

KEY FINDINGS

- Transport services take 4 to 8 weeks for service fulfillment and delivery. 100+ Gb/s services take 43% longer than 1/10 Gb/s services.
- Top barriers to rapid transport delivery: complicated contracts and billing, lack of fulfillment automation and complicated workflow configuration.
- OSS/BSS integration contributes 30% to total service delivery and new service launch times.
- Top transport revenue growth attributes for the next 18–24 months: higher speeds, variety in availability and on-demand services.
- Top motivations for rapid transport service delivery: increased customer satisfaction, increased revenue and reduced OPEX.
- 56% of CSPs are willing to share the costs and/or revenue of pre-deployed networking capacity to enable faster service delivery.
- Majority of companies pursuing multi-domain orchestration.
- SDN and NFV penetration self-identified as being 40–50% and 22–31% of the network, respectively.

Challenges, Trends and Opportunities in Optical and Carrier Ethernet Transport Services: A Study of Communication Service Providers, Resellers and Large Enterprises

An ACG Research Report, 2019

Summary

Carrier Ethernet and optical transport services represent well over \$100 billion in annual revenue for service providers¹. Although Carrier Ethernet services such as E-LINE and E-LAN are mature and well defined by standards organizations such as the IEEE and MEF, wavelength services were just recently standardized and remain inconsistently deployed. Carrier Ethernet and optical services are collectively referred to as transport services in this paper.

The genesis for this project was the launch of Nokia's WaveSuite application software in Q4–2018. By embedding knowledge of hierarchy and multi-tenancy into optical domain service orchestration software, Nokia is reducing the inertia in transport sales and making it easier for network service providers to sell transport services to enterprise customers through any distribution channel that works for the customer, including resellers.

Prior to this research, ACG Research and Nokia had qualitative information from service providers and enterprises regarding the challenges in deploying transport services. In this research project, we augmented our qualitative and anecdotal information with quantitative data gathered through primary research that includes a survey of 70 knowledgeable industry experts.

We formulated the research with a fundamental question. If we could reduce transport services fulfillment and delivery times and improve the quality of experience for transport services customers, what barriers would we need to overcome and what would be the results if we did? From this fundamental concept, we developed a list of 20 questions and obtained survey responses from experts globally. The results are reflected in the analysis and key findings in this report and provide a context and a guidepost for anyone working to improve transport services delivery and customer experiences going forward.

¹ Source: 2018 MEF and ACG.

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Introduction and Key Findings

This primary research project was an outgrowth of the Q4-2018 announced launch of Nokia's WaveSuite applications software. By embedding knowledge of hierarchy and multi-tenancy into optical domain service orchestration software, Nokia is making it easier for network service providers to sell transport services to enterprise customers through any distribution channel that works for the customer. With application development in three key areas, service enablement, node automation and network insight, Nokia is dividing the problem and solution space into manageable focus areas. In this research we gather first-hand information regarding the challenges, opportunities and expectations in improving users' experiences and accelerating the delivery of carrier ethernet and optical transport services.

Key Findings

- On average, 100+ Gb/s transport services take 43% longer time to fulfill than 1Gb/s or 10 Gb/s services; worldwide, 100G+ services take 6.93 weeks while 1G/10G services take 4.83 weeks
- The top barriers to rapid service delivery:
 - Complicated commercial agreements and billing
 - Lack of fulfillment automation
 - Complicated configuration workflows
- Operational support systems/billing support systems (OSS/BSS) integration eats up ~30% of service fulfillment time for existing services and integration time for the launch of new services
- The top transport services attributes to maximize service revenue growth over the next 18–24 months:
 - Ability to offer higher rate (or speed) connectivity services
 - Ability to offer a variety of service availability levels
 - Ability to offer on-demand and elastic services
- Accelerating service delivery times requires pre-deployed networking capacity. **>50% of CSPs** are willing to share the costs and/or revenues for pre-deployed capacity to enable faster service delivery
- Expected benefits of rapid service delivery:
 - Higher customer satisfaction and net promoter score
 - Increased revenue
 - Lower operational expense (OPEX)
- Majority of service providers and enterprises moving toward multi-domain orchestration:
 - Mixed approaches: evolving current solutions, vendor-specific solutions and direct open-source (minority)
 - 70% believe inter-carrier automation/orchestration Critical or Very Important
- SDN/NFV network penetration is increasing as self-reported:

- 40–50% of network is under SDN control today
- 20–30% of network is virtualized today
- Based upon ACG Research’s discussions and ongoing research in the SDN/NFV area, SDN/NFV penetration is increasing, but these results are overstated by 2x. We have witnessed this phenomenon in other network transformations where participants overestimate the achievement or evolution of their network.

Study Context

In 2018, global DWDM optical networking spending reached \$14.4 billion. Data center interconnect (DCI) remains one of the hottest optical networking markets with over \$2.8 billion in revenue and 31.5% annual growth in 2018². Optical DCI is expected to remain strong with a forecasted CAGR of 15.6% through 2023³. Overall IP traffic is expected to grow by 25% CAGR through 2022⁴. The number of incremental 100G+ DWDM port shipments grew by 20% to over 440,000 units worldwide in 2018.

In direct response to the increasing demand for wavelength services, the Metro Ethernet Forum (MEF) is developing service descriptions, attributes and interface specifications to help unify procuring, managing and interconnecting wavelength services. The Nokia-initiated MEF 63 specification, “Subscriber Layer 1 Service Attributes Technical Specification,” was issued in August 2018 and additional documents, including a Network-Network-Interface specification for inter-carrier connectivity, will follow. Yet for all the additional optical infrastructure and capacity being deployed by network service providers, they are not receiving incremental and proportional revenue. In addition, operational costs continue to grow, squeezing operating margins and service providers’ profitability.

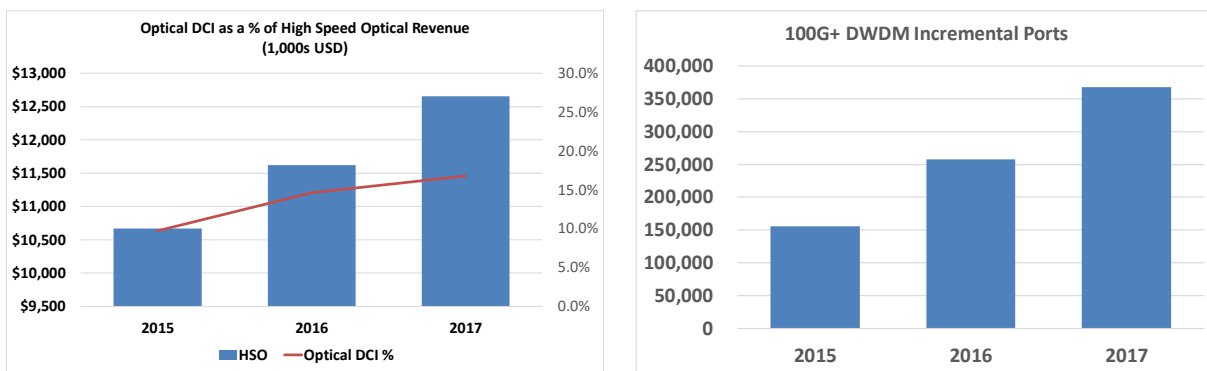


Figure 1. Optical Infrastructure Revenue and 100+ Gb/s Incremental Ports

At the start of this research project we had qualitative and anecdotal information regarding transport services from discussions with network service providers. As an example, it is common for transport services to require months to be delivered. Delivery workflows are complicated, consists of numerous manual steps and require specialized skills only possessed by a small subset of the network operations team. In addition, transportation services commercial agreements are complicated and time consuming to put in place. Resale agreements with intermediate service providers even more so. Once the transport service is finally established, the intermediate service provider that sold the service may be absent from ongoing network visibility and performance monitoring, weakening the very relationship that created the sale in the first place. Even the enterprise customer may have trouble monitoring the real-time performance of its transport services or modifying and adding new services in the future. Thus, the focus of this research is to augment these perspectives and anecdotes with quantitative information gathered

² 2018 ACG Research Optical Networking and Optical DCI Syndication.

³ 4Q-2018 ACG Research Optical DCI Forecast.

⁴ Nokia Bell Labs Traffic Forecast 2017–2022.

from a statistically relevant sample via a consistent and formal survey process. We are looking for quantitative information to either reinforce our current beliefs and approaches or to refute them. Either way, we want to know what communication service providers (CSP) that own networks, value-added service providers (VASP) that resell services and large enterprises that consume services experience and think about transport services today and tomorrow.

Survey Background and Demographics

We included Carrier Ethernet and optical/wavelength services in the broader transport services category that is the focus of this research project. Our rationale was based upon the lengthy deployment history and maturity of Carrier Ethernet services and the importance of capturing the views and insights of professionals working with Carrier Ethernet for many years as such views can inform the future of optical/wavelength services going forward. If we only targeted optical/wavelength personnel, we may have missed valuable insights that inform and enhance the quality of the research.

Scope of Study

We focused the study on transport services consisting of Carrier Ethernet and optical/wavelength services. We targeted and obtained 70 survey responses from qualified, knowledgeable personnel.

Approach of Study

The study consisted of a 20 question confidential survey, a live telephone prescreen, and computer-aided/on-line input. Initial screening questions were used to ensure that survey participants had the appropriate knowledge and skill set to answer the survey questions. If they did not, the participant was rejected.

Participants of Study

The survey was global in scope with respondents coming from North America (NA), Europe Middle-East Africa (EMEA), Latin America and Caribbean (LAC) and Asia Pacific (less China). The survey actively targeted CSP companies, VASP companies and large enterprises. The survey targeted personnel from network engineering, network operations and business services planning and product management. Although job titles varied, most survey participants included C-Suite executives, presidents/vice-presidents and directors/sr. managers.

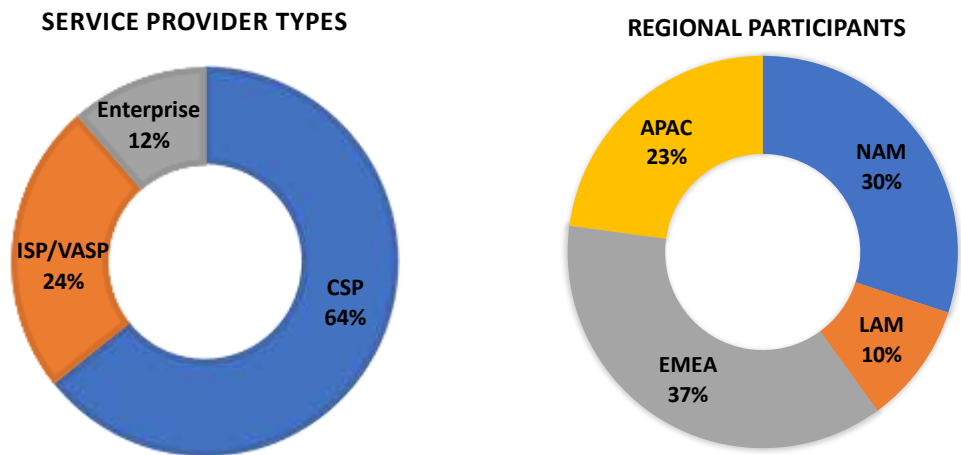


Figure 2. Survey Demographics: Company Types and Regions

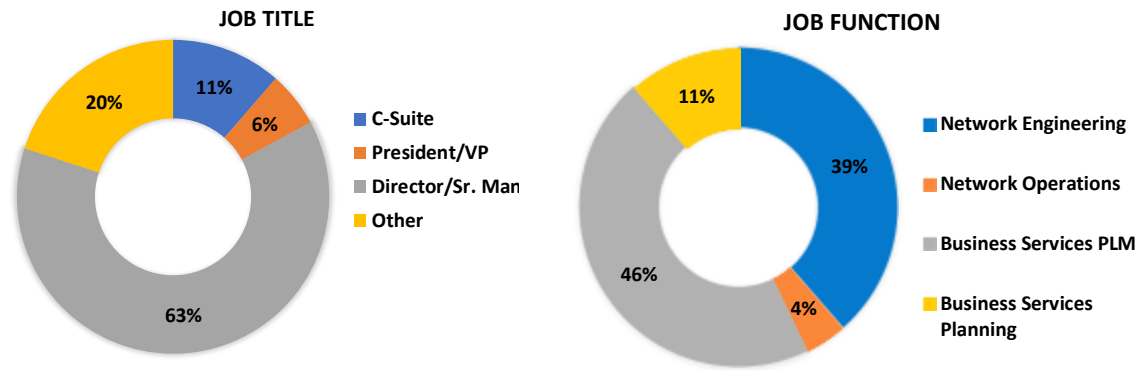


Figure 3. Survey Demographics: Job Title and Job Function

Main Findings

Before we can focus on accelerating transport service fulfillment times, it is necessary that we understand what those times are today. We asked two questions related to service fulfillment times: one regarding 1Gb/s and 10Gb/s services and a second question regarding 100+ Gb/s services. The result, 100+ Gb/s services are less ubiquitously available today and, in all cases, take longer to deliver, on average 43.5% longer than 1Gb/s or 10Gb/s services.

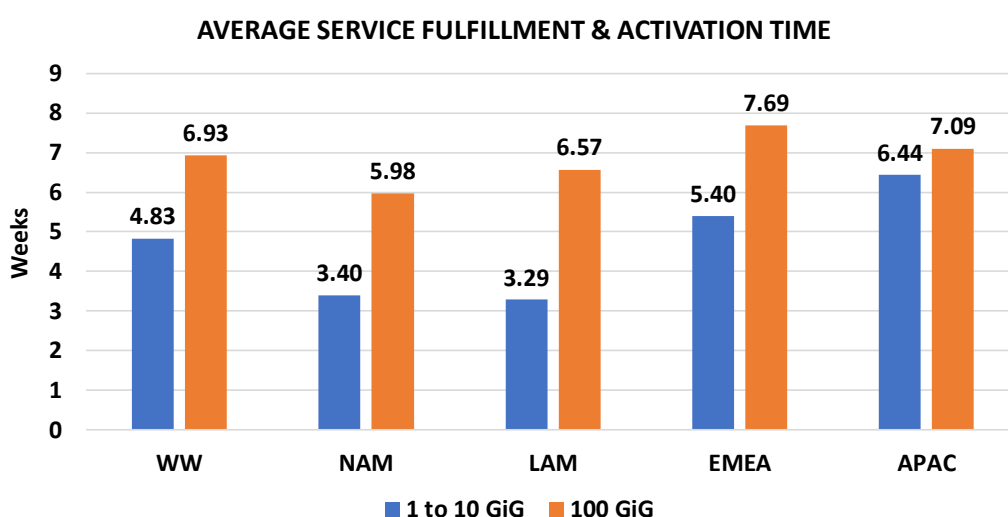


Figure 4. Average Transport Service Fulfillment Times by Region (Weeks)

As visible in Figure 4 and Figure 5, the global average 1Gb/s or 10 Gb/s service fulfillment time is 4.83 weeks; the average 100+ Gb/s service fulfillment time is 6.93 weeks. CSP companies take on average 7.3 weeks to deliver a 100+ Gb/s transport service.

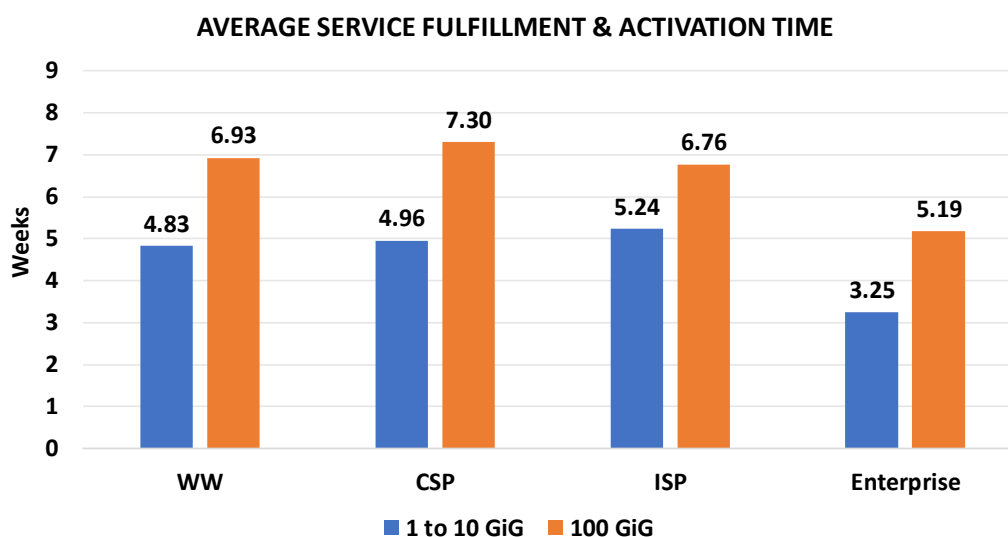


Figure 5. Average Transport Service Fulfillment Times by SP Type (Weeks)

With this baseline information for service delivery times, we can identify the barriers that are preventing rapid transport services delivery today.

Q: In your view, what are the biggest barriers preventing rapid service delivery of optical and Carrier Ethernet transport services?

In Figure 6, the top three barriers are complicated commercial agreements and billing, lack of network automation for fulfillment and complicated service delivery and configuration workflows. Interestingly, “time to extend fiber to the customer site” fell outside the top three, an indication that as fiber has become increasingly available, it is less of a barrier.

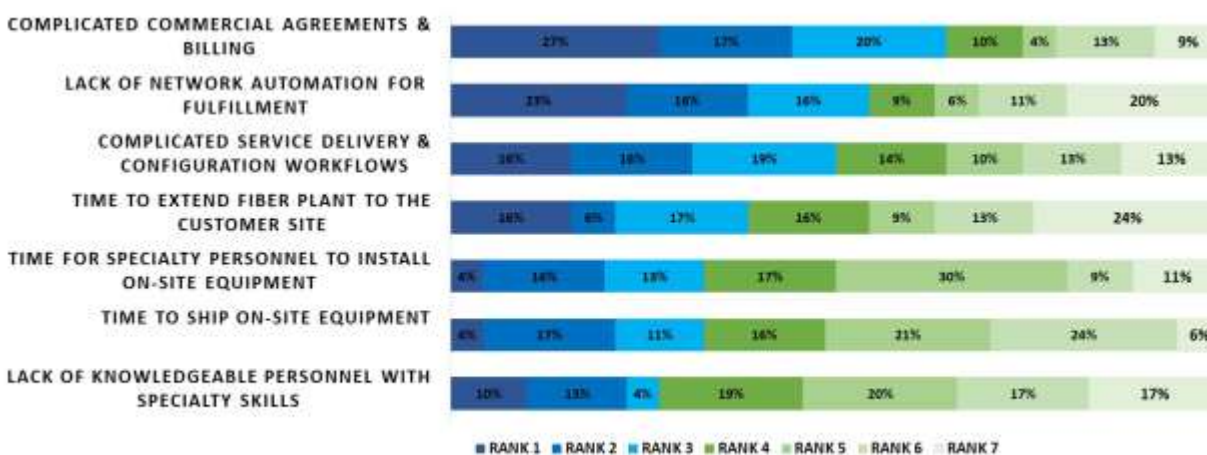


Figure 6. Barriers to Rapid Transport Services Delivery

There are additional indications that billing is an issue, which is reflected in the answers to our next question. There is some anecdotal evidence that OSS/BSS integration time was a big deal in slowing down the fulfillment process for existing services as well as the launching of new ones. Two related questions address the percentage of time that is spent on OSS/BSS integration.

Q: In your experience, how much time does OSS/BSS integration contribute to the total time involved in the fulfillment and activation of an ordered transport service?

Q: In your experience, how much time does OSS/BSS integration contribute to the total time involved in launching a new transport service into the broader market?

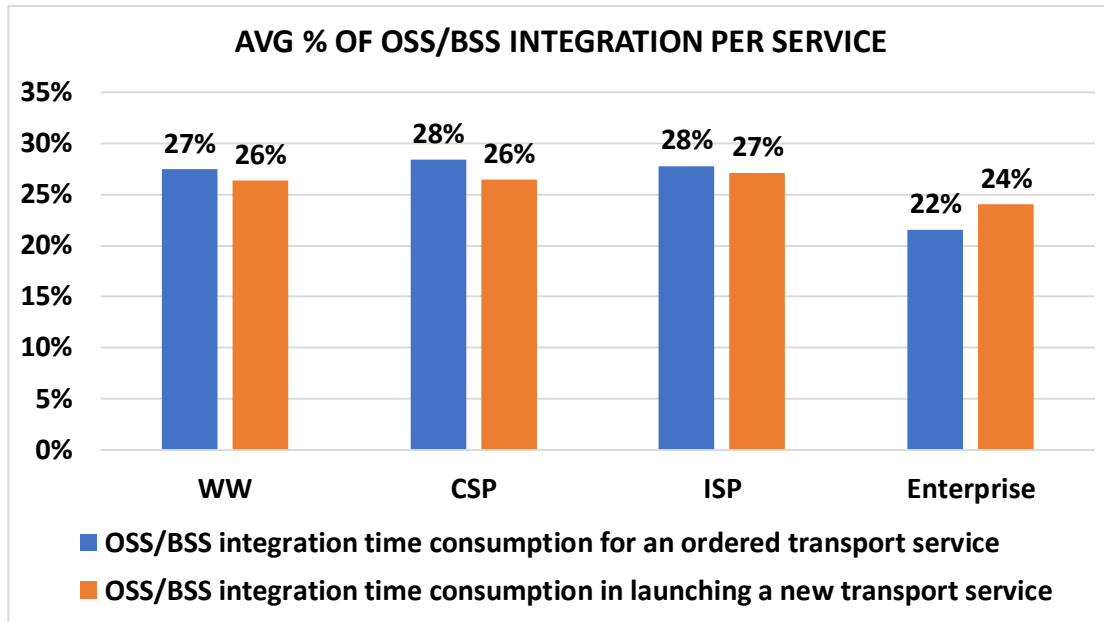


Figure 7. Average OSS/BSS Integration Time vs. Total Time for Service Delivery

The percentage of time for existing and new services is almost identical in each company category, consuming 26–27% of the total time involved in delivering the service. Clearly, OSS/BSS integration and complicated billing are areas of focus for companies looking to accelerate transport services delivery times. Adoption of open application programming interfaces with well-defined architectural frameworks and interfaces like the MEF Lifecycle Services Orchestration (LSO) can help. Solutions that provide web-based portals for viewing billing-related data throughout a services hierarchy can also accelerate the launch of new services by acting as a lightweight OSS/BSS substitute.

The next questions focus on the opportunities for transport service improvement and revenue growth.

Q: In your view, which of the following attributes of optical and Carrier Ethernet transport connectivity services unlock the greatest potential for subscriber service growth in the next 18–24 months?

The respondents rated the following three attributes as having the greatest potential for growth:

- Ability to offer higher rate connectivity services (10G, 100G) at a lower cost (per bit)
- Ability to offer a variety of service availability levels including ultra-high availability services
- Ability to offer on-demand and elastic service creation using SDN

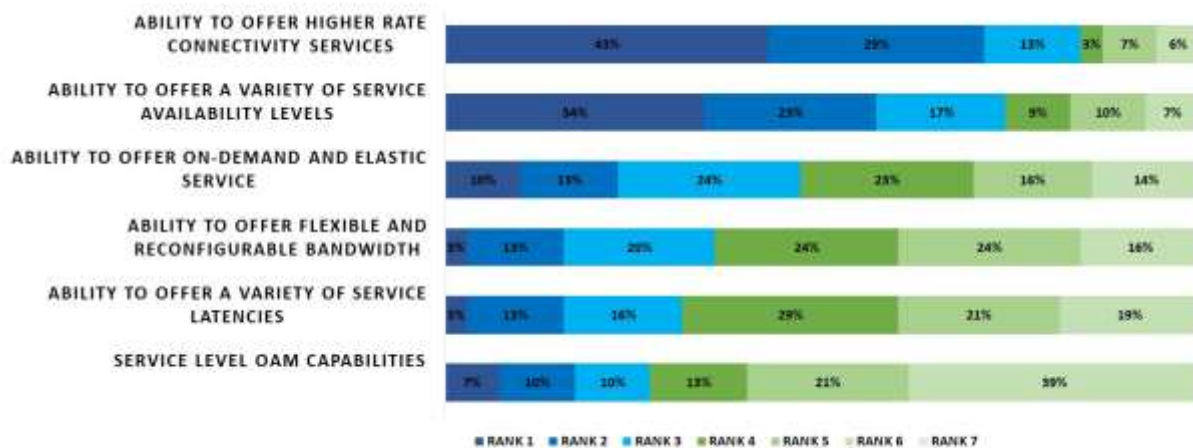


Figure 8. Attributes to Unlocking Greatest Service Growth in Next 18–24 Months

Transport services need to be faster, on-demand and with a variety of availability levels that match the criticality (or noncriticality) of the service to the availability of the network (and corresponding price).

Next, we asked how to improve the quality of experience for transport services customers. We used a five-point scale with 1 being critical, 2 being very-important and so on with 5 being not important at all.

Q: On a scale of 1-5 how important are the following items in improving the quality of experience (QoE) for transport services customers?

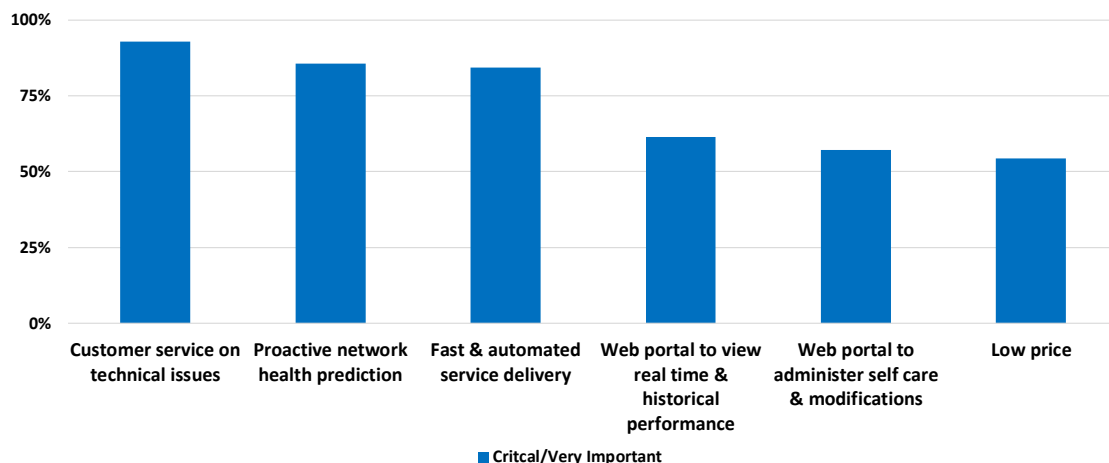


Figure 9. Factors to Improve QoE for Transport Services

Every item received greater than 50% support as being critical/very-important with “low price” being least important and “customer service on technical issues” and “proactive network health prediction” being rated highest priority to deliver an improved QoE for customers.

To enable monitoring of all the transport services and facilitate multi-tenancy and hierarchy, a web portal for the ISP/VAS that sold the service to the enterprise seems like an important part of any solution. To

solicit a more definitive and quantitative answer, a question to the survey was added about the importance of an ISP/VAS web portal for network visibility and performance monitoring.

Q: How important is it for the ISP/VASP to have the ability to visualize and monitor the ongoing performance of the network services that it resold to its customers? (scale of 1 to 5 with 1 critical)

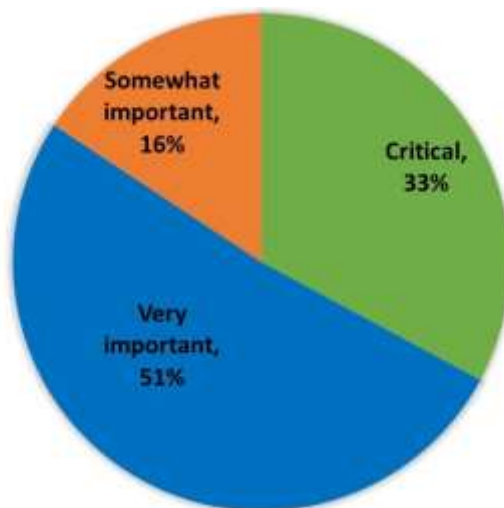


Figure 10. Importance of ISP/VASP Web Portal for Monitoring Services

Fully 84% of all participants indicated that ISP/VASP service monitoring is critical/very-important with 94% of all ISP/VASP respondents reporting the same. Helping resellers retain and enhance their ongoing relationship with their customers is important for customer satisfaction as well as future sales enablement. Providing a pre-developed, easy-to-use web portal appears to be a good approach and is valued by ISP/VASP partners.

One of the most important and potentially controversial ideas that we wanted to explore is the need to pre-deploy excess networking capacity in order to have a meaningful reduction on transport service delivery times. Without excess capacity in the network, on-demand services simply will not be available. Participants were asked about the type of commercial arrangement that they would support in order to pre-deploy capacity in the network.

Q: What commercial arrangement between a CSP (network owner) and the networking equipment vendor would be required for the CSP to pre-deploy excess networking capacity in the network to significantly reduce the time for new service order fulfillment and activation?

The results from this question are very encouraging and demonstrate the business maturity that has occurred over the past 18 months. Fully 56% of all respondents (and 56% of CSP respondents) indicated that the CSP and vendor should share costs and/or revenue. Only 26% thought that the vendor should incur all costs and 17% thought no commercial model existed that would work. CSP companies are realizing that speed is a competitive advantage. The ability to deliver services easier, faster and on-demand has tangible business benefits. One of the best ways to assist CSP companies in gaining support inside of their own organizations is to assist them with business case development and real-world case

study analysis, demonstrating that excess capacity when judiciously deployed is a revenue and service delivery enabler, not an excess capital expense.

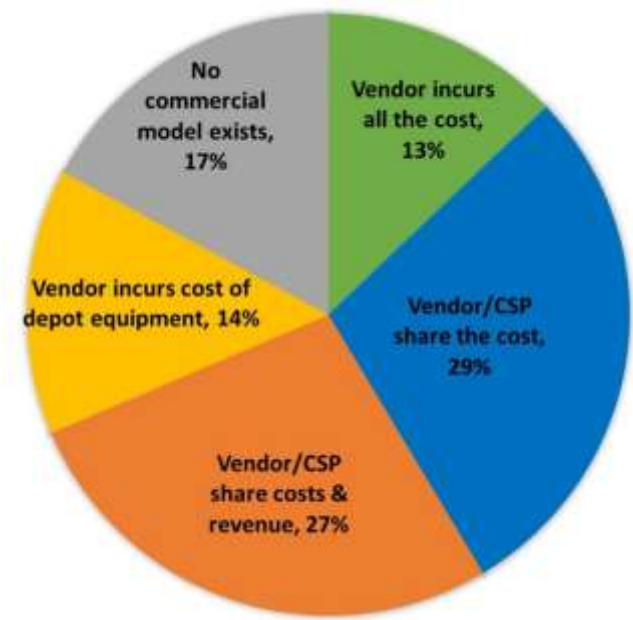


Figure 11. Commercial Arrangement to Pre-Deploy Excess Network Capacity

If they overcome the barriers, enhance transport services, invest in pre-deployed capacity and significantly reduce transport service delivery times, what do CSP, ISP/VASP and large enterprise companies expect the impact to be? This question gets right at the heart of the motivations for improving the way transport services are deployed and monetized.

Q: If you could significantly reduce the delivery time for new optical and Carrier Ethernet transport services (example in hours or days instead of weeks or months), how do you think that would impact your business?

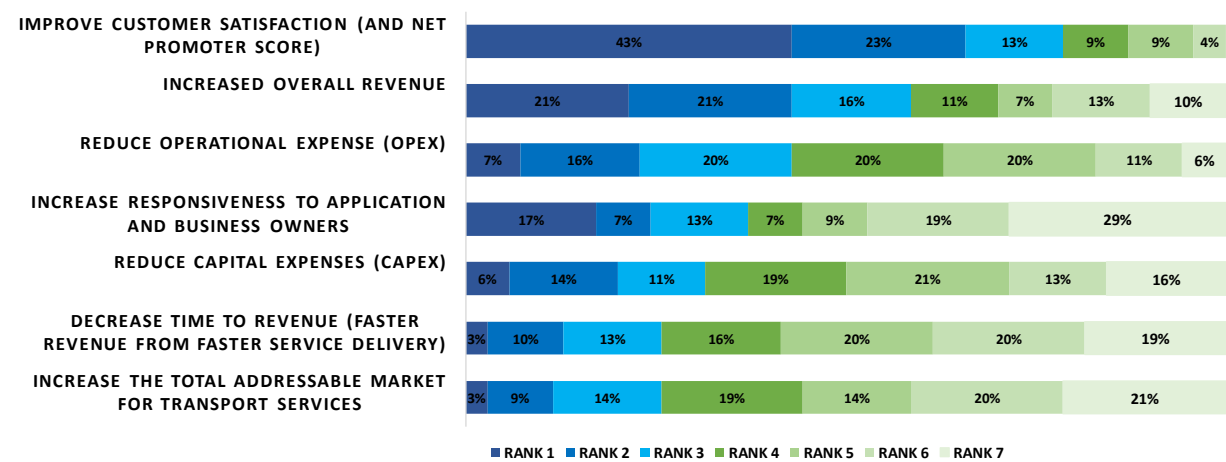


Figure 12. Business Impact from Reduced Transport Service Delivery Time

Respondents report that the net results will include improved customer satisfaction, increased revenue and reduced operational expenses. Going faster will undoubtedly require automation and reductions in complicated, manual workflows. Reduced complexity and increased automation go directly to the company's bottom line in the form of reductions in operational costs.

Orchestration Findings

We have included questions on orchestration in our primary research for a number of years. Orchestration plays a critical role in increasing network automation, collaborating across networks/domains and is a part of the OSS/BSS transformation that is a barrier to rapid transport services delivery, today.

Q: How important is automated inter-carrier network and service orchestration to simplifying and accelerating the deployment of transport services? (scale of 1 to 5)

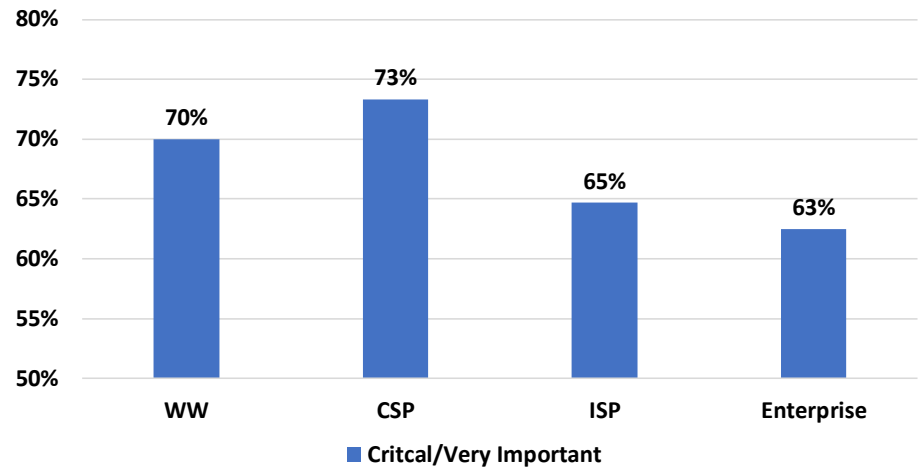


Figure 13. Importance of Automated Inter-Carrier Orchestration

More than 70% of respondents thought it was critical/very-important; 73% of CSP companies indicated automated inter-carrier orchestration was at this level of importance. The importance of this finding ties directly to open collaborations, such as the MEF LSO, where optical wavelength services are being defined and network interfaces such as the Interlude interface is specified.

We then ask companies about their specific transport services orchestration deployment plans.

Q: How do you intend to deploy network orchestration for transport services including optical/wavelength and Carrier Ethernet services?

In each of the research projects, unified multi-domain orchestration has been the majority response. In discussions with service provider and enterprise companies and from our own economic modeling, unified multidomain orchestration has the potential to provide the most benefits, including efficient resource allocation across networks and increased agility to adapt services throughout the deployment lifecycle. Although 50% multidomain orchestration selection is one of the lowest responses, it is important to remember that the focus of this research is on the transport network (and transport services) that is dominated by physical (versus virtual) infrastructure. The high percentage of physical infrastructure in transport services delivery is the main reason for the relatively low multidomain response.

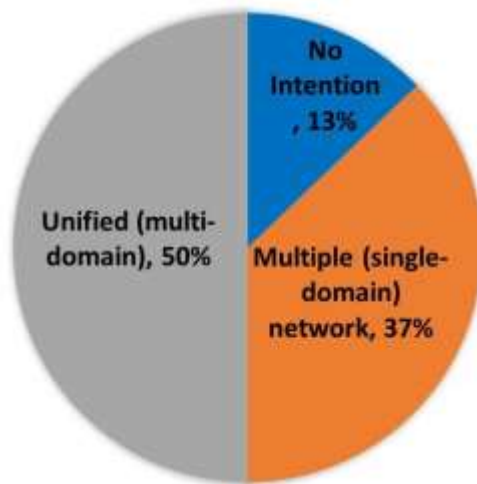


Figure 14. Network Orchestration for Transport Services

We also wanted to understand how companies thought they would realize their network orchestration solution.

Q: How do you intend to realize your chosen network orchestration solution for transport services including optical/wavelength and Carrier Ethernet services?

These results require some interpretation. In our discussions, most service providers indicate a strong preference for utilizing open source software in their orchestration solutions. However, they generally intend to obtain the open source software from a vendor distribution (not direct). Although 40% of respondents indicated they would acquire a vendor-specific solution, most of these vendor-specific solutions are at least partially open source distributions. If you consider direct use of Linux Foundation ONAP and ETSI Open Mano and vendor distributions, then fully 59% of respondents intend to deploy at least a partially open-source orchestration solution. Although still less than the 80% open source (direct or through distributions) utilization we have seen in other research we have conducted, 59% still represents a reasonable majority of all respondents. We also see 10–13% of respondents indicating that they have no intention of deploying network orchestration for transport services; 10% is consistent with other research we have conducted.

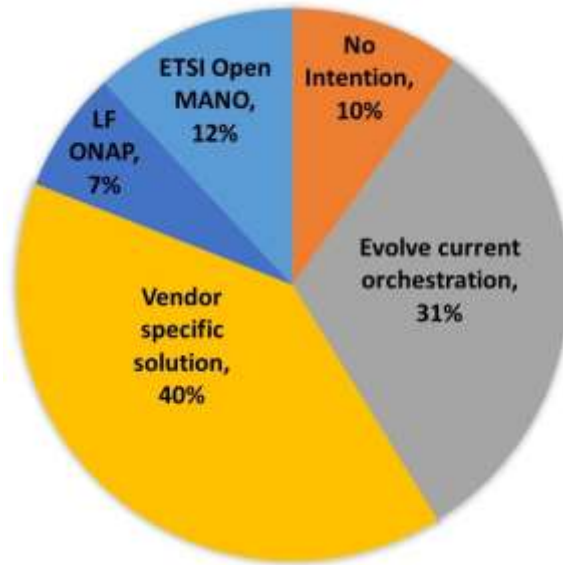


Figure 15. Method to Realize Network Orchestration for Transport Services

State of SDN and NFV in the Network

In the final section of the research, respondents were asked to comment on their perceived progress in achieving SDN control and virtualization of their network. We did **not** limit this question to the transport network or transport services and simply asked generically regarding their network.

Q: What portion of your existing network is under SDN control today?

Q: How much of your existing network is running on virtual (vs. physical) network functions (VNFs)?

The percentage of SDN control and virtualization has been steadily rising. However, these results must be taken with some skepticism as personnel in each network tend to inflate or over-estimate their numbers versus the reality in their networks. In addition, credible public information is difficult to identify as some companies talk about the percentage of their network that has been virtualized based upon a single virtual instance being deployed. Based upon our research and detailed discussions with service providers, the percentage of SDN and the percentage of NFV results in this survey (and other surveys we have done) are overstated by approximately a factor of two. Reducing the numbers by two, we estimate that ~25% of the network is under SDN control and ~13% of it is virtualized. We also acknowledge that large enterprises are ahead of CSPs in both transformation categories. Of course, individual networks may be exceptions to this generalized networking perspective.

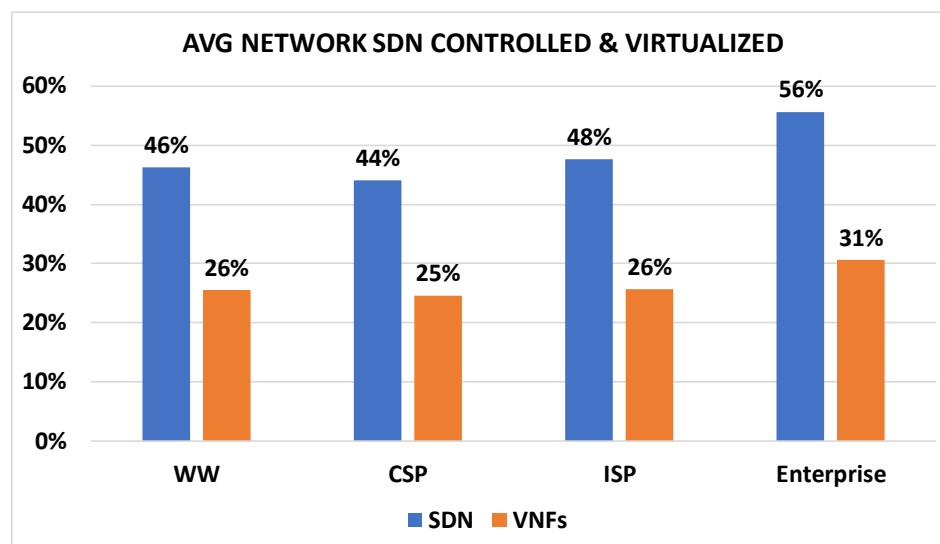


Figure 16. Average Network SDN Control and Virtualization

Conclusions and Implications

The results of this research provide a roadmap to enhance transport services business. We identified that 100G+ services take an average of 6.93 weeks and 1G/10G services take 4.83 weeks delivery time. Top barriers to rapid service delivery include complicated commercial agreements and billing, a lack of fulfillment automation and complicated workflows. OSS/BSS integration is one of the biggest contributors to complexity and time, consuming almost 30% of the total time for service fulfillment and new product introduction. The top service attributes to drive near-term revenue are higher speeds, variety in service availability (and price) and the ability to offer on-demand and elastic services. These findings point toward a need for increased programmability and automation.

Service providers have also evolved their thoughts on the costs and monetization of their networks with over 50% expressing a willingness to share the increased costs and/or revenue with vendors for pre-deployed network capacity to enable faster service delivery. In return, service providers expect the benefits of accelerated service delivery to include higher customer satisfaction, increased revenue and reduced operational costs.

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