILITY MANAGEMENT TECHNIQUES FOR INTELLIGENT TRANSPORTATION SYSTEM IN IOT

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ABSTRACT

-The view of Internet of Things(IoT) has been spread rapidly. In IoT it is essential to connect each node directly to the internet with or without Gateway. IoT should be capable to integrate transparently and consistently a huge amount of distinct and heterogeneous end systems.Now a day, IoT applications accept noticeable attention worldwide. Intelligent Transportation System is one such application of IOT. The key objective of this paper is to convey an overview about Internet of Things, its major applications, the motivation of Internet of vehicles and essential technologies of IoT. Though, this paper will give beneficial understanding for the new researchers, who desire to do study in this area of Internet of Things and promote knowledge aggregation in efficiently.

Keywords: *IoT, ITS, IoV, ATP, Network-based mobility, resource- constrained nodes, PMIPv6, 6LoWPAN.*

I. INTRODUCTION

Technology expands the benefit of goods and services in a secure fashion. It targets at innovative value. The Internet of Things is a recent trend transformation in IT arena[11]. The number of objects that are linked to the Internet is growing rapidly. This has led to formalizing a new thought of Internet, generally called Internet of Things[20]. The phrase "Internet of Things" which is also known as IoT is originated from the two words i.e. "Internet" and "Things". The "Internet" is a universal system of interconnected computer networks that based on stipulated protocols to deal with billions of users globally and the "Things" that can be any object (electronic devices, equipments, monuments, furniture etc) or person which can be identifiable by the real world[15]. So we can say, things are true objects in this natural or materialistic world. The Internet of Things meets a world of networked and mutual devices that provide adequate clue no matter what the location of the user.IoTcomposed of various types of devices and technologies with the purpose to yield connection between things at any time,from any place, to any network[9].

Internet of things is a popular technology covers broad-spectrum of applications ranging from smart homes to smart organisation and smart grid to vehicular networking[10].Intelligent Vehicles that can communicate with each other are the essential feature of vehicular networks. Even they have resources for that intelligence: CPU, transceiver, sensors and memory[3]. Among them, Intelligent Transportation System(ITS) is expectant applications of IOT[2].
Intelligent Transportation System(ITS) is a well-established route to fix or minimize traffic problemsto a certain extent. ITS comprises of all means of transportation- air, sea, road and rail and links elements of each mode-vehicles, infrastructure, communications and operational system.ITS technology can play an essential role regarding information collection and sharing to assure seamless interconnectivity.[25]In recent years, Intelligent Transportation System(ITS) have gained considerable attention on account of their vast impact on people's life as their scope to support vital applications and services to enhance transportation safety and mobility and increase the usefulness of existing transportation resources and time. ITS applications and services depend on current technologies to be deployed and distributed among the intelligent infrastructure systems and vehicles system[11].In IOT/ITS environment everything is able to communicate with each other over internet.Traffic management Centre(TMC) is used in ITS applications where data is gathered, analysed, and merged with several operational and control concepts to direct the complicated transportation problems.[10]

The key objective of ITS is to assess, develop, analyze and organize new sensor, information transmission and communication technologies and concepts to attaintraffic efficacy, improveenvironmental quality, conserve energy, save time and advance safety and comfort for drivers, pedestrians and other traffic group.[16]

The new term of the Internet of Things is expansion of traditional Vehicle Ad-hoc Networks into a universal paradigm known as Internet of Vehicles(IoV)[20]The unification of three networks generate Internet of Vehicles(IoV) which involves, an inter-vehicle network, an intra-vehicle network, and vehicular mobile Internet. It is an unified network for supporting intelligent traffic management, intelligent dynamic information service, and intelligent vehicle control, revealing a remarkable application of Internet of Things(IoT) technology in Intelligent Transportation Service[24]. IoV aims on the smart integration of vehicles, humans, things and environments and is a massive network that provides services for large cities or even a whole country. IoV is an open and integrated network system with high maintainability, controllability, functionality and reliability and is comprised of multiple vehicles, things, networks and users. The motivation for the design and development of IoV is sectioned within three folds. Firstly, the issues related to commercialization in VANETs are revealed. Secondly, the figure of growing traffic crisis is examined. Thirdly, the immensetypes of communication in IoV is determined[6].

i. The Commercialization Issues in VANETs

Though VANETs possess great potential to address safety and efficacy issues of traffic with least functional cost, but from last two decades it has not been able to tempt commercial concern of industries [6]. Several causes of lesser commercial interest in VANETs are discussed below.

- The structure of VANETs could not assure the global and feasible services by ITS applications. Because VANETs have pure adhoc network architecture. Once a vehicle gets detached from an adhoc network, it drops the services from the network regardless of the vehicle being onroad. As it does not support collaborative network architecture. [6]
- However, there is significant growth of personal devices in our daily life, the devices are unfit to communicate with VANET on account of incompatible network architecture [9].
- Functionality of the vehicular network are highly supported network users. The dependency fades out the reliability of the services of VANETs [17].

ii. The Growing Traffic Crises

Growing traffic on roads give rise to unfair and unintended delays that draw inferences leading to loss of revenue and sometimes even loss of life.The three major issues related to on-road traffic include safety, efficiency and pollution. These are major causes of concern on the design and development of IoV[22]. IoV would serve more reliable schemefor vehicular communications, in comparison with VANETs for smart ITS applications. Reliable vehicular communications would efficiently minimize traffic crisis[7].

iii. Communication types

VANET: basically - V2V, V2R, only partially V2I whereas IoV consists of different types of communication:(1)Vehicle-to-Vehicle(V2V), (2)Vehicle-to-Roadside(V2R), (3)Infrastructure of cellular networks and internet(V2I) ,(4)Personal devices(human)(V2D/V2P), (5)Sensors(V2S)
IoV as a three- tier System[7]

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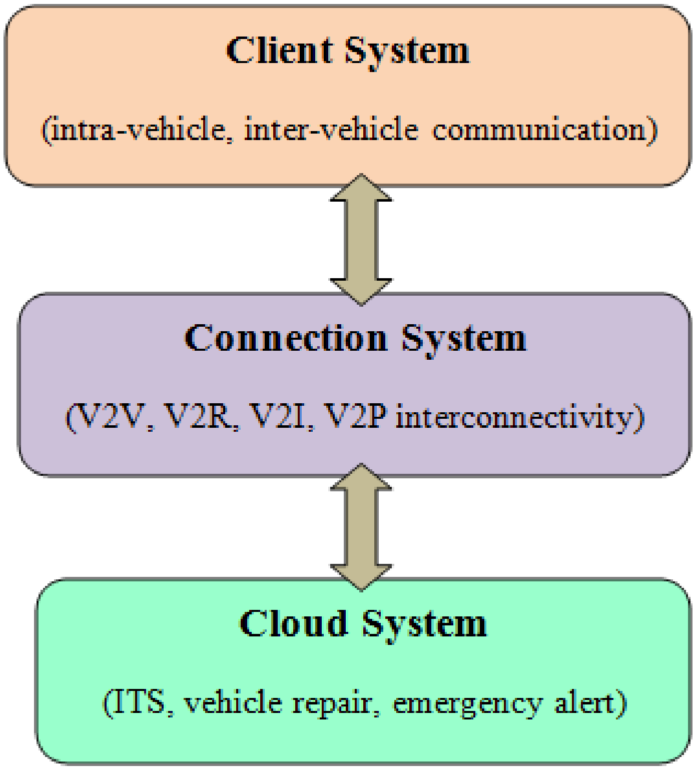

Figure 1: (Three Tier System)

As per the network view is concerned, an IoV system is a three- level "Client-Connection-Cloud" System.
Client System- The client system is a first layer which is a smart vehicle's sensor, which collects vehicular intelligence and detects state of driving andenvironment[22]. It is a universal communications depot that characterize intra-vehicle, inter-vehicle, and vehicle-network communication. Moreover, is a device that facilitates IoV addressing and acquisition of a confidential vehicular identity in cyberspace.

Connection system- This layer deals with V2V, V2R, V2P, V2I(vehicle-to-Internet) interconnectivity to recognize communications and roaming amongad-hoc vehicular networks. It assures real-time network prevalence in respect of utility and performance as well as it is an integration of public and private networking.

Cloud System- TheIoV is a cloud-based vehicle performance information platform. Its ecosystem incorporates ITS, freight/passenger transport, vehicle repair, vehicle supervision, emergency alert delivery, and mobile Internet, creating it a junction for a variety of abundant data sources. Cloud-based services such as virtualization, verification, real-time intercourse, and mass storageare thus required.

Rapid expansion of communications technologies has begun to intermix the model of man-machine-things of Internet of Things into our lives. The technologies perform communications among human and things also things to things possible even make human beings interaction more convenient[24]. Though in such networks, a serious issues regarding increased power consumption, low network lifetime exists for both sensor nodes and mobile nodes. So far, transport protocols mainly depend upon TCP to assure the end-to-end reliability of data transmission. Cellular networks are used to connect more mobile devices to the network to make it more accessible. Even sensor nodes are mostly resource-constrained and truly asymmetric whereas normal PC and server nodes have no resource consideration.

The rest of the paper is organised as follows. Background and related work are introduced in Sect. 2. Section 3 presents the existing protocols for IoT mobility. Section 4 Future aspects. Section 5 concludes the paper.

II. INTERNET OF THINGS AND RELATED FUTURE TECHNOLOGIES

We examine some research papers to identify various Transportation related issues in IoT and presented solutions so far. Among them, few research efforts are handled directly with the topics of routing, mobility, standardization and transmission of data in Internet of Things.

A. Internet of Things Basics

The future of Internet of Things will transmute the existent objects into intelligent virtual objects. The IoT plans to unite whole world under a common framework which will give us ability to automate the things around us and even let us know about the state of the things correctly[28]. The major objective of this paper is to provide a survey of Internet of Things, architectures, and vital technologies and their usages in our daily life.
Somayya et al.[16]presented various techniques and technologies based on networking used by Internet of Things. Also compared them with one another based on their speciality, parameters and protocols used. The protocols used at every layer of OSI model are different.

Even, Himadri et al. [1] has studied the application level IoT protocols namely, The Constrained Application Protocol (CoAP), Message Queuing Telemetry Transport (MQTT) and the Hypertext Transfer Protocol (HTTP)/REpresentational State Transfer (REST). They ave used the cooja simulator for carrying out the simulation. They could make use of different topologies and simulate the scenario according the requirement.

Vandana et al. [12] describe the concept of Internet of Things which has been viable by the convergence of enabling technologies like Near-field communication and Radio frequency Identification(RFID), Bluetooth and low energy. Even, previous work has been described with advantages and disadvantages. At last, applications of IoT were well explained.

Antonio et al. [26] has attempted to address the Internet of Everything through IPv6. Firstly, the need of Internet of Everything is explained. key challenges of IoT were described so broadly. Secondly the IPv6-based solutions were explained along with the future work in IoT. A deep study of everything has been provided by authors which enable future researchers to understand the whole concept easily.

B. Smart Transportation System

Smart city solutions utilize communications and networking technologies for handling the problems deposited by urbanisation and growing population. The energy utilization for transportation includes public transport, personal vehicles, leisure travel and so on. So the energy consumed in transportation become the primary cause of pollution in cities. As a result the authors in [28] supply a unite framework for energy-efficient optimization and scheduling of IoT-based smart cities.

Even, it is necessary to effectively manage various mobility in IoT/ITS to get consistent Internet connectivity. So, the authors in [3] proposed a network-based mobility management scheme which sustains group mobility to yield globally extensive IoT/ITS services. Network mobility based support (NEMO-BS) is a mobility support protocol which deals with a common mobility of multiple nodes as a single unit. NEMO-BS supports systematic group mobility and can be used in public transportation systems where mobile nodes generally get in/out the public transportation , considerable signalling overheads occurs and redundant binding updates can occur. As a result, in [13] the authors presented a delayed management(DLM) scheme to mitigate binding update cost and packet delivery cost in an effective manner by selecting an apt timer.

A scheme of developing a smart city using IoT is provided in [17], which is truly motivated and greatly demanded from city representative because authors seek to insure the arrangement of necessary services and quality of life for city people. Even noise mapping case study of Melbourne is presented to highlight the practical usage of proposed scheme for the adoption of enhanced delivery of important city services.Internet of vehicles is the trendy topic and due to the requirement of sensors to provide safety it is highly used today. So, the authors in [6] presented the broadly classified framework of IoV as a new theme of research and developed form VANET. The benefits of the plan and expansion of IoV are underlined by carrying out a subjective comparison between IoV and VANETs. At last, the challenges and future view of IoV are discussed.

In paper[16] authors advised the process of One of the buzzwords in the Information Technology is Internet of Things (IoT). Smart cities includes easy access and connection with a different kind of devices such as, home appliances, surveillance cameras, actuators, vehicles and so on Therefore, the paper [4] presented a summarized analysis of energy management and challenges in smart cities and give a synthesized framework to raise energy-efficiently and scheduling of IOT-based smart-cities. Two case-studies are designed. First targeted on energy-efficient scheduling in smart homes and the second covers wireless power transmission for IOT devices in smart cities. The simulation results reveal the huge impact of both case-studies.

C. Protocol concepts

i. ATP v/s TCP

Having to deal with reliable data transmission TCP transport protocol remains the first choice. As to consider resource-constrained sensor nodes which are extremely asymmetric in respect of network bandwidth and processing power.

The comparison of proposed protocol is done with traditional TCP to evaluate its effectiveness and the analysis shows the proposed Asymmetric Transport Protocol favours the asymmetric nature of the communicating nodes by reducing energy consumption and latency to improve the service lifetime of the resource-constrained nodes. Still a lot of work needs to be done on considering different parameters[5].

A modified TCP protocol is presented [8], named XJTCP, which is subjected to a cross-layer variation of the jitter-based TCP. Specifically, XJTCP elects the meanwhile jitter as loss predictor in order to assume either a TCP packet loss is due to congestion or to aimless error. Further, it establishes a cross-layer mechanism for considering the discarded medium access control(MAC) frames. The goal of this study is to (of this research was to) enhance TCP performance across wireless networks.

6LoWPAN[19] has been proposed for low power operations that make it adequate for the requirements. This protocol was proposed to minimize the insurance consumption, energy consumption, bandwidth and demand consumption.[14] The lower layer of 6LowPAN uses the PHY layer and the MAC layer from the IEEE802.15.4 whereas the network layer proceed to adjust with IPv6 protocol. The adaption layer introduction in the 6LowPAN will undoubtedly inject delays or failures in the transmission function and security for the powerful nodes.

ii. Routing Protocols

Routing concerns with the process of checking the prime route for the delivery of data packets from source to destination and it is subjected to routing protocols. Routing protocols are a set of rules in which communication network notices while computers attempt to communicate with each other over networks[18]. Moreover, communication between two routing protocols is subjected to the routing algorithm that is completely relying on the parameters to detect the route to transmit the data over two networks. Routing protocols make a routing table to store the outcomes of these metrics. At present two types of routing protocols are available: interior gateway protocol (IGP) and exterior gateway protocol (EGP). RIP, OSPF, EIGRP are most commonly used IGPs and a typical EGP is BGP (Border Gateway Protocol)

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S.no	Parameter	RIPng	EIGRP	OSPF	IS-IS
1.	Ownership	It is an Open protocol	It is Cisco Propritary protocol i.e. owned by someone	It is an Open protocol	It is an Open protocol
2.	Algorithm	Based on Bellman Ford algorithm[23]	Based on Bellman Ford and DUAL algorithm.[23]	Based on Dijkstra algorithm.[23]	Based on Dijkstra Algorithm.
3.	Convergence or Performance	It has slow convergence .[23]	It has very fast convergence .[23]	It has fast convergence than RIP but slower than IS-IS.[23]	It has fast convergence than RIPng, OSPF,but slower than EIGRP
4.	Energy consumption[18]	It has more energy consumption	It has very less energy consumption	It has more energy consumption	It has less energy consumption than OSPF
5.	Overheads	Less overheads	Less Overheads	More overheads	Less overheads
6.	Throughput	Very less	Very high	High	High
7.	Mobility[23]	It doesnot support mobility	It support mobility	Mobility is supported in IPv6 as IPv4 have not much mobility scope	It support mobility.
8.	Connectionless/ Connection oriented	It uses UDP	It uses RTP	It uses TCP	It uses TCP
9.	Routing metrics	It uses hop count as its routing metrics[23]	It uses bandwidth and delay as its routing metrics	It uses cost and bandwidth as its routing metrics[23]	Metric is fixed i.e. 10 per interface.

iii. Communication protocol:

In the wireless sensor networks, it could be any number of nodesrelative to the application area. Every node within the WSN demands a protocol that directs the communication among the nodes for the purpose of safety and successful transfer of collected data.[27] This is promoted by wireless communication protocols. However, there are variety of wireless communication protocols exists but few are convenient for WSNs due to limitations of the nodes such as small memory footmarks and low battery capacity[14]. Comparative study of different communication protocols are:

S.no	Parameter	6LoWPAN	ZigBee
1.	Wireless Protocol Interoperability[27]	The 6LoWPAN Protocol provides interoperability with other wireless 802.15.4 devices as well as devices in any other IP network link (for example, Ethernet or Wi-Fi), with a simple bridge device	ZigBee devices can interoperate with other ZigBee devices, assuming that they use the same profile.
2.	Power consumption[14]	Low	Moderate

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3.	Data rate[14]	Low	Low
4.	Packet Header Size[27]	30 kb	90 kb
5.	Compatibility[14]	Free to communicate with any device, no compatibility issue arises	Compatibility issue arises because they are bound within same profile devices
6.	Reliability[27]	the 6LoWPAN network shows that average delays are minor from end to end and thus, provides greater reliability	ZigBee is less reliable

iv. Data Protocols

This portion presents MQTT, XMPP, CoAP and AMQP data protocols, which is the element of IoT network tier. The main view of this study is to know the utility of each data protocol, comparing with the other data protocols based on various performance measures.[24] The comparison helps us to recognize which data protocol is more apt and satisfactory for manyIoT applications[13]. Specifically, we studied each data protocol in detail to better understand the protocol to transfer the data from one application to another application.

S.no	Parameter	CoAP	MQTT	XMPP	AMQP
1.	Type of Service[13]	UDP	TCP	TCP	TCP
2.	Scalability[1]	Complex	Scalable protocol	Only suitable for small messages	Less scalable
3.	Supprt to QoS[13]	Yes	Yes	No	Yes
4.	Header Size[1]	4-Bytes	2-Bytes		8 Bytes
5.	Latency[1]	CoAP has Low Latency as compared to other protocol	Shows decreasing latency with increasing network bandwidth	Latency increases upto certain limit and then decreases	Shows decreasing latency with increasing network bandwidth
6.	Bandwidth needed[24]	Low	Low	Low	High
7.	Power[1]	Excellent	Good	Low	Low
8.	Advantage[1]	1-1 Communication M-M communication , Resource Discovery	Save power and memory, Low power Usage	Secure, Service discovery, Very Robust, Powerful	Highly reliable, Store & forward communication

III. CONCLUSION

In this paper, the solutions currently available for the implementation of ITS in IOT for Smart Cities are examined. The said technologies like ATP, 6LoWpan etc are close to being standardized, and production houses are using these technologies in their devices to take advantage. But still there is a lot of space for improvement to take advantages of these technologies. While the range of design options for ITS in IOT is wide and standardized protocols are significantly smaller. So, it is concluded that a concrete hybrid concept is more effective for the improvement of ITS in IoT for smart cities.

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