# Performance Evaluation of MANET Using Quality of Service Metrics

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***ABSTRACT:*** *An ad hoc network is a collection of mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. Several routing protocols have been proposed for ad hoc networks and prominent among them are Ad hoc On Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR). Effort has been made to merge software Quality assurance parameters to adhoc networks to achieve desired results. This Paper analyses the performance of AODV and DSR routing protocols for the quality assurance metrics. The performance differentials of AODV and DSR protocols are analyzed using NS-2 simulator and compared in terms of quality assurance metrics applied.*

**Keywords:** Manet , AODV, DSR, SQA, PDR

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## 1. Introduction

An ad hoc network is a collection of wireless mobile nodes (or routers) that forms a temporary network. An ad hoc network is established without the use of any existing network infrastructure or centralized administration. The ad hoc system model assumes that mobile hosts can form networks without the participation of any fixed infrastructure [1]. As to infrastructure less approach, the mobile wireless network is commonly known as a mobile ad hoc network (MANET) [2]. Due to the mobility of the nodes in a MANET, the network topology may be connected in any arbitrary manner and may change dynamically. Such a topology is randomly changing and is unpredictable [3]. Nodes in the MANET share the wireless medium. The density of nodes and the number of nodes depend on the applications in which MANET is used. Each node in the MANET works as intelligent node and works both as a DTE (Data Terminal Equipment) and DCE (Data Communication Equipment). Ad hoc network may operate alone or may be connected to the Internet. Ad hoc networks therefore refer to networks created for a particular purpose. With the increase of portable devices as well as progress in wireless communication, ad hoc networking is gaining importance with the increasing number of widespread applications. Ad hoc networking can be applied anywhere where there is little or no communication infrastructure or the existing infrastructure is expensive or inconvenient to use. Ad hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. Manets

can be exploited in a wide area of applications, from military, emergency rescue, law enforcement, commercial, to local and personal contexts.

New strategy involving Quality (QoS) of Service has been added to evaluate the performance of on demand protocols. Wireless information systems face new kinds of problems, such as narrow band-widths, lack of coverage, devices with small memory and screens which cannot display large amount of data and diversity of users and devices. Software engineering has been used to identify quality components. Quality attributes which are affected by mobile-wireless information systems are Functionality, Reliability , Usability , Maintainability , Portability, Quality in Use and Efficiency. Goal is to carry out a systematic performance study of on demand routing protocols using QOS parameters. The two fields will be merged to achieve a suitable routing protocol. AODV [6] and DSR [4] have been used as base protocols to incorporate the changes.Rest of the paper is organized as: section II describes routing protocols proposed for ad hoc networks. Quality assurance metric is introduced in section III. Simulation and results in form of graphs are represented in section IV. Last Section gives conclusion.

## 2. Routing Protocols

Routing protocols explains how a message is sent from source to the destination. Whenever a packet needs to be transmitted to a destination via number of nodes a routing protocol is required. For ad hoc network numerous routing protocols have been proposed. Routing protocols proposed for ad hoc networks cope well with the dynamically changing topology [4]. Different routing protocols have been proposed and are classified into two major categories as Proactive and Reactive [5] as Table driven/ proactive routing protocols and On-demand/reactive routing protocols. In Table Driven routing protocols each node maintains one or more tables containing routing information to every other node in the network. All nodes keep on updating these tables to maintain latest view of the network. Some of the existing table driven protocols are optimized linked state routing (OLSR), Destination Sequenced Distance Vector (DSDV). In On-demand routing protocols, routes are created as and when required. When a transmission occurs from source to destination, it invokes the route discovery procedure. The route remains valid till destination is achieved or until the route is no longer needed. Some of the prominent on demand routing protocols are Dynamic Source Routing (DSR), Ad hoc On Demand Distance Vector (AODV) and Temporally Ordered Routing Algorithm (TORA). Working of these can be surveyed in [11,13,14 ] .

## 3. SQA Metrics

Quality attributes which are affected by mobile-wireless information systems are:- Functionality, Reliability, Usability, Efficiency, Maintainability, Portability and Quality in Use. Many QoS components should work together to support QoS in Ad-Hoc networks [9].

**Functionality:** Functionality includes suitability, accuracy, interoperability, and security.

**Reliability:** Reliability includes the maturity, fault tolerance, and recoverability.

**Usability:** Usability includes the understandability, learn ability, operability, and attractiveness.

**Efficiency:** Efficiency includes the time behaviour and resource utilization sub characteristics. Time behaviour sub-characteristic is very important in the wireless environment because the price of each minute of data transferring is very high, and the users will avoid expensive systems.

**Maintainability:** Maintainability includes the analyzability, changeability, stability, and testability sub-characteristics.

**Portability:** Portability includes the adaptability, install ability, co-existence, and replace ability sub- characteristics.

**Quality:** Quality in use is the user's view of quality.

## 4. Proposed Plan

Four parameters of SQA parameters have been selected or the purpose of evaluation, these are Functionality, Reliability, Usability and quality in use. These four can be defined mathematically as:

(a) $$F = \Sigma \frac{p_r}{p_s} \times 100 \quad (1)$$

Where $F$ is Functionality, $P_r$ is Packets received and $P_s$ is packets sent

(b) $$\Sigma \frac{\overline{T_{nf}}}{T_s} \times 100 \quad (2)$$

where $R$ is Reliability, $T_{nf}$ is mean time to network failure and $T_s$ is Total packet sending time

(c) $$U = \sum_{n=1}^{N} \frac{T_{dt} - T_{st}}{T_{ac}} \quad (3)$$

where $U$ = Average delay, $T_{dt}$ = delivery time, $T_{st}$ is Sent time and $T_{ac}$ is active transmission time

(d) $$Q = T_r \quad (4)$$

where $Q$ is Quality in use and $T_r$ is Repair time

Though all four parameters are important for evaluation purposes, but for sake of analytical approach; highest priority has been given to Reliability and least to quality in use. Simulations have been carried out on AODV and DSR for evaluation. Scale has been developed and it is uniformly distributed over the range for PDR calculated by random scenarios generated using TCL scripts. The simulations have been performed using Network Simulator 2 (NS-2.34) [12], particularly popular in the ad-hoc networking community. The traffic sources are UDP. The source-destination pairs are spread randomly over the network. During the simulation, each node starts its journey from a random spot to a random chosen destination. Different network scenario for different number of nodes and pause times are generated. The model parameters used in the experiments are summarized as following:-

| **Parameter** | **Value** |
|---|---|
| Simulator | NS-2.34 |
| Simulation Area | 1000m X 1000m |
| Mobile Nodes | 10,50 |
| Pause Time | 100,200,300,400,500 Sec. |
| Speed | 1,2,5,7,10 m/s |
| Channel | Wireless |
| Routing Protocols | AODV & DSR |
| Traffic Sources | udp |

Parameter used is **Packet delivery ratio.** This performance measures and determines the completeness and correctness of routing protocol. Scale used is 1 to 13 in case of pause time as a function and also for speed as a function for appx range of 80% to 100% of PDR. Pause time of 100 means faster movement and 500 means movement starts after 500 ms.

**Reliability :** The scale has been implemented on results obtained. Both speed and pause time has been used a functions.

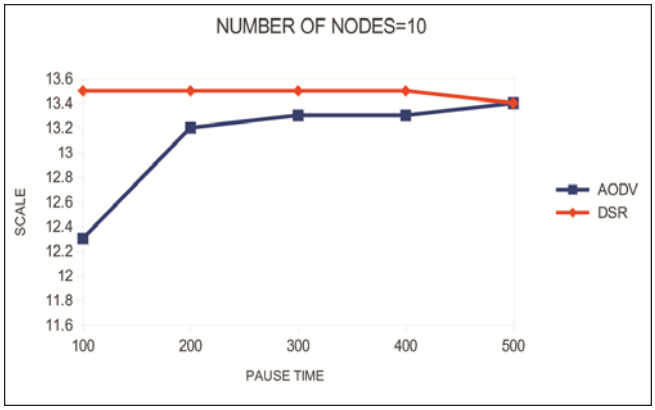



Figure 1. Reliability on pause time for 10 nodes

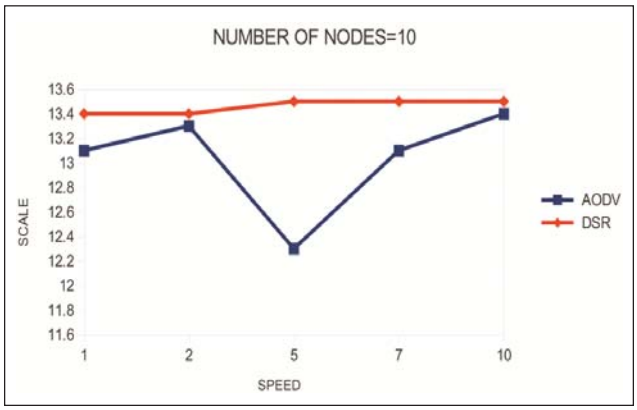



Figure 2. Reliability on speed for 10 nodes

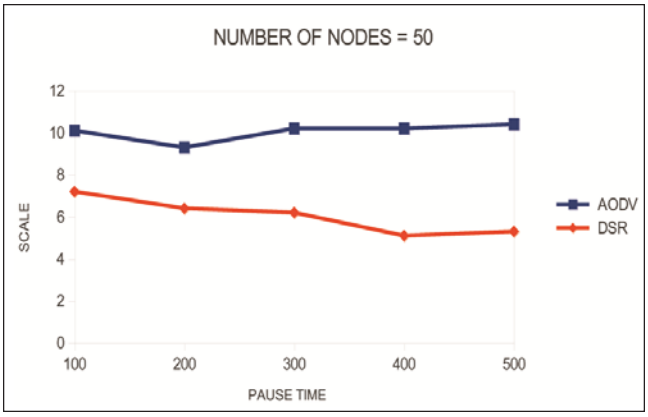



Figure 3. Reliability on pause time for 50 nodes

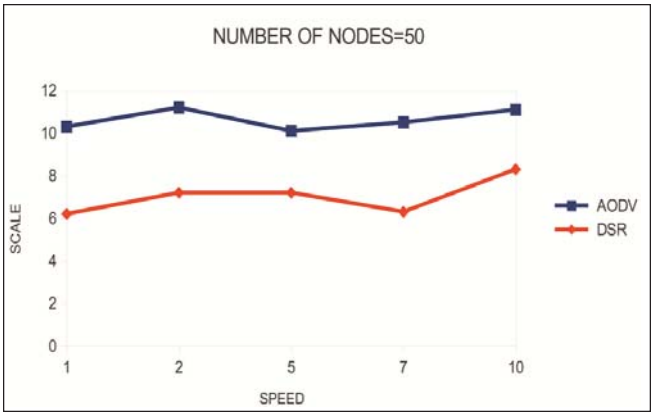



Figure 4. Reliability on speed for 50 nodes

In Figures 1 and 3 the reliability scale has been evaluated for DSR and AODV with the varying pause time from 100 to 500 for nodes 10, 50 respectively. In Figure1 when pause time is 100 to 400, DSR gives better results and both protocols give approximately same results when pause time is 500. In Figure.3 AODV gives better results than DSR. In Figures 2 and 4, the reliability scale was evaluated for DSR and AODV with the varying speed from 1m/s to 10 m/s for nodes 10, 50 respectively. In Figure 2, DSR gives better results than AODV when speed is between 1m/s and 10 m/s. AODV protocol gives better results when speed is between 1m/s and 2m/s, its performance degrades at the speed of 5 m/s . In Figure 4 AODV gives better results than DSR. AODV performance upgrades when speed is between 1m/s and 2 m/s. At speed of 5 m/s its performance degrades and again AODV protocol gives better results when speed is 7m/s and 10 m/s.

**Functionality**: - Output after applying this scale for varying pause time and speed has been explained in figures

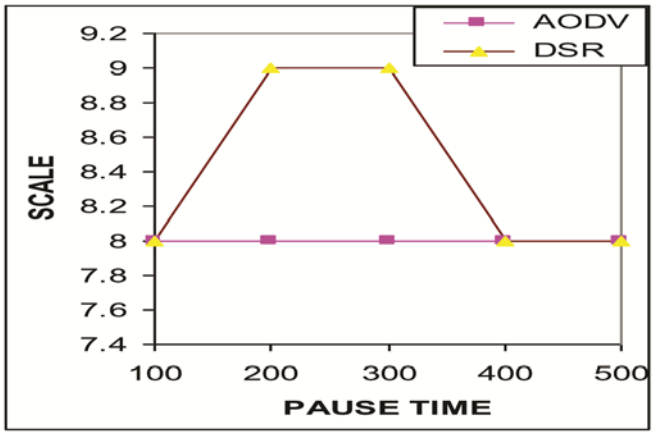



Figure 5. Functionality on pause time for 10 nodes

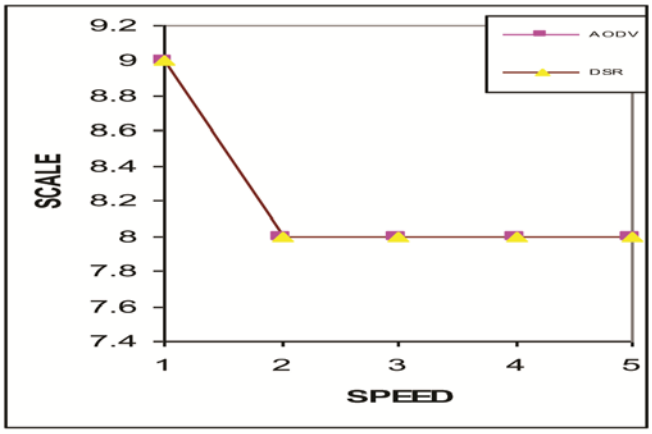



Figure 6. Functionality on speed for 10 nodes

In Figures 5 and 7, the functionality scale was evaluated for DSR and AODV with the varying pause time from 100 to 500 for nodes 10, 50 respectively. In Figure 5, DSR and AODV protocol give same results when pause time is 100. DSR outperforms AODV when pause time is 200 and 300. AODV & DSR gives same results when pause time is 400 and 500. In Figure 7, the AODV protocol gives better results than DSR. In Figures 6 and 8, the functionality scale was evaluated for DSR and AODV with the varying speed from 1m/s to 10 m/s for nodes 10,50 respectively. In Figure 6, it shows that the DSR and AODV protocol gives approximately same results when speed is between 1m/s and 10 m/s. AODV protocol gives better results when speed is between 2m/s and 10 m/s. In Figure 8, AODV is better than DSR when speed is 1m/s. DSR and AODV protocol give same results when speed is 2 m/s. AODV protocol gives better results when speed is between 2m/s and 10 m/s.

**Usability:** - Output after applying this scale for varying pause time and speed are as following:-

In Figure 9 and 11, the usability scale was evaluated for DSR and AODV with the varying pause time from 100 to 500 for nodes

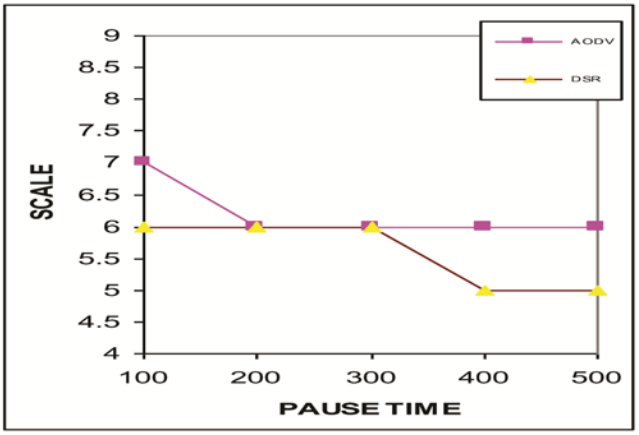



Figure 7. Functionality on pause time for 50 nodes

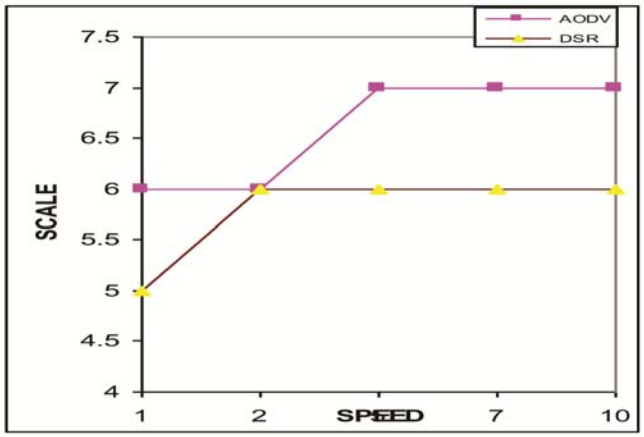
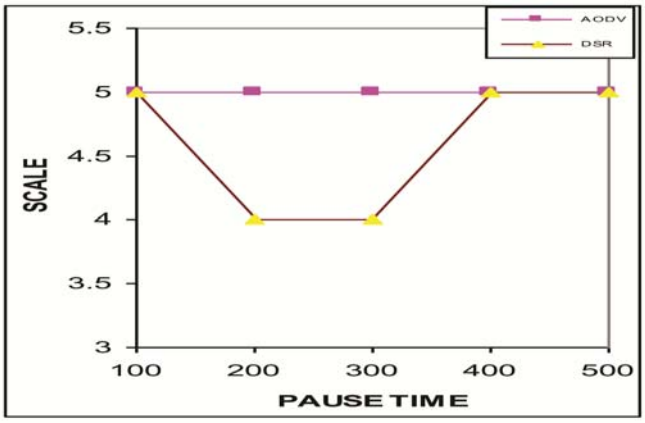



Figure 8. Functionality on speed for 50 nodes

10, 50 respectively. It is found that the AODV protocol gives better results than DSR. In Figure 11 DSR gives better result when pause time is 100. AODV and DSR give same result when pause time is 200 and 300. DSR gives better results when pause time is 400 and 500. In Figures 10 and 12, the usability scale was evaluated for DSR and AODV with the varying speed from 1m/s to 10 m/s for nodes 10,50 respectively. In Figure 10 the observation is that the DSR and AODV protocol give same results when speed is between 1m/s and 10 m/s while DSR gives better results than AODV in Figure 12.



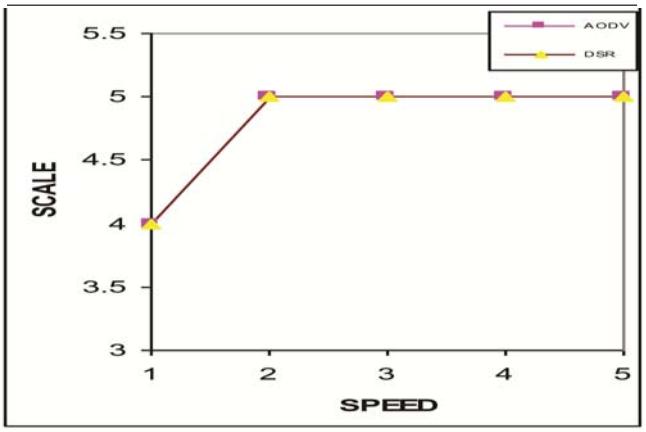




Figure 9, 10. Usability on pause time and speed for 10 nodes

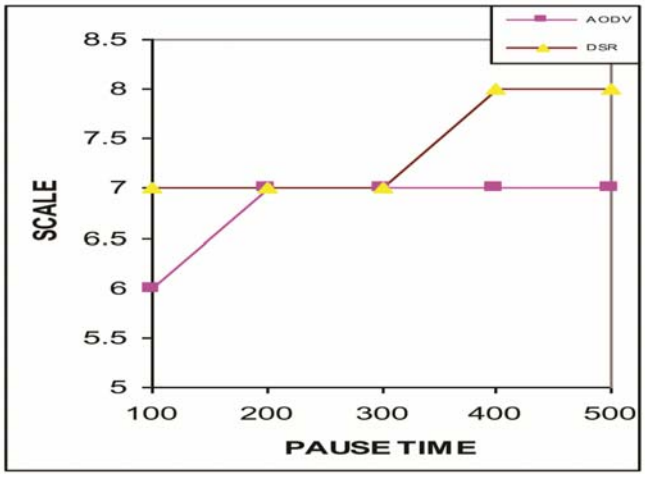



Figure 11. Usability on pause time for 50 nodes

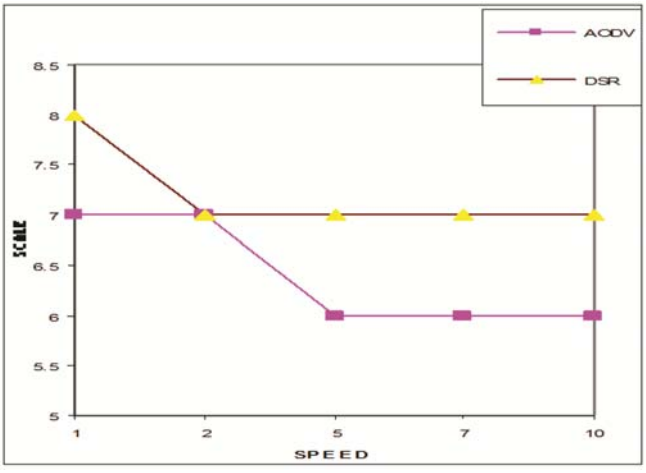



Figure 12. Usability on pause time and speed for 50 nodes

**Quality in use:** - Output after applying this scale for varying pause time and speed are as following:-

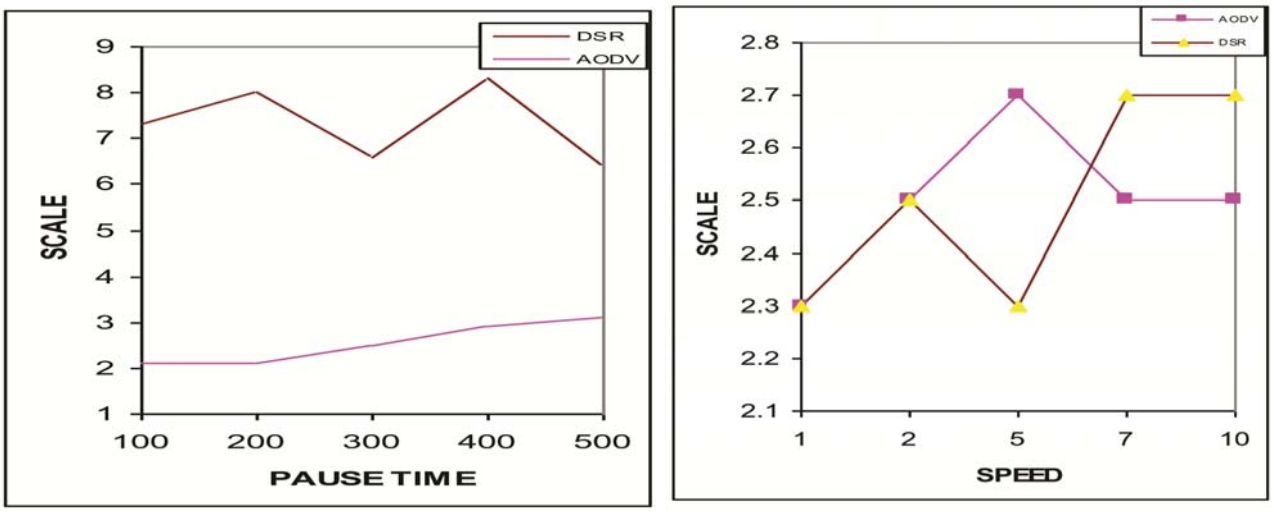



Figure 13,14. Quality in use on pause time and speed for 10 nodes

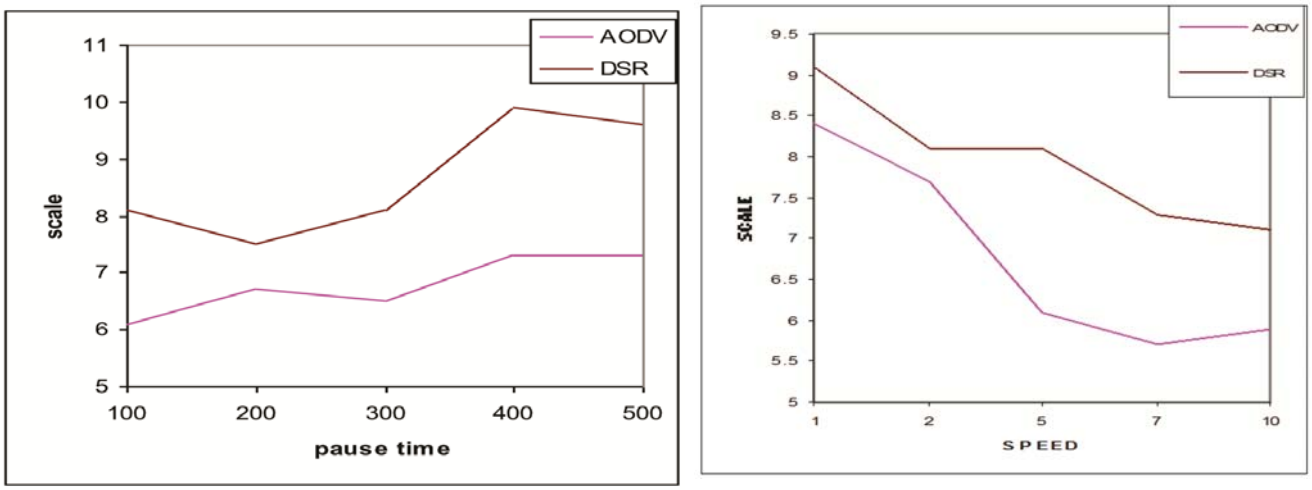



Figure 15,16. Quality in use on pause time and speed for 50 nodes

In Figures 13 and15, Quality in use scale were determined for DSR and AODV with the varying pause time from 100 to 500 for 10 and 50 nodes respectively. In these scenarios, DSR gives better results than AODV. In Figures 14 and 16, Quality in use scale for DSR and AODV with the varying speed from 1m/s to 10 m/s for 10 and 50 nodes respectively have been analysed. It is also found that the DSR gives better results than AODV.

## 5. Conclusions

This paper analyses the performance of AODV and DSR routing protocols for the quality assurance metrics. In this paper, an effort has been made to concentrate on the comparative study and performance analysis of two prominent on demand routing protocols i.e. DSR and AODV. The performance evaluation is done on the basis of scales applied on Packet Delivery Ratio (PDR), in different environments specified by varying pause time, speed and number of nodes. The results after analysis have been reflected in graphs. In Case of Reliability, it can be drawn that AODV performs better at denser medium, while DSR is good for sparse medium in terms of reliability. For functionality it can be said that both perform same at sparse medium but AODV takes an edge in denser medium. In case of Usability, DSR is better in overall performance and DSR is better in Quality in use. As per the assumptions taken, reliability and functionality have more emphasis than usability and quality. Since AODV performs better in Reliability and Functionality so the conclusion can be drawn that AODV is better than DSR. In future, more metrics will be applied and then a final conclusion can be drawn as which protocol performs as overall better.

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