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Electronic Communications Committee

ECC Report 371

Virtual numbers in internet-based or cloud-based solutions or applications

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
CEPT	European Conference of Postal and Telecommunications Administrations
CLI	Calling Line Identification
CLIR	Calling Line Identification Restriction
ECC	Electronic Communications Committee
ECN/S	Electronic Communication Network/Service
EECC	European Electronic Communications Code
KYC	Know Your Customer
NNP	National Numbering Plan
NPA	Numbering Plan Administrator
NTP	Network Termination Point
OI	Origination Identifier
PBX	Private Branch eXchange
PSAP	Public Safety Answering Point
SIM	Subscriber Identity Module
WebRTC	Web Real-Time Communication

0 INTRODUCTION

There are more and more new solutions and applications emerging where industry sees benefit in using E.164 numbers independently from the Network Termination Point (NTP) used by the end-user. They may be temporarily associated with individuals or other entities for short periods of time and/or used for applications where there is no longer a strict relationship with a fixed/mobile phone line. Different terminologies, such as virtual or cloud numbers, are used to describe this phenomenon.

These innovations have been furthermore facilitated by using cloud computing services to provide electronic communications services, referred to in this report as cloud-based communication services. There are many regulatory requirements in place regarding the use of E.164 numbers, in particular those designed to protect the interests of end-users, to facilitate competition, and to ensure the effective and efficient use of numbering resources. This report assesses to what extent these new solutions and applications fit in with the current regulatory requirements and whether there are any gaps that need to be addressed.

This Report provides a generalised overview of the impact of these solutions and applications on the respective value chain for numbering assignments from the primary assignment, down to the level where the E.164 number is used in the context of a specific service, possibly by users other than the end-user that is secondarily assigned the number.

Subsequently, this Report describes different use cases facilitated by these novel solutions and applications, laying the groundwork for a high-level assessment of the relevance of different regulatory requirements for this new numbering usage.

This is then followed by a discussion of various regulatory requirements (e.g. number portability, Calling Line Identification (CLI) issues, emergency communications, relation of the identification of calls with misuse or fraudulent use, extraterritorial use of numbers, etc.) and their applicability, or otherwise, to the use cases analysed. Lastly, and drawing on these discussions, some concluding remarks are put forward.

1 DEFINITIONS

Term	Definition
Virtual number	An E.164 number that is used independently of the network termination point used by the end-user to whom this number is assigned. Such virtual number use may be by the same end-user (i.e. subscriber), or by application users. Sometimes, the term "cloud numbers" is also used interchangeably, particularly if the E.164 number(s) is/are integrated in cloud-based solutions or applications.
End-user	A natural or legal person using or requesting a publicly available electronic communications service and not providing a public electronic communications networks or publicly available electronic communications services[1].
Solution Provider	An entity that offers internet-based or cloud-based solutions comprising the use of virtual numbers in services which may involve both electronic communications networks and/or services together with additional services that extend beyond communications.
Application Provider	An entity that avails of internet-based or cloud-based solutions to integrate communications functionalities as a feature of an application, that it provides, which has broader use.
ECN/S Provider	An undertaking providing a public electronic communications network and/or publicly available electronic communications services.
Primary assignment	The assignment of numbering resources by the Numbering Plan Administrator (NPA) to an eligible applicant (i.e. primary assignee) who receives the rights of use of the resources under specified conditions in an administrative decision.[2]
Sub-assignment	The assignment of numbering resources by an assignee to another entity that is not an end-user.[2]
Secondary assignment	The assignment of numbering resources by an assignee to an end-user (subscriber) who receives the rights of use of the resources under specified conditions in a contract.
Association	A link established between an E.164 number either with another E.164 number, or with a specific service or platform. The associated number is typically intended to be used as CLI in outgoing calls, or as a proxy called party number to establish a return communication towards another number.
Network Termination Point (NTP)	The physical point at which an end-user is provided with access to a public electronic communications network, and which, in the case of networks involving switching or routing, is identified by means of a specific network address, which may be linked to an end-user's number or name.[3]
Application user	The natural or legal person using an application.
Subscriber	The end-user who signed the contract with the provider of publicly available electronic communications services for the supply of such services and is consequently assigned a number.

1 EECC Article 2 (13) and (14) [6]

2 ECC Report 311 Sub-assignment and number hosting - Implementation models, rights of use and obligations for E.164 numbers across the electronic communications supply chain [7]

3 EECC Article 2 (9) [6]

2 THE ASSIGNMENT VALUE CHAIN AND THE IMPACT OF VIRTUAL NUMBERS

Historically, telephone numbers were linked to physical locations/devices where they were deployed but nowadays the very same telephone numbers can gather their service attributes as they are deployed. Today, the same numbers could be used to provide services via the internet in an all-IP environment and may not necessarily be tied to a specific physical line or device. However, in both the traditional as well as the modern and evolved cloud sense, the telephone number provides the same functionality for end users and businesses, for example identifying calling parties.

The use of E.164 numbers as virtual numbers in the context of internet-based or cloud-based communication services is leading to a variety of novel solutions and applications that may challenge long-held policy considerations in the regulation of national numbering resources. CEPT administrations are increasingly being called to strike a balance between safeguarding end-user rights and fair competition, whilst simultaneously ensuring that regulation does not stifle the introduction of innovative services.

It should first be noted that, from a number planning and management perspective, the use of E.164 numbers in specific services is typically determined through the respective service allocations in national numbering plans. For instance, a specific numbering range may be allocated for use in the context of non-geographic services, such as mobile telephony, whereas another may be allocated for use with geographic services, such as in fixed telephony in specific areas.

However, and not necessarily in a regulated manner, providers of internet-based or cloud-based solutions ('solution providers') or applications ('application providers') sometimes offer the possibility for E.164 numbers to be used 'virtually', outside of the service allocation considerations in the national numbering plans as determined by the national Numbering Plan Administrator (NPA). By way of example, an ECS provider may be restricted from assigning certain geographic numbers to end-users located outside of specific locations or areas, however some solution providers sometimes offer functionalities that could enable the end-user to make use of such geographic numbers without any corresponding 'location' restriction (e.g. an end-user may decide to use a geographic number, which had been assigned to this end-user by an ECN/S provider, with a third party solution, such as a virtual PBX application, for decoupled call origination services).

Within this context, this report reviews various case studies of such internet-based or cloud-based solutions or applications where virtual numbers are used to present a specific value proposition to the beneficiary of the respective solution (typically 'application providers') or application (typically 'application users'). To ensure consistency in the description of the respective value-chain for each of the case studies analysed, Figure 1 outlines the conventions used for terminology referring to numbering-related actions, e.g. primary assignment, sub-assignment (if allowed by national numbering policy), secondary assignment, 'association' of number, etc., as defined in section 1, as well as to the various market actors involved.

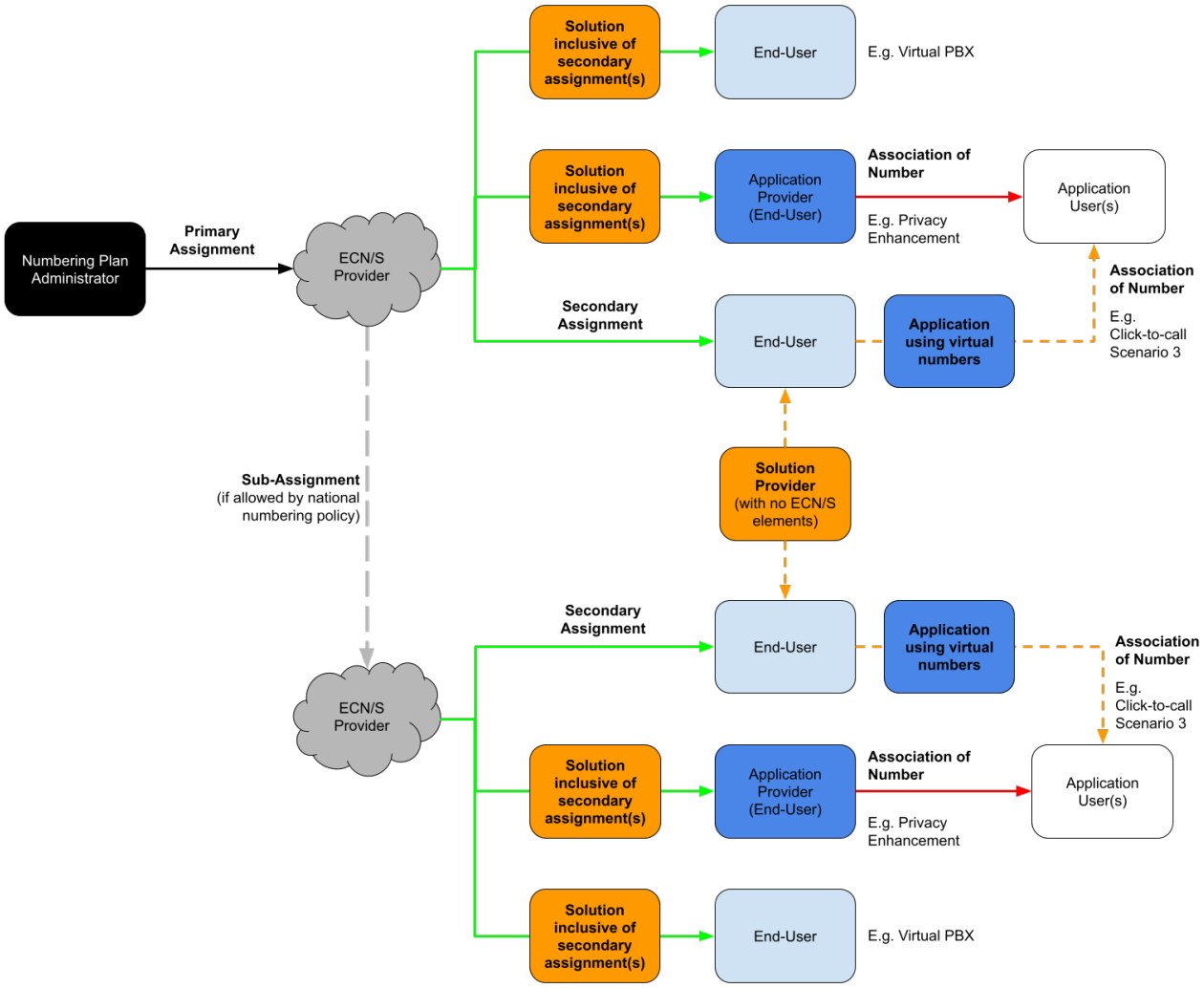


Figure 1: Use of E.164 numbers in Internet-based or cloud-based solutions or applications

Considering the above value chain, some use cases implemented through internet-based or cloud-based solutions or applications merit review, in particular to determine the extent to which these use cases fit within, or challenge, current regulatory practices in CEPT administrations.

Use-cases that comprise number-independent interpersonal communications services as defined in the EECC are outside the scope of this Report.

3 DESCRIPTION OF CURRENTLY KNOWN SERVICES WITH USAGE OF VIRTUAL NUMBERS

In this section, some of the services that are currently known in the sector are described[4]. The exemplifying list and description below are therefore merely tabled for continued deliberations and should neither be seen as exhaustive nor definitive in terms of functionality, routing or set up.

3.1 PRIVACY ENHANCEMENT SOLUTIONS

There are solutions, implemented in applications, which aim to facilitate communication between parties that do not know each other without revealing their personal contact information. For example, in ride hailing services, such as Uber, the privacy of the application users' telephone number (drivers and passengers) can be protected during any communication established between such users (i.e. while they can communicate via their personal mobile service, their personal mobile numbers are not made visible). Instead, the application provider avails of the privacy enhancement solution to temporarily associate virtual numbers from a pool of such virtual numbers with its application users. These virtual numbers are then used as identification of the communication, i.e. calling line identification (CLI), thus protecting the privacy of the parties during short-term transactions. The same solution is also used in other applications such as for food delivery (e.g. Wolt) and lodging (e.g. Airbnb) services.

Typically, the application provider (e.g. Uber) contracts with a solution provider (offering the privacy enhancement solution) and a set of virtual numbers is subsequently temporarily associated with the application users availing of this application feature. It is possible for such a use case that the virtual numbers in question would either be secondarily assigned to the application provider by the same solution provider, acting also as an ECN/S provider, or by a distinct ECN/S provider and then associated with ('imported into') the solution by the application provider. When a communication between the application users is set up, their personal mobile numbers are associated with the virtual numbers in the solution and two legs of communication are established:

1 The first leg is established by the party (application user 1) that initiates the communication. The personal mobile number of that party is used as identification (CLI) of the caller in that communication and is only visible to the application provider. This personal mobile number is associated with a virtual number taken from the pool of virtual numbers assigned to the application provider;

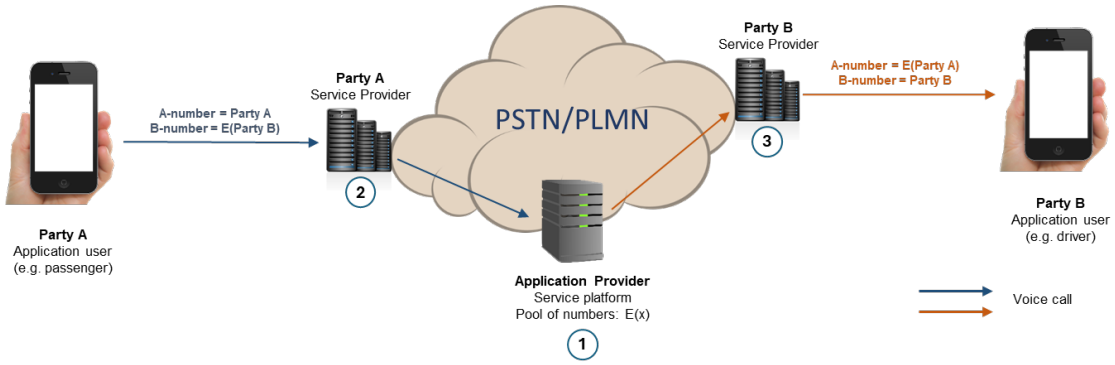
2 The second leg is established by the application provider with the other party (application user 2). The associated virtual number for application user 1 is used as the identification (CLI) of the caller. The personal mobile number of the called party (application user 2) is used solely as the destination (for routing purposes) and is not communicated to the caller (application user 1).

The two legs of the communication are connected by the application provider via the privacy enhancement solution in order to allow the communication between the two parties (i.e. the application users, such as the Uber driver and the passenger). After some predetermined period of time the associated virtual numbers cease to be associated with the parties (temporary association), and so the parties are no longer able to contact each other, since they would not know each other's personal mobile number.

Figure 2 represents an example of the call flow when two application users (party A and B) need to communicate with each other, privately, via the application. In this flow, party A (e.g. passenger) initiates the call to party B (e.g. driver). The first leg of the call (blue arrow) is established through the ECN/S provider of party A. The A-number (CLI) of the call is the personal mobile number secondarily assigned to party A, and the B-number (destination) is the virtual number of the application provider that was previously associated, via the privacy enhancement solution, with party B. The second leg of the call (orange arrow) is established by the application provider, through the privacy enhancement solution and conveyed towards the ECN/S provider of party B. The A-number (CLI) of this call leg is a virtual number from the application provider's pool of

[4] This Report does not consider use cases of getting assigned virtual numbers in isolation, which can also technically permit, not necessarily in compliance with the regulation, an end-user in one country to be assigned a virtual number from other countries via an online process (e.g. through one of many websites that make available virtual numbers for assignment). The principles in ECC Recommendation(16)02 on Extraterritorial use of E.164 numbers [4] apply for these services. Anyway, since such assignment of virtual numbers is typically a step in the process of setting up the use cases analysed here in section 3, similar regulatory requirements may apply and similar conclusions may be drawn concerning use cases that make virtual numbers available for assignment.

numbers, and the B-number (destination) is the personal mobile number secondarily assigned to party B by its respective ECN/S provider. The application provider / solution provider (depending on implementation approach) then joins the two legs and the two parties can communicate without knowing each other's personal mobile numbers.



2

	Application users' telephone number	Platform pool of numbers
A-number	Party A	-
B-number	-	E(Party B)

1

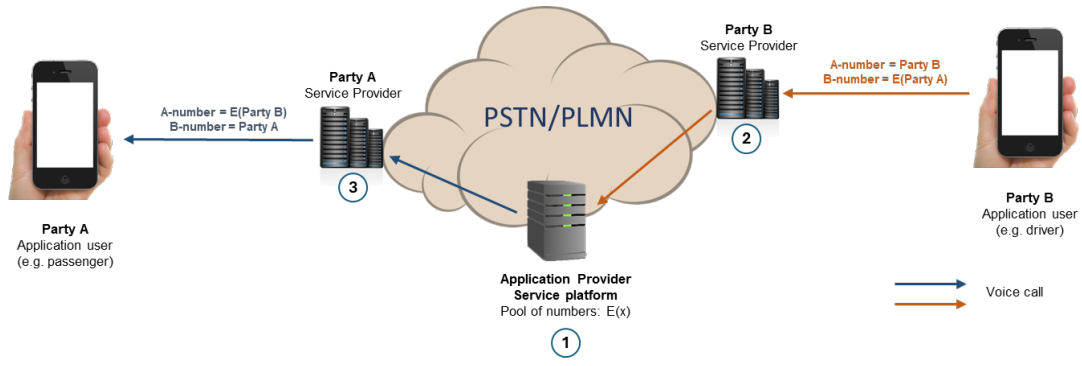
Application users' telephone number	Platform pool of numbers
Party A	E(Party A)
Party B	E(Party B)

3

	Application users' telephone number	Platform pool of numbers
A-number	-	E(Party A)
B-number	Party B	-

Figure 2: Call flow when the application user (party A) initiates the call

Figure 3 represents the reversed call flow, where the application user (party B) 'offering' the service (e.g. driver) initiates the call to the application user (party A) using the service (e.g. passenger). Also in this case the two parties can communicate without knowing each other's numbers.



3

	Application users' telephone number	Platform pool of numbers
A-number	-	E(Party B)
B-number	Party A	-

1

Application users' telephone number	Platform pool of numbers
Party B	E(Party B)
Party A	E(Party A)

2

	Application users' telephone number	Platform pool of numbers
A-number	Party B	-
B-number	-	E(Party A)

Figure 3: Call flow when the application user (party B) offering the service initiates the call

3.1.1 Considerations on the implementation:

In such privacy enhancement solutions, the following aspects may merit specific regulatory attention and will be discussed in further detail in section 4:

1 If the solution makes use of numbers that are secondarily assigned to the application provider (e.g. Uber), then it would be the application provider that is considered as the subscriber, that would benefit of end-user rights related to the assigned numbers (e.g. number portability). Application users that are temporarily associated with such numbers would not gain any corresponding numbering rights;

2 If the solution provider is also responsible for the secondary assignment (not association) of numbers to the application provider, then the solution provider would also be acting as an ECS provider;

3 If the solution provider uses numbers secondarily assigned to it (by an ECS provider) for the implementation of this use case, and only temporarily associates numbers with the application users 'on behalf' of the application provider, then the application provider would not benefit of end-user rights related to the associated numbers as the application provider would not be the assignee (or subscriber) for such numbers;

4 It is unclear whether a further approach is possible, whereby numbers primarily assigned to an ECN/S provider could also be made available as a pool of virtual numbers which can be used, on the basis of temporary associations only, by different end-users availing of such privacy enhancement solutions, possibly across distinct applications. In such an implementation, the numbers would not be secondarily assigned at any point, and any routing to/from such numbers would be handled by the primary assignee. (A similar implementation could also be possible with sub-assigned numbering blocks);

5 Depending on national rules on changes to the CLI, the implementation of such privacy enhancement use case could be considered, on a case-by-case basis, as not permissible in some CEPT administrations, or there could be concerns on the integrity of the CLI;

6 It is unclear to what extent the application users are made aware of how the privacy enhancement solution works, and the effect that such solutions have on the CLI that is being presented to them, or to identify them, in calls that they respectively receive or place via such solutions;

7 It is possible that calls placed via such solutions could have an impact on the exercise of law enforcement, legal interception and/or traceback, particularly if inadequate records are kept of the temporary associations being made;

8 It should be noted that end-users can safeguard their privacy and avoid revealing their personal numbers by using alternative numbers[5]. However, the benefit of using privacy enhancement solutions is that such solutions only require temporary associations, not assignments. However, it should be noted that NPAs are typically not aware of the time that elapses between the temporary association of a number with a specific application user, and its eventual re-use in association with a distinct application user.

3.2 USE OF AN ALTERNATIVE NUMBER

On the market, one can find applications that allow the application user to use an 'alternative number' as the CLI in an outbound call, which alternative number would be different from the E.164 number associated with the SIM profile provided by the respective mobile service provider. By using such applications, the application user can determine which telephone number to show as CLI in an outbound call depending on the nature of the call itself. For example, via the application, the application user could initiate a call related to his/her job via the alternative number linked with the application, whereas a personal call to a relative would be placed with the personal number as the CLI. It should be noted that end-users can obtain a similar benefit by using different numbers secondarily assigned to them via mobile service providers, who would typically assign such new numbers and an associated SIM to the end-user. However, by instead using such applications, the application user would not need to carry two devices or a device with dual-SIM capabilities to draw the benefit of having two (or more) numbers, and selectively showing one number or the other to the called party. In this manner, the application user can more easily protect personal privacy without the hassle of having to either switch devices or the active SIM profile in their device.

[5] Including through the type of applications analysed in section 3.2. The use of alternative numbers would require a secondary assignment of a further number to the said end-user, even if its use would be on a one-off or sporadic basis.

Such an approach also makes these applications more easily accessible to end-users, including on a cross-border basis. Such cross-border access by end-users to numbers from different countries raises regulatory concerns, such as on extraterritorial assignment of numbers to end-users. Examples of alternative number providers, adopting the virtual number route, include the service OnOff[6], SurfShark's Alternative Number[7], and Ninja Number[8].

Typically, when the application user wishes to place an outbound call with the alternative number as the CLI, a call is placed via the dialler in the application, and the application obtains, via an internet connection to the application provider's servers, a replacement destination number for the call (typically a fixed number assigned to the same application provider). This replacement number is required to ensure that the first leg of the call reaches the application provider's servers, not the called party. In turn, the application provider would know, (through the application installed on the mobile device of the caller), of the intended called party's real destination number and a second leg for the call is initiated where the application user's CLI (A-number) is set as the alternative number whereas the called party number would be the destination number input by the application user inside the application's dialler. In this manner, the personal number of the application user is not used as the A-number, and therefore it is not received by the called party, protecting the application user's privacy.

Figure 4 shows an example of an outgoing call placed through such an application, but the implementation of the examples mentioned above may vary. In practice, when the application user wants to place an outbound call using the alternative number provided by the application provider as the CLI, the application user would use the application's dialler to generate the call, via an internet connection, inserting the (real) destination number assigned to the intended called party (Step 1). Subsequently, the application generates a call towards a number that would first reach the application provider's servers (that is, not to the intended B-party). This is shown as Step 2 in Figure 4. For this call, realised through the ECS provider offering mobile services via the SIM in the application user's device, the CLI (From:) field would be the mobile number associated with the in-device SIM, whereas the destination number (To:) would be a number assigned to the application provider. Once the call reaches the application provider's server, the application provider would have visibility of the application user's intended destination and would in turn establish a second call leg towards the intended destination. For this part of the call, the application provider sets the alternative number assigned to the application user as the CLI. The two legs of the call are then connected, establishing the communication between the application user and the intended called party.

[6] https://www.onoffbusiness.com/en/

[7] https://surfshark.com/alternative-id

[8] https://ninjanumber.com/how-it-works/

Example

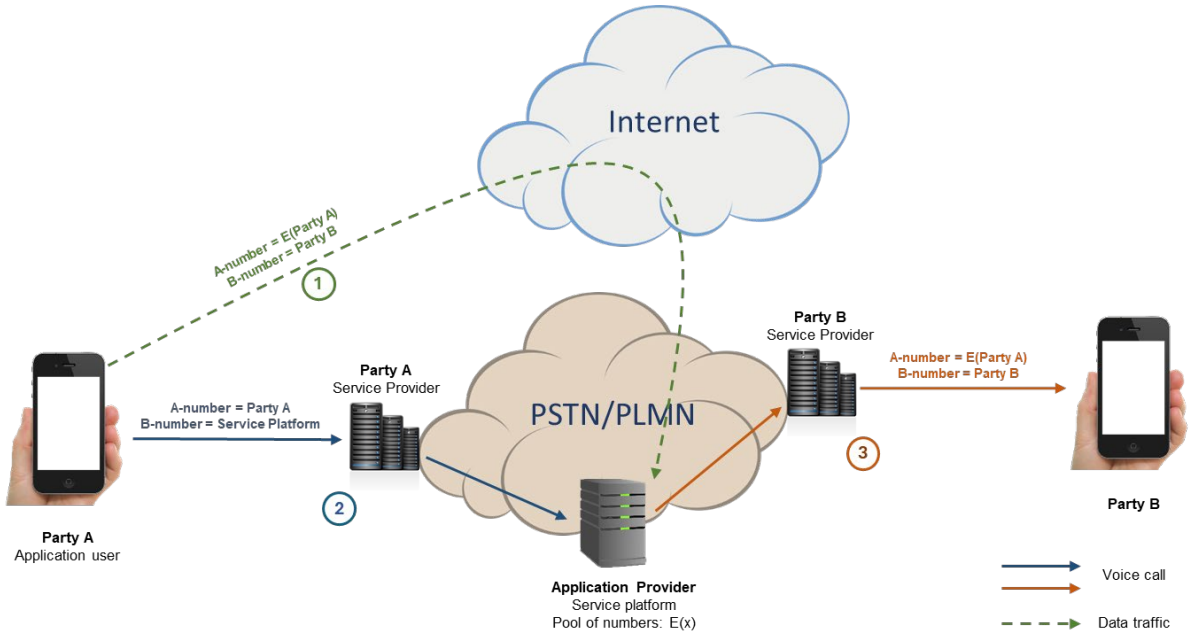


Figure 4: Outgoing calls

Figure 5 shows an example of an incoming call directed to an alternative number provided by the application provider. The call first reaches the application provider's server (Step 1). Depending on the number called by the caller, the application provider would know which application user the call was intended to reach. Via an internet connection, contact is established with the application user (via the installed application) and at this point, the application user would either receive an incoming VoIP call (Step 2), or the application provider's server orders the application to place a call towards its server (Step 3). In the second implementation, the two legs are connected, establishing the communication between the caller and the application user.

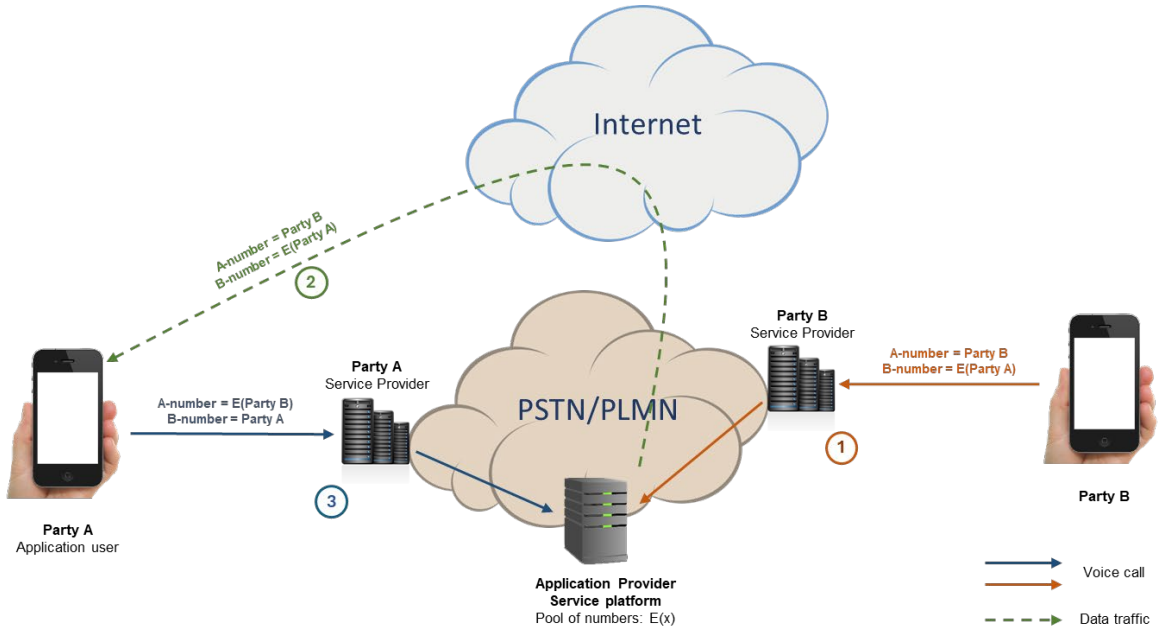


Figure 5: Incoming calls

3.2.1 Considerations on the implementation:

For such 'alternative number' applications, the following aspects may merit specific regulatory attention and will be discussed in further detail in section 4:

1 CEPT administrations typically prohibit the assignment of national numbers to end-users based abroad on grounds that such assignment would constitute extraterritorial use of numbers, particularly given the context of an interpersonal communications service. Thus, where application users based in Country A, for example, are provided with an option to be assigned numbers from countries other than Country A, it is likely that such assignments would be non-compliant with rules on extraterritorial use of numbers (see also footnote 4);

2 Depending on national rules on changes to the CLI, the implementation of such alternative number use case could be considered, on a case-by-case basis, as not permissible in some CEPT countries, or there could be concerns on the integrity of the CLI;

3 Depending on the numbers made available to the application user, cases could arise whereby non-permitted use is made of numbers via the alternative number service. For instance, assigning fixed/geographic numbers to be associated with a mobile device could be prohibited in certain CEPT countries;

4 Further analysis by CEPT administrations may be needed depending on how the solution is implemented, such as for handling of calls to the called party.

3.3 ONLINE CONFERENCING SERVICES

Conference calls or meetings, set up via online conferencing services (applications), typically comprise two types of application users, namely the conference call/meeting organiser and a multitude of participants. In general, the setting up of a conference call or meeting is initiated by the organiser, who would send an invitation (e.g. via email) with "joining instructions" to the potential participants, who subsequently can join the conference call/meeting via different media, including through phone calls. Alternatively, the conference call/meeting organisers may publish (e.g. on a website) the joining instructions to communicate how participants can join the call or meeting.

Regardless of the approach adopted by conference call/meeting organisers, online conferencing services typically rely on connecting various incoming calls (from participants) into a single conference call/meeting. Generally, there is little scope for the online conference service to generate outgoing calls, such as for initiating the conference call/meeting. However, functionality to place outgoing calls via the online conferencing service is sometimes made available, but this is typically only accessible after the call participant has already joined the conference call/meeting, or is attempting to join it. For example, a call participant may decide to join a conference via the option to be 'called in' to the conference on a number explicitly indicated by the call participant. So, in such implementations, the outgoing calls are placed only after the call participants have already decided to participate in the conference call/meeting. In the use case mentioned, the outgoing call is therefore not a way to invite any third party to participate to the conference, but a way to reach participants who want to be reached in order to join the conference call/meeting.

These are use cases that facilitate global accessibility to conference and collaboration platforms by using E.164 numbers from various countries, so as to reduce the cost of calling in to gain access to the conference call. Examples include implementations in platforms intended to offer unified communications (e.g. MS Teams, Zoom). Online conference calls or meetings set up via such applications would typically include a large set of E.164 numbers, from different countries, which could be used by anyone with the joining instructions to dial in to the conference or meeting using their mobile or fixed lines.

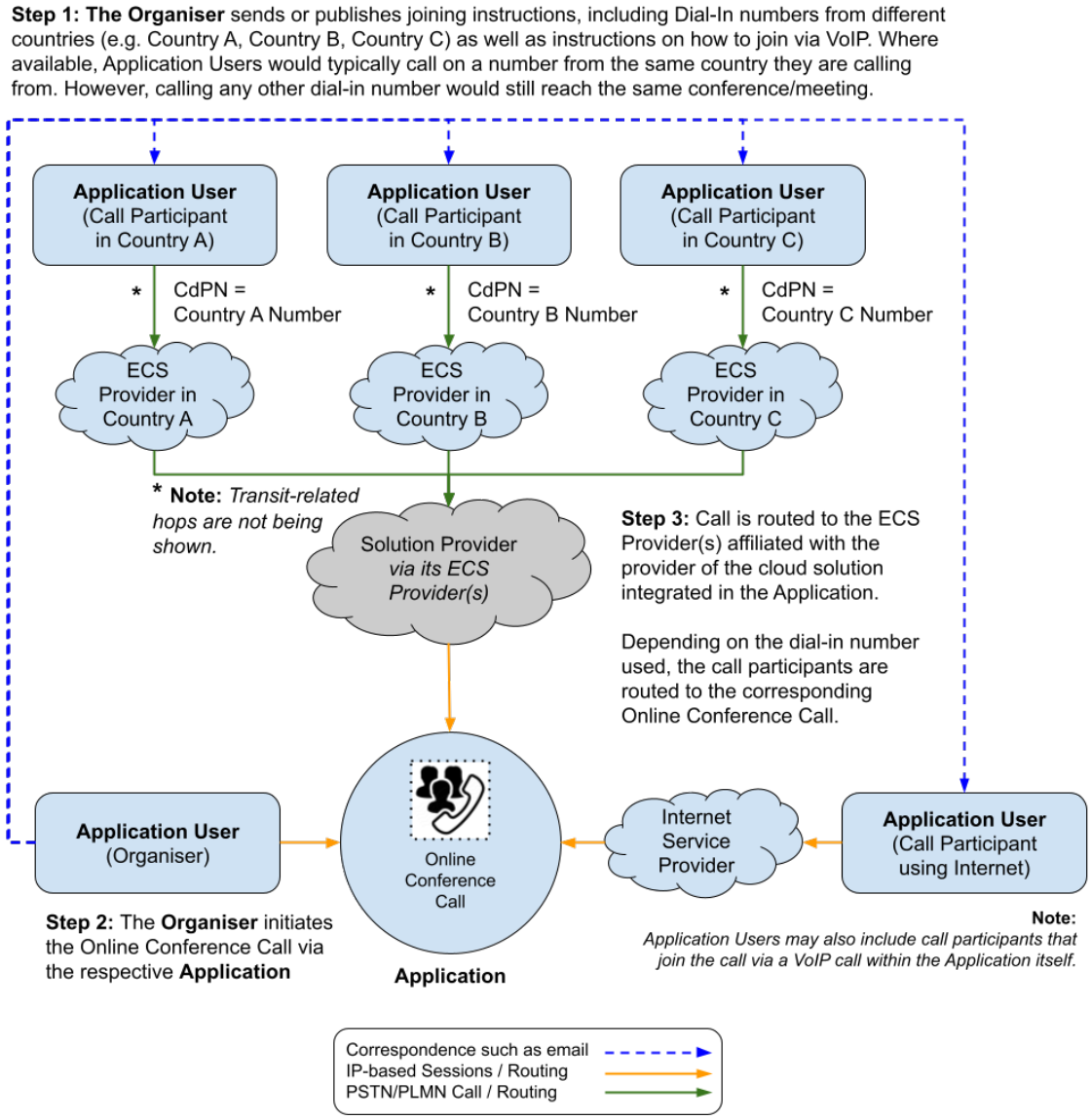


Figure 6: Example of realisation of online conferencing services

3.3.1 Considerations on the implementation:

In the case of online conferencing services, the following aspects may merit specific regulatory attention and will be discussed in further detail in section 4:

1 Some online conferencing services also comprise the provision of ECS and, consequently, any ECS provider(s) involved in service provision should be compliant with national rules on service provision, on numbering and number assignments. Said that, for certain aspects of these services, it is in the interest of NPAs to also acquire visibility of any undertakings involved in providing underlying technical infrastructure, and/or other aspects (e.g. facilitating outbound calls to meeting participants in order to call them in to an ongoing call/meeting; assigning the numbers to be used as dial-in numbers, etc.);

2 The use of numbers from various countries for the dialling-in option to join an ongoing call/meeting may not always be compliant with national rules on the assignment, sub-assignment and/or use of such numbers. For instance, if numbers from different countries are secondarily assigned to the provider of the online conferencing service, (not the meeting organiser), such assignments may come in contrast with rules on the extraterritorial use of numbers. On the other hand, using numbers from various countries for

both dial-in and dial-out purposes could offer practical benefits to organisers and participants alike as consumers can be hesitant to dial or respond to calls that have unfamiliar numbers out of fear of incurring higher costs or lack of trust of accepting such calls;

3 Besides concerns related to extraterritorial use of numbers, some numbers may have specific conditions tied to their use, for example, being restricted to be used solely for incoming-only services. It is not clear whether such numbers would in-turn also be used as CLI for outgoing calls placed from the call/meeting to "bring" participants into the call via the option to be "called in" to the meeting;

4 Furthermore, the possible use of geographic numbers as dial-in numbers for online conference calls/meetings could erode the geographic significance of such numbers, given that such calls would ultimately terminate in the cloud, well beyond the geographic area associated with the NTP.

3.4 CLICK-TO-CALL SOLUTION

A click-to-call solution is characterised by the fact that, by clicking on a designated button or link on a web page a call follows with the enterprise that published the web page. Click-to-call buttons can also be integrated in applications via similar solutions.

Different click-to-call scenarios should be considered:

- Scenario 1 (number-independent communication): Web-browser click-to-call – this version of click-to-call is known as a web call. Using, for instance, WebRTC technology, an end-user can click a button on a website and be directly connected to the customer care agents of the enterprise. The solution uses the web browser on the end-user's device, which would as a minimum need to be equipped with a microphone and speaker. This version of click-to-call is a fully web-based call and without any number-based communication and relies on the connectivity provided by the internet access service provider serving the end-user (caller);
- Scenario 2 (number-based communication): Click to request a call-back – in this scenario, an end-user clicks a button to request to be called back and either enters his/her telephone number in a designated field, or the number on which the end-user would be reachable could already be known to the enterprise in a different way (e.g. the end-user may be already logged in). The request and, in some cases the end-user number, is sent via the underlying solution to the customer care agents of the enterprise who will subsequently get back to the end-user on the provided destination number;
- Scenario 3 (number-based communication): Click-to-call on a mobile device – In this implementation, the solution is set up in a manner that triggers a number-based call towards the designated enterprise's number(s). Accordingly, when an end-user uses the click-to-call button from their mobile, the underlying solution passes on the enterprise's designated telephone number to the phone dialler app on the mobile device and subsequently a normal call, via the phone dialler, would be placed from the end-user's mobile device. The outgoing call relies on the connectivity provided by the ECS provider serving the end-user (caller).

In Scenario 1 (Figure 7) a call between web-browsers is present. In this case, no E.164 number is used to set-up the call. Such a scenario would be considered to comprise a number-independent interpersonal communications service in the EU, in accordance with the recital (18) and Article 2(7) of the EECC[9].

[9] "*Number-independent interpersonal communications services should be subject to obligations only where public interests require that specific regulatory obligations apply to all types of interpersonal communications services, regardless of whether they use numbers for the provision of their service. It is justified to treat number-based interpersonal communications services differently, as they participate in, and hence also benefit from, a publicly assured interoperable ecosystem*".

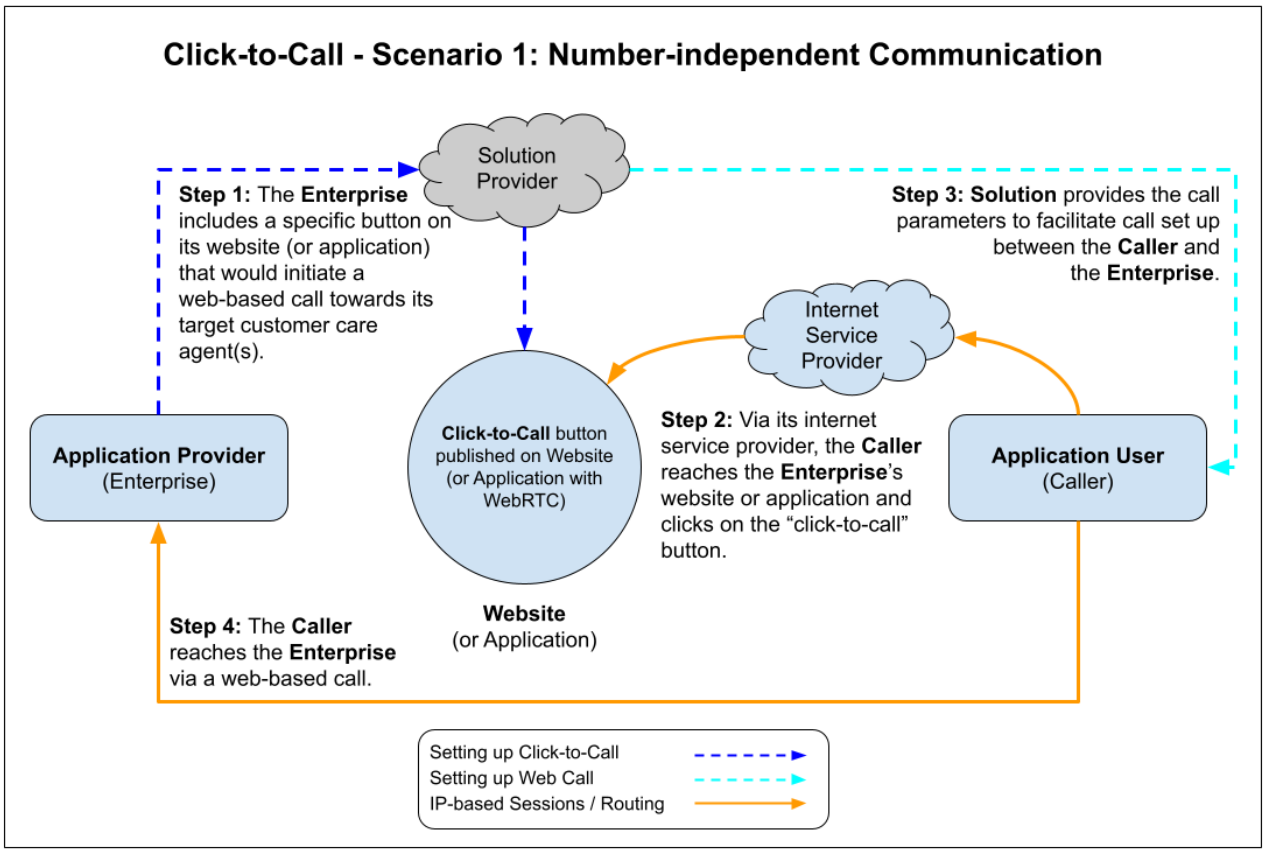


Figure 7: Scenario 1 - example of realisation of click-to-call – via web browser

Realisation of click-to-call – via web browser is out of the scope of this report, as there is no use of E.164 numbers in this case.

For Scenario 2, Figure 8 represents the case where there is an immediate or scheduled call from the enterprise following the end-user (client)'s request on the web page. When the enterprise receives the request, it first verifies that the number and any other information provided are correct. In order to call back the end-user as soon as possible or at the scheduled time, the enterprise leverages its (cloud) solution to initiate a call to the end-user via its ECS provider. It could also be the case that the ECS provider is simultaneously also the solution provider in such use cases.

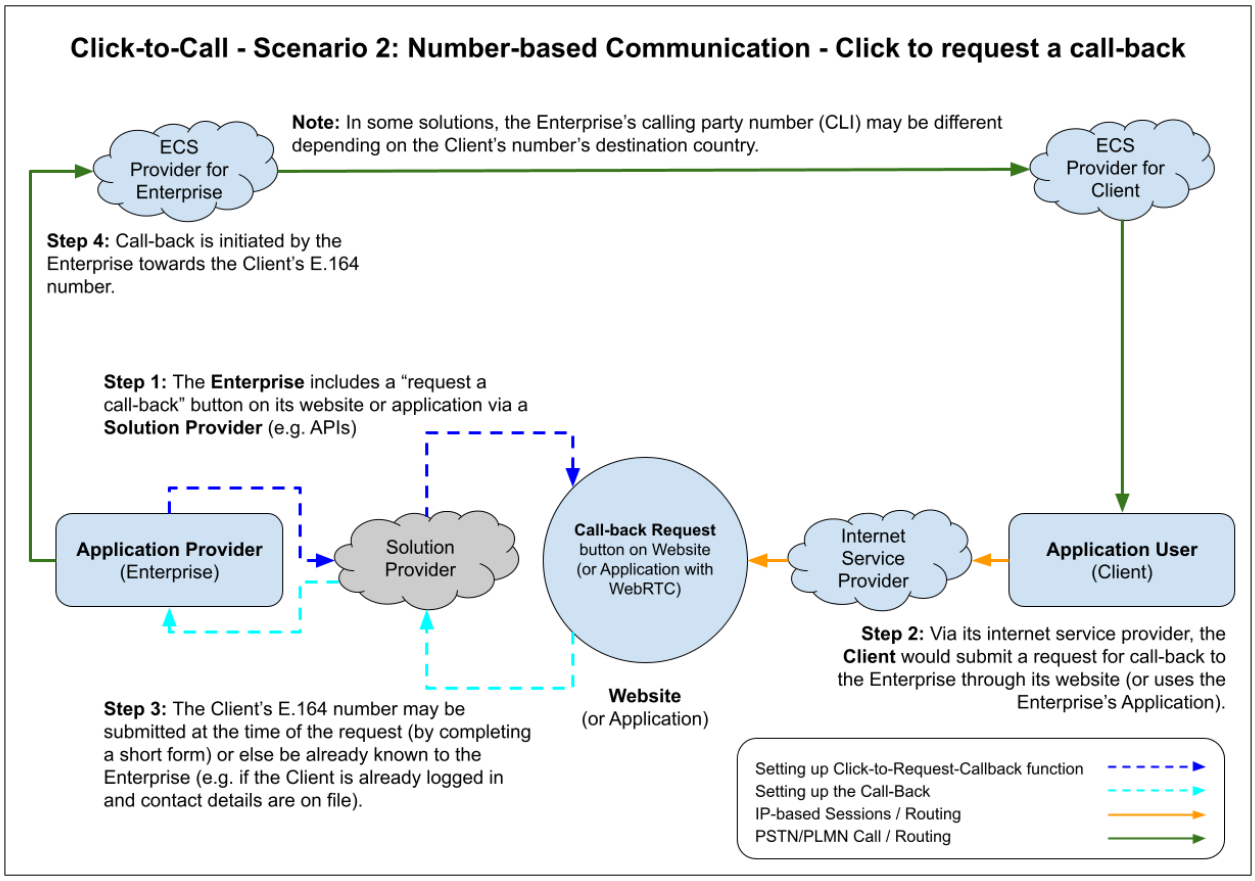


Figure 8: Scenario 2 - example of realisation of click-to-call – via call back

Some solutions may permit the enterprise to display different calling party numbers as their CLI on a case-by-case basis, depending on the client number's destination country. Such implementations may leverage dynamic, temporary association of virtual numbers. The added benefit of such an approach is that called parties are more likely to pick up a call if they see a familiar looking number, such as national numbers. Thus, it may not always be clear whether the number(s) presented as CLI for the outgoing call-backs would be assigned to the enterprise or merely associated with the enterprise, possibly on a temporary basis, via the underlying solution provider.

Figure 9 shows an example of Scenario 3 (direct call). For example, in Google's implementation, if the end-user (caller) clicks the "Click-to-Call" button on a displayed advert, Google temporarily associates a number from its inventory to the respective click-to-call request[10], and passes on this number to the end-user's dialler in order for a communication to be established between the end-user and the merchant whose advert triggered the call. This approach of temporarily associating different numbers with different adverts for the same merchant allows Google's analytics platform to measure the success and conversion rates of different adverts placed by the merchant.

[10] Google also offers the possibility for the merchant to use its own number rather than opt for temporary association of a 'Google Forwarding Number' (GFN). Further information available here: https://support.google.com/google-ads/answer/6341403

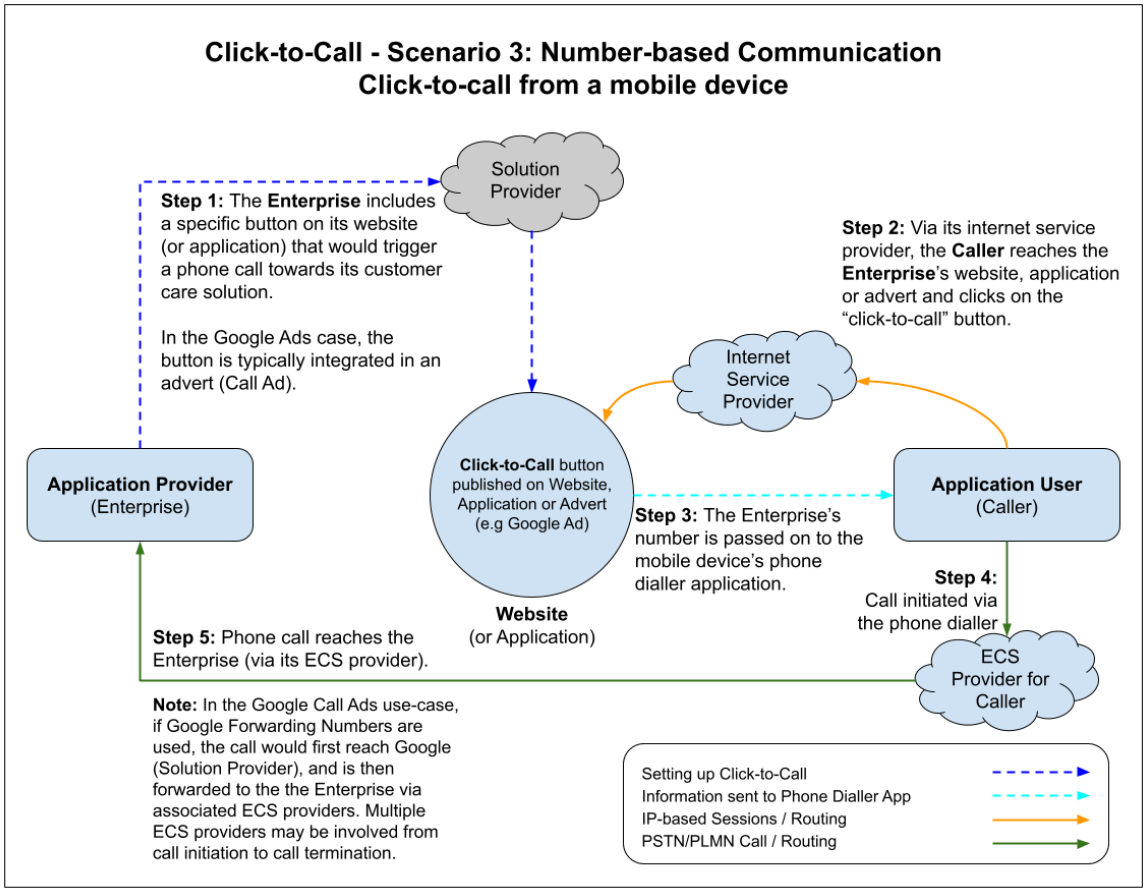


Figure 9: Scenario 3 - example of realisation of click-to-call – via direct call

3.4.1 Considerations on the implementation:

Whilst Scenario 1 is out of scope, there are some aspects in Scenario 2 and Scenario 3 that merit further attention from a regulatory point of view. Namely:

1 Where the provider of the callback request solution also permits the enterprise to set a different number as CLI for outgoing calls in a dynamic way (e.g. depending on the destination country for the call), it could be the case that the numbers used in such implementation would not be assigned to the enterprise, but merely associated with the enterprise on a temporary basis. However, if the solution also comprises the secondary assignment of numbers to the enterprise, the solution provider would be acting as an ECS provider and be subject to regulation on provision of ECN/S and numbering-related rules;

2 Further to point 1, if the outgoing call uses temporary associations of numbers not assigned to the enterprise, the application user receiving a callback (Scenario 2) could wrongly assume that the enterprise's telephone number is the number displayed in the CLI in the return call. Similarly, in cases where a temporary association is made with Click-to-Call buttons (Scenario 3), the number transferred to the dialler may not necessarily be a number assigned to the enterprise – it could instead be from a pool of numbers assigned to the solution provider. This may also mislead the caller;

3 Scenario 3 comprises risks of fraud and non-compliance with regulations on tariff transparency. First, the end-user only discovers the number to be called after clicking the button, and the number passed on to the phone dialler could be a high-tariff destination, such as a foreign, international (assigned by the Director of TSB (ITU-T)) or premium rate number. Secondly, no additional information related to the cost to place calls towards this number would be visible at this point, and this method could therefore be used to circumvent national rules on tariff transparency, such as displaying the cost of calls placed towards premium rate numbers.

3.5 CALL CENTRE SERVICES

Call centre services are an integral part of customer service and support operations or marketing operations for companies across various industries. These services involve the use of trained agents or customer service representatives to handle inbound and outbound calls on behalf of the company. Increasingly, such call centre services are being offered via cloud-based solutions or applications.

Through such cloud-based call centre services, companies can offer global customer services by being reachable on various national numbers connecting to a single call centre (inbound calling). Use case examples include applications such as Call Centre Platforms and Global Enterprise Call Centres offered by companies such as Twilio, Vonage, Jive, Aircall, and Avaya, amongst others. Besides the provision of the related solutions or applications (e.g. APIs that facilitate internal call routing, rules related to call queue management, etc.), such companies are at times also directly involved in the provision of ECS to the application user (e.g. connectivity, numbering), but this depends on the business model adopted.

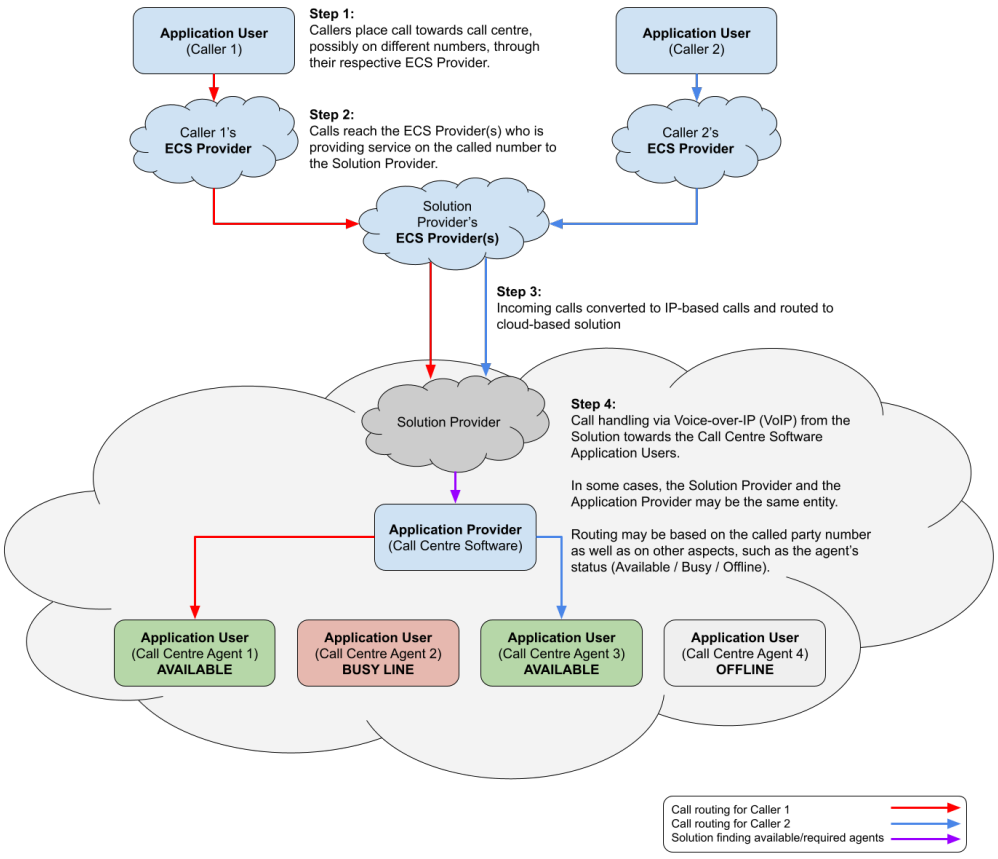


Figure 10: Example of realisation of incoming call to a call centre service

3.5.1 Considerations on the implementation:

Specific characteristics of cloud-based call centre services may merit additional regulatory scrutiny, including:

1 In some cases, cloud-based call centre services also include facilities that enable the (secondary) assignment of numbers to the end-user (e.g. call centre application user). Such assignments could also include geographic and other types of numbers that could be subject to specific and more stringent regulatory requirements. If the respective provider of the cloud-based call centre solution/application is also involved in the secondary assignment of numbers to the enterprise (application user), then the solution/application provider would be acting as an ECS provider and be subject to regulation on provision of ECN/S and numbering-related rules;

2 As with all other cloud-based services that also include number assignments, enforcing national regulations and requirements can be more challenging, as such services can be accessed by end-users on a cross-border basis in a relatively easier manner;

3 Some solutions or applications offer the application user the opportunity to associate various telephone numbers, from different countries, with the call centre application. One benefit for the application user of doing so is to use the different numbers in the context of decoupled call origination, whereby the number used as CLI in outgoing calls could be changed (manually or in an automated manner) to a number from the same country (or region) as the destination of the call. This is typically done to encourage the called party to answer the incoming call. Such use of different calling party numbers from various countries for outbound calls may not always be compliant with national rules on the assignment, sub-assignment and/or use of national numbers, and may also come in contrast with rules on the extraterritorial use of numbers;

4 It is unclear to what extent such cloud-based call centre services can conform with obligations related to emergency communications. For instance, under the EECC, there is an obligation on all services that "allow end-users to originate calls to a number in a national or international numbering plan" to "provide access to emergency services through emergency communications to the most appropriate PSAP". Amongst others, limitations can arise in relation to call handling, routing to the appropriate PSAP, and/or the transmission of caller location information.

3.6 PBX SERVICES

PBX services allow the end-user to make calls (outbound) and to receive calls (inbound). When a call is received, the PBX can direct the call to an answering machine or alternatively the call could be routed to human operators. Such call routing decisions could be made on a rule-based basis or following digit analysis of the called number and/or other options selected by the caller upon first connecting to the PBX interface. For outbound calls, PBX services can include similar functions, whereby an outbound call could be made by a human operator, or through a machine (although the latter functionality could be forbidden in some countries, such as to prevent scams based on robocalls).

PBX with inbound and outbound calling facilities can also be realised through the cloud. In this case, there is no physical PBX at the enterprise's premises, but the enterprise can be reached on its cloud PBX through IP-based connections or traditional PSTN, and its agents would use an application that implements a cloud-based PBX solution (also called virtual PBX) to receive and place calls. At the connected terminals, E.164 numbers are associated for receiving or making calls. So, with this solution, technically, it is possible to receive and make calls using consecutive numbers sharing the same initial digits, followed by extension digits, typically referred to as Direct Dial In (DDI) numbers.

Through cloud-based PBX service an enterprise can present outbound calls, with numbers assigned to the enterprise, even if the enterprise employees (application users) are physically outside the enterprise premises or using other internet access points not controlled by the enterprise. Moreover, provided they have an active internet connection, enterprise employees can receive calls via the cloud-based PBX service even on a mobile device regardless of their location. Typically, the telephone numbers associated with the virtual PBX and the respective enterprise employees would be on a permanent basis, not on a temporary basis.

A cloud-based PBX service can be realised by an ECS provider, although there could be instances whereby the underlying (PBX) solution or application is provided by an entity that is not an ECS provider. Regardless, a cloud-based PBX service can comprise as user equipment both fixed and mobile terminals. Usually, the outbound calls would have a geographic or fixed number as CLI, but, in some cases, mobile numbers are also used. Whilst using a cloud-based PBX application, even if the call[11] is originated by an application user from a mobile phone, the CLI shown to the called party is the number associated to that application user in the cloud-based PBX, which could, for instance, also be a geographic number.

[11] Such call would be realised as an over-the-top VoIP call, not via the SIM (telephony) connectivity provided by the application user's ECS provider (for the personal number associated with the SIM).

3.6.1 Considerations on the implementation:

The functions offered via cloud-based PBX can raise some regulatory concerns, as follows:

1 Since cloud-based PBX can be configured with a geographic number as CLI for outbound calls, this means that a call with a geographic number in the CLI could also be originated from a mobile device, which could be an issue in some CEPT countries where the geographic number cannot be used as CLI if the call originates from a mobile device;

2 A cloud-based PBX implementation associated with a geographic number could also be based outside of the corresponding geographic area represented by that geographic number, including in a foreign country. Such implementations can contribute to further erode the geographic significance of numbers in those CEPT countries where such geographic significance is still attached to certain numbers in the national numbering plan;

3 A cloud-based PBX can realise a change of CLI, which could be a practice that is not in line with national regulation on CLI. So, particular attention should be given for possible misuse of E.164 numbers and CLI spoofing;

4 From a technical point of view, cloud-based PBXs services can also be associated with numbers from a country different from the country of establishment of the PBX application users (typically enterprises). This could be non-compliant with national rules on authorisation and extraterritorial use of numbers, and could also raise issues with law enforcement and legal interception;

5 The use of cloud-based PBX might hinder compliance with national obligations related to emergency communications, in relation amongst others to access to emergency services, call handling, routing to the most appropriate PSAP, and/or the transmission of caller location information.

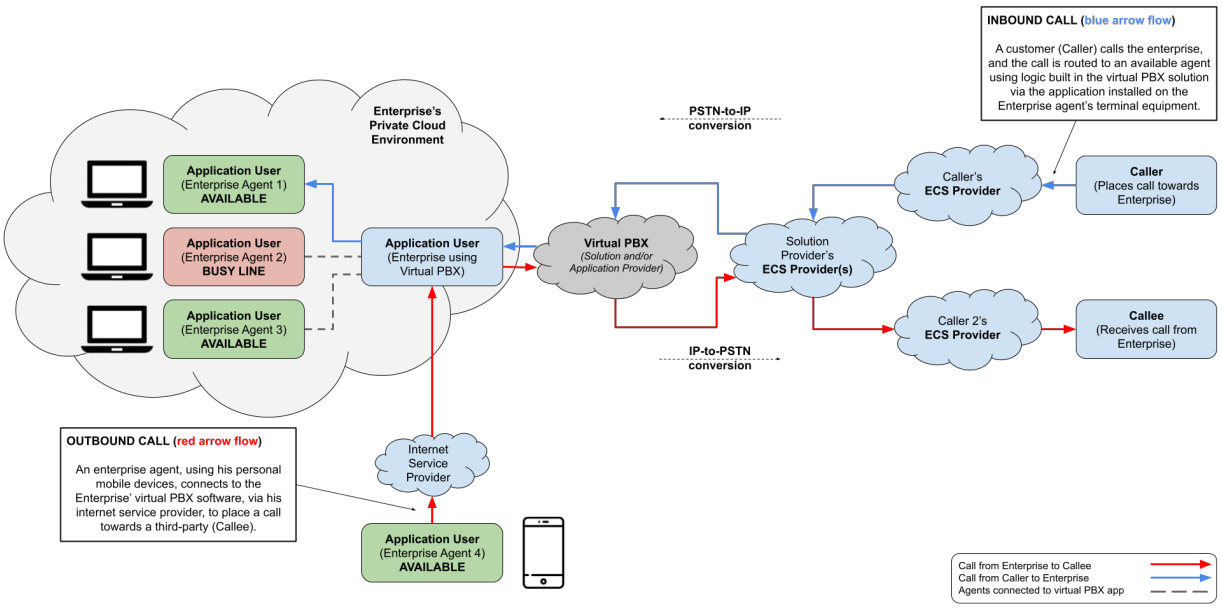


Figure 11: Example of cloud-based PBX implementation

4 REGULATORY ASPECTS

In this section, the various considerations raised in the preceding section for each use case are consolidated and analysed in more detail, in particular to determine whether they fit within existing national frameworks.

As a general disclaimer, the use case descriptions in section 3 may not precisely reflect all the possible implementation approaches by providers offering such applications and/or solutions. Accordingly, given that variations may exist at the implementation level, it is pertinent to note that it is up to CEPT administrations to carry out case-by-case analyses when confronted with enquiries, requests or decisions on the regulatory treatment and obligations of such providers. Thus, the analysis in the forthcoming sections assesses the scenarios as presented in this Report, including where the implementation described is hypothetical in nature.

4.1 ASSIGNMENT OF NUMBERS

This section addresses various aspects related to developments tied with the use of numbers, their respective (secondary) assignment to subscribers, the temporary association of numbers with application users (and possibly also with application providers), and other forms of use of numbers as highlighted in the described use cases.

As a general rule, however, it is important to clarify that it is the end-user secondarily assigned the number (i.e. subscriber) that benefits from any legally mandated rights of use to that number, and any related rights, such as number portability. Such rights are not ‘transferred’ to other end-users when numbers are merely ‘associated’ with them, as further explored in the next sub-section.

4.1.1 Assignment vs association of numbers

As noted in section 2, the secondary assignment of numbers is different from the association of numbers with specific application users. Use cases that rely on the temporary association of numbers with different application users do not, therefore, correspond to scenarios whereby such application users can claim that a "secondary assignment" of that number was made in their respect. Therefore, numbering-related rights, such as the right to request porting, is not "transferred" to the application user with whom numbers may be temporarily associated. Moreover, numbers used in such temporary associations would, typically, have little to no intrinsic value from the perspective of the application user with whom the number was associated.

For instance, in the privacy enhancement solutions, application users cannot 'claim’ that numbers temporarily associated with them should, de facto, be considered as having been assigned to them. Notwithstanding, in such use cases, it is unclear to what extent the application users are informed about how their personal numbers would be shown to called parties when they avail of these privacy enhancement solutions. Similarly, it is not clear whether called parties (via these solutions) are made aware that the number shown to them as the CLI of an incoming call would indeed be a virtual number, not the real (personal) number of the calling party.

Similar considerations were raised in relation to the third Click-to-Call scenario, whereby temporary associations are relied upon to enable the solution provider to offer specific capabilities to the application provider (enterprise) availing of the solution to implement Click-to-Call buttons in its respective application (or website). For example, in the Google Ads case, the number shown to, and dialled by, end-users clicking on the Click-to-Call button may not always correspond to a number assigned to the enterprise. Rather, where temporary associations are relied upon, the number would, in practice, be a number that was secondarily assigned to Google and placed in a ‘pool’ of virtual numbers used for such purposes. However, the end-user may wrongly assume that the number dialled was assigned to the enterprise. Future attempts to reach the enterprise on such a temporarily associated number would therefore fail after the temporary association is reverted by the solution provider.

‘Temporary association’ is different from scenarios where the use of an assigned number (by the assignee) is only temporary or infrequent in nature. Such is the case for applications offering the facility to switch between alternative numbers (see section 3.2). By way of example, application users for such alternative number services may have a second (alternative) number used solely for freelance business purposes, whereas their main number would be used for all other personal communications. In such cases, the intrinsic value of the

'temporary' (alternative) number(s) might be lower when compared to the main number used by the end-user, but the end-user would still benefit from rights of use and other numbering rights (e.g. number portability) by virtue of being the assignee for the numbers used in conjunction with the application. For these types of applications, other considerations may be more concerning (see for instance section 4.1.3).

Lastly, it may be the case that certain use cases could also be provided without any form of secondary assignment being made (see, for instance, consideration 4 (section 3.1.1) of the privacy enhancement solution use case), relying instead on temporary associations made from a pool of numbers assigned (or sub-assigned, see section 4.1.5) to an ECS provider. In such implementations, the regulatory concerns highlighted in this Report would be exacerbated further (e.g. concerns on subscriber identification; conformity with rules on permitted use; extraterritorial use of numbers; etc.)

4.1.2 Identifying the subscriber

This Report does not determine the means by which know-your-customer (KYC) should be carried out but highlights the need to carry out robust and proportionate KYC to protect end-users.

In a number of use cases analysed, the application user may also be presented with an opportunity to be assigned a number to use in conjunction with the respective solution/application. Alternatively, the solution or application would offer the possibility to either port-in or use numbers assigned by other providers. Regardless, strong and reliable KYC and subscriber identification procedures are crucial in use cases involving either (a) the assignment of numbers to an end-user (e.g. alternative number services), (b) the porting-in of numbers, or (c) the use of numbers assigned by third parties inside the application (e.g. setting up such number as the calling party number in a cloud-based PBX). In particular, it should be noted that the 'virtual' nature of the number assignment process could bring about risks in terms of the robustness (or otherwise) of the (KYC) procedures.

Whereas weak KYC procedures could also be present in the more conventional telephony services, it is typically easier to verify the identity of the subscriber where the ECS provider is supplying specific elements tied with the NTP for the connection, such as a (physical) SIM card for mobile telephony services, or the (in-person) installation at the customer premises for fixed telephony, as this process would generally bring the end-user in close proximity to the ECS provider or its agents. On the other hand, where number assignments are made in a cloud-based context, the KYC procedures adopted need to ensure that the physical "distance" from the end-user requesting the assignment does not diminish the robustness of the KYC practices adopted. Services that merely collect information via online forms, without requesting any proof of identity, other than perhaps a payment method, are examples of weak KYC. Moreover, some CEPT countries also require additional documentation to be submitted to the ECS provider, such as proof of residence or business incorporation documents, to minimise the risks that numbers are assigned to ineligible end-users or to end-users with malicious intent.

In any case, if the information on the identity of the end-user is being collected without requesting a proof of identity, then such limited KYC practices could easily lead to abuse and fraud by the respective end-user, which could also expose the involved providers to liability for illegalities committed via their services, solutions or applications.

4.1.3 Extraterritorial use of numbers

Besides aspects related to subscriber identification, use cases involving the assignment of numbers must also conform with rules related to the extraterritorial use of national numbers, which is typically prohibited in the context of interpersonal communications services. This is particularly relevant for cloud-based services given that they can be accessed, with relative ease, on a cross-border basis.

Accordingly, solution or application providers that also offer an option for application users to be assigned numbers should ensure full compliance with numbering rules, particularly for assignment of numbers on an extraterritorial basis. For instance, in alternative number services, application users are sometimes offered the possibility to be assigned numbers from a foreign country in order to acquire a (virtual) 'local presence' which would be beneficial to customers based in that foreign country. Such facilities would typically comprise a cross-border numbering assignment tied to an interpersonal communications service, which is highly likely to be non-compliant with rules in place across various CEPT administrations.

Similarly, cloud-based call centre services and virtual PBXs could also include functionalities that facilitate cross-border number assignment to the application user, whereas providers of online conferencing services could also require a pool of numbers, assigned on an extraterritorial basis, in order to provide dial-in numbers from various countries.

It is pertinent to highlight that there are various regulatory concerns tied to the extraterritorial assignment of numbers, which are analysed in much more detail in ECC Report 194 [3]. Related recommendations can also be found in ECC Recommendation (16)02 [4].

4.1.4 Geographic significance and permitted use

Through various use cases analysed, it is clear that end-users may also take advantage of cloud-based solutions or applications to make use of telephone numbers in ways that are outside of the intended service parameters established in National Numbering Plans (NNPs). For instance, virtual PBXs and cloud-based call centres can be set up to place calls from and/or receive calls on geographic numbers that are intended in the NNP to be solely assigned to end-users based in specific geographic areas in the country. The cloud-based nature of such services can circumvent such a restriction both at a national level as well as from outside the territory. (The latter could also imply non-compliance with rules on extraterritorial use of numbers, as described in the preceding section). Similar concerns on geographic significance may arise vis-à-vis the numbers made available or used through alternative number services and online conferencing services.

Besides the premise of geographic significance, there may be other conditions tied to the use of numbers from specific numbering blocks that could be harder for NPA to enforce if such numbers are used in conjunction with cloud-based services, particularly if the latter services are not visible to the NPA (e.g. not a notified / authorised ECS provider in the respective NPA's country, see section 4.2.1).

For example, an NPA could, in principle, restrict the use of a specific numbering block to inbound-only calls for specific use cases only. Notwithstanding, where end-users assigned such numbers make decoupled use of such numbers via cloud-based solutions or applications, enforcing this condition could become very challenging in practice, especially if the respective upstream providers do not implement sufficient validations on the customer and on the numbers set by the customer to be used as CLI for outbound calls being placed.

4.1.5 Sub-assignment practice

It is unclear whether the provision of the use cases analysed relies on sub-assignment of numbering resources, and if so, to what extent. Nevertheless, it is important to point out that sub-assignment of numbering resources is a practice that is generally strictly regulated by NPAs, such as through the imposition of limitations related to the number of levels of sub-assignment possible, as well as service-related restrictions e.g. allowing only incoming-only services to be provided with sub-assigned numbers; precluding services that comprise extraterritorial assignment of numbers; etc.

Furthermore, the provisions in ECC Report 311 [7] may also assist NPAs in making relevant determinations.

Therefore, solution and application providers involved in similar use cases to those analysed in this Report would need to ensure that any use of sub-assigned numbering resources is in compliance with any related conditions in this respect (as also pointed out in the preceding section).

Furthermore, as outlined in the value chain in section 2, where a sub-assignment is implemented, this is expected to be made solely in respect of another provider of ECS, that is, not to a provider that solely provides solutions and/or applications. Subsequently, the sub-assignee is typically expected to secondarily assign numbers from its sub-assigned block to its subscribers, and the sub-assignee would also have to conform with all applicable rules and regulations related to the provision of ECS and numbering (e.g. number portability).

4.1.6 Recycling of numbers

Number recycling refers to the process of re-assigning a specific number following a period of time from the termination of use of the same number by its last assignee. This practice ensures that the utilisation of numbers is efficient and not wasteful, thereby safeguarding against number scarcity. Some NPAs also mandate

minimum periods that must elapse before a number is recycled and re-assigned to a new subscriber following termination of use by a previous assignee.

In use cases that rely on temporary associations, such as the privacy enhancement solution, online conferencing services, and certain implementations of the click-to-call solution (Scenario 3), the timespan between one temporary association and the subsequent temporary association would typically be determined either by the solution provider or the application provider implementing the solution. It is not known whether such solutions allow sufficient timespan, between one temporary association and another (henceforth, "re-association"), that mirror or exceed any nationally mandated time periods for recycling numbers.

In this Report, specific concerns related to the re-association of numbers were raised. For instance, end-users can be misled into thinking that the number dialled-out after clicking on a "click-to-call" button belongs to a specific enterprise (see, consideration 2 of section 3.4), only to discover after a short period of time that this is not the case. Similarly, considering the privacy enhancement solution as adopted in the ride-hailing scenario (see section 3.1), a driver receiving a call from a specific passenger may not be aware that the number showing in the Caller ID would not necessarily be assigned to the passenger making the call. Attempts to call back the passenger (e.g. in respect of lost items in the car) on this number would not reach the passenger after the temporary association is broken off. In extreme cases, if the number is re-associated quickly, the call-back would reach a different person that is temporarily associated with the same virtual number.

4.2 IDENTIFYING THE RIGHT PROVIDER

This section explores concerns related to the challenging situation of properly and reliably identifying the providers behind innovative cloud-based services. It is increasingly challenging for CEPT administrations to accurately identify whether or not specific providers should be deemed to be providing an electronic communications network or service. In turn, and tied to this difficulty, is the challenge of enforcing compliance with obligations on ECN/S providers.

In general, it is the undertaking that is providing the respective electronic communications service, (i.e. the provider that establishes an ECS contract with the end-user), who is responsible for meeting the corresponding ECS regulatory requirements. In some cases, however, identifying such provider requires a detailed analysis of the value chain of the respective use case and the contractual relationships between the different providers that can be involved in the corresponding value chain (e.g. providers of ECS, and/or solutions, and/or applications). This section explores various challenges related to this aspect.

4.2.1 Authorisation and compliance with numbering rules

Whilst there are variations across CEPT administrations in the national rules governing the provision of ECN/S, it is commonplace to find rules on the need to notify the national regulatory or other competent authority for a general authorisation on commencement of provision of electronic communications networks and/or services, and to seek authorisation, licences and/or approval for any aspect of network and/or service provision that requires the assignment of public, scarce resources, such as national numbering resources. These notification and assignment processes tended to provide a reliable degree of oversight to the respective NPA on the players active in the national markets for ECN/S, particularly with regards to facilities-based providers, such as providers involved in the provision of fixed and/or mobile telephony services.

However, the increasing role played by cloud-based providers of ECN/S can diminish this oversight capability, given that such providers can typically operate without the need to have in-country facilities in every market that they serve. Consequently, such providers could technically also provide services in markets where they are neither specifically authorised (if applicable) nor notified with the respective national competent authority, and such service provision could be non-compliant with other applicable regulations, besides those related to authorisation/notification. This scenario can make it more challenging for national competent authorities to exercise some of their regulatory functions, such as making determinations in a market analysis study.

Moreover, without having full visibility of all the providers active in the national market, enforcing compliance with national numbering rules and safeguarding the integrity of the NNP is understandably more challenging for the NPA, as visibility is a prerequisite to reaching out to address any possible non-compliance. As a general rule, however, for use cases that comprise an element of cloud-based communications services, any

underlying undertaking involved in secondary assignments of numbers to end-users and/or ECN/S provision should do so in full compliance with applicable rules related to general authorisation, numbering, and number management, amongst others. This applies regardless of whether such ECN/S is delivered via 'traditional' means or via cloud-based solutions or applications.

Within the context of this specific topic, various points for considerations on the implementation of the use cases assessed were raised in the preceding section of this Report. In particular, refer to Considerations points (2) and (4) in section 3.1, points (1) and (3) in section 3.3, point (1) in section 3.4, point (1) in section 3.5 and point (4) in section 3.6.

4.2.2 Law enforcement and legal interception

For each use case, it is imperative that the service can be provided in a manner that does not disrupt the work of law enforcement authorities or any necessary legal interception. However, since visibility of the provider(s) involved in such services may not always be readily available to the NPA (as noted in sub-section 4.2.1 above), the issues of ensuring compliance could also trickle down to the work of law enforcement authorities. Such circumstances may indeed result in disruption or delays in the latter's ability to carry out their duties. For instance, providers of call centre services or virtual PBX that permit call origination through decoupled use of numbers could technically provide such functionality without necessarily doing so in full compliance with national laws related to law enforcement and legal interception. Accordingly, whilst interception measures may be in effect for calls originated with a specific number via the network of operators with in-country facilities, similar interception may not be in place via cloud-based services originating calls with the same number being intercepted.

Furthermore, there may be the risk that some use cases could also be (ab)used for illicit or covert communications. For instance, whilst privacy enhancement solutions can protect the privacy of legitimate application users, the same functionality can also be abused by illegitimate application users to harass third parties without revealing their personal mobile number. It is recognised that similar abuse can also be made of facilities such as the supplementary service ‘Calling Line Identification Restriction’ (CLIR), as this hides the calling party’s number from the called party. However, called parties presented with an “Unknown Number” or “Private Number”, instead of a number in the Caller ID, would typically see this as a ‘red flag’ from the outset. However, presenting a diallable number to the called party is unlikely to elicit the same caution and may understandably lead to more answered calls, and subsequently more harm or nuisance on the called party's end. Moreover, with the CLIR functionality, the calling party number is still communicated transparently across the communications networks involved, whereas it is unclear whether, or where, visibility of the true originating number is retained where privacy enhancement solutions are used.

It is therefore essential for national law enforcement and legal interception authorities to be aware of how these services are offered, and to assess how to obtain the needed information from the providers of such cloud-based services. Such awareness is crucial, particularly since, in some of the cases reviewed, the same number can be used by different end-users in a short period of time, which can present some challenges to the mentioned authorities.

In CEPT countries that are subject to the EECC, providers of electronic communications networks and services, except number-independent interpersonal communications services, have, under the general authorisation regime, to enable legal interception by national competent authorities, in such manner as mandated by the respective national competent authorities. Even CEPT countries that are not subject to the EECC have similar obligations. Such obligations typically apply regardless of the specific characteristics/features of the networks or services in scope. For providers of solutions or applications where numbers are used in a more dynamic and temporary manner, the respective provider must therefore ensure that it has the means to maintain and provide relevant information on the use of such numbers when requested by the national competent authorities.

4.3 CLI AND TRUST IN NUMBERS

The service allocations reflected in national numbering plans typically distinguish between services requiring, fixed (geographic or otherwise), mobile or other non-geographic numbers.

This approach tended to provide end-users with an opportunity to recognise the underlying type of service in an incoming call, or prior to placing an outgoing call, simply by inspecting the corresponding leading digit(s) of the number. This also develops recognition and trust in national numbers, and is also crucial where the concept of “geographic significance” is still in force, that is, countries where the national destination code of a telephone number is still associated with a particular area of the country (see section 4.1.4). Often this implicit information is trusted by end-users, and is therefore a determining factor for the caller on whether to call a particular business, for instance, or for the called party on whether to answer an incoming call. Similarly, an inspection of the number could also contribute to facilitate a distinction between national numbers and international numbers, and consequently, on whether domestic tariff rates would apply or not. Accordingly, end-users benefit from the use of numbers that can be recognised and trusted as a reliable representation of the point of origin for the calling party, or the point of termination for a called party.

4.3.1 Erosion of significance of numbers

Understandably, recognition and trust in numbers is also valuable to ECS providers that are involved in the provision of cloud-based solutions or applications. In this respect, such providers would typically prefer to provide services through trusted geographic, fixed or mobile numbers, rather than numbers specifically intended for cloud scenarios. However, the reliance on trusted numbers may be counterproductive, as the cloud-based nature of such services may erode the same foundation upon which such trust was built in the first place.

For instance, since calls where the calling party number is a national geographic number can be received from anywhere in the world, it needs to be recognised that end-users are no longer assured of the likely origin of the call. The same dynamic is at play for various other scenarios enabled through cloud-based services, such as calls with national numbers that are originated from solutions based abroad, or calls with mobile numbers generated from non-mobile agents in a telesales call centre.

4.3.2 What is being identified?

Given the various scenarios analysed, it is increasingly evident that the calling party number can no longer necessarily be considered to be a reliable identifier for the source of the call, the 'expected' device in the network generating that call, or the subscriber assigned that number. This can have implications for policies related to the prevention of misuse of numbers and networks for ECS, and also has implications in the broader battle against fraudulent and nuisance communications.

In CEPT administrations where the calling party number has to unambiguously identify the origin of a call, certain use cases analysed may be at odds with applicable regulations. For instance, in the example presented for the privacy enhancement solution, the calling party number shown to the called party (e.g. driver) would not identify the calling party (e.g. passenger). Moreover, implementations of the ‘click to request a callback’ use case that make use of temporary associations, instead of numbers that are assigned to the enterprise calling back, would also present the same problem as the called party could wrongly assume that the calling party number ‘belongs’ (is assigned) to the enterprise, which would not be the case.

4.3.3 Modification of CLI information

In this Report, there are various use cases that seem to comprise some form of modification of the CLI information of the call being handled. Such modification may be forbidden in some CEPT countries and be against rules or recommendations on handling of CLI. Amongst others, rules and recommendations on the format of numbers and handling of CLI include:

- ITU-T Recommendation E.164 [5] which focuses, amongst others, on the structure, length and dialable format for numbers in the international E.164 numbering plan;
- ITU-T Recommendation E.157 [6], which deals with the topic of international calling party number delivery;
- Obligations to present CLI to called parties prior to the call being established stemming from the EECC;
- Obligations related to the calling party’s right to request the restriction of CLI presentation stemming from Article 8 of the ePrivacy Directive [8];
- Obligations related to the called party’s right to request its provider to restrict the presentation of the Connected Line Identification, also stemming from Article 8 of the ePrivacy Directive; and

- Obligations related to handling of CLI information (and CLIR) in cases involving traceback of malicious or nuisance calls, and/or for emergency calls, from Article 10 of the ePrivacy Directive.

Corresponding obligations in national legislation can typically be found across CEPT administrations, for instance, in EU Member States, in legislation that transposes the abovementioned EU Directives into national law, or in the case of non-EU countries, through provisions implemented in national laws that would reflect the same principles.

It is also pertinent to note that, in IP-based networks, the term “CLI” can refer to either the “network number” or the “presentation number”, since both these numbers are communicated in the signalling between networks whilst conveying calls. In this regard, it is important that regulation related to handling ‘CLI’ is also clear on how the term is being used, and in particular, whether any established obligations are focused on the number being presented to the end-user receiving the call, the number communicated between networks, or both. This is particularly relevant in determining whether any of the use cases reviewed would be considered non-compliant with rules related to CLI modification.

This concern with CLI modification and its trustworthiness is not a ‘new’ concern. Indeed, it had already been raised back in 2009, in the ECC Report 133 [9], where it was noted that, in some countries, “there are regulations/guidelines aiming to guarantee the trustworthiness of CLI”. However, the Report goes on to note that “no legal trustworthiness exists in all countries within the CLI and even for information purposes the CLI cannot necessarily be fully trusted, especially in cases where CLI is transferred between countries”. Furthermore, it is clarified that the “problem is not of technical nature”, and that, whilst “originating network operators have the responsibility for the correctness of the information passed into the network”, on the other hand, “the user provided CLI information (…) is not screened by the network”. The Report concludes with various guidelines which remain highly relevant to date. These Guidelines could support the evaluation of CLI-related obligations for these use cases at a national level.

For example, consider item 17 in the Guidelines provided in ECC Report 133 which states that “the CLI does not identify the calling party; it is rather an identifier of the subscription”. This is quite pertinent to the privacy enhancement use case, since the CLI in phone calls availing of the privacy enhancement solution would indeed not identify the calling party (e.g. passenger/driver), but the underlying subscription, which would typically be for the number assigned to the solution or application provider involved.

In conclusion, the introduction and use of new services like privacy enhancement applications/services, the use of alternative number services, the increased use of cloud-based solutions, virtual PBXs and call centres are evidence of a growing market demand. This on the one hand might require greater flexibility of the rules on CLI[12]. On the other hand, it calls for greater attention that such flexibility does not create regulatory loopholes leading to issues and end-users harm due to abuse and/or fraud.

4.3.4 Flexible use of CLI

It is beneficial to recall that the flexible use of CLI was extensively reviewed in ECC Report 248 [2]. As noted in the conclusion, in this report "several scenarios, which promote competition and innovation, are described where the CLI is used by different networks and the advantages and disadvantages for the end user and other stakeholders are analysed. If sufficient validation measures are implemented then the negative effects of CLI flexibility are reduced, especially with regards to the risk of end user harm".

Amongst others, ECC Report 248 proposes that:

- "CLI validation techniques should be made mandatory";
- "regulatory authorities should carefully consider which number types and under which criteria they consider can safely be used for flexible CLI purposes";
- "an end user, with rights of use to a number, should be permitted to use that number as CLI in alternative services", and
- "operators to whom numbers are assigned should not be able to restrict the use of those numbers as CLI for other services as long as the flexible use is in conformance with the national regulatory framework".

[12] As also reported in ECC Report 248, concerning “Evolution in CLI usage – decoupling of rights of use of numbers from service provision”.

These considerations are highly pertinent to the use cases analysed. For instance, the importance of validation techniques is crucial to ascertain rights of use for numbers associated with certain services, such as call origination services provided through cloud-based call centre solutions or virtual PBXs. Such validations are important not only during the initial setting up phase, but also on a periodic basis to ascertain continued rights of use.

Furthermore, regulatory authorities' decisions related to which "number types" can be used flexibly, and under which criteria, is very relevant to address various concerns already discussed in preceding sections, such as the assignment and use of numbers on an extraterritorial basis and the use of numbers outside of their designated service allocation (e.g. geographic numbers used nomadically).

The notion that end-users with rights of use should be permitted to use their assigned number as CLI in alternative (third-party) services supports the premise of third-party providers offering decoupled call origination services, for instance through the provision of virtual PBX services or other bespoke call origination solutions. At the same time, this should be seen within the context of the importance for continued validation to ensure that such use is only made by end-users when they benefit from rights of use through an active underlying subscription tied to the number. This premise is further emphasised in ECC Report 248 [2] with the point made about operators to whom numbers assigned, namely that such operators should not stop such flexible use of numbers in third-party services, so long as this use is in conformance with national regulations.

4.4 EMERGENCY COMMUNICATIONS

Providers of publicly available number-based interpersonal communications services, where those services allow end-users to originate calls to a number in a national or international numbering plan, must provide access to emergency services through emergency communications to the most appropriate Public Safety Answering Point (PSAP).

The end-users of those services, including users of public pay telephones, shall be able to access the emergency services through emergency communications free of charge and without having to use any means of payment, by using the single European emergency number '112' and any national emergency number specified by the NPA in the NNP.

The providers of the services must ensure that caller location information is made available to the most appropriate PSAP without delay after the emergency communication is set up and this information, shall include network-based location information and, where available, handset-derived caller location information.

The caller location information is defined in the EECC as, "in a public mobile network, the data processed, derived from network infrastructure or handsets, indicating the geographic position of an end-user's mobile terminal equipment, and, in a public fixed network, the data about the physical address of the network termination point".

The location information is fundamental, namely, to locate the end-user, to identify the most appropriate PSAP and to enable a faster dispatch of the necessary means to respond to that emergency and so, it should be as accurate as possible. In this regard the data derived from the handset is important due to its potential high accuracy and high reliability.

Although the above-mentioned obligations and definition are established in the EECC, these are also applicable in most of the CEPT countries, in particular the free access to emergency services through emergency communications and the availability of the caller location information.

Therefore, if a service allows end-users to originate calls to a number in a national or international numbering plan, it must allow free of charge access to emergency services through emergency communications and the caller location information must be made available to the most appropriate PSAP. This is particularly relevant to use cases, such as online call centre services or virtual PBX solutions, that typically offer dialler functionality that allows the end-user to reach any number in national or international numbering plans.

Even if these obligations must be independent of the numbering resources used in the services and the particularities of the service – since regulation should be technological neutral – it should be considered if services that only allow end-users to originate communications to predefined/predetermined numbers and do

not give them the possibility to decide/determine the destination number of the communication, are also subject to these obligations.

Services that only allow the end-user to receive communications are, in principle, not subject to these obligations.

To make available the caller location information, the service providers must comply with the national framework, which might specify both the data of the location information that must be made available and the technological solutions of how that data must be provided to the PSAP. In this regard, it is worth mentioning the ECC Report 361 [10].

Due to the proliferation of services being offered by service providers in multiple countries it is therefore fundamental that countries follow as much as possible the standards and best practices on this matter, particularly in how the location information must be made available, to facilitate the implementation by the service providers.

As previously mentioned, the handset-derived data being processed for location information purposes can be highly accurate and reliable and so, countries and service providers should collaborate with the mobile handsets manufacturers and/or the mobile operating system developer to implement the features/means in the handsets with the necessary capabilities to provide the location data and in accordance with the relevant standards.

4.5 OTHER CONSIDERATIONS

Some of the reviewed use cases also raise very specific concerns stemming from how the solution or the application is implemented and communicated to the respective end-users and/or application users. For instance, Scenario 3 for Click-to-call raises concerns related to tariff transparency, (explored in section 4.5.1). Furthermore, both the privacy enhancement solution and Scenario 2 for Click-to-call (i.e. call-back request) could mislead users if there is insufficient clarity on how the solution or application is working, (section 4.5.2).

4.5.1 Tariff transparency regulations

In some CEPT countries, regulations on tariff transparency are in place to protect end-users from placing calls to high-tariff numbers (e.g. premium rate services) without knowing, in advance, that such call would attract a higher cost than is normally expected. For instance, the regulations may specify that clear tariff information is publicised alongside any printed or displayed advert showing premium rate numbers. Similar obligations to provide tariff information may be in place for other media, such as for radio or television shows.

In this regard, it is concerning that the application of Click-to-Call (Scenario 2) could be resorted to in order to circumvent such tariff transparency obligations. Given that the telephone number to be dialled when clicking the button is only ‘revealed’ to the end-user after the Click-to-Call button is pressed, it is possible that the end-user concerned would have no prior information that the number they are about to call attracts higher than normal tariffs. Given this risk, it is not advisable to use premium rate numbers in this manner. Moreover, such use of premium rate numbers may also be prohibited in some CEPT countries.

On the other hand, where the use of premium rate numbers is not prohibited for such Click-to-Call scenarios, it is nevertheless important that relevant tariff information is displayed alongside the Click-to-Call button to protect the end-users from bill shock as a result of unexpected high-tariff calls.

4.5.2 Awareness on the implementation of the use case

Another concern that merits attention is the extent to which end-users are informed of the implications of using certain solutions. For instance, consider the example provided in section 3.1, whereby the privacy enhancement solution is implemented for communications between passengers and drivers. In such an implementation, it is unclear whether drivers receiving calls from passengers would be aware that the number displayed as CLI would not be the number assigned to the passenger(s), but a temporarily associated number typically assigned to the service platform (e.g. the ride-hailing app provider). Similarly, passengers receiving a call from the driver using this solution could also, erroneously, think that calling back on that number, after the

lapse of some days, would reach the driver that had been assigned to them. Therefore, it is important to note that users of the privacy enhancement solution stand to benefit if they are provided with sufficient information on how the solution works, including details on the period of time during which the temporary association would still be active. This is an area where CEPT administrations could consider bespoke guidelines or regulation on aspects within their remit, such as to ensure that sufficient information is provided to end-users who avail of privacy enhancement solutions, in particular on how such solutions use other numbers to safeguard privacy and on what numbers are used as CLI. This is, of course, provided that such solutions are permitted in the first place.

A similar situation could arise in Scenario 2 for Click-to-Call (i.e. call-back request). As noted in section 3.4, if the implementation of the call-back resorts to the use of temporarily associated numbers (rather than numbers assigned to the enterprise), the called party could presume that the number displayed in the CLI ‘belongs’ to the enterprise that is calling him/her. In such scenarios, it is also possible that the called party is similarly misled into thinking that calling back on the number displayed as CLI for the call-back would connect him/her to the enterprise, which would only be the case for as long as the temporary association is active. Here again, bespoke guidelines or regulations could be beneficial to both industry and end-users alike.

5 CONCLUSIONS

This Report recognises an evolution in the value chain for the use of E.164 numbers in public electronic communications networks and services, and notes an increased role being played by providers that leverage the use of virtual numbers and/or cloud-based technology to offer novel solutions and applications. It is also recognised that, in some use cases, a number is also being temporarily 'associated' with a user different from the subscriber who is assigned that number.

Various use cases are described in section 3, followed by a high-level analysis of specific regulatory concerns that are raised by such use cases. These concerns are in turn further analysed, from a more generic point of view, in section 4. In general, it was found that there are already various ECC Reports and Recommendations that could be beneficial to CEPT administrations in providing insight on how to address the various regulatory concerns that regulators are already facing, or may face in the future, as a result of the implementation of the use cases assessed. In this regard, contributions received during the public consultation urged CEPT administrations to consider bringing about developments in the regulatory framework that are based on the principles of proportionality and technology neutrality, in order to ensure that the use of E.164 numbers in such use-cases, as well as in those still emerging, is regulated in a manner that neither limits innovation nor jeopardises end-users' rights..

In summary, the analysis of the use cases assessed relying on virtual numbers makes it possible for the following conclusions to be made on a general basis:

- Providers of electronic communication services (ECS) using numbers should follow the same regulations independently of the technology being used. In particular, rules related to the assignment and use of numbers and compliance with regulatory regimes for authorisation, licensing and/or numbering would similarly apply regardless of whether a service relies on cloud-based infrastructure or otherwise;
- In this Report different use cases are analysed, such as where a virtual number is associated with the caller and then presented as CLI to the called party. Such services should be carefully considered to avoid potential abuse or fraud[13] and, where appropriate, NPAs should put measures in place to mitigate those risks;
- Furthermore, given that the flexible use of numbers may result in an erosion of trust, NPAs should also consider appropriate safeguards to avoid numbers being used outside of their intended service description. Notwithstanding, drawing from the insights shared by contributors during the public consultation, it is also pertinent to note that there may be opportunities to review service distinctions between number types if such distinctions are no longer beneficial to the safeguarding of end-users' rights, transparency (e.g. tariffs, billing), and/or represent a disproportionate burden on providers;
- Use cases that offer the user the functionality to call any number in national or international numbering plans should be compliant with obligations related to emergency communications, such as ensuring that calls reach the most appropriate PSAP, and, where available, also transmit caller location information.

Besides the above, this Report also recognises that there may be specific regulatory concerns that would benefit from further study or bespoke guidelines, either at a harmonised CEPT level or on a national basis. Moreover, feedback gathered during the public consultation also confirms that the industry itself can play a role through self-regulation, for instance, with regards to establishing good practices in areas such as KYC. In this respect, it is pertinent to recognise that this is an evolving field and that new issues are bound to come to light with increased adoption of cloud-based solutions and applications that encompass ECN/S elements and/or the use of virtual numbers. Lastly, it is acknowledged, and also confirmed during the public consultation, that the use-cases analysed are merely a sub-set of the wide range of services, solutions and applications already available or still at an emerging stage.

[13] In fact, it is relevant to be compliant with the recommendation in ECC Recommendation (19)03 [2], which states that an operator/service provider originating, transiting or terminating electronic communications should not change a valid OI/CLI unless it is in accordance with national regulations or guidelines

ANNEX 1: LIST OF REFERENCES

[1] ECC Recommendation (19)03: “Measures for increasing Trust in Calling Line Identification and Originating Identification”, approved November 2019

[2] ECC Report 248: “Evolution in CLI usage – decoupling of rights of use of numbers from service provision”, approved April 2016

[3] ECC Report 194: “Extra-territorial use of E.164 Numbers”, approved April 2013

[4] ECC Recommendation (16)02: “Extraterritorial Use of Numbers - High-Level Principles of Assignment and Use”, approved April 2016, amended June 2023

[5] ITU-T Recommendation E.164: “The international public telecommunication numbering plan”. Available here

[6] ITU-T Recommendation E.157: “International calling party number delivery”. Available here

[7] ECC Report 311: Sub-assignment and number hosting - Implementation models, rights of use and obligations for E.164 numbers across the electronic communications supply chain, approved May 2020

[8] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Codes

[9] ECC Report 133: “Increasing Trust in Calling Line Identification and Originating Identification”, approved October 2009

[10] ECC Report 361: “Next Generation Emergency Communications – transition from circuit-switched to packet-switched networks, services and PSAPs”, approved November 2024

[11] Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws (Text with EEA relevance) as amended by Directive 2009/136/EC.