

Hallingby, Hanne Kristine

## Conference Paper

# The status of the mobile phone number as general purpose identifier – elaboration on cases from Norway and Pakistan

27th European Regional Conference of the International Telecommunications Society (ITS): "The Evolution of the North-South Telecommunications Divide: The Role for Europe", Cambridge, United Kingdom, 7th-9th September, 2016

### Provided in Cooperation with:

International Telecommunications Society (ITS)

*Suggested Citation:* Hallingby, Hanne Kristine (2016) : The status of the mobile phone number as general purpose identifier – elaboration on cases from Norway and Pakistan, 27th European Regional Conference of the International Telecommunications Society (ITS): "The Evolution of the North-South Telecommunications Divide: The Role for Europe", Cambridge, United Kingdom, 7th-9th September, 2016, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/148672>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# The status of the mobile phone number as general purpose identifier – elaboration on cases from Norway and Pakistan

---

**Hanne Kristine Hallingby**

Telenor Research, Fornebu, Norway

University of Oslo, Centre for Technology, Innovation and Culture, Oslo, Norway

email: [hanne-k.hallingby@telenor.com](mailto:hanne-k.hallingby@telenor.com) Mobile: + 47 915 79 213

## **Abstract**

This paper discusses the mobile number's status as a general purpose identifier in digital customer journeys. The strength and availability of the mobile number as ID is assessed across several markets and examples of use are given. Two cases where the mobile number already is a trusted resource and installed base are presented. Strength and availability for the mobile number as ID varies across markets depending on ID requirements for SIM-cards and the local ecosystem: some markets score high, others low. The cases discussed are Norway and Pakistan. They are respectively a developed and developing economy however; both demonstrate a strong and available mobile number and innovative uses in digital customer journeys. This signals on the one hand a potential universal applicability of the mobile number across markets with very different prerequisites, on the other hand that use of the mobile number is a local phenomenon only. The analysis indicates that across markets there is an ongoing and continuous management of both mobile numbers and other IDs in order to affect strength and availability, to reach a sufficient installed base, and position as an attractive resource for digital customer journeys.

## **1 Introduction**

Mobile digital ID (Jøsang, 2014) is part of current and future digital customer journeys. A customer journey is a sequence of touchpoints involved for a *customer* to reach a specific

goal, enabled by a *service provider* (Halvorsrud, Lee, Haugstveit, & Følstad, 2014). Customer journeys can be restaurant visits, health services, shopping; they can be physical and digital and vary in their ID requirements. Initial registration and later use of digital IDs are customer journey touchpoints. An ID can be owned and managed by the service provider or federated. The *strength* of an ID is to a large degree dependent on the registration phase where credentials are required (Jøsang, 2014). Banks and public bodies have developed separate IDs for their own services with strong credentials (Eaton, Hallingby, Nesse, & Hanseth, 2014). Facebook only requires an email and a password to create an account, still, Facebook Connect is the most federated social login ID across the web (Larralde, 2015). Furthermore, the usefulness of an ID is affected by its *availability* to both customers and providers; significant ID initiatives never reached high diffusion (Jøsang, 2014).

Recently mobile network operators have proposed that the mobile number provides a great ID federation value proposition for digital customer journeys (GSMA and SIA, 2014); the argument is that an ID provided by mobile operators based in the mobile subscription and number is *strong* and widely *available*. However, the ID requirements for subscribing to prepaid SIM-cards vary across markets, and thus its *strength*; this is highly connected to a varying status and strength of national IDs that are used as mobile subscription credentials (GSMA, 2013). Taken together, this constitutes a chain of IDs, from the service provider, via e.g. Facebook Connect, via a mobile number, to a national ID-card or biometric ID-registers. Thus, each ID depends on the one it is built upon and the mobile number can be a weak or strong link in this chain.

Also the public *availability* of mobile numbers varies across markets and thus challenges its value proposition. Building on a systemic and socio-techno approach to technology diffusion and use (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2008; Hanseth & Lyytinen, 2010) it is reason to believe that the ecosystem surrounding the mobile number affects its availability and usefulness, and that its status is dependent on local conditions such as public databases, regulations, and leading users. This article suggests that an ID's strength and availability is affected by how an ID is *registered*, and the *ecosystem* surrounding it. Next, the status of strength and availability of an ID affects how and why it is used for in digital customer journeys.

This paper approaches the mobile number as ID by first exploring the research question: How strong and available is the mobile phone number as a general purpose ID in digital customer journeys? The second research question is: How is the mobile number is used as ID in digital

services? The paper sheds light on the question by surveying ID requirements for mobile subscriptions and availability in European and Asian countries. Next, the paper describes the strength, availability and use in two markets, Pakistan and Norway. More generic examples of use are also given. Thus, this paper has not the intention to elaborate on all the different types of IDs but rather the varying status for the mobile number as a general purpose identifier.

In addition to answering the research questions, the paper demonstrate the role of the mobile number as ID in both a developed and developing economy, on the one hand indicating the generic potential. On the other hand, the varying strength and availability across all types of markets is also an obstacle to a global application.

In section two I first give an overview of how IDs currently is implemented in different digital customer journeys. Then I go into how ID – and specifically mobile number as an ID resource – have been discussed theoretically as an enabling factor for digital services and innovation. Section three includes the methodological approach and specifies the conceptual framework. Section four is a presentation of the results. In section five I both discuss what the results can tell about the mobile number as a general purpose identifier, and some paradoxes comparing developing and developed economies. Section six is a conclusion.

## **2 Background and theory**

### ***2.1 Digital services using ID***

Industry reports tell that customers mainly identify themselves through social login when they use web-services such as brands, music, and gaming. According to Loginradius (2016) 70% used social login and 30% email in Q1 2016. Service providers often federate social logins instead of managing their own. The market for social login is shared between Facebook and Google, with a preference for Facebook (Loginradius, 2016; Larralde, 2015; Jøsang, 2014). Arguably, social login solution plays a significant role as a general purpose identifier (Jøsang, 2014) in the management of identities for web-services. This is a position earned (Dhamija & Dusseault, 2008) in a landscape developed over two decades where many technologies and actors have fought for a dominant position; Facebook's success is partly ascribed to the use of widely adapted identity management solutions such as OpenID and OAuth (Jøsang, 2014). Industry reports do not provide any data on to what degree the mobile number or IMSI (International Mobile Subscriber Identity) on the SIM-card is used as a identifier for web-services; neither do they elaborate on which IDs that are chosen by web-services with higher ID-requirements, such as banks and healthcare.

In contrast, this paper is partly inspired by an observation that the mobile number often is used for identifying and communicating with the customer in certain sectors because it is a more reliable form of ID (Hallingby, 2016). Furthermore, it is observed that high requirements on knowing-your-customer for financial services are not met by social login (Worldbank, 2016; GSMA and SIA, 2014; Khan, 2016). The requirements to identification of customers in more risk-sensitive sectors like banks indicate demand for complying IDs (Eaton, Hallingby, Nesse, & Hanseth, 2014). Even Janrain – one of the companies often cited for their trend reports on social login – have become a lot more concerned with security and privacy issues for login and ID solutions (Schreiner, 2016). Thus, the mobile number can play an increasing role as trusted digital touchpoints in the digital customer journey. This phenomenon is either out of the radar for the industry reports, or so small and localized that it does not show in global surveys. Jøsang (2014) suggests that the SIM-card and IMSI as a general purpose identifier have met resistance from other stakeholders because they fear the competitive advantage this would give to the mobile operators; this could again explain a marginal role.

That being said – the mobile number plays an increasing role in the ID-landscape through the often used “two-factor” password model (Schreiner, 2016). This type of ID-security is often referred to as “something you have” (GSMA, 2014) for instance a device, and “something you know” which can be a password; additional security can be put on top by sending an SMS to a SIM-card (which you have) with a code (which you know) (Hay, 2016). Another sign of need for strengthening IDs – and the perceived strength of mobile numbers as identifying factor – is how Google and Facebook increasingly inquire for the users to add their mobile number to their profile. Recently, Google chose to use the mobile number as login for their new video chat Duo and SMS as way to reach new contacts (Ingraham, 2016). However, despite being widely used the actual identity behind the mobile number and SIM-card is not necessarily known.

In most instances the mobile number can be used as an identifier in private customer databases even without a public directory; the user can herself provide the number and the network operator can provide an IMSI confirmation that at least confirm that it is a “real” SIM-card taking part in the interaction. The latter functionality has been developed into the ID-solution Mobile Connect by GSMA (GSMA and SIA, 2014). In both instances it is only the mobile number that is exchanged; the strength of the mobile number still depends on the local ID requirements for the SIM-card. In some markets where the mobile number has been

made available in public databases and there is an efficient ecosystem for mobile number directories, a service provider can carry out database look-ups and collect name and address of the person in question. Thus, quite efficiently a customer database can be built with the mobile number as a starting point. Hence, not only the *strength* of the mobile number but also its *availability* may vary in different markets and regulatory regimes.

## **2.2 Theoretical approach to ID's role in digital services**

Two fields of discussions can shed light on the issue when discussing the mobile number as a general purpose identity resource: the *regulatory* and the *information infrastructure* field.

These fields have different motivations, but seem to agree on the challenges of lock-in with dysfunctional systems and monopolies, as well as belief that a generally available resource is necessary and can spur innovation by other actors in the ecosystem.

Milne (1997) concluded in her *regulatory* approach that (mobile) numbers are an “extremely valuable resource for all industry players and users” without elaborating on how it could be used as a resource outside the telco domain. Her concerns with lock-in were restricted to the competition between mobile operators and limited number space; the former have later been solved by leaving mobile number management to a neutral part and number portability, the latter has been solved by extensions of the number plans (Rood, 2000). While Milne (1997) promoted the benefits from numbers as a highly available and valuable resource she did not problematize the possibility of a general industry lock-in if relying on mobile numbers; this is a concern that has risen at later stages. Despite, or maybe because of its potential as a general purpose identifier, the SIM-card and IMSI met resistance from other stakeholders because they feared the competitive advantage this would give to the mobile operators (Jøsang, 2014).

*Information infrastructures* are installed bases of existing systems, databases and interfaces which digital services are based upon (Eriksson & Åkerfalk, 2010; Hanseth & Lyytinen, 2010). Hanseth and Lyytinen (2010, p. 4) define an information infrastructure as a “*shared, open* (and unbounded), *heterogeneous* and *evolving* socio-technical systems (which we call *installed base*) consisting of a set of IT capabilities and their user, operations and design communities”; they explain that an installed base can both enable and constrain the evolution of an infrastructure. Ericsson and Åkerfalk (2010, p. 435) explain that “identifiers and registers of identifiers constitute a naming infrastructure, which is an important part of the overall information infrastructure”. The constraints to infrastructure evolution come from lock-in to solutions that are not sustainable and efficient but difficult to do anything with.

Eriksson and Ågerfalk (2010, p. 434) explain how identifiers “play a major role in causing lock-in situations” and how this occurred for the Swedish PID number and Student Identifier; thus the identifier is itself a significant part of an installed base of an information infrastructure. The lock-in effects are also those that motivate actors to provide capabilities that can become an installed base, and thus increase appropriation capabilities. This is also why standards are considered essential for the general sustainability of information infrastructures. Also Rood (2000) describes how potential network and lock-in effects that identifiers are subject to, come from for instance listing in databases and on business cards, and the individuals recognition of certain codes and patterns.

Taken together, the regulatory regime of mobile numbers and information infrastructure approaches firstly, point at why and how the mobile number is a potential general purpose identifier that can play a role as installed base for the emerging landscape of web-services. Secondly, it becomes clear why there is both resistance and skepticism towards using this resource. The literature that suggests how technology – such as mobile telecom – will emerge as an information infrastructure (Jøsang, 2014; Hanseth & Lyytinen, 2010) implicitly suggest several end-games: mobile numbers can emerge as the only general purpose identifier, it can be completely bypassed by others, or co-exist and complement others. The market observations reported above suggest that there will be complementing IDs and that the mobile number can be one of those.

Aligned with the systemic and evolutionary approach to technology innovation (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2008), Eriksson and Ågerfalk (2010) suggest that it takes not only a technical decision to encounter the effects of lock-in. Implicitly they acknowledge that lock-in, or installed base situations, are a fact of life; the negative consequences and hinders for transitions have only to be minimized. Design principles should consider usage, institutional and infrastructural aspects such as:

1. Identifier stability to support knowledge network effects
2. Mnemonic to ease learning and remembering
3. Check-digit to ease manual use
4. Pattern to ease manual recognition and information exchange
5. Database friendly
6. Transition plan for redesign

These are all principles that *ease* the use for different users: end-users (equivalent to customers above), administrators and managers of systems that use the ID. At the same time

the principles signals recognition of the *institutional* role – the symbolic role – an ID has become in a specific context and that the ID plays a role in a larger information infrastructure. Sometimes an ID solution must be managed and coordinated on an institutional level in order to function efficiently. Additionally, Eriksson and Ågerfalk (2010) suggest not overusing IDs that seem interchangeable – this makes them easier to change and maintain.

On the more practical level (Dhamija & Dussault, 2008) suggest how an ID management system should be designed – including requirements on the identifier – in order to be used and satisfying to users. They elaborate mainly on three stakeholders, namely end-users (i.e. customers as used above), service providers and providers of an ID system. As a foundation for their recommendation is their observation that end-users choose ease of use to security in the trade-off between the two. The significance of satisfactory user experience is present in all phases of ID usage, from installing to use (Jøsang, 2014). This means that end-users are not willing to invest much time in privacy and security and thus *simplicity in all phases* is critical; Dhamija and Dussault (2008) predicted that end-users' practices would lead to a preference for already existing systems – which we later have seen for social logins like Facebook (Larralde, 2015). If a certain level of security is necessary, the user must find it *easy to achieve correctness, trust and the right level of security*. Users have many IDs and passwords to manage and cognitive limitation of the user is an important factor; to *ease the mental burden* is good, for instance by making IDs easy to remember by making it mnemonic and through patterns. End-users should also easily be able to recognize and *authenticate the service provider*. Finally, they recognize that Service providers have a need to *control user accounts*, and build trust in all dimensions.

The reason for why the mobile number is in use as a general purpose identifier can be that it meets several of the design principles suggested above, summarized as four characteristics:

- It is “easy” to remember and use (for people, firms, software and databases)
- It is stable, partly due to number portability; stricter ID regimes may increase stability
- It is to a large degree institutionalized and trusted – controlled by a neutral part
- It is installed base – installed into databases and systems managing customers

The mobile number currently meets the two first characteristics to a large degree. For the next two characteristics there are remaining challenges. First, the ID requirement for SIM-cards will still vary across markets and regulatory regimes and thus level of institutionalizing and trust will vary. Second, there may not exist ways to confirm that this is a real number, or databases to look-up automatically and collect and confirm for instance the name and address



of the person and in question, thus it lacks something on being an installed base. These two factors have to do with the *strength* and *availability* of the identifier. This could affect how it is perceived and used in a local market, but also its future potential as a global general purpose identifier and for further innovation.

An additional drawback with the mobile numbers as ID is that the trade-off between ease-of-use and security (Dhamija & Dusseault, 2008) is not very well met. This is a disadvantage that now is encountered by the Mobile Connect solution promoted by GSMA and some mobile operators (GSMA and SIA, 2014), however, beyond the focus of this paper.

### 3 Method

This research is an exploratory case study of a phenomenon that is present in several markets and thus, also subject to a comparison across similar cases (Yin, 2014). It is exploratory in the sense that the research has had an open mind when investigating the mobile number as a general purpose identifier in digital solutions. However, the research does also give room to an explanatory approach where the *strength* and *availability* are suggested as important attributes for mobile number as ID and a potential cause to how and why it may be *used* in digital services. Thus, strength and availability are the two independent variables, and use the dependent variable in the conceptual framework for the research (Miles, Huberman, & Saldaña, 2014).

The comparison is restricted to a few indicators across several markets. The two cases are rich explanation of how the mobile number is used as ID for digital services, and how availability and strength of the mobile number have had impact. Data that serve as indicators for the variables are described in Table 1 **Error! Reference source not found.**. In the general *survey* of ID, strength and availability in the different markets the indicators are fewer. In the two *cases* the data shedding light on both the independent and dependent variables are richer. The data on the dependent variable drawn from the *industry* demonstrates the challenges with identifying relevant data.

Data about strength and availability of the mobile number in different market is not easily available through public sources; for instance, the legalization of the field is in different languages across markets. As an employee in a global mobile network operator I have engaged staff resources to provide information for the survey. For the case comparison I have interviewed experts and people working within the field in the years 2014-2016. Other data are collected through articles and facts from websites, databases and reports on the field.

Table 1 Variables description

Variable	Description
Strength of ID	<p><b>Independent variable</b></p> <p>Survey: Indicators</p> <ul style="list-style-type: none"> <li>• requirement and implementation of ID for prepaid SIM-cards (ID req.)               <ul style="list-style-type: none"> <li>○ Verified with national ID register</li> <li>○ ID documents</li> </ul> </li> <li>• share of prepaid SIM-cards Q4 2015 (Prepaid share)</li> <li>• implementation of mobile number portability (making an individual closer connected to a number) (MNP)</li> <li>• Extremes: High and Low. The markets are assessed on a scale from 1-5 where 5 is High and 1 is Low.</li> </ul> <p>Case: Richer description of mobile numbers' strength as ID</p>
Availability of ID	<p><b>Independent variable</b></p> <p>Survey: Indicators</p> <ul style="list-style-type: none"> <li>• implementation of mobile number portability (makes it easier to re-use, continuity of number) (MNP)</li> <li>• obligations and implementation of mobile number directories (Dir.)</li> <li>• market for mobile number directories (Dir. Mar.)</li> <li>• Other considerations: ease-of-use for end-users and third parties</li> <li>• Extremes: High and Low. The markets are assessed on a scale from 1-5 where 5 is High and 1 is Low. 0 is used when illegal.</li> </ul> <p>Case: Richer description of mobile numbers' availability as ID</p>
Digital services which take use of mobile number as ID	<p><b>Dependent variable</b></p> <p>In this research this variable will be illuminated by examples from the industry, and two cases.</p> <p>The variation of the variable is an assessment of actual use, and phase.</p>

The two cases in this paper are respectively a developed and developing economy, Norway and Pakistan; they have a history that only lately have similarities on the independent variables, namely the strength and availability of the mobile number. Thus, it opens for a

discussion on if the same conditions push development in the same direction, even with very different types of economies.

Table 2 Data sources

Type of sources	Sources
Interviews	<ul style="list-style-type: none"> <li>Public bodies, regulators, third parties, aggregators and mobile operators in Norway (13)</li> <li>Public bodies, regulators, stakeholders, market analysts, and mobile operators in Pakistan (12)</li> </ul>
Survey	<ul style="list-style-type: none"> <li>Mobile operator regulatory staff and operations in Asia and Europe</li> </ul>
Public documents	<ul style="list-style-type: none"> <li>Regulatory websites, facts, guidelines, rulings</li> <li>Newspaper articles</li> <li>Stakeholder websites</li> <li>Industry reports</li> </ul>
GSMA intelligence	<ul style="list-style-type: none"> <li>Data on prepaid SIM-cards market share</li> </ul>

## 4 Results

### 4.1 Survey – How mobile numbers are governed

Post-paid mobile subscriptions are by nature connected to an identity since the invoice is sent to an existing address and subsequently paid – in a strict sense still a weak ID. It is however, the identification for prepaid subscriptions and SIM-cards that is the challenge for ID strength. In many developing economies the majority of SIM-cards are prepaid and up till recently sold with low requirements to ID or weak implementation of the existing requirements (GSMA, 2013; GSMA, 2016); pros and cons for stricter requirements have been discussed in many markets, and decisions have gone both ways in both developing and developed economies. Examples of developed economies which have (so far) chosen not to require ID for prepaid SIM-cards are Sweden and UK (GSMA, 2016), with a share of respectively 28% and 38% of such cards (GSMA, Database). The arguments against ID requirement in developed economies are typically that is an unnecessary collection of user data and data privacy arguments. In developing markets the arguments against is not so much data privacy, but the extra burden the ID requirement put on the poor being an extra hinder for their access to digitization and development. For instance in Pakistan, security issues and the importance of hindering terror have had huge support in the population.

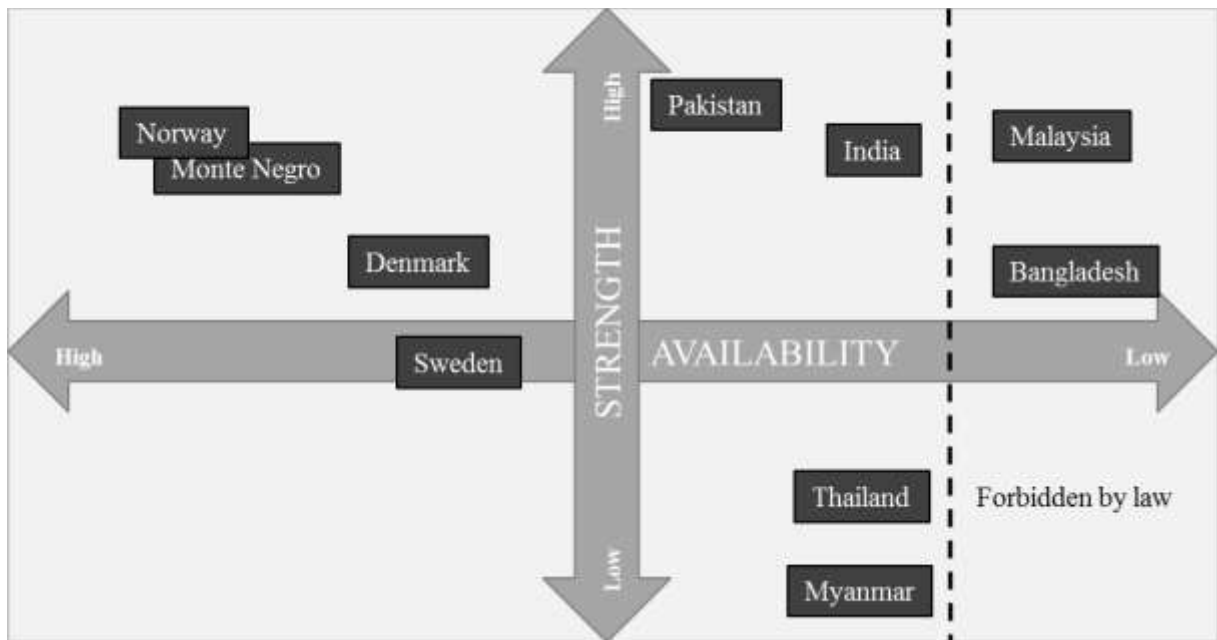


Figure 1 Assessment of ID status in different markets

I have assessed several markets in Europe and Asia along the two independent variables ID *strength* and *availability*. An overview is given in Figure 1. The markets' position on one of the two dimensions indicates how strong or available I assess them to be. More detailed data are reported in Table 3.

Table 3 Description of each market (See Table 1 for short codes)

Market	What	Description	Assessment 1-5
Bangladesh	ID req.	Strict ID requirements and implementation regime for all types of SIM-cards since 2016. Biometric re-verification with national ID-card and register.	4
	Prepaid share		97%
	MNP	No	1
	Dir.	Illegal to share such data.	0
	Dir. Mar.	No	0
Denmark	ID req.	There are no ID requirements for prepaid SIM-cards. 12% of the subscription base is prepaid as of 2015. The customer can volunteer to register, for instance too be listed in public directories.	4
	Prepaid share		12%

Denmark	MNP	Number portability is implemented in 2001.	5
	Dir.	Assuming good availability in directories, but rated lower because it is voluntary to register prepaid SIM-cards in directories	4
	Dir. Mar.	NA	
India	ID req.	Strict ID requirements and implementation regime for all types of SIM-cards since 2012. A long list of ID-cards, passports etc, the AADHAAR cards are highly diffused. Detailed customer databases managed by operators.	5
	Prepaid share		95%
	MNP	Number portability was implemented in 2010. Two mobile network operators maintain a national database.	5
	Dir.	No such provision or implementations although contractual obligation in license – this is similar for all operators. Fixed lines operators provide directories.	1
	Dir. Mar.	-	1
Malaysia	ID req.	Strict ID requirements and implementation regime for all types of SIM-cards. National ID-card, passports etc. Detailed customer databases managed by operators.	5
	Prepaid share		77%
	MNP	Number portability for mobile operators since 2004.	5
	Dir.	Not allowed due to restrictions on Personal Data Protection.	0
	Dir. Mar.		0
Monte Negro	ID req.	Obligated to register all subscribers, fully completed implementation in 2011. Passport or other personal ID required.	5
	Prepaid share		63%
	MNP	Number portability was implemented in 2011.	4
	Dir.	All telco operators have separate directories – one Universal Directory Operator operate one database across all others. Customers check off if to be included in directory.	5
	Dir. Mar.	Apparently.	4
Myanmar	ID req.	There are ID requirements in the regulation, however implementation weaker. ID card is not common in Myanmar and other forms of IDs are accepted, such as letter from village headman. Subscribers are motivated to register.	1
	Prepaid share		99%
	MNP	No	1
	Dir.	No	1
	Dir. Mar.	No	1

Norway	ID req.	The country has had strict ID requirements and implementation regime since about 2004. Passport or similar ID. Detailed customer databases managed by operators. Not biometric register.	5
	Prepaid share		15%
	MNP	Number portability was implemented in 2001 with an operator owned shared database.	5
	Dir.	There is an obligation to share number data with public directories. There are four large databases for directories	5
	Dir. Mar.	There is a well-functioning and profitable market for directories. Some directories have developed into advance look-up databases for third parties providing also credit inquiries.	4
Pakistan	ID req.	The country has strict ID requirements and implementation regime, but only being strictly implemented in 2015. National ID-card with biometric thumbprint. Detailed customer databases managed by operators, however ID confirmation managed by national ID authority NADRA.	5
	Prepaid share		96%
	MNP	Number portability is implemented in 2007 with an operator owned shared database.	5
	Dir.	There is an obligation for fixed lines numbers, but not for mobile numbers due to purposes of privacy. Still – the possibility to access NADRA for confirmation of mobile numbers' identity is a form of directory functionality that will serve some innovations.	2,5
	Dir. Mar.	No active market for mobile numbers, however NADRA charge actors for using their database.	2,5
Sweden	ID req.	There are no ID requirements for prepaid SIM-cards.	3
	Prepaid share		29%
	MNP	Number portability is implemented in 2001.	5
	Dir.	Assuming good availability in directories, but rated lower because it is voluntary to register prepaid SIM-cards in directories.	4
	Dir. Mar.	NA	
Thailand	ID req.	There are ID requirements at purchase – there was a reverification in 2015. However, only photo of card is saved; hence, no data on customers in database.	2
	Prepaid share		83%
	MNP	Number portability was implemented in 2010.	4
	Dir.	No	1
	Dir. Mar.	No	1

The assessment of the markets on the two dimensions reveals that there are markets in almost all quadrants. Thus, some markets would not meet a criterion on trust and being an institution in society, neither being an installed base.

In addition, the results show that the relationship between the ID *Strength* and status of an economy is not directly reflected in the position in the quadrant: both developing and developed economies can be strong on ID-requirements, and vice versa. Along the dimension for ID Strength the share of prepaid SIM-cards will affect how strong the ID regime for mobile numbers appears in that market; for instance in Sweden it is assessed lower due to a higher prepaid share (28%). Bangladesh is assessed to be lower on Strength compared to for instance Pakistan since it does not have number portability.

Along the dimension *Availability* it seems like European countries make mobile numbers available in public directories. Asian countries do not make mobile numbers available, even though fixed numbers are available. There is a line between those Asian countries which strictly forbid sharing of mobile numbers in open directories and those that just do not have such obligations or do not follow up implementation of it. Thus – currently the easy availability to mobile numbers – and thus the mobile number as installed base – is a more significant demarcation than strength between developing and developed economies.

#### **4.2 Industry data on the use of mobile numbers as ID**

Increasingly firms seem to collect a mobile number from customers who use their web-services; however, data about the phenomenon are difficult to obtain. For instance, Statistics Norway collect data about companies use of social media and electronic commerce systems but not about use of email or mobile numbers in the customer dialogue. Still, some general observations can serve as indicator of the status of the use of mobile number as identifier.

A survey in EU countries in 2010 reported that on average 46% of consumers were willing to disclose their mobile number for eCommerce purposes, and 23% for social networking sites; the willingness was as around 75% in the Nordic EU-countries, and 42% in the UK (Lusoli, et al., 2012). This survey indicates that it is common for service providers to *obtain* mobile numbers as a part of the digital customer journey, but also some reluctance from consumers depending on type of service and where they are localized. The lower acceptance in the UK resonates with a regulatory regime and context which appreciates privacy purposes, and is relevant for the trust in and institutionalization of the mobile number.

The use of SMS in customer dialogues is another indicator of how common mobile numbers are as customer identifier. Available articles from the marketing industry reports that 40-50% of marketers worldwide use SMS (eMarketer, 2015). That being said – e-mail is an even more common way to communicate with customers which necessarily include a registration of the consumer. Other communication and engaging channels like social media are also common, but these do not imply registration, neither are they subject to the same marketing regulations as mobile phones and emails are. Salesforce is a Customer Relationship Management system with a 33% market share in 2015 (Hollar, 2015). The relative high use and growth of SMS that Salesforce reports indicates that mobile number is a common data fields in customer databases and thus installed base (Salesforce, 2016).

Pew research institute (Olmstead & Atkinson, 2015) has carried out a comprehensive investigation of which data that apps in Google's Play Store requires from their users. A sign of the relevance of the mobile number is that 35% of all apps – more than 350.000 – “access the phone features of the device. This permission allows the app to determine the phone number and device IDs” (Olmstead & Atkinson, 2015, p. 22). Pew's motivation is to increase the awareness of data requirements and privacy issues with apps. Regardless of whether 35% is too high in that respect, it is still an indication of service providers' interests in the mobile number and its position as installed base.

### **4.3 Case Norway**

Recent research has explored explanations for why the use of SMS Application-to-Person has increased worldwide, and more so in Norway (Hallingby, 2016). SMS Application-to-Person is SMSs sent by a third party via an application, such as meeting notifications, parcel delivery, and warnings. These messages play a role in third parties' strategies for customer dialogue even though they imply a cost per message. The growth is steeper in Norway than in other markets and Hallingby (2016) found that one of the success factors was a good collaboration between the aggregators and MNOs. Interestingly, the interviews with aggregators and third parties indicate that the mobile number increasingly is included in customer data bases as a foundation for communicating through this channel throughout the digital customer journey. The mobile number and SMSs play a different role than email and social media, it is considered easier to obtain correctly, and is used for more critical purposes.

One of the responsibilities for DIFI – the agency for Public Management and eGovernment in Norway – is to make public information and services accessible for citizens and public



agencies. On their way to a digitized public sector they have built a database containing 4 of 6 million Norwegian citizens. The database contains an email address and the mobile number as identifiers. It is up to public agencies to make communication channel strategies; however, digital post to citizens shall always be noted by sending an email or SMS. DIFI expects that in future around 50% of all communication will be accompanied by an SMS despite the higher cost compared to email. Already, SMS is used to communicate in the education and healthcare sector (Helse Vest, 2016) where also the above mentioned DIFI database is used for confirmation of mobile numbers. The majority of citizens want SMS to be used in their dialogue with the healthcare sector (Ankjell, 2015). Thus, the mobile number has already become a part of the installed base in the ecosystem surrounding digital citizen journeys in the Norwegian public sector.

Aggregators and third parties that were interviewed explained that they always attempt to collect customer mobile numbers, however; the current growth is only an indication of the important role mobile numbers have in customer databases and dialogues. Still, the research added some insight into how an “installed base of mobile numbers” facilitated the use of SMS Application-to-Person. One important factor is the regulations of spam, restrictions on digital channels in customer dialogue, and penalties for violation. Furthermore, number portability, MNO obligations to share number data and well-functioning directory market indicate a whole ecosystem where mobile numbers are easily achievable. The case from Norway suggests that a strong ID and highly available resource are factors that spur the use of the mobile numbers as ID. It is easy to use, stable, institutionalized and trusted, and to some degree an installed base due to a vital market for mobile numbers and integration into public databases.

#### **4.4 Case Pakistan**

In 2015 Pakistan carried out a re-verification of all SIM-cards requiring biometric ID. This was already in place for new purchases, but made mandatory for all subscriptions after a terror-attack in December 2014. The re-verification found huge support in the country and was successfully completed in May 2015. About 115 of 215 million SIM-cards were re-verified, connected to about 45 million unique persons (IDs) according to interview with the local telecommunication authorities.

In parallel there has been an ambition in Pakistan to transfer manually based mobile financial transactions from over-the-counter solutions enabled by agents to digital accounts. Both

mobile financial service providers like Telenor's Easypaisa and the World Bank (Worldbank, 2016; Khan, 2016) support this transformation due to the desire to see an uptake of loan and savings. Access to credit and saving products is regarded as important for financial inclusion and economic development on the individual level as well as for the economy, and commercial actors take a role in providing this. However, regulatory authorities for the banking sector set very high requirements to "knowing-your-customer" and thus to the form of identification procedures necessary when a customer acquires such products. Low ID requirements for SIM-cards in the mobile sector have been an obstacle to the uptake of establishment of mobile bank accounts, and subsequently loan and saving products.

The new ID requirement in Pakistan has changed this; after the re-verification of SIM-cards was completed digital accounts has taken a jump (State bank of Pakistan, 2015; Khan, 2016). This is because potential customers only have to call a string; you are able to open an account in a few minutes (Easypaisa, 2016 b). Behind the scenes the already strong mobile ID is at work, fulfilling the knowing-your-customer requirements of banks at the lowest level (Level 0). The solution was implemented by Easypaisa already mid-2014 and in the first place directed towards *new* SIM-card customers that had to obey to ID-requirements. Thus, the solution was already in place when *all* SIM-cards had to be re-verified through biometric identification procedures, and other mobile banking solutions had also been copying the concept. In 2016 Easypaisa even managed to provide a solution where customers of any mobile operator were allowed to open an account, however with a somewhat more cumbersome process (Easypaisa, 2016 a).

The above results also shows that there are not any databases that make mobile numbers publically available in Pakistan; the availability of the ID for mobile numbers is thus of different kind than in Norway. It is a charged look-up in the public ID database NADRA that allows for ID-confirmation, and the mobile account solution was subject to specific allowances from State Bank of Pakistan. The payment to NADRA and potentially other allowances could potentially affect the innovation rate for other types of services.

Mobile bank services provided over-the-counter is a well-established concept and there are many other factors that will affect how this will develop over time. Opening an account is only a first, but necessary step, on the way to loans and savings. Still, the recent growth of mobile accounts it is significant indication of how the strength of the mobile numbers ID is a factor for innovation and building of an ecosystem. Again some criteria suggested above for increasing use of IDs are met. Notably, the stronger ID-requirements affect the

institutionalization and trust in the mobile number, and the extended opportunities for applications builds an installed base.

## 5 Discussion

The above results show that the mobile number as ID vary in strength and availability across markets. However, we see indications of an increasing demand for it in different digital services, also demonstrated by the cases Norway and Pakistan where ID strength is high and availability very good or quite good.

In Norway we see a full integration of the mobile number into digital services, and that the resource to a high degree meets design principles for general purpose ID as suggested above. It is easy to remember, stable, institutionalized and trusted, and already an installed base.

In Pakistan we can observe a recent change with the mobile number that may increase its stability as ID. It has now taken a direction where trust and institutionalization can be built and lay the ground for further innovation. The mobile number's availability and installed base in Pakistan is however still in its infancy.

The analysis shows that it is possible for the mobile number to become an important general purpose ID and installed base for digital services however, it is mostly a local phenomenon. One global ID based on the mobile number with a coherent strength and availability does not exist as of now. However, according to both the field of information infrastructure (Hanseth & Lyytinen, 2010) and innovation (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2008) an installed base originate from local implementations. Thus, change potential in current markets and implementations can indicate further diffusion. Interestingly, local implementations that in a next phase could affect the global relevance of the mobile number may come from developing economies; although these demonstrate less mature implementations they are huge in volume. That being said, the mobile number is widely used for ID purposes such as two-factor password-model, however, where the strength and availability is varying across countries.

The local markets assessed in this paper encounter different challenges and opportunities for the mobile number as a general purpose ID. Markets such as Norway, where both strength and availability is high (e.g. Denmark and MonteNegro), fulfil the criteria for making the mobile number into a general purpose ID with further use and innovation. Markets where strength is high and availability low (e.g. India, Malaysia, and Bangladesh) are similar to the situation in Pakistan; these countries are quite fresh on the implementation of the necessary conditions

and must continue to establish trust and institutionalization around the mobile number as general purpose ID and work with its availability.

In Bangladesh and Malaysia self-registration is a necessity since public databases are prohibited. Thus, once a customer is registered with a mobile number it can to some degree be a trusted resource, especially together with a two-factor verification process. These countries are also in an early phase with uncertain outcomes for the mobile number as an ID.

In markets that are weak on both strength and availability (e.g. Myanmar and Thailand) the mobile number will probably have challenges in order to establish as a general purpose ID.

The typology in Figure 1 is made on a set of cases that are skewed since they are taken from one mobile operator and its markets. However, it serves as a framework for investigating and discussing other markets, and the possibility for the mobile number to become general purpose identifier. Also other types of IDs can be assessed. For instance, Facebook Connect is not strong, but have a very good availability. Thus, when we observe that Facebook and Google have started to acquire the mobile numbers of their users and using mobile numbers for login, they are actually trying to increase trust and degree of institutionalization for their ID and accordingly bringing the same to the mobile number and increasing its position as installed base.

According to the above reasoning, in theory a global ID based on the mobile number could be developed by increasing strength and availability. Again, the stability, ease of use, trust and installed base are the criteria that need to be met, as well as the challenge with the trade-off between ease-of-use and security (Dhamija & Dusseault, 2008).

Further research on mobile numbers as ID should aim to elaborate on how and why firms use mobile numbers as an ID for their customers; this could lead to an understanding how sustainable the phenomenon is as installed base and its global opportunities. For the mobile operators there are new challenges emerging that should be investigated. The expected e-SIM (no physical SIM-card) would not change the ID requirements that mobile operators have to fulfill; however, will the requirements ensure the continued relevance of the mobile operators as an administrator of this resource and customer interface or change it completely? How do requirements on ID and authentication affect SIM-cards for Internet of Things? Finally, will a decoupling of mobile number from mobile operator services be realized with new regulations in Europe, and how can this affect the mobile number as general purpose ID.

## 6 Conclusion

Strength and availability of the mobile number as an ID vary across countries, and thus its position as general purpose identifier. In Norway and Pakistan the mobile number is currently trusted, and respectively established and emerging as installed base with existing cases of innovative uses in digital services.

The analysis suggests that the current status is not fixed, but rather subject to continuous change. Actors can and are taking actions that affect how strong and available their IDs both on a local and global level, and are thus managing their position and chance of becoming one of the general purpose IDs used in digital customer journeys. In the case of the mobile number as general purpose identifier it can remain a local phenomenon or develop into a global installed base.

The ID strength of the mobile number does not fully co-vary with national economy. On the one hand, a strong ID with innovative uses exists in Pakistan as well as Norway. On the other hand, availability of a mobile number – meaning its accessibility in public mobile number databases and a market therefore – is not that well-developed in developing economies and takes other forms. Thus, the role of the mobile number as installed based will be restricted to private databases and thus, cannot be developed to the same type of installed base we see in for instance Norway.

The findings in this paper can be used for both regulatory and commercial purposes. Regulators can find arguments to consider the competitive and societal effects for all types of IDs, and thus restricting and relaxing regulations. Mobile operators can more systematically consider the status of the ID they provide, and third parties better consider their potential use in digital customer journeys.

## 7 References

- Ankjell, H. (2015, November 9-10). *Moving power to the patients*. Retrieved August 11, 2016, from [ikt-norge.no/2015/11/presentasjoner-ehin-2015/](https://www.ikt-norge.no/2015/11/presentasjoner-ehin-2015/): <https://www.ikt-norge.no/wp-content/uploads/2015/11/Presentation-Holly-Ankjell.pdf>
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy*, 37, 407-429.

- Dhamija, R., & Dusseault, L. (2008, March/April). The seven flaws of identity management - usability and security challenges. *IEEE Security & Privacy*, 24-29.
- Easypaisa. (2016 b). *Easypaisa mobile account*. Retrieved August 11, 2016, from easypaisa.com.pk: <https://www.easypaisa.com.pk/consumer/mobile-account/easypaisa-mobile-account>
- Eaton, B., Hallingby, H. K., Nesse, P.-J., & Hanseth, O. (2014, December). Achieving payoffs from an industry cloud ecosystem at BankID. *MIS Quarterly Executive*, 13(4), 223-235.
- Easypaisa. (2016 a). *Easypaisa account for non-Telenor subscribers*. Retrieved August 11, 2016, from easypaisa.com.pk: <https://www.easypaisa.com.pk/easypaisa-account-for-non-telenor-subscribers>
- eMarketer. (2015, June 9). *Businesses are going mobile - but how?* Retrieved August 11, 2016, from emarketer.com: <http://www.emarketer.com/Article/Businesses-Going-Mobilebut-How/1012581>
- Eriksson, O., & Åkerfalk, P. (2010). Rethinking the meaning of identifiers in information infrastructures. *Journal of the Association of Information Systems*, 11(8), 433-454.
- GSMA. (2013). *The mandatory registration of prepaid SIM card users*. London: GSMA.
- GSMA. (2014). *Mobile Identity global review 2013*. London: GSMA.
- GSMA. (2016). *Mandatory registration of prepaid SIM-cards - addressing challenges through best practice*. London: GSMA.
- GSMA and SIA. (2014). *Mobile identity - unlocking the potential of the digital economy*. London: GSMA.
- GSMA. (Database). [www.gsmaintelligence.com](http://www.gsmaintelligence.com). London, UK. Retrieved August 22, 2016, from <https://www.gsmaintelligence.com/>
- Hallingby, H. K. (2016, May 4). Key success factors for a growing technology innovation system based on SMS Application-to-Person in Norway. *Technology Analysis & Strategic Management*. doi:10.1080/09537325.2016.1181745
- Halvorsrud, R., Lee, E., Haugstveit, I. M., & Følstad, A. (2014). Components of a visual language for service design. *The fourth Service Design and Service Innovation Conference* (pp. 291-300). Lancaster: Linköping Electronic Conference Proceedings.

- Hanseth, O., & Lyytinen, K. (2010). Design theory for dynamic complexity in information infrastructures: the case of building the internet. *Journal of Information Technology*, 25, 1-19.
- Hay, M. (2016, February 20). *Blog*. Retrieved August 10, 2016, from [www.janrain.com](http://www.janrain.com): <http://www.janrain.com/blog/two-factor-authentication-need-know/>
- Helse Vest. (2016, June 16). *Bedre oppmøte med utvida SMS-varsling (Norwegian)*. Retrieved August 11, 2016, from [helse-vest.no](http://www.helse-vest.no): <http://www.helse-vest.no/no/nyheter/Sider/Bedre-oppm%C3%B8te-med-utvida-SMS-varsling.aspx>
- Hollar, K. (2015, July 15). *CRM industry user research report*. Retrieved August 11, 2016, from [capterra.com](http://www.capterra.com): <http://www.capterra.com/customer-relationship-management-software/user-research>
- Ingraham, N. (2016, August 16). *Duo, Google's supresimple video chat app, arrives today*. Retrieved August 19, 2016, from [engadget.com](http://www.engadget.com): <https://www.engadget.com/2016/08/16/google-duo-video-chat-hands-on/>
- Jøsang, A. (2014). Identity management and trusted interaction in Internet and mobile computing. *IET Information Security*, 8(2), 67–79.
- Khan, Y. (2016, May 13). *Telenor: Financial inclusion is a good sustainability initiative and business opportunity*. Retrieved August 16, 2016, from [blogs.worldbank.org](http://blogs.worldbank.org): <http://blogs.worldbank.org/psd/telenor-financial-inclusion-good-sustainability-initiative-and-business-opportunity>
- Larralde, A. (2015, April 2). *Social login trends across the web: Q1 2015*. Retrieved February 26, 2016, from [janrain.com](http://janrain.com): <http://janrain.com/blog/social-login-trends-across-the-web-q1-2015/>
- Loginradius. (2016). *Q1 2016 Report - Customer identity preference*. Edmonton: Loginradius Inc.
- Lusoli, W., Bacigalupo, M., Lupiañez, F., Andrade, N., Monteleone, S., & Maghiros, I. (2012). *Pan-European Survey of practices, attitudes and policy preferences as regards personal identity management - Report EU 25295 EN*. Joint Research Centre. Luxembourg: European Commission.
- Miles, M., Huberman, M., & Saldaña, J. (2014). *Qualitative analysis: a methods sourcebook*. Los Angeles: SAGE Publications.

- Milne, C. (1997). The design and management of numbering systems. In D. p. Ingenörfond, *Telecom reform: Principles, policies and regulating practises* (pp. 141-155). Lyngby: Technical University of Denmark.
- Olmstead, K., & Atkinson, M. (2015). *Apps permissions in the Google Play Store*. Pew Research Center. Retrieved from <http://www.pewinternet.org/2015/11/10/apps-permissions-in-the-google-play-store/>
- Rood, H. (2000). What's in a name, what's in a number: some characteristics of identifiers on electronic networks. *Telecommunication Policy*, 24, 533-552.
- Salesforce. (2016). *2016 State of marketing*. San Francisco: Salesforce. Retrieved August 11, 2016, from <https://secure.sfdcstatic.com/assets/pdf/misc/state-of-marketing-report-2016.pdf>
- Schreiner, E. (2016, February 9). *Blog*. Retrieved August 10, 2016, from [www.janrain.com: http://www.janrain.com/blog/securing-identities-two-factor-authentication-in-the-hacking-age/](http://www.janrain.com/blog/securing-identities-two-factor-authentication-in-the-hacking-age/)
- State bank of Pakistan. (2015, Oct-Dec). *Quarterly Branchless Banking newsletter - Issue 18*. Retrieved August 10, 2016, from [sbp.org.pk: http://www.sbp.org.pk/publications/acd/BranchlessBanking-Oct-Dec-2015.pdf](http://www.sbp.org.pk/publications/acd/BranchlessBanking-Oct-Dec-2015.pdf)
- Worldbank. (2016). *Financial Inclusion/Financial Inclusion overview*. Retrieved May 2016, 25, from Worldbank: <http://www.worldbank.org/en/topic/financialinclusion/overview#1>
- Yin, R. (2014). *Case study research. Design and methods*. Beverly Hills: Sage publications.