



Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

REGULATING INTEROPERABILITY

Constanta, July 2007

EXECUTIVE SUMMARY

This report discusses and explores the issue of interoperability to provide interconnectivity for users and access to third party services. It outlines how the approach to interoperability has changed during the development of telecommunications policy and the progress of competition and liberalisation, and highlights the risk that the shift to ex post intervention only in cases of proven market failure could undermine interoperability.

It reaches the following conclusions.

- Interoperability in terms of any-to-any connectivity and access to indirect service providers is of high importance for users, but there is a tension between promoting interoperability and promoting innovation
- Interoperability is a difficult technical issue that is strongly dependent on standards and test facilities and given the increasing complexity of systems should not be underestimated.
- Although standards are essential they are not perfect, and the effective promotion of interoperability needs to take account of weaknesses in standards.
- The current degree of interoperability has benefited from the past history stronger ex ante intervention and regulation of details.
- The trend in regulation is to leave more to the market and to intervene only ex post after market failure has been proved. This may weaken the regulatory basis for interoperability and require regulators to give interoperability more direct attention as an issue of consumer interest.
- The publication and use of Reference Interconnection Offers has provided a valuable focus for interoperability within each country but RIOs may no longer be required for new services where there is no significant market power.
- The market can work to produce a good level of interoperability in practice but the process may be slow and only partially successful.
- The increasing choice between telco provided services and Internet based services may create pressure for the telcos to improve interoperability to avoid losing subscribers to Internet based services where, even if they are not full interoperable, the cost of duplication is low.

The report recommends that regulators and governments who are concerned to maximise interoperability should consider the following:

- Supporting the development of relevant standards and test facilities.
- Ensuring that there are agreed standards and profiles for interconnection between telcos within their country and within Europe.
- Ensuring that there are open and procedures that are balanced between the interests of operators with significant market power and other operators for the introduction of new services and features by operators and service providers with significant market power.

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Regulating Interoperability

1 INTRODUCTION

Interoperability is central to telecommunications, because the provision of any telecommunication service necessarily involves the co-operation of multiple elements or systems. However its scope goes beyond traditional telecommunications since it also includes most IT applications and involves both hardware and software with software becoming increasingly important.

ETSI has defined four different levels of interoperability¹:

- **Technical interoperability** is usually associated with hardware/software components, systems and platforms that enable machine-to-machine communication to take place. This kind of interoperability is often centred on (communication) protocols and the infrastructure needed for those protocols to operate.
- **Syntactical Interoperability** is usually associated with data formats. Certainly, the messages transferred by communication protocols need to have a well-defined syntax and encoding, even if it is only in the form of bit-tables. However, many protocols carry data or content, and this can be represented using high-level transfer syntaxes such as HTML, XML or ASN.1. Generally, ETSI is a user rather than a definer of generic syntaxes with a few notable exceptions such as the definition and use of CSN in GSM.
- **Semantic interoperability** is usually associated with the meaning of content and concerns the human rather than machine interpretation of the content. Thus, interoperability on this level means that there is a common understanding between people of the meaning of the content (information) being exchanged.
- **Organisational Interoperability**, as the name implies, is the ability of organisations to communicate effectively and transfer (meaningful) data (information) even though they may be using a variety of different information systems over widely different infrastructures, possibly across different geographic regions and cultures. Organisational interoperability depends on successful technical, syntactical and semantic interoperability.

Regulators may need to set requirements for interoperability to ensure that certain social objectives are achieved such as an any-to-any connectivity for services or access to emergency services. Regulators need to define how and when interoperability has to be supported and exactly how it has to be supported. An important issue for regulators is deciding when to intervene and impose requirements and when to leave the issues to the market players. Regulators may also promote interoperability within the market without placing explicit requirements. In the past regulators have been quite ready to intervene ex ante to require interoperability in telecommunications but as competition has developed they are becoming more inclined only to take ex post actions in cases of clear market failure. This may affect the degree of interoperability achieved and therefore the report explores how interoperability can be promoted without having rigid requirements.

The scope of this report is limited to technical interoperability and interoperability in regulation. The two approaches are inspired by different motivations and have different protagonists: whilst the technical interoperability concerns mainly network operators, service providers and manufacturers, which see interoperability as a way to better play their respective business roles, interoperability in regulation mainly concerns policy makers and regulators, as a way of fostering competition, protecting the users and promoting specific telecommunication policies.

Technical interoperability and regulatory interests and related procedures interact, quite often in a convergent way where the market players and regulators have common interests or goals, but they also may diverge and this is where regulators may need to take action. Addressing interoperability problems, however, is difficult and experience has shown that there are many pitfalls and risks of unforeseen negative results

The objective of this report is to provide guidance to regulators and policy makers on how to handle interoperability issues and on what measures may be appropriate. The perspective of this report is primarily that of the end user of services.

Interoperability is a high-level "umbrella" requirement that needs to be supported in practice by interconnection between services and network and satisfactory interworking between individual equipments. Interoperability embraces not only technical but also commercial and operational issues.

¹ ETSI White Paper No. 3. Achieving Technical Interoperability - the ETSI Approach. Version: 0.6

2 TECHNICAL INTEROPERABILITY

From the side of operators and manufacturers, interoperability consists in making different elements or systems work co-operatively to provide a telecommunication service. Consequently, interoperability is part of the design and implementation of the telecommunication system, and has to be considered at the level of the functional units that compose the system.

Technical interoperability is achieved by means of the definition and implementation of technical specifications or standards that identify the elements and functionalities that compose the system and define the relationships (protocols) between them.

2.1 Definition of technical standards

The use of standardised solutions benefits operators by allowing them to use multi-vendor solutions, and also enables manufacturers to concentrate their efforts in developing specific parts or components of the telecommunications systems (instead of being obliged to develop and maintain entire monolithic solutions) and also to update or improve individual components, without changing the rest of the system or telecommunication network.

Technical standards are developed by officially recognised standardisation bodies and by industry groups known frequently as fora. Ordinarily the standardisation process has three stages: service definition and requirements, architecture and protocols.

ETSI plays a very important role because according to Article 17 of the Framework Directive, the list of ETSI standards published in the Official Journal of the European Communities serves as a basis for encouraging the harmonised provision of electronic communications networks, electronic communications services and associated facilities and services. The Commission may even request that standards be drawn up by ETSI, and regulators and policy makers may make such standards compulsory.

Whilst good standard are most effective in promoting interoperability, poor standards cause many problems. For example:

- Badly written standards cause ambiguity over what is required, and lead to a failure to achieve interoperability between different implementations by different parties.
- Standards with too many options fail to promote interoperability if implementers select different options. Further work is often needed on profiles to select a unique set of options.
- Standards written using many cross-references are very difficult to use and there is likely to be confusion about the requirements. (During the work on ISDN, when composite requirements were prepared by assembling all the text that was cross-referenced the authors of the standards were quite surprised at the result and its lack of clarity).
- Requirements without associated tests may fail to show clearly which party is not satisfying the requirements.
- Standards that are over specific beyond what is needed for interoperability may inhibit innovation.

Since the cost of correcting interoperability problems increases rapidly when problems are detected later rather than earlier, improvements in the quality of standards produce great benefits.

2.2 Testing activities

Conforming to standards and passing their tests is only the first step to achieve the “technical interoperability”. Implementations need to be tested for interoperability through interoperability testing that explores the interactions between the implementations in many different states. Interoperability testing is also part of the technical interoperability process.

Testing is a complex activity. Most vendors and most important operators already have their own testing facilities. In the case of network operators, these facilities are often intended to evaluate equipment with a view to installing it in the network: therefore only specific types of equipment, from specific vendors, ever reach the operator's test facilities (it makes no sense to evaluate equipment from vendors that the operator does not intend to purchase from). In particular, many operator facilities are focused on evaluation of terminals.

Vendors build their test facilities for a number of reasons: to evaluate and ensure interoperability between all components of a solution offered by that vendor (not necessarily the vendor's own products), as product showcases, and as a platform to open up to developer programmes. It would be unusual to expect vendors to integrate products from rivals into their own test facilities. However, interconnection between different vendor implementations is not uncommon, in particular for the purposes of an "interop" event. Vendors have a particular advantage in establishing their own test facilities, in that it is much easier for them to keep their own equipment and software up to date.

There are several organisations that are deeply involved in interoperability testing. GSMA² and OMA³ are good examples in the area of mobile services.

Unfortunately not all standards contribute to interoperability. Some are never implemented. Some are inadequate. Others fail to cover the features that are later found to be important and need to be changed or enhanced later.

3 INTEROPERABILITY IN REGULATION

Regulators and policy makers are concerned with promoting or guaranteeing the availability of certain services and with the provision of telecommunication services across different networks in a competitive environment.

Requiring interoperability between services and /or service providers enables regulators to eliminate potential abuses of market power from stakeholders who control all the elements in the chain of the supply of the service (e.g.: vertical integration). Having interoperable services (e.g.: mobile and fixed telephony) and also the provision of single services by means of a chain of different providers that run interoperable systems (e.g.: the global telephone network) help to achieve the general policy objective of providing the citizens and the whole society with the best and more convenient communications possibilities at the lower cost.

Consequently, regulators and policy makers consider interoperability issues from a more “macroscopic” perspective than operators and manufacturers.

Regulatory requirements normally result in requirements to offer certain features or interfaces that are defined in specific standards.

Both interoperability and universal service provisions are key topics for policy makers. They are different. Universal service means the minimum set of services of specified quality, which is available to all users regardless of their geographical location and at an affordable price. In contrast, interoperability is not just focused on a limited set of services and on the needs of groups of less favoured users, but on the whole range of services that make up the electronic communications market. Interoperability is however an essential ingredient in the achievement of universal service.

It is worth reviewing how the approach to regulating for interoperability has developed and changed over time within the EU.

3.1 Before competition and liberalisation

Before the start of liberalisation, the interests of regulators and operators were broadly coincident as most operators had a strong relationship with the regulator or government or were themselves government departments.

The most prevalent telecommunication service was the voice telephony, which was offered in most countries as a monopoly, so achieving interoperability between different service providers applied only to global international connectivity.

This objective were covered by international agreements between national administrations⁴ and directly implemented by the corresponding national operators, so there was no need for explicit interoperability requirements in the national regulations.

From the operators’ point of view, technical interoperability was a bit more complex because, apart from the international interconnection requirements they have to deal with some internal interoperability issues like evolution in network equipment and, in some cases, maintaining a network made of multi-vendor equipment. These interoperability issues were

² GSMA has conducted a number of inter-operator trials of SIP and basic IMS applications in a multi-operator environment during 2005 and 2006. Focused initially on SIP interconnectivity, these trials used a single handset type and focused on instant messaging, video sharing and gaming, as well as inter-operator SIP connectivity using GRX carriers.

³ OMA believes that interoperability of mobile services is critical for end users and is vital to ensure the commercial success of mobile data services, including those delivered by 2.5G and 3G networks. The OMA interoperability process (IOP) has been established around the concept of regularly held TestFestivals (OMA TestFests) hosted by OMA, where member companies can bring their implementation to test in multiple cross-vendor combinations. OMA TestFests are designed to have a dual purpose of ensuring the quality of OMA specifications and of enabling vendors to verify and test the interoperability of their product implementations.

⁴ e.g.: International Telecommunications Regulations, from the 88’ ITU Conference

solved by means of very stringent pre-qualification tests (in many cases defined and performed by the operator based in the standards, when available) before the introduction of any new equipment in the network.

3.2 The Services Directive, the ONP Framework and terminal equipment

In most western European countries the introduction of competition in telecommunication markets came with the services directive and the ONP framework. Achieving adequate interoperability between different the service providers established in the same country became a regulatory issue, because lack of interoperability inhibited competition and, hypothetically, could lead to isolation between customers from different operators. New entrants needed interoperability to be able to offer a marketable service.

The fixed telephone service (based on circuit switched technologies) was by far the most prevalent service, and was extended through the introduction of mobile telephony that, from its conception, was fully interoperable with the fixed telephone service. Many new entrants relied on the leased line services from the incumbent operators.

Services were provided almost exclusively by telecom network operators, which employ a dedicated network for each kind of telecommunication service, so the interoperability between the services offered from different providers could still be guaranteed by the interconnection of their respective networks.

Consequently the regulatory requirements regarding interoperability in the ONP framework were limited to specific services that were identified in the directives⁵, and the interoperability requirements were formulated in terms of “*guaranteeing adequate and efficient interconnection of networks*”. These were sets of “ex ante” requirements on incumbents and they helped to promote interoperability.

Third party service provisioning was considered only for value added services.

From the technological point of view, telecommunication networks started to use software based equipment and introduced layered functionalities, from the same or different vendors. This added a new dimension to technical interoperability, which may be designated as “vertical interoperability”, in contrast to the “horizontal” dimension where the parties concerned interact in technical terms on an equal footing.

The liberalisation of terminal equipment produced some important lessons about technical interoperability. In the first and second phases of liberalisation based on NETs and CTRs, there were regulatory approval requirements for terminal equipment to interwork with the network and to interwork via the network in the case of voice telephony. These requirements were expressed technically in highly detailed and complex standards and the approval arrangements allowed little room for deviation from the standards. Substantial practical problems were experienced such as:

- Delays in establishing adequate certified test facilities and agreed sets of tests
- The investment needed for the tests created monopolies in testing and test machines took precedence over the working of the requirements in the standards
- Long delays in changing standards whose requirements were found to be wrong
- Confusion resulting from failure in the standards to distinguish requirements adequately from advisory or informative text.

These problems cause serious delays in bringing terminal equipment to market and taught the lessons that:

- Good standards to support interoperability are very difficult to develop and despite the best intentions mistakes can easily be made
- If there are too many options then a profile (agreed selection of options) of the standard may be needed
- Making a standard with all its detail into a technical regulation does not allow the flexibility that is essential to address errors and ambiguities in the standards
- A fast response system is needed to agree and publish amendments and clarifications to the standards
- Attention needs to be given to both requirements and tests.

⁵ Annex I in Directive 97/33 explicitly request interoperability for the following services

- The fixed public telephone network
- The leased lines service
- Public mobile telephone networks
- Public mobile telephone services

3.3 Current regulatory framework

The 2002 regulatory package adopted a technology neutral principle, and as a consequence became less service specific and relied more on the market. The former asymmetric regulation for incumbents moved towards competition regulation, implemented by means of a market analysis procedure and a toolkit of remedies to be applied on operators having significant market power (SMP operators).

Interoperability of services was kept as a regulatory requirement, but the new approach adopted in the directives results in the withdrawal of the specific requirements contained in the ONP directives, which is substituted by more general statements that, in principle, might apply to any electronic communication service. "Ex post" interventions are expected to replace "ex ante" remedies wherever possible.

Additionally, the new directives also adopted a more open approach when referring to the way of achieving interoperability⁶: they consider that National Regulatory Authorities may impose obligations on operators to meet requests for access to specific network elements or to provide specified services in order to ensure interoperability of end-to-end services to users.

Consequently, in the current regulatory framework NRAs may, in theory, define interoperability requirements in relation to any electronic communication service, but in practice these new powers have rarely been employed. In terms of what is implemented, what was required under ONP is still available.

The one point of note is that the 2002 directives include specific requirements relating to conditional access services and other facilities employed in the provision of digital radio and television broadcasting services⁷. It is interesting to see that the directives explicitly set these interoperability requirements even in the absence of proved market failure, which suggests that the promotion of competition is not the only reason for these requirements.

From the technical point of view, the evolution in the provision of telecommunication services has led to the widespread use of the Internet (originally built as an overlay network over traditional circuit switching public networks) that becomes ubiquitous and is used to support many other telecommunication services.

The use of Internet has been promoted by the great success of person-to-machine communications and applications (e.g. Web access) and machine-to-machine communication services are becoming more common.

The open nature of the Internet and the IP technologies lead, on the one hand, to the proliferation of third party services provided using the Internet as a basic transmission facility and in the other hand to a number of initiatives such as NGN aiming to emulate traditional telecommunication services using IP technologies.

Another important aspect of the open multi-service or service agnostic nature of the Internet is that service providers can offer services globally without having to establish interconnection or interoperability with other service providers (provided that there is not artificial blocking). This means that innovations can grow very rapidly and globally without interoperability. Interoperability between such service providers may become an issue later. Once supported between the service providers it becomes available universally due to the open connectivity platform although there may be some degradation of quality and ease of use. This model contrasts with the development of the NGN where interoperability is built in technically from the start but requires much more extensive commercial and operational activities to achieve in practice because of the need for interoperability between the all the different transport (or transit) networks involved.

All those innovations result in new forms of technical interoperability issues for manufacturers and operators:

- new vertical interoperability issues between different providers, and
- new horizontal interoperability issues between providers of dissimilar but still interoperable services (e.g.: VoIP and telephony, or e-mail to SMS). Specific interoperability devices (gateways) are used in these new scenarios as well as in the traditional horizontal scenarios (between providers of the same type of service) when the networks involved employ different technologies.

In summary, in the 2002 framework technical issues between different operators and providers start to become much more complex and, in theory, the regulation gives more freedom to NRAs to define requirements appropriate for this new rich and evolving situation. However, apart from the specific requisites on conditional access systems already included in the

⁶ See article 12 in the access directive.

⁷ See article 6 in the access directive.

Access Directive, the study of the new interoperability issues by regulators has been uncommon and intervention by regulators has been justified only on competition grounds rather than interoperability grounds.

4 REGULATING INTEROPERABILITY IN THE FUTURE

The aim of the Next Generation Network is that generic access and transport infrastructures supporting multiple services will replace single service networks.

The NGN will coexist with the Internet and also with other kind of informal models (e.g.: special interest networks built as overlay systems on the public networks or services). This evolution and the variety of new scenarios may complicate the issue of the technical interoperability due to the increasing variety of both vertical and horizontal interoperability possibilities in an inter-provider environment.

Additionally, at the retail level, the new scenario will be characterised by a growing number of commercial offers that bundle services or capabilities that presently are in the scope of the telecom regulation with other types of services from the broadcasting field as well as from the Information Society Services or from the Information Technology fields, a prime example being triple play.

Machine-to-machine communications are growing in importance where the communications functionality might be embedded within a more complex service or application that, in the present regulations, might not be considered within the scope or the regulatory framework.

In late 2005 the European Commission started the revision of the 2002 regulatory framework, in a process known as the 2006 review, intended to adopt a new set of directives defining an adequate framework for the regulation of the future communications landscape. The proposals made by the EC so far have not identified major changes concerning interoperability or end-to-end connectivity.

Whilst we may expect that in the future regulatory framework interoperability will be kept as a basic objective, there will be a steady move from ex ante to ex post regulation. There may no longer be a requirement for a Reference Interconnection Offer (RIO) if there is no incumbent or party with significant market power. The loss of the role of the incumbent as the centre of a "star" of interconnected services and of the RIO may affect interoperability as the incumbent with its RIO served as a valuable focal point for interoperability within each country.

Regulators need to prepare for this change. The progressive shrinking of the role of RIOs may lead to new interoperability issues that will have to be solved by regulators using other tools than ex ante powers. As a result, interoperability obligations may become consumer protection issues rather than competition issues.

5 INTEROPERABILITY DRIVERS AND BARRIERS

The degree of interoperability achieved is the result of a trade off amongst different forces that may be considered as drivers or barriers. In order to solve potential interoperability issues we need to understand how these factors interact.

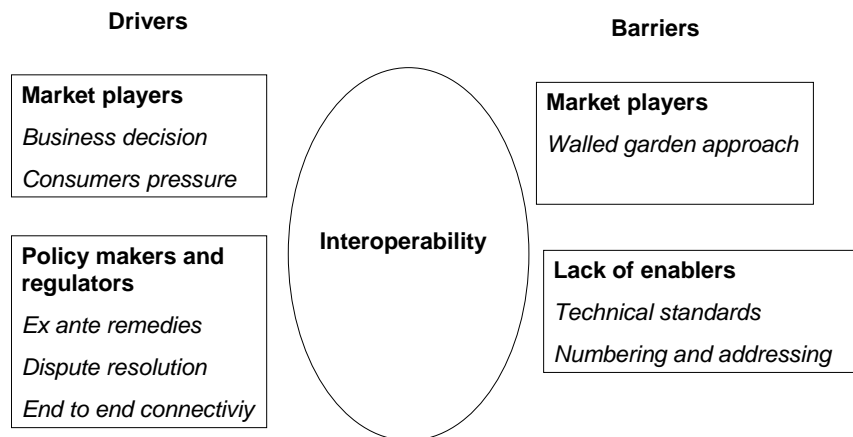


Figure 1: Drivers and barriers for interoperability

5.1 Drivers of interoperability

Market players

The main driver for interoperability in the electronic communications industry is the behaviour of each individual party, and as a result the behaviour of the market itself as a whole. The agreements reached voluntarily by the different parties, acting in their own interests, have contributed to interoperability in many areas such as SMS and MMS in the mobile market.

Technical interoperability has been based on standards but the organisational and commercial aspects have been facilitated greatly by organisations such as the GSMA, which has provided templates for agreements and procedures and also facilitated clearing houses for call details and billing. Thus the market seems to have supported interoperability between equals quite well.

Interoperability between unequal parties has not developed so well. For example:

- Third party control of intelligent network services was resisted strongly in the 1990s despite attempts by the EC to promote such operation
- The number of Mobile Virtual Network Operators is quite low especially in countries where there are few operators with their own infrastructure
- Third party service provision on mobiles, such as WAP services, has developed rapidly only where the services do not compete much with those of the host operator
- Many features that do not require interoperability to work, such as ring tones, are made to be incompatible between different operators as a means to lock-in subscribers.

Despite the potential of NGN and IMS to separate connectivity from service provision, it remains to be seen whether such separation will be offered voluntarily.

Policy makers and regulators

Public administrations have contributed to interoperability in two ways:

- through public procurement,
- through imposing interoperability requirements by regulation, e.g. EC Decision against Microsoft⁸.

We have already seen that the regulatory framework for electronic communications includes different provisions that allow regulators to approve measures with the aim of guaranteeing interoperability:

- Decisions setting ex ante obligations (applying only to dominant market players)
- Resolution of access and interconnection disputes
- Decisions intended to ensure end to end connectivity.

In general terms, the situation described above is expected to remain unchanged in the near future, with the industry itself being the main contributor to interoperability, but complemented by isolated regulatory decisions when the market forces fail to satisfy the general interest.

5.2 Interoperability barriers

To achieve real interoperability it is necessary to overcome the potential barriers such as:

- Resistance to competition
- Lack of appropriate technical standards
- Lack of adequate naming and addressing resources.

Resistance to competition

Following their business strategies, operators and service providers have a tendency to protect their revenues by resisting market entry. In areas where some degree of interoperability is needed (e.g. compatibility of equipment of different vendors in the same network, or end to end connectivity required by the customers) market players readily agree a set of technical standards that solve most of their needs but without giving enough attention to the needs of potential third parties.

When there are no clear needs to develop standards, companies just try to take advantage of first mover advantages in order to be as close as possible to a monopoly situation. An example is Skype in the field of VoIP, which is based on proprietary developments and with absolute lack of interoperability with other potential service providers offering the same type of service. Skype does however support application providers as they increase traffic and do not compete directly.

Technical standardisation

The lack of appropriate technical good quality standards or common published specifications is a serious barrier to interoperability. Such standards or specifications usually require plenty of time to be developed and therefore have to be planned and prepared well in advance.

Regulators may require interoperability through the use of standards. Regulators may also promote standardisation, according to the electronic communications regulatory framework without making it subject to a regulation. In order to prevent the failure of implementation of regulatory decisions due to a lack of technical standards, early identification of specific scenarios where interoperability might be required is highly recommended. This task should lead to the promotion of standardisation activities or the request for drawing up the required standards.

Naming and addressing resources

Services can only be interoperable if there is an agreed method of identification of the parties and entities involved. The lack of adequate names and addresses may become an extremely serious difficulty if different providers use incompatible and privately managed resources. This problem is avoided if established public identifiers are used and allocated by regulators or independent third parties such as registries.

Early identification of naming and addressing needs is highly recommended in areas where interoperability might be required. Regulators should have the powers to guarantee the availability of naming and addressing resources when the lack of such identifiers may become a barrier for interoperability.

⁸ Decision of 24 March 2004 imposing measures against Microsoft, related to lack of interoperability in work group server operating systems.

6 GUIDELINES FOR SOLVING INTEROPERABILITY PROBLEMS

6.1 The categories of problems

When the industry fails to provide interoperability in a scenario where this facility is considered necessary, it is the task of the regulators to impose such interoperability. This regulatory intervention may be seen as a last resort mechanism to defend the rights of the users or to solve a market failure. There are two main categories of interoperability:

- End to end connectivity
- Access to service providers.

End to end connectivity

Decisions regarding interoperability between end users are possibly one of the most challenging tasks that regulators and policy makers will have to work on in the years to come. Decisions will rarely be based on easily measured factors, obtained from market or technical analysis, but on more subjective aspects that ordinarily fall on the side of telecom policy.

The rationale for such decisions will be a desire to configure a given market in a way that, in the long term, will be beneficial for the users and for the society as well. To accomplish this, the first and by far most difficult job for a policy maker to do, is to determine whether or not it is necessary to guarantee end-to-end connectivity in a given scenario (e.g. telephone calls, short messages, instant messaging). This means assessing the cost to users of not having full interoperability.

Once this first decision has been taken, it may trigger other regulatory decisions related to numbering or standardisation to achieve interoperability.

It is worth noting that end to end connectivity applies both to communications between "peer" ordinary users, and to communications between a user client and a "host" service provider (e.g. content providers).

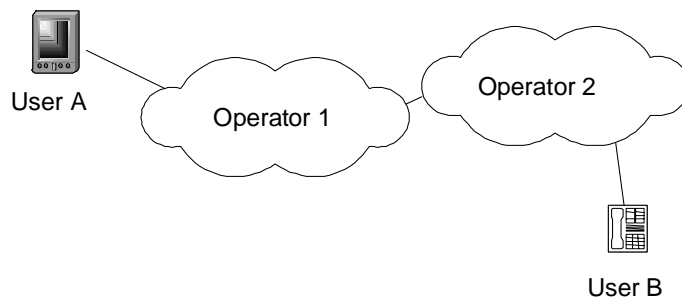


Figure 2: End to end connectivity

Access to ECS service providers

This concerns access by an end user to an indirect provider of electronic communications services (e.g. access to an ISP, or to telephony services through carrier pre-selection). The main decision to be taken is not related to end-to-end connectivity, but to freedom of choice for the customers. In this regard, we expect that decisions on this field will be commonly derived from market analysis. As in the previous category, we may also expect that this issue will become crucial in the years to come with the potential separation of service provision from connectivity.

Decisions will normally be based on objective market analysis, and as a result will fall under the responsibility of NRAs and national competition authorities, depending on whether the decision to be taken is seen as an ex ante remedy or an ex post measure.

Once the regulator has decided on the need to ensure this type of interoperability, the difficulties may arise in the implementation phase. The measures that have to be taken in order to make it technically feasible are not very different than in the case of end-to-end connectivity.

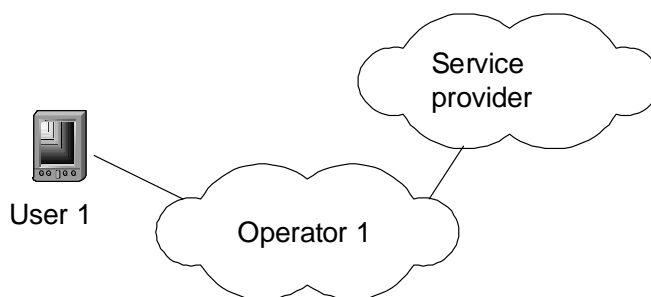


Figure 3: Access to an indirect ECS service provider

6.2 A method for analysing interoperability problems

When analysing an interoperability problem, before deciding on the imposition or not of an obligation, the regulator or policy maker should consider:

- The nature and extent of the problem
- The stakeholders involved
- The consumer opinion
- The alignment with general telecommunications policy objectives
- The impact on competition
- The availability of scarce resources.

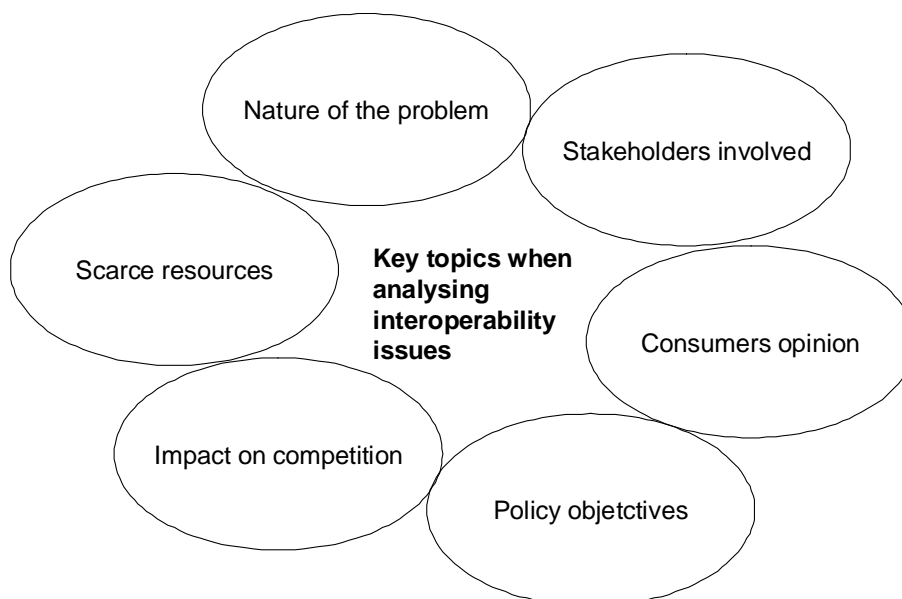


Figure 4: Analysis of interoperability problems

Nature and extent of the problem

Identification of the nature of a potential interoperability problem means analysing whether it falls in the category of end to end connectivity, or otherwise it is a case of lack of access to a service provider that prevents freedom of choice for users. The category involved will determine the way to address the issue and the body entitled to take action.

In analysing the nature of the problem, it is crucial to identify if there is a lack of appropriate technical standards, or a lack of adequate numbering and addressing resources.

The economical side of interconnection may also cause interoperability problems. This may be the case of premium rate services, where interoperability requires parties to agree on complex cascade payments. It is important to detect if interoperability problems come from the provision of an electronic communications service itself, or from charging and billing by a third party, or from content associated with the communication.

Furthermore it is important to assess the extent of the problem in terms of the cost to market development, to users, and to society as a whole of the lack of interoperability.

Stakeholders involved

Identification of the stakeholders that are actually causing the lack of interoperability, taking account of the following:

- Is it only one or several parties that are causing the problem?
- When there are several, it may be useful to make some additional research:
 - Are they playing similar roles, or they are at different points in the value chain?
 - Are all of the parties involved preventing interoperability, or only some of them?
 - Do they, individually or as a group, have a dominant position in the market?

Generally regulators and policy makers should stick to the principle of minimum intervention, refusing to set obligations to more agents than strictly necessary to solve the interoperability problem. For example, for voice telephony, they may require a dominant operator to provide transit services, enabling other market players to interoperate without the need of having direct interconnection.

Consumer's opinion

The consumer's view of the lack of interoperability should be taken into account. Such opinions are especially relevant in the case of end-to-end connectivity, because any decision on this field seeks direct users benefit as a short-term goal.

In cases concerned with increasing the freedom of choice for users, in the application of the regulatory framework regulators have to consider whether a short term benefit for consumers in terms of increased choice resulting from intervention is better than the potential long term benefits of allowing the market to develop its own solution. For example, incumbent operators may benefit from the requirement to provide carrier selection, as some subscribers may prefer an incumbent with carrier selection to an alternative operator (eg cable) who does not offer carrier selection. In other words the intervention that helps indirect operators may distort other aspects of competition such as between incumbents and other access providers.

The view taken on these issues may vary with the state of development of the market with more intervention being justified when the market is less mature.

Alignment with general telecommunications policy objectives

Policy makers have to ensure that any decision on this field is coherent with their strategic view on how they want the market to be in the future. This long term view is what may influence most of the decisions related to end to end connectivity, as they will have to be taken enough in advance to be successful.

In dealing with interoperability issues, some of the key principles and objectives that need to be looked at include:

- Abiding by technological neutrality
- Maximizing benefit for users in terms of choice, price, and quality
- Encouraging efficient investment in infrastructure and promoting innovation
- Ensuring that the integrity and security of public communications networks are maintained

Impact on competition

Market analysis will have to be performed when needed. Moreover, no decision should be taken without a previous forecast of the impact of such a measure in the market. Nevertheless it is often difficult to predict the impact, as parties may not always act rationally. Cultural issues should also be taken into account, for example interoperability on the Internet was arguably increased greatly in the early years by the commitment of all parties to the ethos of unconstrained and open communications that promoted the public interest and much of the development was undertaken by experts on a voluntary unpaid basis. Such communities may be best left to solve their own problems, whereas in the traditional telecommunications world there is a much stronger case for intervention.

Availability of scarce resources

Is there a situation of scarce resources that prevent the market itself from solving the problem? Does this arise from other regulatory decisions such as allocation of numbers, radio spectrum, or rights of way? Regulators and in administrations may solve such problems directly.

6.3 Selecting the best solution

After analysing the problem, regulators need to decide whether to:

- Take no action
- Take indirect action
- Impose a requirement.

This decision should primarily take account of balancing the cost of the interoperability problem and the cost and effectiveness and risks of the solution.

Indirect solutions

Indirect solutions are normally preferable if they are likely to solve the problem within an acceptable time. Such measures include:

- Promoting and even funding the development of needed standards and test facilities
- Publishing lists of standards recommended for interoperability
- Making the necessary resources such as numbers available.

The development of standards takes time therefore regulators should try to identify early the need for standards to promote Interoperability.

The Commission has followed the approach of publishing lists of standards for interoperability but there seems too little awareness of the lists within the market place and hence the measure seems to have had little effect. Issues have arisen in selecting the standards to put in the lists and in understanding the meaning of their inclusion. ETSI has been inclined to include many standards but the inclusion of a large number reduces the focus and perhaps devalues the exercise.

Another approach is to discuss the problem with the parties involved and to indicate willingness to impose requirements if they do not resolve the issue voluntarily.

Requirements

Before imposing a requirement, regulators should consider carefully:

- The on-going costs to users of the absence on interoperability taking account of the degree of maturity and future value of the market
- The cost of implementing the measures required, taking account of the fact that requirements that have not been anticipated and "designed in", may cause substantial extra costs for operators and manufacturers. It is in the early stages of standards work that the best trade off between cost of implementation and benefits of interoperability can be achieved.
- The availability of standards and test facilities to support the requirement and the extent of alternative options within these standards. If there are many options then a set of options (a profile) may need to be selected.

In deciding on the form of the requirement, regulators should not assume that standards are perfect but should allow some flexibility for errors and ambiguities in standards to be resolved. There are several ways in which this can be done:

- Specify the requirement for interoperability only at a high level by expressing it in terms of what should be achieved whilst leaving flexibility over how it is achieved
- Where published standards are used, introduce a fast response system, nationally if necessary, for agreeing and publishing changes and clarifications regarding the use of the standards. These changes can be collected and used later to produce a new version of the standard.

6.4 The introduction of new services, interfaces and features by operators with significant market power

The introduction of new services, interfaces, and features by operators with significant market power needs to be considered carefully as they are able often to use their market power to discriminate against other operators. Some of the tactics that can be used are:

- To introduce a new service or feature on-net only without offering the relevant interconnection interface so that the service or feature cannot be used by the subscribers of other operators.
- To introduce a new service or feature with a user network interface that cannot be implemented by other operators, for example if the incumbent fixed operator introduces a feature such as analogue CLI using a form of user interface that cannot be implemented on cable networks so that an equivalent feature cannot be introduced on other networks. This prevents the other operators from offering an equivalent with comparable economies of scale in terminals and prevents subscribers from having terminals compatible with both networks.

The solution in these cases it for the regulator to require operators with significant market power to publish details of new services sufficiently in advance of their introduction to allow time for interoperability issues to be addressed and for competitors to prepare services. However there is a need to strike a balance between interoperability and non-discrimination, and the need to allow operators with significant market power the incentive to innovate and improve their services.

This situation can create real dilemmas for regulators if operators introduce new services and features that do not support interoperability and fail to give sufficient notice to other operators possibly in breach of regulations. The services and features may be popular with subscribers and it may be difficult for the regulator to find a solution or remedy other than fines that does not cause problems to the users.

7 EXAMPLES OF INTEROPERABILITY ISSUES: PRESENCE AND INSTANT MESSAGING IN MOBILE NETWORKS

In the development of NGN/IMS networks, it may be interesting to study two services that may be of great relevance: presence and instant messaging. Alone or used as building blocks of other more complex services, both services are expected to play an important role firstly in the mobile area, and afterwards in the fixed access area.

As the provision of presence and IM services in fixed networks is in an extremely early stage, we will discuss only the interoperability issues in mobile networks.

For mobile, these two services are relatively new although they may be considered fully standardised by 3GPP. Presence was included in IMS Release 6 (December 2004), and instant messaging stand-alone mode was included in Release 5, and session based mode in Release 6.

7.1 Presence service

According to IMS, presence service is a basic application that may be used either by mobile service providers themselves or by third parties, which are allowed to read and understand presence information.

Presence service, allows a user to be informed about the reachability, availability and willingness of communication of another user, According to the ETSI technical specification on presence service⁹, the exploitation of the presence service is already available in the Internet world, although unfortunately with different non-interoperable mechanisms. This specification identifies the requirements for support of an enhanced version of the presence service through the support of attributes (e.g. services, media components of a multimedia service, location information) in an interoperable manner within both wireless and fixed networks, and with external networks. The specification includes a standardised presence information format to enable interoperability within networks.

⁹ ETSI TS 122 141 V7.0.0 (2005-12). Technical Specification. Universal Mobile Telecommunications System (UMTS); Presence service Stage 1(3GPP TS 22.141 version 7.0.0 Release 7)

If we examine the aspects identified in this report, we get the following results:

Nature of the problem: Potential lack of connectivity and access to presence services provided by third parties. No lack of technical standards or numbering resources detected.

Stakeholders involved: Network operators and service providers. Large operators or service providers may benefit from such a lack of interoperability.

Consumer's opinion: Not known yet as IMS based presence services from mobile devices have not yet started.

Alignment with general telecommunications policy objectives: Long-term lack of interoperability may reduce the degree of competition in the market. On the other hand, strong obligations on opening up the services to any interested third party may discourage investment and innovation. Integrity and security of networks may also be an issue.

Impact on competition: Requiring access for third party providers of presence services would benefit competition but the features may eventually be bundled with the basic subscription making third party provision difficult to sustain. Furthermore subscribers could use Internet based services via mobile Internet access.

Scarce resources: Not an issue.

Overall a regulator would probably conclude that no action is needed at least for the short term, as there are sufficient standards and some alternatives via mobile Internet access. Market forces will probably handle interoperability adequately provided that there is sufficient competition between mobile operators.

7.2 Instant messaging service

Instant messaging services in the Internet world (e.g. AOL, MSN Messenger, Yahoo!) were developed following a closed, non-interoperable approach, based on proprietary technical solutions. They are key building blocks in convergent communications of voice, text and video through personal computers or other devices attached to the Internet.

In spite of the success of instant messaging and the extent of the network effect, there has not been a strong demand from users to get interoperability amongst the different providers. Market players have not moved swiftly to develop open technical standards to achieve such interoperability. More recently some things have changed with agreements amongst some of the players to make their IM capable of interoperability, and Jabber has been developed as an open standard for instant messaging. Users have addressed the problem either by keeping multiple accounts or by organising themselves so that they use the same system. Thus the market is solving interoperability partially and imperfectly, but possibly adequately.

In contrast, IM services developed under IMS standards are expected to have full interoperability from day one. The use of the same identifiers as other IMS services prevents a lack of proper naming and addressing resources. ETSI technical specification on messaging¹⁰ provides the ability to develop interoperable messaging services that use Immediate and/or Session based message types. The ETSI specifications give better support to mobile usage and support charging. They also support enhancement, e.g. operators may be able to create and then advertise chat rooms containing specific content where users who join the room may be charged an 'entrance' fee,

Overall there are basically two approaches for mobile operators in presenting IM services to subscribers:

- as a continuation and expansion of the highly successful SMS services, or
- as an extension of currently well-known Internet services, through agreements with Internet providers.

Depending on the approach chosen, interoperability issues differ significantly. In the former case, IM may be expected to interoperate in the same way as current SMS services, although perhaps this will not happen immediately. In the latter case interoperability problems with current Internet IM services will be transferred into the mobile industry, and it may be very difficult to achieve full interoperability.

¹⁰ ETSI TS 122 340 V7.0.0 (2005-12). Technical Specification. Universal Mobile Telecommunications System (UMTS); IP Multimedia Subsystem (IMS) messaging Stage 1 (3GPP TS 22.340 version 7.0.0 Release 7)

The discussion that follows is focused on the first scenario with instant messaging presented as an expansion of SMS. Although in this case the risk of not having interoperability may be considered very low, for the sake of the example this document goes through the key topics identified to analyse interoperability problems:

Nature of the problem: Potential lack of end-to-end interoperability. No lack of technical standards or numbering resources detected.

Stakeholders involved: Network operators and service providers. Large operators or service providers may benefit from such a lack of interoperability.

Consumer's opinion: Not known yet as IM services are not provided on a large scale on mobile networks.

Alignment with general telecommunications policy objectives: Long-term lack of interoperability may lead to the survival of few strong providers that do not maximize benefit for users in terms of choice, price, and quality.

Impact on competition: Competition would benefit from end to end interoperability. If interoperability is ensured the network effect of this service is much less important, so one of the biggest entry barriers is removed.

Scarce resources: Not an issue.

Overall, again, a regulator would probably conclude that no action is needed at least for the short-term, as there are sufficient standards and some alternatives via mobile Internet access. Market forces will probably handle interoperability adequately provided that there is sufficient competition between mobile operators.

8 CONCLUSIONS

This examination of interoperability leads to the following conclusions.

- Interoperability in terms of any-to-any connectivity and access to indirect service providers is of high importance for users.
- Interoperability is a difficult technical issue that is strongly dependent on standards and test facilities and given the increasing complexity of systems should not be underestimated.
- Although standards are essential they are not perfect, and the effective promotion of interoperability needs to take account of weaknesses in standards.
- The current degree of interoperability has benefited from the past history stronger ex ante intervention and regulation of details.
- The trend in regulation is to leave more to the market and to intervene only ex post after market failure has been proved. This may weaken the regulatory basis for interoperability and require regulators to give interoperability more direct attention as an issue if consumer interest.
- The publication and use of Reference Interconnection Offers has provided a valuable focus for interoperability within each country but RIOs may no longer be required for new services where there is no significant market power.
- The market can work to produce a good level of interoperability in practice but the process may be slow and only partially successful.
- The increasing choice between telco provided services and Internet based services may create pressure for the telcos to improve interoperability to avoid losing subscribers to Internet based services where, even if they are not full interoperable, the cost of duplication is low.

Regulators and policy makers who are concerned to maximise interoperability should consider the following:

- Supporting the development of relevant standards and test facilities
- Ensuring that there are agreed standards and profiles for interconnection between telcos within their country
- Ensuring that there are open and balanced procedures for the introduction of new services and features by operators with significant market power.

ANNEX I

POWERS OF THE REGULATORY BODIES RELATED TO INTEROPERABILITY ACCORDING TO THE EU FRAMEWORK

According to the current EU regulatory framework for electronic communications, regulators may intervene either forcing certain service providers to interoperate in specific scenarios, or simply promoting interoperability through decisions that do not impose direct obligations on service providers.

The Framework Directive (2002/21/EC) and the Access Directive (2002/19/EC) consider interoperability to be a regulatory objective.

Article 8 of the framework directive, on policy objectives and regulatory principles, says that the national regulatory authorities shall promote competition by, inter alia:

“2 (...)

(b) encouraging the establishment and development of trans-European networks and the interoperability of pan-European services, and end-to-end connectivity;”

Article 1 of the access directive, on scope and aim, reads:

“1. Within the framework set out in Directive 2002/21/EC (Framework Directive), this Directive harmonises the way in which Member States regulate access to, and interconnection of, electronic communications networks and associated facilities. The aim is to establish a regulatory framework, in accordance with internal market principles, for the relationships between suppliers of networks and services that will result in sustainable competition, interoperability of electronic communications services and consumer benefits.”

Imposing interoperability

Regulators are entitled to impose binding decisions to guarantee interoperability when justified. These decisions may take the form of an ex ante or ex post remedy to solve a market failure, be the consequence of an access or interconnection dispute, or simply be a requirement to ensure end to end connectivity.

Article 4 of the Access Directive underlines the obligation for service providers to interoperate:

“Rights and obligations for undertakings

1. Operators of public communications networks shall have a right and, when requested by other undertakings so authorised, an obligation to negotiate interconnection with each other for the purpose of providing publicly available electronic communications services, in order to ensure provision and interoperability of services throughout the Community. Operators shall offer access and interconnection to other undertakings on terms and conditions consistent with obligations imposed by the national regulatory authority pursuant to Articles 5, 6, 7 and 8.”

Ex ante obligations

Articles 8 to 13 in the Access Directive cover the market reviews carried out by national regulators that may result in the approval of ex ante obligations, as remedies to be applied to correct a market failure.

Article 12, on obligations of access to, and use of, specific network facilities, reads:

“1. A national regulatory authority may, in accordance with the provisions of Article 8, impose obligations on operators to meet reasonable requests for access to, and use of, specific network elements and associated facilities, inter alia in situations where the national regulatory authority considers that denial of access or unreasonable terms and conditions having a similar effect would hinder the emergence of a sustainable competitive market at the retail level, or would not be in the end-user's interest. Operators may be required inter alia:

(...)

(e) to grant open access to technical interfaces, protocols or other key technologies that are indispensable for the interoperability of services or virtual network services;

(...)

(g) to provide specified services needed to ensure interoperability of end-to-end services to users, including facilities for intelligent network services or roaming on mobile networks;”

Access and interconnection disputes

As a consequence of a dispute between service providers, NRAs may also force interoperability in a particular situation.

Article 20 of the Framework Directive, on dispute resolution between undertakings, reads:

“1. In the event of a dispute arising in connection with obligations arising under this Directive or the Specific Directives between undertakings providing electronic communications networks or services in a Member State, the national regulatory authority concerned shall, at the request of either party, and without prejudice to the provisions of paragraph 2, issue a binding decision to resolve the dispute in the shortest possible time frame and in any case within four months except in exceptional circumstances. The Member State concerned shall require that all parties cooperate fully with the national regulatory authority.

(...)

3. In resolving a dispute, the national regulatory authority shall take decisions aimed at achieving the objectives set out in Article 8. Any obligations imposed on an undertaking by the national regulatory authority in resolving a dispute shall respect the provisions of this Directive or the Specific Directives”

Ensure end to end connectivity

The role of ensuring end to end connectivity is one of the most powerful instruments of regulators, that allow the setting of obligations to undertakings regardless of their market power, but at the same time has been one of the less employed. We may anticipate that with the evolution towards the NGN model and the convergence of services considered isolated today, this may become a key instrument in deciding over interoperability.

Recital 6 of the Access Directive reads:

“(…) National regulatory authorities should have the power to secure, where commercial negotiation fails, adequate access and interconnection and interoperability of services in the interest of end-users. In particular, they may ensure end-to-end connectivity by imposing proportionate obligations on undertakings that control access to end-users. Control of means of access may entail ownership or control of the physical link to the end-user (either fixed or mobile), and/or the ability to change or withdraw the national number or numbers needed to access an end-user's network termination point. This would be the case for example if network operators were to restrict unreasonably end-user choice for access to Internet portals and services.”

Article 5 of Access Directive states:

“1. National regulatory authorities shall, acting in pursuit of the objectives set out in Article 8 of Directive 2002/21/EC (Framework Directive), encourage and where appropriate ensure, in accordance with the provisions of this Directive, adequate access and interconnection, and interoperability of services, exercising their responsibility in a way that promotes efficiency, sustainable competition, and gives the maximum benefit to end-users. In particular, without prejudice to measures that may be taken regarding undertakings with significant market power in accordance with Article 8, national regulatory authorities shall be able to impose:

(a) to the extent that is necessary to ensure end-to-end connectivity, obligations on undertakings that control access to end-users, including in justified cases the obligation to interconnect their networks where this is not already the case;

(b) to the extent that is necessary to ensure accessibility for end-users to digital radio and television broadcasting services specified by the Member State, obligations on operators to provide access to the other facilities referred to in Annex I, Part II on fair, reasonable and non-discriminatory terms.”

Promoting interoperability

As well as imposing interoperability, regulators activity may also promote or facilitate such interoperability. There are two main areas of action for this purpose, standardization and naming and addressing.

Standardization

Regulatory bodies are entitled to either intervene by encouraging the use of standards, or, in the absent of standards, to require European standardisation organisations to draw up the necessary standard in order to ensure interoperability in a given scenario.

Recital 30 of the framework directive reads:

“Standardisation should remain primarily a market-driven process. However there may still be situations where it is appropriate to require compliance with specified standards at Community level to ensure interoperability in the single market.”

Article 17 of the Framework Directive reads:

“1. The Commission, acting in accordance with the procedure referred to in Article 22(2), shall draw up and publish in the Official Journal of the European Communities a list of standards and/or specifications to serve as a basis for encouraging the harmonised provision of electronic communications networks, electronic communications services and associated facilities and services. Where necessary, the Commission may, acting in accordance with the procedure referred to in Article 22(2) and following consultation of the Committee established by Directive 98/34/EC, request that standards be drawn up by the European standards organisations (European Committee for Standardisation (CEN), European Committee for Electrotechnical Standardisation (CENELEC), and European Telecommunications Standards Institute (ETSI))

2. Member States shall encourage the use of the standards and/or specifications referred to in paragraph 1, for the provision of services, technical interfaces and/or network functions, to the extent strictly necessary to ensure interoperability of services and to improve freedom of choice for users.

3. If the standards and/or specifications referred to in paragraph 1 have not been adequately implemented so that interoperability of services in one or more Member States cannot be ensured, the implementation of such standards and/or specifications may be made compulsory under the procedure laid down in paragraph 4, to the extent strictly necessary to ensure such interoperability and to improve freedom of choice for users.

4. Where the Commission intends to make the implementation of certain standards and/or specifications compulsory, it shall publish a notice in the Official Journal of the European Communities and invite public comment by all parties concerned. The Commission, acting in accordance with the procedure referred to in Article 22(3), shall make implementation of the relevant standards compulsory by making reference to them as compulsory standards in the list of standards and/or specifications published in the Official Journal of the European Communities.”

Recitals 9 and 16 of the access directive read:

“Interoperability is of benefit to end-users and is an important aim of this regulatory framework. Encouraging interoperability is one of the objectives for national regulatory authorities as set out in this framework, which also provides for the Commission to publish a list of standards and/or specifications covering the provision of services, technical interfaces and/or network functions, as the basis for encouraging harmonisation in electronic communications. Member States should encourage the use of published standards and/or specifications to the extent strictly necessary to ensure interoperability of services and to improve freedom of choice for users.”

“(…) Openness and transparency of technical interfaces can be particularly important in ensuring interoperability. Where a national regulatory authority imposes obligations to make information public, it may also specify the manner in which the information is to be made available, covering for example the type of publication (paper and/or electronic) and whether or not it is free of charge, taking into account the nature and purpose of the information concerned.”

Naming and addressing

Regulators have the responsibility to guarantee the availability of adequate naming and addressing resources. This includes, inter alia, the responsibility that numbering management does not prevent interoperability.

Article 10 (1) of the Framework directive says:

“(…) Member States shall ensure that adequate numbers and numbering ranges are provided for all publicly available electronic communications services. National regulatory authorities shall establish objective, transparent and non-discriminatory assigning procedures for national numbering resources.