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VCS-RSCBAODV: Vehicular Cloud Storage Concepts for RSCBAODV Protocol to Reduce Connection Breakage in VANET

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Abstract

Vehicular nodes can share the information on the move by forming a temporary network. Routing information shared between vehicles is to be stored in a permanent place for the future use. In that case, vehicular cloud concept is used to increase availability of the data more positively. Vehicular information are connected to cloud using internet. It is used to provide anytime access to the user. Here, user can access public information without any concerns. Moreover, the technologies in the vehicular node is used to provide real time services to the cloud user. Vehicular networks should be capable of handling big data in order to complete data broadcasting successfully. This problems can be avoided by making VANET as Vehicular Cloud which utilizes less local resources. Nowadays, the companies are using this idea to reduce overhead or optimize business process in public transportation. In this research work, the steps are taken to incorporate the vehicular cloud storage concepts in RS-CBAODV algorithm to reduce connection breakage (link breakage) i.e. by storing routing information in vehicular cloud as a service delivery model. There are three different types of services considered to embed vehicular cloud based services. Each services are designed to support hybrid cloud concepts for vehicular networks. They are Content based services, Communication based services and Customized services. Additionally, the RS-CBAODV is taken into consideration to offer services using cloud based VANET. This RS-CBAODV has the properties of existing CS-CBAODV, CBAODV and AODV protocol.

Keywords: *CBAODV, CS-CBAODV, RS-CBAODV, Reactive Routing, Remote Route Backup, Vehicular Cloud Storage, VANET and Connection Breakage.*

1. Introduction

VANET is a subgroup of Mobile Ad hoc Networks (MANETs) with the distinguishing property that the nodes are vehicles like cars, trucks, buses and motorcycles. Each vehicular node can communicate with other nodes for using security and services application. Nodes are mobile in VANETs as well as MANETs, the mobility in VANET is constrained to the boundaries of the road, unlike the nodes in MANETs, where movement of the node is more random in nature. VANET are also characterized by high node mobility and fast topology changes. Unlike MANET, power is not of great concern in VANETs as the vehicle batteries have sufficient and rechargeable power. Vehicular Cloud Computing (VCC) is one of the solution to solve various issues in vehicular networks. VCC is a new hybrid technology that has a remarkable impact on traffic management and road safety by instantly using vehicular resources, such as computing, storage and internet for decision making [1].

2. Related Work

The communication between the Vehicular nodes happens in wireless ad hoc mode by using the IEEE 802.11p standard. The VANET architecture can be classified on WLAN/Cellular, Ad hoc and Hybrid models. Hybrid models can support three types of data transmission [2]. They are:

1. Vehicle to Vehicle (V2V) Communication
2. Vehicle to Infrastructure or Road Side Terminals (RST) Communication
3. Road Side Terminals to Base Station (Local Server) Communication

Junggab Son et. al., presented a survey on vehicular communication by merging VANET with Cloud computing. A VANET based cloud architecture is proposed in the work. The VANET clouds are classified into Vehicular clouds, Vehicles using Clouds and Hybrid vehicular clouds. It provides an outline of security and privacy issues and research challenges in vehicular cloud computing [3].

Bitam et. al., proposed a generic cloud computing model named VANET-cloud for vehicular Ad hoc networks. This model is designed to focus on current solution provided by intelligent transport systems on improving road safety and to ensure passenger comfort. Additionally, various

transportation services provided by VANET-Cloud are reviewed to highlight some of research directions like security and privacy, data integration, energy efficiency, interoperability and resource management [4].

Salahuddin et. al. suggested to use Road Side Unit cloud for managing the resources with the help of vehicular applications. Here, Road Side Unit is used to offer non-safety application with QoS for VANETs. A software defined networking model is created to offer the flexibility to migrate or replicate virtual services and reconfigure data forwarding rules dynamically by including traditional RSUs, Specialized micro-datacenters and Virtual machines. A RSU Cloud Resource Management (CRM) model is used to minimize the reconfiguration overhead, cost of service deployment and infrastructure routing delay. The performance of purist approach to our Integer Linear Programming (ILP) model is compared with the proposed innovative heuristic for the CRM technique. The result shows the improvement of using holistic approach in Cloud resource management with a software designed network [5].

Hussain et. al. generated a secure cloud assisted traffic information dissemination model for vehicular ad hoc networks. VANET is merged with Cloud to provide traffic information as service in a secure way. The different schemes like security, privacy and conditional anonymity are examined in providing VANET clouds [6].

Farooq et. al. designed a data dissemination model for cloud enabled VANETs using In-Vehicular resources. A vehicular cloud network model based on Road side access points is used for identifying In-vehicular resources by considering the mobility pattern of vehicular nodes. Here, the steps are taken to support remote data storage, processing and communication of Cloud based VANET [7].

Sourav Kumar Bhoit et. al. offered a road selection based routing protocol for Vehicular ad hoc network. Here, a novel position based routing protocol is designed to send the data quickly from the source node to destination. The best routing is selected by calculating road ratings for each road connected to the junction. Moreover, a recovery method is proposed to connect the vehicles which suffer from the network gap problem by adjusting the speed of the sufferer vehicles [8].

3. Problem Definition

The problem exists in both Client Storage (CS-CBAODV) and Remote Storage (RS-CBAODV) routing protocols. Here, the routing information can be stored by Client Storage which utilizes more resources like CPU and Memory which creates an issue in communication. Even though the routing information is stored in a special remote storage, the multiple vehicular user accounts has to be maintained in VANET. Because, the VANET has information about a list of vehicular users, routing information and travelling speed and direction of a vehicular node [9].

Additionally, the following challenges are faced while incorporating the VANET with the Cloud computing concepts [10, 11, 12, 13].

3.1 Design and Implementation issue

- Localization
- Efficiency and Portability
- Transliteration and Linguistic considerations
- User level application development

3.2 Routing information issue

- Routing backup
- Routing information integrity and theft
- Routing information usage and loss

3.3 Performance degradation issue

- Long time access
- Too many routing access
- Remote server is hacked by DDOS attack
- Hardware and Software failure

3.4 Security, Operational and Policy

- Location of Data and User
- Responsibility and Intellectual property rights

4. Proposed Model

In this contribution, the vehicular networks are taken into the Hybrid cloud to store the routing related information at the remote place. The vehicular networks are connected to the cloud using RST equipped with internet facility. It is used to provide anytime access to the user who access routing related information [14]. The user can access the public information like traffic status in the network without any concerns. Here, the infrastructure to infrastructure communication concept is used to take VANET to the cloud environment. It is assumed that the remote storage server is designed to provide storage as a service. The technologies in the VANET are used to provide real time access to the user who access routing information [15].

In VCS-RSCBAODV, the User can use their GPS, Camera, Sensors, WiFi network, Mobile Apps, Storage Services and Computer to access the vehicular cloud data. The User may be fixed at any place as Static, movable to any place as Dynamic, not movable or not intended to be moved as Stationary. The user can use various communication types like Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I) and Infrastructure to Infrastructure (I2I). If user

wants to communicate with the other user means, the V2V is selected. The V2I is used when a user wants to connect to the Road Side Terminals. Apart from these two modes, I2I is chosen to bridge the connection between the infrastructures [16]. The schematic diagram of the proposed VCS-RSCBAODV model is shown in Figure 1.

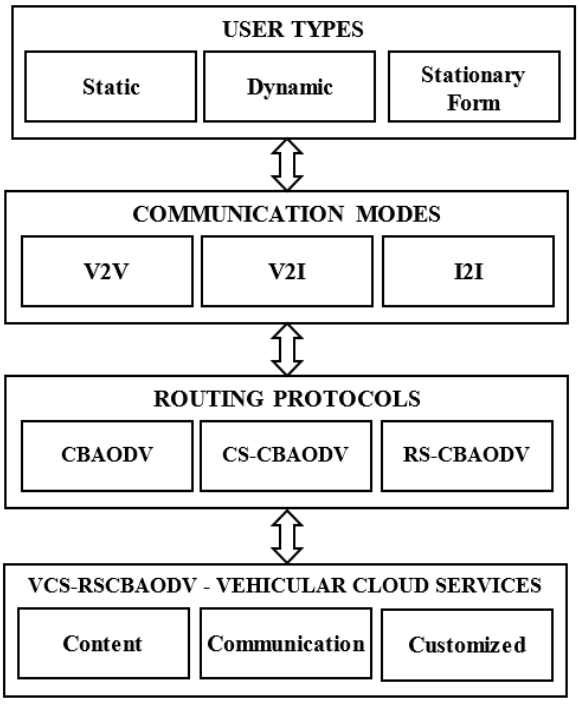

Fig. 1. VCS-RSCBAODV Schematic Diagram

The proposed algorithm of VCS-RSCBAODV is given below:

Step 1: *Vehicular node generates the request to RST*
Step 2: *Selecting the different user level*
if(Static User) {
User is fixed at any place;
} else if(Dynamic User) {
User is movable to any place;
} else if(Stationary User) {
User is not moving or not intended to be moved;
} end if (null)
Step 3: *RST uses the different levels of communication*
Step 4: *The Communication Mode is selected*
if (V2V) {
Vehicle to Vehicle communication is used;
} else if (V2I) {
Vehicle to Infrastructure communication is used;
} else if (I2I) {
Infrastructure to Infrastructure communication;
} end if (null)
Step 5: *RST sends users' request to Client Storage*
Step 6: *Client Storage – classifies, maintains and filters the RSTs' request*
Step 7: *Implementation of Routing Protocols to store routing information*
if (CBAODV) {
Hotspot based level is selected;
} else if (CS-CBAODV) {
Client Storage concept is selected;
} else if (RS-CBAODV) {
Remote Storage concept is selected;
} end if (null)
Step 8: *Delivering the services based on vehicular cloud concept*
if (Content based service) {
Pollution, Traffic, Weather Information and Car condition;
} else if (Communication based service) {
GPS location, VoIP, Message Routing;
Call Recording and Video conferencing;
} else if (Customized service) {
Parking, Entertainment, Healthcare and Hotel Booking;
} end if (null)
Step 9: *RST receives the vehicular cloud services and sends Ack.*
Step 10: *User receives the response as routing information*

5. Assumption and Implementation Strategy

In this research work, several steps are taken into considerations in order to access routing information with the help of cloud. First, the steps are taken to analysis the list of ways to establish and maintain the connectivity between the vehicles. Second, at what level the services are available to the user when they move from one place to another. Third, finding the location specific restrictions are there in placing the RSTs. Fourth, discovering the cost to construct and the techniques to reduce the cost. To incorporate this proposal, the user type, communication types and routing protocols are to be analyzed, designed and tested before implementing vehicular network with cloud.

5.1 Pre-Condition

- Each vehicle is considered as a modern vehicle with necessary technologies and devices
- The Platform for vehicular ad hoc routing should be available
- Each vehicle is designed to receive the different warning messages

5.2 Basic Flow

- The Vehicular network is created
- The RST is implemented with CS-CBAODV, and RS-CBAODV protocols
- The cloud is incorporated to use the three types of services like content based, customized and communication based

5.3 Post Condition

- Vehicles are named and the protocols are used based on the routing information.
- The data loss and the warning messages are analyzed
- The vehicular nodes are ready to broadcast the data

6. VCS-RSCBAODV Services

The information is stored in remote cloud computer which helps to provide information as a service in a three different methods.

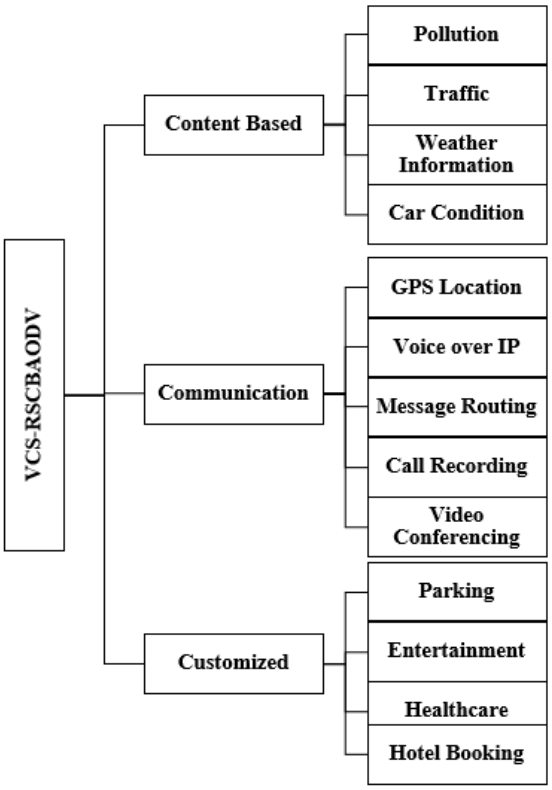

Fig. 2. VCS-RSCBAODV Services

There are the different types of the services considered in the proposed VCS-RSCBAODV model which is shown in Figure 2. They are Content based services, Communication based services and Customized services. Each services are designed to support the hybrid cloud model. It alert the users by sending warning messages during the emergency or in accident situation. It also indirectly helps to use less fuel consumption and reduces environmental damages.

6.1 Content Based Services

This service routes the information according to the content not by directly sending to the end user. The information is classified according to their interest of the user who access the data. It is to decide how an information is useful to the user and to find the flexibility and adaptability level to update the information [17]. Routers and the Services: It is built by analyzing the type of Routers/users and Services because there may be one user who can access more than one data. Here, Routers are used to route the information in the network. They investigate the type of the messages and applies some rules before it is delivered to the destination. Services are used to analyze the type of the information and services to the user to find the flow of the incoming data.
Example: Pollution, Traffic, Weather information and Car condition.

6.2 Communication Based Services

It is used to deliver a collection of different vendor services that uses various business communication services. This type of services used to reduce the cost and to increase the efficiency in business process by considering the communications applications and by integrating the registered communication systems. It delivers the correct solution for the small business by eliminating the requirement for business to handle the communications hardware. The users can just need to hold the account to use these services because the quality and reliability of the services is maintained by the service provider. In the same way, the service provider maintains the servers, connections, managing contents and maintains platform functional [18].
Example: GPS location, VoIP, Message Routing, Call Recording and Video conferencing.

6.3 Customized Services

These type of services are designed as per the requirement and specification of the Vehicular users. The design, flow, style, layout and other features are used to understand the needs of the user. The data in the cloud is designed, developed, tested and published on behalf of the user. The user doesn't need to worry about cost in developing, launching and updating the applications [19].
Example: Parking, Entertainment, Healthcare and Hotel booking.

7. Advantages of VCS-RSCBAODV

The VCS-RSCBAODV has several advantage in using the cloud aspects with the proposed algorithms in VANET and it is given in Figure 3. They are: Congestion warnings, Intersection assistance, Weather warnings, Road conditions and Collision warnings.

7.1 Congestion Warnings

This type of information is routed to the vehicular user in order to examine the consequences of forewarning drivers regarding the congestion in the network based on the violent driving. Congestion may also happens when the load on the network exceeds than the capable capacity of the network. Congestion degrades the performance sharply. Preventive or Deductive method is used to avoid congestion before and after it happens and it can be controlled either by client side or remote side. Even when congestion happens due to aggressive driving and frustration in the network, it could be reduced by sending proper warning messages to the vehicles [20].

7.2 Intersection Assistance

Helping the old age drivers and the deserved drivers by assisting them in driving the vehicles can make immediate response to the incidents occur. If there is an emergency situation means, it automatically send the control information and applies the brakes. The RST sends frequent updates to the vehicular users which help them in controlling the vehicles. In case of failure of RST, the neighboring vehicle can be in process to assist the driver [21]. Example: Parking a Vehicle, Roadsign recognition, etc.,

7.3 Weather Warnings

The warnings will be sent to the vehicular nodes for weather emergencies that makes more attention during driving. The RST will broadcast the alert messages automatically whenever there is a need to send messages. The vehicular node receives the alert messages in the broadcast method [22]. Example: Flash floods, Hurricanes, Extreme wind, Tsunamis, Dust Storms, etc.,

7.4 Road Conditions

When a vehicular user has a plan for a trip to a new place means, this is the first and right alert services to be needed. The roads may be closed either for work, reduced to one lane, closed for season, twin tunnels work, rock work, road work, safety, road construction and maintenance purposes [23]. The user could get this travel information either through the map, text only service, RSS feed, etc.,

7.5 Collision Warnings

This Collision warnings can be used to find the possible reductions in the road accidents. Concepts like Forward Collision Avoidances are considered to alert the user each and every time there is traffic ahead which is about to crash. The automatic braking system will be inaction by sending alert messages to the user. It sends the emergency messages when there is a chance for a collision with the nearby vehicle due to slow, travelling at a constant speed or stopped [24].
Example: Read end collision, Obstacle detection, Rollover warning, Intersection collision, Forward collision, Rear impact warning, etc.,

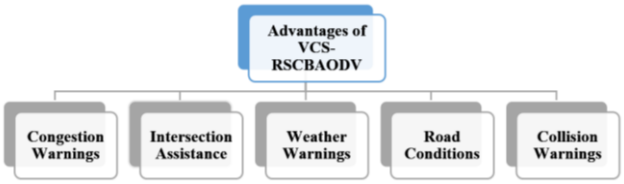

Fig. 3. Advantages of the proposed model VCS-RSCBAODV

8. Conclusion

An idea of using VANET with the cloud computing aspects increases the strength of the network by reducing the connection breakage issues. The routing information is stored in both client and remote storage by considering the cloud aspects. This model is designed to analyze the continuity of services to vehicular users with easier access to travel information by using efficient routing information even there is a chance for data loss. Here, the user defined protocols can also be used for implementation of the routing information in the remote place. The RS-CBAODV is used in remote storage to incorporate cloud concepts. The outcome of this proposed VCS-RSCBAODV protocol is to provide Safe and secure driving, Congestion reduction, Data availability and to provide real time information to the vehicular user. In future, this could be upgraded by incorporating knowledge grid with cloud.

References

[1]. Bitam, Salim, Abdelhamid Mellouk, and Sherali Zeadally. "VANET-cloud: a generic cloud computing model for vehicular Ad Hoc networks." Wireless Communications, IEEE 22, no. 1 (2015): 96-102.

[2]. Abraham, Twinkle Sara, and Kavitha Narayanan. "Cooperative communication for vehicular networks." In *Advanced Communication Control and Computing Technologies (ICACCCT), 2014 International Conference on*, pp. 1163-1167. IEEE, 2014.

[3]. Son, Junggab, Hasoo Eun, Heekuck Oh, Sangjin Kim, and Rasheed Hussain. "Rethinking vehicular communications: merging VANET with cloud computing." In *Proceedings of the 2012 IEEE 4th International Conference on Cloud Computing Technology and Science (CloudCom)*, pp. 606-609. IEEE Computer Society, 2012.

[4]. Bitam, Salim, Abdelhamid Mellouk, and Sherali Zeadally. "VANET-cloud: a generic cloud computing model for vehicular Ad Hoc networks." *Wireless Communications, IEEE* 22, no. 1 (2015): 96-102.

[5]. Salahuddin, Mohammad, Ala Al-Fuqaha, Mohsen Guizani, and Soumaya Cherkaoui. "RSU cloud and its resource management in support of enhanced vehicular applications." In *Globecom Workshops (GC Wkshps), 2014*, pp. 127-132. IEEE, 2014.

[6]. Hussain, Rasheed, Fizza Abbas, Junggab Son, and Heekuck Oh. "Tiaas: Secure cloud-assisted traffic information dissemination in vehicular ad hoc networks." In *Cluster, Cloud and Grid Computing (CCGrid), 2013 13th IEEE/ACM International Symposium on*, pp. 178-179. IEEE, 2013.

[7]. Farooq, Mohd Umar, Mohammad Pasha, and Khaleel Ur Rahman Khan. "A data dissemination model for Cloud enabled VANETs using In-Vehicular resources." In *Computing for Sustainable Global Development (INDIACom), 2014 International Conference on*, pp. 458-462. IEEE, 2014.

[8]. Bhoi, Sourav Kumar, and Pabitra Mohan Khilar. "A Road Selection Based Routing Protocol for Vehicular Ad Hoc Network." *Wireless Personal Communications* (SPRINGER, 2015): 1-21.

[9]. Salahuddin, Mohammad, Ala Al-Fuqaha, Mohsen Guizani, and Soumaya Cherkaoui. "RSU cloud and its resource management in support of enhanced vehicular applications." In *Globecom Workshops (GC Wkshps), 2014*, pp. 127-132. IEEE, 2014.

[10]. Bitam, Salim, Abdelhamid Mellouk, and Sherali Zeadally. "VANET-cloud: a generic cloud computing model for vehicular Ad Hoc networks." *Wireless Communications, IEEE* 22, no. 1 (2015): 96-102.

[11]. Wan, Jiafu, Daqiang Zhang, Shengjie Zhao, Laurence T. Yang, and Jaime Lloret. "Context-aware vehicular cyber-physical systems with cloud support: architecture, challenges, and solutions." *Communications Magazine, IEEE* 52, no. 8 (2014): 106-113.

[12]. Hussain, Rasheed, Zeinab Rezaeifar, and Heekuck Oh. "A Paradigm Shift from Vehicular Ad Hoc Networks to VANET-Based Clouds." *Wireless Personal Communications, Springer*, (2015): 1-28.

[13]. Liang, Wenshuang, Zhuorong Li, Hongyang Zhang, Yunchuan Sun, and Rongfang Bie. "Vehicular Ad Hoc Networks: Architectures, Research Issues, Challenges and Trends." In *Wireless Algorithms, Systems, and Applications*, pp. 102-113. Springer International Publishing, 2014.

[14]. Dressler, Falko, Philipp Handle, and Christoph Sommer. "Towards a vehicular cloud-using parked vehicles as a temporary network and storage infrastructure." In *Proceedings of the 2014 ACM international workshop on Wireless and mobile technologies for smart cities*, pp. 11-18. ACM, 2014.

[15]. Bilal, Sardar Muhammad, Samee Ullah Khan, Sajjad A. Madani, Babar Nazir, and Mazliza Othman. "Road oriented traffic information system for vehicular ad hoc networks." *Wireless personal communications* 77, no. 4 , SPRINGER (2014): 2497-2515.

[16]. Jiang, Tao, Xiaowei Xu, Lu Pu, Yu Hu, and Zhijun Qiu. "A Simulation Study of Connected Vehicle Systems Using Named Data Networking." In *Cloud Computing*, pp. 39-48. Springer International Publishing, 2014.

[17]. Yu, Yu-Ting, Mario Gerla, and M. Y. Sanadidi. "Scalable VANET content routing using hierarchical bloom filters." *Wireless Communications and Mobile Computing* (2014).

[18]. Jothi, K. R., and A. Ebenezer Jeyakumar. "Optimization and Quality-of-Service Protocols in VANETs: A Review." In *Artificial Intelligence and Evolutionary Algorithms in Engineering Systems*, pp. 275-284. Springer India, 2015.

[19]. Aguirre, Erik, Peio Lopez-Iturri, Leire Azpilicueta, and Francisco Falcone. "Characterization of wireless channel response in in-vehicle environments." In *Microwave Symposium (MMS), 2014 14th Mediterranean*, pp. 1-4. IEEE, 2014.

[20]. Yuan, Quan, Zhihan Liu, Jinglin Li, Junming Zhang, and Fangchun Yang. "A traffic congestion detection and information dissemination scheme for urban expressways using vehicular networks." *Transportation Research Part C: Emerging Technologies* 47, ELSEVIER (2014): 114-127.

[21]. Li, Guangyu, Lila Boukhatem, and Steven Martin. "An Intersection-based QoS Routing in Vehicular Ad Hoc Networks." *Mobile Networks and Applications* 20, no. 2, SPRINGER, (2015): 268-284.

[22]. Chowdhury, Niaz Morshed, Lewis Mackenzie, and Colin Perkins. "Requirement analysis for building practical accident warning systems based on vehicular ad-hoc networks." In *Wireless On-demand Network Systems and Services (WONS), 2014 11th Annual Conference on*, pp. 81-88. IEEE, 2014.

[23]. Yuan, Quan, Zhihan Liu, Jinglin Li, Junming Zhang, and Fangchun Yang. "A traffic congestion detection and information dissemination scheme for urban expressways using vehicular networks." *Transportation Research Part C: Emerging Technologies* 47, Elsevier (2014): 114-127.

[24]. Kumar, K. Prem, S. Jemima Evangelin, V. Amudharani, P. Inbavalli, R. Suganya, and U. Prabu. "Survey on Collision Avoidance in VANET." In Proceedings of the 2015 International Conference on Advanced Research in Computer Science Engineering & Technology (ICARCSET 2015), p. 46. ACM, 2015.

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