



**The future of networks:**  
Dealing with transformation  
in a virtualized world



# The future of networks

## Introduction

Communication Service Providers (CSPs) are under pressure. The explosion in customer demand for data is stretching traditional operations to the limit, requiring evermore investment in network capacity. This, combined with growing competitive pressures from both traditional and Over-the-Top (OTT) services, is compelling CSPs to transform their businesses and adapt to remain competitive.

CSPs need to find ways to control costs, increase agility, and efficiently scale their networks and operations.

Software-Defined Networks (SDN) and Network Function Virtualization (NFV) are seen as critical to meeting these challenges, enabling organizations to leverage the power of cloud infrastructure to provide multiple business and operational benefits.

The current momentum behind these technologies is very real. What was mainly a marketing concept a few years ago, now boasts significant support from the industry's major players.

Indeed, there is no shortage of NFV/SDN initiatives. Many industry bodies and open source projects seek to accelerate deployment, including TMForum Zoom, the Telecom Infra Project, Open Networking Foundation's CORD, MEF's OpenLSO, and the Broadband Forum's Open Broadband.

Leading CSPs have also established their own programs focusing on management and orchestration, such as AT&T's ECOMP (which joined Open-O to form ONAP) and Telefonica's OpenMANO. The direction is clear.

However, while virtualization has been proven both in labs and in initial production environments, it is still in its relative infancy. Progress has been slower than expected and there are yet questions that firms need to answer, such as: Is the new technology as reliable as legacy networks and are there enough skilled staff to meet demand?

To delve deeper into the biggest challenges, we interviewed some of the industry's most prominent decision makers. Their responses are outlined in this report.

## Methodology

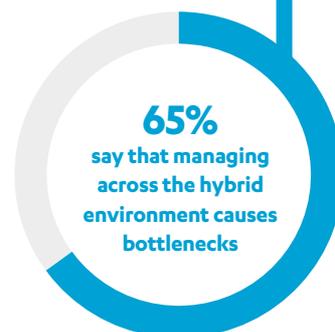
Through over 40 interviews and an online survey with over 100 respondents, Cartesian reached a cross-section of decision-makers from telecoms vendors, system integrators and communication service providers.

Senior technical and operational executives revealed the status of network virtualization, the challenges they are facing, and approaches to overcome them.

Their responses provide a comprehensive overview of the challenges facing an industry undergoing significant transformation.

# Key findings

- ▲ Enabling the faster delivery of innovative services and supporting the creation of new revenue streams consistently ranked as the most important business drivers for network virtualization.
- ▲ Network reliability is a key concern: 90% agree that virtualized networks need to be as reliable as the traditional networks they are replacing. The reliability and stability of NFV/SDN technology ranked as the biggest concern among respondents.
- ▲ NFV/SDN technologies haven't yet lived up to their early hype. Operators are finding it difficult proving their business cases due to higher than projected cost and longer than anticipated implementation of their virtualization initiatives.
- ▲ Multi-vendor integration is a challenge. In some cases, interoperability testing is being delayed by incomplete implementation of the NFV specifications.
- ▲ The distributed architecture creates uncertainty in terms of vendor accountability for network issue identification and resolution. Therefore, within an operator, the most cautious voices are frequently the people in charge of network operations.
- ▲ As well as technological changes, CSPs are facing organizational upheaval which can put hurdles in the way of a smooth transformation. Fears around a lack of operations support and the trust factor between network and IT departments are at the heart of a cultural struggle.
- ▲ Removing silos is a key part of the process. Virtualization requires a multi-disciplinary, horizontal approach, where different departments (e.g. applications vs. networks vs. security) must be able to work together to achieve the strategic aims.
- ▲ CSPs must continue to operate and maintain existing physical networks in parallel with the new virtualized infrastructure. Managing across this hybrid environment further complicates the operational task and was identified as a main cause of bottlenecks by 65% of respondents.
- ▲ As the move to virtualized networks gathers pace, the industry is facing a skills gap. Interviewees pointed to factors such as a lack of internal expertise and a need for more investment in training.





## Network virtualization is underway, but isn't yet living up to the hype

While SDN and NFV are still in their relative infancy, a significant proportion of vendors and CSPs are well underway in transforming their businesses to benefit from these technologies.

In our interviews, CSPs spoke of multiple business benefits offered by network virtualization, citing the likes of greater flexibility, shorter time to market and a reduction in deployment lead times.

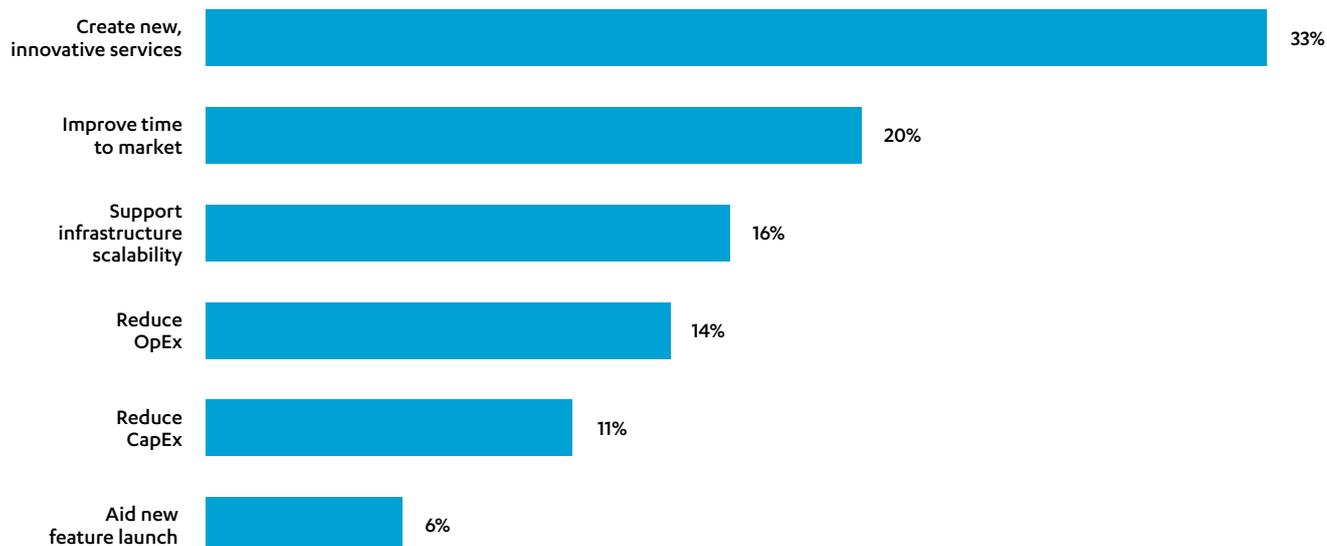
Looking further ahead, longer-term benefits such as expected CapEx and OpEx cost savings, increases in operational efficiencies, the creation of new services and revenue streams, and an ability to meet future customer needs, are also driving businesses to start the transition.

This long term view is highlighted in our survey where 69% of respondents agree that network operators which do not virtualize their networks will struggle to compete, and 74% say that operators must implement NFV/SDN to meet future customer needs.

In a nutshell, NFV and SDN provide an opportunity for network operators to transform their operations and allow customers to use their network in new and exciting ways. However, despite this promise, our research clearly illustrates that NFV and SDN have so far failed to live up to the initial hype and that there are still some hurdles which need to be addressed.

One of our interviewees went as far as to describe the industry as being in a “trough of disillusionment” as businesses have realized that the challenges – which we group into ‘technological’, ‘operational’, and ‘organizational’ – are more significant than first thought.

### Business driver ranked number one for network virtualization



## Technology is an enabler, but also a barrier to virtualization success

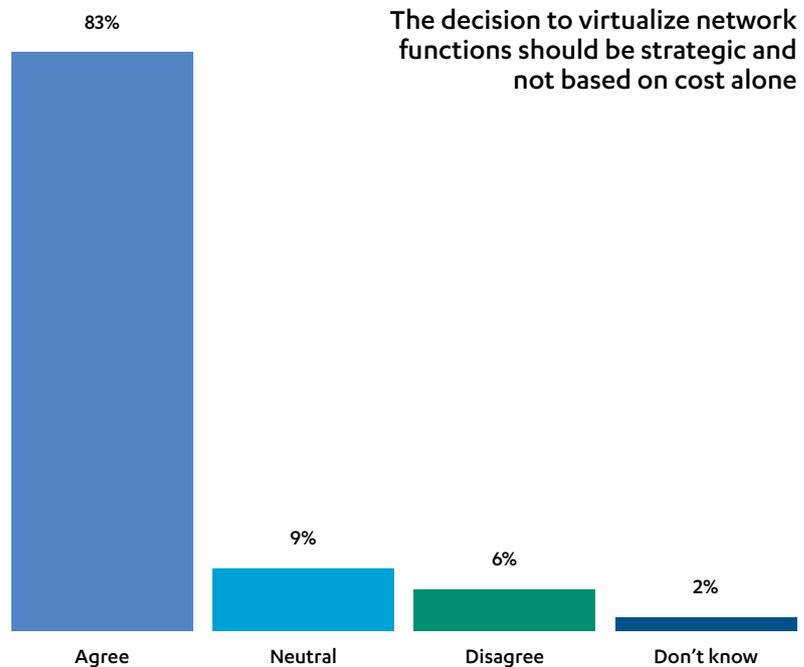
Despite many operators wanting to migrate to NFV/SDN, the technology is still in its infancy. As a result, many CSPs have found the implementation process harder than they initially thought it would be and, for some, progress is slower than expected - 73% of CSPs are behind schedule while just 27% are on or ahead of schedule.

This lack of technological maturity is evident in the operator concerns highlighted in our survey. The reliability and stability of SDN and NFV technology ranked as the most concerning aspect of network virtualization, followed by coping with the coexistence of virtual and legacy domains.

Many of our interviewees highlighted that, although significant progress has been made in recent years, there is still a long way to go before critical network functions start to become fully virtualized.

Another problem is that the goal posts have shifted since businesses first approached virtual network functions (VNFs). Now, rather than just seeking to move away from proprietary, dedicated hardware, CSPs also want the ability to dynamically scale these network functions to achieve cloud-scale flexibility and efficiency. Therein lies the rub. "VNFs are frequently not cloud-native," one of our interviewees explained. "Instead they are ported from legacy platforms to run in virtual machines. This does not deliver cloud benefits."

These issues are also impacting operators' business case for adoption, as cost savings haven't been as easy to come by as everyone thought. Nearly two-thirds (62%) of respondents agree that NFV/SDN offers significant cost savings over traditional networks, but technology factors such as



integration difficulties and having to maintain multi-vendor networks prompted 60% to agree that operators will not realize the financial benefits for several years.

Finally, interoperability has been a greater challenge than expected. One interviewee commented that the existing ETSI specifications don't go far enough to prevent bespoke interfaces. Another noted that testing is being held up by a lack of full implementation of the specs.

The result of all this is that network virtualization hasn't yet lived up to its early hype and operators are realizing that the end goal is still some way off being achieved.



## The operational complexity should not be underestimated

**“Multi-vendor environments create more complexity for vendors and CSPs”**

Undergoing any virtualization project presents significant operational hurdles for businesses to overcome, with over half (52%) of our respondents agreeing that the amount of operational change required to move to a virtualized network is overwhelming.

For example, in many cases the introduction of NFV/SDN requires new operating plans for end-to-end service management, which means operational processes need to be either changed or re-written.

There is also uncertainty when it comes to the scope of vendor responsibilities for the identification and resolution of network issues. This has emerged as a result of NFV’s distributed architecture and a lack of standardization in the industry.

“Multi-vendor environments create more complexity for vendors and CSPs,” one respondent explained. “Local operations are used to dealing with a single vendor end-to-end. Now with NFV, they have a multi-vendor system to manage.”

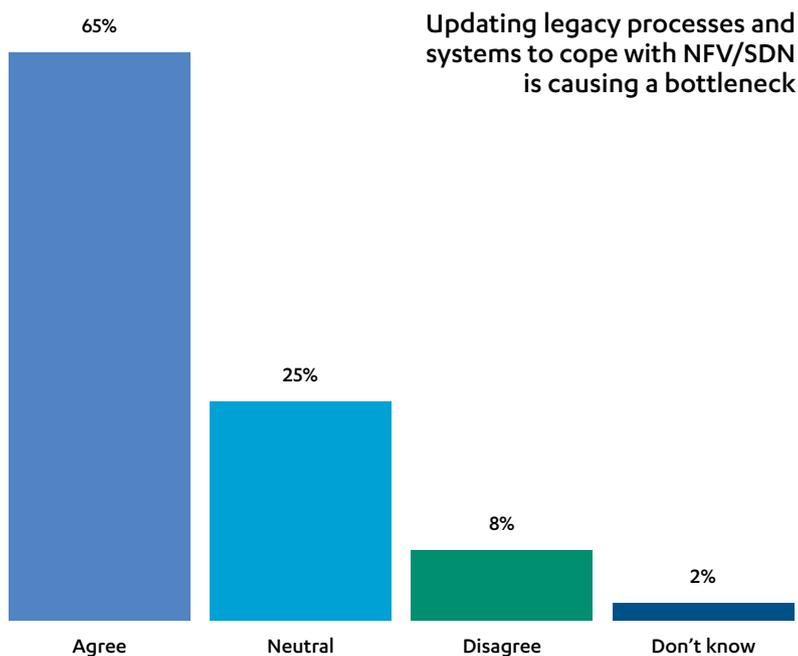
But the major challenge is that NFV and SDN deployments need to be integrated with the existing physical networks and systems and efficiently managing and maintaining these hybrid environments adds an additional layer of complexity for CSPs.

“Figuring out how to work with a hybrid of physical and virtual networks in the transition period, which will be long [is a challenge],” said one of our interviewees. “It is particularly an issue for OSS/BSS and managing different approaches to security.”

The division lead at a global technology firm added: “CSPs do not have a greenfield situation. As there will be no complete technology replacement, they need to continue managing the legacy and need to run hybrids of old and new [systems].”

This issue was also highlighted in our survey research, as 65% said updating legacy processes and systems to cope with NFV/SDN is causing a bottleneck, with a lack of people who understand how to operate in the virtual environment being a key concern.

All of these factors create operational risks for operators and CSPs, meaning the most cautious people involved with network virtualization are often those in charge of network operations.



## Organizational issues are holding businesses back

No digital transformation strategy can be solely focused on technology and, from our discussions with industry professionals, two specific organizational challenges became apparent.

Firstly, embedded cultures are holding many businesses back on their virtualization journeys, highlighting a general acceptance that mindsets need to change.

For example, virtualization is forcing operators to adapt their organizational structure and bring certain functions closer together, such as IT and Networks, as well as Engineering and Operations.

However, this ongoing transition away from vertical silos to horizontal functions is currently resulting in a lack of accountability and responsibility across departments. Many businesses are still lacking a clear structure to define these concepts, resulting in traditional separations between areas of responsibility becoming temporarily blurred.

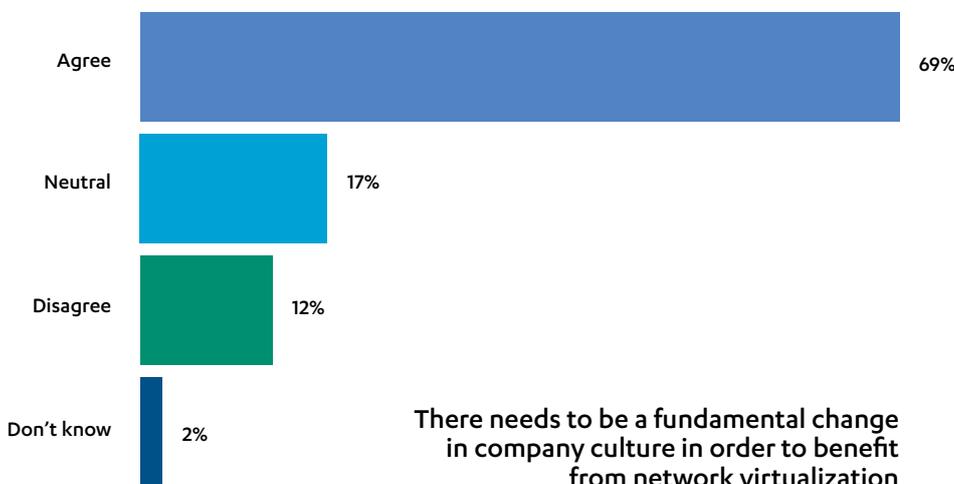
“The biggest hurdle is the culture,” explained the VP of IT Operations at a major US telco. “IT is running the network and network organizations are not ready for that. Network teams are not ready to relinquish control to IT.”

This thought was reiterated by the SVP of Engineering at a US-based network service provider, who said: “There is still a struggle between the network and IT organizations. This has been allowed to continue because the network organizations still have a lot of power, and if they say ‘no’ there are few in the organization that will overturn the decision.

“Operators need to ‘seed’ both the IT and network organizations with folks that know both sides and can begin to change the culture of both organizations.”

Broadly speaking, operators are realizing that NFV adoption involves a cultural transformation as much as a technological one. The main issue is that it is required right across the organization. From sales and marketing to product management, engaging the entire business is central to realizing the opportunities created by SDN and NFV.

**“The biggest hurdle is the culture”**



The second organizational challenge concerns an industry-wide skills gap. Virtualization and cloud network functions require new skills which, according to our interviews, are in short supply.

“There is a clear lack of knowledge in the industry as a whole,” claimed the business unit head of a global enterprise technology firm. “There is a lack of skills, as well as a lack of knowledge in some departments of what NFV is, and what the impact is.”

The prevailing feeling to emerge was that practical experience is scarce and businesses are struggling to find the right talent. The issue is augmented further by the fact that graduates are being attracted to the likes of Google, Facebook and Amazon, meaning CSPs are “now competing in a broader pool for talent.”

This, as one of our industry professionals explained, presents significant challenges: “NFV requires new skills that are not present in the network department,” he said. “In tier 2/3 operators, the network department may

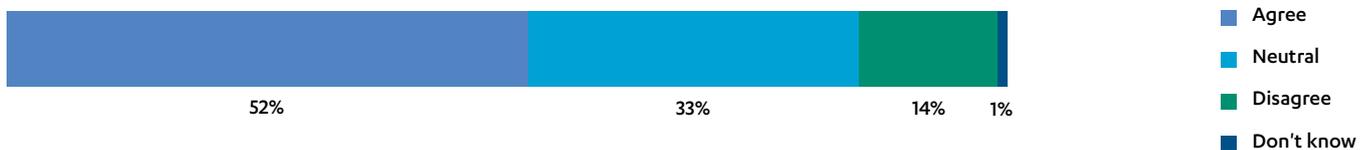
have outsourced some operational functions to vendors. Over time these teams have been downsized.”

As a result, businesses are looking for external advice and support from vendors, consultancies and managed services to bridge this skills gap in the short-term.

Longer-term there’s a growing need to retrain today’s workforce, a point that was raised by the head of virtualization planning at one of the world’s biggest telcos. This is a significant challenge, as training needs to cover not just technology and operations personnel, but also sales and marketing teams.

However, despite many CSPs adopting initiatives such as incentivizing existing workforces to learn new skills and revamping recruiting processes to target people familiar with cloud technologies, interviewees cited a general lack of training support and called for more investment into areas such as software development.

### The amount of operational change required to move a virtualized network is overwhelming

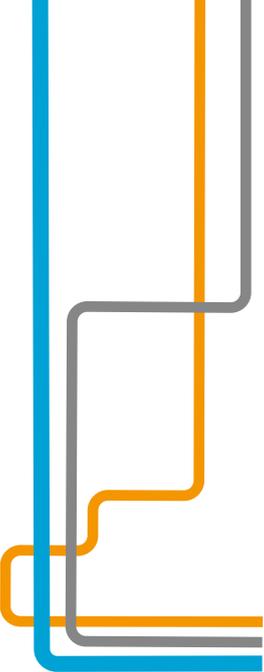


### Operators should use vendors and managed services to bridge the skills gap required to operate NFV/SDN infrastructure



### Operators need to invest more in training staff to manage NFV/SDN infrastructure





# Recommendations

## Steps to power your network virtualization journey

While it's important to note that there is no one-size-fits-all approach to network transformation, we have identified some tangible steps that businesses should consider to ensure the success of their virtualization initiatives:

- 1 Make NFV/SDN a top strategic priority for the firm** – The transformational impact of virtualization should not be underestimated. 69% of respondents agree that network operators which do not virtualize their networks will struggle to compete.
- 2 Create a comprehensive business plan for NFV/SDN deployment** – Ensure you have a complete view of benefits and costs (83% of respondents believe the decision to virtualize network functions should be strategic), considering the operational and organizational impacts as well as the technological ones.
- 3 Prepare employees for change** – Perform an assessment of the workforce and a gap analysis against the new requirements. Develop training programs to ensure employees are adequately educated in the area. Recognize the human component of change management.
- 4 Engage the whole organization** – CSPs that view NFV/SDN as just a technology change will not reap the full business benefits of network virtualization.
- 5 Create a working ecosystem by finding the right partners** – Finding and assembling partners with the right level of experience for your organization is essential. Unlike in the past, where vendors provided turn-key solutions, telecom service providers need to learn how to lead their own network transformation by acquiring the necessary skills and resources to do so.
- 6 Start small** – Not everything needs to change in one go. Start with a few VNFs running alongside the legacy environment and gradually migrate to more VNFs and a service in the virtual environment.
- 7 Ensure you have a robust plan for the back-office** – Operating virtual and physical networks in parallel creates new challenges for OSS/BSS, processes and operating models. Assume you will be in a hybrid environment for several years.
- 8 Participate in standardization efforts from industry bodies** – Learn and share with other operators to accelerate your own deployment and benefit the wider industry.



## Conclusion

It's clear that, despite recent growth in network virtualization, it's not all plain sailing.

Firms are being hampered by a lack of technological maturity and concerns around reliability and stability. Others face issues such as a lack of internal expertise and cultures that have evolved to fit legacy technology and processes, but now hinder progress.

Changes also need to be made within the industry, specifically from the vendor community. Better integration between VNFs from different vendors is needed – along with the adoption of open standards – to accelerate NFV adoption.

“There are quite a few components on the market today, but they are individual VNFs and are not integrated with each other,” said the SVP of Engineering at a US-based network service provider. “It is very difficult to get multi-vendor VNFs to work together. They are all trying to keep their ‘secret sauce’ hidden.”

The Head of Radio Strategy at a multinational telecoms group agreed that the lack of standardization is one of the main pitfalls associated with virtualized networks: “The lack of standardized VNFs [is an issue]. Each vendor is providing their own proprietary orchestrator, but orchestrators do not communicate with each other. This requires a master orchestrator, which is building extra overheads into the process.

“To realize the most benefits of virtualization, all VNFs have to be running on the same orchestration layer, but this is not possible today.”

Taking a multi-vendor approach would allow operators to pick best-in-class solutions for each of their specific requirements which, for the sake of the industry, needs to happen sooner rather than later.

Ultimately, our research confirms that network virtualization is the future and that the industry has already started on this journey. But, there are certainly barriers that need to be overcome to smooth the path and integration process.

In the short-term, firms need to look at ways of solving the technical and organizational problems that are slowing adoption, areas in which external consultancies and partners can play a key role.

But the long-term onus is on industry as a whole to work together to implement standards and increase the level of interoperability. Only then, will the future of networks be truly realized.

**“Firms need to look at ways of solving the technical and organizational problems that are slowing adoption”**

## Afterword

The transition to software-driven, cloud-based services in the telco industry has been well documented but, despite recent rapid progress, we are clearly still in the early stages of our journey.

The initial hype surrounding NFV and SDN technologies prompted numerous Communication Service Providers to invest in technology development and transformation efforts but, although some have seen the benefits, the challenges have proven to be quite complex and harder to manage than many were hoping.

As illustrated in this research, this has resulted in some serious issues, most notably a shortage of technical skills and cultural blocks. Various operational, migration and interoperability difficulties are also holding businesses back in their transformation efforts, prompting feelings of frustration from some within the industry.

As reported in the survey, there is a need to unlock the potential for new services and reduce time-to-market by leveraging NFV and SDN technologies, so we welcome this research and the chance to tackle the most prevalent industry challenges.

Whether through recruitment drives, a greater focus on standardization or the provision of educational programmes, the research shows that we know where changes need to be made, which is a positive conclusion.

The Broadband Forum community of more than 150 Service Providers and manufacturers, along with its partners in standards and open source, have already taken steps to progress the industry that align with the findings outlined in this report, including management of hybrid networks, network architecture, interoperability and migration strategies. The key projects of the Forum addressing these issues (Cloud Central Office and Open Broadband) have made great progress, however, we also recognize that there is still a lot further to go.

We hope the research carried out by Cartesian will provide the industry with extra momentum as it continues down the path to digital transformation and are optimistic that the recommendations provided will help the future of networks be realized sooner rather than later.



Robin Mersh  
CEO, Broadband Forum  
[broadband-forum.org/ob](http://broadband-forum.org/ob)

**“Whether through recruitment drives, a greater focus on standardization or the provision of educational programmes, the research shows we know where changes need to be made”**

Our world is transforming. Every day, communications technology creates new opportunities to connect. Always on the move, this world is as complex as it is exciting – just keeping up is a full-time job. To truly succeed, you need to go further. By making this world simpler and smarter, Cartesian can make this happen.

We are passionate about problem solving, figuring things out, seeing things from a different angle and cutting through the complexities of the industry. We not only provide the right solutions, but also the answers that push our clients forward. And by doing this we help organizations transform – themselves, the industry and the wider world.

Ours is a world of opportunity. Combining analytics, technology and industry experience, we can help you succeed in it – *faster*.

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Transformation. Accelerated.

Contributors: Dr Ron Angner, Michael Dargue, Massimo Fatato, and Shahed Mazumder.

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