Comparison of Different Routing Protocol based on NS-3 Platform

Computer Networking Course Project

In this project, you are required to compare different routing protocols at the network layer and to explore recent literature on routing protocols in order to gain a deeper understanding of routing protocol development.

Note: This Project is **ONLY** for students whose majors are **not computer science and engineering**, **UP TO 2 students** are allowed to form the project team.

Tasks Description

- First, Optimized Link State Routing (OLSR) and Destination Sequenced Distance Vector (DSDV) Protocol should be compared from different perspectives. The students are required to build different networks and run OLSR and DSDV on these networks.
- In addition, a revised version of the OLSR protocol is required for implementation. The students are required to compare the revised OLSR protocol to the standard OLSR protocol, and explain any differences they observe.
- Then, students are required to explore different attributes and their impact for OLSR and DSDV routing protocol.
- Finally, students must review papers related to the OLSR/DSDV protocol in the recent three years (CCF A/B conference or journal). Prepare a survey on the development of routing protocols.
- Choose one of the literature reviews to implement.

Details Description

Part 1. Mesh topologies establishment (2 scores in total)

Ten mesh topologies containing 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 routers need to be implemented, and you should draw all these topologies (The distribution of nodes should be random). Figure 1 shows a sample ns-3 topology consists of 100 nodes.

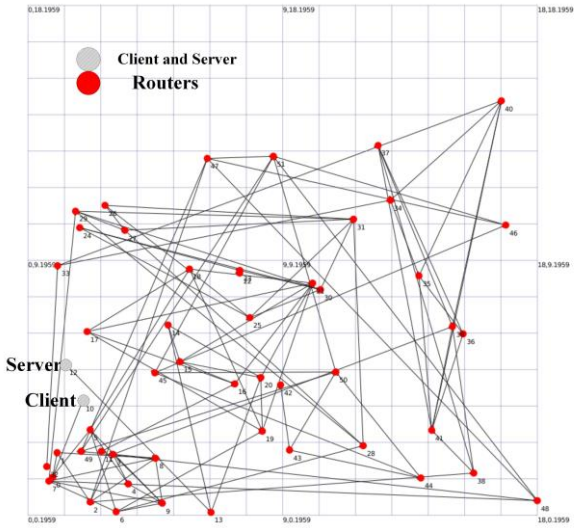

Figure 1. Sample ns-3 Topology Consists of 100 Nodes

Tip: The simulation topologies were configured using ad-hoc, you can build the topologies by the instructions provided by TA.

Notes:

✓ 10 topologies should be drawn. (2 points)

Part 2. Standard OLSR and DSDV running (13 scores in total)

Run standard OLSR and DSDV protocols on these networks, try to compare their Throughput, packet delivery ratio (PDR), end-to-end delay (EED), and normalized routing load (NRL).

Throughput = (Total Bytes Received ×8)/(Simulation Time ×1024)

PDR = (Total Received Packets)/(Total Sent Packets) ×100 %

EED = Delay Sum/Total Received Packets

NRL = Number of Routing Packets Sent/Number of Total Data Packets Received

As you create your networks, compare the performance under different numbers of nodes and routing protocols. At least four images are required to show your results:

1. Throughput vs. No of nodes for different routing protocol
2. PDR vs. No of nodes for different routing protocol.
3. EED vs. No of nodes for different routing protocol.
4. NRL vs. No of nodes for different routing protocol

Analyze these comparison results and explain their difference.

Notes:

✓ 4 or 8 figures should be drawn (You can choose use one figure to compare two routing protocol by using different collar or dash line, or you can draw them separately). (4 points)

✓ Analyze the difference. (4 points)

✓ Explain the reasons. (5 points)

Part 3. OLSR protocol revising (5 scores in total)

In addition, the behavior of OLSR can be modified by changing certain attributes. The method ns3::OlsrHelper::Set () can be used to set OLSR attributes. These attributes include HelloInterval, TcInterval, MidInterval, and Willingness. Other parameters are defined as macros in olsr-routing-protocol.cc.

The list of configurable attributes is:

HelloInterval (time, default 2s), HELLO messages emission interval. (4 s)

TcInterval (time, default 5s), TC messages emission interval. (3 s)

MidInterval (time, default 5s), MID messages emission interval. (2 s)

HnaInterval (time, default 5s), HNA messages emission interval. (3 s)

Willingness (enum, default OLSR_WILL_DEFAULT), Willingness of a node to carry and forward traffic for other nodes. (OLSR_WILL_ALWAYS)

Change these default values as Table 1 shows.

Table 1. Attribute values of OLSR

Attributes	Default Value	Revised Value
HelloInterval	2 s	4 s
TcInterval	5 s	3 s
MidInterval	5 s	2 s
HnaInterval	5 s	3 s
Willingness	OLSR_WILL_DEFAULT	OLSR_WILL_ALWAYS

Based on the new configuration, compare the throughput/PDR/EED/NRL. You have to show:

1. Throughput vs. No of nodes
2. PDR vs. No of nodes
3. EED vs. No of nodes
4. NRL vs. No of nodes
5. Using different color or dash to represent standard OLSR and revised OLSR, draw each in one figure. Analyze and explain the result.

Notes:

- ✓ 4 figures should be drawn. (2 points)
- ✓ Analyze and explain the difference (3 points)

Part 4. OLSR attribute values exploring (25 scores in total)

Fix the number of nodes to 100, and explore the impact of HelloInterval \TcInterval \MidInterval \HnaInterval \Willingness to the performance.

1. Change the HelloInterval to 2, 3, 4, 5, 6, 7, 8, 9, 10 seconds respectively, draw these figures: (2 points)

Throughput vs. HelloInterval
PDR vs. HelloInterval
EED vs. HelloInterval
NRL vs. HelloInterval

2. Change the TcInterval to 2, 3, 4, 5, 6, 7, 8, 9, 10 seconds respectively, draw these figures: (2 points)

Throughput vs. TcInterval
PDR vs. TcInterval
EED vs. TcInterval
NRL vs. TcInterval

3. Change the MidInterval to 2, 3, 4, 5, 6, 7, 8, 9, 10 seconds respectively, draw these figures: (2 points)

Throughput vs. MidInterval
PDR vs. MidInterval
EED vs. MidInterval
NRL vs. MidInterval

4. Change the HnaInterval to 2, 3, 4, 5, 6, 7, 8, 9, 10 seconds respectively, draw these figures: (2 points)

Throughput vs. HnaInterval
PDR vs. HnaInterval
EED vs. HnaInterval
NRL vs. HnaInterval

5. Change the Willingness to OLSR_WILL_NEVER, OLSR_WILL_LOW, OLSR_WILL_DEFAULT, OLSR_WILL_HIGH, OLSR_WILL_ALWAYS, respectively, compare their Throughput, PDR, EED and NRL by a figure or chart. (2 points)

6. Answer these questions:

a) What does each parameter mean? (2 points)

b) How do these parameters affect the routing performance? Using your figures to answer this question. (5 points)

c) How to choose these values in different scenario? Explain your strategy. (e.g, to choose a suitable willingness, in which scenario you prefer to choose OLSR_WILL_NEVER and in which scenario you prefer to choose OLSR_WILL_ALWAYS?) (8 points)

Part 5. DSDV attribute values exploring (25 scores in total)

1. Fix the number of nodes to 100 and change the PeriodicUpdateInterval to 10, 15, 20, 25, 30, 35, 40 respectively, show these figures: (2 points)

Throughput vs. PeriodicUpdateInterval

PDR vs. PeriodicUpdateInterval

EED vs. PeriodicUpdateInterval

NRL vs. PeriodicUpdateInterval

2. Fix the number of nodes to 100 and change the SettlingTime to 3, 5, 7, 9, 11, 13, 15 respectively, show these figures: (2 points)

Throughput vs. SettlingTime

PDR vs. SettlingTime

EED vs. SettlingTime

NRL vs. SettlingTime

3. Change the EnableBuffering to True/False, in each mode, change the number of nodes to 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, respectively, draw these figures: (2 points)

Throughput vs. No of nodes for EnableBuffering (True/False)

PDR vs. No of nodes for for EnableBuffering (True/False)

EED vs. No of nodes for for EnableBuffering (True/False)

NRL vs. No of nodes for for EnableBuffering (True/False)

4. Change the EnableWST to True/False, in each mode, change the number of nodes to 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, respectively, draw these figures: (2 points)

Throughput vs. No of nodes for EnableWST (True/False)

PDR vs. No of nodes for EnableWST (True/False)

EED vs. No of nodes for EnableWST (True/False)

NRL vs. No of nodes for EnableWST (True/False)

5. Change the EnableRouteAggregation to True/False, in each mode, change the number of nodes to 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, respectively, draw these figures: (2 points)

Throughput vs. No of nodes for EnableRouteAggregation (True/False)

PDR vs. No of nodes for EnableRouteAggregation (True/False)

EED vs. No of nodes for EnableRouteAggregation (True/False)

NRL vs. No of nodes for EnableRouteAggregation (True/False)

6. Answer these questions:

a) What do PeriodicUpdateInterval and SettlingTime mean? How do PeriodicUpdateInterval and SettlingTime affect DSDV protocol? Using the figure you plot to answer this question. (4 points)

b) What is the Buffering/WST/RouteAggregation in DSDV protocol? When you enable/disenable them, what result can you observe from the performance? (5 points)

c) In which scenario should you choose to enable/disable Buffering/WST/RouteAggregation respectively? Explain your strategy. (6 points)

Part 6. Conclusion (10 scores in total)

Conclude your result, using these figures to provide evidence. At least, you have to answer:

1. The strength & weakness of OLSR & DSDV routing protocol.
2. The strategy to choose attributes for different protocol in different scenarios.
3. What do you learn from this project?

Part 7. Further survey (20 scores in total)

Do a survey on recent papers related to OLSR or DSDV (CCF A/B conference or journal, 2020-2022) at least two papers should be included.

You have to summarize:

1. What is the challenge they want to solve?
2. What enhancement do they make compared with standard protocol?
3. What is the limitation of their work?

Part 8. Extra bonus (10 scores in total)

Implement one of papers in your survey using ns-3 simulator, compare their performance with standard protocol from different perspectives.

Submission:

1. Technique report. This should include:

- 10 network topologies.
- Analysis and necessary figures to help analysis.

You have to analysis at least:

- The difference between OLSR and DSDV.
- The difference between standard OLSR and revised OLSR.
- Influence of different parameters to OLSR and DSDV. Illustrate your strategy to choose the parameter for different routing algorithm.
- What do you learn from this project.

2. Paper review. This should include:

- At least two papers have to be included. You have to list the title, author, which conference or journal, publication year at first.
- A brief introduction for each paper, including their motivation, challenge and contribution.
- Their limitation (with your understanding). The paper may not mention its limitation, you

have to summarize it by yourself.

- Whether you choose to implement one of the papers for extra credit or not. If you choose to implement, you have to submit another section to compare their performance with standard protocol from different perspectives (with your result, figure or table), and the source code with annotation is also required.

3. **All necessary files** to demonstrate your project, including source code, reference papers.

References:

1. OLSR:
   https://www.mecs-press.org/ijcnis/ijcnis-v10-n10/IJCNIS-V10-N10-4.pdf
2. DSDV:
   https://pdfs.semanticscholar.org/fec5/7082a164bd8ff6464f704dee92f8df1a97f2.pdf?_ga=2.63834287.1420036934.1664270907-1191462900.1664270907

Tips:

1. OLSR Protocol Codes:
   https://www.nsnam.org/docs/release/3.16/doxygen/olsr-routing-protocol_8cc_source.html

2. OLSR TestCase Codes:
   https://www.nsnam.org/docs/release/3.16/doxygen/olsr-routing-protocol-test-suite_8cc_source.html

3. DSDV Protocol Codes:
   https://www.nsnam.org/docs/release/3.16/doxygen/dsdv-routing-protocol_8cc_source.html

4. DSDV TestCase Codes:
   https://www.nsnam.org/docs/release/3.16/doxygen/dsdv-testcase_8cc_source.html

5. While encountering problems with this project, you are suggested to post your questions on Github, TAs will answer the questions on the website.
   https://github.com/yuk1i/cs305-2022f-ns3