Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

HEAVY READING
CUSTOM REPORTS

The Impact of Virtualization on Messaging Services, RAN & the Control Plane

A Custom Heavy Reading Report Produced for Mavenir Systems

MAVENIR

AUTHOR: JIM HODGES, PRINCIPAL ANALYST, HEAVY READING

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1. EXECUTIVE SUMMARY

Network functions virtualization (NFV) has unquestionably redefined the telecom infrastructure and services landscape in the past four years, with more changes yet to come. Thus, communications service providers (CSPs) are now well into defining migration strategies and even putting the final touches on commercial deployments. Still, as with any migration of this scale, several questions and even technology-based decisions are outstanding.

Accordingly, Heavy Reading, in conjunction with Mavenir Systems, undertook the creation and execution of a detailed survey to assess progress, market timing, business, and technical drivers, and even challenges related to the virtualization of messaging services, the radio access network (RAN) and signaling control plane.

Key Findings

The key findings of this custom research study are as follows:

- **Support for a single generic management and orchestration (MANO) orchestrator remains, but more than half of respondents (54%) believe that implementation "will be difficult."** More than a quarter (27%) have accepted that they will use multiple orchestrators. Only 10% believe it will be possible to implement a "single generic orchestrator."
- **The preferred orchestration framework is OpenStack integrated by the vendor (63%).** After that, three options – two OpenStack integration models and VMware – are essentially equal.
- Virtualization of messaging solutions has already started, with a lot more activity scheduled to take place in the next 24 months. **By the end of 2018, 66% of SMS will be virtualized.**
- **The key business driver for the virtualization of messaging solutions is hardware-related opex reduction.**
- **Network scale/elasticity and operational efficiency are both very strong technical drivers for messaging virtualization.**
- **The greatest business challenges for messaging virtualization are cultural challenges (41%-54%) and business case definition (29%-43%).**
- **The greatest technical challenge for messaging virtualization is still orchestration (18%-27%).** A second, related challenge is vendor product interworking and maturity (14%-28%).
- While some respondents claim to have already deployed virtualized 3G and 4G RANs, and the adoption curve for these technologies will continue to grow in 2017 and 2018, **2019 appears to be the ramp year – especially for 5G.**
- **Like messaging, the lead business driver for RAN virtualization is hardware-related opex reduction (30%-43%).** The next two lead considerations are "capex reduction" (19%-25%) and "service agility" (19%-21%).
- **Scalability and operational efficiency are stronger technical drivers for RAN virtualization** than security and application distribution.

- **Surprisingly, the leading business challenge in RAN virtualization is cultural challenges and changes in roles and responsibilities (31%-42%).** As expected, defining the business case is more difficult for 3G RAN (44%) than for 4G and 5G.
- As with messaging virtualization, **the greatest technical challenge for RAN virtualization is orchestration (22%-31%).** A second, related challenge is vendor product interworking and maturity (19%-28%).
- **More than half of CSPs (56%) believe it is not critical to virtualize 4G to ensure a smooth 5G transition.**
- While a small number of CSPs claim virtualized Diameter signaling controller (vDSC) deployments (5%-16%), there is considerable interest in vDSCs: 19%-23% plan to virtualize in 2017, while 16%-24% plan to make the transition in 2018. **This translates into a vDSC deployment rate of 45% within the next 24 months.**
- **However, more than half of rest-of-world (RoW) respondents expect vDSC deployments in 2019 or later.** U.S. respondents, by contrast, have a much more aggressive deployment schedule.
- **Three equal factors are driving DSC virtualization:** hardware opex reduction (22%-30%), capex reduction (24%-28%) and service agility (24%-28%).
- **Like messaging and vRAN, control plane scale and elasticity and operational efficiency are the leading technical virtualization drivers.** However, in this case, operational efficiency tends to carry a heavier weight across all DSC variants.
- **Cultural challenges and defining the business case are the leading business challenges for vDSCs.**
- **Unlike vRAN, the primary technical challenge for vDSC is vendor interworking and maturity, not orchestration.** The lowest-ranked technical concern is scale (4%-14% range).
- **Two thirds of respondents support the concept of virtualizing legacy signaling platforms but have not yet made any tangible plans to execute.** The clear majority of these respondents are from outside of the U.S.

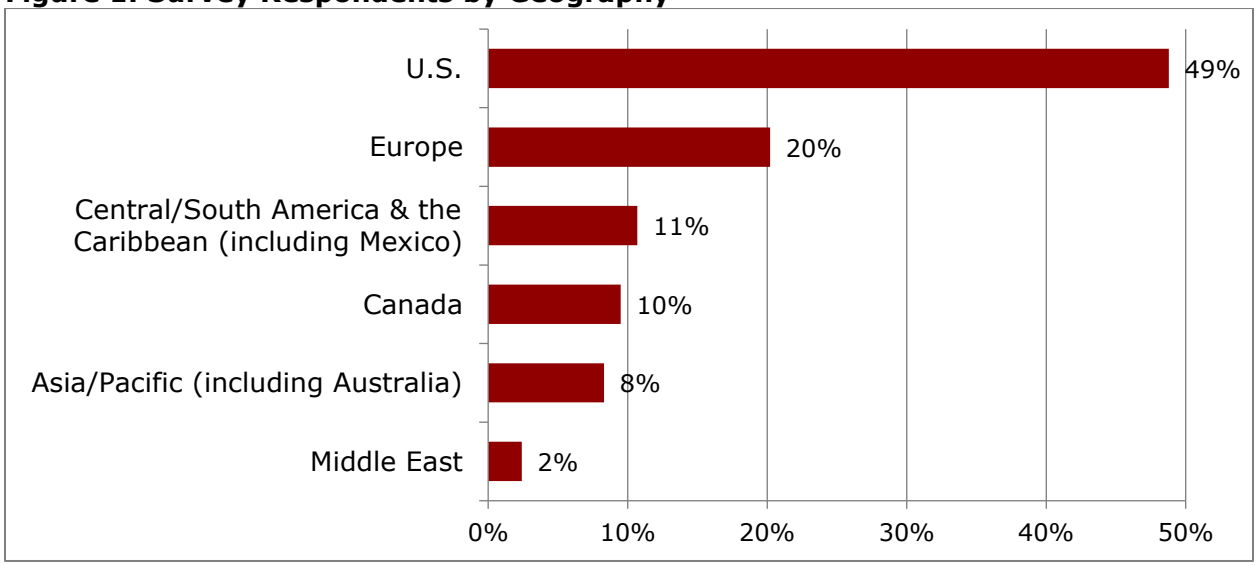
Survey Methodology

This research report is based on a major online survey launched in the first quarter of 2017. The survey was distributed by email to Light Reading's global list of CSP registrants, who were invited to take the survey on the understanding of anonymity (i.e., that their names, job titles and employers will not be made available to the study's sponsor or eventual readers), and that the results will only be presented in aggregate form. Respondents were not told which supplier sponsored the study. The survey contained a total of 22 questions and was promoted to attract a large base of qualified and high-value CSP respondents.

2. SURVEY DEMOGRAPHICS SUMMARY

As shown in **Figure 1**, the survey attracted a global mix of 84 qualified respondents. The largest sample was from the U.S. (49%), followed by Europe (20%), Central/South America (11%), Canada (10%), Asia/Pacific (8%) and the Middle East and Africa (2%). In order to offer more granular insight and assess regional variances, throughout this report we filter the survey data using two categories: U.S. (49% of respondents) and RoW (51%).

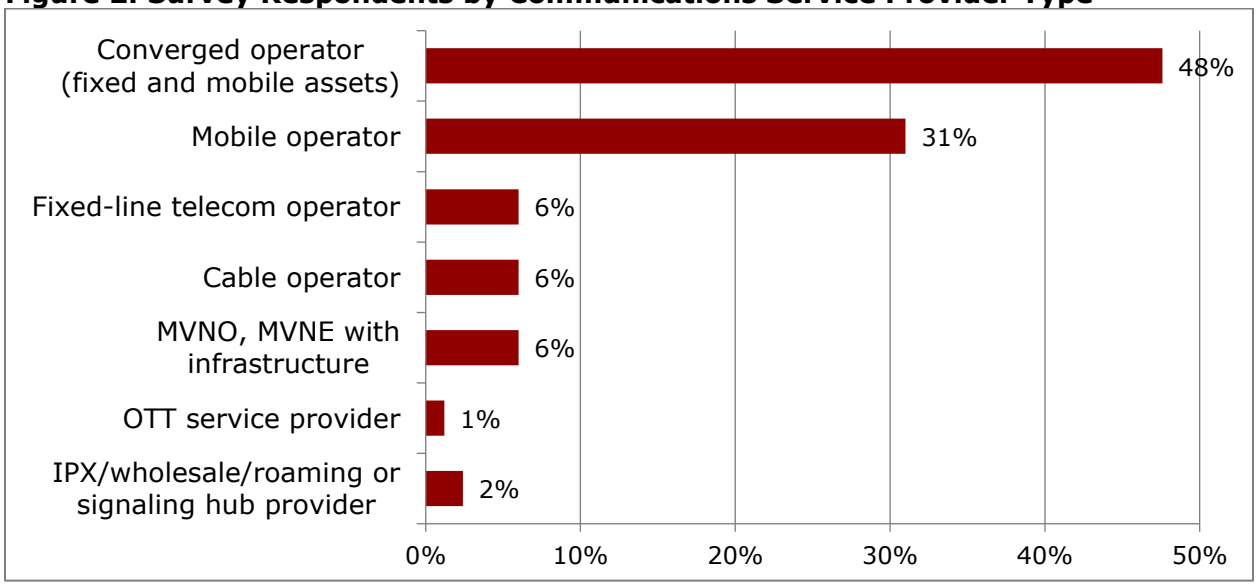
Figure 1: Survey Respondents by Geography



Question: Where is your company located? (N=84)

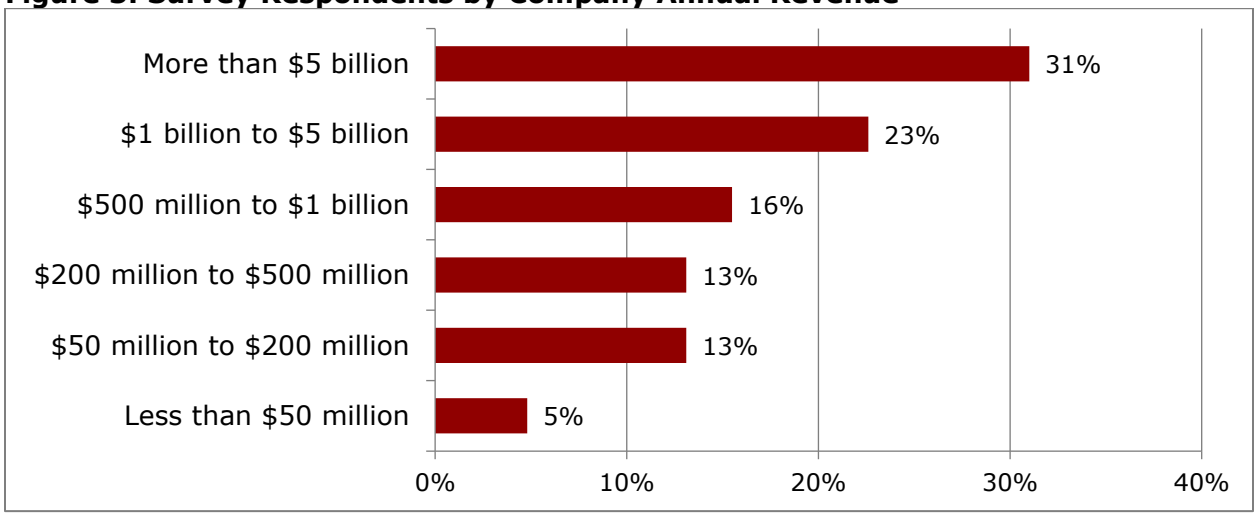
As shown in **Figures 2** and **3**, the survey also attracted a broad range of CSP types and sizes, which provides a balanced and technology-agnostic view of virtualization adoption.

Figure 2: Survey Respondents by Communications Service Provider Type



Question: What type of communications service provider (CSP) do you work for? (N=84)

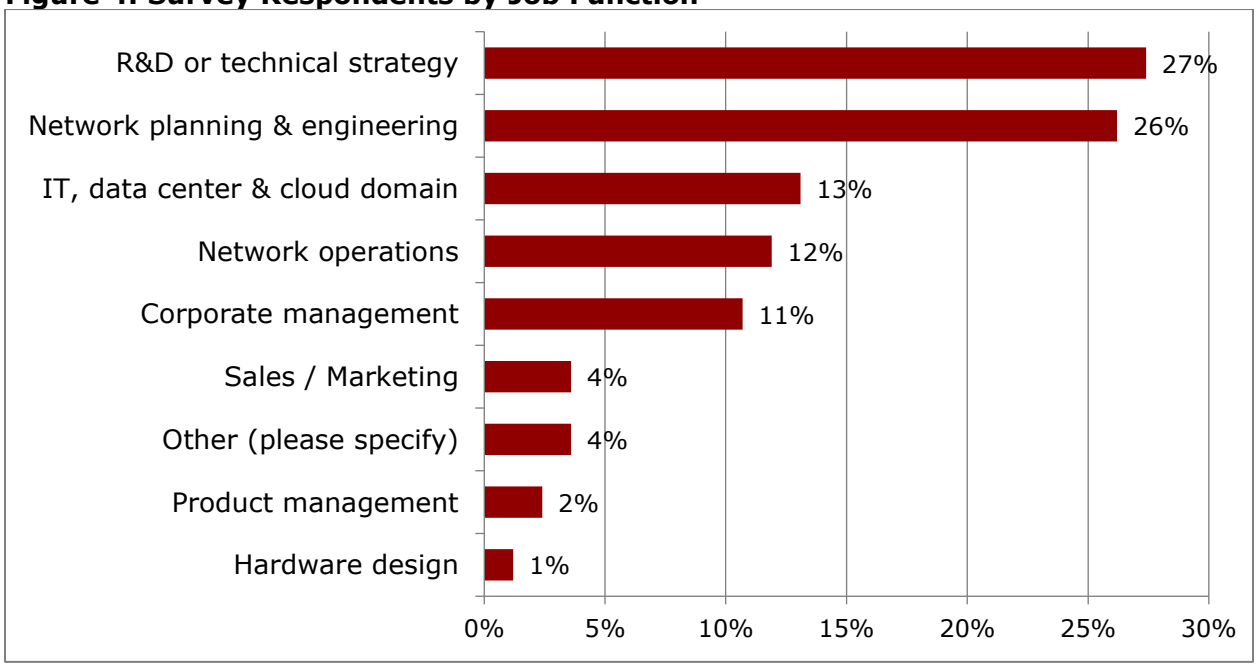
Figure 3: Survey Respondents by Company Annual Revenue



Question: What is your company's annual revenue? (N=84)

Moreover, as shown in **Figure 4**, respondents also performed diverse roles in their organizations, including senior corporate management, R&D, network planning, network operations, IT data center and cloud, finance and sales, and marketing.

Figure 4: Survey Respondents by Job Function



Question: What is your primary job function? (N=84)

We consider the level of representation of respondents from R&D (27%), network planning and engineering (26%), IT and cloud (13%) and network operations (12%) as an optimal mix, because these respondents are ideally positioned to understand the intricate technical challenges, drivers and timelines for virtualizing the RAN and signaling control plane.

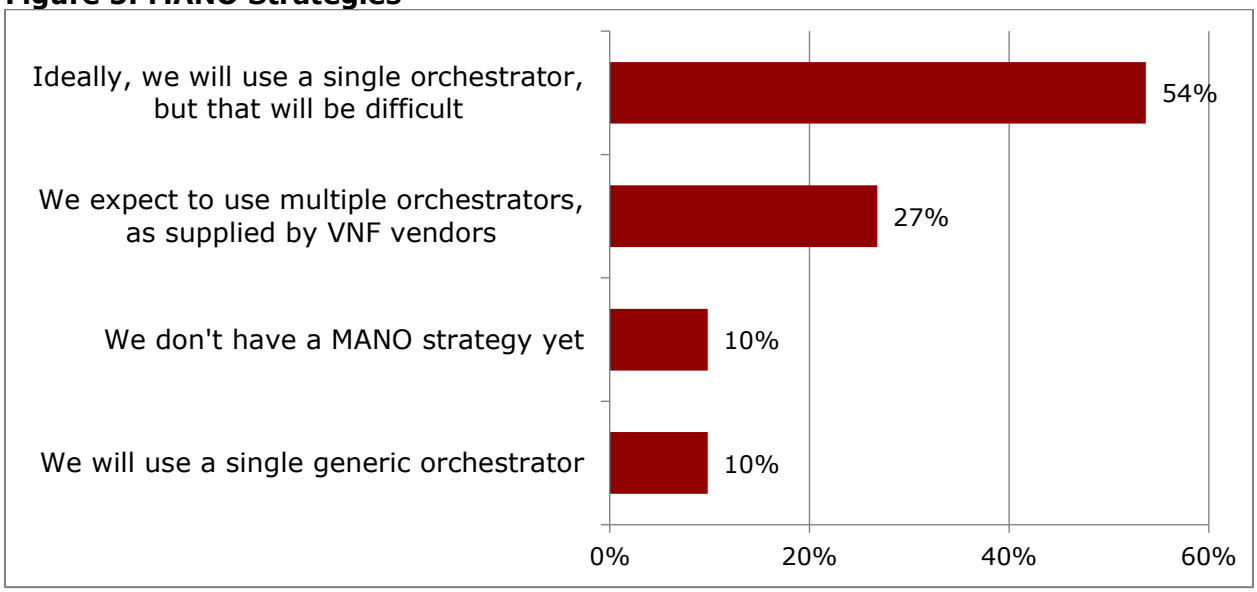
3. NFV IMPLEMENTATION PREFERENCES

Four years into the virtualization journey, there is a sense that the progress of NFV has been limited by a number of interrelated factors. One of these is the complexity of the management and orchestration of virtualized network functions (VNFs).

In many cases, this complexity has manifested itself in the need to support a matching of vendor or partner MANO orchestrators to vendor-specific VNFs, rather than implementing one common generic orchestrator for all VNFs.

As shown in **Figure 5**, this is still an issue. For example, while more than half of survey respondents (54%) would like to use a single orchestrator, they concede that this will still be difficult, while 27% pragmatically accept that they will implement several orchestrators. Only 10% expect that they will be able to implement a single generic orchestrator – the same percentage that have no strategy.

Figure 5: MANO Strategies



Question: Which statement best matches your company's management and orchestration (MANO) strategy for virtualized solutions? (N=82)

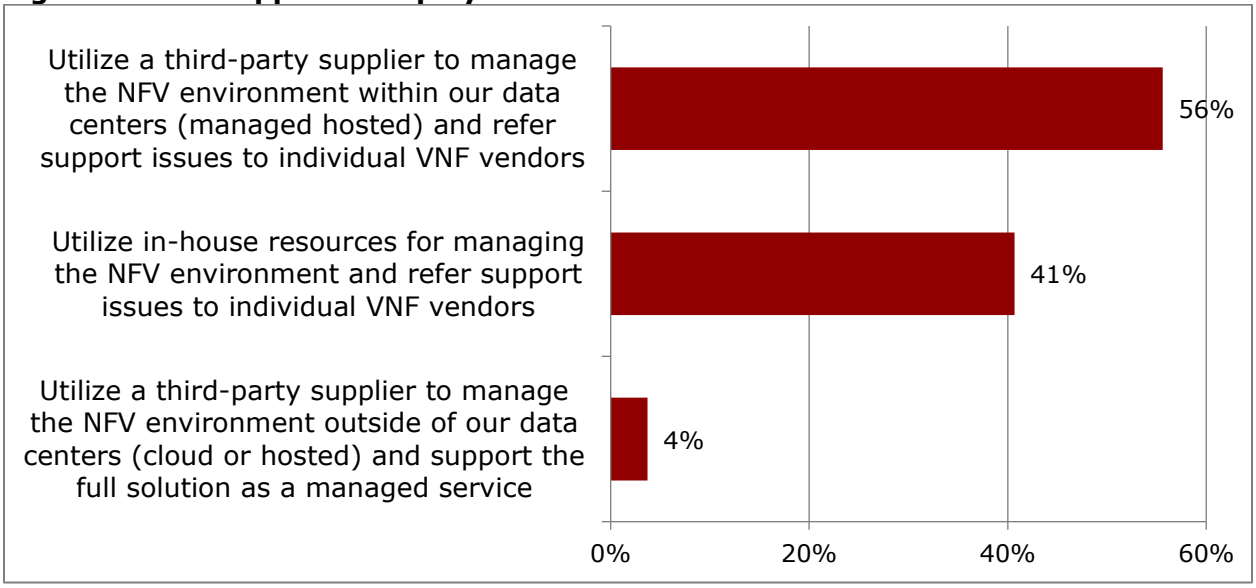
Looking at the MANO strategies using the two filter groups, as shown in **Figure 6**, reveals very similar trends to the global distribution, which confirms that MANO remains a global, galvanizing network issue.

Figure 6: MANO Strategies by Geography

	U.S. (N=39)	RoW (N=43)
Single orchestrator	56%	51%
Multiple orchestrators	23%	30%
Generic orchestrator	15%	5%
No MANO strategy yet	5%	14%

Another key NFV implementation issue relates to support and deployment models. Since NFV is disruptive on several levels, the survey investigated related preferences. As shown in **Figure 7**, the most prevalent approach is to work with a third-party supplier to manage the NFV operational environment (56%), compared to 41% of respondents who prefer to utilize in-house resources.

Figure 7: NFV Support & Deployment Models



Question: Which of the following best matches your company's preferred NFV support and deployment model? (N=80)

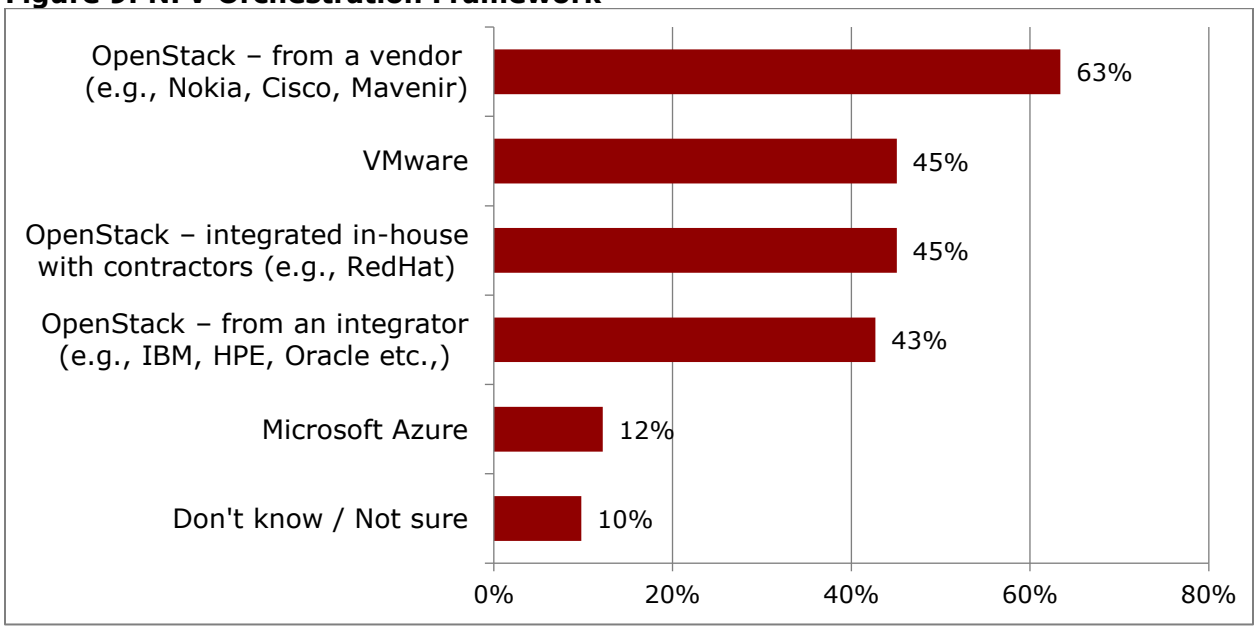
Looking at these results utilizing our two filter groups reveals that RoW participants are generally much more aligned with this third-party supplier model. For example, as shown in **Figure 8**, 67% of RoW respondents adopted this model, compared to only 44% of U.S. survey respondents. We attribute this difference in part to the more common adoption of the managed services models outside of U.S. that lends itself to extending the relationships to NFV and the telco cloud.

Figure 8: NFV Support & Deployment Models by Geography

	U.S. (N=39)	RoW (N=43)
Third-party supplier to manage + VNF vendors	44%	67%
In-house resources + VNF vendors	53%	29%
Third-party supplier managed service model	3%	4%

Just as operational support models vary, so can NFV orchestration frameworks. For instance, as shown in **Figure 9**, while OpenStack is still the leading choice, VMware also remains a strongly supported option (45%). Not surprisingly, of the three integration options available for OpenStack, the vendor support model (63%) is still the most preferred approach, compared to the in-house and third-party integrated models (45% and 43% respectively). This preference for the vendor integration model has been a consistent theme in Heavy Reading research, which we attribute to the entrenched support and integration models that vendors have developed over decades of technology deployments.

Figure 9: NFV Orchestration Framework



Question: Which cloud orchestration frameworks does your company want its NFV applications to support? (choose all that apply) (N=80)

This level of vendor support is a global trend. This is confirmed in **Figure 10**, which shows very similar levels of responses from U.S. and RoW respondents.

Figure 10: NFV Support & Deployment Models by Geography

	U.S. (N=38)	RoW (N=42)
OpenStack from a vendor	64%	63%
VMware	54%	49%
OpenStack integrated in-house with contractor	51%	40%
OpenStack from an integrator	36%	37%
Microsoft Azure	13%	12%
Don't Know / Not sure	3%	16%

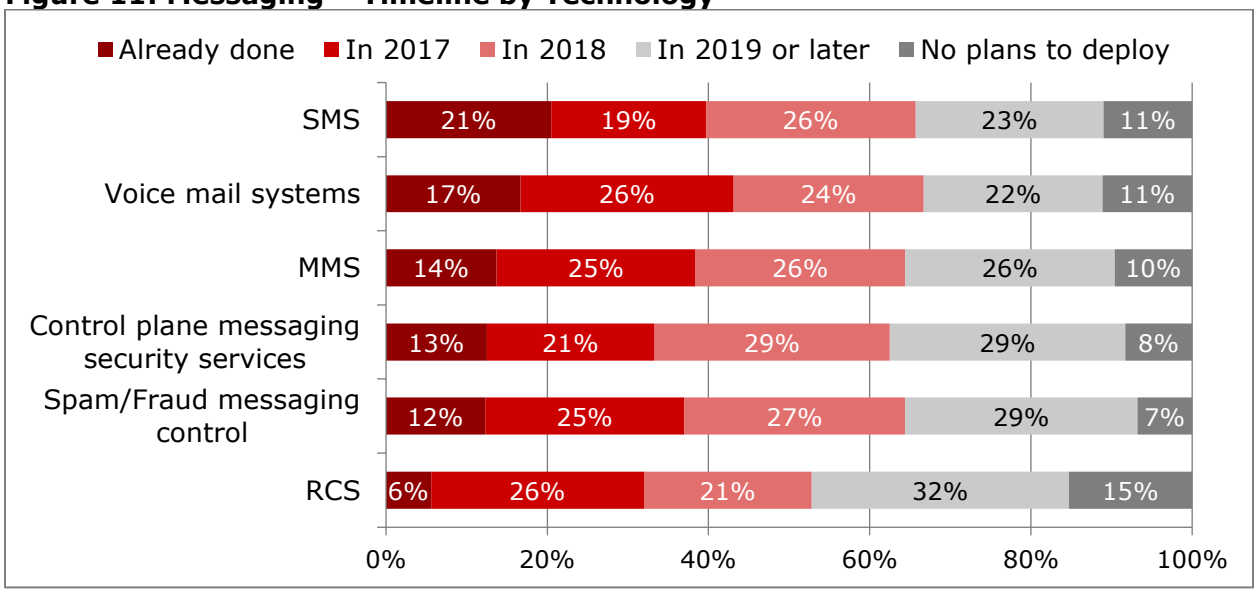
4. VIRTUALIZING MESSAGING SOLUTIONS

The activities of the past four years have confirmed that messaging is a key NFV focus area. This is not unexpected, given that CSPs use multiple access technologies (e.g., cable, fixed and mobile) to unpin their diverse service and application delivery models.

Accordingly, one of the aims of this research project was to confirm timelines and preferences for virtualizing a range of messaging-based solutions, from SMS to email to RCS services. Based on the results shown in **Figure 11**, a considerable amount of virtualization activity has taken place, with more planned in the next 24 months. For example, 21% of respondents indicated they have already completed some form of virtualization for SMS messaging, as have 17% of voice mail systems.

In 2017, more than 25% of respondents said they would start virtualization of MMS (25%), voice mail systems (26%), RCS (26%) and fraud messaging control (25%). Roughly another 25% indicate they will tackle virtualization of these systems in 2018. This aggressive schedule equates to 66% of SMS and 65% of MMS systems virtualized on some level by the end of 2018.

Figure 11: Messaging – Timeline by Technology



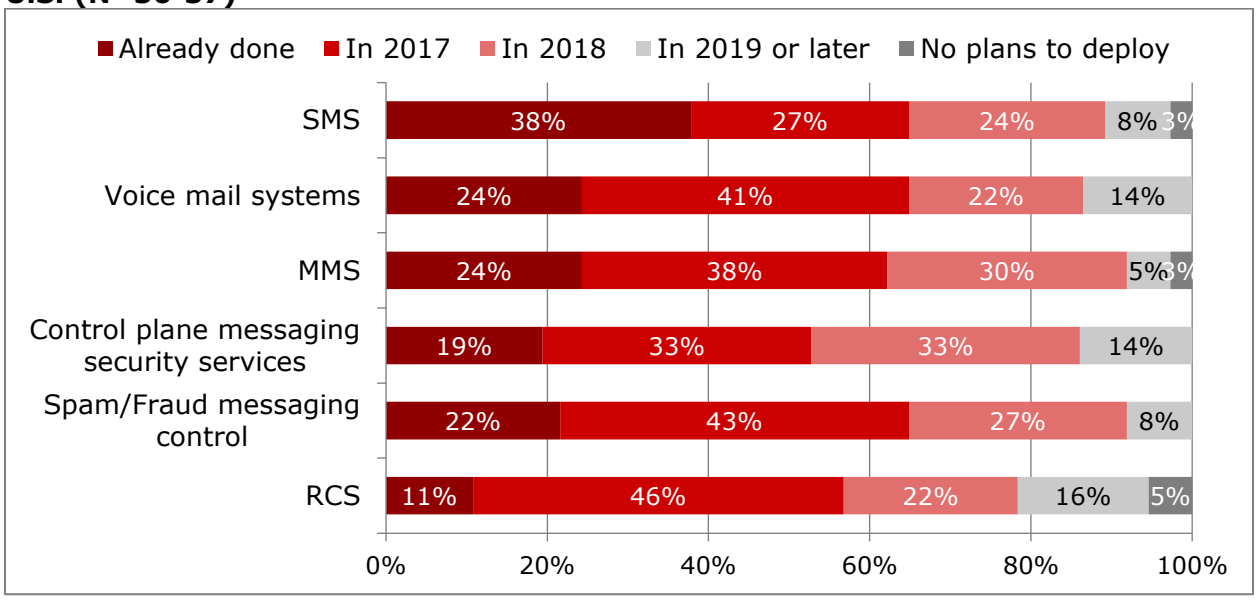
Question: When does your company plan to migrate the following messaging services to a virtualized NFV-based platform and/or launch new virtualized services? (N=72-73)

Filtering this survey result by geography revealed a number of differences. For example, as shown in **Figure 12**, U.S. respondents were much further along in their virtualization journey: 38% of U.S. respondents indicated they had done some level of SMS virtualization, compared to only 3% of RoW respondents.

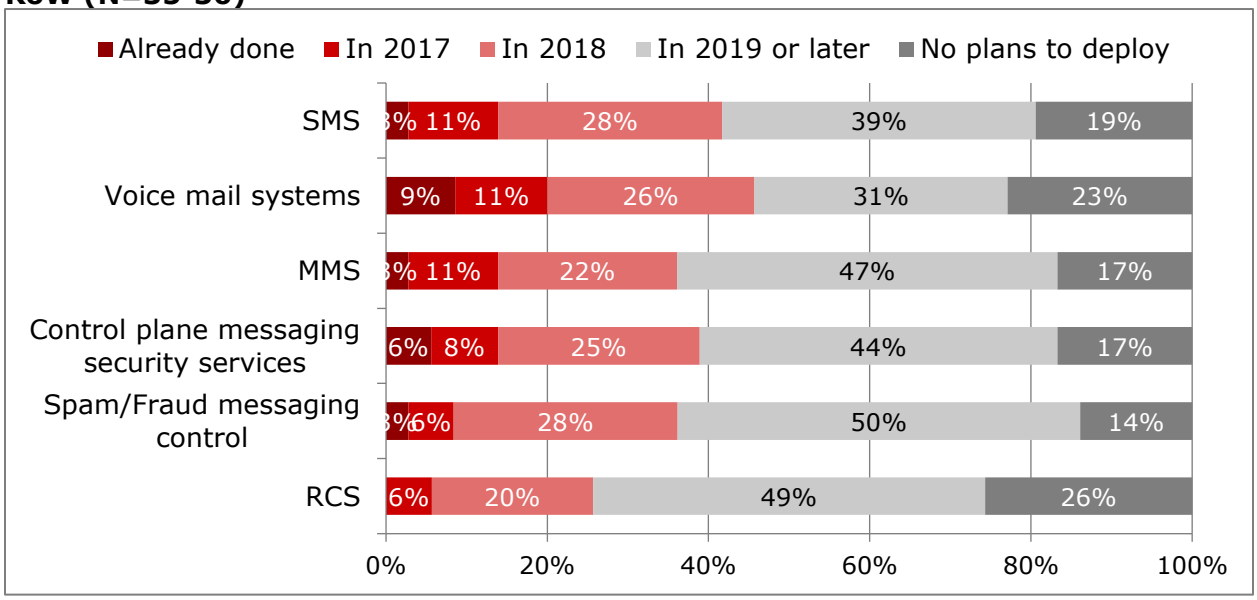
We are not too surprised by this, given that all Tier 1 CSPs in the U.S. have aggressive virtualization plans compared to other markets. In contrast, a larger group of RoW respondents (31%-50%) don't expect virtualization to happen until 2019 or later. The variance has significant impacts. Using SMS as an example, by the end of 2018, 89% of U.S. respondents expect to support virtualized messaging, compared to just 42% of RoW respondents.

Figure 12: Messaging – Timeline by Technology by Geography

U.S. (N=36-37)



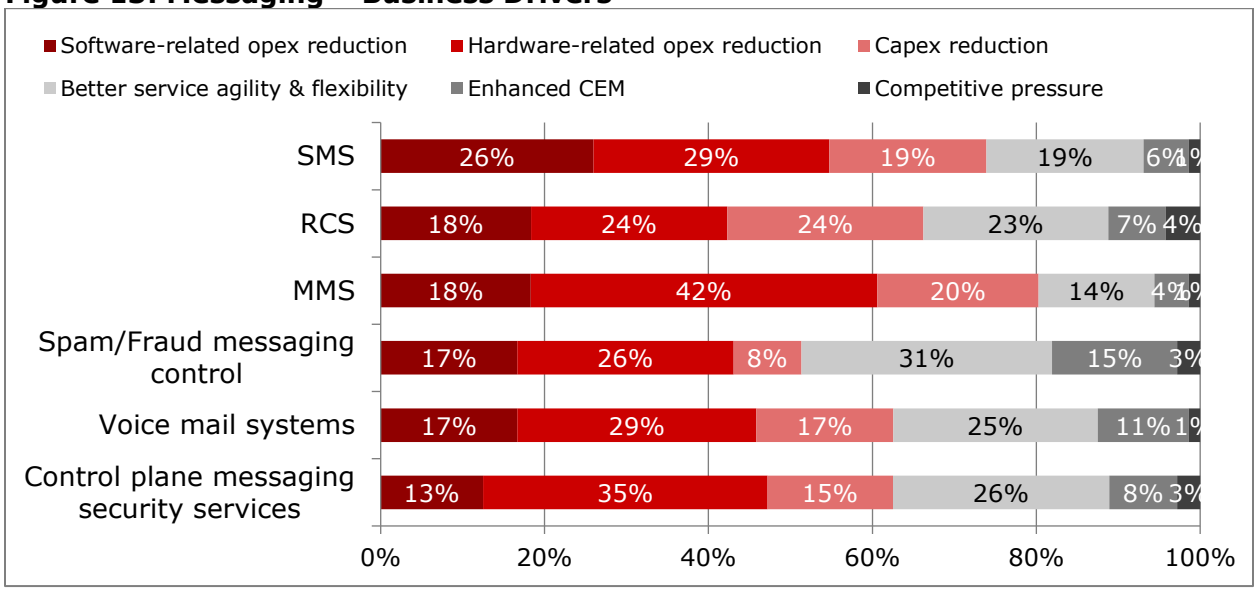
RoW (N=35-36)



Given the overall strong level of support for virtualization of a broad range of messaging solutions, understanding the business drivers was also an important consideration. As shown in **Figure 13**, there are several factors in play that must be considered on a per-application level. While overall, hardware-related opex tended to be the lead driver for most applications, the ranges varied.

For example, while in an SMS context, the leading factor was hardware opex reduction, 29% of respondents selected this compared to 42% for MMS. This illustrates that while each of these services can benefit from virtualization opex-wise, the fundamental difference in service characteristics results in different opportunities to optimize opex.

Figure 13: Messaging – Business Drivers



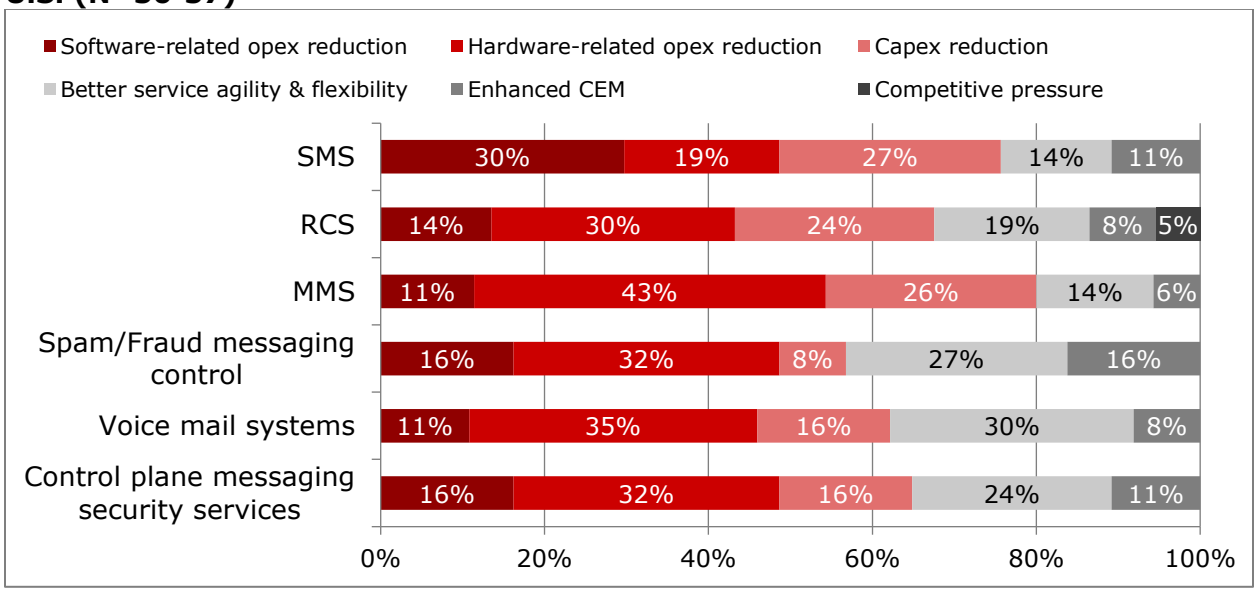
Question: What is the biggest business motivation for using NFV to virtualize these services? (N=71-73)

Filtering this result by geography revealed that while there was a general level of consensus by application related to the value of software- and hardware-driven opex reduction, U.S. respondents also saw greater capex reduction potential.

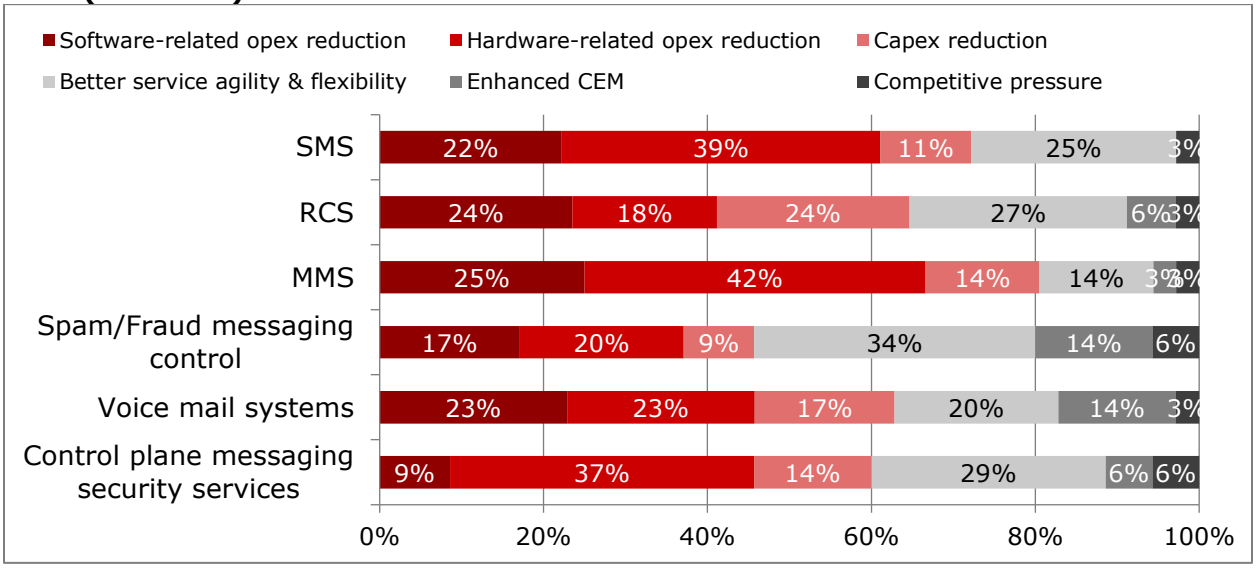
Using SMS as an example, as shown in **Figure 14**, 27% of U.S. respondents saw capex reduction as a business driver, compared to 11% of RoW respondents. This is likely in part due to the greater size and scale requirements of U.S. CSPs to support SMS services, even though SMS traffic continues to decline.

Figure 14: Messaging – Business Drivers by Geography

U.S. (N=36-37)

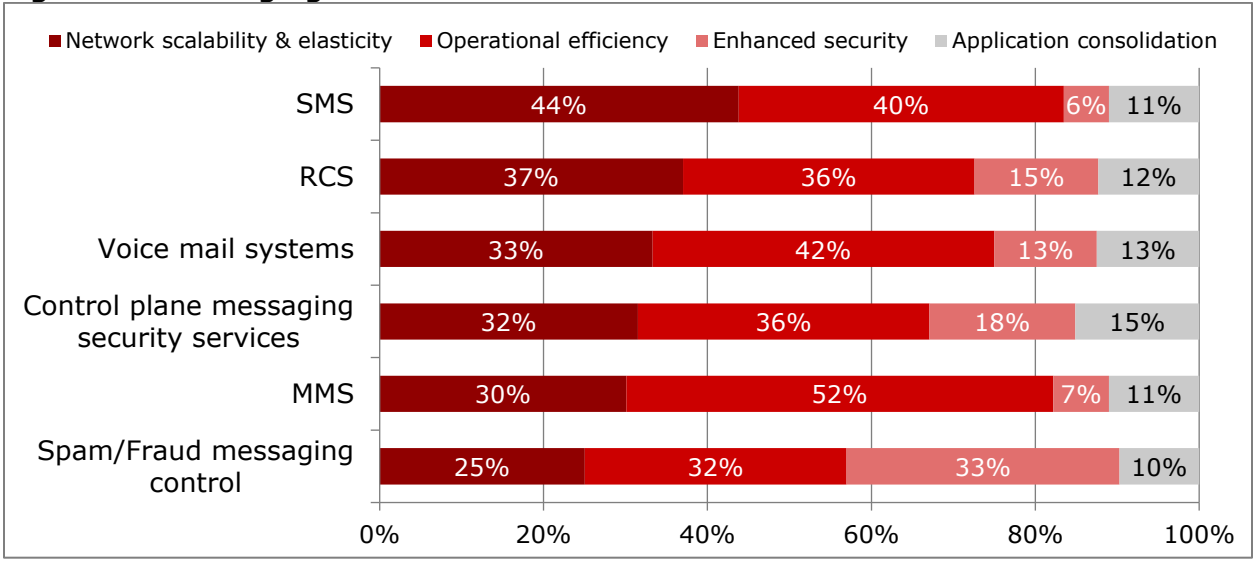


RoW (N=34-35)



The next question of the survey investigated technical drivers. As shown in **Figure 15**, respondents considered the leading technical virtualization driver to be operational efficiency (32%-55% range), followed by network scalability and elasticity (17%-34%). Application consolidation ranked and enhanced security were both quite close in terms of the level of support apart from a single spike for spam/fraud messaging control (33%), which was not unexpected given the security focus of these services.

Figure 15: Messaging – Technical Drivers



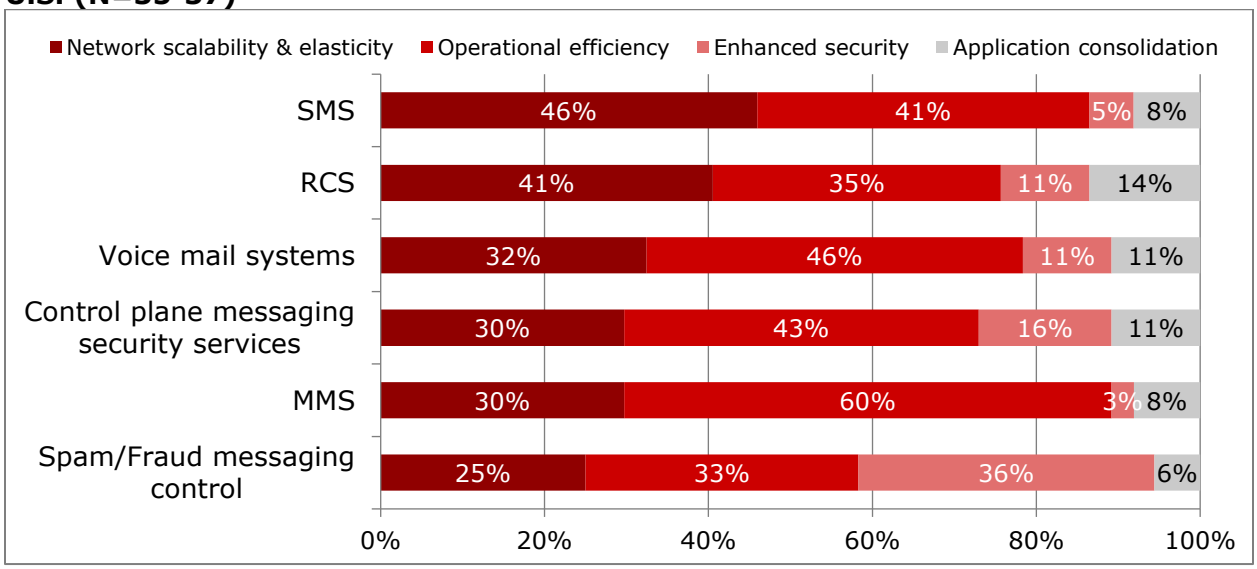
Question: What is the most important technical reason for using NFV to virtualize these services? (N=72-73)

Filtering this result by geography shows that the business driver trends are generally quite similar, even with respect to the security spike for spam/fraud messaging control. For example, as shown in **Figure 16**, 46% and 41% of U.S. respondents related to SMS network

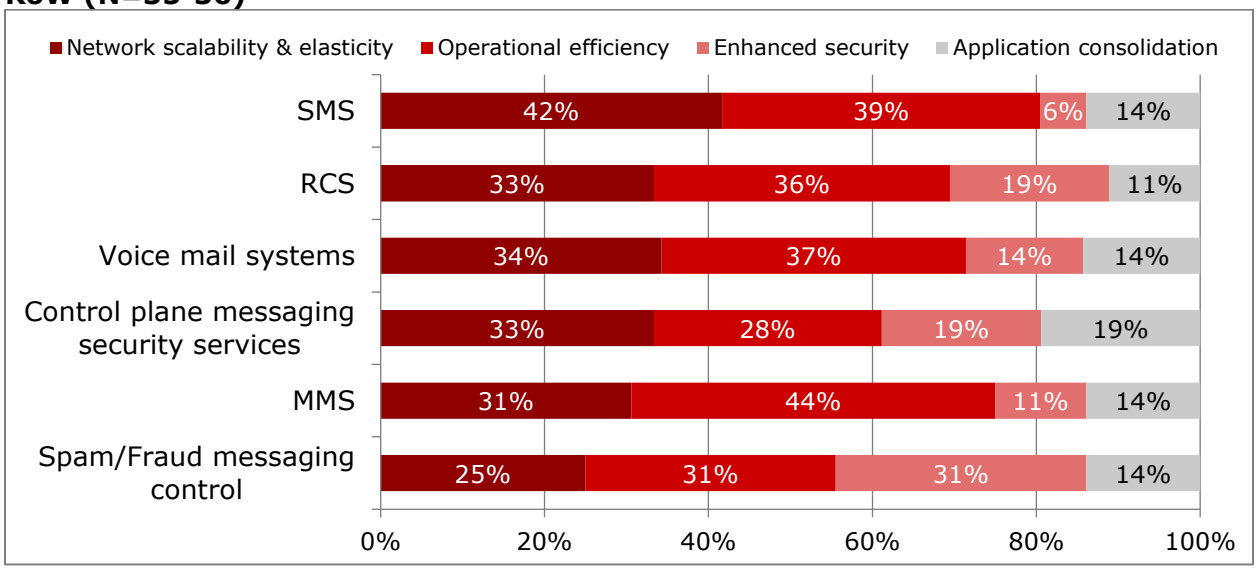
scale and operational efficiency compared to 42% and 39% of RoW respondents. Our interpretation of this data is that there is a common level of agreement on the technical benefits of messaging virtualization, even though execution strategies may differ on a business level.

Figure 16: Messaging – Technical Drivers by Geography

U.S. (N=35-37)



RoW (N=35-36)

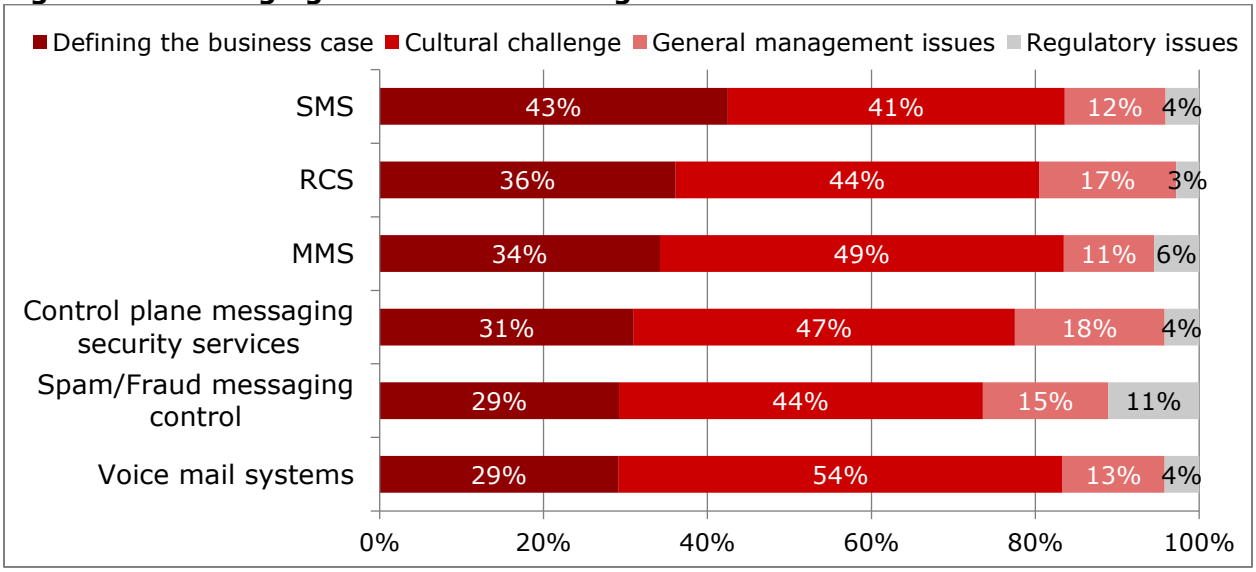


As documented in the earlier section, the progress of NFV is hampered by several common technical issues such as the lack of clarity around MANO implementations. Accordingly, we wanted to quantify the impact of NFV and the related challenges on a messaging services level, both technically and business wise.

Starting first with the business drivers as shown in **Figure 17**, the two lead business challenges are cultural challenges (41%-54%), followed by challenges defining the business case (29%-43%). This high ranking of the cultural impacts is not too surprising, given that

it is often identified as a formidable business challenge in our research, especially as the commercialization phase starts to ramp up.

Figure 17: Messaging – Business Challenges

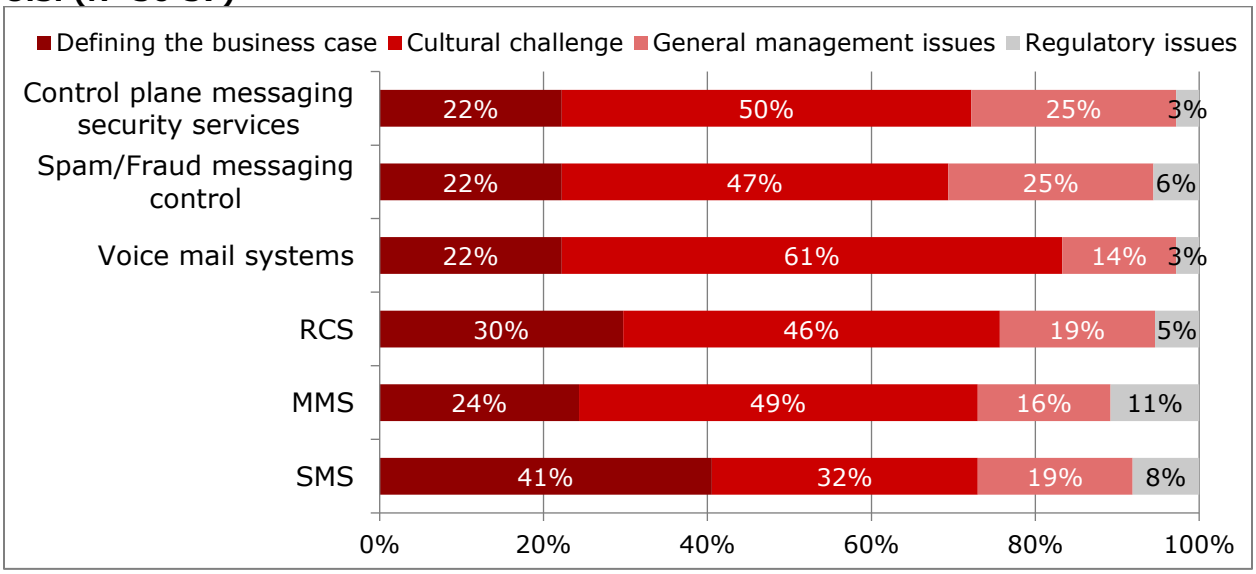


Question: What is the biggest business challenge involved in using NFV to virtualize these services? (N=71-73)

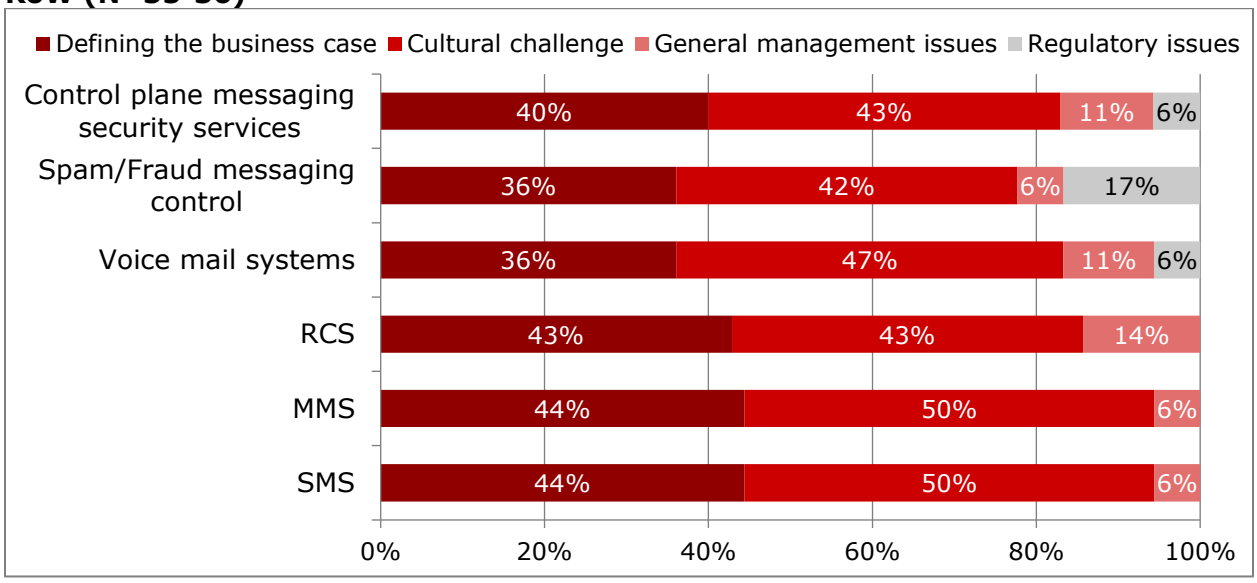
Filtering this result by geography reveals similar trends. As shown in **Figure 18**, U.S. respondents ranked defining the business case for SMS, RCS, and MMS as 41%, 30%, and 24% respectively, while RoW ranked these higher at 44%, 43%, and 44% respectively. In a cultural context, for these same services, U.S. respondents ranked at 32%, 46% and 49% versus similar RoW rankings of 50%, 43% and 50%, which confirms that CSPs globally are fairly aligned in terms of the business challenges.

Figure 18: Messaging – Business Challenges by Geography

U.S. (N=36-37)

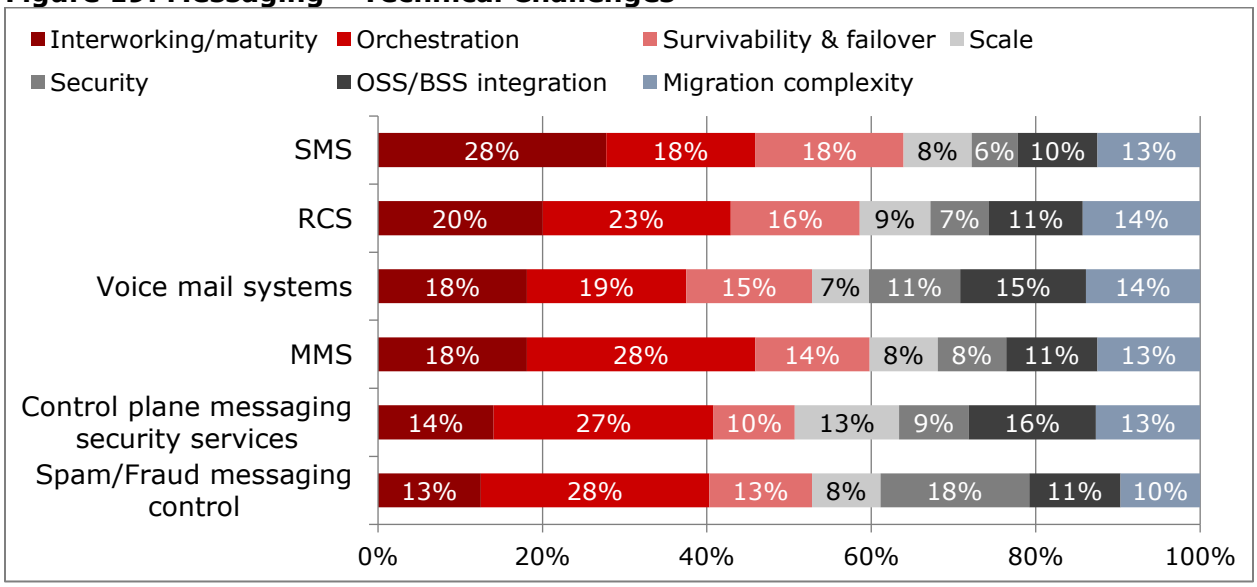


RoW (N=35-36)



The scope of the research project also included documenting the technical challenges associated with messaging virtualization. Consistent with earlier Heavy Reading NFV research, as shown in **Figure 19**, MANO-based orchestration is still the greatest challenge associated with virtualizing messaging solutions (18%-28%), followed closely by vendor interworking/maturity which is directly impacted by orchestration limitations (13%-28%).

Figure 19: Messaging – Technical Challenges



Question: What is the biggest technical challenge involved in using NFV to virtualize these services? (N=71-73)

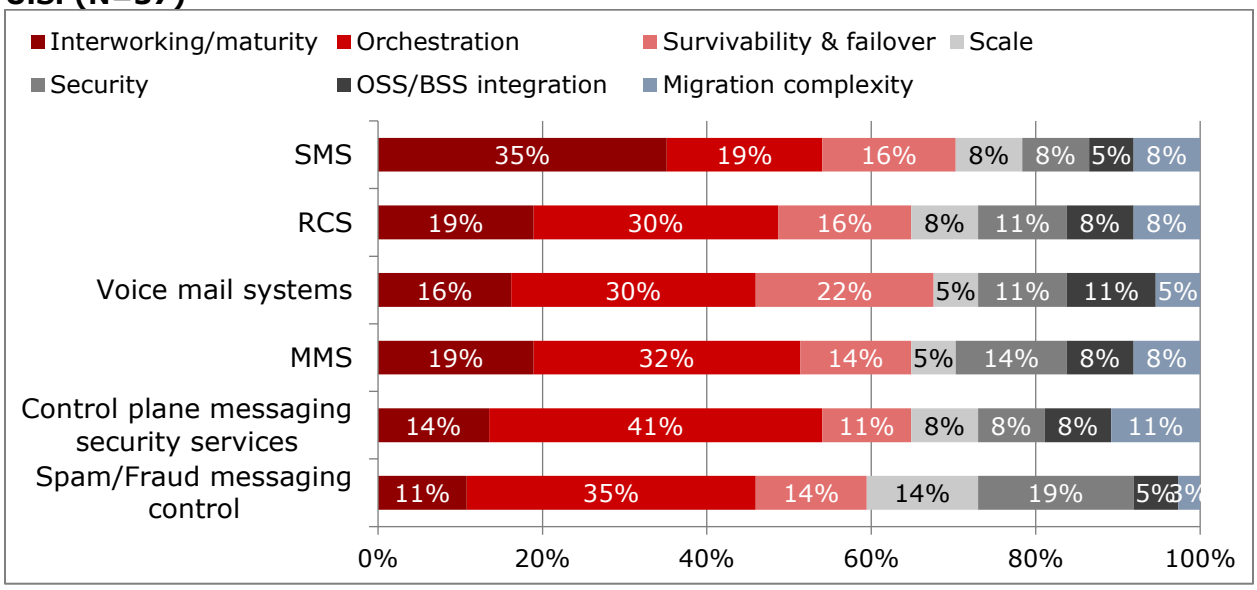
Filtering this result by geography reveals some subtle differences, as shown in **Figure 20**. For example, U.S. respondents ranked orchestration as the greatest concern (19%-41%), followed by vendor interworking/maturity (11%-35%). RoW respondents assessed vendor interworking/maturing as slightly higher (14%-21%) than orchestration (9%-23%). In our

opinion, this shows there is still a considerable level of alignment globally, since if you take vendor maturity as an example and drop the U.S. SMS response (35%), the range smooths out to 11%-19%, compared to 14%-20% for RoW respondents.

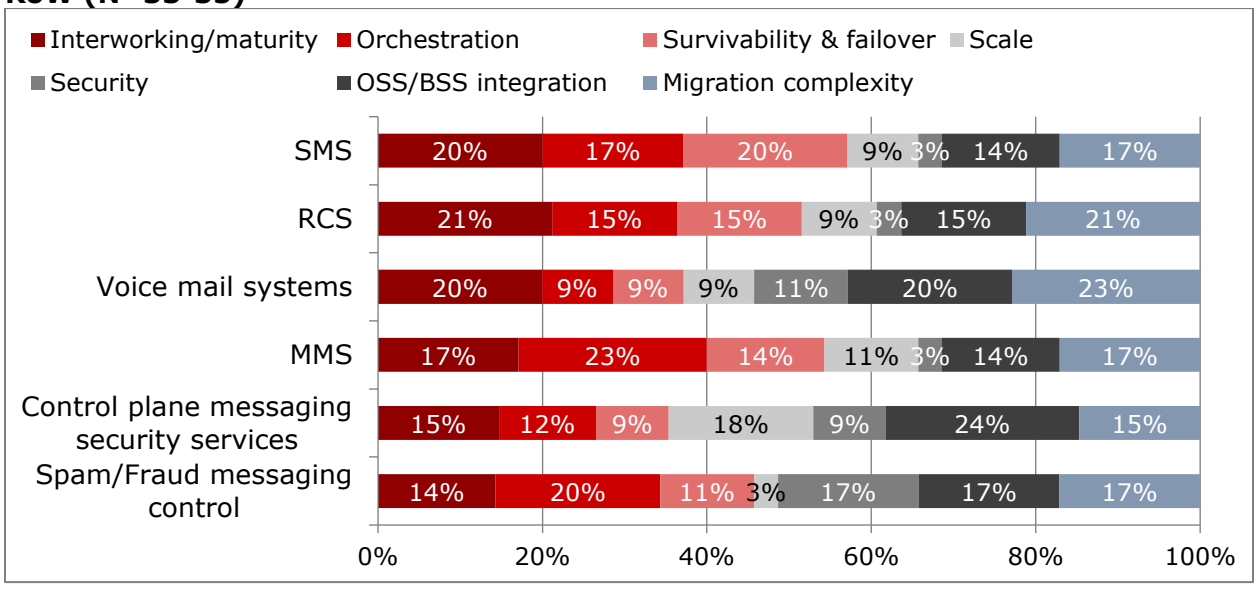
Still, it's clear that U.S. respondents view orchestration as a greater challenge than their RoW counterparts. Of course, there are several factors in play here, but since U.S. operators are more advanced in the implementation of NFV and virtualizing messaging solutions (see **Figure 12**), they are naturally more likely to be facing the technical challenges associated with implementing orchestration-based solutions.

Figure 20: Messaging – Technical Challenges by Geography

U.S. (N=37)



RoW (N=33-35)



5. VIRTUALIZING THE RAN

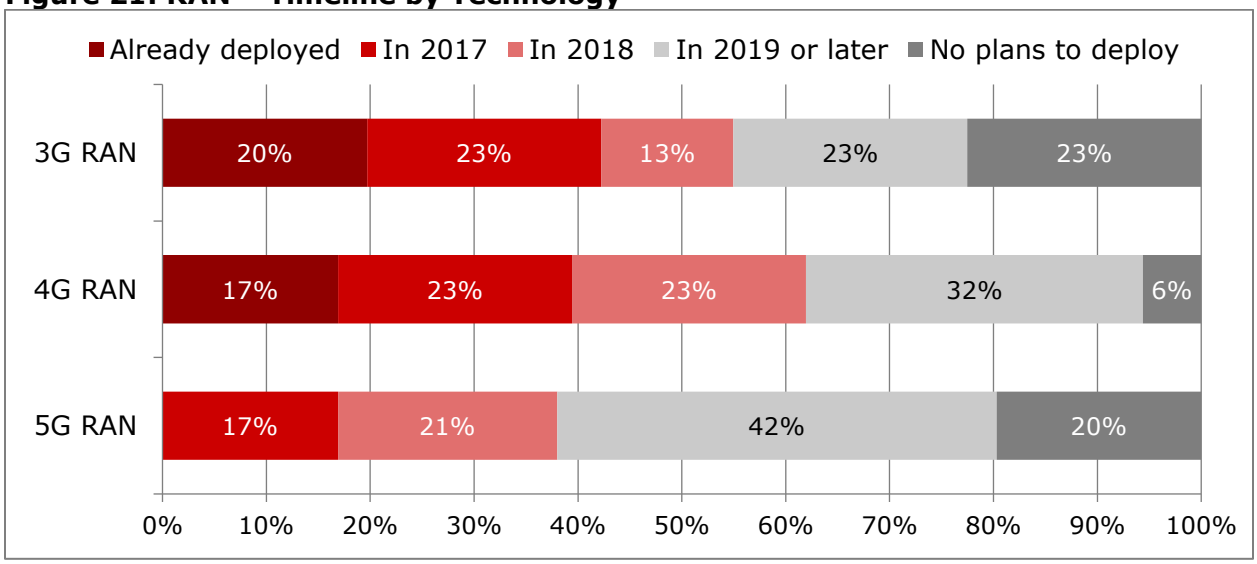
Understanding the drivers, challenges and even timelines of applying virtualization to the various generation of RANs was also a key priority of this research project. Starting first with the timeline, we wanted to understand when virtualization would start and in which years would it ramp up by technology.

Interestingly, as shown in **Figure 21**, a considerable number of respondents said they had already deployed some form of virtualized 3G and 4G RANs (20% and 17% respectively), with added deployments planned in 2017 (23% for both).

We are somewhat surprised by this level of deployment and believe this shows that a sizable number of CSPs have started to take the initial steps in a migration to vRAN that will take several years to cut over. We are also surprised by the large numbers of respondents who plan to virtualize 3G RANs. This is likely due to a number of factors, including the coming to market of multi-generational vRAN solutions (e.g., 3G and 4G on a single platform). See also **Figure 23**.

In looking at 5G, the results are aligned with our view. For example, as expected no respondents have deployed 5G, but 17% plan to start the process in 2017, while the largest group (42%) see 2019 or later as the most realistic deployment window.

Figure 21: RAN – Timeline by Technology

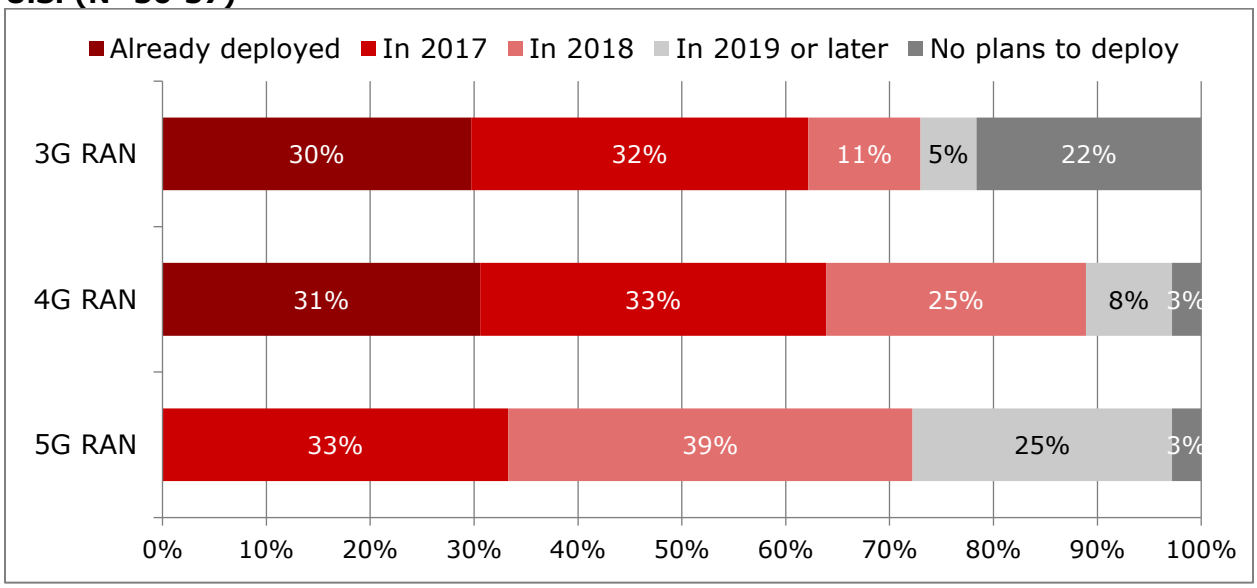


Question: When will your company migrate its existing RAN to an NFV-based virtualized RAN (vRAN) platform and/or launch a new vRAN platform for the following? (N=70-71)

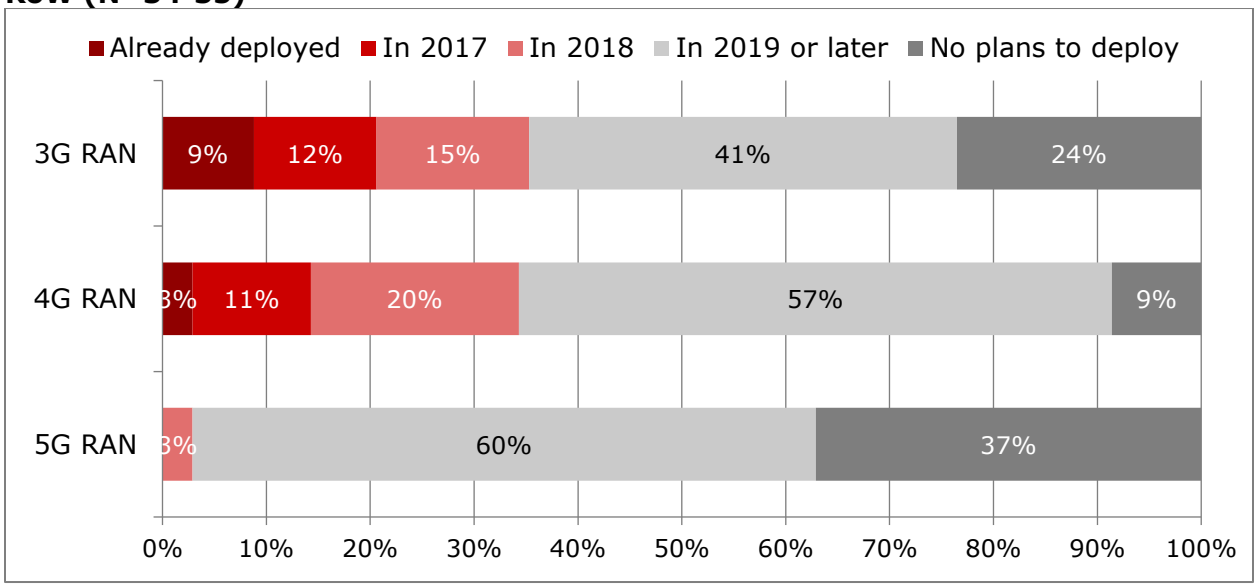
Filtering this survey data by geography, as shown in **Figure 22**, reveals that the high levels of "already deployed" responses for 3G and 4G RAN are very U.S.-centric: 30% and 31% of U.S. respondents fell into this category, compared to only 9% and 3% of RoW respondents. Similarly, 33% of U.S. respondents expected to start 5G deployments in 2017, compared to 0% of RoW respondents. This was predictable, given the aggressive 5G market positioning many U.S. mobile operators are espousing. In contrast, 62% of RoW see 5G happening in 2019 or later, with more than a third (37%) falling into the "no plans" category, compared to only 3% of U.S. respondents.

Figure 22: RAN – Timeline by Technology by Geography

U.S. (N=36-37)



RoW (N=34-35)

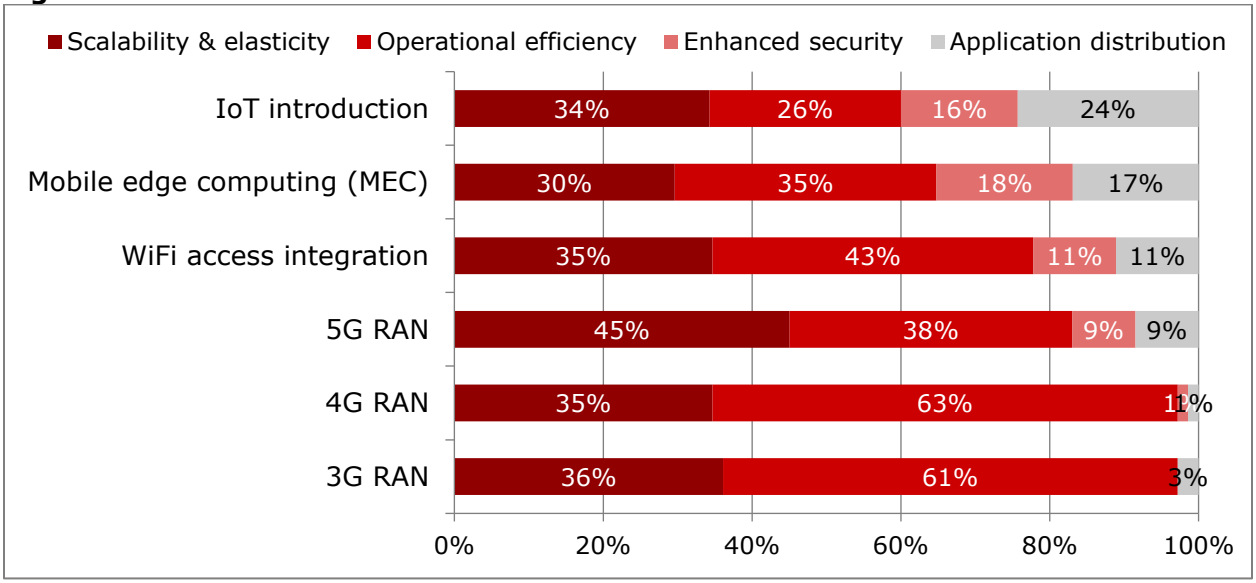


Given the strong support of RAN virtualization noted above, understanding the technical drivers by technology was also of considerable interest. Accordingly, the survey included a question that asked the respondent to break down responses using four options: scale, operational efficiency, enhanced security, and application distribution. This question was also extended beyond 3-5G RAN to include the impact of IoT, MEC, and WiFi integration support since these are also considerations driving RAN virtualization on some level.

As shown in **Figure 23**, scalability/elasticity (30%-45%) and operational efficiency (26%-63%) stand out as the two lead technical drivers. The high scoring of operational efficiency for 3G and 4G RAN (61% and 63%) is particularly notable. This is consistent with the results shown in **Figure 21**, and is further evidence that CSPs see a considerable opportunity to

simplify operational efficiencies if they support 3G and 4G RAN on a common software and shared infrastructure cloud-based platform.

Figure 23: RAN – Technical Drivers

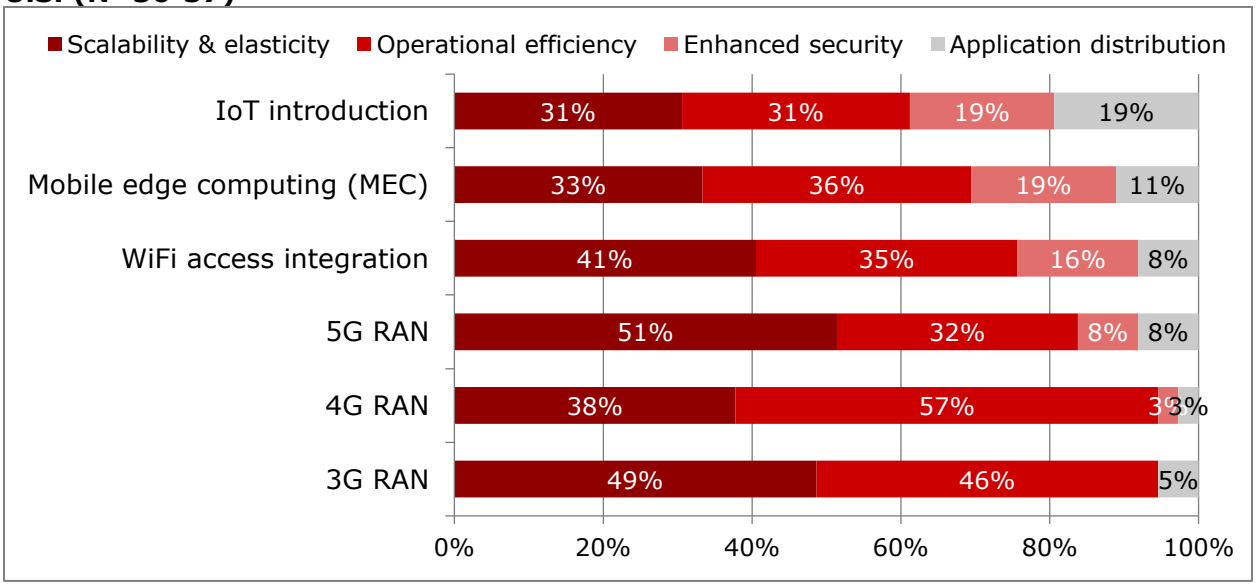


Question: What is the biggest technical motivation for NFV to virtualize the RAN? (N=70-72)

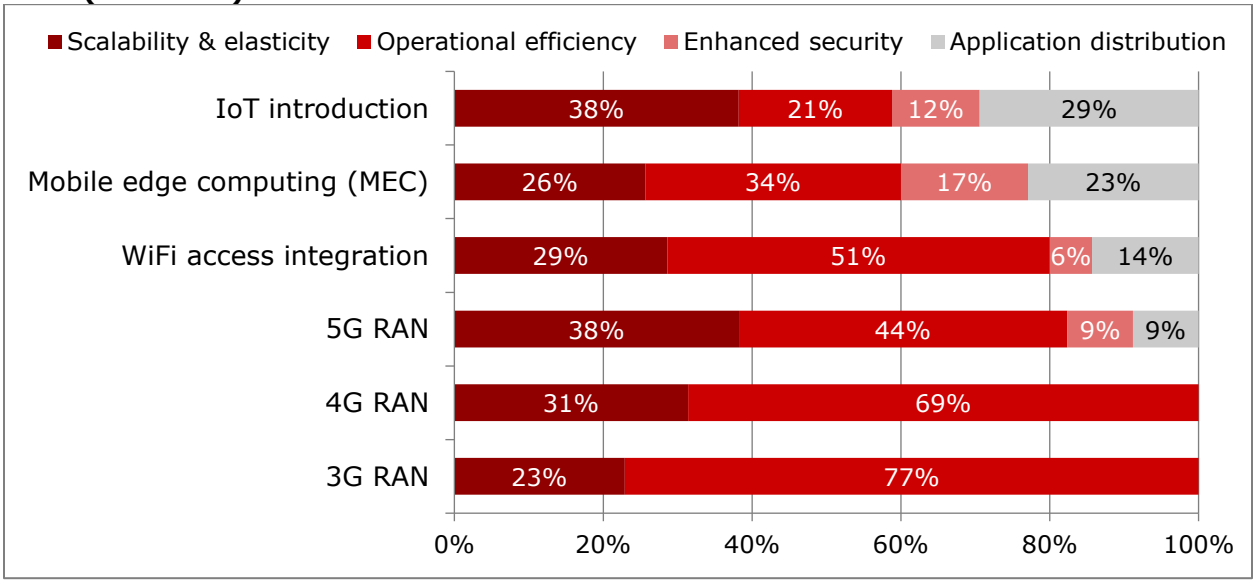
Filtering our survey results by region also identified some unique differences. For example, as shown in **Figure 24**, operational efficiency for 3G and 4G is a much greater consideration for RoW respondents (77% and 69%) than U.S. respondents (46% and 57%). There are several factors to consider here, including the fact that 3G is still very entrenched technology outside of the U.S., which was an early and aggressive early adopter of 4G technology, in part due to the need to migrate off aging CDMA-based networks.

Figure 24: RAN – Technical Drivers by Geography

U.S. (N=36-37)



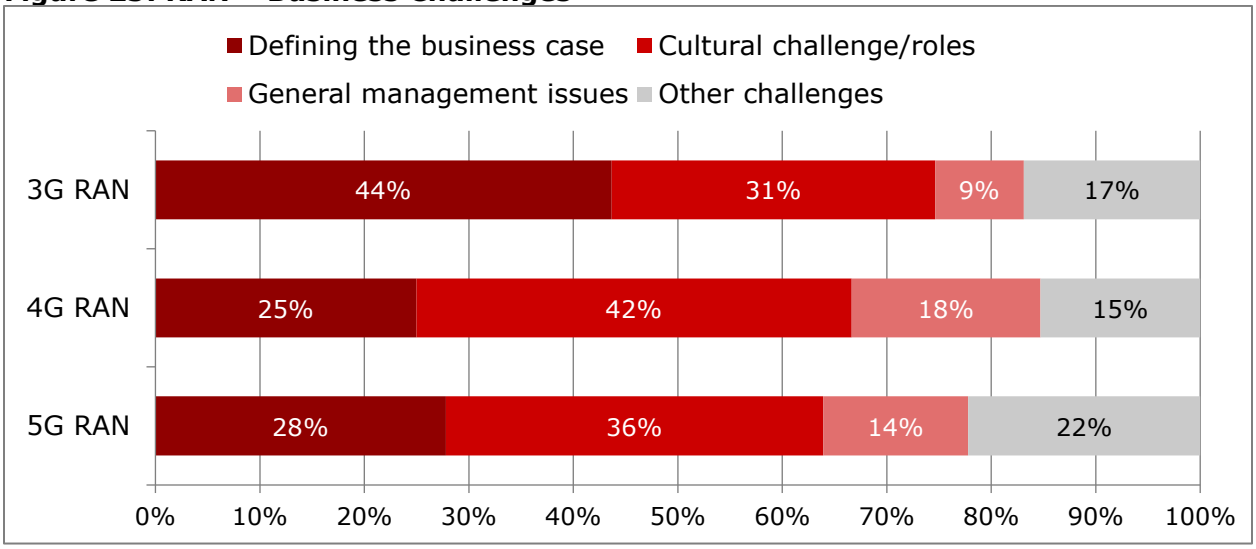
RoW (N=34-35)



We next turned to documenting the business challenges associated with the migration of RANs to vRANs. We asked respondents to rank four factors: business case definition; cultural challenge (changes in roles and responsibilities); general management issues (training, etc.) and other issues related to backhaul licensing costs and software licensing costs.

As **Figure 25** shows, cultural challenges (31%-42%) and business case definition (28%-44%) really stand out. The high ranking of both of these factors have also been noted in previous Heavy Reading research projects, and crystallize employee concerns on remaining career linked to non-cloud platforms, as well as the challenges the CSPs face in rationalizing capital deployment to build networks that still may be hampered by limited vendor interoperability and a lack of a common orchestration strategy.

Figure 25: RAN – Business Challenges

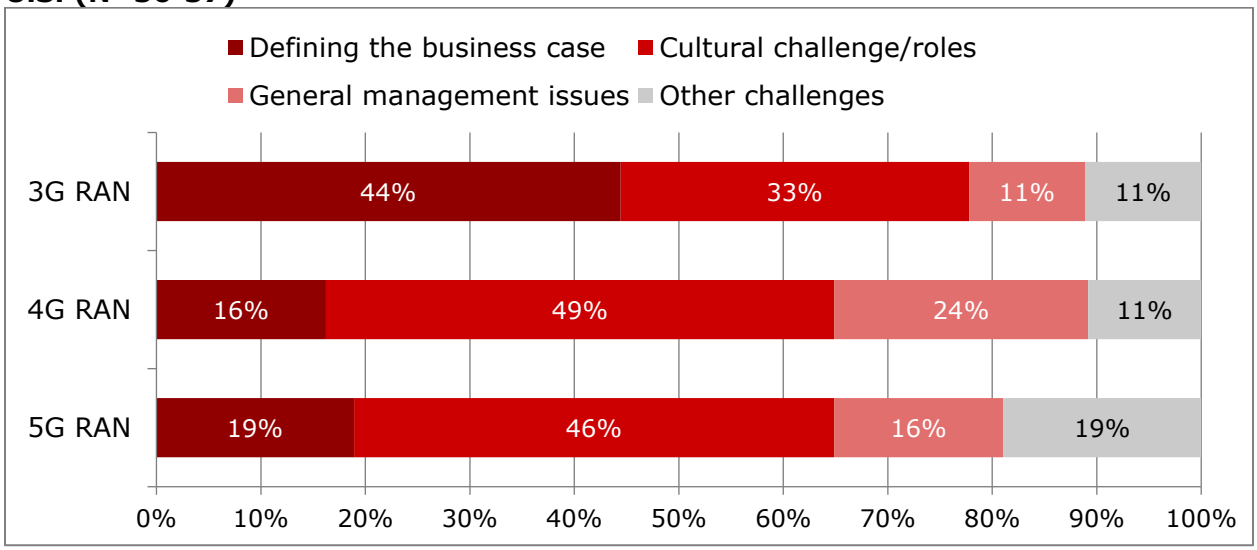


Question: What is the biggest business challenge involved in using NFV to virtualize the RAN? (N=71-72)

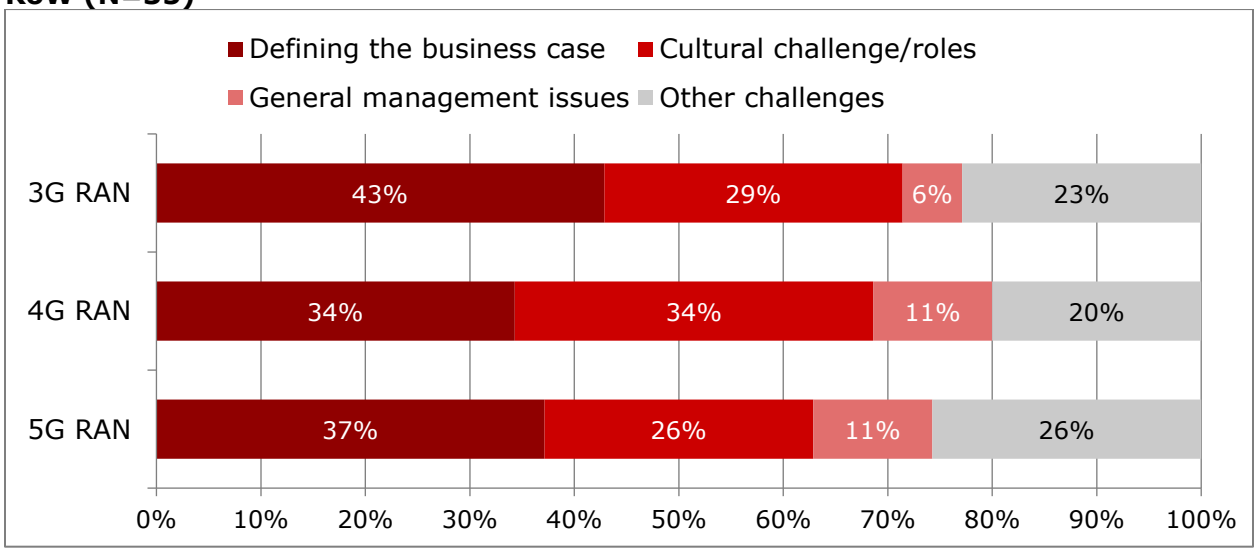
Filtering the results by geography, as shown in **Figure 26**, reveals that both groups of respondents have similar opinions and concerns in ranking these four variables. Consistent with earlier responses on the pace of virtualization and 3G/4G adoption, U.S. respondents are less concerned about the 4G and 5G business case definition than RoW respondents.

Figure 26: RAN – Business Challenges by Geography

U.S. (N=36-37)



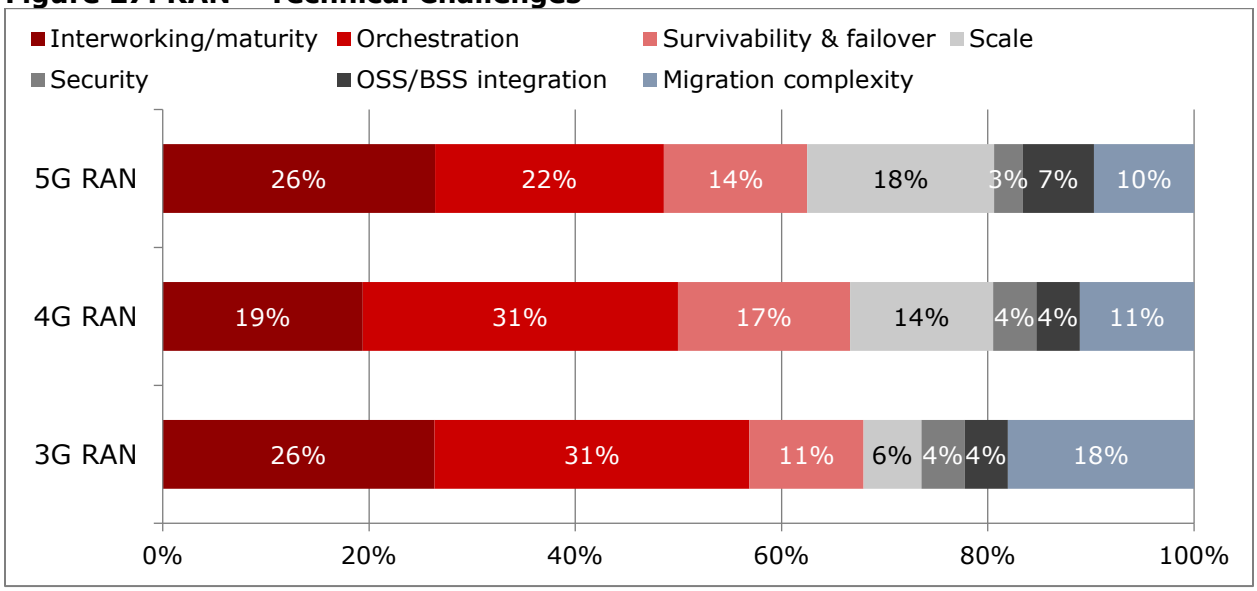
RoW (N=35)



Understanding the technical challenges of RAN virtualization was also a top priority of the project. To provide a common base for comparative purposes, the question used the same seven technical considerations we utilized for messaging solutions. These categories were also utilized in the next section addressing control plane virtualization.

As shown in **Figure 27**, once again we noted that interworking/product maturity (19%-26%) and orchestration (22%-31%) were the two leading technical challenges which confirms the technology reach that both factors have on virtualization in general.

Figure 27: RAN – Technical Challenges

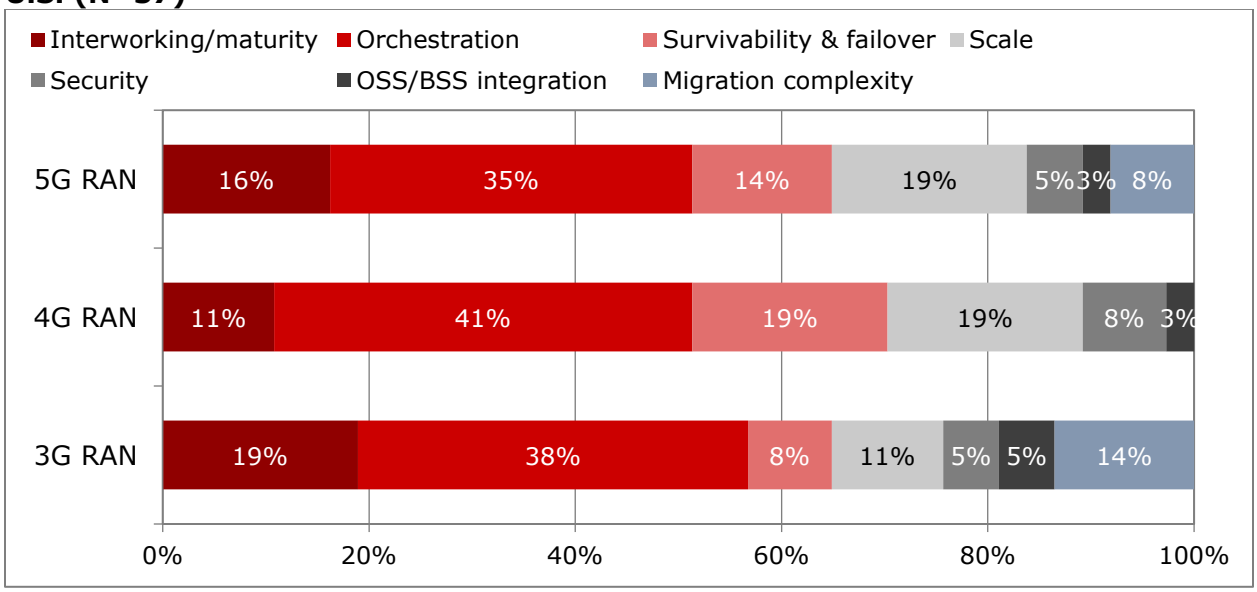


Question: What is the biggest technical challenge involved in using NFV to virtualize the RAN? (N=71-72)

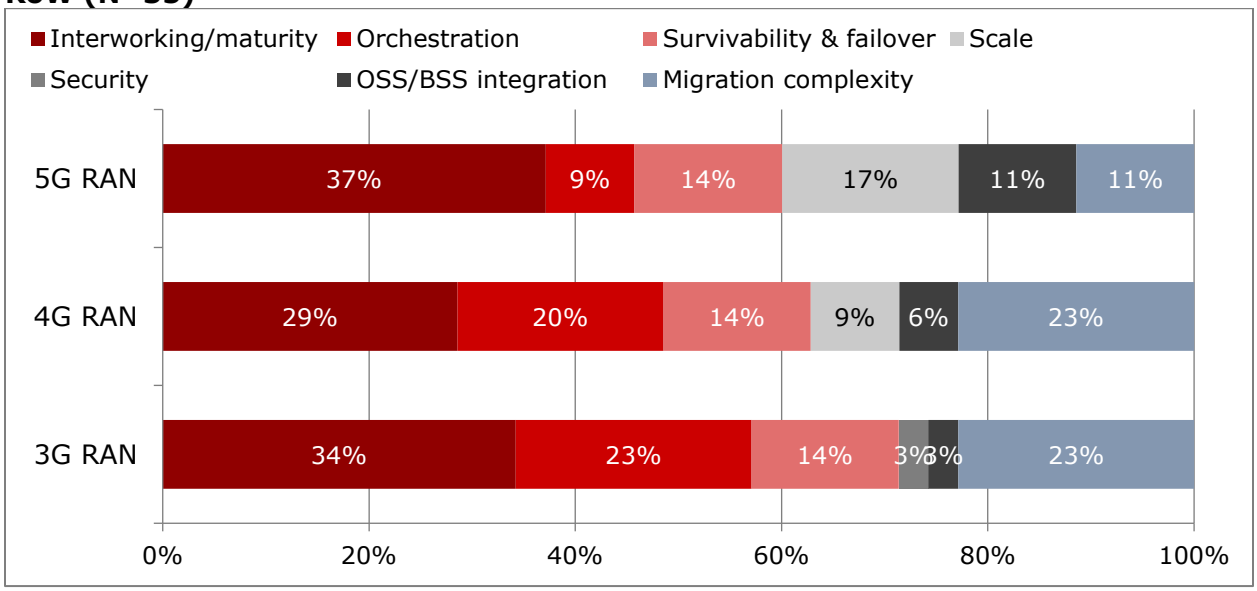
Filtering the results by geography captured several variances. For example, while the general trends of all seven attributes are relatively similar in terms of distribution as shown in **Figure 28**, U.S. respondents are much more concerned about orchestration (35%-38%) than interworking/maturity (11%-19%). In contrast, RoW respondents are more concerned about interworking/maturity (29%-37%) than orchestration (9%-23%). This can be attributed in part to the fact that U.S. CSPs are more advanced in RAN virtualization and are now confronting head-on the challenges that orchestration poses in the commercialization phase.

Figure 28: RAN – Technical Challenges by Geography

U.S. (N=37)



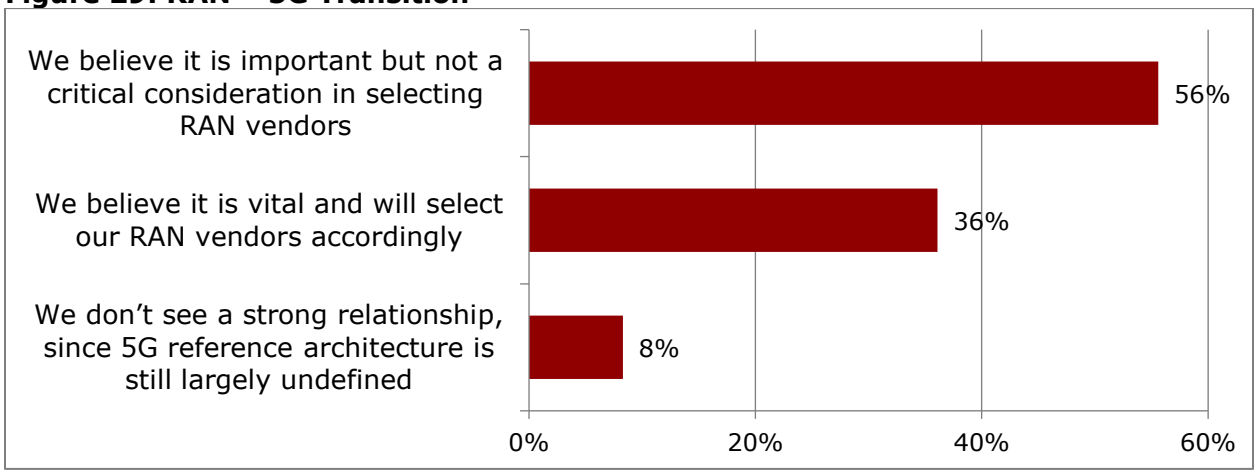
RoW (N=35)



The next question in the survey was designed to explore the vendor relationship linkages between applying virtualization to 4G solutions to enable a smoother 5G transition. As we noted in **Figure 21**, 63% of respondents said they planned to have vRAN implementations commenced by 2017; well before the ramp in 5G deployments.

Still, as shown in **Figure 29**, 56% of respondents view the implementation of 4G as an important but not critical consideration in the transition to 5G. This illustrates the fact that 5G is less about vendor incumbency and more about product performance, orchestration and interworking.

Figure 29: RAN – 5G Transition

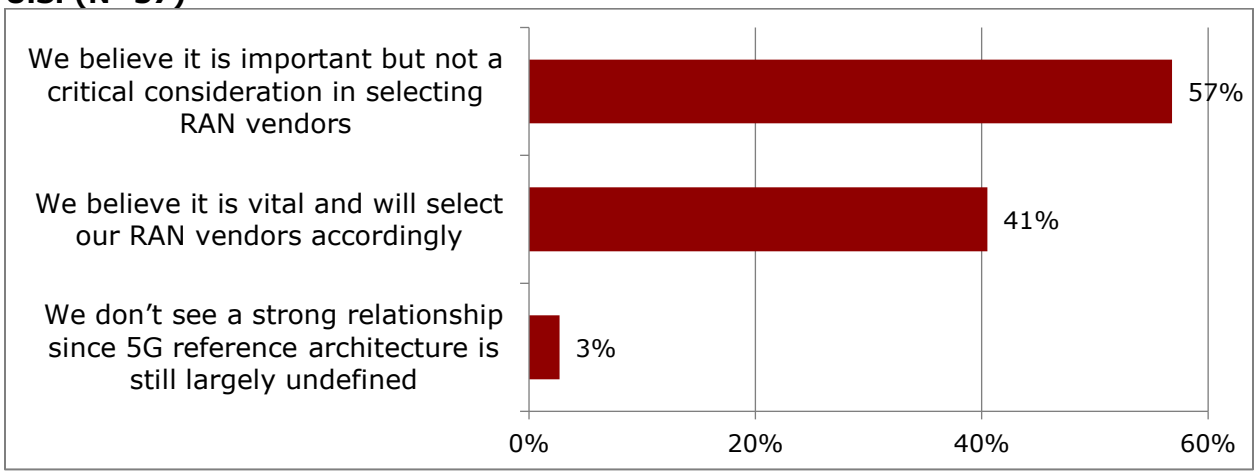


Question: Which of the following best reflects your company's position regarding the importance of virtualizing 4G RAN deployments to ensure a smooth transition to 5G? (N=72)

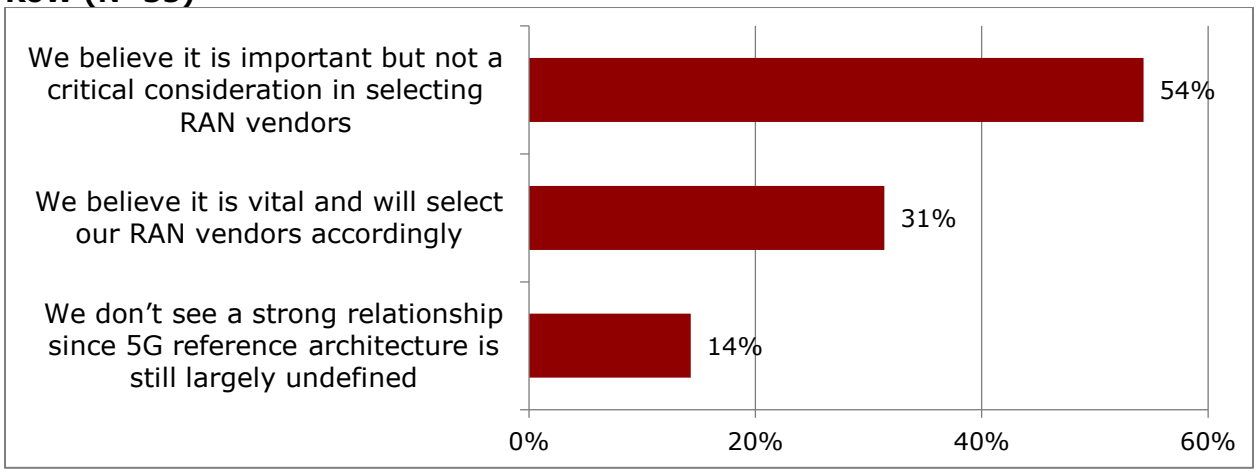
Filtering our survey results by geography reveals that respondents are very much aligned worldwide. As shown in **Figure 30**, U.S. respondent rankings of important and vital/critical (57% and 41%) are very similar to those of RoW respondents (54% and 41%).

Figure 30: RAN – 5G Transition by Geography

U.S. (N=37)



RoW (N=35)



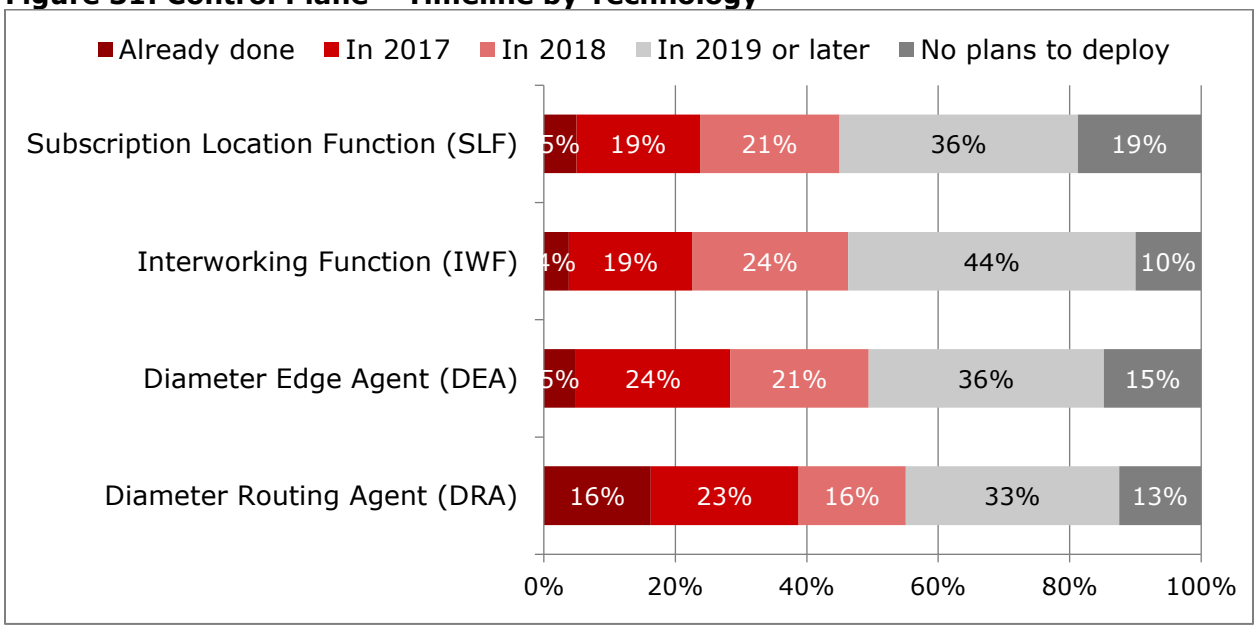
6. VIRTUALIZING THE CONTROL PLANE

The final section of the survey was designed to document control plane virtualization timelines, drivers as well as business and technical challenges. Starting first with the timeline, the intent was to insert a question that captured when CSPs planned to virtualize Diameter-based functional network nodes, ranging from Diameter Routing Agents (DRAs), Diameter Edge Agents (DEAs), and more specialized functions such as Interworking Function (IWF), and Subscription Location Function (SLF).

As **Figure 31** shows, CSPs not surprisingly have initially focused on DRA virtualization with 16% already have completed the task. This makes sense on several levels since the DRAs is a critical element to manage intra-network control plane traffic and vendors have been delivering vDRAs for more than 12 months.

This same focus extends into 2017, but we also start to see more respondents committing to vDEAs (24%) to manage inter-network control plane signaling. This level of support, for instance, translates into more than half (55%) of survey respondents implementing virtualized DRAs by the end of 2018.

Figure 31: Control Plane – Timeline by Technology



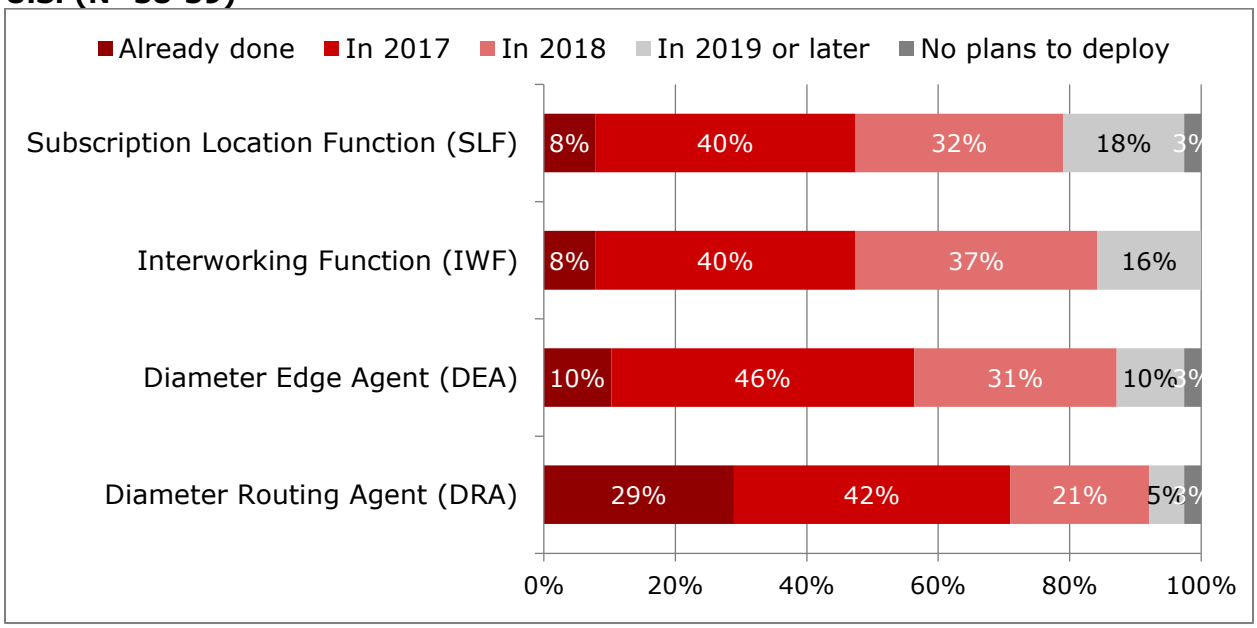
Question: When does your company plan to migrate the following Diameter controller variants to an NFV-based virtualized Diameter signaling controller (vDSC) platform and/or launch new virtualized Diameter controller variants? (N=80-81)

As noted above, there is a strong measure of support for virtualized Diameter-based products. However, as captured in **Figure 32**, there are very wide differences between our two filter groups.

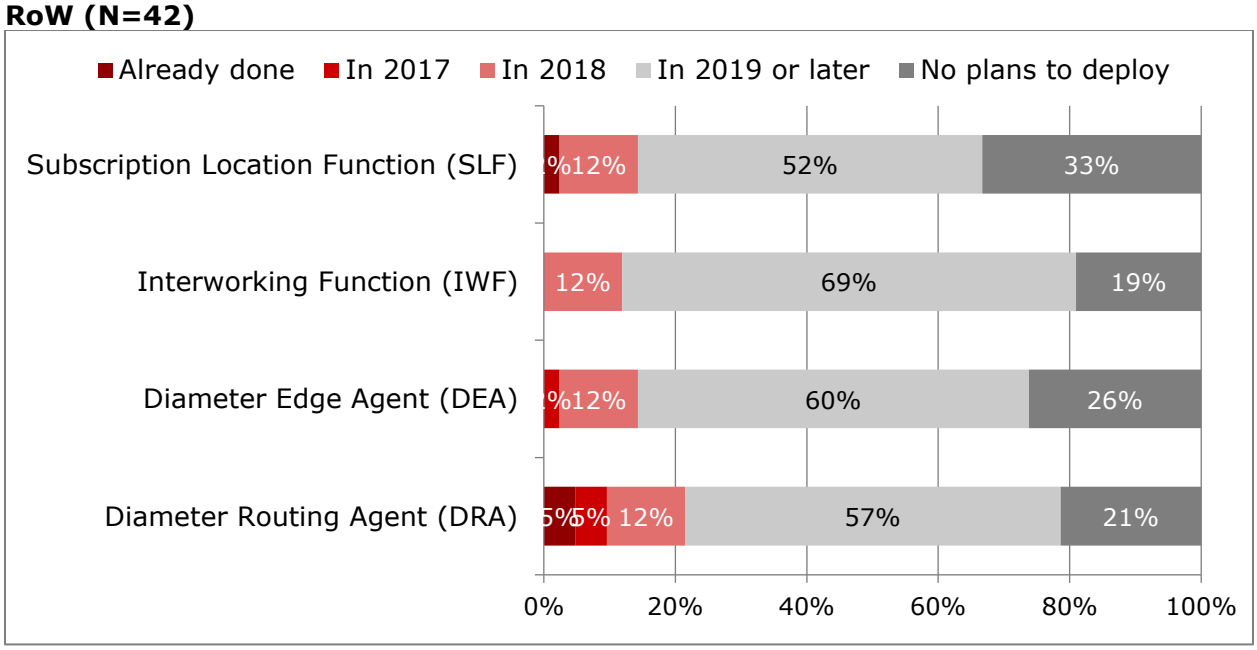
For example, 92% of U.S. respondents plan to have virtualized DRAs in place by the end of 2018, compared to only 22% of RoW respondents. Many factors are likely in play here, including U.S. 4G adoption and support for VoLTE (which is Diameter-based). RoW respondents don't see mass deployment of virtualized variants until 2019 or later.

Figure 32: Control Plane – Timeline by Technology by Geography

U.S. (N=38-39)



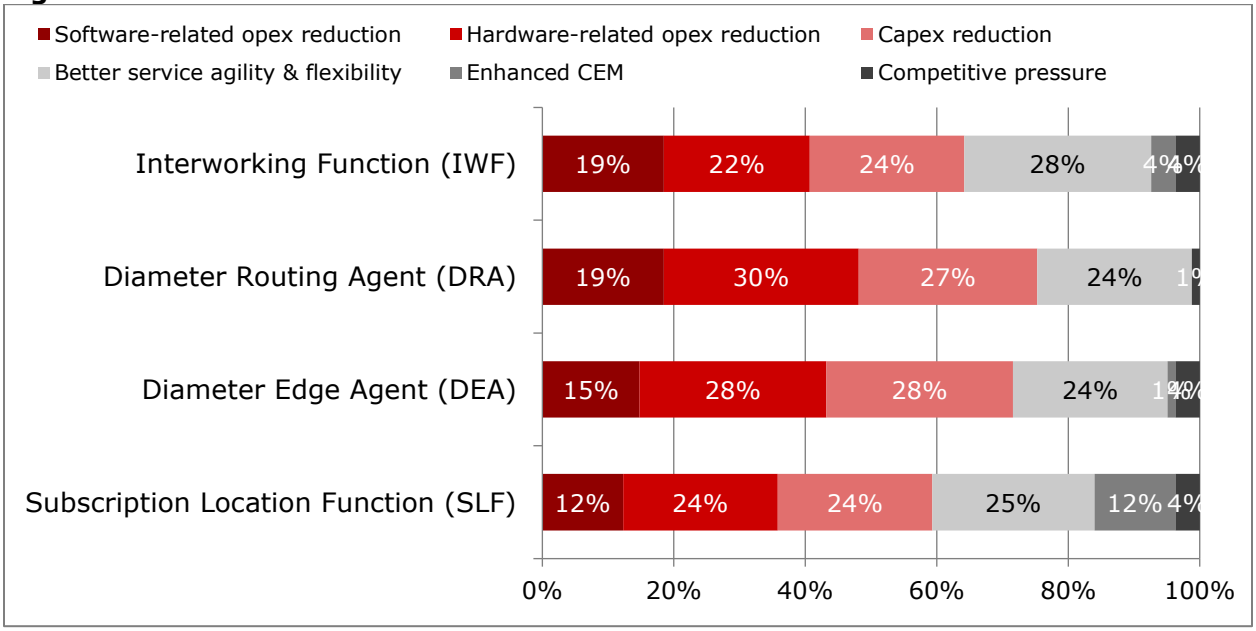
RoW (N=42)



As with the previous sections, the survey also investigated the business and technical drivers and related challenges. In a business driver context, as shown in **Figure 33**, the survey respondents adopted a broad stance of the business benefits and scored the drivers fairly equally.

These respondents viewed hardware opex reduction, capex reduction, and service agility as almost equal in weighting when looking at the specific product variants. This confirms that virtualization represents a solid value proposition on several levels.

Figure 33: Control Plane – Business Drivers

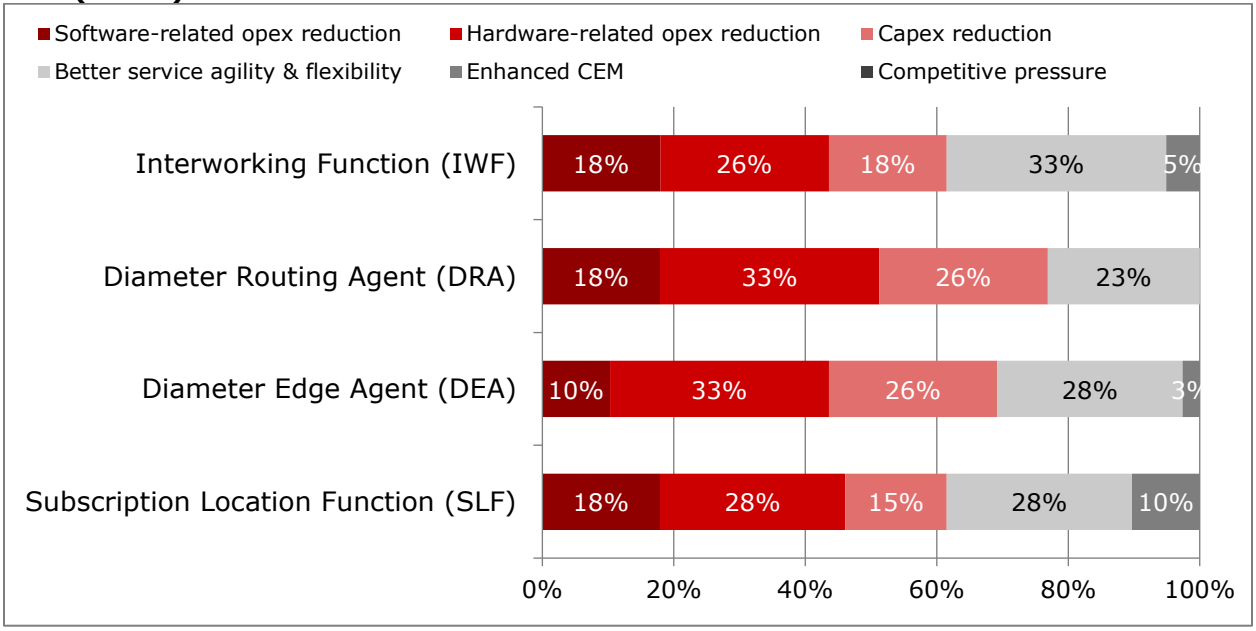


Question: What is the biggest business motivation for implementing virtualized platforms for the following Diameter controller variants? (N=81)

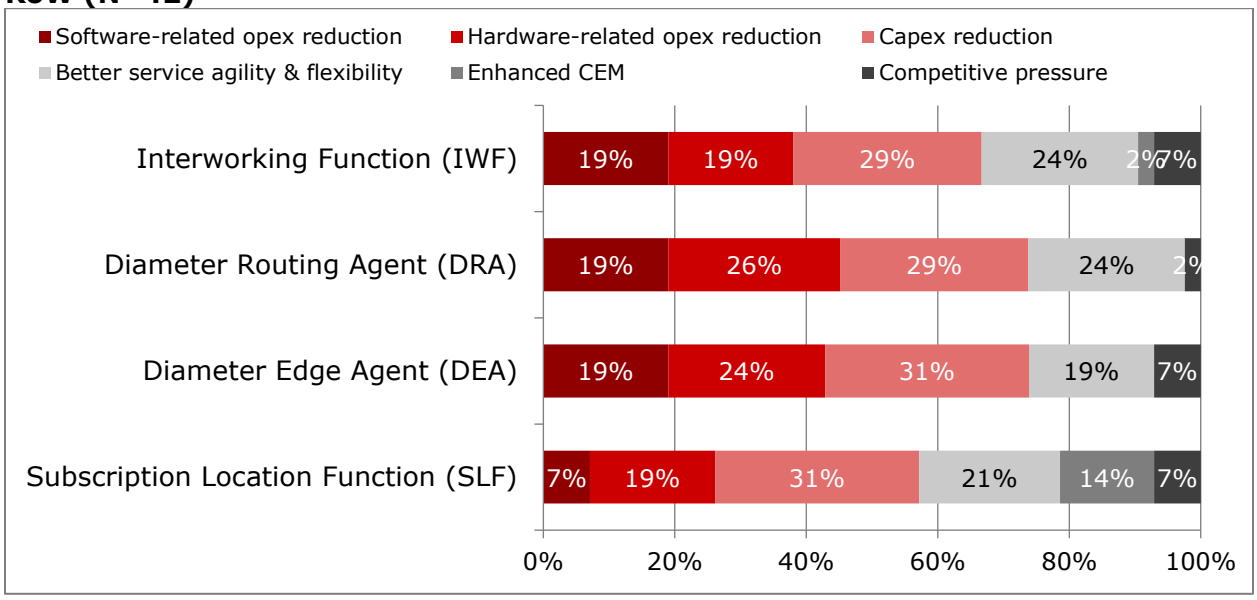
Filtering our survey results by geography shows that despite the differences in implementation timelines, there is considerable alignment on the business fundamentals and drivers. For example, using DRA as an example, U.S. respondents ranked hardware-related opex reduction and capex reduction as the top two drivers (33% and 26%, respectively), as did RoW respondents, with very similar scores (26% and 29%).

Figure 34: Control Plane – Business Drivers by Geography

U.S. (N=39)

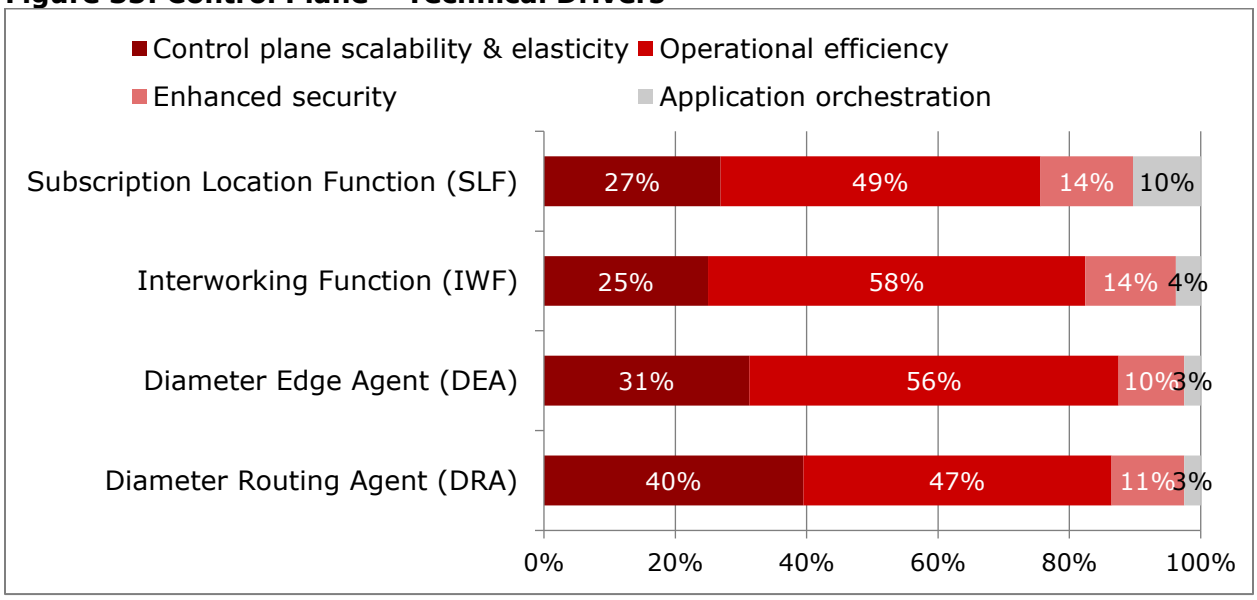


RoW (N=42)



As we did with messaging and vRAN we also asked the survey respondents to rank and apply the common technical drivers to the various DSC variants. Like messaging and vRAN, control plane scale and elasticity and operational efficiency are the top technical virtualization drivers. However, as shown in **Figure 35**, operational efficiency tends to carry a heavier weight across all DSC variants.

Figure 35: Control Plane – Technical Drivers



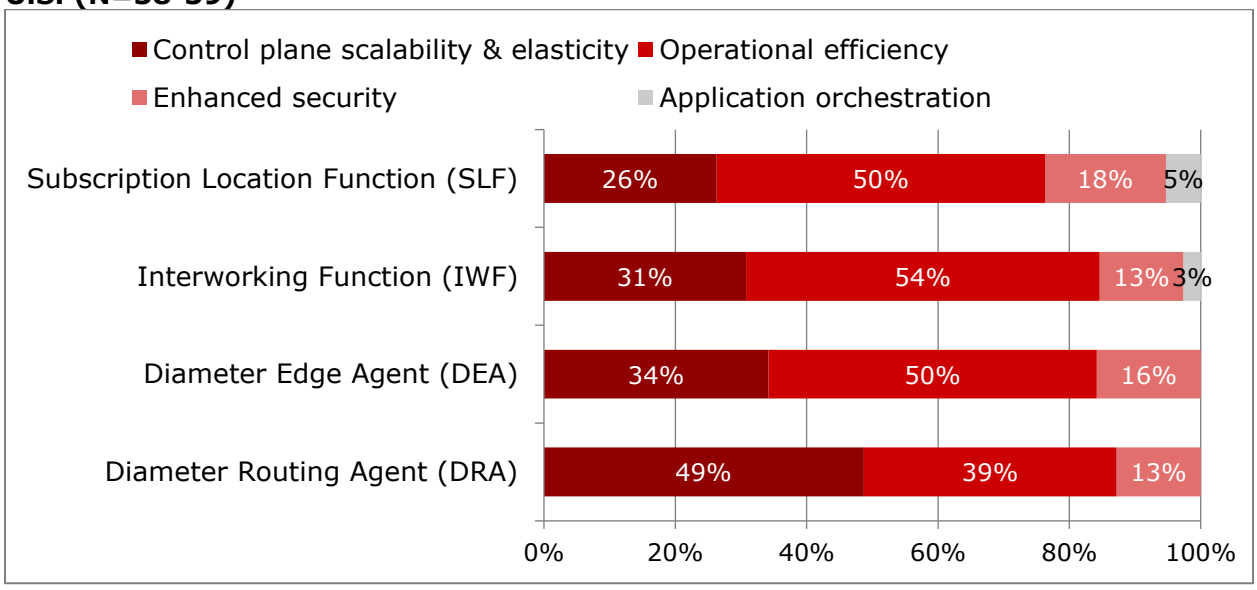
Question: What is the biggest technical motivation for implementing virtualized platforms for the following Diameter controller variants? (N=78-81)

Filtering our survey results by geography shows a considerable amount of alignment on the rankings, but also a few notable variances. For example, as shown in **Figure 36**, in a DRA context, U.S. respondents ranked control plane scale higher than their RoW counterparts

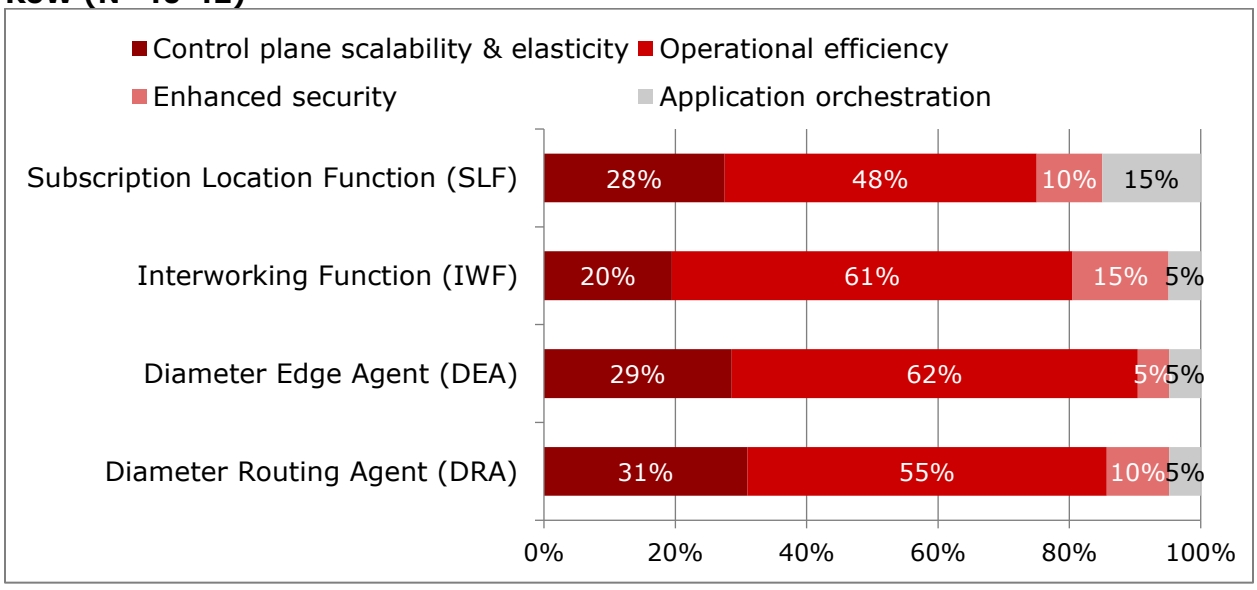
(49% vs. 31%), while RoW respondents ranked operational efficiency higher than U.S. respondents (55% vs. 39%). Still, in looking at both figures, there is a considerable amount of similarity which reinforces that both these drivers are global considerations.

Figure 36: Control Plane – Technical Drivers by Geography

U.S. (N=38-39)



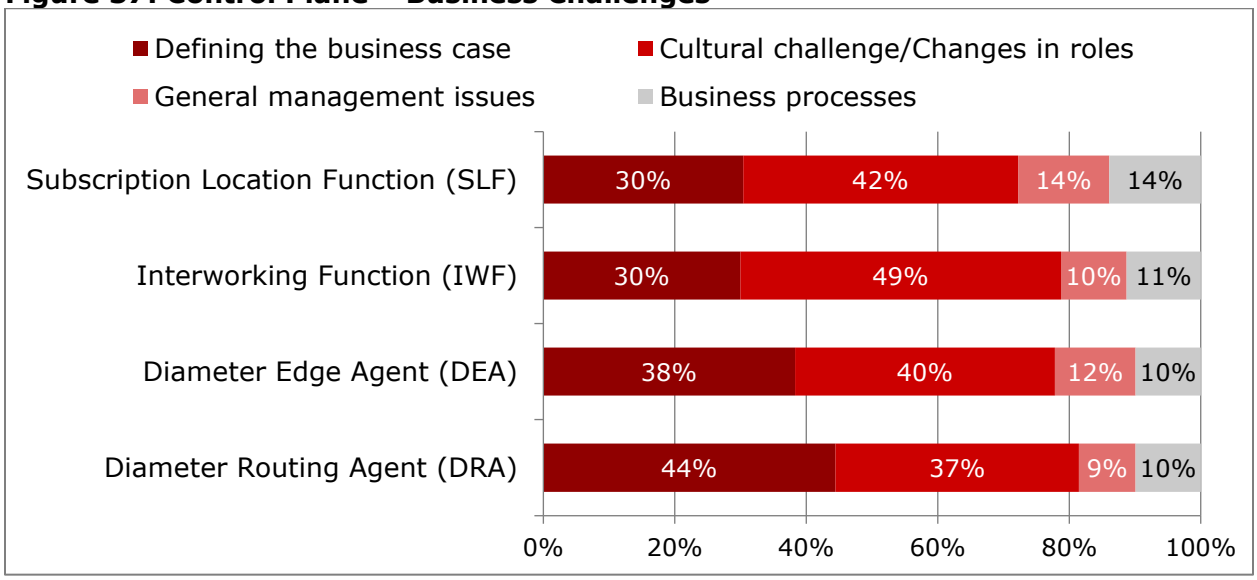
RoW (N=40-42)



Understanding both the business and technical challenges associated with virtualization was also explored to gain insight into the types and impacts of these challenges on the implementation process. For consistency purposes, when we asked survey respondents about the inherent business challenges we utilized the same general criteria such as business case definition, general management issues and cultural changes, augmented with a fourth option – business processes to reflect that Diameter has unique requirements such as negotiation of signaling roaming agreements.

As shown in **Figure 37**, cultural changes (37%-49%) and defining the business case (30%-44%) stand out as the top two business-related challenges. Given the results discussed earlier in this report, we conclude that these two challenges are common and most impactful for the technologies and applications addressed in the survey.

Figure 37: Control Plane – Business Challenges

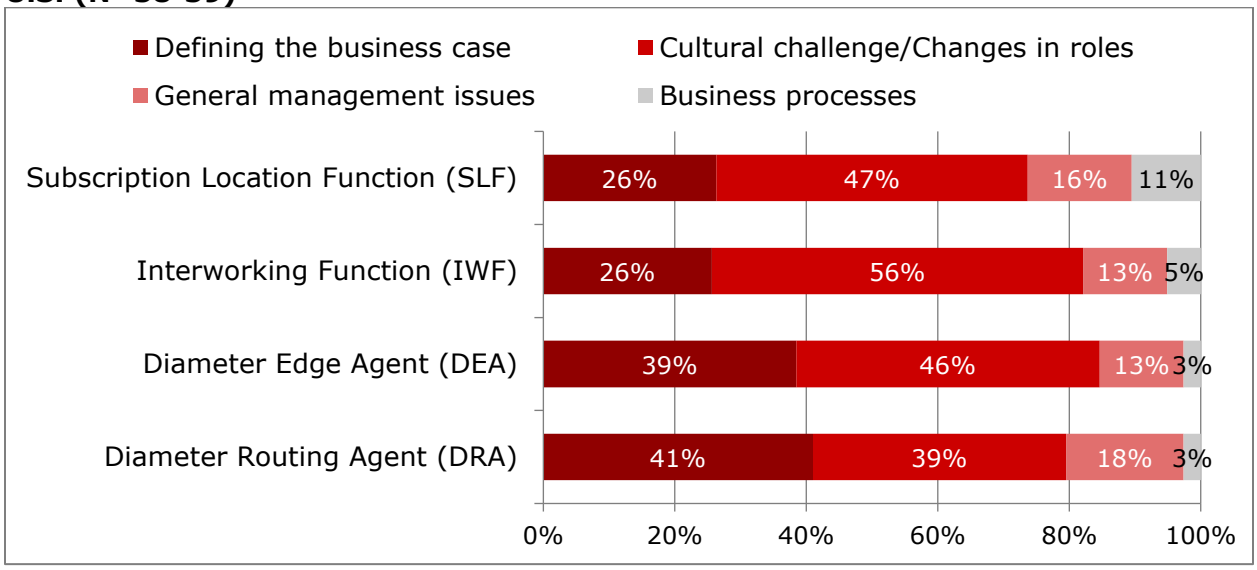


Question: What is the biggest business challenge involved in implementing virtualized platforms for the following Diameter controller variants? (N=79-81)

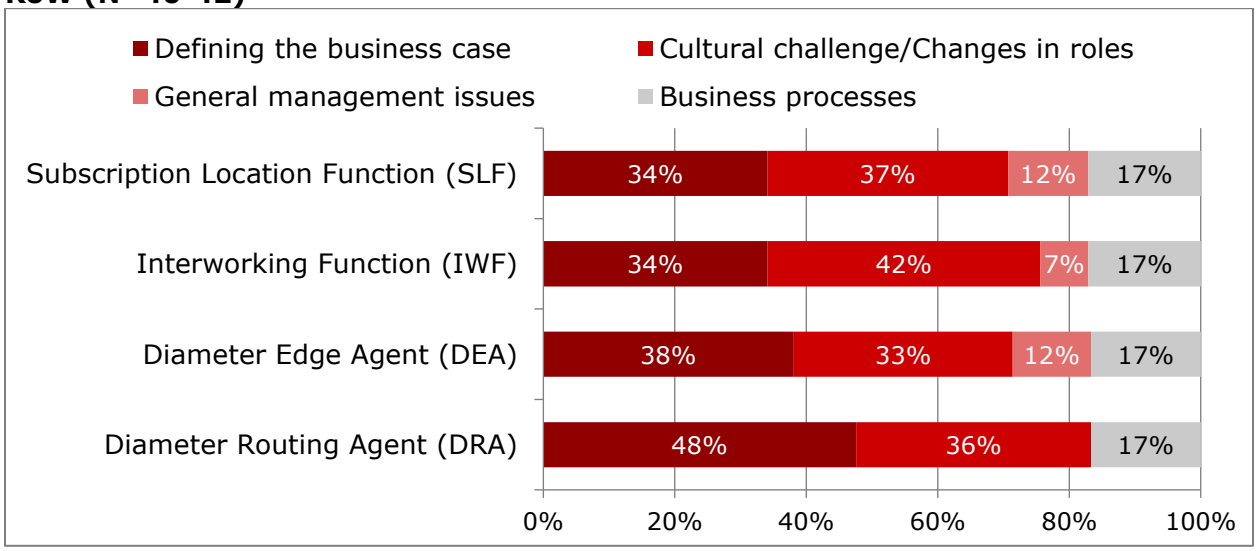
Filtering these survey results by geography confirms the uniform impact of these two challenges. As shown in **Figure 38**, the answers of U.S. and RoW respondents are quite aligned on cultural challenges (39%-56% U.S. vs. 33%-42% RoW) as well as defining the business case (26%-41% U.S. vs. 34%-48% RoW).

Figure 38: Control Plane – Business Challenges by Geography

U.S. (N=38-39)

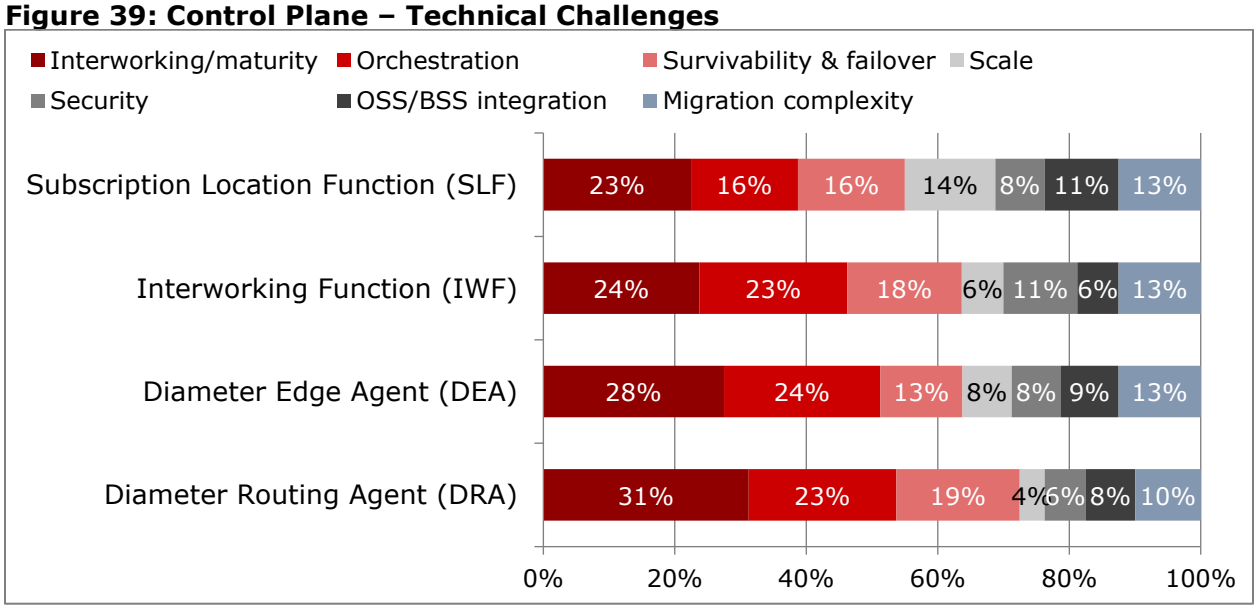


RoW (N=40-42)



The survey also addressed technical challenges of control plane virtualization. To offer a common base we again utilized the same seven categories. While the technical challenges are similar to other responses, as shown in **Figure 39**, unlike the vRAN, the primary technical challenge for virtualizing the control plane is vendor interworking/maturity, rather than orchestration. This is logical, since Diameter VNFs are not directly tied to software and service logic invocation and so, in theory, should be a little less complex to orchestrate. However, since the control plan is based on a very mature standard it is somewhat disappointing that interworking and product maturity remains the lead concern.

Figure 39: Control Plane – Technical Challenges



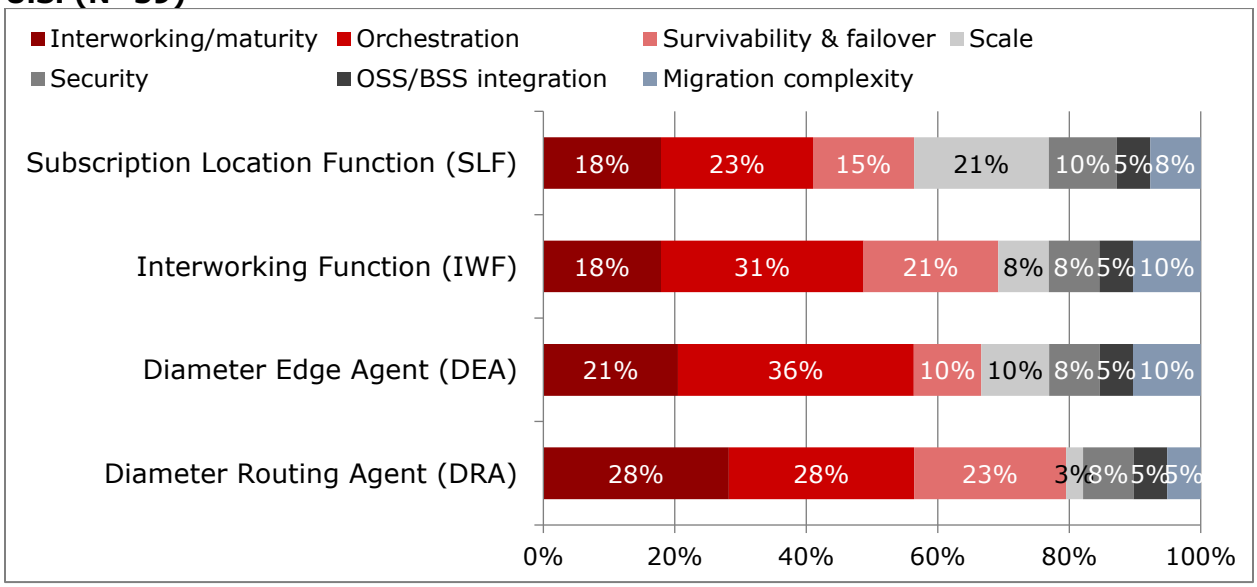
Question: What is the biggest technical challenge involved in implementing virtualized platforms for the following Diameter controller variants? (N=80)

As we noted previously, U.S. respondents have adopted a more aggressive timeline for support of vDSCs than RoW respondents. In theory, this means they should also have well-

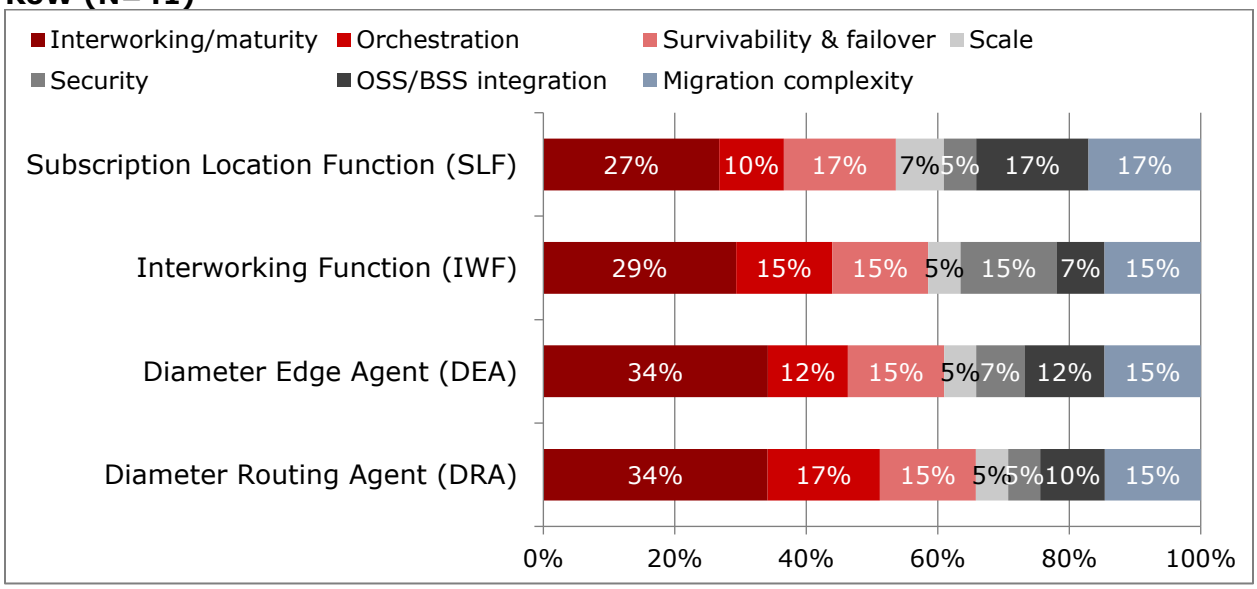
defined views of technical challenges than other CSPs that are still in the early stages of the deployment cycle. In practice, this is also the case. As shown in **Figure 40**, U.S. respondents ranked orchestration as a much greater challenge (23%-36%) than RoW respondents (10%-17%). In contrast, RoW respondents perceived vendor interworking as a greater challenge (27%-34%) than their U.S. counterparts (18%-28%).

Figure 40: Control Plane – Technical Challenges by Geography

U.S. (N=39)



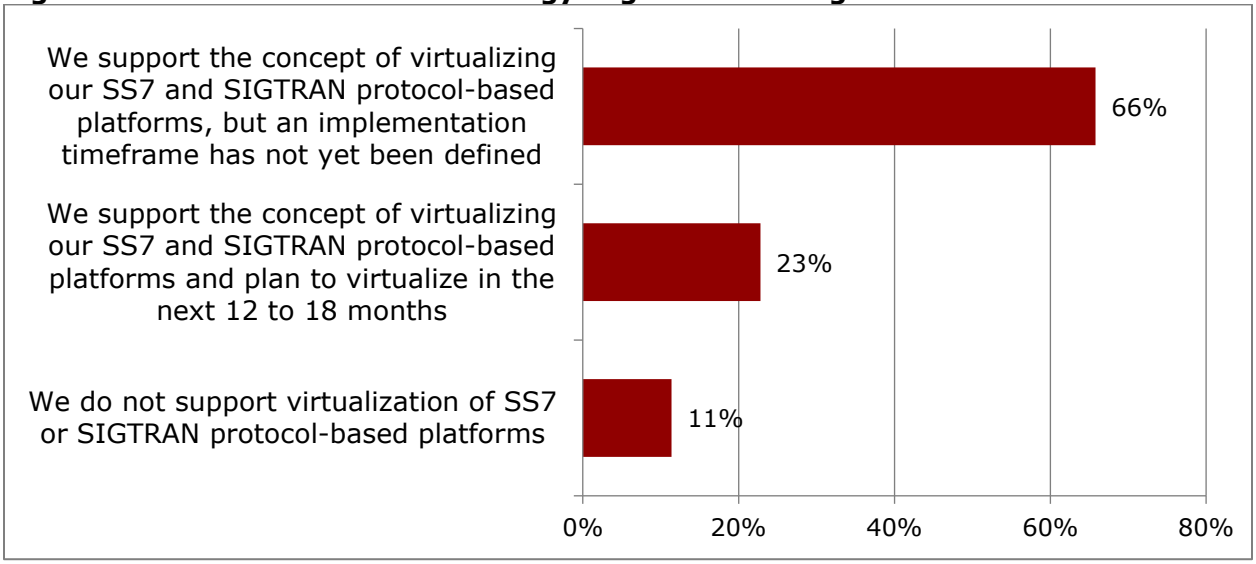
RoW (N=41)



In the final question of the survey, we asked the respondents to offer insight into control plane migration strategies. Specifically, the intent was to gauge interest to use virtualization for other legacy control plane protocols such as Signaling System Seven (SS7) and SS7 Signaling Transport over IP (SIGTRAN). As shown in **Figure 41**, while there appears to be general support, 66% of respondents have not defined a timeframe, which suggests that

implementation is not imminent. In contrast, only 23% plan to begin virtualization of these platforms in the next 12-18 months.

Figure 41: Control Plane – Technology Migration Strategies



Question: Which of the following best reflects your company's position on virtualizing control plane signaling functions? (N=63)

Filtering our survey results by geography reinforces the earlier observation that U.S. respondents are more committed to implementing a virtualized control plane. In this case, as captured in **Figure 42**, this translates to 42% of U.S. respondents supporting virtualized SS7 and SIGTRAN-based systems, compared to only 5% of RoW respondents.

In addition, 81% of RoW respondents fall into the "no defined timeline" group, compared to 50% of U.S. respondents. Thus, it appears that many RoW CSPs will take an extended period to begin implementation, with the risk that the longer the process takes, the less likelihood it will be impactful, as the inevitable pace of legacy system retirements accelerate.

Figure 42: Control Plane – Technology Migration Strategies by Geography

	U.S. (N=39)	RoW (N=41)
Virtualization supported – Implementation timeline not yet defined	50%	81%
Virtualization supported – Implement in 12-18 months	42%	5%
Do not support virtualization	8%	14%

7. CONCLUSION

The research documented in this report provides detailed insights into CSPs' virtualization priorities, drivers as well as the implementation hurdles they face. At a high level, it's readily apparent, that there is consideration support and momentum behind virtualization of messaging solutions, the RAN, as well as the signaling control plane.

Interestingly, as we have documented, many of the same business and technical drivers are germane to all three areas, as are many of the business and technical challenges. Moreover, it's also clear that despite orchestration, vendor interworking and even cultural challenges, many CSPs are maintaining focus and pushing forward with aggressive implementation virtualization timelines. As a result, within the next two years CSPs will take meaningful steps to harmonize network control, achieve profound outcomes in operational efficiency, elastic scale, capex and opex reduction, and service agility.