RESEARCH STRATEGY REPORT

SOFTWARE-DEFINED NETWORKING (SDN) IN THE WAN: SOLUTION OPTIONS AND VENDOR OPPORTUNITIES

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About this report

This report quantifies and analyses four approaches to wide-area network software-defined networking (WAN SDN). It discusses the challenges faced by communications service providers (CSPs) and their vendor partners in deploying SDN to create a programmable WAN and how open-source software is affecting these challenges. The report also classifies and analyses WAN SDN vendors' solutions and approaches, and highlights the leading vendors.

Finally, the report provides recommendations for CSPs that are assessing WAN SDN technologies, and provides WAN SDN vendors with a competitive benchmark.

It is based on several sources.

- Multiple briefings from SDN vendors worldwide. Many deals are being announced for SD-WAN and what some call 'carrier SDN' solutions. We have spoken to many key solution providers.
- Analysys Mason's internal research on network function virtualisation (NFV) and SDN, which permeates our Telecoms Software and Network research practice.
- Interviews with CSP operations managers, who are currently using or procuring WAN SDN solutions.
- Definitional material from Analysys Mason's *Software-Controlled Networking* research programme.

KEY QUESTIONS ANSWERED IN THIS REPORT

- What are the business and operational benefits of introducing SDN into the WAN?
- How will SDN be used to improve control in the WAN?
- Which are the leading vendors and what are their strategies?
- What is the forecast revenue for the WAN SDN market to 2020?
- What is the role of open-source software, specifically OpenDaylight and ONOS, in WAN SDN?
- What is the probable evolution of SDN, influenced by NFV and 5G, and will it integrate with data centre networks SDN?

WHO SHOULD READ THIS REPORT

- Telecoms software vendors that offer an SDN solution, because this report offers an understanding of the industry demand for WAN SDN and the competitive landscape.
- CSPs that have, or are looking to, build an SDN strategy for their WAN, because this report will provide insight into the evolving selection of vendor solutions and market trends for benchmarking.
- CSPs and telecoms software vendors that are seeking to understand where WAN SDN fits into the next-generation operational stack emerging to address NFV and 5G use cases.

Executive summary

CSPs are focusing on WAN SDN as they struggle to deliver new revenue and reduce opex, which is unleashing a 'land grab' among vendors that want to take a share of this emerging and lucrative market.

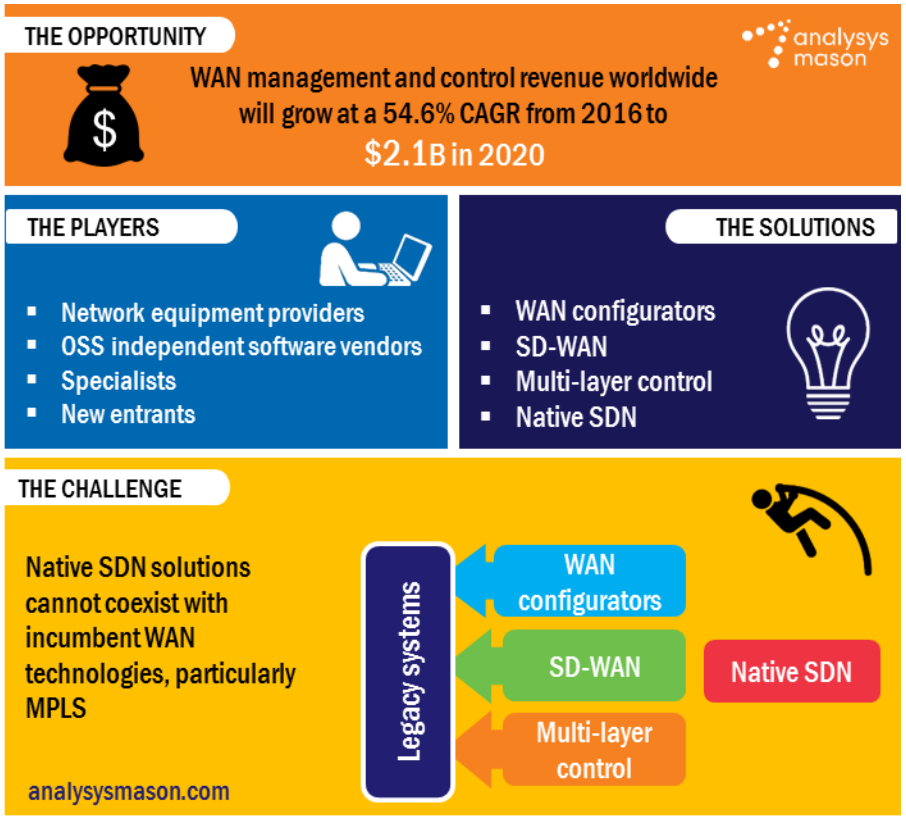
The 'overlay' approaches and clean separation between control and forwarding planes seen in data centre SDN cannot easily be introduced to the WAN. The WAN is a geographically large, complex and highly tuned environment; CSPs will not rip out and replace existing investment to acquire SDN's benefits.

Analysys Mason has identified four sets of solutions to WAN programmability that are emerging under the umbrella term 'WAN SDN'. Native SDN cannot coexist with incumbent WAN technologies and is linked to NFV, so CSPs will adopt it last. The other three solutions are likely to merge into a single platform.

WAN SDN blurs the line between network management and control, disrupts the network management market and pits new and incumbent vendors against each other.

CSPs should press vendors to be very clear about what problems their SDN solutions are solving and how they support inter-vendor interoperability. Vendors should consider combining solutions in an API-enabled platform, preferably based on open-source code.

Figure 1: Vendors face intense competition for the emerging high-value and confusing WAN SDN market[1]



[1] The forecast opportunity for WAN SDN vendors in 2020 includes software and professional services, which is the focus of this report. Our forecast for software-controlled networking estimates an additional USD755 million in related hardware. For more information, see Analysys Mason's *Software-controlled networking: worldwide forecast 2016–2020*. Available at www.analysysmason.com/ scn-software-forecast-nov2016.

Harnessing SDN's automation benefits in the WAN is a much more complex challenge for CSPs than it has been in the data centre

WAN SDN has developed differently from SDN in the data centre. The presence of existing, highly tuned control planes and large distances across the WAN requires a different approach to implementing network programmability.

CSPs and WAN service users want SDN's dynamic, centralised network management, programmable flow control and device configuration to deliver services and network innovation faster and control costs through optimised resource utilisation. However, CSPs will not replace existing network equipment simply to conform to purist SDN definitions or use new protocols. Nor can they adopt data centre SDN overlay approaches[1] because these do not handle bandwidth and latency constraints that are a concern in the WAN.

WAN SDN has three key challenges.

- **Installed base.** WAN SDN approaches need to work with existing network equipment, control plane(s) and routing protocols.
- **Domain coordination.** WAN SDN needs to unite separately managed network domains, for example IP and optical.
- **Dynamic management.** WAN SDN needs to provide programmatic management of the network in real time, bringing network management and control closer together.

Figure 2: Key characteristics of SDN in the data centre compared with those of WAN SDN

SDN in the data centre	SDN in the WAN
Separates control from forwarding plane. This enables programmable connectivity and the use of inexpensive 'white box' switches	Centralises management and control of multiple transport network layers
Automates provisioning and control of virtual machine connectivity in cloud data centres	Automates connectivity provisioning and control in physical, multi-vendor WAN environments
Replaces vendor-proprietary NMS and manual operations	Replaces vendor-proprietary NMS and manual operations
Provides real-time visibility of data centre network topology	Provides real-time visibility of transport network topology
Retains management by the IT operations organisation	Retains management by the network operations organisation

[1] In data centres, SDN is often introduced as a logical overlay network on top of the underlying switching fabric, which maintains its own control plane separately from the SDN. This approach works due to high amounts of available capacity and short physical distances across data centre fabrics.

WAN SDN comes in four basic flavours; CSPs can adopt two quickly, but the other two will require a more disruptive SDN element in NGNs

CSPs face a choice of approaches to WAN SDN and often use more than one in conjunction to automate the management of their physical networks. NFV will push adoption of a more-native, data centre SDN-like solution in the WAN over time.

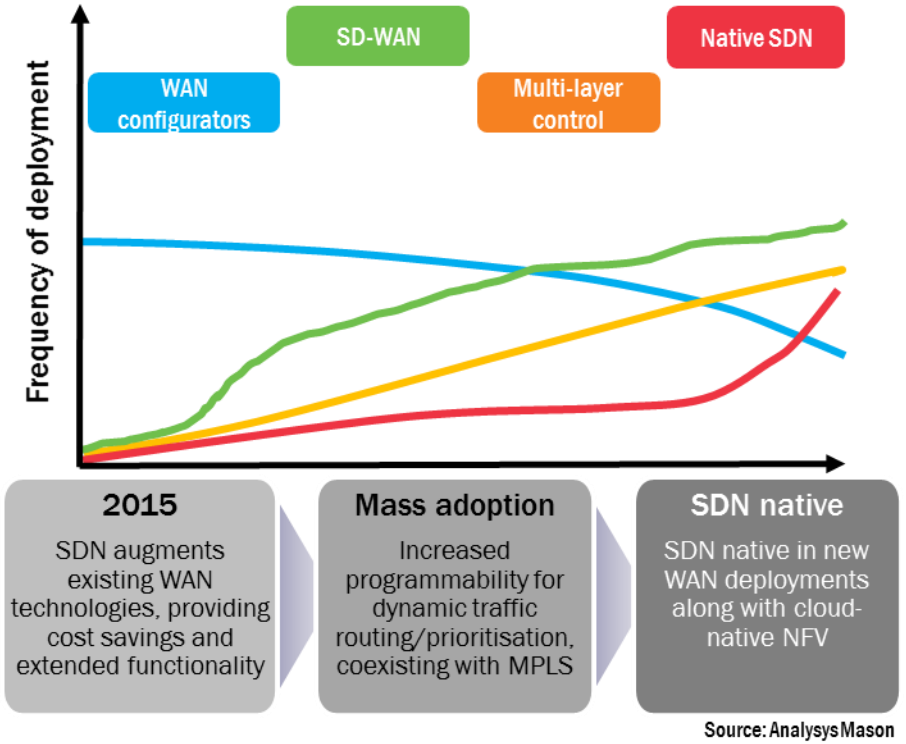
SDN **WAN configurator** solutions that configure multi-vendor devices in support of rapid and automated VPN service delivery have seen most deployment in the market so far. This capability will be incorporated in other flavours of SDN over time.

Take-up of **SD-WAN** overlay solutions was rapid in 2016. These enable enterprises to carry out path selection at the network edge and dynamically steer and prioritise traffic over different access technologies, SD-WAN introduces customer self-service and key cost-saving features for CSPs' enterprise customers.

A third mode of SDN, **multi-layer control**, focuses on extending existing control planes with capabilities that allow more programmatic control of traffic and improved resource utilisation. Take-up of this model is relatively slow because of its potential to disrupt operations teams and incumbent network management systems (NMS), and tools and solutions are fragmented.

Native SDN, which requires the replacement of existing control planes, such as MPLS, with an OpenFlow or OpenFlow-like approach will only be adopted when networks are more virtualised. A handful of operators are trialling this approach.

Figure 3: The four WAN SDN models and their market adoption in the next decade (illustrative and relative; not meant to be directly quantitative)



Source: Analysys Mason

Recommendations

1

We recommend that CSPs press vendors to be very clear on two points: what problems their SDN solutions are solving and in which domains, and how they take advantage of open-source code.

The WAN SDN market is fragmented and difficult to navigate due to solution proliferation and multiple ways to solve the same problems. CSPs need to understand the implications of a given solution on network performance, investment and operations both today and in the future. They should seek clarity around the benefits and limitations of vendor approaches and evaluate the futureproofing advantages of a vendor's open-source strategy.

2

CSPs and vendors should expect SDN strategies to change over time, with simpler deployment approaches giving way to extensive architectural and operational shifts.

Early WAN SDN approaches can deliver rapid benefits: WAN configurators shorten service delivery times and underpin a bandwidth-on-demand experience, while SD-SDN can cost-efficiently deliver incremental service revenue by automating connectivity to small enterprise sites. Multi-layer control is more disruptive, but delivers more control and cost-saving benefits. Native SDN will be needed to support NFV and 5G/IoT use cases.

3

Vendors should plan their SDN solution strategies around the likely scenario that three of the four WAN SDN approaches will converge around a platform play.

CSPs currently need to integrate disparate WAN SDN tools and solutions. Several vendors are already working on WAN SDN platforms that combine these into a coherent set of API-enabled features, easing the pain of integration and providing greater choice of components, such as alternative path computation or optimisation engines to CSP customers. Vendors should aim to provide a market-leading platform or to play in as many ecosystems as possible.

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About the authors

Caroline Chappell (Principal Analyst) is the lead analyst for Analysys Mason's *Software-Controlled Networking* research programme. Her research focuses on service provider adoption of cloud, and the application of cloud technologies to fixed and mobile networks. She is a leading exponent of SDN and NFV and the potential that these technologies have to enhance business agility and enable new revenue opportunities for service providers. Caroline investigates key cloud and network virtualisation challenges, and helps telecoms customers to devise strategies that mitigate the disruptive effects of cloud and support a smooth transition to the era of software-controlled networks.

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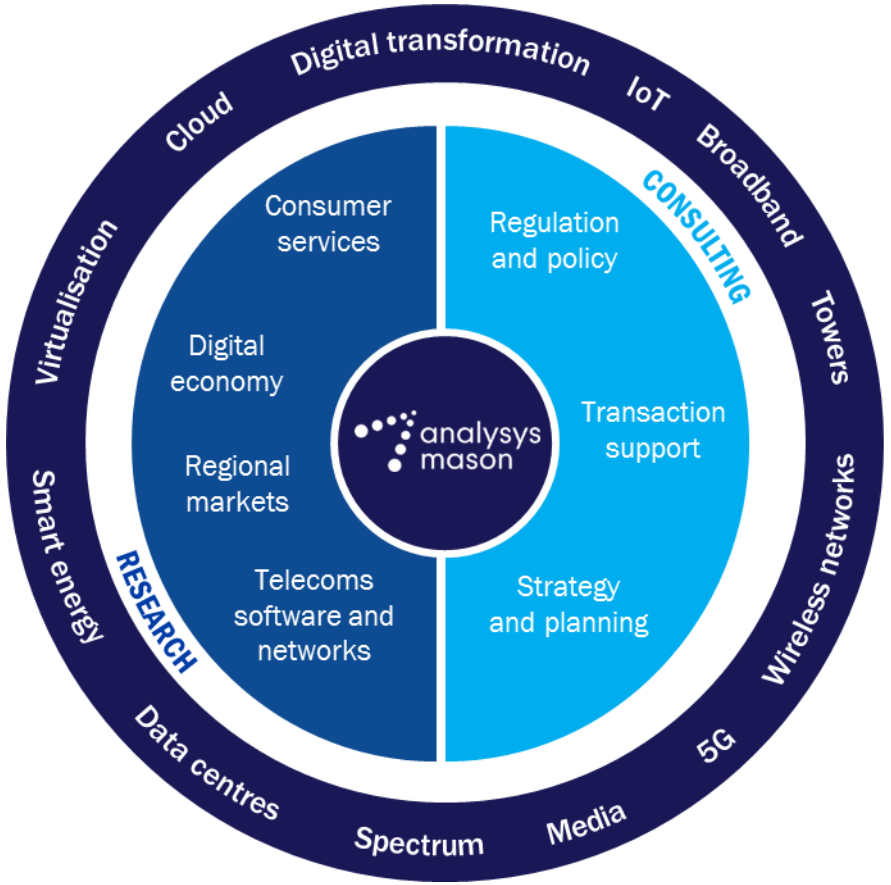

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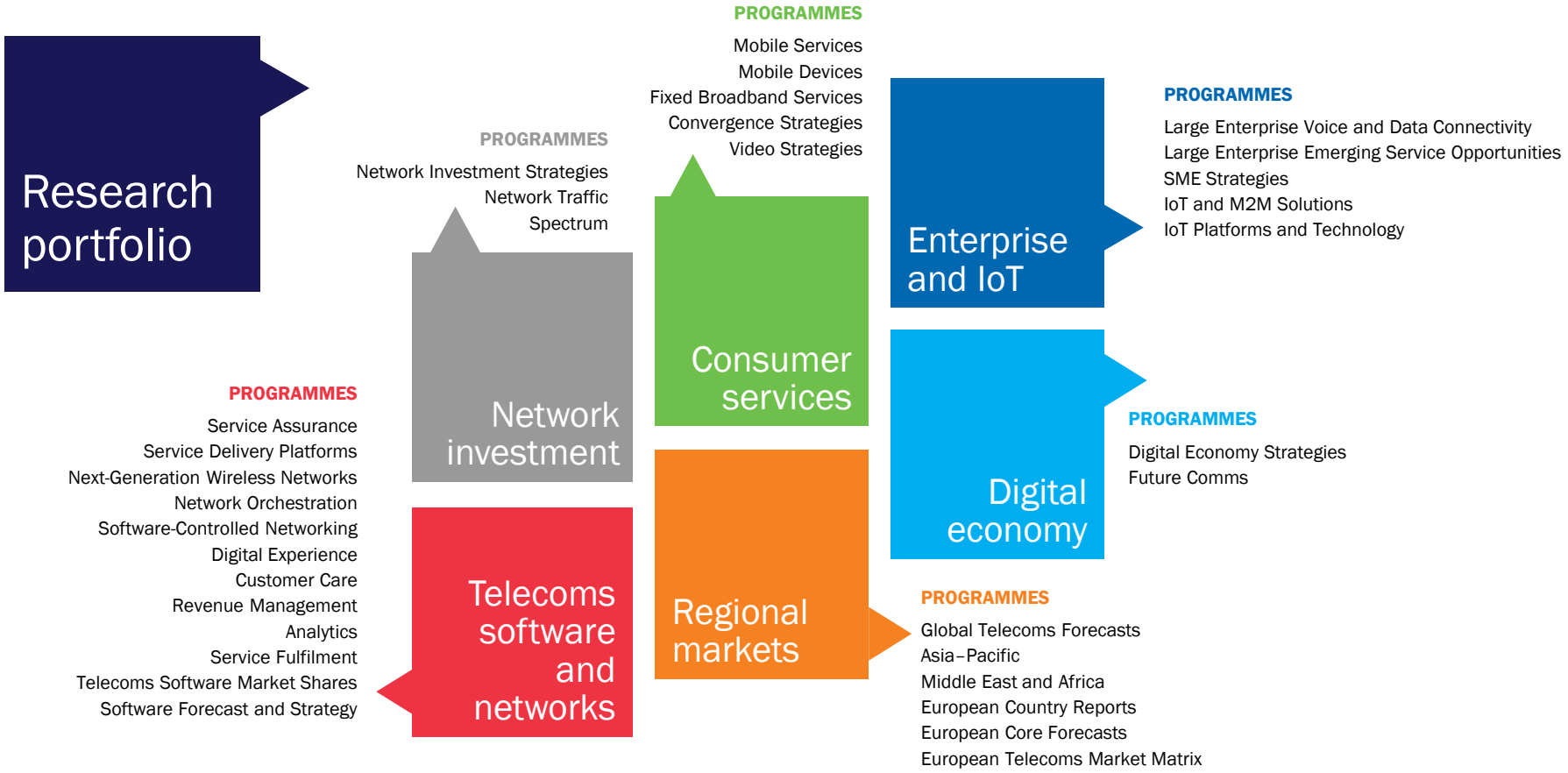

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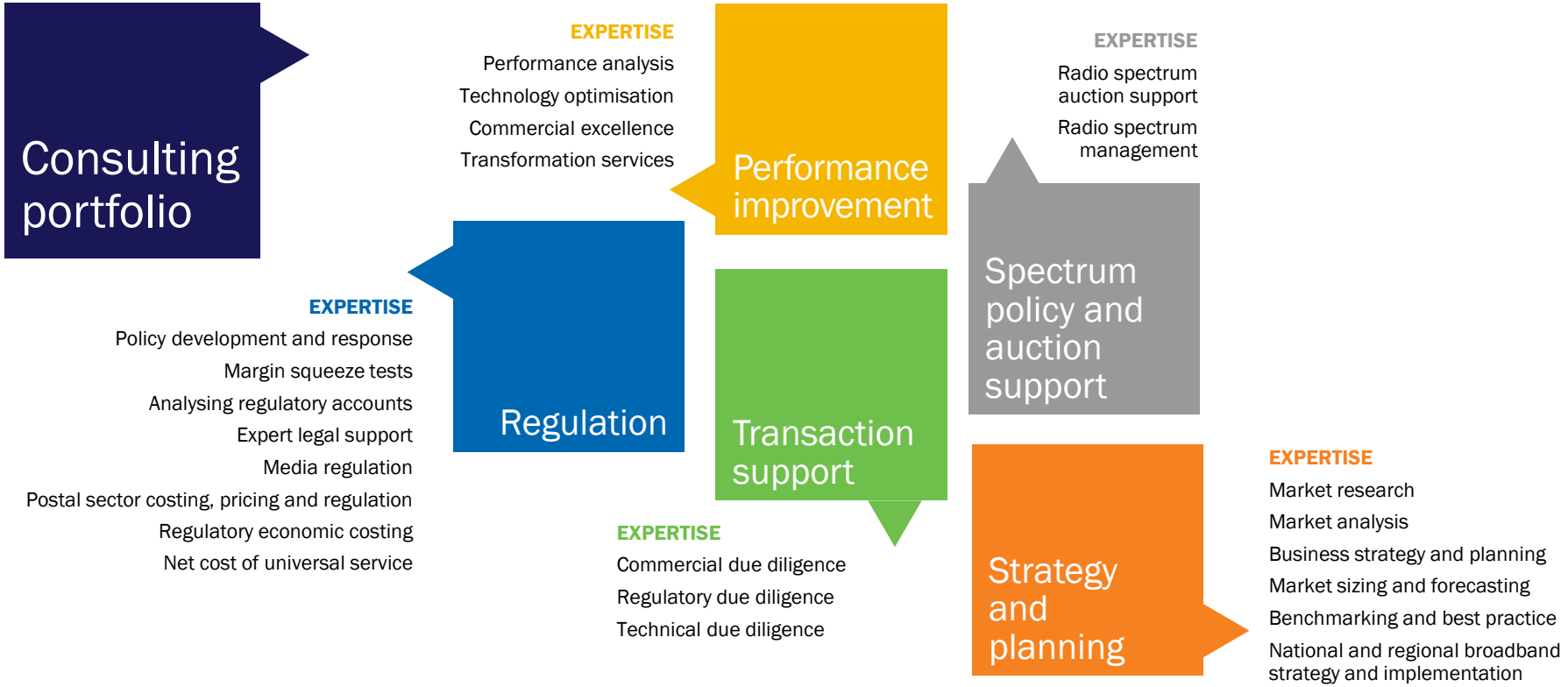

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