Cellular Provider Achieves Continuous Availability for Prepaid Calls

A Gravic, Inc. Case Study

Executive Summary

One of the largest cellular telephone service providers in South Africa holds more than 58% of the country's cell phone market share, providing service to over 31 million customers. It manages a cell network comprised of thousands of cell sites, which provide coverage to over 91% of the South African population. The company also provides cell service to several other African countries, including Tanzania, Mozambique, Lesotho, and the Democratic Republic of the Congo. In total, over 26 million customers in these countries are serviced by this provider.

The prepaid calling card market is the fastest growing cellular service segment in Africa. From a processing viewpoint, prepaid cards generate about 1.5 to 2 million updates per hour against a six-terabyte database. To handle this volume, the company uses three HPE NonStop servers with XP storage along with some other ancillary systems in its production environment. If the prepaid calling card service is not available, much of Africa's cellular service comes to a halt. To ensure the continuous availability of prepaid card service, the heart of this production system is run as an active/active configuration.

The Prepaid Calling Card

Prepaid calling cards are purchased by subscribers at stores throughout the company's service area. Each card carries a unique identification number (PIN) and entitles the purchaser to a specified amount of additional money on his call account. A subscriber activates his additional money by calling the company's prepaid calling card service and entering the card identification number. A subscriber can also recharge his time (without having to purchase another prepaid calling card) by recharging at an ATM or through the bank's web interface. Subscribers' call accounts are kept on Intelligent Network (IN) platforms. These platforms are not supplied by HPE, so communication with these platforms is over TCP/IP using a proprietary message layout.

The Prepaid Recharge System

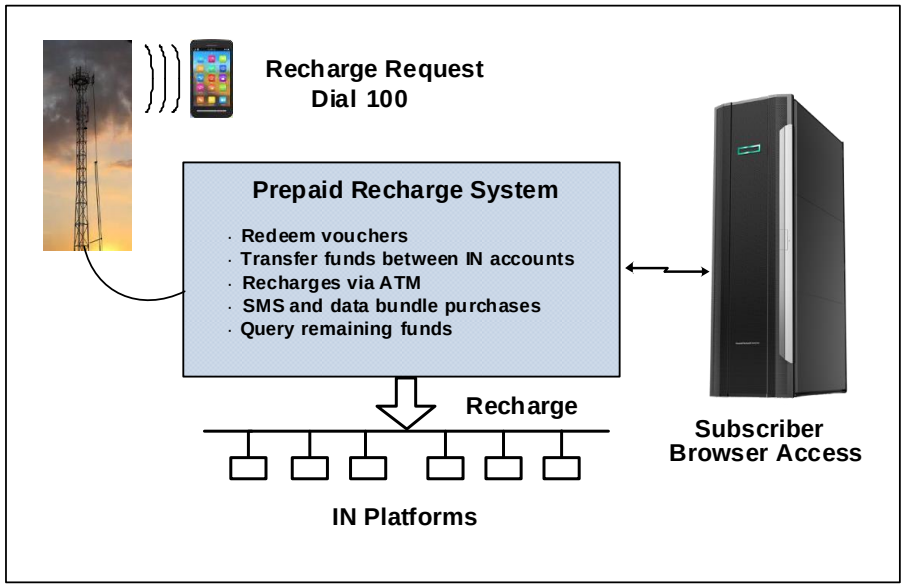

Figure 1 – The Prepaid Recharge System

Prepaid calling cards are generally called vouchers since they represent a monetary value rather than call time (Figure 1). The IN platforms deduct the cost of a call from the subscriber's call account. The prepaid calling card service is provided by the company's Prepaid Recharge System, which manages money recharges by the company's subscribers. This system provides facilities for subscribers to add money to their call accounts by entering a prepaid voucher PIN. Typically, users will redeem vouchers via their cell phones. However, recharge facilities are also available via bank ATMs or at point-of-sale (POS) terminals in the bigger supermarket chains. Web services also allow the subscriber to purchase SMS or data bundles out of his call

account. Using the web services, subscribers can also view their remaining credit and transfer money from one cell phone number to another.

When a user first turns on his cell phone, the cell phone logs him into the network via the closest cell phone tower. Each user is assigned an IN Home Location Register (HLR), which is an active/active HPE NonStop system pair that tracks the current location of the user and his account profile. The user's HLR is determined from the first six digits of his cell phone number. Upon logon, IN will obtain the user's profile from his HLR; this profile information includes his remaining call time. When the user dials a number, IN will establish a connection with the called party. Upon completion of the call, the length of the call is deducted from the user's remaining minutes.

To add money to his account via cell phone, the subscriber dials a special number, which connects him to the company's Prepaid Recharge System through an automatic voice response system. This system will lead him through a menu from which he picks his appropriate service. If he chooses to redeem a prepaid calling card voucher, the user enters the voucher PIN, which adds the amount of money represented by the purchased voucher.

The Prepaid Recharge System will forward this recharge time to the IN system, which will update the user's profile to add the additional money to his account. It will also log the transaction to a Recharge Log for later reconciliation between the Prepaid Recharge System and IN, as well as update the transaction display on the web interface.

The Active/Active Heart

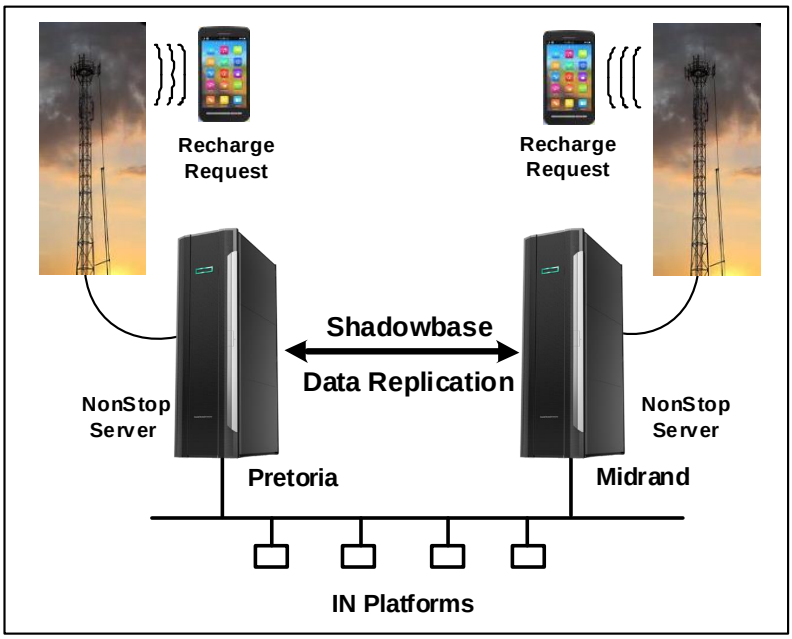

Figure 2 – Prepaid Front End (PPFE)

The heart of this system is the Prepaid Front End (PPFE), which interacts with the user to recharge his account (Figure 2). If the PPFE fails, the subscriber cannot add money to his account. If the account runs out of money, the user no longer has cell phone service. Therefore, the PPFE must be running 100% of the time. If it goes down, then subscribers cannot recharge; and cell phone service will be denied to a large segment of cell phone subscribers.

To ensure continuous availability for the prepaid card service, the company implemented the PPFE as a pair of NonStop nodes in an active/active architecture. The two nodes carry identical databases and are located in Pretoria and Midrand, South Africa. The databases are kept synchronized via Shadowbase bi-directional asynchronous replication, which replicates the primary information contained in the Recharge Logs.

If a node fails, then all call transactions are routed to the surviving node, which continues to provide prepaid card services for all subscribers in the company's network. This routing is possible because both nodes always

have a current, consistent and correct copy of the database. When the failed node is returned to service, its database is resynchronized with the active node; and normal two-node service is resumed.

The service provider did not initially use the system in a true active/active configuration, in which both nodes are actively processing transactions, because of concerns of fraudulent activity. For instance, two subscribers could use the same voucher simultaneously, and if their requests were routed to different nodes, they could both succeed. In a single node setup, the voucher record is locked by the first attempt; and the second attempt is blocked. Therefore, the company used the PPFE active/active system in a *sizzling-hot-standby* (SZT) configuration. All transactions were handled by the primary node and replicated to the backup node, which had all applications running and the database open so that it could instantly take over if the primary node failed.

However, the company has since resolved this concern and has cut over to a true active/active operation, where both nodes are actively handling transactions. To avoid fraudulent use and data collisions, one system will handle odd-numbered vouchers; and the other will handle even-numbered vouchers.

Ancillary Systems

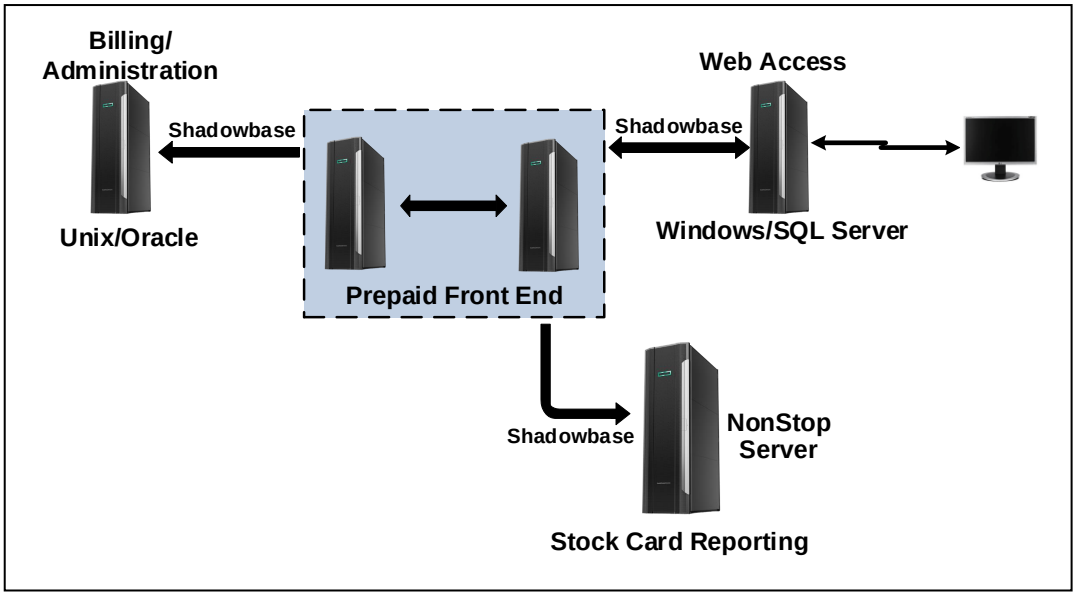

Figure 3 – Ancillary Systems

The PPFE feeds several ancillary systems important to the provision of prepaid card services (Figure 3). These systems are run as monolithic systems since their availability is not so critical. Though there is no need to synchronize the PPFE database with the ancillary systems, Shadowbase data integration software is used to transfer information between these systems by replicating database transactions from one system to another. During normal operation, the ancillary system support is split between the two nodes in the PPFE. If one node fails, its ancillary-system links are switched to the surviving node. Upon recovery of the failed node, the links are switched back.

Web Access

Subscriber web access to prepaid card data is provided by a web server running on a Windows/SQL Server platform. A subscriber can view the available money left in his account, add money to a card, and transfer money from one cell number to another. These types of updates are replicated back to the PPFE database. Shadowbase bi-directional replication is used by the web server to access data from the PPFE to support a subscriber's requests and to replicate updated data back to the PPFE database.

Billing and Administration

The Billing and Administration system is resident on a Unix system that runs under Oracle. Shadowbase software is used to replicate the Recharge Logs to this system to charge the users' accounts for time and other services purchased and to report on the recharge activity.

Stock Card Reporting

The Stock Card Reporting System tracks the prepaid vouchers that were sent to stores for subscriber purchase. It tracks all cards that have been printed since 1996, even those that were used or expired. Currently, there are over two billion cards in the Stock Card Reporting database, of which 50 million or more are active at any one time. The Stock Card Reporting System is implemented on a NonStop server and is fed from the PPFE via Shadowbase uni-directional replication.

Summary

By implementing the critical PPFE as an active/active system, the company ensured continuous availability of subscriber account recharging, calling time transfer, and calling time query services to its subscribers. It also took advantage of efficiencies by imposing reasonable availability requirements on its ancillary systems, which are all monolithic systems fed via data replication from the central PPFE. NonStop servers are judiciously used for the ancillary systems requiring greater availability. The cellular provider's Prepaid Recharge System is an excellent example of a heterogeneous system mixing active/active technologies with high availability systems, all connected by HPE Shadowbase data replication software, operating in uni-directional, bi-directional, and data integration modes.

International Partner Information

Global

Hewlett Packard Enterprise
6280 America Center Drive
San Jose, CA 95002
USA
Tel: +1.800.607.3567
www.hpe.com

Japan

High Availability Systems Co. Ltd
MS Shibaura Bldg.
4-13-23 Shibaura
Minato-ku, Tokyo 108-0023
Japan
Tel: +81 3 5730 8870
Fax: +81 3 5730 8629
www.ha-sys.co.jp

Gravic, Inc. Contact Information

17 General Warren Blvd.
Malvern, PA 19355-1245
USA
Tel: +1.610.647.6250
Fax: +1.610.647.7958
www.shadowbasesoftware.com
Email Sales: shadowbase@gravic.com
Email Support: sbsupport@gravic.com

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