Building Your Business Case for Network Virtualization

A Total Economic Value Assessment Framework for Financial Analysis

Table of Contents

List of Figures

Executive Summary

Traditional TCO analysis is not well suited to make the business case for network virtualization. Not only do SDN and Network Functions Virtualization (NFV) technologies impact existing cost drivers, they create new classes of costs which are influence factors typically not included in TCO models. They also create additional avenues for revenue growth and improved efficiency.

Comprised of three functional layers—IP infrastructure, resource management and orchestration, and service enabling layers—the virtualized network disrupts the traditional service provider business model in several ways. By replacing fixed costs with variable costs, it drives capital efficiency and reduces risk. By automating and simplifying key operational processes, it reduces operational costs and boosts overall productivity. And by combining readily deployable network resources and operational efficiency, it creates service agility, which improves competitiveness and innovation.

To assess the total economic value of virtualization projects, service providers can adopt the following framework:

1. Conduct an economic profit analysis by forecasting service revenue, estimating operating expenses, and calculating IP infrastructure costs.
2. Generate pro forma income statements, balance sheets, and statements of cash flows to enable a complete comparison of capital requirements, including working capital as well as ratio analysis.
3. Assess the multiyear project worth by combining net present value (NPV) with the value of real options created by the new platform.
4. Perform risk assessment to understand the impact of changes to the model's assumptions.

SDN and NFV technologies influence and change implicit assumptions of existing business, thus the business implications are broad. As a result, Juniper recommends a more complete financial methodology and framework to understand how to assess the broad range of benefits and options that service providers will face during the transformation of their networks to gain maximum benefit with the least amount of risk.

The Rules of Networking Are Changing

Network virtualization, which generally refers to the abstraction of network resources such that they can be installed, controlled, and manipulated by software, is fundamentally disrupting the economics of networking. Emerging technologies, often grouped together as NFV and SDN, bring increased agility in delivering network services with improved capital and operational efficiencies. These changes disrupt existing business models and enable new ways of doing business.

While there has been much discussion of SDN and NFV technologies, there has been little structured analysis regarding the long-term economic benefits. In this paper, we present our point of view on assessing the economic impact of network virtualization in the traditional service provider environment. The intent is to establish a comprehensive framework for financial analysis to assist business and technology decision makers in assessing the implications of the transformation to virtualized network infrastructures.

There are several challenges with traditional TCO frameworks. Primarily these stem from the fact that SDN and NFV technologies influence several strategic cost drivers of existing service provider networks, while at the same time creating an entirely new class of costs to consider. Traditional TCO models are generally static short-term models and only evaluate a single implementation. They also fail to consider labor productivity, Selling, General, and Administrative Expenses (SG&A), flexibility, and risk since the focus is primarily on the cost of the assets themselves.

Furthermore, determining the extent of benefit and cost attribution for virtualized services is difficult. How can service providers truly compare the benefits and costs of a traditional network built with routers, switches, and dedicated devices with the benefits and costs of a network based on x86 servers and software licenses? The service provider must build a case for revenue growth and efficiency improvements that is incremental, as compared to the more limited, traditional network approach.

Our assessment framework takes into account all of these factors. The preliminary step in the process is to evaluate how virtualization technologies impact—or disrupt—assumptions in the existing service provider business model, especially regarding capital efficiency, operational efficiency, and service agility. Virtualization engenders clear benefits in each of these areas. With the benefits identified, we then discuss our approach to assessing the economic value of virtualization technologies.

The Virtualized Network Reference Architecture

To help conceptualize the new model, Figure 1 represents a simplified virtualized IP network which is loosely aligned to the European Telecommunications Standardization Institute (ETSI) NFV architecture. It shows three functional layers representing where in the network the financial benefits are derived:

- Flexible IP Infrastructure Layer. This layer represents the set of physical resources (including servers and storage) where virtualized network functions such as virtual firewalls, routers, and switches reside. The primary characteristic and requirement at this layer is the ability to scale capacity relative to traffic growth and demand profiles. This drives capital efficiency and reduces operating leverage and risk.
- Resource Management and Orchestration Layer. The role of this layer is to automate and simplify the network operational processes. The technical requirement is to expose resource APIs to the business enabling layer, allowing it to manage network policies and orchestrate new services as needed. Automation works through predefined policies that are pushed into the network resources below. By automating network operations processes, providers can eliminate bottlenecks, reduce process time, and enhance the customer experience. This function also provides operational efficiencies that enable operators to offset the incremental operational costs related to introducing virtualized resources.
- Service Enablement Layer. This layer ultimately creates a platform for service delivery. It will contain all functions needed to run the network, and they must be in the form of a modular set of software building blocks that the orchestration function can call on. It is above this layer that service providers will build their specific applications and services. This is where the ability to define and roll out new services, or service agility, comes into play.

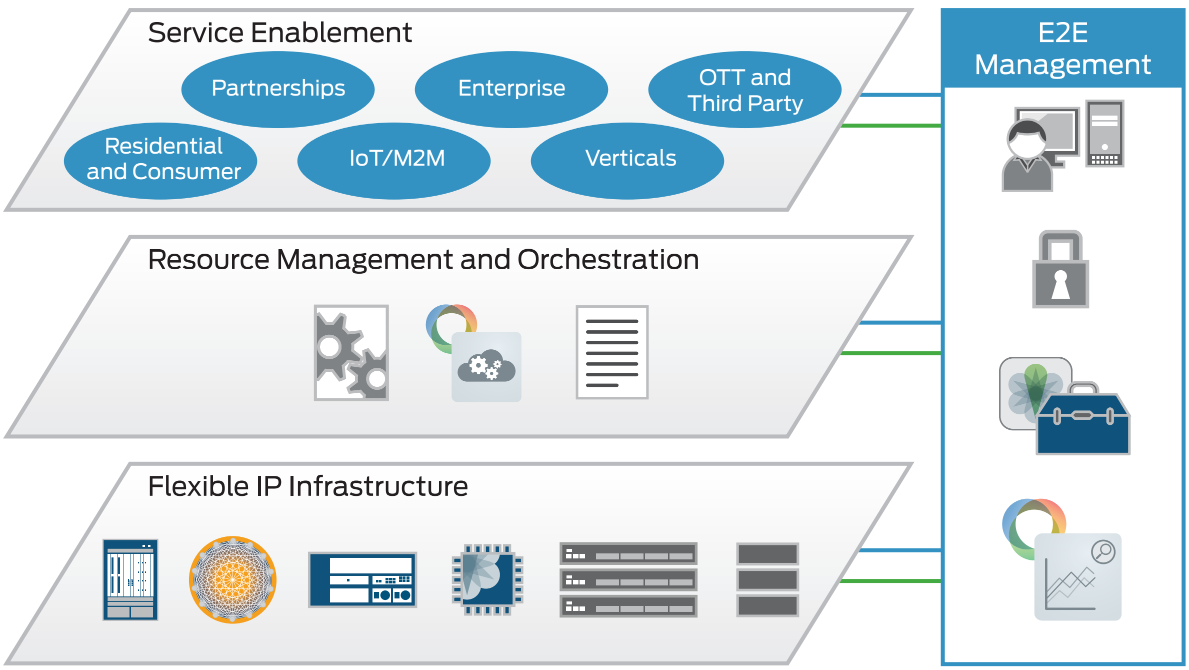

Figure 1: Architectural layers for virtualized networks

Virtualization introduces some complexity, including a new management framework, as shown on the right in Figure 1. The management framework represents incremental investment for planning, designing, training, implementing/modifying support systems and change management as service providers transform their networks and business models. However, by decoupling the network architecture in this way, each layer on the left can be optimized in the way that best aligns with its purpose.

Business Model Disruption

Traditional networks embed services and functions within the network. Leveraging such siloed networks for different purposes and optimizing them for any particular function is a complex proposition. A virtualized framework, however, transforms that equation: the flexible IP infrastructure layer can be optimized to scale network functions more efficiently; the Resource Management and Orchestration layer focuses on automation of network processes; and the service enablement layer focuses on improving time to market for new services.

As a result, virtualization technologies can reduce and in some cases eliminate traditional assumptions regarding capacity management and operational processes, which are large structural concerns endemic to existing service provider business models. Furthermore, with more flexible and programmable networks, service providers can have increased service agility to quickly offer services to new strategic customer segments and buyers.

SDN and NFV create a new value chain that completely transforms the customer experience and disrupts implicit assumptions regarding the cost of delivering services. It is around this new value chain that we will assess the financial benefits and build frameworks for analysis as described in the following sections.

Capital Efficiency, Variable Costs

Capacity management is a critical strategic consideration for every business. In the existing service provider models, capacity management requires extensive planning, forecasting, and deployment of network capacity across a number of functions and geographical areas. Physical network resources may be purchased and deployed to meet capacity forecasts for yearly peak events. This approach creates a relatively high fixed cost and inflexible infrastructure, which in turn creates a high bar to cross in order to achieve profitability, increasing business risk. The costs considered here are CapEx, which require the full outlay of cash at time of purchase. The objective is to maximize output per dollar of invested capital.

With virtualization technology, disruption stems from the delivery of services across shared network resources. With the ability to scale resources when and where network function capacity is required, service providers shift the cost structure from a traditionally fixed-cost basis to one with a higher mix of variable-based costs. It is this replacement of fixed costs with variable costs that drives capital efficiency and reduces risk in the service provider environment.

Figures 2, 3, and 4 show examples of status quo capital allocation models where capital is deployed inefficiently. Each of these situations represents a case in which the current capital deployment model represents either a risk in terms of deployment or an inefficient use of fixed network assets. This risk of excess or insufficient capacity can be minimized by the dynamic nature of virtualized network function (VNF) deployments in the following situations:

- **Demand Forecasting**. This situation comes about as you expand markets or begin to offer new services. Risk comes from the potential gap in your forecast to actual demand. Spend too little capital and you risk not having sufficient capacity to meet customer demand or not meeting SLAs. Put in too much capital, and you are stranding capital assets with underutilized capacity. Both outcomes impact profitability. Virtualization could mitigate this risk by deploying pools of capacity closer to the realization of demand.

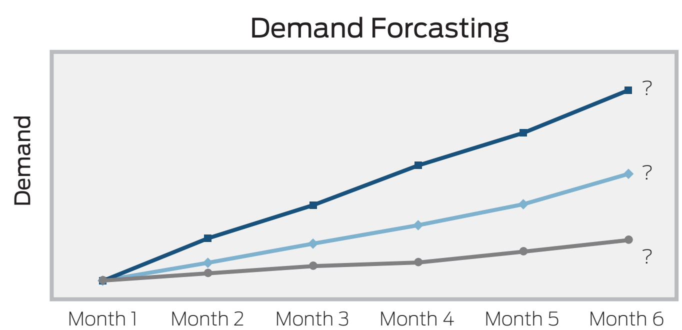

Figure 2: Demand forecast risk

- **Provisioning to Peak**. The second example occurs as a result of provisioning capacity to meet peak demand. This is usually caused by the diurnal cycle that occurs in every business as workloads peak during particular times of the day; however, this situation can also occur on a seasonal basis, or sporadically around major events. This is driven by the inflexibility of network functions to scale out and in dynamically with existing workloads, which requires service providers to provision capacity to meet peak busy-hour demand in each time zone within which they operate. Here, the ability to redeploy assets (licenses) to other parts of the network will work to improve capital efficiency.

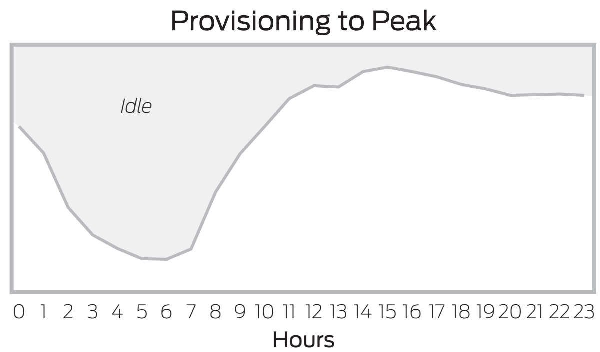

Figure 3. Provisioning to peak inefficiency

- **High Fixed Overhead**. The third example is an expansion of capacity for remote locations and data centers. The traditional model deploys network functions in each location. Proprietary hardware costs multiply as new services are added or extended, or new locations are added. The use of data center/cloud architectures to deliver virtualized customer premises equipment (vCPE) services, or localized x86-based servers to deploy network function capacity in this scenario will lower the fixed overhead of the location.

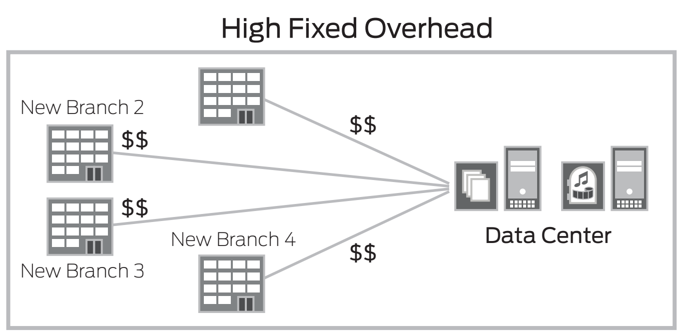

Figure 4: High fixed overhead

Virtualization has a direct effect on the degree of operating leverage (DOL), because it introduces variable costs into the total cost structure. Like financial leverage, DOL is equated to degree of business risk; simply stated, the more leveraged a company's operations, the more sensitive its operating income is to changes in prices, customer preferences, competitive actions, and the regulatory environment. Virtualization technologies, through the introduction of variable costs, lower the portion of fixed costs relative to the total cost of entry for new services, and they enable network functions to scale efficiently with demand. The flip side of this is that higher operating leverage improves profitability once its profit breakeven point is achieved. Therefore, DOL has to be carefully evaluated and aligned with particular use cases to ensure that the service provider can maximize profitability while mitigating business risk.

Operational Efficiency, Automation

A second major disruption comes via process automation, which creates operational efficiency. Business and operational processes are at the heart of every company and represent how value is created for the customer. In existing service provider business models, operational processes are traditionally complex and labor-intensive. Virtualization technologies, most notably SDN and related automation tools, reduce fixed operational costs through automation. These costs are recognized as OpEx on the income statement and paid for out of operating budgets. The objective here is to minimize these expenses in order to increase operating margins and competitiveness.

Automation and simplification of key operational processes boost overall productivity. Carriers should look to tools such as value stream mapping and possibly business process reengineering (BPR) to evaluate the impact of these technologies on operational processes. Once operational processes are mapped or updated, a simplified time-driven activity-based cost (ABC) model (ABM) (Robert S. Kaplan, 2007) provides the most helpful approach to financial benefit evaluation. By identifying process activities and then eliminating or reducing them through automation, one can quantify the relative benefits of the technology at a high level and then evaluate them further as needed.

There are as many different processes as there are implementations of those processes used by service providers and enterprises to run their businesses. Therefore, it is necessary to create a baseline, and without doing so, it is very difficult to assess the degree of influence from automation. Moreover, some companies today may already be highly automated.

To demonstrate this approach we show, as an example in Table 1, three critical operational processes and associated activities needed for any new service introduction. The ROI of automation is based on the difference between the future design of the process with automation and the existing one evaluated on the following process elements:

- **The length of the operational process** —This is the sum of the timeframes each of the activities of the process (examples shown in the third column) needed in order to complete the overall task. This first step is to map out the new process on an end-to-end basis and understand the degree to which activities can be automated and simplified with the new technology to reduce complexity.
- **The quantity of the external cost drivers**—This is what invokes the process, and is the external cost driver identified in the second column of the table. The organization must determine whether this number increases, decreases, or stays the same between network implementations, which could help justify investments in projects such as high availability (HA) architectures that reduce customer impact of outages.
- **The cost of the resource(s) consumed per activity**—Company resources consume OpEx, which typically fall into labor, equipment/technology, rent, space, utilities, and other support. For the processes described in Table 1, the assumption is that the primary resource consumed is labor.

Table 1. Network Operations Processes Examples for Discussion

Network Operation Process	Typical Cost Drivers	Typical Activities (by time)
Service Fulfillment Set of processes/activities that provision customer requests into a network solution	• Number of customers • Number of change, service modification and termination requests	• Order creation/handling • Service configuration, activation and test • Resource provisioning • Supplier requisition
Service Assurance Set of maintenance processes/activities to ensure customer services is available and performing to SLA and QoS agreements	• Number of customer issues • Number of network and equipment issues	• Customer problem and SLA management • Service quality management • Network resource management • Supplier management
Capacity Management Process/activities to ensure the IT and network resources meet demand in the most cost effective manner	• Traffic growth • Number of resources impacted	• Application and workload management • Capacity planning • Inventory assessment • Purchase order and receipt • Installation and testing

Table 1 is meant as a reference, as again, there are many different implementations. However, this approach enables you to assess the influence of automation on internal and external facing processes by breaking down the process into individual steps, assessing what can be automated or programmed and identifying the resource consumed. Once this is understood, you can determine baseline costs and then identify target savings via the sum of each activity times the cost of the resource consumed as calculated in the equation below:

$$\sum_{i=1}^{N} (\text{Length of Process Activity})_i \cdot (\text{Cost of Resource Consumed})_i$$

We believe this is a simple and powerful technique that in the very process of building this equation efficiencies can be discovered. Key considerations that Kaplan points out include starting with the most costly processes, initially starting with a single cost driver, and engaging operational personal to help build and validate the model. While we did not outline all the steps in this process, the intent here is simply to give a view as to how the benefits of automation can be assessed.

Service Agility, Revenue Growth

The combination of readily deployable service resources and operational efficiency leads to service agility, which is the ability to bring to market, provision, and deliver new services quickly and inexpensively. This ultimately improves competitiveness and innovation.

With the aligned operational processes and shared network resources in place, service providers can quickly develop, deploy, manage, and assure services, and adopt agile development methodologies through which new services can be brought to market quickly. With this lower cost structure and greater flexibility, service providers can assess opportunities for new buyers and strategic customer segments that were not previously viable. And, if services take off, then they can expand quickly. If not, they can contract and reuse the resources without stranding assets.

Options available to grow revenues include new services and business models, expansion into new markets, and uptake from existing services as a result of new product offers and bundles. Table 2 describes the associated revenue opportunities for service providers.

Table 2. Revenue Opportunities

New Revenue Sources	Example Services
New Business Models – Two-sided and Transactional Models The increased service agility more easily enables the development of new business models	• Marketplace services offering on-net access to software and Software as a Service (SaaS) • Hosting and IT-related services on-net and off-net • Cloud brokering services • Platform as a Service/IoT/Partnership models • Big Data/Analytics-based services • Advertising models
Expanded Footprint – New Market Segments and Buyers Lower cost of service entry now allows service providers to deliver both existing and new services outside of existing coverage areas and through partners	• Small and medium business market • Expansion of traditional services outside primary service areas
Connectivity Service Bundles – Increased Customer Relevance An expanded portfolio of services increases the value and importance to an enterprise's overall ICT strategy thus reducing churn	• Network services such as CDN, WAN Optimization, and Unified Communications • Security services such as firewall, IDP, Web Filtering and Data Leak protection • Mobile services, such as MDM and WIFM/Hotspot Management

This table shows strategies that service providers can use to drive revenue growth. The first involves the development of new business models. In two-sided models, the carrier can become a broker or reseller of services for other suppliers. These are potentially new services to new and existing buyers. A second approach is to expand the existing footprint. This is essentially taking existing services and offering them to new markets that the service provider currently does not serve. A third approach is to upsell existing services with new service bundles and offerings.

Ultimately, this is about service providers offering more overall value to their customers. The goal for service agility is to enable personalization and self-customization. Using automation and dynamic resource allocation allows operators to provide choice to their customers without any significant impact to product and operational teams. It is the agility and flexibility promised by SDN and NFV that enables service providers to deploy new services quickly, and lower cost of entry to reduce business risk.

Economic Value Assessment

In this section, we will discuss our methodology for assessing the total economic impact of a virtualization project driven by the benefits and disruption that SDN and NFV technologies provide. In doing this, we have employed a holistic, value assessment methodology framework that takes into account the opportunity cost forgone by continuing to offer services in the traditional way. The major component of this effort is the building of a financial model that represents how the services or project will behave from a benefit and cost perspective. Once built, the methodology continues with an assessment of optionality, risk, and total project worth. Figure 5 summarizes the methodology and steps in our evaluation process.

Financial Model

SDN and NFV influence the cost and revenue assumptions in existing service provider business models in numerous ways, including levels of capital investments, ongoing operational costs of fundamental business processes, and the agility to quickly offer new services to deliver revenue growth. Each of these benefits are additive, but can also be isolated independently from a modeling point of view. The first two boxes in Figure 5, Benefit and Cost Model and the Pro Forma Financial Statements, represent the financial model of the service or project.

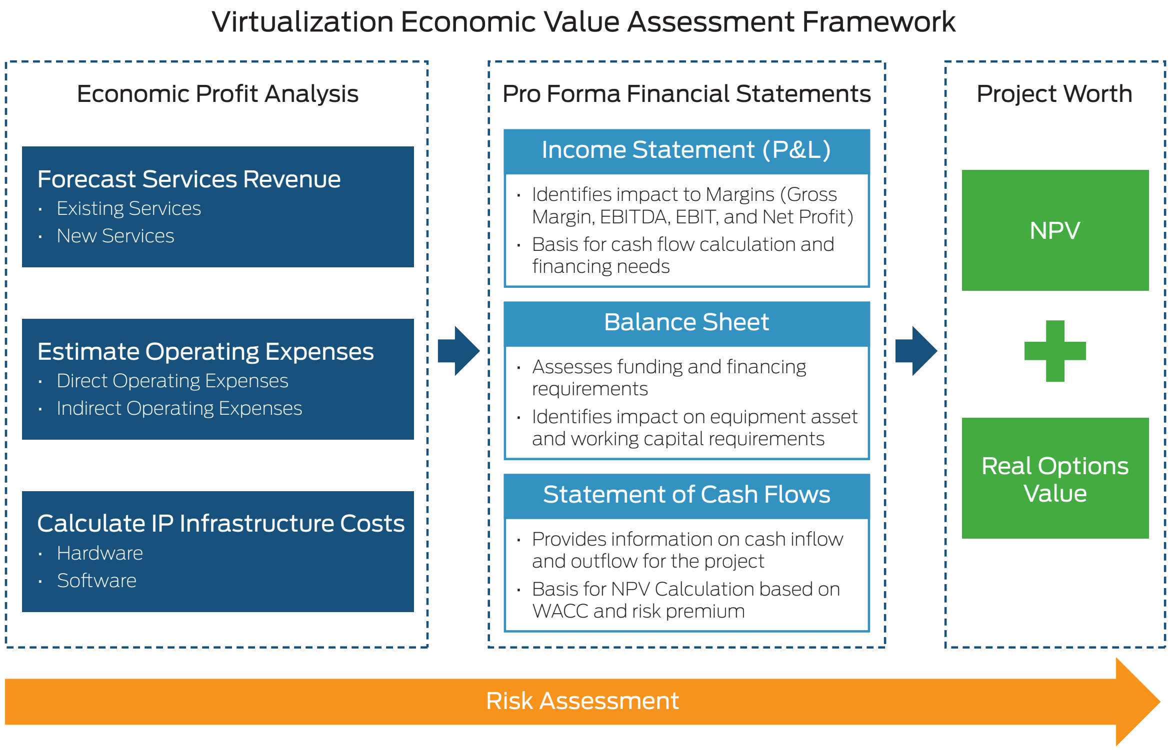

Figure 5: Economic value assessment framework

The first step in any financial analysis is to assess revenue growth (the sales forecast). As noted in Table 2, virtualization could lead to revenue enhancing business models, expanded footprints, and service bundles. The ability to bundle and create new subscription-based business models can help drive revenue growth, which could be measured by new services attach rate. New segments, whether uncharted territory or underpenetrated existing markets, represent growth potential. The impact of expanding existing services to new segments can be measured by the customer base growth rate. Virtualization also impacts customer satisfaction. Research[1] has shown that end customers favor cloud-like on-demand services delivery. The impact of improved customer satisfaction can be measured by reduced churn rate.

The next step is to forecast operational expenses. This should include both direct and indirect operating expenses. Direct operating expenses are expenses that can be traced directly to a service, customer, or operational activity. Indirect operating expenses, which cannot be traced directly to a cost object, are applied as overhead.[2] These costs are driven by underlying strategic cost drivers such as operational complexity, network design, and customer demand.

The network infrastructure costs are likewise driven by the architecture design complexity and size, and by customer demand. However, another consideration is that some of the costs may now be OpEx instead of CapEx. For example, if you choose an annual subscription license model, the cost will be allocated to an operations budget versus a capital budget. There are pros and cons with respect to the shifting between OpEx and CapEx, but the important aspect, as noted above, is the variable nature of the cost. Variable costs enable purchases to be delayed, thus lowering upfront costs. They will also smooth out cash flows, and reduce planning risk. Generally speaking, variable costs are OpEx, given the short-term nature and use of such assets[3].

With the model in place, it becomes a straightforward process to create the pro forma financial statements for the service:

- The pro forma income or profit and loss (P&L) statement identifies the impact to margins and provides the basis for cash flow calculation and financing needs.
- The pro forma balance sheet assesses funding and financing requirements and identifies the impact on equipment asset and working capital requirements.
- The pro forma statement of cash flows provides information on cash inflow and outflow for the project, which becomes the basis for a net present value (NPV) calculation based on weighted average cost of capital (WACC) and risk premium.

[1] SMB Cloud Usage Survey: 74% Would Prefer Bundled Cloud Services

[2] In any event, these costs will show up in the general ledger (GL) under Cost of Revenue and/or Operating Expense accounts such as salaries, depreciation, rent, space, utilities (power and cooling), services/support, maintenance, licenses, etc.

[3] OpEx budgets are usually easier from an approval perspective and this shift frees up CapEx for other potential investment opportunities. CapEx budget, however, enables cost to be depreciated and amortized over a longer period.

The next step is to calculate the project worth. As depicted in Figure 5, there are two components. The worth of a project is equivalent to the NPV of the project with no options, plus the value of the real options that it creates in the future. NPV is often used in capital budgeting to analyze the profitability of a projected investment or project. The information from the pro forma statement of cash flows is used to calculate the NPV with discount rate applied to the projected future cash flows.

Real Options in Networking

A real option is essentially the right to acquire the gross present value of future expected cash flows by making an investment on or before the date that the opportunity expires. Whereas NPV treats each project independently to estimate explicit expected cash flow, real options valuation accounts for future associated benefits, which is an important consideration in an agile environment and represents in many ways the value of service agility. That makes it a good fit for assessing strategic solutions, which not only solve immediate problems, but also bring additional business value through flexibility-driven options. Common models for valuing options include Black-Scholes model and binomial/decision tree.

Similar to financial options where the value of the option is correlated to the volatility of the underlying stock, the value of the real options associated with a network is correlated to the volatility of the underlying demand (traffic) or market. In a world of rapidly changing customer preferences and new competitors, the real option value of your network is potentially higher in this new world, but only if your network is flexible enough to accommodate the unexpected changes that occur.

As depicted in Figure 6, a strategic transformation to virtualized networks presents four types of real options (Mathieu Tahon, 2013): adding or diminishing the *scope* of features and functionality; the option to *scale* up or down an infrastructure's capacity; the option to *switch* a function to a different platform (fixed vs virtual); or *study*, which is a wait-and-see approach. The critical attribute in making real options valuable is the ability to move quickly.

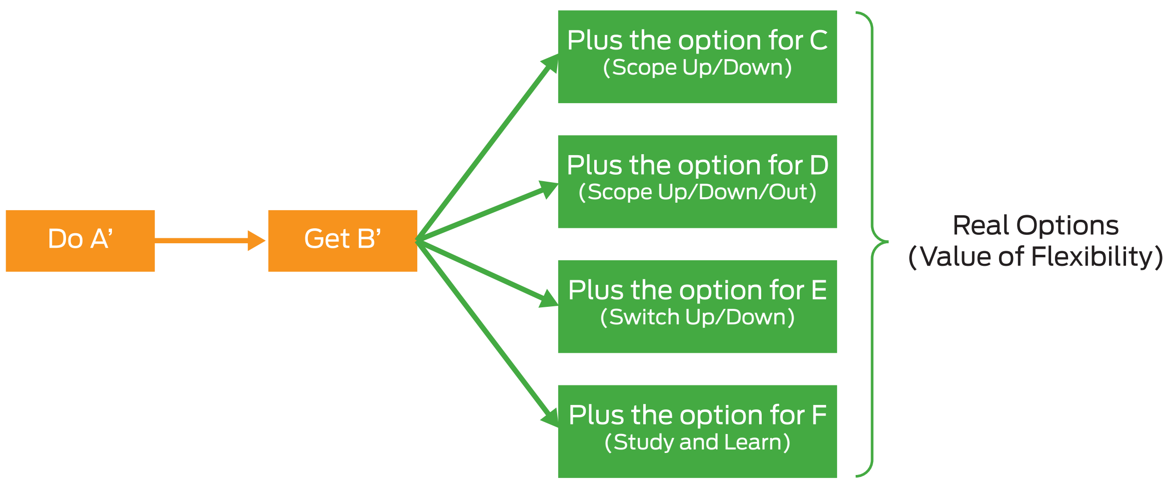

Figure 6: Strategic transformation to virtualized networks creates future real options

The process here is that an investment in "A" drives a result ("B"). Once that outcome is known, the service provider is then presented with the four options, described in the previous paragraph, that will either maximize upside like a call ("up" options), minimize downside like a put ("down" options), or allow you to gather more information ("study" option). With real options, it is about active management of the outcomes for your investments, and with virtualization technologies you have the agility to act quickly before the opportunity expires.

Risk Assessment

The final part of the process is to assess risk, as shown along the bottom of Figure 5. It is impractical, if not impossible, to wait for every piece of information to become certain before making a decision. But understanding your potential risk exposure is something you can and should do. To estimate costs and benefits, business case analysts must make assumptions, changes in which can impact the final results. Techniques such as sensitivity, scenario, or Monte Carlo analysis can help one understand the impact of such changes.

Several types of risks may affect a model's assumptions. Changes in the external environment regarding customer demand, competitive actions, pricing levels, or other market variables could impact the overall business. Some events reduce an organization's financial stability, such as a higher-than-expected cost of capital on project funding. Others may impact a company's infrastructure, leading to network downtime, interoperability, or other technical issues. Finally, organizational readiness and other factors could lead to a deviation from original or expected requirements, resulting in implementation costs that are higher than expected.

Conclusion

Virtualization is changing the rules of networking. Although there has been considerable industry discussion of how NFV and SDN technologies work, relatively little attention has been paid to analyzing virtualization's sustained economic benefits. This gap results in part from the limitations of traditional TCO models, which tend to be static, short term, and focused on single implementations. What is required to make the business case for network virtualization is a set of analytic tools that accurately reflect its transformational nature.

In contrast to traditional networks in which functions are embedded into the infrastructure, the virtualized network architecture is comprised of layers representing IP infrastructure, network control, and service and business enablement. This shift from vertical silos to horizontal planes is likewise disrupting the service provider business models that have prevailed for decades.

In one of the most dramatic changes, network virtualization substitutes portions of fixed costs with variable costs. Service providers can now partner with vendors and share some of the risk for new services built on the vendor's software technology. As such, they reduce their degree of operating leverage (DOL), with networks now behaving in a more granular and adaptive way with respect to traffic growth and customer behaviors. Network virtualization also enables service providers to automate and simplify key operational processes, which reduces costs and boosts productivity. In revenue terms, it also creates service agility, with benefits including the ability to create and try out new business models, expanded footprints, and service bundles with increased customer relevance and lower cost of entry.

In place of TCO analysis, we propose a four-part framework comprised of economic profit analysis, pro forma financial statements, NPV plus real options, and risk assessment. This paper has highlighted the more thorough modeling and analysis techniques that are required to unlock the full business benefits of SDN, NFV, and other virtualization techniques. While it may take more steps, it need not be more difficult to implement in practice with the right tools and methodologies.

For more insight into how this framework applies to your situation, please contact your Juniper representative.

Next Steps

For more information, please consult the following assets:

- Juniper Networks Platform for Agile Service Delivery white paper
- Service Creation Advisory Service data sheet
- Juniper Networks Big NFV Idea web page

Bibliography

Cokin, G. (n.d.). *Activity-Based Cost Management: An Executive's Guide*. New York: Johe Wiley & Sons, Ince.

Institute of Management Accountants. (2006). Implementing Activity-Based Costing. *Statements on Management Accounting, Strategic Cost Management*, 1-31.

Marc de Jong, M. v. (2015, July). Disrupting Beliefs: A New Approach to Business Model Innovation. *McKinsey Quarterly*.

Mathieu Tahon, S. V. (2013). Real Options in Telecom Infrastructure Projects –- A Tutorial. *IEEE*.

Robert S. Kaplan, S. R. (2007). *Time-Driven Activity-Based Costing*. Boston: Harvard Business School Press.

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.

Corporate and Sales Headquarters
Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, CA 94089 USA
Phone: 888.JUNIPER (888.586.4737)
or +1.408.745.2000
Fax: +1.408.745.2100
www.juniper.net

APAC and EMEA Headquarters
Juniper Networks International B.V.
Boeing Avenue 240
1119 PZ Schiphol-Rijk
Amsterdam, The Netherlands
Phone: +31.0.207.125.700
Fax: +31.0.207.125.701

2000612-003-EN Feb 2017