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REVIEW ARTICLE

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A Study of Vehicular Sensor Networks

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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. Vehicular ad hoc networks (VANET) are created by vehicles equipped with short and medium range wireless communication technology [35]. Communication is possible between vehicles within each other's radio range, and with fixed gateways along the road. 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 [36, 37, 38, 44], 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 and junctions. The opportunities for VANET 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 Fleetnet project in Germany [40]. In Japan two DSRC standards have been adopted and the Japanese car manufacturers are working with governments on an ambitious Advanced Safety Vehicle Project [41]. Here at BT Research in UK there is a collaborative project with industrial and academic partners on ubiquitous traffic telematic system, or traffmatics [42, 43]. 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 [39]. On the other hand, certain limitations commonly assumed in other ad hoc sensor networks are not present in these systems. For example, vehicular sensor networks have access to plenty 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.

Vehicular Sensor Networks (VSNs) can be built on top of VANET by equipping vehicles with onboard sensing devices as shown in Figure 3.1. VSN are emerging as a new network paradigm for effectively monitoring the physical world, especially in urban areas where a high population of vehicles, working as mobile sensors, is expected to be always present [84]. Vehicles are typically not affected by strict energy constraints and can be easily equipped with powerful processing units, wireless transmitters, and sensing devices even of some complexity, cost, and weight (chemical spill detectors, still/video cameras, ...). Let us note that VSN represent a significantly novel and challenging deployment scenario, relevantly different from more traditional wireless sensor network environments, thus requiring innovative specific solutions. In fact, differently from wireless sensor nodes, vehicles usually exhibit constrained mobility patterns due to street layouts, junctions, and speed limitations. In addition, they usually have no strict limits on processing power and storage capabilities. Most important, they can host sensors that may generate sheer amounts of data, such as multimedia streaming recorded by cameras, thus making inapplicable data reporting solutions already known in the wireless sensor network literature. The typical scale of a VSN over wide geographic areas (e.g., thousands of nodes), the volume of generated data (e.g., streaming data), and mobility of vehicles make it infeasible to adopt traditional sensor network solutions where sensed data tends to be systematically delivered to sinks using data-centric protocols [77].

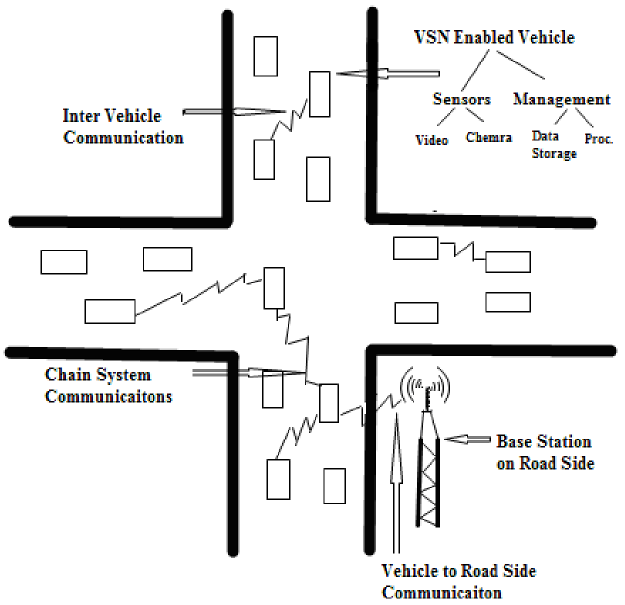

Figure 3.1 Vehicular Sensor Networks

Vehicular Sensor network is mainly used as Machine eye where video camera and other sensod devices are used for harvesting the summaries from the neighbor vehicles and store that in specified data base. And Indexing process is implanted for any query. Many security agencies can use this technique for security purposes.

3. 4 REPLICATION STRATEGIES

Replication Strategy is not a new concept but it an emerging concept in the area of research. In case of MANET it is a challenging task to perform replication process.

3. 4. 1 Issues concerning data replication for MANET databases

In addition to addressing issues such as data stability and availability that exist in traditional databases, a data replication technique for MANET databases must also deal with the following additional issues arising from constraints imposed by their specific environments and applications:

- *Server power consumption*: Servers in MANET run on battery power. Power consumption of servers that provide database management system (DBMS) services to potentially many clients should be minimized. Servers with higher power availability are expected to perform more work than those that have lower power. If a server has low power remaining and if it is replicated with many frequently accessed data items (hot data), then frequent data access requests for these hot data might drain its power soon. Servers with no power remaining would not be able to provide any more services. The replication algorithm should thus replicate data items in such a way that the power consumption of servers is reduced, and is balanced among all servers in the system.
- *Server mobility*: Servers in MANET are mobile and the speed at which the network topology changes is higher than that in conventional mobile databases. Due to their mobility, servers might sometimes move to a place where they cannot be reached by other servers or clients. The replication technique should avoid replicating hot data items in such isolated servers.
- *Client mobility*: Clients that query the servers can be mobile. Clients sometimes send their transactions to the nearest servers to get a quicker response. The decision to replicate a data item in a particular server may be based on the access frequency of that data item on that server. Clients, after issuing their requests for data access to a server, might move to new positions after a certain interval of time, and they might send their query and update requests to the nearest servers from their new locations. Hence, the access frequencies must be dynamic in nature and the decision to replicate data items in appropriate servers must also be dynamic.
- *Client power*: Client machines also run using their battery power. Some clients like PDAs are more power restricted than servers. They are limited by the amount of energy they can use before their batteries need to be recharged. A client might lose its power rapidly if it waits for its transactions ‘results for a long time. The replication technique should be able to replicate data items in appropriate servers in such a way that client power consumption is reduced.
- *Real-time applications*: MANET applications like rescue and military operations are time-critical and may contain both firm and soft real-time transactions. Therefore, the replication technique should be able to deliver correct information before the expiry of transaction deadlines, taking into consideration both real-time firm and soft transaction types in order to reduce the number of transactions missing their deadlines.
- *Frequent disconnection of mobile hosts*: Mobile hosts often get disconnected from the network due to various factors like power failure or their mobility. In addition, some mobile users switch their units on and off regularly to save power, causing more

network disconnections. Servers which hold the data cannot provide services if they are disconnected from other mobile hosts. Thus, ideally, the replication algorithm should be able to determine when a particular mobile host would be disconnected and, accordingly, replicate its data items in a different server to improve data accessibility.

- *Network partitioning*: Due to frequent disconnection of mobile hosts, network partitioning occurs more often in MANET databases than in traditional databases. Network partitioning is a severe problem in MANET when the server that contains the required data is isolated in a separate partition, thus reducing data accessibility to a large extent. Therefore, the replication technique should be able to determine the time at which network partitioning might occur and replicate data items beforehand.

3. 4. 2 Classification of existing data replication techniques

Following from the discussion of the issues that concern replication in MANET databases, some issues can be identify as *the issues of power consumption* (by both clients and servers), *real-time requirements of applications* and *network partitioning* (due to client and server mobility as well as frequent disconnection) as three of the most important issues to be considered in the design of a data replication technique for MANETs. [45] While these issues are also related to conventional networks, they become more severe in MANETs. Since MANETs allows for mobility of both servers and clients, network disconnection and partitioning occur frequently in MANETs. Power failure also occurs commonly in MANETs due to the limited battery capacity of mobile nodes. These occurrences prolong transaction execution time due to unavailability of remote resources. Furthermore, MANETs are commonly deployed for time-critical applications; thus, enabling the execution of transactions before the expiry of their deadlines is difficult in the face of such network conditions. Hence, these issues (namely, power consumption, real-time requirements of applications and network partitioning) should be considered when designing a replication technique for MANET databases. Based on these MANET data replication issues, I can define the following. *Power aware* techniques take into account the power consumption of clients and servers. Replication techniques that support transactions having deadlines and try to minimize the number of transactions that miss their deadlines are called *real-time aware* techniques. Replication techniques that predict the occurrence of network partitioning and replicate data items accordingly ahead of time are called *partition-aware* techniques. An ideal replication strategy for MANET would be power-aware, real-time-aware as well as partition aware. The existing data replication techniques can be collectively classified into five categories based on different combinations of the above mentioned criteria. Power-aware, non-real-time-aware and Non-Partition-Aware techniques, real-time-aware, Non-power-aware, and partition- aware. These categories are useful to classify existing replication techniques based on the MANET replication issues they try to address. This classification is not meant to enumerate or describe all possible types of MANET replication techniques.

3.5 SMART NETWORKING

Dissemination of the data in a smart way is primarily goal that is based on data diffusion via continuous single hop broadcast advertisements [117]. As nodes get interface, they mutually exchange memory contents, thus desired data spread over among the all network participants. The final goal of the process is to reach intended destinations; in particular, this enables communications between disconnected nodes in sparse networks. In such type of Dissemination a mobile node spreads reports in its local storage to encountered nodes and obtains new reports in exchange. A node can set a profile by choosing resource categories of interest; then, information is selectively disseminated with profile matching strategies. a flooding-based approach where nodes exchange all the data within their buffers with neighbors, and a history- based protocol where data is uploaded only to nodes with high probability of encountering base stations. Let us observe that, broadly speaking, smart networking principles do not restrain to single-hop epidemic relay. These can be classified as different smart approaches because of the exploitation of already present sensing devices, such as cameras in mobile phones, symbiotically attached to mobile entities. Application-level protocols for the resolution of queries about sensed data have been proposed in [118, 116]. [118] describes three middleware solutions: Abstracts the network as a database, and resolves declarative queries; Spatial Programming hides remote resources, such as nodes, under local variables, thus enabling transparent access; finally, Migratory Services are components that react to changing context, e.g., the target moving out of range, by migrating to other nodes. The source injects a query in the environment, specifying an area where the query should be moved for resolution. Nodes belonging to the target area form a sequential Virtual Ad Hoc Server: they check if they can reply to the query and relay to neighbors. There are many projects where smart networking is used

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