

CU*ANSWERS HIGH AVAILABILITY PROGRAM REVIEW

EVENT DATE(S): 5/14/2023 – 5/21/2023

SUMMARY

As part of an ongoing business continuity program, CU*Answers actively maintains a high-availability (HA) core processing environment with near real-time data replication between identical hosts located at two geographically dispersed, state-of-the-art data centers. A minimum of twice each year, live HA rollover events are scheduled to redirect CU*BASE production and operations to the secondary data center (located in Yankton, SD) for a period of one full business week or longer. At the conclusion of the rollover event, core processing is redirected back, and operations resumed at the primary data center (located in Kentwood, MI).

These live production HA rollover events are invaluable to ensure the ability to recover CU*BASE GOLD core processing in an effective and timely manner when unexpected incidents occur that threaten to disrupt business operations. As such, the approach to conducting the rollover exercise has shifted over the years to more of a disaster recovery mindset, given the 24/7 nature of the increasingly digital financial services marketplace.

The CU*Answers 2023 spring HA rollover, performed on May 14th through May 21st, was scheduled in part to allow for support teams to complete a planned maintenance project that included an IBM operating system upgrade on both the CUA-PROD and CUA-HA servers. During the week prior to the rollover, the operating system on CUA-HA server was upgraded from V7R3 to V7R4.

New for this rollover event, an additional 1GB fiber data communications circuit was installed, dedicated for data replication traffic between CUA-PROD and CUA-HA. This project increased capacity at the secondary data center, complimenting the existing (2) redundant 1GB Internet circuits for VPN traffic.

As observed during previous rollovers, a slight increase in data latency for transactions between data centers has the potential to quickly cascade into performance issues during peak traffic volume periods for CU*BASE GOLD, online/mobile banking (OLB), and EFT transactions. The strategy in place for this newly installed circuit is to separate the data replication traffic from normal VPN traffic between the Yankton, SD and Kentwood, MI sites to optimize the allocation of system resources for transaction processing.

On the morning of Sunday, May 14th, beginning at 2:00 AM ET, teams initiated the procedures to perform the HA rollover. By 4:00 AM, all applications were back online from the secondary data center. No issues were reported on Sunday.

During the afternoon on Monday, May 15th, with core processing operating from systems in Yankton, SD, teams took the CUA-PROD server offline and began procedures to perform the planned operating system upgrade. This process was completed in approximately three hours, at which time data replication was turned on to allow the systems to re-synch. No issues were reported on Monday related to this process.

At approximately 9:00 AM on Tuesday, May 16th, support teams received calls from credit unions reporting a degradation in CU*BASE GOLD performance. Teams noticed latency spikes that impacted not only GOLD but also EFT transactions and OLB performance. CPU resource consumption on CUA-HA had escalated to the point that the decision to take OLB offline was made. This freed up resources to allow EFT transactions to finish posting and CU*BASE GOLD activities to function.

Unable to quickly determine the root cause, at 10:35 AM teams began to reverse software updates that had been installed earlier that morning for CU*BASE and OLB. Once monitored resources had returned to normal, OLB services were brought back online in groups of 50 credit unions at a time (a process deployed to prevent a surge in system resource demand during peak volume periods). No new issues were reported through the remainder of the day.

On Wednesday morning, at 8:06 AM, a brief spike in CPU utilization was detected but corrected itself before information could be gathered. At 11:45 AM, a larger spike in CPU utilization was detected and procedures to take OLB offline were conducted. Once resource monitors on the system had settled, OLB was brought back online, again in groups of 50 credit unions. While the symptoms were similar to the latency problems detected on Tuesday, the source of the network traffic delays turned out to be something different. Diagnostics led teams to a resource allocation issue on a firewall appliance that monitors traffic between the primary and secondary data centers. Working with the hardware vendor, the fix was applied to the firewall at 2:30 PM. No additional related latency issues were reported for the remainder of the rollover event (Thursday through Saturday).

On Sunday, May 21st, at 2:00 AM, teams initiated the procedures to redirect CU*BASE core processing back to the production data center in Kentwood, MI. As observed during the previous two rollover exercises, the process for resetting identity columns once again took longer than expected, requiring close to six hours to complete.

At 8:00 AM, with the role-swap process completed, teams began to apply network changes to redirect traffic and start subsystems that make up the CU*BASE application on CUA-PROD. Because of the extended amount of time required for the rollback, higher than normal EFT transactions that were queued during vendor stand-in processing mode began to post, consuming system resources including CPU utilization. As a result, teams were required once again to take OLB offline to let transactions post, then bring OLB back online. The HA rollback event finished at 9:30 AM, at which time nightly processing was performed for each credit union to prepare for the new business day. Nightly processing for credit unions in the Eastern Time Zone finished at approximately 10:20 AM.

The remainder of this report reflect the details of the event, challenges observed, and continuing efforts to improve the HA rollover process, given the significance it plays in ensuring availability of CU*BASE core processing during potentially disruptive scenarios.

**All times noted in this report are Eastern Time.*

EVENT DETAILS AND TIMELINE

As noted earlier, one of the key objectives of this scheduled HA rollover was the IBM operating system upgrade for both the CUA-PROD and CUA-HA servers. Prior to this event, multiple similar upgrades had been performed on other IBM servers including Development, Quality Control, Site-Four, and self-processing credit unions. All were completed with minimal issues that were promptly corrected. Teams anticipated and observed a similar successful upgrade process for these two server systems.

Shortly before the scheduled rollover, a new 1GB fiber data communications circuit was installed between the primary and secondary data centers. Data replication traffic between CUA-PROD and CUA-HA was configured to route over this new circuit in an effort to minimize latency experienced during high volume periods for remaining traffic between sites over the existing VPN. Teams monitored traffic closely on this new circuit and noted that the replication issues that had occurred in previous rollovers did not appear during this event.

Timeline of events:

During the **week of May 7th**, teams upgraded the operating system on CUA-HA from V7R3 to V7R4 without issues. Support teams performed testing to ensure that the server was prepared for the rollover period, during which it would become the production CU*BASE server for more than 200 credit unions on the CU*Answers network.

Sunday, May 14

On the morning of Sunday, May 14th, beginning at 2:00 AM ET, teams initiated the procedures to perform the HA rollover. By 4:00 AM, all applications were back online from the secondary data center. No issues were reported on Sunday.

Monday, May 15

During the morning hours, two credit unions reported network connectivity issues to the HA data center from specific branch locations. Working with CNS, these issues were quickly resolved. A reminder is included with each HA rollover announcement to test connectivity in advance to help minimize issues during rollover events.

That afternoon, with core processing operating from systems in Yankton, SD, teams took the CUA-PROD server offline and began procedures to upgrade the operating system. This process was completed in approximately three hours, at which time data replication was turned on to allow the systems to synchronize. Teams monitored network traffic and systems carefully, with no additional issues reported that day.

Tuesday, May 16

Multiple non-rollover-related planned maintenance tasks were scheduled for Tuesday morning, including the application of monthly security updates for servers and appliances across the data center and the installation of software updates to fix a collection of bugs reported since the CU*BASE software release on May 7th. In addition, a large SAV file transfer was initiated at 7:00 AM from the CUA-HA host in Yankton, SD to the CUA-DEV host in Kentwood, MI.

Around 9:00 AM ET, support calls were received from credit unions reporting a degradation in CU*BASE GOLD performance. Teams began to notice latency spikes that impacted not only GOLD, but **It's Me 247** online/mobile banking performance as well. CPU resource consumption increased to the point that the decision to take OLB offline was made. This freed up resources again to allow EFT transactions to finish posting and CU*BASE GOLD activities to function. Shortly thereafter, teams reversed the software updates installed earlier that morning for GOLD and OLB applications.

Once things had settled down, OLB services were brought back online in groups of 50 credit unions at a time. No new issues were reported through the remainder of the day. Teams were engaged with hardware and software support vendors to diagnose the events that occurred and attempt to identify the correct action plan to remediate the issue.

Wednesday, May 17

On Wednesday morning, at 8:06 AM, a brief spike in CPU utilization was detected but corrected before forensics information could be gathered. At 11:45 AM, a larger spike in CPU utilization was detected and procedures to take OLB offline were followed. Once resource demand returned to normal status, OLB was brought back online.

This time, teams were able to isolate the issue to a firewall appliance at the primary production data center in Kentwood, MI. Working with the hardware vendor, the fix was applied to the firewall at 2:30 PM. The fix involved a resource allocation configuration change to the VPN traffic between the data centers that at one time included data replication traffic.

Thursday, May 18 - Saturday, May 20

No rollover related issues were reported during the remainder of the event. Although multiple smaller spikes in CPU utilization were observed (common even in the production environment), all were short-lived and corrected themselves without intervention. Teams continued to monitor system resources carefully and prepare for rollback procedures on Sunday.

Sunday, May 21

On the morning of Sunday, May 21st, teams initiated the procedures to redirect CU*BASE core processing back to the production data center in Kentwood, MI. This process began at 2:00 AM. The previous rollback event ([December 23, 2022](#)) required approximately four hours to complete. This was due in part to an extended IBM process known as identity column reset. It became evident during this May 2023 rollback that additional time may be required. After three hours, the vendor support team was engaged to monitor the role-swap process and determine if/when completion could be expected. During this time, teams discussed and reviewed failback procedures should the need arise. At no point during the process did any indication of problems or errors occur.

At 8:00 AM the identity column reset process completed successfully. Teams began to apply network changes to redirect traffic and bring subsystems online that make up the CU*BASE application. Due in part to the extended amount of time required for the rollback, the stand-in processing queues containing EFT transactions required additional system resources to finish posting. At the same time, members waiting to login to online/mobile banking were accessing their accounts. A spike in CPU utilization created competition for system resources, eventually generating latency in OLB and slowing EFT processing. In response, teams once again took OLB offline to allow EFT transactions to finish posting, then brought OLB back online in groups of 50 credit unions to avoid a spike in resources.

The HA rollback event finished at 9:30 AM, at which time nightly processing was performed for each credit union to prepare for the new business day. Nightly processing for credit unions in the Eastern Time Zone finished at approximately 10:20 AM. No issues were reported for the remainder of the day.

CHALLENGES AND CONTINUING EFFORTS

As mentioned earlier in this report, the server hardware for the CUA-PROD and CUA-HA server environments are identical in capacity, performance, and hardware specifications. While many organizations may see the secondary data center as an area to conserve budgeted funds, the strategy at CU*Answers has always been to anticipate the need to provide CU*BASE core processing for an extended period of time on systems in the HA environment. While bandwidth capacities are identical for data communications, the difference between the production and HA

environments during the rollover event becomes the distance between the two facilities. While many applications adjust to fluctuations in latency automatically, some are more sensitive to spikes (even those measured in milliseconds) and can generate a cascading effect impacting system performance. These rollover events help teams to identify these areas for further improvements to enhance the overall customer experience.

Challenges observed during this rollover event include the following:

1. System resource (CPU) spikes on Tuesday, May 16, and Wednesday, May 17, while operating on CUA-HA.
 - The initial rollover and first business day (Monday) were relatively issue free. It was not until Tuesday morning that the initial signs of problems began to surface. Once detected, issues cascaded very quickly to impact multiple applications including GOLD, online/mobile banking (OLB), and EFT transactions.
 - A number of regular maintenance tasks were performed early Tuesday morning, including the application of monthly security patches on servers and devices other than the IBM systems that provide CU*BASE core processing. In addition, software updates for CU*BASE GOLD and OLB were pushed into production to fix some bugs identified following the May 7th software release.
 - While these same maintenance tasks have been performed during previous rollover events without incident, as a precautionary measure, teams will look to schedule similar tasks outside of rollover periods going forward to minimize risk of disruption.
 - Aligned with the above, future planned HA rollovers will be scheduled more than one week following a major CU*BASE software release.
 - The week following a major software release normally consists of updates to fix any bugs that have been reported. Multiple concurrent activities can create an environment that makes troubleshooting issues that arise much more difficult. Rollover exercises should be isolated with specific objectives and limited scope to minimize disruptions.
 - Once the spike in system resources was detected on CUA-HA (9:00 AM ET), the initial response was to take OLB offline to allow EFT transactions to finish processing. Prior to bringing OLB back online, teams reversed the software updates that were installed earlier in the day. Once completed, OLB was brought back online in groups of 50 credit unions to avoid a sudden spike in resources.
 - Teams continued to monitor systems throughout the day and identify any transactions that may not have finished processing as well as out of balance conflicts as a result of the latency issues. All were reported to have been completed successfully.
 - The sensitivity of OLB applications and subsystems running in CU*BASE to fluctuations in latency between the primary and secondary data centers continues to be an area of research for development teams.
 - Wednesday morning saw another CPU spike requiring teams to take OLB offline. This time, teams were able to identify a potential bottleneck on a CPU in a firewall appliance at the production data center in Kentwood, MI. This was not observed during the latency issues on Tuesday.
 - When the replication data was routed over the new circuit, the configuration for the remaining VPN traffic was not initially reconfigured to optimize resource allocation. This created intermittent CPU spikes during peak traffic volumes when latency began to climb. Resource consumption quickly escalated. Once this configuration change was made (late Wednesday), no additional significant spikes were detected for the remainder of the rollover event.

2. (Closely related to #1 above) ongoing issues with latency were observed between systems at the Kentwood, MI data center and CUA-HA host at the Yankton, SD data center.
 - During non-HA production periods (normal core processing), all servers communicate with each other in the same data center. Spikes in system resources are extremely rare. It is typically only when each packet must travel the distance to the secondary that latency issues surface. Although considered minimal (measured in milliseconds), even the slightest increase in latency can create problems. Peak volume periods for all applications that access CU*BASE may consist of tens of thousands of transactions simultaneously. An increase in latency can cause delays for some transactions, and even an occasional time-out. This often creates a cascading effect with applications attempting to retransmit, creating additional congestion.
 - During previous rollover events, the application most impacted by this latency was data replication between hosts at the two data centers. The additional data communications line installed earlier in May has provided additional capacity and better performance with minimal overhead. On Wednesday evening of the rollover event, a configuration mismatch was discovered between the channel for data replication and the remaining VPN traffic. Once the configuration change was made, there were no recurrences of CPU spikes observed for the remainder of the rollover.

3. During rollback procedures, a longer than expected period was required to complete the IBM identity column reset process. This resulted in a later than planned start time for nightly processing, requiring some creativity among the Operations Team to restructure automated processes to prioritize those credit unions with branches open for business on Sunday.
 - This has been an ongoing issue for rollovers in the past due in part to the complex and integrated design of the CU*BASE platform.
 - The previous rollover exercise ([December 2022](#)) required approximately 3 hours and 45 minutes for this process to complete. This May HA rollover required 6 hours to complete. A substantial increase in time pushed the nightly processing schedule ahead several hours, creating a tight window to finish before credit unions opened for the business day.
 - Teams engaged the data replication solution vendor during the event to help diagnose what is causing the delays and working with them on a solution to improve performance in future versions of the application.
 - As of the date of this report, the vendor has announced new features that will include a progress monitor and estimated time to completion during the rollover process as well as performance improvements through multi-threaded capabilities. These features will be testing in advance of the next scheduled HA rollover this fall.
 - At the same time, teams have engaged the hardware vendor (IBM) to review all configurations between systems and data communications channels between data centers. Log files have been archived for review in an effort to identify potential performance enhancements.
 - As part of our Strategic Technology Plan, teams will be evaluating other potential solutions for replicating data between hosts for core processing.
 - In addition, rollback procedures will be modified to allow all EFT transactions to finish posting before bringing OLB services back online.

4. Communications during the event

- Communications is always a key element to a successful response and recovery effort. Continual improvement has been an objective by learning from each incident and rollover event.
- Both Tuesday and Wednesday of this rollover event saw periods of increasing network latency and cascading resource consumption requiring teams to respond more than once by taking select services offline (primarily online/mobile banking) in an effort to allow prioritized transactions to complete.
 - Given the variety of scheduled planned maintenance activities performed Tuesday morning and the number of applications impacted, initial communications may at first have appeared incomplete or not reflected what all users were experiencing.
 - The goal is to share what is known at the time, what teams are doing to remediate as quickly as possible, and when service levels are expected to be restored.
- As part of every HA rollover debriefing process, areas to improve communications are discussed.

CLOSING REMARKS

Whether planned or unexpected, each recovery test and high-availability rollover exercise supplies the opportunity to continually improve the process. The value and significance of these exercises are multiplied when participants consider the ever-changing threat landscape from hardware component failures, dependency on third-party vendors and supply chains, geopolitical tensions including the use of cybersecurity attacks, and the frequency and scope of today's natural disasters.

Just as significant is the ever-changing technological environment that makes up the CU*BASE core-processing platform. Increased complexity in application development, vendor integration, and network infrastructure requires more frequent reviews and assessments of the business continuity strategies in place to meet recovery time objectives and a shrinking tolerance for downtime. Regular rollover exercises help us measure our progress and adjust accordingly.

Perhaps more than any other period, the past few HA rollover events have exposed opportunities to reassess the technology platform in place and make the necessary changes to build the foundation for the data center that will take us into the future. As the CU*BASE network continues to grow and expand into new markets across the country, these exercises help us determine the best strategy to get us there.

The investment made over the past two decades in building and testing its Business Continuity Program has positioned the CUSO to navigate the storms on the horizon and enables it to reach for new opportunities and serve its owners and client credit unions in innovative ways.

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