

CU*ANSWERS HIGH AVAILABILITY PROGRAM REVIEW

EVENT DATE(S): 2/08/2019 – 2/17/2019

EVENT 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 core processing production and operations to the HA data center (located in Yankton, SD) for a period of 72 hours or more. 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 in an effort 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.

This same business continuity program was put to its toughest test to date when mother nature delivered a one-two punch during the week of February 4th to homes and businesses across the West Michigan area. On the heels of experiencing record-setting cold temperatures from a weeklong polar vortex, several counties experienced consecutive days of ice storms followed by 24 hours of blowing and drifting snow with sustained winds between 30-40 mph and gusts over 50 mph. This resulted in widespread power outages throughout the area warranting the declaration of a State of Emergency for Grand Rapids and surrounding communities.

Due to the weather conditions, the CU*Answers production facility in Kentwood, MI experienced a brief two-hour power outage on Thursday (2/7). During this time, the primary natural gas generator provided power to the data center while staff in dark areas of the building were mobilized to the corporate office location or worked remotely from home. That same evening, a second (partial) power outage occurred at the Kentwood facility creating a brownout condition (operating on two of the three phases that feed the facility). The generator continued to provide power to the data center throughout the evening and into the next day. Staff were once again mobilized to the corporate office location or instructed to work remotely. This incident was compounded by the fact that many staff members had experienced the loss of power for multiple days at their homes in addition to making arrangements for children with schools closed for most of the week.

At approximately 8:50 AM EST* on Friday morning (2/8), while providing power to the datacenter, the generator experienced a failure condition and powered down. The UPS in the data center provided temporary power to the servers and network infrastructure in the data center. The disaster recovery plan was immediately activated and teams engaged to failover CU*BASE to the high-availability data center in Yankton, SD and prepare to restore non-core processing applications at the secondary data center in Grand Rapids, MI.

Select members of the recovery team were assigned the task of triage and repair of the generator, while others were assigned the powering down of non-critical servers and equipment and monitoring the amount of reserve power left on the UPS. The bulk of the recovery concentrated on failing over CU*BASE to the HA data center and

preparing for the continuity of operations with a dark production data center. This included contingency plans to restore non-core systems and establish backup communications channels.

While closely monitoring the amount of remaining UPS power, teams were able to place EFT vendors in stand-in mode and stop new transactions from coming in so that jobs running at the moment of power loss could complete, data still in volatile memory could commit to disk, and data replication between PROD and HA hosts could finish replicating, all on a busy Friday business morning. Knowing the amount of time required to failover the system (one of the benefits of a mature business continuity program with years of failover testing), teams were able to systematically perform the emergency failover process while preserving all transactions.

With minutes to spare before running out of UPS battery reserve, the generator was resuscitated and once again began providing power to the data center. Working with the support vendor, teams were able to locate and secure a portable generator large enough to meet the power requirements of the data center. Due to the widespread power outages in the area, the closest portable generator available was found near Chicago. With the existing weather conditions, it would take several hours before it arrived in Grand Rapids.

With the generator still running, teams continued with the failover process until CU*BASE was brought online at the HA data center at 11:00 AM. Once online, the backlog of transactions from that Friday morning began to pour in, creating a performance issue on the host for both GOLD and online/mobile banking users, including extreme latency and session timeouts. The decision was made to bring online/mobile banking offline to allow EFT transactions to process and GOLD users to login, before carefully bringing online/mobile banking back online for credit unions (divided into six groups of approximately 30 credit unions each).

The performance issues on the HA host was partially due to the backlog of Friday morning transactions that required time and resources to process. Although equipped with additional on-board CPUs, the HA host required a reboot (IPL) to activate them. The IPL was performed at 2:05 AM Saturday (2/9) to enable the additional processing power.

Still running on the primary generator, the (Chicago) portable generator was delivered and installed, tested and ready for use by 11:00 PM Friday evening. At 7:10 AM, the natural gas generator failed again requiring teams to fire up the portable unit. In the meantime, the failed component (oil cooler assembly) on the natural gas generator was identified and replacement part ordered. A temporary "bypass" was put in place (and tested) to allow the generator to operate until the replacement part arrived. This diligence proved instrumental in the recovery effort as the (Chicago) portable generator also failed after a period of time. As a precautionary measure, a tertiary generator was located in Wixom, MI and delivered on Saturday at 6:00 PM. Power was supplied by the (Wixom) portable generator until utility power was restored at 4:00 PM Sunday. The primary natural gas generator was fully tested and ready to provide power in the event that the portable unit failed.

The replacement part arrived for the natural gas generator on Thursday (2/14). Installation and testing were completed by 10:30 PM that evening. With a stable environment, teams scheduled and announced the HA Rollback for Sunday, February 17th to begin at 3:30 AM. The rollback was completed at 5:00 AM, bringing CU*BASE core-processing back to the primary data center in Kentwood, MI.

The following sections identify the timeline of events as they unfolded, as well as challenges observed, lessons learned, and recommendations for consideration.

****All times included in this report are Eastern Standard Time.***

EVENT TIMELINE

The details of this event are best defined in a timeline format to understand the cascading events as they unfolded. Additional information can be found in the Challenges and Continuing Efforts and Recommendations sections of this report.

Thursday, February 7, 2019

- 10:50 AM – Utility power is lost at the primary production data center (Building B) in Kentwood as well as nearby office of CNS and AuditLink (Building C). The primary generator provides alternate power to the data center and operations support center. All staff in areas of the buildings not covered by generator power are mobilized to the Corporate Office for network connectivity in Grand Rapids or sent home to work remotely.
- 12:51 AM – Utility power is restored to Building B and C. Staff return to their regular office locations.
- 11:53 PM – Partial utility power is lost at Building B and C. Primary generator provides power to the data center and operations center only.

Friday, February 8, 2019

- 8:00 AM – Teams at Building B and C are once again mobilized to the Corporate Office or work remotely from home.
- 8:50 AM – The primary generator experiences an equipment failure (loss of oil pressure) and shuts down. Backup UPS in the data center provides temporary power for servers, network infrastructure, and key CU*BASE operators. Duration of temporary power is 45-60 minutes.
- While teams attempt to diagnose and troubleshoot the generator, others are alerting recovery team members and initiating the HA failover to bring CU*BASE online at the Yankton, SD data center.
- 8:55 AM – An Email message is sent to all staff informing them of the potential temporary loss of LAN resources located at the primary data center (Email, network shares, Intranet, corporate web site, Alerts web site, etc.).
- 9:00 AM – After initial assessment of generator, the decision is made to proceed with the emergency CU*BASE HA failover to the Yankton, SD data center.
- 9:04 AM – An alert email is sent to all clients informing them of the emergency scenario including the need to failover CU*BASE and the potential for loss of communication channels (Email, Alerts web site, AnswerBook, etc.).
- 9:23 AM – An ENS text alert is sent to all staff to notify them of the emergency scenario and potential loss of LAN resources (for those who may have not seen the Email alert posted earlier).
- 9:25 AM – Recovery teams are able to get the generator running (temporary fix applied), awaiting to see if it can provide reliable power. Not fully trusting the generator, the decision is made to continue the HA failover process but suspend the restoration of non-core servers at the secondary data center.
- 9:30 AM – Generator continues to provide power to production data center.
- 9:50 AM – Decision is made to locate and secure portable (backup) generator.
- 10:15 AM – Emergency ZOOM conference with EC and Board of Directors held to go over status of event.
- 11:00 AM – HA failover process is complete. Users are reporting performance issues in GOLD (extreme latency and session timeouts). CPU on HA host is running at 99%.
- 11:10 AM – Teams bring online/mobile banking offline to allow the backlog of EFT transactions to process. A splash page is posted to notify members attempting to log in that the system is temporarily unavailable.

- At least one EFT vendor (Worldpay) experienced latency with transaction processing and placed the network in stand-in mode until resources were available.
- 11:25 AM – An alert update email is sent to clients explaining that CU*BASE is again available but that online banking and shared branch services are still offline.
- 11:30 AM – Teams closely monitor CPU on HA host while users log in to GOLD.
 - It is determined that an IPL is required to activate the additional (CPU) processors on HA to match the resources used on PROD. Currently using seven (7) CPUs when PROD typically operates with ten (10) on a Friday morning.
- 11:55 AM – CU*Spy and all Imaging Solutions servers brought online.
- 12:45 PM – Teams bring online/mobile banking up once more for all credit unions.
- 1:48 PM – Due to CPU utilization (99%), teams bring online/mobile banking offline again and post the System Maintenance Splash Page on **It's Me 247** to prevent any new users from logging in.
- 2:00 PM – Decision is made to divide credit unions into six groups (approximately 30 each) and enable online/mobile banking for one group at a time while monitoring CPU utilization.
 - NOTE: This process only affected online credit unions on the CU*Answers CU*BASE platform. Self-processors and credit unions on the CU*NorthWest and CU*South platform were not affected.
- 2:15 PM – Teams bring CU*Talk services online (while monitoring CPU utilization).
 - 2:34 PM – Teams bring online/mobile banking up for the first group of credit unions (34)
 - 2:48 PM – Teams bring online/mobile banking up for the second group of credit unions (32)
 - 2:57 PM – Teams bring online/mobile banking up for the third group of credit unions (33)
 - 3:07 PM – Teams bring online/mobile banking up for the fourth group of credit unions (31)
 - 3:25 PM – Teams bring online/mobile banking up for the fifth group of credit unions (31)
 - 3:53 PM – Teams bring online/mobile banking up for the sixth group of credit unions (21)
- 4:30 PM – Indirect lending systems brought online.
- 4:35 PM – Alert email sent to all credit unions on the completion of the HA failover event and status of primary data center, including restoration of online/mobile banking services.
- 5:30 PM – Status update ZOOM conference call held with EC and Board.
- 6:15 PM – Status update ZOOM conference call held with recovery teams to go over the plan and coverage for the weekend.
- 11:00 PM – Portable generator arrives (from Chicago, IL), connected and tested.

Saturday, February 9, 2019

- 2:05 AM – HA host is taken offline and IPL performed.
- 2:35 AM – HA host is back online with additional CPUs activated.
- 7:10 AM – Primary generator experiences another failure. Operations team activates the portable generator to resume power to the data center.
- 8:00 AM – Crew arrives to diagnose primary generator and to locate and secure an additional portable generator.
- 9:00 AM – Oil cooler bypass applied to primary generator and tested for reliability.
- 9:30 AM – Portable generator (Chicago) struggling to provide reliable power. Decision is made to operate on primary generator until tertiary generator is delivered (from Wixom, MI).
- 6:30 PM – Tertiary generator is delivered, connected, and tested. Acting as back-up unit in case the primary generator shows signs of trouble.

Sunday, February 10, 2019

- 4:00 PM – Utility power is restored at the primary data center. Primary generator is powered off.

Thursday, February 14, 2019

- 10:00 AM – Decision made to schedule the HA Rollback for Sunday morning at 3:30 AM.
- 12:35 PM – Announcement sent to all credit unions informing them of the scheduled HA Rollback event.

Sunday, February 17, 2019

The below describes the events of the HA rollback process to bring CU*BASE core-processing back to the primary data center in Kentwood, MI.

- 12:00 AM – EODBOD processing for all credit unions suspended until completion of the HA rollback.
- 3:30 AM – CU*BASE is taken offline to begin the HA rollback process.
- 4:25 AM – CU*BASE is back online at the primary data center for all credit unions.
 - HA Rollback process complete.
- 4:53 AM – EODBOD processing begins for credit unions in the ET/CT/MT time zones.
 - Online/mobile banking in stand-in mode for ET/CT/MT.
- 5:31 AM – EODBOD processing completes for credit unions in the MT time zone.
 - All services back online for MT.
- 6:00 AM – EODBOD processing begins for credit unions in the HT time zone.
 - Online/mobile banking in stand-in mode for HT.
- 6:12 AM – EODBOD processing completes for credit unions in the HT time zone.
 - All services back online for HT.
- 6:15 AM – EODBOD processing completes for credit unions in the CT time zone.
 - All services back online for CT.
- 6:32 AM – EODBOD processing completes for credit unions in the ET time zone.
 - All services back online for ET.
- 7:36 AM – Daily reports sent to CU*SPY server for processing
- 10:27 AM – SnapShot processing completes for all credit unions.

CHALLENGES

Over the years we have discovered that even those rollovers that are carefully planned provide ample opportunities for valuable learning experiences. That potential for learning is amplified when the scenario involves a threat to primary, secondary, and tertiary power sources at the production data center following two weeks of extreme winter weather including back-to-back ice storms and 50 mph winds. Add to that the timing of the incident involving the peak business volume period of a Friday morning. Some might label it 'the perfect storm'.

That's what recovery teams at CU*Answers were up against when the alert went out that the primary generator failed (running due to the partial loss of utility power). What followed for the next several hours can only be described as an orchestrated event by an experienced and focused recovery team. With the countdown timer on the UPS providing temporary power to the data center, there was little room for error. At the conclusion, teams

were able to failover core processing to the HA data center while preserving the thousands of transactions that were in motion at the time of the disruption.

Challenges observed during this emergency rollover event include the following:

1. As reported earlier, several staff members were working at an alternate location (many from home) due to the winter weather conditions and power outages at Building B and C in Kentwood on Thursday and Friday. This added to the complexity of keeping staff informed of the conditions as they evolved.
2. Some Operations Programmers at Building B did not have access to custom third-party development tools (software) installed on their PCs in their dark offices due to power outages.
3. The utility power failure on late Thursday evening (around 11:50 PM) was reported to a limited group. Most recovery team members were not aware that the data center was operating on generator power until an alert was posted Friday morning.
4. The extreme conditions made troubleshooting the primary generator failure difficult. However, teams were able to recover the generator before the UPS was drained of alternate power, preventing the data center from going dark.
5. CPU utilization on the HA host was running at full capacity during the failover event, extending the duration of downtime for several GOLD and online/mobile banking users.
 - o The existing licensing and profile configuration on the HA host limited the maximum number of CPUs activated to seven. An IPL (reboot) was required to enable the additional CPUs required.
6. As a precautionary measure, the UPS system was inspected by the support vendor due to the number of power fluctuations and length of brownout conditions. The system passed all load tests and did not require further maintenance.
7. While running on the HA host at the Yankton, SD data center, push notifications (for EFT activity alerts) were not available.
 - o It was discovered that the IP subnet on the HA host was incorrect. Due to the circumstances of the emergency failover, the danger of impacting other services by making the IP configuration change in a live environment, and the limited number of credit unions who have deployed push notifications to date, the decision was made postpone the changes to the HA host until after the rollback process.
8. While running on the HA host at the Yankton, SD data center, it was reported that ballot and voting services, promise deposits, and text banking enrollment/unenrollment were not functioning properly.
 - o This was resolved by making a configuration change on the ItsMe247 web servers.
9. An engagement with IBM to fine-tune system performance and to help define the specification for the replacement hardware (new PROD and HA to be installed in June/July) was scheduled for the week of February 11.
 - o The engagement was postponed until after the rollback.

10. After the HA Rollback on Sunday (2/17), access to My Virtual Strongbox using SSO from **It's Me 247** was not functioning properly. Teams worked with the vendor to restore access early on Monday morning.

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 following is a list of recommendations, action items and projects relative to this rollover event.

- For Operations Programming Team members (challenge #2 above) with custom third-party development tools installed on their PCs (not accessible when the offices were dark), options include migrating a few users to a mobile device (laptop) or spreading the team among the office locations to minimize the dependency on power at any one site.
- (To address challenge #3 above) a new policy/procedure will be developed for escalating the news of all utility power failures so that an informed decision can be made whether or not to perform the HA rollover during non-peak off hours or to ride out the power outage on the generator.
- (To address challenge #5 above) the status of the licensing of system resources (i.e. CPU) on both the PROD and HA hosts must be identical (to the extent allowed by the hardware vendor) and communicated to the EC. The configuration on the HA host at the time was a requirement of the way IBM licenses resources in a source/target high availability relationship.
- While operating on UPS battery backup power, teams were anticipating the restoration of non-core servers at the secondary Grand Rapids data center. With minutes to spare before completely draining the UPS of reserve power, the generator was restored. At that time, recovery teams focused on completing the HA failover and placed the restoration of non-core servers on hold.
 - To gain the most experience from this incident, teams will schedule a series of recovery tests in 2019 to revisit the incident of February 8th and simulate the effort that would have been required had the data center gone completely dark. Many of these tests will be performed parallel to production. Some of the tests for critical applications will be performed live to validate our procedures and confirm our capabilities, beginning with the failover of the online/mobile banking environment.
 - To ensure that the proper network infrastructure is in place at the secondary data center in Grand Rapids for the restoration of non-core servers and systems, team will re-inventory current capacities and requirements to identify any gaps, beginning with the bandwidth of the Internet circuit for online/mobile banking and GoAnywhere environments.
- A potential challenge surfaced that would have impacted the recovery effort includes the location of the Secure Remote Access appliance. If the Kentwood data center completely lost power, remote users would have lost network access. In addition, support staff at the Kentwood data center (Operations and iSeries Teams) would have lost connectivity.
 - Teams will evaluate options for adding redundancy to the remote access availability to minimize the impact of the loss of any one site.
- In addition to the loss of remote access capabilities, had the Kentwood data center completely lost power, access to several internal staff to LAN resources (such as corporate Email, network shares, Intranet,

corporate and hosted credit union web sites, Alerts web site, AnswerBook, etc.) would have been interrupted until servers and could have been restored at the secondary Grand Rapids data center. This would impact the ability to communicate to both internal and external parties and access to critical data such as key run sheets and password management databases. The corporate phone system would not have been impacted.

- To determine the full impact during this scenario, teams will engage in exercises to walk through the recovery procedures and interim workarounds so that they are aware of and familiar with the process should the incident occur. This could have prevented users from continually attempting to login during the failover process and minimize any potential frustration.
- With the failure of the primary (natural gas) generator, teams located and secured a portable unit. Due to the widespread power outages in the area and severe weather conditions, the closest unit found was located near Chicago, IL. The truck delivering the unit experienced a breakdown along the way, requiring the dispatch of another truck to pickup and deliver the portal unit to the Kentwood data center (approx. 12 hours to deliver).
 - Teams will reevaluate the current generator support contract and area vendors to determine if one with a shorter SLA is feasible. Had teams not been able to restore the primary generator in a timely manner, there could have been a prolonged period of downtime for the data center.
- As with most (unplanned) emergency recovery events, communications among internal teams and with external parties is always an area where improvement is considered. Teams will evaluate the quantity, clarity, timeliness, and methods used for communicating throughout this incident to determine where opportunities for improvements exist.

CLOSING REMARKS

CU*Answers officially launched the high availability program with the opening of the secondary data center in 2005. The data center has moved twice over the years from Muskegon, MI to where it resides today in Yankton, SD. Since then, we have performed dozens of rollovers, some of them planned and a few (five to be exact) unplanned.

This report details the fifth unplanned scenario where we either chose to rollover due to a system error message, or, in this case, were forced to failover due to availability of resources (power). Technically, a “failover” is performed on the stand-by host when you’ve lost communication with the production host. In this event, we did not lose communications between hosts, but we treated it as if we were about to. Given the amount of time remaining on UPS battery backup power, teams were able to allow processes in motion at the time of the disruption to complete and post, allow data replication to synch up between hosts, and gracefully swap roles from ‘stand-by’ to ‘production’. Because of the time allotted and steps taken, we were confident that no transactions were lost. Given that at any moment on a Friday morning there are hundreds if not thousands of transactions processing, that is a major accomplishment. While there are steps that could have reduced the time required to complete the rollover, a priority was placed on the preservation of data. This in turn also set up the environment for a quiet and uneventful rollback on early Sunday morning.

This recovery effort was the result of continuous planning, testing, and improving. While some might call a planned rollover an “exercise,” this one meets all of the requirements of a true “test.” For us, it’s an opportunity to evaluate our efforts and investments and to continue to improve.

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