

Delivering superior subscriber mobility with HP OpenCall mobility management solutions White paper

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

A discussion on the evolution of mobility management from cellular telephony to all-IP technology, highlighting architectural benefits and business considerations



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HP: a pioneer in network mobility

HP OpenCall revolutionized 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 innovating beyond the initial deployment with firsts in:

- Synchronized mated-pair HLR (1993)
- “No downtime” migration upgrade performed (1994)
- Multi-switch vendor-compatible HLR (1994)
- Integrated HLR/AC (1995)
- WIN-capable HLR (2001)
- Multi-protocol HLR supporting both GSM and ANSI (2002)
- Production-ready, co-resident HLR/HSS (2006)

Millions of wireless subscribers in more than 35 countries across five continents currently rely on this mission-critical technology to register, place and receive calls and to use services. The HP OpenCall HLR is built on a fault-tolerant foundation, comprised of the HP OpenCall Intelligent Network Server (INS) and carrier-grade HP NonStop platform. In the 14 years since the initial deployment of the HP OpenCall HLR, many of the world’s largest carriers introduced this product as their HLR of choice due to its superior scalability, reliability and manageability.

Vivo, the largest provider of mobile telephony services in the Southern Hemisphere, is one of HP’s many satisfied customers to substantially expand the presence of the HP OpenCall HLR in its network in response to major subscriber growth. The merger and consolidation of more than five operators demanded a highly reliable and linearly scalable HLR to guarantee Vivo’s customers the highest levels of service during migrations. The HP OpenCall HLR and HP services team successfully met these requirements.

AIS, Thailand’s leading mobile operator, also continued to support its sustained growth with its HP OpenCall HLR, in response to increased demand for fast and flexible customization of services. The need for product enhancements combined with rapid subscriber growth also lead Verizon, a North American Tier 1 operator, to expand its HP OpenCall HLR in its network.

Several of the world’s major mobile operators recently selected HP’s OpenCall HLR to manage their current wireless networks—with the added benefit of knowing that they will be able to easily and cost-effectively migrate to the next-generation architecture of the IP Multimedia Subsystem (IMS).

The merger of Cingular Wireless and AT&T into Cingular, the leading mobile operator in the United States, required an offering capable of integrating multiple HLR vendor capabilities, and led to the largest HLR deal in HP history. Cingular chose HP OpenCall HLR for its proven reliable and scalable technology as well as the clear evolutionary path to the opportunities presented by the advent of the next-generation IMS network.

Vodacom, South Africa’s leading wireless operator also turned to HP OpenCall over the competition for an extremely reliable HLR that would enable the highest levels of service availability for the growing subscriber base.

Rural Cellular became one of the first mobile operators to support multiple wireless technologies from a single HLR platform when it chose HP OpenCall HLR. Rural Cellular deploys its HP OpenCall HLR to support the ANSI and GSM standards, and as a result benefits from reduced operational costs and greater flexibility to launch and provision new revenue-generating services to all customers, regardless of which network serves them.

No other HLR vendor in the market today allows carriers to manage multiple network technologies from a single centralized HLR.

The next-generation all-IP network architecture requires similar interoperability and presents further complexities to carriers. 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. It calls out the agilities of a computer-based software solution and demonstrates the capacity for change available to network operators to improve mobility management in the network 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 HP OpenCall 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 4,700 installations in fixed and mobile telecommunications in more than 100 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 170 networks
- Service Creation Environment (SCE) and Service Control Points (SCPs) with over 900 SCPs deployed globally in wireless and wireline networks
- Billing and mediation platforms
- UNIX® (HP-UX per IDC), Linux, Windows® and NonStop

Given HP's breadth of experience in delivering mission-critical network solutions coupled with its IT background, HP is uniquely positioned to address challenges in operator networks that consider the future direction of the telecommunications infrastructure.

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—a position that significantly leverages HP's strengths. While the HLR communicates across the standard interfaces with network equipment, it also manages the movement and manipulation of data and expeditiously provides services and service enablers to network entities. This manipulation and transmission of data requires a high-performing, extremely stable database with measures in place to avoid data corruption.

As the network moves into a 3G environment, the management of this data takes on a new level of complexity, as customer demand for service requires a more modern HLR application to operate in 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 rich media 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 solutions 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 Mobile Switching Center (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 where HP has acted on the customer's behalf 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 MSC 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 can continue to exploit their successful 2G business model to 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 is the HP OpenCall Home Subscriber Server (HSS) and data management. The discussion here is 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. The basic architecture of our successful mobility product line continues to evolve to accommodate new capabilities specific to 3G.

The HP OpenCall HSS solution's primary initiatives and goals are to first provide the core HSS capabilities and the supported/defined interfaces as outlined per 3GPP and 3GPP2 standards, and then to also create competitive revenue opportunities with unique product differentiators and enablers. Another primary requirement from HP's perspective is backward compatibility with the 2G HLR. Data sharing and interoperability between both generations' technologies will allow a complete solution (HLR/HSS) that effectively addresses the market and offers deployment flexibility that is unattainable in competitive offerings.

The Dynamic Data Manager (DDM) is a core enabling component of our HSS architecture. The DDM technology provides single point access to all information associated with a subscriber across all applications in a carrier's network. The DDM concept was originated to address the concerns of 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 can provide a 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 can greatly reduce 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 Application Programming Interface (API).

- Configurable data access that allows applications to have access to any/all of the data identified in the system, creating a completely open and flexible data management toolset to develop and activate new services. Permissions are configurable on a per-attribute/per-accessor basis, allowing complete flexibility for data security and management.
- Notification and alert services that provide immediate notification to all parties subscribing to the specific data updates they need to watch or respond to (i.e., registration status, feature activity, etc.).
- Inherent support of secondary access methods to data. If an application becomes unavailable, the data can be immediately available via a mate/backup, creating fault tolerance across any application configured within the DDM.
- Use of the DDM SDK to enable all data to become federated data as opposed to a typical set of isolated, and largely duplicated, data. Through uniting the data, the duplicates and discrepancies are removed, along with the unnecessary expense of synchronizing these sets of overlapping data. A federated data set reduces operational expense and enhances data integrity.

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 or losing subscriber share in a highly competitive wireless market. The increased Average Revenue Per User associated with a new service almost becomes secondary when faced with the possibility of losing a large segment of the installed base for lack of a competitive offering.

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 window and, in turn, cause a carrier to miss a chance to distinguish itself from the competition and generate new revenues.

Carriers have stated that requesting new functionality or enhancements to existing features in switches from Network Equipment Providers (NEPs) can take as long as two years, a delay that could cause them to lose an edge in today's competitive markets. Carriers dependent on a single equipment provider for their network needs may never receive the enhancement. If and when they do, it is usually accompanied with a very high price. For carriers, 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 quickly developed and delivered to customers. HP typically offers two major releases a year as well as interim releases when a carrier requires new revenue-generating features in between major releases. HP IT software architecture and practices can accommodate these changes, rapidly 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 them live in the network. Although delivery timing of this new functionality is contingent on the complexity of the feature, HP has a proven history of delivering to customers what they require when they need it. Some previous examples of services developed and delivered for HP carrier customers include:

- Four medium complexity features in three months
- One new feature in less than 30 days
- Three new features within six weeks
- A configuration change on the HP OpenCall HLR that took virtually no time and allowed the customer to support needed functionality

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. Over the past 14 years, HP has built a reputation for rapidly delivering high-quality, new functionality to meet a customer’s needs.

Reclaim your network

Initially, a carrier was sold switches and HLRs as a single entity, with the HLR dependently collocated on the switch. Once deployed in the carrier’s network, options for network expansion were then limited to a single NEP.

Once a vendor had a monopoly over the equipment introduced in a network, the NEP could dictate to the carrier what functionality it would receive in a release, when the release would be available 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 HLRs, 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—if the carrier wants to maintain a homogenized network view to end subscribers.

Some equipment providers deliver wireless services or features using proprietary implementations when a standards-based alternative exists. This can be another tactic intended to tacitly dominate a carrier network. If subscribers use these proprietary features, the vendor further secures 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 the enhancements are 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, or 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 to 3G networks, or determine it is time to take control of the network. An independent, standards-compliant HLR and HSS empower a carrier to assume 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 and 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 its network, and save cost

in MSC procurement. With an independent HLR vendor and renewed control of their networks, HP 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 equipment from a second switch vendor into its network. This equipment was offered at a fraction of the incumbent switch vendor's 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 trials become deployments in 2007 and 2008, it is important for carriers to assure their networks have an independent infrastructure in place, to assure the compatibility and interoperability 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 markets, 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 14 years. In working with our wireless carrier customers, we have 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 14 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 enable a higher 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, increase 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.²

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, less 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 number of engineers required to maintain the HLR systems. These valuable, trained resources can refocus their efforts to prepare for next-generation activities, and management doesn't have to choose whether the present or future network is a higher priority with its limited resources.

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 that 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.

² This number is based on a standard call model deployed on NonStop S88000 hardware.

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 15 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, the HP 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. The HP OpenCall HLR has been in production for more than 10 years, without an 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, enabling always-available software, and the data integrity of every transaction processed. Completing this true fault-tolerant model, a mated pair deployment model is engaged to provide a solution rated for at least seven nines of true availability. This offers protection from outages crippling a carrier's network.

Lower total cost of ownership

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 carrier's 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 (GPC) 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 recently, 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 offerings available in the telecom market today.

The award-winning NonStop hardware and software continue to lead the industry, 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 14 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 enable that every data modification is successfully secured; providing 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

- Enables GSM messaging to be converted to ANSI equivalent and vice versa
- Enables data sharing between ANSI and GSM

Accessibility

- Enables 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 provisioning

- 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 enables 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 provides data integrity across mated pairs to allow any synchronized mate to instantly be concurred and handle its mate's traffic load.
- 10 years of live software upgrades without an outage.

Segmented subscriber data storage

- Enables 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.

Rapid 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 sharing 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 150,000 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, to 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 systems, but also to 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, 14 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.

Several major carriers 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 these HP customers, the answer was clear. No crystal ball needed.

For more information

www.hp.com/go/hlr

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