ABSTRACT
After a prolonged deliberation, the Mobile Number Portability has been tabled on the Indian Telecom space and it is set to liberalize the final frontiers of competition in the Telephony space. Mobile Number Portability (MNP) is an important regulatory measure taken to reduce switching costs and it is believed to play an important role in fostering competition in the mobile market. MNP implementation has varied significantly across European Union countries, particularly with respect to porting time and customer fees, both of which are important factors when deciding whether to switch to another provider. The research examines the effects of MNP implementation on competition in the European mobile communications industry. The study findings indicate that subscriber churn rates are negatively affected by both the level of charges levied on subscribers wishing to maintain their current number (porting) when switching mobile providers and the length of time required to switch. This paper explains the underlying MNP technology and its impact both porting speed and the switching fees charged to subscribers wishing to change providers while keeping their current mobile number have on subscriber churn rates to the telephony ecosystem.

Keywords— Mobile number portability (MNP), Switching costs, Mobile communications industry.

I. INTRODUCTION
Over the past two decades, the mobile industry has experienced considerable technological progress with the introduction of digital technology and the advent of broadband, which are arguably changing the world more quickly and more profoundly than any other innovation. Effective competition in the communication markets benefits consumers by affording them increased choice, lower prices, better quality and greater innovation. The presence of network effects and switching costs in the mobile telecommunications industry can favor larger firms, causing distortions that are absent in conventional markets. Switching costs include time, money and the psychological impact on consumers of switching mobile operators. Compatibility, size of discount and transaction costs are the three main sources of switching costs in the context of mobile communications. First, there are compatibility costs, which are related to operators’ SIM-locking practices, as well as to standards compatibility. The adoption of common European standards has eliminated compatibility costs by forcing operators to choose a unique type of network technology (GSM, UMTS), but SIM-locking practices still exist as a way of protecting handset subsidies. If clients wish to switch operator, they need to buy another handset or unlock their current mobile phone in order to use the new company’s services. Second, mobile operators usually offer customer discounts, such as handset subsidies and lower prices for on-net calls to raise customer switching costs and lock consumers into their networks. Lastly, transaction costs are accrued when customers breach their contract with their current operator and a contract termination fee is levied.

The absence of mobile number portability (MNP) means that customers lose their current mobile number when they switch operators and are forced to inform all their current contacts of their new number. This is more costly to business clients because they may lose potential customers. In addition, no portability leads to inconvenience as a result of missed calls from contacts still using the old number. Several studies provide evidence that MNP may play a significant role in reducing the costs to subscribers of changing service providers in the mobile communications industry. Best is, we don’t have to go through the trouble of informing all your friends & family that our number has changed - it stays the same.
II. MNP IMPLEMENTATION

Today, consumers can switch mobile operators while keeping their telephone number. Several approaches used by national regulatory authorities (NRAs) to implement MNP vary according to two key factors: Porting period and consumer fees incurred when switching service provider. The porting period is the length of time required for subscribers to switch providers, and portability fees are the charges the subscriber must pay in order to switch. These two factors, porting period and retail prices, affect the switching decision, and the task befalling the NRAs is to make sure these do not act as disincentives to the take-up of number portability. On the other hand, with respect to timing, the time needed to port a number has dropped significantly since MNP was first adopted in Europe.

Number Portability has to ensure that call routing for all mobile sessions Voice, SMS, MMS should be enabled with routing to the ported network for the same called subscriber number. IETF defines three types of number portability (NP): Service provider number portability (SPNP), location portability and service portability. The current paper focuses on the SPNP, which is the agenda set by TRAI to the service provider bodies in India. SPNP allows subscribers to switch service providers while retaining the same phone number. The technology challenges towards implementation come through complexities in number administration, network signaling functions, call routing, billing and service management. A translation element is necessitated in the network as the mobile number addressing scheme becomes a virtual address. Central to the address translation scheme is the NP translation database hereafter to be termed as NPDB (Number Portability Database).

The network classification is done as follows:

**Donor Network:** The network that first assigns a telephone number to a subscriber from one of its administered ranges.

**New Serving Network:** The network of the current service provider serving the ported number.

**Old Serving Network:** The network prior to porting in of the number to the current network. It is not necessarily the Donor network as multiple provider switches is feasible.

The implementation of the routing is through four different schemes:

A. **All Call query (ACQ)**

The Originating Network receives a call from the caller and sends a query to a centrally administered Number Portability Database (NPDB), a copy of which is usually residing on a network element within its network (like SCP).

![Fig. 1 All Call query setup](image1)

The NPDB returns the routing number associated with the dialled directory number. A LRN prefix is usually added to the B-MSISDN for the ported out number. The Originating Network uses the routing number to route the call to the new serving network. Based on the LRN prefix (Location Routing Number) the originating network will route the call to the recipient network. As donor network doesn’t get involved in the entire call flow ACQ scheme is called direct routing as shown in fig. 1.

B. **Query on Release (QoR)**

Fig. 2 shows the Originating Network receives a call from the caller and routes the call to the donor network. The donor network releases the call and indicates that the dialled directory number has been ported out of that switch. The Originating Network sends a query to its copy of the centrally administered NPDB.

![Fig. 2 Query on Release](image2)

The NPDB returns the routing number associated with the dialled directory number. The Originating Network...
uses the routing number to route the call to the new serving network. The QOR mechanism can hold out to be a smart implementation when the MNP porting figures are low. There are no unnecessary SCP queries for B party subscribers that are not ported yet, which is likely to save ample processing capacity on the network as well as associated call setup delay.

However as the porting figures rise (which is close to 25% in most mature MNP markets), the cost of call setup and subsequent release in case of ported out numbers is likely to take an adverse hit on the network utilisation as well as setup cost.

C. Call Dropback

The Originating Network receives a call from the caller and routes the call to the donor network. The donor network detects that the dialled directory number has been ported out of the donor switch and checks with an internal network-specific NPDB. The internal NPDB returns the routing number associated with the dialled directory number. The donor network releases the call by providing the routing number. The Originating Network uses the routing number to route the call to the new serving network. Fig. 3 shows Call Dropback.

D. Onward Routing (OR)

The Originating Network receives a call from the caller and routes the call to the donor network. The donor network detects that the dialled directory number has been ported out of the donor switch and checks with an internal network-specific NPDB. The internal NPDB returns the routing number associated with the dialled directory number. The donor network uses the routing number to route the call to the new serving network. Again from the point of evaluating the efficiency of OR implementation, the scheme is heavily resource intensive with non-optimal utilisation. In circumstances of ported out numbers, there are redundant pairs of voice circuits that are kept engaged for the same call between the Originating Switch, Donor Switch and Recipient switch.

Fig. 4 Onward Routing

Fig. 4 illustrates Onward Routing. The switching matrix as well as the CPU of the donor switch will be kept loaded for the entire duration of the call, for which it is no longer responsible. Except the ACQ scheme all other schemes initiate a call to the Donor network, only to be released or rerouted back to the serving network. Thus ACQ is the most efficient scheme with the most optimal use of the switching and associated network facilities. The ACQ scheme queries the NPDB to retrieve the routing information. The centralized NPDB contains the ported number information from multiple networks.

III. MOBILE NUMBER PORTABILITY REGULATORY GUIDELINES

1. Out of several types of number portability DoT has recommended Service Provider Number Portability (SPNP) for all mobile service operators.
2. MNP will be restricted only for intra circle operators.
3. MNP will be allowed between CDMA and GSM operators.
4. ACQ (All Call Query) direct routing method is to be adopted to implement MNP.
5. The Department of Telecoms (DoT) in India has awarded licenses for two mobile number portability clearing house vendors to operate clearinghouses in two zones within the country.
6. Syniverse Technologies India (North-West zone) and MNP Interconnection, a joint venture by US-based Telcordia Technologies (South-East zone), would act as the clearing houses in the respective zones to manage porting activities.

These CCH will download the MNP database in operators NPDB on daily basis and also manage the communication channels from the SP’s to the NPDB. Major Mobile Operators in India: Aircel, Bharat Sanchar Nigam Ltd (BSNL), Bharti Cellular Ltd (Airtel), BPL Mobile, Idea Cellular, Mahanagar Telephone Nigam Limited (MTNL), Reliance Telecom Ltd, Spice Telecom Ltd, Tata Teleservices, Virgin Mobile, Vodafone Essar.
IV. MNP BUSINESS OPPORTUNITIES

To understand the opportunities in the field of MNP it is imperative to understand the challenges faced for implementing and sustaining the MNP scheme. Cutting across all service providers or the central regulatory body for sustaining the MNP infrastructure, the identified cost element would be as follows:

1. Centralized NPDB setup cost.
2. Upgrading the Signalling infrastructure to support NPDB routing.
3. Network interface and software upgrade for supporting elements in the MNP ecosystem like HLR, MSC, GMSC, SMSC, MMSC, STP, Signalling gateway etc.
4. Upgrade of BOSS component software System for provisioning of NPDB and the UI interfaces.
5. Customer Relationship Management (CRM) enhancement.
6. IVR/IP interface upgrade for interactive provisioning and support.
7. Software and system upgrade maintenance lines to keep up with regulatory changes.

V. COMPETITIONS AND CHALLENGES

Switching costs for consumers is one of the most important issues affecting market competition in the mobile communications industry. The existence of switching costs enhances firms’ market power by allowing them to charge their customer base higher prices. The introduction of MNP is one of the main regulatory measures taken to reduce switching costs in the mobile industry and is designed to generate significant benefits both for consumers and market competition. At an individual level, several studies have estimated consumer switching costs, both directly and indirectly, and indicate that clients who adopt MNP have lower switching costs compared with clients who do not maintain their number when changing provider. This evidence reveals the effectiveness of MNP in lowering customer switching costs and shows that they will not disappear because leading operators use lock-in strategies such as network-based discriminatory pricing schemes and because of increasing barriers for new entrants or small operators to grow sufficiently.

However, some theoretical studies argue that the introduction of MNP does not benefit consumers at all because it can make it difficult for them to distinguish who is the provider when placing a call and may therefore erode the information related to the termination charges they must pay provided theoretical evidence to show that the introduction of MNP cannot guarantee social benefits under specific demand characteristics. Specifically, they concluded that in developing telephony markets with low penetration rates, MNP benefited consumers and new entrants but had no effect on incumbents. Subsequently reported that the effect of introducing MNP on over all welfare is ambiguous. A branch of the literature empirically examines the impact of portability on market competition and results do not always point in the same direction. For example, in a study, although the primary objective was not to investigate the effect of MNP on prices, they found that the regulatory environment variable was not statistically significant in the mobile industry. Similarly, it is also examined the effect of lowering switching costs when number portability is applied to toll-free telephony and found that introducing number portability may not reduce prices when firms cannot price-discriminate between old locked-in consumers and new ones.

In contrast, competition is greater and that MNP is a significant price determinant, and that prices are lower in countries where MNP has already been introduced. As different studies have posited, the impact of MNP introduction has not always been conclusive and depends on several variables, as well as on player strategies, to increase switching barriers. From a regulatory perspective, in addition to the differences in terms of the timing of the introduction of MNP, European countries vary in how MNP has been implemented in the mobile industry with respect to portability period and customer fees, which could affect the adoption of MNP and its impact on competition. For example, it is noted that the porting period is an important determinant of the impact of MNP on competition and that it reduces average prices when switching takes place in less than five days. ‘‘Higher charges tend to lead to higher consumer switching costs and therefore to a lower use of MNP’’, based on data available regarding switched numbers. The variable that measures the number of operators in the mobile industry is positively related to the churn rate and highly significant, indicating that the more operators there are in each market, the higher the churn rate. Since there is a scarcity of empirical studies that consider the rules and requirements put in place by the NRAs to implement MNP, the current study examines how two factors, longer porting period or higher charges, can affect market competition in the mobile industry.

MNP also impacts the internet telephony or VOIP business. A VOIP originated voice call with a termination on traditional mobile operator need to be aware of the porting status of the mobile subscriber before the call can be routed. Thus VOIP now need to know the current serving network for call routing purposes.

VI. CONCLUSION

MNP requirements, such as the porting period and the charges levied on consumers when switching service providers, are important factors affecting the porting of numbers. The finding reveals the importance of MNP implementation on customer churn rate in the mobile industry in European countries. This appears to be the first empirical study to provide evidence of the MNP conditions that have hindered the competitive process and prevented consumers from reaping the benefits of the reduced switching costs they should have been able to obtain through the introduction of MNP. The results show that the portability period and the portability fee required to switch
service provider are negatively related to the level of churn rate in the mobile industry. This means that the cost of switching providers increases along with the increase in the porting period and charges. Longer portability periods and higher portability charges contribute to consumer lock-in and reduce effective competition in the mobile industry. This study is a first attempt to understand how the MNP process affects customer churn rate in the mobile industry. Future studies should focus on the types of strategies operators have used to reduce the effect of MNP on their customer churn.

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