A Novel Scheme for High scale IVC and RVC Over Bluetooth

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Abstract- Vehicular Ad-Hoc Network (VANET) is a form of Mobile ad-hoc network, to provide communications among nearby vehicles called inter-vehicle communication (IVC) and between vehicles and nearby fixed equipment called roadside-vehicle communication (RVC). In VANET, or Intelligent Vehicular Ad-Hoc Networking, defines an intelligent way of using Vehicular Networking. In VANET integrates on multiple ad-hoc networking technologies such as WiFi, IEEE 802.16, Blue-tooth, IRA etc. for easy, accurate, effective and simple communication between vehicles on dynamic mobility. For configuring the vehicle with a unique address, there is a need for address reconfigurations depending on the mobility patterns; we have presented a centralized addressing scheme for VANET using Blue-tooth. By building up a P2P (Per to Per) overlay network on top of VANET's physical infrastructure, we effectively integrated P2P network's advantage on sustaining highly dynamic network into the design of VANET routing protocol. By deploying passive VANET routing algorithms with innovative P2P routing mechanisms, we propose two concepts behind the same Single Hopping and Multi Hopping technique. This project investigates the feasibility of having a Vehicular Ad-Hoc Network (VANET) / Mobile Ad-hoc Network (MANET) routing over Bluetooth. Contrary to this approach, most papers of MANET take WiFi as their underlying technology with the aim to expand the already existing internet, and it has fifty meters plus signal range. With the rapid growth in popularity, Bluetooth is being used in increasingly diverse ways to act as a bridge of communication between different hardware. This project develops on this by testing the effectiveness of a Bluetooth routing system with a fully working router implementation on real mobile phones.

Key words- *Manet, Vanet, IVC, RVC, Bluetooth*

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I. Introduction

Advancements of wireless technology and portable computing have resulted in a greater demand for use of connectivity on the go. It is no longer enough to have wireless network access at your work place or home providing you mobility in the designated range. This has hence brought about a great deal of research in the field of mobile ad-hoc networks (MANET), a rapidly changing network with no infrastructure, where any portable micro processing device like a mobile phone, laptop or hand-held, can be considered a node. Unlike current commercial wireless devices, MANET nodes will have to cooperate together to discovery paths and route traffic from source to destination. [1].

Bluetooth is another (commercially) advancing field brings short range, low power consumption, wireless connectivity for device to device communication. Unlike Wi-Fi's set networking protocols (802.11), Bluetooth's dynamic range of uses comes from its Profiling giving it multiple behaviors of interactivity with other Bluetooth devices. Any two devices with the same profile can talk, like mobile to headset where both are running the Bluetooth Headset Profile (HSP)[2].

This project aims at bring the two field together by attempting to create a MANET routing system using Bluetooth devices and seeing its feasibility in the real world. Currently there are very little number for papers on ad-hoc routing over Bluetooth and even fewer, if any, on MANET over Bluetooth. The likely reason being the short range of a typical Bluetooth making it impractical. The motivation of this project is to see if this problem can be overcome and if we can make use of this untapped resource[3].

Bluetooth enabled mobile phones are the target platform, as their functionalities covers the needs of this project. Java Micro Edition (Java ME) is used to create the routing application making it easier to place it on any Java enabled phone for real-life testing. Security is not to be considered.

II. Bluetooth

Bluetooth is a technology that promises fast, secure, point-to-point wireless communications over short distances (approximately 10 meters) for devices as diverse as mobile phones, consumer electronics appliances and desktop computers. It uses spectrum in the unlicensed ISM1 band of 2.4 to 2.48GHz. Besides being a hardware standard, Bluetooth defines a protocol stack that allows for hierarchical ad hoc networking in the form of "Piconets", in which Bluetooth devices form themselves into point-to-multipoint picocells under the control of one master. Multiple Piconets in overlapping coverage areas form "scatter nets".

JSR82 is the formal name given by the JCP for the Java APIs for Bluetooth. As stated above, the key advantage of the API over others (like for C/C++) is its independence from the Bluetooth stack and radio. This gives a developer the ability to write applications without knowing the underlying hardware as well as making it portable with little or no change in code.

A Bluetooth Stack is required by the Host to properly communicate to the Bluetooth device and to use it. The Host Controller (Host cntlr in Figure) layer provides the interface between the Bluetooth radio and Host. (It is not necessary for the Stack to be written in Java, as will been seen later on with Anetana.)

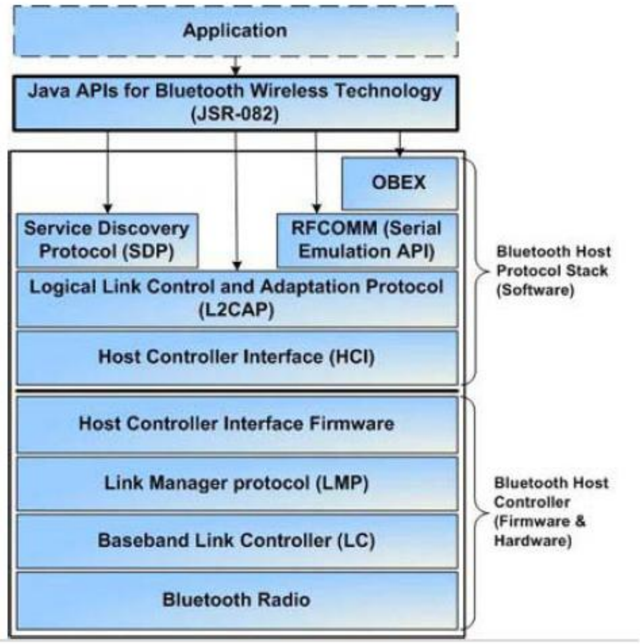

Fig 1:Bluetooth Stack with JSR-82

Finally a Bluetooth API implementation is required to actually write the Java Application with. To clarify, a JSR-82 enabled mobile phone comes with the stack and API already implemented as part of its accessible Java libraries and is ready to use with the built in Bluetooth radio. To enable a standard computer or laptop to use JSR-82, an 'API and Stack implementation' must be used, like Antenna, which will automatically interface with connected or inbuilt Bluetooth devices.

Eclipse will be the IDE used to implement the Application. Eclipse IDE functionalities specific for coding in Java ME using the JSR-82 interface

III. VANET Architecture

Before we see VANET architecture lets have a look at two traditional architectures 'layered' and 'unlayered' architecture.

The first approach—called a layered approachand depicted in Fig. 1—attempts to retain the order of functions and protocol layers with well-defined interfaces betweenthem. It adapts system functionalities to the needs of a VANET communication system, resulting in protocol layers for single-hop and multi-hop communication. The limitations and inflexibility of traditional network stacks when used in ad-hoc networks are well known. Each layer is implemented as an independent module with interfaces (SAPs) only to the adjacent above and below layers.

Consequently, protocols cannot easily access state or meta-data of a protocol on a different layer, which makes data aggregation difficult. Moreover, some VANET-specific layered ISO/OSI model and cannot be uniquely assigned to a certain layer. It is also worth noting that every layer accesses external information separately with no common interface, which might lead to problems when this information influences protocol flow.

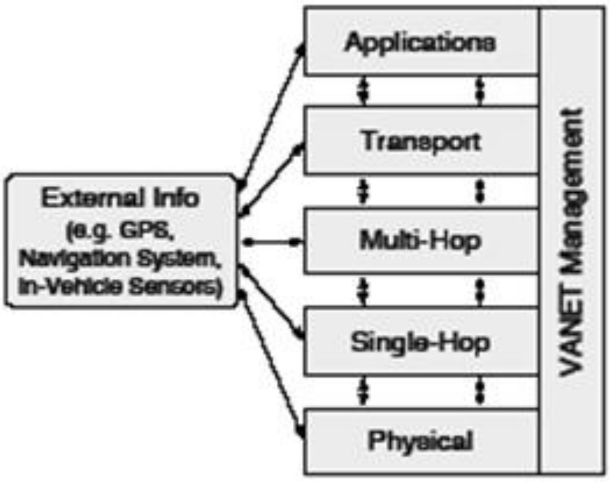

Fig2: Layered Architecture

The second, un-layered approach would be the result of tailoring a whole new system to the needs of VANET's main focus, i.e., safety applications. Having accurate specifications of these applications and the willingness to use the 'probabilistic' channel in the most efficient manner leads to have a highly coupled set of protocols.

Therefore, all application and communication protocols are placed in one single logical block right over the physical interface and connected to the external sensors (Fig. 2). Inside this block, all protocol elements are modularized such that there are no restrictions on interaction, and state information is arbitrarily accessible. Note though, that due to arbitrary and complex interactions of their modules this 'architecture' inherits a high design complexity. This makes protocol specification a complicated matter and so, once designed, it becomes an extremely inflexible system for other types of application (e.g., it would be difficult to integrate IP applications). Also it would be tough to systematically avoid control loops, which is rather easy in the layered approach with its clean top-down or bottom-up packet traversal. While both approaches would certainly be feasible, each has strengths and weaknesses with respect to assignment of functions, information sharing, flexibility, complexity, and other VANET-specific requirements[6,7].

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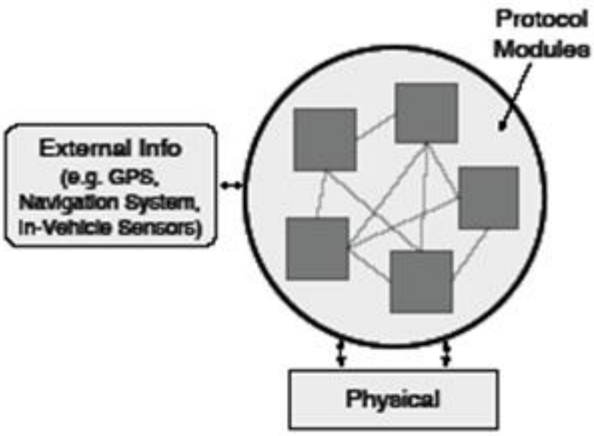

Fig3: Un-layered Architecture

Finally Fig. 4 presents a concept in between the two 'extreme' options discussed above. In this proposal we intend to use the most adequate features of both options, i.e. Having a layered approach that gives us a clear and modular structure in which to build our applications and protocols, but also offering a clean way of sharing information and to cooperate between any protocol module on any layer as needed.

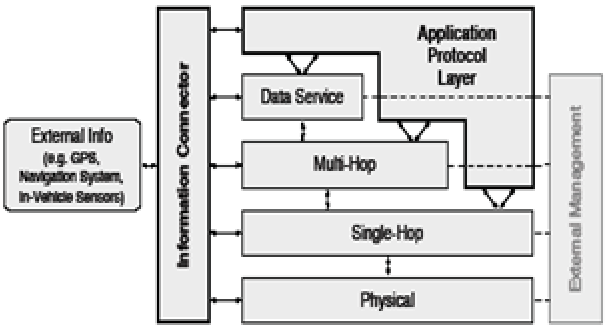

Fig 4: VANET Architecture

Describing our proposal, we identify the following key features[9,10]

Presence of layers: To alleviate a structured protocol design, we use the same core structure as in the layered approach. We believe that the original meaning of each layer is still valid for VANET ,however, modifications/ extensions are required.

Staircase approach: An application can select from among multiple service access points to lower layers. Depending on its requirements, an application can choose whether to use or to bypass a service offered by a lower layer, logically expressed by a staircase shape. This is in contrast to the traditional ISO/OSI protocol architecture, where applications can only access the directly adjacent layer. Our proposal offers more flexibility to send packets, though the standard path for outgoing packets will still be top-down through the layers accessing the available service access points (SAPs) of adjacent layers. Information connector: All protocols can connect to an 'information connector', i.e., a common interface that efficiently exchanges sensor update information, data extracted from packets, and state information (and their change) of protocol layers and devices. The information crossbar basically follows a publisher/subscriber pattern: Published information services can be subscribed by any entity. The information connector maintains information collected from each authoritative source and asynchronously notifies subscribers of matching information.

External management plane: The external management plane symbolizes a configuration interface to set long-term system settings. In the sense of this proposal, it is not involved in the dynamic self-organization motivated by the different network conditions. The single-hop layer incorporates all functionality dealing with communication to direct radio neighbors. In addition to traditional MANET link layer functionality, there will be a protocol element that adds the node's position to every packet. The multi-hop layer contains protocol elements for forwarding packets to non-neighbored nodes, using neighbors as forwarders.

IV. Routing Protocols

Mobile Ad hoc Routing Protocols

There exist hundreds of routing protocols for many different purposes. Mobile ad hoc routing protocols are very specialized in their task. There are two main characteristics to distinguish them. The first characteristic is when they gather their routing information. On one hand we have the proactive (table driven) protocols, which always try to have complete, up-to-date routing information. This automatically implies a certain overhead, which dramatically increases with high mobility. On the other hand we have the group of reactive (on demand) protocols, which only try to gather routing information when it is needed. The second characteristic is how they route data towards the destination. We distinguish here the destination based (link state) protocols from the topology based (distance vector). In a destination based protocol a node knows all details about the used routes. It includes the complete information about the routing path in every sent data packet. In a topology based protocol a node knows only about its neighbors and the next hop toward a destination. Like this a data packet only has to carry the destination address. This can be an important advantage for large networks with long routes.

Description: In November 2001 the MANET (Mobile Ad hoc Networks) Working Group for routing of the Internet Engineering Task Force (IEFT) community published the first version of the AODV routing protocol (Ad hoc On demand Distance Vector).

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AODV belongs to the class of Distance Vector routing protocols (DV). In a DV every node knows its neighbors and the costs to reach them. A node maintains its own routing table, storing all nodes in the network, the distance and the next hop to them. If a node is not reachable, the distance to it is set to infinity. Every node periodically sends its whole routing table to its neighbors. So they can check if there is a useful route to another node using this neighbor as next hop. When a link breaks, a misbehavior called Count-To-Infinity may occur.

AODV is an ad hoc on demand routing protocol with small delay. That means that routes are only established when needed to reduce traffic overhead. AODV supports unicast, broadcast and also multicast without any further protocols[8].

V. Experimental setup & Results

There are four essential components to make Bluetooth with Java work and communicate between devices.

- Bluetooth Devices (minimum of two)
- Bluetooth Host (minimum one)
- Bluetooth Stack (an instance per device)
- Java Bluetooth API (an instance per device)

Bluetooth Devices are simply radios, hence why you need to two to communicate between them. The Bluetooth radio may be USB dongle on a desktop computer, or inbuilt to a laptop or mobile. A Bluetooth device needs to attached to or part of a Host. This is the actual physical computing device, like the computer having the USB dongle connected or the mobile having the inbuilt Bluetooth radio. Keeping in mind it is possible to connect many USB dongles to one computer. This is normally how a developer tests[5].

All the tabs are disabled at the beginning apart from the remote device scanning panel. At this point user can only scan for a device. If any device was found, a new row added at the device detailed panel along with the details of the device. User can add the same at the destination DDL by clicking on add button after selecting the required row.

While scan for other Bluetooth devices by clicking on the scan button the status panel change the status and icon color changed to red (busy).When device is detected it's added at the device panel.

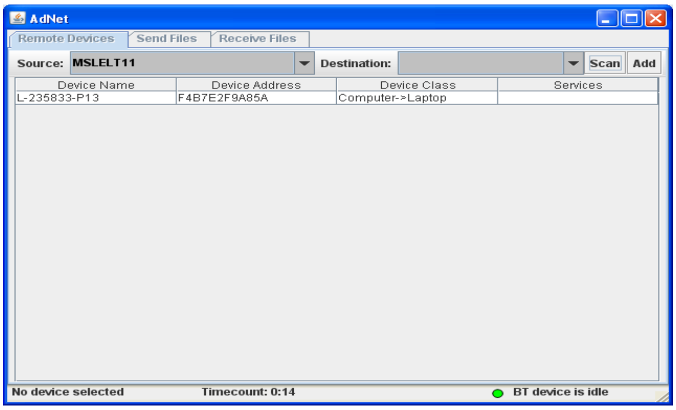

Fig 5: Adding detected device

User can send a file by browsing and selecting/not selecting destination device file path from "Send Files". User can choose between different transfer protocol. Here sending files using OPP protocol.

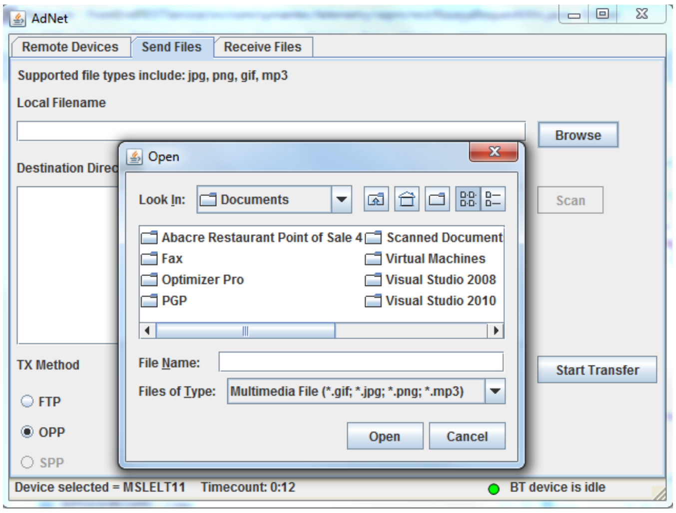

Fig 6: File Transfer using OPP

On the other hand User can import files from the selected device using Bluetooth Technology, under receive files tab in the user interface.

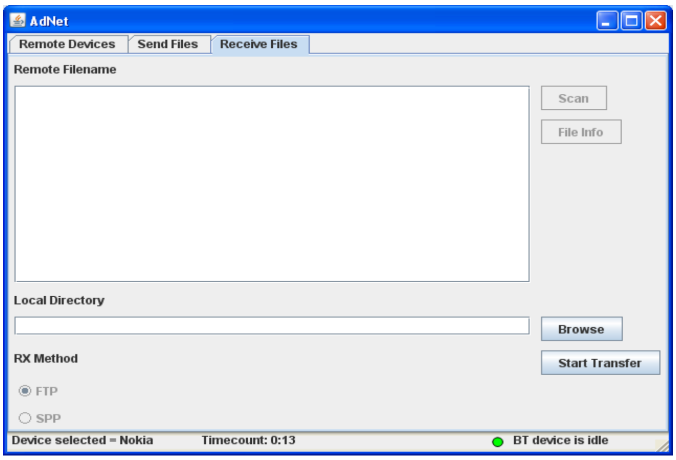

Fig 7: File Importing at Receiver.

VI. Conclusion and Future scope

The goal of this project is to explore the development of wireless Vehicular Ad-Hoc Networking / Mobile Ad-Hoc Networking (VANET/MANET) technologies. The vision is safety and commercial applications enabled by short to medium range communication systems and/or networks (vehicle-vehicle or vehicle-roadside). Such technology should provide priority for time-critical safety messages. Vehicular ad hoc networks provide an exciting area of research at the intersection of a number of disciplines and technologies. There is a plethora of future applications for VANET/MANET, ranging from diagnostic, safety tools, information services, and traffic monitoring and management to in-car digital entertainment and business services. However, for these applications to become everyday reality an array of technological challenges need to be addressed. In this project we would focus on sensor networks built on top of VANET/MANET and described a number of their applications.

One of the most exciting application areas of wireless ad hoc networks is the automobile sector. Ad hoc network technology will be used in the near future in the car's onboard communication unit in order to collect real-time data on traffic and road conditions from a variety of onboard sensors. Areas of application include services like safety warning systems, traffic control, and real-time traffic re-routing by intelligent traffic management systems. These types of networks will be used in the future to collect real-time data on road conditions and traffic from a variety of onboard sensors. Some of the important applications of the resulting sensor networks are safety applications including collision and other safety warning systems, driver assistant and information systems and, further down the road, intelligent traffic management systems. Such systems will feed sensor data collected from vehicles and roadside sensors into traffic analysis and simulation software and use the result for control and management of traffic on the road.

VANET/MANET applications will include on-board active safety systems leveraging vehicle-vehicle or roadside-vehicle networking. These systems may assist drivers in avoiding collisions. Non-safety applications include real-time traffic congestion and routing information, high-speed tolling, mobile infotainment, and many others. The goal of this project is to explore the development of wireless Vehicular Ad-Hoc Networking (VANET/MANET) technologies. Enabled by short- to medium-range communication systems (vehicle-vehicle or vehicle-roadside), the VANET/MANET vision includes vehicular real-time and safety applications, sharing the wireless channel with mobile applications from a large, decentralized array of commercial service providers. VANET/MANET safety applications include collision and other safety warnings. Non-safety applications include real-time traffic congestion and routing information, high-speed tolling, mobile infotainment, and many others.

The opportunities for VANET/MANET are growing rapidly with many vehicle manufacturers and their suppliers actively supporting research and development in this area. In the US, the FCC approved 75 MHz of spectrum for inter-vehicle communications (IVC) and vehicle-to-roadside communication (VRC), known as Dedicated Short Range Communication (DSRC). The resulting DSRC system is expected to be the first wide scale VANET in North America. In Europe several national and European projects have been conducted, including the Fleet net project in Germany. In Japan two DSRC standards have been adopted and the Japanese car manufacturers are working with governments on an ambitious

Advanced Safety Vehicle Project Creating high-speed, highly scalable and secure vehicular sensor networks presents an extraordinary challenge due to a combination of highly dynamic mobility patterns, which result in highly dynamic network topologies, combined with the high velocities that can be involved.

For example, vehicular sensor networks have access to ample computational and power resources within the network itself, and can utilize high-performance wireless communication and advanced antenna technology. Finally, it can be expected that a significant fraction of vehicles will have an accurate knowledge of their own geographical position, by means of GPS.

The projected would be best demonstrated on hardware models. The hardware models would be more interactive and would display the accurate results and actions which take place in a Vehicular Ad-hoc Network (VANET).

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