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Smart Vehicle- to-Vehicle Communication with 5G Technology

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Abstract—Vehicle-to-vehicle (V2V) communication aim to avoid vehicular accident by providing advisory to the driver as less congestion, mishap warning, road investigation, etc. Technological developments in electronics, computing, identifying, robotics, control, signal processing, and communications makes this things possible. Different technology like WAVE) is based on the IEEE 802.11p standard , DSRC,CALM standard mainly used in v2v communication. One major technical challenge in all technology is to achieve low-latency in delivering emergency warnings in various road situations. 5G technology with its specific potential feature e.g. End to End latency -1ms,High data rate, mobility, traffic density makes V2V communication smart

Keywords- V2V,V2I,WAVE, DSRC, IEEE802.11P, latency, 5G,throughput

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I. INTRODUCTION

The Insurance Institute for Highway Safety (IIHS) estimated that if all vehicles had forward collision and lane departure warning systems, side view (blind spot) assist, and adaptive: 1) between vehicles, known as vehicle-to-vehicle (V2V) communication, 2) between vehicles and infrastructure (V2I headlights, nearly a third of crashes and fatalities could be prevented (IIHS, 2010). Automatic braking when the car detects an obstacle will also likely reduce a significant number of rear-end collisions Vehicles are considered an Electronics sensors in smart transportation system. They are equipped with components/systems to enables services for vehicle occupants, other vehicle on road and third party recipients. Different types of communication modules with storage and computing .Many newly 'intelligent vehicles' are equipped with advanced wireless communication module for supporting three types of communication and 2 I2V), or 3) between vehicles and any neighboring object (V2X).

II. V2V REPRESENTAION

Figure -1 Visual Representation of V2V Communication
Courtesy DOT HS 812 014 August 2014

III. TECHNOLOGIES USED IN V2V COMMUNICATION

Different technologies used in vehicle wireless communication are is the Wireless Access for Vehicular communication. The network topology looks almost the same as for the cell phone networks GSM and 3G, where a fixed base station regulates the traffic within the cell and is responsible for handover and roaming Environment (WAVE) technology which is based on the IEEE 802.11p standard and Dedicated Short Range Communication (DSRC). Another is the Communication Access for Land Mobiles (CALM) standard. In addition some Zigbee communication modules and Visible Light Communication (VLC) are also used n vehicle [1] The mobile broadband standards, having deterministic MAC methods together with QoS support, cannot be used in *ad hoc* mode (vehicle-to-vehicle) but could with advantage be used for other types of data traffic (e.g. Internet access). The IEEE 802.11p standard together with the WAVE protocol stack could be used for *ad hoc* vehicle-to-vehicle communication.

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IV. COMPONENTS FOR VEHICLE

An On-Board Unit (OBU) Interact with driver with display warning, alerts, offering automotive services and communication with a vehicle's surroundings .Advanced Powerful OBUs will act as a PC for handling calculating tasks supported by ample storage capabilities. Followings are some of the components required for v2v communication

a)**Sensors**: Sensor detect component malfunctioning n.

,damages, provide driving assistance ,provide alert and warning about roads hazards , report about traffic and weather conditions. The MobEyes platform uses V2V communication.[2] A prominent road monitoring platform is CarMote [3].

b)Data Storage and Computing

Due to advances in data storage technologies, it is anticipated that in-vehicle storage capacity will reach multiples of Terabytes in the future, enabling the vehicle to act as a mobile data server.[4] While moving, other vehicles harvest the meta-data and send queries to obtain data of interest. Another example is the FleaNet platform [5] Vehicular clouds has advantage of their autonomous formation. Neighboring vehicles can autonomously form a cloud to provide instantaneous services (e.g., collecting traffic information at congested intersections for traffic light management). A detailed comparative study of vehicular and conventional clouds is presented in [6].

c)Relaying

In DB-VDG, queries can be sent to retrieve information from areas of interest and replies can be routed back from vehicles in these areas. Both queries and replies are delivered via intermediate vehicles that act as relays. (DB-VDG) [7]

d)Infotainment

Infotainment refers to the combination of information with entertainment. With the on-board communication capabilities supporting communication with surrounding mobile agents

e)**Localization**

Vehicles can be considered potential resources for locating objects. Through their sensing and communication capabilities, they can recognize and locate objects, and send this information. Vehicles can be used to locate neighboring vehicles for the sake of estimating the distance to these vehicles or informing them about their positions for accuracy purposes.

V. 5G IN V2V COMMUNICATION

a)Feature of 5G

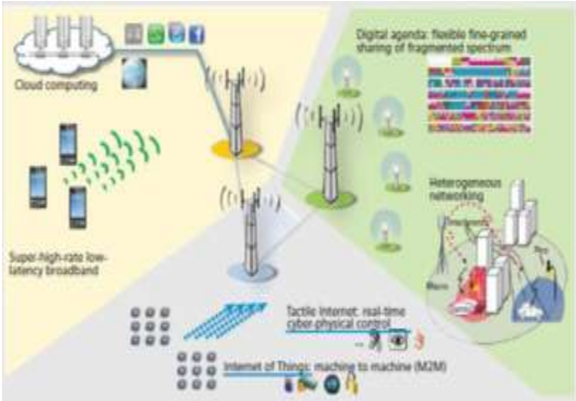
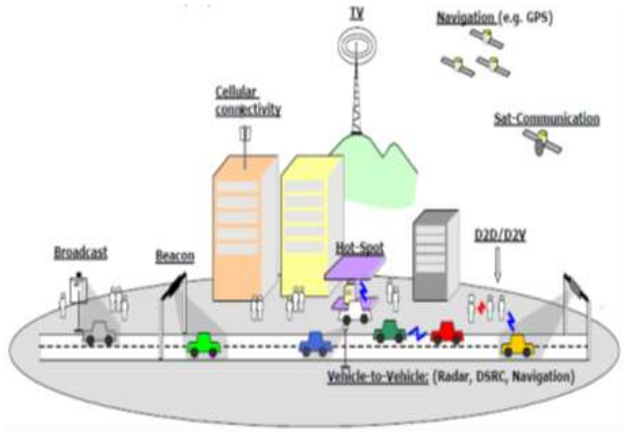


Fig.2: 5G architecture

Source: An Example of 5G Application Scenarios with Multiple Access Requirements, IEEE Comm. Magazine, Feb 2014

Key Features of 5G Technology:
i)Data rate : 1000 Mbps
ii) Mobility : 1000 Km/h
iii) Traffic volume density : 500 Tbps/Km2
iv) Connection Density : 106 (Users /Km2)
v) End to End latency =1ms
vi)Battery Life : 1000 Days

b)Use of 5G in v2v Communication



Source IEEE Comm. Magazine, Feb 2014

5G will also look at a "Reliability/latency oriented" use case, which will fit into the needs of services like Industry automation, critical information broadcast or self-driving cars. In this case, 5G technology should adapt itself to a much optimized network in terms of coverage, latency and mobility. [8]

New types of services

Several networks are currently providing connectivity for end-user devices: cellular, Wi-Fi, mm-wave, and device-to-device are a few examples. 5G systems are likely to tightly coordinate the integration of these domains to provide an uninterrupted user experience. However, bringing these different domains together has proven to be a considerable challenge and Hotspot 2.0/Next Generation Hotspot are perhaps the first examples of cellular/Wi-Fi integration.

New frequencies for radio access

It is clear that 5G will need Gbits backhaul and, so far, only fibre optics and wireless can provide this service. s. The disadvantage is t mmW needs Line of Sight (LOS) operation. It can be resolve by electrically steerable antennas and directional mesh for a true SON backhaul in a Non Line of Sight (NLOS) environment. NLOS mmW links, which use advanced MIMO to enable high data rate links into a dense urban environment where the complex multipath environment may be used to synthesize many different spatial paths to support a dense backhaul.

Massive MIMO

Massive MIMO has become a key term and attractive technology for 5G, offering significant gains in traffic density as well as data throughput peak rates.

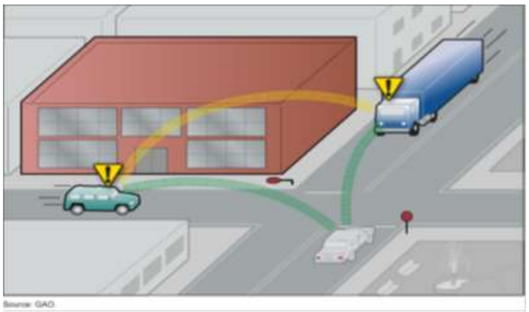
Traffic Management

As the full deployment of IP based networks is being rolled out, already currently in LTE networks using IPv6, then the ability to offer differentiated traffic quality according to the needs of the service is being deployed.

The safety applications

V2V safety applications that address common rear-end, opposite direction, junction crossing, and lane change crash scenarios, information that another vehicle in an adjacent lane is positioned in the original vehicle's "blind spot" zone when a lane change is not being attempted.

c) Potential Vehicular use of 5G [9]



Source :GAO

Note: In this scenario, the truck and sports utility vehicle are at risk of colliding because the drivers are unable to see one another approaching the intersection and the stop sign is disabled. Both drivers would receive warnings of a potential collision, allowing them to take actions to avoid it.

The following section describes several potential vehicular use cases for 5G.

Vehicular Internet/Infotainment: The vehicles themselves form another group of Internet users for map, traffic data and high-resolution picture download, as well as sensor data and image upload.

Pre-Crash Sensing and Mitigation: Pre-crash sensing enables vehicles to sense imminent collisions and exchange relevant data among vehicles involved, allowing vehicles and drivers to take counter-measures to mitigate the impact of the collision. Pre-crash sensing requires highly reliable and extremely low latency vehicle-to-vehicle communications.

Inter-Vehicle Information Exchange: Peer-to-peer inter-vehicular communication using D2D cellular technology under the guidance of the operator policies can allow vehicles to communicate information related to road safety and traffic congestion directly in a mesh fashion, thus offloading data from the traditional RAN infrastructure. This is just one possible example of the type of information that can be exchanged

Public safety: Allowing a public safety responder to push a button (push-to-talk) to communicate with other public safety responders. This needs to be extremely reliable, working both on and off network without any delay for dialing phone numbers. The feature needs to allow communication with one or more groups (e.g., local police, regional police, and local public safety) in real time. Public safety users must be able to monitor multiple groups simultaneously (scanning communication on different groups) and allow additional users to join an on-going group discussion.

VI. CONCLUSION

Smart vehicle can do sensing, data storage, computing, cloud, data relaying, infotainment and a means for locating other objects. In particular, V2V communication requires a significant latency reduction with respect to 4G,leading to a challenging 5 ms end-to-end delay. Additionally, reliable V2V services shall be provided in a variety of cases, including the out-of-coverage scenario, where one or both devices in communication cannot get network connectivity. IoT traffic requires an extended device ID space (enhanced addressing schemes), well beyond IPv6. Moreover, *flexibility* is also about backward compatibility: 5G architecture shall be able to support and coexist with legacy (e.g. 4G) systems

Thus smart v2v communication can be achieved with 5G technology.

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