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MANDATING OPENNESS IN REGULATED MARKETS

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Executive Summary

With geopolitical tension rising, technological competition between the world's superpowers is fierce, supply chain resilience is high on the agenda, and the EU's competitiveness is a growing concern. Europe urgently needs to attract investment and promote more competition and innovation – particularly in high-tech sectors where European companies have struggled to commercialise and scale their ideas and emerge as global leaders.

In this context, policymakers are increasingly mandating that large platforms become more open and interoperable – meaning that third parties, whether competitors and/or those providing complementary services, can work with the large platform's assets or across different ecosystems and develop their own innovations.[1] Decisions about mandating openness, however, involve complex and context-specific trade-offs. This paper seeks to inform debates about interoperability in general, rather than assessing how EU policy-makers are implementing and enforcing existing EU laws on which policy choices have already been made.

In well-functioning markets without the exercise of market power, platforms are rarely simply "open" or "closed". Instead, platform operators act as ecosystem orchestrators, seeking an optimal degree of openness that maximises the attractiveness of the overall system for users and, in some cases, for particular user groups. They may also use the degree of openness as a form of competitive differentiation. Policymakers wishing to mandate greater openness must make a series of interlocking decisions about where in the value chain access is granted, to whom, under what technical and commercial conditions, and at what price.

Interoperability can be a powerful catalyst for "generative" innovation. By granting third parties access to some of their resources, platforms can accelerate innovation from third parties, increase returns from specialisation, lower entry barriers, and enlarge system value by enabling rich ecosystems of complementary products and services. In some cases, platforms also pursue core resource openness, for example through open-source strategies, to reduce hold-up risks, promote standardisation, and disintermediate rivals. Empirical evidence shows that openness can significantly increase rates of complementary innovation. It is important, however, that interoperability is designed well and subject to suitable governance mechanisms. However if not designed well, for platform providers, mandated openness can weaken incentives for long-term and high-risk investment, and limit platforms' ability to distinguish themselves from competitors. For third parties, poorly designed interoperability mandates can lead to free-riding, quality degradation, excessive competitive crowding, fragmentation, and lower innovation incentives in the absence of effective decentralised coordinating mechanisms, such as well-established industry standards.

This paper aims to provide a framework for policymakers to help them determine when and how to intervene to make platforms more open. To do this, we propose a four-part framework to help policymakers decide:

- **whether a market warrants an openness intervention.** Regulated interoperability may be justified in cases where there is an important and durable bottleneck operated by a vertically

[1] In this paper, for ease of expression we use the term 'open' as meaning the easing of restrictions on – or even the active facilitation of – the use, development, and commercialisation of an asset by third parties.

integrated provider or which enjoys strong network effects, inadequate (or no) competitive pressure, the presence of market power and the provider does not have objectively justified reasons for denying others fair access to the bottleneck;

- **where openness should be imposed.** Openness should be imposed at the level of specific functionalities. Opening a platform's peripheral assets presents lower risks than mandating openness for core resources, but opening core resources can sometimes enable more innovation.
- **how much access should be mandated.** Different approaches involve different trade-offs between generative and disruptive innovation, risks of free-riding and quality degradation and multi-homing costs.
- **how to implement interoperability.** Policymakers can use different regulatory features and governance mechanisms to balance the risks and opportunities of openness.

Our conclusion is that when and how to impose interoperability is highly context dependent. It varies across markets and across points in the value chain, reflecting differences in security risks, technical feasibility, investment costs, and the importance and the nature of innovation. In some upstream technology markets, such as connectivity, openness through standards and licensing has been integral to enabling scale, specialisation, and high levels of investment. In other contexts, the costs and risks can be higher, and the benefits can be more uncertain.

In many markets, competition between platforms can provide incentives to balance openness and control in ways that reflect consumer preferences for both choice and simplicity. However, concerns may arise where platforms are vertically integrated and competition between platforms is weak or distorted. High switching costs, for example, can reduce competitive pressure, shifting incentives away from innovation and towards value extraction or foreclosure. In such circumstances, platform operators may adopt a degree of openness that is not socially optimal, potentially stifling certain types of innovation.

Against this backdrop, the central policy challenge is not just about whether to mandate openness – but where and how to do so in a way that maximises net benefits while managing the associated costs and risks. Getting these delicate policy decisions right is essential. Where it is well designed and deployed well, interoperability can be a powerful tool both for European consumers (giving them more choices, lower prices and better-quality services) and for Europe's innovation ecosystems (giving European firms a fairer chance to enter and grow in digital markets).

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1. Introduction

1.1 Openness or Integration?

In many parts of the economy, from supermarkets to telecommunications companies to digital platforms, platforms face a strategic decision about how open to be with third parties that want to work with their assets and where and how to provide that openness. By "openness" we mean the easing of restrictions on – or even the active facilitation of – the use, development, and commercialisation of an asset by third parties.

This decision usually involves trade-offs. This paper seeks to explore these trade-offs to inform debates about interoperability in general, rather than assessing how EU policy-makers are implementing and enforcing existing EU laws on which policy choices have already been made.

As examples of the trade-offs, openness can increase the importance and therefore the value of an asset, and it can create more opportunities for competition and innovation by third parties. On the other hand, tight integration can also sometimes provide a better or more consistent experience for consumers,[2] give firms incentives to invest in their assets (or competing assets),[3] boost some innovations such as those which require coordination of different players, and have other advantages like improving energy efficiency.

Openness is not a unidimensional decision; rather it involves a number of interlocking questions:

- **Platforms may be open at some points in the value chain and not others**. For example, many smartphones do not easily allow new operating systems to be installed, but they allow a range of third-party apps to be downloaded and run. And at some points – such as the integration of basic cameras and smartphones – openness does not make technical or economic sense, since the majority of consumers benefit from having a manageable set of choices.
- **Firms may be open to third parties in relation to some functions, or for some purposes, but not others**. For example, providers of the biggest mobile operating systems have typically provided significant access to their platforms for app developers (even in areas like mapping and office productivity apps, or camera technology, where the third parties compete with apps from the operating system provider) while some have until recently limited third party use of some of these functions (such as access to a phone's payment chip).
- **There may be rules about who is granted access**. For example, in many cases such as electronic communications, access to an incumbent firm's infrastructure was based on contracts with access criteria imposed. These can be imposed for legitimate business reasons (e.g. to protect the asset's security) or for other reasons (such as to disincentivise access).
- **A price may be imposed on access**, which may be necessary in some cases to protect the asset owner's investment and limit inefficient market entry.
- **Technical requirements need to be set to determine how third parties can obtain access**,

[2] Copenhagen Economics, 'The Economic Rationale for Vertical Integration in the Tech Sector', 2020.
[3] Jan Krämer and Daniel Schnurr, 'A unified framework for open access regulation of telecommunications infrastructure: Review of the economic literature and policy guidelines', *Telecommunications Policy*, vol 38, issue 11, 2014.

which should address a range of factors including protecting the safety of the platform.

None of these decisions is binary. For example, the academic literature often refers to an inverted U-shaped curve.[4] Too closed, and third parties will not invest in the platform, and it may then be unattractive to users; platforms can generally only be more closed than is optimal if they are insulated from competitive pressure, such as where their users are 'locked in'. But if openness is imposed in a poorly designed way or without suitable governance mechanisms, then a platform may lose its usability, convenience and ability to gain users' trust, and the operator may lose incentives to develop and maintain the platform.

As a result, platforms are rarely simply "open" or "closed". Instead, platforms in well-functioning markets without the exercise of market power will try to obtain the right degree of openness, based on making their overall ecosystem as attractive as possible to its users,[5] and in some cases – such as where the platform aims to differentiate itself from competitors – a particular group of users. In cases where multiple platforms compete, how a platform manages openness can be an important dimension of competition.

The optimal level of openness will be context dependent – it will differ based on the particular market and the particular point in the value chain where openness is being considered. Security concerns, for example, are more relevant for – and are more easily solvable in connection with – some types of platforms than others.[6] The costs of implementing openness also vary greatly, in part based on whether a particular platform or sector has designed with openness in mind from the start or whether openness is being 'retrofitted'. Similarly, the degree of innovation which third-parties may be able to unlock will depend on the economic sector and the place in the supply chain where openness is available. Upstream technology markets (such as for network connectivity) are often highly open because they are developed with standards and open, clearly defined licensing practices, even though they require tight technical integration with upstream and downstream players.

1.2 Mandating Openness

In some markets, policy-makers have little reason to become involved in questions about how open firms should be, or where those points of openness should be. Even in markets where players tend to be vertically integrated (that is, they provide both an asset and services which use or derive from that asset), downstream players may still have a choice of platforms. Competition between platforms can provide the right incentives for upstream players to balance openness with control: if an online marketplace fails to stock a sufficient diversity of brands, and the market has strong competitive dynamics, they will lose sales, but if they stock all third-party products indiscriminately and regardless of quality, they will lose customers' trust. Competition between platforms can also provide incentives for openness at the points in the value chain where consumers appreciate choice – such as having the ability to pick between competing products and different ways to pay for those products – while providing a seamless and integrated offering in other parts of the value chain where consumers

[4] Kevin Boudreau, 'Open Platform Strategies and Innovation: Granting Access vs. Devolving Control', *Management Science*, vol 56, no 10, 2010.

[5] Ibid; Kevin Boudreau, 'Let a Thousand Flowers Bloom? An Early Look at Large Numbers of Software App Developers and Patterns of Innovation', *Organization Science*, vol 23, no 5, 2012; Feng Zhu and Carmelo Cennamo, 'Toward a Better Understanding of Open Ecosystems: Implications for Policymakers', Working Paper, November 2023.

[6] For example, security concerns can be more easily addressed where the access is physical rather than logical or software-driven (e.g. access to physical infrastructure) and where the number of access seekers is limited.

appreciate simplicity. The benefits of openness also explain why some services, such as connectivity technologies, involve players which sometimes voluntarily invest significant resources in developing global standards for interoperability. In doing so they can maximise their customer base and earn greater returns on their innovations. At the same time, these incentives do not always mean that openness should be entirely unconstrained. The need to promote trust means that even platforms without vertical integration – and which have clear incentives to maximise the use of the platform – also have incentives to manage openness in practice.[7]

In markets where platforms are vertically integrated and there is no (or a suboptimal degree of) competition between competing platforms, however, the balance between openness and control adopted by platforms will not always be socially optimal.

The mere existence of multiple platforms in a market or sector may not be determinative about whether the current degree of openness is optimal. For example, if switching costs are high and the market is mature (so that most of the addressable market is already served), then a platform may impose little competitive pressure on another platform in the same market. High barriers to switching do not just prevent users from leaving a platform; they prevent users from trying alternatives (multi-homing). In these cases, a platform operator may be focused primarily on extracting value from their existing customers (instead of innovating to keep the platform attractive for new customers) or from protecting their position from disintermediation. For example, a downstream player could use access to a platform to help attract a critical mass of customers before migrating those customers off the platform – which pits the interests of downstream players (and, indirectly, consumers if the downstream player's success leads to greater competition or innovation) against those of a platform operator. This may lead to less openness than is optimal, because it may encourage platform operators to stymie innovation by downstream players.

There are growing concerns about platforms not being open enough and therefore stifling innovation. In recent years, such concerns have fuelled an increase in calls for regulation to force platforms to become more open to boost competition, innovation and investment.

Requirements to become more open, as a competition law remedy or as a regulatory obligation, have a long history. Telecommunications regulation has long obliged certain telecoms firms to allow competitors to use their assets. Similarly, access obligations are familiar from competition cases involving essential assets, such as in the 2004 Microsoft antitrust case. In recent years, rules about sharing access to assets have been imposed in a range of new sectors, including in banking and payments (through the second Payment Services Directive and Interchange Fee Regulation[8]) and in the digital sector (through the Digital Markets Act).

[7] Boudreau above nn 5 and 7; Marc Bourreau, Jan Krämer and Miriam Buiten, 'Interoperability in Digital Markets', CERRE, 2022, p 27.

[8] PSD2 (Directive 2015/2366) is described in section **Error! Reference source not found.** below. The Interchange Fee Regulation (Regulation 2015/751) art 7 requires that payment card schemes (such as Visa and Mastercard) can allow third parties to act as 'processors' for transactions taking place under that scheme, in competition with the processing services offered by the scheme itself. This therefore represents a type of 'vertical interoperability'.

1.3 Interoperability as a Tool for Openness

One purpose for which platforms might become open is to ensure 'interoperability'. Interoperability is broadly defined as the ability of two or more systems or components to exchange information and to effectively use the information that has been exchanged. Within the context of platforms, interoperability is not a simple technical feature: rather, it is a strategic outcome governed by the platform's architecture. The extent of its implementation, or lack thereof, has profound consequences for innovation, competition, and value creation.

Interoperability is one technical mechanism by which a platform owner executes a strategic (or regulatory) decision on openness. In the physical world, interoperability might be determined by written rules – often in the form of contracts or specifications – about which parts of a firm's network assets can be used, by whom, and in what circumstances. In the digital world, interoperability is commonly achieved through interfaces like Application Programming Interfaces (APIs) and Software Development Kits (SDKs), which are codified instructions that enable third-party contributions to be compatible with certain parts of a platform and one another.

Understanding interoperability also requires appreciating two related concepts:

- **Modularity**: interoperability requires a degree of modularity in the firm providing access. Modularity is a design principle where a system is decomposed into components connected through prespecified interfaces: allowing interoperability to be granted to some parts of a system but not others and allowing differentiation between how different parts of a system are accessed. This structure also allows for what Baldwin (2024) terms "distributed modular complementarity (DMC)," making it feasible for an ecosystem of autonomous firms to form around the platform. Without modularity, systems are tightly coupled, making external integration difficult.
- **Architecture**: A platform's architecture is the conceptual blueprint that defines how interoperability functions. It partitions a system into a stable platform core and a set of complementary modules, bound by a set of design rules. Many modern digital platforms rely on a Layered Modular Architecture (LMA), for example, which provides a robust framework for complex interoperability by allowing heterogeneous components across different layers (e.g., devices, networks, services, content) to be orchestrated together.[9]

Connectivity technologies (such as 4G, 5G, WiFi and Bluetooth) provide a strong example of how interoperability can be a fundamental architectural design choice, not merely imposed as a regulatory remedy. Interoperability in this context is embedded through global standards and licensing frameworks and depends on deep vertical coordination between many different players in the connectivity sector such as device manufacturers, network operators, and network equipment manufacturers. In other contexts, it may not always be easy to identify where in a platform's architecture openness is a viable option (and platforms could try to adopt architectures which obscure this in order to make interoperability appear less feasible). For example, in the telecoms context, many regulators globally tried to impose a degree of separation between incumbent telecommunications firms' retail and network businesses, in order to ensure the network assets could be made available

[9] Youngjin Yoo, Ola Henfridsson and Kalle Lyytinen, 'The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research', *Information Systems Research*, vol 21, no 4, 2010.

to third party companies to use. This often resulted in lengthy attempts to 'unscramble' a firm's different assets.[10]

Interoperability has numerous elements. In digital sectors, technical interoperability, for example, ensures that systems can physically and logically connect with each other – so they can exchange each other's data. This process can involve agreement about, and creating, technical interfaces, data formats, network protocols, and security standards to make that communication possible. Functional interoperability provides an additional layer, by ensuring the exchanged data is meaningful and usable to both sides — so that different firms or systems can understand the information and apply it consistently within their own services. This can require an alignment of functionality. Because of this requirement to maintain a degree of alignment, interoperability usually involves questions about the pace and direction of innovation – including whether it should be led by the firms subject to interoperability obligations (which will require third parties to continuously keep up, and risks interoperability being continually broken), by third parties (which may stifle the platform operator's ability to innovate and be agile), or through some other process to balance the two interests. We do not delve into ways to balance these interests here.[11]

Interoperability can be technically and, often, commercially complex to administer: the quality of access needs to be determined, technical approaches need to be decided upon, and there will often need to be mechanisms put in place to ensure openness does not introduce security risks which cannot be mitigated to an appropriate level with proportionate effort. However, the degree of difficulty (and the associated costs) varies depending on the context, and the extent to which interoperability is being imposed. The connectivity sector, for example, requires high levels of irreversible capital investment, and has often involved close coordination of different players at different points of the value chain (such as device manufacturers, network operators and network equipment providers). These factors mean there have often been strong incentives for players in the sector to develop and work based on shared standards and to innovate with interoperability as a primary consideration. In other sectors, interoperability might not occur unless it is imposed by regulation.

Platform operators and access seekers may sometimes disagree: while they may some shared interests (such as ensuring user-friendly design), they may have different interests or weigh these interests differently. Interoperability therefore needs to be accompanied by governance mechanisms to resolve disputes.[12]

1.4 Horizontal v Vertical Interoperability

A critical distinction is the difference between vertical and horizontal interoperability. This distinction relates to the position of interacting components in the value chain and the type of network effects they leverage, as summarised in Table 1.

[10] For example, in the UK, BT was forced to establish Openreach as a separate network business division in 2006, but the regulator Ofcom continued to push for more independence for Openreach, a process that continued until 2017 when BT agreed to make Openreach a distinct subsidiary with its own legal personality.
[11] Zach Meyers, 'Open Tech Platforms: Technology and Governance Mechanisms', CERRE, February 2026.
[12] But see Ibid and Zach Meyers, 'Which Governance Mechanisms for Open Tech Platforms?', CERRE, January 2025.

Essentially, horizontal interoperability means that systems or firms at the same level of the value chain can work together, connecting and exchanging information seamlessly at the same level. One could further distinguish two types of horizontal interoperability: *inter*-user (enabling different users to connect– such as, e.g., cross-platform messaging, video calling) and *intra*-user interoperability (enabling the same user to seamlessly connect and interoperate their own devices across different ecosystems). For example, interoperability could enable two consumers on different telephone networks to call or SMS each other; those different mobile ecosystems to exchange files, contacts, calendars, photos and videos with each other easily; and it could allow users of instant messaging services to exchange communications without using the same app or its underlying platform. Vertical interoperability, on the other hand, refers to coordination between different levels of the value chain: for example, when an operating system allows third party app developers to access and use the system's functionality, rather than reserving those functions only for the operating system provider's own apps. The distinction between 'vertical' and 'horizontal' interoperability was relatively clear in sectors like telecommunications where the business models and value chains were, for a long time, relatively static and hierarchical. However, the distinction does not always have the same salience in the digital sector, since digital ecosystems can be more dynamic. For example, downstream points in the value chain can often overtake upstream layers in their innovative potential and their importance for consumers, and 'downstream' layers – such as apps – can often operate seamlessly across different 'upstream' layers like operating systems.

Table 1: Distinction Between Vertical and Horizontal Interoperability

Type of Interoperability	Definition	Focus/Purpose	Network Effect Link
Vertical Interoperability	Enables products or services at **different levels of value chain** to operate together.	Promotes innovation **on complementary products and services** and their modular combination. It allows complementors to access the platform ecosystem.	**Indirect network effects** (between the platform users and complementors).
Horizontal Interoperability	Enables **similar services or products at the same level of value chain** to operate together.	Enables **inter-user and intra-user connectivity,** allowing users to "mix and match" hardware devices and service applications according to their preferences. This can promote competition *among* platforms (or inter-platform network applications) on the merit of the single platform, device or application's characteristics rather than on the underlying network effects, which users will preserve.	**Direct network effects** (between users).

Table 2 illustrates examples of these strategic choices regarding openness and architecture.

Table 2: Platform Examples Illustrating Interoperability and Openness Strategies

Platform	Type of Platform Market[13]	Interoperability/ Openness Strategy	Description of Interoperability Dynamics
Lead-firm Controlled Platform	Complementary Innovation Market	Different degree and level of (Access to Resource) openness. Control over critical layers is generally retained according to the tradeoffs dictated by the business model of the platform	**High Vertical Interoperability (Controlled):** Connects hardware to digital content and software via APIs/SDKs. Control points at complement layer through either quality screening and certification process (gatekeeping) or standards/protocols enforcement. Horizontal interoperability (within the same ecosystem) mediated by the architectural and governance rules of the gatekeeper
Open-source Platform	Complementary Innovation Market	More Open / Resource Openness	**High Vertical and Horizontal Interoperability (Decentralised):** The open-source software allows co-development of the "core", reducing costs of development for firms while enhancing their benefits by converging on the same OS. It also allows for greater modularity across and at the same layer by enabling OEMs to customise implementations. In fully decentralised systems, coordination issues and misappropriation issues may arise in the absence of strong norms or shared governance practices.
Jointly Sponsored Platform	Standards-based Product Platform	Shared Sponsorship / Standards-Based Openness (interoperability imposed through mutual dependence)	**Modularity via Standards:** Joint sponsors use modular architecture with published design rules and standards to allow independent firms to supply components.
Messaging Services	Information/ Communication Platform	Targeted Horizontal Interoperability	**Direct Network Interoperability:** The focus of regulatory discussion (e.g., DMA Article 7) is to enforce horizontal interoperability so users of rival services can connect and communicate.

[13] See Carmelo Cennamo, 'Competing in Digital Markets: A Platform-based Perspective', *Academy of Management Perspectives*, vol 35, no 2, 2021 for the different digital markets typologies.

1.5 Identifying the Optimal Level of Openness

Mandatory interoperability can deliver potentially significant benefits – such as more innovation and consumer choice – but also costs and risks if it is not designed well and with appropriate governance mechanisms. In particular, mandatory interoperability can shift incentives to innovate between different players in the ecosystem and between different types of innovation. The way in which mandated interoperability impacts these incentives, however, is not always straightforward. For example, traditionally interoperability has been considered to diminish third parties' incentives to innovate in radical ways which avoid or disrupt the platform operator. While interoperability can secure a stronger focus on intra-platform competition and innovation by third parties, in digital markets interoperability can also provide these third parties with a 'foothold' to promote potentially more disruptive and beneficial innovation outside the platform. Other relevant factors which impact the effects of interoperability include the degree of R&D intensity, the required investment horizon, and the extent to which investors have sunk costs. Tracing how these incentives could function in particular markets, and at particular points of the value chain, is fundamental to ensuring interoperability is applied and implemented in a proportionate way with net benefits.

For example, in connectivity, interoperability through standardisation has led to positive impacts on competition and innovation because it has helped enable firms to specialise and build scale, thus supporting the business case for investing in capital-intensive, high-risk activities. At the services and application layer, where the investments required to enter markets are not always as high, the impacts of interoperability can be more variable.

As noted above, where competition is working effectively, the platform operator may be best placed to make decisions on openness that strike the optimal balance. However, in cases where competition is not working well or there are market failures, policy-makers should not necessarily assume that platform operators will make decisions on openness that align with consumer interests. This may be the case, for example, where a platform is a monopolist, or where there are competing platforms but high real or perceived barriers to switching so that customers may suffer from 'lock in' effects.

In that context, this paper seeks to provide forward-looking guidance for policy-makers on the optimal level of openness, with a particular focus on innovation incentives.

The paper explores how to design good interoperability mandates. How to weigh and manage the costs and risks will be context dependent. This makes it important for policy-makers to consider carefully not just *whether* to impose interoperability, but *where* – which functions and services should be 'separable' so they can be provided by third parties, and which make sense as part of a firm's integrated offering – and *how*. We also explore other regulatory options that can be used when there is evidence of a market working sub-optimally for consumers, but blanket and unconditional interoperability rules would be disproportionate.

The paper is structured as follows. Section 2 seeks to explore how mandated openness has a differential impact on incentives for different types of innovation. Section 3 then examines how these considerations have played out in previous regimes for implementing openness. Section 4 examines the dilemma between promoting inter-platform and intra-platform competition. Section 5 then draws

from this analysis to provide a policy framework for determining how to mandate openness across different sectors.

Getting the answer right is important for the EU. Interoperability has important implications for three of Europe's strategic priorities:

- Competitiveness – mandated interoperability can shift the incentives to invest between different players. It may in some circumstances also shift incentives towards incremental innovation over more disruptive innovation; and in some circumstances it might make disruptive innovation more viable. The EU has a demonstrated lack of radical innovation.[14] That means the EU faces a strategic decision about whether, in the context of particular markets and market segments, its strategy to boost competitiveness should be to promote disruptive or incremental innovation.
- Security – interoperability can have implications for integrity, security, privacy, which need to be carefully managed in deciding when and how to impose obligations. But conversely, interoperability can help encourage supply chain resilience by opening up more choices and making systems more transparent to enable vulnerabilities to be quickly noticed and fixed.
- Digital sovereignty – increasingly, European policy-makers are concerned to reduce Europeans' reliance on foreign ICT providers, particularly in markets where almost all providers are from one single country. Interoperability – if it is well designed and deployed appropriately – could help provide European users with more choices and are not locked in, and that European options have a fair chance to enter the market.

[14] Mario Draghi, 'The future of European competitiveness', September 2024; Antonio Manganelli, 'Competitiveness, Digital Transformation and EU Policies', CERRE, November 2025.

2. Interoperability and Innovation Incentives

2.1 A Catalyst for "Generative" Innovation

Interoperability, particularly the vertical interoperability that grants third-party service providers access to a platform, is widely seen as a primary catalyst for "generative" innovation. Generativity means a system's capacity to foster complementary innovation from autonomous, heterogeneous firms. This can allow a system to expand and evolve without hierarchical control from the core platform's creator.[15]

This capacity is structurally enabled by a platform adopting a modular architecture, which separates the "stable core" from the "flexible periphery" via enduring interfaces.[16] These interfaces, often called "boundary resources",[17] such as APIs and SDKs in the digital world, or technical specifications in the physical world, function as codified design rules that facilitate interaction between third parties and the platform operator, and allow external developers to connect to the platform.

This "access openness"[18] primarily benefits complementors by lowering entry barriers, promoting complementary innovation by attracting a large and diverse pool of independent third parties, and in turn benefiting the platform by enlarging the entire system's value. This is achieved through several mechanisms:

- **Acceleration of innovation:** granting outsiders access to the platform via interoperable interfaces is strongly associated with an acceleration in the rate of innovation. The most significant empirical evidence for this comes from Boudreau,[19] whose study of the handheld computing industry (1990–2004) found that granting liberal access to complementary hardware developers was associated with a **factor of 4.6 to fivefold acceleration in the innovation rate**. Similar impact on complementary innovation has been documented in other digital platform's contexts, including videogame software[20] and mobile OS[21] (though the impact is not just attributable to openness). This demonstrates a direct link between peripheral access and the speed of ecosystem development.
- **Greater returns from specialisation:** interoperability enables a modularised division of innovation tasks. This allows a platform owner to specialise in the core infrastructure while

[15] Carmelo Cennamo and Juan Santaló, 'Generativity Tension and Value Creation in Platform Ecosystems', *Organization Science*, vol 30, no 3, 2019; Amrit Tiwana et al, 'Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics', *Information Systems Research*, vol 21, no 4, 2010; Jonathan Zittrain, 'The Generative Internet', *Harvard Law Review*, vol 119, 2006.
[16] Carliss Y Baldwin and Kim B Clark, 'Design Rules, Volume 1: The Power of Modularity', 2000; Yoo et al., above n 9.
[17] Ahmad Ghazawneh and Ola Henfridsson, 'Balancing platform control and external contribution in third-party development: the boundary resources model', *Information Systems Journal*, vol 23, issue 2, 2013.
[18] Boudreau, above n 4.
[19] Boudreau, above n 4; Boudreau, above n 5.
[20] e.g., Carmelo Cennamo and Juan Santaló, 'Platform competition: Strategic trade-offs in platform markets', *Strategic Management*, vol 34, issue 11, 2013, Cennamo and Santaló, above n 15.
[21] Jens Foerderer et al., 'Does Platform Owner's Entry Crowd Out Innovation? Evidence from Google Photos', *Information Systems Research*, vol 29, no 2, 2018.

external firms specialise in niche complements, experimenting with different variants.[22] This division of labour allows the system to leverage diverse, heterogeneous knowledge from a broad pool of contributors and leads to greater returns from specialisation for all participants.[23]

- **Reduced development costs:** open ecosystems and interoperable interfaces can reduce development costs for third parties. By providing low upfront costs, publicly available specifications, and documentation, platforms can mitigate technological uncertainty and make it easier for less-experienced third parties to join.[24] For example, developers using the open-source Chromium project can have high confidence that any toolset or framework will be compatible with browsers like Google Chrome and Microsoft Edge, dramatically simplifying the development and testing process.[25] And when fixed telecoms markets were liberalised, pre-existing international standards for telecommunications networks (which existed because the national incumbents had incentives to enable calls to and from networks in other countries, since these foreign networks were not competitors) made it easier for new players to enter the market.

The influx of third-party innovation translates directly into greater value for the platform and its users:

- **System value enlargement:** interoperability allows products from independent firms to connect, creating a "system of interconnected products" that offers an integrated solution to a customer's set of needs.[26] This "mix-and-match" capability **enlarges the value of the standalone offering** by extending its uses. For example, the value of any smartphone is not just in the device itself, but in its ability to seamlessly interoperate with hardware and an ecosystem of millions of apps, extending its functionality for productivity, entertainment, and social connection.[27]
- **Generativity and network effects:** this strategy stimulates faster network growth and a greater variety of complementary offerings. This is the essence of generativity—the ability to constantly produce new, unanticipated output.[28] Mobile OS platforms, for instance, manage controlled interoperability through their APIs and application marketplaces to fuel the creation of innovative applications that extend the functionalities of mobile devices, reinforcing strong indirect network effects.

2.2 Strategic Benefits of Core Resource Openness

Beyond opening the periphery, some platforms engage in “Core Resource Openness”, which involves ceding some control over the core platform itself, often through open-source licensing. This strategy can be used for multiple purposes, including achievement of dominance in a market (which can then

[22] Cennamo, above n 13.
[23] Cennamo and Santaló, above n 15.
[24] Joel West, ‘How open is open enough?: Melding proprietary and open source platform strategies’, *Research Policy*, vol 32, issue 7, 2003; Cennamo and Santaló, above n 20.
[25] Cennamo and Zhu, above n 5.
[26] Cennamo, above n 13.
[27] Cennamo, above n 13.
[28] Cennamo & Santaló, above n 15; Yoo et al., above n 9.

be leveraged to increase revenues in other markets), but can create powerful innovation incentives through the following mechanisms:

- **Reduced hold-up risk:** by giving up some measure of control over the core architecture, a platform owner can credibly commit to not exploiting its partners.[29] This is critical for complementors, as it offers protection against "hold-up" problems and reduces switching costs. The appeal of Linux in enterprise servers, for example, stems partly from the flexibility it gives users and developers to switch between different Linux vendors, ensuring they are not locked into a single proprietary, closed system.[30]
- **Market position and standardisation:** Opening the core architecture can be a powerful strategy to achieve a strong market position by leveraging a massive ecosystem. The open nature of the **IBM PC architecture** was key to its success and the formation of the "Wintel" platform, as it allowed thousands of independent firms to supply compatible hardware and software, rapidly building an influential platform system.[31]
- **Disintermediation of rivals:** Resource openness can be used as a competitive weapon to disintermediate a proprietary, standards-based platform controlled by a rival. By championing open-source software and platform-independent web applications, Google was able to reduce the market's reliance on Microsoft's proprietary APIs.[32] Similarly, the adoption of **open-source browsers like Firefox and Chromium** was instrumental in eroding the dominance of the proprietary Internet Explorer.[33]

The positive effects of interoperability, distinguished by whether access is granted to the periphery (boundary platform resources) or the core (core platform architecture resources), are detailed in the tables below.

Table 3: Positive Effects of Access to Boundary Platform Resources (Ecosystem Openness)

Positive Effect	Description / Mechanism	Example / Evidence
Greater Returns from Specialisation	Modularity allows for a modularised division of innovation tasks. Complementors specialise in niche products, leading to greater returns from specialisation due to asset complementarity.	Firms specialise in complements, experimenting through different variants of niche products that extend the platform's functionality.
Acceleration of Innovation Rate	Granting outsiders access to the platform to open up complementary development is associated with a dramatic acceleration in the rate of new device development.	In the handheld computing industry (1990–2004), granting access produced up to a fivefold acceleration in the rate of new device development.
Reduced Development Costs (Lower Barriers)	Open ecosystems provide low upfront costs and publicly available specifications and documentation. This mitigates technological	Developers using open-source software (OSS) face lower technological uncertainty and higher benefits from standardisation and

[29] Boudreau, above n 4.
[30] Cennamo and Zhu, above n 5.
[31] Carliss Y Baldwin, 'Design Rules, Volume 2: How Technology Shapes Organizations', 2024.
[32] Ibid.
[33] Cennamo and Zhu, above n 5.

	uncertainty and makes it easier for less-experienced developers to join.	interoperability across toolsets, devices and applications based on the OSS, simplifying development.
System Value Enlargement	Interoperability allows multiple products (core and complements) to interact, creating a system of interconnected products that offers an integrated solution. This enlarges the value of the standalone offering.	A mobile OS platform connects the phone's hardware to digital content and software, increasing the phone's value because users can do many more things through it (greater technological "affordances").
Generativity and Variety	Greater "platform openness" stimulates faster growth of the network and a greater number and variety of complementary offerings. This generativity is crucial for extending usage scope.	Mobile OS platforms fuel the creation of innovative applications that extend the productivity and entertainment functionalities of mobile devices.
Leveraging Diverse Knowledge	By granting access to independent complement developers, platform owners draw on a diverse set of capabilities and concepts from a broader pool of contributors.	Accessing external knowledge has been a pervasive argument for open innovation.

Table 4: Positive Effects of Access to Core Platform Resources (Platform Architecture Openness)

Positive Effect	Description / Mechanism	Example / Evidence
Increased Innovation Rates (Minor)	Devolving control (opening the platform core, often via open-source) is associated with an acceleration in development.	In the handheld computing industry, opening the platform implied an increase in the innovation rate by roughly 20%.
Reduced Hold-up Risk	By giving up some measure of control, a platform owner can credibly commit to not exploiting its partners, restoring complementors' incentive to invest.	The appeal of Linux in enterprise servers stems partly from the flexibility to switch between different Linux vendors, helping users avoid lock-in.
Market Dominance and Network Effects	Openness, by allowing more users and complementors to join, can positively affect platform dominance. If the technology is highly complementary, openness ensures the system scales efficiently.	The open nature of the IBM PC architecture was key to its success and the formation of the Wintel platform, as it leveraged a massive ecosystem.
Disintermediation of Rivals	Resource openness (open-source) can be used as a strategy to disintermediate a proprietary, standards-based platform controlled by a rival.	The adoption of open-source browsers (Firefox, Chromium) contributed to the decline of the proprietary Internet Explorer.

2.3 Managing the Impact of Openness on "Architectural" Innovation

While Section 2 detailed interoperability's role as a catalyst, an equally robust body of research argues that ungoverned interoperability can in some circumstances reduce incentives for certain types of innovation. This can impact both the platform provider, who orchestrates the ecosystem, and the complementors, who create additional value within it. Studies highlight that properly governing openness can be essential for enabling coherent user experiences and fostering high-risk, long-term, platform-level innovation in some contexts.

The types of impacts which need to be managed can be broadly categorised into three areas: incentives for the platform provider to innovate; the emergence of a "tragedy of the commons" among complementors; and the need for mechanisms to manage security and privacy.

2.3.1 Incentive Effects on Platform Providers

For the platform owner, the primary disincentive for openness stems from a loss of appropriability—the ability to capture the value from their own R&D investments and resulting intellectual property. Mandating interoperability, especially when it requires sharing core resources or network access with rivals, can reduce incentives to invest in costly, long-term R&D for the core platform, though this impact is context-specific.[34] Its impact is less significant if openness is imposed in contexts where the platform owner can still generate sufficient profits from that investment.[35]

These impacts can be driven by several distinct mechanisms, summarised in Table 5:

- **Strategic exploitation and platform forking:** when a platform's core resources are made open (a form of "Resource Openness"), it exposes the owner to strategic exploitation. A hostile rival can "fork" the platform by appropriating the open core to create a clone or substitute, thereby leapfrogging the upfront R&D costs spent by the original platform owner. The most-cited example of this is Amazon's Fire OS, which was a fork of the Android Open-Source Project (AOSP). Karhu, Gustafsson, & Lyytinen (2018) note this strategy saved Amazon an estimated $1 billion to $2 billion in initial development costs. However, the evidence on the reduced incentives in architectural innovation is not clear, as forking can also contribute to the value of the overall system, by rallying in multiple companies, including direct competitors, which can contribute to co-development and enhancement of the core platform, and widen its adoption. While forking creates negative outbound spillover rents for the original developer, it also has greater generative value by lowering barriers to entry for a new competitor and expanding consumer and complementor choice.
- **Changes to R&D incentives:** in a regulatory context, mandating interoperability can result in platform operators needing to share their assets directly with competitors. This "lowers innovation rents and incentives to invest in the creation of that facility",[36] though it does not

[34] Çağrı Çavuş, 'Does DMA interoperability promote innovation: a comparative study from EU competition law to the DMA', *European Competition Journal*, vol 21, issue 1, 2025.
[35] Michael Katz and Carl Shapiro, 'Systems Competition and Network Effects', *Journal of Economic Perspectives*, vol 8, no 2, 1994; ibid.
[36] Krämer and Schnurr, above n 3; Çavuş, above n 34.

necessarily mean those incentives will disappear. When platform owners retain their incentives (because, e.g., they may obtain benefits on sales from complementary products and services), however, they may nonetheless face increased costs and longer time-to-market having to redesign the platform architecture in a way to make available (interoperable) to third-parties features that were available only to first-party services and devices while preserving the customer experience, privacy and safety and quality levels. For basic connectivity and utility features, interfaces or other technological standards might be used to coordinate interactions and preserve safety of data exchanges. Industry standards can often help lower the resources and costs required to implement interoperability. But other, non-standardised core and more integrated features of the platform might require more complex redesign and workaround solutions.

- **Impacts on differentiation:** mandated interoperability, by its nature, can limit innovation that occurs *outside* of the mandated value network, restricting the R&D avenues a firm can pursue when it involves novel, differentiating features.[37] For some basic connectivity functionalities, standardisation may be highly desirable, ensuring connectivity and greater "mix and match" complementarities that users can enjoy and complementors and the platform themselves can leverage in their own product design. Modern standards (like the RCS Universal Profile) support modular extensions, allowing platforms to build proprietary features on top of the standard. But in the cases when mandated openness imposes standardisation of differentiating platform features (i.e., platform commoditisation), policy-makers should be aware of risks of homogenising strategic features and reducing differentiation between platforms. In such a scenario, where distinctions fade, users are likely to default to the largest platform,[38] which can paradoxically reduce market diversity and contestability.[39] However, this is less likely to be a concern in cases where switching is difficult, and most users are 'locked in'.
- **Security and privacy impacts:** openness may have impacts on security and privacy which may need to be mitigated. However, the impact of openness on security and privacy is complex. From a technical standpoint, open APIs can increase the "attack surface" of a platform, creating new entry points for misuse by threat actors (Grenz & Kirchner, 2025). However, risks can be mitigated when interoperability is implemented via standardised protocols (e.g., industry-standard APIs) which inherently define and limit the scope of data exchange, preventing unilateral data extraction by either party. And open standards can enable security risks to be more quickly identified and put more pressure on platform owners to address them, giving users more choices over their security rather than the platform operator enforcing a "one size fits all" approach.[40] There are different views, in this context, about whether closed or open systems offer greater security and privacy.

Table 5: Impacts of Openness on the Platform Provider

[37] Çavuş, above n 34.
[38] Cennamo, above n 13.
[39] Colangelo & Martinez, 2025.
[40] Meyers, above n 11.

Type of Openness	Mechanism	Examples / Evidence
Resource Openness (Access to Core)	**Strategic Exploitation (Platform Forking):** Forfeiting IPR of the platform core (e.g., via open-source) enables hostile firms ("forkers") to leapfrog upfront investments.	**Android Forking:** Amazon created the proprietary Fire OS by leveraging the Android Open-Source Project (AOSP) core, saving an estimated $1 billion to $2 billion in initial development costs. While this can generate negative outbound spillover rents for the original developer(s), it also demonstrates the 'generative' value of the open-source model, as it lowered barriers to entry for a new hardware competitor and expanded consumer choice.
Mandated Interoperability	**Impacts on R&D Incentives:** Mandating an incumbent to share its network can in some cases reduce the incentive to innovate in the core R&D, though the impact depends on whether the platform can still capture sufficient profits from that investment.	Mandating access to an "essential facility" impacts innovation rents and incentives to invest in the creation of that facility, though the effects are context-specific.
Mandated Interoperability	**Loss of Differentiation through Standardisation:** Interoperability may limit innovation that occurs outside of the mandated value network. This may lead to a reduction in differentiation between platforms.	When distinctions fade, users may prefer the largest platforms, potentially reducing market diversity, though this is of less concern in markets with high barriers to switching and where most users are already locked in.
Open Technical Interfaces (APIs)	**Security and Integrity:** the impact of openness on security and privacy is mixed. Open APIs may create vulnerable entry points for misuse and cyber threats. But open systems are often subject to more scrutiny, and openness can help users have more choices over their own security.	Open APIs need to be designed in ways which limit unnecessary risks.

2.3.2 Managing Impacts on Complementors

Paradoxically, increased access for complementors also has some impacts which need to be managed in the design of interoperability mandates. In a mature or overly open ecosystem, individual complementors may have an incentive to free-ride on the platform's shared assets (including the platform's established quality reputation) by underinvesting in quality and user satisfaction.[41] This dynamic is driven by several functional and economic failures:

- **The need to protect quality:** interoperability mandates need mechanisms to avoid a situation where the market can become flooded with low-quality or imitating complements. This moral hazard creates a "lemons problem" that damages the shared reputation and diminishes user trust. The classic example is the collapse of the Atari video game console, which lacked technical quality controls for third-party developers.[42] Modern platforms mitigate this 'lemons problem' not by closing the ecosystem, but by enforcing automated quality standards and certification programs, ensuring openness does not come at the expense of system integrity. This is not merely an anecdotal risk; Cennamo & Santaló (2019) provided empirical evidence from the video game industry, finding that an increase in low-rated games was associated with an **average revenue loss of about $36.5 million for high-rated games** and a drop of about **3.3% market share** for the platform in that quarter. High-quality providers are penalised for the low-quality offerings of others. Similarly, Zhang et al. (2022) show how developers in the iOS platform were less inclined to cooperate and share knowledge for innovation when the platform could not control access due to exogenous technical hacking ("jailbreaking") into the platform system.
- **Competitive crowding out:** the idea of "letting a thousand flowers bloom"[43] can backfire. While adding complements in new categories is beneficial, Boudreau found that adding producers of *similar* applications (e.g., more games to a market saturated with games) causes competitive crowding, which hurts complementors' incentives for developing software applications. The intensified competition within the same niche can overwhelm the positive network effects, reducing the profitability and innovation incentives for all. Again, this indicates that interoperability mandates need to incorporate some degree of 'platform orchestration', albeit that role should not necessarily be performed by a vertically integrated platform operator.
- **Fragmentation and functional failure:** loosely governed interoperability can lead to "splintering" (excessive product variety) and "fragmentation" (incompatible standards), which ultimately constrains the system's value for users.[44] The demise of the Symbian OS is a key example, where conflicting governance mechanisms and a fragmented, localised app market rendered it uncompetitive.[45] Good governance rules are essential.

[41] Cennamo & Santaló, above n 15.
[42] A Gawer & MA Cusumano, 'Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation', *Harvard Business School Press,* 2002.
[43] Boudreau, above n 5.
[44] Michael G Jacobides, Carmelo Cennamo and Annabelle Gawer, 'Externalities and Complementarities in Platforms and Ecosystems: From Structural Solutions to Endogenous Failures', *Research Policy*, vol 53, no 1, 2024.
[45] Joel West and David Wood, 'Evolving an Open Ecosystem: The Rise and Fall of the Symbian Platform', *Advances in Strategic Management*, vol 30, 2013; Cennamo and Zhu, above n 5.

These impacts highlight the role that platform operators play in competitive markets, by orchestrating the way a platform operates to protect its quality and reputation, and the interests of complementors as a whole. This role remains important when openness is mandated. However, to address any conflict of interest, the platform operator should not be able unilaterally to make certain decisions without oversight – such as security limits, the vetting of access seekers, and price setting. These impacts therefore highlight that governance mechanisms need to be put in place to protect the platform without allowing the platform operator to take discretionary decisions only in its own self-interest.

Table 6: Impacts of Openness on Complement Providers

Type of Openness	Mechanism	Selective Examples / Evidence
Access Openness (Unrestricted)	**Free-Riding:** Complementors might underinvest in user satisfaction to free-ride on the platform's system reputation, which is a shared asset.	**Atari Collapse:** The system failed because the platform gave "too much freedom to third-party developers," and the market was "swamped with rubbish games," destroying ecosystem viability. Mandated interoperability can therefore still require quality control mechanisms.
Access Openness (Wide Access)	**Competitive Crowding Out:** Granting wide access may "cause competitive crowding, which hurts complementors' incentives for developing software applications."	Expanding an already large complementor network may decrease the rate of innovation for novel products on mobile app platforms. This indicates that a degree of 'platform orchestration' may be necessary in some form.
Loosely Governed Interoperability	**Fragmentation and Functional Failure:** Unmanaged openness can lead to fragmentation (incompatible standards) or splintering (excessive variety), which jeopardise system integrity and limit the interoperability of existing components, constraining user value.	**Symbian OS Demise:** Conflicting governance mechanisms led to a fragmented and localised app market, contributing to the demise of Symbian. Good governance rules for interoperability should avoid this outcome.

3. The Evolution of Mandated Openness

The preceding sections illustrate a tension: interoperability can be a catalyst for generative innovation (Section 2) but policy-makers which wish to mandate it need to design rules to protect architectural innovation and preserve system quality (Section 2.3). When openness is left to the market, and the market is fully competitive, the right way to balance this potential tension will lie somewhere on the multi-dimensional spectrum of strategic decisions that platform owners must continually manage.[46]

When openness is a question for regulators, however, they are faced with a difficult question of how to design legal tests that aim to at least approximate the socially optimal degree of openness for a firm – while also trying to provide legal predictability, and to properly reflect the relative costs of type I errors (imposing obligations of openness in inappropriate circumstances) and type II errors (failing to imposing openness when it would be socially beneficial). As we will see below, when implementing competition law and regulation, courts, regulators and policy-makers have traditionally adopted a conservative approach to openness – one which focused primarily on protecting the property rights of asset owners and promoting incentives for disruptive rather than generative innovation. However, their approach has evolved in recent years in ways which reflect a loss of confidence in the possibility of market-led disruptive innovation in some contexts (or at least in the possibility of such innovation happening quickly enough), and more confidence in the ability of regulation to foster innovation.

3.1 The Essential Facilities Doctrine

The starting point is that the law does not impose any obligation on firms to provide access to their assets, except in special circumstances. This position respects firms' freedom of contract and their rights to decide what to do with their own property – recognising that firms' rights to exploit their inventions and investments are essential so that they have an incentive to take risks and innovate in the first place.

However, EU competition law has long imposed 'special responsibilities' on dominant firms, which have in certain cases effectively required firms to allow others access to their assets. In the *Commercial Solvents* case, for example,[47] the court decided that a firm which had decided to vertically integrate by using its inputs to produce finished goods could not cut off supply to its existing customers, thereby eliminating downstream competition. In the 1995 *Magill* case, the court went further, ruling that the exercise of intellectual property rights could infringe competition law, in "exceptional" cases. In that case, a broadcasting company had refused to provide information about its programming to a television magazine publisher. The court decided the conduct was abusive because the refusal to provide information prevented the appearance of a new product, which the broadcaster did not offer and for which there was potential consumer demand.[48]

[46] Cennamo and Zhu, above n 5; Boudreau, above n 4.
[47] Istituto Chemioterapico Italiano v Commission of the European Communities, Cases 6 and 7/73, 1974.
[48] Radio Telefis Eireann (RTE) and Independent Television Publications Ltd (ITP) v Commission of the European Communities, Cases C-241/91 P and C-242/91 P.

Shortly thereafter, however, the European Court of Justice settled on a very narrow approach to mandating access to an asset: the "essential facility" doctrine. This required an asset owner to provide third parties with access to an asset where:

- access to the asset was "indispensable" for the third party to compete;
- the refusal to provide access would eliminate all competition in a market; and
- the refusal was incapable of being objectively justified.[49]

This relatively restrictive approach illustrated a concern on the part of the EU courts to limit interventions in the market; to give upmost priority to incentives by firms to invest in their own assets, even where there might be significant efficiency gains from the reuse of an asset. Exceptions to the "essential facilities" rule were created for circumstances where these incentives were less relevant (such as where a facility was produced using public funds) or where law-makers had decided that other interests took priority (such as where an asset owner was required by a specific law to grant access to third parties).[50]

The "essential facility" requirements proved difficult to meet in many cases. There were a few exceptions. For example, in the 1990s, Microsoft provided information about its dominant PC operating system freely to firms that wanted to offer servers to interoperate with Windows. This stopped once Microsoft entered the market for workgroup servers, making it more difficult for competitors to compete with Microsoft in the server market. In 2007, the EU General Court held the cessation to be in breach of EU competition law.[51]

Despite this, in general, reliance on competition law to make companies more open often seemed insufficient to tackle potential competition problems in many sectors. The restrictive case law was not the only reason. Another was the very slow timeframes for completing antitrust investigations: the Microsoft case, for example, began as a complaint from Sun Microsystems in 1993; the European Commission did not reach a final decision until 2004, and it was three years after that before the EU courts handed down an appeal judgment. Consequently, competition cases were sometimes resolved after harm in the market had already occurred – which, in markets with strong network effects, could give the firm denying interoperability an opportunity to develop a nearly unassailable advantage. A further problem was that interoperability could only be pursued case-by-case and issue-by-issue. This meant there was little way to put in place governance mechanisms which could be able to address all of the many technical details required for interoperability to be effective, giving platform operators significant discretion about how to implement it. The ex-post case-by-case approach also provided little way to ensure the ongoing provision of effective interoperability as technologies and markets developed.

In the digital economy, several cases indicate that European courts are now de-emphasising the "essential facility" doctrine and are identifying more scenarios where it does not apply. In the 2021 Google Shopping case, for example, the European Court of Justice (ECJ) distinguished between 'refusal to supply' and 'discrimination' abuses. The Court clarified that different legal tests apply depending on

[49] Oscar Bronner GmbH & Co. KG v Mediaprint Zeitungs- und Zeitschriftenverlag GmbH & Co. KG, Mediaprint Zeitungsvertriebsgesellschaft mbH & Co. KG and Mediaprint Anzeigengesellschaft mbH & Co. KG., Case C-7/97, 1998.
[50] Lietuvos geležinkeliai v Commission, Case C-42/21 P.
[51] Microsoft Corporation v Commission, T-201/04.

the specific nature of the conduct and the indispensability of the asset and that the 'essential facilities' doctrine is not the sole framework for assessing alleged access-related abuses.[52] The 2025 Android Auto case provides a further example:[53] in that case, the ECJ determined that the "essential facility" doctrine applied only for infrastructure which was developed solely for a company's own needs and which was reserved for its own use. It did not apply to infrastructure which had always been intended to be accessible by third parties.

This represents a significant shift away from the courts' previous restrictive and rigid approach, towards one that can better take the full context and circumstances into account.

3.2 Sector-Specific Regulation

While competition law has evolved, a growing number of sectors are now subject to specific regulation forcing some or all firms in that sector to be more open. In large part, this was the result of the slow-moving nature of competition law, and a desire in some sectors – particularly those which were previously characterised by a monopoly, often state-owned – to not only *prevent* anti-competitive conduct, but rather to facilitate entry by new players and to *actively promote* competition.[54]

One of the key sectors where a dedicated access regime was introduced to force a company open was electronic communications. When competition was introduced, the incumbent telecommunications provider still had access to a number of essential assets which policy-makers thought it would be uneconomical for new players to replicate (or at least not immediately) – mostly notably, the copper loop between each premises and its local telephone exchange, which often provided the only fixed-line physical connection to a home. EU communications law therefore empowers national regulators to decide that certain firms must allow competitors to use their assets. However, before a regulator can do so, mandated openness must generally meet several requirements, for example the access obligations must be:[55]

- proportionate and the least intrusive way of addressing the problems identified in the market analysis;[56]
- based on a finding of market power;[57] and
- imposed only where their absence would "hinder the emergence of a sustainable competitive market … and would not be in the end-user's interest".[58]

In addition, obligations were precluded if they would "compromise the economic or financial viability of a new network deployment".[59]

[52] Google LLC and Alphabet Inc. v Commission, Case T-612/17; Case C-42/21 P; C-165/19 P.
[53] Alphabet Inc. et al v Autorità Garante della Concorrenza e del Mercato, Case C-233/23.
[54] Experiments with relying only on competition law (such as in New Zealand) were widely regarded as a failure: see Malcolm Webb and Martyn Taylor, 'Light-Handed Regulation of Telecommunications in New Zealand: Is Generic Competition Law Sufficient?', International Journal of Communications Law and Policy, issue 2, 1998.
[55] Access Directive (Directive 2002/19/EC) recital 13.
[56] European Electronic Communications Code (Directive 2002/19/EC) (**EECC**) art 68(2).
[57] EECC art 68.
[58] EECC art 73.
[59] EECC art 61(3).

This approach seeks to encourage efficiency and EU-wide consistency, with the Commission issuing a recommendation on "product and service markets within the electronic communications sector susceptible to ex ante regulation".[60] National regulators have to take the "utmost account" of the Commission's recommendations, but this does not replace the need for a detailed market analysis, and regulators are allowed to define markets different to those in the Commission's recommendation. In this way, the approach to access in electronic communications preserves the case-by-case approach of competition law. Furthermore, like competition law, it is envisaged that there will be a price (set by the regulator) for firms seeking to make use of a regulatory right to access and interoperate with another firm's assets, and in most cases incumbents were empowered (usually with requirements for industry consultation) to draft contracts setting out the conditions and terms on which access was granted.

There are significant protections in place for asset owners reflecting principles of competition law – including strict requirements of proportionality, protection of the viability of new investments, and an overarching requirement that access obligations are in consumers' interests.

In other respects, however, the approach in electronic communications follows the recent loosening of competition law. First, there is no requirement of "indispensability". In fact, many regulators expressly adopted a "ladder of investment" approach – regulating at one level of the value chain in order to incite competitive investments at a lower level of the value chain, and then slowly shifting the central focus on regulation further up the chain to encourage competitive investment higher and higher up the chain over time.[61] This approach was instead designed specifically to third party investment in complementary assets. Furthermore, rather than imposing regulation only where its absence would eliminate competition, the onus is reversed: refusal of access only needs to "hinder" the emergence of (future) competition.

Furthermore, while competition law would generally be limited to imposing obligations based on a set of principles – primarily leaving the asset owner to decide the detailed terms of openness – European telecommunications laws allowed regulators to design much more prescriptive access obligations. Furthermore, the law generally provided for governance mechanisms to help iron out the technical and commercial details of providing access where the industry could not agree – often with recourse to fast arbitration and, as a last resort, quick regulatory intervention in areas of disagreement.[62]

Policy-makers designing the EU's electronic communications framework therefore sought to strike a careful balance. In general, Europe's telecommunications access regime has been widely regarded as a success internationally – with high levels of investment and low consumer prices – and has been widely used as inspiration in third countries' telecoms law.

Certain sector-specific factors that have contributed to this success. One is the existence of global standards and licensing frameworks. Since entry in many telecommunications-related markets is risky and requires high levels of capital, industry players have long collaborated to produce global standards such as for 5G, to enable players to specialise in parts of the overall value chain and to increase their addressable market. Furthermore, much telecoms infrastructure has been built with interoperability

[60] EECC art 64; Recommendation on Relevant Product and Services Markets, 2020/2245.
[61] Marc Bourreau, Pinar Dogan and Matthieu Manant, 'A critical review of the "ladder of investment" approach', *Harvard Library*, 2010.
[62] EECC art 26.

in mind from the start: even before competition was introduced in the 1990s, for example, the previous national monopolies needed to ensure global consistency so that users could make phone calls to international destinations, where the calls would need to partly rely on foreign telecommunications networks. Innovation in this sector also tends to be more predictable. These enabling conditions are not always present in other markets, which suggests that these other markets may require a more in-depth assessment and more difficult trade-offs.

There has been increasing criticism about the long-term impacts of Europe's rules on openness in the electronic communications sector. On the one hand, smaller telecoms firms have sometimes argued that access often took a very long time to become workable – mostly because of incentives by incumbents to delay and stifle workable access obligations. On the other hand, many of the largest European firms most likely to be subject to access obligations argue that telecoms regulators have been too willing to intervene in the market. For example, the "ladder of investment" approach encouraged complementary investment, culminating in many new entrants investing heavily in copper-based infrastructure (such as ADSL). While this promoted cheap and widespread internet access in Europe, it may have discouraged disruptive investment – by encouraging these new entrants to rely on the incumbents' network rather than building their own, superior, fibre-based networks. And the risk of mandated openness may in turn have discouraged incumbents from building their own fibre infrastructure sooner.[63] While these criticisms deserve to be considered carefully, overall the EU regulatory regime has been quite successful at promoting investment and competition, particularly for new fibre networks where Europe is more competitive than the US or other regions.[64] Nevertheless, the strength of these criticisms highlight the importance of ensuring interoperability and access are imposed at the right point in the value chain, and with sufficient incentives to encourage disruptive innovation as soon as it becomes viable – a point we will return to later in this paper.

3.3 The Evolution of Regulated Access

In recent years, rules demanding more openness have been imposed in a range of new sectors, often in response to observing perceived market failures or persistent barriers to effective competition. Examples of mandated openness in other sectors include:

- **The introduction of interoperability obligations in the Digital Markets Act**. Similar to the traditional approach in electronic communications, the DMA does not only seek to prevent anti-competitive behaviour. However, rather than expressly promoting competition, the DMA aims to deliver "contestability and fairness". The DMA applies an obligation of interoperability to all providers of operating systems and virtual assistants once they qualify as gatekeepers.[65] It also mandates interoperability between providers of certain communications services. The DMA seeks to circumvent certain issues like pricing, which was often a cause of litigation in the electronic communications sector, by setting a zero price for certain types of

[63] Often, as in the UK, the incumbent only began investing in fibre at scale after regulatory assurances of a lighter-touch approach to openness obligations.
[64] Richard Feasey et. al., 'The Future of European Telecommunications: In-Depth Analysis', CERRE, September 2024, p 11.
[65] The obligation requires the gatekeeper to provide access to "the same hardware and software features accessed or controlled via the operating system or virtual assistant … as are available to services or hardware provided by the gatekeeper" (Digital Markets Act, Regulation 2022/1925, art 6(7)).

interoperability (though access to other assets under the DMA is under fair, reasonable and non-discriminatory conditions). Other issues – like how to ensure safety and security when opening up operating systems – are referred to in the text by way of exceptions. The aim of law-makers – understandably, given the slow pace of developing workable access obligations in competition law and electronic communications – was to impose market changes quickly, rather than undertake lengthy analyses resulting in a more tightly circumscribed set of rules, which would likely have been susceptible to extensive litigation and delays.

- **The introduction of open banking and the proposal to expand this to open finance**. Under the second Payment Services Directive (PSD2), banks are required to share data and interact with third party payment firms, so that those firms can access a customer's financial data and initiate payments from the customer's bank account with their consent. Unlike most previous access and interoperability obligations, but like the DMA, PSD2 applies obligations to almost all banks, and sets a zero price for access to banks' data and system for certain regulated purposes – reflecting a focus on efficiency and speed of implementation.[66] EU law-makers are currently considering a Commission proposal for a framework for financial data access (FIDA) which would expand access rights to a broader range of financial data than those covered by PSD2 – including not only banking data, but also data regarding insurance, investments and pensions. Much of this data is not already standardised across the industry.
- T**he move towards mandating open access to all passive infrastructure in the electronic communications sector**. In order to promote faster rollout of next generation networks, the EU's Gigabit Infrastructure Act now imposes obligations on many different types of firms which operate passive infrastructure such as underground ducts and pipes, and requires them to make the infrastructure available for companies wanting to rollout new fixed-line networks.[67] This law does envisage access providers charging a "fair and reasonable" price for access – which includes "the operators' need for a fair return on investment" – and allows them to reject access requests for certain reasons including safety, integrity, security, and technical suitability.[68] National regulators are required to quickly resolve disputes about the terms of access.[69]

Many of these newer laws have common characteristics including:

- setting out in primary legislation, which market participants are subject to access and interoperability obligations;
- hard-wiring into legislation the points in the value chain where interoperability must be imposed; and
- seeking to minimise the risk of lengthy disputes – either by resolving the disputes in primary legislation (as with the questions of who is subject to mandatory interoperability and at which points) or by setting out a speedy dispute resolution process.

[66] Banks may choose (and in many cases have chosen) to make access available for purposes beyond the scope of PSD2, for which they are free to charge, many of which have been commercially successful.
[67] Gigabit Infrastructure Act (**GIA**), Regulation 2024/1309.
[68] GIA art 3(5).
[69] GIA art 13.

The policy objective of this newer approach is understandable: to avoid the extremely slow process of introducing interoperability, avoid the ability of access providers to strategically delay the implementation of interoperability by raising issues like security without offering reasonable solutions to address them, and to achieve faster improvements to competition.

In some cases, these approaches reflect a loss of confidence in the possibility of, or benefits of, market-led disruptive innovation - or at least a frustration with the length of time it has taken for disruptive innovation to emerge. In some respects, this is understandable: while the 1990s saw the rise and fall of many tech giants, for example, the last 20 years (until the rise of AI-focused firms like NVIDIA and OpenAI) tended to see the largest players consolidate their positions with few real challengers. This may have contributed to policy-makers focusing in some contexts on promoting *intra-platform* competition rather than waiting for new *inter-platform* competition to emerge, and in other contexts of creating simple and clear rules rather than more complex and fact-specific ones.

These attempts to solve the problems of interoperability quickly have a trade-off, however: they provide less opportunity for regulators to evaluate the optimal level of openness – taking into account impacts on innovation, investment and security – in the particular circumstances.

In some cases, however, a streamlined approach to access conditions may reflect a sensible approach. For example, mandating access to passive infrastructure has a significant impact on third parties (reducing the cost of rolling out network infrastructure by up to 80%[70]) while having minimal impact on innovation (since there is little innovation inherent in basic infrastructure like underground pits and pipes and overhead poles, and therefore little gain for consumers by unnecessarily replicating this infrastructure). In other cases, the degree of innovation remains to be seen. For example, PSD2 aims to promote 'open banking' as an alternative to card-based payments but despite the significant resources banks across Europe have invested in making the solution work, its take-up has been modest and its ability to compete with market-led disruptive innovations like digital currencies is unclear.

[70] See European Commission, Gigabit Infrastructure Act Proposal and Impact Assessment, 2023.

4. Interoperability and Competition: From Intra-Platform to Inter-Platform?

As alluded to in the previous section, a critical question involves navigating the tension between fostering competition *within* a platform's ecosystem (intra-platform competition) versus competition *across* distinct platform ecosystems (inter-platform competition). Increasingly, as explained in section 3, regulatory interventions favour the former. But such measures must be carefully calibrated so as to strike the right balance and give sufficient weight to the ability of platform owners to differentiate themselves and preserve innovation incentives that drive competition at the ecosystem level. This is not to say that policy-makers face a binary choice between one or the other type of competition to promote. Rather, a decision on the optimal level of openness should account for the potential trade-offs that exist and thus requires a choice on where to strike the balance between the two when such trade-offs exist and are pronounced.

4.1 Unlocking Intra-Platform Competition

Interoperability is widely regarded as a regulatory instrument for addressing bottlenecks and promoting intra-platform competition—that is, competition in the market. This form of competition occurs within a single ecosystem, typically among complementors[71] or between the platform owner and its complementors.[72] Interoperability can enable third-party complementors to access or interface with the infrastructure of a dominant platform, thereby increasing contestability of the complementor market. Addressing these dynamics is essential for ensuring fairness and sustaining value creation once a platform has achieved a dominant position.[73]

A structural challenge is the dual role often played by dominant platforms, which can act simultaneously as infrastructure providers and downstream competitors.[74] While first-party complements provided by the platform can foster innovation and generate demand spillovers that benefit third-party complementors,[75] this activity also creates incentives for self-preferencing. Platform owners may be inclined to discriminate against non-integrated complementors to favour their own offerings, thereby limiting effective competition.[76] Furthermore, dominant platforms can leverage proprietary data collected in primary markets to gain asymmetric insights and enter

[71] Meyer et al., 'Digital platforms and business ecosystems: a multidisciplinary approach for new and sustainable business models', *Review of Managerial Science,* vol 18, 2024; Cennamo & Santaló, above n 20.
[72] E.g., Foerderer et al., above n 21; Feng Zhu and Qihong Liu, 'Competing with complementors: An empirical look at Amazon.com', *Strategic Management Journal*, vol 39, issue 10, 2018.
[73] Jacobides, Cennamo and Gawer, above n 44.
[74] Andrei Hagiu, Tat-How Teh and Julian Wright, 'Should platforms be allowed to sell on their own marketplaces?', *RAND Journal of Economics*, vol 53, issue 2, 2022.
[75] Carmelo Cennamo, 'Building the Value of Next-generation Platforms: The Paradox of Diminishing Returns', *Journal of Management*, vol 44, no 8, 2018; Andrei Hagiu and Daniel Spulber, 'First-Party Content and Coordination in Two-Sided Markets', *Management Science*, vol 59, no 4, 2013; Foerderer et al., above n 21.
[76] Massimo Motta, 'Self-preferencing and foreclosure in digital markets: Theories of harm for abuse cases', *International Journal of Industrial Organization*, vol 90, 2023; Jorge Padilla, Joe Perkins and Salvatore Piccolo, 'Self-Preferencing in Markets with Vertically Integrated Gatekeeper Platforms', *Journal of Industrial Economics*, vol LXX, no 2, 2020; Zhu and Liu, above n 72.

secondary markets, potentially displacing or handicapping business users who rely on the platform infrastructure.[77]

In this context, vertical interoperability (VI) — i.e., requirements that the dominant platform make architectural changes to open its interfaces (APIs, standards, data flows) to independent complements or upstream/downstream players — can act as an ex-ante remedy to re-balance power and enhance fair competition in the market.[78] Specifically, VI can prevent vertically integrated platforms from foreclosing non-integrated rivals by denying access or privileging their own services.[79] The economic logic is that by reducing access barriers and hold-up risks, more complementors can compete, which may lower prices, improve quality, increase innovation and consumer choice.[80]

Implementing VI involves many design choices. One widely referenced principle is "equivalence of inputs" — whereby the gatekeeper must supply non-integrated complementors with the same interface quality, functionalities and data views that it supplies to its own downstream operations.[81] But requiring full equivalence can reduce the dominant platform's incentives to invest in and maintain the underlying infrastructure, particularly when the marginal return on investment is shared across many external actors rather than captured internally.[82]

Horizontal interoperability can create similar design questions. For example, horizontal interoperability requires defining the functions which must be available to competing platforms. This creates a trade-off: the broader or more attractive the functions which are interoperable, the lower the possibilities for smaller competing firms to differentiate their offerings to attract new users. However, the narrower the functions which are interoperable, the more competition is still shaped by the level of proprietary network effects specific to each firm.

The critical regulatory design question, therefore, is how to design interoperability obligations which have the most positive impacts on competition and on innovation.[83]

This leads to a broader debate: should regulation primarily protect the innovation process (on the view that disruption drives competition)[84] or should it prioritise the competition process (as traditional antitrust approaches do)? While fully resolving this is beyond this report's scope, it is evident that regulation must account not only for barriers to entry and switching costs but also for how ecosystem actors' innovation incentives evolve under different openness regimes.

[77] Jan Krämer and Shiva Shekhar, 'Regulating Digital Platform Ecosystems Through Data sharing and Data Siloing: Consequences for Innovation and Welfare', *MIS Quarterly*, vol 49, no 1, 2025.
[78] Çavuş, above n 34.
[79] Giuseppe Colangelo and Alba Ribera Martínez, 'The Metrics of the DMA's Success', *European Journal of Risk Regulation*, vol 16, issue 3, 2025; Bourreau, Krämer and Buiten, above n 7.
[80] Fiona Scott Morton et al., 'Equitable interoperability: The 'super tool' of digital platform governance', *Yale Journal on Regulation*, vol 40, issue 3, 2023.
[81] Bourreau, Krämer and Buiten, above n 7.
[82] Wolfgang Kerber and Heike Schweitzer, 'Interoperability in the digital economy', MAGKS Joint Discussion Paper Series in Economics, No. 12-2017.
[83] Bourreau, Krämer and Buiten, above n 7, p 21.
[84] Cennamo et al., 'Digital Platforms Regulation: An Innovation-centric View of the EU's Digital Markets Act', *Journal of European Competition Law & Practice*, vol 14, no 1, 2023.

4.2 The Unintended Consequence: Dampening Inter-Platform Competition?

Turning to ecosystem-level dynamics, one must ask: If interoperability is mandated too broadly or imprecisely, could it reduce competition **between** platforms (inter-platform competition) by eroding the differentiation that enables multiple ecosystems to co-exist, or by encouraging more third-party investment *within* a large platform's ecosystem?

As long as users can switch between platforms without excessive difficulty, inter-platform competition—competition for the market—occurs between distinct ecosystems driven by network effects (both direct and indirect) *and* by platform differentiation.[85] A key source of value in many platform architectures is in their unique identity—superior hardware-software integration, differentiated user interface, stronger privacy or value ecosystem, among others.[86] If mandated interoperability drives standardisation of key, differentiating functionalities across platforms, it may reduce these differentiation levers and thus reduce the number of viable platform choices for users – which can be a loss if users were anyway able to switch between those platforms. Mandating standardisation without design features to reduce this effect can entrench incumbents rather than improve contestability by reducing differentiation. Recent modelling indeed suggests that horizontal interoperability obligations do not always increase contestability and may impede efficient entrants by reducing incentives to multi-home (Krämer et al., 2023).

A further question is whether mandating access to infrastructure can have the effect of giving third parties a degree of 'comfort' or the ability to relax about their dependency on a 'gatekeeping' platform provider, promoting more investment *within* the platform's ecosystem than promoting competition *with* the ecosystem. In this way, if regulation is not well designed, it may effectively discourage more disruptive investment from third parties.

Consequently, regulators must weigh the potential trade-off between intra- and inter-platform competition. When the trade-off is present or when intra-platform competition can then enable more inter-platform competition can be best understood by examining two different competitive scenarios.

4.2.1 From Intra- to Inter-Platform Competition

In certain contexts, granting interoperability access to complementors may trigger competitive dynamics at the ecosystem level: a complementor may use its access to the incumbent platform's user-base to gain users and then shift those users onto a rival ecosystem—a form of "piggy-backing" (Parker et al., 2016). By accessing the platform stack, complements can evolve into potential competitors at the system level. In this way, vertical interoperability can help both intra-platform competition while *also* being a trigger for eventual inter-platform competition.

[85] Mark Armstrong & Julian Wright, 'Two-sided Markets, Competitive Bottlenecks and Exclusive Contracts', *Economic Theory*, vol 32, 2007; Cennamo & Santaló, above n 15; Feng Zhu and Marco Iansiti, 'Entry into platform-based markets', *Strategic Management Journal*, vol 33, issue 1, 2012.
[86] Cennamo, above n 13.

Research by Adner and Lieberman (2021) identifies three distinct pathways through which this disruption through complements can occur:

- **Commoditisation (Complement Drives Down Added Value):** The complementor gains power, reducing the influence and profit margins of the core platform without necessarily reducing demand. This shifts the "locus of differentiation" from the core platform to the complement. For example, if AI applications (e.g., ChatGPT, Gemini) become the primary interface for user access to and consumption of information, they could commoditise traditional search engine platforms, reducing the incumbent's influence even if the search engine remains technically necessary. Usually, this type of disruption is more likely in mature markets/technologies where the level of performance of the incumbent technology has reached a point of diminishing returns. By commoditising the platform technology, the complementary technology can open a new path for the next layer of innovation and unlock new value to the benefit of the whole ecosystem.
- **Adjacent Entry (Complement Enters as Direct Rival):** The complementor converts a partnership into direct rivalry by producing the core offer itself. This is often motivated by a desire to avoid hold-up risks or to capture synergies. For example, Netscape originally complemented Windows by enhancing its utility. However, as browsing became central to the PC experience, it became a rival, prompting Microsoft to integrate its own browser.[87]
- **Value Inversion (Complement Becomes a Substitute):** A complement improves to the point where it unintentionally substitutes the core offer. For example, initially launched as a complement to Online Web-portals, Google's search toolbar became so valuable to users to eliminate the need for browsing through those portals to access to their preferred news and content, thereby displacing the yesteryear incumbents.

Conversely, vertical interoperability can facilitate ecosystem partitioning rather than pure displacement. Khanagha et al. (2022) illustrate this through the case of Cisco's Fog computing initiative. Facing commoditisation in its core networking business and a peripheral role in the Cloud ecosystem, Cisco leveraged its networking strengths to create a new platform layer, Fog computing, that bridged Cloud and Edge computing. By targeting non-overlapping market niches (latency-sensitive IoT applications), Cisco utilised vertical interoperability to partition the ecosystem. This allowed it to retain complementarity with the dominant Cloud platform while competing via a differentiated value proposition. These cases show how interoperability can potentially lead to disruptions at the ecosystem level, thus increasing contestability of dominant, core platform services.

4.2.2 The "Competitive Bottleneck" Case: Standardisation vs. Differentiation

In markets characterised by "competitive bottlenecks" (typically where one side of the platform single-homes and the other multi-homes), platforms compete aggressively for users, and differentiation is the key dimension preventing easy tipping to one dominant player solely by virtue of network size.[88]

[87] Çavuş, above n 34.
[88] Armstrong and Wright, above n 85; Cennamo & Santaló, above n 15.

Platforms thus invest in unique features (hardware-software integration, privacy, UX) to attract both users and complementors.[89]

Mandating interoperability in this context will require care to protect differentiation, which might otherwise be threatened through the following mechanisms:

- **Reduction of Multi-homing Incentives**: While interoperability and multi-homing are sometimes viewed as substitutes for achieving contestability,[90] mandating interoperability (particularly horizontal interoperability) can paradoxically reduce consumers' incentives to multi-home. If the dominant platform becomes interoperable with rivals, users may simply stay with the dominant platform to access its full functionality without switching, thereby reducing contestability.[91]
- **Privacy Spillovers and Entrenchment:** Kretschmer et al. (2025) argue that in competition between a data-funded incumbent and a privacy-preserving entrant, interoperability can introduce privacy spillovers. If data is exchanged across services, the privacy-preserving entrant loses its key differentiator. Consequently, the entrant becomes less attractive, and the dominant position of the incumbent is entrenched rather than challenged.
- **Reduced Complementor Investment:** When interoperability creates standardised cross-platform features, complementors find it easier to multi-home but have weaker incentives to invest in platform-specific specialised features or quality enhancements.[92] This lack of dedicated investment can undermine the platform's ability to create unique value at the detriment of consumer choice: they will find the exact same applications (offering same consumption experience) across different ecosystems, reducing their incentives to switch or multi-home. As complementors shift to generic (i.e., cross-platform) rather than platform-specific investments, inter-platform competition becomes more about price or network size rather than innovation or feature-rich differentiation.[93]

In sum, while interoperability is a vital tool for unlocking intra-platform competition, regulators must design it in ways which protect inter-platform competition – and, where possible, allow its use to create more disruptive inter-platform competition.

[89] Zhu & Iansiti, above n 85; Cennamo, above n 13.
[90] Marc Bourreau, Adrien Raizonville and Guillaume Thébaudin, 'Interoperability Between Ad-Financed Platforms With Endogenous Multi-Homing', *Journal of Industrial Economics*, CES IFO working paper, 2023.
[91] Ibid; Bourreau, Krämer and Buiten, above n 7.
[92] Niloofar Abolfathi, 'Multihoming and single-homing complementors' responses to intensified between-platform competition: Evidence from the YouTube–Twitch rivalry', *Strategic Management*, 2025; Carmelo Cennamo, Hakan Ozalp and Tobias Kretschmer, 'Platform Architecture and Quality Trade-offs of Multihoming Complements', *Information Systems Research*, vol 29, no 2, 2018.
[93] Vardit Landsman and Stefan Stremersch, 'Multihoming in Two-Sided Markets: An Empirical Inquiry in the Video Game Console Industry', *Journal of Marketing*, vol 75, 2011; Cennamo, above n 13.

5. Defining the Optimal Level of Openness

The preceding sections have shown that interoperability and openness can generate substantial benefits for competition and innovation, if they are imposed with careful design. Mandated openness can reallocate innovation incentives across different actors in an ecosystem and across different types of innovation—generative versus disruptive, peripheral versus architectural. These effects are not uniform across sectors, market structures, or points in the value chain.

As a result, determining the *optimal* level of openness is not a matter of applying a general presumption in favour of interoperability, nor of deferring unconditionally to platform operators' design choices. Instead, it requires a **structured, sequential assessment** that clarifies (i) whether intervention is justified, (ii) where in the value chain it should apply, and (iii) how deeply openness should be imposed, considering implementation and governance choices.

In this section we provide a four-part test policy framework to guide policy-makers and regulators determine whether and how to make such interventions in the future, rather than assessing how EU policy-makers are implementing and enforcing existing EU laws on which policy choices have already been made.

5.1 Step 1 – Does the Market Warrant an Openness Intervention?

Openness decisions should normally be left to market forces. In well-functioning markets, platforms may have incentives to calibrate openness in ways that maximise the attractiveness of their ecosystems to users and complementors.

Therefore, in line with previous CERRE work,[94] we consider that intervention could be justified on economic grounds where there is credible evidence that competition is not working effectively and that mandated openness can help address that problem. In practice, the following conditions would justify mandatory interoperability.

An important bottleneck

First, the proposed obligation must target a **genuine bottleneck.** This is, for vertical interoperability, a resource, interface, or function that downstream or upstream players must access to reach a significant number of users or to undertake economically meaningful innovation. In the case of horizontal interoperability, this will normally be a competitor's customer base which cannot otherwise be accessed (for example because those customers will not multi-home). Because mandating openness can be resource-intensive and intrusive, the bottleneck should be important for value creation in the ecosystem, not merely useful for niche or marginal offerings.

Generally, this militates towards greater openness for the most important inputs which are more 'essential' and can be used for multiple downstream purposes. Important bottlenecks might include,

[94] Bourreau, Krämer and Buiten, above n 7.

for example, basic functionalities accessible via an operating system or a physical network asset such as ducts or pipe. Less important bottlenecks might include very specific functionalities accessible via an operating system for which there would be little third-party demand.

At the same time, policymakers should be cautious about requiring ex ante proof of third-party demand. Mandated openness may itself create the conditions for entry, and a strict demand requirement risks creating a chicken-and-egg problem. The relevant question is whether access would plausibly enable meaningful competitive or innovative activity, not whether demand for such activity already exists.

Durability of the bottleneck

Second, the bottleneck must be **durable**. That means it should be a stable core component of the relevant ecosystem and there should not be a significant likelihood that the ecosystem could evolve in a way which makes the bottleneck less relevant over a reasonable timeframe.[95]

Openness obligations are difficult to implement and costly to reverse, particularly where they require architectural changes and new governance systems. Intervention should be less likely where the bottleneck is likely to be eroded by foreseeable technological developments, alternative architectures, or business models. Market maturity is a critical consideration. In a nascent and rapidly evolving market where different players are still experimenting with different business models, policy-makers need to be cautious to avoid locking in (technological and business model) design choices which might not result in optimal outcomes in the long term. By contrast, for stable and entrenched components of mature ecosystems, the case for intervention is stronger.

For vertical interoperability, the bottleneck operator is vertically integrated

Third, to justify vertical interoperability, the bottleneck operator must be **vertically integrated** in a way that creates incentives for foreclosure or self-preferencing. Platforms often act as 'ecosystem orchestrators', making decisions about how to balance the benefits and risks of openness[96] to all, or a particular group, of users. These choices become potentially problematic when the platform also competes with (or would compete with) third parties that depend on access to the bottleneck, creating incentives to restrict or degrade access in ways that harm competition and, ultimately, consumers. Therefore, interoperability is much more likely to be a suitable remedy when a platform is vertically integrated and is (or would be, if it were open) in competition with third parties.

For horizontal interoperability, the bottleneck operator enjoys network effects

To justify horizontal interoperability, on the other hand, the bottleneck operator must be able to enjoy significant network effects due to its position in the market. In many cases, this means that potential competitors must be unable to efficiently compete because the incumbent can offer a much more

[95] For example, functionality provided to an app developer via an operating system might not be a chokepoint to the extent that an app is able to achieve the same functionality through different means (e.g. through a web browser) if the alternative means is equally attractive to a consumer. However, where web browser apps are denied access to important functionality which native apps (those downloaded through an app store) are allowed, then the app store may be a relevant chokepoint (if other requirements are met).

[96] Boudreau, above nn 4 and 5; Cennamo and Zhu, above n 5.

attractive offering due to the size of its existing customer base. Factors such as willingness of users to multi-home may make horizontal interoperability more difficult to justify.

Inadequate levels of competition

Fourth, there must be **inadequate competitive constraints**. The mere existence of multiple platforms is not sufficient to conclude that there are adequate levels of competition, however. What matters is whether platforms impose meaningful competitive pressure on each other, considering switching costs, single-homing, ecosystem lock-in, and differentiation strategies. Competition should be assessed on the basis of the different nature of the underlying digital markets. For example, in some cases competition may occur between different business models and ecosystems, and with platforms differentiating their architectures, which enable them to offer differentiated value propositions to their users, also by through distinct complementary innovation.

Adequate levels of competition might not exist, however, if switching between ecosystems is difficult, such as from lock-in effects. In such cases, existing users may not benefit sufficiently from any competition between the platforms to attract new users (such as through differentiation).[97]

Objective justifications

As we have explained above, there may be legitimate reasons for a platform to choose not to be fully open. For example, a platform may play an 'orchestrator' role and will have a legitimate desire to protect the integrity, quality and safety of the platform and its broader ecosystem. Similarly, there may be good reasons to govern openness in a way that protects consumers (such as protecting children from inappropriate content, or which delivers other important social values like media plurality). Nonetheless, platform operators may at the same time have incentives to preclude competition – and may benefit from cloaking decisions made to stifle competitors in the language of objective justifications. This will require examining whether:

- **The extent to which the platform is closed has been objectively justified**. There may be some functionalities which are only capable of being carried out by a 'system orchestrator', such as decisions about how to allocate scarce resources (such as the remaining capacity in a duct, the frequencies of a copper line, or the system resources used by different apps on one device) or to protect fundamental characteristics of the platform (such as protecting security and providing independent information about the quality of third party apps). The key will be to ensure these reasons are objectively justified based on credible evidence and represent the most proportionate solutions, rather than being smokescreens for denying interoperability for commercial reasons, and in some cases policy-makers may choose for efficiency to exhaustively set out the reasons why a platform can deny access to a third party. Furthermore, in many cases these decisions do not need to be made by the platform operator: they could be made in an inclusive way or by an independent third party that does not have a conflict of interest.
- **Risks can be adequately mitigated.** Often, a proportionate approach to addressing risks can only emerge through an inclusive governance process. Platform operators may in some

[97] See, e.g., the findings of the Competition and Markets Authority (UK) in its *Mobile ecosystems: Market study final report*, 2022.

circumstances not have incentives to constructively propose solutions (for example to privacy and security issues) until they are engaged in such a process in the shadow of regulation, and they may have incentives to present these risks as unmanageable or unduly expensive in order to reduce the risk of being forced to become more open. However, where security and privacy issues are raised, policy-makers should seek independent technical advice to understand whether these issues are real and obtain assurances that they can be proportionately addressed. Interoperability mandates should acknowledge, and be designed in ways that recognise that, bad actors may seek to exploit a platform's openness and therefore that a process to mitigate these risks – for example, by vetting access seekers – may be essential. Policy-makers should recognise that privacy and security issues can be more easily resolved in some contexts (such as access to physical assets) than others (such as software-based systems, where third parties can gain visibility or control over system functions which provide pathways to misuse sensitive resources such as personal data). However, this does not necessarily mean that a platform operator with a conflict of interest should have sole discretion over whether and how access is granted.

5.2 Step 2 – Where in the Value Chain Should Openness be Imposed?

Once intervention is justified in principle, the next question is where to implement openness. As we have noted below, this requires a degree of specificity: both as to the point in the value chain where more openness would be optimal, and the particular functionalities which should be made open.

Core versus periphery

A fundamental distinction defined in the literature is between:

- "**ecosystem (peripheral) openness**", which involves providing interfaces like APIs and SDKs to *grant access* to third-party complementors to the ecosystem, and typically support generative innovation by complementors; and
- "**platform architecture (core) openness**," which involves *devolving control* over the core functionalities or design rules of the platform architecture itself, often via open-source licenses,[98] and carries higher risks, including platform forking[99], commoditisation, and weakened incentives for architectural innovation.[100]

The innovative impacts of openness change depending on whether it is applied to the platform's core or its periphery. As a general rule, the risks to be managed increase as intervention moves deeper into the core of the platform. Opening the core therefore requires a stronger justification, or more rigorously designed governance mechanisms, than opening peripheral interfaces.

[98] Boudreau, above n 4; Kimmo Karhu, Robin Gustafsson and Kalle Lyytinen, 'Exploiting and Defending Open Digital Platforms with Boundary Resources: Android's Five Platform Forks', *Information Systems Research*, vol 29, no 2, 2018.
[99] Karhu, Gustafsson, & Lyytinen, ibid.
[100] Baldwin, above n 31.

This analysis will have to be context-specific. For example, in network connectivity, deeper levels of vertical interoperability may sometimes promote innovation. The sector is, in any event, made up of players which are highly specialised and interoperability has developed on a market-led basis because it helps to improve risk-weighted returns on investment. In this context, much 'core' innovation happens in an environment which is already deeply embedded with international standardisation processes. In this case, technology providers already benefit from interoperability because it enables performance, reliability, and energy-efficiency gains. However, given the high levels of irreversible capital investment in the sector, mandating more openness at the 'core' than the market has already achieved itself carries significant risk.

In many contexts there may not necessarily be a neat distinction between 'core' and 'periphery'. For example, as noted above, in the fixed-line electronic communications context the focal point for vertical interoperability has slowly moved further upstream over time – from mandating full access to an incumbents' services, to only parts of the hardware, with the focus now being on access to passive infrastructure. In this context – unlike in digital platforms – there is less ability to innovate and differentiate at the deepest layers of the stack (for example, there is not a lot of potential innovation involved in the creation of passive infrastructure such as ducts and pipes) than at upstream levels (such as internet access services), meaning less cost to imposing vertical integration at the furthest upstream points.

Functional specificity

Openness should be considered at the level of **specific functions**, not on entire layers or systems. An operating system, for example, includes many thousands of functionalities made available to (certain or all) app developers. Platforms typically expose thousands of functionalities, only some of which may constitute important and durable bottlenecks. Blanket access obligations risk imposing unnecessary costs and constraining innovation in areas where market forces already operate effectively.

The tests above for intervention (such as whether a function is an 'important' and 'enduring' bottleneck) are likely to apply to some functionalities and parts of the operating system, but not necessarily all of them. In practice, the case for intervention is likely to be strongest for certain **'basic' or 'commoditised' functions**, where the pace of innovation has slowed, particularly those functions which are common to and facilitate switching or interoperability across ecosystems – such as access to a device's commoditised hardware functions and functionality to enable easy cross-device data transfers. It is less likely to apply to 'nice to have' functions, particularly those which serve as competitive differentiators for different operating systems.

Market-type considerations

The optimal location for openness also depends on the type of platform market involved:

- In **complementary innovation markets** (e.g. mobile operating systems), the primary concern is foreclosure of complementors. Controlled vertical interoperability at the ecosystem

boundary is often the most proportionate response.[101]

- In **multi-sided transaction markets** (e.g. marketplaces), openness may be required to address discrimination, ranking bias, or self-preferencing, often through governance and access rules rather than deep architectural intervention.[102]
- In **information markets** (e.g. search), the key risks often lie in vertically integrated intermediation layers rather than in the core matching or ranking functions themselves.[103]

Intra- versus inter-platform competition

Policymakers must explicitly assess whether openness is likely to promote competition **within** a platform (intra-platform) or **between** platforms (inter-platform). In some cases, interoperability can enable complements to evolve into ecosystem-level competitors, in which case, intra-platform competition can lead to inter-platform competition. In others, it may entrench incumbents by reducing differentiation and discouraging switching: intra-platform competition will thus come at tradeoff with inter-platform competition.

Where openness risks homogenising key differentiating features, it may weaken inter-platform competition (as discussed in section 4) and reduce long-run contestability.

5.3 Step 3 – How Much Openness Should be Imposed?

The third step, openness is justified and well targeted, concerns the ***degree*** of openness. The relationship between openness and innovation is not linear. Empirical evidence points to an **inverted-U relationship,** more openness (e.g., granting licenses to all comers but maintaining some control) can maximize innovation if it is accompanied with good governance mechanisms. Some degree of "good gatekeeping"[104]—such as the quality screening and certification processes used by platforms like SAP[105]—is necessary to prevent negative effects described in Section 3.2 and to protect security and privacy. Without curation, an ecosystem can suffer from the "tragedy of the commons," where free-riding on quality and market fragmentation lead to a collapse in user trust and innovation incentives.[106] However, careful thought must be given to the platform operator's conflicts of interest,

[101] it is important that interoperability addresses two issues: (i) easing user switching across ecosystems; and (ii) restricting imbalanced competition between first-party and third-party complements (ie., limiting abusing the dominant position to self-preference own complements against those of complementors).
[102] In this case, interoperability should address: (i) market foreclosure issues (platforms may contend, and lock-in, providers by conditioning the access to the marketplace, or some of its features, to exclusivity clauses, or undermining their discoverability in eg. recommendation systems if providers multihome); and (ii) self-preferencing (in relation to point 1: they may foreclose market access to providers in the market niches where they have their own offerings)
[103] In this case, interoperability should address: (i) market foreclosure issues (guarantee equal access across all providers, independently of their homing strategy; and equal market conditions (ie., weight in the ranking/recommendation systems)…); and (ii) greater openness of vertically integrated modules, higher up in the value chain, that are responsible for intermediating search queries (from the end-user side) with advertising bidding (from the provider side) – such as the case eg. of ad tech (Damien Gerardin and Dimitrios Katsifis, 'The Antitrust Case Against the Apple App Store', *TILEC Discussion Paper*, 2020; Alexander Witte and Jan Krämer, 'Evaluating structural and behavioral remedies for anticompetitive conducts in the ad tech ecosystem', *Telecommunications Policy*, vol 49, no 5, 2025). Separating these modules from the core platform, and allowing for interoperability with the core platform, can enable greater competition at the ads intermediation level of the value chain, while still preserving the well-functioning of the platform across its broader functionalities.
[104] Cennamo and Zhu, above n 5.
[105] Jonathan Wareham et al., 'Technology Ecosystem Governance', *Organization Science*, vol 25, no 4, 2014.
[106] Cennamo & Santaló, above n 15; Gawer and Cusumano, above n 42.

and in cases where competition is not working effectively it may be inappropriate for all curation and 'gatekeeping' decisions to be made unilaterally by the platform operator alone.

While the degree of openness has a range of dimensions, the following might be considered key focal points on the spectrum of openness:

- **Full mandated interoperability on an 'equality of inputs' basis:** This approach requires that the platform operator and third parties area able to access the interoperable assets or functions using the same processes, systems, and on the same terms. This may be most suited for durable chokepoints where generative innovation is key, trade-offs with inter-platform competition are limited, and the potentially increased security and integrity risks are manageable. It might therefore the most appropriate approach where there is minimal architecture-level innovation risk. In implementing it, policy-makers ought to be conscious of architectural homogenisation and take care to consider impacts on incentives for platform R&D.
- **'Equality of outputs':** This approach does not require that the platform operator and third parties access the interoperable assets or functions using the same processes, systems, and on the same terms. However, it does typically require that third parties can achieve the same outcomes (such as providing the same consumer experience) as the platform operator can achieve. This can also lower implementation costs, because while the platform operator has to design ways for third parties to access the interoperable assets, it does not have to re-engineer its own downstream systems and how they interact with the assets. However, it provides less transparency and can lead to disputes about how to assess the quality of 'outputs'.
- **Access on "FRAND" (Fair, Reasonable, and Non-Discriminatory) terms:** This approach allows the platform to impose price and non-price rules of access to preserve incentives and screen low-quality entry. These conditions do not necessarily have to be identical to those applied in the firm's own use of its assets. The benefit of this approach is that it gives the asset owner greater incentive to keep investing in the platform, because it can still gain some greater profit out of the asset than third parties. This might be the most appropriate solution where there are clear benefits to granting access to an asset, but equality of inputs or equality of outputs are both disproportionate. However, the lack of certainty over access conditions may dampen incentives for access seekers to take advantage of interoperability.
- **Non-interoperability remedies such as rules on transparency and governance:** A less interventionist approach could bind the platform to apply equitable and transparent rules about how third parties can access assets. Transparency rules have long been used in telecoms, for example, to allow regulators to scrutinise a firm's decisions and to make it easier to identify when conduct might be occurring which requires more intrusive regulation, thus encouraging good behaviour. This may be an appropriate mechanism where the risks of more onerous intervention are high: if the regulator can offer a plausible threat of imposing more stringent measures, then the platform operator has an incentive to behave fairly to avoid the risks and costs of those measures. However, these rules also provide the least certainty to access seekers and can be subjected to gaming by the platform operator.

In selecting among these options, policymakers should explicitly weigh trade-offs between generative and disruptive innovation, risks of free-riding and quality degradation and multi-homing costs.

5.4 Step 4 – Implementation, Safeguards and Adjustment Mechanisms

The final step concerns how openness is implemented and governed. Policy-makers face genuine dilemmas about how to weigh the various incentives which mandated openness can have for different types of innovation. These dilemmas may be less acute in cases where radical or architectural innovation is less likely to be impaired (for example, this may be more likely where the platform operator has market power).

In these cases, there is a range of implementation tools that could help to minimise the trade-offs, including the following:

- **Regulatory holidays and regulatory forbearance** – in regulated sectors like telecommunications, regulators have strategically decided to commit to imposing no (or less onerous) access and interoperability rules on certain new investments. In countries like the UK, this was seen as a key measure to encourage the incumbent fixed-line telecommunications provider to invest in upgrading its copper network to fibre.[107] Delaying interoperability for a defined period may in some cases allow a platform better opportunity to recoup its R&D on a *new* high-risk investment, thereby encouraging radical innovation by potentially enabling the platform operator to enjoy returns which reflect temporary market power (Schumpeterian rents). This would mitigate the negative effects of forced excessive interoperability obligations on incumbents' incentives to innovate, especially in dynamically and rapidly evolving markets and where the risks of market tipping are not as immediate. However, regulatory holidays need to be approached with some caution since they can be subject to the risk of regulatory capture. A key example is the German government's attempt to grant a regulatory holiday to its national telecoms incumbent, which the Commission argued would jeopardise the position of the incumbent firm's competitors and unnecessarily reduce incentives for market entry.
- **Access pricing** – as noted above, interoperability imposes costs on a platform operator, in the form of fixed costs of implementing openness, but also through the ongoing costs of providing and maintaining access (which might include the process of vetting access seekers and monitoring compliance by those who use access). In addition, mandated interoperability generally should not normally deprive a platform operator of its opportunity to make a reasonable and risk-weighted return on its investments.
- This means (in line with previous CERRE studies[108]) that (in general) mandated interoperability should include an access pricing regime, rather than grant access for free. However, there may be exceptions, for example in cases where the platform operator will be assured of recovering its investments in a platform (which might be the case if it can recoup the costs elsewhere or

[107] See Bert Willems and Gijsbert Zwart, 'Regulatory Holidays and Optimal Network Expansion', CentER Discussion Paper, 2016; in the UK, Ofcom regulated the wholesale price only of a basic superfast fibre product in order to give the major network operator Openreach more flexibility to earn returns on higher-speed fibre products.
[108] Bourreau et al, above n 7.

if its downstream market share is sufficiently high, and likely to remain so, so that its costs can be recovered).[109]

- If an access pricing regime is considered essential, policy-makers should be aware that it can often be extremely complex to administer, even in sectors like telecommunications where assets are primarily physical; the task is likely to be considerably more difficult in cases such as digital markets where assets are digital and investments tend to be riskier. Different pricing models (such as basing pricing on actual replacement costs or on the efficient costs of replicating an asset using the latest technologies) can give policy-makers tools to help achieve a better balance between promoting inter-platform and intra-platform competition. However, they are also subject to significant regulatory gaming, since there is a significant information asymmetry between the platform operator (which understands its own cost base) and the regulator trying to set a fair access price. This may sometimes weigh in favour of a simpler approach or even, in certain circumstances or for certain assets, no pricing.
- **Purpose limitations** – in some cases, policy-makers have a very clear idea of the particular business models they would like mandated interoperability to promote. For example, in Open Banking, regulation specifically required banks to interoperate with 'payment initiation service providers': firms which would be allowed to trigger a payment from a consumer's bank account. Limiting access in this way enabled policy-makers to take a more cautious, measured and targeted approach to market entry, in a sector where privacy and security concerns were paramount. However, it also has the obvious effect of constraining innovations which might have otherwise emerged.

Implementation safeguards

Effective interoperability requires technical and governance mechanisms to manage trade-offs, including interface design, security and privacy protections, and mechanisms for dispute resolution. In many cases, inclusive governance structures and independent arbitration are necessary to balance flexibility for platform evolution with predictability for access seekers. As we explain in the following sub-section, many choices around how interoperability is implemented will have to be resolved with close engagement between regulators, the platform operator, and access seekers.

Dynamic correction mechanisms

Given uncertainty and irreversibility, openness regimes should include **periodic review mechanisms** that allow adjustment in light of observed effects on innovation, competition, security, and investment, while preserving sufficient regulatory stability. This periodic review could help to signal to policymakers where further flexibility in the implementation of the interoperability regime is required. However, in designing this type of review mechanism, policy-makers should take into account the need to protect policy predictability – such reviews should be signalled early and allow a sufficient period of regulatory stability.

[109] Jacques Cremer et al, 'Access Pricing for App Stores Under the DMA', *Journal of Competition Law & Economics*, vol 12, issue 4, 2025.

5.5 Technical and Governance Mechanisms

Where interoperability is imposed, policy-makers need to design technical and governance mechanisms to determine the technical characteristics of access and any access criteria. For example, on the technical side, the implementation of interoperability can be facilitated through APIs or rules designed by the asset provider; mutually agreed interfaces; or the development of common standards by European standardisation bodies.[110] On the practical side, these mechanisms need to solve problems such as identifying and authenticating the access seeker; providing interfaces for the exchange of information; and determining the format of those exchanges.

Governance mechanisms are also essential for two reasons. The first is so that there is a process for making decisions about the right technical and commercial mechanisms. In some cases, a regulator or policy-maker might choose to answer some questions in primary legislation out of efficiency. However, it is rare that a regulator or policy-maker will – when mandating openness – be capable of resolving all of these questions up front. The second reason is that disputes about how technical mechanisms operate in practice, and how they should evolve, are nearly inevitable.

Broadly speaking, the design of technical and governance mechanisms implies trade-offs. For example, where standards and governance mechanisms do not already exist, and there is a policy imperative to move quickly, the platform operator will be in the best position to design the mechanisms itself since it understands its own platform. On the one hand, this preserves the platform operator's flexibility and privileges its ability to innovate and evolve its platform quickly. On the other hand, this provides a platform operator with the means to undermine the effectiveness of interoperability in particular cases: so, a more open and inclusive set of governance mechanisms will be essential. For example, access seekers may be unwilling to invest unless there are stricter curbs on how interoperability mechanisms like APIs can be changed by the platform operator. The design of governance and technical mechanisms can offer a way to mediate between interests. For example, on the governance side, the platform operator could be required to consult with access seekers and access seekers could have recourse to an independent arbitrator or dispute resolution mechanism. In addition, governance mechanisms at the EU level ought to involve cooperation with different agencies – such as data protection and cybersecurity authorities – and external independent experts to help ensure that risks associated with openness are sufficiently mitigated.

How trade-offs should be managed and reflected in the design of technical and governance mechanisms, will vary based on the maturity of the particular sector, the current speed and potential for both architectural and generative innovation, and the degree of differentiation between different platforms. These trade-offs can be easier when dealing with a more mature technology where industry standards already exist: for example, in these cases platform operators can simply be encouraged or required to adopt the industry standard (as occurred with the EU's 'common charger' rules) unless there is a good reason for them not to. Since the standard already exists, concerns about the slow speed of developing interoperability will be less of a concern, and "free riding" will be less of an issue because all participants would adhere to the same technical specifications.

[110] Meyers, above n 11.

In other cases – such as for horizontal interoperability – industry players may have already started collaborating. In other cases, mandating openness will also require creating and mandating participation in new decision-making forums. Policy-makers should give careful consideration to the right mechanisms as part of their overall design of interoperability.

6. Conclusion

In conclusion, optimal openness is not a static choice but a dynamic balancing act.

There are cases where policy-makers can have legitimate concerns that the degree of openness adopted by platforms is suboptimal – likely in sectors with inadequate levels of competition or where platform operators control a strong bottleneck in the value system. However, policy-makers seeking to mandate a greater degree of openness need to pay particular attention to the design of interoperability mandates and putting appropriate governance mechanisms in place to manage the impacts. Europe's competitiveness depends on improving the incentives for deep technology innovation, while also recognising in some cases it will need to innovate on the top of existing platforms.[111] The trade-offs are difficult. Mandated interoperability can have profound benefits for consumers, competition, and innovation and investment – while, in the right contexts, helping to support a service's technological feasibility and performance – but only if it is designed well.

Our first recommendation is therefore that **mandating a greater degree of openness requires a careful and case-by-case analysis**, which needs to have regard to the context and market dynamics.

Secondly, once policy-makers have decided that interoperability has a potential justification, policy-makers must then evaluate carefully **where in the value chain to implement interoperability and over which features**. This will require a careful assessment of how to ensure interoperability has the greatest possible impact on both intra-platform and inter-platform competition, drawing distinctions between 'core' and 'periphery' assets.

Thirdly, policy-makers will need to determine the right **degree of openness to mandate**. Again, this requires delivering a level playing field to promote generative innovation, while having mechanisms to ensure future investment on the other.

Fourthly, and finally, **policy-makers should consider how to design the commercial, technical and governance mechanisms to implement interoperability**. These details can profoundly affect the incentive effects of mandated openness. These decisions range from:

- Whether to allow a degree of regulatory forbearance, for example so new investments have a period of lighter-touch or no regulation;
- How to set the price for access in a way which appropriately balances the need to incentivise access seeker investment while protecting the interests of current and future platform operators;
- Whether to impose limitations on how interoperability rights can be exercised;
- The design of technical and governance mechanisms to address *how* openness will be delivered and how disputes will be resolved; and
- The design of periodic reviews so that the regime can be finessed over time.

The EU is grappling with a 'competitiveness crisis', which is closely tied up with the bloc's poor record in commercialising disruptive innovations and in deploying existing technologies in productivity-

[111] Zach Meyers, 'Can the EU reconcile digital sovereignty and economic competitiveness?', CERRE, September 2025.

enhancing ways. That demands European policy-makers act carefully and forensically when mandating interoperability. Interoperability can be a valuable tool both for European consumers (giving them more choices, lower prices and better-quality services) and for Europe's innovation ecosystems (giving European firms a fairer chance to enter and grow in digital markets) when properly designed and deployed.

About CERRE

Providing high quality studies and dissemination activities, the Centre on Regulation in Europe (CERRE) is a not-for-profit think tank. It promotes robust and consistent regulation in Europe's network, digital industry, and service sectors. CERRE's members are regulatory authorities and companies operating in these sectors, as well as universities.

CERRE's added value is based on:

- its original, multidisciplinary and cross-sector approach covering a variety of markets, e.g., energy, mobility, sustainability, tech, media, telecom, etc.;
- the widely acknowledged academic credentials and policy experience of its research team and associated staff members;
- its scientific independence and impartiality; and,
- the direct relevance and timeliness of its contributions to the policy and regulatory development process impacting network industry players and the markets for their goods and services.

CERRE's activities include contributions to the development of norms, standards, and policy recommendations related to the regulation of service providers, to the specification of market rules and to improvements in the management of infrastructure in a changing political, economic, technological, and social environment. CERRE's work also aims to clarify the respective roles of market operators, governments, and regulatory authorities, as well as contribute to the enhancement of those organisations' expertise in addressing regulatory issues of relevance to their activities.

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