A Study of Link Buffering for OLSR

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Outlines

- Background
- Introduction of an extension for OLSR
  - Link Buffering
  - Packet Restoration
- Performance evaluation
- Conclusion
- Future work

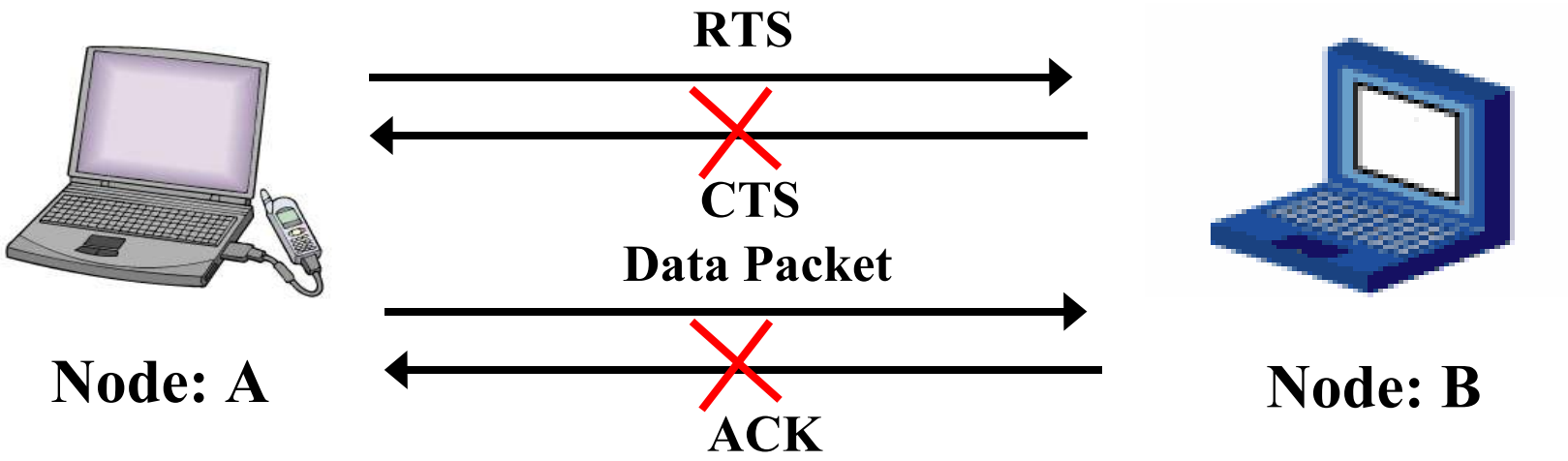
Background

- The hello-based detection of link disconnection is not enough quick as required and it is difficult to keep accurate link information under high mobility environments.

  → Degradation of packet delivery ratio

- Link layer notification method is defined as one of the methods to detect link disconnection as fast as possible.
- In high-mobility, high-density and high-loaded ad hoc networks, it is difficult to keep high performance even if only link layer notification is used.
- In order to improve performance in such a environment, we propose an extension of OLSR.

Link Layer Notification



- Link layer notification is described in section 13 of RFC 3626.
- How is link disconnection detected ?
  - When not receiving CTS after sending RTS.
  - When not receiving ACK after sending a data packet.

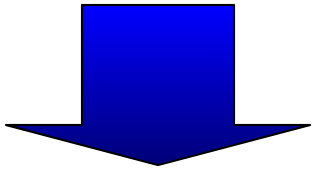
Extension for OLSR

- The extension includes two mechanisms:
  - Link buffering
  - Packet restoration

- They are used together with link layer notification, that informs detection of link disconnection to upper layers.

Link Buffering (1/5)

When link disconnection is detected by link layer notification, the node conducts two actions.

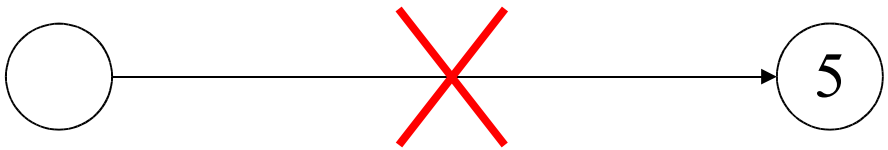


Action 1: The node changes all routes using the disconnected link to route_invalid state.

Action 2: The node updates the neighbor table and routing table.

Link Buffering (2/5)

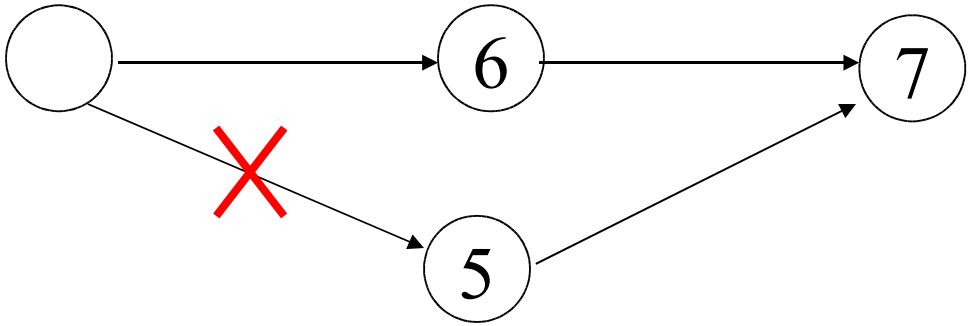
Action 1



Destination	Next Hop		State
3	5		invalid
4	10		valid
7	5		invalid

- Normally, a route entry is in the route_valid state.
- When a node is informed of link disconnection, it changes all routes using same next hop to route invalid state.

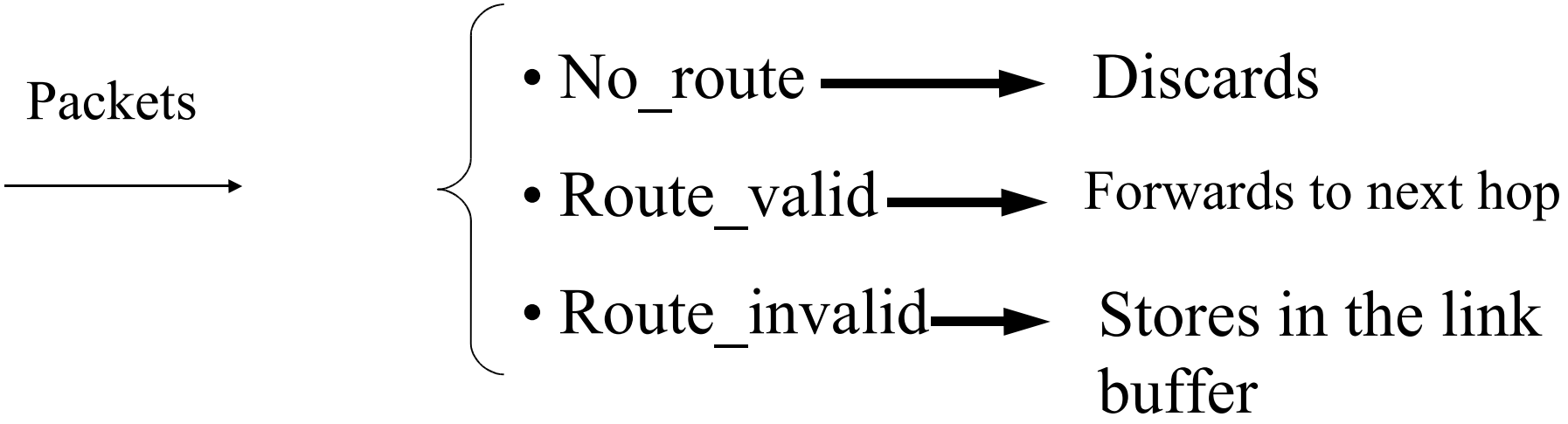
Link Buffering (3/5)
Action 2



Destination	Next Hop		State
3	No route		invalid
4	10		valid
7	6		valid

Link Buffer (4/5)
Data packet forwarding

When a node receives a data packet, it behaves differently according to the route entry and its status.



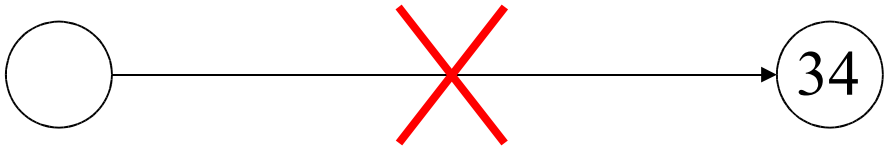
Link Buffering (5/5)

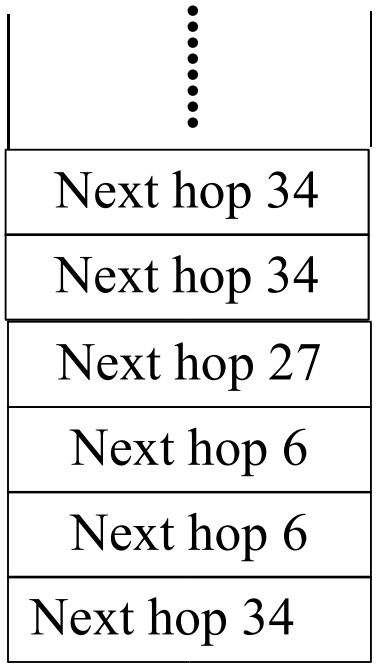
- Route state transition occurs in following cases:
  - When a node receives control packets.
  - When a node is informed of link disconnection.

- The node forwards all packets destined to a destination in the link buffer if the route's state changes to route_valid.

- If a route for the destination is not updated within BUFFERING_TIME, the node discards all packets destined to the destination in the link buffer and deletes the route entry in the routing table.

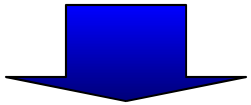
Packet Restoration





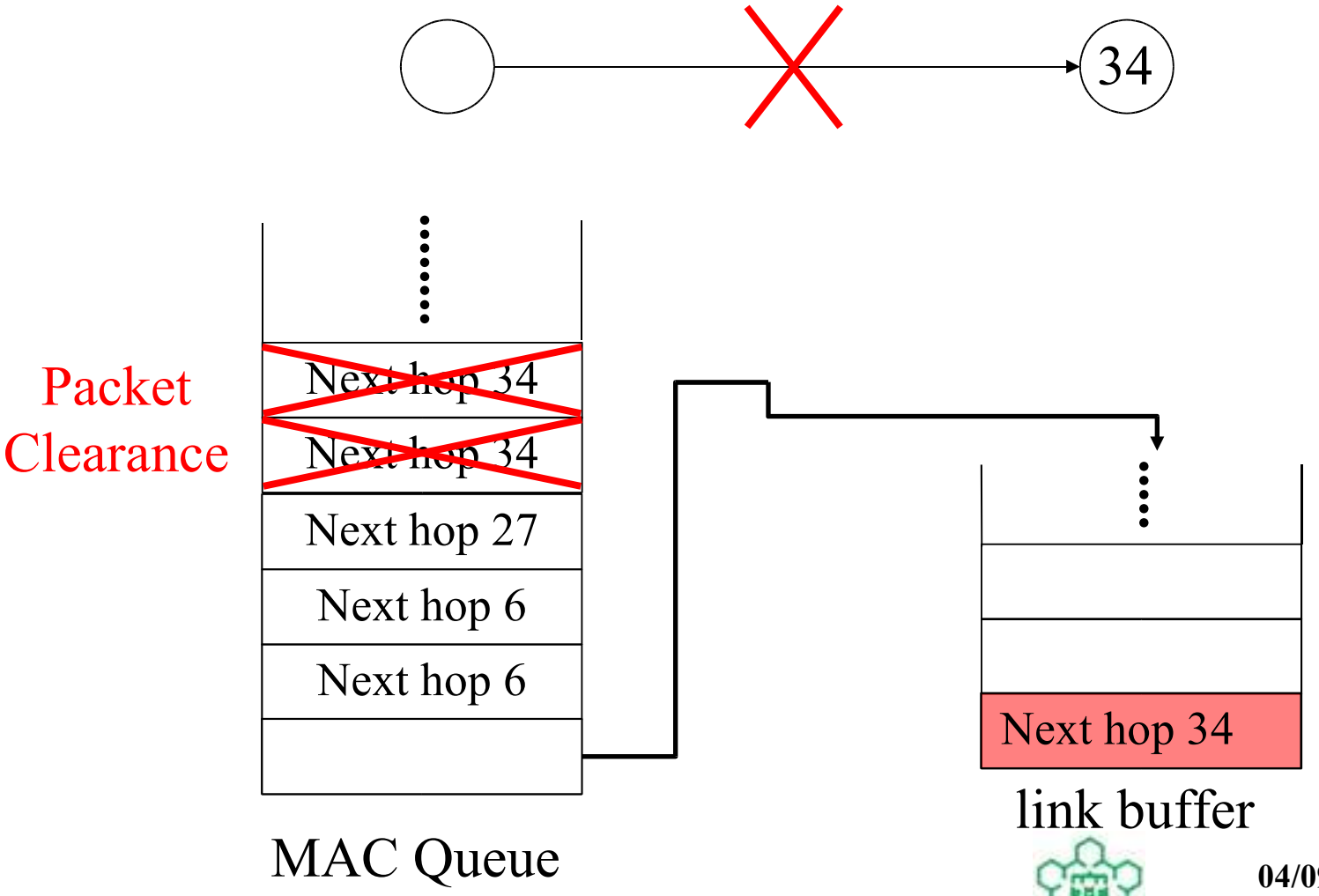
MAC Queue

- The node doesn't drop the packet with same next hop in MAC queue.
- The node repeats wasteful data transmission to disconnected link.

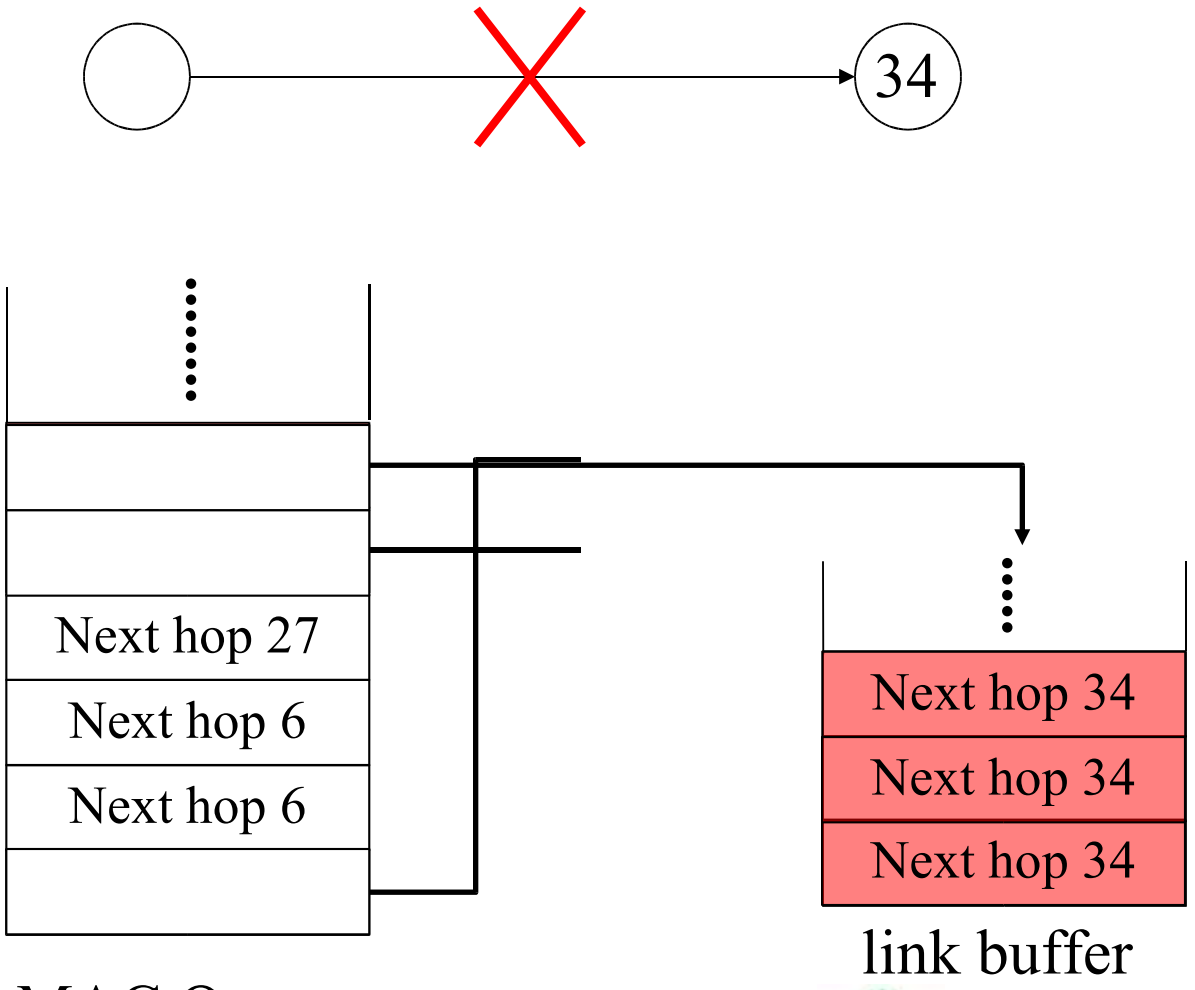


- Simple restoration
- Full restoration

Simple Restoration



Full Restoration



Parameter	Value
Simulation time	900 [sec]
Terrain range	300 × 1500 [m]
Number of nodes	100
Propagation model	Two-ray ground
Power range	100 [m]
Bandwidth	11 Mbps
Mobility model	Random way point, Pause time = 0 [sec]
MAC protocol	IEEE802.11
MAC queue size	50
Traffic type	CBR: 4 packets /sec, 64 [byte]

Table 1: Simulation model and parameters

Parameter	Value
Hello interval	1 [sec]
TC interval	1 [sec]
Holding time of neighbor information	1 [sec]
Holding time of topology information	3 [sec]
Link buffer size	Unlimited
BUFFERIUNG_TIME	3 [sec]

Table 2: Parameters of OLSR and Link buffering

Various version of OLSR

- OLSR-C: OLSR with packet clearance.
- OLSR-SB: OLSR with packet clearance and link buffer.
- OLSR-SR: OLSR with packet clearance, link buffer and simple restoration.
- OLSR-FR: OLSR with packet clearance, link buffer and full restoration.

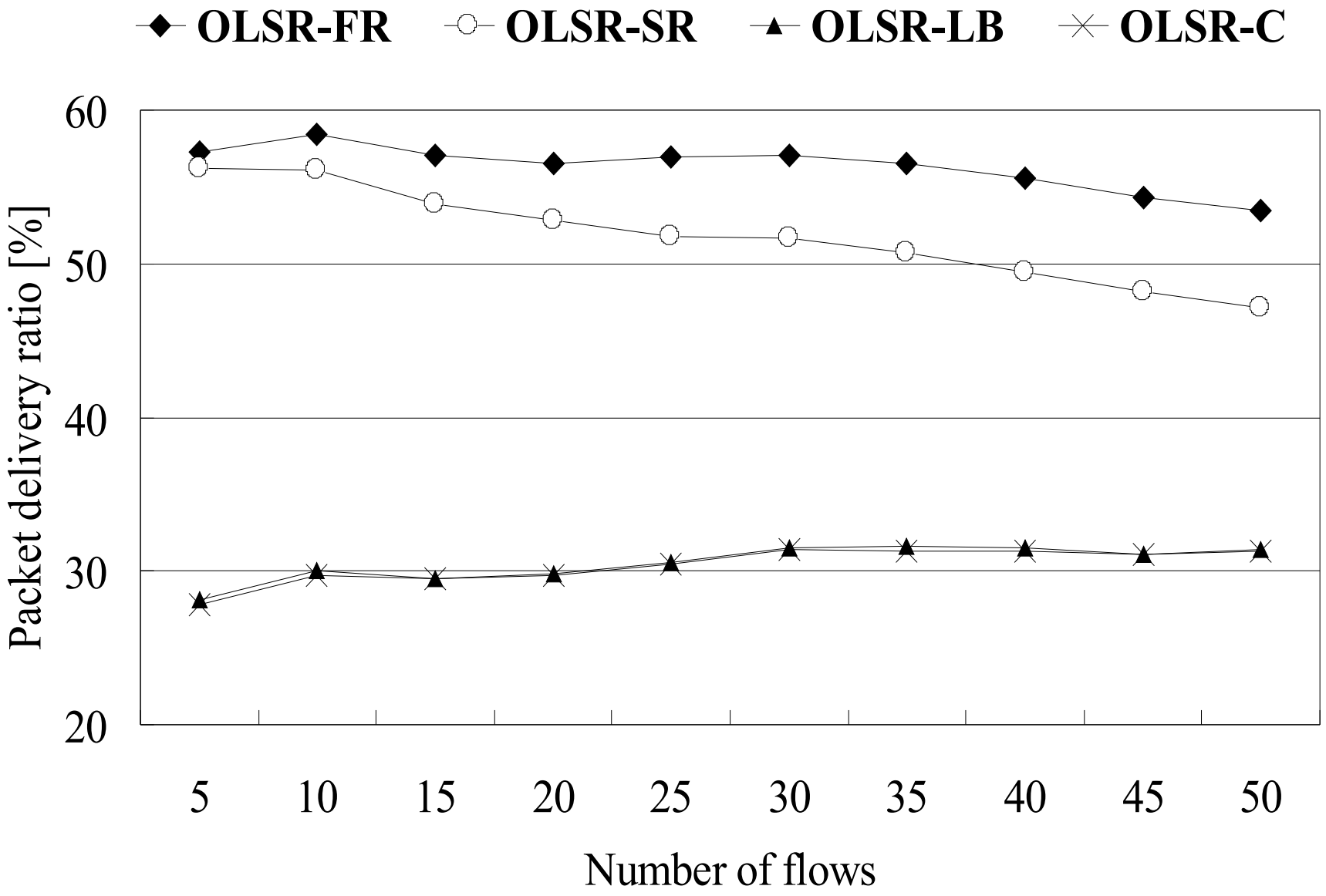


Fig. 1 Packet delivery ratio with 100 nodes and 20~40 m/s.

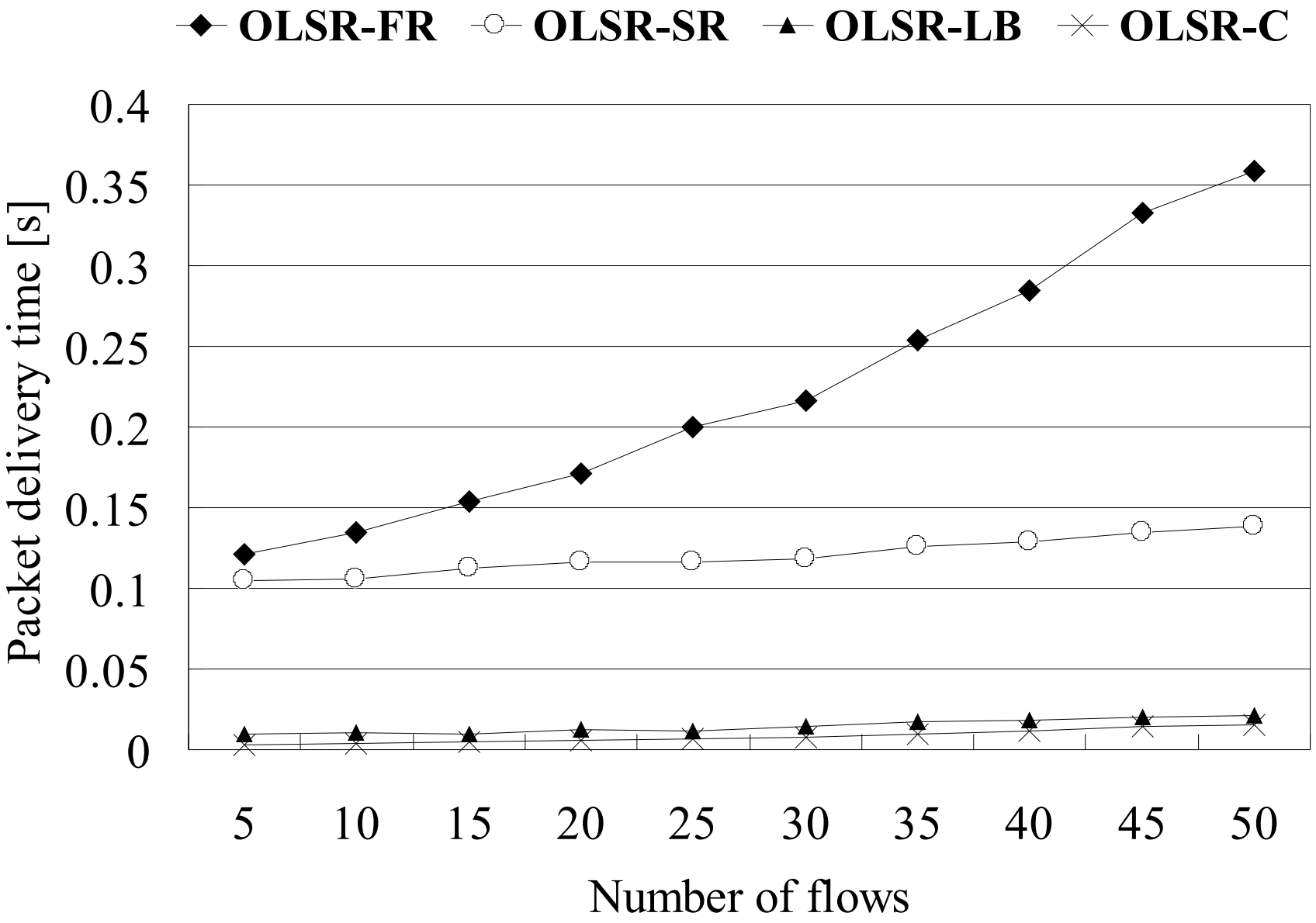


Fig. 2 Packet delivery time with 100 nodes and 20~40 m/s.

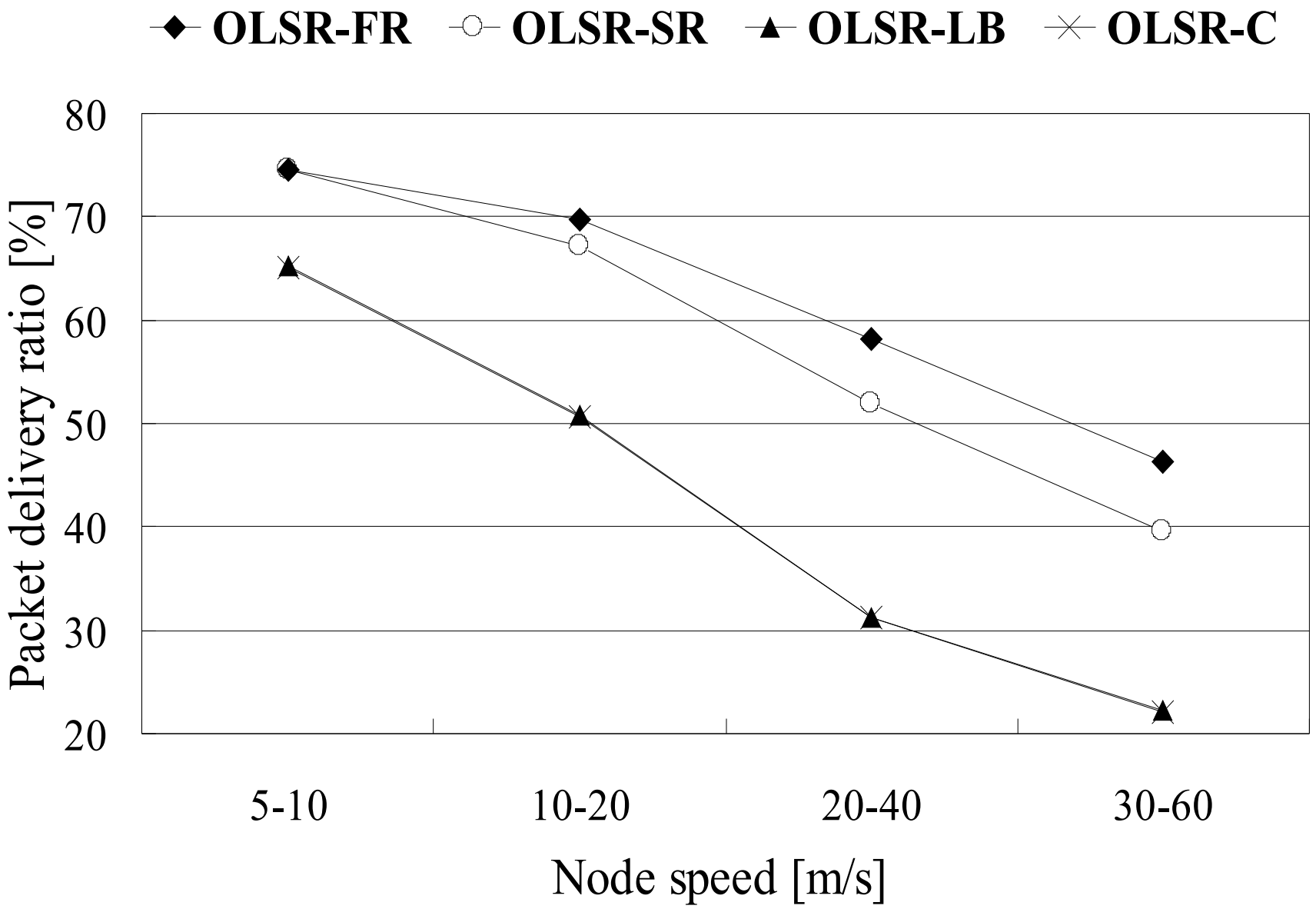


Fig. 3 Packet delivery time with 100 nodes and 30 flows.

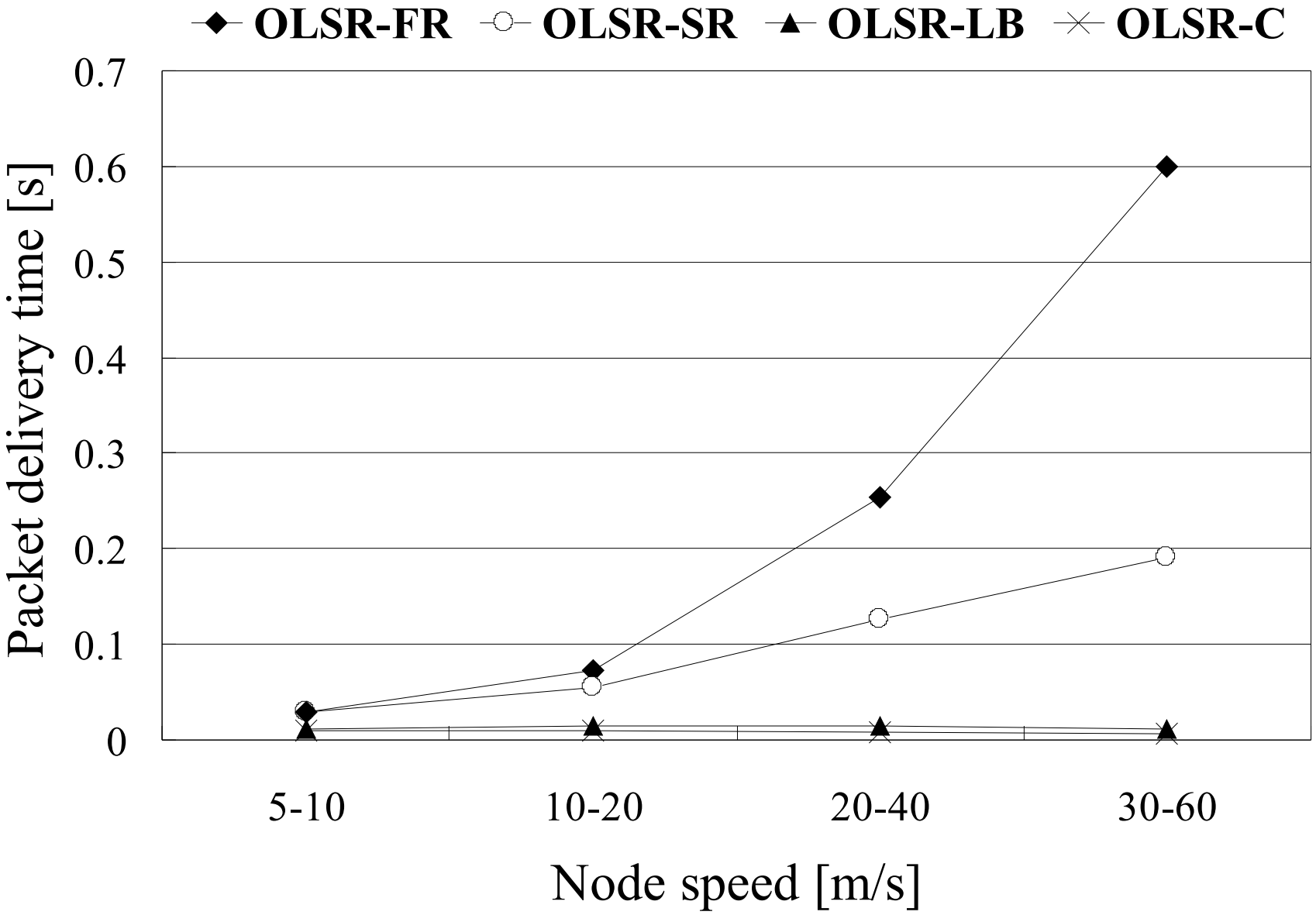


Fig. 4 Packet delivery time with 100 nodes and 30 flows.

Conclusion

- We proposed “Link buffering” and “Packet restoration”, which are used with link layer notification and evaluated their performance.
- OLSR-LB has little effect when node density is relatively high, since a new route can be instantly recalculated in OLSR when link disconnection is detected.
- OLSR-SR and OLSR-FR significantly outperform OLSR without link buffering and packet restoration.

Future work

- We need to evaluate the performance of OLSR in various environment (low mobility).
- We need to improve the mechanism how to retransmit the packet in link buffer.