



**Response to Public Consultation on the
Review of Number Portability in Singapore**

**Prepared for:
Info-Communication Development Authority of
Singapore**

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PROPRIETARY

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Contact Information:

William Ku
Director - South Asia Pacific
Syniverse Technologies

8 Temasek Boulevard
Penthouse Level, Suntec Tower Three
Singapore 038988

Mobile : +65 9688 9998
Email: william.ku@syniverse.com

1. EXECUTIVE SUMMARY

Syniverse Technologies Inc. (Syniverse) appreciates the opportunity to deliver this response to questions posed in the MNP Consultation Paper by the Info-Communication Development Authority of Singapore (IDA). We are confident that our approach to Mobile Number Portability will meet both the current and long-term needs of the IDA, the Operators of Singapore and most importantly, the subscribers comprising the marketplace. We understand that you are in the initial phase of MNP. Should you have questions at all regarding our solution or the intricacies of MNP, please do not hesitate to call William Ku, Director – South Asia Pacific at +65 9688 9998 or william.ku@syniverse.com.

1.1 *Solution Overview*

Syniverse's proposed solution is designed to address all elements of a NP solution which includes inter-operator communication (IOC), communication between operator and central database (Service Order Activation or SOA), centralized repository of all porting routing information and the means to broadcast that information to all operators for call completion. Our solution is an all-encompassing integrated business solution that addresses efficient architecture, business processes and the local-marketing expertise required to launch this new industry service.

The proposed centralized model leverages Syniverse's overall Central Service Bureau Model and will afford Participating operators with multiple benefits that include:

- **Full Service End-To-End Solution Delivery** – Syniverse will deliver IDA every element of a Number Portability Solution – all under the watchful eye of a secure and reliable hosting facility managed and located within Singapore.

Syniverse will work with operators to facilitate and guide the NP planning process. We will assist in setting-up the steering and decision making groups that address crucial areas such as: business process formulation, technical planning, implementation planning and acceptance testing committees.

Syniverse will work with operators to manage the complexity of change within their Network, Customer Relation Management, Billing, Provisioning, and Point of Sale infrastructure that must occur to accommodate the porting process. Syniverse can also optionally provide back-office integration work necessary to connect Operator port-flow processing to the NP system.

Reporting will be delivered via a secure Internet portal for information management. Lastly, full ISO 9001:2000 certification ensures quality and controls to our valued customers.

- **Central Application for a Standard, Automated Approach to Number Portability** - A standard, published interface into the systems means operators implement a single API which translates into a FAST, COST-EFFECTIVE implementation.

Tiered-architecture separating core system functionality and written on industry standard platforms, translates to a highly flexible service. As a result, NP business rules can be modified and implemented quickly. The automated approach enables fast, efficient ports, which can impact the success of NP in Singapore by increasing subscriber satisfaction.

Our Service Bureau approach allows operators to share the solution costs among all operator-users in a fair and equitable manner. Flexible business models are easily employed utilizing this approach.

Central application means ONE CONTROLLED SOURCE from which operators can manage routing and call processing activity.

- **Security of Participating Operator's Data** – Syniverse's trusted third party position in the industry means that your data will be secure at all times. Syniverse will protect the privacy of subscriber data insuring that the data of your most important asset; the subscriber, will not be compromised.
- **Marketing/Product Development Expertise** – Syniverse has the existing infrastructure and expertise to assist IDA create additional value-added opportunities and product enhancements. Our Product Management and Business Development team will manage both the lifecycle of this service as well as drive new complimentary service opportunities (at your discretion) that leverage the database such as Calling Name (CNAM), Wireless Directory Assistance (WDA), and others within the marketplace.

Syniverse is able to provide IDA with a master database to support the NP process. After our solution has been implemented, IDA will have a centralized database that will provide you and all operators within Singapore the ability to:

- Allow a fixed or mobile phone user to keep his phone number after changing the subscription to another operator
- Allow operators to seamlessly communicate porting information between Donor and Recipient Operators.
- Maintain a record of the routing information associated with ported phone numbers so that calls can be routed properly
- Have one consistent, reliable source for porting data, namely the NP Central database
- Have one standard interface in which operators communicate both to each other and the central database
- Provide a central point of reference for any Service Provider or Network Operator to understand which Network Operator currently owns the number
- Provide a fully automatic process, requiring no human intervention
- Provide a manual GUI interface as an alternative to a fully automated process
- Maintain common functionality
- Maintain historical data for analysis

1.2 ***Our Experience***

Syniverse is well positioned to meet IDA's requirements for the provision of Number Portability within Singapore. To bring NP to market, we will leverage our current industry relationships and our core competencies in:

- Central Database Facilities
- Inter-Operator Procedure and Collaboration Expertise
- C7/SS7 and IP Network Expertise
- Call Handling Expertise
- World-Class Customer Care

Syniverse is well known for its being an independent third party who facilitates more than 300 operators around the world, to inter-work with each other for carrying out mission critical business. Syniverse has the staff and infrastructure in place to support this initiative and looks forward to establishing a long and mutually beneficial relationship with the IDA. Syniverse has the necessary knowledge and experience to support IDA's end-to-end implementation of all elements of Number Portability (NP). We have the necessary experience in developing and delivering carrier-grade solutions in a secure and reliable production environment. Syniverse has demonstrated our ability to process high-volume, high-value transactions associated with NP in a consistent and efficient manner while providing exceptional customer service to both fixed and mobile operators within India. Most importantly, we have experience in several countries around the world in addressing their unique requirements and the inherent complexities associated with the porting of numbers. By implementing a centralized application and reference database, all existing and future operators can share in the benefits while equally distributing the associated costs with our flexible pricing models. Lastly, we have the capability to assist the Operators of Singapore's efforts to ensure the NP system successfully integrates into their back-office infrastructure.

1.3 ***World-wide Experience Providing NP Services***

Syniverse's solution leverages our experience with the United Kingdom Mobile NP system that we have had in production since July 2001. This proven solution has 100% market share in UK and has recorded porting of reaching in excess of 90,000 numbers per month, and availability above 99.5%. The product has also been implemented to support NP in Finland, where mobile porting is running at more than 20% per year.

In the United States, Syniverse operates, in a service bureau environmental NP solution for all the top tier operators, seven days a week, including holidays. Since the start of mobile number portability in the U.S. (November 24, 2003), we have processed more than twenty+ million port requests.

Syniverse was a contributing editor to the Cellular Telecommunications Internet Association (CTIA) Wireless NP Report (TR45.2) to modify the IS-41 request to accommodate the need for troubleshooting and customer service.

Syniverse actively participates in several past and present NP industry teams

including:

- Local Number Portability Administration Working Group (LNPA WG), including the following subcommittees:
 - WNPO – Wireless Number Portability Operations team (WNPO)
 - Fallout Reduction Task Force (FORT) – working with wireless operators to develop industry methods, procedures and standards to help reduce fallout rates and resolve fallout faster. Syniverse is a co-chair of the FORT.
 - Wireless Testing Subcommittee – working to coordinate service provider-to-service provider testing and developing the WLNP test plan
- Operations and Billing Forum (OBF) - Syniverse participates in several ways including its Wireless Committee and the Local Service Order and Provisioning (LSOP) Committee
 - Intermodal Subcommittee – to help address issues in porting between fixed and mobile carriers

Syniverse also played a key role in several industry subcommittees that, having completed their mission, have been disbanded. The most notable of these was the Wireless NP Operations Team, which defined wireless specific industry practices and processes and resolved issues associated with WLNP. This subcommittee is rolling up to the LNPA WG in August 2004.

Syniverse is a member of CIBERNET subcommittees dealing with the intercarrier communication process for exchange of customer porting information. In addition, the Syniverse Users' Group has a subcommittee dedicated to WNP and related issues.

1.4 The Syniverse Difference

Syniverse is best positioned to provide the solution for IDA for several reasons:

- A Track Record of Success – We have successfully deployed a full NP service offering within the United Kingdom, Finland and the United States over the past 3 years. We have been providing services to mobile and fixed operators worldwide clients for more than 20 years.
- A Proven Solution – Our approach is based on our solution that has been successfully deployed in Finland in an NP environment very similar to the requirements defined in the IDA Public Consultation Paper.
- Top-class program management expertise – Program management is one of our core strengths. We understand the common implementation challenges and have the experience to successfully manage projects. We coordinate and manage network design, engineering and implementation activities.

We have engineered the implementation of numerous large-scale projects that span different countries across multiple time zones and have continually met the expectations of our satisfied customers.

- Excellence in services – We have been providing services to around 300 operators and carriers in support of the systems that we have delivered for mission critical business processes, providing near 100% availability.
- Strong knowledge of demanding J2EE applications – We have successfully implemented multiple large scale and demanding systems using an industry standard J2EE architecture.

Our solution is based on an existing, proven product that requires only minor potential modifications based upon the porting requirements within Singapore. Therefore, we can ensure a timely delivery of the solution in a cost efficient way with low risk.

Syniverse looks forward to working with IDA to support the deployment of an NP Solution that meets and exceeds your requirements.

1.5 Syniverse Profile

Syniverse (formerly TSI Telecommunication Services, Inc.) is a global communications technology company specializing in innovative business and network engineering solutions that manage and interconnect voice and data systems in 26 countries throughout North America, Central and Latin America, Asia Pacific and Europe.

Syniverse provides technology interoperability, network services and call processing to more than 300 customers representing mobile operators, wireline carriers and emerging telecom market entrants. Products include SS7 intelligent network solutions, clearing and settlement services, voice and data roaming facilitation, fraud management, revenue enhancement solutions and more than 25 other integrated services.

Syniverse is public company (NYSE: SVR) headquartered in Tampa, Fla., U.S.A., with offices in major cities throughout the United States and international offices in Singapore, Hong Kong, Beijing, New Deli, London, Amsterdam, Bratislava, Rome, Luxembourg, Rio de Janeiro and Belo Horizonte.

For more information, visit www.syniverse.com.

1.6 Syniverse Response to Info-Communication Development Authority of Singapore's "Public Consultation on the Review of Number Portability in Singapore"

Question (1) – IDA welcomes views and comments on whether the existing number portability implementation for fixed and mobile services remains relevant and able to support future market needs.

Syniverse Response:

Syniverse agrees with the conclusion that changes to the current number portability solution in Singapore would facilitate competition both within the same type of service and for intermodal porting, and that it would expedite the adoption of new IP technologies including Wireless Broadband Access ("WBA"). The conversion from the existing porting systems to a central application and All-Call-Query will achieve the goals of the IDA by facilitating faster porting times, new player entry, increased acceptance and use by consumers and more cost effective routing.

A new porting solution would provide the following benefits:

- The ability to use both an SS7 database for routing calls in the traditional fixed line and mobile networks, while at the same time supporting routing between IP carriers and between traditional and IP carriers requiring the population and use of both ENUM as well as SS7 databases.
- It could support later more efficient technologies being utilized by IP service providers such as XML/SOAP interfaces, and the processes of order through the internet.
- It would work more efficiently as the volume of ported numbers increase with increased competition.
- It would support routing for SMS/EMS and the growing number other services coming from IP.

A new centralized database solution would also better support the adoption of policies that have proven to be vital to allowing free unhindered competition:

- It would better support porting time intervals that are as close to real-time as possible. Customers are discouraged from porting their number when they will not have service for long periods of time.
- It would allow for ported number routing that does not impose continued cost on the old service provider to support a customer that no longer pays them for service.

By moving to a centralised porting model with All-Call-Query, the IDA will be positioning the Singapore telecommunications for the future

Question (2) – IDA welcomes views and comments on IDA’s assessment of the shortcomings on the existing MNP solution. Are there shortcomings that need to be addressed?

Syniverse Response:

. Syniverse agrees with each point made identifying the shortcomings of a call forward solution, specifically: inefficient use of telephone numbers, incorrect caller line identification and, inability to port multimedia messages. Additionally, it should be reinforced that additional shortcomings of onward routing scenarios can be attributed to this methodology. For example, should any issues occur at the donor operator’s switch either technically or via a business shortcoming, calls maybe unable to be delivered to a ported subscriber. Within this scenario, the recipient operator is dependant upon the donor for the service of their new subscribers. This particular arrangement has been deemed risky and hence unacceptable in implementations in other countries. Additionally, the current peer-to-peer arrangement of the exchange of porting information may also be potentially improved with a central application when new players enter the marketplace, the utilization of a central system and the associated standardization expedites the implementation process of these new operators. The net result will be more choices for the subscribers of Singapore.

IDA also welcomes industry and in particular consumer feedback on their views and experience with existing MNP services in Singapore. Specifically, IDA requests feedback on the following:

(i) Is the ability to retain your telephone number a critical consideration for switching from your current service provider to another service provider? What other factors would you consider before switching to another service provider?

In response to this question Syniverse sites consumer research that have concluded that being able to take your number is important to them: “Nearly half of all cell phone users (47%) report that keeping their cell phone number when they change cell phone service is “very important.” Another 20 percent said number portability is “somewhat important. (AARP; 2003).

(ii) Have you considered obtaining MNP service when switching to another service provider but have been reluctant or discouraged from doing so? What are the reasons for not using MNP?

Syniverse has observed porting transactions that ‘fall-out’ and/or take longer to complete then expected are frequently canceled by the consumer. Syniverse cannot say how many of these consumers obtain a new number compared with those who may cancel the order altogether.

Question (3) – IDA welcomes views and comments on the impact of the entry of IP Telephony and WBA players on the existing FNP implementation. Will the FNP solution be able to support these players effectively? What are the areas that the IDA needs to consider and address in the FNP implementation?

Syniverse Response:

As the IDA evaluates Number Portability, it is imperative that the selected solution have the flexibility to ensure calls are routed in any fashion that the network operators/IDA deem appropriate for the country requirements. This includes routing from both IP and WBA telephony players. Currently, Number Portability solutions deal primarily with the porting of a circuit switched voice call. The fundamental activity and processes behind the porting of a number in this environment will remain unchanged regardless of the routing technology. So, as the market changes in terms of technology and other market developments, the Syniverse system can evolve to meet the needs of Singapore. FNP Operators will still need to communicate with each other and the central database where the porting information resides, and ultimately disseminate this information to interested and affected parties to ensure call processing activity. The Syniverse Number Portability application can facilitate all of these various methods listed above. Hence your investment in the Syniverse proposed solution will be safe regardless of future routing and call processing technology. Primary factors in your decision include cost, benefit and lifecycle. While solutions such as onward routing can be implemented quickly and cost-effectively in the short-term, long-term inefficiency must be considered. Given the growth statistics and general direction of Singapore, the All-Call-Query appears to be most advantageous and is the recommended approach. Lastly, MNP must also consider new services that result from IP and future technologies. Currently, these include VOIP, ENUM, Multi-Media Voice, Video Conferencing, Presence Detection and others. Syniverse will work with the IDA to ensure that these new platforms can communicate with the selected Number Portability platform. Additionally, the Syniverse system is agnostic to FNP or mobile Number Portability. The system facilitates both modes of communication. As a result, many of the considerations that the IDA must consider for mobile can also be leveraged in FNP.

Question (4) – IDA welcomes views and comments on the use of a centralised database approach in implementing number portability and the Direct Routing/ACQ for routing calls. Specifically, IDA welcomes views and comments on the following:

(i) The advantages and disadvantages of implementing number portability using a centralised database approach.

Syniverse Response:

The advantages of utilizing a centralised database implementation far outweigh the disadvantage. The listing of both these advantages and disadvantages include:

The central database Approach carries the following Advantages:

- NP managed by an independent, neutral entity
- Security of cross-network information
- Independent audit of processes
- Independent dispute resolution
- Responsible to the Regulatory Authority
- Standardized API interface to Central System
- Assist Operators with back-office system integration
- Detailed Implementation/Project strategies coordinated with all operators
- An accurate central copy of the national database is maintained for reference by all operators

The central database approach carries the following Disadvantages:

- Operators by virtue of implementing peer-to-peer interfaces can potentially leverage their unique process and interface to gain a competitive advantage in the market. The benefit in this instance is a potential net gain of subscribers.
- Economy of scale – This disadvantage is directly correlated to the number of market players. For example, if only 2 operators are in a given number, the solution can be justified utilizing a peer-to-peer approach. However, as more operators enter the market, the efficiencies and cost savings of a central model begin to be realized.

(ii) Should the centralised database be run by the operators (e.g. a consortium of the operators) or by an independent and neutral party (e.g. a third party vendor)? What are the pros and cons of each option identified or proposed?

Syniverse Response:

The central database should be maintained by a single organization third-party organization such as Syniverse whose core competency includes the set-up, administration and management of Number Portability solutions. This enables the operators within Singapore to focus on their core competency of providing superior voice and data services to their end-users. The responsibility of Syniverse would be to technically and operationally maintain the database service, ensuring that the information held within the database is accurate, and updated where necessary, whilst providing a level of availability appropriate to a telecommunications network. Additional responsibilities would include the facilitation of working groups and other interested

parties to establish the operating business rules and procedures necessary to implement Number Portability. The administration and operation of this central system should be awarded in a managed-service approach. Many different business models can be selected with respect to system cost and recovery of those costs. Syniverse would look forward to discussing further with the IDA and operators all necessary elements of this implementation approach.

iii) The likely costs components and cost estimates in implementing a centralised database in Singapore? What are the commercial or charging arrangements that should be considered when implementing a centralised database, e.g. should the charges be apportioned or recovered from operators based on equal sharing, usage, market share ect? What are the pros and cons of each of these options identified?

Syniverse Response:

The structure of costs for Number Portability varies with the technological implementation and with the specific business model arrangements selected by the industry. From an economic point of view, these costs fall into three specific categories, each of which can be separately analyzed. These include:

- System Set-Up Costs – Results from decisions to implement NP and incurred at outset. These comprise one time costs and would be incurred even if no subscribers ported their number
 - Cost of establishing and maintaining central application
 - Cost of SW upgrades necessary to modify OSS, Switching
- Administrative Set-up – Admin costs caused directly by a subscribers request to port their number on a per line or group of lines basis
- Conveyance/NPDB Query – costs for the additional conveyance of calls resulting from individual calls

In considering the fixed costs of the initial set up of the service, the outlay will be incurred prior to any subscribers benefiting from the mandate. Fixed costs are typically defined as the infrastructure of the central system administered by a potential third party. Additionally, fixed costs will be absorbed by operators specifically as they modify networks, Operational support systems, integration and other NP implementation costs. A primary decision in a central model is the determination of whether these costs can be allocated on a shared basis. To facilitate this, regulators will provide guidance regarding whether the costs of a central solution may be shared, the allocation methodology (market share vs. usage ect.) and what measures will be granted to recover these costs if any. Regarding the variable administrative costs associated with each port, decisions must be made as well to determine what party will be charged (Donor, Recipient, and Subscriber) and what measures if any will be granted to recover. In order to ensure the level of porting would not be inhibited, any potential charges to the subscriber should be minimized. Too high a level of per subscriber set-up charge will compromise the ultimate objective of enhancing consumer interest and potentially reduce the propensity to port. Lastly, conveyance cost of the ensuring the call or content receives the ported subscriber must be accounted for. Typically, this charge in an All-

Call-Query routing scenario is absorbed by individual operators and not shared unless the service is provided by a third party.

In view of the highly competitive characteristics of the mobile industry, particularly after MNP has been made available, each mobile operator could have a more or less similar ratio of porting-in and porting-out customers. There should not be a great concern about established mobile operators imposing too high a per subscriber set-up charge on the RNO, because they themselves would also be the RNO for ported numbers from the new mobile operators. It is expected that the DNO charge set by each mobile operator should be similar and some of them may even agree to set zero charges on a reciprocal basis based upon this. If the variable database updating/porting administration charges to be imposed on the Recipient Network Operator (RNO) or by the Donor Network Operator (DNO) could not be commercially agreed, the regulator should be prepared to look into the actual amount of work involved and determine the reasonable charge that could be imposed. In all circumstances, it is necessary to ensure that all the per subscriber porting set-up/variable cost procedures would be carried out efficiently and that no operators should be asked to compensate for the other parties' inefficiencies. The general level Long-Run Average Incremental Cost (LRAIC) theory can be considered for gauging this charge.

Charging Arrangements/Models for NP

Operators can potentially recover these costs as directed in the guidelines set forth by IDA. Listed below are several cost recovery model examples of many permutations; each with unique tradeoffs.

Model One

This first model uses a fund owned and controlled by the regulatory agency or its assignee. Each operator contributes to the fund based upon its number of subscribers and withdrawals are based on actual costs. The benefit of this model is that the costs are shared among all subscribers of all operators. Because portability benefits everyone, not just those who port, through better coverage, better customer service and better rate plans, this is considered a fair cost model. The downside is that there is no incentive to keep costs down, since an operator will be reimbursed for costs incurred.

Model Two

This second cost model calls for each operator to assess a small monthly fee to all its subscribers. Since all subscribers benefit from number portability, this is a fair model, which allows for cost sharing among the subscribers. And costs are kept at a minimum because the operator wants to keep its monthly fees low or it will lose subscribers. In this model, the regulators should enforce a reasonable ceiling for charges.

Model Three

The third model involves charging the subscriber who ports. In this case, the recipient operator, the donor operator, or both may collect the fees. Please note that in some countries contract law limits what the donor operator may collect. In general, the recipient operator is in a better position to charge a fee because it is gaining a customer. The recipient operator also may choose to waive the fee during special incentive periods or for highly valued subscribers. Charging a subscriber to port is a deterrent to porting and operators may end up paying up front for mandated changes for which it can never fully recover costs.

Alternative Models to Apportion NP Costs:

- Imposing Costs directly to Donor Operator
- Imposing Costs directly on Recipient Operator
- Sharing it among all Network Operators
- Allowing Market Players to negotiate how cost is apportioned
- Requiring all Operators to bear own costs
- Imposing costs of NP on market subscribers
- Fixed monthly charges, per transaction charges, connection/subscription charges, data downloads, or combinations of above

(iv) What are the pros/cons of Direct Routing/ACQ versus Indirect Routing? What issues and factors need to be considered in deciding which method to adopt? What are the likely cost component and estimates in implementing a Direct Routing/ACQ in an operator's network?

Syniverse Response:

As the IDA evaluates the evolution of Number Portability, it is imperative that the selected routing solution have the flexibility to ensure calls are routed in any fashion that the network operators/IDA deem appropriate for the country requirements. Currently, Number Portability solutions deal primarily with the porting of a circuit switched voice call. The fundamental activity and processes behind the porting of a number in this environment will remain unchanged regardless of the routing technology. Operators will still need to communicate with each other and the central database where the porting information resides, and ultimately disseminate this information to interested and affected parties to ensure call processing activity. The Syniverse solution Number Portability application can facilitate all of these various methods listed above. Hence your investment in the Syniverse proposed solution will be safe regardless of future routing and call processing technology. Each of the routing techniques however, has various advantages and disadvantages that are depicted below for your evaluation criterion. Primary factors in your decision include cost, benefit and lifecycle. While solutions such as onward routing can be implemented quickly and cost-effectively in the short-term, long-term inefficiency must be considered. Given the growth penetration and number of ported numbers currently in Singapore, the All-Call-Query appears to be most advantageous and is the recommended approach. Lastly, MNP must also consider new services that result from IP and future technologies. Currently, these include VOIP, ENUM, Multi-Media Voice, Video Conferencing, Presence Detection and others. Syniverse will work with the IDA and operators to ensure that these new platforms can communicate with the selected Number Portability platform.

After the inter-operator process functionality of the central application has been completed and the port is in effect, calls made to the ported number must be re-routed – i.e. an incoming call must find its way to the new service provider. The routing information used prior to the implementation of porting would route the call to where it always went – the Old Service Provider. Although there are many variations and

hybrids, routing of incoming calls in a ported environment can be categorized into three basic methodologies or schemes:

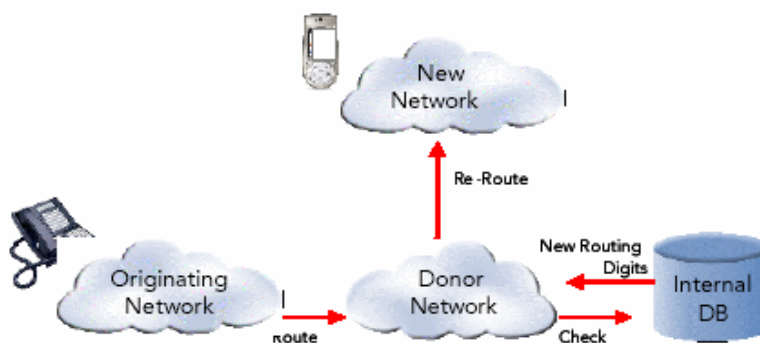
- Onward Routing (OR)
- Query on Release (QoR)
- All Call Query (ACQ)
- Call-Drop-Back

A description of the call processing for each of these schemes follows, but first a brief explanation of the roles of the operators in the following diagrams.

The originating network typically refers to the network that places or originates the call, but for purposes of this document, it could refer to the network prior to the terminating network. If the call originates in another country, the network denoted by "originating network" in these diagrams would be the long distance operator. If the call was originated by a mobile operator that subtends all calls to the local PTT, then that PTT would take on the role denoted by "originating network" in these diagrams. This role is referred to as the "N-1" network, i.e. the network one prior to the terminating network. The donor network is the network from which the number was ported. The donor switch is the switch to which the number range is assigned, and to which, by default, calls are routed.

The new network is the network to which the number has been ported. Although the following diagrams are simplified, there could be more than one donor and/or new network, if the subscriber has ported, and then ported again.

Onward Routing (OR)



In the OR scheme, calls generated from an originating network are routed just as if there was no porting, that is, according to the path indicated by the dialed digits. The donor network checks against an internal database, notes that the number has been ported, determines to which network the call should be routed, and then routes ("trunks") the call to the new network.

The internal database may be a stand-alone database, shared by all switches belonging to that donor operator, or may be switch-resident, and only contain information about numbers ported out of that switch. This method has been referred to as a “call forwarding” scheme and has some positive aspects and some drawbacks. Most switches have some call forwarding capability, therefore this method is a very quick and relatively simple to implement. It does not involve a centralized database, as does the other methods, and therefore does not require close cooperation among competitive operators. This scheme does require the setup of multiple call segments; this scheme can become very inefficient with regard to transmission facilities (i.e. circuits and trunks) and switch resources (i.e. cards, racks, and memory) – all expensive components in an operators network. Furthermore, a donor network that loses subscribers may incur costs for additional transmission facilities and switch resources to handle the routing for subscribers that it has lost – not a good position to be in.

Query on Release (QoR)

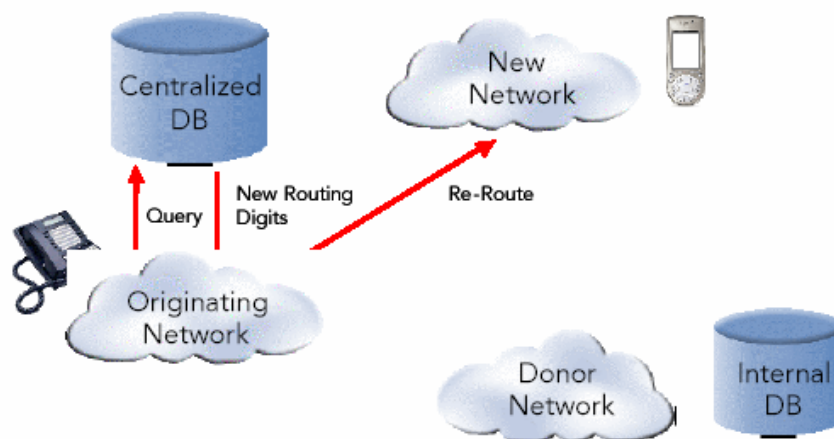


In the QoR scheme, the originating network first routes the call as if porting had not happened. The donor network checks if the number was ported, and if so, the call is released back to the originating network. Note that the donor network does not keep track of where the subscriber has ported, just that the number is not resident on the switch. The originating network queries a centralized database, determines the revised routing to the new network, and re-routes the call correctly. With QoR, circuits are allocated to the donor network but are released immediately rather than remain tied up for the length of the call, as in OR. And although the donor network is still involved in each call, its involvement is minimized. This method therefore is more efficient in terms of circuit and transmission facilities. But a new network element is needed – a centralized database. This requires that all operators agree on a process by which the centralized database is updated and maintained – typically by agreeing on a third party to own and operate the database. Also, the costs to own and operate the centralized database must be borne by all the operators. Various countries have rejected this particular approach. The primary reasoning behind this decision is the additional amount of time (delay) required for call processing activity.

A special note on a hybrid model, proposed on paper but not seen implemented, known as Call Drop Back or Return to Pivot (RTP). As in OR, in RTP the donor operator maintains an internal database, which is used to look-up new routing information. The call is released back to the originating operator along with the new routing information that is also passed back to the originating operator. The originating operator in turn uses the routing information provided by the donor network to reroute the call. Therefore a centralized database is not needed, and a circuit from the donor operator to the new operator is not required. However, major changes to the signaling protocol are necessary to make this scheme happen, which is the major reason it has not been widely adopted.

OR is efficient when a limited number of ported numbers exist, by comparison, QoR becomes more cost effective as porting becomes more common. But as porting becomes even more prevalent in a country; QoR is less efficient than All Call Query.

All Call Query (ACQ)



In the scheme known as ACQ, the originating network does not route calls to the donor network; in fact, once a number has been ported, the donor network is not involved at all. The originating network queries a centralized database and the call is re-routed to the new network.

There are two forms of ACQ – in one, literally all calls are queried, in the other, the line range in which the number belongs is checked to see if that line range is eligible for porting prior to the database query. In reality, where ACQ is used, most operators query all calls to simplify administration. As in QoR, there is a process to update and maintain the database and a third party to own and operate the database. All the operators must agree this upon. And as in QoR, the costs to own and operate the database must be borne fairly by all the operators. As porting volumes increase, QoR becomes the most efficient scheme for call routing. In some cases, countries have started with OR when porting volumes were low, and have migrated to ACQ as volumes have increased. In

some countries, QoR and ACQ coexist, and the choice of implementation is left to each operator.

The general costs of this system include:

- Switch (Fixed and Mobile MSC)
 - Switch Upgrades for Number Portability query
- New Network Function of NP Database
 - Real-time network databases (STP or SCP-based)
- C7/SS7 Network
 - Links to database for real-time queries

(v) What impact would the use of a centralised database and change in technical routing solutions have on other industry players, such as the mobile content and application service providers? IDA notes that currently some mobile content and application providers rely on the phone numbers N1 (the ported customer's original phone number in the Donor Network) and N2 (the new phone number assigned to the ported customer in the Recipient Network) of a ported customer for proper authentication and billing purposes. Will mobile content and application providers benefit from a centralised database?

Syniverse Response:

The potential decision to move from the existing routing solutions to an All-Call-Query will impact industry players who have the need to route voice or data to the ported subscriber. Generally, these entities fall into the following category:

- Content providers
- SMS providers
- MMS providers
- Any other third party entities requiring routine information

There are several options available to these providers for routing content to the correct carrier or switch after the number has ported. This will entail either access to the central database to obtain a copy and all subsequent updates or access via a third party.

(vi) What is the impact on downstream markets, e.g. telecom equipment dealer and existing ported numbers? If so, who are the affected parties and what are these impacts?

Syniverse Response:

Any downstream applications and systems that depend upon the correct routing information of ported numbers will be impacted by number portability. Virtually all systems are affected. However, as Number Portability Centralized Applications and All-Call-Query routing has been implemented in many different countries, the IDA and operators can leverage this learning into the service delivery within Singapore. In short, Syniverse and other vendors who supply operator ancillary infrastructure are ready to assist your efforts. Examples of critical systems and processes are:

- Billing

- Customer service
- Provisioning and order activation
- Call delivery
- Roamer registration and support
- Emergency contact numbers
- Text messaging (SMS)
- Directory assistance
- Caller ID
- Calling name presentation
- Switches
- Maintenance & CSC systems
- Home Location Registers (HLRs)
- Visiting Location Registers (VLRs)

(vii) Are there other implementation issues IDA should consider in its number portability review?

Syniverse Response:

As the IDA considers the implementation of a new system within Singapore, one issue to consider and manage effectively is fallout. The preceding sections outlined the normal porting process. However, the process will not always go smoothly. In many cases, a port request will go from the Recipient Network Operator (RNO) to the Donor Network Operator (DNO), but the DNO may not be able to respond right away, or may find that there is something about the port request that requires manual intervention. Any interruption to the normal porting flow is referred to as fallout (the normal process is often referred to as a “sunny day” scenario). For instance, the old provider may find a different last name on the port request than what is in its database for the requested number. For example, the DNO may have 813-555-1234 = “Li” in its subscriber account database, but the port request might specify 813-555-1234 with the last name of “Ng”. The DNO won’t really know for sure if the RNO is trying to port in a subscriber named “Ng” and typed the phone number incorrectly, or is trying to port in 813-555-1234 but under a different last name (maybe the subscriber was recently married or changed last name after a divorce). In this case, the DNO may not be sure if the last name or the telephone number is correct and since it doesn’t want to port out a subscriber that didn’t request a port, it will request resolution. In other words, the port request will “fallout” of the normal porting process and will require manual intervention.

What is Fallout?

Fallout can happen in several ways:

- The network connection or systems that connect the two carriers may be temporarily unavailable.
- The information submitted to the DNO may not match what the DNO has in its databases for the number being ported (e.g. billing address is different, last name is different, etc.)
 - Subscriber gives different information to the new carrier than what the old carrier has on file
 - Data entry errors – e.g., typing a zip code incorrectly
 - Alternate spellings of last names, street names, etc.
- The Port request or port order is not formatted correctly (e.g. a mandatory field is blank, or a numeric field contains alpha characters)
- The volume of ports may be temporarily too high to confirm all pending port requests in the time allowed by the standard.
- The complexity of the port request may require additional time to confirm – a port request is considered complex if it involves:
 - A reseller
 - More than one telephone number
 - Intermodal

No matter what the cause, the process for resolving the fallout is the same: the port request must be handled in a less automated fashion. In many cases the port request will require extensive manual handling to resolve the fallout. For example, in the case of the last name in the Port Order not matching the last name in the DNO records, it could be that the subscriber recently changed her last name because of a marriage and hadn't gotten around to notifying her old carrier of the name change. On the other hand it could be because the number was typed incorrectly at the point of sale. To get to the bottom of this it may be necessary for the RNO to call the DNO to find the exact cause of the fallout, or perhaps even call the subscriber to obtain additional or correct information.

Validating Port Requests

When a DNO receives a port out request it will check the format and content of the request to ensure the request is properly formatted. It will also check the request against its account database to ensure the request is accurate and requests a number that can be ported. Each carrier may select which fields of the port request it will check against its own database. It is expected that the most useful fields will include telephone number, account number, and another specific identification ID such as a social security number in the US.

What are Fallout Centers?

Most operators will either set up specialized call centers to handle fallout resolution or outsource to the 3rd party. Syniverse provides both fallout centers as well as fallout management software to isolate these issues and assist operators in repairing the order for continued processing. These call centers are sometimes called fallout centers, port centers or resolution centers. A fallout center will need access to the Number Portability central system and billing systems and must be able to make and receive calls from the trading partners, its vendors, and other pertinent parties. A fallout center will usually consist of a number of people divided into groups each of which will be responsible for resolving a certain kind of porting fallout. For instance, one group might handle all fixed

ports in and another group handles ports out to wireless carriers. Or they might handle simple vs. complex ports in different groups, have a group designated for subscriber contact, a group for a particular trading partner or any other set up that makes sense. This approach allows different levels of training and specialization which decreases training costs and improves fallout resolution times and costs. One of the critical tools a port center will rely on is a tool to get information from the porting systems and into the various queues assigned to a particular group. This system should also allow these fallout incidents to be sorted, grouped, tracked and provide tools for resolving them. In short, this tool should allow work to flow into the port center and help it flow out in a corrected fashion. For this reason, these systems are typically called workflow systems. A few minutes on the Internet or a few calls to consultants, current vendors or industry groups should help a carrier find a vendor that can help them determine potential port center and workflow management solutions.

Question (5) – IDA notes that in Singapore, the number levels have been associated with the particular type of service. However, the association of the number levels with a particular service may no longer be sustainable due to technological and market developments. Therefore, it may not be critical or useful for end-users to identify a particular number with the type of service. IDA welcomes views and comments on possible implications of allowing inter-model number portability (i.e.) porting numbers between different services) and the de-linking of a particular number level with a type of service.

Syniverse Response:

Although a number has changed from one type of service to another in intermodal porting, it is possible to know the type of carrier (wireless, fixed, ect.), the specific carrier and the switch from which the call originated and terminated. Information is available in the call detail record and signaling messages that can be used for roaming, rating and billing and most switches should have software that is capable of supporting it. This is available to the operators. However, from a subscriber's perspective, they will not have the visibility to determine if the porting number is terminating to a specific type of service. For example, the subscriber may think they are calling fixed to fixed when they are actually calling fixed to mobile resulting from intermodal porting. This may result in a much higher tariff paid by the subscriber. Hence intermodal porting can reduce tariff transparency. Callers can no longer tell from the number dialed and as a consequence, what price they will pay for the call. As a result, the IDA fundamentally has the following options with respect to regulation: A) choose to restrict the tariffs charged under Number Portability or B) require enhanced tariff transparency services. It should also be noted that a byproduct of intermodal porting is that subscribers will no longer be able to associate a specific service by virtue of the numbers dialed.

Number Portability obscure differences in price between on-net and off-net for terminated calls. In many countries, some operators charge significantly less for on-net than off-net calls as a way of attracting customers. Number Portability can hide such price differences.

Number Portability can also cloak differences in the price of making calls to competing networks of the same kind. For example, in a call made from a fixed line to a mobile, the interconnection costs of the mobile network may differ from that of another mobile network. In some EU member states this led to different retail prices for fixed to mobile

calls according to the mobile network called. Operator NP between mobile operators hides these differences in retail price and this also reduces tariff transparency.

Potential measures to ensure tariff transparency:

- Allowing the loss of tariff transparency on the grounds that it is immaterial; requiring the dominant fixed line operator to set a uniform retail price for calls to all mobile networks – whatever the call termination charge
- A full tariff transparency service (in which the user is automatically informed of the price of calls in advance of making them) would help solve these problems. Examples of these are recorded announcements at the start of a call or when the caller has a terminal with a screen the tariff or service information could be displayed on it.
- Provided via voice information service, SMS service, or Web page), which enables the subscriber to identify the network of the called party.
- Another approach, evident in Hong Kong and in the U.S., is to allow full transparency, with carriers taking advantage of on-network rates where available

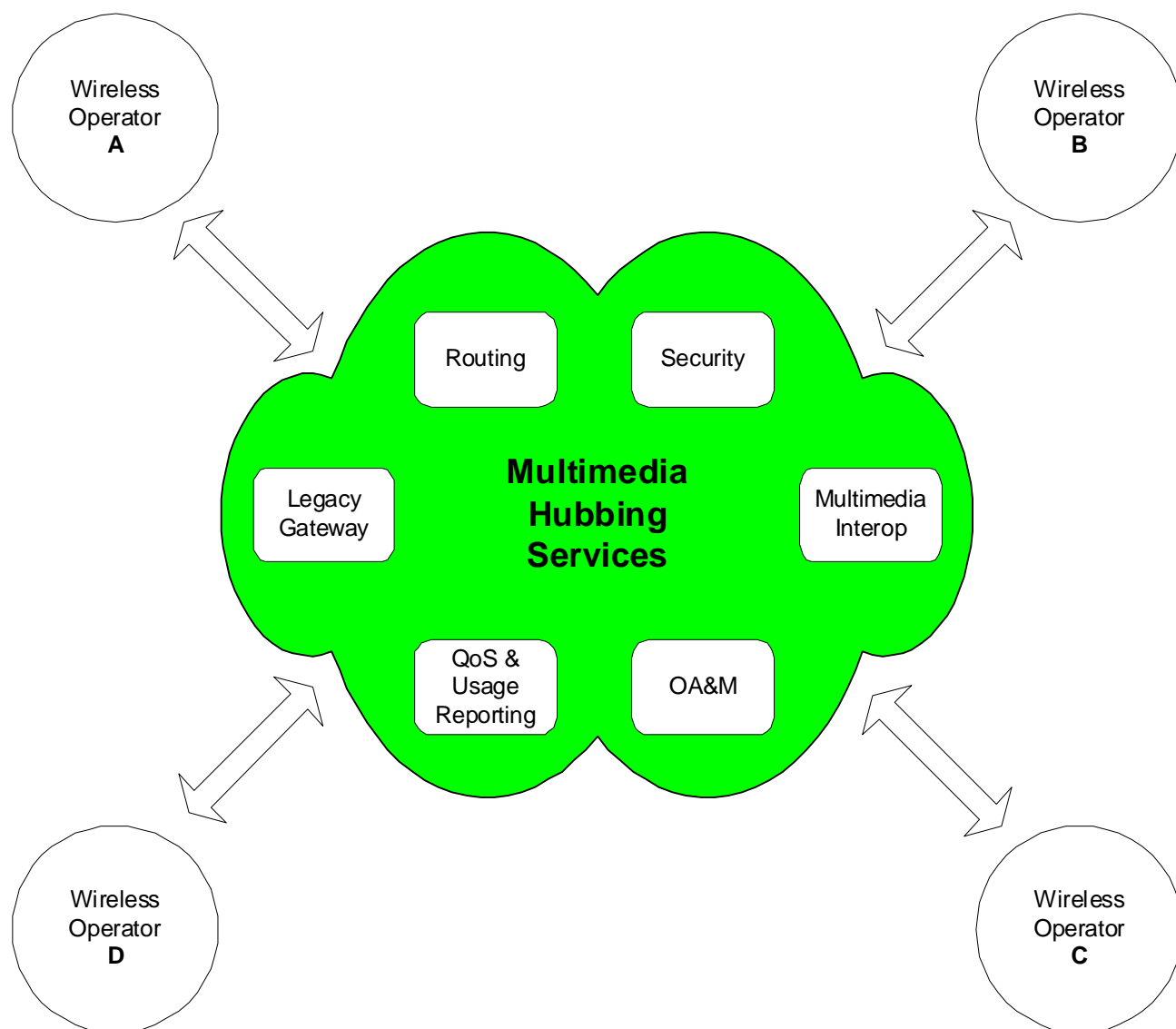
Question (6) IDA notes that in addition to having a centralised database infrastructure for number portability, such infrastructure can be expanded to support other common platform services. IDA welcomes views and comments on how the centralised database infrastructure can support and develop other aspects of the info-communications market. Are there other services and applications that can leverage such infrastructure?

Syniverse Response:

The choice of Database Infrastructure vendor, and hence the choice of number portability methodology, will determine the type of support the infrastructure provides to new and upcoming common platform services, including Video, audio, multi-media.

A Syniverse solution leverages our intense involvement in IMS (the IP Multimedia Subsystem) to provide an infrastructure which can support today's TDM-based voice call routing, as well as post-NP implementation of SIP-based "call" routing, where calls can be any of voice calls, rich multi-media calls, multi calls, multi-party calls, online game playing, content delivery, etc.

To address this need and specific infrastructure, we have developed a multi-media hubbing engine, as pictured below. Realizing that signaling and media may take divergent paths in an all IP model, it is proposed that an IMS-compliant model be utilized.



As the mobile industry migrates from separate voice and data services to Multimedia Services and IMS compliant services, IP-based solutions for MNP should be considered.

Mobile (and fixed) operators can be inter-connected using IP. Special allowances for gateways from legacy to IMS-complaint networks is provided for by the IMS specifications, and hence by a Syniverse's solution.

VoIP for voice and other applications (i.e., Push to Talk) are supported directly by this framework, using SIP (Session Initiation Protocol) for session control.

Many existing broadband-based VoIP providers are turning to IP Hubbing Services for several reasons, including Simplified inter-connections; Inter-system routing when connecting IP to other IP networks; and Replacement for PSTN for cost-effective growth. Syniverse is helping lead this trend by providing future-proof hubbing solutions, with Number Portability as one part of the total solution.

A routing server takes advantage of the inherent power of SIP. Routing for multimedia sessions uses an industry-standard SIP Proxy Server. Number portability is considered

(i.e. a look-up "query" is performed) when determining routing for approved destinations. Invalid or non-approved destinations return an appropriate SIP error code to the calling application. A Syniverse's solution can operate as a Redirection Server, a Stateless Proxy Server, or a Stateful Proxy Server, depending on the needs of the operators.

Security is a major concern for IP-based carriers. A Multimedia Security Services enforces security between networks by:

- Protecting against denial of service attacks
- SPIT (SPAM over Internet Telephony) filtering
- Reporting of anomalous behavior
- Dropping unauthorized sessions
- Functioning as protocol-aware, multimedia firewall
- Protecting either signaling traffic alone or protecting the media path (if not over a private or otherwise secure path)

Syniverse's intrastate also promotes Multi-media interoperability. Our hubbing intrastate provides interoperability between broadband-based (wireline) multimedia and mobile networks and provide interoperability between Wi-Fi service providers and mobile networks. We can act as a technology bridge for 2.5G-based networks, as well as provide streaming video to MMS conversion and SIP-based instant messaging to SMS conversion. Finally we dynamically modify video resolution for lower-speed connections.

Operations, Administration & Maintenance is also of greatest concern to operators. The use of a hubbing solution for Number Portability and IP routing allows:

- Centralized control of inter-system traffic
- Full audit trail of all traffic traversing the IP Multimedia Hub for voice or multimedia sessions
- Historical visibility of signaling traffic
- Alarm detection and generation / Threshold alarms
- Minimize individual switch translations for each ported number
- Eliminates a major administrative burden
- Increases routing accuracy
- Decreases time to complete a port
- Frees up switch database administrative resources

In summary, a Syniverse Centralized Routing Database can provide important support services for NP Direct Routing, including:

- Reconciliation audits and reports; Real-time query via IN; and Backup for disaster-recovery.
- Data routing services for SMS or MMS can be provided via ENUM or through data gateways.
- IP-based Hubbing solution is a cost-effective, scalable solution for NP and is a "future-proof" solution that is ready for 3G/IP multimedia services

Question (7) IDA welcomes views and comments on IDA proposed approach set out above to implement the number portability in Singapore. Specifically, IDA welcomes views and comments on the following:

(i) The Feasibility of using a centralised approach for fixed and mobile number portability services in Singapore, in light of technology and market developments;

Syniverse Response:

As the IDA evaluates Number Portability, it is imperative that the selected solution have the flexibility to ensure calls are routed in any fashion that the network operators/IDA deem appropriate for the country requirements. Currently, Number Portability solutions deal primarily with the porting of a circuit switched voice call. The fundamental activity and processes behind the porting of a number in this environment will remain unchanged regardless of the routing technology. So, as the market changes in terms of technology and other market developments, the Syniverse system can evolve to meet the needs of Singapore. Operators will still need to communicate with each other and the central database where the porting information resides, and ultimately disseminate this information to interested and affected parties to ensure call processing activity. The Syniverse solution Number Portability application can facilitate all of these various methods listed above. Hence your investment in the Syniverse proposed solution will be safe regardless of future routing and call processing technology. Primary factors in your decision include cost, benefit and lifecycle. While solutions such as onward routing can be implemented quickly and cost-effectively in the short-term, long-term inefficiency must be considered. Given the growth statistics and general direction of Singapore, the All-Call-Query appears to be most advantageous and is the recommended approach. Lastly, MNP must also consider new services that result from IP and future technologies. Currently, these include VOIP, ENUM, Multi-Media Voice, Video Conferencing, Presence Detection and others. Syniverse will work with the IDA to ensure that these new platforms can communicate with the selected Number Portability platform.

(ii) IDA's proposed number portability requirements to achieve the desired outcomes of number portability as set out in Annex 3; and

Syniverse Response:

Syniverse agrees that all requirements as set in annex 3 are fully attainable. The Syniverse Central Number Application can facilitate all listed requirements.

(iii) IDA believes that 9 months is reasonable and adequate time for implementation of a new number portability solution. If respondents feel otherwise, please justify in detail why the timeline is insufficient.

Syniverse Response:

Once a date is mandated by the IDA regarding the change to a central system and All-Call-Query, Syniverse can accomplish the implementation to meet the target 9 months. Milestone tasks to consider in this implementation include:

- **Project Management and Control** – Project Management and Control is a fundamental aspect of the quality of Syniverse's delivery mechanism and we adhere rigorously to our own internal project management processes. We also work hard to ensure excellent communication of requirements, progress and issues when necessary.
- **Product Review Workshops** – A number of workshops will be held during the initial period and are built into our plan to enable Syniverse to present the details of the various technical and non-technical aspects of the product to the relevant and appropriate Operator resources. These workshops will form the basis of the NP Product training allowing the intended audience to gain a thorough understanding of the product, both from a technical and non-technical perspective.
- **Customization, Unit and System Test** – Experienced Syniverse NP technical staff perform Business Process, XML Messaging and GUI screen layout customization and localization working alongside a clearly delimited configuration management and test organizations to ensure that the resultant system is functionally correct.
- **Production Hardware Planning and Set-up** – Sizing of the requirement and set-up of appropriate new hardware or configuration of existing hardware. This includes the installation and set-up of the 3rd party software and the Core NP product. On completion of the installation, appropriate testing and fine-tuning will be carried out.
- **Production System Deployment** – Once the base product is installed and tested the product will be configured with the appropriate country specific information and this includes implementation of the configurable parameters of the NP Product. The system will undergo regression testing thereafter.

- **Operator Integration** – Syniverse can provide the Operators with some test facilities for their own tests. These include a test client and a test server for sending and receiving M2M messages and an installed message receiver with functionality on the Production system.
- **Trial Operation** – Syniverse recognizes the need for operators to test “live” data, end-to-end, in a test environment. We have extensive experience bringing up markets, with several large operators simultaneously preparing for the same mandated go-live date. Syniverse’s offer incorporates two facets to assist in this effort. We can optionally support a test platform through to the go-live date, for operators to use for end-to-end testing. Additionally, we can optionally provide hands-on support for testing, whereby Syniverse coordinates the testing schedule, facilitates the actual tests, and assists in troubleshooting, where appropriate.
- **Stability Verification Phase** – The most critical phase of operation and the most widely watched by industry and press, are the first few weeks of actual operation. Syniverse experience has shown that staffing additional resources during this period, providing rapid response to correct software anomalies, as well as assist operators in finding errors in back-office systems and modifications, is the most effective way of maintaining a stable environment.