



Implications of the emerging technologies Software-Defined Networking and Network Function Virtualisation on the future Telecommunications Landscape

Executive Summary

A study prepared for the European Commission DG Communications Networks, Content & Technology by:



This study was carried out for the European Commission by



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ABSTRACT

This forecast study explored the technological, economic, and regulatory implications of Software Defined Networks (SDN) and Network Function Virtualisation (NFV) using a Delphi panel of experts, workshops, expert interviews, and extensive desk research. It finds that SDN and NFV will play an important role in the future telecommunications landscape with the most important usage scenarios being (1) Virtualisation of Mobile Core Networks, (2) Virtualisation of Content Delivery Networks, and (3) Virtual Network Platform as a Service (VNPaaS).

Focussing on these usage scenarios, the study describes corresponding CapEx and OpEx reductions. While cost reductions – ranging between 3.7% and 9% of total cost – are significant, they appear to be somewhat lower than expectations presented in industry outlooks. Beyond the telecommunications landscape, SDN and NFV are likely to be instrumental in the development and roll-out of innovative services, applications, and products as well as in facilitating major trends with substantial economic and societal impact.

As regards the regulatory implications of SDN and NFV, the present study shares BEREC's view that it is premature to make any specific recommendations. However, the experts involved in this research clearly highlighted access (to virtual networks) regulation as the most likely area where new rules may be necessary.

EXECUTIVE SUMMARY

This is the Draft Final Study Report for the project "Implications of the emerging technologies Software-Defined Networking (SDN) and Network Function Virtualisation (NFV) on the future Telecommunications Landscape" (SMART 2015/0011). The study set out to explore the most likely SDN and NFV usage scenarios and their technological, business, economic, and regulatory implications in the foreseeable future.

Based on a Delphi Expert Panel of almost 700 experts from 55 countries, three workshops, additional expert interviews, and extensive desk research, the findings can summarised as follows.

The most relevant usage scenarios out of the ones defined ETSI (European Telecommunications Standards Institute) for SDN and NFV appear to be (1) Virtualisation of Mobile Core Network, (2) Virtualisation of Content Delivery Network, and (3) Virtual Network Platform as a Service (VNPaaS), as these were identified by the experts on the panel and in the workshops as being the most significant. Technologically as well as with regards to the alleged business impact, SDN/NFV appears to be approaching a phase of disillusionment. The results of this study confirm that at least some of the expectations have been inflated.

As regards the economic impact beyond the telecommunications landscape, it was found that SDN and NFV are enabling technologies that are likely be instrumental in the development and roll-out of innovative services, applications, and products as well as in facilitating major trends that have substantial economic and societal impact. These trends include connected cars, augmented reality, virtual reality, and universal communications.

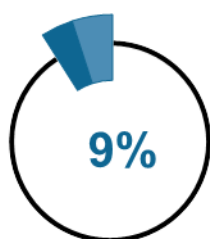
BEREC (Body of European Regulators for Electronic Communications) has recently published an input paper on the regulatory implications of SDN and NFV. Their main conclusion is that the implications are difficult to foresee at this point, although some areas of regulatory intervention clearly merit further monitoring as the technology develops and is being deployed. The findings of the present study by and large concur with these findings. The areas to observe critically in the coming years are access to virtual networks, spectrum regulation, and network neutrality.

A SWOT analysis of the ability of the European policy framework to facilitate SDN and NFV development and deployment conducted as part of this study concludes that there is positive and strong support from innovation measures such as Horizon2020 for SDN and NFV, and that the side-by-side development of open-source and traditional standards can be an opportunity to be seized by policy makers. Challenges referring to the transition process from legacy infrastructures to virtual ones is identified as a threat.

Virtualisation of Content Delivery Network

Short description

Streaming content is one of the fastest growing types of traffic in today's networks. This is mostly due to the rise of smartphones, tablets, and laptops – and the increased availability of content delivered over IP. This relates equally to linear (live) and non-linear (on-demand) content. Currently, CDNs are integrated into the operator's network and are typically distributed, in order to be as close as possible to the end user. By basing CDNs on NFV, network operators may profit from higher flexibility in the network as they may assign resources dynamically (e.g. instantiating CDN servers on demand). This enables them to efficiently match the demand for content with its delivery.



Savings for this use case may range from 5% to 9% of the total cost of telecommunication providers.

Cost savings are likely to be concentrated on OpEx aspects, with less traffic going through the network. Impacts on CapEx are less obvious. Indeed, impacts in terms of CapEx are unknown, as virtualisation will reduce the need in terms of nodes or servers, but the number of nodes will increase significantly compared with today's architectures, generally using central storage resources.

About 17% of the experts expect virtualised CDN to require less regulation. On the other side, about 12% expect there will be more regulatory intervention.

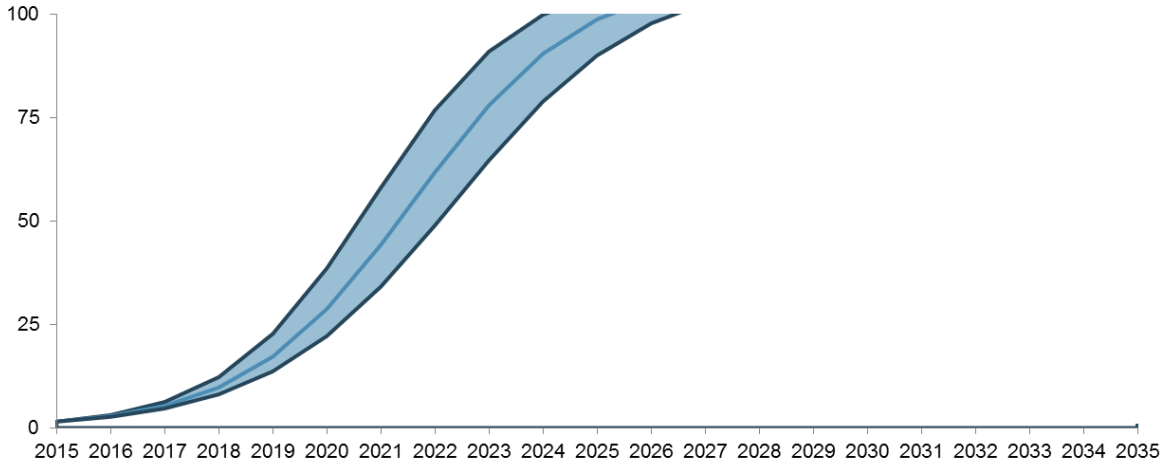
Please indicate your expectation as regards the need for future regulatory intervention



- deregulate
- less regulatory intervention
- maintain current regulatory intervention
- more regulatory intervention

15,9% don't know
12,7% no answer

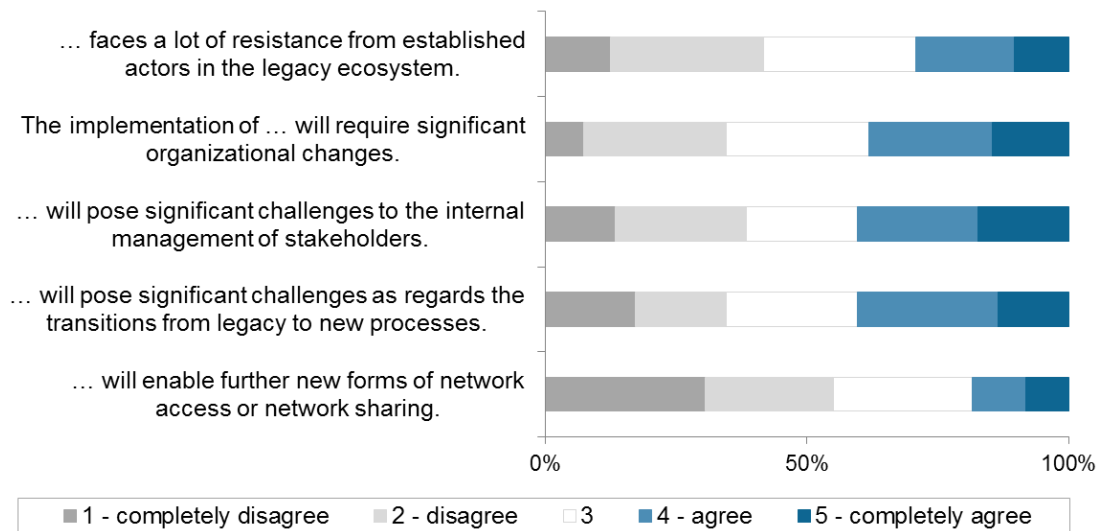
Experts' expectation of vCDN deployment timeframe



Between 2020 and 2022 experts expect that vCDN will be deployed in 50% of the networks.

Especially in comparison to the other scenarios, the experts are somewhat indifferent to whether the barriers will pose a threat for the deployment of vCDN.

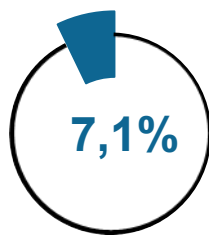
For "Virtualisation of the Content Delivery Network", please rate the following statements



Virtual Network Platform as a Service

Short description

Some companies want to keep full control over the services that run on their networks; in some cases they might even prefer to develop their own services. Service providers can offer these companies a Virtual Network Platform as a Service (VNPaaS). In that case the company can focus on running their services – now on a virtual network platform. By running services on a platform that is maintained and managed by a third-party (the service provider), the company may realise savings.



Savings for VNPaaS usage scenario could lead up to 7,1% in total telco costs.

The key benefit of VNPaaS is the ability for the operator to provide services with the actual resources consumed by the end users. The OpEx savings realised through VNPaaS can be compared to those realised through traditional PaaS, like scalability of deployed software with failover and load balancing.

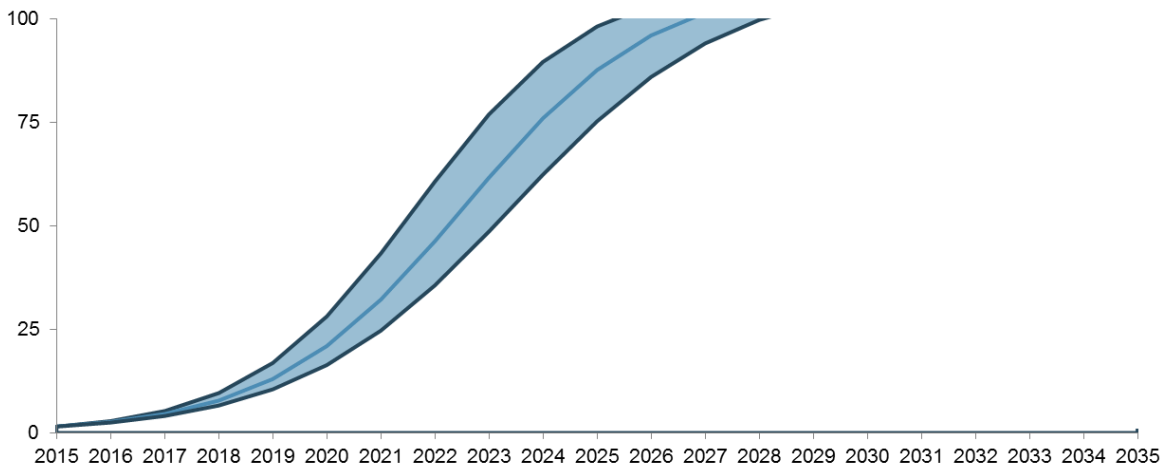
For VNPaaS, experts expect less or roughly the same level of regulatory intervention as today. However, it should be noted that with regard to access to virtual networks, they recognised a potential area of future additional regulatory intervention.

Please indicate your expectation as regards the need for future regulatory intervention



■ deregulate	13,7%	don't know
■ less regulatory intervention	5,5%	no answer
■ maintain current regulatory intervention		
■ more regulatory intervention		

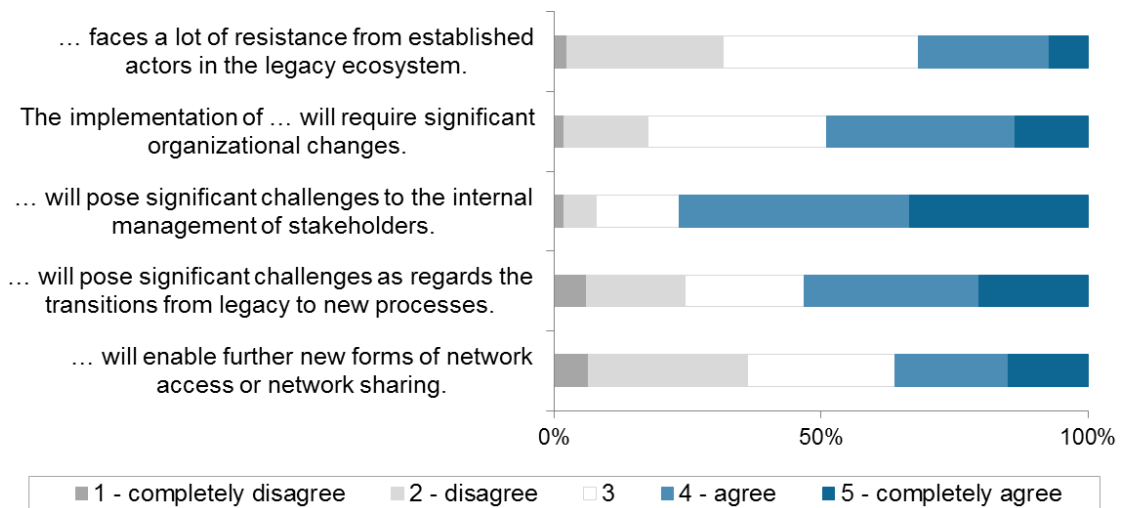
Experts' expectation of VNPaaS deployment timeframe



Following the expectations of the Delphi experts, the use case VNPaaS will be implemented in over 50% of the networks between 2021 and 2023.

Most of the experts agreed on significant challenges to the internal management of stakeholders posed by VNPaaS.

For "Virtual Network Platform as a service", please rate the following statements



Virtualisation of Mobile Core Network

Short description

NFV aims at the reduction of the network's complexity and thus wants to reduce operational costs by using standardised virtualisation technologies, and map them to high-volume hardware. By virtualising the mobile network core, network operators can assign available resources in a flexible manner and dynamically adapt to the current load of the network. This flexibility is important due to a high level of complexity in the mobile core network and fluctuating demand for network resources of end users over time. Virtualising the mobile network core helps mobile network operators to save energy by activating the "sleep-mode" for some of its base stations. Mobile core network resources can then be used for some other purpose until they are needed again.



Savings may range from 3,7% to 5,0% of the total costs of telecommunication providers.

Benefits from vEPC are globally generic to SDN/NFV. By running each network function of the EPC on VNFs running on standard servers instead of dedicated appliances, the industry expects a reduction in terms of OpEx and CapEx along with operational benefits.

For virtualisation of the Mobile Core Network, experts overall expect the level of regulatory intervention to remain the same. Notably, the assignment of spectrum frequencies may have to be revised if SDN/NFV come into full effect.

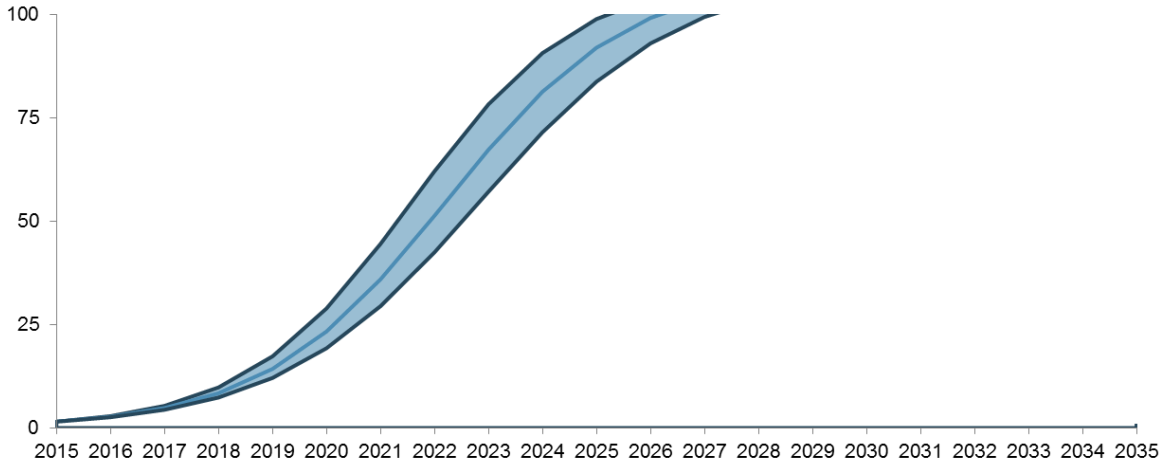
Please indicate your expectation as regards the need for future regulatory intervention



- deregulate
- less regulatory intervention
- maintain current regulatory intervention
- more regulatory intervention

14,7% don't know
5,1% no answer

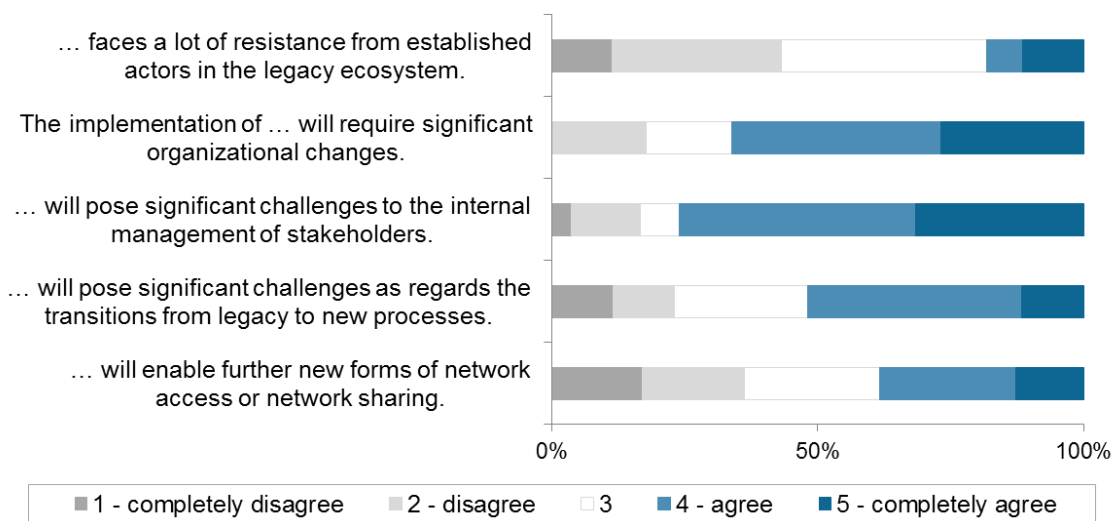
Experts' expectation of Virtualisation of Mobile Core Network deployment timeframe



Most experts expect 50% of the deployment of Virtualisation of the Mobile Core Network before 2022.

Similar to VNPaaS, the main barriers for the scenario Virtualisation of the Mobile Core Network are the need for significant organisational changes and the challenges for the internal management of stakeholders.

For "Virtualisation of the Mobile Core Network", please rate the following statements



European Commission

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