

A Methodology for Transformation of Data Center Networks

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Executive Summary

Business evolution and technology advancements during the last decade have driven a sea change in the way data centers are organized and managed. Virtualization, service-oriented architectures, “big data,” and “cloud” are just a few of the key factors leading organizations to completely rethink the way they handle the applications, data, security, and access that constitute their critical IT resources.

The widespread adoption of virtualization in the data center has led to highly complex workload management, especially when it comes to the network. As new applications are added, network complexity grows exponentially until service delivery is hampered and the user experience degrades. This impacts an organization’s ability to keep up with the pace of business. It is perhaps not surprising, then, that in the findings of a study¹ of over 3,000 CIOs, an overwhelming theme was the need for radical simplification of infrastructure through transformation. Ironically, getting to operational simplification involves a complex set of choices and decisions.

These types of initiatives often result in a major transformation of the data center, both physical (servers, cooling, power, etc.) and logical (software, databases, applications), with a heavy emphasis on virtualization. Making these decisions requires a broad range of expertise for both planning and execution of the transformation.

Often overlooked in such transformation discussions, or left as an afterthought, is the data center network. However, a poorly designed or inadequate data center network may jeopardize many of the benefits expected from a data center transformation project. The network transformation should be an integral part of any data center transformation project, and it requires specialists who can provide the insight to make the right choices and implement them correctly.

This white paper is designed to give IT managers, architects, and staff a view of best practices for transforming a data center network. It also offers insight into what to demand from consultants, project managers, and staff regarding the network aspects of the project. The techniques outlined here are the fruit of many years of experience by a large number of consultants and engineers at Juniper Networks. The methodology is based on one that has been used successfully by Juniper consultants in many data center transformation projects around the world.

Introduction: An Approach to Data Center Transformation

Virtualization has resulted in ever greater resource utilization and efficiency in the data center. As a result, many data centers are going through major transformations to take even better advantage of virtualization technologies. As virtualization increases, so too does the complexity of the network, which can reduce the benefits of virtualization and impact an organization’s ability to keep up with the pace of business. Networks must, therefore, evolve along with other data center technologies to enable customers to utilize their data center resources to the fullest extent and to maximize return on network investment.

In order to derive maximum benefit from a data center transformation project, it is important to optimize the network architecture for the new environment. This should be done without impacting project velocity, and at the same time reduce risk while controlling cost. To do this is no easy feat, however. A flood of new products, technologies, and architectures is radically changing the data center, and this has a different meaning for, and a different impact on, virtually every organization.

The network is the nervous system of the data center, so transforming it requires careful planning and a proven methodology. It requires much more than just project management skills; it also involves making important decisions regarding technologies, data flows, priorities, service levels, and multiple other items that will have major impacts on the effectiveness of the new data center environment. For this reason, a complete data center network transformation methodology is required, and must be adopted in parallel with other aspects of the data center transformation activities. The methodology that is described in this white paper has been successfully utilized by Juniper Networks Professional Services consultants in many customer engagements around the world.

Data Center Migration or Transformation?

Data center *migrations*, almost by definition, limit risk and scope by removing components of transformation. Typically, migrations could be data center moves or consolidations which may be driven out of the need for physical optimization such as reducing from many small to a few larger data centers.

By data center transformation, we mean that the environment or architecture will undergo a change. This has different implications from a data center migration, since transformation results in a different, optimized architecture and/or operating model once it is complete.

Although this document focuses on data center transformation, it is equally applicable to migrations. In both cases, the customer journey needs to be mapped out with an initial assessment which can then be used to inform both migration and transformation steps.

¹ IBM Institute of Business Value, 2011, The Essential CIO—Insights from the Global Chief Information Officer Study.

A data center network transformation methodology must cover the complete planning-to-implementation process—from identification of network needs to actual deployment. It must define a clear roadmap for each step of the journey, yet be flexible enough to adapt to specific situations and requirements. A network transformation methodology should be based on real-world experience in network development, implementation, migration, and transformation, consistent with industry best practices. The critical nature of the data center requires an appropriate level of project governance, including project management, risk evaluation, and risk mitigation.

Types of Network Transformation

Before discussing the details of the transformation methodology, let's first discuss the types of transformation options available. The type of data center network transformation required can be very different based on several dependencies, such as the size of the data center, service-level agreement (SLA) requirements, or high availability (HA) needs and capabilities. Below are some of the possible types of network transformations, and their typical use cases. The choice of implementation of the data center transformation will have a major impact on the planning for the network transformation.

Big Bang: This refers to cases where the entire data center is transformed at one time. A typical use case would be for a small data center that can tolerate complete shutdown for an extended period (several hours). This could be because of soft SLAs (allowing night or weekend maintenance), or due to strong HA capabilities, i.e., there is another data center or a disaster recovery site that could be used to keep critical applications accessible during the maintenance window. This type of transformation minimizes the time constraints, but usually increases the risk, as it can make rollbacks difficult.

Pod-by-pod: This is a quite common technique for data centers that haven't started their data center transformation journey. It requires pods of a manageable size (i.e., not huge ones), and no Layer 2 (L2) extensions between pods. This transformation type requires Layer 3 (L3) connectivity between the legacy infrastructure and the new environment, and it allows a more granular approach to data center transformation than the Big Bang. It also carries less risk.

Phased Dynamic Interconnect: Used for large data centers which have started their data center transformation, i.e., usually with L2 extension across different pods, or when the pods are too large to be migrated during a single maintenance window. This transformation type requires both L2 and L3 connectivity between the legacy infrastructure and the new environment, and usually needs in-depth planning to interconnect the two solutions in a redundant manner. This transformation type is the most flexible one, allowing migration of services and applications in any order, permitting you to adapt the migration to your specific application dependencies and traffic flows.

The variety of transformation types, each offering benefits and constraints, requires careful evaluation, as the final selection will determine the capabilities and capacities of the transformed data center.

Data Center Network Transformation Methodology

Although the need for data center network transformation is often clear, the data center is one of the most valuable assets of any organization and as such the prospect of transformational change can be disconcerting. It is common, and perfectly natural, for customers to express concern about issues such as:

- “We do not know how to set up processes and plans for such an exercise.”
- “We have the skills to operate the data center but not to execute this type of change.”
- “The risks seem extreme.”
- “Our project managers are unfamiliar with projects of this scope.”
- “Our data center has grown almost organically so far; where do we start untangling that complexity?”

Want to know more about Network Transformation Plans?

Juniper Networks Professional Services proposes a Data Center Transformation Assessment that can help you understand the differences between the transformation types, and make the right selection, as well as get more details on the different steps that will be required. For additional information on this service, please contact your Juniper account manager, services business manager, or visit www.juniper.net/us/en/products-services/consulting-services/assessment-analysis/#literature.

Data Center Network Transformation Phases

Any methodology for network transformation should fit into a lifecycle for the overall data center transformation project. Juniper Networks takes a lifecycle approach when delivering services, similar to many other vendors in the technology marketplace. This end-to-end approach to the network lifecycle is based on three high-level phases: Plan, Build, and Operate. Project management spans across the three separate phases to ensure a seamless transition and attention to the overall health, risk, and control of the network during the project.

A robust data center network transformation methodology fits into the Plan and Build phases of the network lifecycle. The Juniper Networks methodology described here is based on years of experience transforming and migrating networks of all types for customers of all sizes. The specifics of the data center network transformation methodology are the result of applying the general principles, learned over many years, to the specific needs of today's data center evolution.

This transformation methodology is based on four phases, with the first three being part of the Plan phase of the network lifecycle:

- Assessment
- Design
- Validation

The final one is part of the Build phase:

- Implementation

The four project phases must be supported by an overall project management and risk management function.

Project management and risk management must be customized to fit the specific project constraints of anticipated benefits, cost, timing, and risk against each phase. As per normal project management practice, each phase would be closed off with a phase review process. The phase review requires acceptance by all project stakeholders and sponsors.



Figure 1. Four project phases in data center network transformation methodology

Since the focus of this methodology is transformation, the Operate phase of the lifecycle has been intentionally excluded from the context of this document. Nevertheless, it is important that the operational requirements of the target environment be assessed, designed, validated, and implemented in conjunction with the operations staff during all phases of the transformation project.

Assessment Phase

In order to ensure the optimum output of the project, it is essential that the input be right. The goal is for everything to work right the first time to save time, money, and impact on users. The Assessment phase provides the foundation of appropriate input and must not be neglected.

Assessment is the most strategic phase of the transformation project. All remaining activities will depend on what is discovered and exchanged during this phase. It is crucial to consider the complete data center ecosystem, the strategic goals expected of the data center transformation, and make sure that each step of the journey is aligned.

It is not enough to merely assess the legacy data center network infrastructure and propose newer equipment. Rather, a number of detailed assessments should be made and options evaluated that consider the total data center environment. To build a complete understanding of the environment requires an assessment from multiple perspectives, including:

- The business requirements and objectives of the transformation
- The infrastructure of applications (criticality, SLA, redundancy, traffic flow), servers, network services, administration and automation tools
- Existing processes, including change management processes
- Inherent and potential risks, making sure the possible threats are identified and catalogued
- Success criteria for transformation and handover requirements for operations

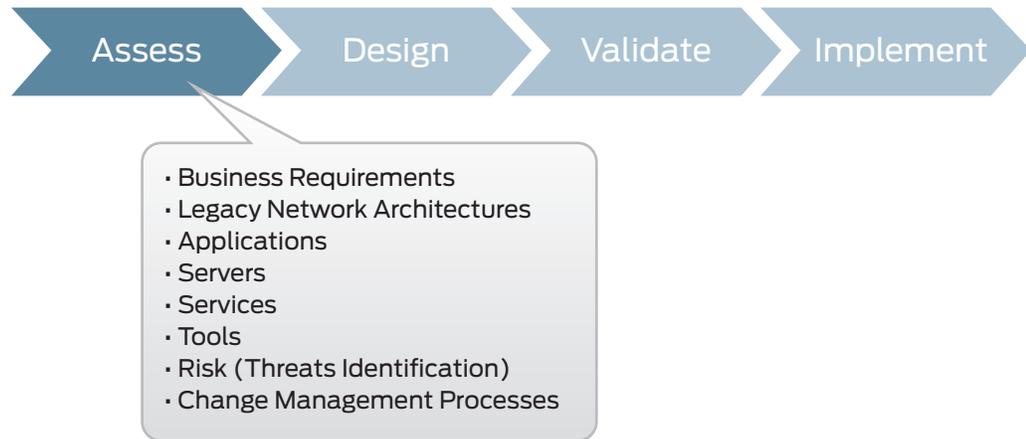


Figure 2. Assessment phase

Assessment Phase Outcomes

Once this phase is completed, the gaps between the capabilities of current technology and the capabilities required to achieve the business and technology goals should be clear. This phase should deliver a full understanding of the options and recommended approach for bridging the identified gaps. It should also identify potential areas of risk and furnish recommendations for risk mitigation.

Design Phase

Once the data center environment is understood and the options agreed upon, the work of designing the transformation can begin. This will include both design of the network and mapping out the transformation journey. This must be done in close conjunction with all parties: architects, planners, and operations, as well as any data center transformation consultants and partners.

In the design phase, a series of activities must be carried out that will provide the deliverables necessary to:

- Validate the proposed concept (Proof-of-Concept Testing)
- Create the appropriate data center network design in accordance with the strategic goals, requirements, and data center ecosystem (High-Level Design, Low-Level Design)
- Build the procedures for implementing (Network Implementation Plan) and validating (Network Acceptance Test Plan) the new data center network
- Develop a Risk Mitigation Plan in accordance with the threats identified previously and their level of risk (probability and impact)
- Construct the Network Migration or Transformation Plan, which will include all activities to implement the transition, with all required validation steps and rollback procedures

This is also the key phase for building the skills of in-house staff, via regular training and more specific transfers of information delivered by the transformation team to operations staff.

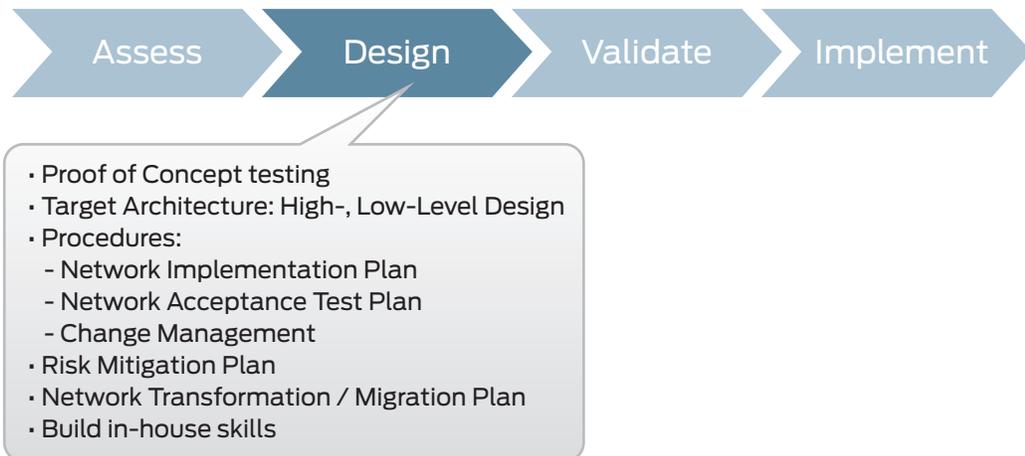


Figure 3. Design phase

Design Phase Outcomes

During this phase, detailed high- and low-level designs along with a Network Transformation Plan will be created. This will help ensure the greatest possible efficiency during the transformation in order to have minimal impact on data center operations. This plan describes the process and procedures that will be used to control changes as well as the anticipated transformation steps, timing, and resources required.

Validation Phase

In any complex project, there is always the possibility that specific aspects or issues are not discovered during the earlier phases, and so have not been taken into consideration. The Validation phase of the data center network transformation methodology is designed to uncover such issues, further reducing transformation-related risk.

This phase allows validation of the deliverables of the previous phases. It is divided into two sections:

- Lab testing: Validate the target architecture and the Network Transformation/Migration Plan, as well as the end-to-end interoperability of all the components of the new solution.
- Pilot implementation: Because labs cannot simulate all real-life constraints, pilots of the transformation must be conducted prior to full implementation. Those pilots should follow exactly the same processes as those of the future full implementation:
 - Deployment of the new infrastructure
 - Acceptance testing
 - Pilot cutover to the new architecture
 - Verification of the success of the pilot cutover
 - Monitoring for an agreed upon stability period

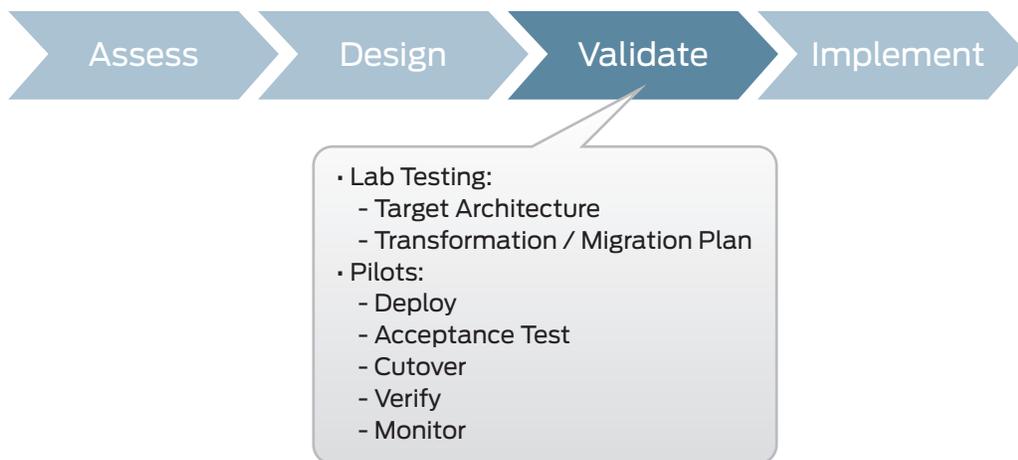


Figure 4. Validation phase

Validation Phase Outcomes

As a result of the Validation phase, the design of the proposed network should meet requirements and all testing acceptance criteria should have been satisfied. It will also have validated that the transformation can be achieved with the expected impact and results.

Implementation Phase

The final step in the data center network transformation methodology is to put into production the new network to replace the existing connectivity. This is the Implementation phase.

For this phase, it is essential that the transformation team work closely with operations staff and any data center transformation partners to put into production the tested and validated hardware and software for the new data center network. All parties must perform extensive monitoring of issues and risks at every step and ensure that the target network is:

- Deployed as described in the Network Implementation Plan
- Tested as specified in the Network Acceptance Test Plan
- Fully connected as all data center servers/applications/services are moved to the new infrastructure

Once the deployment has been completed, the success of the implementation will be verified and the data center will continue to be monitored for a predefined period of time (agreed to amongst all parties involved).

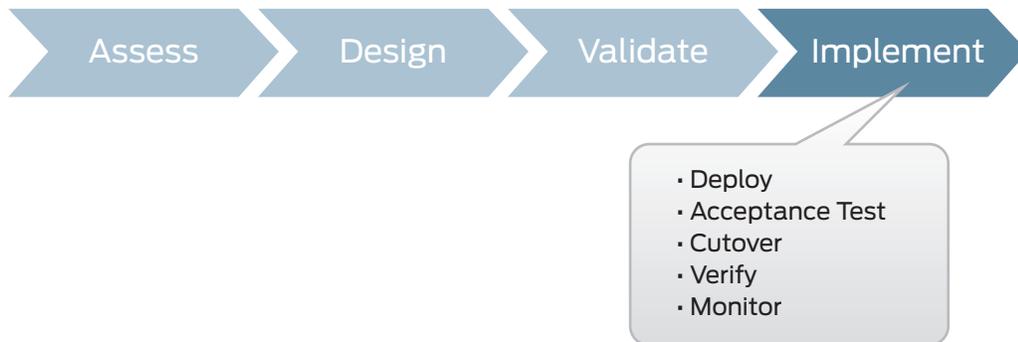


Figure 5. Implementation phase

Implementation Phase Outcomes

Once this phase is completed, the new network will be operational, delivering the expected benefits of the transformation.

Project Management

The data center is at the heart of most businesses today. As such, the process of implementing significant data center change must be effectively planned, managed, and controlled to minimize risk and ensure effective, efficient transition. Project management best practices must include the appropriate processes, controls, and procedures, to ensure the successful project execution and delivery of the transformed data center.

The goal of project management is to ensure the successful execution and delivery of the data center network transformation by managing the various roles and documents using accepted project management best practices. With that in mind, Juniper Networks has developed the Juniper Project Management Methodology (JPMM) based on the standardized PMI and PRINCE2 project management methodologies, utilizing the best practices from both and incorporating additional internally developed processes.

When undertaking a project to either design and transform an existing network or design and build a new network, it is important that proper controls and procedures be established to ensure a successful implementation. In general, professional project management emphasizes risk management, project planning, the creation of written reports tracking project tasks against scheduled due dates, and project documentation. More specifically, a dedicated project manager takes responsibility for the following tasks:

- Create and maintain the project plan that serves as the guide for the project's flow, task list, dependencies, responsibilities, quality, communications, and timeline
- Help identify action items and risks to the project and, with other project team members and stakeholders, coordinate a resolution or mitigation and monitor their execution and completion
- Facilitate change control to address changes to the timeline, scope, and various tasks performed within the project
- Issue regular project status reports to maintain consistent and accurate content and flow of communication, and provide accountability relating to the overall progress of the project
- Coordinate all project stakeholders, both internal and external, such as the provider, the vendor, and other third-party contractors
- Control the project deliverable documents by maintaining a central repository and assigning project document tracking numbers

The project manager serves as the central point of contact throughout the course of the project and ensures consistent communication, successful issue resolution, and timely delivery. A dedicated project manager deals with all aspects of project execution, removing the most burdensome aspects of the project from operational staff, permitting them to contribute to the project but not impacting "business as usual."

Risk Management

The data center is a crucial asset for the business, which is why it is common to have SLAs associated with it. The time available for the transformation is limited, and any potential for business disruption must be eliminated or at least minimized. It is therefore essential to manage the risks associated with any transformation project.

Risk management includes identifying areas of potential risk, considering the types of issues that could potentially be encountered (e.g., performance hits, connectivity loss, security vulnerability, cost impacts, or project delays), and then defining and executing a risk mitigation plan to eliminate or at least minimize the impact of each threat.

The chart below outlines a variety of risk management procedures that should be implemented throughout the lifecycle of a data center network transformation project.

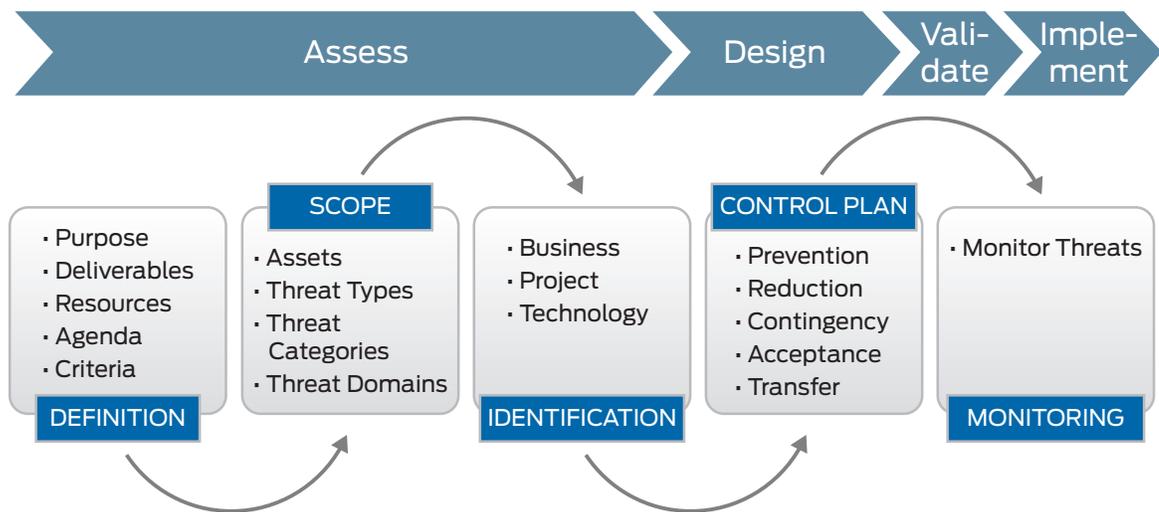


Figure 6. Data center network transformation project risk management procedures

The process starts by defining the risk management that will be required, detailing the purpose of the risk management activities, listing the various deliverables to be provided, identifying the resources that will be needed, preparing a detailed agenda, and defining success criteria.

The second step is to scope the risk management. This involves identifying which assets need to be covered, the categories that will have to be accounted for in the Risk Mitigation Plan (processes, products, people, and premises), and the threat domains, which can be related to business (revenue impact, cost, company credibility, user/customer experience, or loss of competitive advantage), project (delay, success, cost), or technology (historical, migration, or new solution introduction).

Risk identification occurs in two steps. First, it must be established how the threats will be identified (interviews, brainstorms, technical reviews, and/or from generic risk database). Once this is defined, the threat identification will begin. The different threats identified should be sorted by threat domain, and then evaluated to understand the risks behind each of those threats, in order to later apply the right level of mitigation. Juniper recommends that this evaluation be done with a Probability/Impact matrix.

Once threats are identified, a control plan should be built.

The risk-level evaluation should be used to propose the right approach to mitigate each risk. This mitigation can be: prevention, reduction, contingency, acceptance, or in some cases transfer.

A key aspect in risk mitigation is being able to monitor the risk. Risk must be monitored throughout the project lifecycle.

Some Generic Technological Threats

Although threats are usually specific to environments, some generic threats are well known. Here is a sample of the generic threats that will need to be addressed when planning a data center network transformation:

Historical Threats: This usually requires an assessment of the legacy environment. The most common ones include:

- Complexity of operation, due to configuration complexity, OS dispersion, suboptimal (legacy) design, and so on
- Hot points, such as areas of high CPU usage, high network utilization points, etc.
- Equipment that has reached end of life (EOL) or end of support (EOS)
- Lack of stability
- Lack of scalability

Want to know more about Risk Management?

Juniper Networks Professional Services proposes a Data Center Transformation Assessment that includes a risk analysis and mitigation plan. It will allow you to identify more detailed and specific threats around your data center network transformation, characterize those threats, and build a solid plan for mitigating them. For additional information, please contact your Juniper account manager, services business manager, or visit www.juniper.net/us/en/products-services/consulting-services/assessment-analysis/#literature.

The goal of assessing these threats, in light of a coming transformation project, is not to solve them in the legacy environment. The objective is to control them until the transformation is completed, to integrate them into the migration plan, and to make sure the new solution is designed to either mitigate or eliminate them.

Migration Threats: Typical threats include:

- Lack of feature parity between versions
- Use of proprietary protocols
- Threat of change (any change period is subject to higher risk)
- Premises capabilities (power, space, etc.)
- Interconnection capabilities between legacy and new environments
- Seamless management of both the legacy environment and the new solution during the transformation

A proper assessment, planning, and validation of the transformation can mitigate these well-known risks.

New Solution Introduction: When introducing a new solution, together with a new vendor or not, some specific threats have to be taken into consideration. These can include:

- The need for a new architecture and detailed design
- The operational aspects of the new solution
- The maturity of the solution.

Risk management addressing all three types of threats is an integral part of the Juniper Networks Data Center Transformation methodology.

Juniper Networks: Experts in Network Transformation

Each transformation project is unique. Every customer has different requirements, resulting in different transformation plans. Juniper Networks Professional Services consultants are available to develop a transformation plan specific to each unique situation. You expect the best possible service from your network vendor, which is why Juniper Networks consultants are industry-leading subject matter experts, with an average of 15 years' experience in networking and security, and with deep expertise in data center environments and transformation projects. Our consultants all have extensive experience in multivendor environments and with multiple system operators. We understand complex transformations because we've done them many times before.

The unmatched level of knowledge and capability of our consultants allows us to apply the methodology described in this white paper to your unique requirements, and deliver excellence to your data center transformation project.

Conclusion

As IT becomes ever more central to the success of most businesses, projects to transform the IT systems, and more specifically the data center, have become strategic. A crucial piece of the data center transformation puzzle, and one which is too often left until the end, is the network. As the central nervous system of the data center, its transformation must be an integral part of the entire data center transformation project.

The methodology developed by Juniper Networks Professional Services has proven its worth in numerous network migrations and transformations. By combining a structured, multiphased approach with highly skilled project management and risk mitigation, Juniper Networks is able to provide the expertise needed to ensure that your network transformation is closely integrated with and complementary to your entire data center transformation project. This allows you to maximize the value you receive from your new IT architecture.

For More Information

MetaFabric Architecture Data Center Solution

The Juniper Networks® MetaFabric™ architecture allows customers to accelerate time to value, while simultaneously maximizing network value over time in an increasingly dynamic, application-driven world. Built on the three guiding principles of Simple, Smart, and Open, MetaFabric architecture enables customers to cost-effectively run their data center networks more efficiently, while retaining their investment value over time. Using open interfaces, multivendor virtualization, and SDN technologies, along with flexible deployment options, the MetaFabric architecture delivers applications and services within a single data center and across multiple data centers, as well as extending workloads to a public cloud. You can visit the MetaFabric Architecture webpage at: www.juniper.net/us/en/solutions/enterprise/metafabric/.

Juniper Networks Professional Services proposes a MetaFabric Assessment that can help you understand how a move to a Simple, Smart, and Open data center will enable you to support current business activities, while also providing a more cost-effective, scalable, robust, and adaptable environment for the future. To order this service or for additional information, please contact your Juniper account manager, services business manager, or visit www.juniper.net/us/en/products-services/consulting-services/assessment-analysis/#literature. You can also find the Juniper Networks Data Center LAN Migration guide at www.juniper.net/us/en/local/pdf/design-guides/7100128-en.pdf.

Juniper Networks Professional Services

As leaders in networks and security, Juniper Networks Professional Services consultants and engineers are uniquely qualified to assist service providers in designing, implementing, and optimizing security solutions. Our team appreciates the complexities and the subtleties inherent in large-scale internetwork design and can assist service providers and enterprises, plus provide customized and integrated “turn-key” solutions.

Juniper Networks Professional Services helps accelerate your network’s time to value and enhanced security, bringing revenue-generating capabilities online faster for bigger productivity gains, faster rollouts of new business models and ventures, and higher levels of customer satisfaction. Your onsite staff will work closely with Juniper specialists, building operational capabilities and reducing your exposure to IT risks. As a result of our previous experience involving hundreds of customers around the world, Juniper Networks Professional Services is uniquely qualified to help you design, implement, and optimize your network for confident operation and rapid returns on infrastructure investments. These professionals understand today’s network and security demands and those that are just around the corner—for bandwidth efficiency, best-in-class security, solid reliability, and cost-effective scaling.

Juniper Networks Service and Support

Juniper Networks is the leader in performance-enabling services that are designed to accelerate, extend, and optimize your high-performance network. Our services allow you to maximize operational efficiency while reducing cost and minimizing risk, achieving a faster time to value for your network. Juniper Networks ensures operational excellence by optimizing the network to maintain required levels of performance, reliability, and availability. For more details, please visit www.juniper.net/us/en/products-services/services/technical-services/.

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.

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