RESEARCH ARTICLE OPEN ACCESS

Dynamic Carpooling Using Wireless Ad-Hoc Network

Abhishek V. Potnis

ABSTRACT
The increase in awareness about the conservation of natural resources in today's world, has led to carpooling becoming a widely followed practice. Carpooling refers to sharing of a vehicle with other passengers, thus reducing the fuel costs endured by the passengers, had they traveled individually. Carpooling helps reduce fuel consumption, thereby helping conserve the natural resources. Conventional Carpooling Portals require the users to register themselves and input their desired departure and destination points. These portals maintain a database of the users and map them with the users, who have registered for their cars to be pooled. This paper proposes a decentralized method of dynamic carpooling using the Wireless Ad-hoc Network, instead of having the users to register on a Web Portal. The user's device, requesting for the carpool service can directly talk to another user's device, providing the pooled car, using the Wireless Ad-hoc Network, thereby eliminating the need for the user to connect to the internet to access the web portal.
Keywords **–** carpool, wireless, ad-hoc, wi-fi direct

I. INTRODUCTION

Increase in the population, pollution and the rate of consumption of the natural resources are some of the major issues that have gripped the world. People have now begun to realize the importance of conservation of natural resources. This awareness among the people has led to carpooling becoming a widely followed practice, in the developed and developing countries in the world. Carpooling has emerged an effective way to help conserve the environment. It not only helps people cut their fuel expenses by sharing, but also helps in reducing air pollution. Carpooling also helps conserve the fuel resources, which otherwise would have been used, incase people travelled individually. In today's world of advanced technology and internet, many carpooling web portals have emerged, that help users to carpool. This paper proposes a novel decentralized way of dynamic carpooling using the Wireless Ad-hoc Network, which allows two devices to directly communicate with each other.

II. RELATED WORK

1. Need for Dynamic Carpooling

In today's spontaneous world, short travel trips are not usually planned well ahead of time. This makes it difficult to carpool in such situations. Dynamic Carpooling refers to travelling by a shared-ride on a very short notice. Dynamic Carpooling has become a reality only due to the advancement in technology over the years.

2. Limitations of contemporary Dynamic Carpooling

Most users use carpooling portals for dynamic carpooling. The web portals require the users to register themselves with them first, and then the user can input his/her departure and destination points. The web portals maintain a centralized database of users at the backend. They then use the database to map the users requesting the carpool to a user nearby with a pooled car. All this time, a user needs to be connected to the internet from his device

3. Proposed method of Dynamic Carpooling

The user needs to connect to other devices in vicinity using Wireless Ad-hoc Network to request for a carpool service. The messages are forwarded from one device to another through the broadcasting mechanism. Thus the dynamic carpooling works in a decentralized fashion, thereby eliminating the need for the user to connect to the internet. Moreover connecting to a local network is always preferred over connecting to the internet for data retrieval. Thus the advantages of the proposed system are as follows:

- No Internet Connection required to request a carpool service.
- Data Retrieval is faster over a local network as compared to the Internet.
- Decentralized approach ensures no bottleneck at a particular device as in case of centralized web portal approach.

III. THE PROPOSED SYSTEM

1. SYSTEM ARCHITECTURE

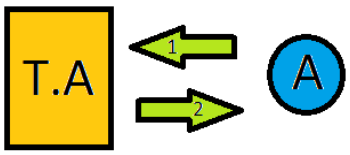

Fig 1(a) Initial Communication of the User Node with a Trusted Authority

1 – User Node Requests Trusted Authority for an Identifier; 2- Trusted Authority verifies the user credentials and grants the user node a Identifier

In Carpooling, trust is an important issue. The passenger needs to know whether the credentials of the driver are valid or invalid for his/her own safety. Hence, a Trusted Authority issues each device node with a unique Identifier, only after validating its user's credentials.

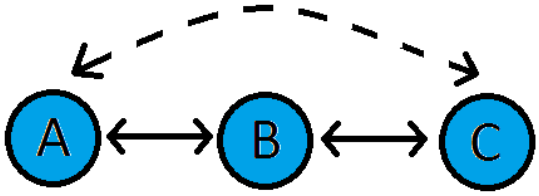

Fig. 1(b) Actual Communication between the nodes

The Fig. 1(b) depicts the process of communication between the nodes. Node A communicates with B, B with C, so indirectly A can communicate with C. This communication uses broadcasting mechanism. In case, a node receives the same message more than once, the first message is received, while the others are discarded.

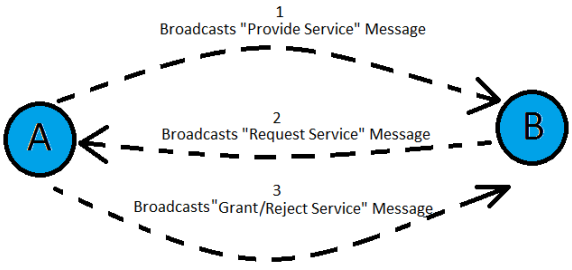

Fig. 1(c) Working of Dynamic Carpool System using Broadcasting mechanism

Fig. 1(c) depicts the actual working of the Dynamic Carpool System. Consider node A as the user's node whose car is to be pooled. So the user enters the departure and destination points and the node A broadcasts the "Provide Service" Message to all other nodes in vicinity. Now consider the user of node B is interested in availing a carpool service. So node B listens for any broadcasted "Provide Service" Messages. Once it receives the "Provide Service" Message either directly from A or through some other node, it checks whether its departure and destination points match with that in the "Provide Service" Message. If they match, then Node B broadcasts a "Request Service" Message to Node A. When Node A receives the broadcasted "Request Service" Message either directly from B or from some other node, it checks to see if the capacity does not exceed, and then depending on the capacity, it broadcasts a "Grant/Reject Service" Message to B. If B receives a "Grant Service" Message, the user of B comes to know about the user of node A and carpools with him/her.

A. Message Format

Message Type
From Location (Departure Point)
To Location (Destination Point)
Original Sender Identifier
Seats Available
Hop Count

Fig. 2 Service Message Format

I. Message Type: Denotes the type of the message.
00 Provide Service Message
01- Request Service Message
10- Grant Service Message
11- Reject Service Message

II. From Location (Departure Point) and To Location (Destination Point): To be filled by the user.

III. Original Sender Identifier: It contains the identifier of the node, the message originated from.

IV. Seats Available: It contains the number of passengers the car can carry. The node that broadcasts the "Provide Service" Message, updates its value after it every "Grant Service" Message it sends.

V. Hop Count: It denotes the number of nodes that have forwarded that message. If the Hop Count exceeds a certain value, then that message is discarded. This is done to prevent congestion on the network. This field also ensures that only the nodes in vicinity receive the forwarded messages.

B. Memory

Each node has its own memory, which stores the identifier of the node, the departure and destination points, and in case of the node of the user that provides the carpool service, the number of seats available.

Each node has a buffer, to store incoming messages. The buffer is useful for the node of the

user that provides the carpool service, to receive multiple request messages. In such a case the buffer can be considered as a simple queue, to store the incoming request messages.

2. IMPLEMENTATION

The proposed system can be implemented using the newly introduced Wi-Fi Direct Standard. The Wi-Fi Direct Standard allows two or more devices to communicate with one another at Wi-Fi Speeds.

IV. CONCLUSION

This paper proposes a novel decentralized method of dynamic carpooling using wireless ad-hoc networks. Using this method, users will easily and efficiently be able to carpool without have to go through the hassles of accessing web portals online. The Wi-Fi Direct Standard is a newly introduced Wi-Fi Standard and many devices have started implementing it. This method could be improved further to be able to support on-the-way destinations for users by intelligently mapping the route from the departure point to the destination point.

REFERENCES

[1] Rendong Bai; Singhal, M., "Carpooling in Mobile Ad Hoc Networks: the Case of Multiple-Target Route Discovery," Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks and Workshops, 2007. WiOpt 2007. 5th International Symposium on, vol., no., pp.1, 9, 16-20 April 2007 doi: 10.1109/WIOPT.2007.4480025

[2] Nianbo Liu, Yong Feng, Feng Wang, Bang Liu, and Jinchuan Tang, "Mobility Crowdsourcing: Toward Zero-Effort Carpooling on Individual Smartphone," International Journal of Distributed Sensor Networks, vol. 2013, Article ID 615282, 9 pages, 2013. doi:10.1155/2013/615282

[3] Biplav Srivastava, ""MAKING CAR POOLING WORK – MYTHS AND WHERE TO START" - IBM Research Report, RI 12014.

[4] Jinqi Zhu, Yong Feng, and Bang Liu, "PASS: Parking-Lot-Assisted Carpool over Vehicular Ad Hoc Networks," International Journal of Distributed Sensor Networks, vol. 2013, Article ID 491756, 9 pages, 2013. doi:10.1155/2013/491756

[5] R. Manzini and A. Pareschi, "A Decision-Support System for the Car Pooling Problem," Journal of Transportation Technologies, Vol. 2 No. 2, 2012, pp. 85-101. doi: 10.4236/jtts.2012.22011.

[6] Swati.R.Tare, Neha B.Khalate, Ajita A.Mahapadi, "CarPooling Using Android Operating System-A Step Towards Green Environment", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 4, April 2013

[7] Daniel Camps-Mur, Andres Garcia-Saavedra, Pablo Serrano, "Device to device communications with WiFi Direct: overview and experimentation"