Submitted in response to:

Info-communication Development Authority of Singapore

Request for Information for:

Public Consultation on the Review of Number Portability in Singapore

Submitted by:

NeuStar, Inc.

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Introduction

The Info-Communication Development Authority (IDA) of Singapore released the Public Consultation On the Review of Number Portability in Singapore on 6 September 2005.

IDA has invited all stakeholders to participate in a collective thinking process about number portability (NP) in Singapore and requested comments from all interested parties in response to 7 questions raised in the Paper.

As the exclusive administrators for the Number Portability Administration Center ("NPAC", www.npac.com) in the US and Canada, the North American Numbering Plan Administrator ("NANPA", www.nanpa.com) for 19 countries, and the National Number Pooling Administrator (www.nationalpooling.com) in the US, NeuStar, Inc. ("NeuStar", www.neustar.biz , NYSE:NSR) has 10 years of hands-on NP design, implementation, deployment, operations, administration, maintenance and provisioning experience. All of these franchises were awarded through open, competitive procurement processes.

In addition to North America, NeuStar has also been actively involved in NP initiatives worldwide. In December 2004, through an open, competitive procurement process, NeuStar was awarded an exclusive contract to design, implement, deploy, support and maintain the NPAC system for all mobile and fixed operators in Taiwan. The Taiwan MNP and Fixed Number Portability (FNP) Services will be launched on 13 October 2005.

NeuStar has a group of industry recognized and respected subject matter experts in NP. Their experience and expertise cover areas such as regulatory policies, NP implementation and deployment, NP business and operations porting flows, NP standards and specifications, FNP, MNP, inter-modal NP, NP business models, cost recovery and allocation mechanisms, centralised NP database design, implementation and operations, value-added services that resulted from and are enabled by NP. Our co-founder and CTO, Mark Foster, was one of the lead inventors of Local Number Portability (LNP).

As the neutral 3rd party, NeuStar welcomes the opportunity to work closely with IDA, all Singapore operators, and other local constituencies to find the best NP solution with the most realistic implementation timeline that will be most suitable to Singapore and beneficial to all stakeholders.

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1. IDA has identified that developments in the info-communications sector, namely the development of technologies, increasing competition within the same markets, and fixed-to-mobile substitution, warrant a review of our existing number portability implementation for fixed and mobile services.

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

As noted by IDA, there are current shortcomings in the existing MNP solution, which is based on Call Forwarding and results in:

- Inefficient use of mobile telephone numbers
- "Incorrect" Caller Line Identification ("CLI") display
- Inability to support Multimedia Media Message ("MMS") and IP-based services

Since November, 2003, US customers have had the ability to port their telephone numbers between fixed and mobile operators, facilitated by centralised NP databases. Being launched on 13 October 2005, customers of Taiwan's fixed and mobile operators, respectively, will also begin to experience transparent and seamless porting through the use of a centralised NP solution. As a result of industry's decision in the US and now Taiwan, customers will realize the benefits of competition as it is enabled through the centralised database approach for NP.

A centralised NP database can easily be enhanced to support new and emerging services, such as those that are based on IP, as opposed to CCS7, can only be supported through the centralised database approach, which will provide customers with a transparent and seamless porting experience. The centralised database approach also represents the most cost effective architecture to design and implement the centralised database needed to support domain name system (DNS) look-ups for IP-based services, such as Multimedia Messaging Service (MMS), VoIP, and Push-To-Talk over Cellular (PoC).

Short Message Service (SMS) is generally routed over the CCS7 networks, so these networks need to be able to route based on the full phone number instead of the phone number prefixes after MNP. If SMS is routed via an IP network, its routing information could also be obtained via a DNS look-up to access a copy of the centralised database.

These are just a few examples we have experienced in US, Taiwan and other NP countries NeuStar has been involved in, and we welcome the opportunity to work closely with IDA, operators, and other service providers to make sure that the selected NP solution will work for value-added services such as SMS, MMS, IP Multimedia Subsystem (IMS), location-based services, data, voicemail and fax.

2. IDA notes that there are several shortcomings within the existing MNP solution. While the penetration rate is high in the mobile telecommunication market, IDA believes that these shortcomings need to be addressed so that the barriers to switching (with the MNP solution) will be lowered and end-users will further benefit from enhanced competition.

IDA welcomes views and comments on IDA's assessment of the shortcomings on the existing MNP solution. Are there other shortcomings that need to be addressed?

IDA also welcomes industry and in particular, consumers' feedback on their views and experience with the 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?

(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 service?

(iii) Do you think the existing MNP solution is adequate, e.g., pricing, porting timeframes, settlement of outstanding charges and other performance experience? What aspects of the MNP solution could be improved upon?

In addition to the shortcomings discussed in NeuStar's response to Question (1), it should be noted that the current MNP solution in Singapore will become progressively less efficient from a network routing perspective as well as utilization of network bandwidth and resource, and ultimately more costly to the end-user.

It should be noted, that an end-user that wishes to utilize a new carrier's 3G capabilities is currently forced to change their telephone number in order to subscribe to this carrier's services.

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 IDA needs to consider and address in the FNP implementation?

IDA also welcomes industry and in particular consumers' feedback on their views and experience with the current FNP 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?

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

(iii) Do you think the existing FNP solution is adequate, e.g., pricing, porting timeframes, settlement of outstanding charges and other performance experience? What aspects of the FNP solution could be improved upon?

As noted in Question (3), the impact of the entry of IP Telephony and WBA players on the existing FNP implementation will increase porting volumes, which will make the current QoR and Call Forwarding solutions progressively less efficient and more costly. For example, a call from one IP Telephony service provider's customer to another IP Telephony service provider's that could be routed directly between the two service providers via IP must go through two unnecessary conversions between packet switched network and circuit-switched network. A centralised database approach represents the most cost effective long-term approach:

- **Direct routing:** Allows calls, messages or sessions be set up to the terminating network directly
- **Facilitates technology upgrades:** Allows for ease of transitioning from switches running obsolete technologies with minimal disruption for users
- **Graceful customer migrations:** Minimizes customer service disruptions
- **Homogenous numbering interoperability:** Enables the various industry players to share the same as well as interchangeable numbers for FNP, MNP, IP, and WNP networks, while allowing the customer to keep the same phone number when he upgrades his mobile service from 2G to 3G.

4. IDA has identified various areas for review with regard to the existing number portability implementation. These include administrative arrangements, technical solutions and commercial arrangements. IDA notes that a *centralised database approach* has been adopted in many countries due to benefits it offers. IDA also notes that with respect to the technical routing solutions, the *Direct Routing/ACQ method* has been adopted as the preferred method, as it provides a long-term, optimized call routing solution.

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:

As noted in the IDA Public Consultation on the Review of Number Portability in Singapore, in many overseas jurisdictions, such as the US, Canada and Taiwan, a centralised number portability database has been established, which is administered by a neutral and independent third party.

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

As a neutral 3rd party with 10 years of hands-on NP design, implementation and operations experience (and lessons learned) in US, Canada and Taiwan, NeuStar firmly believes that the centralised database approach with a neutral 3rd party administrator is the most fair and efficient option for all competing operators.

Advantages: The advantages of a centralised number portability database approach is the insurance that a "common platform" has been implemented, which reflects a single standardized service interface to support ordering, provisioning, and the notification process to all operators in a fair and evenhanded manner.

A centralised number portability database provides operators with a master routing database which glues network and service inter-operation together. This "glue" enables switch routing information and network element identification to be kept in the centralised database, which when queried by the operators, ensures full inter-operation of calls and telephone number related services of similar and disparate network types.

The centralised number portability database provides a technology neutral way of ensuring seamless service inter-operation between competing networks and their subscribers, now and in the future, serves as the basis to expand to new and emerging technologies and service, e.g. IP telephony and WBA.

The centralised NPAC records all the transactions exchanged between the losing and gaining service providers that can be used for auditing, reporting and especially for dispute resolutions.

The centralised number portability database approach has proven to be more cost-effective over time.

Disadvantages: The centralised database approach has a higher initial start-up cost. However, the initial investment could be absorbed by the 3rd party clearinghouse provider through a transaction-based business model, where there will be no up-front cap-ex required from the operators.

(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?

While on the surface, there appears to be little difference between having a consortium of operators or a neutral 3rd party operating the NP centralised database, there is in fact subtle but important differences. It really comes down to the expense of management and oversight in order to ensure neutrality and confidentiality.

Operator Consortium Approach: Given the nature of administering a centralised database, it is likely that a single or small group of operators would actually run the centralised database. This may create unfairness when a particular operator's employee who is loaned to run the centralised database may handle special requests from its operator without abiding by the industry agreed guidelines and bypassing the normal channel/process.

It is IDA's objective to ensure that number portability will be implemented by all market players, it is therefore in the interest of all operators to work interactively in a cooperative manner to design, develop, and implement the shared centralised database that is to be utilized for NP. Through commercial agreements entered into by each of the operators, an operator consortium should be able to manage and maintain a common, centralised database that provides industry with mutually agreed upon standards of operational efficiencies and service level performance.

Pros:

- Ensures the attention and participation of all of the operators.
- Potentially less overhead
- Wealth of telephony experienced operations personnel available

Conversely, given the highly competitive and diverse goals of the industry operators, it is difficult to ensure that all competing operators will receive fair and even-handed treatment under consortium management, and that their customer data and all other confidential and sensitive information is not used in any unauthorized manner. Under this approach, given the competitive relationships between consortium members, resolving problems and issues can prove difficult, as direct responsibility for problems may be difficult to establish.

Cons:

- Not a naturally cooperative environment
- Potential for unfairness
- Problem resolution can prove difficult

Independent and Neutral Administrator Approach: As noted in paragraph 16 of the IDA document, a common industry approach in implementing number portability involves the establishment of an independent or neutral third party to run a centralised number portability database and manage the porting processes and information among the operators.

Pros: A centralised database approach with a neutral 3rd party administrator has generally proven to be the most fair and least controversial option. A neutral 3rd party administrator ensures that all competing operators are treated in a fair and even-handed manner, and that

their customer data and all other confidential and sensitive information is not shared with others.

- Responsibility: Establishes one entity with sole responsibility for managing, maintaining and administering a common, centralised number portability data base on behalf of industry and in accordance with industry specified standards of operation and service levels;
- Neutrality: Ability by industry, to conduct periodic reviews of the neutral 3rd party administrator to ensure strict neutrality compliance, as established by industry consensus. By design, NP administration is not adversely influenced by competitive pressures.
- Auditability: Given the contractual relationship between the neutral 3rd party and the industry, this approach facilitates the overall management and oversight of the number portability administration function.

Cons:

- Potential for lack of expertise: There is the potential that the neutral 3rd party administrator may become unresponsive to the industry and fail to meet operational performance standards
- Risk of financial instability.

However, these cons can be mitigated by careful selection of a reputable and experienced number portability administrator with solid financial track records.

(iii) The likely cost components and cost estimates in implementing a centralised database in Singapore? What are the commercial or charging arrangements that can 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, etc? What are the pros and cons of each of these options identified?

Typical NP cost components of a centralised database implementation:

- Dual data center space (primary and backup sites)
- Connectivity to operators
- Hardware
- Software licenses
- System development
- Network and Information Security equipment
- Personnel

  Management

  Operations

  Maintenance

  Development

  Security

  Subject matter experts

The costs associated with the implementation of a centralised database could be significant. Several variable factors can influence the actual costs involved. Much is dependant on the final requirements of the system. Factors such as service availability, porting interval expectations, performance, outage tolerance, system availability, hours of operation, among others will all greatly influence the overall implementation cost.

From a cost recovery perspective, number portability often follows one of two common approaches. Other cost recovery models have been adopted in different countries, based on their unique situations. NeuStar suggests IDA study all available models and associated pros and cons to make a right decision for Singapore.

In the US markets, regulators allowed operators to recover NP related costs through a Cost Allocation Methodology. In certain other countries, the model employed is a Cost Causer Model, which assigns the NP related costs back to the carrier that created the cost. As another example, a one-time portability fee will be paid by the subscriber to the losing operator; however, the regulator typically establishes a cap for this fee.

Cost Causer Model. In this model, NP costs are charged proportionally to the amount that operators port numbers into their networks. Therefore the more port-ins an operator causes, the larger its proportion of the costs will be.

Pros: The Cost Causer Model is a transaction based costing model that assigns the specific NP charges back to the carrier that has incurred the charge. This model forces carriers to prudently focus on utilizing NP strictly as a competitive tool.

Cons: As operators become more comfortable with NP, they have found that the NP platform enables them to perform internal network/switch related operations, as a cost effective method and with the least service interruption to subscribers as an alternative to other more traditional approaches. Under a Cost Causer Model, the use of the NP platform can become expensive to a small operator, hence causing them to forego such network/switch efficiencies, leaving in place inefficient network routing or stranding numbering resources.

Allocated Cost Recovery Model. In this model, all transaction and NPAC system upgrade NP costs are pro-rated among the participants of the NPAC contract, based on their respective telecom-related revenues, thus harmonizing costs among all telecom participants. In the US, the Federal Communications Commission (FCC) allowed operators to recover NP deployment related costs via a Cost Allocation Methodology that assesses a monthly NP surcharge to each served subscriber for a period of up to five years. These costs, however, must be approved by the FCC before being applied, based on certain capital expenditures and expense.

Pros: In general, allocating NP costs among all carriers has benefited local competition in the US, enabling smaller operators to effectively compete with Incumbents without undue financial hardships. Allocation of costs is also of benefit to the consumer, resulting in a wide variety of programs and service packages offered by the new entrants into the telecommunications markets.

One other aspect, as noted previously, is that operators have learned that the NP platform enables operators to perform internal network/switch related operations. Use of the NP platform can also assist operators in restoring subscribers' telephone service in the case of network outages due to failures, natural disasters or acts of terrorism.

Restoration of the telecommunications infrastructure can sometimes take many months, however, through NP, operators are able to "port" government and commercial telephone numbers out of an affected area, thus restoring incoming calls to these customers – without incurring huge internal costs for restoring service by the affected operators for restoring service.

Cons: Since the start of NP in the US, carriers have seen their allocated costs increase over time. This increase in NP allocated costs are due to: 1) competition increasing consumer demands to change their local carrier; 2) entry into the local competition markets by wireless carriers; 3) utilization of NP for network grooming; 4) local carrier consolidations and the use of NP to homogenize their numbering resources. Operators not taking advantage of the efficiencies offered by NP tend to perceive their costs rising without increased benefit.

The key for a good cost allocation mechanism is to have very well defined rules with little ambiguity and that is easy to enforce. In general, it is a good practice that NP costs be shared amongst all benefiting constituencies so as not to overburden any specific party.

(iv) What are the pros and 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 components and estimates in implementing a Direct Routing/ACQ in an operator's network?

Following is a comparison of the four most common routing options, which are depicted in the Table below:

	Off-Switch Solutions		On-Switch Solutions	
	(a) ACQ (All Call Query)	**(b) QoR (Query on Release)**	**(c) Call Forwarding**	**(d) Drop-back**
Involve Donor Network	No	Yes	Yes	Yes
Physical Call Segment	One	One	Two	One
Database	Centralised (all ported numbers)	Centralised (all ported numbers)	Local/Internal (only ported out numbers)	Local/Internal (only ported out numbers)
End – to – End CCS7 Connectivity (call)	No	Yes	No	Yes
Facility Efficiency	Best	Less	Least	Less
Initial Costs	High	High	Lower*	Lower*

** Note: Grow exponentially with increase of ported numbers*

Please note that: (1) The total costs for Options C (Call Forwarding, or Onward Routing) grow exponentially with the increase of ported numbers; and (2) Option C (Call Forwarding) will not facilitate location portability i.e., it will not be local call forwarding any longer.

More specifically, the on-switch solution is technically not efficient nor operator neutral, since it relies on the donor network's switch to apply the routing information for an incoming call to a ported-out number. It also requires the donor operator to trace all their ported-out numbers that they no longer serve.

In addition, the Call Forward routing solution is not suitable for porting from 2G to 3G since the subscriber would not be able to realize the 3G-specific services when a session is routed through a donor network's 2G system. Other issues include caller line identification (CLI) and IP-based services such as multimedia messaging service (MMS).

The comments above capture the reasons why countries, such as the UK, are working on replacing Call Forwarding (Onward routing), in order to support increased porting volumes and the strong market demand on 3G and IP-based services.

As for off-switch options, both ACQ and QoR require queries to a centralised NP Database (NPDB). QoR queries the NPDB only when the called number has ported out of the donor network, so it queries less than ACQ. However, QoR does involve the donor network, which is less efficient and not operator-neutral in a competitive environment. And it also needs additional standards-work to pass the "number ported out" indication, a new call release reason, in the CCS7 ISUP parameter, which requires the donor network's switch software upgrade to return the new release reason when it receives an incoming call to a ported-out number.

Therefore, as a result noted in the comments above, a majority of the NP countries in Europe have selected ACQ as their elected long-term NP solution, which is the most fair and efficient option. Other ACQ countries include US, Canada, and Taiwan. While the initial implementation costs might be somewhat higher, the ACQ solution would be justified in the long run, and evident when the porting volumes increase.

Just as a point of reference, a US study indicated that it would be more expensive to implement/operate under Call Forwarding than ACQ when 12% of the numbers are ported. However, please note, that the study was done by a major operator back in 1996 for FNP based on data from one US State. To fully understand the cost comparison between these two solutions in Singapore, a new study under Singapore's unique market situations would be warranted.

Cost components of Direct Routing/ACQ network implementation:

- Switch software upgrades
- SMSC software upgrades
- CCS7 software and network hardware (to increase link capacity) upgrades
- Network translation changes

Another cost component of Direct Routing/ACQ network implementation that should be considered is the required upgrade of the Operations Systems by each service provider.

(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 number 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 approach

Generally speaking, signaling protocol and switch software upgrades are required to support NP, with the centralised database functioning as the "Golden Database" for routing information to the operators. The existing interconnection arrangements can stay the same as long as the same routing principles are used. Under this approach, the switches need to know which number in which parameter should be used for call routing.

In the US and Canada, for example, after performing an NPDB query, the routing number (with the same format as the dialed number) is used as the called party number for call routing. In this case, the routing tables that were used prior to the implementation of number portability are still being used. The same applies to the interconnection arrangements for signaling. Just like the switch upgrades to support routing involving NP, the signaling networks also need to be upgraded to support global title translations (GTT) on the full phone numbers after NP, as compared to on the phone number prefixes before NP.

With a centralised database and no need for N2, the content and application providers need not know the N2. They can address their messages that contain the contents to the N1 number and route the messages to the mobile operator that is currently serving that number by querying a local or remote database for the routing information or the current serving SP information. They can also contract with a third party for performing such queries and routing the messages to the current serving SP of N1 by forwarding the messages to that third party.

Overall, a well-designed and operated NP solution could expand the general mobile content and application providers markets and offer other functional services such as a multi-functional, Mobile Content Clearinghouse which can improve ROI and streamline operations for operators:

NeuStar welcomes the opportunity to work closely with IDA, operators and switch vendors to find the best NP solution with the least impact to existing interconnection arrangements in Singapore.

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

It should also be noted that Number portability impacts virtually all existing service provider systems and processes. Operations Support Systems (OSS), switches and signaling infrastructure can all be affected to varying degrees, depending on the many consensus decisions made with respect to implementing long-term number portability. New services, systems and/or processes (such as service order administration systems, local service management systems, number portability query databases, and inter-carrier validation processes/services) may also be required depending upon the NP process and architectural decisions made. In other words, any system or process that deals with the phone number may be impacted. A vendor would need to upgrade its product/system when needed

There would be no effect to existing "ported" customers, as their service is Call Forwarding, which has no relationship to any number portability solution that may be implemented. At some point in time, mobile operators may wish to port these telephone numbers over to the permanent NP solution, which will rectify the inefficient use of mobile telephone numbers, correct Caller Line Identification ("CLI") displays, and will allow mobile customer to receive MMS messages and access other emerging IP-based services.

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

The successful implementation of NP certainly has its challenges. Leveraging what NeuStar has learned from our extensive involvement , where we worked hand-in-hand with industry participants in the design, implementation, and general day-to-day operations experience, we would like to offer the following observations, which are by no means exhaustive, but

seeks to identify certain major industry challenges previously encountered in NP implementations:

Industry Consensus: Achieving industry consensus in the competitive telecommunications industry is critical in order to bring diverse trading partners and varied constituents to a common solution that best satisfies the needs of Singapore's operators and customers. The ability to facilitate common solutions, acceptable to diverse and varied telecom stakeholders, has been key to the success of US and Canadian NP.

Consumer Services: NP impacts normal consumer services and will need to be further reviewed, specifically for inter-modal porting. Specific consumer services to be considered, to list a few, are:

- Directory Listings
- Emergency Services (medical, police, fire, etc.)
- Do Not Call Listings
- Repair Services
- Operator Services

Porting Business Rules: Agreement will need to be achieved on the business rules that will dictate issues such as, time intervals, dispute resolution, porting in error, and any number of other operational process that need to be governed by business rules. Also worth noting will be the need for reseller and pre-pay specific business rules, as these situations warrant special handling in porting situations.

Inter-carrier Porting Processes: Industry consensus, specifically with the introduction of inter-modal porting, will need to re-evaluate on how "new" and "old" service providers will exchange customer information, validate the subscriber's agreement and determine the subscribers ability to port. The response time expectations and the degree to which the process will be automated will also need to be decided.

Employee Education: Operator employee education and training is extremely critical and a rigorous training must cover all functional areas of the porting process. For example, the point-of-sale employees must be trained to handle new customers who want to port their phone numbers. Training material will need to be produced and training performed prior to NP rollout.

Consumer Education: It should not be overlooked that a key success factor is the need to educate the general population as to the opportunities and processes involved in portability.

5. IDA notes that in Singapore, the number levels have been associated with the particular type of service. However, the association of 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-modal number portability (i.e., porting numbers between different services) and the de-linking of a particular number level with a type of service.

The centralised database approach to NP is, generally speaking, numbering agnostic. The ACQ scheme would ensure that the calls to the ported numbers are routed correctly and reach the intended customers.

"Inter-modal" porting is not an issue when the call charge is the same or has small difference before and after porting. For example, a fixed operator customer in Singapore today pays the same charge/rate whether he/she calls a fixed or mobile customer in Singapore. So "inter-modal" porting in this case will not cause the caller confusion in terms of the call charge if a customer ports his/her phone number from the fixed operator to a mobile operator or vice versa.

However, it is recommended to be careful in introducing "inter-modal" porting between services when the difference in call charge is quite significant. For example, if a toll free number can be ported to a mobile operator and someone calls that number, that person would be surprised to see a call charge that he /she thought would be free. It could be supported if the customers are well educated about the "inter-modal" porting or the caller could be informed about the call charge difference due to porting before the call is connected to the called party.

"Inter-modal" porting will enable conservation of the numbering resources because the phone numbers can now be assigned to consumers from a common pool for several services instead of an individual pool per service.

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, in particular content development. Are there other services and applications that can leverage on such infrastructure?

Expansion of the centralised database infrastructure utilized for number portability can support numerous other common platform services, as noted by IDA. As noted below, there are directly related services that are currently sharing the centralised database infrastructure in the US, examples of which are noted below.

- SMS/MMS Gateway and Exchange that can process the inter-carrier SMS or MMS messages based on the centralised NP data and route the messages to the mobile operators that currently serve the destination phone numbers.
- VoIP Gateway and Exchange that can process the calls that are to be terminated from the IP domain to the current serving circuit-switched domain by using the centralised NP data to determine the fixed or mobile operators that currently serve the called phone numbers.

Although not directly related to NP (or make use of the centralised NP data), the NPAC infrastructure can be expanded to support other services since all the fixed and mobile operators are connected with the NPAC infrastructure. A few examples are described below.

- Number Administration System: The fixed and mobile operators can access the system to request for phone number resources or report their forecasted number resource usages and others. This system can be expanded to support number pooling administration.
- Common Short Code Registry: This system provides a web-based interface for the content/application providers to view, request, renew or cancel the common short codes and communicates with the mobile operators to approve the new common short code applications or report the status (e.g., conducting testing) of each of the approved common short code application that has not been activated for service.
- Mobile Content Clearinghouse: Mobile operators can share one mobile content platform that provides contents that are accessed by the mobile operators' customers. The mobile content platform can support bulk messaging by sending SMS or MMS messages to all or selected mobile subscribers either periodically or one-time.
- Emergency Notification System: The system could be used to notify mobile users in a specific geographic area via an SMS message to all users or a specific group of users based on any perceived need. Example: Emergency broadcast of an emergency condition such as a tsunami that is imminent, immediately after an earthquake has been detected.
- Disaster Recovery Planning: Enables the ability to develop ad hoc or predefined disaster recovery plans for any specific purpose.

7. IDA has proposed to adopt a centralised database approach for implementing number portability. The implementation of number portability must fulfill the number portability requirements set out by IDA. IDA also requires that mobile operators resolve all shortcomings in the MNP solution identified above. As a start, all existing fixed line operator (including IP Telephony service providers allocated with the number level "6") and mobile operators should interface with the centralised database to implement FNP and MNP.

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 database approach for fixed and mobile number portability services in Singapore, in light of technology and market developments;

The use of a centralised database approach for number portability services has been successfully utilized commercially by US and Canadian fixed operators since 1998, and by US mobile operators since 2003. This technology is mature and has been adopted in many markets and Singapore should be able to adopt the approach without a problem.

It should also be noted, that to facilitate subscriber competition, a well designed and operated centralised NP platform also enables operators to perform internal network/switch related operations, most cost effectively and with least service interruption to subscribers. For example, the centralised NP platform in the US, called Number Portability Administration Center (NPAC), has been used by operators to perform network/switch technology migrations (i.e.: TDMA to GSM, 2G to 3G), traffic engineering, load balancing, maintenance and disaster recovery. In addition, the NPAC has also been used to manage telephone numbers more efficiently (a.k.a.: "Number Pooling") since 2001.

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

As noted in Annex 3 of the IDA Public Consultation document, the proposed use of a ***centralised database approach*** in implementing number portability and the ***Direct Routing/ACQ*** method for routing calls meets all of the IDA requirements.

As a neutral 3rd party with 10 years of hands-on NP design, implementation and operations experience (and lessons learned) in US, Canada and Taiwan, the centralised database approach, utilizing the Direct Routing/ACQ method for routing calls:

- Does not result in any unreasonable degradation in service quality, reliability or convenience to end-users;
- Is cost effective, efficient and a robust solution in the long-run fur current and future services and capabilities;
- Easily scaleable and capable of meeting future porting demands;
- Ensures efficient use of numbering resources;
- Is a long-term robust, cost effective and efficient solution, facilitates ease of entry of new players and provides non-discriminatory treatment between players when administered by a neutral 3rd party;
- Does not rely on the donor network operator to route calls to ported subscribers;

- Causes no unnecessary or adverse impact to service provisioning of other service providers in the implementation of new NP solutions.

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

The introduction of the ideal NP solution is a complicated and multi-step process that must include:

- Drafting and finalizing regulations and policies;
- Defining system requirements and interface specifications;
- Agreeing on business rules and porting flows;
- Selecting vendors and solutions, to design, implementation, deployment and testing of the NP system;
- Operations readiness and internal training, and;
- Public marketing campaign and user education/promotion

Typically, based on worldwide experience, preparation and implementation timelines can be anywhere from 6 to 15 months, depending on the degree of new development, certification and testing necessary. This period cannot really begin to any great extent, of course, until NP rules are established and process decisions are made, the process of which may be a time consuming effort.

It would be our recommendation, based on our experience, that the sooner Singapore can begin addressing the multiple issues and getting the process started, the better prepared and positioned it will be.

As a neutral 3rd party with 10 years of hands-on NP design, implementation and operations experience (and lessons learned) in US, Canada and Taiwan, NeuStar would welcome the opportunity to work closely with IDA, all operators, and other local constituencies to find the best NP solution with the most realistic implementation timeline that would be most suitable to Singapore and beneficial to all stakeholders.

Conclusion

Leveraging what NeuStar has learned from our extensive, first-hand NP design, implementation, and operations experience, based on the studies done by various countries and the global trends, we would like to offer the following observations and recommendations:

A. An ACQ-based, centralised database solution (a.k.a.: NPAC) is the best long-term approach

B. NPAC is the most economic NP approach in the long run:
   - Ensures neutrality and fairness amongst all competing telecom operators
   - Least performance impact to the networks when porting volume grows
   - Most efficient solution for all emerging, IP-based services (MMS, PoC, VoIP, etc), as well as CCS7-based services
   - Best solution for challenges faced by onward routing (CLI, 2G-3G, etc.)

C. NPAC can be used to streamline inter/intra-carrier operations:
   - Number resource sharing, re-distribution, and single number assignment
   - Network/switch upgrade (e.g.: TDMA->GSM, 2G->3G)
   - Network/Switch traffic engineering and load balancing
   - Network/Switch maintenance and disaster recovery

D. A light weight, standards-based, all inclusive NPAC is the most economic solution for Singapore:
   - XML/HTTP interface
   - API for operators' point of sales (POS), service order entry (SOE), and operating support services (OSS) systems
   - Optional, shared pre-port validation and communications systems, local NP service ordering and management systems, and Service Control Point (SCP) functionalities to minimize operator-side cap-ex and op-ex

E. A well-designed and operated NPAC could be expanded, in a phased approach, to a multi-functional, convergence clearinghouse to improve ROI and streamline operations for operators:
   - SMS/MMS Gateway and Exchange
   - VoIP Gateway and Exchange
   - Mobile Content Clearinghouse
   - Number Administration System
   - Common Short Code Registry

F. Select the most experienced, and proven NPAC implementer and operator:
   - Implementation schedule and cost advantage with proven NP platform

- Need implementation and operations experience from both NPAC (centralised database platform) and operators' point of views
- Leverage proven experience in defining Functional Requirements Specifications (FRS), Interface Inter-operability Specifications (IIS), Methods and Procedures (M&Ps), business rules and operations flows
- Need knowledge and extensive implementation/operations experience for voice, data, the convergence of voice and data, and the convergence of fixed and mobile
- Ensure most positive user experience for mobile subscribers
- Ensure system's highest availability, reliability, and scalability

G. Adopt transaction-based, clearinghouse business model:

- No up-front cap-ex investment required from operators for NPAC and other shared functions
- Most competitive transaction cost, leveraging economy of scale and proven operating experience

APPENDIX -- NEUSTAR PROFILE

NeuStar, Inc. (www.neustar.biz, NYSE:NSR) is a leading provider of essential clearinghouse services to the communications industry and Internet service providers around the world. NeuStar operates directories that manage virtually all telephone area codes and numbers, and enables the dynamic routing of calls among thousands of competing communications service providers (CSPs). In North America, the network of every telecommunications service provider is either directly or indirectly connected to NeuStar's centralised clearinghouse, virtually every telephone call placed is routed using NeuStar's system, and every telecommunications service provider is one of NeuStar's customers.

Neutrality is NeuStar's defining characteristic. NeuStar is required, under FCC rules and orders establishing the qualifications and obligations of the North American Numbering Plan Administrator, National Pooling Administrator and North American Portability Management LLC, to operate its numbering plan, pooling administration and number portability functions in a neutral and impartial manner. NeuStar cannot favor a particular telephone service provider, telecommunications industry segment or technology or group of telecommunications consumers over any other. NeuStar's neutrality efforts are reviewed periodically by independent third parties. Every NeuStar employee, contractor, and board member must abide by the company's published, FCC-approved Code of Conduct, and also must comply with an extensive list of neutrality procedures and principles. NeuStar maintains complete confidentiality of all competitive customer information.

NeuStar's critical technology services meet the addressing, interoperability and infrastructure needs of CSPs. These services are used by CSPs to manage a range of technical and operating requirements, including:

1) Addressing: We enable CSPs to use critical, shared addressing resources, such as telephone numbers, Internet domain names, and Common Short Codes:

- Telephone Number Administration

  North American Numbering Plan (NANP) Administrator

- Telephone Number Pooling

  National Pooling Administrator

- Internet Domain Name Services

  .biz and .us Domains

  .cn and .tw Registry Gateway Services

  .travel Registry Infrastructure

- Common Short Codes

2) Interoperability: We enable CSPs to exchange and share critical operating data so that communications originating on one provider's network can be delivered and received on the network of another CSP. We also facilitates order management and workflow processing among CSPs:

- Wireline and Wireless Number Portability
- Order Management Services

  Local Service Request

  Customer Account Record Exchange
- IP Traffic Exchange
- Identity Services eXchange (IP-based)
- Global Common Directory (.gprs root DNS)

3) Infrastructure: We enable CSPs to more efficiently manage changes in their own networks by centrally managing certain critical data they use to route communications over their own networks:

- Network Management
- Connection Services
- Service Order Provisioning
- Public Safety and Security Services

Since our inception, NeuStar has been the company that the communications industry turns to for mission-critical services. NeuStar has demonstrated its reliability in managing large databases, consistently executing millions of transactions daily, maintaining confidential data, and enabling the secure exchange of network and business information to ensure interoperability between next generation networks.

NeuStar's services are backed by our employees that have extensive telecommunications backgrounds and all are seasoned professionals who actively apply their knowledge, experience, and skills, directly or indirectly, to resolving the communications industry issues for the benefit of the industry. They have served on state public utility commissions, as leaders of industry forums, and have made significant contributions as active members of technical and engineering standards bodies.

The following examples demonstrate our ability to consistently meet the needs of the communications industry:

1. **North American Numbering Plan Administration (NANPA)—** Since 1997, NeuStar has been operating the telephone numbering registry for the North American Numbering Plan (NANP) as a public numbering resource, serving customers throughout the United States, Canada, Bermuda, and many of the Caribbean Islands.

2. **Number Portability Administration Center (NPAC)—** In April 1996, NeuStar was chosen to serve as the Local Number Portability Administrator (LNPA). In that role, NeuStar operates the call and signaling/routing registry for North America that allows customers to keep their existing phone numbers when changing local service providers. Since 1997, it has been relied upon by 5,000+ service providers to route over two billion phone calls every day.

3. **National Number Pooling Administrator—** In June 2001, the Federal Communications Commission's (FCC) Common Carrier Bureau announced that it has selected NeuStar as the National Thousands-Block Number Pooling Administrator. NeuStar serves as the designated

entity responsible for administering thousands-block number pools by assigning, managing, forecasting, reporting and processing data that will allow service providers in areas designated for thousands-block number pooling to receive telephone numbers in blocks of 1,000.

4. **Taiwan Number Portability Administration Center (TW NPAC) —** In December 2004, Telecom Technology Center (TTC), along with 13 largest mobile and fixed operators in Taiwan, selected NeuStar as the exclusive turn-key solution provider to design, implement, deploy, support, and maintain the NPAC system for all telecom service providers in Taiwan. The NPAC will go live in October 2005, to enable mobile and fixed number portability services in Taiwan.

5. **Internet Top Level Domain Registry for .biz and .us —** In November 2000, the Internet Corporation for Assigned Names and Numbers (ICANN) selected NeuLevel, Inc. (a subsidiary of NeuStar), to act as the registry for the first business-centric TLD name on the Internet— dot-biz (.biz), which has been "on-line" since the fall of 2001. In September 2001, the US Commerce Department selected NeuStar to act as the registry for, and to "re-launch" the United States Internet country code TLD – dot-us (.us), which came "on-line" in April 2002.

6. **OMS Clearinghouse —** NeuStar's OMS Clearinghouse is based on a transaction type service bureau model that enables telecom OMS data interchange functionality. The Clearinghouse supports five products: Wireless Manager, Voice Manager, Data Manager, Access Service Manager, and CARE Service Manager. The Clearinghouse facilitates the data interchange of these products to and from telecom service providers and telecom customers across the entire industry.

7. **Common Short Code (CSC) Registry —** In October of 2003, through competitive procurement process, NeuStar was selected by the Cellular Telecommunications & Internet Association (CTIA) to design, develop, and operate the CSC Registry. Common Short Codes (CSCs) created a common addressing system for wireless data applications across all participating U.S. carriers. CSCs, for the first time, enabled marketers, wireless content and application providers to reach a mass-market audience. The Registry and the CSC Program, successfully launched in October 2003, enabled interoperability across wireless carriers, content and application providers, and ultimately end users.

8. **Global Common Directory for GSMA and its Membership Operators —** In September of 2005, through competitive procurement process, NeuStar was selected by the GSM Association (GSMA) to manage a global common directory (.gprs root DNS) enabling GSM networks to interoperate, providing over 1.5 billion mobile subscribers across 680+ global mobile operators with access to mobile data, content and multimedia services -- both on roaming or home networks.