

Delivering superior subscriber mobility with HP OpenCall mobility management solutions

- HP OpenCall Home Location Register (HLR)
- HP OpenCall Home Subscriber Server (HSS)



A discussion on the evolution of mobility management

HP: a pioneer in network mobility

HP OpenCall pioneered the off-switch mobility management marketplace when it deployed the first general-purpose computing platform-based Home Location Register (HLR) in 1993. HP OpenCall continued to innovate after the first initial deployment:

- First synchronized mated-pair HLR in 1993
- First “no downtime” migration upgrade performed in 1994
- First multi-switch vendor-compatible HLR in 1994
- First integrated HLR/AC in 1995
- First WIN-capable HLR in 2001
- First multi-protocol HLR supporting both GSM and ANSI in 2002

Millions of wireless subscribers in 35 countries across five continents currently rely on this mission-critical technology to register, place/receive calls and use services. The OpenCall HLR is built on a fault-tolerant foundation, comprised of the HP OpenCall Intelligent Network Server (INS) and carrier-grade HP NonStop platform.

Rural Cellular joined a long list of satisfied HP OpenCall HLR customers in April 2004. The following excerpts from the Rural Cellular press release highlight new functionality that HP has incorporated into the HLR, which allows operators to support multiple networks, and subscriber roaming in-between, with one HP OpenCall HLR.

HP announces Rural Cellular as one of the first mobile operators to support multiple wireless network technologies from a single HLR platform

HP today announced that Rural Cellular Corporation will deploy in full production an advanced home location register (HLR) that supports—from a single platform—the world's major wireless network technologies as well as interoperability between them.

... Rural Cellular will deploy the HP OpenCall HLR to support two of those standards, ANSI/TDMA-CDMA1 and GSM/GPRS1. The HP OpenCall HLR maintains vendor and wireless network protocol neutrality between the two.

With multi-standard network support combined into a single HLR, operators can unify regional operations into one cohesive network that spans ANSI/CDMA/TDMA, GSM/GPRS/EDGE, and UMTS radio access. This key feature can deliver significant benefits, including reduced operational costs; faster return on investment; and greater flexibility to launch and provision new revenue-producing services to all customers, regardless of which network serves them.

"We needed to add GSM/GPRS service to our ANSI/TDMA service, and HP will help us simplify what might have been a more complex and difficult task," said Ann Newhall, executive vice president and chief operating officer, Rural Cellular Corporation. "This technology will give us a more flexible infrastructure that will better support our growth initiatives."

In addition to the information outlined in the press release, it is important to note that HP enabled Rural Cellular to consolidate subscribers from four different HLR vendors onto a single HP OpenCall HLR. In addition, HP replaced vendor-dependent proprietary features with functionally equivalent open features to enable simplified service interoperability and roaming, while also correcting switch deficiencies. This process allows Rural Cellular to drive vendor implementation within its network, makes it easier to operate and manage, and gives the company increased agility in preparing for the future.

No other HLR vendor in the market today allows carriers to manage multiple networks from a single centralized HLR. The 3G architecture requires similar interoperability. Is your current HLR vendor prepared to get you there?

This paper outlines HP's vision on subscriber mobility, illustrating this vision with real-world examples. This paper shows how network operators can become more agile, take back control of the network and improve mobility management today while preparing for tomorrow's requirements.

HP OpenCall: expertise and experience in the telco space

While HP is well-known as one of the premier information technology (IT) companies, many are surprised to learn that the HP OpenCall Business Unit has been delivering network equipment and solutions into service provider networks for decades. In fact, in addition to the HLR proof points listed above, did you know that HP is a leader in:

- Signaling middleware—HP OpenCall has more than 4,000 SS7 platforms in 50 countries.
- SMS platforms—70 percent of SMS goes over HP OpenCall.
- Mobile prepaid wireless solutions— over 120 million licensed users.
- Telco and IT service management solutions—HP OpenView/TeMIP runs in 160 networks.
- Service creation (SCE) and service control points (SCP) with over 450 installations and a 39 percent market share.
- Billing and mediation platforms.
- UNIX® (HP-UX per IDC), Linux, Windows® and NonStop.

The HLR sits both in the core and at the edge of the network, providing a bridge between legacy telecommunication infrastructure and the information technology space. While the HLR interfaces with the typical network equipment, it also manages the movement and manipulation of data and rapidly provides services and service enablers to network entities. As the network moves into a 3G environment, the management of this data takes on a new level of complexity as the application environment modernizes and evolves into an IP network. With HP's proven expertise in core data management provided in a highly reliable solution, no other vendor is better prepared to transition customers into this new telecom model.

HP: not just another vendor

HP has years of experience collaborating directly with carriers and their networks, working with most of the network equipment providers and partnering with third-party application providers to deliver the best, most reliable system for a customer's network.

HP will propose alternative features and solutions to problems that enable carriers to regain network control. Because we do not deploy switching equipment, HP is unbiased in analyzing and identifying issues that arise when supporting a multi-vendor MSC base. Oftentimes, these problems can be solved with HLR enhancements. Updates to the general-purpose computer-based HLR are typically faster than enhancements to switching systems, allowing for faster resolution of the network issue.

One example involved a carrier who began to experience a larger than average, steady traffic surge. The carrier asked HP to analyze the situation, after having little success resolving the issue with its switch vendor. Upon analysis, HP uncovered a pattern of duplicate authentication and triple registration traffic from a particular switch type in certain situations. Working with the carrier, it was determined that the switch had received a faulty upgrade from the vendor, and the problem was quickly resolved.

HP is not your typical vendor. HP is a partner that provides solutions and services from a neutral position in the best interest of the carrier.

Moving to the 3G IMS environment—HP has a defined path to get there

Many challenges arise as networks evolve to 3G and the IP multimedia subsystem (IMS). Carriers must:

- Analyze their existing networks to evaluate successes and challenges.
- Determine how the migration to 3G will impact their network(s) and how they will support their existing network growth in 2G, while preparing and deploying their 3G networks.
- Understand how to minimize infrastructure cost and complexity, while maintaining interoperation between both networks. The complexity of managing existing 2G services data could increase as much as fourfold when supporting similar 3G services and a new portfolio of 3G application services, such as multimedia. Simplifying the management of these networks is critical to long-term, future strategies and overall success as the evolution commences.

Although HP is currently implementing a broad IMS strategy and supporting applications, the focus for this paper will be the HSS and data management at a somewhat high level to protect our intellectual property and advantage. Upon request, HP will engage and disclose with customers the broader IMS strategy and full details on our 3G solution suite.

HP is currently implementing HSS on its proven network architecture, which will be discussed later in the paper. The basic architecture and concepts that have evolved in the mobility product line continue to evolve to accommodate new capabilities specific to 3G.

The primary initiatives and goals with respect to HP's HSS solution revolve around providing the core HSS capabilities and the supported/defined interfaces as outlined per standards, while also creating unique product differentiators and enablers to provide added value for our customers. Another primary requirement from HP's perspective is not only a unified product to support both 3GPP and 3GPP2 protocols (similar to the HP OpenCall HLR ANSI/GSM interoperability), but also backward compatibility with the 2G HLR. Data sharing and interoperability between the technologies will allow a complete solution (HLR/HSS) that addresses the market needs and offers deployment flexibility that is unattainable in competitive offerings.

A core architecture component to allow this to occur is the Dynamic Data Manager (DDM). The DDM is a network data manager that provides single point access to all information associated with a subscriber across all applications in a carrier's network. The DDM originated from an HP customer, who had 16 different applications associated with its 2G network and became challenged with managing the complexity of its network. The DDM provides the carrier with the following advantages:

- Single point data management, as opposed to complex provisioning systems with a separate data stream for each supported application. The single access point for data management greatly reduces the time to implement, support and certify tests from a customer care or business front-end system.
- Rapid feature deployment for new applications, which "plug" into the DDM through a common API.
- Configurable data access allows each configured application to have access to any/all of the data identified in the system, creating a completely open and flexible data mechanism to develop and trigger new services. Permissions are configurable on a per-attribute/per-accessor basis, allowing complete flexibility for data security and management.
- Notification and alert services providing data modifications to all parties that require notification of changes to any data (registration status, feature activity, etc.).
- Inherently provides a secondary access method to data. If an application were to go down, a remote backup can be started and the data is available to the mate/backup, creating fault tolerance across any application configured within the DDM.

- Federated data as opposed to isolated, duplicate data. By uniting the data, duplicates and discrepancies are removed, assuring the integrity of the data.

As stated earlier, HP is able to disclose both IMS and 3G solutions, such as HSS and DDM, with interested parties in a more focused setting.

HP's mobility management advantage

Faster time to market with new service enablers

Offering new services to subscribers in a timely manner can be the difference between gaining subscriber market share or losing subscribers to a wireless market competitor. The increased Average Revenue Per User the service brings almost becomes secondary when faced with the possibility of losing a large segment of the installed base.

Timing is everything for carriers. It is often dependencies with the embedded network that prolong market introductions, not the new services. Delays can cause the failure to launch differentiated services within the market "windows of opportunity," and the carrier misses out on a chance to distinguish itself from the competition and generate new revenues.

Carriers have stated that requesting new functionality or enhancements to existing features from the NEP switch vendor can take as long as two years, which is often too late to maintain an edge in today's competitive market. Carriers dependent on a single equipment provider for their network needs may also never receive the enhancement. If and when they do, it is usually accompanied with a very high price. As a carrier, new functionality is typically needed within six months of its market introduction by a competitor.

Through HP's well managed software process and IT background, new features and functionality are rapidly delivered to customers. HP typically delivers two major releases a year, which carriers can accept (full or partial) or skip. The HP OpenCall HLR has historically provided interim releases when a carrier requires new revenue-generating features, in between major releases. HP's IT software practices can accommodate these changes, rapidly, without disrupting scheduled full releases, and without compromising quality.

When carriers transition to the HP OpenCall HLR from competitors' HLRs, HP has been able to implement new and matching services before deploying live in the network. Although delivery timing of this new functionality is contingent on the complexity of the feature, HP gives customers what they require when they need it and have proven flexibility in responsiveness with most deployments. Some recent examples of services developed and delivered for HP carrier customers.

- Four medium complexity features in three months.
- One new feature in less than 30 days.
- Three new features within six weeks.

HP has also quickly deployed "switch fixes" to accommodate NEP switch vendors' misinterpretation of standards. These enhancements can be isolated to specific NEP switch manufacturers or a single NEP MSC. This is an example of how the HP OpenCall HLR not only controls the subscribers but also provides the carrier the ability to control the network and work around NEP mistakes as well.

Over the past 12 years, HP has built a reputation for rapidly delivering new functionality to meet a customer's needs, and has the customer references demonstrating this success.

Reclaim your network

Initially, carriers were sold switches and HLRs as a single entity, with the HLR dependently collocated on the switch. Once deployed in the carriers network, options for network expansion were then limited to a single network equipment provider (NEP).

Realizing this, once in the network the equipment provider could dictate to the carrier what it would get, when it would get it and demand top dollar for the new services, with little room for negotiations by the wireless carrier. The carrier was at the mercy of the vendor, with very little control of its network or its future.

Today, some vendors include their own HLR claiming “no costs” associated with the product; but the costs are typically built into the bigger picture (MSCs, radio access network [RAN] etc.). This strategy implicitly grants the NEP vendor leverage over future changes to the carrier’s network.

Equipment providers deliver wireless services or features using proprietary implementations when a standards-based alternative exists as another tactic intended to tacitly dominate a carrier network. Hoping subscribers will use these proprietary features, the vendor would further secure the carrier’s dependence on the vendor’s solutions.

Many of the carriers that HP has encountered have shared the following observations of their equipment providers, before migrating to HP OpenCall HLR solutions:

- The incumbent network equipment provider will not honor my requests for enhancements, nor be responsive to my business needs.
- The incumbent network equipment provider may deliver my requested enhancements, but it may take two years, when it is no longer needed.
- If the incumbent network equipment provider does provide the enhancement, it will only be available in limited areas.
- The requested enhancements will cost more than a switch, possibly two switches.
- Annual fees are typically associated with this limited functionality.
- If the enhancement is delivered, I usually have to buy an entire feature set rather than simply the feature itself.
- I usually have to buy more licenses than I need, instead of “pay as I need.”
- I am limited to the third-party equipment (SMSC, voicemail, etc.) that I can deploy in my network.
- I am at the mercy of my current network equipment provider.

More importantly, one must consider whether to continue being tied to a single network equipment provider when evolving into 3G networks, or determine it is time to take control of the network, before it becomes too late. An independent, standards-compliant HLR and HSS empower a carrier to take control of its 2G and 3G infrastructure.

For these very reasons, HP was approached in the early 1990s to create an independent, standards-compliant HLR, which worked with all market-deployed NEP mobile switching systems. The primary driver was the carrier’s desire to transparently introduce another switch manufacturer into its network to remain commercially competitive. Adhering to standards and creating unique features through network transparency allowed the HP OpenCall HLR to inherently function with all switch manufacturers and allowed the customer to diversify, reassume the helm of their network, and save cost in MSC procurement. With an independent HLR vendor and renewed control of their networks, HP’s customers have created an equipment negotiation advantage that significantly reduces expansion costs.

Applied economics

A carrier decided to gain control of its network and migrated to the HP OpenCall HLR. The carrier then decided to deploy a second switch vendor into the network, which was offered at a fraction of the incumbent switch vendor prices. As further network expansion was required, the carrier then had the choice of which vendor would best meet the carrier's criteria in the form of a request for proposal, which included:

- Best pricing for equipment
- Best pricing for services
- Requests for enhancements
- Timely delivery

By establishing a competitive market environment, the carrier was able to manage the switch vendors and leverage their behavior as a negotiation advantage moving forward for future network expansion, upgrades or replacement.

As IMS unfolds in 2005 and 2006, it is important for carriers to assure their networks have an independent infrastructure in place, to assure the compatibility and interoperation between their core network components (such as HLR/HSS) and their network infrastructure. Vendor-independent networks are required for carriers to succeed as everyone evolves to IMS.

Taking control: replacing proprietary features

Proprietary features can be defined as features in which the functionality is not standardized through the appropriate standards bodies and is unique in the NEP's network. Proprietary features can typically be classified into two distinct groups:

Independent proprietary features, which work seamlessly in any network and are independent of proprietary messaging, parameters or interfaces, making them functional and transparent to other vendor equipment.

Vendor-dependent proprietary features, which require unique messaging between entities and are likely to have more negative impacts than positive benefits. This group of proprietary features will be the focus of this section as NEPs commonly implement these for HLRs and MSCs to stifle competition.

Although vendor-dependent proprietary features may offer a unique capability/feature to both carriers and their subscribers, there are many negative impacts that a carrier will experience:

- These features only function between the NEP-provided HLR and MSC, and within the carrier's footprint. When subscribers roam outside their home market, the proprietary features cease to work as other switches cannot process the messaging.
- From a subscriber perspective, it is not a reliable feature. When it works, it is nice, but it does not always work; the result is inconsistent service within a limited service area.
- Costs for these features are compounding as carriers are sometimes charged an annual premium to use these limited feature sets.

The primary long-term impact of deploying these proprietary feature sets is that the carrier becomes dependent on the NEP vendor. The NEP gains control of the carrier's network, limiting the carrier to a single vendor for network upgrades and equipment expansion because once subscribers are accustomed to functionality, it becomes difficult to remove it.

In order for the carrier to regain control of its network, it must evaluate and determine alternative features that will provide functionality similar to the vendor-dependent proprietary features.

HP encountered vendor-dependent proprietary features with each of its customers' HLR network implementations over the past 12 years. In working with our wireless carrier customers, HP has

successfully enabled the carriers to regain control of their networks by replacing and displacing these vendor-dependent proprietary features.

HP has been successful in replacing a majority of these features with standards-based equivalent functionality or with independent features, which allow seamless service irrespective of equipment vendor. This action increases feature usage, driving additional usage revenues. Most importantly, the carriers have freed themselves of the equipment provider dependencies and are able to leverage the NEP manufacturers for other aspects of their networks.

HP eases migration pains

When a carrier makes the decision to upgrade to another vendor's HLR, the task of transitioning equipment and migrating data can seem challenging and overwhelming. This perceived problem also appears to grow as time passes and options seem to disappear.

As carriers begin the evolution to 3G, a window of opportunity has opened as today is the most opportune time to consider a transition to an alternative HLR. Most NEPs' HLRs were built on switching technology that will not transition to the all-IP network. Once a commitment is made for 3G and evolution begins, a carrier may become even more dependent on its existing vendor if the vendor supplies the 2G network infrastructure; the carrier may then settle for the same quality of service going forward. If a carrier is currently an HP OpenCall HLR customer, 3G is simply an extension to the existing solution and independence is maintained.

Although the challenges surrounding migrations to new solutions are unique to the carrier, HP's HLR carriers have experienced 100 percent successful migration from their old HLRs to HP OpenCall HLR. Similarly, customers have never migrated from the HP OpenCall HLR to another HLR solution, showing an unmatched level of customer satisfaction. No other vendor has the track record or experience that HP offers the customer. One customer stated, "Teaming with HP, we performed a heart transplant of our network with no bleeding and no impact on customers."¹

Over the past 12 years, HP has mastered migrations, in which HP takes ownership and deploys HP engineers who are dedicated to subscriber migrations. Customer involvement from all internal organizations (IT, engineering and operations) is at this team's disposal as specific details around every migration are customized to meet a carrier's needs.

HP's subscriber migrations occur in live markets, with no downtime to subscribers or network equipment. HP has on different occasions migrated as many as 1.2 million subscribers and three HLRs in a single evening.

HP's migrations allow a carrier to migrate at its own comfort level, with well-defined processes, procedures and specialized teams in place to assure the highest success rate. These migrations are carefully managed with all alternatives preplanned and approved with the customer so that if at any point the customer becomes uncomfortable with the process, it knows its options.

The migration exercise typically includes the following activities:

- Network and provisioning planning
- Feature/function mapping
- Data extraction and mapping tools
- Special network routing utilities

HP has implemented unique migration utilities that allow migrations to occur in small batches (as few as 10 subscribers for testing) or large (as many as 1.2 million in a single evening), which are fully transparent to the network. The utility also allows timeframes to span as little as one evening or as long as several months.

¹ Mel Bailey, director of network operations support, Former Triton PCS

Efficient management of large subscriber capacities

HLR subscriber capacities typically dictate the number of HLRs a carrier supports in its network. The number of HLRs typically drives up the per-subscriber cost model for a carrier, with each HLR requiring operations staff to support it. This number of HLRs also determines the complexity of networks, impacting network routing, number and dial planning, provisioning, interfaces, etc. Thresholds on the underlying hardware determine the supportable subscriber capacities on the system. Historically, for on-switch or switch-based HLR solutions, the maximum capacity is approximately 500,000 subscribers per HLR. Other off-switch, or computer-based solutions, maximize this number to 1.5 million subscribers per HLR. The HP OpenCall HLR has the scalability and capacity to support 8 million subscribers on a single HLR, based on an average-size call model.

Prior to implementing the HP OpenCall HLR, one of HP's existing customers required 20 HLRs to manage 16 million subscribers. HP was able to reduce the number to two mated pairs. The customer was able to immediately benefit from:

- Lower operations costs with fewer systems to manage
- Increased floor space from a smaller equipment footprint
- Less power consumption from a more efficient system
- Fewer upgrades (four instead of 20) per release
- Fewer interfaces/equipment, reduced STPs, SS7 connectivity, etc.
- Fewer dedicated human resources
- Simplified network management through centralization

The above stated benefits clearly define why the HP OpenCall HLR solution delivers the best total cost of ownership.

By increasing capacities and deploying on reliable systems, the HP OpenCall HLR allows the carrier to significantly reduce the required engineers to maintain the HLR systems. These valuable, trained resources can refocus their efforts to prepare for the next-generation activities, and management doesn't have to make the difficult decision of whether the present or the future is a higher priority.

As carriers migrate to 3G, a transition period will demand simultaneous support for both the newly deployed 3G networks and existing 2G networks. Simplifying the topology with less equipment, HP greatly reduces the complexity of managing the evolution, which will endure for many years.

HP has greatly surpassed other vendors' HLR subscriber capacities since the HP OpenCall HLR's inception. This dominant subscriber capacity position is primarily due to inherent linear scalability of the HP NonStop server hardware. CPUs are added as a carrier's increased subscriber growth requires them. Below are a few elements of the NonStop product which are discussed in later sections of this paper:

- Fastest data access methods
- Hardware architecture
- Software architecture
- Over a decade of network analysis and experience

Complete front-to-back system fault tolerance

The HLR is the heart of a carrier's network; therefore, it must be the most stable and reliable component of a carrier's network. While switches and other network components may experience a failure or an outage, an HLR outage has a much larger subscriber impact. HLRs serve many more subscribers from a central point than any of these other network elements.

An HLR outage typically results in millions of subscribers without service and generally creates national or global visibility through media coverage. This leads to loss of potential revenues, which based on the number of subscribers impacted has reached as high as 5 million Euros per outage. This revenue loss, however, pales in comparison to the negative publicity for the carrier, which is dangerous in a highly competitive market with all parties vying for market share. Secondary impacts, including increased subscriber churn, audits and lawsuits, typically follow a major outage.

As a carrier, you must ask yourself: *“Can I afford an HLR outage? How costly have previous outages been with my current HLR provider? How are my subscribers impacted by CPU failure, operating system failure, application failure, hardware failure, STP failure and transaction failure?”*

Is my HLR truly fault-tolerant?

Other vendors may claim fault tolerance and five nines availability, but these claims are typically filled with interpretation and caveats. Over the past several years, other HLR vendors have attempted to replicate what HP defined 10 years ago as “fault tolerant HLR solutions,” but these other vendors have met with little success, primarily due to the hardware and architecture their solutions are built upon.

The HP OpenCall HLR product line has been built upon the most reliable hardware and architecture available in the world. For more than 30 years, HP’s NonStop hardware line has been the computer of choice for financial (stock exchange) and banking applications around the world due to its fault-tolerant properties. In production for more than 10 years with 120 million licenses, the HP OpenCall HLR has yet to cause a network outage.

Each hardware component of this general purpose computer has a backup component that becomes active when a failure occurs in the primary component. Fault tolerance is also built into the application and platform, assuring always-available software, and the data integrity of every transaction processed. Completing this true fault tolerance model, a mated pair deployment model is engaged to provide a solution rated for at least seven nines of true availability. This ensures an outage will never cripple a carrier’s network. A testimony to this proven reliability: In 11 years of operation, a major wireless provider has not experienced an outage due to hardware or software HLR error.

Lowest total cost of ownership

When you purchase a vehicle, do you simply buy the cheapest vehicle on the market? Or, do you evaluate the maintenance history, life expectancy, the included features and the overall value of the vehicle?

Total cost of ownership (TCO) is a model that has been used to determine the long-term value and savings potential as opposed to the typical short-term, upfront costs associated with new systems. It identifies total cost savings that a carrier will typically experience over a three to five year period based on several identified input areas.

In our competitive experience, several network equipment providers will include the HLR “free of charge,” although the actual cost of the HLR is appended to the other equipment, exclusive to the deal. This tactic is somewhat appealing to carriers, but the long-term financial impacts prove much more costly.

The total cost of ownership model accounts for upfront costs as well as these often overlooked points where the HP OpenCall HLR provides significant value:

- Resources (equipment, floor space, power, human resources)
- Costs of downtime
- Time to market

- Subscriber churn
- Subscriber fraud
- Network negotiated equipment
- Centralization
- Multiple network support (2G and 3G)

The TCO of the HLR becomes clearer when we refer to an earlier section in which a carrier reduced its HLR needs from 20 HLRs to two mated pairs.

It has been HP's experience that the HP OpenCall HLR typically has a return on investment (ROI) in a three- to five-year period, and accelerated ROI for larger carriers. A recent evaluation with a carrier calculated a savings of more than \$80 million U.S. over a three-year period.

The carriers ROI was stated as \$80 million over three years, but the forecast is greater when 10-year assumptions are used and 3G migrations are included in the analysis. Obviously, the accuracy of such numbers has many assumptions and may not be part of the concise estimates required for comparative analysis.

It all began on a general-purpose computing platform

A general-purpose computer is a versatile computer that can host a wide variety of applications. Being general-purpose, GPC provides a resilient architecture that enables flexibility with respect to:

- Storage
- Accessibility
- Openness for usage in many different markets for many different applications

Historically, HLRs were first deployed as a tightly coupled solution with the specific switch infrastructure, thereby limiting the capabilities, capacities and functionality.

It wasn't until about five years ago, that the NEPs realized the significant advantages and flexibility of an HLR hosted on a general-purpose computing platform. Since that realization was widely accepted in the industry, vendors have tried to succeed in this new architecture arena, which is quite different from the one they spent 20 years mastering on the switch-specific computer. Some made several attempts, and others are still challenged by creating IT-based applications, typically changing the hardware platforms and starting over.

Other IT-based startup companies have also realized the value of HLR solutions and are now advertising computer-based HLRs, similar in architecture to the HP OpenCall HLR. However, these startup IT companies lack the years of proven telco core network experience, worldwide deployment and reach, and support infrastructure.

Since the early 1990s, HP has continued to re-evaluate the hardware, platform and core architecture, and although no "overhauls" to the underlying solution have been required, each component has been enhanced to make the total HLR solution one of the best in class available in the telecom market today.

The award-winning NonStop hardware and software continue to measure up as best in class, as evidenced by:

- Large market share in the financial sector (stock exchanges, banking) due to its inherent fault tolerance
- Wide deployment in the Internet realm (Yahoo, AOL, etc.) for reliability, and scalability
- Worldwide deployment in telecom (wireline and wireless)

But the most significant advantage that the telecom portfolio has over the competitors is that all the major components of the solution (hardware, platform and HLR application) are all implemented internally to HP. This unmatched advantage allows greater synergy and the ability for HP to enhance each component in a prioritized fashion. This advantage allows HP to control the content and releases associated with each component. No other HLR or mobile application available has this technology advantage.

HP's architectural advantage

As stated in the previous section, HP has evolved and improved its hardware and HLR software architecture for the past 12 years to consistently enhance a customer's experience and value from 1G networks (ANSI, GSM and PDC) through 3G (3GPP and 3GPP2). Below is a subset of the features that make the HP OpenCall HLR the most experienced mobility application and platform.

Reliability

- Not only from reliable systems, but also transaction-based to assure that every data modification is successfully secured; ensuring the integrity of subscriber-dependent data and network expected results.

Flexibility

- Configurable to accommodate our diverse portfolio of customers, networks and their needs.

Protocol interoperability

- Allows GSM messaging to be converted to ANSI equivalent and vice versa.
- Allows for data sharing between ANSI and GSM.

Accessibility

- Allows carriers to push real-time data from the HLR to other applications to create their own custom applications, or use our portfolio of third-party applications.
- Allows these same applications to pull/query the HLR for subscriber-based information to implement new services.

Security

- Providing such a high level of accessibility also requires an extreme security mechanism.
- Data security is provided down to the field level, as well as record, file and user level.

Multiple application support

- Authentication capabilities and functions reside, execute and share data in conjunction with the HLR.
- Similarly, GPRS capabilities also reside, execute and share data with the HLR.
- Third-party applications can also reside alongside the HLR, minimizing hardware and related costs.

CORBA-based and CLI

- Provides greater flexibility and views for the carrier.
- Can also be used to allow subscribers GUI access to modify their personal settings. Security settings determine the extent of subscriber access.

Memory

- Subscriber images are cached to further increase throughput and maximize subscriber capacities.

Load balancing across CPUs

- The HP OpenCall HLR in conjunction with the NonStop operating system allows HP to employ unique subscriber storage techniques, which inherently balance the traffic load across all CPUs.

Data synchronization,

- Back in the early 1990s, HP invented ADS (Application Database Synchronization), which assures data integrity across mated pairs to allow any synchronized mate to instantly be concurred and handle its mate's traffic load.
- Live software upgrades with no downtime (since 1995).

Segmented subscriber data storage

- Allows the HP OpenCall HLR to only store information that is relevant, creating a variable-length record structure and maximizing subscriber capacities.
- Although a complex algorithm is employed to gain the benefits, it is performed transparently to the user by the simple access APIs and user views.

Lightning-fast subscriber queries and updates

- The mass update utility provides carriers with the ability to execute SQL-like queries on millions of subscribers and return data results in minutes.
- Average queries can return data to output files at the rate of one million subscribers per minute, providing near real-time results.
- Update capabilities in mass fashion are also included although execution times are paced due to obvious reasons.

Network entity record files

- Profiles for all switches are maintained in the HLR.
- The HP OpenCall HLR provides the ability to modify the behavior of switches in a carrier's network and any other network around the globe where a subscriber roams.
- These profiles can be "learned" or automatically populated on the first interaction of the switch and a subscriber.

Object-oriented code base

- For rapid change capabilities.
- For flexibility.
- For portability.

HP's latest architectural breakthrough is the Dynamic Data Manager, which is being built in conjunction with HSS. The Dynamic Data Manager will open data access and share not only between HSS and HLR, but also to all applications in both 2G and 3G and across all supported protocols.

Local 24x7 support

In this round-the-clock world, networks must be consistently run smoothly 24 hours a day, seven days a week. No exceptions. But if issues were to arise, is your vendor reachable or available? If you have a non-critical question, are you typically calling across time zones to reach your vendor, and do they even speak your language?

With over 130,000 employees, more than 5,000 telecom engineers worldwide and local account teams established in most major cities, HP's global coverage for a carrier's needs is first class.

Each carrier is typically assigned a local account team to address non-critical issues, support its network planning and to give the carrier the attention it deserves. The local account team has direct access to the product family, which is also strategically deployed internationally.

For critical issues that arise, 24x7 support is always available with a real person answering the call.

Managing a new network entity, such as an HLR, can also create anxiety for a carrier's operators and engineers. With this in mind, HP has developed a successful program in which experienced HLR

engineers are deployed for customer-defined durations to not only operate the system, but to also train the local carrier's operators on how to manage the systems.

Conclusion

The market is leading carriers to consult crystal balls and catch a glimpse of how their networks will look a few years from now with respect to 3G. Obviously, hindsight would be a wonderful advantage. But as a carrier in a 2G world, hindsight on 2G should indicate what should not be repeated.

Solutions, such as HLR and HSS, will coexist for many years as one grows and one expires, but supporting both concurrently for a period will be required. This fact alone will greatly increase the complexity of the network with respect to equipment, applications, engineers and many unforeseen factors. Consolidation and centralization will play a key differentiator in minimizing the complexity of these networks. Fault tolerance will be required if consolidation and centralization are introduced.

Rapid deployment of features, functionality and customization is needed today and will be required moving forward. Carriers will need to have better control over their vendors, and traditional vendors will need to be more responsive, like IT companies.

HLR flexibility is required to handle diversified network situations and manage unique subscriber needs. Data manipulation and management and a transparent transition to 3G, with little or no impact to the existing network remain factors for all HLRs making this transition.

HP has been deployed in the NEP core network market space for several decades, 12 alone in the HLR market space, where it has been a technology leader, paving the way for innovation that has created the most reliable networks that serve millions of global subscribers every second of every day. HP has differentiated itself from traditional equipment providers by bringing its IT strengths and contributing them to the evolution of wireless networks.

Rural Cellular recently evaluated where they are today and where they wanted to be. They used their 2G hindsight, and took their first step in planning their network evolution to 3G.

For Rural, the answer was clear. No crystal ball needed.

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