Bank Chooses HPE NonStop Shadowbase Solutions for BASE24™ Business Continuity

A Gravic, Inc. Case Study

Executive Summary

For the past fourteen years, a regional bank serving a major resort island was using an ACI BASE24 Classic™ financial transaction switch to manage its network ATMs and POS terminals. For business continuity, its BASE24 system was running in an active/passive mode on a pair of HPE NonStop S-Series servers. Early in 2015, the bank found that it needed to upgrade these servers, which along with the operating system and application software, were nearing their end-of-support life. The bank made the decision to migrate its BASE24 system to a pair of NonStop NS-Series servers, again running as an active/passive pair.

The bank also decided to replace its current data replication product with an HPE Shadowbase solution due to cost issues and to improve its business continuity failover time. This replacement also positioned the bank to take advantage of the HPE Shadowbase *sizzling-hot-takeover* (SZT) configuration, which would further reduce failover times to a value more acceptable to its shareholders. An important goal was to reliably enable a failover to complete in just a few minutes, matching what some customers have already achieved when running Shadowbase SZT in their BASE24 Classic environments.

Via a staged migration using HPE Shadowbase Zero Downtime Migration (ZDM), the old BASE24 systems were successfully replaced with HPE NonStop NS-Series servers, and the old business continuity data replication product was successfully replaced by HPE Shadowbase software, all without any necessary service outages or reductions in service availability protection. This process was executed by the bank in cooperation with a professional services team comprising members from several disciplines.

This case study illustrates that there are no barriers to choosing HPE Shadowbase software as the BASE24 business continuity solution.

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The Bank's Original BASE24 System

The original configuration employed by the bank running its BASE24 system is shown in Figure 1. It comprised a production system (\S78PRD) and a backup system (\S78BKP), each running on an HPE NonStop S-Series server. The production system ran the BASE24 application, which managed the bank's ATMs and POS terminals, and it communicated with other hosts in the financial transaction network to forward ATM and POS transactions for authorization.

The BASE24 files were initially all unaudited Enscribe files. The source system could not run audited files (via HPE NonStop's TMF facility using AutoTMF), because the customer used $DSMSCM and $SYSTEM for application data volumes. (TMF auditing is not recommended/should not be used on these special disk packs.)

The source Enscribe files were replicated to the backup system by a replication product that intercepted changes to the production databases via an intercept library that was legacy to the source application and created extract files of the database changes. The extract files were then sent to the backup system via an Expand communication link to update the backup databases with the source application database changes.

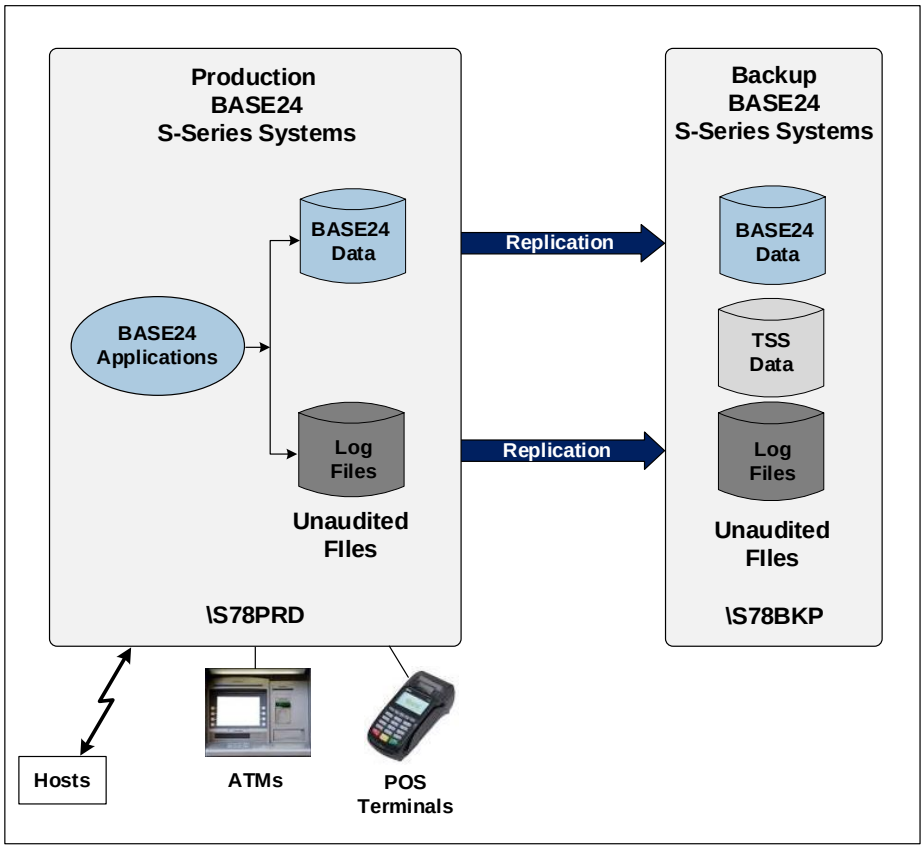

Figure 1 – The Original BASE24 System

The BASE24 files included configuration data for the ATMs and POS terminals, security data [ACI Trusted Security Solutions (TSS) configuration files], and log files. To maintain compliance, TSS was upgraded to an audited application version. Therefore, it only ran on the backup which meant that the application data volumes on the source and target nodes were different. Consequently, the backup node target files were mapped to other disks on the system.

The log files held all of the transactions processed by the BASE24 application during the day. The transactional data in these files was processed daily through a batch settlement process, and an extract file was built. The extracts were then sent to the card issuing organizations for reconciliation, and the accounts of the

corresponding acquiring banks and merchants were credited and debited with the appropriate transaction values.

The Bank's New BASE24 System

As shown in Figure 2, the bank's new production system (\NSPROD) and backup system (\NSBKUP) are both NonStop NS-Series servers. The backup system is kept synchronized with the production system by using HPE NonStop Shadowbase data replication.

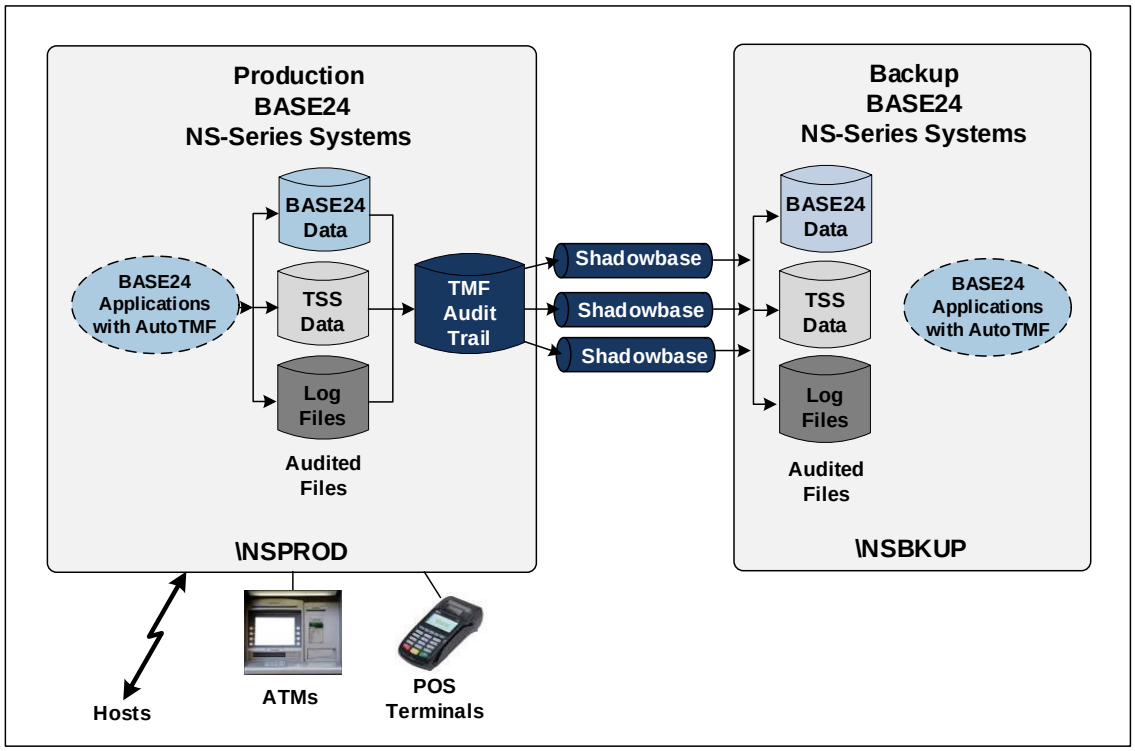

Figure 2 – The New BASE24 System

A key requirement of the upgrade project was to install the latest BASE24 Classic application on both systems. Since the backup system has the BASE24 application already installed and tested, it serves as a hot backup and can take over processing from the production system in just a few minutes. When coupled with the Shadowbase bi-directional replication capabilities, this is known as a *sizzling-hot-takeover* (SZT) configuration.

HPE Shadowbase replication is configured to be bi-directional, meaning it can simultaneously replicate in either direction. This configuration supports failover to the backup system, which must then act as the production system and replicate changes back to the original production system once that system is restored to service, to bring the systems back into synchronization.[1]

HPE Shadowbase software requires TMF audited files for the databases it replicates, since it uses the TMF Audit Trail as the source of changes being replicated to the target system. Therefore, the BASE24 application was modified to use audited files with HPE NonStop AutoTMF software.[2]

Upgrade Challenges

The bank faced several challenges as it planned its upgrade. The primary problem was the existing BASE24 version possessed some data inconsistencies with the new BASE24 version running on the NS-Series servers. Therefore, data transformation was required in migrating the production data from the old BASE24 release to

[1]While the Shadowbase software configuration permits for simultaneous replication in either direction, the bank chose to license Shadowbase replication for uni-directional mode only for the initial release.

[2]Using AutoTMF to audit database file updates is a non-invasive process, and does not require any changes to the application itself. There are many implementations of AutoTMF for BASE24 customers.

the new BASE24 release. Since the bank's IT department had limited resources, it did not get involved in the configuration of the system and depended upon outside organizations for system configuration and upgrades.

However, in addition to its aging S-Series systems, the failure to implement timely BASE24 upgrades led to another impetus — bringing its BASE24 application up-to-date: it was no longer PCI-compliant. The payment card companies such as Visa and MasterCard, as well as the bank's auditors, were enforcing PCI compliance. While routine mandates had been applied semiannually over the years, the current configuration did not lend itself as a viable business continuity solution. Coupled with its aging systems, the bank found that the upgrade to the current application had become a necessity.

Due to a lapse in upgrades, the bank was running a BASE24 system that was years out-of-date and hurdled several major upgrades of BASE24 in order to bring it to its current version; each upgrade included significant modifications to the structures of the BASE24 databases. Additionally, the bank upgraded to an entirely new pair of NonStop servers (i.e., it performed a "hardware refresh"), which included many configuration complexities and changes in operational procedures.

As previously mentioned, the bank also decided, in part, to move from the original product that replicated data between the production and backup systems, to HPE Shadowbase software due to the licensing costs for the original replication product growing at an unsustainable rate. It favored Shadowbase software since it was sold and supported by HPE and the required Shadowbase licenses offered the bank significant savings.

During this complex conversion, the bank enlisted the aid of a professional services (PS) team assembled by HPE through a Statement of Work (SoW). This team utilized the following resources:

- HPE for hardware, operating system and software support;
- PayX International, an industry leading provider of consulting services and support in the payments industry for BASE24 Classic and BASE24-eps, among other payments products;
- Gravic Shadowbase personnel, for configuring the replication environment.

Part of the SoW exercise also included training the in-house personnel to manage the day-to-day aspects of AutoTMF and Shadowbase software.

Since the bank felt it was imperative that the switchover to the new system be seamless and with no impact on its customers, the project was organized into steps. Each step accomplished only one task and involved only the necessary project partners, with the results thoroughly tested before the next step began. The multiple steps were carried out from June through October 2015 (four months), when the new system was put into production.

Project Steps

The upgrade project progressed smoothly through the following developmental steps:

Step 1: Discovery

Members of the PS team from each discipline were deployed to the bank's location for a discovery step, where the migration specifications were formalized for the system hardware, network, software, BASE24 Classic and replication requirements. This step was the most critical of the whole migration exercise as PayX identified the key differences between the old and new BASE24 versions that needed to be addressed. HPE scoped the configuration details and effort for the use of AutoSYNC and AutoTMF, and Gravic personnel defined the Shadowbase replication requirements for the migration.

Step 2: Install the HPE NonStop NS-Series Systems

The installation of the new pair of HPE NonStop systems was HPE's responsibility. HPE initiated this step with an audit of what would be required. It then provisioned the NS-Series servers and installed them. Following a successful hardware installation, it then installed the required operating system and monitoring software and tested the entire installation. PayX and Gravic participated in the final testing of the system to ensure that it reliably provided all of the features they needed.

The result of this step was the NonStop NS-Series active/passive business continuity pair – consisting of the production system (\NSPROD) and the backup system (\NSBKUP) – were ready to accept the BASE24 application and the Shadowbase replication software.

Step 3: Install BASE24 Classic

The next step was for PayX to install the BASE24 Classic application on both of the NS-Series systems. Once installed, the BASE24 applications were thoroughly tested and the customer was thoroughly trained on the new application. Customer buy-in was mandatory in confirming the operation of the new BASE24 environment before continuing. At this point, all of the BASE24 files were still unaudited Enscribe files.

Step 4: Install Shadowbase Replication between Old and New Environments

Since PayX was also responsible for identifying the differences between the data elements of the legacy BASE24 Classic release and the new BASE24 Classic software running on the new NS-Series servers, PayX provided the transformation logic to Gravic personnel who then wrote data transformation routines (customized user exits) to perform the necessary data changes. HPE Shadowbase software was then installed to replicate data from the old backup to the new backup server, and the migration replication (from the old to the new system) was tested. The goal was to provide real-time migration of data while the old backup system was still in operation.

Step 5: Modify BASE24 with AutoTMF to Use Audited Files

In order to support HPE Shadowbase replication, BASE24 needed TMF audited Enscribe files, which was accomplished by HPE adding AutoTMF to all of the BASE24 processes running on the new NS-Series servers. AutoTMF monitors all database activity and bundles sequences of data changes into NonStop TMF transactions. As the transactions execute, TMF logs all transaction changes into the TMF Audit Trail. The AutoTMF modifications required no code changes, since AutoTMF is installed as intercept libraries on all processes. The resulting modified BASE24 application was again tested to ensure that it worked properly and that all files logged their changes into the TMF Audit Trail.

Step 6: Configure Replication for Migration of the Existing Production Data to the New Environment

Since the NonStop S-Series server class is at end of service life and hence is not supported by HPE's current offering of Shadowbase software, a SoW was executed with Gravic to load and run a G-series version of the software on the backup S-Series server as a data source. To minimize impact on the backup server, an Expand configuration was built, with the Shadowbase consumer processes (where the user exits performing the transformation exercises would run) located on the new NS-Series servers. This configuration only implemented a Shadowbase uni-directional replication environment, since the customer did not have any intention of ever falling back to the old environment.

Step 7: Implement Shadowbase Software on the New Production System

The Gravic team then installed HPE Shadowbase replication to replicate data between the new production and backup systems. Shadowbase bi-directional replication was installed to support operations following a failover. During normal operations, Shadowbase software replicates data from \NSPROD to \NSBKUP. However, following a failover, it replicates from \NSBKUP (the new production system) to \NSPROD (when it is restored to service as the new backup system), thereby bringing the two systems' databases into synchronization. This replication continues until eventually a fall back operation can be executed to return \NSPROD to become the production mode. Once Shadowbase software was installed on the new servers, it was tested in both directions via the AutoTMF-enabled BASE24 applications running on the new servers.

Step 8: Modify the Old Backup System to Create Audited Files

The problem of moving the data files from the current system to the new system needed to be addressed. Since the current system executed live transactions, it was imperative that this move not affect the bank's customers and their use of the bank's production BASE24 switch facilities. Unfortunately, the standard approach to achieve the data migration is to take a long outage of application services. During the outage, the data files are backed up, transformed, and restored into the new environment. Called the "big-bang" approach, this is a risky approach to undertake, as it requires a long service outage and an "all or nothing" mentality for the switch.

By contrast, the customer chose to eliminate the risk and lengthy outage associated with the big-bang approach and implement HPE Shadowbase Zero Downtime Migration (ZDM), which allows the migration from one system to another to occur with no (or minimal) application downtime.

Since HPE Shadowbase ZDM requires the use of audited data, the first action was to create TMF audited copies of the BASE24 unaudited files on the old backup server. The old backup server was chosen as the data source for the migration to minimize the chance that an error could affect the online operations of the BASE24 switch that was running on the old S-Series production server. Hence, the old production server was not involved in or impacted by the Shadowbase data migration effort.

A facility was added by PayX to create an audited copy of each BASE24 file to reside on the old backup server. This step did not require any additional licensing for the old data replication solution on the old backup server. Then, as changes were replicated from the old production system to BASE24 unaudited files on the old backup server, they were replayed into the audited files, also on the old backup server. The changes to the audited files were recorded in the TMF Audit Trail on the backup server, which acted as a source of changes for Shadowbase replication, as shown in Figure 3.

Once PayX added this facility, it was thoroughly tested by the Gravic team to ensure that all of the changes replicated from the old production server were properly recorded in the old backup server Audit Trail.

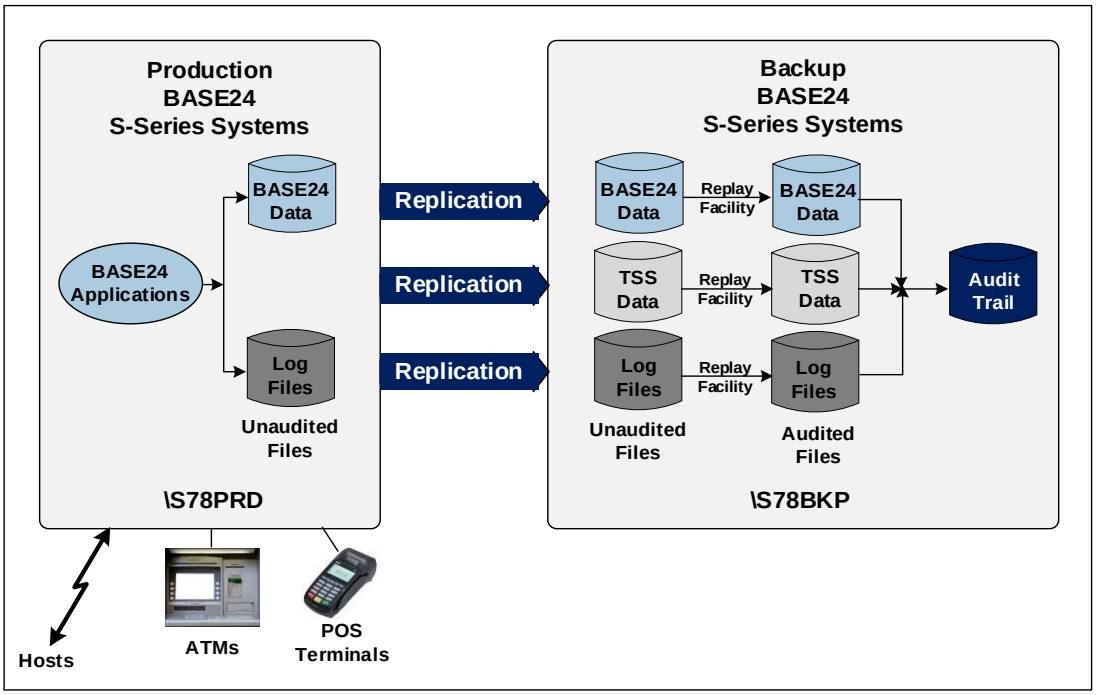

Figure 3 – Configuring the Backup Server as a Shadowbase Source Database

Step 9: Link the Original BASE24 System with the New BASE24 System

Now that a current and audited copy of the production database was available on the old backup system, it could be copied to the new systems. The Gravic team configured HPE Shadowbase software to read the changes fed into the old backup server's Audit Trail and replicate them to the BASE24 database on the new production system, as shown in Figure 4. From there, the data changes were replicated by Shadowbase software to the new backup system. HPE Shadowbase Compare compared the databases on the old and new backup servers to prove proper operation.

There were a few challenges. First, the file formats on the new BASE24 system were different from those on the old system because the old system had fallen behind in its upgrade versions. Shadowbase user exits were used to convert the old formats to the new ones while the data was replicated. Second, there were actually three types of Enscribe files that needed to be replicated, relative files, key-sequenced files, and entry-sequenced files, with each requiring a different replication configuration. Therefore, three Shadowbase replication threads were created, one for each type of Enscribe file.

At this point, the teams were ready for a ZDM migration from the old BASE24 system to the new one.

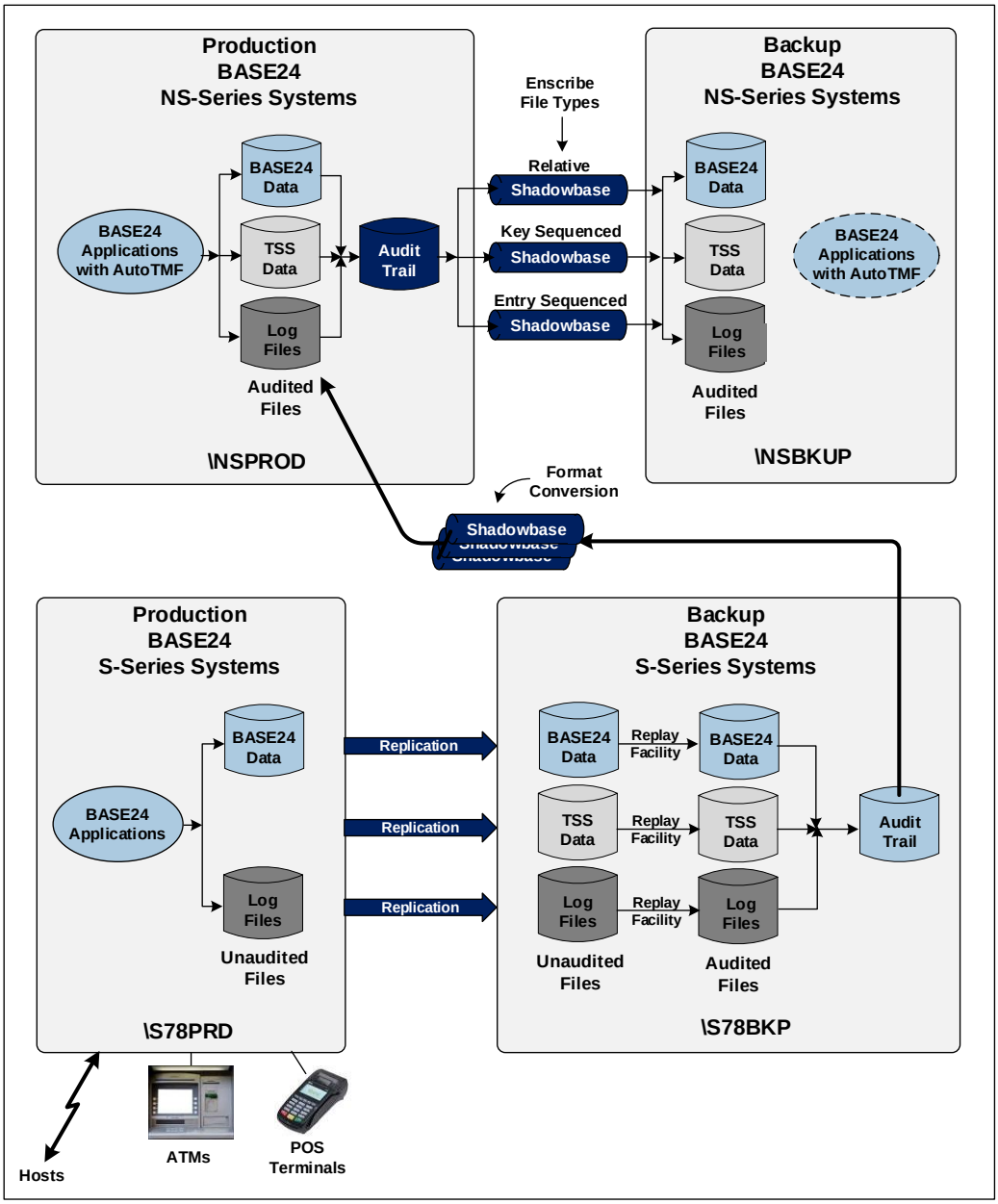

Figure 4 – Shadowbase Configuration for a Zero Downtime Migration

Testing the New BASE24 System

Settlement Testing

The new BASE24 system was tested for several weeks, and HPE Shadowbase ZDM was used to bring the new system online. The BASE24 files were loaded from the original system onto the new system using HPE Shadowbase SOLV (an online copy utility), which allows a source database to be copied to a target database while the source system is actively processing transactions. Shadowbase SOLV utilizes the connection between the old system and the new system described earlier in Step 8; it also provides the reformatting required between the BASE24 file structures on the old system and the upgraded BASE24 file structures on the new system. In this way, the entire BASE24 database was migrated to the new system with no downtime required. Furthermore, via the mechanism described in Step 8, the new BASE24 system database was continuously kept current with the old system, while the old system continued as the production environment. Three database instances were kept synchronized with HPE Shadowbase replication (starting from the old

backup's audited database, to the new production database, and then finally to the new backup database) as changes were made by customers using the old production system.

Then, the new system was run independently of the old system, yet the old system still hosted the online application. However, both systems went through the settlement processing to confirm the proper operation of the new system's BASE24 application and Shadowbase replication. This testing was performed for several weeks.[3]

Failover Testing

Before going live, the new system underwent failover testing. The failover process was never properly implemented nor tested in the old environment. Instead, the old backup server was basically used as a data vault to safe-store the BASE24 data so that it could be used to recover the old production system if it ever failed. BASE24 was not even installed on the old backup system, and hence it operated as a (very) cold standby.

During the previous four years, the bank's BASE24 system experienced three faults with typical recovery times of over two hours. There was never an attempt to bring up the old backup system; rather, the fault was fixed on the old production system and returned to service.

The PS team rigorously tested failover of the new production system to the new backup system, and then fail-back to the new production system. Failures of all the critical components in the system were simulated. Both new systems were shut down, and networks were failed. Often, the testing faults were severe enough to let the new production and backup systems become unsynchronized, for example due to misconfiguration, so then the SOLV utility was needed to refresh the unsynchronized files.

Failover testing continued until the team had a great deal of confidence in the ability of the new system to failover reliably. When testing was completed, system recovery time had been reduced from two hours or more to *only four minutes*! More importantly, the failover process was demonstrated as fully documented and has become a reliable method for the bank to use to restore application processing in the event of catastrophic failure of the production environment.

Migrating the Bank's BASE24 System

At this point, the team was prepared to bring the new system live. All of the testing demonstrated conclusively that it could be brought online reliably and without downtime using HPE Shadowbase ZDM. However, the bank decided to exercise extreme caution and ensure an orderly cutover, even if it meant incurring a small amount of downtime.

Therefore, the bank negotiated a Service Level Agreement (SLA) with their customers that stated that cutover would occur in the early morning hours when the transaction load was minimal and the transaction services would be restored within two hours of the initiation of the migration. During this time, ATMs would be out of service, but the POS terminals serviced by the bank were still usable with manual procedures.

When the migration was to take place, the bank finished its normal settlement process at 4pm with its old system, and shut it down in the early morning. Before the bank shut down the old production system, it drained its queues to the old backup system. The Shadowbase replication stream between the old backup and the new production server was kept active, thereby bringing the new production system into full synchronization with the final state of the old system. After the Audit Trail changes being replicated from the new production system to its backup system were drained, and the two systems were synchronized, the new system was ready to be brought online. Transaction requests were enabled/rerouted from the networks to the new production system, and user transaction processing services were restored. The new BASE24 system running on the new NS-Series servers was now online and in production.

The first transactions were actively processed on the new production system just 15 minutes after the migration began, and the new BASE24 system was fully functional after 45 minutes, well within the two-hour SLA. During this entire process, the old backup system remained in service to act as a fail-back in case anything went

[3]This step actually highlights one of the key advantages of the Shadowbase ZDM sequence – the entire new environment can be loaded, tested, reset, and re-loaded, etc., as many times as necessary to validate that the databases match before the cutover.

wrong. As expected, it wasn't needed. The bank now conducts regular failover testing, with complete tests that bring the new backup system into full service. The new backup system handles live traffic for a while before failing back to the new production system.

The Next Move

The bank is now positioned to move from its active/backup configuration to a HPE Shadowbase SZT architecture. Since the new backup system is running as a hot-standby, only the following needs to be done:

1. *Enable the Shadowbase environment for bi-directional replication with proper licensing.* Start the BASE24 application on both nodes. Even though the network is only feeding transactions to the BASE24 application on the new production node (thereby avoiding data collisions), the application can be up and running on both nodes. In the event of a failover, service can be restored much more quickly without having to wait for the BASE24 application to come up before re-routing users. An additional benefit is that with BASE24 running on the new backup node, it's very easy to periodically send test transactions to verify that it is fully functional and ready to take over in an instant (a "known-working" system).

2. *Test the Shadowbase SZT configuration.* Stop transaction flow to the current production node and allow the Shadowbase replication queue to drain (bringing the backup system into synchronization with the production system), and route user traffic to the backup (now production) node. The bank executed this step in several iterations as part of their user acceptance testing, and was able to inactivate the production system and route users to the backup node in about four minutes. Once an SZT configuration is enabled and operating, if the new production system fails, all that is needed is to re-route users to the new backup system (which is known-working and ready to process transactions), resulting in failover times that can be measured in seconds.

Summary

The bank took a very stale, aged BASE24 system and upgraded both the hardware platform and BASE24 software with no outages except for a brief time during the final cutover. At the same time, the bank replaced a costly data replication product with HPE Shadowbase software. The cutover outage could, in fact, have been completely avoided if the bank had elected to use HPE Shadowbase ZDM that was installed and tested (an abundance of caution).

Choosing a team whose members had specific expertise to support the project was another major factor in the success of the upgrade. This team included HPE for the NS-Series system upgrade, PayX for their BASE24 expertise, and Gravic for the configuration of the HPE Shadowbase software.

In addition to bringing its system into PCI compliance, the bank implemented reliable failover procedures that reduced its recovery time from two hours to under four minutes. The bank is now positioned to reduce its outage time to just seconds when it moves to a full Shadowbase SZT configuration.

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