Enlightened Transportation Conformity for Vehicular Special Nexus

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***Abstract*— Vehicular ad hoc network (VANET) is a form of mobile ad hoc network which afford communications among adjutants vehicles as well as between vehicles and nearby roadside equipment or infrastructure. VANET is important for intelligent transportation system (ITS). In order to validate an ITS system, simulation techniques are usually prefer. Wireless sensor network (WSN) have a lot of advantages such as real time communication, low power consumption, wireless distribution and as it is wireless it is flexible without cable limitations. Due to the wide variety of services can provide by the Vehicular Networks, they are come into focus now days. Wireless mobile ad hoc networks are a assortment of mobile nodes communicating among them self's without any existing infrastructure networks with the help of wireless links. Routing protocol has become one of the most imperative issues in transmitting data among Vehicles in VANET. Wireless vehicular ad-hoc networks are the networks without any physical connections. There is no fixed topology in these networks due to the mobility of nodes, multi path propagation, interference and path loss. Hence to function properly a dynamic routing protocol is needed for these networks. Many Routing protocols have been developed for accomplishing such task. In this paper, modeling and simulation of Destination-Sequenced Distance Vector routing protocol (DSDV) is done. Simulation is performed in ns2 (Network Simulator 2) for Quality of service (QoS) parameters such as Number of packet sent, Number of packet received, Packet delivery ratio (PDR), Point average delay, Mobility model, Delay, Packet loss, Throughput. This paper provides an overview of DSDV routing protocols by presenting its characteristics and functionality.**

Keywords—DSDV, ITS, VANET, V2I communication, V2V communication.

I. INTRODUCTION

Traffic congestion is a foremost problem that is occurred due to many vehicles and cars moving on road and traffic jam is also occurred due to an improper driving and accidents. This is the serious issue which is increasing day by day and accidents took place much more than usual. In our country hundreds of people are injured and died in highway/road accidents. This causes unnecessary traffic jam. Due to this traffic density a significant amount of time and fuel was wasted. An intelligent transportation system (ITS) uses modern technologies for traffic flow management like communications and information technology. It also encourages vehicle drivers to use alternate forms of transport and provides information for driving safely to avoiding unnecessary traffic jams. This implementation helps to avoid traffic congestion, avoid accidents and their impact afterwards that they create and also it helps in saving time and more important the drivers/passengers have peace of mind while they are traveling.

Now days, there is a large field of interest in the development of wireless sensor network (WSN) techniques and helpful for moving vehicle applications, to implement WSN communication between roadside rigid infrastructure equipment and vehicles or between vehicle to vehicle. As discussed above the Traffic congestion has become a major problem in the development of any country. To solve this problem fundamentally lot of countries are unswerving to ITS research and development. ITS is an advanced information technology, control technology, electronic sensor technology, data communication transmission technology and the effective integration of computer technology applied to the entire surface traffic management system established in a large range, all-round role, real-time, accurate and efficient integrated transport management system in the future direction of development of transport system [1].

Wireless sensor nodes have a lot of features such as small-sized, low in cost, battery-driven and easy to install and repair. These features are useful in the broad range of applications deploying wireless sensor nodes in a dense distributed manner to form specialized WSNs. The main objective of WSNs is to monitor physical or environmental phenomena like temperature, pollutants, sound, vibration etc [1].

VANET is an most important component of Intelligent Transportation Systems. The major advantage of VANET communication is in safety systems, safety systems increases safety of passengers by exchanging of warning messages between vehicles. Infrastructures are to be deployed throughout, using IVHW (Inter-Vehicle Hazard Warning) system to generate a warning message that is displayed on the display screen which is built in the vehicle so that better warning can be monitored efficiently. This type of network is in focus now days because of communication between vehicles without any infrastructure and dose not require costly cellular network to be deployed [3].

II. NEED OF ENHANCED COMMUNICATION

Enhanced communication helps to avoid traffic congestion and traffic jams, accidents as well. Vehicle drivers are encouraged to use alternate forms of transport. Not only in saving time and drivers/passengers to have peace of mind while they are traveling but also provides information for driving safely.

III. SURVEY OF VANET COMMUNICATION

3.1 Vehicular ad-hoc network (VANET)

VANET technology uses moving vehicles as nodes in a network to create a mobile vehicular network. VANET uses every participating vehicle as a wireless node, allowing vehicles to connect each other and create a network with a wide range among them self. As vehicles fall out of the signal range and drop out of the network, other vehicles can join in, connecting vehicles to one another so that a mobile Internet is created [2].

VANET communication is divided into two parts:

a) V2V communication (Vehicle to Vehicle communication)

b) V2I communication (Vehicle to Infrastructure communication)

3.1.1 V2V communication (Vehicle to Vehicle communication)

Fig.1 V2V communication [1]

Vehicle to Vehicle communication approach is suitable for short range vehicular networks. It is Fast and gives the real time safety. No need any roadside Infrastructure. V2V communication is not affected by Vehicle Shadowing. In vehicle shadowing a smaller vehicle is shadowed by a larger vehicle preventing it to communicate with the Roadside infrastructure.

3.1.2 V2I communication (Vehicle to Infrastructure communication)

In V2I type of communication there is base station (Roadside Unit) that is located at the side of the road which acts as a base station to transmit/receive messages that are being generated by the network when any sort of incident occurs [3].

It makes use of preexisting network infrastructure such as wireless access points (Road-Side Units, RSUs). Communications between vehicles and road side units are supported by V2I protocol and V2R protocol. The additional cost is required because of Roadside infrastructure.

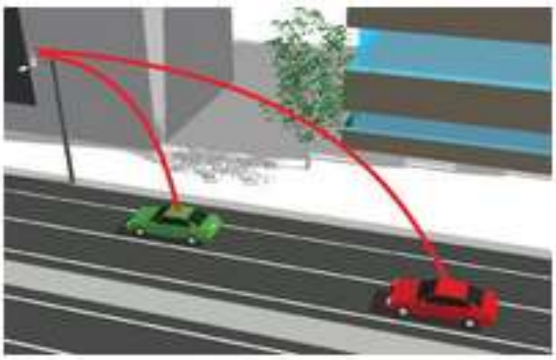

Fig.2 V2I communication [1]

Fig.3 gives us the detailed idea about how the vehicles can communicate with each other as discussed in V2V communication and communication between vehicles to roadside infrastructure as discussed in V2I communication.

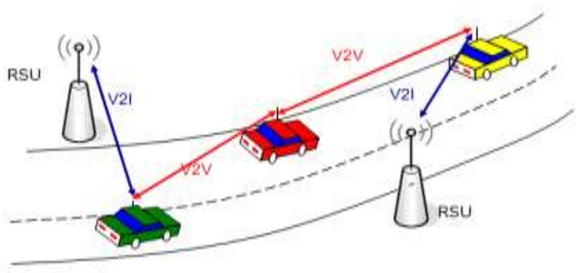

Fig.3 VANET communication.

If any emergency event has been occurred such as accident, traffic jam etc. then how vehicle can communicate with each other and with roadside infrastructure base station to avoid traffic and unnecessary wastage of time, this also shown in Fig.4

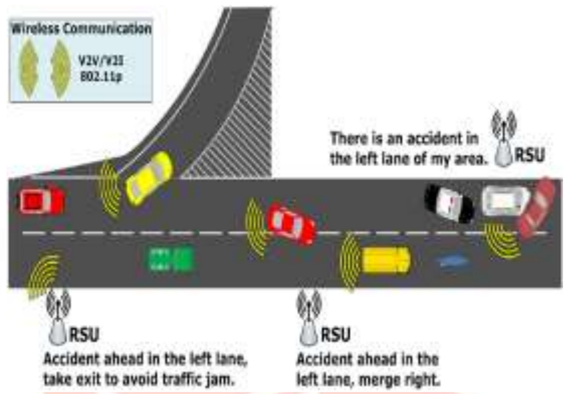

Fig.4 Emergency event occurred [1]

IV. CHALLENGES FOR VANET COMMUNICATION

In V2V communication, all the vehicles are not connected all the time because they are moving at different speed due to which there might be quick network topology changes. The anonymity problem: The addresses of vehicles on highways are unknown to each other. All vehicles broadcast periodically to inform neighbors about its address but the address position map will change frequently due to relative movements between vehicles.

V. ROUTING PROTOCOL FOR VANET

A routing protocol for ad hoc networks is composed of a routing algorithm with a set of rules that monitor the operation of the network. MANET protocols are categorized into three forms. Fig. 2.1 shows the categories and list of protocols.

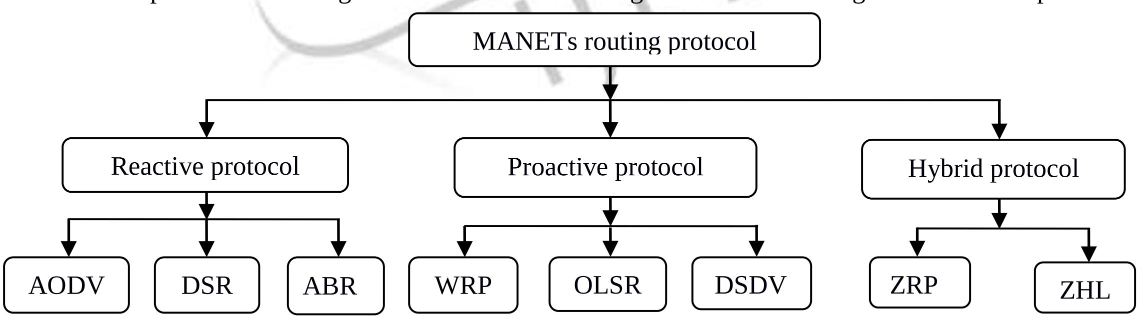

Fig.5 Taxonomy for VANET

Routing protocol in VANET is the important part of results and generally we will consider only AODV and DSDV protocols as we are more focusing on reactive and proactive routing protocol.

A) AODV (Ad hoc On-demand Distance Vector)

AODV Routing protocol is a reactive ad hoc routing protocol. It creates a new route only when necessary. As it is reactive routing protocol that establishes route only on-demand in source to destination node and does not require maintaining routes to node that are not communicating [1]. Route discovery in AODV is done by using Route Request (RREQ) and Route Reply (RREP). As long as the new route remains valid AODV protocol would not act. When it has invalid or expired AODV will only react when the route is needed again. With the help of two mechanisms AODV protocol is composed: Route Discovery and Route Maintenance [4].

B) DSDV (Destination Sequenced Distance Vector)

Destination-Sequenced Distance Vector routing protocol (DSDV) is a typical routing protocol for VANETs, which is based on the Distributed Bellman-Ford algorithm. In DSDV, each route has a sequence number which is originated by the destination, indicating how old is the route. Each node manages its own sequence number by assigning it two greater than the old one (call an even sequence number) every time. The old route is replaced, When a route update with a higher sequence number is received [5].

C) DSR (Dynamic Source Routing)

DSR protocol is a typical on-demand routing protocol. It is based on the concept of on-demand source routing Adaptive routing protocols.

VI. PERFORMANCE METRICS

Several performance metrics are used in the evaluation of routing protocols for network simulation, viz.-

A) Throughput

It is the average rate of successful message delivery over a communication channel. Number of packets received at destination is calculated and taken as throughput. The throughput is measured in bits per second (bps) and sometimes in data packets.

$$\text{Throughput} = \text{Packet size} / \text{Transmission time}$$

B) Packet Delivery Ratio

It is the ratio of the number of packets received by the destination to the number of data packets generated by the source. The Packet delivery ratio determines protocol efficiency in delivering packets from source to destination. The higher the value, better are the results.

$$\text{PDR} = \frac{\text{received packets}}{\text{total number of sent packets}}$$

C) End to end delay

It is a time required for packets to reach to destination node from source node. This includes all possible delays caused by buffering during route discovery latency, queuing at the interfaces, queuing transmission delays at MAC and propagation and transfer times of data packets. This is the average overall delay for a packet to traverse from a source node to a destination node. So, average delay of a routing protocol is calculated as [15]:

$$\text{End to end delay} = \frac{\sum e}{P}$$

Where, $e = T_d - T_s$

T_d = Time when packet received at destination

T_s =Time when packet created by source

D) Jitter

Jitter is the variation of delay. That it is the variation in the delay of received packets. At the sending side, packets are sent in a continuous stream with the packets spaced evenly apart. Due to network congestion, improper queuing, or configuration errors, this steady stream can become cumbersome, or the delay between each packet can vary instead of remaining constant.

E) Packet Loss

It is the difference between the number of packets sent and number of packets received.

F) Total energy consumption

Total energy consumption parameter includes the total amount of energy consumed by the network, minimum energy consumed by each node etc. This parameter is important to increase the life of network.

VII. DSDV (Destination Sequenced Distance Vector)

The route with better metric is used, in case of different routes with the same sequence number. When any significant topology change is detected, updates are transmitted periodically or immediately. There are two ways for performing routing update, namely full dump and incremental update. In full dump the complete routing table is transmit the node and in incremental update a node sends only those entries that have changed from last update. To avoid fluctuations in route updates, DSDV employs a "settling time" data, settling time is used to predict the time when route becomes stable. In this paper the performance evaluation of DSDV (Destination Sequenced Distance Vector) routing protocol is calculated based on some performance metrics parameters [2]. Basic difference between AODV and DSDV is, AODV is a reactive protocol (routes are only generated on demand, in order to reduce routing loads), and DSDV is a proactive protocol (with frequent updates of routing tables regardless of need). Vehicular ad hoc network is a collection of independent mobile nodes that can communicate to each other via radio waves. To those nodes that are in radio range of each other, the mobile nodes can directly communicate. Whereas others nodes need the help of intermediate nodes to route their packets [2].

DSDV is a proactive protocol and it is based on the distance vector algorithm. Due to dynamic topology of the network the nodes periodically broadcast routing updates. The routing information is kept in routing table at each node about all the available destinations with the number of hops to that particular destination. To provide loop freedom DSDV uses sequence numbers, this is provided by the itself destination. The node immediately updates the sequence number when a route to the next hop is broken and broadcasts the information to its neighbors.

When a node receives new routing information then nide checks if it has a similar kind of information in its routing table. If the node already has that routing information then it compares the sequence number of the received information with the one it has already. If the sequence number of the information it has is less than that of the received information then it discards the information with the least sequence number. If the both the sequence numbers are the same then the node keeps the information that has the least number of hops to that destination or the shortest route.

Once a root has been established, it is maintained by a route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired [7].

VIII. SIMULATION AND RESULT SCENARIO

8.1 Network Simulator 2

It is a powerful network simulator which provides substantial support for simulation of TCP routing, multi cast protocols over wired and wireless networks. Simulators help in easy verification of protocols in less time, money. NS offers support for simulating a variety of protocol suites and scenarios. Users can define arbitrary network topologies composed of nodes, routers, links and shared medium. A rich set of protocol objects can then be attached to nodes, usually as agents. The simulator suite also includes a graphical visualize called network animator (NAM), to assist the user get more insights about their simulation by visualizing packet trace data.

Detailed simulation requires a system programming language which can efficiently manipulate bytes, packet headers and implement algorithms that run over large data sets. For these tasks run-time speed is important and turn-around time, run simulation, find and fix bug is less important. On the other hand, a large part of network research involves slightly varying parameters or configurations, or quickly exploring a number of scenarios. In these cases, iteration time and re-run is more important. NS-2 is written in C++, with an Object-oriented Tool Command Language (OTcl) as a Front-end. OTcl is an object-oriented variant of the well-known scripting language TCL. OTcl is used for simulation scenario generation, periodic or triggered action generation and for manipulating existing C++ objects.

C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but can be changed very quickly, making it ideal for simulation configuration. In brief, basic architecture of NS includes tcl simulation script, NS-2 shell [8] which has C++ and OTcl simulation objects, and simulation trace files having NAM animation.

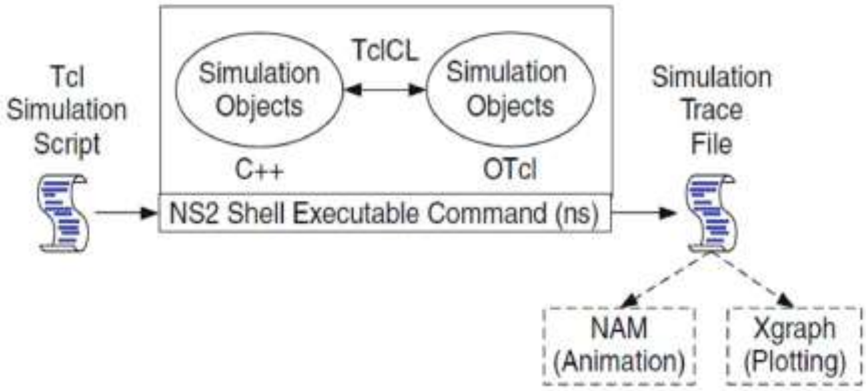

Fig. 6 The basic architecture of NS [8]

As shown in figure 8.1 the basic architecture of NS provides users with executable command ns which take on input argument called a Tcl simulation scripting file. Users are feeding the name of a Tcl simulation script as an input argument of NS-2 executable command ns. The C++ defines the internal mechanism of the simulation objects, the OTcl sets up simulation by assembling and configuring the objects as well as scheduling discrete events. The C++ and the OTcl are linked together TclCL. These C++ objects are used to set up a simulation using a Tcl simulation script. However, these objects are insufficient for advancements.

One need to develop own C++ objects, and use OTcl configuration interface to put together these objects. After simulation, NS-2 outputs either text-based, e.g. trace files or .tr files and animation based simulation results. To interpret these results graphically and interactively, tools such as NAM (Network AniMator) and GNU plots are used. To analyze a particular behavior of the network, users can extract a relevant subset of text-based data and transform it to a more feasible presentation.

All nodes move toward a new destination position in the region and stay there for a specified time called pause time and again proceed toward a new direction. If nodes change their location over time, they have to update their location estimates frequently in order to avoid inaccuracies resulting from using out dated location estimates.

Diverse simulation scenarios have been created by varying number of nodes, number of constant bit rate (CBR) sessions in the entire network referred as flow count, and amount of pause time. All nodes move toward a new destination position in the region and stay there for a specified time called pause time and again proceed toward a new direction. If nodes change their location over time, they have to update their location estimates frequently in order to avoid inaccuracies resulting from using out dated location estimates.

These kinds of diverse simulation scenarios helps to check the performances of protocols for different situations, also helps to improve Qos of a network. NAM file is generated which represents the simulation of scenario for given scenario. Fig. 6 shows the NAM file i.e. animated file of DSDV protocol for 100 nodes after running TCL script, which exemplifies the moving nodes and packet transmission between node 0 and node 1.

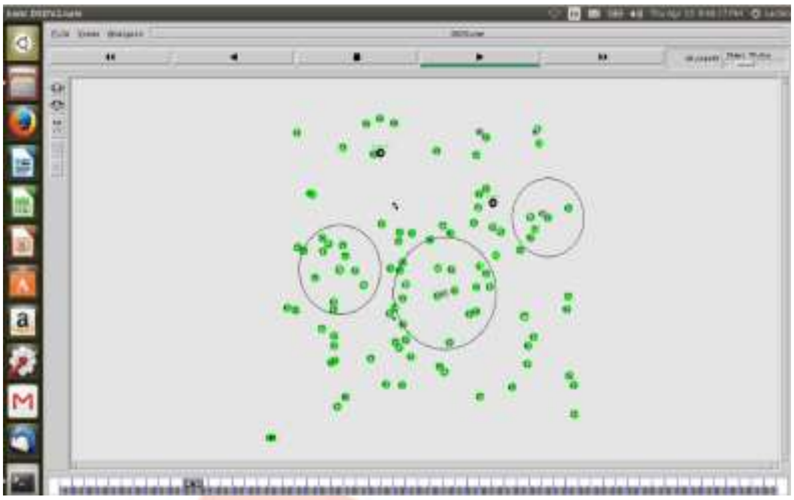

Fig.7 Network animator visualization

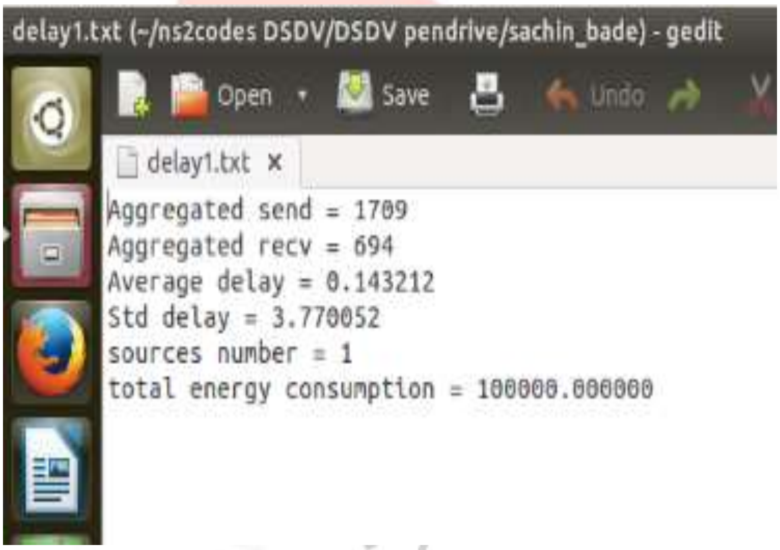

Fig.8 Analysis of DSDV routing protocol

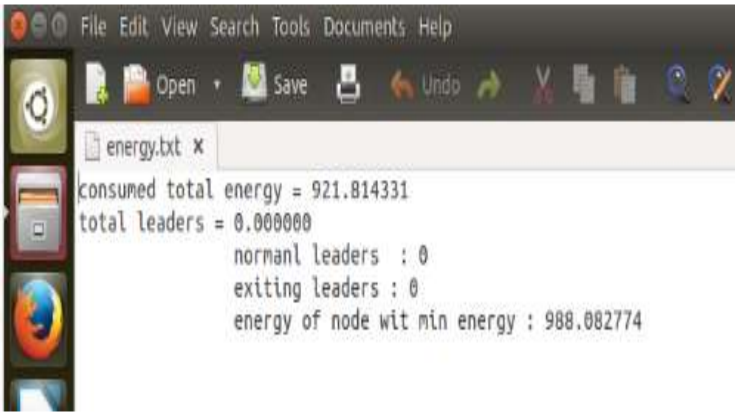

Fig.9 Energy evaluation on network simulator

Table 1 Simulation Results obtained for various performance parameters

Sr.No	Performance Parameters	Calculated Value
1	Aggregated send	1709
2	Aggregated recv	694
3	Average delay	0.143212
4	Std delay	3.770052
5	sources number	1
6	total energy consumption	100000.000000
7	energy of node wit min energy	988.082774
8	consumed total energy	921.814331

IX. EVALUATION OF CONSEQUENCES

The foremost parameters of Quality of Service which are considered in this paper for evaluation of DSDV routing protocol are packet loss, end-to-end delay and throughput. Each result is discussed in the next section.

1) End-to-end delay

The end-to-end delay is the time required to transmit a packet from source to destination. In Fig.7 DSDV demonstrates almost same average of delay in various speeds. In this circumstances, the sender with a higher speed reaches to destination in a shorter time that is a reason to reduce the end-to-end delay. Routing tables of DSDV must be updated repeatedly which leads to increasing delay in the network. As a result, by increasing the vehicle speeds, end to end delay in DSDV becomes longer.

2) Packet Loss

Packet loss is quantity of packets which have been sent by source and on the other side didn't receive by destination. In this scenario by increasing the speed of source node, the amount of packet loss also increased. In DSDV protocol, packets are buffered in a queue when a link broken happens; in addition establishing a new route is faster in DSDV so fewer packets will be dropped from queue and the value of packet loss will not breed dramatically. Fig.7 and Table 1 show the results.

3) Throughput

Throughput is rate of transfer data from a source to a destination during specific time. Fig.6 shown that by increasing the vehicle speed, the throughput in DSDV will be decreased because sender and receiver become close to each other faster in higher speed. As shown in Table1 DSDV demonstrates almost same amount of delay in different speeds, however it shows less amount of packet loss in this case. Consequently, in higher speed scenario, outcome of DSDV for this parameter will decrease.

X. CONCLUSION

Initially, data are sent over the path with higher path preference probability which can provide lesser delay, higher bandwidth, and shorter path in terms of number of hops. In case of any link failure leading to path breaks, alternate possible paths with next higher path preference probability are immediately considered and data transmission will be continued.

Performance of DSDV is checked for the packet delivery ratio, energy, throughput and delay parameters for varying number of nodes and data rate. In case of energy, DSDV protocols present almost same energy consumption.

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