

CU*ANSWERS HIGH AVAILABILITY PROGRAM REVIEW

EVENT DATE(S): 12/20/2022 – 12/23/2022

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. The “unplanned” high-availability rollover detailed in this report is a prime example.

During the evening hours on December 19th, teams monitoring systems at the CU*Answers data centers received an alert identifying a component failure on the production CU*BASE host (CUAPROD). The component turned out to be a fan-out module (I/O system board) on the primary server. Given the level of redundancy configured within the system, the failure did not pose an immediate threat. Core processing was able to continue without any performance degradation. The process to replace the component, however, would require that the system be taken offline and powered down. As a result, the team began to plan and schedule a high-availability rollover.

Working with the hardware vendor (IBM), teams developed the game plan with steps necessary to safely replace the failed components while minimizing downtime for CU*BASE users. On the morning of December 20th, the plan was presented and discussed with the CU*Answers Executive Council. During the meeting, the decision was made to schedule the rollover for that evening, anticipating a rollback on December 22nd to ensure full capacity at the production data center going into the holiday weekend.

On the evening of December 20th, starting at 11:45 PM ET, recovery teams performed the HA rollover to bring CU*BASE online at the secondary data center in Yankton, SD. Once nightly processing was completed and core processing application testing confirmed, teams brought CUAPROD offline to begin the hardware component swap. Delivery of the replacement components was delayed in part due to the winter storm that was impacting travel across the mid-west region.

On the morning of December 22nd, the CUAPROD server was brought back online with the new hardware components installed acting as the secondary host, with production core-processing provided from CUAHA at the Yankton HA data center. By mid-day, all system diagnostic testing was completed and data replication between hosts synchronized. The rollback was scheduled and performed that evening, beginning at 11:45 PM ET. An issue surfaced during the rollback process that extended completion of the event until 3:45 AM ET. As a result, the job automation schedule was modified to accommodate a shortened nightly processing window across all time zones.

As credit unions began to open for business on Thursday, December 23rd, following the rollback and time-shortened nightly processing window, a number of issues were reported in CU*BASE GOLD and online banking. These errors were resolved by modifying select identify column sequence numbers. During the delayed rollback process, the data replication vendor was engaged to help troubleshoot the issue. One of the system commands used to diagnose the problem briefly interrupted the process and prevented the column reset process to complete fully.

In addition, some ACH posting files were delayed for the early FedLine window. These were all resolved later that morning. Details about these issues and remediation process are included in the following sections of this report.

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

EVENT DETAILS AND TIMELINE

The IBM Power10 hardware that hosts the production and high-availability systems for CU*BASE core processing are complex, enterprise-grade servers comprised of several integrated components and SAN appliances spread across multiple rack enclosures in both the Kentwood, MI, and Yankton, SD, data centers. System hardware is configured with a high level of redundancy to optimize availability. Many components are hot-swappable and can be replaced without interruption. Others require that the system be placed in a restricted state and/or powered down to ensure safety of the components and data integrity. In this incident involving one of the system's fan-out modules, accessing the failed component required the removal of other hardware devices and cabling.

While unplanned rollovers are relatively rare, having the capability to perform them with minimal downtime is a tremendous return on investment. The experience of the recovery teams and confidence in the test-validated procedures enabled decision makers to schedule, announce, and perform the initial rollover event within 24 hours and complete the entire repair/recovery process within 72 hours.

There were a number of factors that went into the decision-making process for scheduling this "emergency" rollover event, including:

- Timing of the event just days before the Christmas holiday weekend. Teams needed to consider any disruptions during high-volume transaction windows for members who may be holiday shopping as well as staff who may have plans with families. Consistent and regular cross-training has provided a large team of qualified individuals for each role so that response team coverage is sufficient in all scenarios.
- Middle of the business week where nightly processing windows are shortened across multiple zones. Planned rollovers are normally performed on weekends with lower transaction volumes and larger maintenance windows. Conducting a mid-week event would require a heightened level of planning.
- Amount of time required to perform the system maintenance to replace the hardware components in addition to completing adequate diagnostics and testing before rolling back. There was flexibility baked into the strategy that would allow postponing the rollback until after the Christmas holiday if necessary.
- Winter storm "Elliott" impacting travel across the mid-west region (delaying delivery of replacement hardware under warranty).

Every rollover event brings with it an inherent amount of risk and unique set of circumstances. Performing these events in a live, production environment forces recovery teams to anticipate what could happen and to ensure that all procedures are carefully validated and tested. Over time, the experience and skills gained prepares teams for a wide range of disruptive scenarios.

Timeline of events:

Monday, December 19

At approximately **10:00 PM**, an alert was received indicating a potential hardware failure on the production core processing server (CUAPROD). A support call with the hardware vendor (IBM) confirmed that a fan-out module had failed, part of system I/O communications framework. No system degradation was observed due to the investment and configuration in redundancy on the host. The replacement part was ordered under warranty and steps identified to perform the swap. Given the sensitivity of the work involved, a system power down would be required to remove and replace the failed component.

Tuesday, December 20

At **10:40 AM**, the replacement fan-out module arrived at the production data center.

At **12:00 PM**, the action plan was presented to the Executive Council for approval. An HA rollover was scheduled for later that evening to redirect CU*BASE core processing to the secondary data center so that the failed hardware component could be replaced. Announcements regarding the scheduled HA rollover were sent to CU*Answers online credit unions.

At **11:45 PM**, the HA rollover process was initiated by bringing CU*BASE offline (stand-in mode with third-party EFT vendors).

Wednesday, December 21

At approximately **2:00 AM** the HA rollover completed, and nightly processing started on the HA host at the Yankton, SD data center.

After nightly processing completed and data replication synchronized between primary and secondary systems, CUAPROD was taken offline and powered down for planned maintenance. Once the failed component was replaced, the system was powered up. Although no error messages were received from the fan-out module, system performance degradation was observed. After diagnostic testing, additional hardware components are ordered under warranty with expected delivery around **9:00 PM**. Teams suspected that the removal/reassembly process of system components to gain access to the failed fan-out module may have incurred minor damage to one of the cable system connectors.

Thursday, December 22

Around **1:00 AM**, replacement parts arrived at the Kentwood, MI data center. After nightly processing and data replication synchronization completed, the hardware support vendor (IBM) was dispatched for part installation.

At **10:00 AM**, the replacement parts were installed and system performance validated. Data replication was allowed to catch up with scheduled rollback set to begin later than evening.

At **11:45 PM**, the HA rollback process was initiated by bringing CU*BASE offline (stand-in mode with third-party EFT vendors).

Friday, December 23

An issue surfaced during the rollback process that extended the event by more than 90 minutes. Anticipating a completion time around **2:00 AM**, an operating system process for resetting database identity columns continued to run until approximately **3:30 AM**. During that time, recovery teams engaged the software vendor for the data replication solution to help troubleshoot. A system debug command was initiated to gather more information about what was occurring. The rollback process completed without intervention at **3:45 AM**.

At **4:00 AM**, with a shortened window to complete nightly processing, Operations started the EOD/BOD jobs for eastern and central time zones. To compensate for the late start, teams divided up the scheduled automated jobs in an attempt to finish before credit unions began to open for the business day.

As credit unions began to open, reports of errors in multiple programs including GOLD, online banking, and RDC were received. Also, the automated job for processing the early ACH window failed for multiple credit unions (15 in all).

Upon inspection, it was determined that the prolonged identity column reset process did not complete fully. Teams would later learn that the syntax used for the debug command inadvertently placed a lock on records as it was reading them, prohibiting the system process from resetting that identity column resulting in a few credit union libraries that were not accessible by the applications. This was corrected by performing a manual reset on those impacted, requiring restricted access for a brief period (1-2 minutes).

As a precautionary measure, teams postponed the early ACH posting for the 15 credit unions impacted until the next available FRB window, giving teams time to validate the results. All ACH postings were caught up by the second window.

The efforts above were completed for all credit unions by **11:00 AM** and all reported issues resolved by **2:30 PM**.

CHALLENGES AND CONTINUING EFFORTS

Every rollover event, planned or unplanned, provides an opportunity for a valuable learning experience. Even those that appear relatively smooth on the surface often require decisions to be made and resolutions to apply behind the scenes. Every recovery team member gives their all to minimize the impact to clients and members, while performing their job with an intense focus. Challenges observed during this rollover event include the following, grouped by the acquisition and installation of the new hardware and the HA rollover process itself.

1. Encryption key permissions on HA for Experian data
 - This was the first rollover since the 22.10 CU*BASE GOLD release that included changes to data encryption at rest for Experian client credit unions. After the rollover, credit unions were not able to perform credit pulls from Experian.

- It was discovered that during the software release in October, the encryption key permissions for the Experian data were not configured correctly on the CUAHA host, preventing the data from replicating (encrypted at rest). This data was restored from backup, but teams were not able to modify the encryption key permissions until after the rollback to CUAPROD.
 - Once the rollback was performed, the permission issue was resolved for this and future events.
2. Delay in getting warranty parts delivered
- Although this challenge did not create the need to extend the planned maintenance period, the winter storm (Elliott) that plagued the mid-west region did require additional travel time outside of the warranty agreement. This was not a concern until it was learned that additional parts were needed after the initial fan-out module was replaced.
 - Teams are working with IBM to ensure proximity to part inventories should the need arise again in the future.
3. Delays created longer window for data replication to catch up
- While teams were waiting for the second delivery of replacement parts, data replication between primary and secondary hosts was queuing up. Once CUAPROD was back online, replication was allowed to catch up. During this time, the amount of system resources required for the volume of replicated data was causing intermittent latency for other applications, most notably online (OLB) and mobile banking.
 - During two brief periods, logs confirmed that some RDC and OLB transactions failed to complete. Support teams engaged with impacted credit unions to correct all issues and perform account adjustments if necessary.
 - Once replication completed, applications returned to normal status and reports of errors diminished.
 - Teams will research whether or not a more effective method to allocate system resources (QoS) is available for the replication process in the event this were to occur in the future.
4. During rollback, a longer than expected period was required to complete the identity column reset process.
- 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.
 - Teams continue to work with multiple vendors on a solution to speed up the process.
5. After the HA rollback, shortened nightly processing windows across time zones
- Performing nightly processing for 200+ credit unions across six time zones is a carefully coordinate and orchestrated task requiring more than 8,000 automated daily jobs on the system.
 - The time-shortened window after the rollback required teams to carefully divide the automated jobs to prevent overlapping processes, dependencies, and the potential file locks.
 - This resulted in a delay for some credit unions in meeting the FRB deadline for the early ACH processing window.
 - To avoid shortened processing windows, the preferred dates for rollover events occur during weekend hours. Knowing that emergencies can occur at any time, having the flexibility to adapt to prevailing circumstances is critical to the resilience of operations. Demonstrating these capabilities helps to build confidence in the business continuity program.

6. Communications during the event

- Communications is always a key element to a successful response and recovery effort. Continual improvement has been an objective where we learn from each incident and rollover event.
- Due to the quick actions required to resolve issues once reported, often sending announcements using email channels seems ineffective.
- While alerts are posted on the web site in a timely manner, tools to inform external credit unions clients quickly are desired. Teams are researching ideas for acquiring or building such tools for future events. One solution may be to modify an existing global alert tool in CU*BASE so that a subset of impacted credit unions can be targeted.

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 we consider the ever-changing threat landscape from hardware component failures, dependency on third-party vendors and supply chains, and the frequency and scope of today's natural disasters, including global pandemics.

Just as significant is the ever-changing technology 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.

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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