



The Economic Benefits of Juniper Apstra and CN2 in a Modern 5G Network

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EXECUTIVE SUMMARY

This paper presents the results of a total cost of ownership (TCO) analysis on the benefits of the Juniper Apstra data center automation platform and the Juniper cloud-native Contrail Networking (CN2) SDN in a distributed 5G network. Built upon a Tier 1 operator's existing and planned deployment, our study analyzed a 5G network with the following network design:

- Two main DCs for management and orchestration (MANO) clusters and servers
- Ten central data centers for packet core control planes
- One hundred edge data centers for 5G user plane functions (UPFs), Open-RAN centralized units (CUs), and other edge services

For each data center, Apstra manages and automates the data center switch fabric underlay while CN2 provides the integrated container network interface (CNI) and SDN overlay virtual networking to interconnect, protect, and isolate VNF and CNF workloads. Together, Apstra and CN2 simplify Day-0, Day-1, and Day-2 operations to reduce complexity, resulting in substantial network cost savings. Our TCO model considers both data center capital (CapEx) and operating costs (OpEx), including server, environmental, software, and labor expenses. The result of our Apstra and CN2 5G analysis shows OpEx savings of 41%, TCO savings of 23% and return on investment (ROI) of 312%.

Overview of 5G Network

This TCO analysis calculates the three-year accumulated value and ROI of Apstra and CN2 automation, measured mostly in OpEx savings, when deployed in a real operator's network. The study is based on the existing and forecasted expansion of a Tier 1 operator's 5G network serving over fifteen million subscribers. Today, the total number of active 5G users is small, but subscriber and capacity growth coupled with the distributed architecture of 5G will expand the data center footprint, particularly at the network edge. The 5G network and data centers are purely for 5G services as the 4G service is delivered over a separate network.

The type and number of network data centers are summarized in Table 1. Starting with 20 edge data centers, this volume will grow to 100 over the next three years. The life cycle of all data center switch fabrics, from core to edge, is managed and controlled by Apstra. Similarly, the centralized CN2 SDN control plane provides dynamic networking and security policy management for remote Kubernetes clusters throughout the network.

Data Center	Number	Functions
Main	2	MANO cluster: Automation, service assurance, CI/CD pipeline, Kubernetes and CN2 control servers
Central	10	Packet core control plane, 60 servers, 12 servers per rack, Juniper QFX10002 and QFX5120 spine-leaf switch architecture
Edge	100	Packet core UPF, O-RAN CU, future edge applications. Juniper ACX 7100 collapsed fabric with 20 servers per edge DC

Table 1. Network Data Center Descriptions

Key Benefits of Apstra

Apstra is a next-generation switch fabric orchestration, automation, and management system. It provides single pane of glass intent-based design, deployment, and operations of data center networks (Figure 1). Apstra manages networks across many data centers, including large central data centers and distributed edge data centers. It is completely hardware and OS vendor agnostic, allowing for management, monitoring, and automation across heterogeneous data center networks. Apstra tracks all information about the network and uses this data for life-cycle management and automation, which simplifies and reduces the cost of Day 0, Day 1, and Day 2 operations. It also has predefined templates that can be used for easy to deploy designs. Alternatively, more complex designs can be customized.

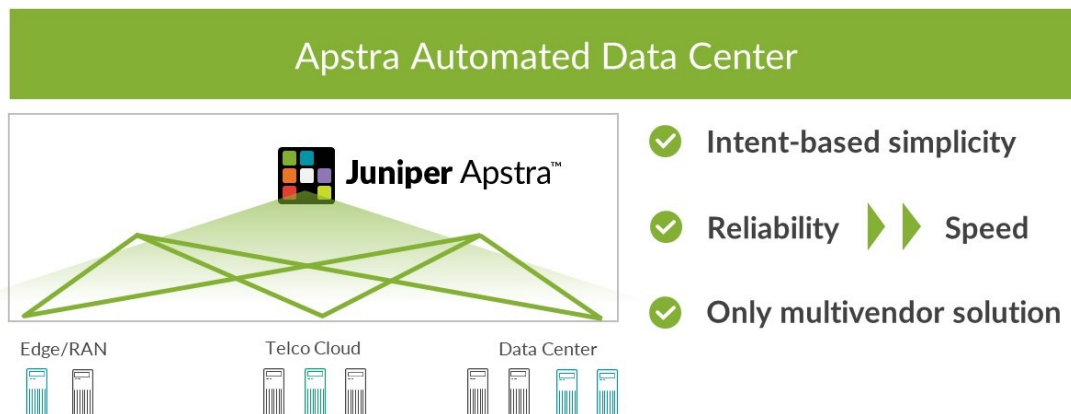


Figure 1. Apstra Automated Fabric

Some key benefits of Apstra include:

- Reduces labor expenses in Day 0, 1, and 2 operations
- Faster deployment; many issues such as cabling and configuration problems are automatically detected and resolved
- Improved Day 2 operations, including fault management, inventory management, configuration control, monitoring, and analytics with time views of the network for effective troubleshooting and service assurance

Key Benefits of CN2

CN2 is a cloud-native CNI and SDN providing hybrid-cloud and multicloud networking. As a hybrid SDN, CN2 integrates multiple versions of OpenStack, OpenShift, and Kubernetes across private and public cloud infrastructures (Figure 2). It provides centralized control over scalable vRouter forwarding planes, advanced routing features, and simplified, intent-based management and control. CN2 uses a modern DevOps environment with GitOps automation and CI/CD pipelines for SDN configuration and life-cycle management. It provides advanced application security and service chaining of CNFs and VNFs to support the world's largest data centers and networks.

A key benefit of CN2 is that the deployment and networking of new cloud infrastructure and application workloads is automated, minimizing the need for manual configuration from the network operations team. This contrasts with other CNI solutions that are targeted at local pod networking and require manual design and configuration to deploy new cloud services. Manual configuration slows down service delivery and introduces potential errors in configurations.

CN2 reduces network OpEx through advanced automation to reduce Day 0, Day 1, and Day 2 operations. All CN2 configurations are managed by GitOps, providing a modern DevOps CI/CD pipeline that:

- Ensures consistent network configurations are deployed
- Reduces user errors and improves network availability
- Improves the speed to deploy network moves, adds, and changes

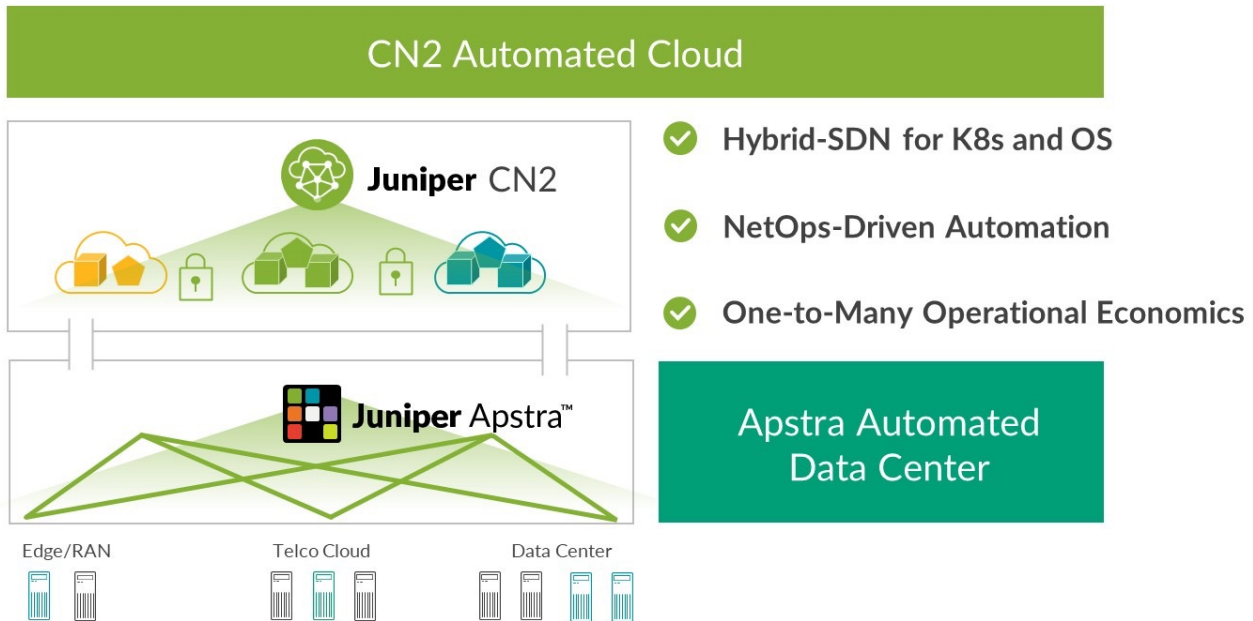


Figure 2. CN2 Cloud-Native Contrail Networking

Some key benefits of CN2 include:

- Hybrid SDN for Kubernetes and OpenStack, which provides infrastructure investment protection and infrastructure evolution
- DevOps Driven Automation: simple, repeatable CI/CD pipeline automated test and assurance at cloud scale
- One-to-many operational economics: centralized multi-cluster networking and monitoring for scalable operations across distributed data centers

Categories of Labor Expenses

Overburdened and understaffed, operations teams value data center automation to streamline tasks, reduce costs, and speed time to deployment. To assess Apstra's and CN2's TCO and ROI in this key area, we considered multiple categories of Day 0, Day 1, and Day 2 labor responsibilities for a 5G deployment. Using data and experience from network operator deployments, we quantified the labor savings for both Apstra (Table 2) and CN2 (Table 3) in each of their respective labor categories.

Categories	Tasks
Day 0	<ul style="list-style-type: none"> • Basic network design • Detailed network design • Scope requirements
Day 1	<ul style="list-style-type: none"> • Network implementation • Testing • Operations documentation
Day 2	<ul style="list-style-type: none"> • Data center network operations • Outage costs and remediation • Troubleshooting

Table 2. Apstra Labor Categories

Categories	Tasks
Day 0	<ul style="list-style-type: none"> • High-level planning and requirements definition • Basic SDN, container, and VM design • Detailed SDN, container, and VM design
Day 1	<ul style="list-style-type: none"> • Initial SDN configuration and deployment • SDN testing • Workload qualification and testing
Day 2	<ul style="list-style-type: none"> • Troubleshooting and fault remediation • Scale up: add new containers and VMs to increase capacity • Moves, adds, and changes for containers and VMs • Configuration validation • Test and certification of new software releases • Software upgrades

Table 3. CN2 Labor Categories

TCO Model Assumptions

In our TCO model we consider both CapEx and OpEx. However, the benefits of Apstra and CN2 are primarily OpEx focused. We compared two scenarios:

1. Network TCO with Apstra and CN2
2. Network TCO without Apstra and CN2

For each scenario we created models that replicate the Tier 1 operator’s network described in this paper and summarized in Table 1. We also modeled the operator’s plans for 5G network growth.

Specifically, we assumed that 5G subscribers will grow from 1 million to 15 million subscribers over 3 years. We also assumed the edge data centers will grow from 20 to 100 sites over 3 years. The following categories of OpEx have been considered in our model:

- Apstra annual software subscription
- CN2 annual software subscription
- Environmental expenses (power, cooling, floorspace)
- Commercial Kubernetes deployments
- Server maintenance expenses
- Day 0, Day 2, and Day 2 labor expenses as specified in Table 3

TCO Results

With a nearly identical CapEx profile, OpEx, specifically in Full Time Equivalent labor savings, drives the TCO comparison. Our findings show total OpEx savings of 41% and ROI of 312% on the Apstra and CN2.

Financial Metric	Savings & ROI
OpEx	41%
CapEx	0%
TCO	23%
ROI	312%

Table 4. Key Financial Results

A breakdown of the Apstra software license expense versus the OpEx savings is presented in Figure 3, which shows the differences in OpEx between the two scenarios. A positive difference indicates that there is savings. A negative difference is an additional expense. All the differences are positive (savings) except for the Apstra software license, which is an additional expense. The Day 2 expense savings are on-going savings and therefore are the primary contributors to the ROI. It should be noted that this is a three-year TCO comparison, and these Day 2 savings will continue to accrue over many years beyond the scope of our TCO model.

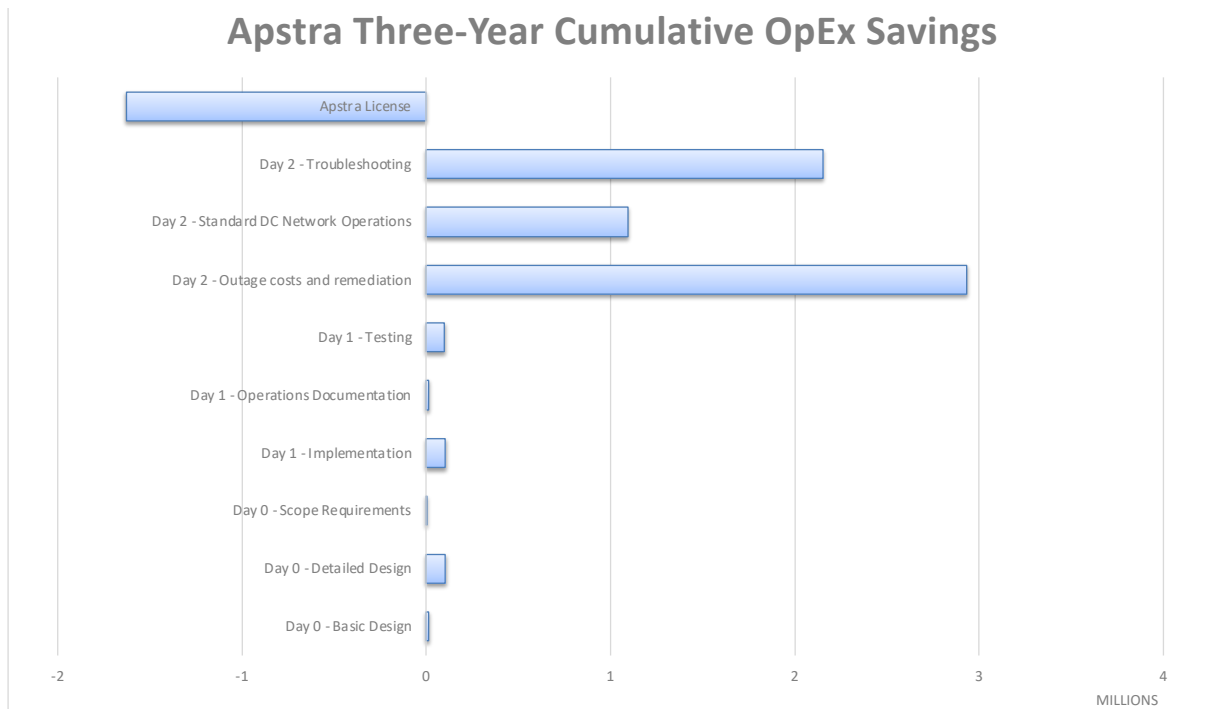


Figure 3. Apstra Three-Year Cumulative OpEx Savings

Similarly, a breakdown of the CN2 software license expense versus the OpEx savings is presented in Figure 4. Most of the savings is also in Day 2 OpEx; however, there is also significant savings in Day 0 design and planning activities.

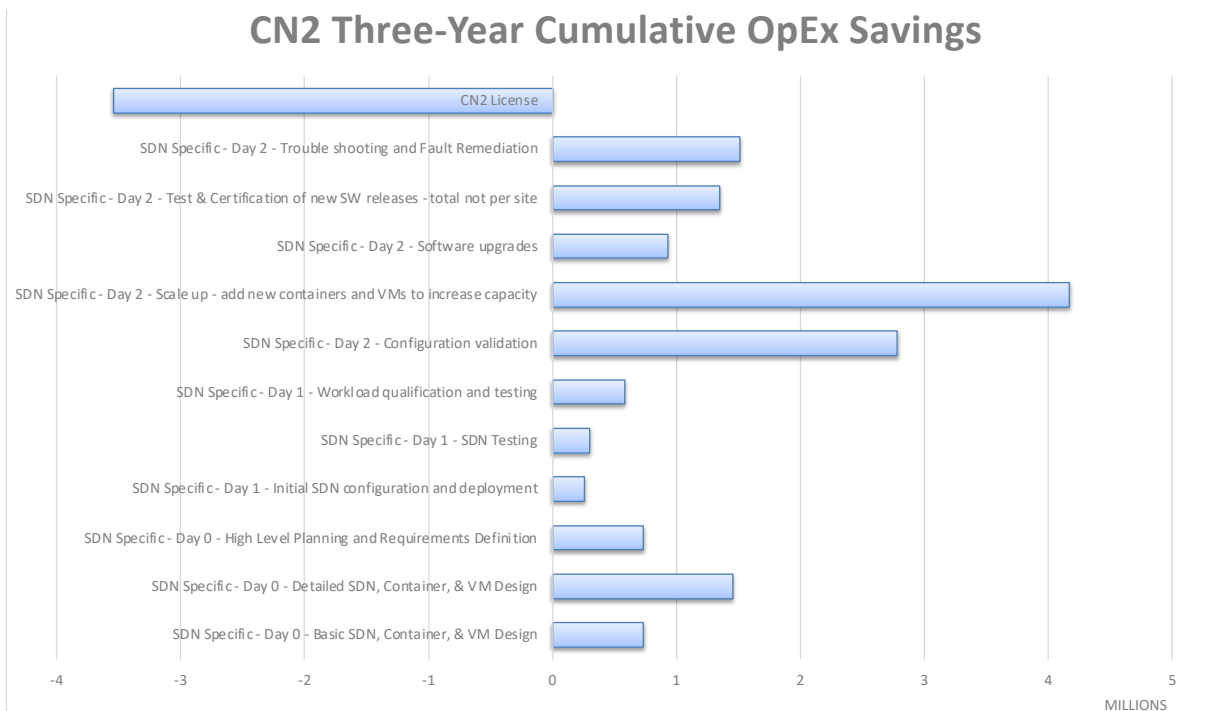


Figure 4. CN2 Three-Year Cumulative OpEx Savings

Comparisons of the three-year cumulative labor OpEx with and without Apstra is presented in Figure 5, and a similar comparison for CN2 is presented in Figure 6. These charts show the cumulative OpEx for both scenarios with and without Apstra and CN2. The savings (Figure 3 and Figure 4) are the differences in these total cumulative operations expenses. In both scenarios the labor savings are higher, which results in ROI of 312%, than the cost of Apstra and CN2 software licenses.

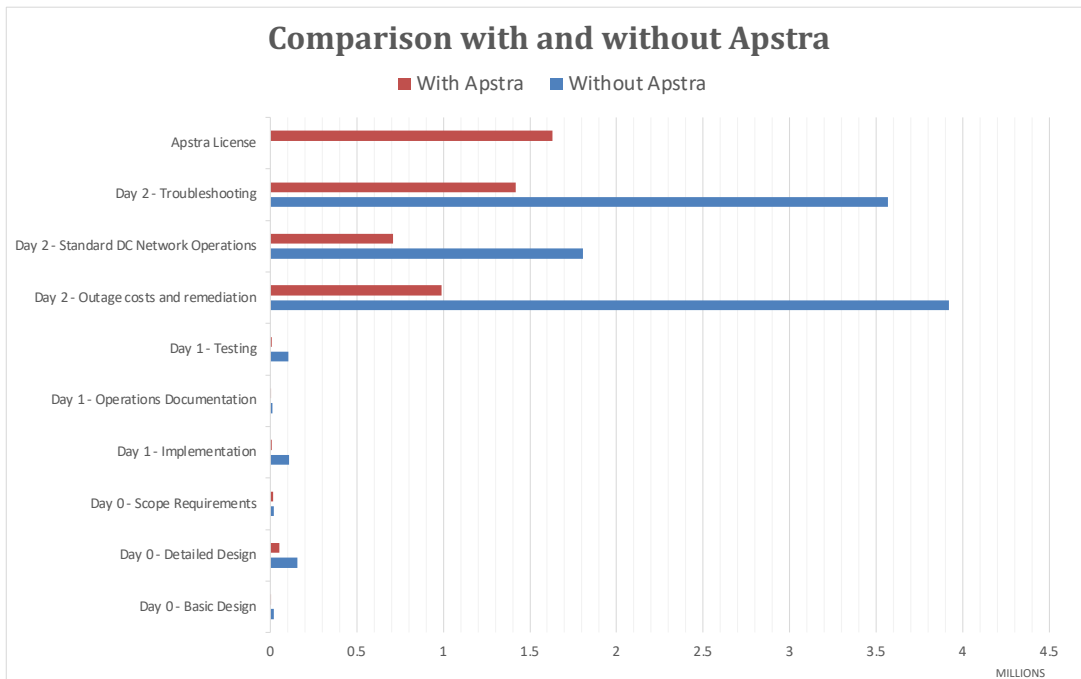


Figure 5. Three-Year Cumulative OpEx Comparison with and without Apstra

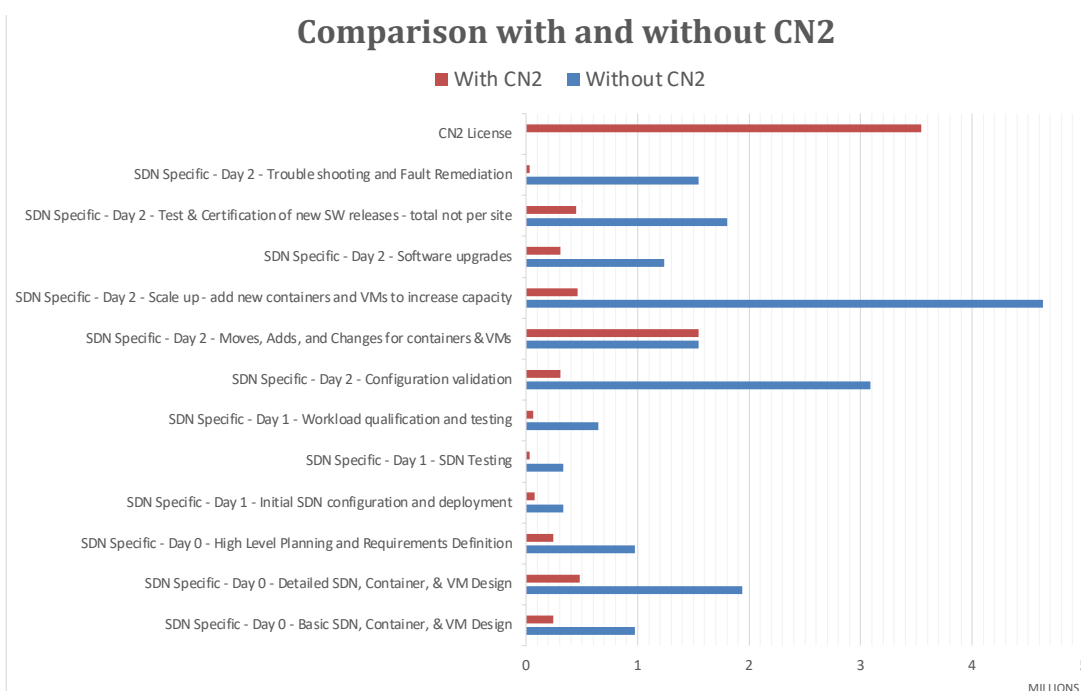


Figure 6. Three-Year Cumulative OpEx Comparison with and without CN2

Conclusion

This paper presents the results of an analysis of the benefits of Apstra and CN2 in a Tier 1 operator's 5G network data center deployment. Apstra's heterogeneous switch fabric management platform reduces labor and improves efficiency in managing switch fabrics distributed across multiple central and edge data centers. CN2 improves efficiency in operating an SDN virtual router network connecting workloads within and across 5G data centers and providing service chaining to deliver sophisticated telco services. Both Apstra and CN2 greatly simplifies many Day 0, Day 1, and Day 2 operations activities, which directly results in reduced network OpEx and faster time to service deployment. The results of our model show OpEx savings of 41%, TCO savings of 23% and ROI of 312% in Apstra and CN2 software.

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