

Competition in the Cloud: Unleashing Investment and Innovation Within and Across Platforms

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Abstract: Innovation in the cloud is challenging Europe's telecoms industry and its regulatory system. The shift from 'desktop to data centre' and the provision of computing in the form of a service means that cloud offerings are increasingly dependent on the quality of the underlying communications infrastructure. Critical parts of the infrastructure are regulated, and the role that regulation plays may limit services innovation and in turn may mean that communications infrastructure could become the 'weakest link' in a cloud offering. This article presents an argument that draws on law, economics, and business platforms strategy to expose the incentives and impediments to innovation in cloud computing. It assesses how European policy goals, the Lisbon Treaty and regulatory action interact, and proposes a change in the EU regulatory regime to reflect a duty to promote innovation as a stated goal. This change would encourage new business models to emerge, allowing the incumbent EU telecom network providers the opportunity to contribute to innovation in the cloud. Such innovation would help spur investment and wider competition across platforms which would help realise Europe's objective to drive growth and competitiveness.

Key words: platforms, double-sided markets, innovation, incentives, cloud, competition law, ecosystem, telecom, market performance, market structure, regulation, technologies.

This article examines the problem of ecosystem participants' incentives to invest in innovation. It uses broad economic principles, recent advances in strategic management theory, and a legal analysis of commercial terms in ICT supply chains,¹ to determine how the regulation of communications, competition law and policy impacts on the cloud ecosystem's participants' innovation incentives.

¹ See e.g. QMUL Cloud Legal Project at <http://cloudlegalproject.org>

We contend that the current legal and regulatory thinking that regulates the 'technology layers' that underpin the cloud rests on an overly narrow interpretation of economic theory which neglects the consequences on innovation incentives of interdependencies between components and markets, as well as the potential for value creation that can arise when a set of mutually enhancing business models emerge across the ecosystem.

The article is structured as follows: we start with a brief exposition of the cloud ecosystem, highlighting the interdependency between its constitutive markets. We then use economic theory to outline the problem of innovation in this context, incorporating recent advances in strategic management research on technological platforms, to highlight how platforms structure competition and innovation in interdependent ecosystems such as the cloud. We continue by outlining the evolution of regulation and competition law over the past 15 years, and highlight the underlying economic assumptions underpinning policy. The article suggests that the legal framework has evolved and that the Lisbon Treaty provides a basis under which policymakers can now take into account a variety of different factors than in the past. We then suggest that the time has come for a re-evaluation of the policy towards the sector.

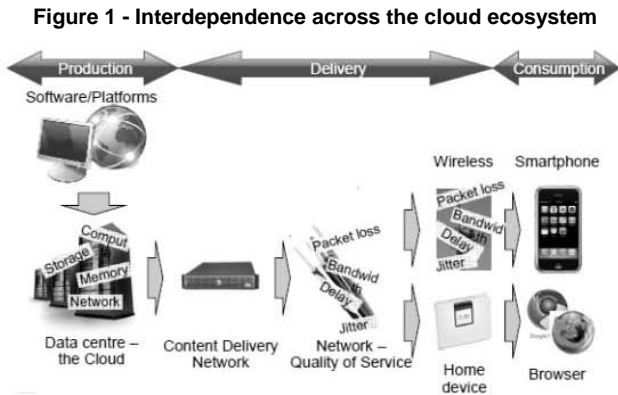
■ Setting the stage: the cloud as an interdependent, platform-based ecosystem

The interdependence of the cloud's constitutive elements across the supply chain can be illustrated by figure 1).

The benefits of the cloud's offerings have been well-documented². However, to fulfil its promise, firms from different industries, namely the telecom space and the IT space, need to coordinate - especially at the

² See www.cloudindustryforum.org/ and <http://opencomputingalliance.org> for examples of cloud computing cost savings. Despite these savings the main infrastructure suppliers have already made their investments. See <http://blogs.informatandm.com/3730/press-release-european-telcos-remain-cautious-in-cloud-gold-rush/>, MENDLER C., "North American and Asian operators account for 90% of cloud investments": European telecom operators risk being sidelined in the global cloud computing market as aggressive North American and Asian operators spend billions to build international presence. New research from Informa's Telecom Cloud Monitor has found that European operators accounted for only 7% of the US\$13.5 billion that operators committed on cloud assets in 2011. North American and Asian operators accounted for 90%, or US\$12 billion.

interfaces across the supply chain. The cloud supply structure, still in its formative stages, is constituted from an array of firms whose products and services are complementary to each other: a business ecosystem (MOORE, 1996; IANSITI & LEVIEN, 2004). Firms in this ecosystem provide an element of a set of complementary products and services connected to others through a variety of physical and/or virtual conduits.



Source: authors, based on von BORNSTAEDT, 2011

The cloud's value proposition relies on effective complementarity between these products and services. However, the existence of such complementarity should not be taken for granted. The next section begins to explore its consequences on innovation incentives for ecosystem participants.

Innovation incentives and disincentives in interdependent ecosystems

Innovation in the cloud is problematic because of the presence of multi-tiered and fragmented suppliers. Each is dependent upon innovation and investments of systemic or infrastructure providers to deliver their services with optimal quality to end-users. An added problem is that profit-maximizing firms may not have the incentives to invest in risky or costly activities (such as R&D investments) if regulatory constraints impair their ability to capture profits from such investments.

From an orthodox neo-classical economic perspective, this coordination problem would be solved by efficient pricing in competitive markets. But key assumptions of the neoclassical model do not apply in the cloud context.

One obvious difficulty is that part of the supply of this market is already regulated because the incumbents are historically monopolistic providers of key infrastructure services. Second, there is no consensus on what the value is, how to create it, and how to price it.

In this context, why should firms invest in risky R&D? Firms cannot predict with certainty if and when they will succeed, and how much they will have spent getting there. Value may not be fully appropriated if a rival simply copies the innovation (ARROW, 1962). In addition to these well-known problems, innovation within systems of interdependent economic actors adds further complexity.

In an interdependent ecosystem (as a form of supply chain), it is not only rivals that can exploit the innovation and capture its value: it can be the firm's buyers, suppliers, or complementors.³ In a recent extension to neo-classical economic theory, the literature on double-sided markets (see for example ROCHET & TIROLE, 2003 and 2006) predicts that markets will efficiently provide mechanisms to solve that coordination problem, through pricing subsidies. However, a regulatory environment that only applies to one part of the supply chain is likely to hamper the market's solution to the coordination problem outlined above.

Coordination can occur through financial subsidies or transfers to ensure firms are incentivized to innovate on their own product or service. But a different kind of coordination may be needed when systemic innovation, rather than modular (or autonomous) innovation is required. Systemic innovation requires several firms to coordinate their investments in "co-specialized assets".⁴ For example, improving the Quality of Service (QoS) in end-to-end ICT solutions requires several firms to engage in technological innovation in coordinated fashion, to ensure continued interoperability and mutually enhanced technological solutions.

These conceptual elements help clarify how key business decisions in the cloud are structured around technological platforms, which are at the core of today's innovation ecosystems. The next section presents a definition of platforms and their impact on competition and innovation.

³ BRANDENBURGER & NALEBUFF (1996) define complementors as "developers of a complementary product" where two products are complements if greater sales of one increase demand for the other.

⁴ See TEECE (1986) on the problem of "appropriability" in joint risky innovation investments.

Platform competition and innovation

Industry platforms are technological building blocks that serve as a foundation for a number of firms to develop complementary products, technologies or services (GAWER, 2009c: 45). The nature of platform competition has been explored in the economic literature on double-sided markets (ROCHET & TIROLE, 2003, 2006; PARKER & VAN ALSTYNE, 2005; ARMSTRONG, 2006; RYSMAN, 2009), and refined by theorizing in strategic management, which focuses on how platform-based ecosystems emerge and on how the boundaries of platform markets evolve over time, through competition and innovation (GAWER, 2009a,b,c; GAWER & CUSUMANO, 2002). The pervasiveness of platform competition in ICT markets has been noted by several authors, including EVANS, HAGIU & SCHMALENSEE (2006). In this article, we enrich the now traditional economic view of platforms as double-sided markets, by viewing them dynamically, as evolving, foundation technologies associated with coalitions of participants (or ecosystems) characterized by sets of mutually enhancing business models.

Platform industry dynamics combine competitive and collaborative behaviours within an ecosystem. As members continuously innovate and try to create value, they also attempt to gradually gain bargaining power vis-à-vis other members of the ecosystem. Over time, they may try to become platform leaders themselves, and even start competing with the firms they previously related to as complementors. Firms who own platform technologies vie for dominance through the strength of their associated business ecosystems (MOORE, 1996; IANSITI & LEVIEN, 2004), within which they aim to stimulate innovation that is complementary to their platform (GAWER & CUSUMANO, 2002, 2008).

Platform leaders often behave as self-appointed custodians of the ecosystem, in order to foster the conditions for complementary innovations to the firm's platform, thus creating virtuous cycles that increase value for their product as well as sustain the complementors' innovation incentives. This is especially true in the case when demand for the platform is fueled by direct or indirect network effects (EISENMANN, PARKER & VAN ALSTYNE, 2006). While regulating the interactions between ecosystem participants, platform leaders also self-regulate to preclude exploiting their dominant position, thereby cultivating and not destroying ecosystem participants' innovation incentives (GAWER & HENDERSON, 2007; GAWER, 2009a; BOUDREAU & HAGIU, 2009). By ensuring fair play, with the help of network effects, firms can and do achieve dominance.

Platform leaders have achieved unprecedented levels of market influence, raising antitrust concerns. Network effects (MARSHALL, PARKER & VAN ALSTYNE, 2006) can rapidly attract increasingly large numbers of users to a platform quickly. This implies the likely emergence of monopolists or quasi monopolists in platform markets. The US and EU antitrust cases against Microsoft, as well as antitrust attention on a variety of firms such as Apple, Intel, IBM, and Google, attest to the authorities' awareness of these issues.

■ **Is innovation in cloud computing threatened by the EU regulatory framework? Or: "*Is the cloud held back by its weakest link?*"**

Technology markets are regulated under e-commerce laws, communications regulation and competition law. In Europe such laws regulate monopoly and require that certain facilities (such as access and backhaul facilities in telecoms networks) are supplied on cost-based and non-discriminatory terms. Why? The traditional view contends that the law should mirror what happens in competitive markets and competition authorities and regulators should regulate the market to achieve outcomes that are as near to the ideal conditions of competition as possible.

The current regulatory framework is based in a key assumption, that telecoms access is a monopoly which should be 'remedied'. What is the thinking behind the remedy? A central idea is to impose 'conditions that would arise in a competitive market' on the monopoly. Competition law and regulation suggest that in a competitive market, prices are likely to align with long-run incremental costs. Authorities have also used the 'consumer welfare' test as their guiding goal, and sought to ensure that consumer welfare is achieved by imposing the attributes commonly found in competitive markets.⁵

In accordance with the observation that competitive markets tend to produce prices that align with costs over the long run, accounting and cost

⁵ Neelie Kroes: "[...] the objective of Article 82 is the protection of competition on the market as a means of enhancing consumer welfare and ensuring an efficient allocation of resources" (FORDHAM, 2005). Also the Staff Discussion Paper on Article 82 contains consumer welfare as a central element.

structures have been put in place which attempt to model such cost alignments and impose them on incumbent telecoms operators (ERG, 2005, 2004; OFCOM, 2008, 2004; OFTEL, 2002).⁶

The Lisbon Treaty and the policy agenda

Europe's legal and regulatory architecture is evolving, and this traditional model is under scrutiny. The European Court of Justice rejected the European Commission's attempt to pursue a 'one note' consumer welfare approach to competition law, meanwhile a broader range of factors can now be taken into account under the revisions that have been introduced in the Lisbon Treaty.

The main Treaty provisions dealing with Competition are articles 101 and 102. The texts of the articles have not changed since the 1957 Treaty of Rome. However, the context and additional provisions of the Treaty have changed and that may be all important in terms of how the competition provisions will be interpreted in the future.⁷ After the changes agreed at Lisbon President Sarkozy made the following comments:

⁶ Although there are a number of differing models that may be applied, it was for some time thought that the modernisation of competition law in the EU which began in the late 1990s under Mario Monti, as Competition Commissioner, had as its central goal the 'consumer welfare' model. This was advanced by DG Competition in various policy initiatives and initially confirmed by the European Court of First Instance. It was then later overturned by the full European Court of justice on appeal in Case C-501/06 *P GlaxoSmithKline v Commission*.

"With not far short of 50 years of application and reflection, in *GlaxoSmithKline*, the EU's General Court (in the pre-Lisbon form as the Court of First Instance) seemed to provide curial confirmation that the modernized Union competition law was also to be viewed through this standard lens when it stated that the purpose of European Union competition law 'is to prevent undertakings, by restricting competition between themselves or with third parties, from reducing *the welfare of the final consumer* of the products in question'. The welfare of the consumer being measured by the price the consumer pays for goods, Union competition law was to be used to protect practices that '*reduce those prices and thus [...] increase the welfare of final consumers*'." (ODUDU, 2010: 602). Emphasis added.

On appeal, the approach of adopting consumer welfare to the exclusion of other policy objectives was rejected by the Court of Justice:

"However, the exclusion of broader public policy and ideological debates from EU competition law adjudication has not readily been accepted. Reviewing *GlaxoSmithKline*, the Court of Justice rejected an efficiency-only approach, finding that 'neither the wording of [Article 101 TFEU ex] Article 81(1) EC nor the case-law lend support to such a position'. Consequently, it is not necessary that final consumers be deprived of the advantages of effective competition in terms of supply or price for competition law to be infringed." (ODUDU, 2010: 602).

⁷ The law that currently applies in the EU is derived from the Lisbon treaty, since that Treaty is the current governing Treaty. However, when interpreting the Treaty, and in particular when interpreting the competition provisions, the Court of Justice can be expected to take into

"We have obtained a major reorientation on the objectives of the Union. Competition is no longer an objective of the Union or an end in itself, but a means to serve the internal market."

This is in line with the approach of the Court of Justice in *GlaxoSmithKline* cited above. There has been some controversy over some changes to the Lisbon Treaty⁸ and the demotion of one goal to Protocol 27. (The change to the status of the goal whether in a preamble or elsewhere in the Treaty has since been found by the Court to be immaterial).⁹

This is a separate point from the one that new provisions have been added into the EU treaty by the amendments agreed at Lisbon. The most significant changes contained in the Lisbon Treaty as far as competition policy are the additions which broaden the objectives of the new European Union. By comparison, the provisions of the previous version, which date back to the early 1990s in the Maastricht Treaty, referred to the principle of the open market economy with free competition.¹⁰ In the Lisbon Treaty (TEU) the member states of the European Union have committed themselves to work towards a "highly competitive social market economy, aiming at full employment and social progress."

account previous caselaw, as it relates to the competition rules in the Maastricht and other previous treaties. Such case law is not irrelevant to the current position, but the current position can be expected to evolve in the light of the new provisions in the Lisbon Treaty.

⁸ See *The EU Reform Treaty & the Competition Protocol*: by Alan Riley, Professor of Law at City Law School, City University, London: www.ceps.eu/ceps/download/1370.

⁹ Article 3(3) TEU provides that one of the objectives of the EU is to "establish an internal market" which includes the development of "a highly competitive social market economy". This provision is supplemented by Protocol 27 (annexed to the TFEU), which provides: "[...] the internal market as set out in Article 3 of the Treaty on European Union includes a system ensuring that competition is not distorted." See case C-52/09 *Konkurrensverket v TeliaSonera Sverige AB* [2011] not yet reported, at paragraph 20.

¹⁰ Under Maastricht, a number of cases represent the interface between competition and other social policies. This is a continuing issue as conflicts between different Treaty goals are examined by the Courts. See trade liberalisation/fundamental rights and freedoms: *Schmidberger* (lorries/assembly), *Omega* (war game/human dignity), *Viking*, (services/ social rights not protected) *Laval*(services/collective agreement). As has been commented: "These judgments have been based on legislation adopted under the existing European treaties. The Treaty of Lisbon will, if anything, make it easier to rectify the current legal situation thanks to its changes to the decision-making procedures. It also contains some important new social safeguards that do not exist in the current treaties, and the treaty makes the Charter of Fundamental Rights legally binding on the EU institutions. [...] The EU institutions and Member States, when implementing EU law, will have to respect these rights". Source: Unite website Richard CORBETT (2008): "Why the ECJ rulings highlight the need for a reinvigorated social Europe".

This change is fundamental and provides an anchor point for the 'third way' approach that has been adopted in Germany and which provides both for the competitive process and for that process to function for social purposes within a framework of regulation.¹¹ Most recently, Commissioner Almunia has called for a modern 'Industrial Policy' which involves taking into account both competition and other objectives, and he has pointed out that the Commission's Digital Agenda is integrated with its competition policy forming a modern industrial policy for the IT and communications sector.¹² This is in accordance with his interpretation of the new addition after Lisbon.¹³

Commissioner Almunia has made a series of speeches designed to highlight his view of competition policy as part of an integrated approach to the market. While the approach to the digital single market is contained in the digital agenda the idea of looking at both competition policy and other policy objectives together is one that applies in other sectors. Take as a comparative example the energy sector. In his speech on the 8th March 2012 Commissioner Almunia made the following comments:

"Of course, competition and regulation are complementary in the policy mix to deepen the Single Market. Through regulation, the EU legislators can eliminate the remaining barriers. However, this push would be ineffective if companies were de facto allowed to rebuild the obstacles removed by legislation. It is thus our responsibility as competition enforcers to make sure that it does not happen.

Take the energy sector for example. It has undergone a wave of liberalisations but our vigilance is still much needed to ensure that competition is not distorted on the ground and that markets are not artificially partitioned to the detriment of other operators and consumers.

In line with the EU 2020 flagship initiative for sustainable growth, the EU still has to make progress towards a more resource efficient,

¹¹ This can also be traced back to a line of cases where conduct that hinders economic freedom and the production of competitors constitutes an abuse. (e.g. *Commercial Solvents*, *Suiker Unie*, *United Brands*, *Hoffmann-La Roche*, *Michelin*, *BPB*, *British Airways*, *Hilti AG*, *DT*, *FT* and *TeliaSonera 2011*) These cases form the DNA of Article 82 EC.

¹² See 10 Feb 2012, Speech/12/83 Joaquín Almunia, Vice President of the European Commission:

<http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/12/83&format=HTML&age=0&language=EN&guiLanguage=en>.

¹³ Commissioner Almunia, Lisbon 14th January 2011: Competition policy and the social market economy: "Our competition policy is the expression of the model born in Europe after World War II and known as 'social market economy'. Competition policy, therefore, *has a regulatory role and this role is essential to preserve a social economy and social fairness.*" Emphasis added.

greener and more competitive economy. Translated into concrete action, this means that we aim to achieve an integrated European electricity wholesale market by 2014."

This indicates an approach under the 2020 initiative which seeks to achieve a more competitive, sustainable resource efficient and greener economy. It could be argued that each of these objectives is incompatible with each of the others; Almunia is outlining an approach that assumes that they can be all achieved and read together.

In addition to the substantive change in the aims as outlined in article 2 (3), the Treaty of Lisbon also includes reference to the charter on fundamental human rights and makes a number of changes which bring to bear a broader range of policy areas within the remit of the European Commission. The inclusion of additional aims such as culture and innovation has led some to suggest that these matters can and should be taken into account in competition decisions (LEJOUR, KOSKELINNA & SLUISMANS, 2008; TOWNLEY, 2009). Furthermore, the social cross-sector clause in Art.9 TFEU impacts the economic orientation of the European Union and needs to be borne in mind when interpreting the new treaty:

"In defining and implementing its policies and activities, *the Union shall* take into account requirements linked to the promotion of a high level of employment, the guarantee of adequate social protection, the fight against social exclusion, and a high level of education, training and protection of human health." (Emphasis added)

Compared to the former Art. 127(2) EC, its successor goes beyond macroeconomic employment issues. The wording of the new social cross-sector clause does not specify the weight of the social policy goals mentioned vis-à-vis market goals. One could derive an increased significance due to the place it has received in the Lisbon Treaty, as it has been moved from the employment chapter to the "general part" preceding the more specific Treaty provisions.

Potentially conflicting policy priorities are contained in the treaty since the Treaty of Lisbon states that one of the Union's objectives is to work for "the sustainable development of Europe based, in particular, on a high level of protection and improvement of the quality of the environment". This may have a direct read-across to the type of competition or the expected market structure envisaged by DG Competition and has implications for the maintenance of capacity and productive efficiency over time, of a type that would not ordinarily be associated with the pursuit of efficiency and (short-term) consumer welfare. Furthermore, there may be scope to integrate

emerging EU competitiveness concepts like the European Common Interest and access to "critical raw materials" which might include telecoms in future, as part of a more holistic Commission approach.¹⁴ Given that other factors can be taken into account, there is perhaps greater scope to pursue policy objectives, as is the case under the current EU Digital Agenda. Ensuring a consistent approach among the various objectives in accordance with the Treaty is a role for the Commission.

Legal precedents: the 'equally efficient competitor' test

In Case C 52/09 *Konkurrensverket v TeliaSonera Sverige AB* the Court of Justice of the European Union held at paragraphs 30 and 31 that:

"In particular - it is for the referring court to examine, in essence, whether the pricing practice introduced by TeliaSonera is unfair in so far as it squeezes the margins of its competitors on the retail market for broadband connection services to end users".

A margin squeeze, in view of the exclusionary effect that it may create for competitors who are at least as efficient as the dominant undertaking, in the absence of any objective justification, is in itself capable of constituting an abuse within the meaning of Article 102 TFEU (see, to that effect, *Deutsche Telekom v Commission*, paragraph 183). The Court's decision is known as confirming that the approach to be adopted under EU competition law is now based on the 'equally efficient competitor test'. This is helpful in providing some clarity, but the enquiry does not end here. Monopoly is accepted as creating inefficiency and stifling innovation. In this context the existing incumbent telecoms operators are expected to be inefficient, and the concern was about the effect of pricing of wholesale components on the retail parts of the technology stack.

By adopting a competition law test for legality of actions that mirror an 'equally efficient operator' at the retail level the European Court is driving incumbent monopoly to compete on the basis of a theoretically equally efficient new entrant at the retail level. To do otherwise will risk infringing the rules against exclusionary conduct and margin squeeze. It would therefore appear that pricing monopoly components must be done in a way that does not exclude equally efficient downstream operators, service providers, ISPs and mobile companies from their retail markets.

¹⁴ See European Competitiveness Report, 2011 for a discussion of these themes.

■ The special significance of competition law for microeconomic policies

As can be seen from the above discussion, the legal context is evolving, and the competition and regulatory authorities have an increased opportunity to take a more growth-oriented approach towards technology markets. There will still be a need to impose on monopoly an outcome that would have arisen in competitive markets, but which outcome much depends on the underlying theory of competition and the type of market from which that theory is drawn.

Which type of markets see prices tend towards marginal cost in the long run? This would be relevant for markets such as commodities or utilities alike. Given the circumstances that prevailed in the early to mid-1990s, when telecommunication markets were being liberalised and regulated for the first time, the prevailing regulatory objective was lower prices for consumers. The context was that lack of competition had meant that incumbents were inefficient and prices for voice telephony had become very high. As communications markets have developed to support an ever wider range of voice video and data services, is it now fair to suggest that this is now an out of date approach?

Put another way, while it may once have been right for telephony to be regulated on the assumption that it should be supplied as a commodity; given the diversity of converged solutions, of voice video and data as well as hardware and software platforms that now exist, has the time come to adopt a different model of competition, namely the model of platform competition outlined above, for the underlying provision of communications?

In addition, current utility type regulation assumes very limited service level provision and limited liability. By assuming liability within the set of regulated products, the approach imposes a system based on that assumption. This undermines incentives and risk allocation. Where service and performance are demanded by the retail market, it may need to be passed on to the infrastructure operator. The player that can most efficiently bear and manage the risk should drive market development.

If regulation or assumptions about the model of competition behind regulation is not revised its 'dead hand' may affect markets long after it has served a useful purpose.

The imbalance of the regulatory framework and economic consequences can be illustrated with facts and figures. For example, the regulatory framework pre-supposed that infrastructure competition could be promoted at all levels of the system (ELIXMANN, ILIC, NEUMANN & PLÜCKEBAUM, 2008), established that local access is likely to be a non-replicable monopoly, and has to be regulated as such. This is achieved under the European telecommunications legislation through the regulation of access. The basis for access regulation is to use the incumbent operator's own costs as a starting point for imposing an access price. Often this is taken as the long run incremental costs with mark-ups. This approach starts from the theory that the conditions of competition in a homogenous utility type market should be imposed on the monopoly supplier. EU competition law, by contrast, is concerned with exclusion. It takes as a starting point the position that even an efficient incumbent cannot exclude competitors from the market and needs to ensure that it operates its prices above the level of a reasonably efficient downstream competitor. This approach can be in line with the ideas of a new industrial policy being proposed by Commissioner Almunia if downstream competitors are seen as a source of innovation, and that competition law is concerned with innovation in downstream markets, not just efficiency of provision in upstream supply. The logical 'gap' between the two is innovation in the upstream access layer.

There may be an opportunity to increase consumer welfare through the improvement of end-to-end performance and the overall improvement of the end user experience. At present this may be impeded by profitability considerations and each part of the vertical supply chain competing with other parts of the chain or ecosystem for revenues and profits: pursuing individual interest at the expense of end-to-end performance improvements.

As a matter of regulatory priority and policy, ironing out these 'Pinch points in the supply chain' could be prioritised. Regulators could re-focus and seek quality improvements and innovation on an end-to-end basis.

This is not just a theoretical idea. A feasible starting point would be for regulators to take a basket of the terms and conditions that are offered at the innovative retail level and seek to ensure that risks are driven through the supply chain. With longer-term forecasting and greater commitment from downstream players, such an approach would increase innovation throughout the supply chain and provide a workable basis for co-investment going forward. This set of issues should be prioritised and could be further developed with empirical research.

■ Promoting global competition and innovation for the digital economy

It is well understood that regulation affects the conditions for investment in the economy. The current EU package of communications regulation is itself designed to deregulate markets and increase investment. In particular, the existing regulation accepts, in line with WTO commitments that regulation of the access layer is fundamental to global trade and investment. The WTO Reference Paper (1996) imposes access to underlying communications infrastructure and is based on an obligation on incumbent telecoms players to provide their services on open non discriminatory and cost based terms. These obligations are the basis on which the entire digital ecosystem depends.

The current policy, where it has worked well, has assumed a commodity and cost related supplies on undifferentiated terms. One possible negative consequence however is that incumbent operators are deprived of the incentives to innovate and support more complex data services that have evolved and are emerging at the retail level. Under the law, incumbents have to take into account their effects on downstream retail markets and seek to ensure that they do not exclude competition. Perhaps they should be examining what this means in terms of the terms and conditions of supply and the service levels that they should be introducing in order support innovation at the retail level. Given the rapid pace and development of technology markets a more enlightened approach is appropriate and timely. Policy could change and the authorities could mirror the effects of competition in a way that supports innovation and longer term sustainability so that the system benefits all. It would mean that players in downstream markets, such as internet companies and broadband suppliers, should continue to obtain access to communications facilities on cost-related prices. However, while price competition can drive efficiency, competition for quality of service improvements could be improved.

Innovation in end-to-end experience involves adjusting individual contributions to value and profit

Quality of service improvements carry risk, cost and benefit, and a new focus on the scope for innovation on an end-to-end basis may allow all parts of the supply chain to adjust their share of the end-to-end bargain, allowing greater returns for those that add value and reduce risk. This plays into the

debate about whether the current 'utility' or 'commodity competition' approach provides access suppliers with sufficient returns and whether the congestion driven by internet growth is causing problems for traffic management. Also there are concerns that the system is not providing a level of return sufficient for incumbent operators to make the capital investments needed to build next generation access and fibre networks.

To help resolve the impasse, regulators could consider the end-to-end experience. The change to the underlying legal basis for competition law (now with greater flexibility under the Lisbon Treaty) and recognition of this by the relevant authorities would allow 'end-to-end quality of service', and 'innovation throughout the cloud ecosystem' policies to be adopted. The model adopted by regulators would reflect competition in modern competitive data services markets rather than traditional competitive commodity voice markets. This would mean that regulators would think about end users' experiences and measure risk and its passage through the technology stack. Telcos could be required to improve their quality of service for the benefit of others in the ecosystem, which depend on them and regulators could test innovation and quality of service improvements such that greater risk would support greater reward.

■ Conclusion and policy recommendations

In this paper, we have combined an economic and a legal perspective in order to shed light on the problem of innovation incentives in the cloud ecosystem.

We have suggested that end-to-end delivery of high-quality cloud based services may be constrained by regulatory and competition policy at the network access layer. We propose that regulation should not treat the access layer as an undifferentiated utility, as this negatively affects EU telecom network providers' innovation incentives, with ripple effects throughout the cloud's, due to the interdependencies between its constitutive elements. Ultimately there is a risk that poor regulation will prove to be harmful to the competitive process as well as to consumers' welfare.

In order to stimulate the investment required to allow the potential of cloud to be realized, changing business models for EU telecom network providers are required to align investment incentives and expected profits. The legal framework has evolved, and the Lisbon Treaty provides a basis

under which policymakers can now take into account a variety of different factors than in the past.

We are not proposing that the regulation should be abandoned. Rather, we have identified the opportunity for a change of approach, moving from a commodity-utility model to a more innovation-led model. In order to be implemented effectively, this proposal would need to be combined with an understanding of firms' capabilities and increased forecasting by downstream retail operators and services suppliers of the types of quality of service required by cloud computing services as well as of the types and volume of traffic that would be generated. Forecasting information could then be aggregated across the EU by the BEREC, the Body of European Regulators for Electronic Communications, allowing customer requirements to be fulfilled by nationally regulated access suppliers.

This change, by allowing the required business models to emerge, would benefit incumbent EU telecom network providers by giving them a chance to engage their capabilities and therefore contribute to innovation in the cloud. It would also give them a fairer chance to compete in today's global technology markets, which are increasingly structured around platform leaders. Finally, it would also have positive effects on non-EU, global competition and innovation: by allowing alternative platforms to emerge to those having emerged from the IT space, this would spur global competition, unleash investment in the cloud at large and would stimulate innovation not only within but also across platforms.

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