# Use of Cell Phone Density for Intelligent Transportation System (ITS) in Bangladesh

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*Abstract*— **Traffic congestion in the large cities of Bangladesh is a rising crisis that has to be taken into account seriously, not only by governments, but also by the private sector. After a wide survey in the field of Intelligent Vehicle / Transportation System (IVTS), different alternatives are analyzed to solve this problem and the concept of Intelligent Vehicle / Transportation System is proposed as the best solution. This work analyzes the latest trends in this area and compares the different options. In addition, comparisons between Europe, Japan and United States, highlighting the advancements in this field of each one of them was conducted. Ideas and procedures are unified while developing a well structured concept of Intelligent Vehicle / Transportation System which contains separate fully-functional units with their own characteristics interrelated to each other to conform a flexible system that can respond in an effective way to solve the problem of traffic congestion. Some of the most relevant efforts in this area and their role in the great scale implementation of IHS are described.**

***Index Terms*— ITS, Cell Phone Density (CPD), GPS, CIP**

## I. Introduction

TRRAFIC congestion is not a new problem. In the 1940's, the introduction of affordable mass-produced cars provoked a rapidly increasing population of drivers demanding paved city and rural roads. This fact quickly expanded the scope and intensity of the traffic problems. The increase of automobiles and trucks during several decades after the car boom has resulted in the construction of more and more highways in Bangladesh; the massive 40-year construction of the nationwide interstate highway is only now nearing completion. The relief from traffic congestion through the construction of highways has only been temporary, because new commercial and residential growth follows the path of the project.

The traditional solution has been to construct more and larger highways. However, due to the high financial, social, and environmental costs of such projects, that is no longer seen as a viable option. Many innovations have come to use in a more efficient way the existing infrastructure, such as: improved traffic-signal controllers, changeable highway signs, rerouting rush-hour traffic, creation of traffic-control [1] centers that monitor and display gross traffic conditions, use of preplanned alternative traffic solution based on repeated daily traffic patterns, etc.

The more efficient use of the existing road network using the emerging advancements in technology seems to be the most acceptable answer. However, there is not a consensus of how to face the problem. It is necessary to find the way to operate the existing system more effectively and efficiently, but this system does not respond dynamically to traffic congestion. It is unable to change traffic-handling rules rapidly in response to actual traffic conditions. In that sense, it is indispensable to create the basis for a new generation of vehicles and highways that will interact intelligently as a unit. This new concept to face the growing traffic problems and its traffic congestion has reached crisis levels in most major cities throughout the Bangladesh and is becoming a major problem in smaller cities and rural areas as well. Not only is traffic congestion a source of frustration for commuters, this congestion is also costly and a significant contributor to air pollution. This traffic congestion has been increase day by day in the world. The average American motorist spends 36 hours in traffic delays every year. The cost of traffic congestion just in the United States is $78 billion, representing the 4.5 billion hours of travel time and 6.8 billion gallons of fuel wasted sitting in traffic [2][3]. Billions more dollars have been spent on electronics and systems to alleviate this logjam.

In Bangladesh the traffic load is monitored by the highway police. As a result, day by day traffic congestion has been increased. In the globalization era, the way of monitoring traffic congestion must be changed. In the rest of the world currently, transportation agencies collect highway traffic data from radar devices, video cameras, roadside sensors, and other hardware requiring expensive field installation and maintenance. Transportation agencies currently spend more than $1 billion per year for traffic monitoring systems covering less than 10% of our national highway system. Data is delivered to a Traffic Management Center (TMC) via high-speed fiber-optic communications where it is organized [4],

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analyzed, and then delivered to the public by overhead or roadside message boards, Department of Transportation Web sites, and through partnerships with radio, television, and other media outlets. This hardware-oriented field equipment approach to collecting traffic data and providing information is costly and is practical in select urban areas only. An emerging concept is the idea of using a Global Positioning System (GPS) device to determine a series of positions of mobile communication devises and transmit these data via a wireless network to a central computer processor. The processor can then calculate the speed and direction of the device for use in determining traffic flow [4]. While this approach can give very accurate information for a small number of devices, any attempt to gather positioning information from a large number of devices will use up large amounts of scarce bandwidth from the wireless network and prove to be very costly. Additionally, GPS data is not available for most of the wireless networks operating today. Although some nationwide trucking companies have GPS location devices in their trucks, these vehicles represent a small fraction of the number of vehicles using the roadways.

While most wireless telephony networks do not have GPS data capabilities, they do have a vast infrastructure of communication facilities. These facilities generate data routinely to enable the system to properly function, e.g., to enable cellular phone users to place and receive calls and stay connected to these calls as they move though the cell sectors of a system. Examples of these data include call detail records (CDR), handover messages, and registration messages.

## II. WHAT IS ITS

Intelligent transportation systems (ITS) encompass a broad range of wireless and wire line communications-based information and electronics technologies. When integrated into the transportation system's infrastructure, and in vehicles themselves, these technologies relieve congestion, improve safety and enhance productivity [2][6]. Information technology (IT) has already revolutionized many industries, and now appears poised to transform countries' transportation systems. Indeed, IT is likely to emerge as the major tool to solve surface transportation challenges over the next several decades, as an "infrastructure" gets built alongside countries' physical transportation infrastructure. In fact, the scenarios described above are not visionary or futuristic; they are real, already exist in several countries today, and are available to all countries that focus on developing and deploying them. The scenarios describe applications of intelligent transportation systems (ITS), systems that deploy communications, control, electronics, and computer technologies to improve the performance of highway, transit (rail and bus), and even air and maritime transportation systems. Intelligent transportation systems include a wide and rowing suite of technologies and applications such as real time traffic information.

systems, in-car navigation (telemetric) systems, vehicle-to-infrastructure integration (VII), vehicle-to-vehicle integration (V2V), adaptive traffic signal control, ramp metering, electronic toll collection, congestion pricing, fee-based express hot lanes, vehicle usage based mileage fees, and vehicle collision avoidance technologies.

## KEY TECHNOLOGY FOR IMPLEMENTATION

### A. *Global Positioning System*

Embedded GPS receivers in vehicles' on-board units (OBUs, a common term for telemetric devices) receive signals from several different satellites to calculate the device's (and thus the vehicle's) position. This requires line of sight to satellites, which can inhibit use of GPS in downtown settings due to "urban canyon" effects. Location can usually be determined to within ten meters. GPS is the core technology behind many in-vehicle navigation and route guidance systems [8]. Several countries, notably Holland and Germany, are using or will use OBUs equipped with satellite-based GPS devices to record miles traveled by automobiles and/or trucks in order to implement user fees based on vehicle miles traveled to finance their transportation systems.

### B. *Dedicated Short Range Communication*

DSRC is a short- to medium-range wireless communication channel, operating in the 5.8 or 5.9GHz wireless spectrum, specifically designed for automotive uses. Critically, DSRC enables two-way wireless communications between the vehicle (through embedded tags or sensors) and roadside equipment (RSE). DSRC is a key enabling technology for many intelligent transportation systems, including vehicle-to-infrastructure integration, vehicle-to-vehicle communication, adaptive traffic signal timing, electronic toll collection, congestion charging, electronic road pricing, information provision, etc. DSRC is a subset of radio frequency identification (RFID) technology. The technology for ITS applications works on the 5.9GHz band (United States) or the 5.8GHz band (in Japan and Europe) [5][11]. At present, DSRC systems in Europe, Japan, and the United States are generally not compatible (although there are indications that Europe may be trying to migrate to 5.9GHz). In 2004, the U.S. Federal Communications Commission (FCC), atypically for a U.S. regulator, prescribed a common standard for the DSRC band both to promote interoperability and to discourage the limitation of competition through proprietary technologies.

### C. *Wireless Technology*

Similar to technology commonly used for wireless Internet access, wireless networks allow rapid communications between vehicles and the roadside, but have a range of only a few hundred meters.[3] However, this range can be extended by each successive vehicle or roadside node passing information onto the next vehicle or node. South Korea is increasingly using WiBro, based on WiMAX technology [11], as the wireless communications infrastructure to transmit traffic and public transit information throughout its transportation network

### *D. Mobile Telecommunication*

ITS applications can transmit information over standard third or fourth generation (3G or 4G) mobile telephone networks [6]. Advantages of mobile networks include wide availability in towns and along major roads. However, additional network capacity may be required if vehicles are fitted with this technology, and network operators might need to cover these costs. Mobile telephony may not be suitable for some safety-critical ITS applications since it may be too slow.

### *E. Radio Wave or Infrared Wave*

Japan's Vehicle Information Communications System (VICS) uses radio wave beacons [7] on expressways and infrared beacons on trunk and arterial roadways to communicate real-time traffic information. (Arterial roadways are moderate capacity roadways just below highways in level of service; a key distinction is that arterial roadways tend to use traffic signals. Arterial roadways carry large volumes of traffic between areas in urban centers.) VICS uses 5.8GHz DSRC wireless technology.

### *F. Road Side Unit*

Road side Unit is instrument that located on road side which establishes the communication among the vehicle of the road that is around the 100 meters of RSU [9] and also communicate other RSU located nearby it. Road Side sensor nodes measure the road condition at several positions on the surface, aggregate the measured values and communicate their aggregated value to an approaching vehicle. The vehicle generates a warning message and distributes it to all vehicles in a certain geographical region, potentially using wireless multi-hop communication.

### *G. On Board Unit*

On board unit is embedded with the vehicle. The OBU is a telemetric devices mounted inside the driver cabin [9]. The OBU has a module, which interacts with the GPS satellites for computing the position information of the vehicles. The data stored in the OBU is wirelessly transmitted to the backend systems by means of the 3G transmission system. A range of sensor inputs can be connected to the OBU to get control outputs.

## III. ITS IN BANGLADESH

Bangladesh witnessed rapid growth of transport since Independence. The overall annual growth rate was nearly 8.2 per cent for freight transport and 8.4 per cent for passenger transport. Even then the transport intensity of the Bangladesh economy is considerably lower than that of many developing countries. Bangladesh is a developing country. Its economic status cannot afford reforming of mega cities. And also have a very few scope for constructing new highways in these cities. As a consequence we cannot construct all the required infrastructures for IHS through all the mega cities in our country. It is proven that the current traffic block is awful and it is quite impossible to avoid the traffic congestion under the existing traffic control system. Today, we share a mega-city of concrete with nearly 12.6 million inhabitants and 334 thousand motorized and half a million non-motorized vehicles. The problem of easy transportation is compounded by the fact that there are nearly 2,500 garment factory units in Dhaka City with its more than one and half million workers, all of whom require reliable transport facilities. The spillover effect affects all entrepreneurs in the private sector underlining the strong linkage that exists between good urban transports on the one hand and the socio-economic life on the other. We must not forget that infrastructure is a kind of link that acts as a barometer in determining how a city's network is functioning. We all know that the status of transport greatly determines accessibility to jobs and economic resources in the form of direct investment, education and health facilities and availability of other social services. It plays a vital role in the process of integration of the people living in mega-cities and their alternative opportunity costs in terms of available resources. It is indeed most unfortunate that as Dhaka continues to grow; its citizens face greater suffering from lack of infrastructural support. In this regard, our proposed system can be the best solution to implement ITS.

## IV. CENTRAL INTEGRATION POINT (CIP) FOR ITS

Every people have at least one electronic communications device of this day. There are more than 100 million cell phone users in Bangladesh at 2011 December. Each day, thousands more sign up. Millions more have two-way pagers. The radio signals emitted from these devices can reveal our location at anytime. This ability to locate cell – phone users will become a vital component of future traffic-management systems. On a short stretch of roadway in Dhaka, **Cell-Loc** is testing out its new cell-phone tracking technology [10]. In July 2010, the company sent a known vehicle down a 1.25-mile (2-km) section of a major roadway, through the heart of the town, to test the accuracy of its system. The truck carried a GPS receiver onboard to compare the system's accuracy. We collected data from both the GPS receiver in the vehicle, and from system that was monitoring the cell phone remotely, and we compared the two and found them to be, not identical, but close enough for applications.

Here's how the **Cellocate** system will work, according to Hillson and company documents:

- **Listening posts** are placed throughout a city, either next to a cell-phone base station or in independent locations. Listening posts are comparable to half a base station: They can detect but not transmit radio signals.

- Three listening posts are needed to get a **two-dimensional position** of a cell-phone user.

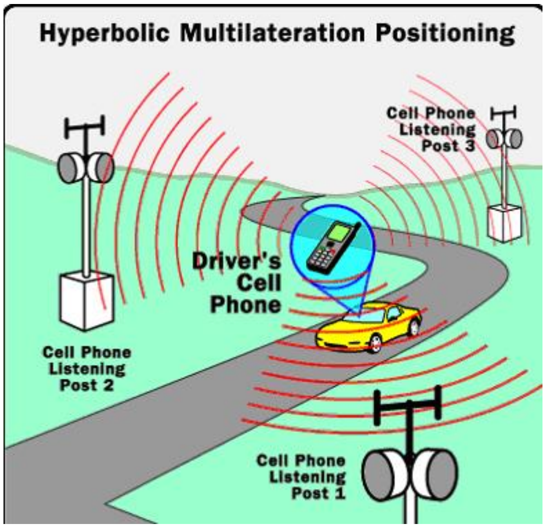


Fig:-1: Hyperbolic Multilateration Positioning

- Listening posts **detect** cell-phone transmission, **decode** it and then **time-stamp** the arrival of a wavefront from the transmission.
- Once three towers have time-stamped a transmission, the information is quickly sent to a central computer that uses **hyperbolic multilateration** [12] to determine the cell phone's position on a highway.

Once information is detected from cell phones, it has to be **disseminated** to motorists. In order for drivers to be routed around traffic, they must be informed of how fast the traffic is flowing, if it's clogged or if there is an incident blocking traffic altogether. This is where the cell-phone service provider comes into the picture. The provider would send this information out to customers.

There are three ways to transmit information to motorists:

- Collected information is fed into a large repository that can be accessed via a Web site. A map on the screen would show various roadways in green, yellow and red to indicate free-flowing traffic, slow traffic and clogged traffic, respectively.
- Registered users, whose locations are known, are sent **customized traffic reports** based on the road and direction in which they are traveling. Systems will also advise users of alternate routes around congested areas.
- Information is displayed on conventional **electronic road signs**.

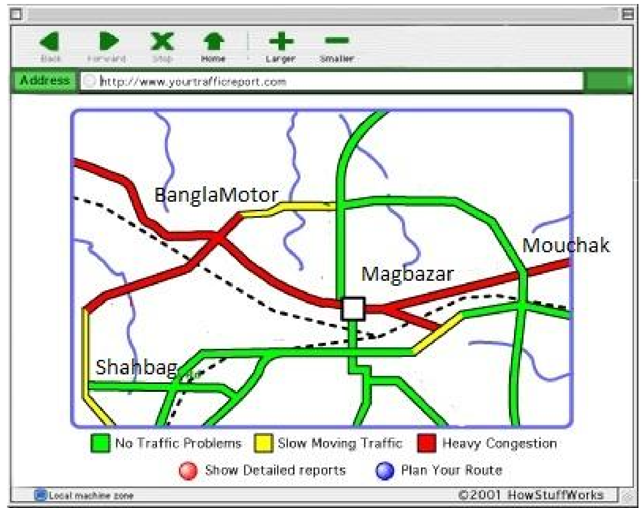


Fig:-2: 2D road map at maghbazar point

By getting information to the customers more quickly, developers believe that commuters will have enough time to react to these warnings and find another way around the congested areas. This would be an advance compared to how information is released today, which is primarily through radio or television news reports. By the time the radio and TV report an incident, it's typically too late for most commuters to act on the information. Cell phones and other digital devices are as commonplace as cars, so why not combine the two to solve the problem of congested highways? In the next few years, we will learn for ourselves whether these new technologies will make our commute to work easier or if our only hope is to find a way to stay home.

## V. OPERATIONAL CONCEPT FOR ITS

The multi-application/ vehicle to vehicle, multi-element, multi-directional OBU can select the emergency warning pattern, the forward pattern, the rearward pattern, or the 360 degree pattern depending on the requirements of the application being implemented.

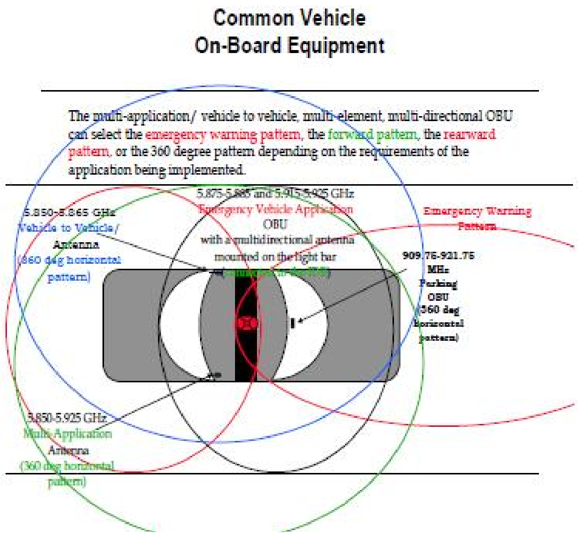


Fig:-3(a): Common Vehicle On-Board Equipment

When the care comes to range of network then OBU device collect the information about the area and network send the information about the area or voice messages about the road information into the care monitor.

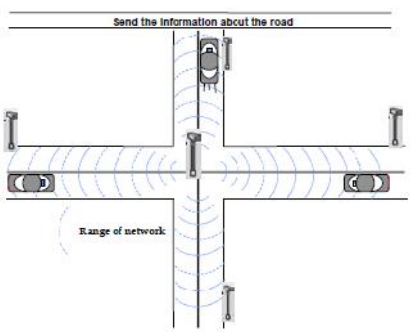


Fig:-3(b): Traffic information site at normal

Suppose that one care come to Shahbag to Banglamotor in Magbazar road and Magbazar road has Cell phone listening post1 ,when the care come to the Cell phone listening post1 then the network send the messages into 2Km road information and Driver are Looked monitor and see the map or details information about the road.

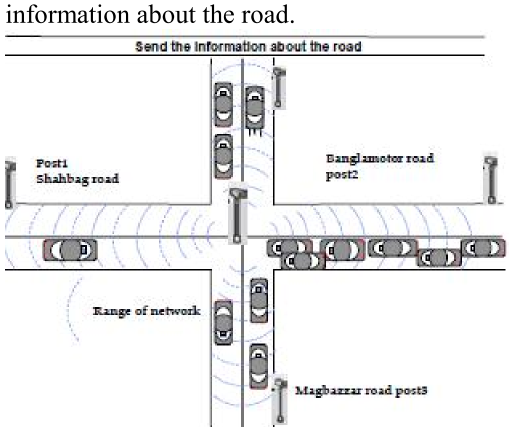


Fig:-3(c): Traffic information site at heavy congestion

## VI. Conclusion

After years of planning, implementing and improving in small scale, Intelligent Vehicle / Highway System (IVHS) is starting to be a striking and essential alternative to alleviate the traffic congestion in the major cities of the Bangladesh. Pioneer projects and organizations such as PROMETHEOUS, IVHS America, DRIVE, and ERTICO have established the basis to go one step further in the introduction of this concept in a larger scale. The development of a theoretical support, in conjunction with the application, of the latest advances in the microelectronic, computer science and communications have definitively placed IVHS as the foremost option to solve this problem. There is an international competition between U.S., Japan and Europe in this area and also a competition between private companies, universities and various government agencies. However, we observing vast evidence that international cooperation go beyond this rivalry. All the factors involved in these efforts all over the world recognize that the principal adversary in this fight is the traffic congestion and its consequences.

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