Performance Evaluation of Distance-based Content Routing and Named-data Link State Routing

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Outline

- Motivation
- Background Overview
  - Distance-based Content Routing
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Motivation

- Comparative Performance Evaluation
  - DCR & NLSR
- Experimental Measurements
  - Number of routing updates
    - DCR is much less than NLSR
  - Convergent Time
    - DCR is faster than NLSR

References

- Publications:
  - *J.J. Garcia-Luna-Aceves, "Routing to Multi-instantiated Destinations: Principles and Applications", ICNP 2014, USA*
  - *J.J. Garcia-Luna-Aceves, "Name-Based Content Routing in Information Centric Networks Using Distance Information", ICN 2014, France*
  - *Lan Wang, et al. "NLSR: Name-data link state routing protocol", ICN 2013, USA*

Distance-based Content Routing

- Routers
  - Build and update its neighbor tables and routing tables
  - Process the update information received from neighbors
  - Maintain the latest sequence number by anchor
  - Calculate the best distance to destination instance
  - Determine the qualified successor

Distance-based Content Routing

- Anchors
  - Are producers
  - Speak for a destination instance
  - Assign sequence number incrementally
  - Send update prefix information periodically

Distance-based Content Routing

- Ordering
  - Greatest Sequence Number
  - Shortest Distance to Anchor
  - Smallest Node ID

Distance-based Content Routing

- Failure and Recovery
  - Detection
    - Wait for a timeout of update interval
    - No response from the neighbor
  - Recovery
    - Update the distance to failed node as INFINITY
    - Trigger immediately sending updates to neighbors
    - Neighbors update new anchors and new distances

Name-data Link State Routing

- Info Interests
  - Each node sends Hello to neighbors
  - Periodical broadcasting
  - Maintain active links with neighbors

Name-data Link State Routing

- Link State Advertisements (LSA)
  - Adjacency LSA
    - Number of Active Links
    - Neighbor Name, Link Cost
  - Prefix LSA
    - Valid Sign
    - Prefix Name

Name-data Link State Routing

- Multipath Calculation
  - Periodic Route Calculation
  - Dijkstra's Algorithm
    - Calculate path cost to all destinations
    - Update routing tables
    - Rank all next-hops by path costs

Name-data Link State Routing

- Failure and Recovery
  - Detection
    - No response from neighbor
    - Wait for first Hello interval (60s)
    - Retry sending Hello for three times
  - Recover
    - Multipath routes available to all destinations
    - Move to an alternative path right after detection

Distinctions Between DCR and NLSR

- Loop Prevention
  - NLSR could run potential loop in node failure
    - When no next-hops for that failed node, it causes looping
  - DCR prevents loop all the time
    - sends updates to notify neighbors and switch to new successors and alternative routes
- Sequence Number
  - NLSR sets sequence number for prefixes at fresh time
  - DCR periodically assign incremental sequence number

Simulation Environment

Parameters	Values
Network Simulator	ndnSim 1.0 at NS 3
Simulation Time	390 seconds
Total nodes	154
Total prefixes	900
Total producers	10% of total nodes
Bit Rate	CBR
Bandwidth	10Mbps
Node Failure Time	After 120 seconds
Node Recover Time	After 300 seconds
Node Failure Interval	[120s, 150s]
First Hello Interval (NLSR)	60 seconds
Retried Hello Interval (NLSR)	15 seconds
Adjacency LSA (NLSR)	5 seconds
Prefix LSA (NLSR)	1800 seconds
Update Interval (DCR)	30 seconds

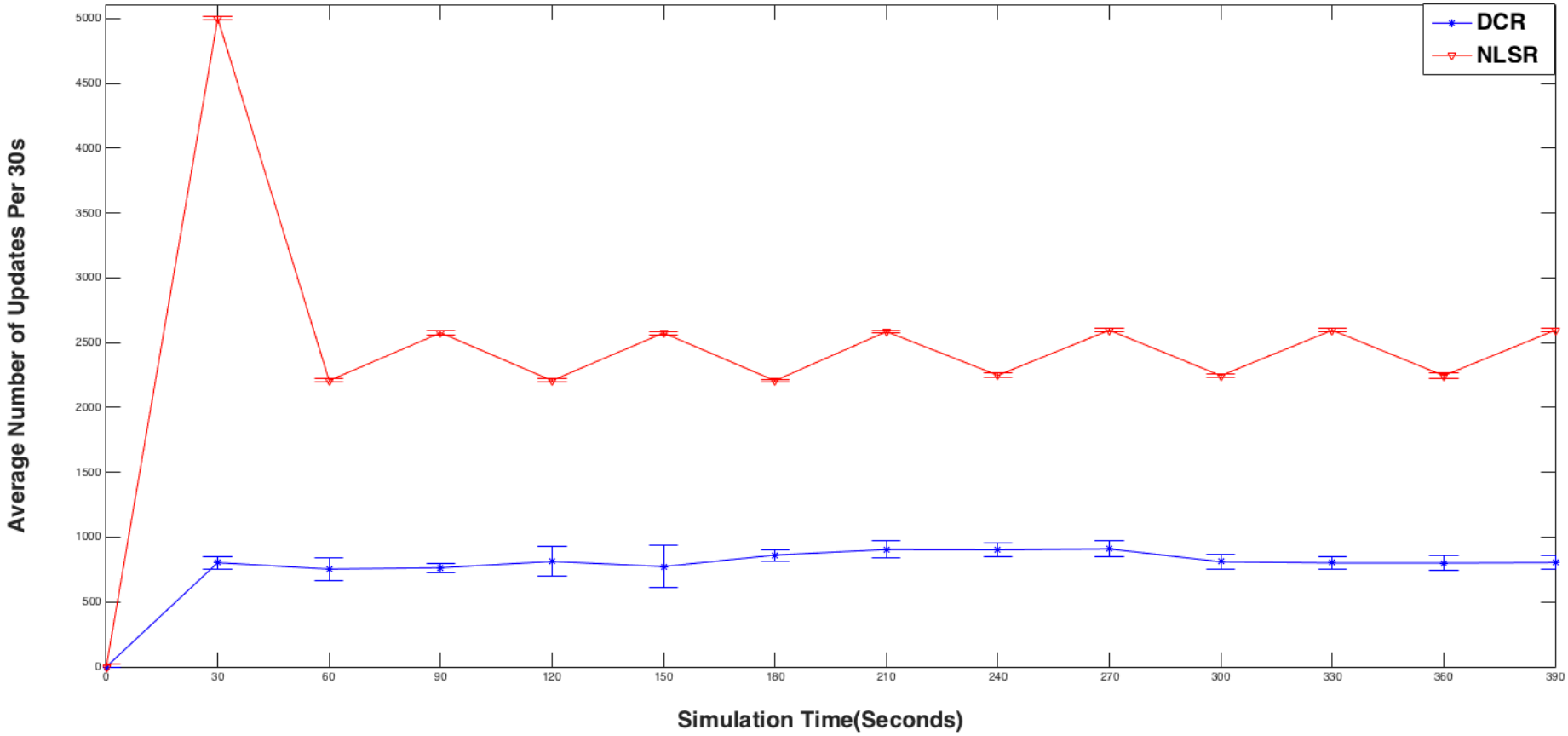
Scenarios

Parameters	Values
Random Seeds	5
Measurement Interval	30 seconds
Mean of update messages per interval	765
Mean of Convergent Duration (DCR)	5.5 seconds
Run time output files	154
Results files + Perl Scripts	6
Total number of experimental data files	5*(2*154 + 6) = 1570

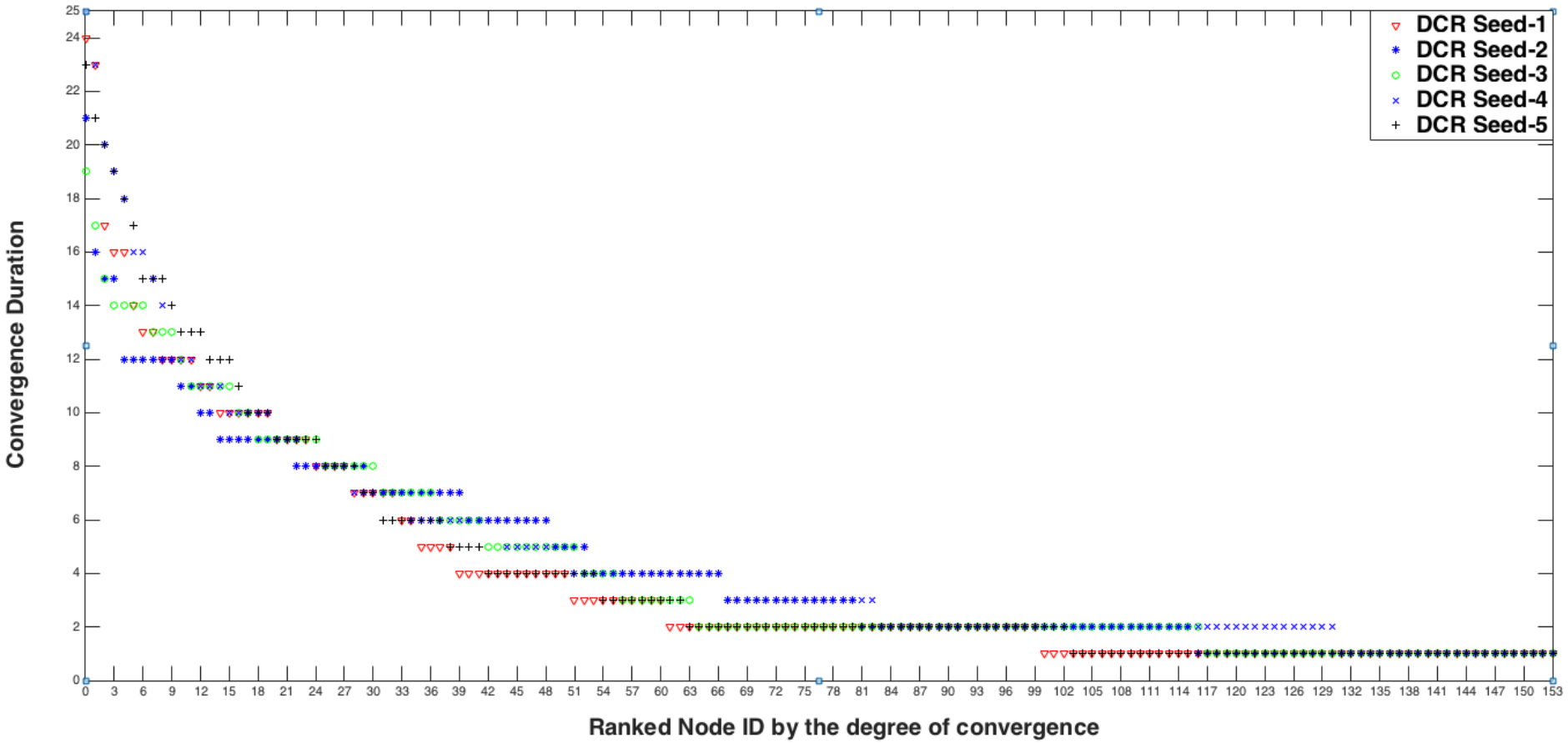
Node Failure Settings

- No sampling error
- Failed node is chosen uniformly random
- Failure time is chosen uniformly distributed
- Run each test per node failure
- Five random seeds
- Totally run nearly 1600 times

Average Number of Updates Per Interval



Convergence Time



Conclusion

- DCR Compares with NSLR
  - Loop-free mechanism
  - Less average updates of messages
  - Faster network convergence

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Questions