SNMP over UDP vs TCP

Wes Hardaker (Sparta, Inc.)

July 29, 2008
1. Introduction

2. Study Details

3. Results

4. Conclusions
Outline

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Purpose

Measure performance of UDP vs TCP in lossy networks
- How SNMP performs in bad environments
- How to pick the right protocol for the right task

Why
- Lossy networks are still common.
- Past UDP vs TCP studies
  - Aren’t recent
    - TCP performance has increased recently
  - Often studied small losses only
    - (e.g. 1%)
Lossy Networks

Lossy networks exist because of...

- Congestion
- Mobility
- Wireless Meshes
  - Rarely 0% loss and loss rate
  - Aren’t just 0 or 100%
  - “Links with intermediate levels of loss are the common case”
    - From: Link-level Measurements from an 802.11b Mesh Network
- Satellites
  - Affected by weather (Rain, Snow, Fog, ...)
  - Loss rates vary drastically (0% to 40%)
Case in Point: MIT’s RoofNet
Constant Change

Worthy Notes
- This data will be obsolete tomorrow
- Lossy networks are here to stay
- Hope for the good, plan for the bad, expect the ugly

Continual Change: Help is always around the corner
- Channel path improvements
- TCP Improvements
  - TFRC, TCP Westwood, TCP-Real, ...
- Traffic prioritization
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Very Quick Study

- ... but the results are still interesting
- Studies beget studies: lots of interesting follow-on potential
Study architecture

Study Environment
- Simulation environment: Emulab

Machine and Network Details
- Two 850MHz P-III Fedora8 linux systems
- Net-SNMP agent and a perl script client
- Linked via an emulab controlled link
- Loss rate was varied at each node’s interface
  - eg, 2% potential loss on each means 3.96% loss total
- 1000 GET requests
  - SNMPv2c
  - sysContact.0
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Study 1: GET sysContact.0

- A single sysContact.0 instance requested
- Maximum expected round trip time: .01s
- TCP maximum wait time fixed at 2 minutes
  - Beyond that, the manager gives up
- UDP retries set very high
- UDP timeouts varied
  - UDP .050 = 5X maximum
  - UDP .100 = 10X maximum
  - UDP .200 = 20X maximum
  - UDP 1.00 = 100X maximum
0% Loss

![Graph showing 0% loss over requests for TCP and UDP at various packet sizes.]
9.7% Loss
18.9% Loss
27.7% Loss
29.4% Loss

![Graph showing 29.4% loss with different lines representing TCP and UDP with varying delays.](image)
31.1% Loss

![Graph showing 31.1% loss over time for different protocols (TCP and UDP with varying delays).]
32.7% Loss

32.7% loss

seconds

requests

tcp
udp .050
udp .100
udp .200
udp 1.00

32.7% loss

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34.3% Loss
35.9% Loss

35.9% loss

requests

seconds

tcp
udp .050
udp .100
udp .200
udp 1.00
43.7% Loss
51.0% Loss
64.0% Loss

64% loss

tcp
udp .050
udp .100
udp .200
udp 1.00
75.0% Loss

![Graph showing 75% loss for TCP and UDP with different packet sizes.](image-url)
Results from Small Packet Study

- tcp
- udp .050
- udp .100
- udp .200
- udp 1.00

Loss vs Time

- x-axis: loss rate
- y-axis: seconds

Study 1: GET sysContact.0
Study 2: GET 250 sysContact.0

Study 2 Goals

- Medium quantities of data
  - (IE, more than an MTU in size)

Study 2: GET 250 sysContact.0 instances

- SNMP GET of 250 sysContact.0
- Maximum expected round trip time = .05s
  - UDP .200 = 4X maximum
  - UDP .400 = 8X maximum
- Fragmentation results:
  - 3 GET fragments
  - 4 RESPONSE fragments
    - (sysContact.0 was 4 bytes containing “test”)

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Study 2: GET 250 sysContact.0

0% Loss

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2.0% Loss

Results

Study 2: GET 250 sysContact.0

1.9% loss

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3.9% Loss

![Graph showing 3.9% loss with requests on the x-axis and seconds on the y-axis. The graph compares TCP and UDP with different loss rates.]
9.7% Loss
18.9% Loss
27.7% Loss

![Graph showing 27.7% loss with lines for tcp, udp .200, and udp .400]
29.4% Loss
31.1% Loss

31.1% loss

seconds
requests

tcp
udp .200
udp .400

0  100  200  300  400  500  600  700  800  900  1000
0  100  200  300  400  500  600  700  800  900  1000
32.7% Loss

![Graph showing 32.7% Loss]

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Loss vs Time

Results from Large Packet Study

- tcp
- udp .100
- udp .200
- udp .400
Study 3: Multiple TCP Sessions

Study 3: GET sysContact.0

- 250 instances of the sysContact.0 requested
- Multiple runs at the same loss compared
- Goal: to test TCP performance variability
3.96% Loss

Multiple TCP runs at 3.96% loss
Results

Study 3: Multiple TCP Sessions

5.91% Loss

Multiple TCP runs at 5.91% loss

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9.75% Loss
27.7% Loss

Multiple TCP runs at 27.7% loss

Requests vs. Seconds
Results from Multiple Large Packet TCP Study

- TCP
- UDP .100
- UDP .200
- UDP .400

Loss vs Time

seconds vs loss rate
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Conclusions

Most conclusions up to you...

- I’m not going to draw elaborate conclusions
- Significant interpretation up to the reader/viewer

Questions for the viewer

- When is it wise to use UDP vs TCP?
- What types of management traffic...
  - Should be prioritized?
  - Should or sent via the best delivery method?
  - Should be sent via the most friendly route?
Minor Conclusions

- TCP is great under ideal conditions and even mildly bad ones
- Proper setting of UDP timeout values is critical
  - No one sets them up properly
- Don’t let UDP fragment.
- Knowledge is power
Future Work

Notes
- No immediate plans to perform follow-on work.
- Goal Reminder: isolate the comparison to just TCP vs UDP

Future Work
- Explore all the TCP option settings
- Compare managing a complete set of objects
  - sysContact.0 is predictable, unlike the full set of objects
- Compare varying rates of network delays
- Compare using changing loss rate over time
- Compare TCP using auto-kill-and-restart procedures
- Compare with effects of traffic prioritization
Questions

Questions?