Opportunistic Routing Algorithm in Vehicular Adhoc Networks(VANETs

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Routing in VANETs

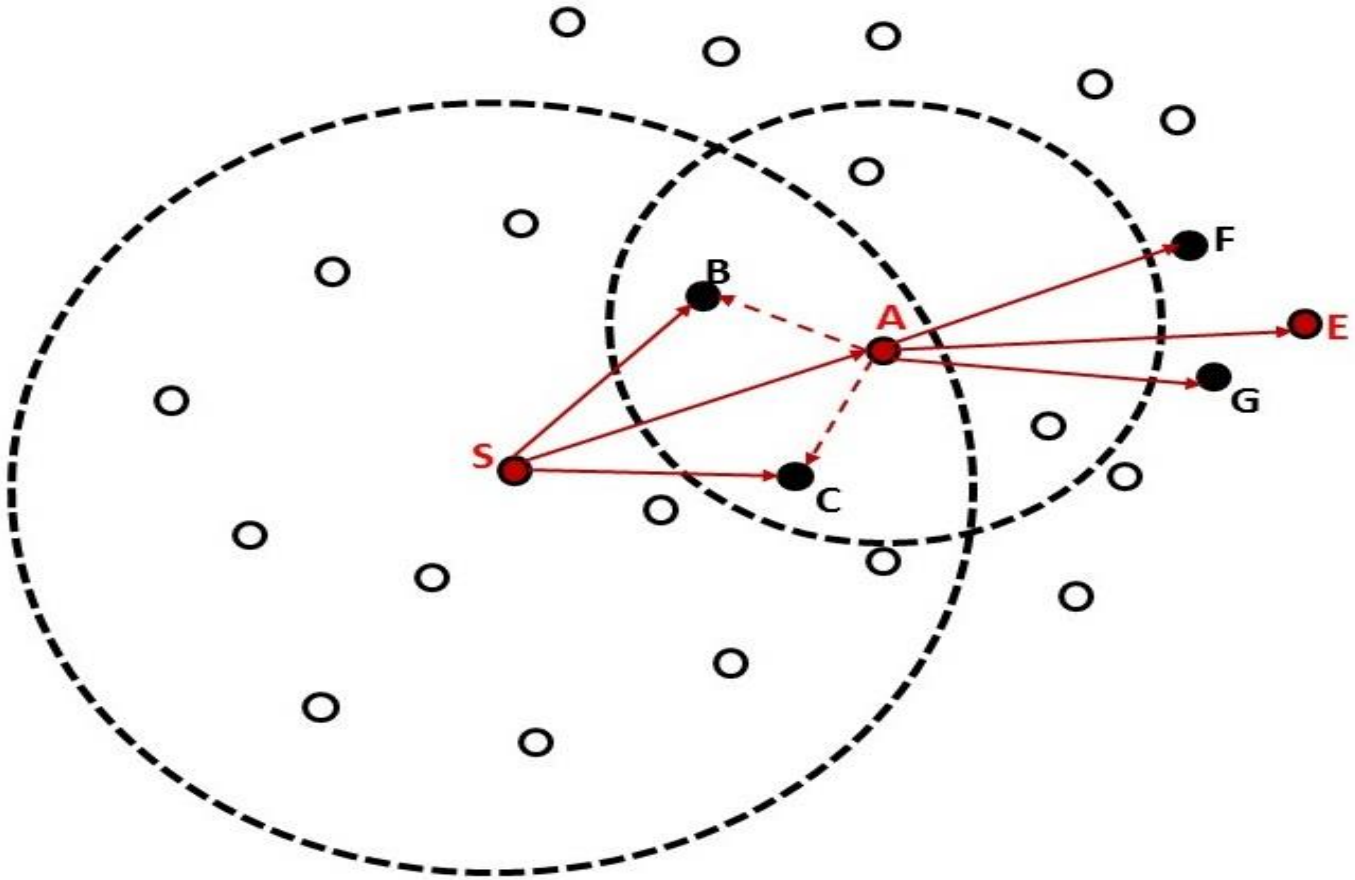
- Vehicular Networks have attracted the interest of the **real life community**, since many issues are open, especially in the research area of **efficient routing techniques at highway and Intersection or Junction.**
- While the most important objective has clearly been to enhance **the general safety of conveyances traffic,** and the world are exploring novel conveyance applications like **traffic management .**
- Underneath this circumstance, **most important routing protocols that discover and manage end-to-end methods is a smaller amount desirable as a result of high protocol overheads.**
- The research challenges for applications of VANETs remains to design of **Routing algorithms** for the **Intelligent transportation systems (ITS)** to **improve safety on the roads.**

Opportunistic Routing

- Opportunistic Routing (OR) could be an extremely new routing technique that's an **efficient, economical and enhances routing** scheme for wireless networks (shown in Fig. 1) and the special case of a **wireless network is VANETs [7].**

- In VANETs, the most challenge is that the **extremely dynamic nature of vehicular nodes(** i.e., vehicular node mobility) on roads or highways, so the **extremely dynamic topology suggests** that the **dynamic topology changes** over times mean frequently.

Example



Opportunistic Routing (OR)

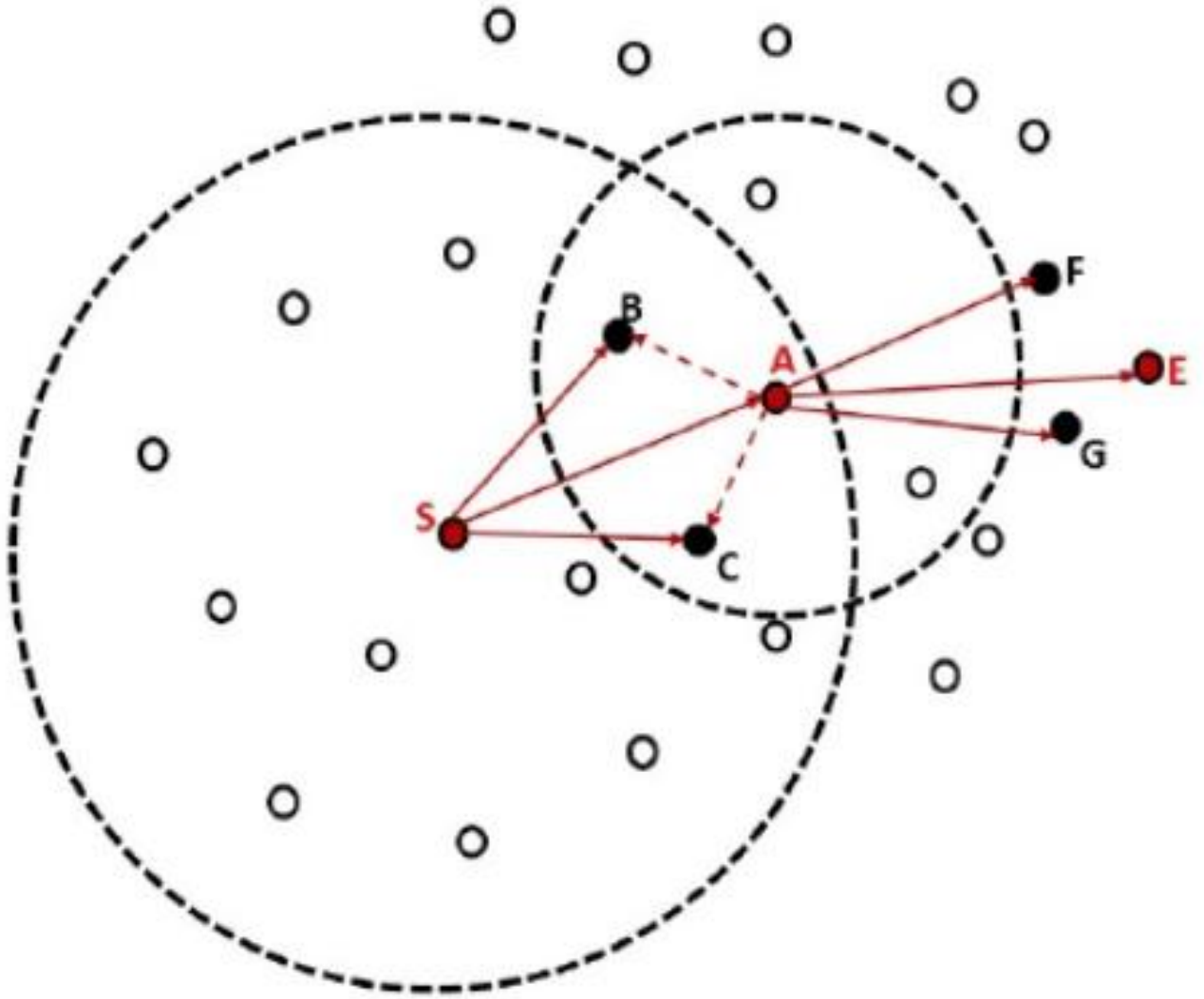
- **Opportunistic Routing (OR) is an effective and enhanced routing scheme for wireless multihop environment.**

- **OR is an approach which selects a certain number of best forwarders (candidates) at each hop by taking the advantage of the broadcast nature of the wireless medium to reach the destination.**

- **When a set of candidates receive the packet, they coordinate with each other to figure out which one has to forward the** packet toward the destination.

- **Most of the researches in this area have been done in mesh networks where nodes do not have mobility.**

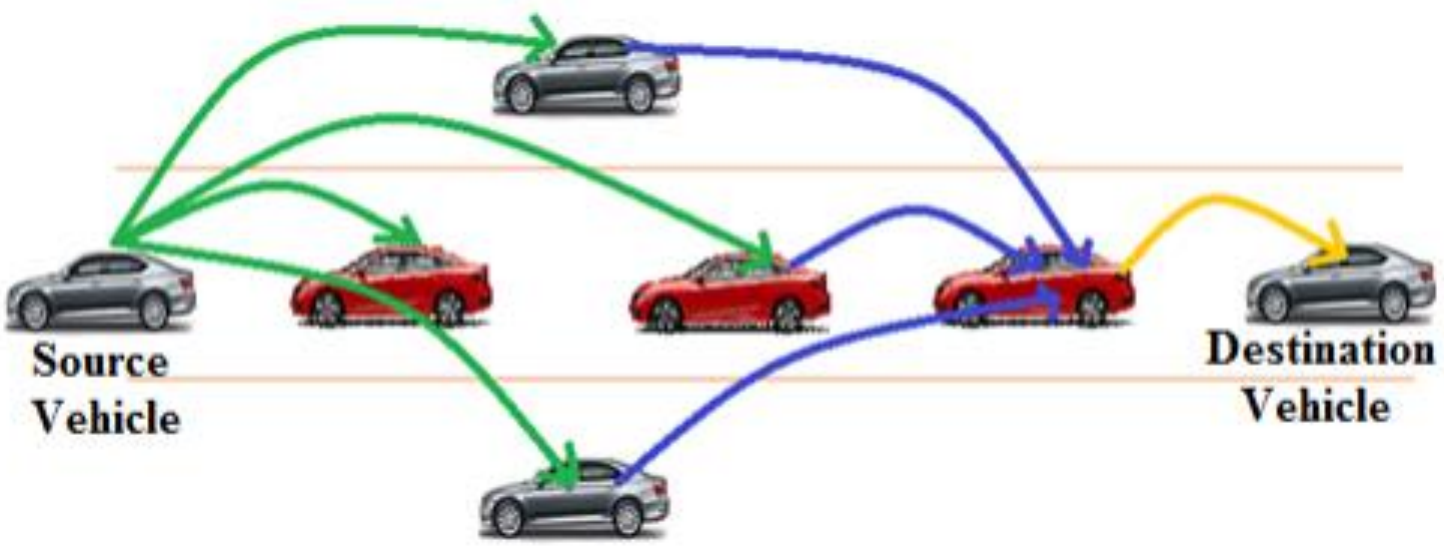
Opportunistic Routing Example



Introduction

- The new promising approach, Opportunistic Routing (OR) (shown in Fig. 1) is dealt with VANETs only.
- The primary responsibility of Opportunistic Routing is its capability to hear the communicated message and to manage among relaying vehicular nodes.
- Some work has been done that incorporates OR with VANETs.
- So, we are trying to develop such a system.

Opportunistic Routing Example in Vehicular Ad-Hoc Networks(VANETs)



OR scheme for Vehicular Ad-Hoc Networks(VANETs)

- We propose a novel OR scheme for Vehicular Ad-Hoc Networks(VANETs) to overcome the routing problem in VANETs.

- We center our consideration around the incorporation of Vehicular networks and Opportunistic Routing, which is the concept that we call as Vehicular Opportunistic Routing.

- To deal with the dynamic nature of vehicular node,

Opportunistic Routing(OR)

- Unlike traditional routing protocols, say DSR, AODV, OLSR, etc., where **nodes select only one of their neighbours to forward data packets towards their destination**.

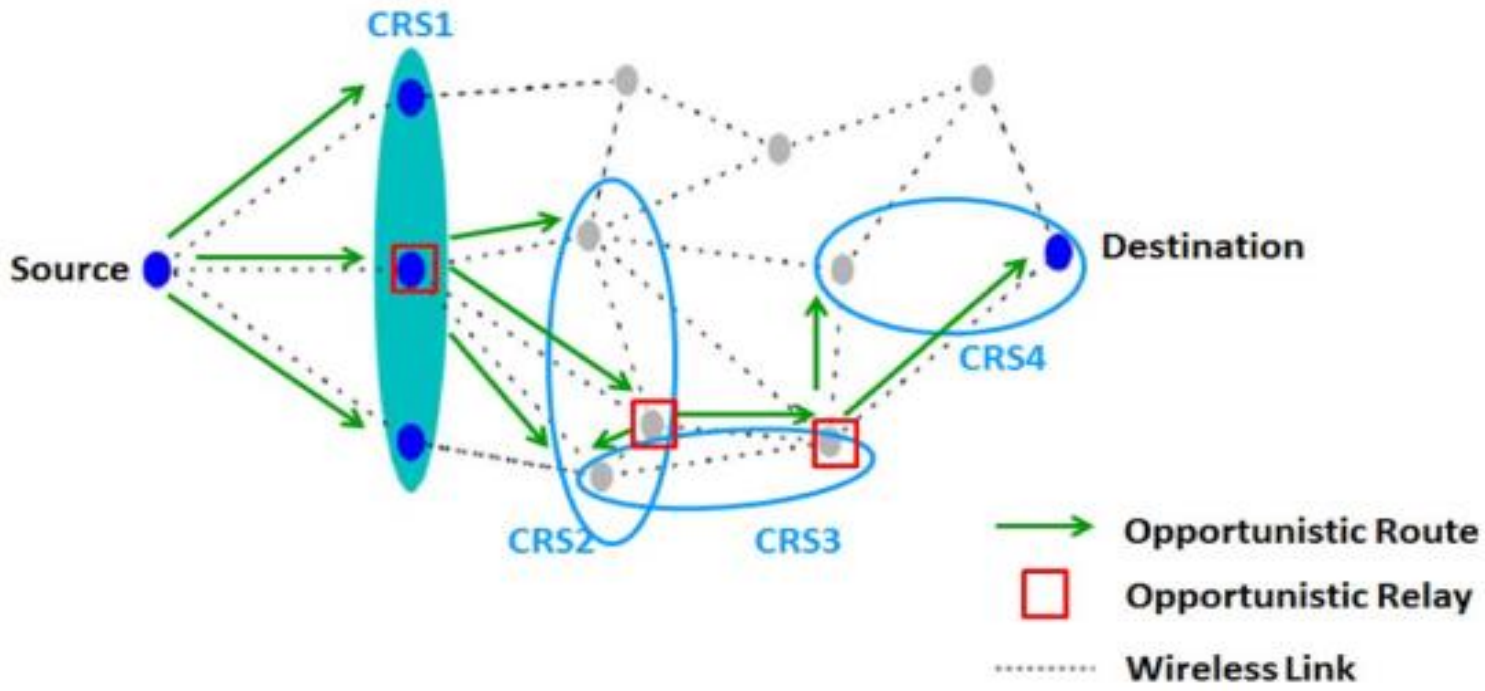
- OR approaches suggest each node to employ a **subset of neighbour nodes to act as potential next-hop forwarders.**

- This subset of nodes is called ***candidate set.***
- The candidate set is selected and prioritized by performing a ***candidate selection*** algorithm.
- Nodes in the candidate set will be responsible to cooperate with each other following a ***candidate coordination*** method.

Opportunistic Routing

- Finally, **one of the selected nodes which has received a copy** of the packet will act as the **actual next-hop forwarder** and will be in charge of progressing the data packet one hop closer to the destination.

An example of packet forwarding using opportunistic routing in VANETs



Issues

- How to provide an effective algorithm with reasonable computational time that relies only on the local topology information. **Inefficient coordination between candidates increases duplicate transmissions** and affects network performance by imposing useless flows on the wireless networks.

- Although OR protocols focus on increasing the reliability of routing, such protocols will be less effective **if some nodes in the network act selfishly or maliciously** and prevent from behaving as reasonably as expected.

OR in VANETs

1. **Performance metric calculation**
2. **Candidate node selection and prioritization**
3. **Candidate coordination**

Objectives

- **Investigation of performance metric features a goodly result on the functioning of associate OR protocol in dynamic networks. Our survey indicates that almost all of the planned OR protocols use Expected Any-path Transmission (EAX) performance metric that is additional suited to dynamic wireless networks.**

- **The candidate node choice rule is amenable for choosing out the candidates and assignment priority for them.**

- **The whole candidate coordination is required just in case of OR as a result of the OR protocol should use probably a viable signal. Inefficient coordination between candidates will increase duplicate transmissions and create a bearing network performance by splendid useless flows on the dynamic wireless networks**

Performance metric

- Metric calculation mechanisms generally are divided into local and end-to-end methods.
- Local or hop-by-hop metrics consider only the information of **the local neighboring nodes** to forward the packets.

- On the other hand, in end-to-end approaches, **the information and states of the all nodes are considered to select the best route** from source to the destination.

Performance metric

- Although end-to-end method is more efficient and lead to the optimal result, it is difficult to carry the information and state of the whole topology in a mobile scenario which have frequently topology changes.
- Therefore, **it is obvious that local trend is more suitable for dynamic networks.**
- In the local approaches, beacon messages are broadcasted regularly so that each node gets some information about its neighbors.
- In this case, nodes only consider the information of their **local neighbors for making decision to select the candidates.**

OR Protocol

- OR protocol which consist of two phases: **candidate selection and candidate coordination.**

- To obtain the local information in OR, each node **broadcasts its ID, current position, velocity, and the number of neighbors**, which we refer to as density of node, by broadcasting hello message every $Tinterval$.

- Once the hello messages are received by a node, it has the local information of its neighbors **and can select some of its neighboring nodes as its candidates set.**

Performance metric calculation

- **Expected Transmission Count (ETX)** measures the number of times that a packet must be transmitted/retransmitted, on average, at a link or on route, to be received by the designated node.
- **Expected Any-path Transmission (EAX)** captures the ExNT while taking into account the multiple paths that can be used in OR.

Candidate node selection and prioritization

- In this phase, the sender node specifies a **set of capable nodes as the candidates set to forward the data packet** and sorts them according to a metric.
- Note that the selected candidates can be **prioritized** based on **expected transmission count (ETX) , hop count to the destination, geodistance and so on .**
- In case of existence, it will enter the **coordination phase**. Several coordination methods have been proposed to handle this part such as **timer-based, Acknowledgement-based, RTS-CTS, and network coding .**

Candidate Selection

- In the candidate selection phase OR considers different parameters to select some of the neighboring nodes as the candidates set.
- In OR, the nodes which are **closer to the destination** that the current node are considered as the potential candidates.
- Using the hello message information including the current position, velocity, and direction of nodes, each node can estimates the future position of its neighbors.

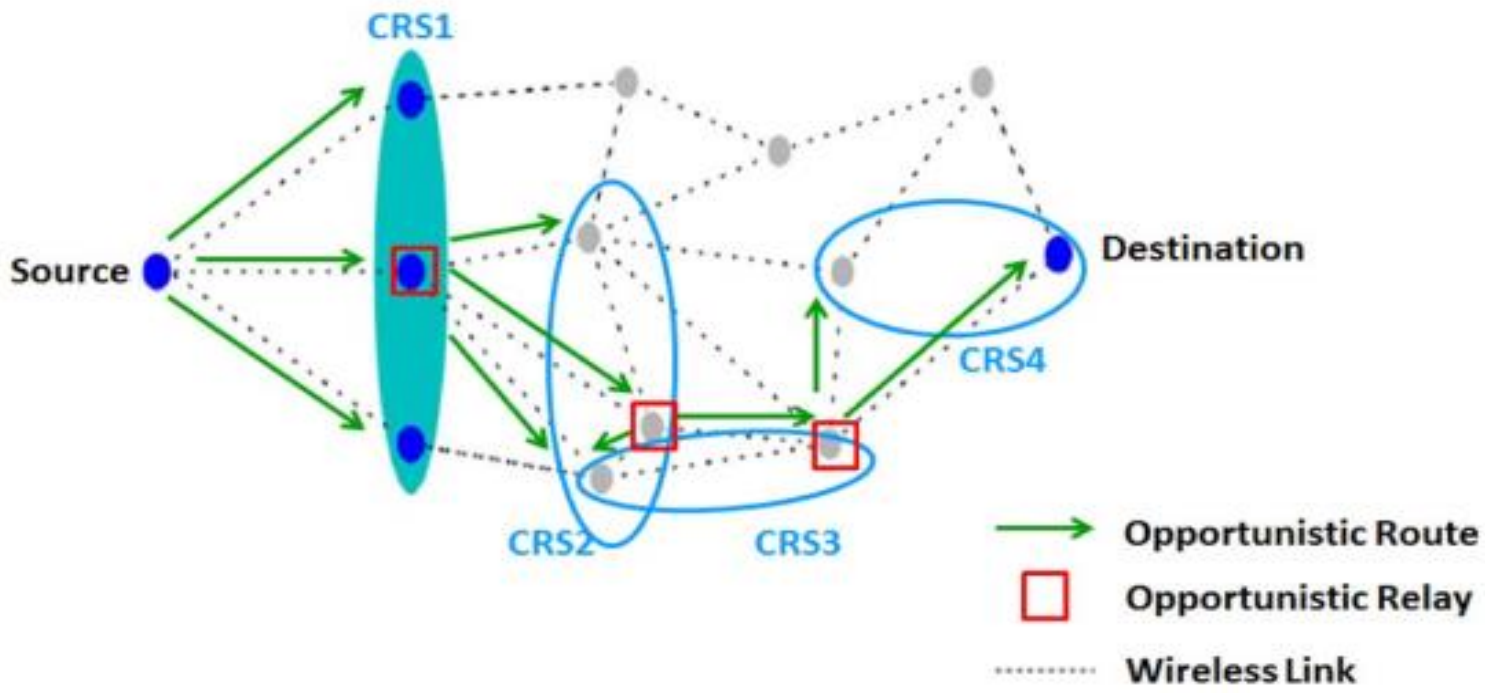
Candidate Selection

- Based on Equations (1) and (2) the position of neighboring nodes will be predicted for a short period of time.
- Note that in Equations (1) and (2), θ is the angel of the adjacent node with horizon line, $Vcurrent$ is the current velocity of the neighboring node, and X & Y are the predicted and current coordinate position.

$$X_{next} = V_{current} * \cos\theta + X_{current} \qquad (1)$$

$$Y_{next} = V_{current} * \sin\theta + Y_{current} \qquad (2)$$

An example of packet forwarding using opportunistic routing in VANETs



Candidate Coordination

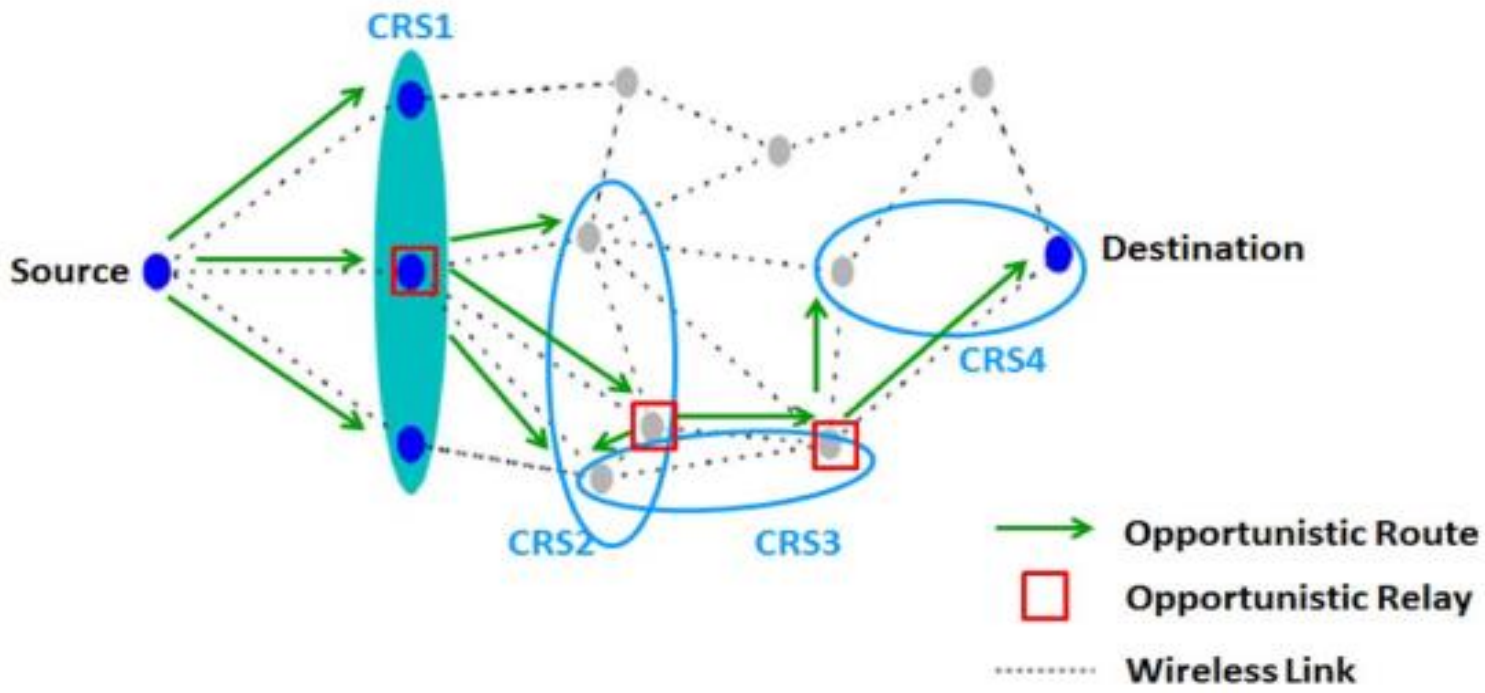
- When a node **selects its candidates**, it puts them in the **header of data packet and broadcasts it.**

- Each node that receives the packet will check **if its ID is exist in the header or not.** In case of not existing, the node will simply drop the packet.

Candidate Coordination

- Otherwise, the candidate will wait for a period of time according to its priority which is mentioned in the candidates set in order to transmit the packet.
- During this period of time the candidate will listen to the medium to see whether any other **higher priority candidate is forwarding the packet or not.**

An example of packet forwarding using opportunistic routing in VANETs



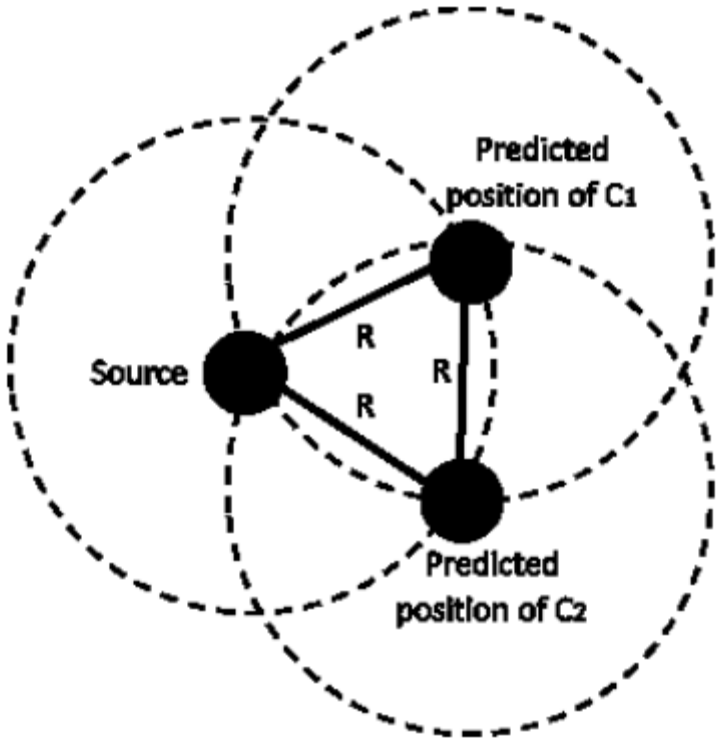
Candidate Coordination

- A candidate will forward the packet if it does not hear the transmissions of the same packet from other candidates during its waiting time.

- Note that the highest priority candidate will not wait and as long **as receives the packet it will immediately forward it.**

- **This process continues till the data packet reached to the destination**

Coordination zone



Complexity for Proposed Scheme

- The complexity of the traditional candidate selection algorithm for Opportunistic Routing is in the order of $O(V^2)$, where V is the number of vehicular nodes.
- In our proposed approach we have used Dijkstra Algorithm with binary heap for candidate selection(CS) in OR.
- Using this approach, the time complexity of CS in Vehicular OR is O(ElogV).

Queries…?