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A Survey: Crucial Crime Information Sharing Mechanism Using DTN for Rural Areas

Neha Agrawal and Rajesh singh

Department of CSE/IT NITM Gwalior, (M.P) India
agrawal02neha@gmail.com, raj25682@gmail.com

Abstract

Mobile ad hoc routing protocol allows nodes with wireless adaptors to communicate with one another without any pre-existing network infrastructure. In this work, we develop techniques to deliver messages in the case where there is never a connected path from source to destination or when a network partition exists at the time a message is originated. Opportunistic networks is a more general concept of delay tolerant networks which opens an exciting avenue for connecting nodes opportunistically and communicates wirelessly and at the same time expands the potential for real-life application problems. In opportunistic networks, end-to-end communication among users does not require a continuous end-to-end path between source and destination. This is achieved by temporarily storing messages at intermediate nodes, waiting for future opportunities to forward them towards the destination. This system will help us to provide police services to villages. When a crime is reported in a village & police is needed there as soon as possible. We can use high frequency sensors there to locate the crime location and to inform police. This type of system will be helpful in those places where traffic frequency is high.

Keywords: Delay tolerant networking (DTN), MAP, MANET, TCPCL

1. Introduction

The opportunistic networking stems from the research area of mobile adhoc networks (MANET) but in mobile adhoc networks packets can only be transmitted when the links between nodes is established and packets can get lost when the network contacts is intermittent so packet delivery ratio is not good in MANET. To overcome this problem a **delay tolerant networking (DTN)** is used. DTN works when traditional networking fails and new routing protocols are needed. It enables communication in sparse mobile adhoc networks when there is no path between source to destination [1]. DTN generally cannot support the TCP/IP (transfer control protocol/internet protocol) based communication due to problem of frequent topology changes. Then we come to opportunistic network which is a subclass of DTN, the goal of this study is to add more realism to the simulations of DTN .The only difference between MANET and Opportunistic network is storage capacity of nodes. It follows the store-carry and forward scheme to communicate between the nodes, a node store messages when no forwarding opportunity towards the final destination exists and wait until it gets a mobile device to bring the message closer and closer to the destination. Problems like Long propagation and variable queuing delay can be sort out by node mobility and then forwarded by during opportunistic contacts by transferring messages in one's node storage to another's node storage along a path expected to reach the destination.

On the other hand ,opportunistic networks is used where connectivity is unreliable and there is need for data transfers to and from such locations like processing data by sensors or medical devices for providing basic communication like email *etc*.

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The performance of these networks depends on how far apart the sender and receiver is, how far nodes move, how dense the node population is, how far apart the sender and receiver is .Delivery latency may vary. The frequency, duration and other characteristics are dependent on the mobility patterns. In opportunistic networks, disconnections and highly variable delays caused by human mobility are the norm.

Simulation plays an important role in analyzing the behavior of DTN routing. for this purpose I am going to use a new simulation environment called opportunistic network environment simulator(ONE).It is java based tool and open source having capabilities of analyzing different application protocols and DTN routing [2]. ONE offers mobility modeling, visualization, message exchange, provide interfaces to import and export mobility traces, energy consumption *etc*. Researchers can easily understand the main logics of different DTN routing algorithms because the simulator offers the source code of famous routing protocols within it [1].

2. Challenges in Routing

In simple routing the link between the routers are established so packet can be transferred from one node to other node [3].Now if link is not established then packets will be dropped. Figure shows the problem during routing.

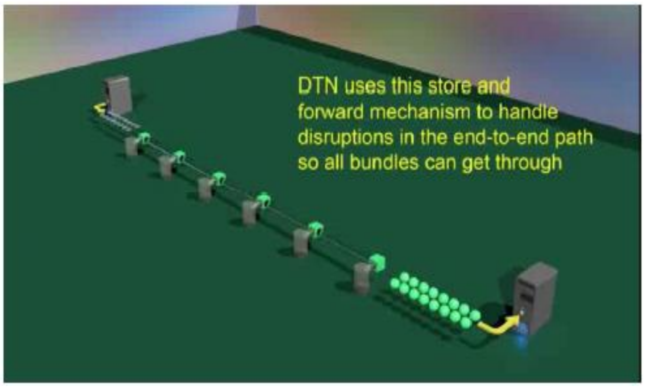


Figure 1. Problems During Routing

In **Delay Tolerant Network** each node has a resource to store the package. Now node will check if link between node is established or not [3]. If no, then the node will store the packet & forward the same when the link is established. The DTN scenario is given in the Figure

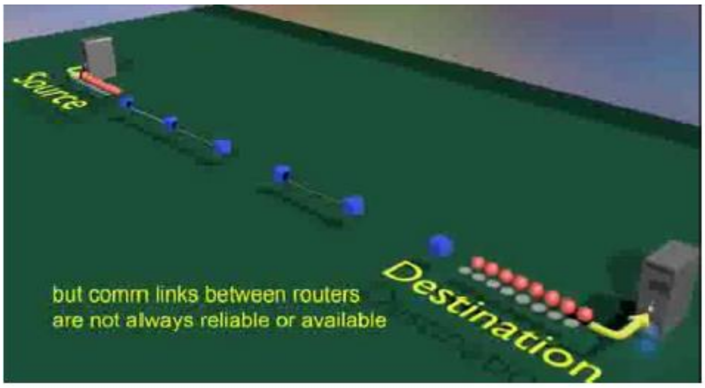


Figure 2. DTN

Thus, DTN use store & carry forward mechanism to send packets from source to destination.

3. Routing Issue in DTN

A. Routing Objectives in DTN: The most important routing objective in DTN is to maximize the probability of message delivery [3]. To minimize resources like buffer space battery energy is also an important routing objective. While DTN applications are expected to be tolerant of delay, this does not mean that they would not benefit from decreased delay but it’s still meaningful to minimize the delivery latency.

B. Energy: In DTN nodes are moving from one place to another place so it’s always lack of energy. Lots of energy is consumed for sending, receiving & storing messages.

***C.* Security:** It is always an important issue not only in DT but also in all networks. In DTN message can traverse from one node to other node before reaching to the destination. So security issue may occur at all nodes.

***D.* Buffer space:** The intermediate routes should require enough buffer space to store all the messages to be transmitted. More number of pending messages needs more available buffer space.

***E.* Resource Allocation:** The routing protocols must balance the goals of maximizing message delivery & minimizing resource consumption which are conflict with each other.

4. Background

DTN research has facing lots of problems by lack of good simulator. There are many simulators like NS -2(network simulator-2), OMNET++ (**O**bjective **M**odular **Ne**twork **T**estbed in C**++)**, but they are not giving a good DTN support.DTN routing simulators evolving since now from its first release.

From the last decade the researchers mainly focuses on efficient routing protocols. These protocols can be evaluated by simulation. There are several simulators like NS-2 (its successor NS-3), OMNET+ +, ONE (opportunistic network environment) simulator *etc*. and each one have its own benefits and drawbacks [2]. The ONE simulator is specifically designed for simulations related to DTN. And it is used in different publications, although simulation is broad area for research.

Now we come to oppnets architecture that adds one more layer called as bundle layer which helps to bridge inter networks and communication can be done by asynchronous messages of different sizes by using store carry and forward paradigm [1]. It have fix TTL (time to live).Simulators that considers only routing like ONE have one another problem that it always need input data which shows the link between 2 nodes is up or when it is down.

The taken data can be generated by some random process like by pseudo random generator or it may be derived from mobility simulation or by real world traces *e.g.*, using CRAWDED database which contains diverse wireless trace data sets for tracings mobility information. These traces helps in proposed routing strategy, to improve synthetic models for ex- Lee, *et al.*, [4] developed a movement model related to GPS (global positioning system) traces. And it also helped Verichele, *et al.*, [6] to gather mobility traces at an international music festival to simulate and integrate existing DTN protocols.

The ONE’S background says that it provides reasonable mobility capabilities and supports DTN routing and shows the results of the simulation progress in a better way. The figure shows the taxonomy of opportunistic networks

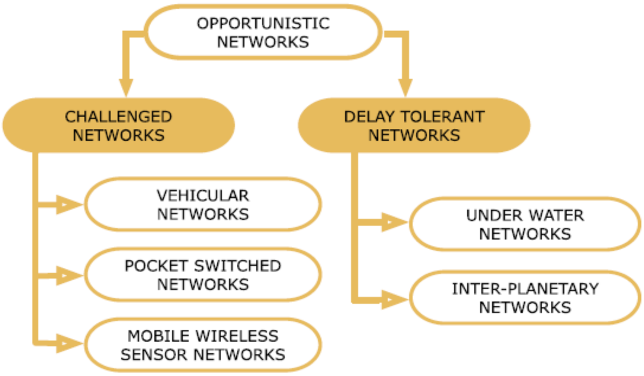


Figure 4. Taxonomy of Opportunistic Networks

5. Literature Survey

Basic network:

- A network has nodes that are interconnected connected to each other
- These nodes are usually static
- Communication path usually pre-determined (as in the network layer of the OSI model)

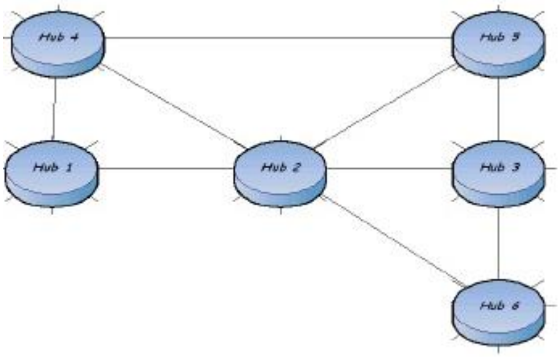


Figure 5. Opportunistic Network (Oppnets)

- Nodes are mobile/fixed
- Communication possible even if there no connecting route between nodes.
- route are build dynamically, *i.e.*, communication path not predetermined
- For the next hop a node would be opportunistically chosen only if it would bring the message closer to the destination

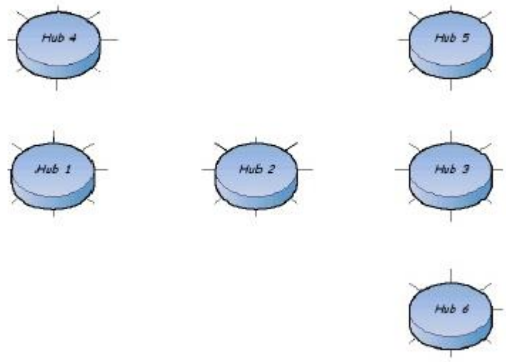


Figure 6. Detailed View of Opportunistic Networks

Opportunistic networks share concepts with delay tolerant networks. The DTN architectures focus on a scenario in which independent internets, each characterized by internal internet-like connectivity, are interconnected through a DTN overlay. In order to achieve end to end connectivity, the DTN overlay exploits occasional communication opportunities among the internet, which might either be scheduled over time or completely random.

Oppnets can be seen as a generalization of DTNs (**delay tolerant networking**). Specifically, in opportunistic networks no a-prior knowledge is assumed about the possible points of disconnections and existence of separate Internet-like sub-networks are formed by individual nodes, that are possibly disconnected for long time intervals, and that opportunistically exploit any contact with other nodes to forwards messages [2]. The routing approach between conventional DTNs, the points of disconnections (and, sometimes, the duration of disconnections) are known, routing can be performed along the same lines used for conventional Internet protocols, by simply considering the duration of the disconnections as an additional cost of the links. Since opportunistic networks do not assume the same knowledge about the network evolution, routes are computed dynamically while the messages are being forwarded towards the destination. Each intermediate node evaluates the suitability of encountered nodes to be a good next hop towards the destination.

For example, as shown in Figure, the user at the desktop opportunistically transfers, via a Wi-Fi ad-hoc link, he have a message for a friend and then works to carry the information closer to the destination. This user passes close to a train station, and forwards the message to a traveler going to the same city where the destination user works. At the train station of the destination city, a car driver is going in the same neighborhood of the destination's working place. The driver meets destination user on his way, and the message is finally delivered.

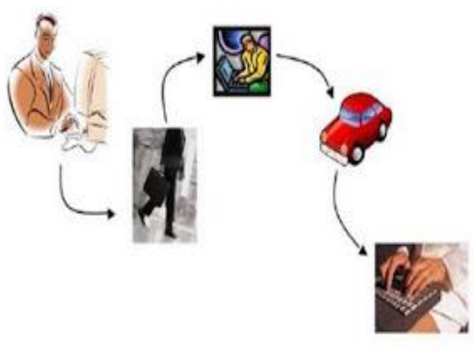


Figure 7. The Opportunistic Networking Concept

Three Interesting Projects Deploying Opponents:

- **Wildlife monitoring :** Opportunistic networks are also applied to interdisciplinary projects focusing on wildlife monitoring devices are attached to animals, and an opportunistic networks is formed to gather information and carry it to a few Base Stations (BS) possibly connected to the internet , Contacts among animals are exploited to aggregate data, and carry them closer and closer to the BS . This is a reliable, cost-effective and non-intrusive solution.
- **ZebraNet Project:** Concrete applications implementing these ideas have been used in the ZebraNet project. ZebraNet is an interdisciplinary project of the Princeton University performing novel studies of animal migration and interspecies interactions, by deploying opportunistic network on zebras in the vast savanna area of the central Kenya under control of mpala Research Center. http://www.mpala.org/researchctr/research/ongoing .html
- **DakNet Projects:** Finally, we mention the use of opportunistic networks to bring internet connectivity to rural areas. In developing countries and rural areas, deploying the infrastructure required to enable conventional internet connectivity is typically not cost-effective. However, Internet connectivity is seen as one of the main booster to bridge the digital divide. Opportunistic networks represent an easy-to-deploy and extremely cheap solution. Typically, rural villages are equipped with a few collection points that temporarily store messages addressed to the internet .Simple device mounted on bus, bicycle or motorbikes that periodically pass by the village collect these messages and bring them in regions where conventional Internet connectivity is available (e.g. a nearby city), where they can be delivered through the internet . Projects implementing these concepts are currently ongoing. For example, the DakNet and Kiosk Net Projects focus on realizing a very low-cost asynchronous ICT infrastructure to provide connectivity to rural villages in India, while the Saami Network connectivity Project provides connectivity to inhabitants of Lapland.

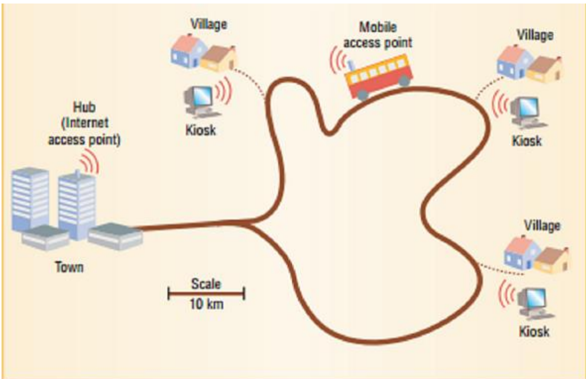


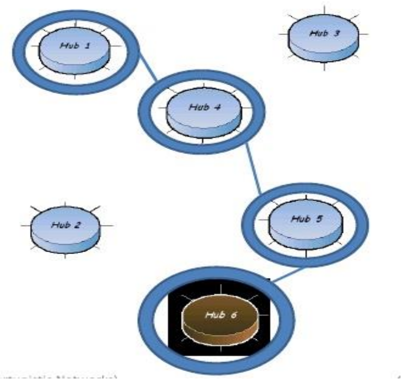
Figure 8. DakNet Concept

Physical transport, in this case a public bus, carries a mobile access point (MAP) between village kiosks and a hub with internet access. Data automatically upload and downloads when the bus is a range of a kiosk or the hub**.**

How Opportunistic Network Works?

- Each node receiving a message exploits LOCAL knowledge to decide which is the best next hop, among its current neighbors, for the message to reach the eventual packet destination [3]

- When no forwarding opportunity exits (*e.g.*, no other nodes are in the transmission range *etc*.,) the nodes stores the message and waits for future contact opportunities with other devices to forward the information



Architecture of Opportunistic Network:

Chung-Ming Huang and Kun-chan Lan have published a review on opportunistic network in: 2008, where they discussed about recent trends in this area [6]. They said that the intermediate nodes in oppnets, implementing the store-carry-forward message switching mechanism by overlaying a new protocol layer, called the bundle layer, on top of heterogeneous region-specific lower layers. Here, the node acts as a router, the bundle layer can store, carry and forward the entire bundles (or bundle fragments) between the nodes in the same region. On the other hand, the bundle layer act as gateway and used to transfer messages across different regions, as shown in Figure

Application Layer	
Bundle Layer	
Transport Layer A	Transport Layer B
Network Layer A	Network Layer B
Link Layer A	Link Layer B
Physical Layer A	Physical Layer B

Figure 10. The Protocol Stack

In this paper, the authors have discussed two specific **challenges** in an opportunistic network: the contact opportunity and the node storage as discussed below

1) Contact: Due to the node mobility or the dynamics of wireless channel, a node Might make contact with other nodes at an unpredicted time. Since contacts between nodes are hardly predictable, they must be exploited opportunistically for exchanging messages between some nodes.

2) Storage constraint: As described above, to avoid dropping packets, the intermediate nodes are requires having enough storage to store all messages for an unpredictable period of time until next contact occurs.

Further the authors talked about **network layer** in a separate section to discuss about some routing solutions for an opportunistic network. They said that based on the number of copies of a message forwarded by the node, we can define two different routing schemes: forwarding-based (single copy) approach and flooding-based (multiple copies) approach. They explained the forwarding-based approach as

A. Forwarding-based approach

In the forwarding-based scheme, based on what type of knowledge nodes use to select the appropriate or the best path to destination node, the prior studies can be classified into three categories: direct-transmission, location-based and estimation-based.

1) Direct-transmission:

In this approach, after the source node generates a message, the message is hold by the source node until it reaches the destination node. The main advantage of this scheme is that it incurs minimum data transfers for message deliveries.

2) Location-based: In the location-based approach, nodes will choose the neighbors who are closest to the destination to pass the message. LeBrun, *et al.*, proposed a method using the **motion vector (MoVe)** of mobile nodes to predict their future location [8]. The MoVe scheme uses the knowledge of relative velocities of a node and its neighboring nodes to predict the closest distance between two nodes. After the nodes future location are calculated, messages are passed to nodes that are moving closer to the destination

3) Knowledge-based: In the knowledge-based approaches, based on certain knowledge about the network, the source and intermediate nodes decide which node to forward the messages as well as whether it should transmit the message immediately or hold the message until it meets a better node. This scheme formulates the routing in order to minimize the end-to-end delivery latency

Musolesi, *et al.*, [9] present the **Context-Aware Routing (CAR)** protocol that provides an asynchronous communication for message delivery. So In CAR, if a message cannot be delivered synchronously, the message is sent to a host that has the highest probability of successful delivery and acts as a message carrier. They showed in their simulations that if the buffer size is small, the packet delivery ratio of CAR is better than that of epidemic routing due to that CAR only creates a single copy for each message. Burgess, *et al.,* [10] proposed a protocol called **MaxProp** for effective routing of messages. A node uses MaxProp to schedule packets transmission to its peers and determines which packets should be deleted when buffer space is almost full. Kun et al proposed a **shortest expected path routing (SEPR)** similar to link-state routing to maintain a topology map to each other. SEPR first estimates the link forwarding probability based on history data. When two nodes meet, they exchange the link probability update messages called effective path length (EPL). A smaller EPL value suggests a higher probability of delivery. When a node received a smaller EPL, it will update its local EPL value. EPL is also used in deciding which nodes to forward the messages. Using SEPR protocol, the same message could be forwarded to multiple nodes to increase reliability and to reduce delay

B. Flooding-based approach

In the flooding-based approach, every node broadcasts the received packet to all of its neighbors. However, in an intermittently connected network, some nodes might not be able to receive the broadcast packets due to network partitions. Therefore, each node stores the messages until the messages finally arrives the destination.

1) Epidemic Routing: The most representative protocol of this type is Epidemic Routing. Whenever two nodes come into communication range, they exchange summary vectors that contain a compact unambiguous representation of the messages currently stored in the local buffers [9, 10]. The dissemination process is somehow bounded because each message is assigned a hop count limit giving the maximum number of hops it is allowed to traverse till the destination. For this reason, Epidemic Routing incurs significant demand on both bandwidth and buffer

Spray and Wait Routing: An alternative, drastic way of reducing the overhead of epidemic without relying on network coding is implementing by Spray and Wait.

Spray phase*:* for every message originating at a source node, L message copies are initially spread – forwarded by the source and possibly other nodes receiving a copy – to L distinct "relays"

Wait phase: if the destination is not found in the spraying phase, each of the L nodes carrying a message copy performs direct transmission (*i.e.,* will forward the message only to its destination).

2) Estimate/Prediction Routing: In Estimate/ Prediction routing, nodes do not blindly forward the messages to all or some neighbors. Instead, nodes estimate the probability of each link to destination Lindgren, *et al.,* proposed a probabilistic routing protocol, PRoPHET (Probabilistic Routing Protocol using History of Encounters and Transitivity) Routing: PROPHET estimates a probabilistic metric called delivery predictability [10]. It is an evolution of epidemic that introduces the concept of delievery predictability. The delievery predictability is the probability for a node to encounter a certain destination. The PRoPHET forwarding algorithm is similar to epidemic except that during a contact, nodes also exchange their delievery predictability to destinations of messages they store in their buffers, and messages are requested only if the delievery predictability of the requesting node is higher than that of the node currently storing the messages. The context information used by PRoPHET is the frequency of meetings between nodes

Then the authors discussed about **transport layer** and said that the existing transport layer protocols, such as TCP, are not suitable for an environment where frequent disruption is a norm and end-to-end paths are typically not available. In [11], authors proposed the Licklider Transmission Protocol (LTP) that provides retransmission-based reliability over links. LTP implements ARQ of data transmissions by soliciting selective-acknowledgment reception reports. Farrell, *et al.,* [12] proposed a generic transport protocol for opportunistic networks by using an extended LTP mechanism to create an end-to- end capable transport protocol called "LTP transport (LTP-T)". Since Bundle Protocol requires the services of a "convergence layer adapter (CLA)" to send and receive bundles using an underlying Internet protocol, then authors present one such convergence layer adapter that uses the well-known Transmission Control Protocol (TCP). The TCP-based convergence layer (TCPCL) is used to link two bundle nodes. The lifetime of a TCPCL connection will match the lifetime of its underlying TCP connection. In other words, a TCPCL connection is initiated when a bundle node initiates a TCP connection to be established for the purposes of bundle communication.

Then they make us aware about a most important layer *i.e.,* **bundle layer** and said that this layer is responsible for storing, carrying and forwarding the data in an opportunistic network. Except from unicast bundle delivery, multicast and anycast delivery approaches are typically used when there is more than one destination [13]. This layer uses a ***Bundle Delivery Approach*** and this approach says that in an opportunistic network, applications utilize nodes to send or receive data that is carried in bundles which can be delivered to a group of nodes. When the group size is greater than one, the delivery semantics may be either anycast or multicast. For anycast delivery, a bundle is delivered to at least one and preferable only one of the members in a group. On the other hand, for multicast delivery, the bundle is intended to be delivered to all members in the same multicast group.

Then next layer comes *i.e.,* **application layer** and in this layer the author wants to tell us about mailing facility in oppnets. Scott, *et al.,* [14] proposed the use of SMTP proxies to hide the disruptions between end users in a challenged network. This proxy is responsible to help the client to perform its work and exchanges the corresponding information to a peer proxy. The peer proxy receives the information and sends it to its SMTP server. The drawback of this proxy based approach for SMTP protocol is that the proxy has to execute the entire SMTP protocol forwarding the information via the inter-proxy protocol. In [14] the authors describe architecture to enable mail communication in a heterogeneous environment that combines traditional server-based mail delivery and opportunistic communications for different types of devices. In this architecture, mail messages are sent in bundles into the opportunistic network and carried toward a mail gateway (MWG). The MWG is responsible to forward and receive the mail between the infrastructure network and the opportunistic network. The MWG and corresponding device could implement the Bundle Protocol to eliminate unnecessary process. In addition, each device can be configured with Mail. In addition, each device can be configured with Mail User Agent (MUA) option to send or retrieve mails either through proxy or using separate mail folders.

6. Proposed Work

As we know, there are number of vehicles on highway. So we are going to use high frequency sensors in vehicles. It will help us to establish connection between kiosk (a type of hub station) & villages. With the help of this, we connect villages to internet. This system will help us to provide police services to villages.

When a crime is reported in a village & police is needed there as soon as possible. We can use high frequency sensors there to locate the crime location and to inform police. Any server connected to internet will inform nearest police station so that police can reach there on time. This type of system will be helpful in those places where traffic frequency is high.

7. Conclusion

In our proposed system, we will use kiosk (type of hub Station) which will help us to connect nearest villages to internet using high frequency sensor used in vehicles. As we know on highways, traffic frequency is always high so villages will always be connected. When any crime is reported in village, a main server can locate the place of crime & inform nearest police station according the location. The people of village can help police to detect about the seriousness of crime and police can easily reach to exact location conveniently. So with the use of this system, crime will be less because police can locate crime easily & people start trust on security system.

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