

Cullen International, together with the Universities of Leuven and Namur, held on February 2, 2017 a seminar on '*internet and IP peering*'.

The seminar discussed the technical arrangements, commercial agreements and regulatory implications on IP interconnection.

Around 60 people from industry, EU institutions, member states' permanent representations in Brussels, national regulatory bodies and academia participated.

The slides can be found [here](#).

Some of the key points made by the speakers are highlighted in this report.

Dr. Cara Schwarz-Schilling (BNetzA, Co-Chair BEREC NGN expert working group) [presented](#) BEREC work on IP interconnection issues in the context of regulatory debate over net neutrality. The presentation addresses BEREC early work on IP Interconnection in 2007, the joint OECD/BEREC workshops, the TSM and an outlook for 2017.

Samih Souissi (ARCEP) [described](#) some of the key findings arising from the French regulator data collection exercise on IP interconnection.

Jan Tichem (ACM) [presented](#) an analysis of IP Interconnection in the Netherlands. On that basis, ACM concluded that the likelihood of competition problems resulting in consumer harm is currently very low in the Netherlands, without ruling out this possibility completely.

François Lemaigre (Cogent) presented Cogent Communications business model and its position on the regulation of IP Interconnection. Cogent is a global Tier 1 transit carrier.

NB. Cogent is perhaps best known in regulatory circles because of the [2012 case](#) brought against Orange's Open Transit before the French competition authority.

Judith Rudolph (Vodafone) [gave an overview](#) of Vodafone's global IP business, presented market trends and the company's position in regards to regulation of IP Interconnection.

The seminar has greatly benefited from the presentations of two technical experts who have helped the audience grasp some of the technical concepts necessary for a proper understanding of IP Interconnection.

- **Olaf Kolkman (ISOC): Routing on the (see [Presentation](#))**
- **Patrik Fältström (Netnod – Swedish IXP): Peering, transit and payments (see [Presentation](#))**

Peering and transit agreements - technical concepts

Readers familiar with peering and transit agreements can skip this section and go straight to the next.

ASs

Internet is composed of 54,000 'autonomous systems' (ASs). These should not be confused with telco's networks. ASs are built on top of telco's physical networks. The European Commission, for example, is an Autonomous System.

Prefixes

ASs are often divided into several subnets. This division enables AS managers to define different routing policy for different kind of traffic (route heavy data traffic through a cheaper route). Together AS managed 600,000 subnets or IP address blocks, each of which is characterised by a routing prefix and a routing policy.

Routing policy

Routing decisions (i.e. the choice of a particular path chosen to convey IP packets between two different ASs) is defined by each AS administrator. Routing is based on the destination address in the packet. Packets with the same destination may be routed through different paths.

Routing table

Each destination address is looked up in a routing table that lists the routes to particular network destinations based the size of the packet, the protocol of the payload, or other information available in a packet header or payload as well as on the various of IP interconnection agreements concluded.

IP Interconnection agreements

Autonomous systems (ASs) complement each other. An isolated AS would resemble an intranet and would not allow a general access to information available on the internet. This means that ASs have an incentive to reach interconnection with other networks through peering or transit.

Peering

Peering means that two networks exchange traffic directly between each other without going through a third ASs. Peering can be physically implemented through connecting two networks with a cable/fiber.

Peering agreement can be:

- settlement free: when there is broad symmetry of the exchange of traffic between networks. In such case, the two operators simply share the costs of the cable/fibre connection or
- with a settlement fee: operators peer for economic efficiency reasons but the gains are not split evenly due to traffic asymmetry of between the two networks. Networks bargain over peering deals and settlement fees can be part of the bargaining solution.

Private vs. public peering

The physical interconnection between two networks can take place in any location chosen by the parties (private peering) or at an IXP (Internet Exchange Point), a physical location where many operators are present. The main European IXPs are based in Frankfurt ([DE-CIX](#)), Amsterdam ([amsix](#)), London ([LINX](#)) and Stockholm ([netnod](#)).

Transit

A network buys connectivity from the rest of the internet. The network pays the capacity of the volume of traffic that can cross an interconnection (i.e. at an exchange point).

European Peering Forum

The [European Peering Forum](#) is the main European event for peering managers to discuss bilateral peering business opportunities.

Experience gained in monitoring IP interconnection agreements in France since 2012 - Samih Souissi (ARCEP)

Samih Souissi, advisor at ARCEP's Open Internet Unit, presented some key findings of the French regulator collect of information on IP interconnection. Since 2012, ARCEP has been monitoring IP traffic generated by the main French ISPs and their interconnection partners. ARCEP gathered data both on a periodical and an *ad hoc* basis. Data collected included the financial and technical terms of interconnection agreements between autonomous systems, volume of data exchanged, capacities, location of interconnection. Mr Souissi announced that ARCEP will publish data on IP interconnection, including relevant data for 2016, in May 2017 with the publication of a report on the state of internet in France.

The overall interconnection traffic exchanged by the four main ISPs (Bouygues Telecom, Free, Orange, and SFR) increased by 30%, between the end 2014 and the end 2015, to reach an average traffic rate of 5.7 Tbps. The measurement includes peering between ISPs and with third party operators, and traffic with transit operators. Traffic is mainly conveyed through transit operations, but ARCEP notes that ISPs in France are increasingly using peering. ARCEP also notes a strong growth in traffic generated by major content and application providers (sometimes up to 150%) explained by a more intensive use of direct interconnection between CAPs and ISPs. ARCEP will publish many additional and detailed findings as part of the report on the state of the internet in France in May.

Mr Souissi also explained that ARCEP intervened in two IP interconnection cases: in

- 2011, ARCEP provided an [opinion](#) to the French competition authority in the Cogent case. The transit operator Cogent considered that Orange was abusing its dominant position by asking to be paid for extra bandwidth capacity ([Flash](#)). Cogent and Orange (through its transit operator OpenTransit) had a peering agreement where the exchange of traffic between the operators was free, based on a ratio threshold set at 2.5 to 1. The French competition authority [considered](#) that requiring compensation for the provision of extra bandwidth capacity in peering agreements where there is a significant traffic imbalance is not to be considered as anti-competitive behaviour.
- in 2012, ARCEP investigated Free's (Iliad Group) interconnection practices after allegations that the ISP was slowing down traffic at peak times to websites such as Google's YouTube ([Update](#)). ARCEP [concluded](#) that there was no discrimination by Free as congestion affected all traffic and resulted mainly from the sizing of Free's interconnection links with IP transit operators and IP peering agreements. The interesting point in this case, explained Mr Souissi, is that the mere fact to publicly launch and publicly close the formal investigation led Free to increase its traffic capacity limits.

BEREC work on IP interconnection and net neutrality - Dr. Cara Schwarz-Schilling

Dr. Cara Schwarz-Schilling (BNetzA, Co-Chair BEREC NGN expert working group) presented BEREC work on IP interconnection issues in the context of the regulatory debate over net neutrality.

BEREC 2007 report on IP Interconnection

BEREC started its work on IP interconnection as early as 2007 and initially focused on voice interconnection in view of migration from PSTN towards IP-networks.

The first report on IP interconnection (ERG (07) 09), published in March 2007, addressed the differences in regulatory regimes applied to voice interconnection in circuit-switched networks and interconnection arrangements in IP-based networks. In both cases traffic is transported across the same access bottleneck. However, voice termination in "traditional" circuit-switched networks has been subject to ex-ante cost

regulation on each access network, while IP interconnection is largely unregulated. An important factor to explain this lies in the underlying differences in charging mechanisms. The common wholesale billing regime in PSTN is Calling Party's Network Pays (CPNP) that gives rise to a termination monopoly and high wholesale charges. Data transport for Internet Access Services on the IAS-providers network is included in the end-user price at the retail level with Bill and Keep being applied as charging mechanism at the wholesale level.

Peering and transit

IP interconnection arrangements typically exist in the form of transit or peering in the core networks. Wholesale charges are determined by traffic flows in both directions. In transit agreements, the Internet access provider pays to the upstream network for both upstream and downstream transmission of traffic. In peering agreements, normally there are no payment flows, as long as a number of requirements are met. Typically traffic imbalances shall not exceed a specified limit. Internet access providers that fulfil the requirements for peering can choose between peering and transit services. The report concluded that as long as Internet access providers have a choice of transit providers, the market remains competitive. Moreover, the charging mechanism Bill and Keep avoids the problems resulting from the termination monopoly.

BEREC 2010 statement on Next Generation Future Charging Mechanisms/Long Term Termination Issues

In 2010, BEREC released a common statement on Next Generation Future Charging Mechanisms/Long Term Termination Issues ([BoR \(10\) 24 Rev 1](#)) where it reached similar conclusions. Looking at the pros and cons of BaK and CPNP regimes, BEREC also suggested that BaK would be more promising than CPNP as a regulatory regime for voice termination in the long term.

BEREC/OECD workshops on IP interconnection

Several expert workshops on IP interconnection were organised by BEREC in cooperation with OECD in 2011, 2012 and in [November 2016](#), aimed at bringing together key experts from the broader Internet community and NRAs. An updated [survey on IP interconnection trends 2016](#) by Packet Clearing House revealed that 99.9 % of peering agreements concluded in 2016 were informal "handshake" agreements without any written document (up from 99.5 % in 2011). It also showed the growth of multilateral peering agreements, both in number of agreements and the size of each agreement. It should be noted however, that no information is available on how quantities of handshake peering agreements relate to traffic volumes.

The workshops discussed the future of IP interconnection in the light of recent market developments and regulatory initiatives on net neutrality, such as the EU [Telecoms Single Market Regulation \(Tracker\)](#) and the [FCC's Open Internet Order](#) in the US.

What role for NRAs on IP interconnection disputes?

In BEREC 2012 report on IP interconnection in the context of net neutrality ([BoR \(12\) 130](#)), violations of net neutrality were considered unlikely if traffic is treated according to best effort principle. This principle is generally reflected in today's IP interconnection agreements that are based on both transit and peering arrangements. While this may still leave space for disruptions at the wholesale level, however, such disputes have been few and resolved by market players in relatively short time without regulatory intervention. This is largely due to competitive pressure from end-users at the retail level and the application of Bill and Keep as charging mechanism at the wholesale level.

Current Regulatory Framework ([article 5 of the Access Directive](#)) foresees that NRAs can impose an obligation to interconnect on a non-discriminatory basis, but it does not provide a legal basis for mandating free peering. Any regulatory measure could potentially be harmful, so it should be carefully considered.

Typical disputes have involved mutual recriminations by content and application

providers (CAPs) and Internet access providers (“eyeball ISPs”), e.g. Netflix vs Comcast in the US:

- CAPs accuse eyeball ISPs for causing congestion by refusing to upgrade port capacities or even slowing down content.
- Eyeball ISPs refer to growing traffic asymmetries and accuse CAPs for causing congestion by sending traffic via certain routes. As a solution, ISPs propose to implement a paid peering arrangement (often combined with a guaranteed end-to-end quality of service).

BEREC has been critical of any initiatives by ISPs to include an explicit reference to a specific IP interconnection charging method, such as sending party network pays and end-to-end quality of service delivery (see BoR (12) 120 rev.1 “*BEREC’s comments on the ETNO proposal for ITU/WCIT or similar initiatives along these lines*”). BEREC sees its key role in protecting the continued development of the open, dynamic and global Internet, rather than reversing the established charging mechanism using quality of service as a justification.

Wholesale IP interconnection and the TSM

Dr. Schwarz-Schilling reminded that the present EU regulatory framework explicitly excludes wholesale IP interconnection from the scope of the Telecoms Single Market Regulation (TSM). BEREC [guidelines](#) on the implementation of the net neutrality rules published on August 30, 2016 clarified that the [article 3\(3\) of the TSM](#) concerns equal treatment of all traffic “*when providing internet access service*” and therefore excludes IP interconnection practices from its scope. However, NRAs may consider the interconnection policies and practices of ISPs that have the effect of limiting the exercise of end-user rights under the [article 3\(1\) of the TSM](#).

Outlook

In 2017, BEREC will examine recent technical and commercial evolution and update the 2012 report on IP interconnection in the light of new developments. BEREC will assess if the developments described in 2012 report are still ongoing. This relates to (e.g.) price declines for transit or CDN services, the increasing role of CDNs and direct interconnection agreements between large CAPs and eyeball ISPs as well as the flattening of network hierarchies. Putting these 2012 findings to the test may allow BEREC to assess whether market mechanisms are still able to cope with an ongoing increase in traffic volumes and look at Public Authorities activities since 2012.

IP Interconnection: theories of harm and ACM's experience - Jan Tichem (ACM)

Following the 2014 Netflix vs. Comcast dispute in the US, the Dutch Ministry of Economic Affairs requested ACM, the regulatory and competition authority, to investigate the IP interconnection market in the Netherlands to determine:

- whether restrictive IP Interconnection behaviors exist in the Netherlands and,
- whether existing regulatory instruments were sufficient to address the problem.

ACM published its [study](#) in October 2015.

The study is structured as follows:

- Formulation of two possible theories of harm
- Interviews of players in the market Contents and Applications Providers (CAPs), Internet Service Providers (ISPs), Internet eXchange Points (IXPs), transit providers and experts.
- Assessment of likelihood of competition problems in NL

Theories of harm 1: Exploitation of a competitive bottleneck

In this first theory of harm, an ISP may extract rents from the exploitation of a competitive bottleneck.

NB. The competitive bottleneck theory of harm was applied by all NRAs in their market analysis decisions on mobile and fixed voice termination.

Applied to internet, the competitive bottleneck theory may exist when: users

- are not reachable on other network

NB. mobile data is of course available, but but is currently subject to data limits

- users would not or could not switch networks in case of congestion transit
- is not available as a substitute to the current IP interconnection arrangements
- no countervailing bargaining power exists.

A possible scenario is that the ISP may exploit the situation by refusing a settlement free peering, demanding a high settlement fee peering, or offering only partial transit access to its network.

Theories of harm 2: Foreclosure of market for content

The second theory of harm explored by ACM is that ISPs might use their market power on the market for internet access to foreclose the market for content.

Many ISPs offer both access services and content to end users. The idea is that vertically integrated ISPs may compete with CAPs by favoring their own content and hindering IP interconnection with other CAPs (i.e. ISP demands paid peering or congests interconnections). According to ACM findings, such a foreclosure does not occur in practice for the following reasons:

- First, ISPs face competition. Therefore, a CAP experiencing hindering IP interconnection would just switch provider to access end-users.
- Second, there is no incentive for an ISP to exclude/foreclose a CAP. Indeed, the volume and quality of content in the ISP's network (whether produced in-house or by competitor) make its internet access product more valuable for end users. Hence, the end users willingness to pay a higher price for the ISPs access increases (Chicago Critique).

Not all restrictions are anticompetitive: possible efficiencies and justifications

Restrictive interconnection behaviour may in some circumstances be motivated by anti-competitive concerns. However, ACM notes that it is equally true that this behaviour can be motivated by pro-competitive concerns or otherwise legitimate reasons. From a commercial and economic perspective, the following efficiencies and objective justifications may apply to restrictive interconnection behaviour:

- Protecting transit business: ISPs with a business model based on transit will have less incentive to peer because a direct link will undermine their transit requests. Settlement fees can be a way to split gains from peering and be mutually beneficial to the two networks.
- Paid peering may be an efficient contractual solution. For instance, big Network A offers transit access to small Network B; then both parties decide to move to paid peering. The payment of settlement fees might be justified by the fact that small Network B enjoys better quality access and lower fee than in its transit agreement.
- Settlement fees can simply reflect bargaining strength, mirroring the asymmetry in traffic exchange between two networks.
- Refusal to peer may be caused by excess capacity on other peering links. Upgrading or initializing a peering link might require huge investment.

Difficulty to distinguish between 'anti-competitive toll' and 'fair bargaining' in peering deals

While ACM acknowledge the difficulty to distinguish between 'anti-competitive toll' and 'fair bargaining' when analysis peering deals. However, as Jan Tichem pointed out,

“even if the benefits of peering are unevenly distributed, peering is always an efficient solution when settlement-fee is not higher than savings on transit costs plus possible value of quality improvements”.

Experience of ACM at the time of the report (end 2015)

The likelihood of competition problems such as anti-competitive settlement fees or refusals to peer resulting in consumer harm is currently very low in the Netherlands. Paid peering is rare and the vast majority of peering arrangements are closed via a handshake. Even though paid peering would have been more efficient, CAPs reverted to transit access because they did not want to set a precedent by paying fees to a ISPs.

No degradation of quality due to IP interconnection conflicts was observed. Transit seems to be efficiently priced and there was sufficient transit capacity anyway according to interviewed CAPs

ACM conclusion was that it is unlikely that a competitive bottleneck in IP interconnection can be exploited. The reasons are as follows:

- Multi homing: customers can often receive the content of CAP B through different networks. ACM reasons that 43% of households are connected to the Internet through a fixed broadband network. In addition a fast growing number of inhabitants has a mobile subscription that includes broadband Internet access. This indicates that a growing number of residential Internet users might be multi-homing. However, ACM has considered that the two modes are not substitutable. ACM notes that this conclusion may change in the future, depending on the technological developments. The current situation implies that a large part of the users of Internet access can be considered single homing.
- ISP switching: Customers are very quality-sensitive and price-sensitive in the internet market. The retail market for Internet access is currently considered, by ACM, to be effectively competitive. If they perceive low quality or price increases, they will easily switch internet provider.
- Are peering and transit substitutable? ACM concludes that IP transit and peering are in the vast majority of cases substitutes. In addition to direct peering, ISP A can be reached by CAP B through transit via other ISPs that have direct/indirect access to ISP A. Every ISP fights to ensure universal connectivity; for this reason ISP A can be reached indirectly by CAP B through its various agreement with other ISPs' networks (i.e. transit through ISP C) even though ISP A does not want to sign a settlement free peering agreement.

ACM does not suggest that peering and transit are always perfect substitutes:

- Vertical integration: In some cases, ISPs operating an access network also own a transit network. If so, the ISP may also control a significant number of transit routes into the access network, which may effectively reduce the number of alternatives for a paid peering link with the access network.
- QoS: peering may yield superior quality to transit, as it reduces the distance over which traffic is carried and it reduces the number of hops the traffic has to traverse. In practice, however, the difference in quality of the connection between transit and peering is often negligible. Furthermore, many applications are not so sensitive to latency and packet loss. Video streaming, for example, makes use of buffering which allows content to be enjoyed at high quality even if a transit link is slower than a peering link
- Large amounts of traffic: where two networks exchange very large amounts of traffic, a network cannot simply shift its traffic to a transit link as transit providers would have to upgrade interconnection capacity with the destination network. The Netflix cases show that transit providers may find it too risky to close IP

interconnection deals with the destination network such that the transit provider can satisfy large demands for transit.

Regarding the existence of Countervailing bargaining power, ACM reasons that CDAs may have countervailing bargaining power if, for instance, they have a unique content essential for ISPs. The theory known as the 'Chicago Critique', is that ISPs vertically integrated into content do not necessarily have an incentive to foreclose competing CAPs' services (e.g. OTTs) on their network. The reason is that if consumers derive benefits from non-affiliated CAPs' services, these services also increase the value of the ISP's network to the consumers. ACM study explores the exception to the Chicago critique but concludes that these do not apply.

Concluding remarks

Bargaining peering agreements might sometimes lead to temporary congestion, but parties seem to find the most efficient way of interconnection anyway. It is not clear if settlement fees sometimes paid by CAPs are too high. Competition law seems sufficient to address potential problems.

François Lemaigre (Cogent) and Judith Rudolph (Vodafone)

François Lemaigre (Cogent)

Mr Lemaigre explained that compared to all other connectivity methods (Direct peering, CDN, IXP participation or others..) transit stands alone in its ability to deliver universal connectivity, the hallmark of the internet. Transit has a multiplier effect because paying clients' prefixes are propagated to all peers, and then to all their respective clients (direct and indirect). By contrast, every other method only delivers connection to a subset of the internet. Because of the propagation of prefixes to peers of the transit operator, each internet actor (content or access provider) enjoys complete economic independence in the selection of their transit provider, without any risk of losing universal connectivity. As a result, bandwidth has always been a true commodity and its price has been coming down steadily, following technical advances in the world of transmission (1Gbps to 10Gbps to 100Gbps) and computing powers (router processing improvements).

Every connectivity method has its own technical and/or price advantages. Transit, because of its ubiquity, provides the ultimate competitive pricing gauge for other connectivity methods. Without a genuine transit alternative option, Access Providers prefixes are only propagated to their preselected upstream providers and their clients. This forces all content and application providers to purchase "access" from those preselected providers, and to lose their economic independence in the process. As a consequence, says Mr Lemaigre, bandwidth can no longer be a price-driven commodity. The "Internet" becomes a series of parallel silos linked to specific destinations, with each of those destinations carrying potentially different and arbitrary prices. Without transit, universal connectivity (reaching all internet endpoints with a single connection) can no longer be ensured, he said.

Cogent suggests that the provision of a True Transit Default Alternative (local, uncongested and providing access to all internet endpoints) should be Regulators' first priority. All internet players would then be able to reach APs end users while keeping their economic independence in selecting their own Transit Provider.

Mr Tichem (ACM) indicated that, in the absence of an abuse of dominant position or a dysfunctioning of the IP interconnection market, it would be difficult for NRAs/NCAs to oblige ISPs to buy transit in addition to what they currently buy.

Judith Rudolph (Vodafone)

According to Ms Rudolph, the economics of the interconnection ecosystem will continue to drive market evolution with strong competition across the value chain. A variety of factors will shape this market, namely transport unit costs, continued price decline in the transit market, the use of private networks as well as increasing localisation of traffic. Overall strong internet traffic growth fuelled by video demand will ensure a dynamic system with competition driving technological innovation as well as an economical mix of commercial models including peering and transit arrangements.

Vodafone position is that given the competitive nature of the market, there is no case for market failure that would warrant ex-ante intervention. Where ISP disputes arise, competition law mechanisms and existing regulations are best placed to resolve the issue as precedent illustrates.