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# Inter-Operator Carrier ENUM

Leveraging ENUM to Unlock the Value Behind  
Communications Over IP



# Inter-Operator Carrier ENUM—A Business Perspective

## Leveraging ENUM to Unlock the Value Behind Communications Over IP

### Executive Summary

In a world that is going all-IP network operators are looking for ways to bring together the Internet and telephony worlds. Carrier ENUM is an enabler that bridges the gap between Internet Protocol (IP)-based and traditional telephony services.

Carrier ENUM is a key enabler for the exchange of IP traffic between operators. It allows customers to continue to use the telephone number in an all-IP world and allows operators to centralise IP-based services behind the telephone number.

#### What is Carrier ENUM?

- Telephone Number Mapping (ENUM) translates telephone numbers to IP routable addresses
- It enables the routing of IP based services using the telephone number
- It is based on the Domain Name System (DNS) that is used to route domain names, e.g. www.boozallen.com, on the Internet
- Carrier ENUM is a private implementation of ENUM that is managed by network operators

### The Value in Carrier ENUM

The value of Carrier ENUM can be found in three areas: (1) reinforcing the telephone number; (2) reducing network costs; and (3) promoting new revenue streams in the service space:

- Carrier ENUM reinforces the asset of the telephone number. It links telephone numbers to e-mail addresses, instant messaging accounts, and any other communication service. Indeed individuals are more

likely to share their telephone number before sharing an e-mail address. With Carrier ENUM, no details need be shared other than the telephone number.

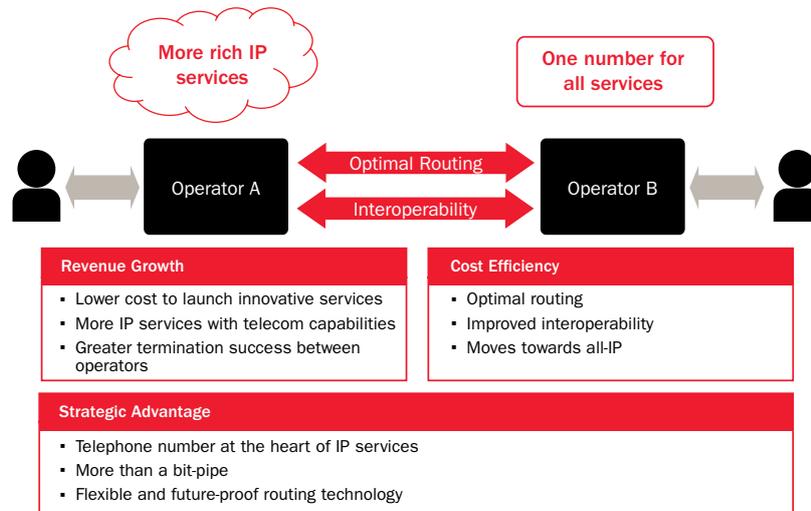
- Carrier ENUM provides network cost savings. It provides a single IP-based routing mechanism that supports all services and takes out the costly routing duplication that occurs for each individual service (e.g. SMS, voice, etc). The management of routing tables for each application is made redundant, as these tables are replaced with queries to Carrier ENUM servers that are managed centrally by operators. In addition, Carrier ENUM is capable of simplifying access to number portability registries.
- Carrier ENUM stimulates new revenue opportunities. The barriers to set up new services are lowered through using Carrier ENUM's ready-to-use routing mechanism and gateway capabilities between IP and telephony. This enables innovation for services and creates new revenue opportunities.

### The Critical Success Factors of Carrier ENUM

There are four critical success factors for the widespread success of inter-operator Carrier ENUM:

1. *Co-operation*: Multiple operators need to recognise the benefits of Carrier ENUM and co-operate to make it work.
2. *Technical capabilities*: Adequate IP interconnects and a central Carrier ENUM capability should be in place and must operate with high performance and reliability.
3. *Simplicity*: To ensure adoption the implementation must be simple, supported by commonly agreed interoperable business and technical frameworks.

**Exhibit 1**  
Benefits of Carrier ENUM



Source: Booz Allen Hamilton

4. *Openness and competition:* Carrier ENUM must be implemented in a manner that is open to all operators. Operators should participate in a competitive development environment to ensure innovation in new services.

**Proposed Rollout Plan**

Booz Allen Hamilton proposes a three-phase rollout for inter-operator Carrier ENUM.

*Phase 1: Intra- and inter-operator cost efficiency improvements:* After a pilot program, inter-operator Carrier ENUM is rolled out across operators. The rollout is driven by the cost and inter-operability improvements of the move to all-IP. The end user should observe no disturbance during this first phase.

*Phase 2: New services enablement:* The second phase would offer new Carrier ENUM-enabled services; i.e. developers could create IP-based services for mobiles that allow carrier-enabled services to be embedded. Through the new services, end users would visibly recognise the direct impacts of Carrier ENUM.

*Phase 3: Subscriber preferences enablement:* In the third and final phase, operators would begin providing support for customers to set their communication preferences.

**Key Players and Recommended Action**

There are two key players in the Carrier ENUM ecosystem: the operators (fixed or mobile) and a

trusted third party to manage a universal Carrier ENUM offering. They need to understand and embrace their roles in Carrier ENUM rollout.

- *Fixed and mobile operators* need to agree to co-operate on the implementation of inter-operator carrier ENUM and they should plan to roll it out in the absence of business or technical complexity. They should engage with service developers to align service offerings to the new capabilities.
- A *trusted third party* should develop Carrier ENUM offerings that meet the needs of multiple operators. They guide the industry through the development of a common framework.

The benefits of inter-operator Carrier ENUM are clear: it enables global interconnect of telephony services using IP; it allows customers to continue to use the telephone number in an all-IP world; and it puts the telephone number at the heart of IP-based services. The technology streamlines inter-operator communications and opens the door to service innovation, both refining and enriching the user experience.

For Carrier ENUM to flourish, co-operation is essential. Operators need to mandate a third party to drive a multilateral framework. The operators must then subscribe to the framework in order to make it a success. With operators moving to next generation networks and with IP interconnects available, Carrier ENUM is the necessary next step to realise the value of communications over IP.

**Introduction**

The rich world of Internet communications is constantly developing. It is a world of perpetual excitement whose landscape features any number of innovative services that have captured the imaginations of users in all kinds of environments.

These services impact all areas of life enriched by information—among them, art, music, shopping and socialising—that fuel further innovation.

The Internet’s fast pace and global impact adds a new dimensions to the way we all keep in touch with one another. Alongside this new world, the traditional world of telecommunications plays an increasing part in everyday life. The challenge is for operators to find effective ways to bring the two worlds together and build further value for their subscribers.

One way to bridge the gap is Carrier ENUM, which links together these telephone and Internet worlds. Since it does so without relying on legacy technologies, it supports the operators in their move towards all-IP.

In addition, Carrier ENUM opens the door to new sources of revenue, as it lowers the barriers to the rollout of new IP-based services that interact with telephone services.

Today’s telephony Internet services primarily are offered as standard IP-based services, e.g. by using a phone browser to access an Internet page on the World Wide Web. The operator offers the bit-pipe that provides the necessary data connectivity.

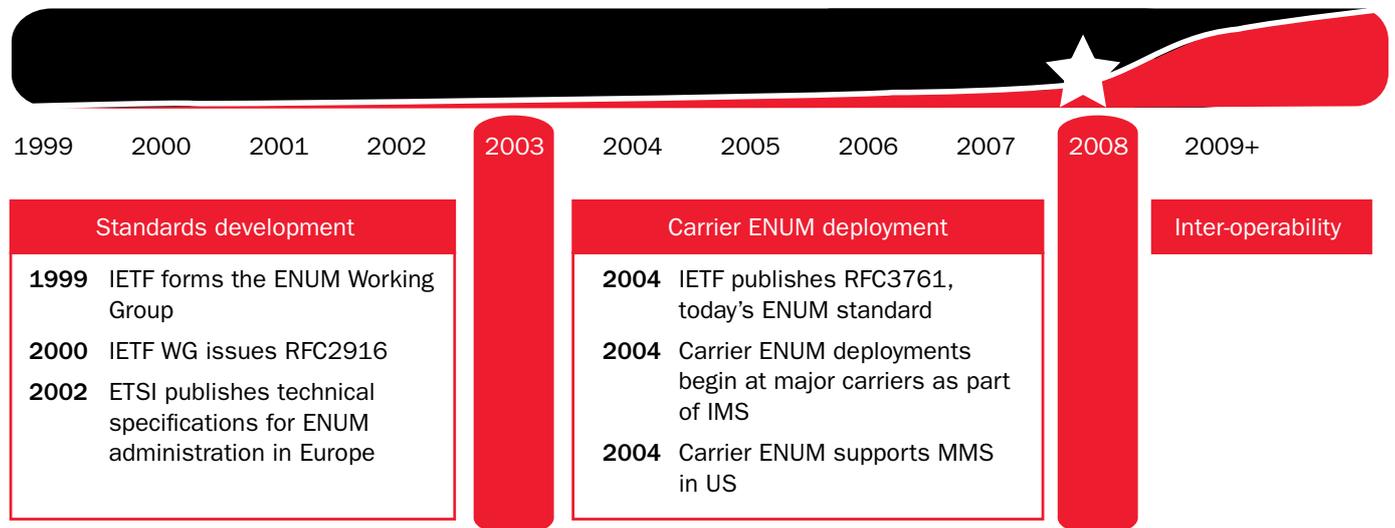
But operators can offer much more. Indeed, they now have the technology and resources to deliver carrier-grade performance, a billing relationship, improved security and access to its core phone services in a manner so efficient that not even Internet service can provide.

Carrier ENUM allows the operators to leverage their existing assets and enrich Internet services with their own offerings.

**What is Carrier ENUM?**

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- It enables the routing of IP based services using the telephone number
- It is based on the Domain Name System (DNS) that is used to route domain names, e.g. www.boozallen.com, on the Internet
- Carrier ENUM is a private implementation of ENUM that is managed by network operators

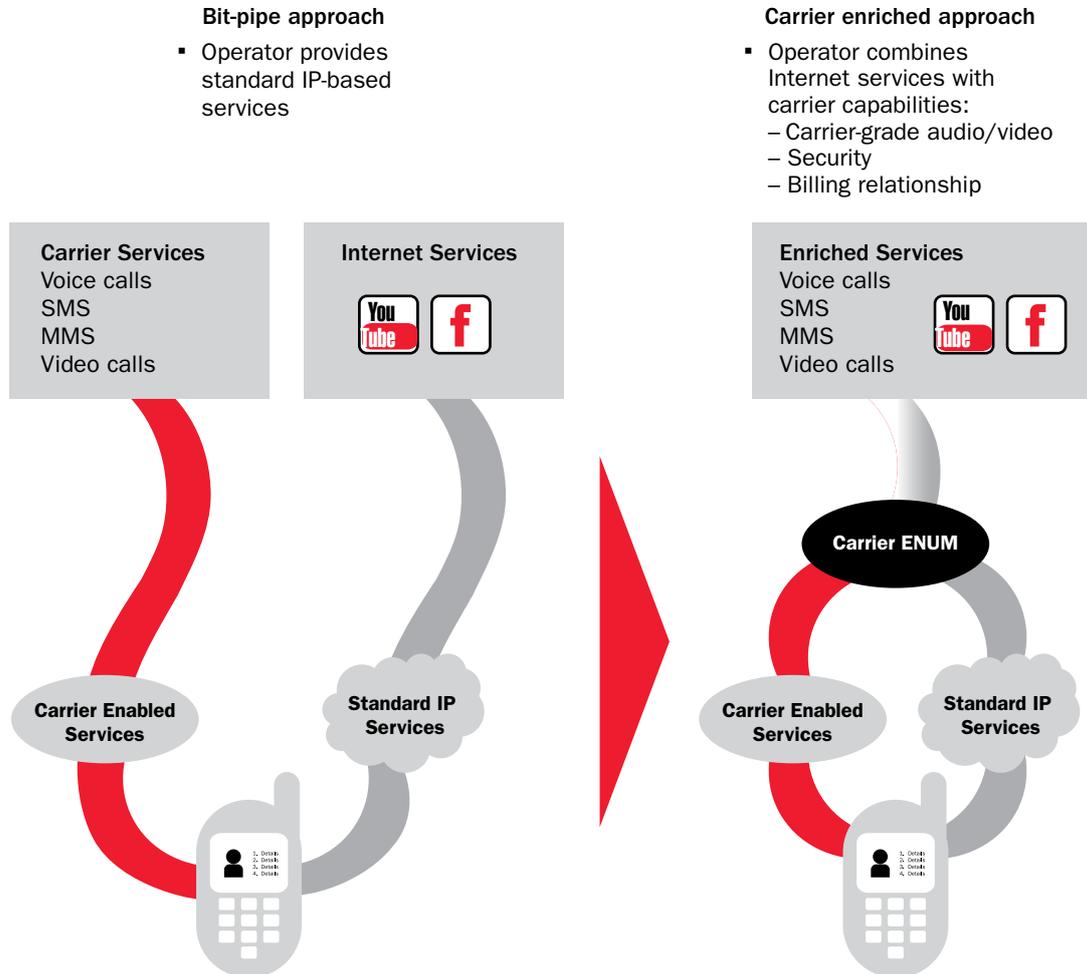
**Exhibit 2**  
History of ENUM



Source: www.enum.org website; Booz Allen Hamilton analysis

**Exhibit 3**

## Bit-pipe vs. Carrier ENUM enriched IP services



Source: Booz Allen Hamilton

As Exhibit 3 demonstrates, operators can differentiate new Carrier-ENUM enabled services from existing standard Internet services and open the door to a new world of communication.

**Overview of Carrier ENUM**

Carrier ENUM was originally developed as a way to enable the continued use of telephone numbers in next generation IP networks.

Since it facilitates the inter-operability of traditional telephone equipment with the IP world and its services, it is increasingly recognised as a strategic technology for both service enablement and technology convergence.

**What is Carrier ENUM?**

Technically, Carrier ENUM is a mechanism and industry standard that allows users to communicate seamlessly between telephone numbers and IP routable addresses (or URIs). As such, it is a key facilitator for the routing of any service (voice calls, for instance) over IP.

**Carrier ENUM Facts**

- Established industry standard
- Proven and scalable technology
- Flexible and service agnostic
- Future proof and secure
- Managed by the operator

### Carrier ENUM (B2B) vs. Public ENUM (C2C)

Although the mechanism of ENUM is consistent between Public ENUM and Carrier (Private) ENUM, their distinct characteristics make them suitable for use in different environments.

Public ENUM is an open database and a service enabler that is readily accessible, providing freedom for a range of Internet services. However, it is inappropriate for supporting the services of a telecom operator. The capability cannot be managed by the operator and the personal data of end-users it contains is shared publicly and therefore open to abuse.

In contrast, Carrier ENUM is managed and populated by operators. It is a capability that uses data that is quality assured by operators and therefore can be trusted.

	Public ENUM	Carrier ENUM
Overview	<ul style="list-style-type: none"> <li>Public, online subscriber directory</li> </ul>	<ul style="list-style-type: none"> <li>Today: Operator internal directory to facilitate the routing of IP services</li> <li>Tomorrow: Private, inter-carrier directory to simplify service interoperability</li> </ul>
Key Characteristics	<ul style="list-style-type: none"> <li>Uses public DNS infrastructure</li> <li>Relies on user opt-in</li> <li>Openly accessible over the Internet</li> <li>Holds a flexible variety of data</li> <li>User manages own data</li> </ul>	<ul style="list-style-type: none"> <li>Uses private DNS infrastructure</li> <li>Operator opt-in</li> <li>Operator populates data and manages access</li> <li>Operator manages available services</li> </ul>
Target Group	<ul style="list-style-type: none"> <li>Individuals in the online community, interested in general service enablement</li> </ul>	<ul style="list-style-type: none"> <li>Operators interested in facilitating the set-up of enriched communication services over IP</li> </ul>
Suitable Applications	<ul style="list-style-type: none"> <li>Internet services</li> </ul>	<ul style="list-style-type: none"> <li>Peering relationships between operators</li> <li>Internet and carrier-enabled services</li> </ul>
Pro's	<ul style="list-style-type: none"> <li>Open, so useful for Internet services</li> <li>Can hold a variety of personal data</li> </ul>	<ul style="list-style-type: none"> <li>Secure, inaccessible from the Internet</li> <li>Separate domain from Public ENUM</li> <li>Managed by the operator</li> <li>Supports services between operators</li> <li>Supported by commercial frameworks</li> </ul>
Con's	<ul style="list-style-type: none"> <li>Non-private</li> <li>Relies on users to update</li> </ul>	<ul style="list-style-type: none"> <li>Requires take-up by several operators to become valuable</li> </ul>

Public ENUM is openly accessible and managed freely on the Internet. Public ENUM is more suited to general Internet applications and acts more as a free, online directory. However, users opt in by choice and must normally pay to do so. As a result, take-up is low and most Public ENUM look-ups have limited or no results.

With Carrier ENUM the operator populates the user data that is stored in the database. It then manages which parties can access that data and the types of service for which the data can be used.

Carrier ENUM is not intended to replace Public ENUM – rather it serves a different purpose. It is used by operators to link their telephone numbers with IP services and to show the availability of those services to other operators.

Designed to be flexible, future-proof and service agnostic, it can support all communication services, including voice, messaging, e-mail, push-to-talk, video calling, collaboration services and file transfer.

While many of these services are separately available on the Internet, users of each one are allocated different IDs, e-mail addresses and user names. Because Carrier ENUM can help unify these addresses, the full range of a user's services become accessible through the use of one telephone number, which is then used for routing purposes.

Carrier ENUM is based on international standards and works with fixed, mobile and Internet communications.

It is built through a mechanism that is based on the Domain Name System (DNS), which has a long successful track record as the routing system for Internet domain names, such as www.boozallen.com. With that support, it provides the necessary scalability for successful large-scale implementation.

As shown in Exhibit 4 below, Carrier ENUM draws on the best aspects of both DNS and traditional voice routing. As a result, it is easy to understand and the costs of development and deployment are small.

By using Carrier ENUM, the operator is able to support multiple communication services to its subscribers through just their telephone number.

**Exhibit 4**  
Shared Attributes Between Carrier ENUM, DNS, and Traditional Routing Tables

	DNS (Resolution & routing of Internet services)	Carrier ENUM (Service agnostic look-up & routing)	Routing tables (Traditional voice routing)
Data structure	Centralised	Centralised	Distributed
System structure	Tree	Tree	Distributed look-up tables
Used to locate...	IP hosts	IP hosts and network servers	Network servers
Quality of service	Not real-time	Carrier grade	Carrier grade
Number portability	Not applicable	Supported	Supported

■ Shared attributes

Source: Booz Allen Hamilton

For example, one telephone number could provide access not just to traditional voice mailbox services, but to such advanced services as can convert voice-to-text, to create an instant message or an e-mail.

With this kind of capability, Carrier ENUM becomes the key technology to enable phone services in the Internet world and, at the same time, provide the most efficient routing of a number of other services.

### Value in Carrier ENUM

The benefits of Carrier ENUM can be seen from three perspectives:

- Reinforcing the operator's asset of the telephone number
- Efficiently using existing infrastructure to cut costs and improve interoperability
- Discovering opportunities for revenue growth through better support for new or enhanced services

### Telephone number as an asset

Customers have long grown accustomed to sharing telephone numbers to keep in touch with each other.

Telephone numbers are managed by the operator on behalf of the customer. They hold significant value to the customer and are key assets for the service operators.

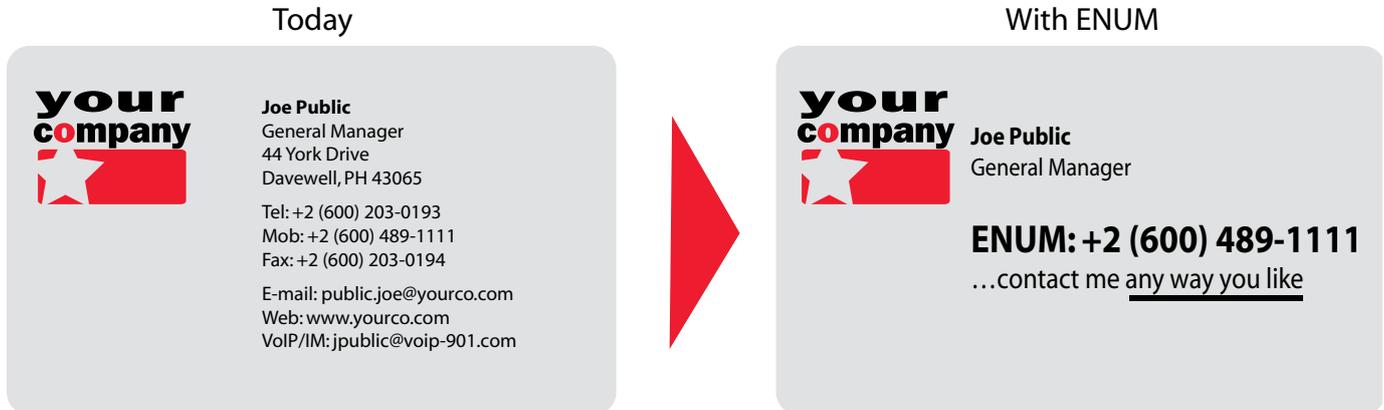
The value of a telephone number is strongly embedded in subscribers' lives. In the U.S., for instance, some supermarket loyalty programs use phone numbers as IDs in case the customer leaves his loyalty card at home. This shows how strongly embedded phone numbers are in our lives.

### Telephone Number as an Asset

- A well-understood and memorable address
- Favourite tool for keeping contact
- Managed by the operator on behalf of the customer
- Associated with a billing relationship
- Global routing tool for operators
- Implies trust in coverage and quality of service
- Ported number can stay with customer for life

**Exhibit 5**

## All Services Through One Telephone Number



Source: Booz Allen Hamilton

While customers do share their other addresses for e-mailing and instant messaging, the majority of people prefer to use a telephone number as the primary point of contact. The sharing of other addresses becomes secondary and requires extra effort for both the sender and the receiver.

Carrier ENUM allows customers to continue to use their telephone number as the primary contact even as the world moves to all-IP. It eliminates the complication of sharing other addresses. And it provides subscribers with easy access to the majority of communication services that they use every day.

With Carrier ENUM, the telephone number becomes even an even more valuable asset, for both the operator that provides it and the customer who uses it.

**Efficient use of infrastructure**

As a common routing platform, inter-operator, Carrier ENUM facilitates an operator's move to all-IP while simplifying and improving both routing and number portability. As a result, it is a strong driver for inter-operability and cost efficiency.

It is a little-known fact that Carrier ENUM capability is not new to operators. In fact, many networks already use it as an internal function. The mechanism is integral to the IP Multimedia Subsystem (IMS) an emerging

platform for the support of multimedia services on mobile devices.

Many of the leading operators are beginning to use one form or another of IMS. Both fixed line and mobile operators see IMS as a strategic platform for supporting and integrating their range of IP-based services.

Despite that potential, most operators' Carrier ENUM implementations support only internal IP communications. In order to unlock the full benefits of improved routing and interoperability, the Carrier ENUM capability needs to be extended to work between operators.

**Cost Savings from Carrier ENUM**

- Supports operators move to All-IP
- Simplifies today's complex Number Portability Management
- Improves routing efficiency by providing information about most efficient route and communication channel
- Allows consolidation of multiple service-specific routing mechanisms into a single routing mechanism

**Move to all-IP: How it works**

Carrier ENUM is a mechanism that can unify the traditional telephone and IP worlds. It enables the routing of calls to traditional telephone numbers through IP means and thereby facilitates the operators' move to all-IP.

A telephone number, in itself, cannot be used to route over an IP network. It must first be mapped to a Uniform Resource Identifier (URI), a string of characters used to identify Internet resources.

Carrier ENUM maps telephone numbers to these URIs and can work between operators.

As services move to all-IP, there will be reduced traffic passing through legacy technologies. And that reduction will ease congestion problems. This, in turn, leads to operational excellence and complexity savings as it eases the load on key network elements such as the HLR (Home Location Register). It also allows the procurement of standardised (and often lower-cost) IP hardware.

**Number portability simplification**

Carrier ENUM could simplify the notoriously complex matter of number portability.

Operators have traditionally implemented number portability based on a variety of designs. Some mechanisms involve centralised number portability databases that suffer from complexity of interfaces. Moreover, they are often incompatible with IP-based services. Other mechanisms forward calls to ported numbers, which results in inefficient routing.

Carrier ENUM presents a single interfacing solution that enables optimal routing and follows common standards between operators.

A senior expert at a major European fixed and mobile operator explains that the industry faces “a lot of problems in the support of number portability” and suggests that “Carrier ENUM could be a golden arrow for the number portability problem if regulatory issues were overcome”.

Inefficient routing in number portability is highlighted in Exhibit 6. A communication is originally routed to the ‘donor’ network for a subscriber that has already been ported to a ‘recipient’ network. In such a scenario, the communication is forwarded (or re-routed) from the donor to the recipient—a costly inefficiency that Carrier ENUM could eliminate.

Carrier ENUM determines the correct recipient network at the start of routing the communication. Because the use of central number-portability solutions is heavily regulated in most countries, however, operators would require regulatory support to replace or adapt the existing mechanism.

**Optimal routing**

By finding more information upfront in the routing process and by offering simpler data management, Carrier ENUM allows the operator to route services more efficiently and effectively.

Also shown in Exhibit 6 with Carrier ENUM the service capabilities as well as the details of the destination address of a communication are discovered early in the routing process. This not only enables optimal routing of these services over IP, but if the calling party knows the capabilities of the recipient, it can tailor the communication before it is sent. This could result in a higher quality service and a reduction in the load on the network nodes that convert between incompatible formats.

Routing tables are currently used extensively in the process of routing of a call. These routing tables require laborious management, including careful planning and synchronised changes.

With Carrier ENUM these routing tables would be redundant, since locally stored knowledge of the destination would no longer be necessary. Through inter-operator Carrier ENUM, the data that supports routing is discovered from the source where it is most up-to-date. Offloading some of the burden of the management of distributed routing tables would result in direct cost savings.

**Single routing mechanism**

Because Carrier ENUM is service agnostic, it can reduce costs by removing the need for the operator to provide long-term support for several parallel routing mechanisms.

Since the single mechanism would provide lower set-up and operating costs, the newly created services could be implemented more quickly and, in doing so, immediately leverage the benefits of the Carrier ENUM capability. These new services would fall in line with an all-IP strategy from the outset.

**Value in services**

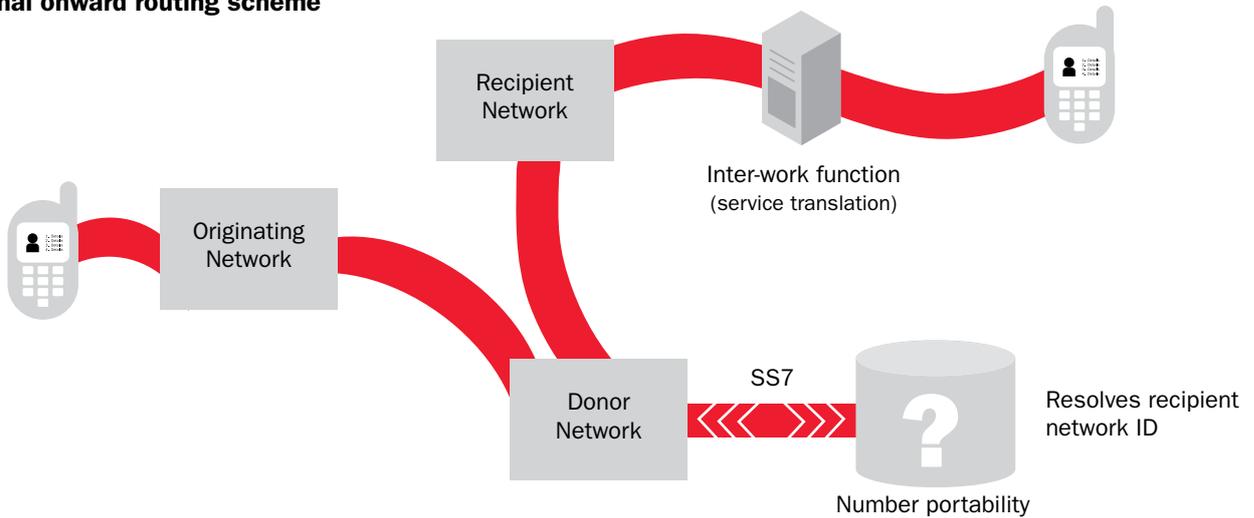
Carrier ENUM presents four areas of value through the support of services. It lowers the cost of offering a broader set of new (or enhanced) services and the customer could set preferences between those services. Not only would it centralise the telephone number among those services but it also could increase the success rate of reaching the customer.

**Lower cost of new services**

Carrier ENUM offers a mechanism that enables IP services on telephone devices. Since it lowers cost

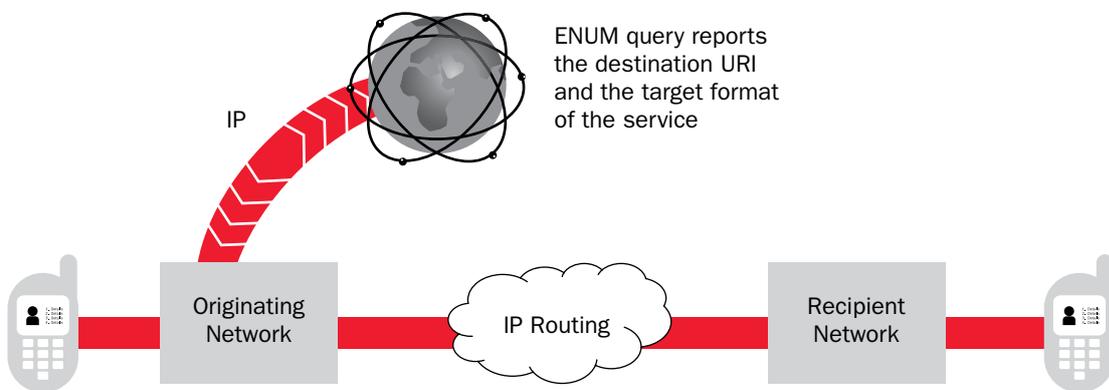
**Exhibit 6**  
Routing Benefits of ENUM

**Traditional onward routing scheme**



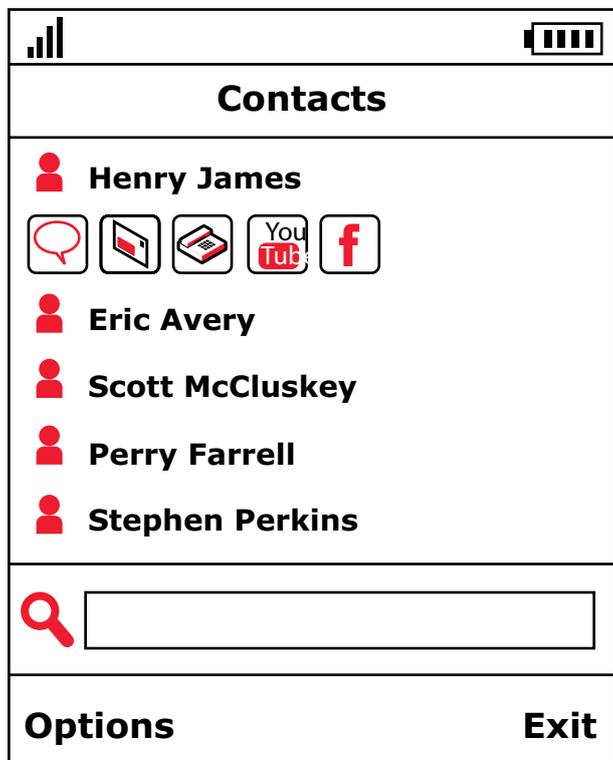
**Inefficient, since recipient network and service capabilities are unknown until the destination is reached**

**Routing with Carrier ENUM**



**Greater efficiency since destination and service capabilities are determined at the start of routing through Carrier ENUM**

**Exhibit 7**  
Innovative service enablement through Carrier ENUM



Source: Booz Allen Hamilton

barriers, it encourages the rollout of new services. Furthermore, it introduces a simple gateway between the traditional telephone and such new, rich offerings as web services.

When the originating network makes the Carrier ENUM query, it is presented with a range of available services of the called party.

New services and their associated routing data can easily be added using Carrier ENUM. With minimal effort, this simple process provides immediate routing support for the additional service.

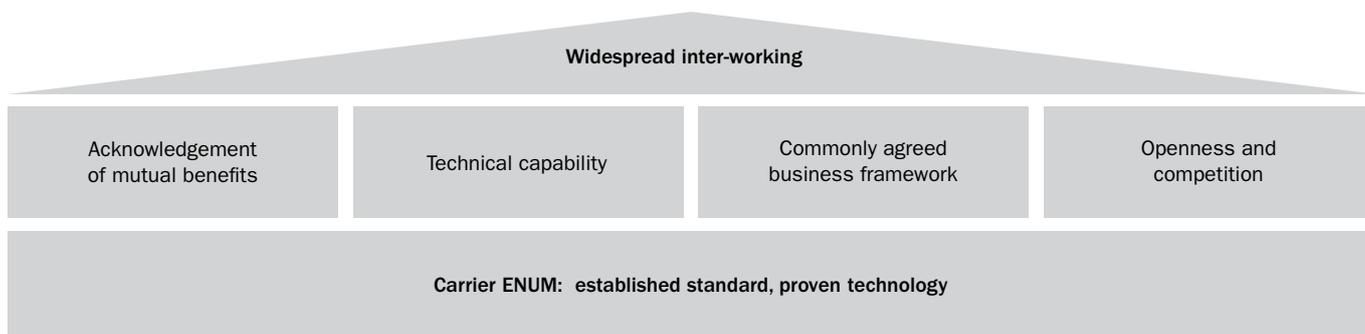
Such a reduction in effort for implementation could act as a catalyst for innovation around new services. Exhibit 7 shows a sketch of extended services presented for a given contact. The routing for these services may only require simple implementation through Carrier ENUM.

Revenue Growth Through Carrier ENUM
<ul style="list-style-type: none"> <li>▪ Lowers cost of new service introduction</li> <li>▪ Improves termination success rate</li> <li>▪ Allows subscribers to manage their individual communication preferences</li> <li>▪ Strengthens the phone number as a key operator asset</li> </ul>

Consider this scenario: A user wants to send a friend a picture. Traditional MMS does allow for picture messaging between selected operators. But, a more advanced service automatically could post this photo onto the message board of the recipient’s social-networking site.

Carrier ENUM would confirm the support for the social networking service and respond with the correct network destination for the picture. Should that social networking service not be supported, the picture could be automatically delivered through other means, such as e-mail or traditional MMS.

**Exhibit 8**  
Critical Success Factors of Inter-operator Carrier ENUM



Source: Booz Allen Hamilton

Of course, the potential for Carrier ENUM extends far beyond the sending of pictures. Since it is service agnostic, Carrier ENUM, in fact, provides accessibility to a range of new capabilities and revenue streams both for operators and service providers.

#### ***Improved ability to reach the customer***

If a customer cannot be reached through one channel, he may still be reachable through another. Carrier ENUM has the ability to identify and select that second channel.

Bringing addresses together through Carrier ENUM has the potential to bring an improved customer experience while increasing revenues with improved termination success rate.

#### ***Ability for the subscriber to set preferences***

Carrier ENUM supports a configuration of the services based on the needs and usage of the customer. Initially, the operator would establish these preferences. But the operator also would have the option of enabling the customer to change those options and determine a new preferred point of contact.

Allowing customers to better manage their communication habits would almost certainly engender improved customer satisfaction.

#### ***Centralising the telephone number***

Carrier ENUM reinforces the centrality of the telephone number not only in the perception of the user, but also in the operation of the network.

As more services begin to make use of the telephone number for routing, the telephone number becomes a more powerful asset. The centrality of the telephone number becomes ever more important as the user accesses more communications services.

The operator will determine which services Carrier ENUM will support. Such consideration gives operators the opportunity to ensure that each introduced service either has a sustainable business model itself, or at least has a positive impact on existing business models.

#### **Critical success factors for inter-operator Carrier ENUM**

Although many operators have made use of Carrier ENUM capabilities, they have generally used it as an internal mechanism in support of IMS and other services.

To realise the full benefits of Carrier ENUM, a number of critical success factors must be met to drive the growth of inter-operator Carrier ENUM.

#### ***Acknowledgement of mutual benefits***

Inter-operator Carrier ENUM needs to be adopted by multiple operators to allow IP based traffic routing between those operators.

In order for operators to make the commitment to adopt inter-operator Carrier ENUM, its benefits must be well understood and recognised.

#### ***Technical capability***

Carrier ENUM enables the inter-operability of services over IP. However, there are two technical prerequisites. Operators first must have:

- IP interconnects that support inter-operator services
- Carrier ENUM implementations with a single, common root.

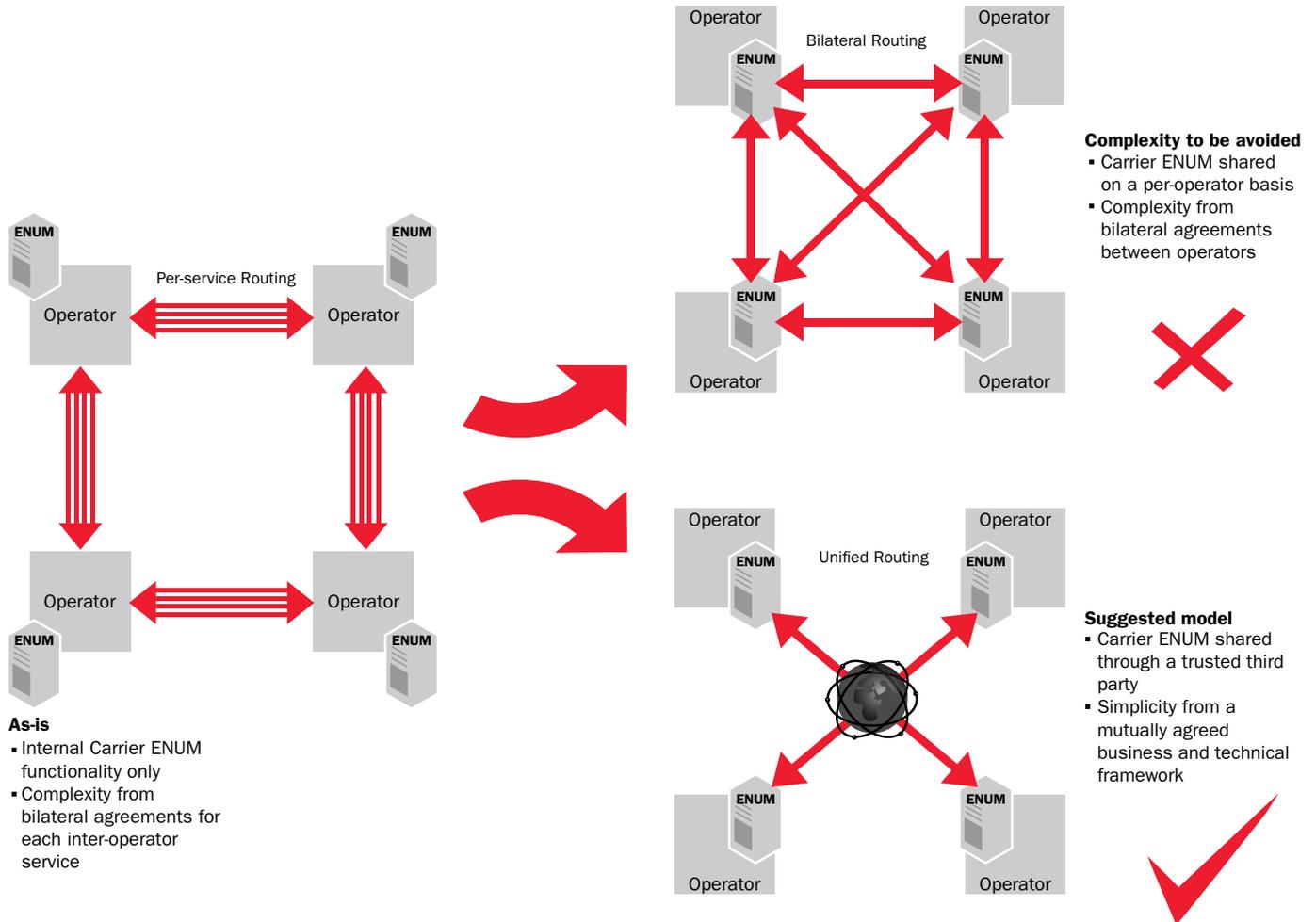
Even if the two technical considerations are in place, the operator also must be confident that the Carrier ENUM is delivered with sufficient accuracy, performance and reliability before it is adopted for the routing of a service.

Initial implementations of inter-operator Carrier ENUM would be best suited to non real-time services such as e-mail and messaging. Real-time services could be supported once carrier-grade performance is assured.

For example: call setup in voice networks requires carrier-grade performance. This level of service is a critical part of the user experience in that it reinforces the perception of the quality of real-time services.

Although carrier-grade performance is feasible for Carrier ENUM, the cost of providing such performance is still to be determined.

**Exhibit 9**  
Simplicity in Carrier ENUM through a mutually agreed business framework



Source: Booz Allen Hamilton

A senior R&D expert at a leading European operator explains, “We know what response times and quality of service we should be expecting [from Carrier ENUM] and we are clear about the functionality. We are not clear about what the infrastructure costs would be to achieve that.”

**Commonly agreed business framework**

If the implementation of inter-operator Carrier ENUM is overly complex, it will have trouble once it comes to market. And even the most basic inter-operator Carrier ENUM program needs to be supported by service agreements.

Exhibit 9 shows how operators currently manage individual agreements for every inter-operator service.

Operators, in fact, have two options: They can set up new bilateral agreements between each pair of operators to support Carrier ENUM, or they can draft a mutual agreement between a community of operators based on a commonly agreed framework.

- | ENUM Critical Success Factors   |
|---|
| <ul style="list-style-type: none"> <li>Acknowledgement of mutual benefits between operators</li> <li>Technical capability, including carrier-grade performance, scalability, reliability, and accuracy</li> <li>Commonly agreed business and technology framework</li> <li>Implementation that supports openness and competition</li> </ul> |

Bilateral agreements may initially seem preferable: They provide quicker ad-hoc arrangements with greater flexibility. But because each bilateral Carrier ENUM agreement could have individual charging principles, security procedures, codes of conduct, etc., there may be problems of compatibility among participating parties. And, as large number of operators have witnessed with such issues as roaming and termination agreements, the consequent complexity can be daunting.

This complexity can be avoided. A multi-lateral framework offers simplicity through homogeneous agreements and is the logical choice for a widespread inter-operator Carrier ENUM implementation.

#### **Openness and competition**

In order to demonstrate fairness and to encourage uptake, the inter-operability of Carrier ENUM should be open to all operators that sign up to the conditions of the commonly agreed business framework.

Innovation is far more rapid in a competitive environment than in a heavily controlled environment. Rapid innovation and development would unlock greater potential for services based on Carrier ENUM. Moreover, it would enrich the experience of end-users with more services that they value.

#### **Proposed roll-out of ENUM**

To roll out Carrier ENUM, fixed and mobile telecommunication players can aim for one of three options:

1. They can limit the uptake of Carrier ENUM and continue to marginalise it as a routing functionality for internal IMS capability.
2. They can build bilateral inter-operator agreements with other selected operators and take advantage of improved routing capabilities.
3. They can push for unified, centralised Carrier ENUM that fully exploits its potential to enable a range of new and existing services and simplify routing.

As outlined in this document, Booz Allen Hamilton recommends that operators choose the third option.

Furthermore, in order to meet the operator's goals of an efficient rollout, a three-phased adoption of Carrier ENUM is proposed:

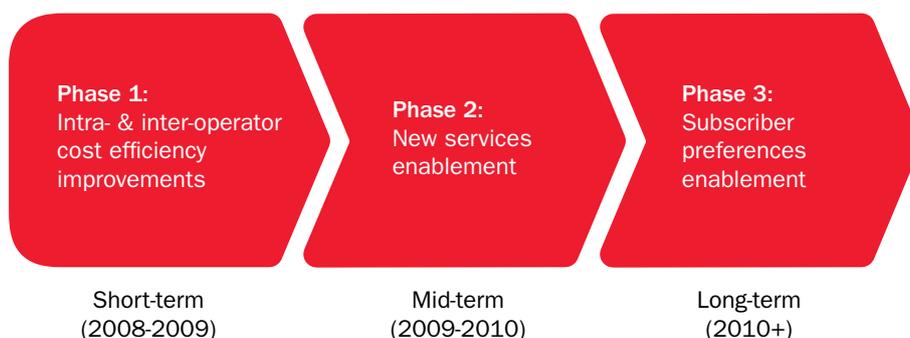
#### **Phase 1: Intra- and inter-operator cost efficiency improvements**

This initial phase would build on existing Intra-Operator ENUM initiatives as part of IMS deployments. Furthermore, it would involve large-scale inter-operator trials or pilots. And, finally, it would involve the mandate of a trusted third party to provide a centralised routing capability in order to enable inter-operator Carrier ENUM.

In this phase, Carrier ENUM functionality would be completely behind the scenes from the customers' point of view. Operators would leverage Carrier ENUM functionality purely to improve their intra- and inter-operator routing mechanisms.

#### **Exhibit 10**

Suggested phases of ENUM roll-out



As a result of this phase, the operators would save cost through improved inter-operability with other operators, beginning with those capabilities (MMS or number portability, to name two) that suffer from inter-operator complexity.

### **Phase 2: New services enablement**

When Carrier ENUM has been deployed by a majority of operators and reached critical mass, it is expected that service providers immediately will start to take advantage of it.

The potential of Carrier ENUM will become visible through companies introducing advanced services that bridge the gap between the Internet and telecom worlds.

Such innovative services will leverage Carrier ENUM to allow seamless access to Internet applications via telephones and IP devices, the integration of phone services into the Internet and the use of phone numbers as universal identifiers.

In this phase, customers will begin to realise the benefits of Carrier ENUM. Operators will use the opportunity to create new revenue streams by starting to charge their customers (or service providers) for new Carrier ENUM-enabled services.

### **Phase 3: Subscriber preferences enablement**

The final phase is only suitable for operators that set up Carrier ENUM data provisioning on a per-phone-number basis.

This phase is characterised by widespread Carrier ENUM adoption and the general availability of services that intelligently combine Internet- and phone-enabled features. Carrier ENUM will be an established operator capability and customers will be accustomed to the new services that are built on it.

To allow customers even greater influence on how Carrier ENUM supports their communication needs, operators should provide user interfaces that allow customers to change their preferences across all Carrier ENUM enabled services (e.g., voice mail converted to e-mail while on holiday).

With this final phase, the roll-out would be completed and Carrier ENUM would have become a standard capability for operators and service providers alike.

### **Key players and recommended actions**

Carrier ENUM is an established standard and the underlying technology is proven and readily available from suppliers today.

To make Carrier ENUM a global reality, two key parties need to act now:

- *Fixed and mobile operators* need to agree on Carrier ENUM as the next capability that they want to implement. They should seek to implement with simplicity from both business and commercial perspectives. Operators are not only the key beneficiaries of Carrier ENUM from cost and revenue perspectives, but they are also key to its implementation: They “own” the data that needs to be populated and managed on Carrier ENUM. Their commitment is crucial to its success.
- *A trusted third party* needs to develop a Carrier ENUM offering that can be centrally provisioned and provide the necessary carrier-grade performance, reliability, and accuracy. The benefits of Carrier ENUM will only materialise if such an offering is available from a player with a proven track record and the trust of the operator community.

It is now up to these two parties to make the next move and to ensure that Carrier ENUM soon becomes a reality.

### **Conclusion**

The benefits of inter-operator Carrier ENUM are clear: it enables global interconnect of telephony services using IP; it allows customers to continue to use the telephone number in an all-IP world; and it puts the telephone number at the heart of IP-based services. The technology streamlines inter-operator communications and opens the door to service innovation, both refining and enriching the user experience.

Many of the leading operators already have the internal Carrier ENUM capability in service. The effort to bridge

this capability between operators could be driven by the cost savings of simplifying and improving the interoperability of a select service such as MMS, which would benefit from inter-operator simplicity.

For Carrier ENUM to flourish, co-operation is essential. Operators need to mandate a third party to drive

a multilateral framework. The operators must then subscribe to the framework in order to make it a success.

With operators moving to next generation networks and with IP interconnects available, Carrier ENUM is the necessary next step to realise the value of communications over IP.

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