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Exploring the regulatory conditions of internet interconnection – A survey among internet interconnection professionals

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Exploring the regulatory conditions of internet interconnection

A survey among internet interconnection professionals

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Abstract: There is no central feature of the internet that has been subject to as little formal regulation as internet interconnection. However, local public regulation is starting to emerge – be it through disclosure regulations, mandatory peering or licensing terms. Due to the networked nature of the internet, local rules may acquire a global scope. This report presents an initial overview about what kind of formal regulation networkers encounter in their professional practice and it provides insights into how this regulation affects internet connectivity.

Keywords: internet interconnection, regulation, peering, internet exchange point (IXP), infrastructure, competition law, standards, transparency, basic rights, licensing, universal service

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Contents

Executive summary.....	3
1. Introduction	4
2. The survey	4
3. Participants of the survey	5
3.1 Categories of network actors.....	5
3.2 Professional roles of participants.....	6
3.3 Regional distribution.....	7
4. Encounters with public regulation and perceived influence	8
5. Networkers' experiences with public regulation	11
5.1 Licensing requirements for international operators.....	12
5.2 Universal service directives.....	12
5.3 Mandatory peering at specific locations.....	13
5.4 Economic incentives for local operators only	14
5.5 Competition laws.....	15
5.6 Regulatory authority imposes its own standards.....	16
5.7 Regulatory authority imposes the use of standards developed by private actors	18
5.8 Regulatory authority operates exchanges	19
5.9 Disclosure regulation	20
5.10 Basic rights for citizens.....	21
6. Conclusion	22
7. Bibliography	25

Executive summary

Network interconnection is a central feature of the internet that has been subject to only little formal regulation. However, local public regulation is starting to emerge – be it through disclosure regulations, mandatory peering or licensing terms. Due to the networked nature of the internet, local rules may acquire a global scope.

This report explores internet interconnection professionals' encounters with public regulation and it provides an initial overview about how this regulation affects internet connectivity. On the basis of a convenience sample of 163 survey submissions, the following has been found:

- Nine out of ten kinds of regulation presented to the participants have been encountered by more than half of them. This result gives reason to revisit the widespread notion that internet interconnection is an unregulated space. 66% of the participants have encountered a regulatory authority that imposes its own technical or operational standards. Moreover, imposition of regulatory standards was regarded to be the most influential on internet interconnection practices, together with competition laws (both 67%).
- Local regulation of internet interconnection creates a tension between the regulated and the unregulated space in the internet. In order to overcome the normative difference, network operators need to make an extra effort. The degree to which network operators are affected by local regulation depends on a networks' structure rather than on its size. Local regulation raises more difficulties for the kinds of infrastructural innovations that depend on having many points of presence.
- For networkers, public regulation of internet interconnection is relevant in three thematic domains: 1) in the economies of internet interconnection, 2) in engineering and operations, and 3) in the modes of governance.
- Overarching observations note that public regulation of internet interconnection contributes to a formalisation of the otherwise very informal sector. It also shines a spotlight on how networks are categorised and are thereby “prepared” for the application of regulation. Further, various examples highlight how regulatory authorities co-opt internet infrastructure for new policy purposes that were previously not understood as central to internet operations, e.g., data retention.
- Local networkers value the presence of international network operators not only as potential peering partners but also as mediators for know-how about best practices and advanced modes of internet interconnection.
- Networkers are very critical about regulations that contradict engineering principles. The most accepted forms of regulation also apply in other societal spheres: basic rights for citizens, e.g., for broadband, and competition regulation.

1. Introduction

Internet interconnection has often been described as a largely unregulated field that is governed by interconnection agreements between the private actors who operate autonomous systems on the internet (DeNardis 2010, p. 13). However, more recently cases have come to the fore in which nation states and their regulatory authorities have implemented policies that either aim at internet interconnection specifically or affect it.

This survey is of an exploratory character. It was conceived in preparation for a panel discussion at the 10th Internet Governance Forum 2015 in Joao Pessoa, Brazil, which was titled “Internet interconnection under regulatory pressure”. The aim of both the survey and the panel discussion was to start understanding the regulatory landscape of internet interconnection and to begin a discussion about if and how local regulation of internet interconnection can have implications for global internet connectivity. So this survey is an early stage endeavour meant to identify avenues for future research about internet interconnection, not to test hypotheses.

The survey assumes a practitioner’s point of view. It captures and explores internet interconnection professionals’ encounters with public regulation. It brings to the fore how the practitioners assess these encounters and the types of regulation with regard to their interconnection practices. The overarching research question is: How do different types of public regulation of internet interconnection affect the production of internet connectivity in the eyes of interconnection professionals?

2. The survey

The survey was conducted online. It consisted of a mandatory quantitative part with optional qualitative follow-up questions. In the quantitative part, participants had to indicate what category of network operator they represent and what role they have within their company. Then they were presented with ten kinds of regulation. The development of ten items for this part was informed by Baldwin, Cave, & Lodge’s (2012, pp. 105-165) overview about regulatory strategies. So the view that this report offers is generalising in the sense that it does not further differentiate specific forms that types of regulation can take. For each of the kinds of regulation survey participants were asked if they had encountered it and, if so, how influential they perceived this type of regulation to be for their interconnection practices on a scale from 1 to 5. For each kind of regulation, the qualitative follow-up questions were only presented to those participants who said they had encountered this regulation. The first qualitative question asked them to detail how the regulation in question had affected their interconnection practices. Then they were asked to indicate in which country they had encountered such regulation. This latter information may be viewed in the corresponding data set (Meier-Hahn 2016). Optionally, survey participants could provide information about where

the network they represent is headquartered and how many points of presence the network has.¹

A simple quantitative analysis was performed on the first part of the survey. The second, qualitative part was analysed by means of an inductive thematic analysis as the aim of this analysis was to develop codes and themes from the data and to have a rich description of the data set as a result.

There are limitations to this research. The survey is of exploratory character; it is based on a convenience sample and not representative². The link to the survey form was distributed on nine network operator mailing lists reaching each continent with an invitation for any interconnection professional to participate. The form was online for eight weeks, starting Oct. 19, 2015. The sample population is 163 persons, which includes all those who filled out at least the mandatory quantitative part of the survey. The size of the population is not large enough to perform a regression analysis.

On two occasions before the survey was closed, limited preliminary information from the survey was mentioned at public events.³ Technically, both of these events could have influenced the results because members of the audiences could have made submissions to the survey afterwards to influence the results. However, the first event was attended by only about 40 people from diverse backgrounds, and only five additional data sets were entered in the time span between the second event and the closing date.

3. Participants of the survey

3.1 Categories of network actors

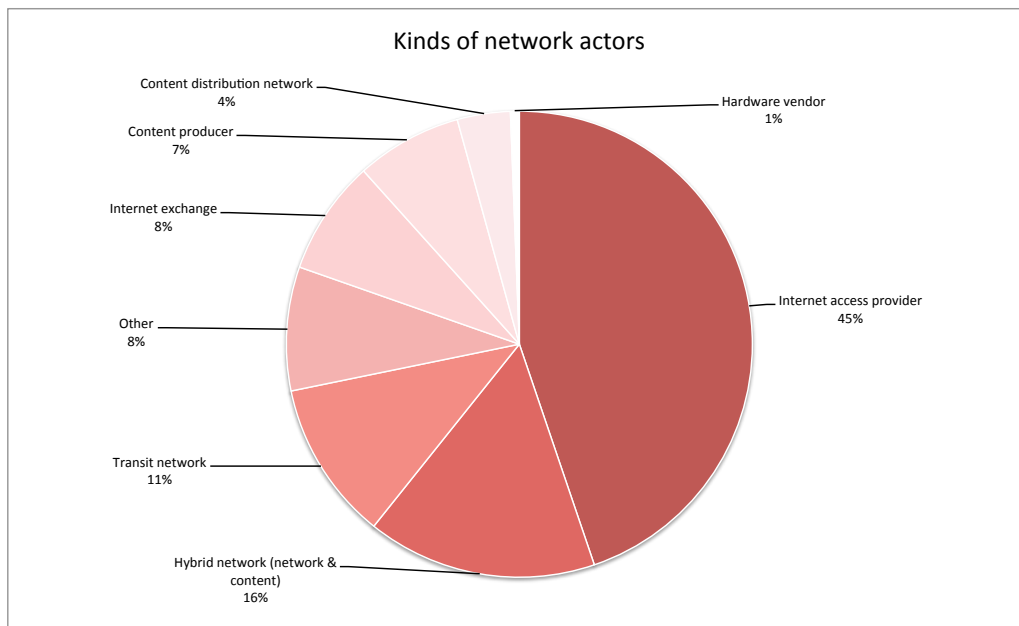
Survey participants represent several categories of network actors. Most participants work at internet access providers (45%), followed by hybrid networks that both operate a network and own, produce or host content (16%), transit networks (11%), internet exchanges (8%), content producers (7%), content distribution networks (4%) and hardware vendors (1%). In addition to the categories that were given in the survey, partici-

1. This question was optional because the participants should be able to answer anonymously and in some cases it would have been possible to infer the identity of the company or even of the participant from these data points.

2. It is unclear how representativeness could be achieved in this field that evolves in a decentralised way. To the author's knowledge, there are no social-professional unions where interconnection professionals register. Further, there is no quantitative assessment about how many of the more than 50,000 autonomous systems of the internet manage their interconnections actively. Estimations range between 1,000 (Sowell 2012, p. 22) and a maximum of about 10,000 autonomous systems (Meier-Hahn 2015b).

3. These events were the panel discussion at the Internet Governance Forum on Nov 11, 2015, and the 71th RIPE Meeting in Bucharest on Nov 18, 2015.

pants suggested more categories, which are subsumed under “Other”. These types of network actors make up a share of 8%.



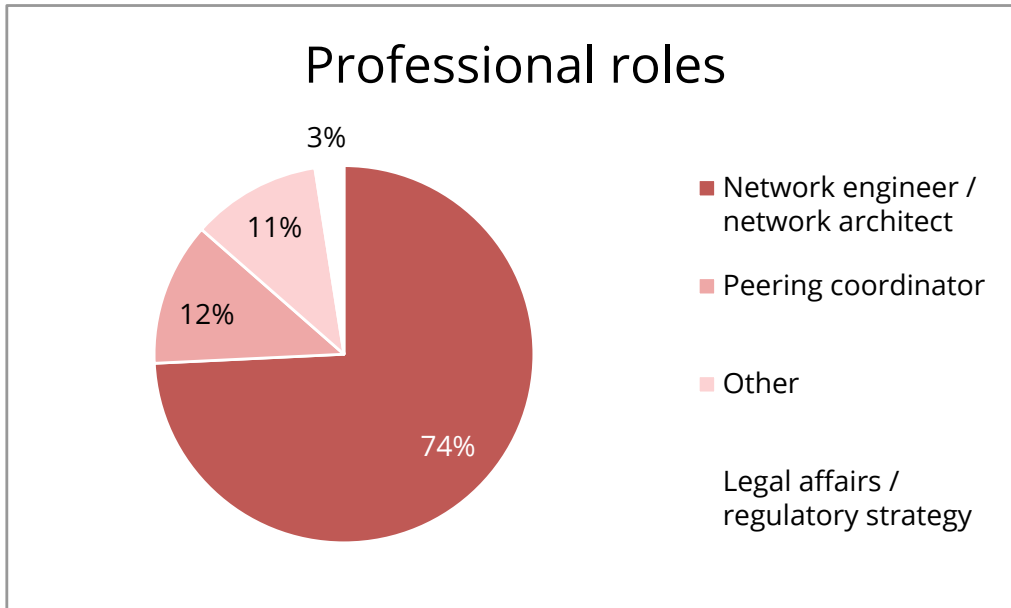
**Other: Research and or education network (4), transit & internet access (3), infrastructure as a service provider, hosting provider, BGP Network Performance Management*

Figure 1: Types of network actors

The variety of other categories that were named beyond those given indicates how classifications of network actors are in flux (Weller & Woodcock, 2012, p. 10). This rings especially true as infrastructural innovation happens. Authorities rely on categories to specify the scope of their regulations. Therefore, by emphasising certain characteristics of network actors over others classifications bear a policy dimension. (Bowker & Star, 2000; Meier-Hahn 2015a)

3.2 Professional roles of participants

The largest group of survey participants are network engineers or network architects (74%). So they have a high degree of technical expertise. Twelve per cent are peering coordinators, which is a job profile at the crossroads of business and engineering. Only three per cent of the participants have regulatory or legal tasks at the core of their job profiles. Eleven per cent of the participants’ roles did not fit with the categories given; mostly those participants either work on a higher level (e.g. CEO, CTO, COO) or they are tasked with a combination of roles.



**Other: Chief Executive Officer, Owner, Consultant, Chief Technology Officer, Chief Operating Officer, Network Strategist, Capacity Planner, Managing Director, IT Manager, combinations of roles.*

Figure 2: Survey participant's professional roles.

Note: It should be kept in mind that the great majority of participants are not specialised in legal matters. So this survey presents perceptions of non-legal professionals about legal issues. This perspective is relevant nonetheless in as far as these practitioners are the ones who actually shape internet connectivity, also with their understanding and interpretations of the legal situations that they navigate.

3.3 Regional distribution

Half of the population provided information about where the network they represent has its headquarters. The list includes 28 countries plus Hong Kong, which is listed as if it were an independent state because of its special regulatory status in China.

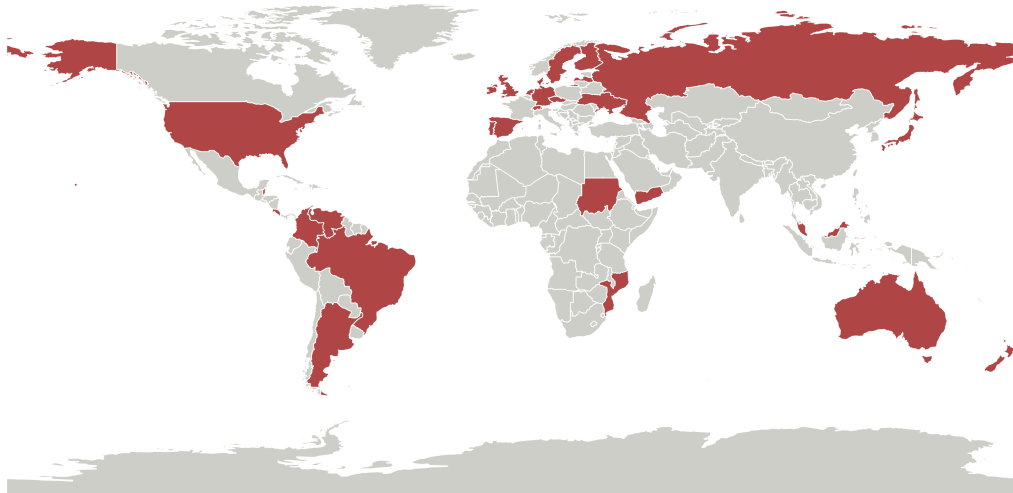


Figure 3: Regional distribution of survey participants

Participants' organisations' headquarters as indicated: United States of America 15, United Kingdom 13, Australia 8, New Zealand 6, Germany 6, Russia 3, Netherlands 3, Brazil 3, Venezuela 2, Sweden 2, Hong Kong 2, Finland 2, Yemen 1, Ukraine 1, Switzerland 1, Sudan 1, Spain 1, Portugal 1, Mozambique 1, Malaysia 1, Latvia 1, Japan 1, Ireland 1, Denmark 1, Czech Republic 1, Costa Rica 1, Colombia 1, Belize 1, Argentina 1.

Since the other half of the participants chose not to provide this information, the map shows the minimum diversity of the regulatory landscape that the participating networkers are subject to and therefore can assess. Also, several networks operate so-called points of presence (PoPs) in more than one country and therefore can report on numerous country's regulations. In this sample, 66 participants have PoPs in less than five countries, 20 participants have PoPs in five to 100 countries.

4. Encounters with public regulation and perceived influence

Initially, the participants were presented ten kinds of public regulation. They were asked to indicate 1) whether they had encountered this type of regulation, and if so, 2) how influential they perceived the regulation to be with regard to their interconnection practices on a scale from 1 to 5.

Nine out of the ten kinds of regulation have been encountered by more than 50% of the survey participants. The levels range from 48% who have encountered "licensing requirements for international operators who wish to peer at an internet exchange" to 66% who have been subject to a "regulatory authority that imposes its own technical or operational standards". These levels indicate that internet interconnection may be less of an unregulated space than initially assumed.

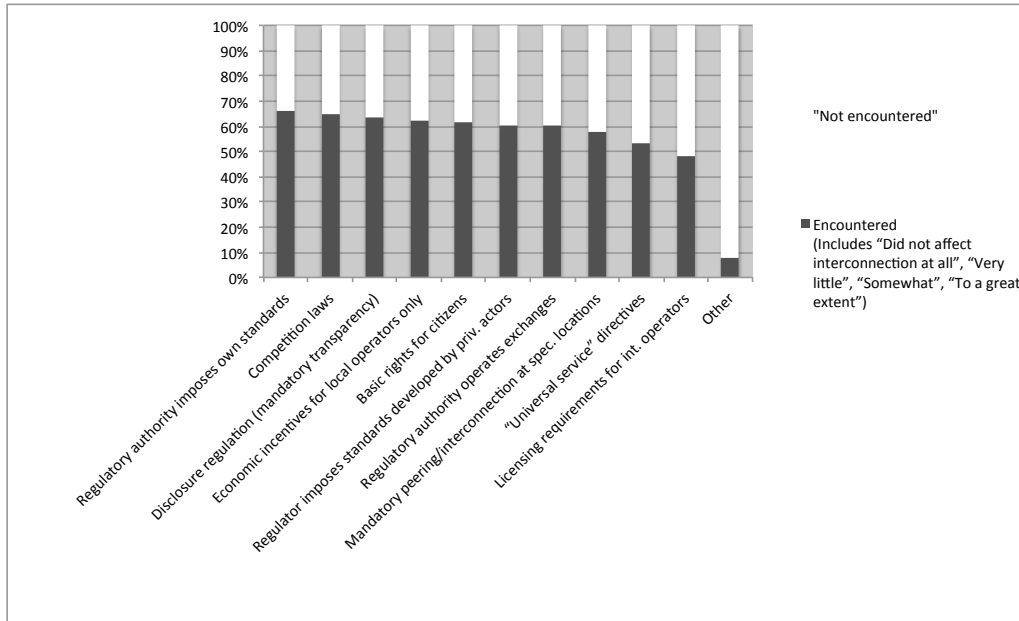


Figure 4: Encounters with formal regulation; population N1=163

The variance between the least encountered type of regulation and the most encountered type is 18%. So there is not one typical type of regulation. Regulation is not a binary. Public authorities' toolboxes are filled with various regulatory instruments so that interconnection regulation takes many shapes. The regulatory instruments do not need to be labeled "internet interconnection" to influence connectivity.

In addition to the ten kinds of regulation given, participants could enter other relevant kinds of regulation in an open textfield. Participants added three kinds of regulatory interference here: censorship regulation (241), legislation that they find old and inadequate (241) as well as actions by law enforcement that lack regulatory underpinnings (44).

Encounters with regulatory authorities show that formal rules exist, but they do not tell us anything about how such regulations influence internet interconnection in practice. This was addressed in the following questions. The second question explored how intense the interconnection professionals experienced the effects of the regulation on their interconnection practices. For each type of regulation, the population N consists of all of the networkers who said they encountered this type of regulation. Each regulation's N is noted above the columns.

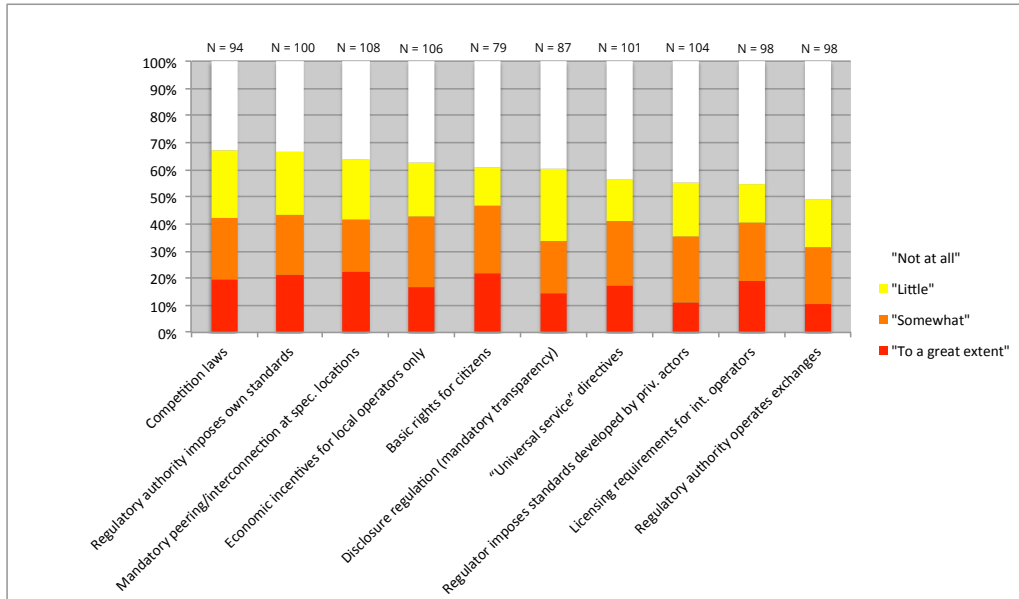


Figure 5: Perceived influence of formal regulation on interconnection practices

The chart shows how influential the affected participants find the regulations with regard to their interconnection practices. The more an item is experienced as influential, the greater the regulation's guiding power is. So "influence" indicates a regulation's potential to actually change interconnection practices.

It should be remarked that where regulations do exist, it does not mean that all aspects of the practice of interconnecting networks are set. Regulations mostly do not determine internet interconnection but they guide it.

Overall, "competition law" and "when a regulatory authority imposes its own operational or technical standards" are perceived as the most influential types of regulation (67%), followed by "mandatory peering at specific locations" (62%) and "economic incentives for local operators only" (61%). Participants regard it as least influential when a "regulatory authority operates an internet exchange" (49%). A possible explanation for this low number is that operating an exchange is not necessarily coupled with an obligation for networks to interconnect at this public exchange.⁴

4. A handful of submissions point to an ambiguous phrasing in the survey form. Due to this, 14 datasets include scattered data points where participants have stated that regulations have "not affected them at all" whereas, according to a follow-up question, their correct answer would have been that they "have not encountered the regulation" in question. This means that the numbers for encounters with regulation (Fig. 4) are actually lower whereas the levels of regulatory influence are higher than indicated (Fig. 5), because the share of participants who have experienced a type of regulation but regard it as not influential would be smaller.

5. Networkers' experiences with public regulation

The second part of the survey explores how interconnection professionals assess the impact of regulations in detail. A thematic analysis was performed on the qualitative data. This analysis brings to the fore the thematic domains to which participants link interconnection regulation. Across networkers' experiences with all types of regulation three interconnection-specific thematic domains returned and four overarching themes could be identified. The thematic domains are:

1. *Economies of internet interconnection*. This includes the influence networkers perceive on their peering policies⁵, their transaction costs, freedom of choice as well as mergers and acquisitions, or, in more general terms: growth and development of the sector. The statements also provide exemplary evidence for how regulatory effects depend on a network's role in a market. Roles can differ, e.g., by economic disparity (incumbent/competitor) but also along the lines of other categories such as geographical reach (local, national, international) or by the services that a network provides (e.g., internet access, transit or hosting).
2. *Engineering and operations - making things work*. Interconnection professionals deal with the effects of regulation directly in their daily operational practice. It influences them in how they design the network, how they shape the flow of traffic and how they establish connectivity with other networks. Regulations may encompass what hardware operators are allowed to use, how they route traffic or what a network design looks like. Participants see parameters affected such as speed of operations, network performance and network security.
3. *Modes of governance*⁶. In the course of describing their encounters with regulation, numerous participants questioned who had taken on agency with what legitimacy and in how far the rule of law was guaranteed in the modes of governance that they have become subjected to. A perceived lack of regulatory legitimacy is often paralleled with complaints that "the community" has not been consulted in the process of discussing the rules.

The four overarching themes are developments that come with formal regulation of internet interconnection as such. They can play out in all of the specific domains as well. These themes are:

- formalisation of the sector,

5. In peering policies networks outline which conditions other networks have to meet before they will consider them peers and exchange traffic with them on a cost neutral basis. A peering policy expresses an important part of a network's business proposition.

6. The term "modes of governance" is used in the sense of self-, co- and hierarchical governance as described by Kooiman (2003, pp. 77-132). In their answers networkers allude to such categories, albeit not always explicitly.

- categorisation of network actors,
- the co-opting of internet infrastructure for purposes other than internet operations and
- unintended consequences and indirect effects of regulation.

5.1 Licensing requirements for international operators wishing to peer at an exchange

Licensing requirements formalise internet interconnection at the points of presence. Having to register with a regulator or even having to incorporate locally in order to interconnect at an exchange increases the complexity of the interaction and it prolongs the interconnection activation. Networkers perceive this as a burden, “placing such locations lower down the list” (7) of desirable places to interconnect. Licensing requirements appear to be an especially cumbersome type of regulation for networks that have many points of presence as a characteristic, such as CDNs. One CDN representative stated that the would-be classification as an international internet service provider has kept his/her network from acquiring a license. Another one described licensing requirements as “a hard stop” (100). A third CDN reported that due to licensing requirements, his network was unable to interconnect in places like India, Vietnam and Egypt. All together, five content-heavy networks stated that they did not pursue their interest to interconnect in India or pulled out from India due to the licensing requirements there.

“This lead [sic] to a decision to pull out of India, and serve India from Singapore, rather than deal with the ISP licensing requirement in India, as most of our business is as a content provider, it didn’t make much sense for us to get licensed as an international provider just to get connected to the exchanges there.” (292)

Licensing requirements limit international networks in their choice. This is not only relevant with regard to the workings of this market but also with regard to international operator’s network designs and their routing decisions. Where networks rather serve the citizens of one country from another country, as one participant reports (292), the connectivity suffers, e.g., by increased latency or by added hops on the path of the traffic. Also, it should be noted, that network effects take place. For every one connection to an exchange that is not taking place, at least two networks are affected – potentially, the whole population of the exchange is affected because it misses an opportunity to interconnect with the network that stays absent.

5.2 Universal service directives

Universal service directives are regulatory tools to achieve a baseline level of internet service for anybody in a country. They can take shape in several forms, e.g., as an obligation for an incumbent operator to offer services in any region of the country under

similar terms and conditions as a tax for all suppliers to provide services in less developed regions or by subsidising disadvantaged customers directly.

In Russia, operators have to pay into a universal service fund so that internet services are also provided in less developed regions (7, 30, 241). Encounters with universal service schemes were also reported from Finland (7), Denmark (97) for the incumbent operator, Australia (168, 185), Venezuela (406) and Panama (406).

Beyond this, the survey data is not rich enough to infer broader themes about how universal service directives can influence internet interconnection practices without checking back with some survey participants who have provided answers with little to no context.

5.3 Mandatory peering at specific locations

Some regulators require networks to engage in multilateral peering at internet exchanges in their country. Any network that wishes to interconnect there has to agree to exchanging traffic on a cost neutral basis with any other network that is also connected to that exchange.⁷

For networks that have an open peering policy,⁸ mandatory peering is not a threshold at first sight.

By obliging hesitant incumbents to interconnect, mandatory peering would alleviate costs for all other local networks because some local networks would eventually be able to move some of the transit traffic with the incumbent into a cost-neutral peering relationship. But cost savings are not the only reason that some small, local networks welcome mandatory peering. Some equate mandatory peering with access to large, international networks at an exchange, which they highly value. As one internet access provider representative highlights (399) it is the large networks that can typically engage in technically advanced modes of interconnection, such as IPv6 peering. So if mandatory peering makes large operators peer at an exchange, this may enable technological innovation locally. The international operators would – and some think they

7. As participants report, regulators sometimes also determine where local networks have to or can establish access to the internet, e.g., for university networks (439). Cases of such extensive control, where the networkers cannot design their networks independently are not covered in this report.

8. Peering policies are the documents in which networks outline their general business proposition with regard to internet interconnection. These policies describe which criteria another network has to meet before it will be considered for a peering relationship in which two networks exchange traffic on a cost neutral basis. Peering policies can generally be divided into “open”, “restrictive” and “selective”. Networks with an open peering policy are interested in peering with any other network at a common point of presence. Restrictive means, that a network is generally not interested in new peering relationships. Selective networks chose their peering partners on a case-by-case basis.

should – “partake in shaping the industry” (396), emphasising the development dimension of mandatory peering. Mandatory peering is also associated with improving the quality of services (438).

However, critical voices outweigh the positive statements about mandatory peering. Objectors emphasise that this type of regulation is not only “far from normal” (15), but that it also has unintended, systemic effects. Mandatory peering is said to discourage large operators. They reportedly tend to stay away from such exchanges all together, because they are likely to disagree with interventions in their restrictive peering policies. Reluctant operators may have financial reasons not to let regulators force them into peering, but they may also worry about operational aspects. By making internet interconnection binding, mandatory peering prevents “sensible engineering practices” (7) such as de-peering networks that do not adhere to common best practices and cause other networks harm.

When networks stay absent from an exchange, this in turn affects the population that is present at the exchange. The fewer operators there are at an exchange, the less of a network effect this exchange can enable. One CDN representative elaborates:

“Since we peer openly, it [mandatory peering] doesn't affect us directly, but we believe that it is bad policy, since it disincentivizes participation by some other networks and thus reduces the set of our potential peering partners.”
(100)

Several participants are in line with this assessment (71, 209, 225). One representative of a restrictive network advises to outright “keep away from such location” (373).

On a side note, mandatory peering is the one type of regulation that caused most misunderstandings in the questionnaire. The questionnaire inquired about *public regulation*. Yet, several participants (242, 245, 292) referred to their experiences with private peering policies. They elaborated how networks with highly restrictive peering policies posit that potential peering partners must interconnect with them at several points of presence. This is an interesting finding in itself, because such privately established “mandatory peering” policies are seemingly perceived as *de facto* regulation.

5.4 Economic incentives for local operators only

This question inquired about encounters with economic incentives for *local* operators, but only when these incentives have been caused by regulators.⁹

9. Several participants pointed out that for them “local peering represents less costs on international links” (406) in general, so even without formal regulation they see an incentive for local networks to interconnect (13). Also, it was reported that some internet exchange points offer differential pricing based on geographic region (225). While all of these aspects can be part of a local incentive structure, they do not relate to public regulation, so they are only mentioned for the sake of completeness.

There is a general criticism against local subsidies or other economic incentives. They are to be distorting the market by creating “an ‘unlevel’ playing field” (100).

Interviewees detailed that higher pricing for international operators or subsidies for local initiatives could lead or have led to the “decision not to do things at all” (6) (214, 221) when not one of the privileged parties. Operators may withdraw from trying to interconnect in that region when they find the financial threshold too high. This can impact the quality of connectivity, as this peering coordinator reports: “it has at times made it cheaper to serve traffic through transit providers elsewhere rather than continue to try to serve content within the region” (292). So when networks stay absent from a region because only local operators benefit from economic incentives, this may have unintended operational consequences, such as higher latency for the traffic from the distant networks.

Others assess this question in the context of what the competitive landscape looks like: “Helping smaller networks to connect is beneficial, providing commercial advantages for the incumbent is bad” (7). From this point of view, incentives are good when they alleviate the economic disparity between actors in a market.

Overall, survey answers indicate that economic incentives just for local operators are not a hard stop for international operators, but it causes them to weigh cost/effort against benefits of interconnections at such locations more carefully than in other places.

Apparently, incentives for local operators can be encountered in some developing countries (15 about Vietnam).

5.5 Competition laws

Generally, competition laws are often used for cartel cases, cases of “abuse of dominance” and merger control cases. Since survey answers neither necessarily relate to the same market nor to the same jurisdiction they are difficult to compare. However, there are some overarching findings about what competition law as a type of regulation may mean for internet interconnection.

In contrast to the generally critical attitudes towards formal regulation of internet interconnection, network operators do not perceive competition laws burdensome per se. Cases where competition law directly interferes with operations are an exception, albeit it can have stark consequences, as a Yemenite operator explains. In Yemen there is just one governmental body that provides the interconnection for all the companies active there, which “hinders [...] interconnection planning and makes it slow at best” (274). An operator from a Brazilian research network reports hardware restrictions. According to him, public companies are mandated to prefer national equipment, even if the price for it is up to 20% higher than the competitor’s price.

But competition laws do not simply limit interconnection practices in a top-down way. They can also empower operators (13). Competition regulation introduces the rule of

law or the threat thereof into the otherwise often informal internet interconnection relationships. This means that network operators can file claims against each other on the basis of competition law, and some make use of that option. For instance, in Switzerland there is a case pending which draws upon competition and anti cartel laws (Fiber7 versus Swisscom) (16). Other operators report that threatening competitors with the use of competition laws can be enough to achieve peering with reluctant counterparts (13, 209). Some networks use competition laws actively as a tool to push local monopolies into rendering services for them (44).

With competition conflicts in the air comes the need for operators to be able to justify their interconnection practices (6) towards public authorities. Justification in turn demands documentation, which means more legal work around internet interconnection. This, a recurring theme, makes locations less preferable for some (7) as it increases the cost of service (30).

The growing need for potential justification drives the sector to formalise interconnection relationships, which have historically evolved in a highly informal way. Formalisation might also put an end to the long-lasting era of “mate’s rates” where business relations could be based on personal relations only (6). An internet access representative whose company has been examined in a merger and acquisitions process outlines what may become the new normal in times of competitive conflicts:

“Our whole philosophy in this area is base[d] on a view that there is the possibility of a dominance finding in terms of termination/origination of Ip [sic] traffic towards our end-users. This drives us to work to be even-handed and be ready to justify all actions to a regulatory or completion authority.” (383)

In other words: where competition laws are mobilised, subjected operators unify their peering policies and make them consistent across all of the networks they interconnect with. Fairness, as in “treating peering requestors equally”, may increase in the market. In turn, trading choices and the flexibility to cut deals becomes limited (185, 221).

How competition laws affect network operators depends on the roles of these networks in their market environments. Several answers reflect this. Participants differentiate by introducing categories such as “transit providers”, “incumbents”, “competitors”, “little operators” or “small suppliers”.

5.6 Regulatory authority imposes its own technical or operational standards

Network operators have encountered authorities that regulate by setting technical or operational standards in several realms of internet interconnection. Asked how regulator’s standard-setting has affected them, participants provided numerous examples. The following list presents the participant’s statements. The factual existence of such regulations could not be crosschecked.

Authorities allegedly:

- demanded direct access to a network's routers (328 about Turkey);
- demanded multi-lateral peering via a route server (15 about India and Vietnam);
- have placed requirements on peering relationships (100), e.g., by limiting a network's selection of interconnection partners to networks that can provide a Service Level Agreement required by the regulator (98 about Malaysia);
- have told operators how many links their networks should have "and what their max utilization should be" (209 about the Netherlands);
- require operators to "document and get permission for every network node" (241 about Russia);
- mandate traffic shaping in the course of a government's fibre-optics rollout initiative (221 about New Zealand).

Survey participants also mentioned two law initiatives, which are additionally reported here for the sake of demonstrating the bandwidth of possible policy measures that can surface in the form of "standard-setting".

- Regulators might soon ask Australian operators to "provide their network and security designs" in the course of mandatory data retention (185).
- A Ukrainian transit network representative elaborates about planned surveillance legislation in Russia and Ukraine, which would take effect where networks interconnect: "There are lot of law initiatives [sic] now, for example interconnect all government [sic] agencies only through security service black box node, force to install black box spying devices for the cost of operators, ask black box registry for is it that MAC/IMEI has right to access Internet, and so on." He contends: "Right now our community successfully fights with these initiatives, but I believe it will not lasts forever." (44)

When regulatory authorities impose their own technical or operational standards interconnection professionals stand largely united against such regulation. Just a handful of participants assess the effects with indifference (245, 361) or weigh arguments (7, 292). The majority of statements are very critical.

General criticism is rooted in three deficiencies that operators attribute to regulators: lack of technical competency, lack of legitimacy to determine technical standards and too much tolerance or even support for the co-opting of internet infrastructure.

- *Competency*: Across the survey, it can be noted that operators often times perceive regulators to lack the technical expertise to judge or develop technical standards (292, 361, 399) that are in favour of internet interconnection (392, 100) as a fundamental mechanism of the internet. Some operators provide anecdotal proof by reporting that regulators tried to oblige them to implement standards which they were not able to apply technically (292, 399). In the eyes of several interconnection professionals, regulators do not oversee the effects that their technical requirements might have (274).

- *Legitimacy*: Some survey participants explicitly address the governance dimension that lies in standard-setting. They question that regulatory authorities have the legitimacy to mandate standards in this field. They demand that it should be up to the technical community to assess the viability of standards (274) and that regulators should pay attention to what has been identified as best practices by the community (100) already.
- *Co-opting*: Several of the examples of standard-setting listed above point to a development that internet governance scholars have called the co-opting of systems of internet governance for political “purposes other than those for which they were initially designed” (Musiani 2014). Examples include surveillance or data retention.¹⁰

Some operators disagree so greatly with regulatory standard-setting that they either completely avoid locations where regulators impose their own technical standards or that they do interconnect but disobey the rules. Statements like the following about standards imposed by regulators are striking: “we work around it” (15), “we usually avoid those countries” (328), the “‘operations permit’ [...] usually requires some technical solutions, not always needed, but usually faked just to get this permit” (11), “we manage around them where possible” (371).

5.7 Regulatory authority imposes the use of standards developed by private actors

In the context of this report, private standards are standards that have been developed in a closed process by private actors. They do not have to be proprietary, but they can be.

In two regards participants’ assessments about when regulators impose the use of private standards overlap with their assessments about the use of standards that regulators have developed themselves: survey participants doubt regulators’ competency (10, 100, 399) and they distrust private standards and/or find them illegitimate (292, 392). The litmus test for legitimacy is whether the community has been involved or not.

“Standards are, by definition, developed by the Internet community, publicly and openly. Anything that fails that test is not a ‘standard.’” (100)

10. The assumption that the internet was designed for specific purposes, and therefore that it can be co-opted by using it for other purposes is arguably debatable. To the contrary, Benkler and Clark emphasise that the internet’s openness towards all purposes is its unique feature. They describe the internet as “a system only a researcher could love: general, abstract, optimized for nothing, and open to exploration of more or less anything imaginable using connected computers” (Benkler & Clark, 2016, p. 5). A more neutral way of describing the policies could be to talk about new purposes that go beyond what users have come to think of as typical purposes of the internet.

It appears less problematic when standards are “created in joint effort” (376) or appear “well thought through and logical” (7), which already assumes some transparency for the process of standard creation.

There are some indications that issues with private standards arise especially at the interface between internet interconnection and hardware. This is where equipment vendors play a role. Examples provided include scenarios in which networks are mandated to use equipment that has been provided by the regulator or that has been licensed by a related organisation. Two participants report this about Russia (11, 241). In another scenario, reported from New Zealand (221), government fibre contractors de facto impose private standards in the course of executing their tasks of rolling out fibre-optics.

Another recurring objection that has also been brought forward against the implementation of private standards is that they increase the cost of service (30) and regulatory authorities are perceived as not taking into account the cost of implementation of such standards (399).

5.8 Regulatory authority operates exchanges

When regulatory authorities operate internet exchanges “it does raise an eyebrow” (15). Some operators even stay away from such exchanges per se (209, 328).

Others say that an internet exchange that is operated by a regulator may be better than having no local peering at all. In places where the community of network operators previously could not agree to cooperate and build an internet exchange themselves, regulatory initiatives may be helpful in overcoming the lack of local self-coordination (100).

However, the details matter. Participants state several criteria that governmental exchanges need to fulfil to be accepted: the exchange needs to be “well run” (15), it needs to be operated in a transparent manner (292) and the regulator cannot have a negative “prior history around the operations of an exchange” (15).

These expectations, again, allude to the previously voiced doubt that regulators may lack competency, in this case to operate an exchange (7, 361, 399). As one participant states, “some exchanges have some very weird ideas about what you can and what you can’t do” (328). This implies that there are informal norms or best practices for operating an exchange, which regulators are allegedly not aware of or do not adhere to. By demanding transparency, participants show that they have an understanding of internet exchanges as being sites of internet governance. It matters to them what kind of a governance model the internet exchange has codified for itself. Also, in order for connected parties to send their traffic over the switching fabric that belongs to the exchange, the regulatory authorities need to be trusted. As a concept, reputation cannot be imagined without a social group (or groups) which share the information that someone can be trusted. So the regulator’s acceptance as an operator of an internet exchange also depends on processes that are internal to the community of networkers.

A (likely unintended) consequence of governmental internet exchanges may be that they prevent competition among internet exchanges when they are the sole provider of an interconnection platform. (274)

5.9 Disclosure regulation (mandatory transparency)

Due to the architecture of the internet, there is already some transparency in internet interconnection (6). With sufficient know-how, anybody can find out about interconnections between networks, e.g., by taking probes or by analysing the routing table. What is not transparent are the commercial agreements under which networks exchange traffic. So while disclosure regulation may make interconnection structures even more transparent, it affects the commercial sphere and the market more so (6, 7, 15, 30, 221, 288, 383). Several participants reacted adversely to disclosure regulation, e.g., by stating that some deals could only take place if they remained secret, because otherwise conflicts would arise with corporate and economic politics (6, 7).¹¹

Disclosure regulations differ with the (scope of the) publics to which the disclosed information becomes available. So for detailed analysis, it would be helpful to differentiate where the transparency has to be created and vis-à-vis whom. Disclosure can be limited to the network's stakeholders (354, 399),¹² to an internet exchange point (269), to the regulatory authority (15, 241, 268, 383) or it can target the general public.

Also, the kinds of information that operators have to disclose vary: some need to “file with the government every year to tell them who [they are] peering with and where” (268 about the US), others have to document every network node, including the location and the point of presence (241 about Russia), in yet other cases networks need to prepare reporting that is specific to an interconnection (269 about France). One networker reports that his/her network had to disclose interconnection arrangements “as a consequence of remedies approved as part of a merger control process” (383), indicating how disclosure regulation and competition regulation can be intertwined or combined.

Disclosure regulation can have global effects when it means that the information about interconnection agreements is going public. Different legal systems may collide, e.g., when a national regulator demands public disclosure from networks that may be

11. Such corporate and economic politics could be unified peering policies. “Deals” not taking place due to disclosure regulation could mean that networks which proclaim to have unified peering policies actually do make exceptions. Such exceptions would become visible, thus undermining the power of the “unified peering policy” argument in business negotiations.

12. Internal disclosure rules may not necessarily stem from public regulation. An example for this is a consortium of research and education networks that needs to give all members of the organisation insight into all interconnections, including commercial peering connections and upstreams (354).

bound to non-disclosure agreements in other jurisdictions (7) or when the data that is to be disclosed would include proprietary information (288). Also, it should be noted that disclosure always affects two parties: the party that is obliged to provide the information and the interconnection partner. Accordingly, survey participants point to a commercial risk (7). Operators who are active in several regions may be disadvantaged when their information is public due to regulation in one region whereas the competitor's information is not.

By necessitating documentation, disclosure regulation also contributes to the overarching theme of formalisation of internet interconnection (see also pp. 15-16).

5.10 Basic rights for citizens (e.g., rights to internet access or broadband)

“Basic rights for citizens” is the only type of regulation for which almost all statements are neutral or even affirmative. Two main rationales back the affirmative reasoning. The first is that the internet is an infrastructure that is of public interest (7, 168, 273, 371). Networkers who share this rationale clearly see end-users (aka citizens) as stakeholders in internet interconnection – sometimes “even in the absence of any regulatory pressure” (371, 273). They feel bound to act on the end-user's behalf in their interconnection practices. For example, with the end-users in mind they will make sure to connect to an internet exchange that they perceive of as neutral (225) or they will try to optimise connectivity with those networks that the customer base uses most (148). Basic rights manifest citizen's status as stakeholders in internet interconnection. They offer legal protection for end-users who can then legitimately claim connectivity as a common infrastructural resource. Parallels between internet connections and utility connections become apparent (168). The second affirmative rationale rests on the assumption that basic rights to internet access or broadband increase the number of customers who connect to the internet and thereby “contribute to economic development of the country” (406).

When citizens have basic rights to internet access or broadband, the effects of such regulation also depend on the role that the network actors have in a market. “In theory local actors are more keen to be seen to be interconnecting for end user benefit” (7) states one internet access provider representative. Another specifies: basic rights would primarily influence incumbents. Competitors would be affected rather indirectly, when the incumbent's behaviour changes due to such regulations (221).

For other kinds of regulation individual networkers have described that they try to work around the regulation in question. So it seems worth mentioning that there was no such statement about basic rights.

6. Conclusion

The survey set out with two goals: to explore the regulatory context of internet interconnection from the perspective of interconnection professionals and to illuminate the degree to which local regulation of internet interconnection can have consequences for global internet connectivity.

An overarching finding is that local regulation of internet interconnection creates a tension between the regulated and the unregulated space. It prompts networks at a regulated location to adapt to a set of rules that diverge from common best practices, as described by the participants. The effect of local regulation then lies in marking a difference from global, albeit informal norms. Any network that wants to overcome this difference has to make the extra effort to adapt to the thus different regulatory environment. This is true outbound and inbound: when international networks want to interconnect at a location with a specific regulation but also when local networks want to interconnect somewhere outside of their original jurisdiction, where the regulatory landscape differs.

In how far a network is affected by local regulation is a question of the network's structure. Networks that have a wide reach with many points of presence as a characteristic encounter this normative difference more often than networks with only few points of presence. Reach however, is not necessarily linked to the size of a corporation but more so to the type of offering or service that a network provides. Content distribution networks or so-called infrastructure as a service providers for example do not need to have high turnovers before they interconnect at many locations; it is rather a central feature of their business and network architecture to be present at the edges of the network. This leads to the conclusion that local interconnection regulation can hinder infrastructural innovation that depends on points of presence in multiple jurisdictions. This finding is irrespective of the kind of interconnection regulation.

Another general insight concerns regulation that influences especially international operators in their decision to either join an internet exchange or stay absent. When international operators stay absent from an internet exchange, it does not affect the connected networks evenly: larger networks can arrange interconnection at a different location, but small or local networks that are connected only to that one internet exchange suffer disproportionately, because they cannot easily "meet" the potential peering partner at another point of presence. Local networks also value the presence of international actors from a development perspective. International networks are seen as brokers or mediators who transfer know-how, e.g., about best practices or technical standards to less developed regions. In practice, they can be the matching part for local network operators who want to enter advanced modes of internet interconnection such as IPv6 peering.

Painting participants' reports about the regulatory instruments in broad strokes, it can be said that fundamental criticism has been voiced mostly regarding those kinds of regulation that are likely to contradict engineering principles and operational (best)

practices. This corresponds to the thematic domain “engineering and operations”. Cases in point are when an authority imposes technical or operational standards, prescribes the use of specific hardware or mandates peering. Beyond that, network operators are not averse to public regulation of internet interconnection per se. This becomes clear when looking at survey participants’ reports about their encounters with competition regulation and with basic rights for citizens. Basic rights that guarantee citizens broadband access to the internet are probably the form of regulation that interconnection professionals accept the most. One possible reason may be that basic rights justify claims for connectivity bottom-up by putting the users first and, in the end, every networking professional also is an internet user. The second rather accepted kind of regulation is competition regulation, which plays out in the thematic domain “economies of interconnection”. Operators may perceive it as cumbersome, they may dispute the specific shapes that this regulation takes, the regulation may even prevent them from connecting at such locations. But competition regulation does not pose a full stop to internet interconnection. Operators are willing to engage with it. They hardly question the legitimacy of the regulatory instrument as such.

What is notable about both basic rights and competition regulation is that they both enable the rights holders to make claims. The basic rights in this context are rights *to* something such as internet access or broadband, so they entail the promise for a service for the rights holders. And competition regulation may restrict some networks, but it allows others to demand the regulatory authority to intervene in favour of balancing the market. Further, neither basic rights nor competition regulation are specific to internet interconnection. Basic rights apply in all areas of societal life, and competition regulation is supposed to ensure fair competition between companies in all kinds of markets. It appears that regulations which affect internet interconnection that go back to general regulatory principles receive legitimacy from the very fact that they are also applied in other societal spheres.

The survey has brought to the fore that internet interconnection is not the unregulated field that it is broadly considered to be. Roughly half of all survey participants have been influenced by public regulation in their professional practice. Analysing their assessments in detail though, it becomes clear that in order to understand the relationship between public regulation and internet interconnection, we need to embrace this field in its empirical complexity. In some jurisdictions public regulation currently may imply severe interventions, but it hardly ever determines all aspects of how networks interconnect. So it would be simplistic to conceptualise internet interconnection and public regulation as incompatible as networkers have occasionally done. However, networkers’ statements do raise awareness for an aspect that regulators may not always be aware of: the fact that even where internet interconnection regulation is absent, it does not mean that there are no rules. When claiming to be acknowledged as enactors of internet governance, networkers hint to “the community” and to the existence of best practices as informal norms. A challenge for future research will be to explore such informal norms and their scope. What do these norms say? How are they enacted, transmitted, ensured, debated, developed? What are their limits? If networkers perceive

them as superior to formal regulation, on what grounds do they claim legitimacy for informal rules? With this work done, we will be equipped to move beyond the question of “public regulation yes or no” and enter into a discussion about how to balance formal regulation of internet interconnection and informal norms.

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