Heavy Reading – Independent quantitative research and competitive analysis of next-generation hardware and software solutions for service providers and vendors

KEY FINDINGS

Network appliances are now undergoing a fundamental transition in response to two drivers: increased transport network throughput and the impact of virtualization

The impact of NFV and SDN on network appliances is expected to be profound and overall positive

100G penetration in core transport networks is forecast to grow from 22% today to 75% by 2018

The lead use cases for virtualization are the acceleration of virtual functions, of virtual switching and of virtual appliances

73% of network operators plan to deploy virtualized appliances within a 12-24 month window

71% of vendors plan to develop and deliver virtualized appliances to market within this same window

SEPTEMBER 2015

The Future of Network Appliances

A custom Heavy Reading report produced for Napatech A/S

This custom research report, conducted on behalf of Napatech, presents and analyzes the results of a major survey addressing the evolution of network appliances. The research study derives data from an online survey of 136 qualified service provider and vendor respondents. Overall, the study confirms there is a strong degree of interest in both developing and deploying virtualized network appliances.

In addition, the research identifies that carriers and vendors are aligned in which network functions represent the best virtualized appliance candidates. They are also aligned with respect to the critical attributes that virtualized appliances must support. However, the survey confirms that differences do exist between them with respect to virtualized appliance pricing preferences, including the overall attractiveness of an open source pricing model.

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I. Introduction & Key Findings

The Future of Network Appliances Custom Research Study was launched in the second quarter of 2015 with the intent to provide sponsor Napatech with a granular view of the future of both traditional hardware and virtualized network appliances.

The survey was distributed by email to Light Reading's global list of communications service provider (CSP) and network equipment provider (NEP) registrants, who were invited to take the survey on the understanding of anonymity (i.e., that the respondents names, job titles and companies 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.

Some of the key areas and questions investigated include:

- What transport data rates (e.g., 10G vs. 100G) have CSPs currently implemented in their access, metro and core transport networks, and which speeds do to they plan to support in a few years?
- What is the perceived value of network appliances (both CSPs and NEPs)?
- How committed are CSPs and NEPs to deploying or developing traditional hardware management appliances?
- How committed are CSPs and NEPs to deploying or developing traditional hardware security appliances?
- To what extent do CSPs and NEPs see a need for hardware acceleration in SDN/NFV networks?
- How committed are CSPs and NEPs to the development and deployment of virtualized appliances?
- What technical challenges do CSPs and NEPs face in the development and deployment of virtualized appliances?
- What pricing models do CSPs and NEPs prefer for virtualized appliances?
- What attributes do CSPs favor when evaluating NEPs in the virtualized appliance selection process?

1.1 Key Findings

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

The market for network appliances is strong. As a proof point, 47% of respondents classified network appliances as essential, while another 39% ranked as valuable. Only 13% indicated that network appliances has little or no value. Another positive we see is that this sentiment is supported both CSPs and NEPs. For example, NEPs split it as 52% essential, 35% valuable, while CSPs split it as 43% essential, and 43% valuable.

However, like many network components, network appliances are now undergoing a fundamental transition in response to two drivers: increased transport network throughput and the impact of virtualization. Increases in data network throughput are happening at all levels due to the deployment of 100G. For example, while we consider this an aggressive forecast, CSPs forecast 100G data rates penetration in the access to grow from 9% penetration today to 58% by the end of 2018. Similarly, metro transport network throughput is also aggressively forecasted to grow from 14% penetration today to 71% by the end of 2018. Core transport network penetration of 100G is forecasted to grow from 22% penetration today to 75% by the end of 2018.

Survey results show that the impact of NFV and SDN on network appliances will be profound and overall positive. We classify the impact as positive, since the survey input clearly shows that both NEPs and CSPs see a continued need for network appliances in a 100G virtualized world.

However, this means the market for traditional hardware appliances has reached maturity, and will start to decline in favor of virtualized appliances. For example, in a traditional management appliance context, which includes load balancers, policy controllers and network performance monitors, roughly half of the products have already been developed or developed. On average, only about 22% of NEPs (19%) and CSPs (24%) are still developing or deploying new products, while another 19% may deploy or develop them in the future. The products with the least growth potential in traditional format are network performance monitors.

A similar trend is noted for traditional security appliances, including firewalls and intrusion detection systems. Only about 18% of NEPs and CSPs are still developing or deploy new products, while another 14% may deploy or develop in the future. Approximately 10% have no plans to develop or deploy. The products with the least growth potential in the traditional format are firewalls.

However, it's important to note that SDN and NFV will also rely heavily on hardware acceleration, which we see as driving the development and deployment of a new class of virtualized hardware acceleration platforms and appliances. The functions that collectively NEPs and CSPs see as the most desirable areas are acceleration of virtual functions (57%), acceleration of virtual switching (53%) and acceleration of virtual appliances (43%). The NEPs and CSPs are both generally aligned in ranking these three. (NEPs = 58%, 48%, 40%; CSPs = 56%, 59%, 46%).

As noted above, acceleration of virtual appliances has considerable support among both NEPs and CSPs. Accordingly, both are committed to development and deployment of these products. As a result, 73% of network operators plan to deploy virtualized appliances within a 12- to 24-month window. Similarly, 71% of vendors plan to develop and deliver virtualized appliances to market within a 12- to 24-month window.

Moreover, the survey confirmed that the first wave of virtualized management appliances functions have already been developed and deployed. The lead functions are network performance monitors (38%), followed by application performance monitors (29%). This is consistent with our earlier finding that noted network performance monitors had the least growth potential based on a traditional management appliance model.

The survey results also confirmed that the first wave of virtualized security appliances functions have already been developed and deployed. The leader is firewalls (43%), followed by intrusion detection/prevention systems (30%). This is consistent with our earlier finding that firewalls had the least growth potential based on a traditional management appliance model.

Although NEPs and CSPs are generally aligned in terms of virtualized management and security appliance deployment and development priorities, there is some deviation on a more granular level. This includes deployment drivers, implementation challenges, pricing models and even vendor selection attributes. For example, NEPs believe the top two critical drivers for deployment of virtualized appliances are scalability (55%) and network flexibility (49%). However, while CSPs also rank scalability the highest (65%), they rank capex reduction as the second driver (60% CSP, 26% NEP). Wide deviations were also noted with respect to opex (50% CSP, 30% NEP) and service flexibility (61% CSP, 38% NEP), which suggests that NEPs are focusing on building highly scalable, high-cost products that will not enable any significant reduction in opex and capex, while CSPs view the latter as critical attributes for deploying virtualized products.

These different views also are reflected in implementation challenge rankings. For example, while based on all responses the top three challenges are security (50%), interworking (38%) and throughput (35%). NEPs show lower rates of critical responses for these that CSPs – perhaps because they intend to develop scalable, secure and high-throughput products with less focus on

cost. However, we do see very close alignment on interworking as a high priority (38% NEP, 38% CSP) as a positive step toward dealing with the issue.

We also noted some deviation in preferred pricing models. Overall, the top three favored approaches were open source (46%), one-time investment (45%) and per-usage basis (30%). However, looking at the split between CSPs and NEPs, CSPs seem to prefer the open source (55% CSP, 36% NEP) and one-time investment (52% CSP, 37% NEP) approaches to a much greater degree than NEPs.

While CSPs prefer an open source pricing model, overall they do not consider it a top three factor in selecting virtualized appliance vendors. The top attributes are PoC trial performance (81%), RFP compliance (66%) and virtualization product roadmap (64%), which suggests that CSPs may be willing to pay a capex premium for the right product with optimal performance capabilities. We consider RFP compliance as tied to the CSPs' previously noted interworking concerns.

There is also some good news in that there is a strong sense of alignment between NEPs and CSPs on the critical attributes that virtualized appliances should support. The top of the list for both is the ability to move a virtual appliance application on the fly (42% NEP, 43% CSP). The only potential disconnect is delivery of common software releases, which a greater percentage of CSPs (34%) view as critical compared to NEPs (21%).

Finally, CSPs seem split on which approach to take with respect to purchasing software and hardware. While 49% indicated they would prefer to purchase hardware and software from a single vendor, 42% indicated they would prefer to purchase hardware from a server vendor and software from an application vendor. Given this split, we also believe that open source may become a more important selection attribute for those CSPs that wish to go down the path of purchasing software from one vendor and hardware from another to ensure interoperability.

1.2 Report Scope & Structure

The Future of Network Appliances is structured as follows:

Section II provides demographic data on CSP and NEP survey respondents.

Section III documents the key trends and drivers in the appliance market, including the evolution of traditional hardware management and security appliances to virtualized appliances.

Section IV captures virtualized appliance vendor selection attributes, including preferred pricing models.

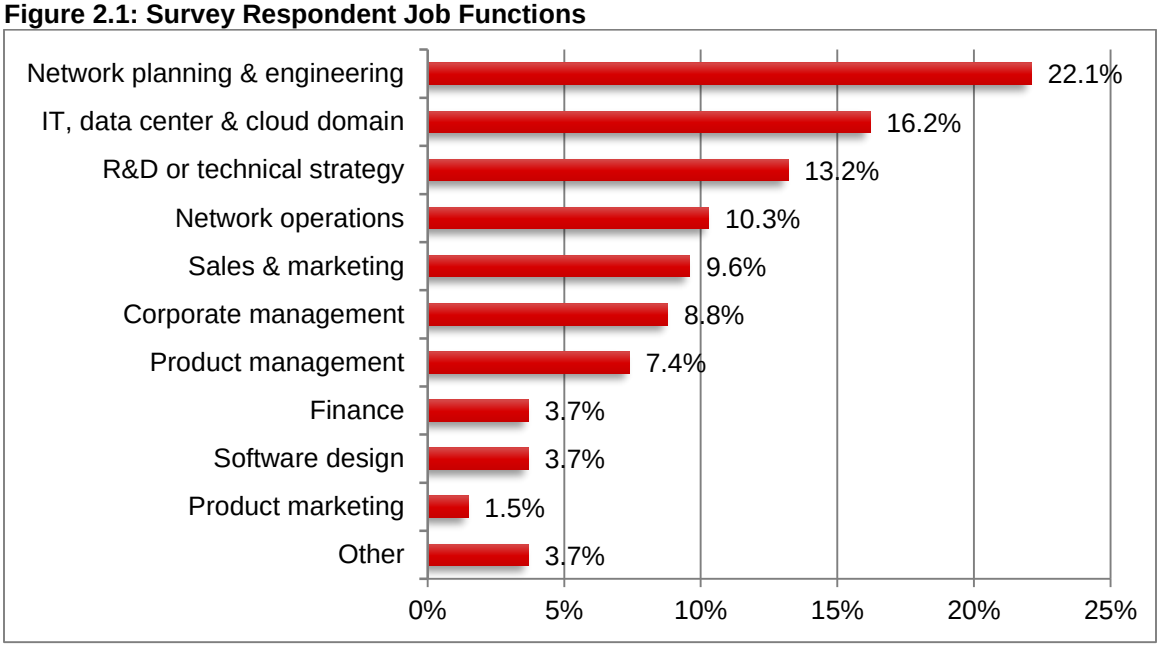
Section V provides a conclusion and summary.

II. Survey Demographics Summary

This report is based on a major online survey launched in the second quarter of 2015 to obtain valuable insight from both CSPs and NEPs on the value and evolution path of virtualized management and security appliances. The survey contained 21 questions, some of which were germane to only CSPs, some for NEPs only, and some which applied to both CSPs and NEPs.

The survey attracted a large base of qualified and high-value CSP and NEP respondents, with the 136 qualified respondents optimally mixed between CSPs (69) and NEPs (67). These respondents performed a wide range of carrier and vendor functions, including technology and engineering, corporate and product management, network planning, IT data center and cloud, software design, finance, and sales and marketing, providing a multifaceted view of both value propositions and challenges. The U.S. attracted about 55%+ of both CSP and NEP respondents.

Figure 2.1: Survey Respondent Job Functions



Question: What is your main job function? N=136

In addition, as shown in **Figure 2.2**, both CSP and NEP survey respondents performed a broad range of technical and marketing functions. For example, NEP respondents were highly versed in the IT data center and cloud domains (25%), which ensures a forward-looking view of the future of hardware appliances. Similarly, the CSPs were well represented by network planning and engineering staff (30%), who have hands-on deployment experience with traditional network appliances and will unquestionably perform a front-line role in the implementation of virtualized appliances.

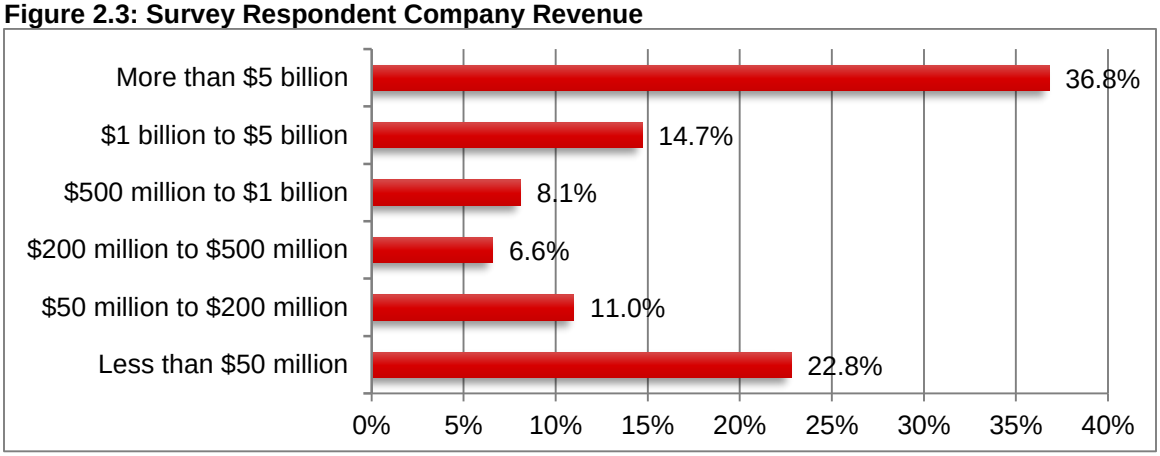
Figure 2.2: Survey Respondent Job Functions – NEP vs. CSP

JOB FUNCTIONS	NEP	CSP
Corporate management	9%	9%
R&D or technical strategy	11%	16%
Network planning & engineering	13%	30%
Network operations	6%	15%
IT, data center & cloud domain	25%	7%
Sales & marketing	12%	7%

JOB FUNCTIONS	NEP	CSP
Finance	5%	3%
Software design	6%	2%
Product management	9%	6%
Product marketing	0%	3%
Other	5%	3%

A revenue demographic question was included in the survey to capture the size of the companies our CSP and NEP respondents represented. As shown in **Figure 2.3**, a broad range of companies were represented, which also enhances survey reach.

Figure 2.3: Survey Respondent Company Revenue



Question: What is your company's annual revenue? N=136

As noted above, 37% of respondents worked for large companies (more than $5 billion). However, as shown in **Figure 2.4**, there were considerable differences between NEPs and CSPs. Most of the largest companies were CSPs (49%), rather than NEPs (24%). We consider this as a positive, since we believe the largest CSPs will be more aggressive in devising and implementing virtualized appliance strategies. However, even in this case, the remaining 51% was well distributed among the midsize and smallest operators, which serves to provide a balanced view of overall readiness.

Among NEPs, only 24% of the survey respondents came the largest revenue category, while 39% were from the smallest, which we see as a reflection of the fact that the NEPs landscape is highly entrenched and served by a number of smaller NEPs that provide highly specialized software and hardware, which is integrated by Tier 1 NEPs or other systems integrators.

Figure 2.4: Survey Respondent Company Revenue – NEP vs. CSP

COMPANY ANNUAL REVENUE	NEP	CSP
Less than $50 million	39%	7%
$50 million to $200 million	16%	6%
$200 million to $500 million	8%	6%
$500 million to $1 billion	5%	12%
$1 billion to $5 billion	9%	20%
More than $5 billion	24%	49%

III. The Future of Network Appliances

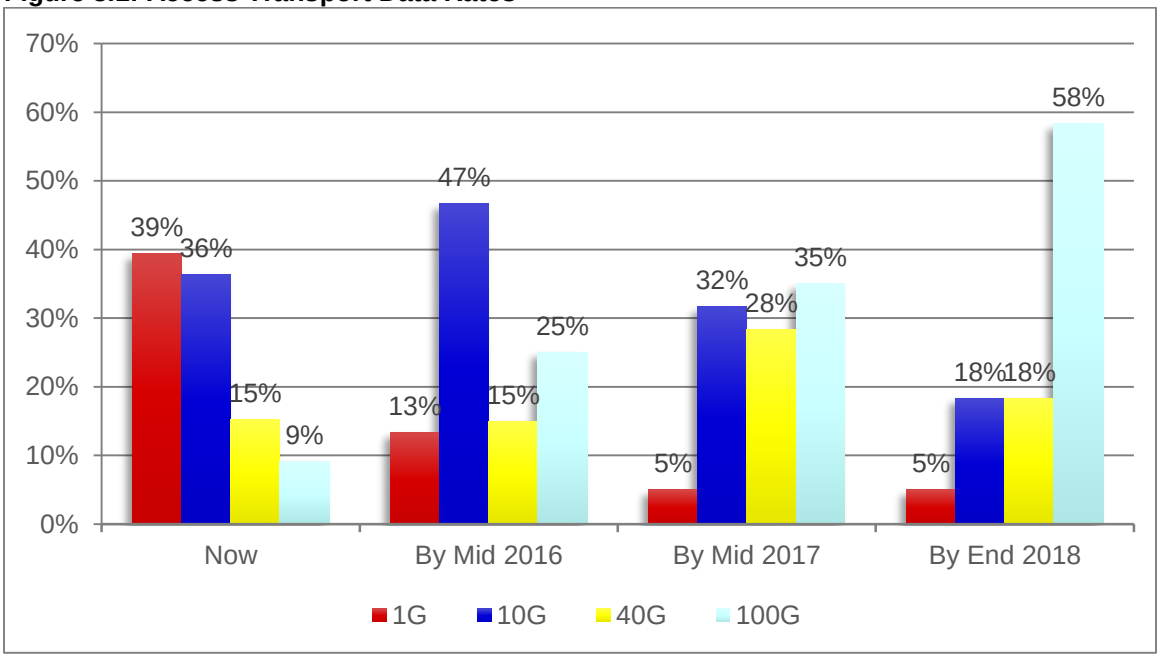
In this section of the report, we examine in detail the survey findings as they relate to the current state and evolutionary path of network appliances.

As a starting point, given that hardware appliances and the acceleration capabilities they support are considered tied to transport layer throughput requirements, we first explored CSPs' strategies to deploy and upgrade to higher-performance data rates in their access, metro and core transport networks. A key finding from the input presented below is that in a few years all transport networks will have reached the tipping point from a services delivery perspective, as they will have much greater throughput to support high-bandwidth services.

Starting first with access transport data rates, as shown in **Figure 3.1**, CSPs are currently relying mostly on 1G (39%) and 10G (36%) technology in the access. However, looking forward on a short-term basis (the next 12 months), these same operators plan to deploy 10G technology, largely at the expense of 1G. Accordingly, by mid-2016 CSPs forecast that the penetration of 1G gear will drop from 39% to 13%, while 10G will experience strong growth from 36% to 47%.

Also notable is the dramatic forecasted uptake of 100G deployment in the access by the end of 2018. Overall, CSPs see that 100G will from less than 10% today to 58% by 2018. As shown in the figure, the greatest increase take place from 2017 to 2018. We are somewhat surprised by such a strong growth projection for 100G in the access and consider this an aggressive forecast. We believe there are several factors that survey respondents are factoring in here, including the impact of 4G reaching its commercial zenith, as well as the preliminary impact of early 5G network upgrades to support the high capacity that 5G will consume.

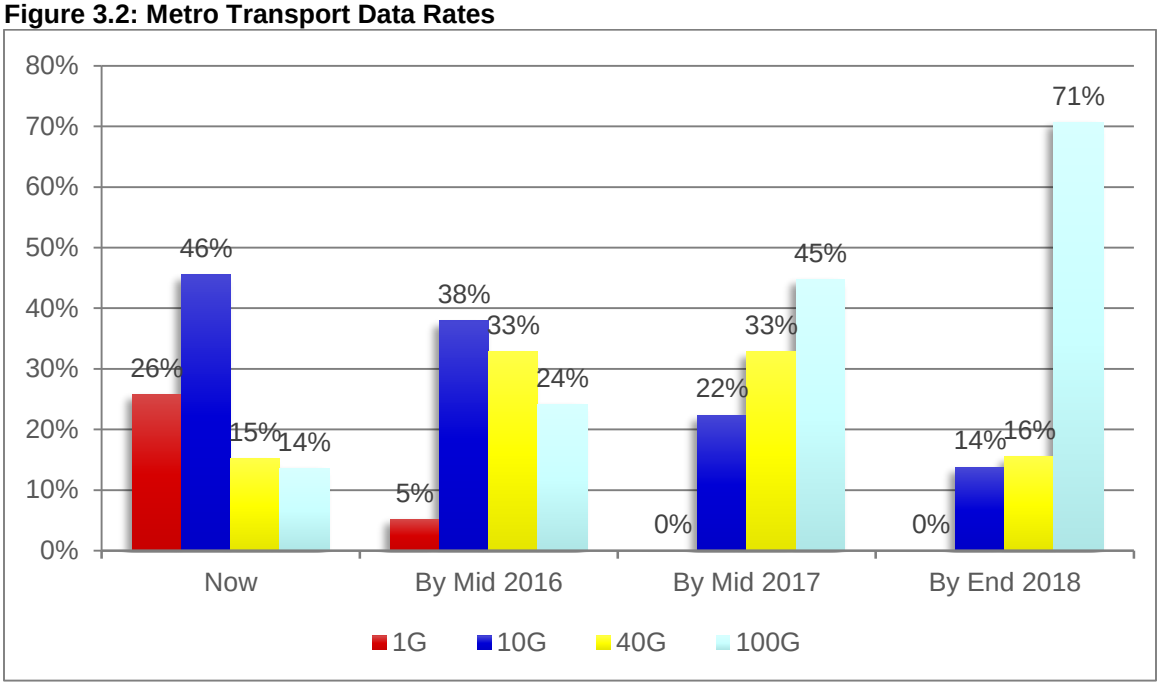
Figure 3.1: Access Transport Data Rates



Question: What are your company's most common current and planned data rates for its access transport network? N=62-66

We also noted similar trends in survey respondent opinions on metro and core throughput evolution. As shown in **Figure 3.2**, while 46% of operators are leveraging 10G in metro networks today, this number will steadily drop to only 14% by the end of 2018. In contrast, 100G will grow from 14% today to 71% by the end of 2018. We also consider this an aggressive forecast, with 4G and 5G likely factoring into 100G adoption.

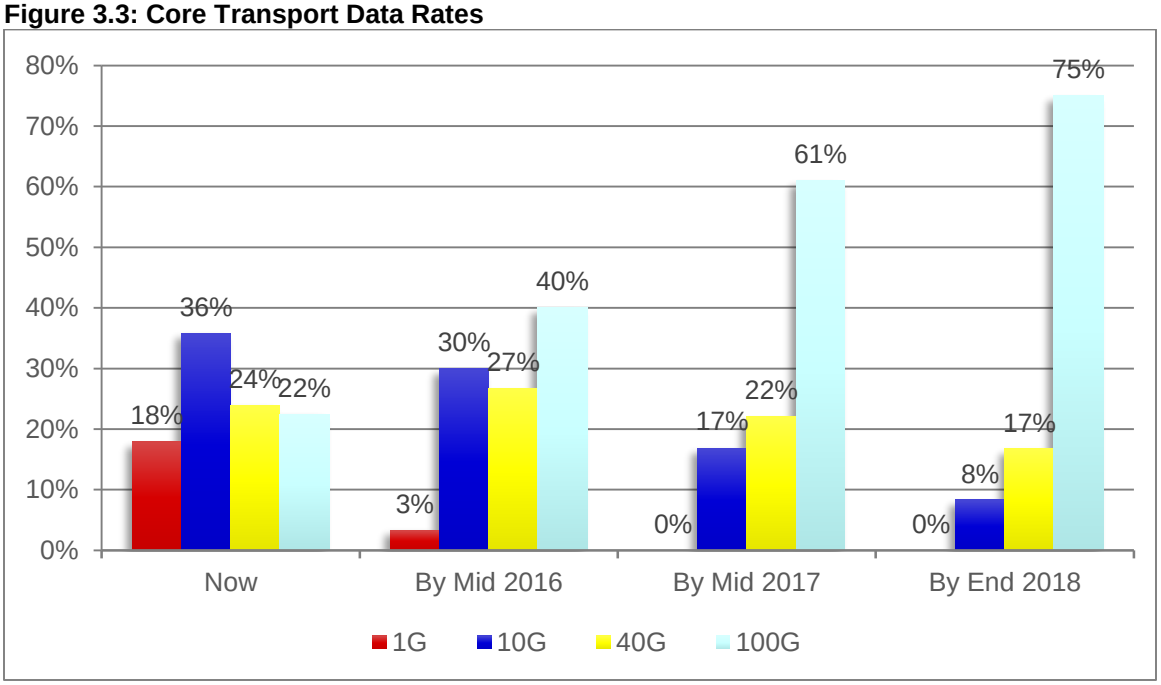
Figure 3.2: Metro Transport Data Rates



Question: What are your company's most common current and planned data rates for its metro transport network? N=63-66

In the final question in this series of three, we extended the discussion to the core transport network. As shown in **Figure 3.3**, the trends are very similar. As we anticipated, the adoption and penetration of 100G is stronger here than in the other two transport network categories. This translates to 75% adoption by the end of 2018, compared to 71% and 58% in the metro and access respectively. We consider this forecast less aggressive and a realistic view of 100G adoption in the core.

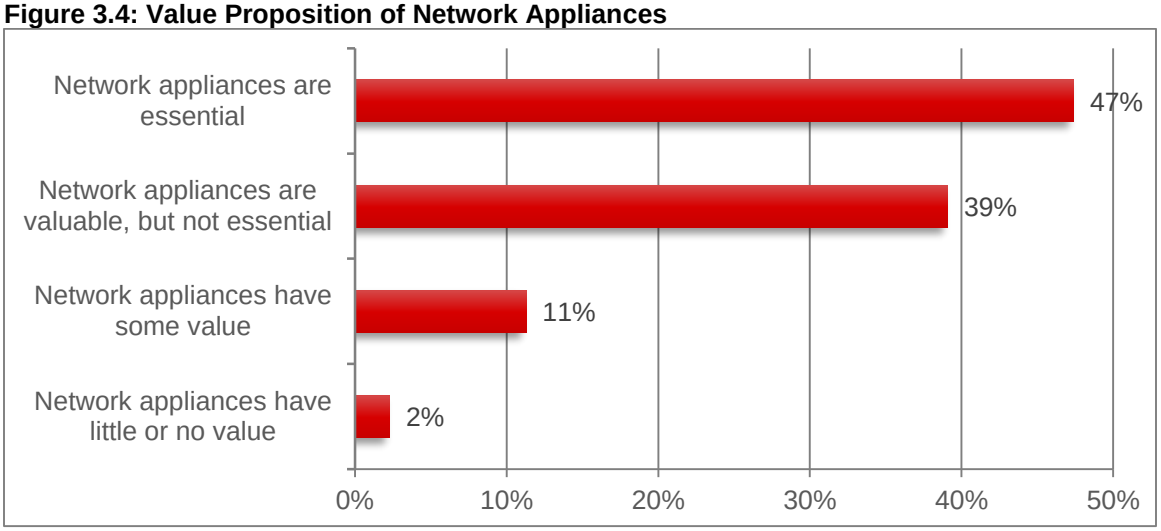
Figure 3.3: Core Transport Data Rates



Question: What are your company's most common current and planned data rates for its core transport network? N=60-64

CSPs see their transport networks as undergoing a fundamental evolution in throughput speeds over the next few years, which in theory should be a positive development for network appliances. In order to test this premise and to provide a foundational benchmark, we first asked both CSP and NEP survey respondents for their opinion about the overall value proposition of network appliances. Overall, as shown in **Figure 3.4**, support of network appliances is very strong, with 47% assessing them as an essential network component, and 39% assessing as valuable, but not essential. The remaining 13% broke down to 11% some value and only 2% no value.

Figure 3.4: Value Proposition of Network Appliances



Question: Which statement best matches your company's view of the value proposition of network appliances? N=131

Given that this question was designed to measure not only *overall* support levels, but also differences between CSPs and NEPs, we filtered the results of these two distinct groups. As shown in **Figure 3.5**, overall the trends are similar, which we see as representing a positive vendor-customer endorsement model. For example, while NEPs provided a higher level of "essential" responses (52% NEP, 43% CSP), the summed percentages of "essential" and "valuable" responses are almost identical (52% + 35% = 87% NEP; 43% + 43% = 86% CSP).

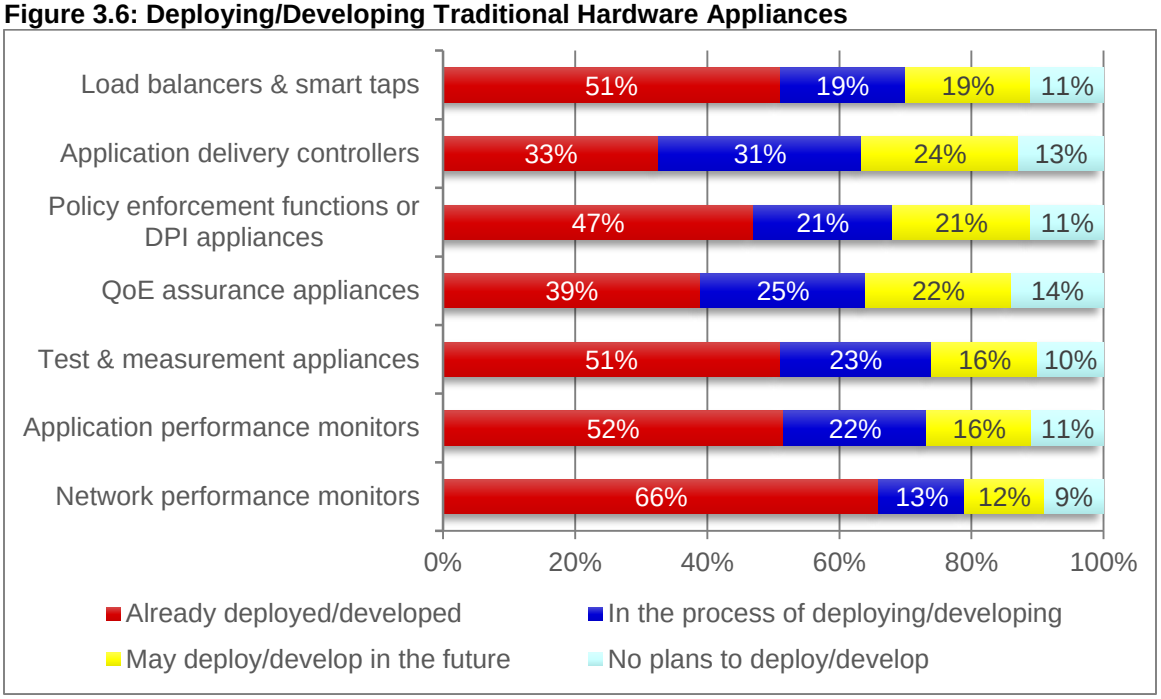
Figure 3.5: Value Proposition of Network Appliances – NEP vs. CSP

ATTRIBUTES	NEP	CSP
Network appliances are essential	52%	43%
Network appliances are valuable, but not essential	35%	43%
Network appliances have some value	14%	9%
Network appliances have little or no value	0%	5%

As previously noted, there is a strong perceived value proposition of traditional hardware appliances, both from vendors that create the products and the network operators that ultimately deploy them. Accordingly, in the next series of survey questions we investigated the specific types of functions NEPs had already built or were building on traditional hardware appliances, and which ones CSPs had deployed or planned to deploy.

To accomplish this, we first asked both groups to identify these functions, based on the list of seven functions traditional hardware appliances are known to support. As shown in **Figure 3.6**, the top three products that are most likely to have been built or deployed are network performance monitors (66%), application performance monitors (52%), and test and measurement appliances/load balancers and smart taps (both 51%). Not far behind was policy and DPI appliances, at 47%.

Figure 3.6: Deploying/Developing Traditional Hardware Appliances



Question: Please indicate your company's plans to deploy or develop the following traditional hardware management appliances. N=129-131

Looking at the responses from CSPs and NEPs separately reveals that both groups are generally aligned in terms of which products have been built/deployed or are in the process of being developed/deployed. For example, looking at the already built and deployed category, network performance monitors were top ranked for both groups (74% CSP, 57% NEP). CSPs ranked load balancers and smart taps second (60%), while NEPs chose application performance monitors (47%). The network function that received the lowest "already deployed" score was application delivery controllers (37% CSP, 29% NEP). However, it's notable that application delivery controllers were highest ranked for the "in process" phase of deployment/development (31% CSP, 30% NEP).

The network function with the largest deviation is load balancers and smart taps: While 60% of CSPs have already deployed these products, only 42% of NEPs have developed these products or supporting capabilities, which we believe is in part due to the market size, timing and business evolution of the competitive landscape.

Overall, despite the deviations noted in **Figure 3.7** in terms of already built vs. deployed, we believe the fairly consistent rankings of the top three represents the fact that, function-wise, there is not a serious disconnect between the products the CSPs have already deployed and the marketplace of available products that NEPs have already built.

Figure 3.7: Deploying/Developing Traditional Hardware Appliances – NEP vs. CSP

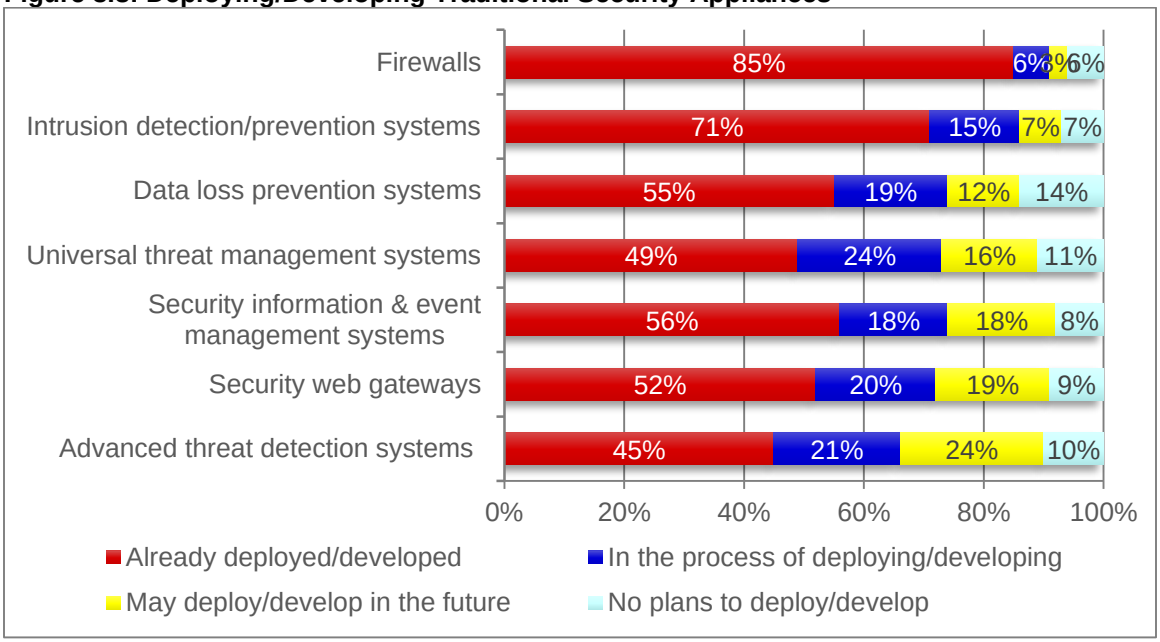
ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Network performance monitors	57%	74%	9%	17%	19%	6%
Application performance monitors	47%	56%	17%	27%	21%	11%
Test & measurement appliances	42%	59%	23%	23%	20%	13%
Quality of experience assurance appliances	36%	42%	22%	27%	18%	26%

ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Policy enforcement functions or DPI appliances	43%	51%	13%	29%	25%	17%
Application delivery controllers	29%	37%	30%	31%	23%	25%
Load balancers & smart taps	42%	60%	20%	19%	20%	19%

We followed the same approach for investigating alignment between CSPs and NEPs for traditional hardware-based security appliances. As shown in **Figure 3.8**, we requested they identify which specific security functions they had developed/deployed, or were likely to in the future. In this case, the top three functions already developed or deployed were firewalls (85%), intrusion detection/prevention systems (71%), and security information and event management systems (56%).

Additional functions that also garnered significant response levels included data loss prevention systems (55%), security gateways (52%) and universal threat management systems (49%), which we view as representing the fact that traditional security appliances have been both developed and deployed to support a number of critical network security functions.

Figure 3.8: Deploying/Developing Traditional Security Appliances



Question: Please indicate your company's plans to deploy or develop the following traditional hardware security appliances. N=129-131

Looking at the responses from CSPs and NEPs separately, as shown in **Figure 3.9**, reveals that the two groups are fairly well aligned, in that products have been built by NEPs that CSPs have needed and hence deployed. For example, 80% of NEPs have built firewalls and 90% of CSPs have deployed them, which we believe translates into a valuable but mature product area. The same is true for intrusion detection/prevention systems (76% CSP, 66% NEP).

The network function with the largest deviation is universal threat management systems (60% CSP, 38% NEP), which we believe can also be explained in part due to the market size, timing and business evolution of the competitive landscape. As a proof point, this security function scored the highest in the "in process" deployment/development category (23% CSP, 25% NEP), which suggests that NEPs are in the process of responding to an underserved carrier market.

Figure 3.9: Deploying/Developing Traditional Security Appliances – NEP vs. CSP

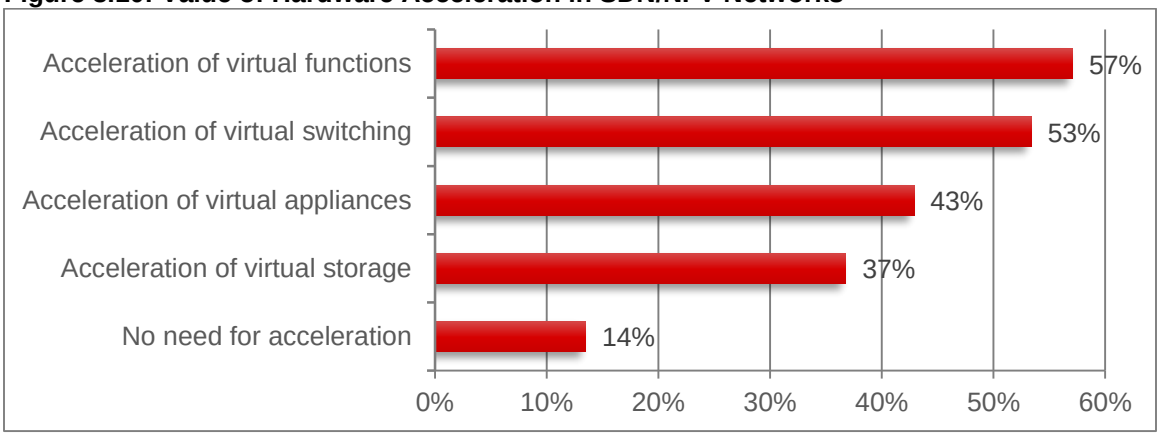
ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Firewalls	80%	90%	5%	8%	5%	2%
Intrusion detection/prevention systems	66%	76%	14%	17%	11%	3%
Data loss prevention systems	51%	60%	15%	22%	15%	9%
Universal threat management systems	38%	60%	25%	23%	22%	11%
Security information & event management systems	50%	62%	17%	20%	21%	15%
Security web gateways	42%	63%	25%	15%	20%	17%
Advanced threat detection systems	37%	53%	19%	23%	32%	17%

One of the key mandates of this research project, in addition to documenting the present market dynamics, was to document the future of hardware appliances by examining the factors that are shaping their evolutionary path.

In this regard, it is widely believed that both software-defined networking (SDN) and network functions virtualization (NFV) will have an unprecedented impact, fundamentally changing how hardware and software is developed and deployed. Still, there are a number of key questions that need to be answered, including to what extent hardware acceleration remains relevant in an SDN/NFV-enabled world.

In order to obtain a holistic industry view, we asked both CSPs and NEPs to provide their opinions on where hardware acceleration remains a vital component to support these deployments. The responses to this question, shown in **Figure 3.10**, confirm that there is global support of hardware acceleration in this new network realm. For example, 57% of all respondents indicated that hardware acceleration was necessary to support acceleration of virtualized functions, while 53%, 43% and 37% saw a need for hardware acceleration to support virtual switching, virtual appliances and virtual storage respectively. In a further positive point, only 14% considered hardware acceleration as *not required* to support SDN/NFV.

Figure 3.10: Value of Hardware Acceleration in SDN/NFV Networks



Question: Where does your company see a need for hardware acceleration in SDN/NFV networks? N=130-131

We also wanted to understand if there were similar or disparate views between CSPs and NEPs. As shown in **Figure 3.11**, the views are very similar in terms of priorities, with only acceleration of virtual switching having a greater than 10% spread in response opinions (59% CSP, 48% NEP).

Even here, it's worth noting that both selected virtual switching as their second-highest priority. Overall, we believe this strong level of alignment between carriers and their vendors is an important foundational factor to move the virtualized product acceleration market forward.

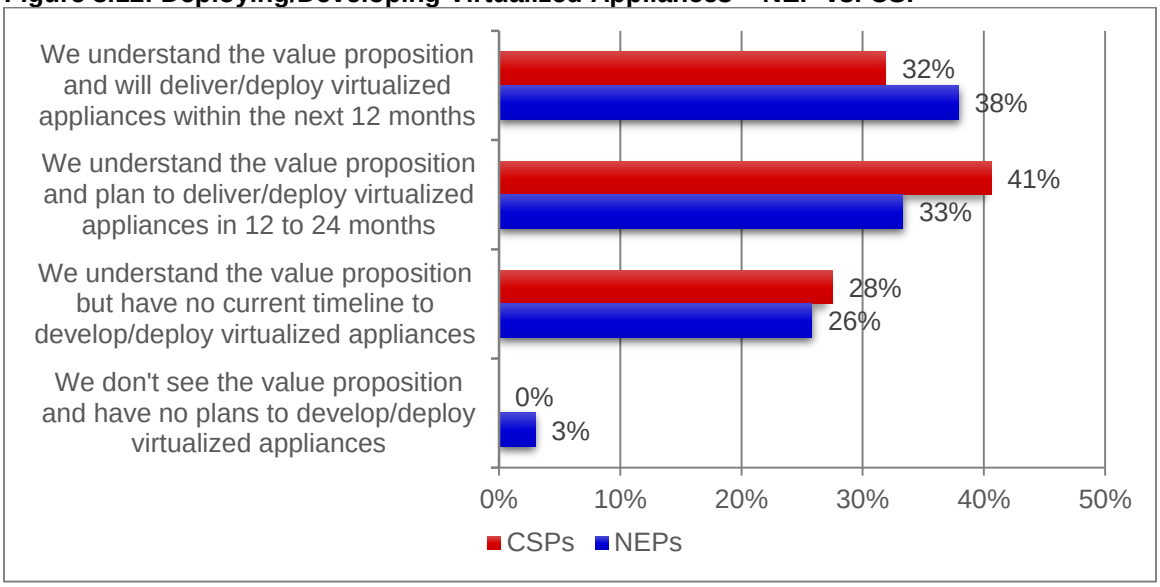
Figure 3.11: Value of Hardware Acceleration in SDN/NFV Networks – NEP vs. CSP

ATTRIBUTES	NEP	CSP
Acceleration of virtual functions	58%	56%
Acceleration of virtual switching	48%	59%
Acceleration of virtual appliances	40%	46%
Acceleration of virtual storage	33%	41%
No need for acceleration	13%	14%

The survey was also designed to document the interest in and timeline for CSPs and NEPs to deploy and develop virtualized appliances.* Accordingly, the survey included two questions related to value proposition and deployment/development windows. As shown in **Figure 3.12**, it's clear that CSPs see a strong value proposition in deploying virtualized appliances, with 32% committed to deployment in 12 months, and 41% with plans to deploy within 12 to 24 months. This leaves only 28% who understand the value proposition, but have yet to develop concrete plans. But perhaps more important is the fact that *0%* of CSPs indicated they *did not* understand the value proposition associated with deploying virtualized appliances.

Among NEPs, the metrics also represent a strong commitment to developing virtualized appliances. As the figure shows, 38% of NEPs plan to deliver products to market within 12 months, and 33% within the next 12 to 24 months, which is very well aligned with CSPs' deployment requirements. Only 26% of vendors have not yet started product development, and only 3% don't see the value proposition at all.

Figure 3.12: Deploying/Developing Virtualized Appliances – NEP vs. CSP



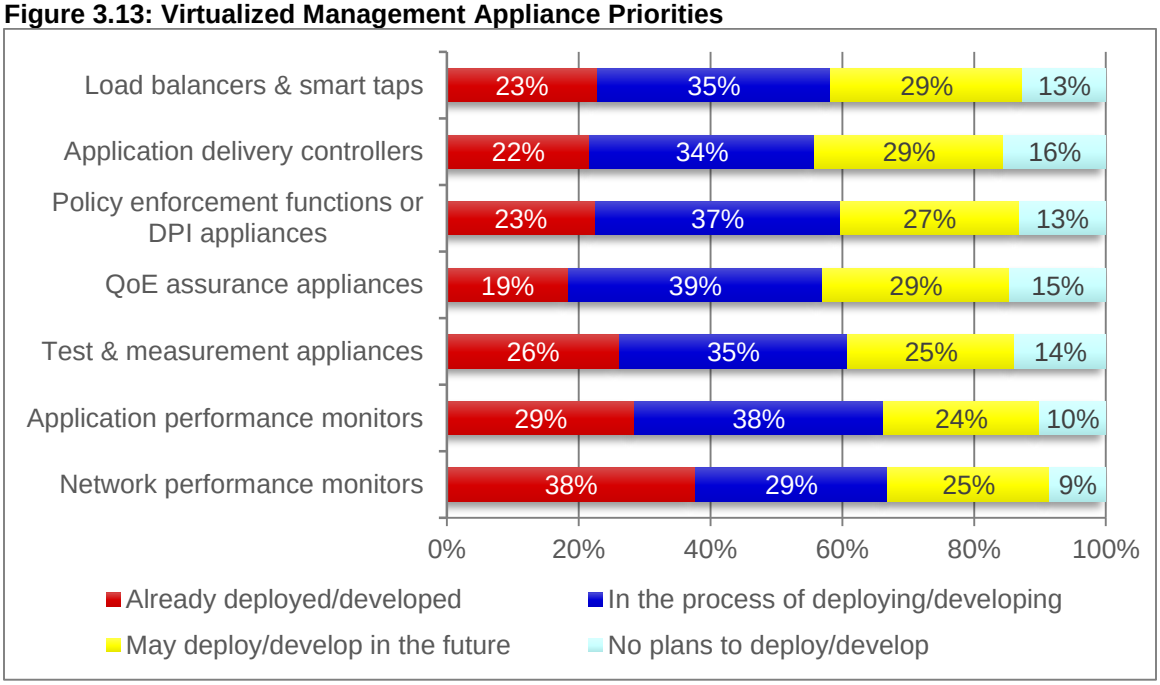
Question: Which statement best describes your company's thinking about the value of developing/deploying virtualized appliances? N=67-69

* To ensure clarity, we included the following definition of virtualized appliances in the survey: "For purposes of this survey, a virtualized appliance is defined as an open platform that uses virtualized software designed to run on any commercial hardware acceleration platform."

The next section of the survey investigated which virtualized appliance products were considered the highest priorities from a deployment and development perspective. To accomplish this, we followed the same approach utilized earlier with traditional hardware appliances and asked two distinct questions: one for virtualized management appliances, one for virtualized security appliances. For consistency, we also reused the same product categories from the earlier questions.

As shown in **Figure 3.13**, survey responses confirmed that the first wave of virtualized management appliance functions have already been developed and deployed. The lead functions were network performance monitors (38%), application performance monitors (29%) and test and measurement appliances (26%). We believe the number one ranking of virtualized network performance monitors is also factor in explaining why survey respondents saw the least growth potential based on a traditional management appliance model for this product, because the market had become saturated and new approaches were necessary.

Figure 3.13: Virtualized Management Appliance Priorities



Question: Please indicate your company's plans to deploy or develop the following virtualized management appliances. N=129-131

Examining the data split between CSPs and NEPs, as shown in **Figure 3.14**, indicates generally strong alignment between both groups in terms of the functions already developed or deployed, or in process. Where significant gaps do exist – such as with respect to deployment/development of policy enforcement functions (15% CSP, 30% NEP), catch-up appears to be occurring in the "in process" phase (48% CSP, 27% NEP).

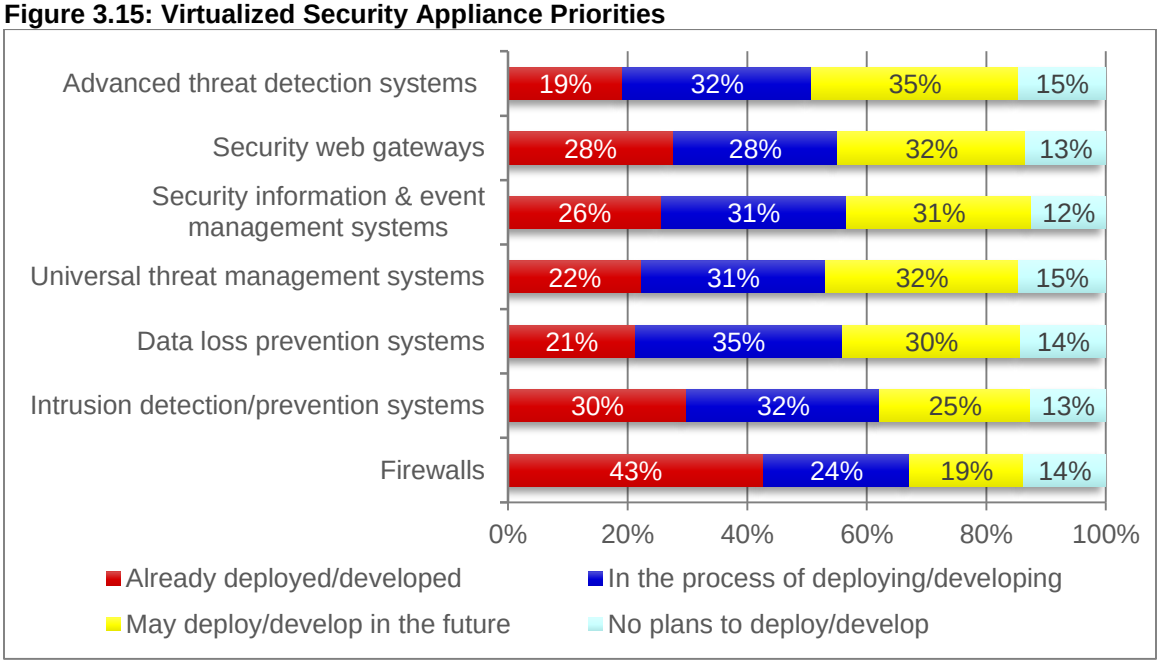
Figure 3.14: Virtualized Management Appliance Priorities – NEP vs. CSP

ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Network performance monitors	39%	36%	24%	34%	23%	27%
Application performance monitors	33%	23%	30%	45%	23%	25%
Test & measurement appliances	26%	27%	33%	36%	24%	27%
Quality of experience assurance appliances	20%	17%	33%	44%	27%	30%

ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Policy enforcement functions or DPI appliances	30%	15%	27%	48%	25%	29%
Application delivery controllers	24%	19%	32%	37%	23%	35%
Load balancers & smart taps	28%	18%	28%	43%	25%	33%

The survey results also confirmed that the first wave of virtualized security appliances functions have already been developed and deployed. The leader is firewalls (43%), followed by intrusion detection/prevention systems (30%) and then security gateways (28%). We believe the number one ranking of virtualized firewalls is also a factor in explaining why survey respondents saw the least growth potential based on a traditional security appliance model for this product, because the market had become saturated and new approaches were necessary (see **Figure 3.15**).

Figure 3.15: Virtualized Security Appliance Priorities



Question: Please indicate your company's plans to deploy or develop the following virtualized security appliances. N=127-131

Looking at the CSP and NEP data splits once again reflects a general sense of alignment between both groups. For example, in terms of already developed/deployed, while the percentages may differ, the priorities are similar (e.g., firewalls and intrusion detection were both ranked 1 and 2).

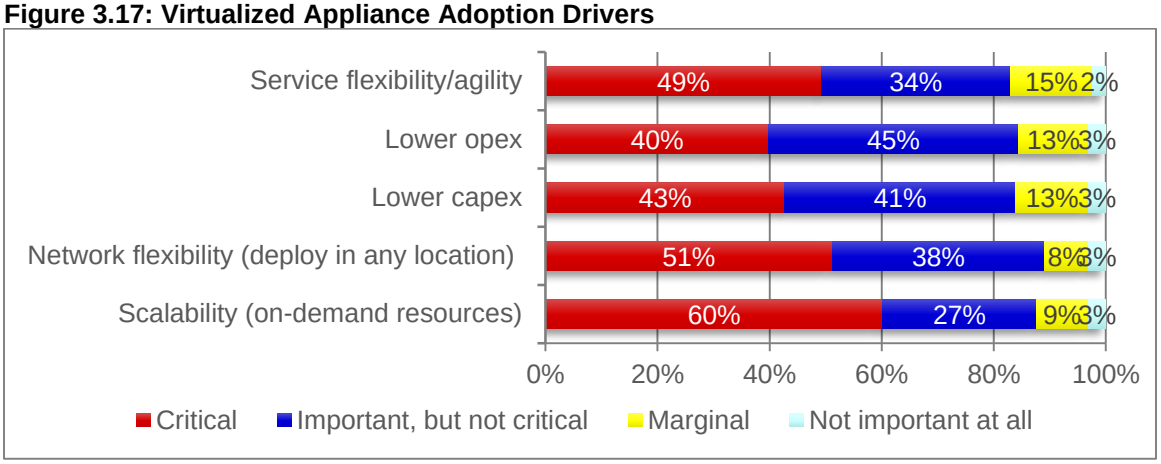
Figure 3.16: Virtualized Security Appliance Priorities – NEP vs. CSP

ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Firewalls	49%	37%	17%	32%	15%	23%
Intrusion detection/prevention systems	37%	23%	23%	42%	23%	27%
Data loss prevention systems	22%	21%	37%	32%	25%	36%
Universal threat management systems	28%	16%	25%	37%	28%	37%

ATTRIBUTES	ALREADY		IN PROCESS		MAY	
	NEP	CSP	NEP	CSP	NEP	CSP
Security information & event management systems	32%	19%	29%	33%	26%	37%
Security web gateways	34%	21%	19%	37%	28%	35%
Advanced threat detection systems	23%	16%	32%	31%	27%	42%

The next two survey questions were designed to capture the technical and business drivers fueling interest in virtualized appliances, as well as the challenges associated with their delivery. Starting with adoption drivers, as shown in **Figure 3.17**, the top three drivers identified based on critical response levels were scalability (60%), network flexibility (51%) and service flexibility (49%).

Figure 3.17: Virtualized Appliance Adoption Drivers



Question: Please rate the importance of the following factors in driving your company to deploy or develop virtualized appliances. N=128-131

Looking at these drivers in the eyes of CSPs and NEPs separately reveals some differences in view. As shown in **Figure 3.18**, while both groups rank scalability as the leading driver (65% CSP, 55% NEP), NEPs rank network flexibility second (49%), while CSPs point instead to service flexibility (61%). Third-place rankings are also not aligned: NEPs selected service flexibility (38%), while CSPs looked to capex reduction (60%).

Figure 3.18: Virtualized Appliance Adoption Drivers – NEP vs. CSP

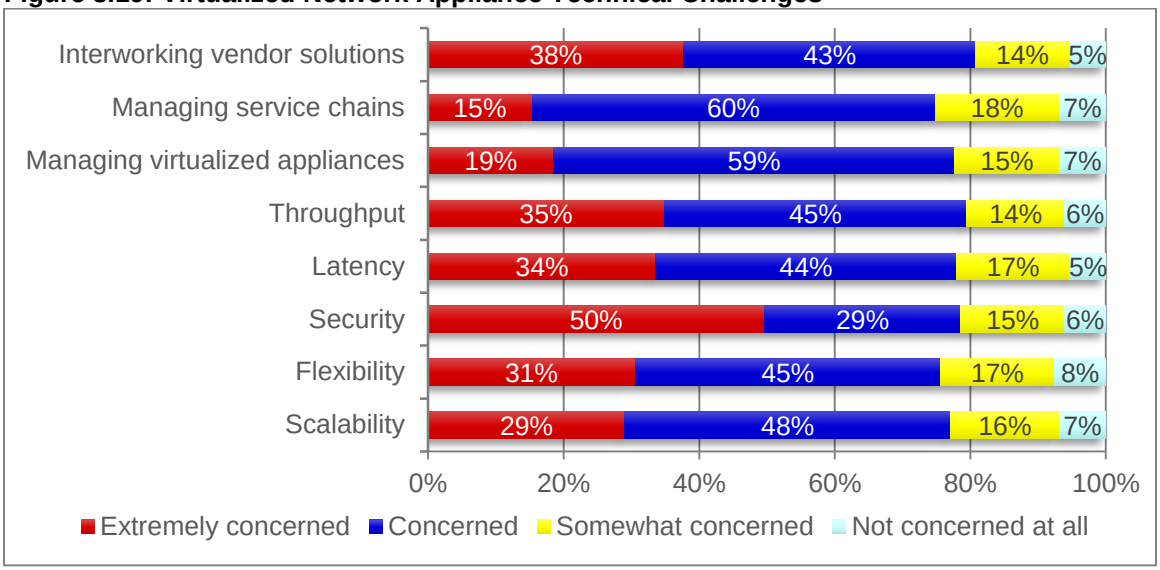
ATTRIBUTES	CRITICAL		IMPORTANT		MARGINAL	
	NEP	CSP	NEP	CSP	NEP	CSP
Scalability (on-demand resources)	55%	65%	31%	24%	11%	8%
Network flexibility (deploy in any location)	49%	53%	39%	38%	8%	8%
Lower capex	26%	60%	49%	34%	21%	5%
Lower opex	30%	50%	42%	47%	23%	2%
Service flexibility (service agility)	38%	61%	39%	27%	20%	10%

It's also worth noting that, like capex reduction, CSPs and NEPs have significantly different views on opex reduction: While 50% of CSPs ranked opex reduction as critical, only 30% of NEPs did. Factoring in the differences in service flexibility (61% CSP, 38% NEP) suggests that NEPs are focusing on building highly scalable, high-cost products, while marginalizing the value of reducing

opex and capex, which CSPs view as critical attributes for deploying virtualized products. As we shall see later, these differences also influence the preferred pricing models for CSPs and NEPs.

In addition to the drivers, we also wanted to understand the perceived challenges associated with delivering these products. As shown in **Figure 3.19**, the top three challenges identified, based on the level of "extremely concerned" responses, are security (50%), interworking vendor solutions (38%) and throughput (35%). The top ranking of security was somewhat expected, given that this consideration traditionally ranks highly in Heavy Reading's NFV and SDN research projects.

Figure 3.19: Virtualized Network Appliance Technical Challenges



Question: How concerned are you about the following technical challenges related to deploying or developing virtualized appliances? N=130-131

Looking at the CSP/NEP splits, as shown in **Figure 3.20**, shows that while both rank security as the leading challenge, they differ on second and third choices. While CSPs rank latency and throughput as areas of extreme concern, NEPs are less intimidated by these challenges – possibly because they feel confident they can develop scalable, secure and high-throughput products, with a secondary focus on cost. However, we do see very close alignment on interworking as a high priority (38% of both NEPs and CSPs) as a positive step toward dealing with the issue.

Figure 3.20: Virtualized Network Appliance Technical Challenges – NEP vs. CSP

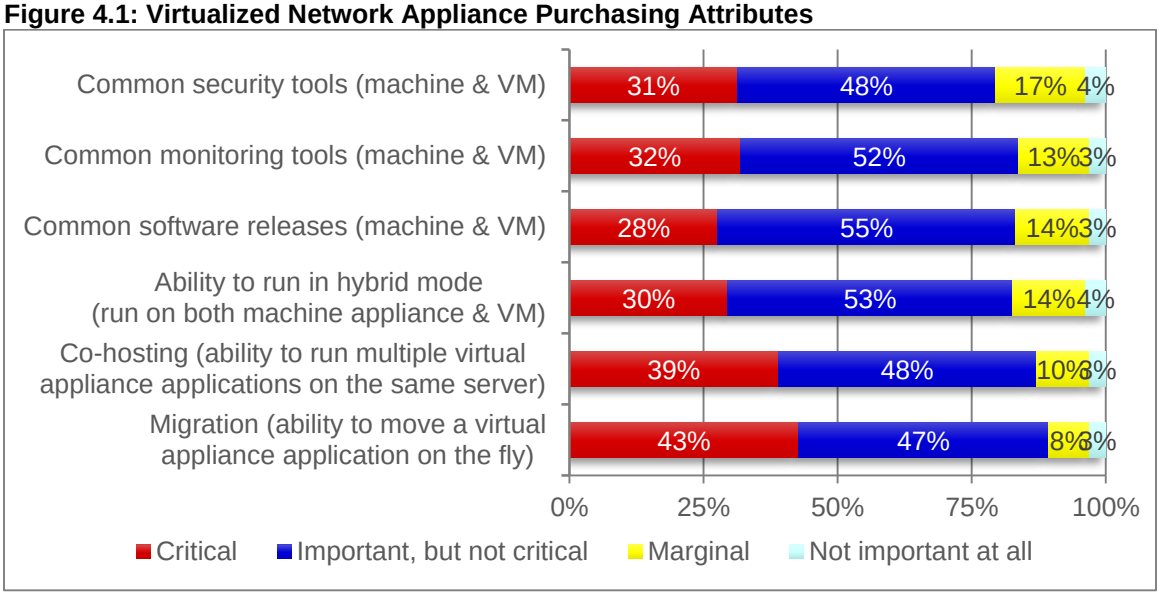
ATTRIBUTES	EXTREMELY		CONCERNED		SOMEWHAT	
	NEP	CSP	NEP	CSP	NEP	CSP
Scalability (ability to scale to meet demand)	22%	36%	52%	44%	16%	16%
Flexibility (ability to deploy in various locations)	24%	38%	51%	39%	15%	19%
Security (appliance-based vs. software-aggregated security)	42%	58%	31%	27%	18%	13%
Latency (E-W and N-S)	24%	44%	51%	38%	18%	16%
Throughput (ability to support data processing demands)	27%	43%	49%	40%	16%	12%
Managing virtualized appliances (managing software agents)	15%	22%	60%	59%	16%	14%
Managing service chains	18%	13%	57%	63%	16%	20%
Interworking vendor solutions (lack of standards and proprietary software implementations)	38%	38%	45%	41%	11%	17%

IV. Virtualized Product & Vendor Selection Criteria

In the final section of the survey, we document the criteria that are used to make virtualized appliance purchasing decisions, as well as the factors that CSPs balance in making final vendor virtualized product selections.

Starting first with purchasing attributes, we invited both CSPs and NEPs to provide rank a number of virtualized related attributes. As **Figure 4.1** shows, based on "critical" response levels, the top three responses are migration (43%), co-hosting (39%) and common monitoring tools (32%). Still, it's important to note that the levels of critical responses are tightly packed, so it's clear that CSPs and NEPs alike see a number of critical components that virtualized appliances must support. For example, the ability to operate in a hybrid mode often ranks highly in other NFV research we have conducted.

Figure 4.1: Virtualized Network Appliance Purchasing Attributes



Question: Please rate the importance of the following virtualized network appliance attributes from a product purchasing perspective. N=128-131

There is also some good news in that as shown **Figure 4.2**, there is a strong sense of alignment between NEPs and CSPs on the critical attributes that virtualized appliances should support. The top of the list for both is migration (43% CSP, 42% NEP), with alignment on the secondary ranking of co-hosting as well (39% CSP, 39% NEP). The only potential disconnect is delivery of common software releases, which a greater percentage of CSPs (34%) view as critical compared to NEPs (21%).

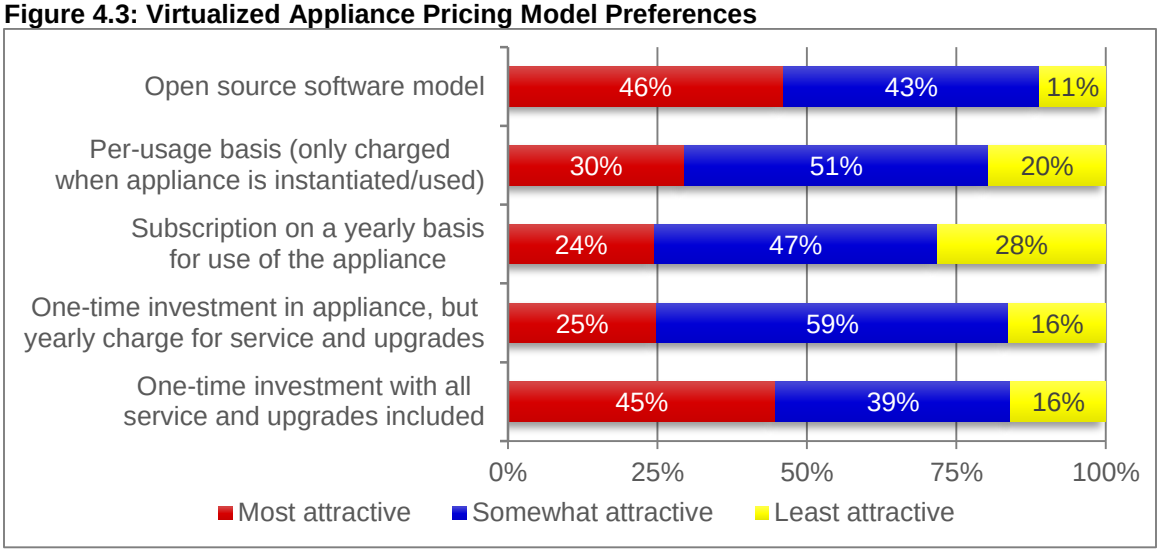
Figure 4.2: Virtualized Network Appliance Purchasing Attributes – NEP vs. CSP

ATTRIBUTES	CRITICAL		IMPORTANT		MARGINAL	
	NEP	CSP	NEP	CSP	NEP	CSP
Migration (the ability to move a virtual appliance application on the fly)	42%	43%	46%	48%	8%	8%
Co-hosting (the ability to run multiple virtual appliance applications on the same server)	39%	39%	44%	52%	12%	8%
Ability to run in hybrid mode (run on both machine appliance and VM)	27%	32%	49%	57%	19%	8%
Common software releases (machine and VM)	21%	34%	56%	55%	18%	9%

ATTRIBUTES	CRITICAL		IMPORTANT		MARGINAL	
	NEP	CSP	NEP	CSP	NEP	CSP
Common monitoring tools (machine and VM)	32%	31%	48%	56%	15%	11%
Common security tools (machine and VM)	28%	34%	48%	48%	18%	16%

The preferred pricing models of virtualized appliances was also addressed in the survey. Specifically, we wanted to get an overall view, as well as CSP- and NEP-specific preferences. From a global perspective, as **Figure 4.3** shows, the top three most attractive preferences are open source (46%), one-time investment (45%) and then, considerably behind, per-usage basis (30%).

Figure 4.3: Virtualized Appliance Pricing Model Preferences



Question: Please rate the attractiveness of the following pricing models for virtualized appliances. N=126-131

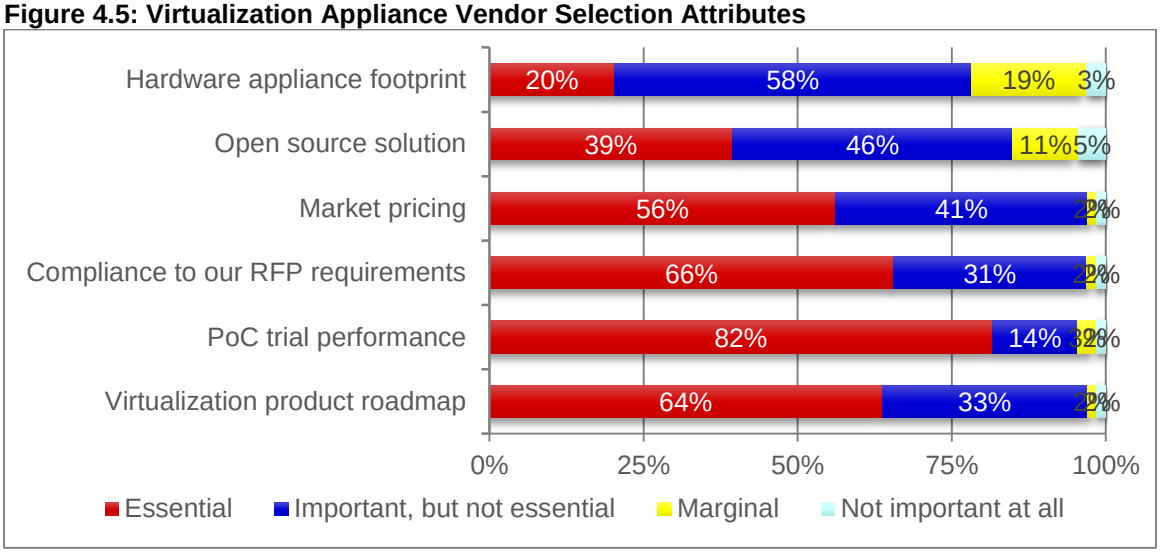
However, as shown in **Figure 4.4**, there are differences between CSPs and NEPs. Essentially, CSPs seem to prefer the open source (55% CSP, 36% NEP) and one-time investment (52% CSP, 37% NEP) approaches to a much greater degree than NEPs, in part because they are more capex-friendly. In fairness to the NEPs, they do see both as more valuable than the other approaches, but tend to understate the value, by virtue of a larger percentage of "somewhat attractive" responses.

Figure 4.4: Virtualized Appliance Pricing Model Preferences – NEP vs. CSP

ATTRIBUTES	MOST		SOMEWHAT		LEAST	
	NEP	CSP	NEP	CSP	NEP	CSP
One-time investment with all service and upgrades included	37%	52%	48%	31%	15%	17%
One-time investment in appliance, but yearly charge for service and upgrades	21%	29%	67%	52%	13%	20%
Subscription on a yearly basis for use of the appliance	32%	17%	48%	47%	20%	36%
Per-usage basis (only charged when appliance is instantiated/used)	27%	32%	55%	46%	18%	22%
Open source software model	36%	55%	51%	35%	13%	9%

Still, while CSPs prefer open source pricing models, as **Figure 4.5** shows it is not a leading factor in selecting virtualized appliance vendors. The top three attributes based on "essential" responses are PoC trial performance (82%), RFP compliance (66%) and virtualization product roadmap (64%). Overall, we believe this shows that as long as pricing is still competitive (56%), CSPs may be willing to pay a capex premium for the right product with optimal performance capabilities. We also consider RFP compliance as tied to the CSPs' previously noted interworking concerns.

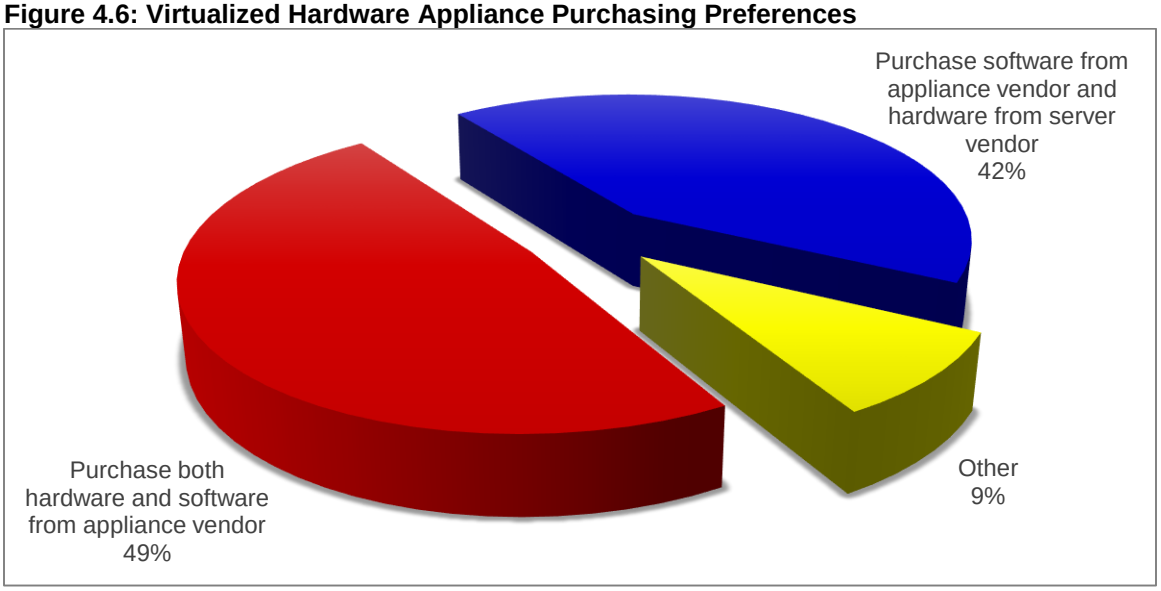
Figure 4.5: Virtualization Appliance Vendor Selection Attributes



Question: Please rate the following attributes for selecting a virtualized appliance vendor. N=68

Finally, in the last question of the survey we asked CSP respondents about their view of purchasing virtual appliance hardware and software from one or multiple vendors. As **Figure 4.6** shows, CSPs seem split on which approach to take. While 49% said they would prefer to purchase hardware and software from a single vendor, 42% said they would prefer to purchase hardware from a server vendor and software from an application vendor. Given this split, we also believe the open source debate may become a more important selection attribute for those CSPs that wish to go down the path of purchasing software from one vendor and hardware from another to ensure interoperability.

Figure 4.6: Virtualized Hardware Appliance Purchasing Preferences



Question: What is your company's preferred approach for sourcing virtual appliances and supporting hardware in the future from vendors? N=68

V. Conclusions

This custom research survey project confirms that CSPs and NEPs not only understand the value proposition of traditional hardware appliances, they also perceive a strong value proposition of virtualized appliances to help them optimize the performance of their NFV-enabled virtualized networks. Moreover, the survey shows that CSPs and NEPs are well aligned with respect to which network functions represent the best initial virtualized appliance candidates. They are even aligned with respect to the critical attributes that virtualized appliances must support. However, the survey also confirms that differences do exist between CSP and NEP virtualized appliance pricing preferences, including most significantly the overall attractiveness of an open source pricing model.

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Jim leads Heavy Reading's research on the impact of SDN, NFV and D-NFV on the control plane and application layers at the core and edge. This includes the evolution path of SIP applications, unified communications (UC), IP Multimedia Subsystem (IMS), session border controllers (SBCs), Diameter signaling controllers (DSCs), IP exchange (IPX) and WebRTC.

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