NON-CONFIDENTIAL VERSION

Promoting trust in telephone numbers

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Comments should be addressed to:
Alex Quinn, BT Group Regulatory Affairs, BT Centre, London EC1A 7AJ
alex.quinn@bt.com

1 Executive summary

1.1 The migration from PSTN services to IP services will enable BT to improve consumers' experience of communications services with new benefits and features. BT has announced plans to migrate all our services to IP by 2025. Other Communications Providers (CPs) are also progressing their plans.

1.2 If industry can work together effectively we will be able to maximise the opportunities presented to us by IP and simplify complex processes. For this, we need to develop the right tools and systems for the future. A common numbering database is a critical part of this and we are delighted to see Ofcom's focus on it in this consultation.

1.3 BT is particularly excited about the potential of a common numbering database to either facilitate or deliver the following benefits:

- **Calling Line Identification authentication and call blocking**: this will provide a step change for consumer experience by letting them know when they can trust the number that is calling, and sharing information within industry to identify and block as many nuisance and fraudulent callers as possible.
- **Improved and simplified number portability processes**: these will result in smoother and quicker switching for consumers.
- **Direct call routeing**: this will simplify how calls are connected to end users and reduce network costs.
- **Enhanced number management**: this will allow Ofcom to issue smaller number blocks and prevent number scarcity issues.

1.4 We and others in industry, working with Ofcom, have been discussing such developments for some time now. This consultation is an excellent opportunity to check that our priorities and expectations are aligned and identify areas for further work. Where there are competing priorities or objectives Ofcom will need to provide governance over the development of a common solution so it reflects all use cases.

1.5 Whilst a database is necessary to deliver the above benefits it is not sufficient. Ofcom, the OTA2 and industry need to continue to work together to ensure the design delivers the correct functionalities. It is also essential that regulation, processes, and systems that will interact with or be supported by the database are reviewed and improved to get the best out of it.

1.6 Industry has also discussed the form a database will take. So far, BT has provided consultancy, number port expertise and design input to evaluate a distributed ledger technology (DLT) based solution facilitated via blockchain. This has the potential to meet the requirements set out and we should pursue it. However, Ofcom and industry should keep an open mind about alternative technologies to deliver the database in case it becomes apparent that a DLT isn't a viable solution.

1.7 Finally, the transition from the PSTN to IP will only be complete in 2025. Until then, we will need processes that are compatible with both technologies. We anticipate this being difficult and complex, requiring continued collaboration amongst industry and with Ofcom, and a degree of flexibility and pragmatism.

2 Introduction

2.1 BT welcomes this consultation on proposals to set up a common numbering database. The move to IP provides us with many opportunities as an industry to develop smoother processes and enable new benefits and features for consumers. But it will take several years, and it is important therefore to plan ahead. Critically, we need to ensure that we have the right systems and processes in place to facilitate the realisation of these benefits.

2.2 BT has been discussing the potential benefits of a common numbering database with Ofcom and the rest of industry for some time through the OTA2's Network Port Exec Steering Group (NPESG). These discussions have been fruitful in contrast to previous efforts which lacked cross-industry agreement. There is now a great deal of alignment across industry on goals, but we recognise that there is a lot of work to be done to realise these outcomes. This consultation, and the further engagement proposed by Ofcom, should help focus efforts by laying out clearly the benefits and priorities for industry.

2.3 Ofcom highlights many potential benefits of a common numbering database, and BT is hopeful that they can all be delivered. Our overall position is therefore highly supportive of what Ofcom has set out. We discuss each in turn in sections 3 to 6 of this document. We also want to note that the development of a common numbering database should not be contingent on it delivering all of these benefits concurrently. If some of the benefits cannot be realised immediately, we still see merit in developing the database as long as there are sufficient and clear long term benefits.

Blockchain technology could be the best mechanism for delivering the benefits of a common numbering database

2.4 Currently the leading candidate for a common numbering database takes the form of a distributed ledger that uses blockchain technology. The premise of a distributed ledger is that each participant would keep its own numbering database. Through blockchain technology an immutable record of transactional activity between parties will result in an update of a core "digital asset", in this instance, the status of a telephone number. These updates would occur on a regular basis ensuring all participants' databases remain in sync.

2.5 A distributed ledger technology (DLT) supported by blockchain has some benefits that cannot be delivered by a central number database:

- It provides greater resilience in that there is no dependency on a single, central data store, potentially managed by a third party.
- It uses consensus across a consortium of network providers to ensure integrity of the common numbering database is kept intact and is less likely to become corrupted compared to central numbering database.
- It is flexible such that it can be adapted in the future to meet changing requirements if necessary.
- It can provide role-based permissions that allow different participants to have different levels of access and visibility and conduct different actions.

- It can utilise ‘smart contracts’ to model existing business processes that involve a series of actions by multiple parties. This can support a process of validation and verification of number ports, and setting robust criteria around updates.
- Finally, it would allow Ofcom better visibility of compliance by CPs with their rules and regulations around number management and porting.

2.6 As a relatively new technology, however, there are a variety of unknown factors that prevent a categorical commitment from BT at this point in time to blockchain as the technology of choice for the common numbering database.

2.7 These include, for example, the ability to access and use the blockchain DLT as a conventional database for updating Voice switch networks. Other unknowns concern factors such as the ability to archive DLT data, consortium participant management and datastore disaster recovery. However, BT is cautiously optimistic that satisfactory solutions can be found to address these concerns and that blockchain will be proven as a suitable technology base.

2.8 Alternatives to blockchain would essentially require a conventional, centralised numbering database solution. BT believes these options should be not be discounted but is less enthusiastic that the required functionality can be provided unless a bespoke solution is developed, most likely at considerable cost. Moreover, such a solution is unlikely to receive a high degree of industry support due to an inherent lack of trust over a centralised data store.

2.9 Overall BT believes that if we as an industry are to develop a common numbering database then we should pursue blockchain as a preferred option. We are providing people and expertise to support Ofcom and industry stakeholders to progress a proof of concept exercise with the aim of stringently evaluating blockchain technology. We hope this will help resolve uncertainty and establish the necessary criteria against which a decision regarding its viability can be reached.

2.10 The timeframes published in Ofcom’s consultation are a good target. The proposals for a 2022 launch of the database seem sensible, as we expect the majority of consumers to have migrated to IP. This will allow some of the new processes to bed-in prior to the switch off of the PSTN. However, given the amount of testing and development still required it is difficult to commit to 2022 as a hard deadline. Ofcom should work further with industry to develop more detailed timelines once all the requirements have been agreed and the technology for delivering them has been finalised.

2.11 Furthermore, due to the number of participants involved and the complexity of the PSTN network, the migration to IP is unlikely to be straightforward. We therefore anticipate an iterative process in developing the database. Industry and Ofcom will need to continue to be collaborative, pragmatic and flexible throughout the migration period.

3 Calling Line Identification authentication and call blocking

3.1 Nuisance and fraudulent calls continue to cause consumer harm despite the efforts by Ofcom and industry over the years to prevent them. The move to an IP network will allow industry to utilise new technologies and techniques in this battle that should enable us to see a step change in customer experience.

3.2 The methods for dealing with nuisance and fraudulent calls can be separated into two broad categories. One method is to provide consumers with information about the call they are receiving so that they can make an informed choice as to whether to answer or return the call, or not. Ofcom's General Condition (GC) C6 requires communications providers to provide Calling Line Identification (CLI) facilities by default, to facilitate such screening.

3.3 The other method is to block calls either at the network level or at the consumer level. BT has introduced Call Protect which allows consumers to customise their permissions to divert suspected nuisance or fraudulent calls to their 'junk' voicemail. Network level blocking is currently not viable due to the architecture of the PSTN network, but it will become an option as we migrate onto an IP network.

3.4 In the remainder of this section we discuss how a common numbering database can advance both these methodologies, as well as further actions industry can take to drastically reduce the level of consumer harm from such calls.

Implementing Secure Telephone Identity Revisited (STIR) would provide an indication of whether a number is trustworthy

3.5 A call receiver can currently screen a call using the presentation CLI (the number displayed on the receiving phone). But this provides limited information about the caller. Therefore, unless they recognise the number, or it appears suspicious, they might not be able to identify whether it is a genuine call. This is especially difficult because with IP it is possible for nefarious callers to spoof both the network and presentation CLIs, to appear like genuine numbers.

3.6 One way in which consumers could be better informed is if in addition to the CLI there was a signal on the caller display that confirmed whether the presentation CLI appears genuine or not after their CP conducts an authentication process. This would not result in the CPs blocking calls where they could not authenticate the CLI, but it would provide the consumers with more information to make the decision themselves as to whether to answer the call or not. Moreover, CPs could develop their call protection products to give the power to consumers to automatically reject or pre-screen unauthenticated numbers depending on what best suits their circumstances.

3.7 One methodology for doing this is known as STIR. The Network Interoperability Consultative Committee (NICC) discussed how this could be best done in their report into its implementation published in 2018[1] (the "NICC report"). In summary the

[1] https://niccstandards.org.uk/wp-content/uploads/2019/03/ND1522V1.1.1.pdf

terminating CP would examine the identity of the network CLI when the call is received and will validate it against a digital signature provided by the originating CP.

3.8 The originating CP would use an Authentication Service that utilises a private key to sign the CLI, and the terminating CPs would use a Verification Service with an associated public key in order to check that signature.

3.9 Where calls are presented to a CP for termination or transit, the CP will also sign the call. This provides traceability through the telephone network where there is a long chain of interconnected transit CPs.

A common numbering database is required to deliver STIR

3.10 To be able to perform this task two conditions need to be present: (i) the call must take place via IP from end to end, and (ii) there must be some kind of up to date database of which CP currently holds which number (i.e. where it has been ported to), so that the signatures against the number can be validated.

3.11 When designing the database, we need to ensure that some form of private key authentication process is incorporated to perform this validation. This process would likely require a Certificate Authority that grants the certificate to the originating CP to allow them to generate the keys required to facilitate the authentication by the terminating CP, as shown in Figure 7a within the "NICC report".

Industry also needs to agree how to treat international calls

3.12 One limitation of STIR based on such a database is that although it would provide an audit trail of the path a number has taken once the number is inside the UK, it would be unable to verify numbers when they come into the UK from outside.

3.13 Given the vast majority of fraudulent and nuisance calls originate outside the UK, the identification of foreign originated calls could be very valuable to consumers. It would allow them to choose to block all of these calls if they do not expect to be called from abroad, they could opt to use a call screening service, or they could answer the calls but do so cautiously making them less susceptible to fraud. For those international calls that have a CLI this can be displayed to the call recipient, but without providing certified verification, giving them the information required to determine whether to accept the call e.g. if it is a number they recognise.

3.14 Under the CLI guidance published by Ofcom[2] CPs that take on the role of an international ingress must inject an 08989 number in certain conditions e.g. where the CLI has not been received. Downstream CPs can use the presence of the 08979 CLI as an indicator that the call entered the UK from overseas. However, if the inbound call contains a Network Number then the 08979 number is not injected hence downstream CPs cannot determine that the call has entered from outside the UK.

3.15 To address this, we suggest that all CPs should have to inject a 08979 network CLI for all international ingress traffic (the presentation CLI information to be displayed to the

[2]Paragraph 4.15, https://www.ofcom.org.uk/__data/assets/pdf_file/0021/116670/cli-guidance.pdf

called user would be left untouched) so that CPs can identify clearly whether a call has come from outside the UK and this information can be passed on to the consumers.

3.16 This number will also indicate which CP first received the call into the UK, which will allow terminating CPs to identify who has the relationship with the international providers propagating these calls, removing the need to trace the calls and making it easy to identify repeat offenders. This would also allow networks to quickly identify scam calls and block them from reaching end users. For instance, the sudden appearance of thousands of calls a second with the same UK Presentation CLI, but an 08979 network CLI could be investigated quickly as a suspected scammer.

A common numbering database is also required for effective network level call blocking

3.17 The other method available to prevent nuisance and fraudulent calls is by blocking the numbers at the network level. This isn't currently viable due to the network architecture of the PSTN. Once we have moved to all IP, it will be feasible to block CLIs within the network, preventing fraudulent and nuisance calls from that number altogether.

3.18 CPs will be able to block numbers with malformed and absent CLIs but to go further they will need a database to help facilitate this work. Such a database could list all valid and invalid CLIs within the UK numbering plan, providing a simple reference table to identify and blacklist invalid CLIs.

3.19 The database could then go further, as well as identifying invalid CLIs it could mark numbers unallocated to CPs as such and all CPs could block calls from these CLIs as well. Blocking all invalid and unallocated CLIs could reduce the number of nuisance and fraudulent calls dramatically. E.g. BT's records indicate that over half of customer reported scams from geographic numbers originate from invalid or unallocated CLIs.

3.20 We discuss in section six the potential for a number database to facilitate the allocation of smaller number ranges, but one upshot of this is that fewer numbers need to be allocated in the first place so that a greater percentage can be identified as not in use just by looking at the ranges that are unallocated.

3.21 CPs do not assign every number they have been allocated to a customer. There is the potential to use the database to keep an up to date record as to which numbers have been assigned to end users and which haven't. Such number state management could provide a great deal of detail on which CLIs should not be in use and prevent many instances of misuse. We recognise that this would take considerable effort to ensure that records kept up to date, and also note that industry would need to agree standardised classification for this.

3.22 Finally, there are also instances of numbers that are never legitimately used for outbound calls. Fraudulent callers will often spoof CLIs of advertised numbers that are only used for inbound calls by organisations such as banks to gain consumers' trust. The database could include a facility to indicate such numbers and therefore allow CPs

to block any calls received from these CLIs. Ofcom and industry should assess the appetite for such a facility to determine whether to build it into the database.

A common numbering database would support better sharing of information across industry

3.23 The inability to easily identify ownership of numbers makes it difficult for terminating CPs to perform necessary checks and validation to determine whether the CLI is spoofed before taking action.

3.24 Where nuisance calls do occur, it would be possible to use the database to mark numbers suspected of misuse by using some kind of 'red flag'. The blockchain technology would disseminate this information much quicker than the processes currently in place. Each CP could then assess the details of the 'red flag' and choose to agree to the assessment and block the number or challenge it. With effective processes in place this method could deal with problematic numbers much quicker and help facilitate network level blocking.

3.25 This does not mean that Ofcom does not need to be involved in the number blocking process. They will still serve a vital function in making a determination whenever industry cannot unanimously agree on the status of a number. The common numbering database could be used to highlight these queries and disputes to Ofcom through some form of smart contact. By having access to the database Ofcom will be able to identify such problem numbers and see related information much more quickly. Ofcom will also still need to act when it sees patterns of bad behaviour from CPs, but the presence of a database should help identify such patterns and thus discourage the behaviour in the first place.

The database will only be as good as the processes built around it

3.26 Whilst a common numbering database is necessary to implement either STIR or call blocking, it needs to be implemented effectively to be successful in reducing nuisance calls. For maximum benefit, a reliable and consistent method of data maintenance would need to be established such that network operators can have confidence in the accuracy of the data. Methods and mechanisms for accessing the data and its application in the context of call management, must also be agreed and applied consistently across CPs.

3.27 These mechanisms will to some degree have a dependency on the technology used to support the common numbering database, but they are also dependent on the method of implementation. For example, a solution might be chosen that positions the CLI function of the common numbering database as an "edge of network" capability which could be dipped, dynamically, by network operators at the point of call connect. Alternatively, it could be implemented on the basis that network operators would take a batched feed, periodically, which would be used to update internal Voice network switching capabilities, off-line.

3.28 Industry will need to investigate these potential architecture solutions further. However, given the use case for such a database relies on a concept of a single,

industry numbering database that provides other functions the design requirements of CLI authentication need to be considered in parallel with those for number portability, routeing and management.

3.29 It is important in the industry discussions about the development of the database that dealing with nuisance calls is seen as a priority and not an afterthought, so that we ensure that any design fully realises the potential to act in this area.

3.30 An independent arbiter such as Ofcom or OTA2 may also have to intervene in any instances where a CP does not follow the procedures for keeping the database up to date.

Rushing the implementation of STIR may undermine its effectiveness

3.31 As Ofcom has identified, STIR can only be reliably implemented in standards compliant IP networks. Given that PSTN switch off will not occur until 2025 there will still be a considerable amount of traffic in the network that interconnects through the PSTN which will result in a large volume of calls not being reliably verified and authorised by the terminating CP.

3.32 Although it is possible to apply STIR just to the calls that take place across IP networks BT considers that this might be confusing to consumers who will observe many valid calls that aren't authorised. This could lead to consumers not appreciating the value in the STIR technology as it cannot inform them one way or another for many of their calls. Furthermore when STIR becomes more established and is able to be applied to more calls closer to 2025 consumers may not recognise its increased reliability and therefore not use it properly.

3.33 We think it would be good to test the technology thoroughly prior to passing through any verification to consumers. Trials could start to take place after the database is launched in 2022. But it is likely that consumer products that utilise STIR would not be launched until closer to 2025.

3.34 On the other hand, the technology that allows network level blocking within the IP network can be applied on IP networks immediately. Therefore, as soon as the database is populated (which Ofcom estimates to be 2022) CPs can and should utilise it to start network level blocking on their IP networks.

4 Improved and simplified number portability processes

4.1 The ability to port a number is essential for consumers wishing to switch providers, and a critical enabler of effective competition within the industry.

A common numbering database could deliver many improvements to number porting

4.2 Residential fixed line portability works relatively well from a consumer experience perspective, mainly because the process involves porting a single geographic line and the lead time allows for any porting transactional issues between gaining and losing parties to be resolved within published timescales. However, as Ofcom has identified porting for businesses is more complex as it often involves multiple lines and thus is more likely to result in failures.

4.3 We agree with Ofcom that a common numbering database can help deal with all four of the main issues with the current porting processes. This will smooth out and speed up the porting processes for consumers. In particular:

- We would see a reduction in fixed line order rejections, through better information.
- It would lead to greater transparency of who CPs need to co-ordinate with.
- It could deliver increased automation, reducing mistakes and costs.
- It will highlight non-compliance so that it can be dealt with more easily.

4.4 We discuss how each of these improvements will be achieved in further detail below.

4.5 The current industry geographic number port process relies on direct interaction between CPs using, primarily, an exchange of port orders via e-mail, with only a very small volume of orders employing electronic file transfer. This model requires CPs to perform extensive validation of every port order based on an understanding of the industry documented process, resulting in a relatively high degree of port rejections for avoidable reasons (as compared to a centralised clearing process).

4.6 The current port validation process that is reliant on post code checks is increasingly problematic in the IP world (where numbers don't always indicate location). A common numbering database will assist in maintaining data integrity, which will avoid many of the port order rejections that occur. Alternatively, the common numbering database has the potential to facilitate an authentication and validation process for port orders using another form of identifier to avoid this issue completely. Ofcom would need to explore the options from a customer experience perspective to determine how such a process would work best.

4.7 Non-geographic number portability currently follows a slightly different porting process from geographic number porting but it suffers from similar issues. BT's view is that non-geographic number portability, as an industry process, would benefit from alignment with the geographic number port model in an increasingly IP world. It would be beneficial to increase the flexibility to port numbers between IP services as geographic and non-geographic numbering differences become less relevant, as well

as the efficiencies to be gained by a need to support just a single port process at the industry level.

4.8 Currently a gaining provider can find it difficult to identify who it needs to coordinate with to progress port orders. In the case where the number has previously been ported or the customer has obtained the number from a reseller (which occurs more frequently with non-geographic numbers that often have more complex hierarchies of resellers) they may not be aware of the CPs involved. In these situations currently a gaining CP may first send a port order to the range-holder which will reject it, leading to it having to identify the current CP or reseller which can be a resource intensive task before rerouting the order to them adding a delay to the process.

4.9 Multi-line geographic number portability, where several losing network and service providers might be involved, exaggerates these deficiencies further and is in even greater need of refinement.

4.10 A common numbering database could lay out clearly which CPs numbers currently sit with, as well as the range holder, making the process of identifying the other relevant parties relatively easy and speeding up the process for the consumer.

4.11 As discussed above, porting can be process intensive with lots of manual processing involved, and can be slow to deliver for the customer. A common numbering database platform would simplify the transactional aspects of port order exchange.

4.12 CPs could receive communications relating to port orders directly through their portals into the numbering database, removing the need to generate and process emails between CPs. It would also absorb many of the validation steps that currently require manual processing. Reducing the cost of processing and delivering the potential to reduce port order lead times.

4.13 On occasion some losing providers don't comply with the current porting processes. They can do this by using the "cancel other" function to reject the port order. Sometimes there are perfectly valid reasons for doing so, but this can also be done for unjustified reasons.

4.14 A common numbering database with clear porting processes alongside it can limit the circumstances under which an order rejection is used. Blockchain technology can ensure an immutable record is kept of the times each CP has rejected orders and their reasoning for doing so. In the case of any disputes this would be easier and quicker to investigate. This should disincentivise CPs from abusing the process as it would be easy to identify repeat offenders and act against them.

The database needs to be designed to incorporate mobile porting later

4.15 Mobile number portability is a simpler industry process as there are fewer network operators involved. This has enabled shorter lead times due to higher levels of automation given the transactional process elements (between donor and recipient

CPs) are handled by an automated process facilitating the exchange of a port order token (PAC) to achieve validation.

4.16 Mobile number portability is also based, essentially, on onwards routeing and like fixed number porting, lacks a common numbering database. Although BT considers the existing mobile number port process to be "fit for purpose" at the moment, with the likely introduction of more fixed-mobile converged services and the lack of geographic constraints for IP Voice there will come a time where it would make sense to align the fixed and mobile porting processes.

4.17 We believe, therefore, that any database should be designed with the potential to incorporate mobile number porting eventually even though this will not be its immediate use. To ensure this, we would suggest that Ofcom and the OTA2 ensure that the NPESG consult with any mobile network operators that aren't currently represented in the group at the appropriate junctures during the design and development of the database.

4.18 This means that any common numbering database must support number portability that will facilitate both onwards routeing and direct routeing of both calls and SMS without the need for modification.

Potentially it could also assist with the migration from PSTN to IP, but we shouldn't wait for this to proceed

4.19 We are hopeful that the early deployment of a common numbering database will also help to facilitate the migration of telephony services from PSTN to IP, which will require each number to be ported onto the new service. However, even if the target launch date of 2022 is met, the timeframes for the migration to IP mean that up to half the numbers will need to have been ported already.

4.20 If the database is launched in time, then the simpler port processes will be able to support increased volumes and therefore would be beneficial to the migration. However, given the uncertainty around the launch date, and the requirements to start the migration prior to the target date we should avoid being dependent on the deployment of a common numbering database in order to deliver the migration. Therefore, the migration of numbers to IP services should be prepared based on current capabilities.

It is essential that we have the right processes in place for transitioning to and maintaining the database

4.21 Any process based on a central numbering database capability, blockchain or otherwise, will succeed or fail based on the quality and accuracy of commonly available data. BT believes that set-up, migration to and subsequent maintenance of the database are key to any implementation proposals, irrespective of the technology platform.

4.22 In designing the database industry will need to consider compatibility with current processes and systems to ensure that it can be updated easily with little overhead, but

it will also need to be flexible such that it doesn't limit how porting processes and systems can develop in the future. One of the benefits of a DLT is that each CP can customise its interface with the numbering database to align with their business needs.

4.23 The initial population of the numbering database will take several months during which porting processes will have to interact with numbers inside and outside of the database. There needs to be a process in place during this period where providers can identify easily if a number is already in the database and therefore ensure it updates the ledger with the port order, or if it isn't. A smart contract can be built that would perform this check for CPs but they'd all need to utilise it to keep the database up to date.

4.24 To achieve the best outcomes from the new porting processes BT believes that their roll out should be staged, such that the simplest processes (e.g. single line) start to utilise the database first and once industry is satisfied the processes are working they can move onto the more complex porting cases. So, whilst Ofcom's target launch date of 2022 for the database should see the commencement of the new porting arrangements, we expect it will take up until 2025 perhaps for all fixed porting to utilise the numbering database.

5 Direct call routeing

5.1 Currently, in the UK when a number is ported calls are directed to it via onward routeing. Calls are sent by the originating CP either directly or indirectly to the range holder who adds the gaining CP prefix and onward routes the call. The range holder levies an average porting conveyance charge (APCC) in order to recover their incremental transit costs.

5.2 IP can allow calls to direct route. If the originator knew that a number has ported from the range holder to a gaining CP they could route the call straight to the gaining CP (or route via a transit provider if they preferred.)

5.3 This would deliver several benefits:

- It removes the requirement to charge APCCs, simplifying billing processes and reducing costs for terminating networks.
- Removing the transit operator (usually the range holder) avoids issues where transit operators may go out of business which potentially results in calls not connecting. Occasionally transit operators also inadvertently cease interconnect with the terminating network. Removing them from the chain ensures that all those involved in the call connection are incentivised to deliver the call to the end user.
- Direct routeing de-risks the chances of an IP call traversing a TDM network, which would inhibit call feature capabilities such as high definition voice, call-waiting and call-forwarding etc.

A common numbering database is required to facilitate direct routeing for IP

5.4 In order to obtain the benefits of direct routeing we need a clear and simple method for originators to determine the terminating CP at any given point. A common numbering database could provide the basis for a routeing table as it would include details of the current terminating CP.

5.5 For a database to facilitate direct routeing it must be kept up to date, and CPs must be able to access these updates regularly. As discussed in section 3 we need to determine whether a solution best functions as an “edge of network” capability which CPs use as a routeing table, or a more light touch solution that provides a batched feed regularly for CPs to update their own routeing tables which are stored offline. Industry should therefore measure the level of demand in terms of how many interactions will be required, in order to assess which methodology could cope best with it.

5.6 If the database is not updated on a regular basis then calls to routed numbers may fail for a period or at least will have to continue to use onward routeing. It is important to establish how long it will take all CPs to update their routeing tables to decide whether we need to continue to support onward routeing for these cases.

5.7 We consider that it won’t be efficient to force all CPs to utilise such a database to implement direct routeing as the overheads required to maintain up to date routeing

tables may be too large for some of the smaller CPs. They may have to either arrange interconnect agreements with a CP that has access to up to date routeing tables or continue to rely on onward routeing. It is important that we endeavour to design a database that allows for flexibility of use by different CPs dependent on their resources.

5.8 The points discussed above apply both to mobile numbers and to fixed numbers even though the priority for the common numbering database is to facilitate solutions for fixed numbers due to the move to All-IP.

Industry will need to adapt their billing processes during the transition period to IP

5.9 We also need to consider the arrangements during the transitional period between implementing the new numbering database and the completed switchover to IP. The switchover is due to be completed by 2025, by which point direct routeing can take place without any network issues. However, prior to then whilst there are still some numbers hosted on the PSTN we need to consider how this affects routeing and billing arrangements.

5.10 Currently interconnect billing arrangements are incompatible with direct routeing. They rely on the fact that calls are sent to the number's range holder and assume that the range holder has received interconnect revenue for any calls to ported numbers; the recipient of a ported transit call will identify the range holder (from the post-prefix digits) and bill them for termination.

5.11 Whereas with direct routeing there will be no need to involve the range holder in billing for a call to a number that has been ported out as they will not interact with the call. An alternative methodology will need to be agreed by industry for interconnect billing, or Ofcom will need to update their relevant guidance[3] if an agreement cannot be reached.

5.12 Furthermore, given during the transitional period (and perhaps beyond - see paragraph 5.7), industry will need to run two concurrent billing processes to reflect the two routeing processes. Industry will therefore need to agree interconnect billing models to support this hybrid environment. In order for CPs to identify which billing process they should use BT considers that one potential solution could be to introduce parallel sets of porting prefixes in order indicate whether direct or onward routeing has taken place. Further work is required by industry to determine whether this is a feasible solution or whether other solutions exist.

[3] For example the 2004 INCA/CLI for NTS Interconnection charging memorandum and final direction, and paragraph A.103 of the 2013 NGCS statement.

6 Enhanced number management

6.1 A common numbering database will facilitate more effective number management once we have migrated to IP, reducing number scarcity issues. This is because it will provide better oversight of number use for Ofcom and allow it to take advantage of the potential to distribute and reclaim smaller number blocks under IP.

6.2 The new IP network will allow Ofcom to allocate numbers in quantities better aligned to CP's requirements than at present, and it will allow CPs to return numbers that sit within their ranges but are not currently being used, drastically reducing the threat of number exhaustion. This will also remove incentives for CPs to hold onto blocks they are not using in anticipation of number exhaustion in that area.

6.3 Ofcom has the power to reclaim numbers under GC B1.18 when they aren't being utilised efficiently, but it is very difficult for them to exercise this power. This is because there is no simple mechanism for Ofcom to see which numbers have been ported to other CPs, which are in use, and which aren't.

6.4 To do so currently requires Ofcom to conduct number audits that are resource intensive for both Ofcom and industry; even then, it can only reclaim numbers where the full number block is available, otherwise it would impact end consumers.

6.5 We have seen on occasion CPs return a full number block (particularly where it is subject to number charging) because they no longer have any active numbers sitting on it. However, that does not preclude the fact that some of those numbers may have been ported elsewhere and are still active. We see similar issues where a CP exits a market and the numbers are returned to Ofcom.

A numbering database is therefore needed to reduce number scarcity

6.6 Allocating and returning numbers in smaller number blocks (perhaps down to the individual level) will require a comprehensive database. Such a system can be designed to allow for the allocation of variable sized number blocks as CPs will often still require contiguous blocks of numbers. Smart contracts can be built in to ensure that if allocating individual numbers or small blocks the database determines the most appropriate, leaving larger contiguous blocks for allocation if required.

6.7 Using the same database as for porting means it will be automatically kept up to date with the number's current CP. This will make investigations and action into behaviour much easier, as well as preventing CPs from returning numbers that have been ported which would leave consumers without service.

6.8 The benefits to number management of a common numbering database are clear and obvious. For it to work, enforcement is key. We want to stress how important it is for

Ofcom to bear in mind that it would only work if processes were enforced so that all CPs and resellers (if involved) interact with it appropriately.

Improved number management will be a continuous process

6.9 BT proposes that industry maintains the range-holder principle within any new methodology and build it into the design of any new technology for allocating numbers, although numbers can be theoretically allocated on an individual basis. This is because, as set out in section 5 above, until the completion of, and perhaps beyond the transition to IP, onwards routeing number portability will still be in place. Furthermore, many interconnect arrangements between network providers (including for IP) today exist at the number block level, and these arrangements would need to be amended. Finally, CPs would likely want to maintain some spare capacity for consumers, so eventually we would expect Ofcom to allocate different sized number blocks on a flexible basis to meet CPs requirements.

6.10 In section 3 we have outlined some of the potential benefits of using the database to record the status of a number e.g. to record individual numbers as “working” or “spare” etc. In order for this to work, however, industry needs to design simple, standardised processes for updating the database that minimise the overheads involved. Industry needs to determine what the minimum viable level of information required to produce the benefits identified is.

6.11 It will require considerable work from CPs to align their internal record keeping processes with the number management database. Industry should ensure that this work doesn’t delay the development of the numbering database. If necessary one should be developed with the potential to facilitate advanced number status management to be implemented at a point in the future, rather than risk delaying any introduction of the database.

6.12 Ofcom gives a target date for a numbering database launch of 2022, with number allocation being delivered from 2025 after the completion of the migration to IP. This is because whilst PSTN interconnect still exists the network decode resource will constrain the ability to deliver routeing to individual numbers or small blocks, which is sensible. BT agrees with Ofcom however that as soon as the database is in place this will provide some number management benefits even if it’s just improved oversight and transparency about number statuses.

7 Annex 1 – BT's responses to Ofcom's questions

3.1	Do you have further views about the implementation of STIR?	Refer to paragraphs 3.5 – 3.16.
3.2	Are there any other approaches we should consider for addressing CLI authentication?	Rather than alternative approaches there are additional steps that should be taken in conjunction with implementing STIR in order to reduce nuisance and fraudulent calls – Refer to paragraphs 3.12 – 3.30.
3.3	Do you agree a common database would be required to support the implementation of STIR?	Yes – Refer to paragraphs 3.10 and 3.11.
3.4	What are your views on using blockchain technology as the basis for a common numbering database to support CLI authentication? What other solutions do you think should be considered and why?	BT believes that blockchain should be explored as the preferred option due to the benefits laid out in paragraphs 2.5 and 3.24, however we shouldn't discount alternative solutions such as a central numbering database as discussed in paragraph 2.8.
3.5	What are your views on timeframes?	Refer to paragraphs 3.31 – 3.34
4.1	What are your views on the current implementation of number portability in the fixed and mobile sectors?	Refer to paragraphs 4.2 – 4.16
4.2	What are your views on sharing the functionality of a common numbering database for CLI authentication to also support improvements in UK porting processes?	A CLI authentication process that does not incorporate an up to date record of porting transactions will not be able to function, refer to paragraph 3.10. Furthermore given the ability to share the costs of a database across a number of use cases it is logical to utilise the database for both, refer to paragraph 3.28.
4.3	We are currently supporting a blockchain pilot. Do you have any views on using this technology for port transactions and a routing database? Are there other alternatives that should be considered?	BT believes that blockchain should be explored as the preferred option due to the benefits laid out in paragraphs 2.5 and 4.14, however we shouldn't discount alternative solutions such as a central numbering database as discussed in paragraph 2.8.
4.4	What are your views on implementation timeframes and the importance of a common database solution being available to support the migration of telephony services to IP?	Please refer to paragraphs 4.19 – 4.24.
5.1	What are your views on the potential for a common database solution to also provide shared functionality to support number management?	Please refer to paragraphs 6.6 – 6.8.
5.2	What do you see as the benefits or disbenefits of changes to number management post PSTN retirement?	Please refer to section 6.
6.1	Do you agree, in principle, with the need to develop and adopt a common numbering database? If not, why not?	Yes – please refer to paragraphs 1.1 – 1.5, and throughout the response.
6.2	If you do not agree with the need to develop and adopt a common numbering database, do you	N/A

	have any suggestions on how the issues we have set out in this consultation could be addressed?	
6.3	Do you agree that in the first instance industry should lead the implementation of a common numbering database, with Ofcom providing support to convene and coordinate key activities? If not, what are your views on how implementation should be taken forward?	Yes it is essential that industry continue to be at the forefront of the design and implementation of the common numbering database, however it is equally important that Ofcom continues to oversee this process. Refer to paragraph 1.4 and 1.5.