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Improving Mobile Ad-hoc Network (MANET) Communications with Red Hat Enterprise MRG Messaging

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JBoss Solutions Architect, Red Hat

06.27.12

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MRG-M Improves Mobile Communications

- TCP/IP challenges in a mobile environment
- Intermediate MRG-Messaging brokers improve TCP/IP
- RHEL emulates networks out-of-the-box

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TCP/IP Challenges in a Mobile Environment

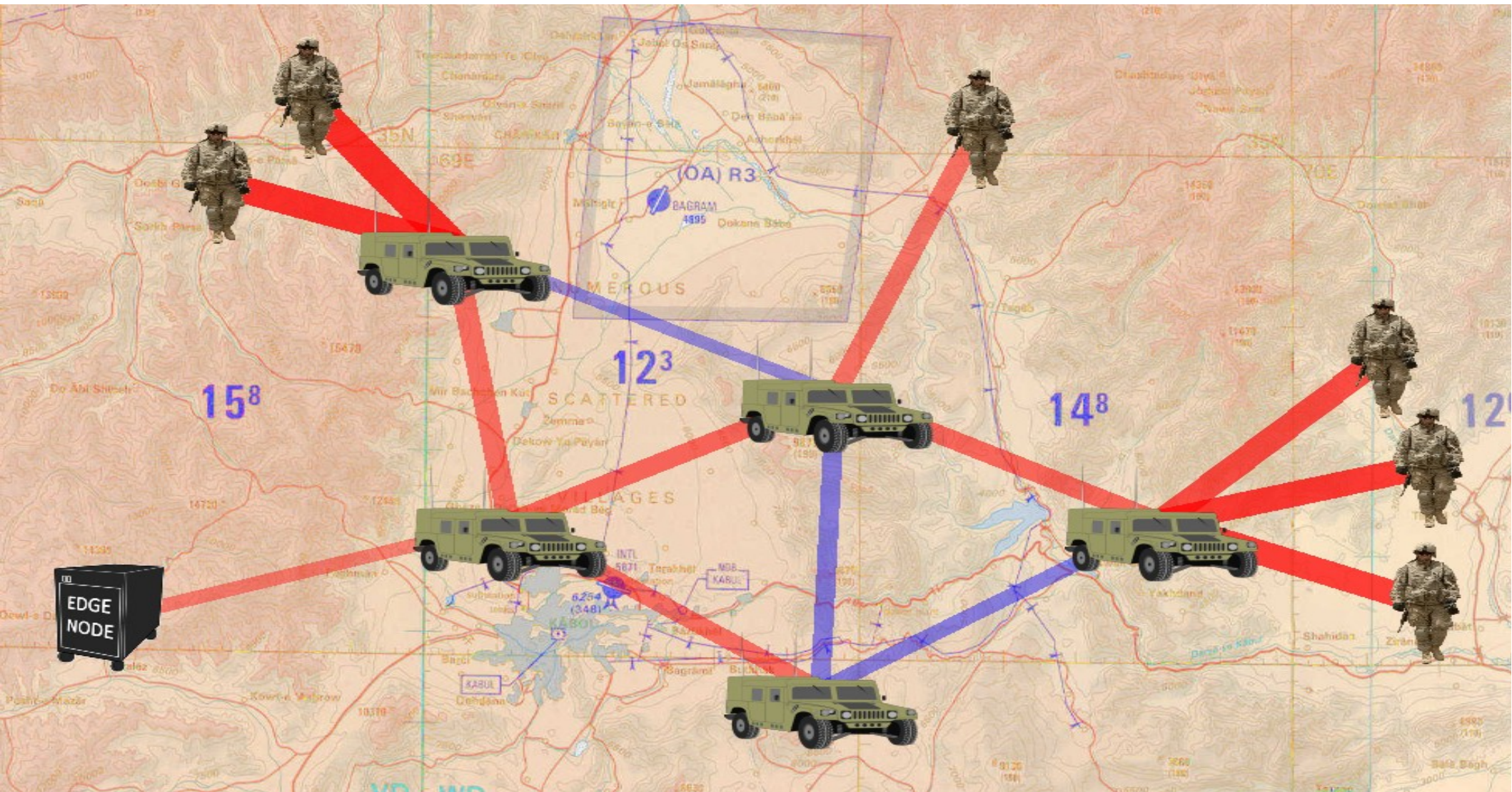
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Mobile Ad-hoc Network



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No connection to destination



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No connection to source



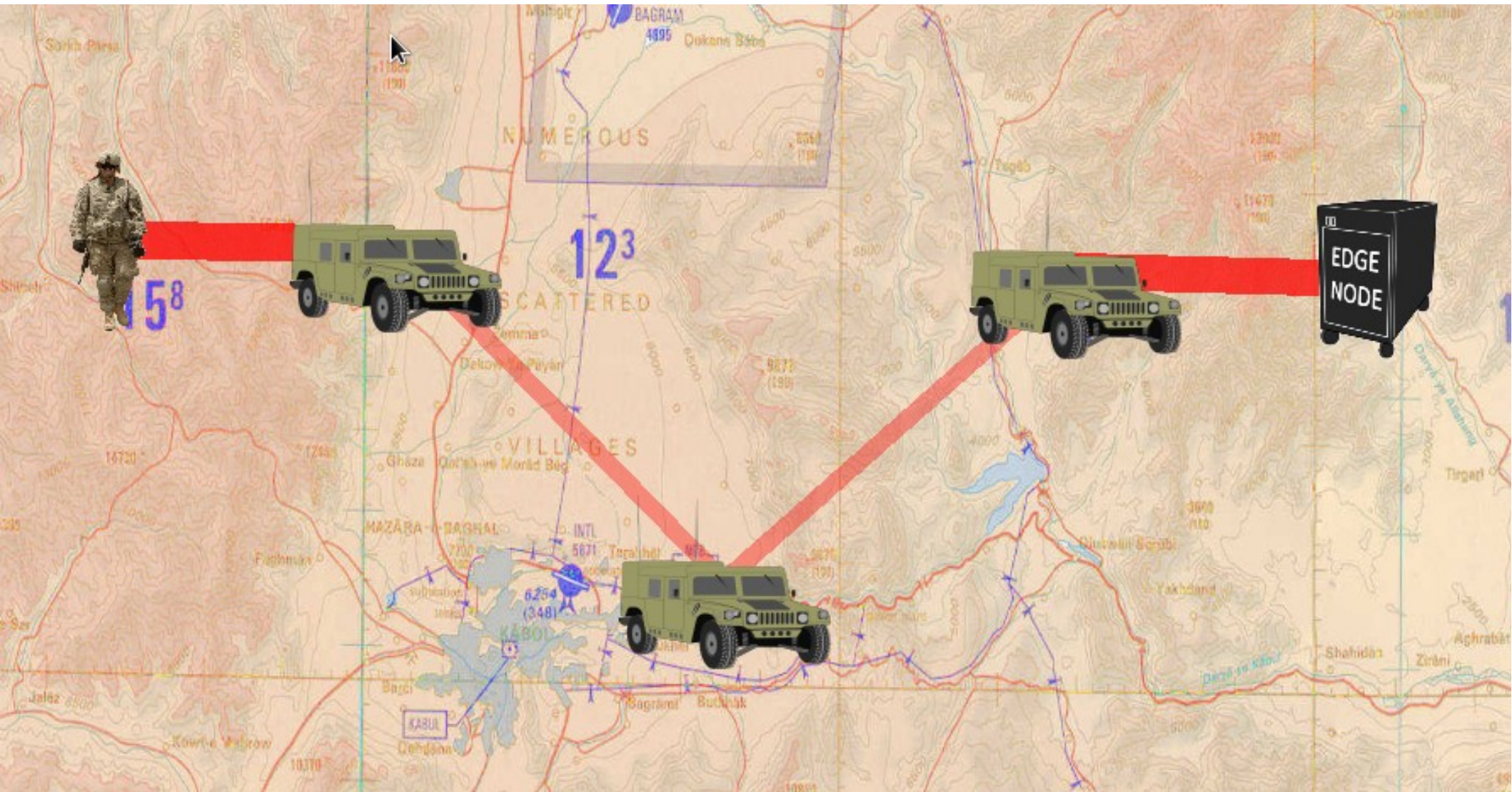
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Unreliable connections



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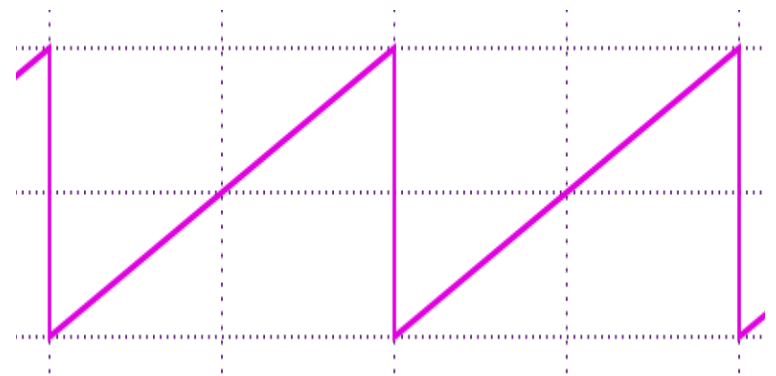
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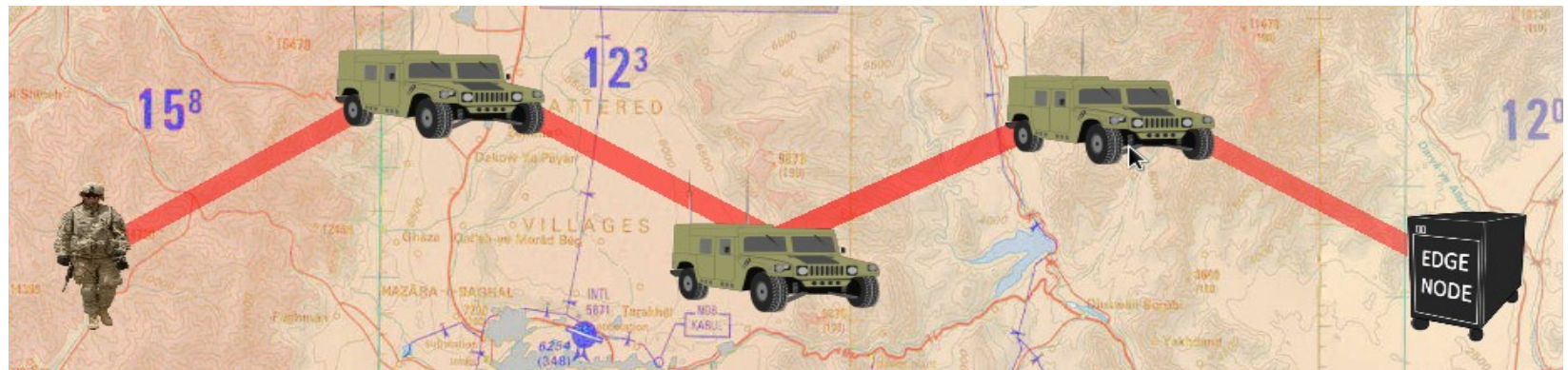
TCP/IP Challenges

- Poor performance in MANET
 - Packet losses
 - Network disconnect/reconnect
 - Poor R/F conditions
 - Re-transmits from source
 - “Slow start” congestion control



A Better Way

- Avoid end-to-end communications
 - Eliminate cumulative effects over multiple hops
- Use intermediate message brokers
 - Store and forward
 - Trade latency for better throughput



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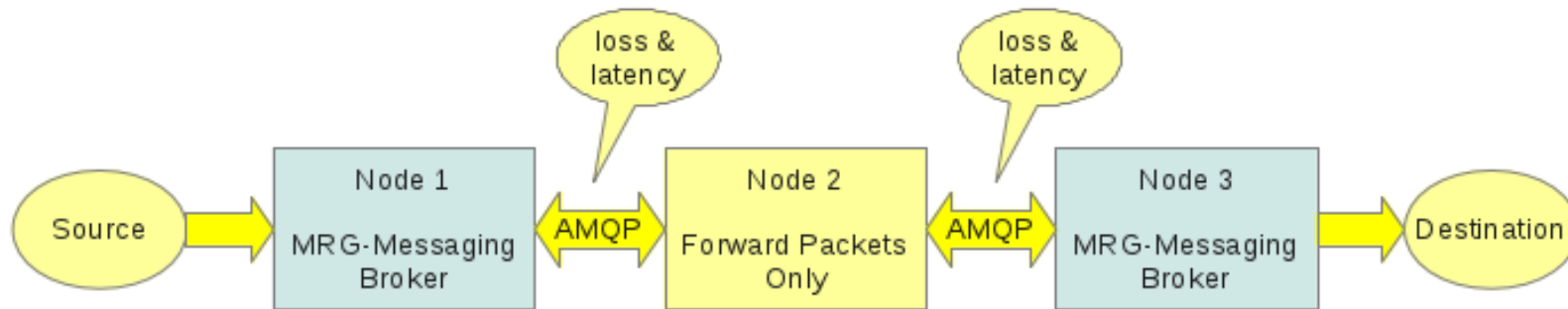
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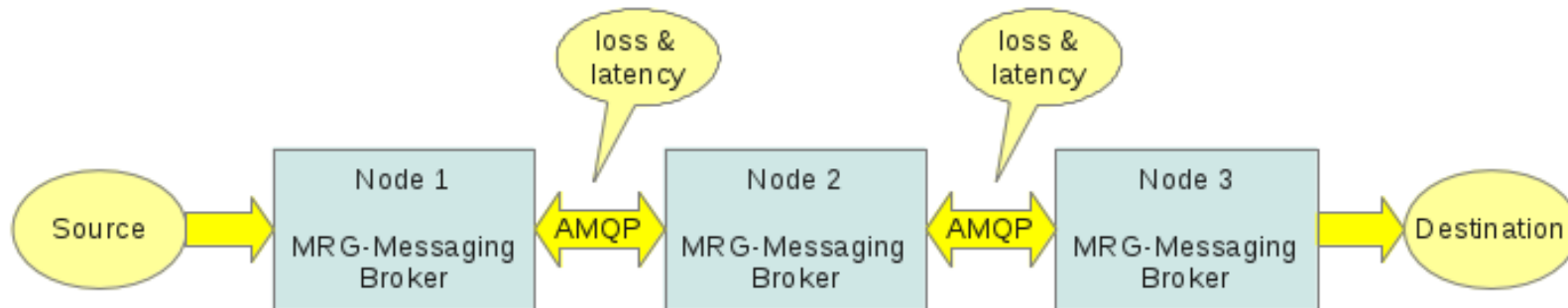


Test Scenarios

No Intermediate Message Broker



Intermediate Message Broker



Red Hat MRG-Messaging Enhances AMQP

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JP Morgan Chase and Red Hat – Where it all started...

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AMQP and MRG-Messaging



News Feed Item

Red Hat Affirms Commitment to AMQP as Company's Strategic Open Messaging Protocol

Interest in AMQP is growing

Red Hat is committed to AMQP

But remember AMQP is a specification

AMQP \neq MRG Messaging

AMQP + Lots of Features = MRG Messaging

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Advanced Queueing Features

Core Messaging

P2P, fanout, pub-sub, sync, async

Reliable messaging

Transactions local to dtx

Multiple clients (**C++, JMS, .NET, Python, Ruby, Perl**)

Advanced Features

Queue Semantics: TTL, **Ring Queue, Last Value Queue, Initial Value Exchange**

Routing patterns, including XML XQuery

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Management and Security

Management tools

Web-based GUI

Command line tools

AMQP-based framework & APIs (QMF)

Security

SASL authentication

SSL/TLS/ Kerberos encryption

Role-based Access Control (ACL)

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Performance and High Availability

High Performance

C++ broker, optimized for RHEL

AIO for high-speed durability

RDMA support for ultra low latency

High Availability

Active-Active Broker Clustering

Federated disaster recovery

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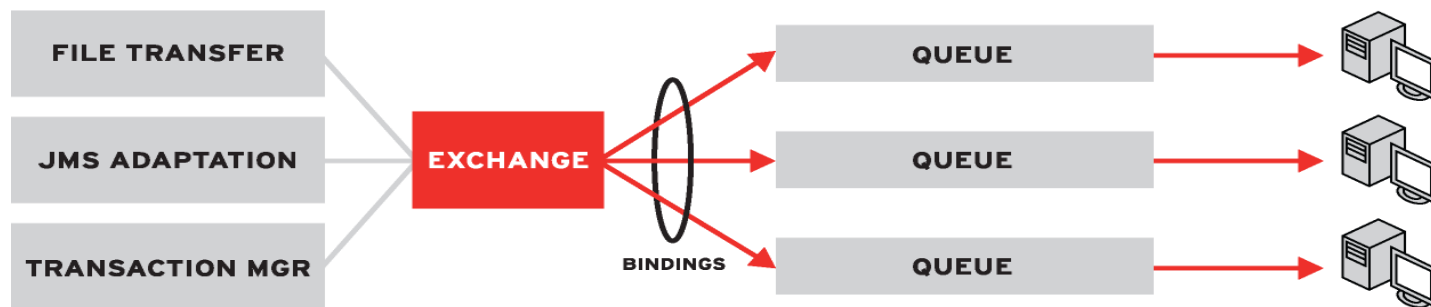
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The AMQP Model

- The AMQP architecture specifies building blocks
 - Exchanges
 - Message “routing key” determines destination queue
 - Queues
 - Stores messages for delivery
 - Bindings
 - Defines routing criteria between Exchange and Queue



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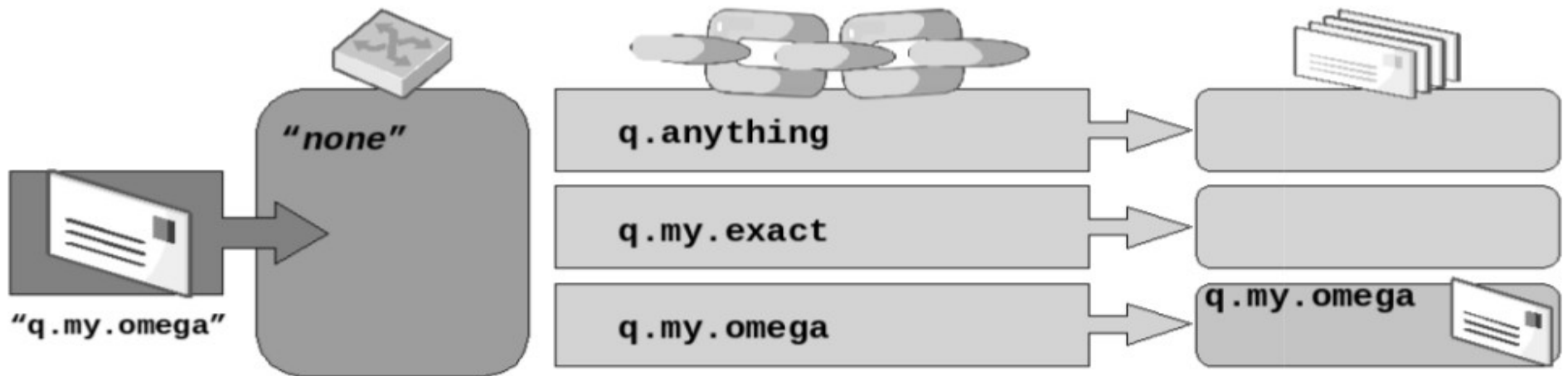
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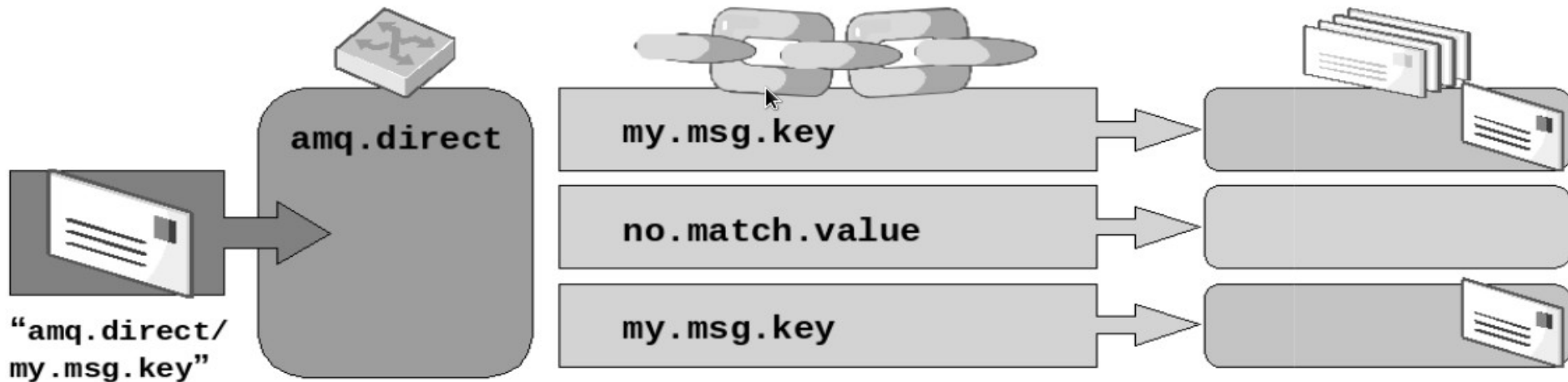
Exchange Types

- Default Exchange
 - Binding key is name of queue
 - AMQP 0-10 automatically binds every queue
 - Only one allowed



Exchange Types

- Direct Exchange
 - Routing key matches binding key
 - AMQP 0-10 provides “amq.direct”
 - Multiple allowed



- Fanout, Topic, Headers, XML (custom type)



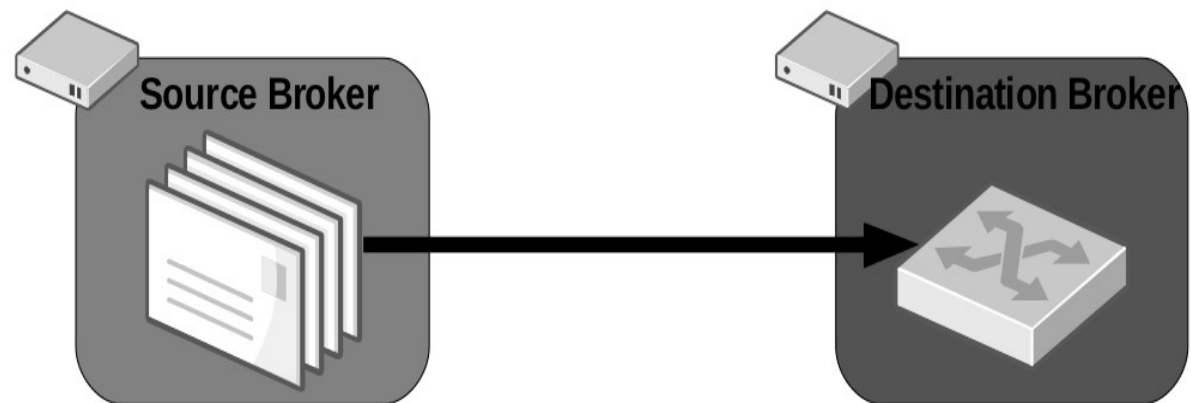
MRG-M Federation

- Message routes that connect one or more brokers
 - Durable
 - Dynamically created
 - Automatic delivery
 - Queues hold messages when connection dropped
 - Resilient connections (auto reconnect with backoff)



Message Routes

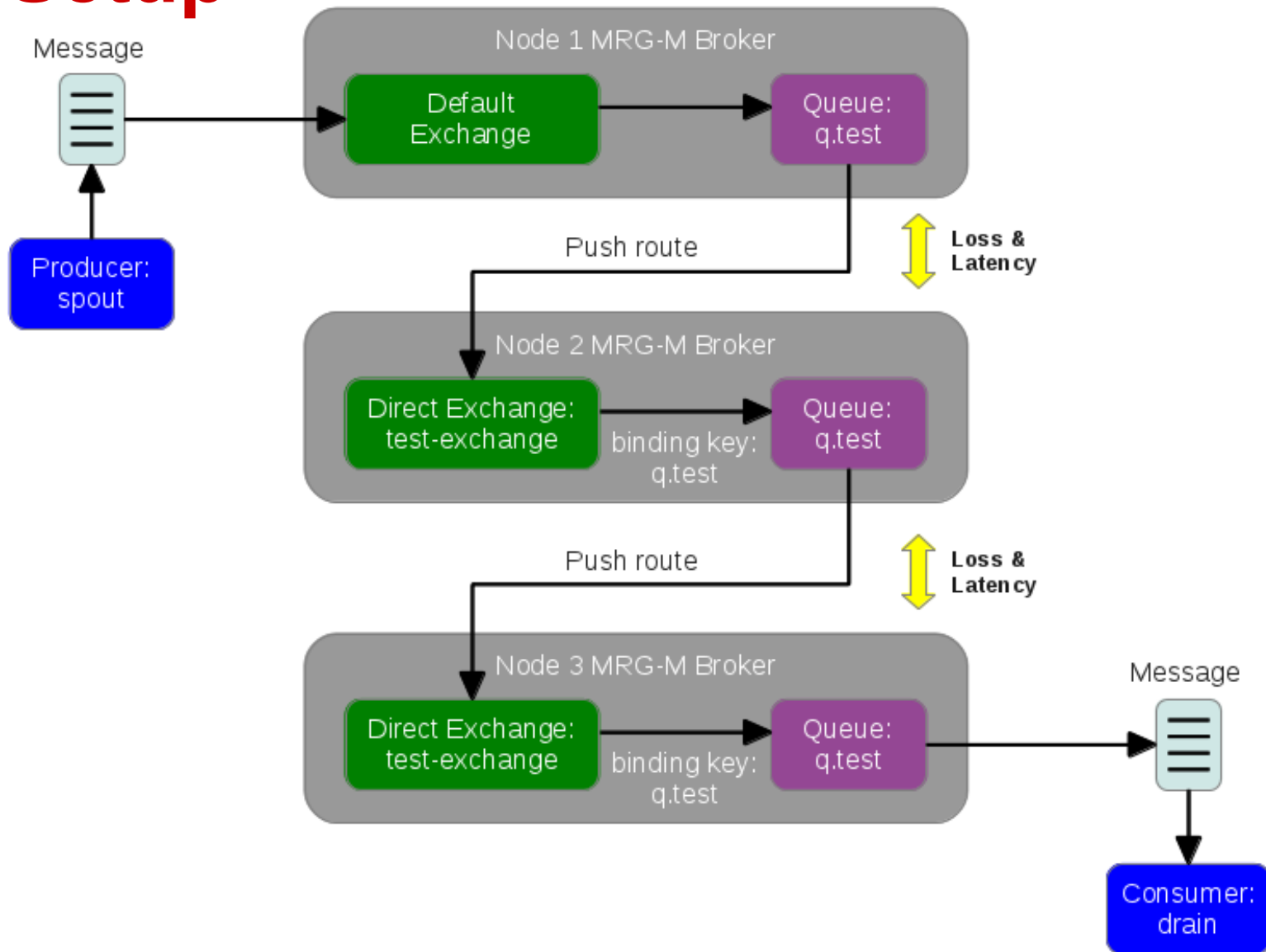
- Queue Route
 - Source queue to destination exchange
 - Can be push or pull
 - Optional acknowledgments



- Others
 - Exchange, Dynamic Exchange



Test Setup



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RHEL Emulates Networks Out-of-the-box

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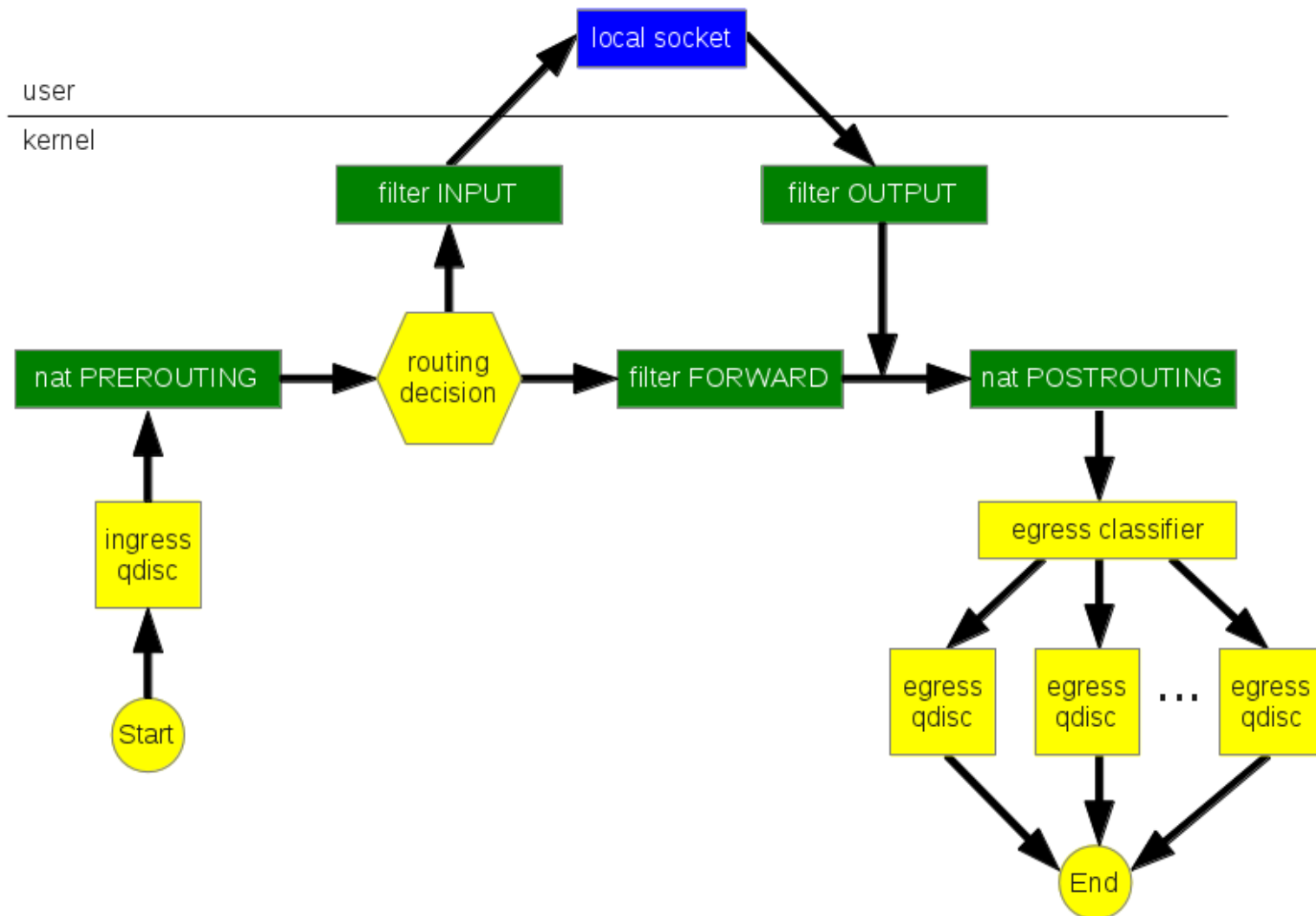


Network Simulation

- How do you simulate a unreliable network?
 - Buy dedicated hardware and/or software
 - Use other open source tools like WANem
 - Use built-in RHEL facilities
 - Traffic control (tc)
 - Network emulation (netem)



Linux Networking



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Queuing Discipline

- qdisc
 - Algorithm that manages a queue
 - Can be classful or classless
- root qdisc
 - Every network device has at least one qdisc
 - Default is pfifo_fast
- class
 - Parent can be qdisc or another class
 - Leaf must have qdisc



htb qdisc

- Used with netem to limit rate
- Rate limit via token bucket filter (tbf) algorithm
 - Bucket fills with tokens at constant rate
 - As bytes sent, token are removed
 - If insufficient tokens, packet is held
- Hierarchy Token Bucket (htb) qdisc
 - Enables rich link sharing via a hierarchy of classes
 - Filters direct packets to different qdiscs
 - Enables single link to act like multiple virtual links

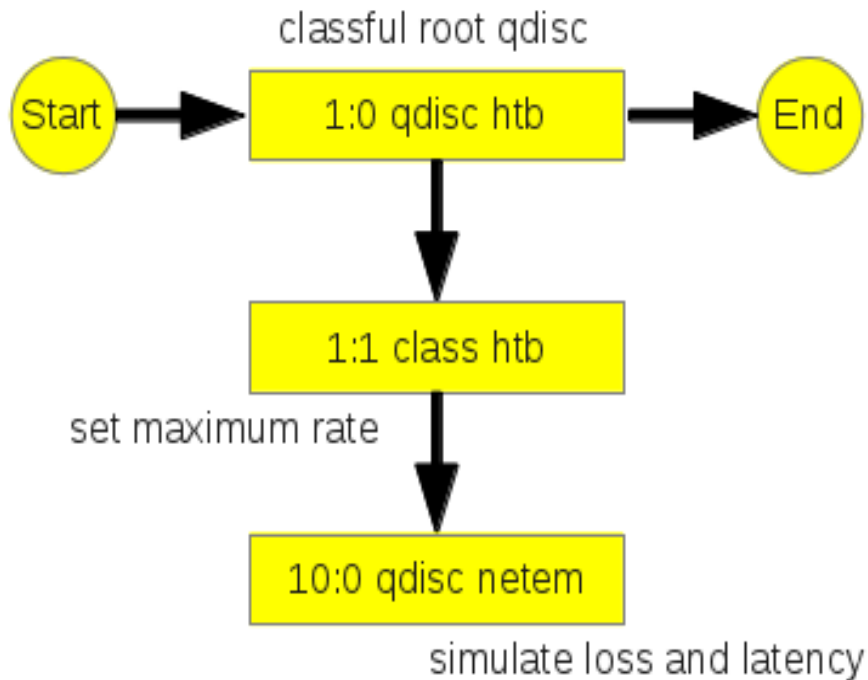


netem qdisc

- Nearly all functionality of full blown emulator
 - Latency (and jitter)
 - Loss
 - Duplication
 - Corruption
 - Reordering
- Add randomness and correlation
 - distribution tables (Normal, Pareto, or experimental)



Network Setup



```
ethtool -offload eth0 tso off
tc qdisc replace dev eth0 root
    handle 1: htb default 1
tc class add dev eth0 parent 1:
    classid 1:1 htb rate 100Mbps
tc qdisc add dev eth0 parent 1:1
    handle 10: netem limit 9000
    delay 100ms loss 0.1%
```

tso – TCP Segmentation Offload

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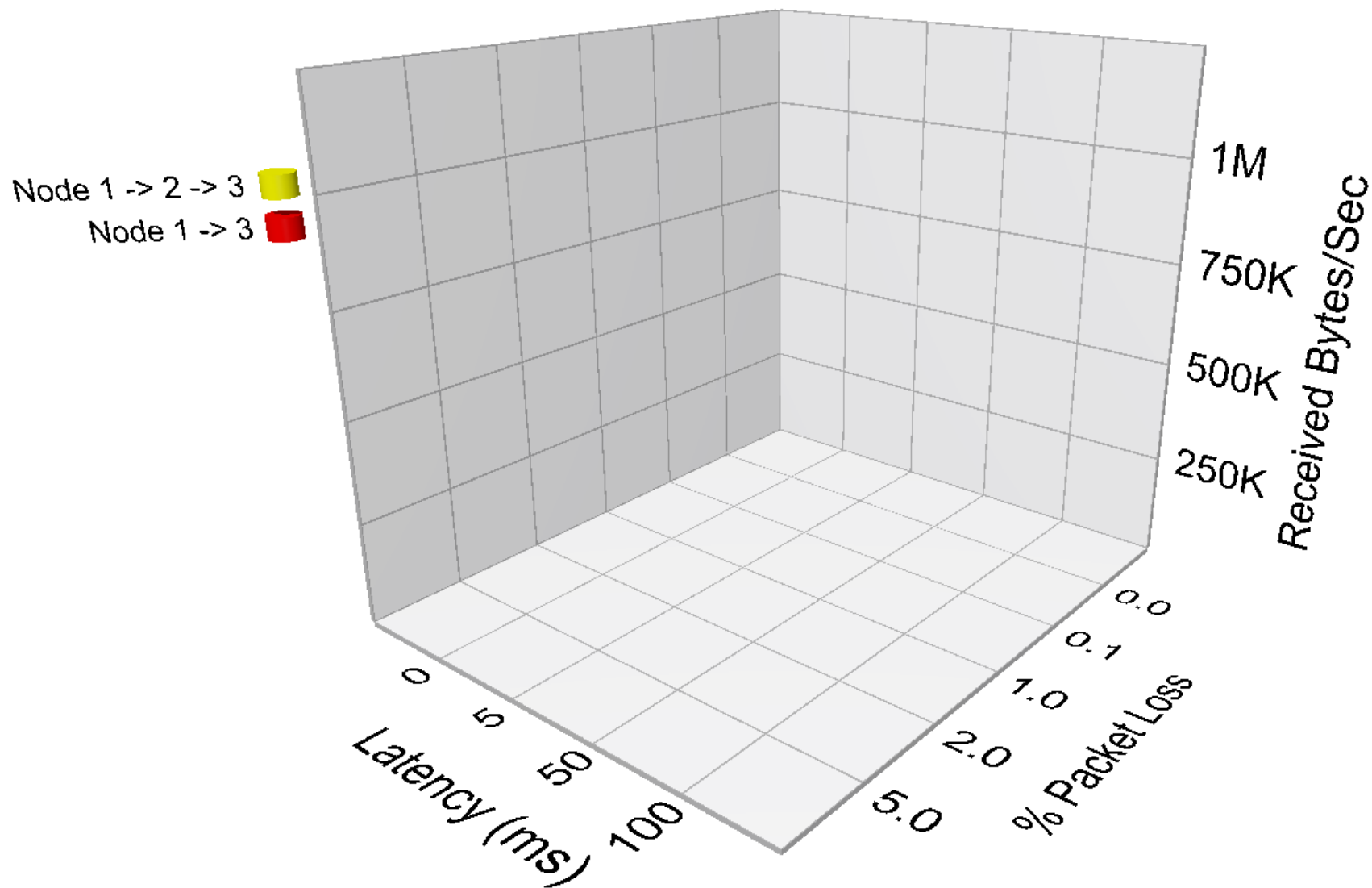


Test Methodology

- Spout on Node1
 - Messages varying in size from 1K to 128K
- Drain on Node3
 - Write received messages to file
 - Determine elapsed time from first to last message
 - Calculate receive rate
- Two scenarios
 - Intermediate MRG-M broker (Node 1 -> 2 -> 3)
 - No Intermediate MRG-M broker (Node 1 -> 3)
- Vary packet loss and latency



Let's take a look at the results ...



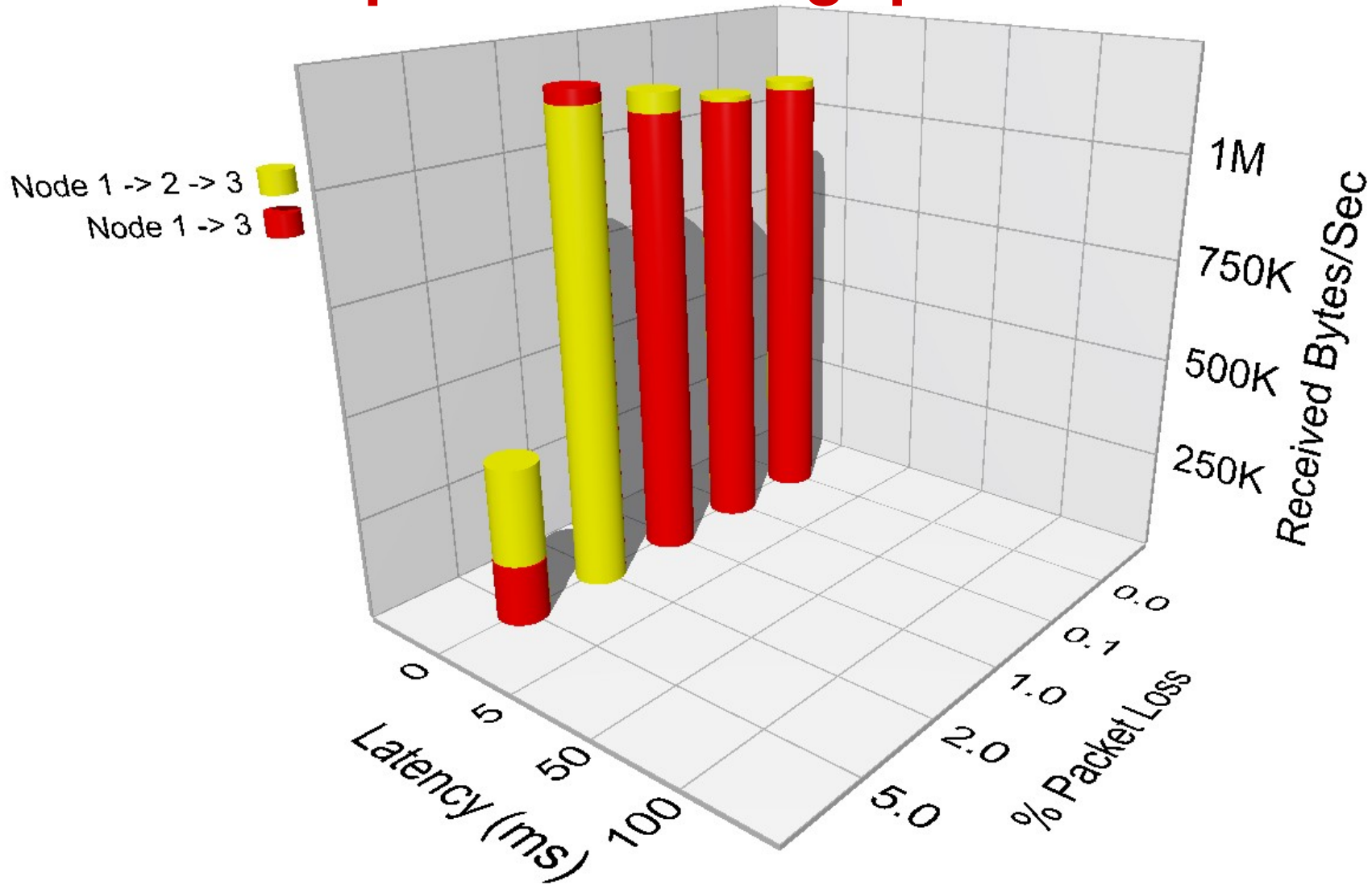
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MRG-M Improves Throughput



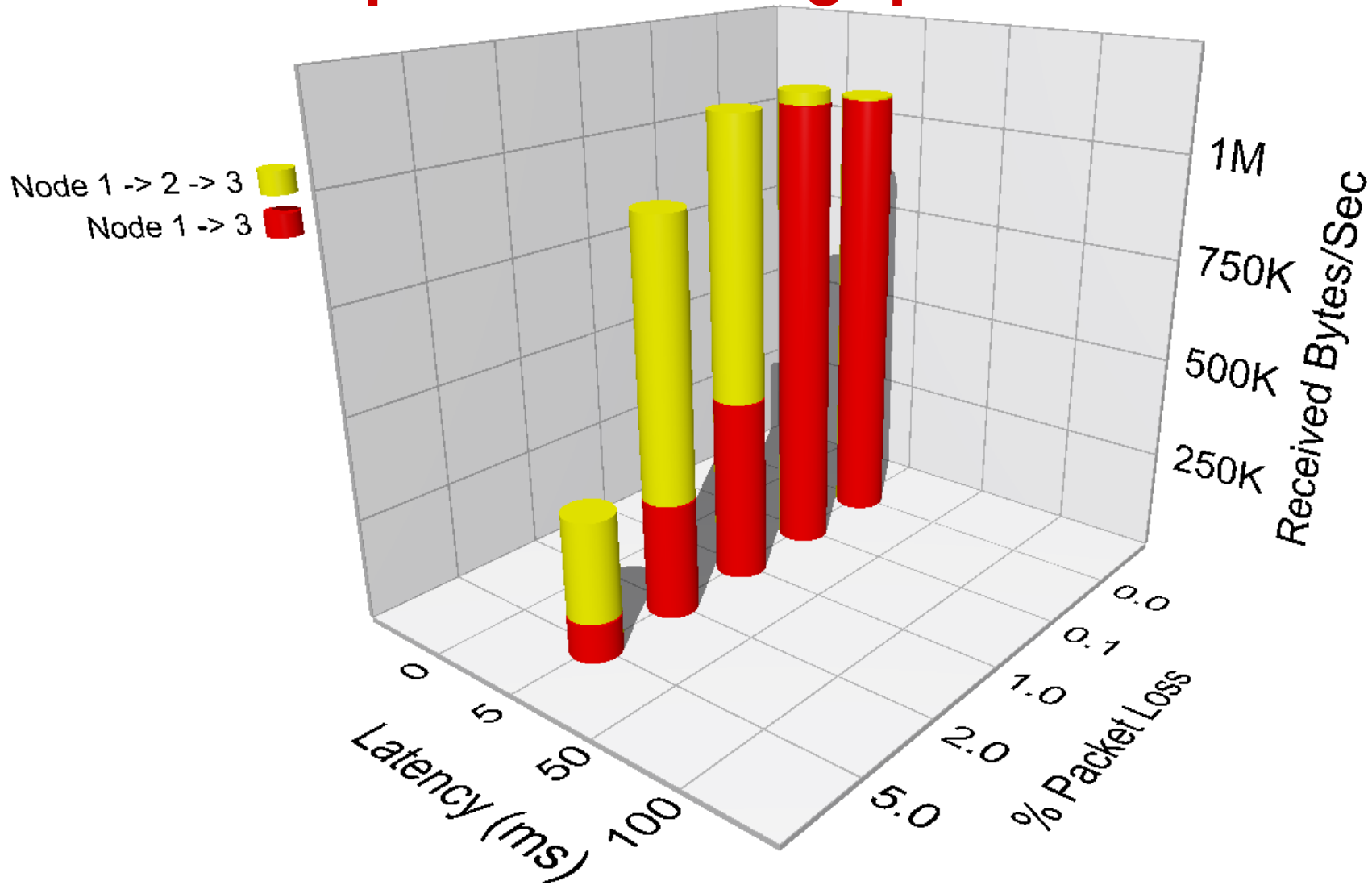
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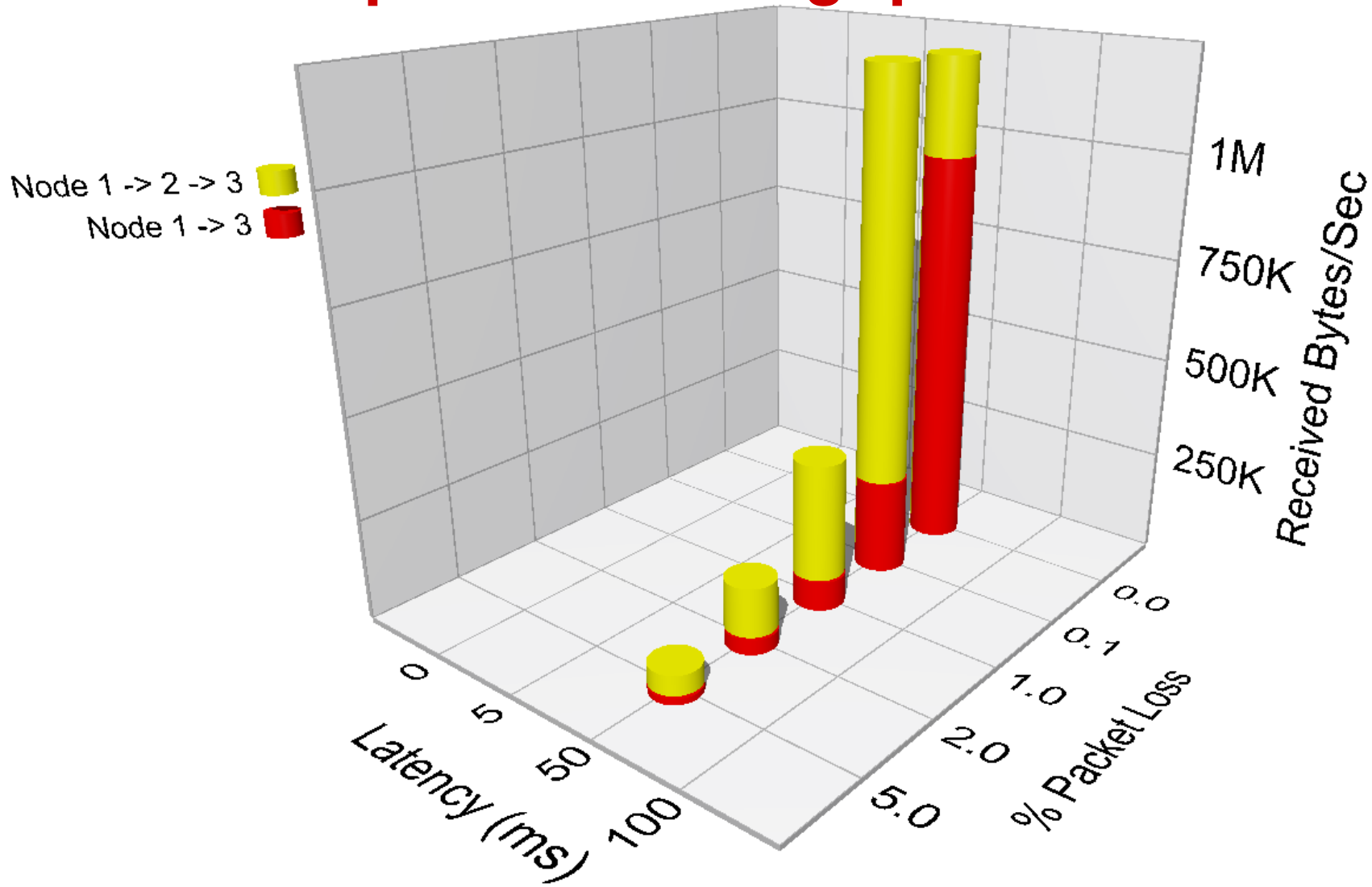
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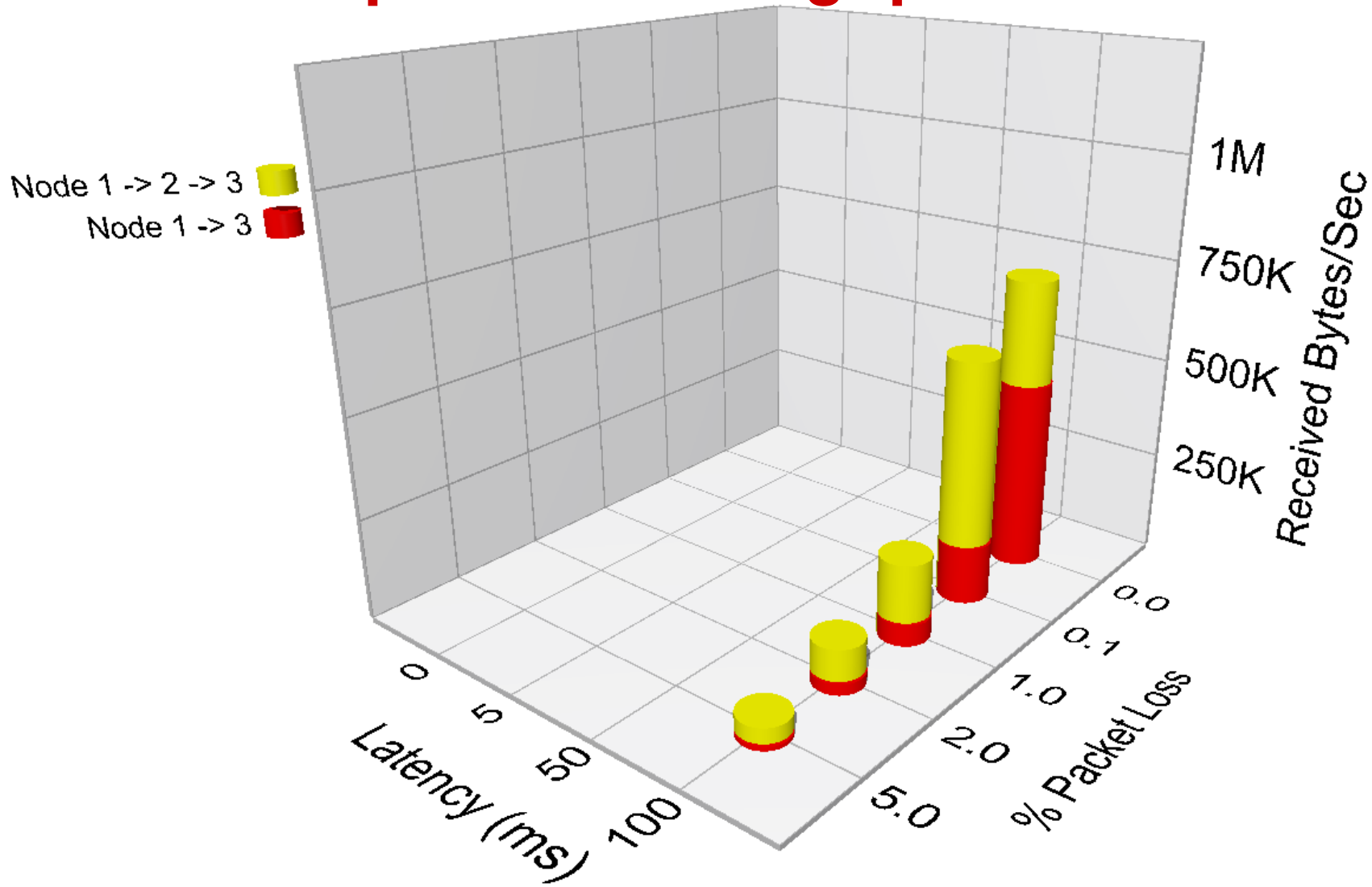
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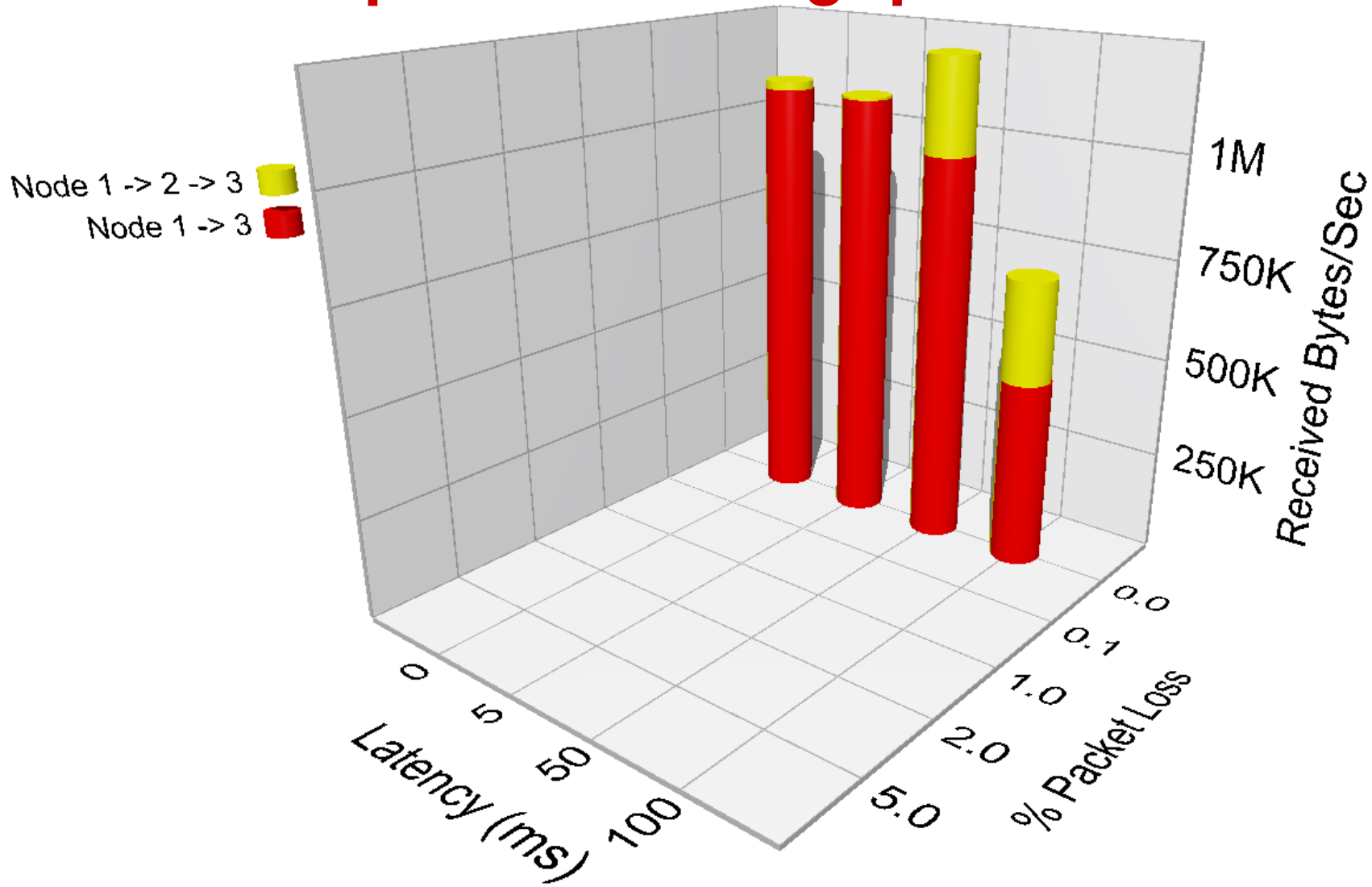
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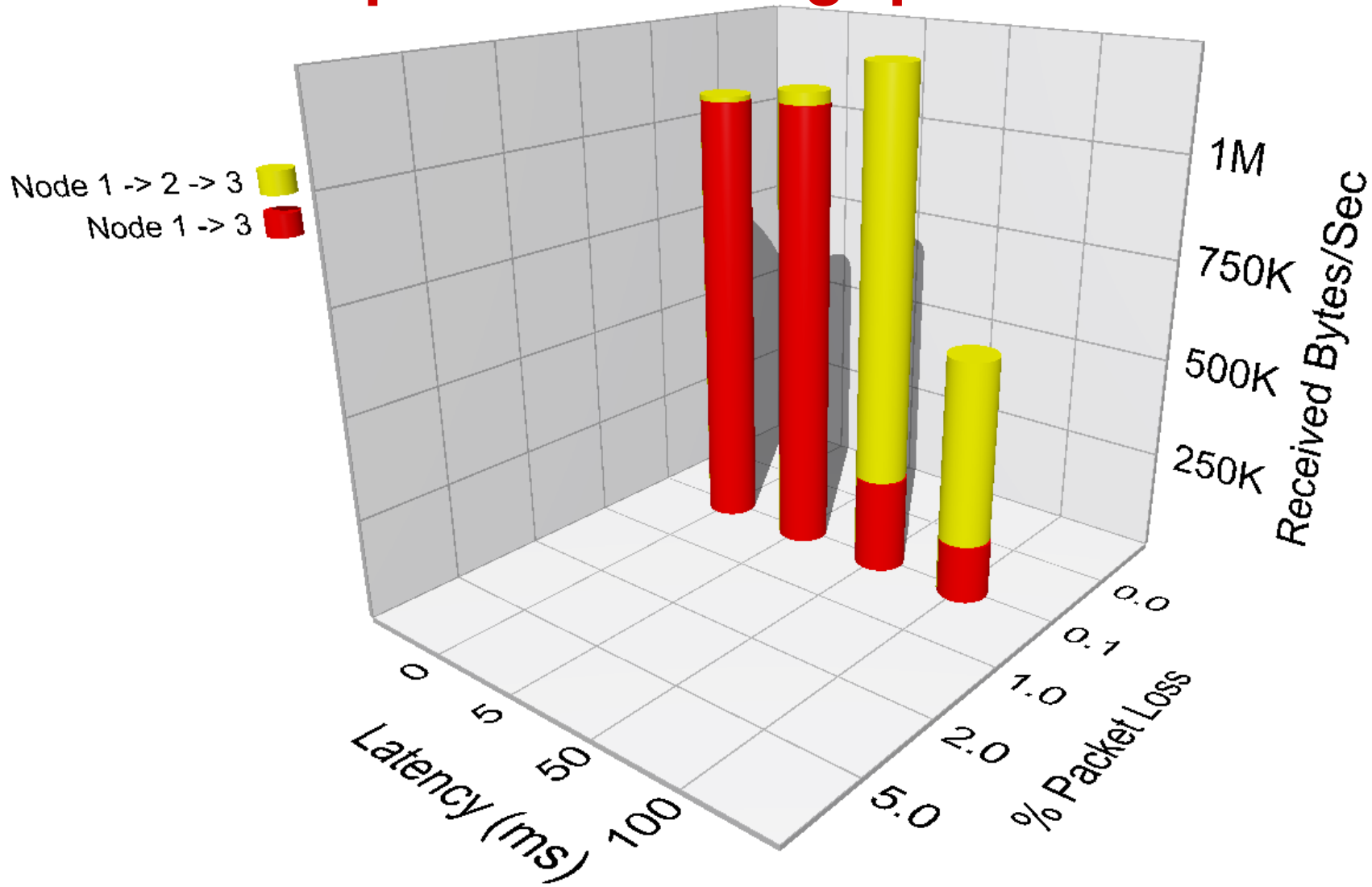
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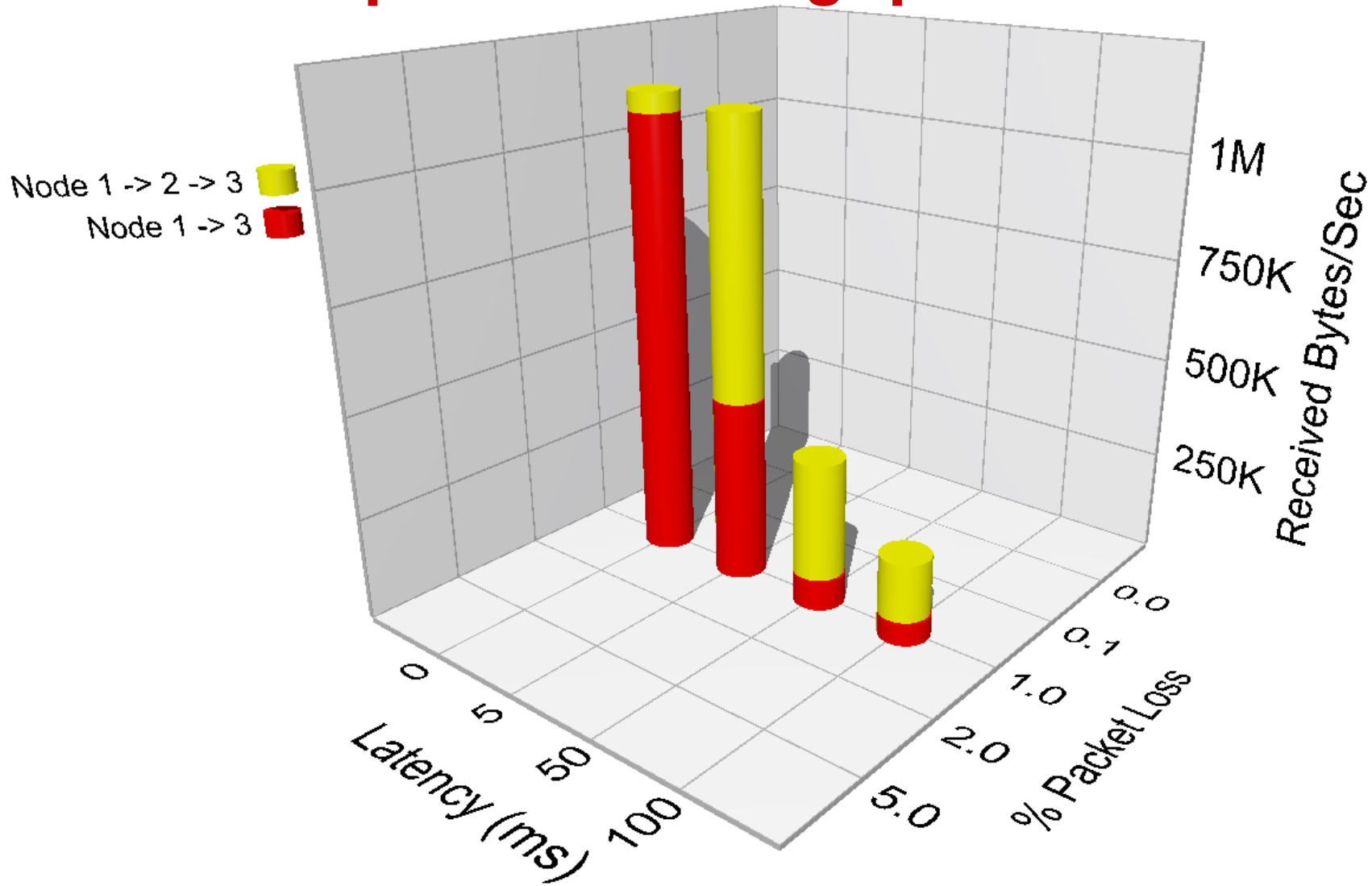
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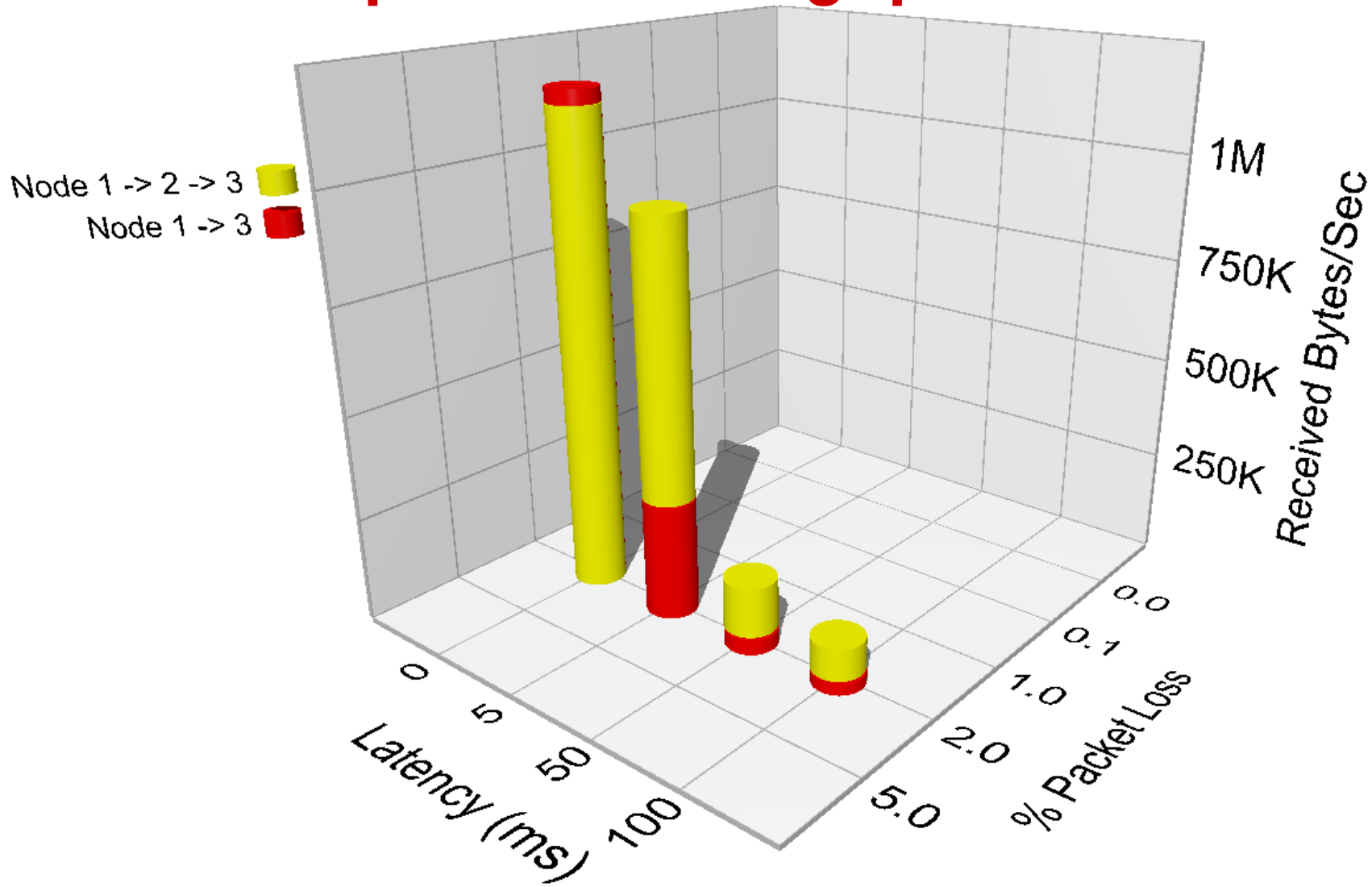
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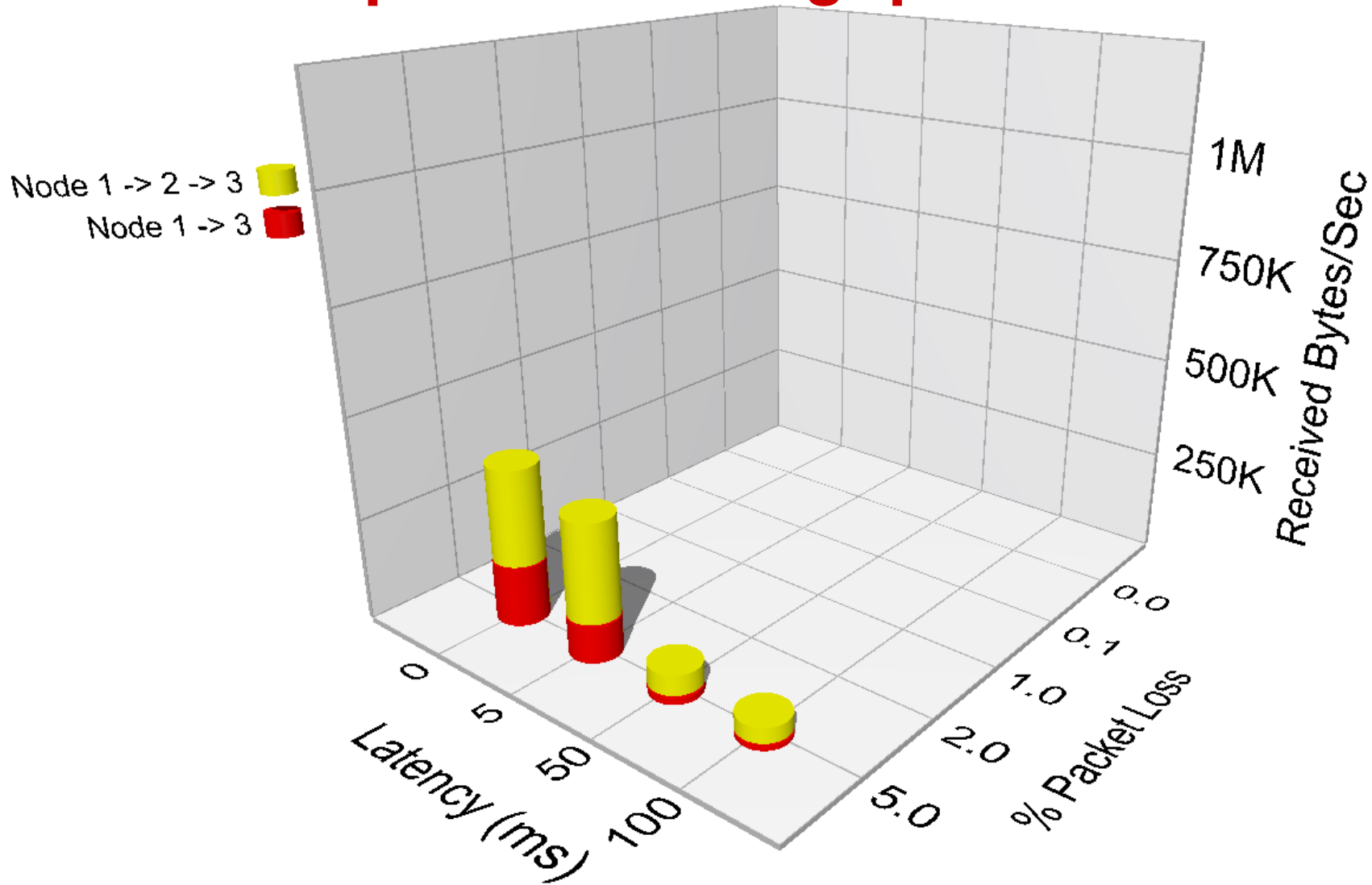
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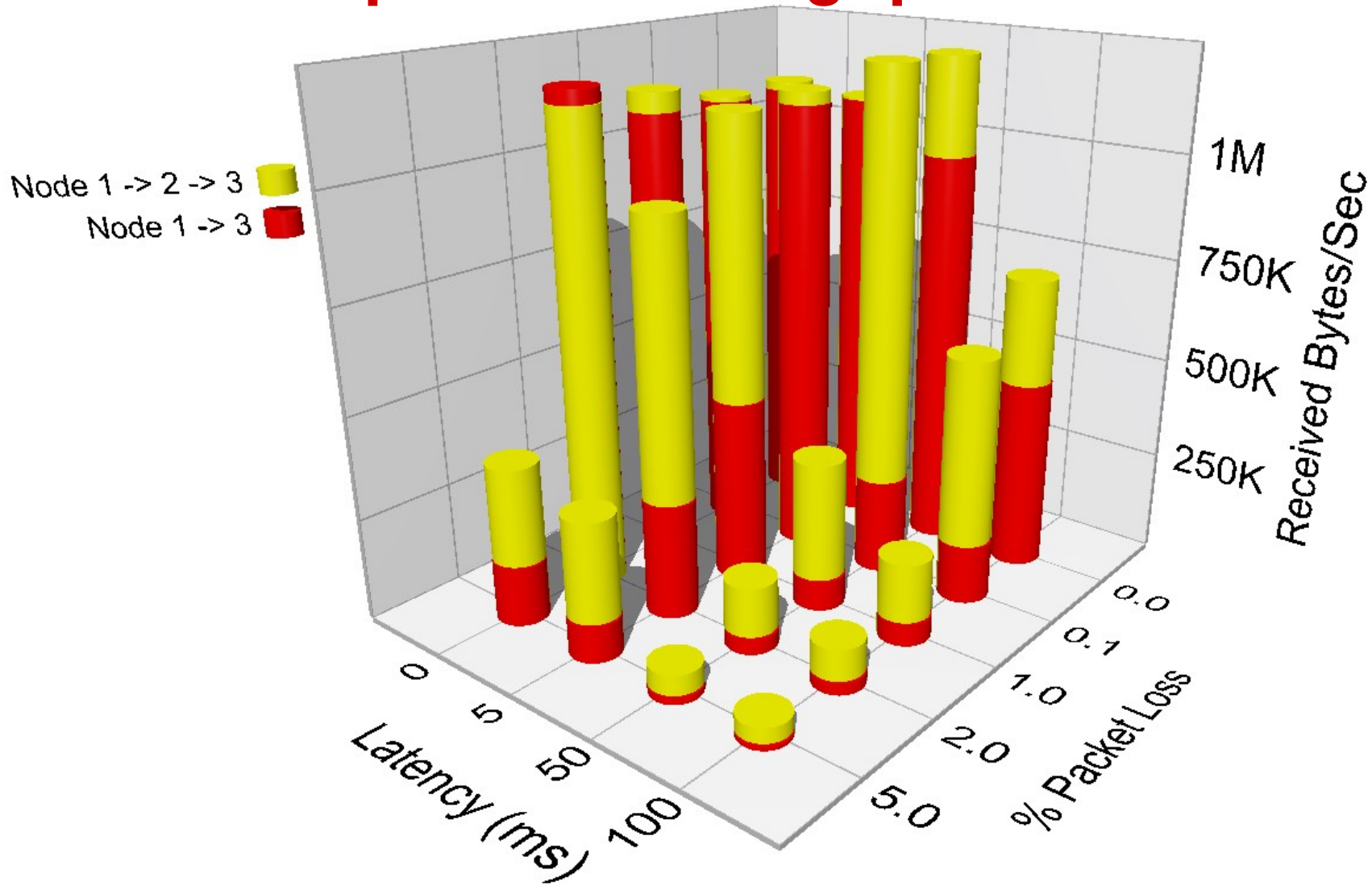
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MRG-M Improves Throughput



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What did we learn?

- 3X improvement with intermediate MRG-M broker
- Packet loss and latency devastating to TCP/IP
 - Cumulative effects crush throughput
- Next steps
 - Run in non-virtual environment
 - Collect additional metrics on TCP/IP performance
 - Investigate tuning of TCP/IP to maximize performance



Learn More!

- Red Hat's web site has links to videos, white papers, and more under Resources tab
 - <http://www.redhat.com/products/jbossenterprisemiddleware/messaging/>
- MRG-Messaging Documentation
 - http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_MRG/index.html
- Red Hat Enterprise Linux Manual Pages
 - tc, tc-htb
- Linux Advanced Routing and Traffic Control
 - <http://lartc.org>

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Sessions

- Thursday
 - 1:20, Room 310: MRG Update and Roadmap
 - 2:30, Room 309: Real World Perspectives Panel
 - Clark Palmer, Chief Engineer for Meteorcomm
 - 4:50, Room 209: MRG-Messaging Taste of Training
 - 6:00: Jim Whitehurst Innovation Hour with Tim Potter of Meteorcomm
- Friday
 - 9:45, Room 206: Realtime Intelligent Messaging with MRG-M

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