

Comparative Study of Ad-Hoc Protocols in MANET and VANET

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Abstract

One new type of ad-hoc network in Vehicular Ad-Hoc Network (VANET), in which vehicles constitute the mobile nodes in the network. The ad-hoc protocols in Mobile Ad-Hoc network (MANET) is already introduced earlier. But the pattern of working in VANET and MANET is quite different in nature even for multimedia data. VANET performance is quite different than ordinary data over VANET scenario. This paper presents a comparative test of various mobility scenarios of Vehicular Ad-hoc Network in three well-known Indian Metros along with the MANET scenario for low mobility on ordinary data and high mobility on RTP data. Due to the high cost of deploying and implementing such a system in real world, most research in VANET relies on simulations for evaluation. The AODV, ADV and DSR routing protocol have been used for the simulation. In order to make the comparisons three well known performance parameters have been considered these are packet-drop, throughput and total time taken by the simulator to simulate the given network. To carry out the simulation process an open source simulator tool is used for this study namely-NCTUns-6.0. With suitable simulation set-up the simulation has been performed. Based on the simulation result of the above mentioned protocol, the output have been compared for different mobility patterns for three Indian Metros(Kolkata, Chennai and Mumbai) and we also got the simulation result of MANET.

Keywords: VANET;MANET; Ad-hoc network; ADV; AODV; DSR; Performance; Throughput; Packet Drop; Packet Collision; NCTUns6.0 network simulator.

1. Introduction

Vehicular Ad-Hoc Network (VANET) communication has recently become an increasingly popular research topic in the area of wireless networking as well as the automotive industries. The goal of VANET research is to develop a vehicular communication system to enable quick and cost efficient distribution of data for the benefit of passengers' safety and comfort.

We have obtained an interesting result in our previous work[1] based on different scenario, that the simulation shows a better result in dense traffic situation. Therefore we have taken Kolkata, Delhi and Mumbai scenario for more real life implementation. Further we have studied the [2] paper where we have observed that in real time protocol is ADV protocol is far better than AODV[3]. Therefore, we attempt to find out the result on the over populated scenario like Indian scenario with data communication.

In present situation we need to apply the navigation system with automation for all kind of traffic vehicles. But there is a big question of security involves as it the automation is deployed with human. Here we proposed a simulation based on different scenarios of different city and to find out the successful rate of VANET in different scenario.

We adopted the AODV and ADV along with DSR Ad-hoc routing protocol as it is believed to be the best routing protocol for VANET scenario. We can deploy infrastructure based or agent based routing protocols. Whereas the above three routing protocols are more costly and dedicated type protocols.

Therefore, we try to find out the best performance of VANET on scenarios on the basis of Ad-hoc routing. The only precondition is that all vehicles should equipped with mobile communicating device and sensor device and those are much cheaper than agent based or infrastructure based VANET.

1.2 Routing Protocols

Ad-hoc routing protocol setup the path, exchange information and take decision of runtime path[12].

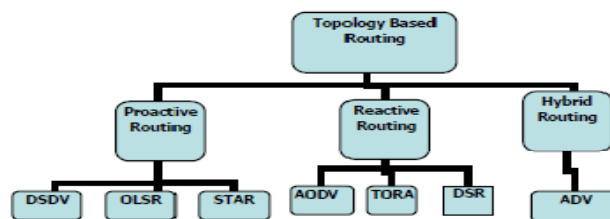


Fig 1: Ad-hoc Routing Protocols [7].

In this paper we work on reactive routing(AODV,DSR) and Hybrid Routing (ADV)

There is three types of topology based routing

1. Proactive (table-driven) routing protocols
2. Reactive (on-demand) routing protocols
3. Hybrid routing protocols

- **Proactive Routing**

Proactive routing protocols are based on shortest path algorithms[7]. It maintains and update information on routing among all nodes of a given network at all times even if the paths are not currently being used. Thus, even if some paths are never used but updates regarding such paths are constantly broadcasted among nodes [13]. Route updates are periodically performed regardless of network load, bandwidth constraints.

- **Reactive Routing**

On demand or reactive routing protocols were designed to overcome the overhead problem, that was created by proactive routing protocols, by maintaining only those routes that are currently active [8]. These protocols implement route determination on a demand or need basis and maintain only the routes that are currently in use, thereby reducing the burden on the network when only a subset of available routes is in use at any time [9].

AODV maintains and uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Route discovery in AODV can be done by sending RREQ (Route Request) from a node when it requires a route to send the data to a particular destination. After sending RREQ, node then waits for the RREP (Route Reply) and if it does not receive any RREP within a given time period,

DSR, ADV and AODV can be compared and evaluated based on the packet delivery ratio, normalized MAC load, normalized routing load, and average end-to-end delay by altering the number of sources, speed, and pause time.

2. Related Work

Our previous work “Performance Analysis of VANET Scenario in Ad-hoc Network by NCTUns Simulator”[1]We done the simulation of VANET on diffrent scenario and we got some satisfactory result on mesh type road stracture for AODV protocol. Hence we try to find out the how other protocols like Adaptive routing protocol(ADV),Dedicated short distance protocol(DSR) performs?

We have study further “Performance Evaluation of ADV with AODV for Real-time and Multimedia Applications in Vehicular Ad-hoc Networks (VANETs)”[2] and “Performance Evaluation of AODV and ADV Protocols in VANET Scenarios”[4] related to our present work.

In those papers we found they done the simulation on multimedia traffic for VANET. Hence we try to simulate on ordinary data traffic , how those protocols works?

3. Proposed Analysys

3.1 Performance metrics

Different performance metrics are used to check the performance of routing protocols in various network environments. In our study we have selected throughput and packet drop to check the performance of VANET routing protocols against each other. The reason for the selection of these performance metrics is to check the performance of routing protocols in highly mobile environment of VANET. Moreover, these performance metrics are used to check the effectiveness of VANET routing protocols i.e. how well the protocol deliver packets and how well the algorithm for a routing protocol performs in order to discover the route towards destination. The selected metrics for routing protocols evaluation are as follows[6][9].

1) Throughput

Throughput is the average number of successfully delivered data packets on a communication network or network node. In other words throughput describes as the total number of received packets at the destination out of total transmitted packets [6]. Throughput is calculated in bytes/sec or data packets per second. The simulation result for throughput in NCTUns6.0 shows the total received packets at destination in KB/Sec, mathematically throughput is shown as follows:

$$\text{Throughput (bytes/sec)} = \frac{\text{Total number of received packets at destination} * \text{packet size}}{\text{Total simulation time}} \text{ kb/s}$$

2) Packet Drop

Packet drop shows total number of data packets that could not reach destination successfully. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc. Packet drop affects the network performance by consuming time and more bandwidth to resend a packet. Lower packet drop rate shows higher protocol performance.

3) Collision

The Collision of data packet is the number of packets collides to each other due to congestion. It affects the performance directly on the bandwidth. Lower packet collision rate shows higher protocol performance.

B. Testing scenario conditions of VANET:

- 1) Network is taken ad-hoc and the path is absolutely dynamic in nature.

- 2) Lane Width is taken 30m
- 3) Initial average distance is 500m in between different car.
- 4) Simulation time is taken 200sec on average
- 5) RTS threshold is 3000bytes
- 6) The car profile is taken five
(20%---speed is 18km/hour, 20%---speed is 36km/hour, 20%---speed is 50km/hour, 20%---speed is 60km/hour,20%---speed is 80km/hour)
- 7) Number of lane is taken 2

Table 1: RTP video traffic data[3]

Session bandwidth	1600 Kbps
Media Type	Video
Payload Type	34
Encoding	H263
Sampling Rate	90 kHz
Bits per sample	1
Frame Rate (F/sec)	30

Table 1: RTP video traffic data[3]

Session bandwidth	1600 Kbps
Media Type	Audio
Payload Type	127
Encoding	GSM
Sampling Rate	8 kHz
Bits per sample	1.65
Packet time	20 ms

Table 3: Simulation environment parameter(for MANET and VANET both).

Frequency (MHz)	2400
fadingVar	10.0
RiceanK	10.0
TxAntennaHieght (m)	1.5
System Loss	1.0
Trans Power (dbm)	3.0
AverageBuilding Height (m)	10
Street Width (m)	30
Average Building Distance (m)	80

Path Loss exponent	2.0
Shadowing Standard Deviation	4.0
CloseInDistance (m)	1.0
RxAntenna Height (m)	1.5

C. Testing scenario conditions of MANET:

- 1) Network is taken ad-hoc and the path is absolutely dynamic in nature.
- 2) Initial average distance is 500m in between different mobile node.
- 3) Simulation time is taken 120sec on average
- 4) RTS threshold is 3000bytes
- 5) The mobile profile is taken five
(20%---speed is 1m/s, 20%---speed is 2m/s, 20%---speed is 4m/s, 20%---speed is 3m/s, 20%---speed is 6m/s)

1) Draw Topology

In this step we designed roads networks and select the total number of nodes. First we designed the roads by selecting the appropriate icons for road design that is provided by NCTUns6.0 network simulator. Total length of the roads network also defined in this step. These nodes are highly mobile and we have selected vehicular nodes as it is required by the network. Roads are designed according to real situation for the movement of vehicular nodes [Fig1].

C. Simulation Setup

The first step for simulation setup is to create Vehicular Ad Hoc Network. We designed two different networks for evaluation of routing protocols. Network is created by using blank project workspace that is provided by NCTUns6.0 network simulator. For simulation setup for VANET we followed following mentioned steps [5]:

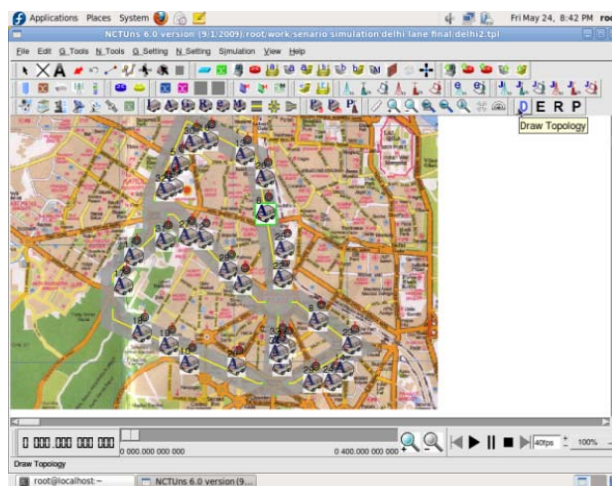


Fig.2: Draw topology of Delhi Traffic Scenario on NCTUns6.0 network simulator.

2) Edit properties

It is the most important step for our simulation setup. In this step we assigned different values in each parameter of vehicular nodes and configured each parameter that is provided by NCTUns6.0 network simulator. Besides these node settings other important settings for simulation and communication among various nodes such that defining the total simulation time, signal selection, implementation of routing protocols for communication, communication type etc. In this simulation study we selected the following network parameters and tools for vehicular nodes and communication among them:

- TCP/IP network transmission mode.
- The protocol is taken AODV of ad-hoc category
- IEEE 802.11b standard used for each vehicular node.
- 1400 bytes of TCP packets used for communication.
- 30 cars are selected for three different scenarios.
- 15dbm Transmission power used for node operation.
- Radio obstacles are set for the interruption of signals in city scenario.

3) Simulation

After making necessary changes in vehicular nodes, network environment and tools we run the simulation[Fig 2,3] to generate the results.

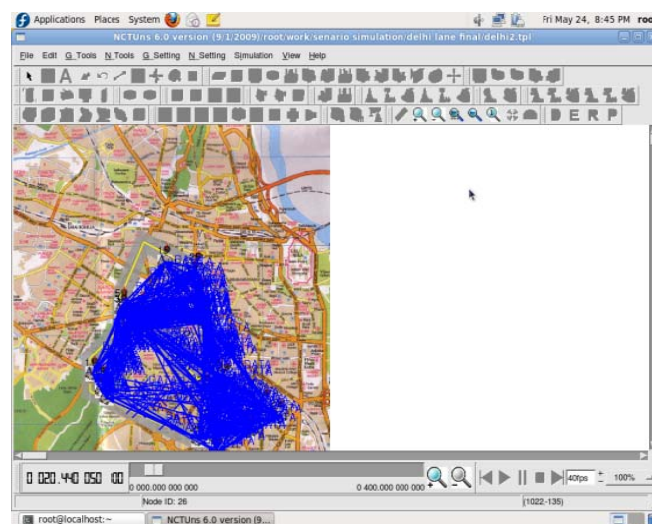


Fig.3. Run mode with packet transmission from different moving car of Delhi Traffic Scenario on NCTUns6.0 network simulator.

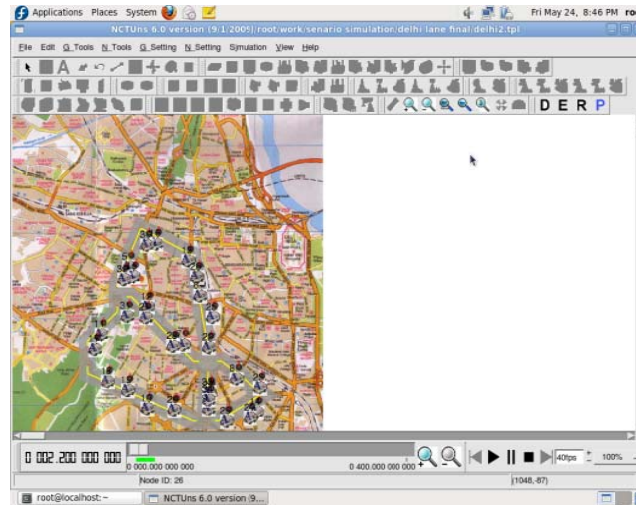


Fig.4: Moving car with packet transmission from different moving car of Delhi Traffic Scenario on NCTUns6.0 network simulator.

4. Testing And Results

4.1 Scenario

We have considered three different congested City map of India from website[10] and we draw the two lane road on the map on the simulator. Next we place the 30car on each scenario map.

Senario:1



Fig. 5:Kolkata Scenario.

Senario:2



Fig. 6 Delhi Scenario.

Senario 3



Fig.7: Mumbai Scenario.

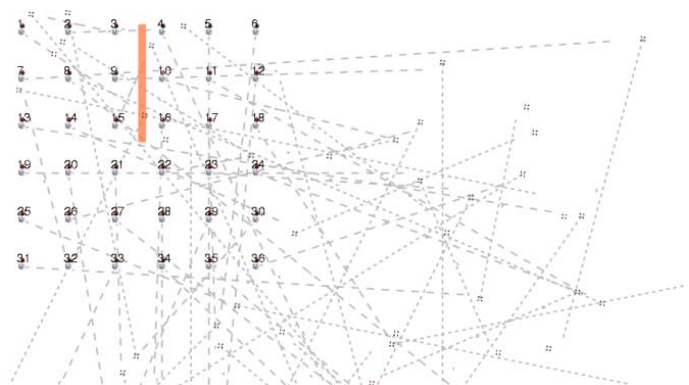


Fig. 8: MANET scenario of 36 node.

Result

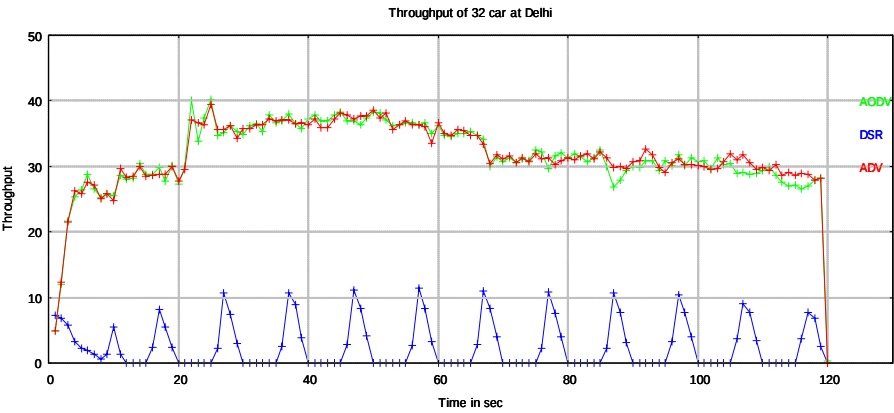


Fig. 9: Throughput in kb/s vs time in sec plot of Delhi scenario(car density 32)

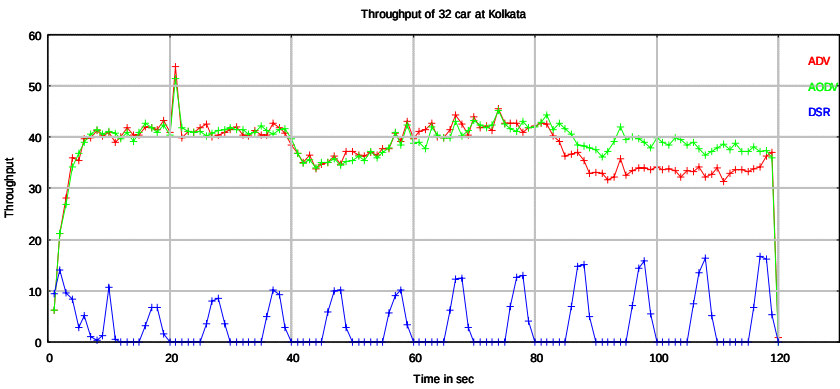


Fig. 10: Throughput in kb/s vs time in sec plot of Kolkata scenario(car density 32)

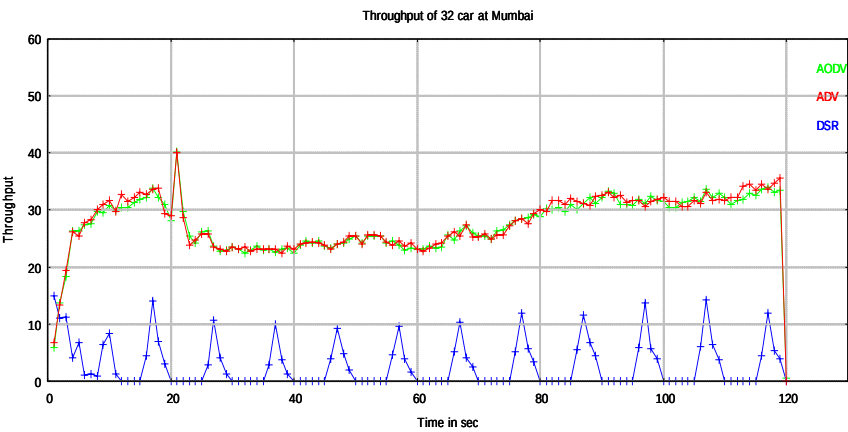


Fig. 11: Throughput in kb/s vs time in sec plot of Mumbai scenario(car density 32)

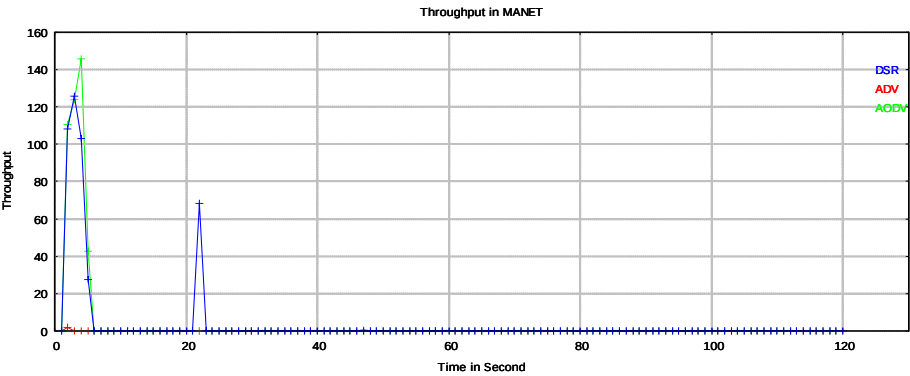


Fig. 12: Throughput in kb/s(y-axis) vs time(x-axis) in sec plot of MANET scenario(node density 36)

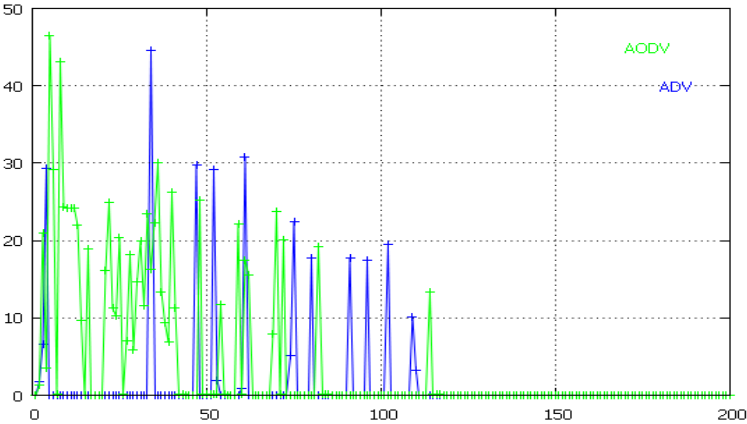


Fig. 13: Throughput in kb/s(y-axis) vs time(x-axis) in sec plot of VANET scenario for Video data (car density 32)

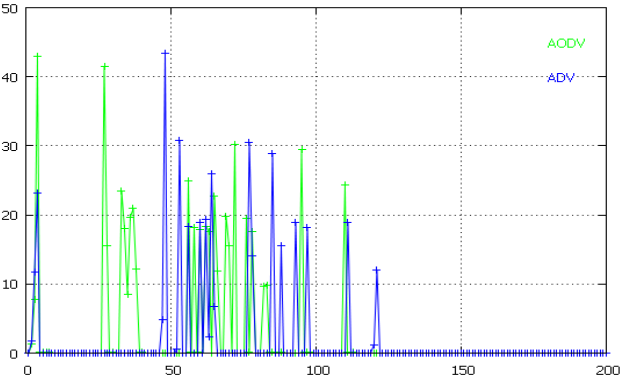


Fig. 14: Throughput in kb/s vs time in sec plot of VANET scenario for Audio data (car density 32)

4.2 Observation

The Figures above show the performance of AODV, ADV and DSR for VANET of three different scenario of Delhi, Kolkata and Mumbai. We have taken only throughput vs time data for analysis as it more effective to explain the performance. Where we have found almost same performance of ADV and AODV for all different city scenario where the throughput level is different due to different scenario.

But we got an interesting result on the MANET, where the AODV and DSR is far better in than ADV. Further ,more we simulate the AODV and DSR protocol in VANET for real time protocol(audio and video traffic), where we got ADV is better than AODV.

4.3 Analysis:

The ad-hoc on demand distance vector routing protocol(AODV) is based on flooding with the help of RREQ and RREP packet.

Dedicated short distance routing protocol(DSR) work best on table based data for static type structure. It always build the table, based on that it transmit data. If structure destroyed, it rebuild the table and start communication among them. Therefore DSR is table driven and AODV is on demand. The Adaptive Distance

Vector (ADV) is a also a Distance Vector Routing algorithm[2]. ADV is similar to other distance vector algorithms but it reduces the routing overhead by fluctuating the frequency and size of routing updates owing to variation in traffic and node mobility. It maintains routes to active receivers only so that the number or entries advertised is reduced. It triggers partial and full updates so that periodic full updates are avoided like AODV.

Normally DSR have less overhead than AODV and ADV. But DSR is not good for highly dynamic network.

Therefore taking above character of ADV, AODV and DSR protocol, it is expected for all Ad-hoc ordinary data DSR is periodic fluctuating in nature. Whereas other two is expected steady in nature. But, if we take the busty data (like real time data) the ADV may work better than AODV. Hence we deployed three different VANET scenario of Kolkata, Delhi and Mumbai. Where we got a almost identical performance for ADV and AODV. We further got these two is far better in throughput than ADV and AODV as expected theoretically.

Next we perform the simulation in MANET for less dynamic in nature. Hear we got a very interesting result, that DSR is far better than ADV. But we got AODV is comparable to DSR.

Finally we try to simulate of VANET for RTP(Video and Audio). Hear we got ADV is little beat better than AODV as it expected. Because of busty data the performance is varies than AODV.

5. Conclusion and Future Work

It is found that found almost same performance of ADV and AODV for all different city scenario where the throughput level is different due to different scenario. But we got an interesting result on the MANET, where the AODV and DSR is far better in than ADV. And for busty and bulk fluctuating data in high mobility ADV is batter in VANET. We found that DSR have less overhead than ADV and AODV. Whereas DSR is less effective compare to other two in VANET scenario. So, we try to merge DSR and ADV, to get a better result over VANET scenario.

6. Acknowledgement

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