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Performance Analysis of AODV, AOMDV and ZRP using NS-2: A Survey

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Abstract: A MANET or mobile ad-hoc network is a wireless, self-organizing, self-configuring network of mobile nodes or devices that are connected without any specific infrastructure. In order to communicate in a MANET we have Routing Protocols like AODV, AOMDV and ZRP. To verify the effectiveness of these protocols as a survey we have analysed the performance under different radio ranges and we measured the Throughput, Packet delivery Ratio (PDR), Normalized Routing Load (NRL), and End-to-End delay using different traffic methods like FTP, CBR over TCP. We have taken varying no of nodes along with time. The performance analysis was performed using the Network Simulator-2 (NS2) tool.

Keywords: MANET, AODV, AOMDV, ZRP, Throughput, PDR, NRL, End-to-End delay.

I. INTRODUCTION

As we know that MANET routing protocols has three types of classification proactive, Reactive and hybrid [1] [2]. The AODV (Ad-hoc On-demand Distance Vector) and AOMDV (Ad-hoc On-demand Multi-path Distance Vector) Routing protocols fall under the category of Reactive routing or on-demand routing and ZRP (Zone Routing Protocol) fall under the category of hybrid.

The Radio ranges are the communication boundary of MANET mobile nodes. If any two nodes want to communicate each other both nodes must be in a specific range i.e., one must be available in the range of other, then only the communication will happen. If the sender and the receiver will not in the specific range they will try to use any other intermediate node(s) which are in their range for the purpose of communication. In this surveywe have used the three radio range limits on each of three Routing protocols individually by varying the number of nodes with different traffic methods like FTP and CBR with TCP Individually.

A. File Transfer Protocol (FTP)

An FTP is a standard networking protocol used for the transfer of computer data or files between a server and client on a network or a computer network [3].

B. Constant Bit Rate (CBR)

CBR is aused in telecommunications, and it is related to the quality of service. With respect to the codecs the CBRencoding means that the rate at which a codec's output data should be consumed is constant [4].

II. LITERATURE SURVEY

Anuj K. Gupta et al proposed Review of Various Routing Protocols for MANETs [5]. In their work they have made comparisons between Reactive, proactive and hybrid routing protocols and the found that AODV is having high Throughput value and high routing overhead but it doesn't have multi-paths. And also they found that ZRP will reduce the number of transmissions and overlapping zones is dis-advantage of ZRP and it doesn't have multi-paths. Sachin Kumar Gupta et al proposed Performance Metric Comparison of AODV and DSDV Routing Protocols in Manets Using NS-2 [6]. In their work they have compared the performance of AODV & DSDV they found that AODV is having good packet delivery ratio (PDR) compared to DSDV and also AODV is having less delay compared to DSDV.

Mahesh K. Marina et al proposed Ad hoc On-demand Multipath Distance Vector Routing [7]. In their work they compared the performance of AODV and AOMDV they found that AOMDV is having 20 per cent less routing overhead compared to AODV. Vivek B. Kute et al proposed Analysis of Quality of Service for the AOMDV Routing Protocol [8]. In their work they have analysed the performance of AOMDV Routing Protocol and they analysed different QoS issues of AOMDV and found that its performance is degrades with CBR traffic and it is consistent with TCP traffic.

Kavita Pandey et al proposed A Comprehensive Performance Analysis of Proactive, Reactive and Hybrid MANETs Routing Protocols [9]. In their work they compared AODV, DSDV, ZRP routing protocols and they found that AODV is giving overall better performance compared to others.Deepak Kumar et al proposed Qualnet based Simulation of OLSR, DSR and ZRP Protocols under variable Node Transmission Power and Density [10]. In their work they made comparisons between OLSR, DSR and ZRP and found that hybrid protocols like ZRP will give better performance with increasing the transmissions ranges or Radio ranges. Parma Nand et al proposed Performance Analysis of FSR and ZRP Routing Protocols for MANET [11]. In their work they compared FSR and

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ZRP routing protocol and found that ZRP is only suitable for low mobility scenarios.

III.PERFORMANCE METRICS

In this survey we have used four performance metrics Throughput, Packet Delivery Ratio (PDR), Normalized Routing Load (NRL), and End-to-End Delay [1].

IV. SIMULATION ENVIRONMENT

In this survey we have used Network Simulator -2(NS-2). NS-2 is a discrete event driven simulations tool. NS-2 provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks. [12] [13] [14].

V. SIMULATION ANALYSIS & RESULTS

The simulations results are plotted using GNUPLOT. GNUPLOT is a portable command-line driven graphing utility for Linux, OS/2, MS Windows, OSX, VMS, and many other platforms [15].

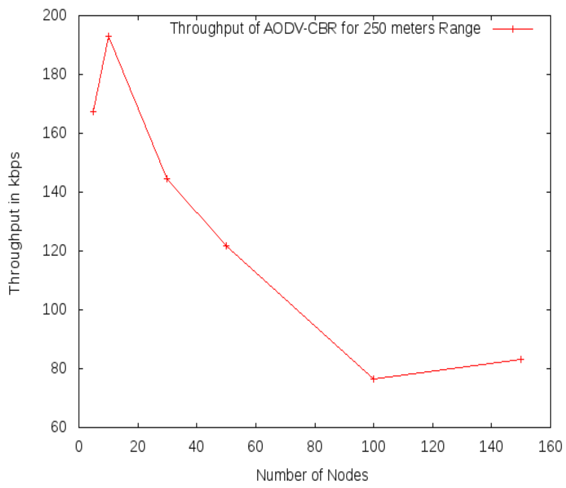

Figure 1: Throughput of AODV over CBR for 250 meters Radio Range.

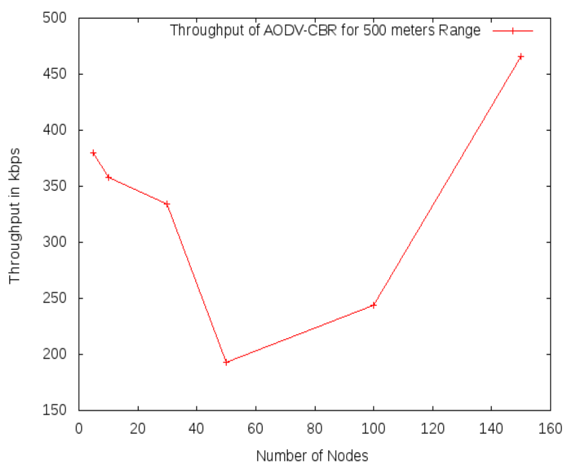

Figure 2: Throughput of AODV over CBR for 500 meters Radio Range.

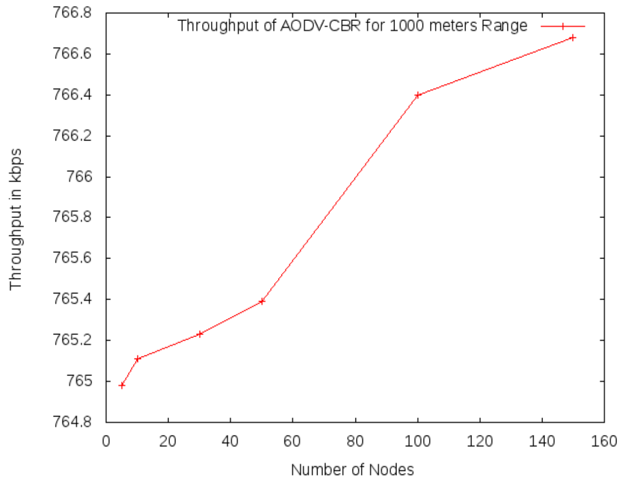

Figure 3: Throughput of AODV over CBR for 1000 meters Radio Range.

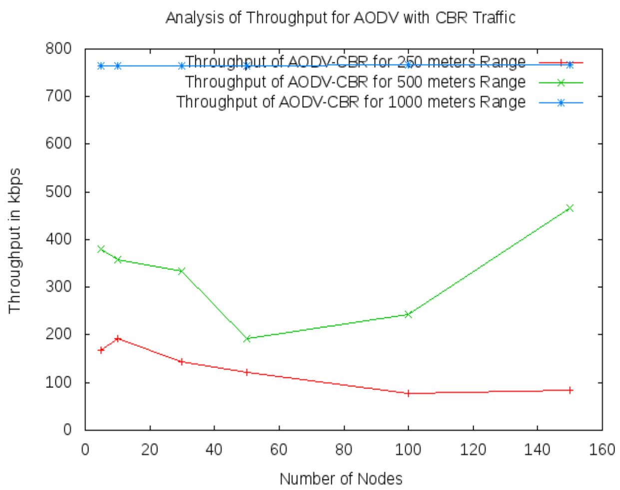

Figure 4: Overall Analysis of Throughput of AODV over CBR.

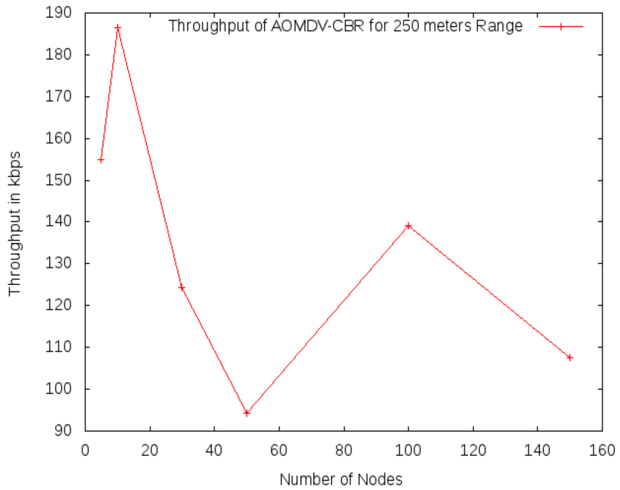

Figure 5: Throughput of AOMDV over CBR for 250 meters Radio Range.

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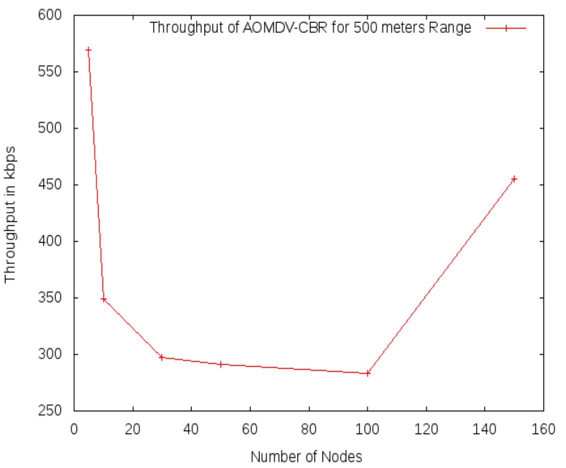

Figure 6: Throughput of AOMDV over CBR for 500 meters Radio Range.

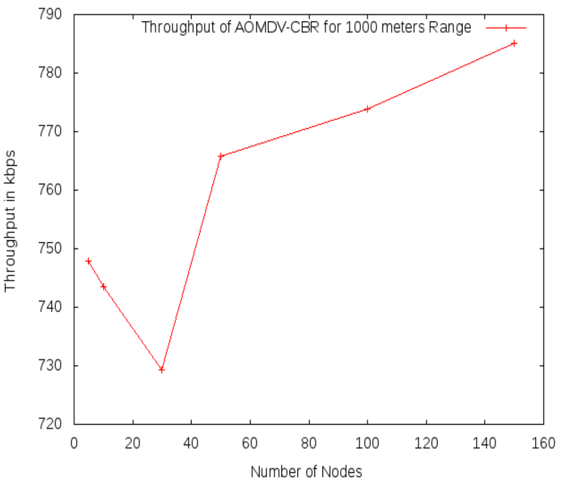

Figure 7: Throughput of AOMDV over CBR for 1000 meters Radio Range.

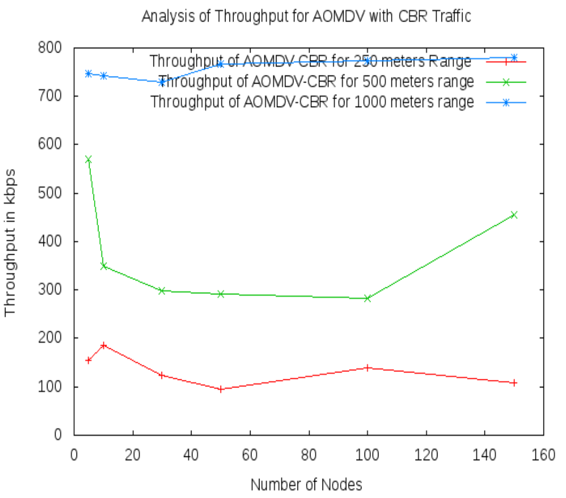

Figure 8: Overall Analysis of Throughput of AOMDV over CBR.

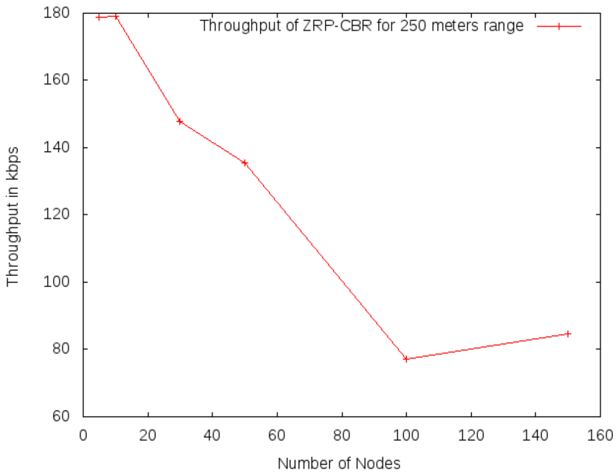

Figure 9: Throughput of ZRP over CBR for 250 meters Radio Range.

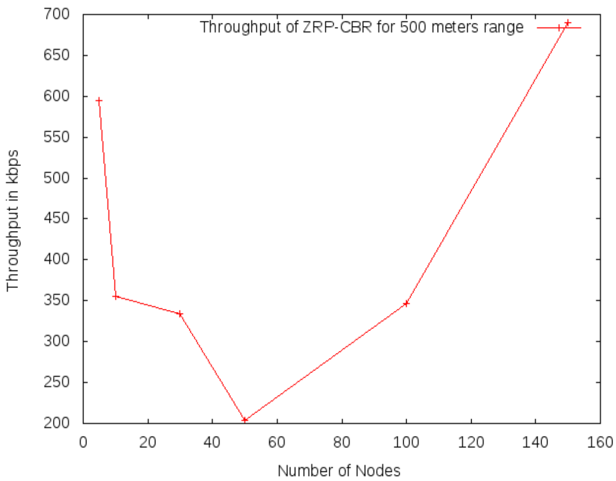

Figure 10: Throughput of ZRP over CBR for 500 meters Radio Range.

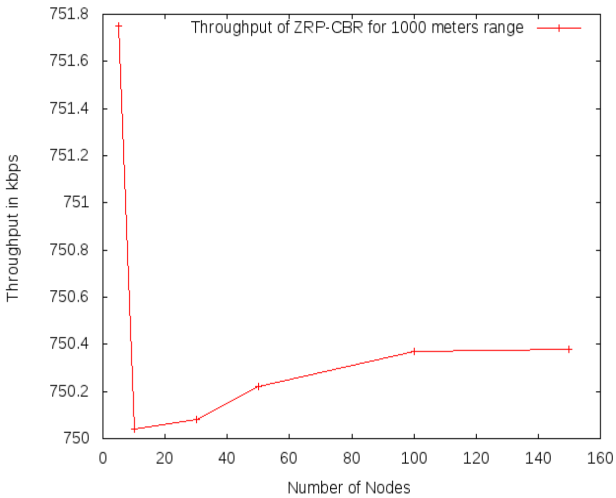

Figure 11: Throughput of ZRP over CBR for 1000 meters Radio Range.

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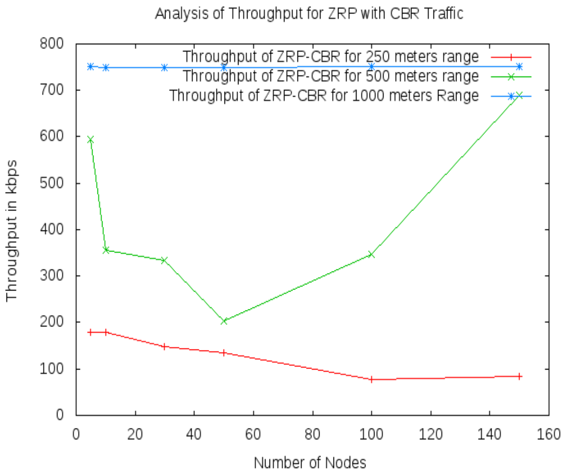

Figure 12: Overall Analysis of Throughput of ZRP over CBR.

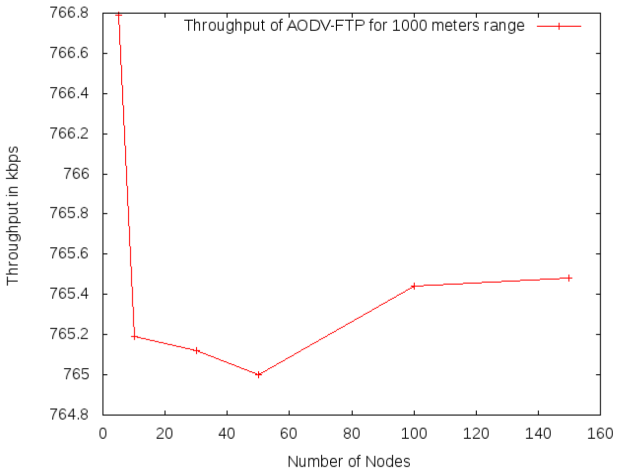

Figure 15: Throughput of AODV over FTP for 1000 meters Radio Range.

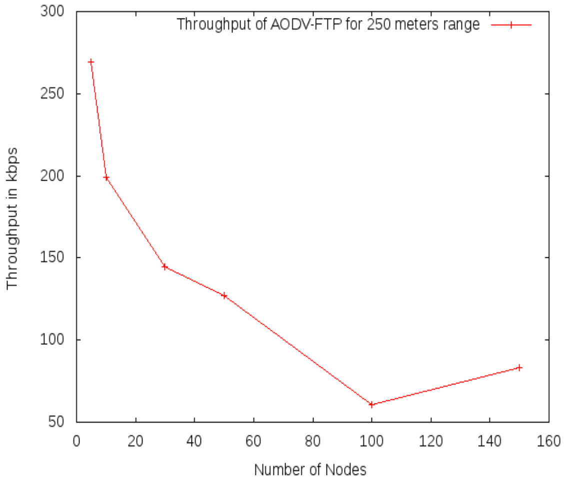

Figure 13: Throughput of AODV over FTP for 250 meters Radio Range.

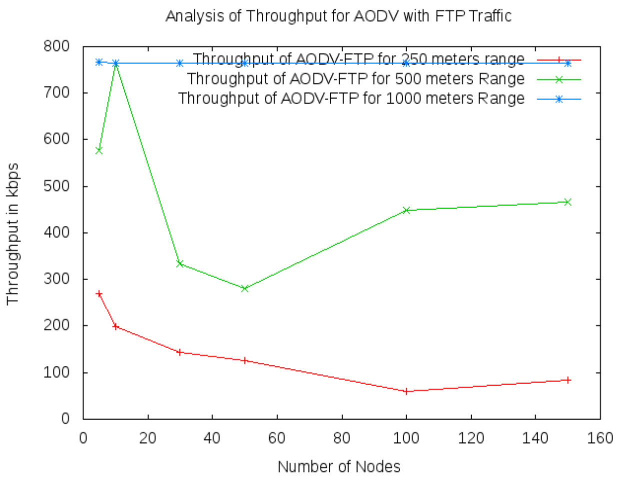

Figure 16: Overall Analysis of Throughput of AODV over FTP.

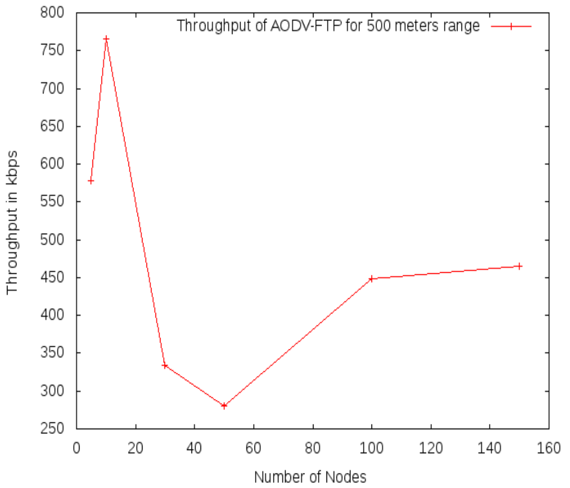

Figure 14: Throughput of AODV over FTP for 500 meters Radio Range.

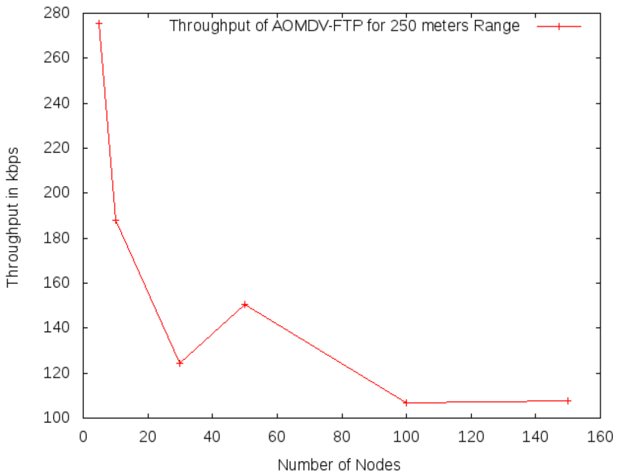

Figure 17: Throughput of AOMDV over FTP for 250 meters Radio Range.

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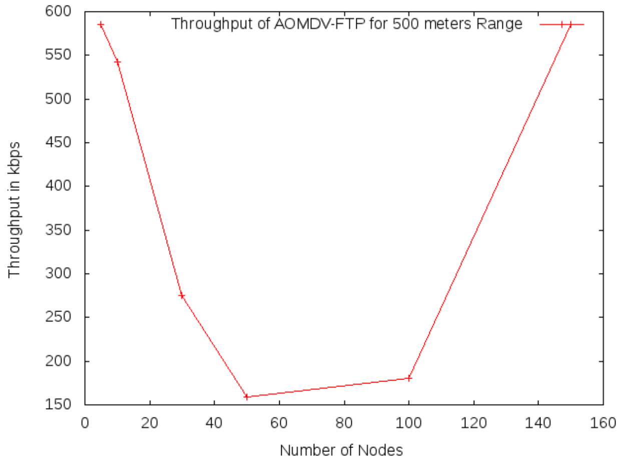

Figure 18: Throughput of AOMDV over FTP for 500 meters Radio Range.

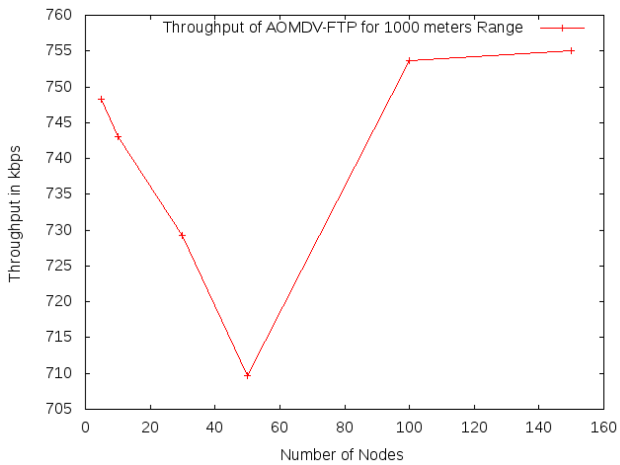

Figure 19: Throughput of AOMDV over FTP for 1000 meters Radio Range.

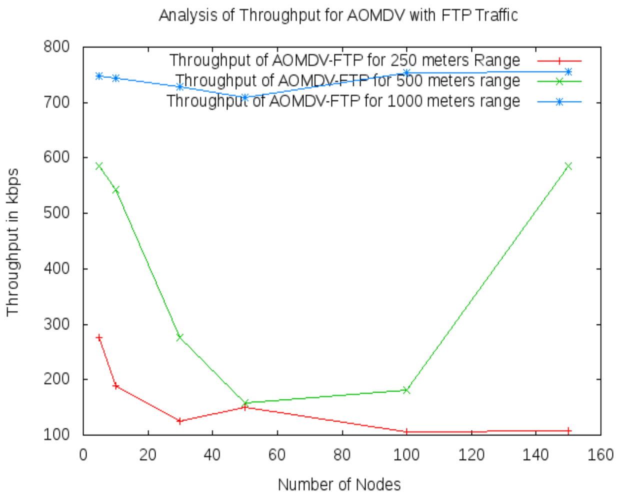

Figure 20: Overall Analysis of Throughput of AOMDV over FTP.

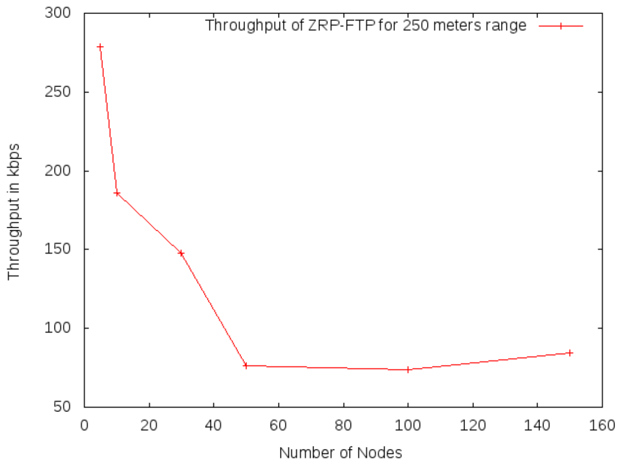

Figure 21: Throughput of ZRP over FTP for 250 meters Radio Range.

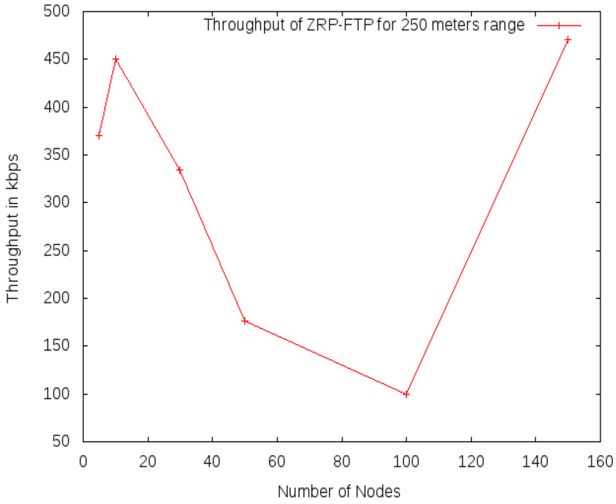

Figure 22: Throughput of ZRP over FTP for 500 meters Radio Range.

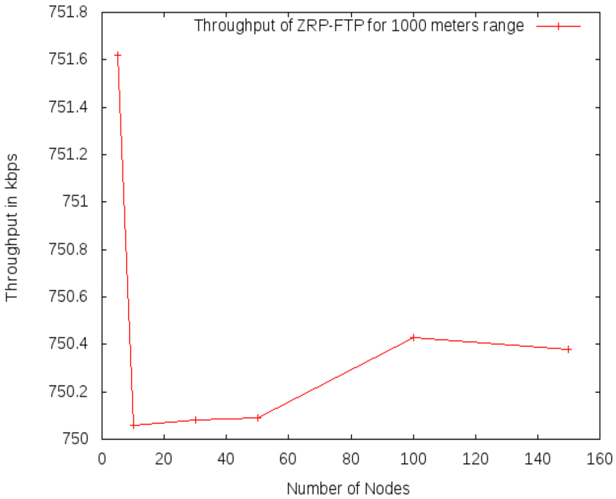

Figure 23: Throughput of ZRP over FTP for 1000 meters Radio Range.

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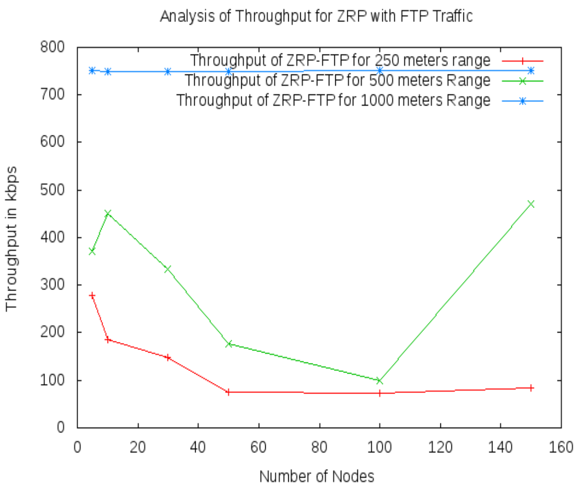

Figure 24: Overall Analysis of Throughput of ZRP over FTP.

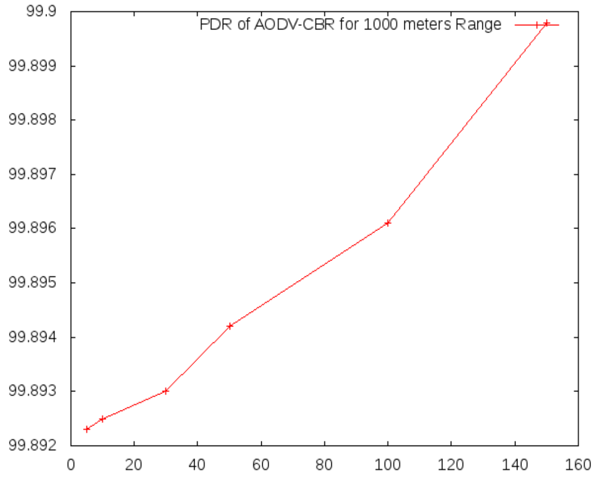

Figure 27: PDR of AODV over CBR for 1000 meters Radio Range.

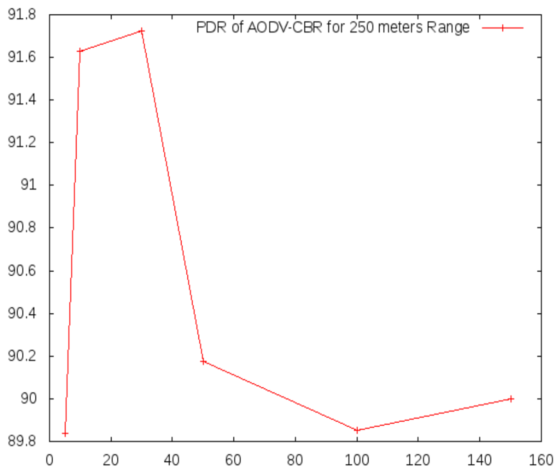

Figure 25: PDR of AODV over CBR for 250 meters Radio Range.

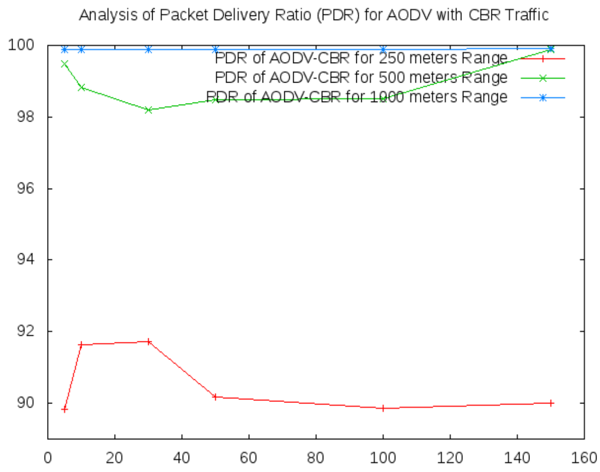

Figure 28: Overall Analysis of PDR of AODV over CBR.

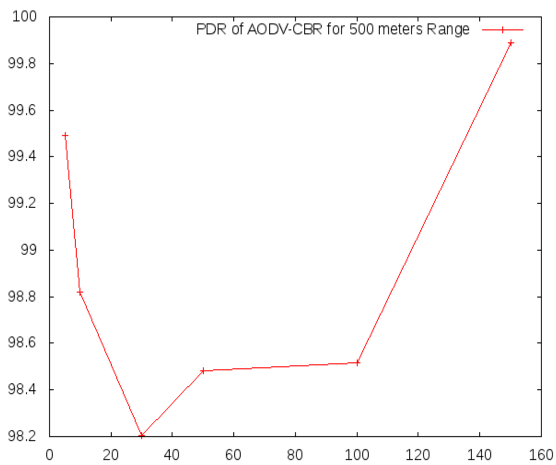

Figure 26: PDR of AODV over CBR for 500 meters Radio Range.

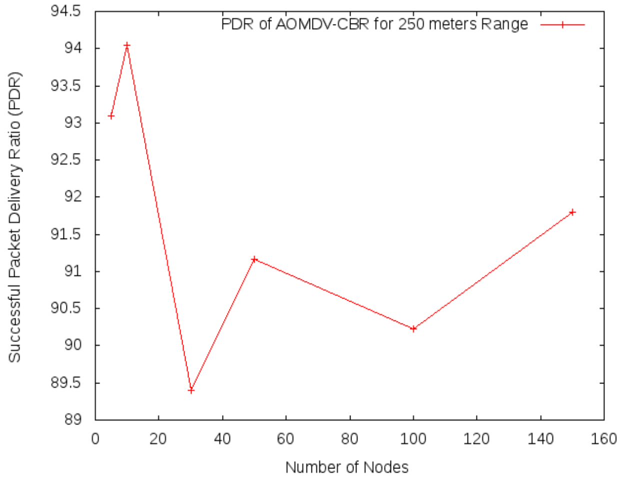

Figure 29: PDR of AOMDV over CBR for 250 meters Radio Range.

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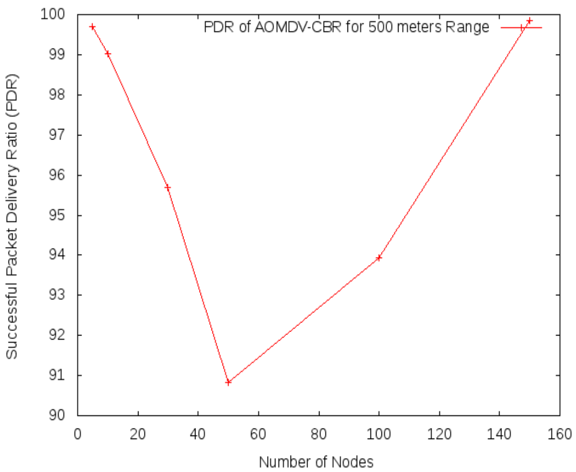

Figure 30: PDR of AOMDV over CBR for 500 meters Radio Range.

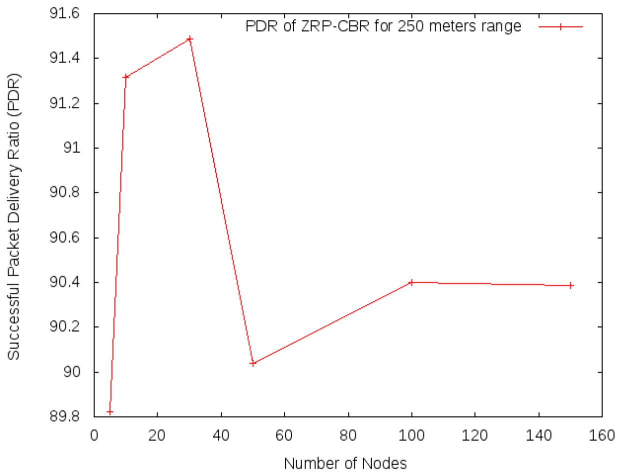

Figure 33:PDR of ZRP over CBR for 250 meters Radio Range.

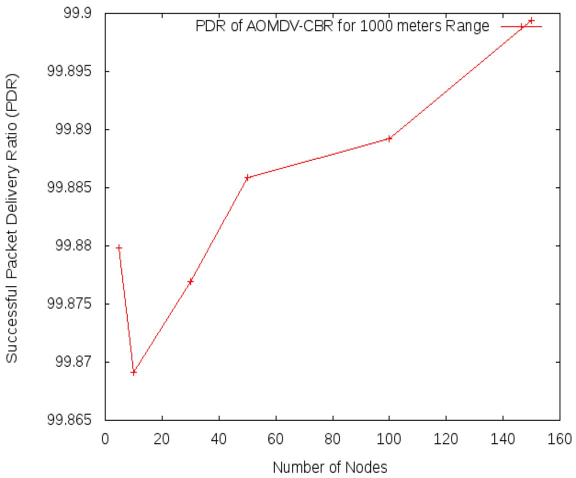

Figure 31: PDR of AOMDV over CBR for 1000 meters Radio Range.

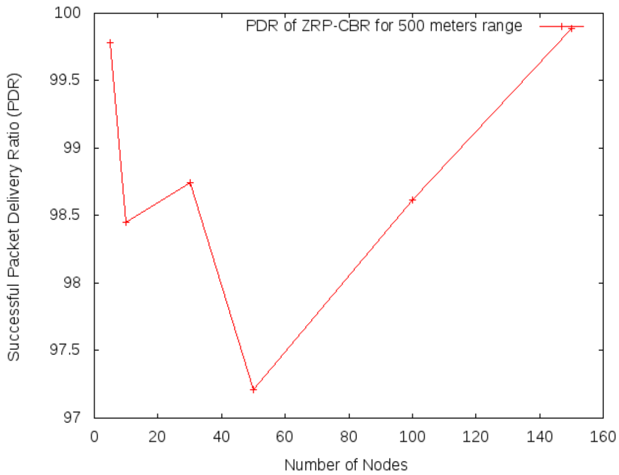

Figure 34: PDR of ZRP over CBR for 500 meters Radio Range.

Figure 32: Overall Analysis of PDR of AOMDV over CBR.

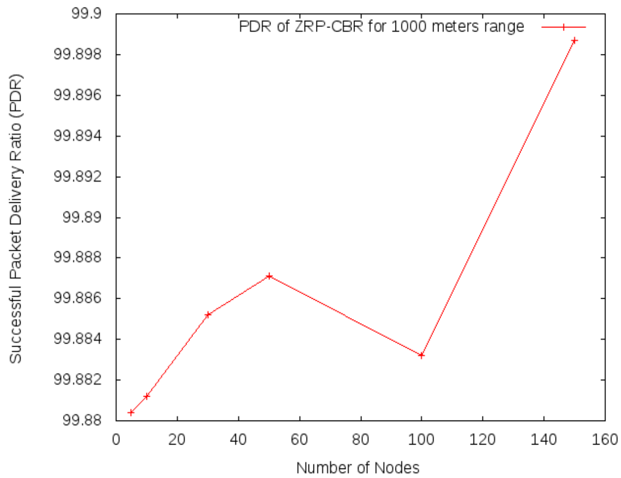

Figure 35: PDR of ZRP over CBR for 1000 meters Radio Range.

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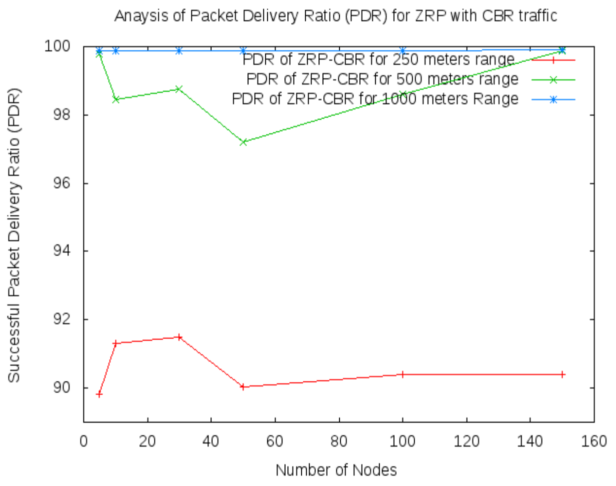

Figure 36: Overall Analysis of PDR of ZRP over CBR.

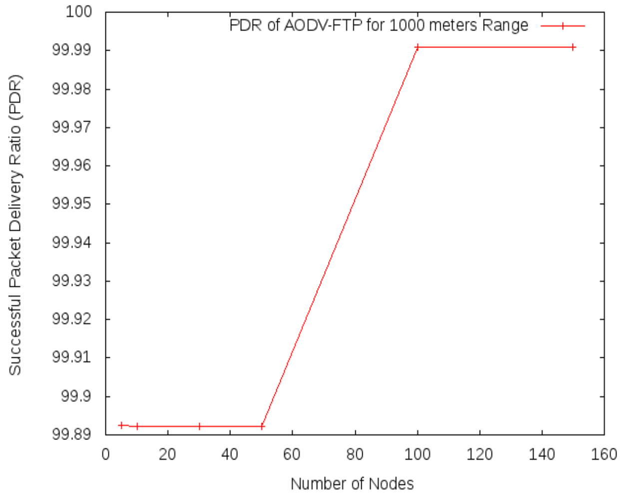

Figure 39:PDR of AODV over FTP for 1000 meters Radio Range.

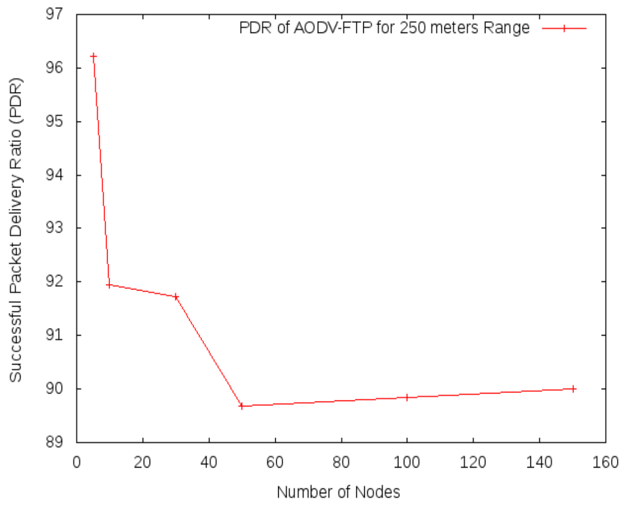

Figure 37: PDR of AODV over FTP for 250 meters Radio Range.

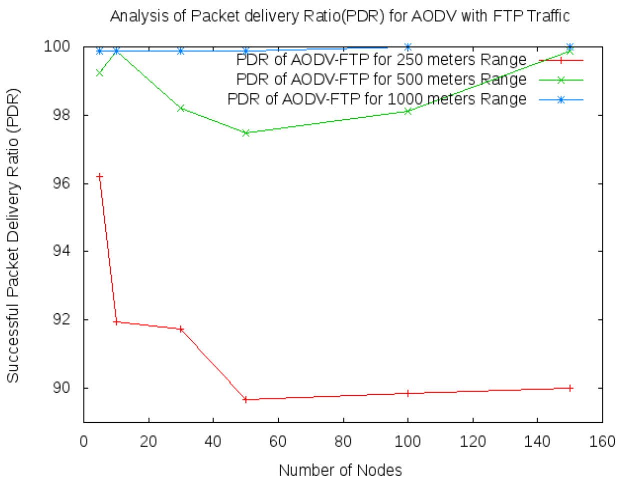

Figure 40: Overall Analysis of PDR of AODV over FTP.

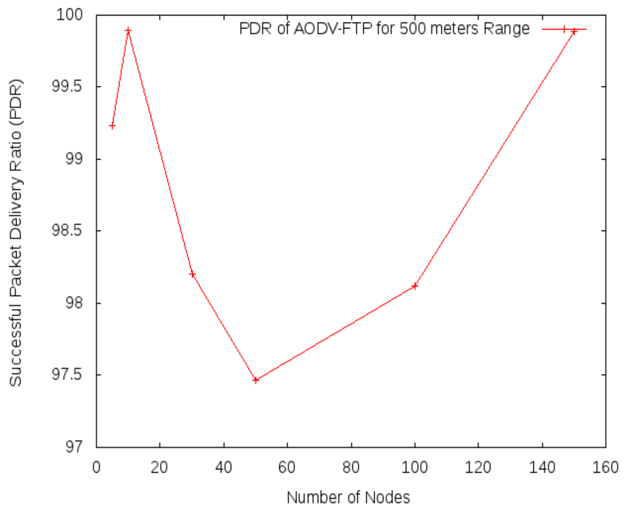

Figure 38: PDR of AODV over FTP for 500 meters Radio Range.

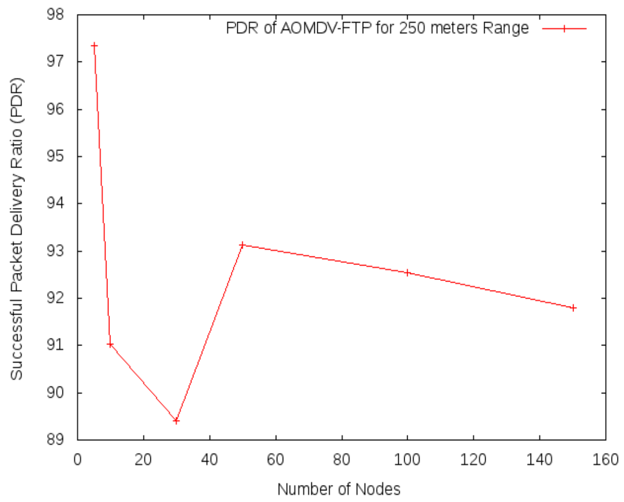

Figure 41: PDR of AOMDV over FTP for 250 meters Radio Range.

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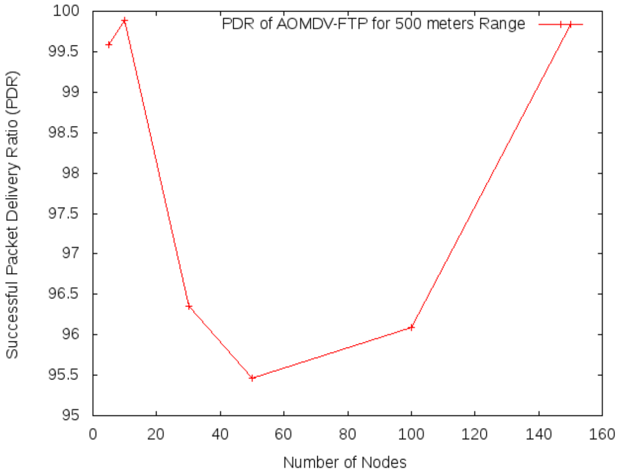

Figure 42: PDR of AOMDV over FTP for 500 meters Radio Range.

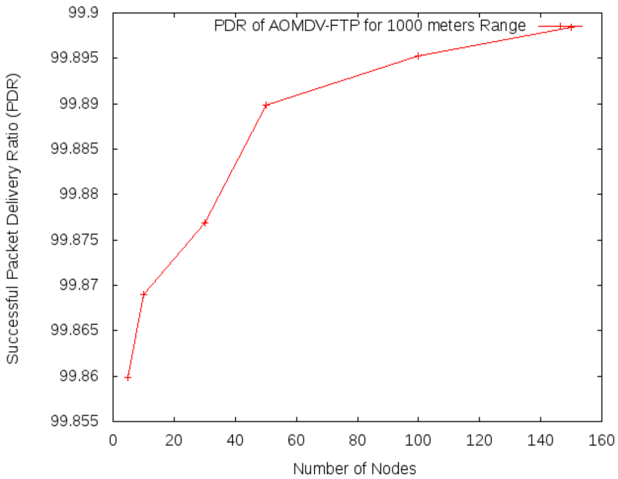

Figure 43: PDR of AOMDV over FTP for 1000 meters Radio Range.

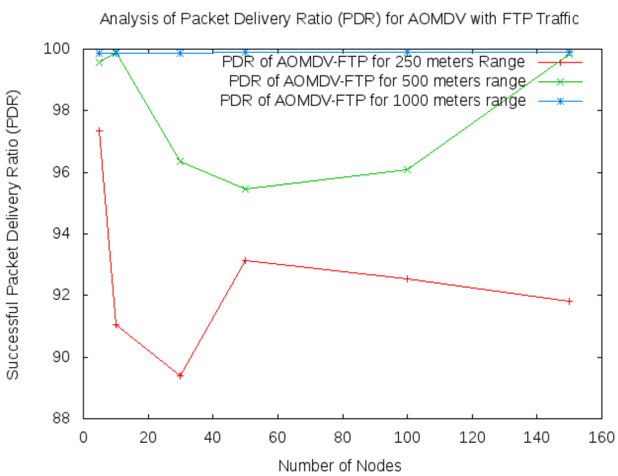

Figure 44: Overall Analysis of PDR of AOMDV over FTP.

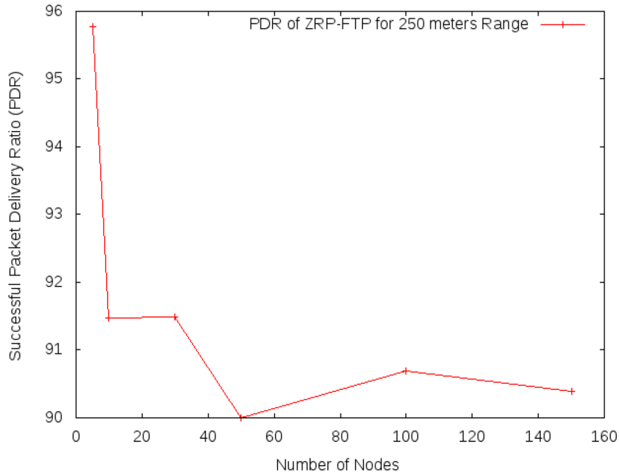

Figure 45: PDR of ZRP over FTP for 250 meters Radio Range.

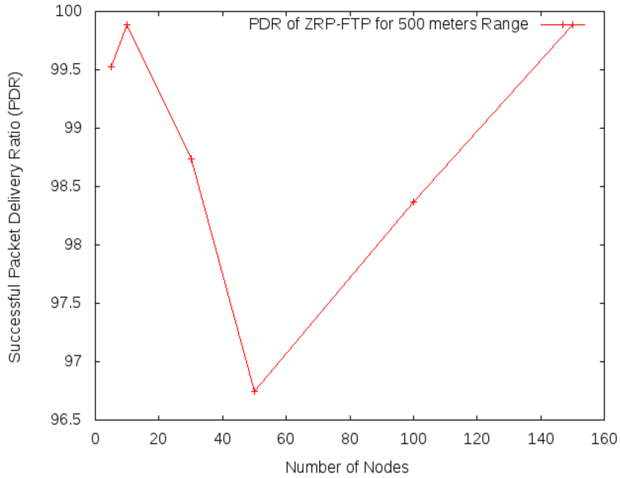

Figure 46: PDR of ZRP over FTP for 500 meters Radio Range.

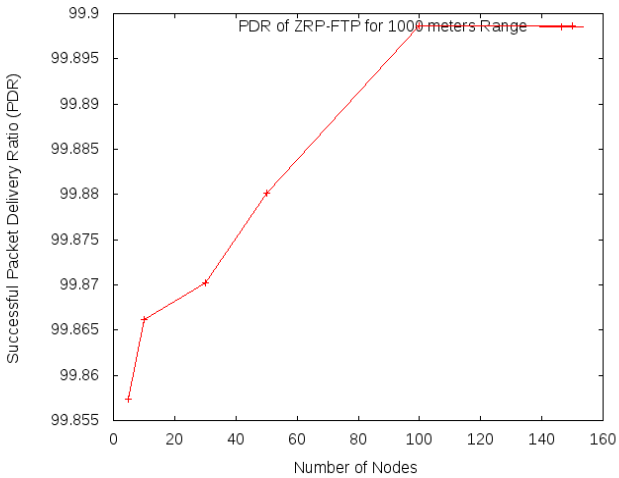

Figure 47: PDR of ZRP over FTP for 1000 meters Radio Range.

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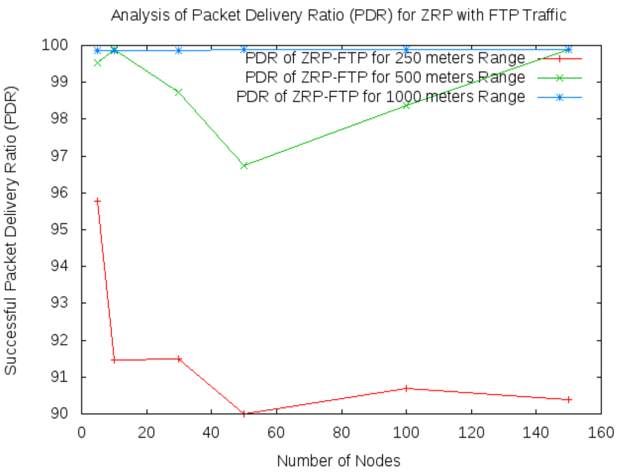

Figure 48: Overall Analysis of PDR of ZRP over FTP.

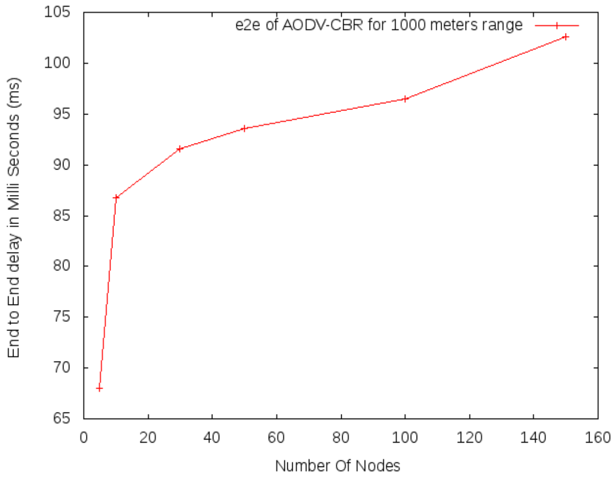

Figure 51: e2e of AODV over CBR for 1000 meters Radio Range.

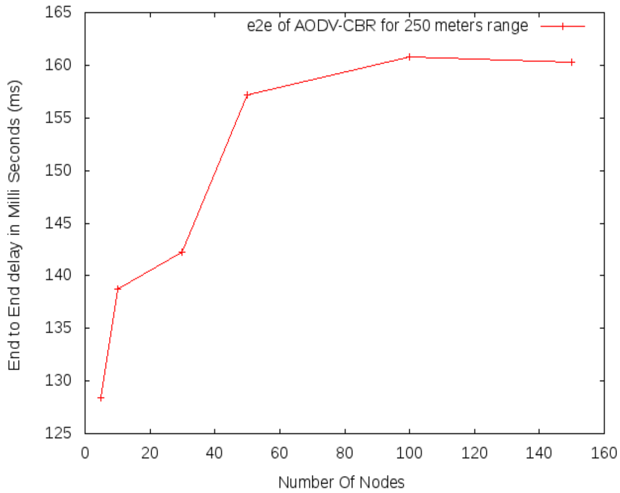

Figure 49: e2e of AODV over CBR for 250 meters Radio Range.

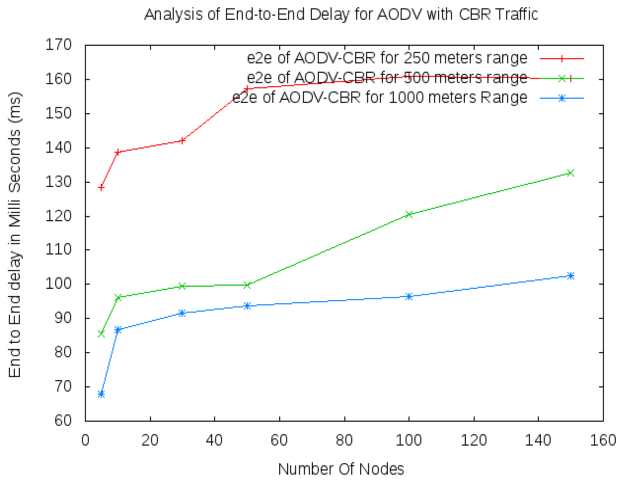

Figure 52: Overall Analysis of e2e of AODV over CBR.

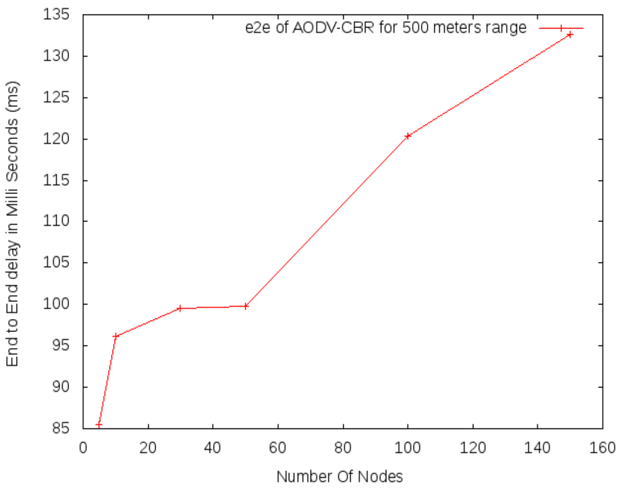

Figure 50: e2e of AODV over CBR for 500 meters Radio Range.

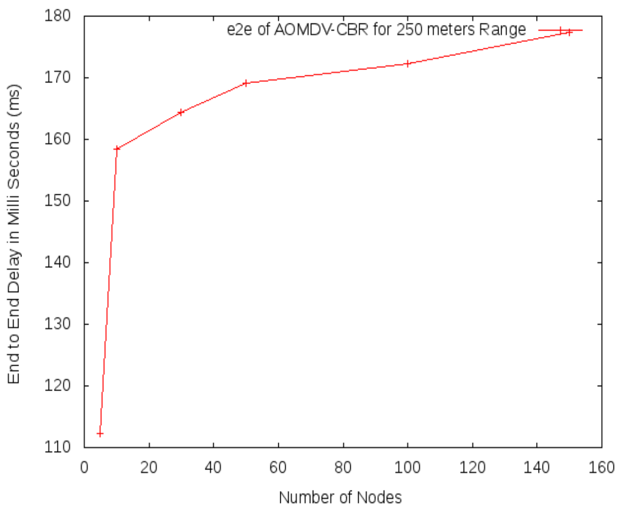

Figure 53: e2e of AOMDV over CBR for 250 meters Radio Range.

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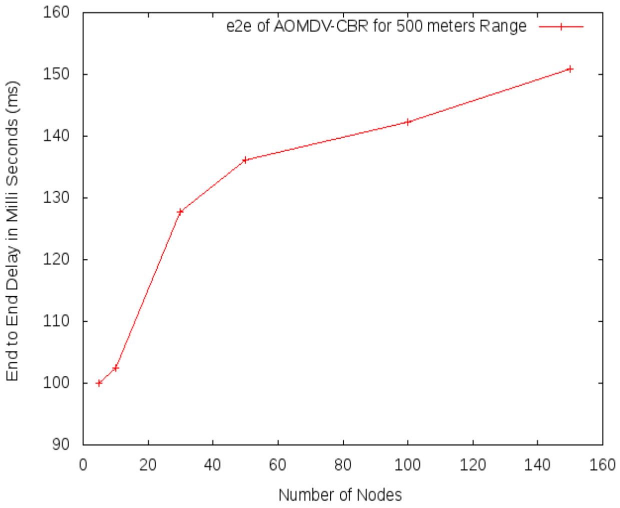

Figure 54: e2e of AOMDV over CBR for 500 meters Radio Range.

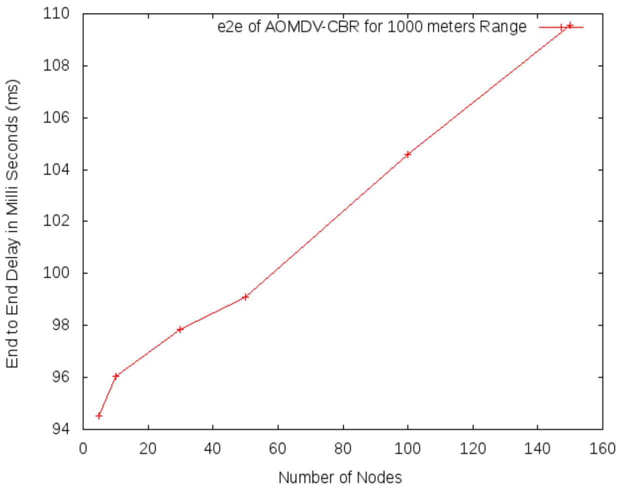

Figure 55: e2e of AOMDV over CBR for 1000 meters Radio Range.

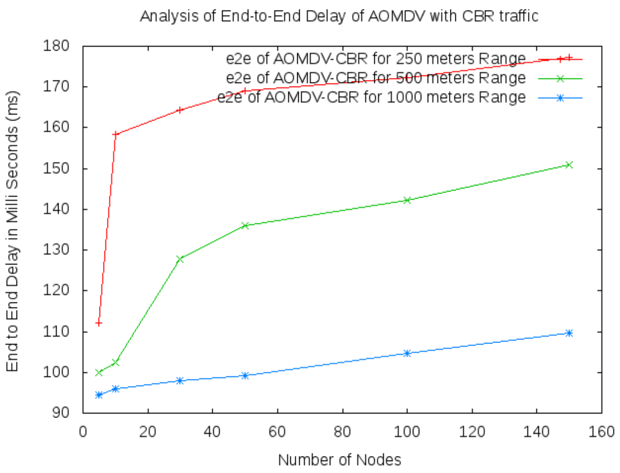

Figure 56: Overall Analysis of e2e of AOMDV over CBR.

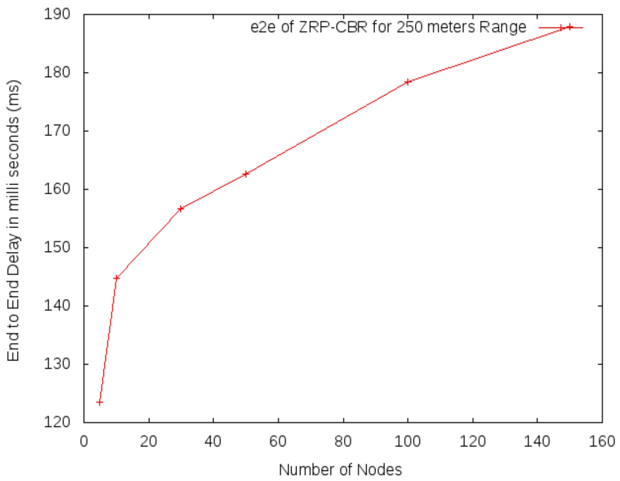

Figure 57: e2e of ZRP over CBR for 250 meters Radio Range.

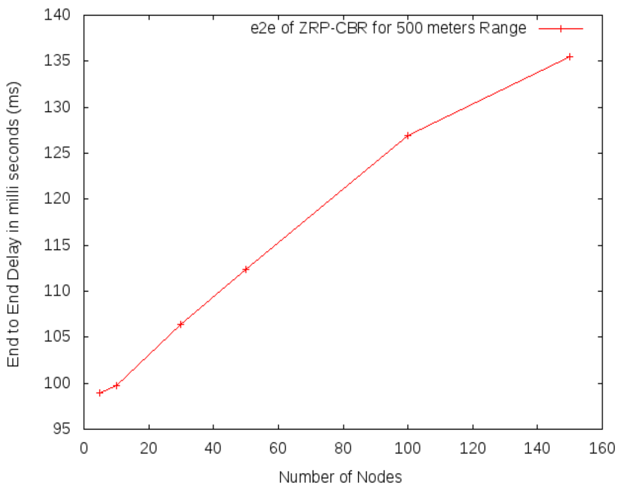

Figure 58: e2e of ZRP over CBR for 500 meters Radio Range.

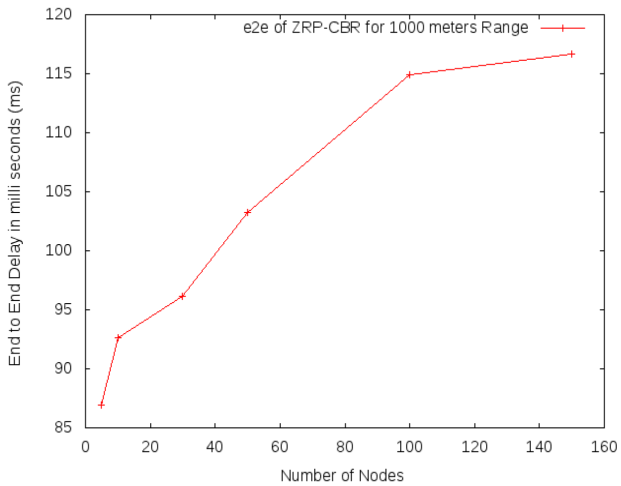

Figure 59: e2e of ZRP over CBR for 1000 meters Radio Range.

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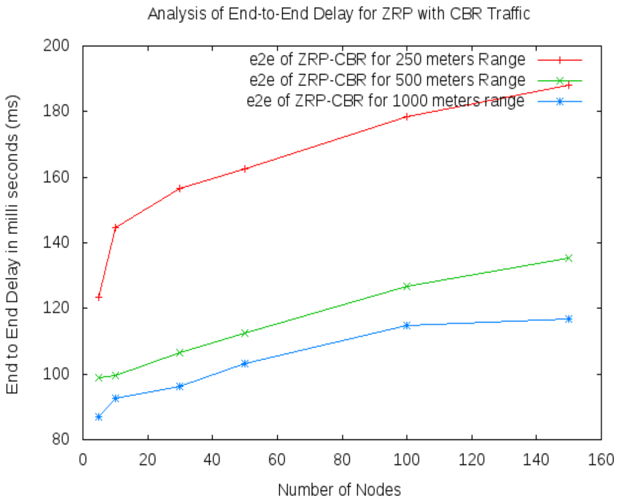

Figure 60: Overall Analysis of e2e of ZRP over CBR.

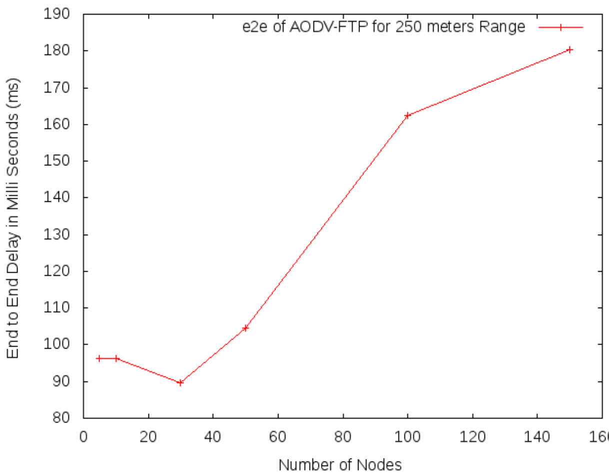

Figure 61: e2e of AODV over FTP for 250 meters Radio Range.

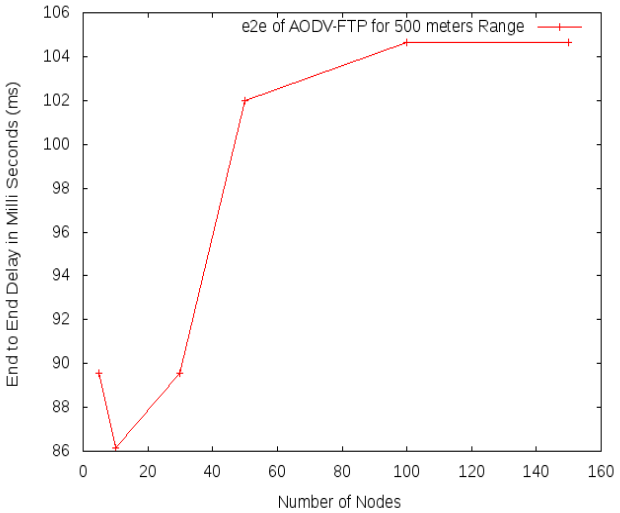

Figure 62: e2e of AODV over FTP for 500 meters Radio Range.

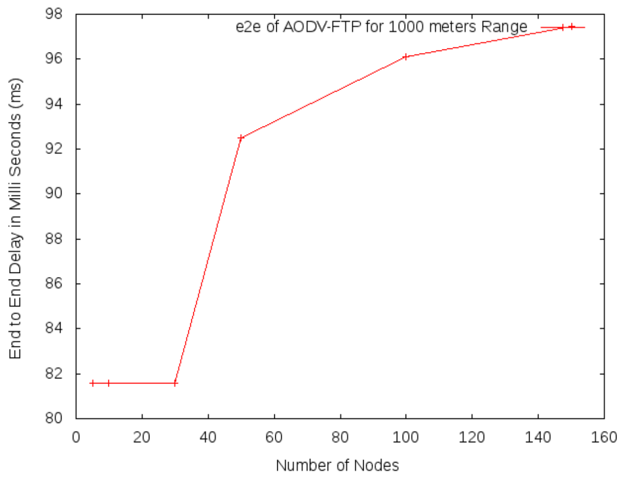

Figure 63: e2e of AODV over FTP for 1000 meters Radio Range.

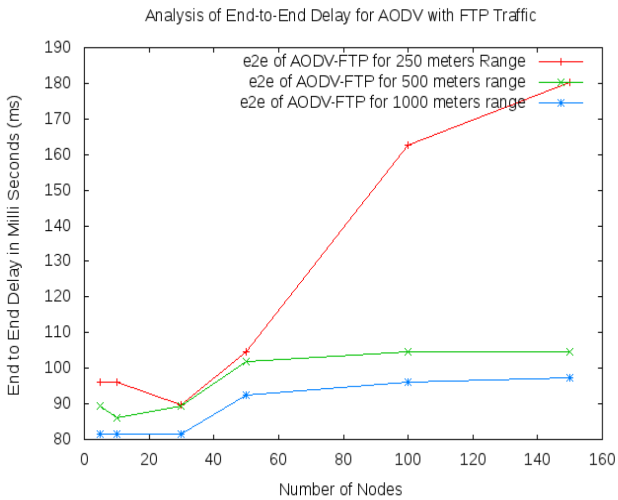

Figure 64: Overall Analysis of e2e of AODV over FTP.

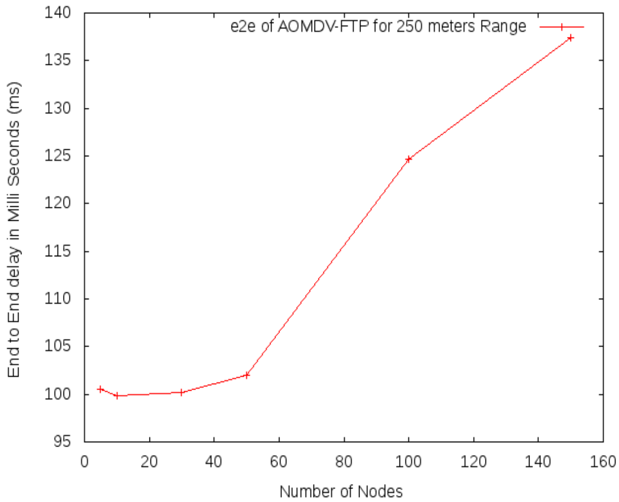

Figure 65: e2e of AOMDV over FTP for 250 meters Radio Range.

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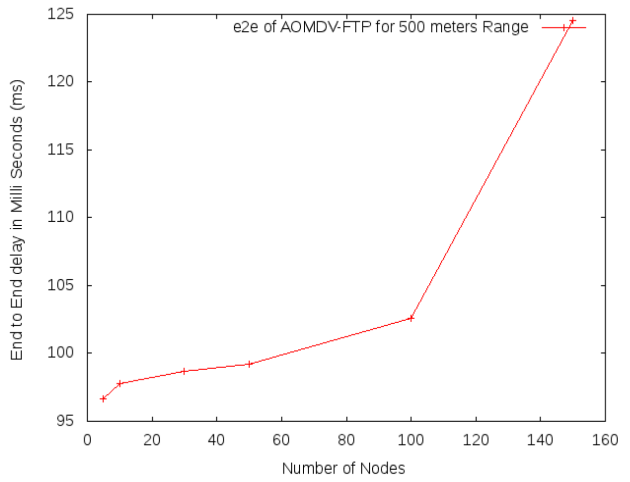

Figure 66: e2e of AOMDV over FTP for 500 meters Radio Range.

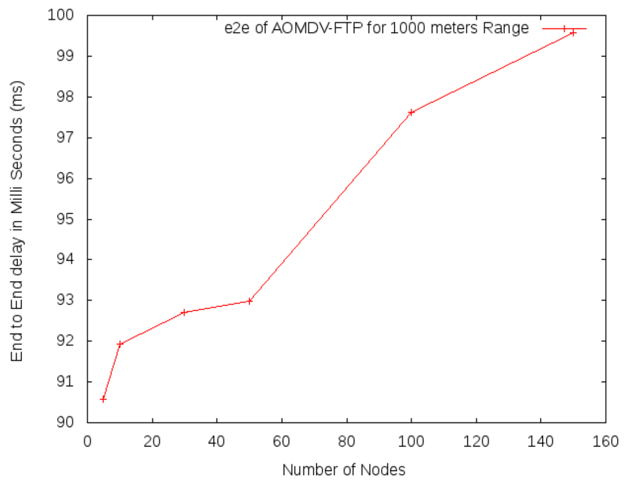

Figure 67: e2e of AOMDV over FTP for 1000 meters Radio Range.

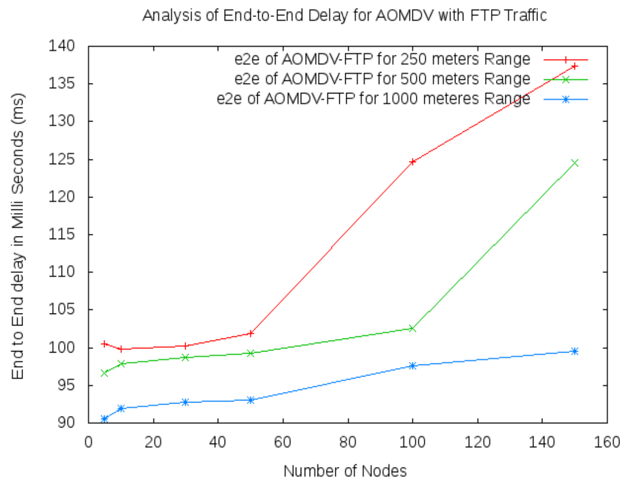

Figure 68: Overall Analysis of e2e of AOMDV over FTP.

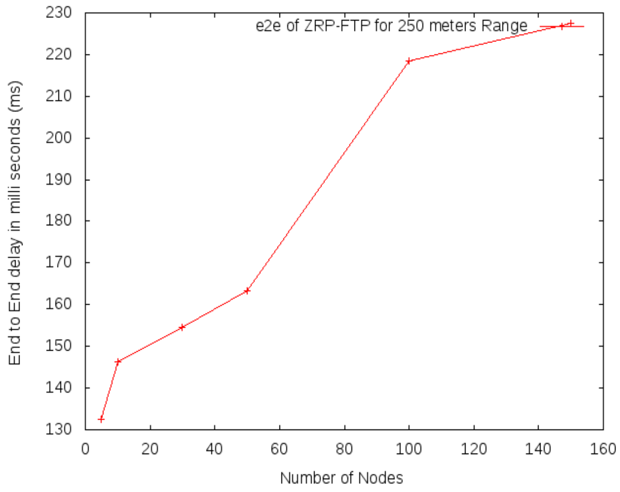

Figure 69: e2e of ZRP over FTP for 250 meters Radio Range.

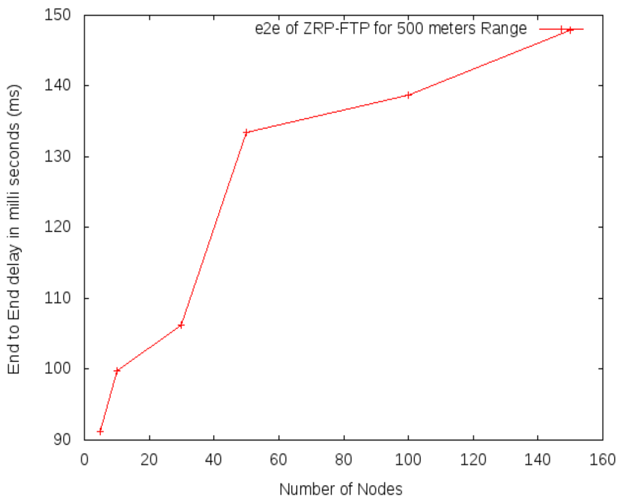

Figure 70: e2e of ZRP over FTP for 500 meters Radio Range.

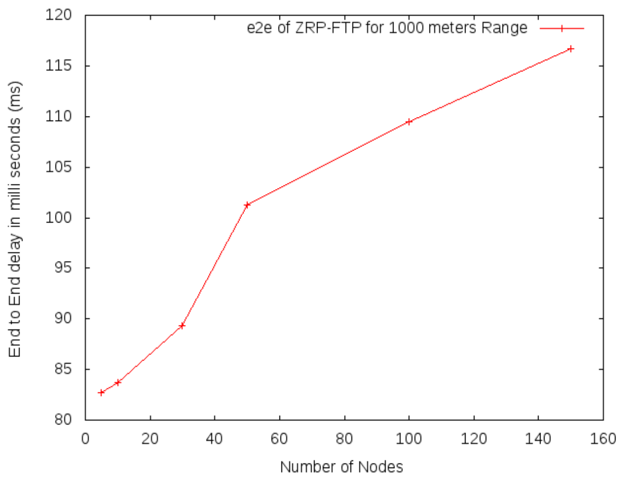

Figure 71: e2e of ZRP over FTP for 1000 meters Radio Range.

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Figure 72: Overall Analysis of e2e of ZRP over FTP.

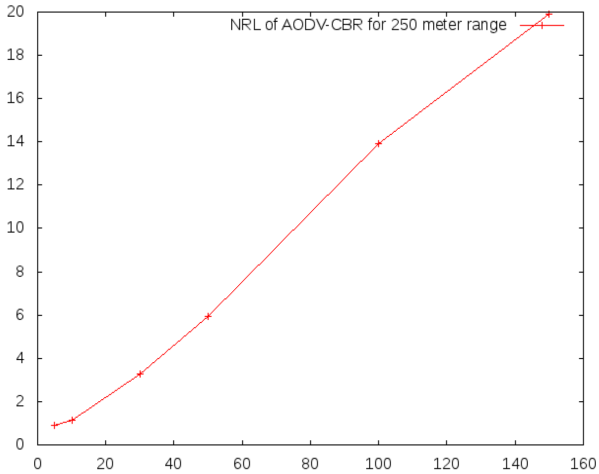

Figure 73: NRL of AODV over CBR for 250 meters Radio Range.

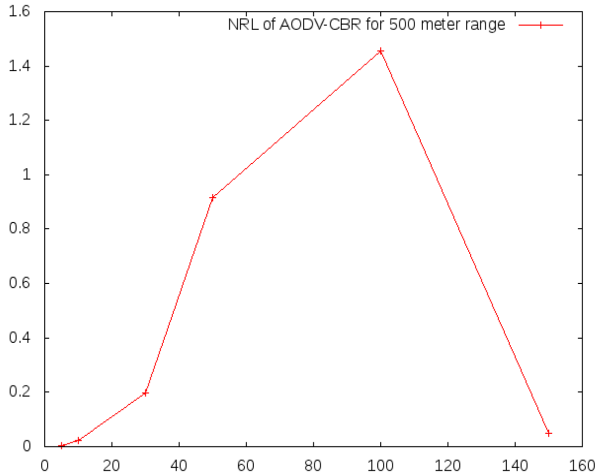

Figure 74: NRL of AODV over CBR for 500 meters Radio Range.

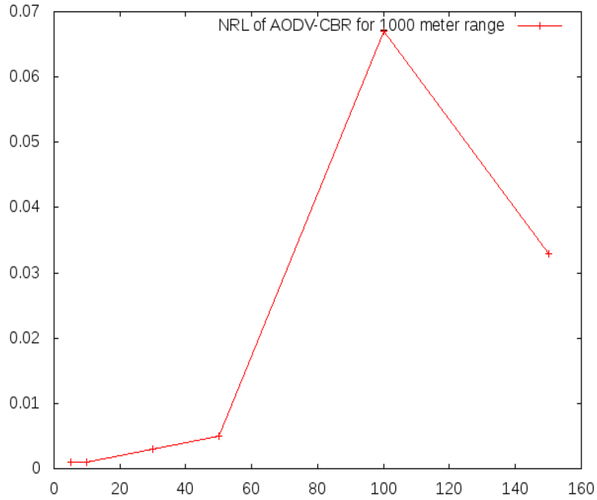

Figure 75: NRL of AODV over CBR for 1000 meters Radio Range.

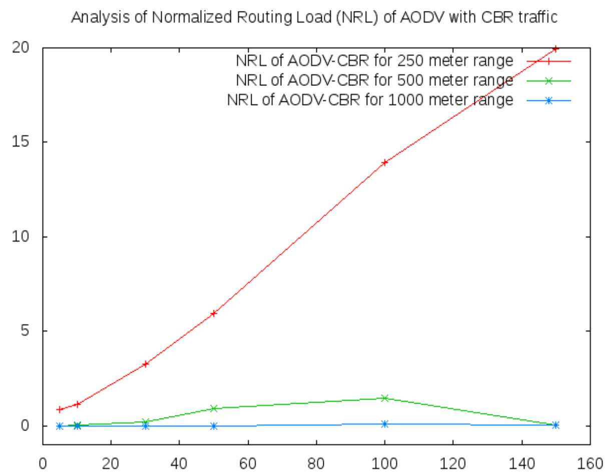

Figure 76: Overall Analysis of NRL of AODV over CBR.

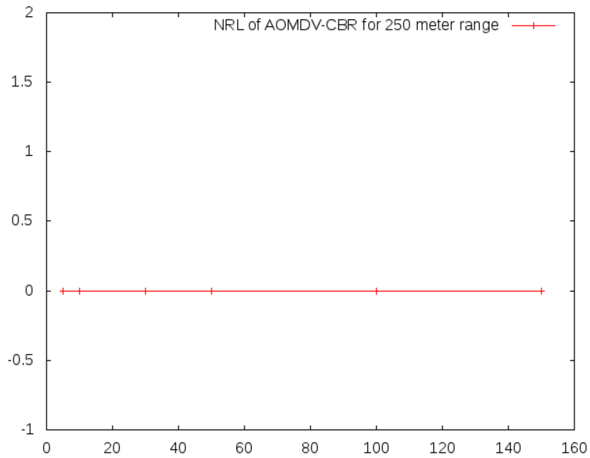

Figure 77: NRL of AOMDV over CBR for 250 meters Radio Range.

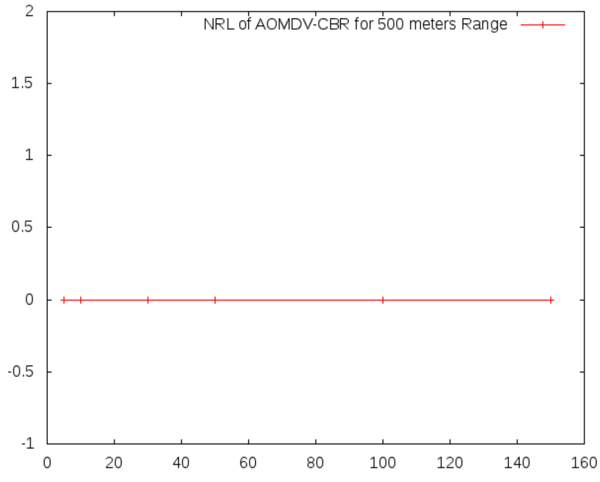

Figure 78: NRL of AOMDV over CBR for 500 meters Radio Range.

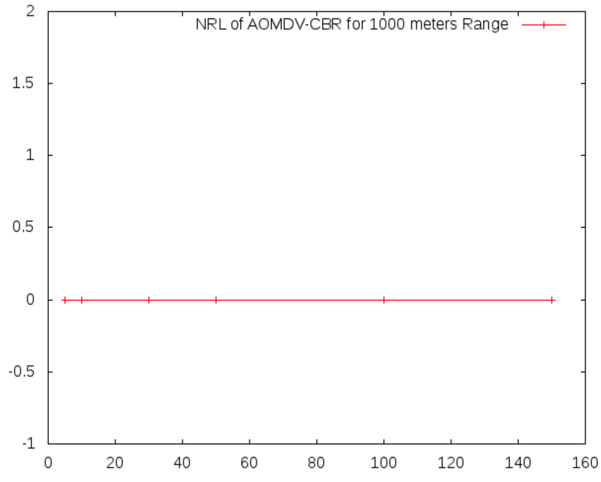

Figure 79: NRL of AOMDV over CBR for 1000 meters Radio Range.

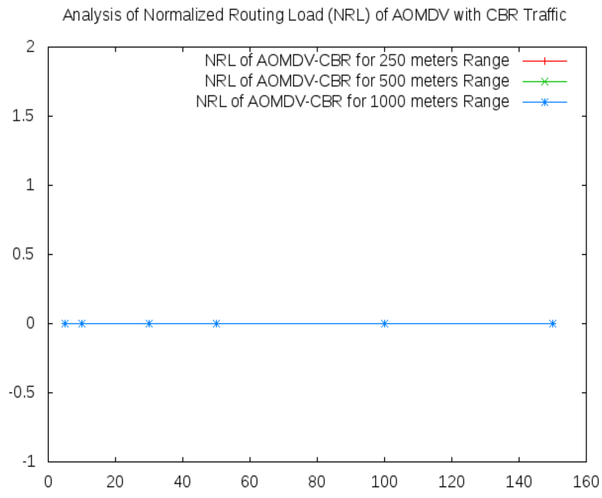

Figure 80: Overall Analysis of NRL of AOMDV over CBR.

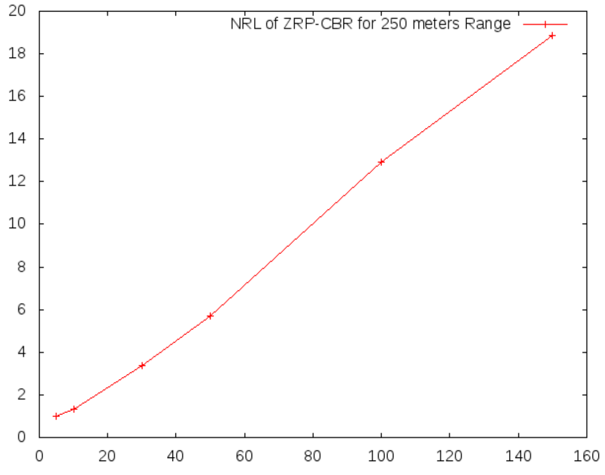

Figure 81: NRL of ZRP over CBR for 250 meters Radio Range.

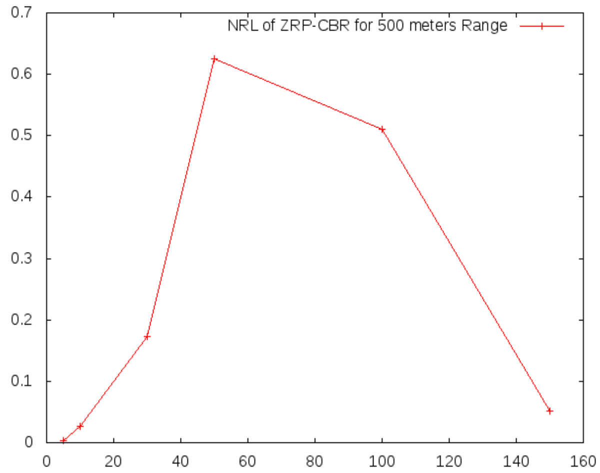

Figure 82: NRL of ZRP over CBR for 500 meters Radio Range.

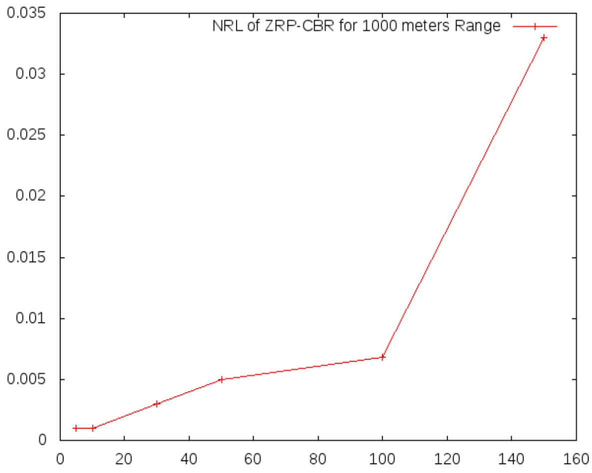

Figure 83: NRL of ZRP over CBR for 1000 meters Radio Range.

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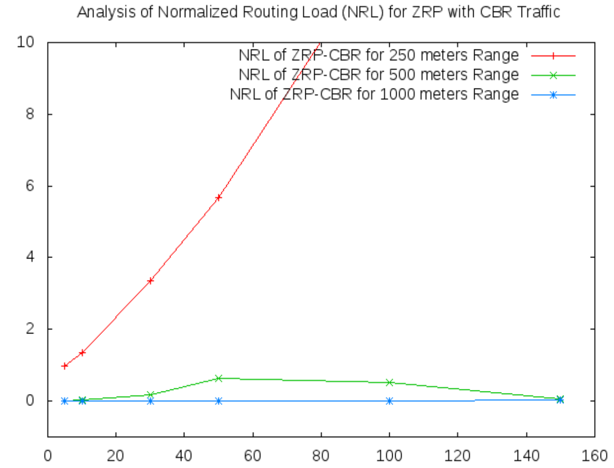

Figure 84: Overall Analysis of NRL of ZRP over CBR.

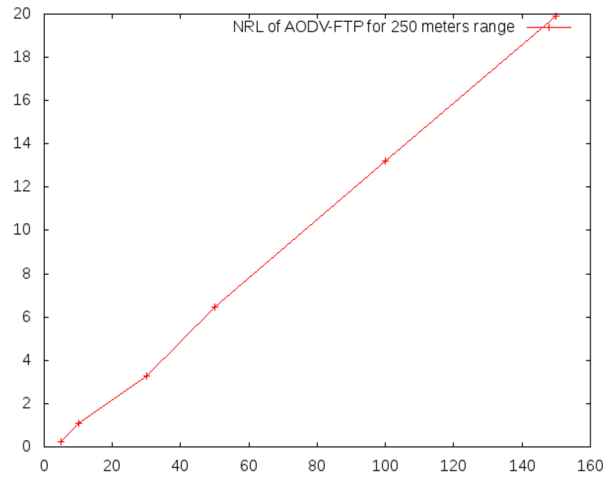

Figure 85: NRL of AODV over FTP for 250 meters Radio Range.

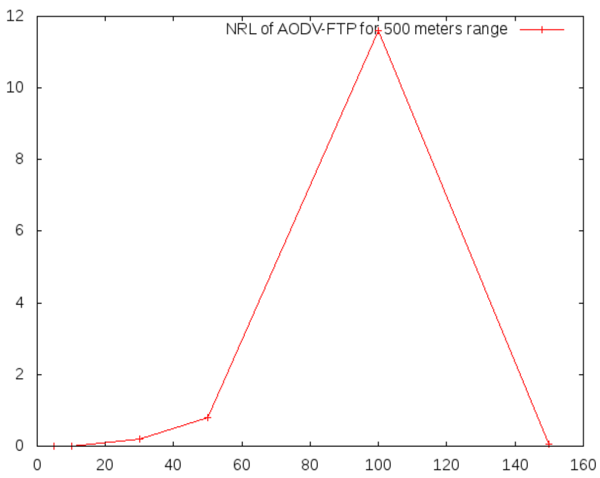

Figure 86: NRL of AODV over FTP for 500 meters Radio Range.

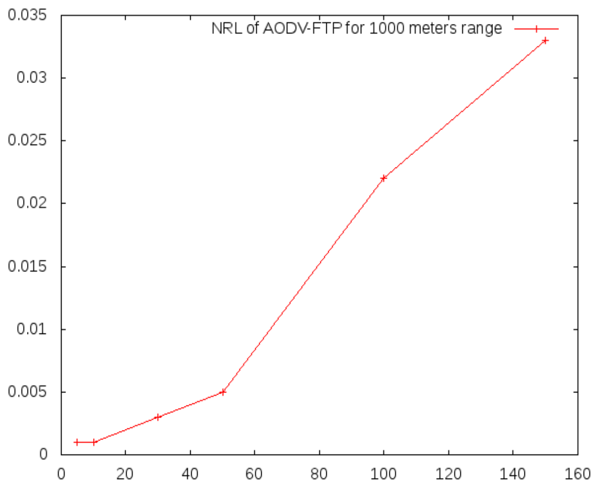

Figure 87: NRL of AODV over FTP for 1000 meters Radio Range.

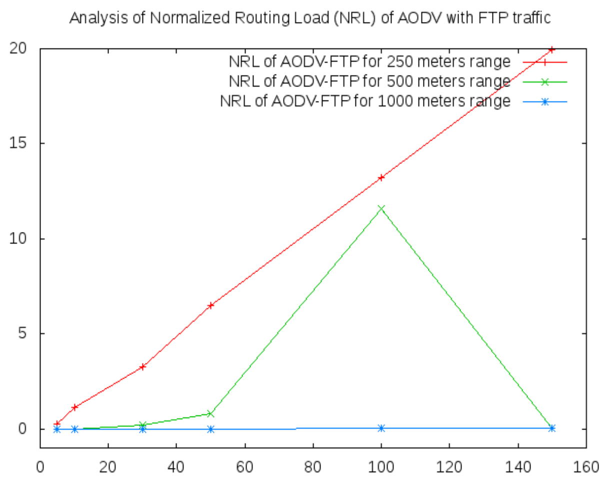

Figure 88: Overall Analysis of NRL of AODV over FTP.

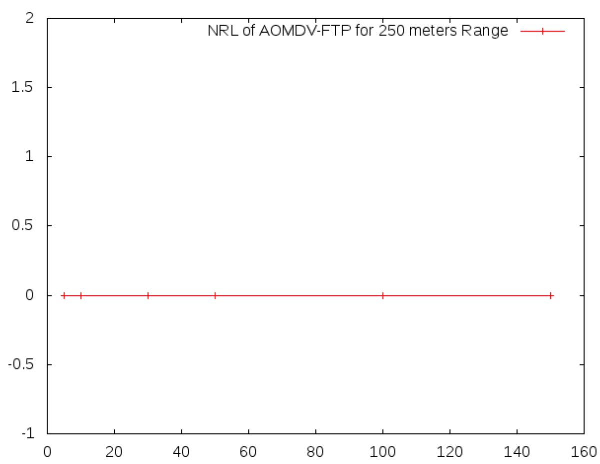

Figure 89: NRL of AOMDV over FTP for 250 meters Radio Range.

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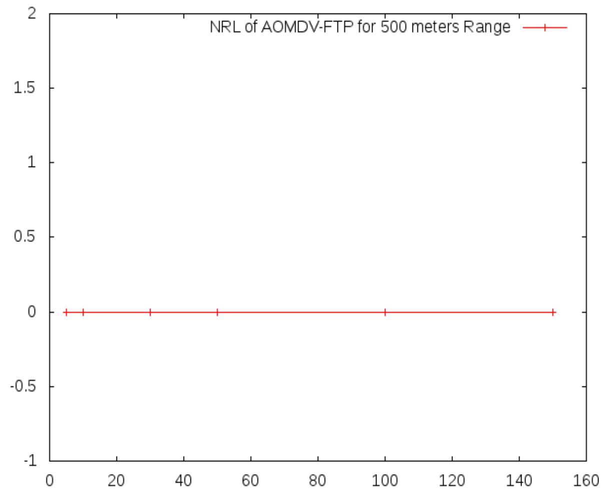

Figure 90: NRL of AOMDV over FTP for 500 meters Radio Range.

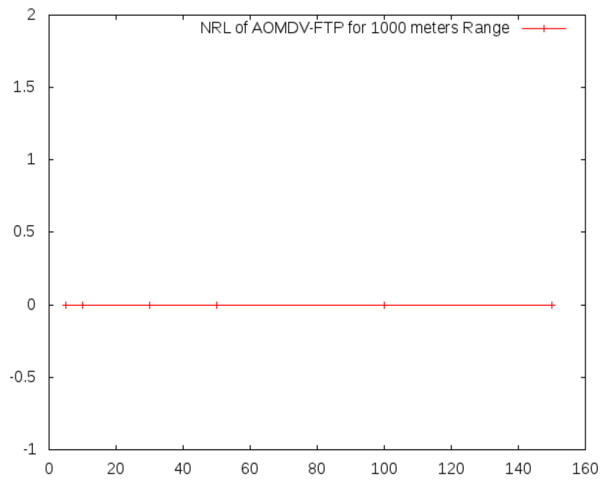

Figure 91: NRL of AOMDV over FTP for 1000 meters Radio Range.

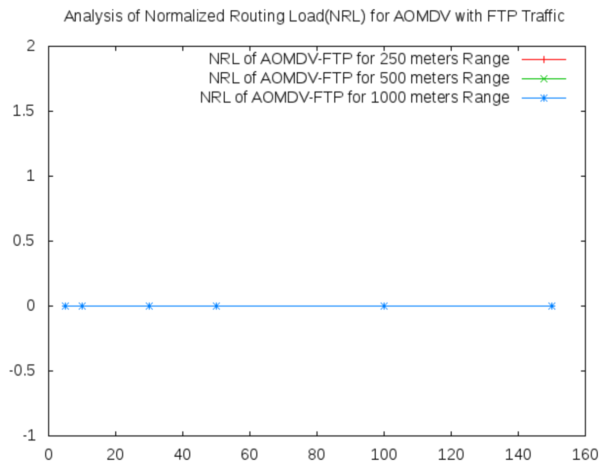

Figure 92: Overall Analysis of NRL of AOMDV over FTP.

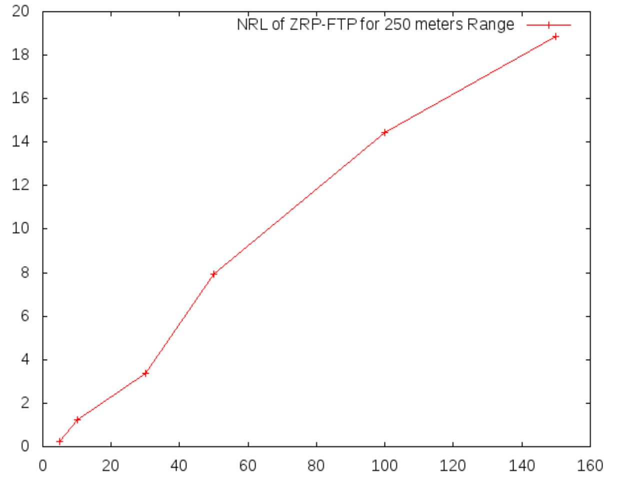

Figure 93: NRL of ZRP over FTP for 250 meters Radio Range.

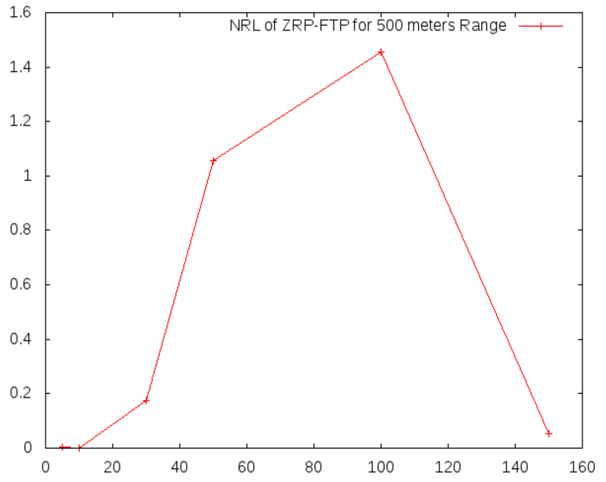

Figure 94: NRL of ZRPover FTP for 500 meters Radio Range.

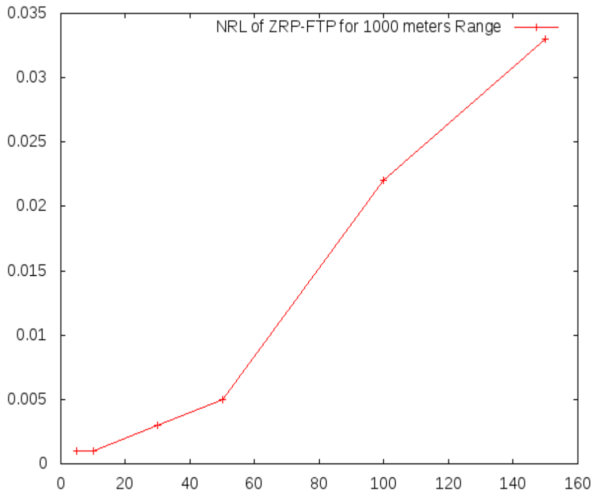

Figure 95: NRL of ZRP over FTP for 1000 meters Radio Range.

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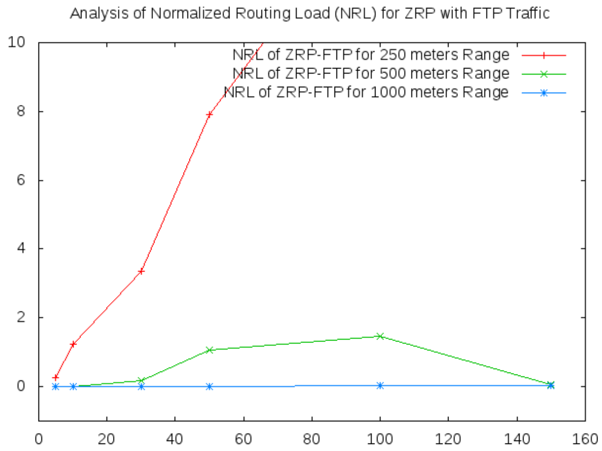

Figure 96: Overall Analysis of NRL of ZRP over FTP.

Table 1: Overall Performance Analysis of Routing Protocols of 250 meters Range TCP over CBR.

	AODV	AOMDV	ZRP
Throughput	Good	Excellent	Medium
PDR	Avg.	Excellent	Good
NRL	High	Low	Medium
e2e delay	Low	Medium	High

Table 2: Overall Performance Analysis of Routing Protocols of 500 meters Range TCP over CBR.

	AODV	AOMDV	ZRP
Throughput	Good	Excellent	Medium
PDR	Good	Excellent	Avg.
NRL	Medium	Low	High
e2e delay	Low	Medium	High

Table 3: Overall Performance Analysis of Routing Protocols of 1000 meters Range TCP over CBR

	AODV	AOMDV	ZRP
Throughput	Good	Excellent	Medium
PDR	Good	Excellent	Avg.
NRL	Medium	Low	High
e2e delay	Low	Medium	High

Table 4: Overall Performance Analysis of Routing Protocols of 250 meters Range TCP over FTP.

	AODV	AOMDV	ZRP
Throughput	Good	Excellent	Medium
PDR	Good	Excellent	Avg.
NRL	High	Low	Medium
e2e delay	Low	Medium	High

Table 5: Overall Performance Analysis of Routing Protocols of 500 meters Range TCP over FTP.

	AODV	AOMDV	ZRP
Throughput	Good	Excellent	Medium
PDR	Good	Excellent	Avg.
NRL	Medium	Low	High
e2e delay	Low	Medium	High

Table 6: Overall Performance Analysis of Routing Protocols of 1000 meters Range TCP over FTP

	AODV	AOMDV	ZRP
Throughput	Excellent	Good	Medium
PDR	Excellent	Good	Avg.
NRL	Medium	Low	High
e2e delay	Low	Medium	High

The above figures 1 to 96 show the performance of the selected three routing protocols under different radio ranges and under different traffic methods the. For all the graphs the X-axis represents the number of nodes varies from 5 to 150 in number. And the figures from 1 to 24 the Y-axis represents the Throughput value in kbps for example 750.65 kbps. From figures 25 to 48 the Y-axis represents Packet Delivery Ratio (PDR) value in percentages (%) for example 98.89%. the figures from 49 to 72 the Y-axis represents End-to-End delay in mille seconds (ms) for example 132.75 ms. The figures from 73 to 96 the Y-axis represents Normalized Routing Load (NRL). The tables from 1 to 6 represent the simplified result data for all the above 96 graphs.

VI. CONCLUSION

In this survey we have analyzed the performance of AODV, AOMDV and ZRP with different radio ranges and with two traffic techniques. In terms of Throughput AOMDV is good under CBR & FTP. Next AODV is having overall good performance. The ZRP is having the least .In terms of PDR AOMDV is having good delivery ratio under CBR & FTP. After AOMDV the AODV is showing good delivery ratio. ZRP is the least. In terms of three selected ranges for the NRL the AOMDV is having very less, so it can be considered as having good routing load. Later, ZRP is good only up to 250m range and AODV is medium load at 250m. AODV is good at 500m & 1000m. In terms of e2e delay the AODV is having very less delay under CBR & FTP. Next AOMDV is having good performance. The ZRP is having less delay only at less number of nodes, but as the number of nodes is increasing in the network the delay is also increasing. Finally we conclude that the AODMV is very good in terms of throughput, PDR and NRL and having more delay compared to AODV. If the number of nodes is increasing the delay andload also increases for ZRP so it is suitable for small networks especially those networks with nodes that has less mobility.

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