COSCAnet-FT
transparent network support for highly available cloud services
Motivation

Situation when using Cloud Computing

- nodes/services can fail
- routers can fail
Cloud Computing Service Outages in 2014

Google Apps Incident Report

Google Services - March 17, 2014
Prepared for Google Apps customers

We are aware of the service disruption and are working on it. Sorry for the inconvenience.

Go Back

Facebook © 2013 - Link

Adobe Customer Care Team

Post tagged "Outage"
Adobe Service Outage Update

Posted on May 15, 2014 by Adobe Customer Care Team | Comments (0)

Several Adobe services were down or unreachable for many of you over the last 24 hours. The failure happened during database maintenance activity and affected services that require users to log in with an Adobe ID.

We want to assure you that this was not security related – none of your information or content was lost or exposed.

First, and most importantly, we want to apologize for this outage because we know how critical our services are to you and how disruptive it's been to those of you who felt the impact. We understand that the time it took to restore service has been frustrating, but we wanted to be as thorough as possible. We have identified the root cause of this failure and are putting standards in place to prevent this from happening again.

We are aware that we didn’t meet your expectations (or ours) today. For this, we apologize. Thanks for bearing with us as we worked to resolve this – and know that we will do better.

Updated 11:20am PDT, May 16, 2014: Added information to clarify outage was not security related.

Office 365

Recent Office 365 service issues

Posted by Rajesh Jha MSFT
on 6/26/2014 1:25 PM

Rajesh Jha, Corporate Vice President, Office 365 Engineering

I lead the engineering organization that builds, operates and supports our Office 365 service. A core principle of running Office 365 is service reliability and we take this extremely seriously.

On Monday and Tuesday of this week, some of our Office 365 customers hosted in our North America datacenters experienced unrelated service issues with our Lync Online and Exchange Online services. First, I want to apologize on behalf of the Office 365 team for the impact and inconvenience this has caused. Email and real-time communications are critical to your business, and we aim to fully resolve the issue.
Content

• Replication
• COSCAnet-FT approach
• Evaluation
• Conclusion
Fault tolerance

State of the art

\[ c \rightarrow r \]

Replication

\[ c \rightarrow r \]
Replication

Passive replication

- significant failover time
- failover time vs. high availability

Active replication

- failover time $\rightarrow 0$
- not transparent for client(-applications)
Fault tolerance

goal: value-added service for fault-tolerance

requirements for active replication
  • deterministic execution (Domaschka 2012)
  • totally ordered multicast

totally ordered multicast on transport layer
  • integration into transport layer (TCP)
  • exploitation of reliable stream properties
  • client: standard protocols / software
Replicated Sockets

Connection to a group of processes (multiple endpoints)

- active replication (high availability)
- transparent for client (and server application)
- implicit **configuration** via COSCAnet
  - socket bind: set up of a route
  - group name: virtual IP address
Incoming segments

Requirements
• ensure order
• input length exactly one segment per read
• modify acknowledgements

\[ \text{ack}_t = \min(\text{ack}_t(p_i) | i \in \{0, \ldots, n\}) \]

Data \((c, p_i)\) to all

mechanisms required
Outgoing segments

Requirements

• aggregate data
• delay acknowledgements

\[ \text{ack}_t = \max(\text{seq}_t(p_i) | i \in \{0, \ldots, n\}) \]

• adapt window size

\[ \text{rwn}_t = \min(\text{rwn}_t(p_i) | i \in \{0, \ldots, n\}) \]
Further Addressed Challenges

- connection establishment
  - random starting sequence numbers
  - determinism during errors
- implicit passive failure detection
  - no data
  - FIN
  - RST
- handling of time stamps
- handling of a router crash
  - collect information
  - protocol with replicas (recovery)
## Latency Experiment

<table>
<thead>
<tr>
<th>experiment</th>
<th>setup</th>
<th>latency</th>
<th>overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>latency (LAN)</td>
<td>native</td>
<td>0.0999 ms ± 0.0473</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>NAT/1</td>
<td>0.1996 ms ± 0.0406</td>
<td>99.8 %</td>
</tr>
<tr>
<td></td>
<td>NAT/2</td>
<td>0.1997 ms ± 0.0806</td>
<td>99.9 %</td>
</tr>
<tr>
<td></td>
<td>NAT/3</td>
<td>0.0698 ms ± 0.0698</td>
<td>100.1 %</td>
</tr>
</tbody>
</table>

Latency (WAN):
- native: 10.428 ms ± 0.356
- NAT/1: 10.532 ms ± 0.181
- NAT/2: 10.556 ms ± 0.306
- NAT/3: 10.638 ms ± 0.285

- ~ 100%
- 1-2%
Throughput Experiment

<table>
<thead>
<tr>
<th>experiment</th>
<th>setup</th>
<th>bandwidth</th>
<th>per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>fail free (LAN)</td>
<td>native</td>
<td>109.7 MB/s ± 1.6</td>
<td>100 %</td>
</tr>
<tr>
<td></td>
<td>NAT/1</td>
<td>107.0 MB/s ± 0.9</td>
<td>97.5 %</td>
</tr>
<tr>
<td></td>
<td>NAT/2</td>
<td>54.6 MB/s ± 1.7</td>
<td>49.8 %</td>
</tr>
<tr>
<td></td>
<td>NAT/3</td>
<td>35.8 MB/s ± 2.5</td>
<td>32.6 %</td>
</tr>
</tbody>
</table>

\[
\text{~99 \%}
\]

\[
\text{faster}
\]

\[
\frac{b}{\left|\text{reps}\right|}
\]
Conclusion

• transparently integrate group communication for active replication on transport level
• special router maps addresses and multicasts TCP segments
• reasonable throughput and latency during fail-free periods
Future Work

- support for other protocols than TCP
- compare content
  - detect Byzantine Faults
- integration of scalability groups