



Intelligent Networks Architecture The Oracle Vision



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The Oracle Vision

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Contents

1. INTRODUCTION	1
1.1 TRADITIONAL IN SERVICE DELIVERY.....	1
1.2 THE NEW MODEL FOR SERVICE DELIVERY.....	3
1.3 SYNERGY WITH FUTURE IN DIRECTION.....	4
1.4 CONCLUSION.....	4
2. BENEFITS OF ORACLE IN THE TRADITIONAL IN MODEL	5
2.1 OVERVIEW.....	5
2.2 PERFORMANCE.....	5
2.2.1 <i>Throughput for Real Time Response</i>	5
2.2.2 <i>Throughput for Provisioning</i>	6
2.2.3 <i>Scalability</i>	6
2.2.4 <i>Capacity</i>	7
2.3 AVAILABILITY.....	7
2.4 MANAGEABILITY.....	8
2.5 SERVICE CREATION.....	8
3. WEB IN	9
3.1 OVERVIEW.....	9
3.2 FACTORS AFFECTING TO MOVE TO WEB-IN.....	9
3.2.1 <i>Mobility</i>	9
3.2.2 <i>Ubiquity of Web-Based Standards</i>	9
3.2.3 <i>Corporate Intranets</i>	9
3.2.4 <i>Business via the Internet</i>	9
3.3 THE CHANGING USER INTERFACE.....	10
3.4 MOBILITY, SERVICES AND THE INTERNET.....	10
3.5 ORACLE WEB-IN TELEPHONY TODAY.....	11
3.6 ORACLE DEVELOPMENT TOOLS AND USER COMMUNITY.....	11
3.7 SYNERGY WITH NETWORK COMPUTING ARCHITECTURE.....	12
4. TECHNICAL DETAILS	13
4.1 SCP (SERVICE CONTROL POINT).....	13
4.1.1 <i>Transaction Recovery</i>	13
4.1.2 <i>Media recovery</i>	13
4.1.3 <i>Node Availability</i>	13
4.1.4 <i>Disaster/Highest Availability</i>	14
4.2 CALL PROCESSING (SCF).....	14
4.3 PROVISIONING TRANSACTIONS.....	14
4.4 ORACLE SERVICES.....	15
Figure 1: Traditional Intelligent Network Architecture.....	1
Figure 2: The New de-Facto Intelligent Network Architecture.....	3
Figure 3: Movement of Intelligence out of the Network.....	4
Figure 4: Oracle Scaleable Architecture.....	7
Figure 5: Web IN.....	11
Figure 6 Network Computing Architecture.....	12
Figure 7: Mated-Pair Approach.....	14
Figure 8: IN Data Management Layer.....	15

1. Introduction

This document describes Oracle's view of the changes affecting telecommunications companies today, and in particular the implications these have for the traditional Intelligent Networking-based (IN) services. It describes the impact that technology is having upon the way these services are being delivered, now and in the immediate future, and shows the benefits that companies can derive by basing current and future services upon open technology provided by Oracle.

The document is based on Oracle's recent experience with IN vendors, telecommunications companies and end-users. Many of these telecommunications companies and IN vendors are now discovering the advantages of using Oracle's open technology in the previously proprietary world of Intelligent Networking databases and service delivery, and in the open world of the Internet.

The telecommunications industry is experiencing fundamental change, caused by many factors, in particular;

- Continuing deregulation, leading to increasing competition from new technology start-ups
- The requirements for new services, in order to increase usage and retain customers
- The dramatic rise in mobile telecommunications over the past few years.

In conjunction with these changes, a revolution is occurring in the previously closed IN environment. The dynamic, open world of the Internet and its related technologies are beginning to make a significant impact upon the telecommunications services that are being delivered to customers, and the technologies that are being used to deliver them.

There is now no doubt that Internet technology and services will have a dramatic effect upon the way that telecommunications services are implemented, delivered, provisioned and managed. Oracle is empowering its customers to be at the forefront of this revolution.

Oracle is now providing its customers a unique capability to leapfrog traditional IN service delivery models. Oracle products are being used to deliver the 'traditional' IN-based services, and also, increasingly, the newer, Web-based or focused services. In many cases these new services will supplement or replace the older services, using an open, reliable, scaleable, and flexible infrastructure that will support the increasing complex and competitive telecommunications environment. This environment must meet today's requirements to support highly performant and reliable services, and tomorrow's requirements to be Internet capable, and fully integratable with new technology such as JAVA and Object technology. These capabilities were not even thought of when IN standards were first developed, but today's telecommunications environment must support them.

By providing all these capabilities to its customers, Oracle is enabling them to deliver new, advanced telecommunications services to market quicker, cheaper and more reliably than ever possible before.

1.1 Traditional IN Service Delivery

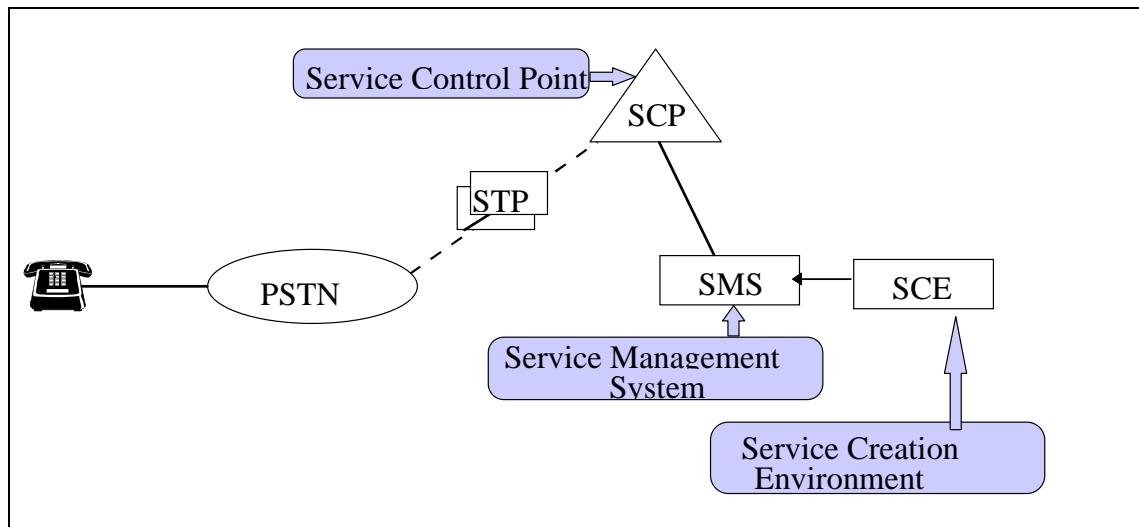


Figure 1: Traditional Intelligent Network Architecture

The above diagram illustrates in outline the traditional Intelligent Network architecture. Intelligent Networking is an industry defined mechanism for extending the capability to manage telephone calls, by migrating much of the 'intelligence' used to route calls out of the switches and into programmable platforms. IN defines the standards used for communication between logical and physical entities used to process telephony interactions, including calls and associated services. It was created to make the system independent of particular service providers or Network equipment vendors, and allow faster delivery of services based on open standards.

In theory therefore the various IN architectures (there are a number of variants, in time and geography) allow for dynamic creation and modification of services based around a set of standard protocols and message sets. Services are the revenue stream of business for the telecommunication industry, where time to market and bundled services are key to generate new customers and increase business with existing customers, whilst keeping existing customers. Within these self-contained environments, new services are defined and created within the Service Control Environment (SCE), and then downloaded to programmable Service Control Points (SCP), via the Service Management System (SMS). The SMS is also used to provision the data for services.

In practice, the reality of IN has not fully met the promise of its originators, for several reasons, including;

1. Much effort was focused on Service Creation aimed at the SCP, omitting the provisioning aspects of service delivery.
2. Standards were slow to be agreed and slower to be delivered, and incompatible variants have arisen, increasing complexity.
3. Many of the services are too difficult to use. DTMF is not the ideal user interface, but is generally the only one defined by standards. It is not uncommon for a service to require the user to enter 20 or 30 digits to control one aspect of it.

Combined with these factors is the fact that most IN systems use specialised databases and programming languages or constructs, increasing incompatibilities between different vendors equipment, and also meaning that skills and applications cannot be easily transferred between operators or vendors.

Oracle's technology is today being used as a more cost effective and faster way to deliver services for these traditional architectures, and also to enable these and newer services to co-exist and interact with Internet based applications. It is Oracle's belief that the new architecture now emerging, based in large part upon standards derived from Internet technology, will lead to many of the above problems being overcome.

1.2 The New Model for Service Delivery

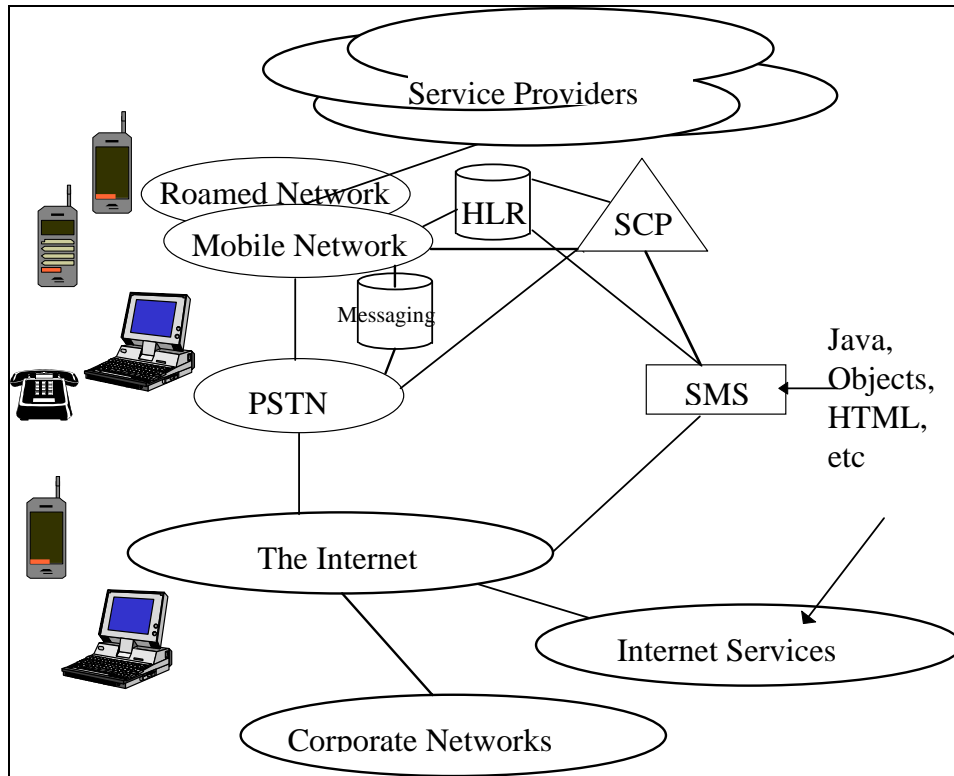


Figure 2: The New de-Facto Intelligent Network Architecture

Figure 2 shows the new, de-facto architecture developing in response to the proliferation of mobility, combined with new Open Internet technologies and advanced handset capabilities. Much more complex and dynamic than the traditional model, it is a model where the boundaries of Mobile and Fixed, Intelligent and Switch, Computer and Handset, are blurring and will eventually disappear.

The ubiquity of the HTML standard, handsets with in-built web browsers, services designed for self provisioning via the Internet, and the arrival of programmable, downloadable intelligence within handsets and other network devices, are some of the key technologies that are transforming the way telecommunications services are delivered to customers.

These technologies allow customers to bypass many of the services that traditionally could only be provided by the network provider, and, crucially, they also bypass the traditional IN function of determining when and how service selection is made. For example, when the handset can be programmed with a number of different service addresses, and make the choice for the user, or when a mobile handset performs voice recognition and dials the required person or service, the functionality that was previously envisaged as being centralised is no longer needed there.

As this intelligence moves out of the Intelligent Network, into terminal devices and Internet/Intranets, it will have a far-reaching implication for service-delivery and capability. This is shown in Figure 3.

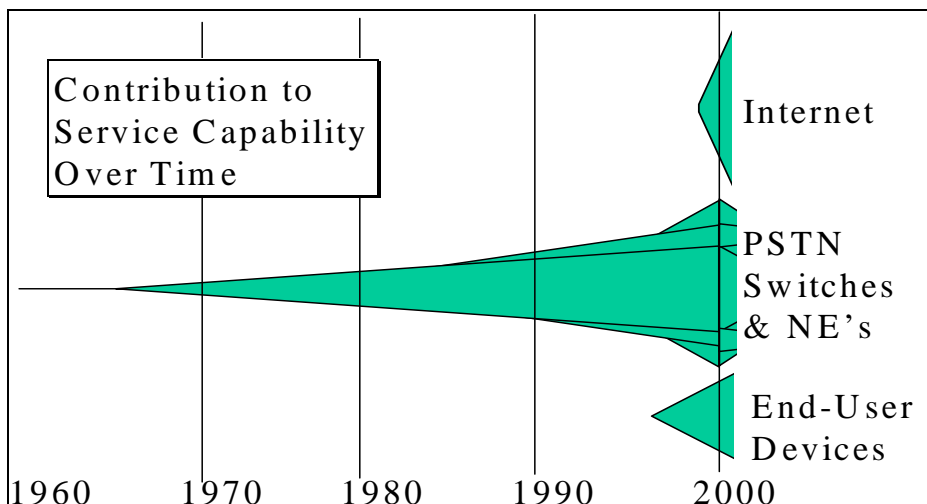


Figure 3: Movement of Intelligence out of the Network

Note also a key difference between the traditional IN architecture and that shown in Figures 1 and 2. In the traditional model, the entire environment is within the realm of a single telecommunications company, which is therefore able to control most or all of the aspects of service delivery. This is no longer the case in the new model, and therefore much more of an emphasis is placed upon the capability of the operators to provide and support standards-based interfaces and capabilities, in order to allow easy interoperation with other service providers. Oracle is currently providing this capability within the Computing environment, and is now starting to provide the same commonality within the Telecommunications environment.

1.3 Synergy With Future IN Direction

IN standards are moving forward, in Europe with CS2, CS2+ being the closest to release, along with CAMEL to provide a formal mechanism for IN within GSM. Without doubt some vendors and operators will release services based upon these standards, but at the same time, an increasing number of operators, frustrated by the incompatibilities and slowness to market of IN standards are taking a more pragmatic, Service Node¹ or Internet-based approach.

Looking further forward, the vision put forward here by the authors is very much in line with the direction taken by TINA-C. This consortium put forward in the middle 1990's a future vision based on what was then very much a state-of-the-art computing direction. It encompassed distributed processing, objects and had a more comprehensive focus on management than the original IN. The new direction that is now being taken by the defacto adoption of Internet based standards such as CORBA is very much in line with TINA and their view of where IN is heading.

1.4 Conclusion

In tomorrow's Internet-focused world, the user will take much of the responsibility for determining which services they use, even if this is made transparent to them, and the Telecommunications Companies and Service Providers that succeed will be the ones who live within and enable this new mode of service delivery. They will succeed by providing customers with valuable, easy-to-use, self-provisioning services that therefore increase the amount of bandwidth, time and functionality that customers wish to spend.

The rest of this document is in three sections. Section 2 describes how the telecommunications companies can benefit by using Oracle technology in the previously closed 'traditional' IN model. Section 3 describes how customers can extend these benefits to the new service model where interaction with Internet technology and services is key to the service. Section 4 contains technical detail for those looking more closely at the details of Oracle technology.

¹ Whilst Service Node is often referred to as 'IN' by those selling or implementing it, to a large extent, Service Nodes bypass much of the CCF and SCF and thus move the intelligence out to the periphery of the network.

2. Benefits of Oracle in the Traditional IN Model.

2.1 Overview

Although the traditional IN Model defines separate Service Control and Service Data Functions, in practice both have been combined together to form the Service Control Point. There are two reasons for this.

Firstly, standards between the SCF and SDF are not well enough defined to allow interoperability between different vendors products.

Secondly, were the two functions to be hosted on separate platforms, then until very recently, the technology available would not have supported the response time and availability requirements of telecommunications companies. Whilst this separation will likely remain the case within an Oracle infrastructure, the performance characteristics and remote access capabilities of Oracle's product set are such that a separate SDP is now a realistic possibility. One could say that technology has finally caught up with the early vision of the IN architects.

In order to meet the strict response time and throughput requirements of call handling in the network, most of the subscriber information for managing calls is currently stored in proprietary databases, carefully structured to provide rapid response because the older generation database and hardware technology was stretched to its limits to meet the exacting requirements of the telecommunications environment. This was valid when the systems were originally developed, especially given the constraints of platforms and database architectures 15 or so years ago (Many of today's IN systems can trace their ancestry back 10 years or more). However, this is no longer the case. As Oracle's telecommunications customers are discovering, its open technology can provide a low cost, high performance route to traditional applications development, as well as providing the springboard for more advanced, Internet-enabled services. And because Oracle runs on all major computing platforms, it provides a wide choice of hardware that can be matched to the precise needs of the service provider, and also allow flexibility for future changes.

The rest of this section concentrates upon the fundamental requirements of Performance, Reliability, Availability and Management, and how Oracle technology can meet these. Finally, it discusses Service Creation.

2.2 Performance

Performance can be further subdivided into Throughput, Scalability, and Capacity.

2.2.1 Throughput for Real Time Response

Throughput is essentially a function of response time, that is, the quicker a system can respond to queries, the more queries it can process in a given period of time. It is also a function of the internal architecture of a system, because large numbers of subscribers may exhaust resources such as memory or operating system tables, even though response times themselves may be satisfactory. Because the numbers of subscribers using IN services are typically orders of magnitude larger than those that might be expected to be connected to a computer system, problems can therefore arise in this area for some systems. Because Oracle is architected to support tens of thousands of simultaneously connected users with sub second response times, it is well suited to the IN environment, where in a large network one would typically expect to find many hundreds or thousands of users simultaneously making calls, using services, or otherwise using the resources of the IN platforms.

Oracle-based systems provide the capability to support huge user numbers, with response times well below 100 ms (and below 10ms for many applications), and throughput capability in the 1000's transactions per second. It is necessary to minimize response times in order to maximize the use of expensive switching equipment. It is also necessary because in today's complex telecommunications environment, there may be many different IN transactions needed to provide a single service, and thus the cumulative effect of several apparently insignificant delays can soon add up to unacceptable performance. Note that these exacting response time requirements are met within Oracle's open database using SQL, thus providing a highly flexible and capable interface able to accommodate future additional services. Proprietary systems may be able to meet some of these requirements, but usually with a hand-crafted and inflexible database design, or using in-memory tables. Such techniques provide performance at the gain of application complexity, inflexibility to meet future changes, and lock-in to particular hardware.

Both real-world Oracle applications, and benchmark tests carried out by a variety of Network Equipment vendors, have confirmed the capability of Oracle to meet the exacting requirements of the IN environment.

2.2.2 Throughput for Provisioning

In addition to supporting real-time data access, it is also necessary to support a provisioning interface.

This is the interface that is used to load the initial information associated with a service, and also subsequent changes, as time, the user, or the service provider alters aspects of the service. Usually the provisioning interface requires that data is transformed or otherwise manipulated in order that it can be placed into the particular format the IN platform requires, having originated from a provisioning system elsewhere in the network. An Oracle database can receive data in the same format as the provisioning systems, from Oracle and also legacy systems, and importantly it can also feed back data into the provisioning systems. As more and more services involve user interaction with their data, and updates of that data, it becomes increasingly important that the SCP is able to reflect back changes to its data to a central provisioning system. Oracle provides capabilities within its database to be able to do this transparently, thus relieving the service designer and creator from having to build this into their application.

In addition to speeding service delivery through lowered application build time, an Oracle solution therefore creates a more robust and high quality service through the need for reduced testing, and a common update mechanism across multiple services. This facility, replication, is available in a number of configuration options, enabling it to support a wide variety of requirements. These include single master to multiple copies, timed copies, continuous copies and multi-way copies. These functions are all requirements of telecommunications services, the difference is that with Oracle, they are provided and supported as part of the standard product, rather than needing to be hand-crafted for each particular service.

2.2.3 Scalability

It is vital that IN applications and SCP and SMS nodes can be scaled. Often, the service provider will be unsure of the eventual success of a service, and may wish to grow the platform in line with the growth of the service, rather than starting with a large, expensive hardware platform on day-one.. Also, if the SCP supports multiple applications, then the provider may wish to add new nodes or modules to the platform in order to separate applications, even though they share common data. Oracle's technology provides these models, supporting clustered systems, modular expansion of disc, CPU and memory, and even massively parallel capabilities for such applications as video streaming.

Oracle's software technology provides the ability to transparently scale up services without needing to modify the underlying applications, by using Oracle Parallel Server. There is also the capability to support replication, often a required alternative to scale the network using mated pair / round robin approach. This is because there are many services where network topologies or other factors mean that it is more cost-effective to have a geographically replicated database, so that enquiries can be actioned at a local node without incurring the costs and time delay of long-haul SS7 traffic. As mentioned previously Oracle's database technology includes a number of replication options, to allow master databases with automatic replication to outlying 'slave' systems, or topologies where multiple systems can each update the other. Thus, whatever the requirements of the service, it is highly likely that there is an Oracle option to meet it.

Figure 4 shows growth without application change. Oracle's inherent support for SMP and clustered technology is the enabling factor for this key requirement.

Starting with a small system and limited traffic, an Oracle-based IN system grows from a single CPU to a multi CPU to a clustered system, and finally to a geographically distributed high performance system. The key point is the ability to grow without application change, because without this the Service Provider cannot gain the time-to-market and lowered cost advantages. If the application needs to change, then not only is time lost and cost increased directly, but the effects on downstream systems and additional testing time and resources are likely to eclipse the direct costs.

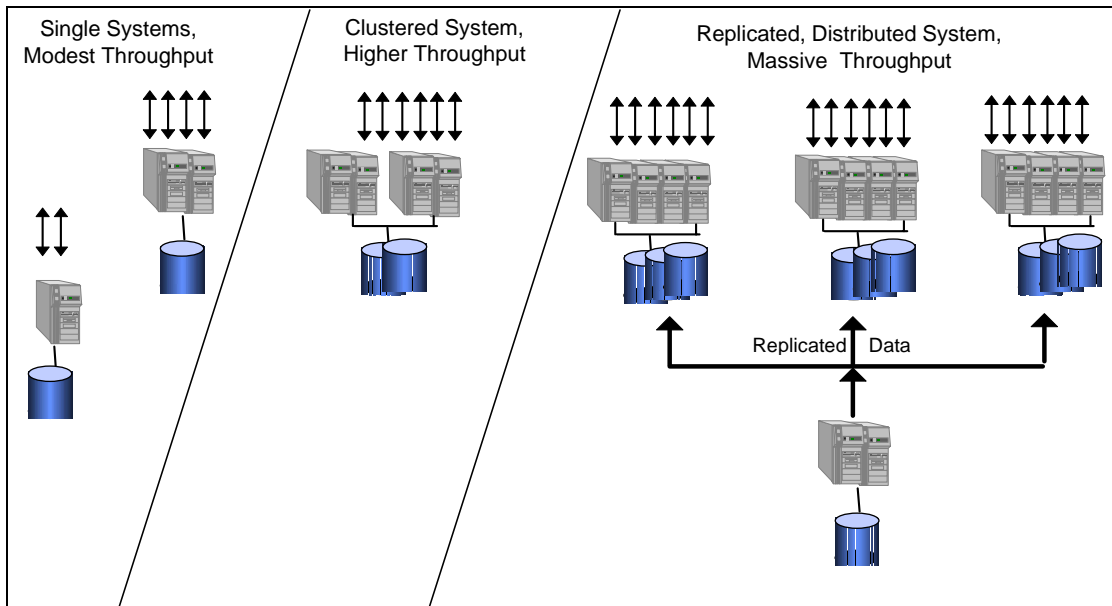


Figure 4: Oracle Scalable Architecture

2.2.4 Capacity

The database capacity requirements for IN applications vary but are often much smaller than those typically used in commercial applications, and thus easily manageable by an Oracle database. In fact, they are often such that all the required data can be loaded into memory, thus greatly speeding access to data. Oracle does support a memory resident option where several database functions are optimized, on the expectation that the data will usually be found in memory, rather than on disc. However, it is vital that such memory resident databases are protected, as in the Oracle system, in the event of component failure, so that any changes made from the network or the management systems are preserved.

In the traditional IN model, the SDF was predominately enquiry based, with infrequent updates (for example, 1-8-00 and VPN), and early IN systems reflected this, with extensive use of specialised in-memory caching schemes to speed throughput. These however have a problem with today's much more update intensive environment, (some applications, such as HLR, are characterised as update-predominant). Whilst today's computer technology does have the capacity to move much or all data into memory, it also needs the capability of the transaction protection of the Oracle database to ensure total reliability.

A reliable system must protect the application from four types of failure:

- transaction
- media,
- node
- disaster

An Oracle database will provide complete reliability across all these types of failure, whilst at the same time supporting the highest levels of performance. An Oracle solution therefore avoids the typical tradeoff between reliability and response time/throughput. More detail on protection and recovery from failure is included in Section 4.

2.3 Availability

The availability of a service directly impacts the revenue stream of the service provider which therefore translates into the exacting requirements for uptime of the Telecommunications industry. Typically, these are that service cannot be down for more than 2 or 3 minutes per year. Availability also translates directly into quality, as today's customers and businesses demand 'dial-tone' reliability for their advanced telecommunication services, in addition to standard 'POTS' availability expectations. Even in the world of Mobile Telecommunications, where users typically have had a lower expectation of reliability, operators are finding that their customers are demanding an ever increasingly higher level of availability, and these users are also much less likely to have qualms about moving to another provider than they would for fixed service.

Oracle is able to meet these exacting requirements through a variety of approaches, including; mated pair, high availability and replicated databases. Combinations of some or all of these approaches can satisfy even the most demanding requirements. Oracle is also working closely with hardware vendors such as CISCO, Sun and HP to continue to enhance and improve the reliability of systems. For example the recent 'Five 9's' (99.999%) system uptime announcement recently jointly made by CISCO, HP and Oracle.

2.4 Manageability

Monitoring of the IN platform/application is fundamental to providing continuous availability. As the underlying hardware and software becomes more reliable, human error becomes an increasing cause of downtime, and therefore it is essential that comprehensive and capable facilities are provided to link the technology with management systems, to allow not only reactive, but also preemptive and automated monitoring.

Oracle provides the ability to monitor the database as well as the database network transactions using the Oracle Enterprise Manager. This manager provides the ability to monitor the system, schedule jobs and set trigger on events to send messages to the OSS systems using SNMP-MIBs. Typically, proprietary, specialised databases will not be able to provide the same levels of management capability, especially when it comes to integration with other higher level management systems.

2.5 Service Creation

In the traditional IN environment, Oracle supports a variety of Service Creation mechanisms. These include Oracle's own Developer 2000 products, which provide a structured and self documenting approach to application construction, and third party 'drag and drop' programming environments. However, the experience of the industry is that the early promise (or hype?) of SCE's has not been met, and will never be met, partly because there are too many factors outside of the direct control of SCE, and partly because Service Creation, and in particular code creation, is only a minor part of the process of delivering an application.

Other factors, including producing the business case, designing the overall approach, testing, piloting, marketing, personnel training, and rollout across the network, far outweigh the code creation part of the lifecycle for anything but the most trivial of changes to an existing service.

The Internet is however changing part at least of this, and here, Oracle's Web-enabled development tools can provide operators with a head start. It is Oracle's view that much of the future user interface will be web enabled in one way or another, particularly when it comes to service provisioning and much of the User Interface. This may be directly visible to the user entering data via a Web form or Java applet, or it may be hidden by protocols such as WAP and smart devices, but in either case, the Internet will play an increasingly important role in future telecommunications services. The following section provides more detail on the Oracle vision for the new Web-based services, and their interaction with IN.

3. Web IN

3.1 Overview

The Internet was not in existence in its current form at the time of the development of the early IN standards, but it is already making a fundamental impact upon current IN services, and it will be the principal factor for future IN services and the direction of future IN standards. Many services that previously were deemed to be within the province of IN will instead be subsumed by the Internet, for example Information Delivery and Intelligent Agents, and it is therefore essential that the SCF and SDF are able to closely integrate with technology such as Objects, JAVA and HTML, whilst retaining the capabilities of quick response time, high throughput and high availability. To a large extent, "intelligence" is moving out to the periphery of the network, into the user devices and into the services that connect to the Internet, and thus Internet integration is becoming a necessity even for current IN services.

3.2 Factors Affecting to Move to Web-IN.

Oracle has identified a number of factors which, taken together are accelerating the move towards Web-centric IN. Key amongst these are; Mobility, the Ubiquity of Web-based Standards, the move to Corporate Intranets, and finally the rapid rise of Business on the Internet.

3.2.1 Mobility

Mobility is playing a key role in the move towards a 'Web-centric' approach to services. As companies increasing make their employees mobile, and roll out their information infrastructure based on Intranets, the requirement to provide a Web interface on remote devices, from PC's to NC's to PDA's to handsets increases, and thus so does the ubiquity of these devices for the Operator to use as the front-end to their services.

3.2.2 Ubiquity of Web-Based Standards

As users become increasingly familiar with Web-type interfaces through their normal work or play, the incremental cost of adding additional functions decreases, the learning curve becomes shorter, and the load on the Operator consequently less. Web interfaces provide a common access point and set of standards that a majority of business users have access to, plus many private ones. Services can be rolled out to millions of customers simultaneously, where previously dedicated software, communications equipment and training would have been needed. This factor by itself is enabling services that until recently were prohibitively expensive to provide access to, or were otherwise limited by the availability of particular end user devices and software. The web provides a common, ubiquitous set of access capabilities that all services can take advantage of.

3.2.3 Corporate Intranets

As companies realise the cost and time saving advantages to be gained by moving to a Network Computing Architecture, more and more employees (who of course when not being employees are users of telecommunications services in a private capacity) are becoming used to a Web-based interface. We have probably already reached the point where there are more users familiar with this interface than any other single computing interface standard.

3.2.4 Business via the Internet

Finally, the general move by businesses to go on-line via the Internet² is directly affecting service capabilities and requirements. As an example, consider the case of a 1-800 call center for a business.

Traditionally, their customers would dial the number directly, and therefore would need to know it before they could dial it.

Today, they may conduct much of their business via the companies Internet pages, bypassing the 1-800 service except when they have a query that needs a human operator. The web page will tell them what the number is.

² A recent Gartner report showed that by end 1997, 34% of all US medium size businesses were conducting business via the Internet, and that this would increase to 50% by the end of 1998.

Tomorrow, the customer will click on an icon on the web page and be connected directly through to a service agent, whose terminal will have been populated with details of the interaction so far. The voice interaction will take place over a second phone line, or, in the not-too-distant-future, over the same line as the Internet connection. Note that we said the 'voice interaction' rather than telephone call, because in some scenarios, no separate call was made to implement this service.

This simple example shows the primacy that the Internet is starting to assume, and how vital it is that traditional IN services can coexist and interact with Internet services.

3.3 The Changing User Interface

The Internet is already starting to have a significant effect upon the user interface. The inadequacy of the DTMF interface, plus the complexity associated with dial-in connectivity, have been largely responsible for the failure or disappointing growth of many services. It is now generally accepted that the Internet will provide and support the user interface that will at long last make many services practical. Web based interfaces are not only providing a new mechanism for high capability and easy to use interfaces, but are also being formulated, defined and rolled-out using a much faster track than has previously been the case with IN standards. Operators will need to embrace these new standards, which are being defined and implemented at 'Internet Speed'. The alternative is to be left behind by newer, fleetier operators who do not have the burden of legacy applications or interfaces to support, and who will be using these interfaces.

Within both wireline and wireless environments, operators are today rolling out user provisioning interfaces based on Web Browser technology that make universal access to their business and private customers a reality. Because these also potentially impose a large and uncontrollable provisioning load upon their systems, they will need to ensure they have the appropriate technology to manage this. At some advanced telecommunications operators, customers can investigate, choose, select and activate new services directly, without the need for any involvement in the selling or provisioning process by the operator at all.

Services that previously were extremely complex to manage, such as diary-based single-number, now are manageable for the customer, and can be implemented by almost any service provider with Internet access and some basic telecommunications capability. It is no longer necessary to own the customer to provide the service, and existing operators will therefore need to ensure that they also can offer a rich blend of services and Internet integration if they are not to be relegated to the level of bit-carriers. The concept of the phone company without a network is nearly here.

3.4 Mobility, Services and the Internet

In the same time period that the Internet has become the dominant force in computing another revolution has occurred in telephony. This is the massive expansion of mobile telephony, and in particular the huge success of GSM. The number of GSM subscribers today has exceeded the expectations of all but the most optimistic of GSM proponents of only a few years ago. Today, GSM is available worldwide in about 100³ countries, including some regions of the USA, and forecasts for the year 2000 are that GSM users will be in the region of 200 million, approximately 60 per cent of the worldwide wireless market.

To date GSM telephony is overwhelmingly voice-based, but another revolution looks as if it is about to occur here. New GSM data standards, such as GPRS and HSCSD will dramatically raise the data speeds available, to 100 k/bits/sec (from 9.6) and beyond, and at the same time lower the cost and increase the resilience of the data connection. These new standards, together with the ubiquity of the laptop computer and mobility equipped organizer such as the Psion and Windows CE devices, will undoubtedly lead to a huge rise in the use of mobile data services. Future standards, with even more global focus, such as UMTS, will serve to increase these trends.

At one time, it would have been envisaged that such data use would have been for corporate connectivity, such as email, but it now seems clear that there will also be a huge demand for information services, of all kinds. Indeed, the mobile traveler probably has greater need for many services than when in the office. Booking travel and accommodation, enquiring upon directions, receiving information relevant to the journey. All this in conjunction with a new generation of mobility-aware applications such as Sales Force, Service Technician and Delivery support.

For the corporate and small business user, Oracle has already launched its first truly Internet-aware mobile application, Unified Messaging. This provides the user with a single web-based interface for reading and managing all sorts of messages, including voice, fax, e-mail and GSM Short Message. The next step will be to ally this with Personal Numbering services, where again a web-based interface will make practical the

³ "GSM is now in more countries than McDonalds." Mike Short, Chairman, GSM MoU Association 1995-96

...66 Million Customers, 256 Members in 110 Countries/Areas. GSM MoU Report March 16, 1998

updating of profiles. The Web based interface can of course be used from a standard browser, and in the future, from JAVA or WAP capable handsets, to provide a useable but slimmed down version of the full web page, suitable for a smaller display device or more restricted interface.

Needed in conjunction with all these products, and especially relevant for the user when they are mobile, is push technology, which enables users to be notified by the network (such as by short message) when they have relevant information. This is much more convenient and practical for the user than having to constantly dial in to check for information, as they can be assured that they will be notified once it has arrived. Allowing the user to manage their own profile means that they themselves can determine which information they deem important, and when they wish to receive it. Without such features, services can fail on the grounds of useability.

Oracle technology, such as Application Server, Oracle 8 and Lite databases, and Advanced Queuing are or will underpin all these applications.

3.5 Oracle Web-IN Telephony Today

As we have seen, the Internet is merging with the telephony industry. Operators are today providing Oracle-based Value Added Services that give control to the subscriber to make changes to their profile. A typical example is to provide the profile information to the subscriber via the Internet. The subscriber logs in and make the changes to the profile, such as define the order of search for the follow me service, increases amount to the pre-paid calling card, etc. This type of service is supported by Oracle as shown in Figure 5.

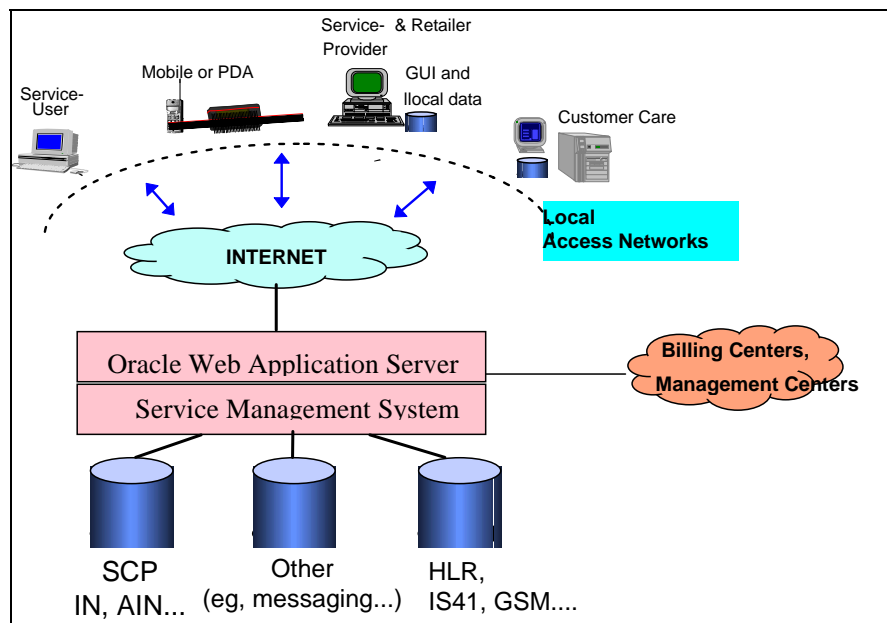


Figure 5: Web IN

3.6 Oracle Development Tools and User Community

Oracle has two main 'strands' of tools to design and create applications that work with its strategic products, including Web Application Server, Oracle8, Oracle Lite and Oracle8/Advance Queuing. These are Oracle JBuilder for Java, and Oracle Web Developer Suite.

Oracle JBuilder for Java is Oracle's new component-based development tool for building server-centric network computing applications in Java. With JBuilder for Java, developers can use Java to build 2-tier and 3-tier applications. JBuilder for Java is based on the industry-leading compiler and language technology in Jbuilder™ from Borland International, Inc., and has been optimized for developers building network computing applications with the Oracle Data Server and Oracle Application Server. JBuilder for Java is based on industry standards including JavaBeans, CORBA, IIOP, and JDBC.

Oracle's Web Developer Suite suite offers advanced tools to build applications. For example, Designer/2000, which lets you create business logic, does most of the coding for you. Creating forms is a matter of dragging and dropping and connecting fields. Designer also lets you reverse-engineer database tables, views, constraints, and indexes from any ODBC database, making the redesign of preexisting client/server applications to the Web that much easier.

Oracle is committed to support the industry standards such as CORBA, JAVA, LDAP, SSL, and is doing so by integrating these within its core technology. In addition to Oracle provided development tools such as Designer/200 and Developer/2000 to design and develop such an application, various third party products are also available. In addition, Oracle Services uses standard methodology such as Custom Development Methodology (CDM), a proven method used by customers world wide to manage and deliver solutions.

In contrast to proprietary IN technologies, there is a huge user base of tens of thousands of architects, analysts and programmers with experience of the above, thus providing a resource pool many orders of magnitude larger than any single switch or SCP vendor can ever have available.

3.7 Synergy with Network Computing Architecture

Driven by market demands, companies are attempting to extend their business-critical computing systems to business partners, suppliers and distributors. Increasingly companies are reaching out to consumers via Web / Internet technologies. Instead of the nightmare of managing hundreds of user's desktops (and their applications), the beleaguered MIS department is faced with opening business systems to thousands or even tens of thousands of users. Existing host and client-server solutions are not capable of enabling this opportunity. Oracle's Network Computing Architecture (NCA) maximises the strengths of host systems (manageability, scalability) and client-server (rich user interface, open choice) while minimising the weaknesses of each. The key is shifting the business logic off the individual client machines (where it is so difficult and expensive to manage) into a middle-tier application server.

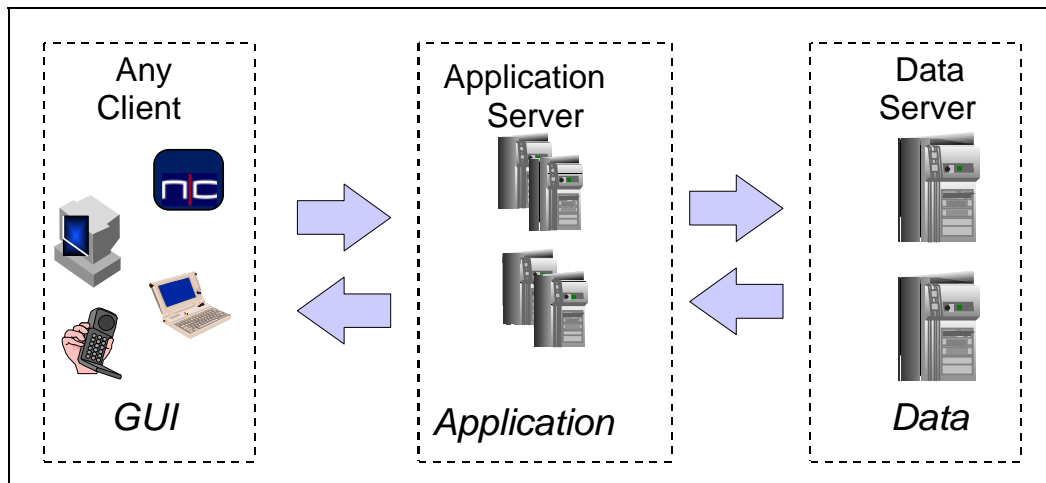


Figure 6 Network Computing Architecture

Web-IN complements the Oracle NCA vision, because it takes advantage of much of the same set of underpinning technology and tools, to address the requirements of telecommunications services, at the same time as recognising the combining of these two, hitherto separate worlds.

One of the major goals of network computing is to lower the total cost of ownership of technology; both on the client side and the server side. Pulling business logic into the network where it can be professionally managed is one facet. Another facet is providing a common set of integrated services (i.e. transactions, security, directory, etc.) at every tier of the architecture. Contrast this integrated approach with today's currently fragmented world of applications, databases and middleware. For example, the security models for clients, servers, email, databases and transaction monitors are separately configured and managed. This expensive and complex problem is addressed by the powerful server-side capabilities of Oracle's application and data servers.

This multi-tier architecture is commonly drawn as a three-tier environment, but it might easily be two tier (with the data and applications residing on one central, scaleable tier) or even more than three tiers when necessary (for example in widely distributed, component-based solutions). This flexible, tiered computing architecture fits naturally into the telecommunications world, where many of the same challenges need to be met.

4. Technical Details

The IN data management layer handle two types of transactions that can conflict with each other. These are call processing, and data provisioning transactions. The objective of the management layer is to manage transactions in such a manner that they meet the system requirements while supporting the response time and throughput requirements of both transaction types. At the center of these two transactions is the SCP containing the database which contains all the required information for handling the calls, plus the associated applications which actually contain the logic necessary to implement the service, or that part of it which resides on the SCP.

4.1 SCP (Service Control Point)

The SCP contains the service logic, and stores the call control and call routing instructions for the delivery of the IN services. The SCP gives the service provider the theoretical capability to rapidly adapt services to the customers needs and to meet market demands, something that can only happen in practice if it contains a flexible and adaptable data model.

As the SCP database contains all the routing and delivery information, it is important that the SCP is able to meet performance and availability requirements. Early IN implementations typically were able to cope with the unavailability of the SCP, but today this is usually not the case, and if the SCP is unavailable the service usually will be as well, whether that service is an advanced feature, or a basic fundamental such as call set up or mobility support. Because the reliability requirements for different operators and services are different, Oracle provides a range of solutions to address reliability requirements. These are wider than just fault tolerant nodes, since the common use of a fault tolerant system to address these requirements does not, at all address the need for disaster recovery or geographic independence.

These cover protection from four types of failure:

- transaction
- media,
- node
- disaster/highest availability

and in conjunction with availability also provide a number of solutions to scalability issues.

4.1.1 Transaction Recovery

the function of transaction recovery is to ensure that the database remains logically consistent in the event of a failure, or other event, that causes some data updates that are part of a logical set not to be completed. The Oracle Database's transaction protection facilities will ensure that either all data updates done as part of a logical set are completed, or none are, and any incomplete updates are backed out.

This will be increasingly important in the future, as users access and change more data, and Oracle's unique Web-aware transaction protection ensures that updates completed as part of a series of web originated updates will be logically consistent.

As would be expected from the world's leading database, the transaction recovery mechanisms are fully capable of supporting the high update rates that might be experienced in a high volume environment.

4.1.2 Media recovery

The Oracle database manager is aware of, and cooperates with, a wide variety of hardware systems from all the leading vendors. It encompasses dual and triple mirrored disc, RAID, multiple ported controllers, remote and local disc arrays, and a variety of backup devices. In all but the most extreme circumstances of multiple failure, media failure will be invisible to applications and will be automatically recovered on line with no down time.

4.1.3 Node Availability

Oracle works with leading vendors such as Sun, HP and Sequent to provide high availability through a number of techniques, including SMP, clustering and Oracle Parallel Server (OPS). OPS works in conjunction with hardware clustering technology to ensure that in the event of a CPU or system failure, other nodes in the cluster continue to process and have access to shared data. Depending upon the circumstances and configuration, there may be no downtime at all, or just a few minutes.

4.1.4 Disaster/Highest Availability

For those applications needing the highest possible uptime, high availability or fault-tolerant systems are insufficient. The application needs to be able to survive in the event of a complete system failure. This might be caused by local factors, such as hardware or software failure, by operator error, or by catastrophic failure, such as fire, flood or electrical outage.

Oracle8 contains a range of capabilities aimed at providing resilience to cover all these failure scenarios. These include standby databases, replicated databases, support for multi-site mirrored discs, or combinations of all of these. Oracle can therefore be sure that it can configure an architecture to support just about any set of failure scenarios.

Equally importantly, Oracle has the skilled and experienced consultancy available to help its customers plan, design and implement such systems. To provide the highest levels of availability, more than technology is required.

One of the standard ways of providing high availability of a service is the mated-pair solution, this is extremely common with the telecommunications environment, and is recognised by some standards which allow mate nodes to 'talk' to each other, (even though these are today rarely implemented).

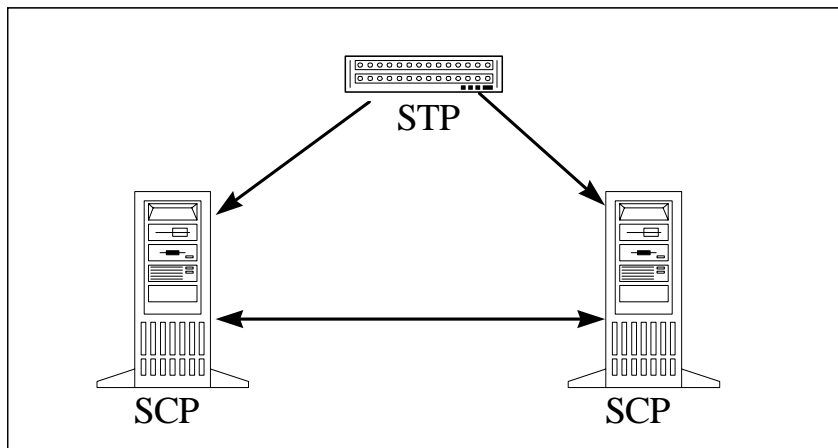


Figure 7: Mated-Pair Approach

Figure 7 represents the mated-pair approach implemented in a network. The STP sends the transaction to either of the SCPs (located at two sites connected over a network). If the STP does not receive a response within a pre-determined time, it registers the SCP as being down and transmits the request to the mated-pair. Alternately, the STP can be configured to send the transactions to either of the SCPs in a round robin fashion. For either of these solutions, the requirement of this approach is that both of the SCPs need to be synchronized within a specified amount of time (ranging from 1 to 10 seconds - depending on the application). This is achieved by replicating data between the mated-pair in real time.

Oracle provides three types of replication, each slightly different and suitable for different service scenarios. The customer can therefore choose the configuration best suited to their service without needing to compromise.

4.2 Call Processing (SCF)

The call from the SSP is forwarded via the SS7 network to the SCP embedded within a Transaction Capabilities Application Part (TCAP) message. TCAP is an industry standard of defining the messaging for call processing. The SS7 network should be able to handle data depending routing. This will enable the service provider in configuring the service dynamically, without having to shutdown the service. The industry standard for data distribution routing is handled with the System Signal 7 (SS7) protocol. The data dependent routing will be based on a predetermined parameter such as the actual service being provided (example 800 # service) or partitioned based on telephone numbers (example, east cost & west cost area codes, etc.). The basis of partitioning the service will be dependent on the number of calls that need to be processed per second. In addition, an Internet Protocol (IP) approach is now starting to appear for some network devices, especially as interaction with Internet services becomes an integral part of newer services.

4.3 Provisioning Transactions

The second type of transactions impacting the SCP are those used to provisioning or update the service. These provisioning transactions are used to update the call processing data, usually initiated by the creation, update or deleting of a subscriber or service in the system. This is typically initiated by a Subscriber

Management System (SMS). Note however that in many scenarios, and increasing so, data may be updated by the user. In the classical IN this was known as 'Non Standard Update', perhaps hinting how often it was expected to occur! This is no longer the case, and the platform must also have the capability to manage network-generated updates. This may mean, for example, the requirement to reflect a change back to a management system, so that it can be held in a central 'master' system, or so that it can be replicated to other geographically separate nodes. The SCP should also be able to handle the provisioning transactions initiated by one or more SMSs and to manage the case where updates may conflict. This may require embedded logic within the database to manage consistency and manage conflicts, or understand who holds the control for any particular data entity. The general business rule, in a case where multiple SMSs send transactions to the SCP, requires that the SMS can modify only subscriber information that it owns, i.e. the SMS should have created the service/subscriber, but the system needs the flexibility to manage other models as well.

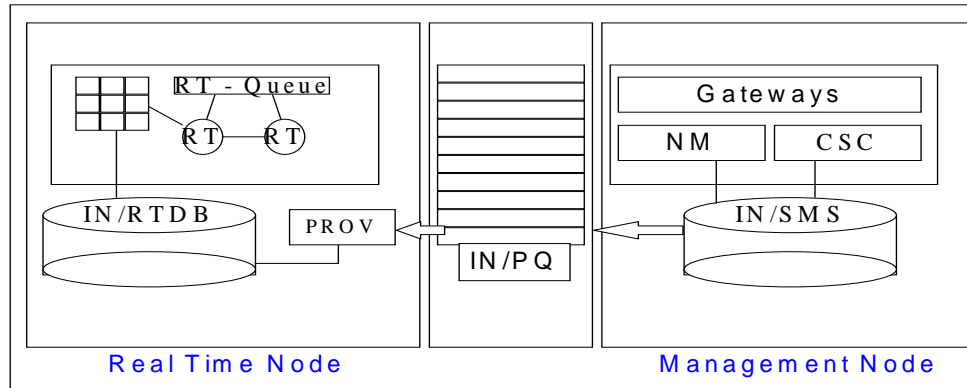


Figure 8: IN Data Management Layer

Figure 8 represents the architecture for the IN data management layer. Oracle can meet the call processing and provisioning requirements. Oracle meets the call processing requirement by configuring the instance to cache the entire real-time (user data) into memory. The application use standard SQL to perform the read (select) and write (insert/update/delete) transactions. The provisioning transactions can be queued using Oracle8 / Advance Queues. O8/AQ is a persistent queue implemented within the database and provides features such as priority, time expiration, queue propagation, etc. It is robust and highly performant, enough that leading Object Management and Transaction Monitor vendors will use it to provide the underlying technology to support their queuing requirements.

4.4 Oracle Services

Oracle Consulting Services is a global organization and is working closely with multiple operators and vendors to provide a comprehensive range of solution to the telecommunications industry. These include;

- Unified Messaging solutions with a high degree of Web integration,
- Real Time Prepaid Mobile Phone database,
- Customer Care and Billing solutions,
- Call Centers,
- SCP platforms.

Oracle Consulting Services are now working closely with leading switch, IN platform vendors and operators to help design and implement their next-generation telecommunication services platforms.