CU*ANSWERS HIGH AVAILABILITY PROGRAM REVIEW

EVENT DATE(S): 12/10/2016 – 12/18/2016

SUMMARY

As part of an ongoing business continuity program, CU*Answers actively maintains a high-availability (HA) core processing environment with real-time CU*BASE data replication between identical hosts located at two geographically dispersed, state-of-the-art datacenters. A minimum of twice each year, HA rollover events are scheduled to redirect core processing and operations to the HA datacenter for a minimum period of 72 hours. At the conclusion of the rollover event, CU*BASE core processing is redirected back and operations resumed at the primary datacenter (located in Kentwood, MI). These HA rollover events are invaluable in an effort to validate procedures and ensure the ability to recover CU*BASE/GOLD core processing in an effective and timely manner.

This was put to the test during the early hours of Saturday, December 10, when recovery teams were notified and mobilized without notice to perform an emergency rollover and avoid a possible disruption of core-processing services during peak business hours. Initial notification occurred at approximately 1:30 AM ET; pre-roll tasks completed by 2:30 AM; and role-swap process concluded by 3:30 AM. At that time, all CU*BASE/GOLD core-processing services were being served from systems at the HA data center at Site-Four in Yankton, SD. Throughout the following week, teams coordinated with hardware and software vendors to isolate and remediate the problem that triggered the rollover decision. On the evening of Sunday, December 18, the HA rollback process was completed, bringing core-processing back to the primary production data center in Kentwood, MI.

This "emergency" rollover event comes on the heels of a prior scheduled rollover performed on October 16-19 which followed the relocation of our HA environment from our secondary data center in Muskegon, MI to Yankton, SD. Details of the October event are documented in a separate report at: https://www.cuanswers.com/solutions/business-continuity/auditing-and-testing/ .

Notable characteristics of this event include:

- This rollover event was unscheduled and initiated based on abnormal performance characteristics of the production host that generated multiple instances of brief interruptions for CU*BASE/GOLD users starting on November 29.

- Remediation of the root cause required the assistance of support teams from multiple vendors for both system hardware and third-party software applications.
    - Early symptoms led support teams to diagnose a hardware problem; while the root cause ended up being a software defect (bug) in a third-party application that generated the errors (and ultimately system performance degradation) in the host operating system.
    - Having identical redundant host environments allowed us to perform deep diagnostics on the stand-by host without the risk of a disruption of service.

- This event was the first unplanned rollover performed since moving the HA environment to the Site-Four data center in Yankton, SD (September 2016).
  - This event required the cooperation and support of Operations Team members at Site-Four, putting the colocation agreement between the two parties to the test.
  - The experience gained in performing HA rollovers over the past 10+ years provides the confidence to make these decisions with short notice, completing the process prior to the beginning of the business day.

- This unplanned HA rollover (Kentwood, MI to Yankton, SD) was performed at the same time as the planned Site-Four HA rollover (Yankton SD to Kentwood, MI).
  - The Site-Four HA rollover was conducted from Sunday, December 11 through Wednesday, December 14 involving credit unions from CU*Northwest and CU*South.
  - CU*Answers and Site-Four have a reciprocated colocation agreement for providing the high-availability hot-site locations. In the agreement, each hosting partner provides both operations and network support to the visiting partner. During this HA rollover, both were conducted simultaneously.
- For the purpose of this unscheduled rollover event, connectivity from external sources was "back-hauled" through the Kentwood and/or Muskegon datacenters using existing VPN channels.
  - Following the HA rollover in October, a project was launched to create the necessary VPN tunnels from external sources (i.e. credit union branch networks) directly to the Site-Four datacenter. This connectivity will be validated through offline testing and confirmed during the next scheduled HA rollover (tentative Q2 2017).

The following sections identify challenges observed, lessons learned, and recommendations for consideration related to this event.

EVENT DETAILS

The symptoms that led to the decision to perform an unplanned HA rollover began on Tuesday, **November 29**, when GOLD users reported intermittent sessions dropping between 7:05 and 7:35 AM ET. Early signs within the systems logs pointed to a potential hardware failure in the disk controller environment. Working with the IBM hardware support team, hot-swappable components were replaced on Wednesday, **November 30**, during a maintenance window of 10:30 and 11:30 PM. This was performed without interruption for clients or members.

During the early morning hours of Saturday, **December 10**, the production system began to behave in a manner similar to the disruptive event on November 29 (prior to the hardware replacement). System log files confirmed this behavior prompting the proactive decision to perform the HA rollover so that deeper diagnostics could be performed on the production host.

On **December 10**, at 2:30 AM ET, the production host in Kentwood, MI was taken offline and rollover procedures initiated to bring CU*BASE core processing online at the HA environment in Yankton, SD. By 3:25 AM, the rollover process had completed and recovery teams began testing core processing applications and systems before making them available. By 3:40 AM, member-facing applications such as online/mobile banking were back online. Recovery teams worked to resolve connectivity issues with each third-party EFT vendor and self-processor. Support teams (CSR and CSO) were put on alert for a potential increase in call volumes.

On Monday, **December 12**. while running live on the HA host at Site-Four, users once again reported CU*BASE/GOLD sessions dropping at 10:40 AM. This confirmed that the problem was not isolated to the production host alone, but existed on both the Primary and HA environments. This time, log files revealed a third-party application defect generating errors in the IBM host operating system (V7R2).

On Tuesday, **December 13**, the vendor for the third-party application provided a software update that was tested and installed on the HA host. After 24 hours of observation, the same software update was applied to the production host the following day (December 14).

On Thursday, **December 15**, after monitoring both hosts for 48 hours, the decision was made to schedule the rollback for the evening of Sunday, December 18, during non-peak business hours.

On Sunday, **December 18**, at 10:00 PM, the rollback process was initiated bringing CU*BASE/GOLD core processing back to the primary datacenter in Kentwood, MI. This process was completed and systems back online by 10:46 PM.

CHALLENGES

As our Information Technology systems and networks continue to grow in both size and complexity, the ability to orchestrate a perfectly-tuned environment becomes more challenging. Rather than scale back and settle for less, innovation requires pushing forward, learning along the way, while preparing for the unexpected.

As noted above, the circumstances leading to the decision for this rollover event can be traced back to a CU*BASE/GOLD interruption that occurred on the morning of November 29, 2016. Analysis of log files by both internal and vendor support teams identified a hardware component that was generating disk I/O (input/output) errors. The next day, the hardware component was replaced without interruption of service. When similar errors surfaced ten days later, the decision was made to perform an unscheduled rollover in an attempt to better isolate the problem. Once the errors surfaced on the secondary host, the effort to determine the root cause changed focus. It was at that time support teams were able to identify the chain of events and the source that was ultimately responsible for generating the error condition.

Due to the nature of these 'live' rollover exercises (redirecting production traffic from 250+ credit union locations to systems at the HA datacenter in Yankton, SD), potentially significant challenges and issues are anticipated and prepared for in advance, such as those observed in this event as detailed below:

- During the hours following the HA rollover (Saturday, December 10), an attempt was made to complete the daily card maintenance batch file transfers from December 9 before performing standard EOD/BOD processing. Operators observed a longer than normal file transfer rate and decided to abort the batch jobs and proceed with the EOD/BOD prior to credit unions opening for the business day. Card maintenance batch jobs were completed and posted on December 10.
  - o The source of the latency in batch transfers was due to network communications between the HA host and the GoAnywhere secure file transfer server. Configuration changes have resolved the latency for most transaction but a few larger file transfers were still experiencing longer than normal times. Support teams continued to investigate and test potential solutions.

- On the morning of the HA rollover (Saturday, December 10), CU*Answers support teams reached out to each credit union to confirm connectivity to CU*BASE/GOLD. Five branches identified having difficulty connecting. These were resolved with the support of CU*Answers Network Services.
  - This was not expected given that these branches were able to connect to the HA environment during the previous rollover performed back in October. CU*Answers will continue regular communications to remind client credit unions to frequently test connectivity to the HA environment between rollover events. In addition, documentation listing the network requirements for connecting to the HA environment will be refreshed and published in a highly visible area.

- On the morning following the HA rollover (Saturday, December 10), it was discovered that applications utilizing the API infrastructure were not able to connect to the HA host. This was resolved by changing the name of the API database within the system host table.
  - With the introduction of new servers for the production and high-availability host environments back in September, the database table names were not synchronized, creating the need to manually change them with each rollover. Support teams are collaborating to determine the best action to take to automate this process.

With each rollover event, whether planned or unplanned, the organization and its recovery teams grow stronger and more knowledgeable. To continue to improve, the business continuity program is reaching beyond the ability to recover and restore effectively and into the arena of predicting potential interruptions and developing new strategies to mitigate the risk through collaboration with hardware and software vendors. This requires a deeper understanding of how each component interacts and how individual changes can affect overall performance and reliability.

CONTINUING EFFORTS AND RECOMMENDATIONS

Whether planned or unexpected, each recovery test and high-availability rollover exercise provides the opportunity to continually improve the process and adjust procedures. The best way to accomplish this is to "Practice. Learn. Repeat/" The following is a list of action items and projects relative to this rollover event that will be pursued in an attempt to draw closer to that goal:

1. On the morning following the HA rollover, there were five credit union branches that were not able to connect to the HA host at Site-Four.
   a. Several of these branch locations were documented as "tested successfully" prior to the event by the client credit union using the tools provided during the previous rollover in October.
   b. Related to the above, the documented requirements for network connectivity published in the AnswerBook will be updated and reminders will be issued on a regular basis to ensure that credit union branches remain able to connect to the HA host at Site-Four moving forward.
2. Throughout the rollover period, daily processing involving the transfer of large batch files utilizing the GoAnywhere server experienced significant latency. Although workaround measures were implemented as a temporary solution, the source of the latency must be corrected.
   a. Internal support teams will continue to troubleshoot through packet capture and application testing outside of the rollover maintenance window.

3. Third-party EFT vendors will be engaged in an effort to improve the process and recoverability of network communications and further minimize downtime during high-availability and recovery events.
   a. Proactive communications prior to the HA rollover events will continue in an effort to minimize downtime with each vendor.
   b. The scope of future HA rollovers will be expanded to include the redirection of network traffic to the secondary datacenter for those vendors who have invested in high-availability technologies.
   c. The growing size and amount of time required for the transmission of the card maintenance files has been squeezing the available windows for performing these types of tests and exercises. Efforts to collaborate will continue with third-party EFT vendors on solutions such as increasing bandwidth to reduce time required for file transmissions.
4. Celebrate success, then press forward.
   a. When stepping back and evaluating all of the planning and effort invested over the years to achieve the level of preparedness the CU*Answers network has obtained through rigorous HA rollover exercises, a level of confidence is gained, helpful to continue building the networks and systems that will meet the demands of tomorrow.
   b. The relocation of the HA environment to the Site-Four datacenter in 2016 provides a level of redundant operational support not available previously. Building on this relationship will enhance the capabilities to respond and recover from unexpected disruptions.

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