

CU*ANSWERS HIGH AVAILABILITY PROGRAM REVIEW

EVENT DATE(S): 3/10/2024 – 4/07/2024

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. Twice each year, live HA rollover exercises are scheduled to redirect CU*BASE production and operations to the high availability 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 rollovers are invaluable to validate procedures and ensure the ability to recover CU*BASE GOLD core processing in an effective and timely manner when incidents occur that threaten to disrupt business operations. In addition, the ability to run core processing operations from a secondary data center for several days provides extended maintenance periods at the production site for any necessary equipment modifications and upgrades with minimal downtime requirements.

As detailed in this report, the 2024 Spring HA rollover event comprised an eight-hour maintenance window, including a one-hour planned power interruption, to replace the core network switch stack. This stack comprises the backbone of all data communications between servers and devices in the production data center. We also planned to use the power interruption to upgrade the electrical infrastructure to accommodate capacity for projected growth and a recently installed computer room air conditioning unit (CRAC). All physical and virtual servers were powered down to minimize the risk of problems in mounting data volumes on the SAN once network connectivity would be restored. To minimize downtime for core processing applications and users, CU*BASE GOLD and online/mobile banking traffic was redirected to servers at the high availability and secondary data centers prior to the network and power interruptions.

On Sunday, March 10, beginning at 12:01 AM ET, recovery teams initiated the process to redirect online and mobile banking traffic to systems at the secondary data center (Grand Rapids, MI). At 1:00 AM, the HA rollover was performed to bring core processing online at the Yankton, SD site. The switch and electrical infrastructure upgrade project began at 4:00 AM with power interruption occurring from 5:40 AM – 6:25 AM. Once completed, teams began powering up network devices and servers. By 8:05 AM (55 minutes ahead of schedule), internal systems were online with a few exceptions, detailed later in this report.

The ongoing benefits of the maintenance project include expanded capacity for cooling the data center (new technology with high efficiency capabilities) along with an upgraded core switch backbone to increase bandwidth from 10Gbps to 100Gbps, with enhanced resilience to eliminate single points of failure. Combining both of these projects into one maintenance window allowed teams to minimize impact to client credit unions and members.

As teams gathered on March 17th to perform the HA rollback, system error messages were detected on the PROD host. As a precautionary measure, the HA rollback was postponed until teams could properly diagnose the source of the errors. On Wednesday, March 20th, working with the manufacturer and vendor support teams, a decision to extend the rollover period was announced with a scheduled HA rollback date of April 7th. Sunday March 31st was not considered for rollback, to avoid any interruptions near the month-end processing period. This three-week extension also allowed teams to perform more comprehensive diagnostics and testing prior to returning production back to the PROD host.

Teams gathered once again on April 7th beginning at 3:00 AM to begin the HA rollback process. By 4:10 AM, all core processing systems were back online at the production data center.

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

**All times noted in this report are Eastern Daylight Time (EDT).*

EVENT DETAILS AND TIMELINE

Ongoing planned maintenance is required throughout the data center to achieve the performance and reliability metrics necessary for 24/7 core processing today. Redundancy and agility are part of the strategic planning to design an environment where system and network maintenance projects can be completed during non-peak hours with minimal impact or downtime to users. The scope and complexity of this planned rollover put the strategy to the test once again, pushing up against the boundaries of the available maintenance window.

Multiple teams worked together to prepare in advance a playbook detailing the steps required to isolate and prioritize the technology supporting the most critical components so that they are the last to power down and the first to power up. While servers and systems are often rebooted during updates and security patch applications on a monthly basis, the actions to fully power down systems to the point where all moving components come to a complete stop is a rare event in the 24/7 data center. Once the plan was approved, the date was scheduled and announced.

The maintenance event described below was divided into multiple phases on Sunday morning, March 10th:

1. **Online and Mobile Banking Rollover** (12:01 AM – 1:00 AM)
 - To provide online and mobile banking from the secondary data center in Grand Rapids, MI.
2. **CU*BASE HA Rollover** (1:00 AM – 2:00 AM)
 - To provide CU*BASE GOLD from the HA data center in Yankton, SD.
3. **Daylight-Saving Time Observed** (2:00 AM – 3:00 AM)
4. **Nightly Processing on HA begins** (3:00 AM – 4:00 AM)
5. **Network Maintenance Project** (4:00 AM – 9:00 AM)
 - Power down all network servers and infrastructure devices (firewalls, switches, routers, etc.).
 - Cut power to the server room and perform electrical system upgrades.
 - Move all servers and devices to the new core switch stack (from 10GigE to 100GigE).
 - Power up all infrastructure devices and network servers.

To minimize downtime for members accessing their accounts through online and mobile banking platforms during the maintenance period, a rollover was performed to bring **It's Me 247** and **CU*Publisher** applications online at the secondary data center in Grand Rapids, MI.

Wednesday, February 14

Prior to the planned HA rollover, a brief one-hour rollover test for the online/mobile banking (OLB) environment was performed on **Wednesday, February 14th** from **5:00 – 6:00 AM**. This preliminary test was conducted as a proactive measure to validate changes made since the [previous exercise](#), and to minimize the impact to members during the planned power interruption at the primary data center. After a successful test, teams shifted their attention to finalizing the playbook that would be used during the main event.

Sunday, March 10

Beginning at **12:01 AM**, teams initiated the changes to redirect traffic for online and mobile banking. The process primarily involves making necessary domain name server (DNS) record changes for the web sites involved. A small number of issues were observed (as detailed later in this report) but overall traffic redirection was completed by 12:30 AM. Teams continued to monitor the applications until the next phase of the event.

At **1:00 AM**, recovery teams began the HA rollover process to bring CU*BASE core processing online at the high availability data center in Yankton, SD. The rollover completed by **2:30 AM** with connectivity to all third-party EFT vendor networks confirmed. During each rollover process, all third-party EFT vendors function in “stand-in” mode adhering to predefined settings on transaction types and amounts (set by the credit union).

Daylight-saving time changes occurred at **2:00 AM, springing the clocks ahead to **3:00 AM** as reflected in the event timeline from this point forward.*

With the planned power interruption at the production data center, Operators were relocated to workspace at the Grand Rapids, MI, corporate office for the duration of the event. Once all post-rollover application testing was completed, the Operations Team performed normal EOD/BOD processing to prepare for the new business day.

At **4:00 AM**, networking teams began to power down non-essential servers to minimize the duration of the network maintenance. Once the rollover had completed and all tests confirmed, all remaining servers and network infrastructure devices were powered down, following a strategically created playbook, complete with workaround procedures and contingency plans. The final phase involved powering down the server room UPS, placing the generator in bypass mode, and disabling the transfer switch.

At **5:40 AM**, teams were ready to shut off utility power to the server room and complete the process of upgrading electrical infrastructure to accommodate projected capacity needs. At **6:15 AM**, the electrical project was completed. At **6:25 AM**, power was restored to the server room and teams began powering up network infrastructure devices and servers.

By **8:05 AM**, most internal servers were back online with a few exceptions.

Originally scheduled for 9:00 AM, teams were cleared to conduct the rollback for online/mobile banking at **8:25 AM**. The remainder of the maintenance period included additional application testing given the scope of this exercise and ensuring communications and performance metrics for the newly installed core switch stack appliances (12 devices in all).

Sunday, March 17

At approximately **2:40 AM**, teams identified system error messages on the PROD host. After performing initial diagnostics and discussing with senior management, the decision was made at **3:20 AM** to postpone the rollback (originally scheduled to begin at 3:00 AM).

Wednesday, March 20

Working with manufacturing support vendors (IBM), teams were not able to isolate and confirm the root cause of the system messages in time for resolution and testing for a planned rollback on Sunday, March 24. With month-end processing coming up on the following weekend, the decision was made to extend the rollover period once again, allowing teams ample time to complete the necessary system maintenance. An announcement was published with the new HA rollback date of Sunday, April 7th.

Extending the rollover period from one to four weeks did result in a few additional issues and challenges for credit unions. Due to the storage and bandwidth requirements for select file libraries (primarily CTE and Data Warehouse), these data files are not replicated to the HA host and therefore not available during HA rollover periods. In a true disaster scenario, these files could be recreated on the HA host. Details about these challenges are included in the next section of this report.

Sunday, April 7

Beginning at **3:00 AM**, recovery teams started the process to roll back CU*BASE production to the primary data center. This was completed by **4:10 AM** with all services back online.

CHALLENGES AND CONTINUING EFFORTS

Each 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 multiple phases as noted earlier:

CU*BASE HA Rollover

1. Increased planning effort required for a complete power interruption at the primary data center.
 - As technology continues to evolve at a rapid pace, the size and complexity of the core processing environment grows exponentially. The amount of planning required to orchestrate and coordinate a graceful power shutdown and power up of all devices in the data center far exceeds the time required to execute the plan itself. Yet the knowledge and experience gained throughout the process outweighs the effort.
 - One example is in the area of automated job scheduling, given the integration between hosts across multiple data centers for online and self-processing credit unions. As new products and services are added to the core platform, pressure is applied to shrinking nightly processing windows across six time zones, requiring consolidation of processes and multi-threading

capabilities. Documenting and understanding process flow across data centers is vital to maintaining reliable and resilient operations.

- While overall a significant success during this rollover event, areas of improvement in job scheduling and future investments in redundancy will be discussed as we look to further enhance our capabilities for planned and unplanned disruptive events.
2. Daylight Savings Time observed during the planned rollover event.
 - While not a significant issue or challenge, the time change to EDT did reduce the amount of time available to complete the tasks involved on the morning of March 10. Considering the number of ongoing projects and implementations, teams sought to identify a weekend that would allow for a power shutdown at the primary data center. After eliminating several options, the decision was made to proceed, giving teams an opportunity to test their capabilities and level of preparedness. Even with the loss of one hour due to the time change, teams adjusted to the timeline and completed all tasks before the end of the scheduled maintenance period.
 3. Third shift Operations Team members temporarily relocated to the Corporate Office location during the power outage.
 - As a precautionary measure, Operations Team members' work areas were temporarily moved to the Corporate Office on 28th Street to avoid any potential connectivity issues while running nightly processing on the HA. On mornings of HA rollover exercises, nightly processing is suspended until the rollover is completed and we are operating on the HA host (or PROD during a rollback). This already delays nightly processing by 2-3 hours. Having an uninterrupted environment is key to completing EOD/BOD processing across all time zones.
 4. System and network maintenance performed during the data center power interruption.
 - To limit the number of planned maintenance events, teams were able to use this rollover to complete multiple projects, including a battery inspection of the server room UPS and fiber switch card replacement for communications between PROD and the SAN.
 5. Extended HA rollover period (from one to four weeks).
 - While we typically schedule HA rollover periods to avoid significant events such as end-of-month processing, this extended rollover shifted EOM processing for online credit unions to the HA server. As noted earlier, the CU*Answers high availability strategy includes identical equipment at both the primary and secondary data centers. Both PROD and HA are identical systems, purchased at the same time with the same capacities for storage and performance. The primary difference is the distance between HA and other servers in the primary data center (approx. 750 miles) with slight increases in network latency - measured in milliseconds.
 - No issues were reported, and all EOM processing completed on time.
 - While the increased network latency did not impact EOM processing, some Real Time Payments (RTP) communications did experience a time-out resulting in a small number of expired transactions.
 - Teams took steps to reduce latency by conditioning the traffic through quality of service (QoS) controls at the network layer.
 - Future data center strategies may involve moving the secondary RTP servers to the same data center as the HA host to enhance communications.
 - Data Warehouse files not available on the HA server.

- One credit union had archived data in the Data Warehouse on PROD intended for use during a scheduled NCUA meeting. The extended HA rollover restricted access to this data.
 - As noted earlier, due to the storage requirements of Data Warehouse libraries, DW files are not replicated to the HA host. As a result, they are not available through CU*BASE during a rollover period.
 - Due to the circumstances, an alternate workaround was performed to transfer select files to the HA host during non-peak volume periods.
 - Custom Training Edition (CTE) libraries not available on the HA server.
 - CTE is a service offered that provides a copy of the live production CU*BASE library to credit unions who subscribe. As the product name implies, it is commonly used by credit unions for training staff on the GOLD application using the current credit union configuration and member database.
 - Similar to the Data Warehouse issue noted above, CTE library files are not replicated to the HA host.
 - By extending the HA rollover from one to four weeks, some credit unions reported that staff training schedules were impacted. CU*BASE does provide a common training library for all credit union (aka Bedrock) that is available on the HA host.
 - Project research is underway to identify tools to move large data files between servers without impacting live replication, as well as hosting the DW and CTE libraries on an alternate host. More details will be published in the next revision of the CU*Answers [Strategic Technology Plan](#).
 - A request from one credit union for a restoration of archived tape libraries was received during the HA rollover period. Due to the size of the data files, these requests are typically suspended until production has returned to PROD. Once the rollover period was extended, alternate steps were taken to fulfill the request.
 - This involved identifying the specific data required (as opposed to the entire CU library file). Teams then restored the library file on our development server (DEV) and extracted/transferred the data needed to the HA host during non-peak hours.
 - Project research is underway to migrate to a virtual tape library (VTL) strategy with replication between data centers. Once implemented, this would allow local file restorations whether on PROD or HA.
 - Historical data for select system-level reports are not available during HA rollovers.
 - Device specific system logs are not replicated between servers. When running a historical report (i.e., system-level logins) while on the HA host, activity included in logs from the PROD host will not appear. Due to the short duration of activity on the HA host (~2-3 weeks per year), this information is not available until CU*BASE has returned to the PROD host.
 - Application-level logs are replicated and available while on the HA host.
6. Future HA rollovers may become less like a mirror of production (for lower priority features).
- This challenge was also included in the previous HA rollover report. As new features and services are added to the core processing platform, it is becoming necessary to prioritize those that will be available during a disaster recovery scenario (high priority), and those that will be restored later (low priority).

- The purpose of performing the HA rollover exercise is to validate procedures and confirm our capabilities to recover should an unplanned disruptive event occur. To properly balance the effort required to minimize downtime and recover less critical features and services, prioritization must occur. That may mean that some services are not available during the brief rollover windows conducted twice each year.
- Teams will continue discussing methods to optimize this process and find the balance that best meets the corporate goals and objectives.

Online and Mobile Banking Rollover

7. The online and mobile banking rollover was relatively successful with a few exceptions.
 - MACO (multi-authentication) for online banking is redundant within the data center but not across data centers. During the power outage, MFA for online banking users was not available. This would require users to use their credentials and password for access.
 - Hosted web sites are not replicated to the secondary data center. Those with login widgets to OLB would not have been available for users to access the application.
 - In a true disaster, web sites would be restored from backup. Given the short duration of this power outage (< one hour), the time required for restoring web sites would have exceeded the actual downtime.
 - This was the first OLB rollover to include RTP transactions on secondary servers. Due to the recent launch of these services, however, the amount of traffic observed was very light. Testing was successful. Additional monitoring will be in place for future rollovers as RTP transactions increase over time.

8. Servers that store optics log data for online/mobile banking applications are not replicated at the secondary data center.
 - This historical information is not available for the maintenance window during the power interruption.

9. Member profile images while on HA (one-way replication).
 - A feature of the latest version of online and mobile banking platforms is the ability to upload profile images as part of the member experience. Replication of these images is a one-way transfer (primary to secondary). When functioning on the secondary servers, profile images are not replicated back to the primary server.
 - Teams are reviewing options for profile images prior to the next OLB rollover. One option is to disable the feature to upload a new image while on secondary servers. Another is to manually synchronize profile images prior to the rollback process.

Network Maintenance Project (core switch stack and electrical system upgrade with power interruption to production data center)

10. Some non-mission-critical applications were unavailable during the maintenance window, specifically for monitoring availability and performance metrics on devices throughout the network.

- Due to the sheer number of devices involved (servers, routers, firewalls, switches, etc.), teams began to power down non-essential systems and ports to ensure completion within the maintenance window.
 - This will be a consideration for future similar projects, balancing the cost involved with the value of having redundant monitoring tools.
11. Remote access was available, but some users configured to Remote Desktop Protocol (RDP) to PCs at the production data center were not getting the OTP required for access.
- A temporary configuration change was made to enable OTP for the impacted users during the power interruption at the data center. These temporary changes were reversed after the maintenance project completed.
 - Plans to migrate from OTP to MFA for remote access soon may help to resolve this.
12. Application servers that are not part of the current high availability strategy were offline during the power interruption. Multiple announcements were sent to credit unions prior to the event. This included services such as:
- CU*SPY (reports and statements)
 - Secure file exchange (SFTP)
 - Snapshot libraries
 - Hosted email and web sites
 - CU*Answers corporate email and web sites
 - Hosted credit union equipment (facilities management)
 - CheckLogic (check images)
 - And more.

CLOSING REMARKS

This year marks the 20th anniversary since the first High-Availability exercise was performed at CU*Answers. Since then, regular exercises have been scheduled, beginning with four rollovers per year, and trimmed to two rollovers once teams had gained enough experience and procedures were fine-tuned. Even today, as this report reflects, there are challenges to overcome and opportunities for continuous improvement with each exercise performed.

Conducting live, production CU*BASE rollovers helps provide answers to the questions that offline, self-contained test environments cannot. Each live HA rollover exercise performed has provided valuable information for adjusting core processing today and building core processing for the data center of the future. As current technology evolves and new technologies emerge, making key investment decisions becomes more critical to ensuring stability and capacity of operations going forward. The ever-expanding network of CU*BASE credit unions and integrated vendors requires that the Business Continuity Program at CU*Answers is embedded within the culture across the organization.

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.