Data center fabric business case analysis (BCA)

Realize savings for all phases of the data center network operations life cycle

White paper

In today's modern data center networks, switching hardware costs are not the only measure of differentiation. The real value lies in the technology that makes networks easier to consume, more open and flexible, while having a positive impact on overcoming operational barriers to growth and scale.

This Nokia Bell Labs Consulting business case analysis (BCA) presents the operations savings that data center engineering and operations teams can realize as they transition from current generations of data center leaf-spine networks to next-generation leaf-spine fabrics. In addition to the next-generation fabric providing higher capacity and supporting great port speeds, the majority of operational gains will result from new network operation system capabilities and accompanying fabric management tools.

The Nokia Bell Labs Consulting BCA is unique in that it takes a complete and detailed approach to quantifying the savings related to designing, deploying and operating data center fabrics. Existing studies mainly focus on CAPEX savings, and while others include OPEX savings, they often only cover a subset of the operations phases, job functions and job tasks for data center fabric operations.

The BCA models a comprehensive set of operations tasks for Day 0 design, Day 1 deployment and Day 2+ operations of the data center fabric life cycle. It presents the OPEX savings that can be realized when evolving to Nokia's next-generation, scalable leaf spine data center fabric. Nokia's Data Center Fabric solution is powered by Nokia SR Linux, a modern open NOS, Nokia's high-performance data center switching platforms and Nokia Event-Driven Automation (EDA), a modern data center network automation platform that combines speed with reliability and simplicity.

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Executive summary

Accelerating demand for distributed cloud-based applications is putting immense scaling and operations related pressures on data center network teams. The key challenge for data center operators is to balance the need to constantly scale data center networks against the increasing costs of designing, building and operating them.

The Nokia Data Center Fabric solution addresses this challenge by:

- Enabling more scalable, high-performance leaf-spine data center fabrics using SR Linux, an open, extensible and programmable Network Operating System (NOS) and a portfolio of next generation data center switching platforms
- Improving operations agility and flexibility for all phases of the data center fabric life cycle using Nokia Event-Driven Automation (EDA), a modern data center network automation platform that combines speed with reliability and simplicity.

The Nokia BCA study helps answer the question "What approach should we take for our next data center expansion or build out and why?" It helps data center teams to decide whether to:

- Keep their existing data center fabric, which may be limited in its ability to support or implement the required operations tools as the network scales
- Evolve to a data center fabric that offers a comprehensive and unique set of tools that makes operations simpler and more agile as the data center network scales.

The BCA models a migration scenario from a present mode of operation (PMO) to a future mode of operation (FMO). The PMO is a data center network based on a 10GE/40GE or 25GE/100GE leaf-spine architecture, and the FMO is a higher scale and capacity data center fabric based on a 10GE/25GE/100GE, 100GE/100GE or 100GE/400GE leaf-spine architecture. The FMO is powered by the Nokia SR Linux NOS running on Nokia high-performance data center switching platforms and Nokia EDA.

The BCA models a very comprehensive set of tasks by job function that are part of the Day 0, Day 1 and Day 2+ phases of the data center fabric operations life cycle. It models the operations efforts in hours and calculates the hours saved for two FMO scenarios:

- FMO 1 – Nokia SR Linux only
- FMO 2 – Nokia SR Linux and Nokia EDA.

BCA highlights

- Cumulative effort savings up to 40% over 4 years for all operations tasks
- Effort savings of up to 43% with Nokia SR Linux for specific operations tasks
- Effort savings of up to 60% with Nokia SR Linux and Nokia EDA for specific operations tasks
- Power and space cost savings per GE of up to 50% and 62% respectively
- A 2.6X increase in fabric capacity

The following sections highlight the key operations savings and benefits that can be realized based on the business case analysis.

Cumulative effort savings of up to 40%, over 4 years for all tasks associated with the data center fabric life cycle

Over 4 years, the total effort for the PMO scenario is 104,217 hours. In comparison the total effort for FMO 1 is 83,633 hours, representing 20% effort savings compared to the PMO. The total effort for FMO 2 is 62,728 hours, representing 40% effort savings compared to the PMO.

The Nokia BCA offers a true indicator of cumulative savings because it models a complete and comprehensive set of job functions and associated tasks across all phases of the fabric operations life cycle. Existing studies mainly focus on CAPEX savings, and while others include OPEX savings, they often only cover a subset of the operations phases, job functions and job tasks.

Effort savings of up to 43% with Nokia SR Linux for specific tasks within the fabric operations life cycle

These operations savings are attributed to using Nokia SR Linux in the FMO 1 scenario. SR Linux is a modern and truly open NOS, which features a unique architecture designed from the ground up to enable data center NetOps teams to increase their operations efficiency – for design, onboarding and integration, configuration, change management and trouble-shooting tasks.

Effort savings of up to 60% with Nokia SR Linux and Nokia EDA for specific tasks within the fabric operations lifecycle

These operations savings are attributed to using Nokia SR Linux and Nokia EDA in the FMO 2 scenario. Nokia EDA additionally provides a set of NetOps tools to automate a wide range of network operations tasks. Implementing both SR Linux and EDA maximizes operations efficiency for data center network design, onboarding and integration, configuration, change management and trouble-shooting tasks.

Power and space cost savings per GE of up to 50% and 62% respectively and a 2.6X times capacity increase for Gigabit Ethernet ports

These numbers indicate the power and space savings and capacity increase that can be achieved when moving to a higher scale next-generation leaf-spine fabric architecture. This information can be helpful as a data point in internal business cases covering CAPEX spend associated with future data center buildouts. The power, space and capacity savings are a result of evolving to new generations of data center switching silicon that are more efficient compared to previous generations.

Objectives and methodology

BCA objectives

In today's 5G and cloud era, modern, highly distributed applications are being implemented by a wide range of businesses, including cloud providers, colocation and interconnection providers, gaming and social media companies, Communication Service Providers (CSPs) and enterprises across many industries. Data center networks have to adapt to these evolving application needs.

The objective of the Bell Labs Consulting BCA is to show the operations savings that data center operations teams can realize as they plan their transition to a next-generation leaf-spine-based fabric. These next-generation fabrics are higher capacity supporting increased port speeds for both server and network uplink connectivity as well as providing enhanced network operations and automation tools. Data center teams can benefit from these tools and best practices for operations tasks that are error prone, repetitive, or complex to perform manually. This allows the teams to focus on higher value tasks and strategic initiatives.

The tool models a migration scenario from a present mode of operation (PMO) to a future mode of operation (FMO). The PMO is a data center fabric based on a 10GE/40GE or 25GE/100GE leaf-spine architecture, and the FMO is a higher scale and higher capacity data center fabric based on a 10GE/25GE/100GE, 100GE/100GE or 100GE/400GE leaf-spine architecture. The FMO is modeled using Nokia's Data Center Fabric solution, which includes:

- Nokia SR Linux, a modern data center network operating system (NOS)
- Nokia's high-performance data center switching platforms
- Nokia Event-Driven Automation (EDA), which is a modern data center network automation platform that combines speed with reliability and simplicity.

Level of automation in data center switching infrastructures

Data center and cloud infrastructures typically have hundreds to thousands of servers, which run legacy and cloud-based applications. The data center networks that support these infrastructures need to provide scalable connectivity operations. This is achieved by managing groups of switches in the data center network as a logical unit called a fabric, and by operating the fabric as a whole by introducing network automation.

As data center networks have grown, the operations burden has outpaced the ability for the operations staff to keep pace. Due to this, many tasks have been automated and this trend is continuing to grow with the move to the era of cloud native design.

Data center operations teams may implement basic automation or advanced automation for their data center switching infrastructures. Basic automation may include scripting the CLI, scripting of basic updates, and basic tool use such as Ansible, Python, etc. The user continues to use the CLI but has portions of it scripted, so the process is not entirely manual.

Advanced automation may include adoption of APIs, and intent-based configuration and maintenance as well as AI/ML capabilities. Configuration and maintenance occur in a tool, and the CLI is rarely used. Software updates/rollbacks can be scheduled ahead of time, and the user can roll back with a click vs. CLI.

The following findings from 650 Group reflect the level of adoption of automation across various market segments:

- For hyperscalers, the level of automation (basic plus advanced) is forecasted to increase from 48% in 2020 to 82% by 2025.
- If we exclude hyperscalers, the level of advanced automation across all other markets segments was at 23% in 2020 and forecasted to increase to 66% by 2025.
- For enterprises, the level of advanced automation was at 2% in 2020 and forecasted to increase to 58% by 2025.

These numbers indicate that hyperscalers continue to lead the way with enhancing their data center network operations by extensively embracing network automation, while the rest of the market is in the earlier stages of adopting network automation practices. There is consensus among operations teams on the value of network automation and a majority o f teams plan on increasing the level of automation as they evolve their data center infrastructures.

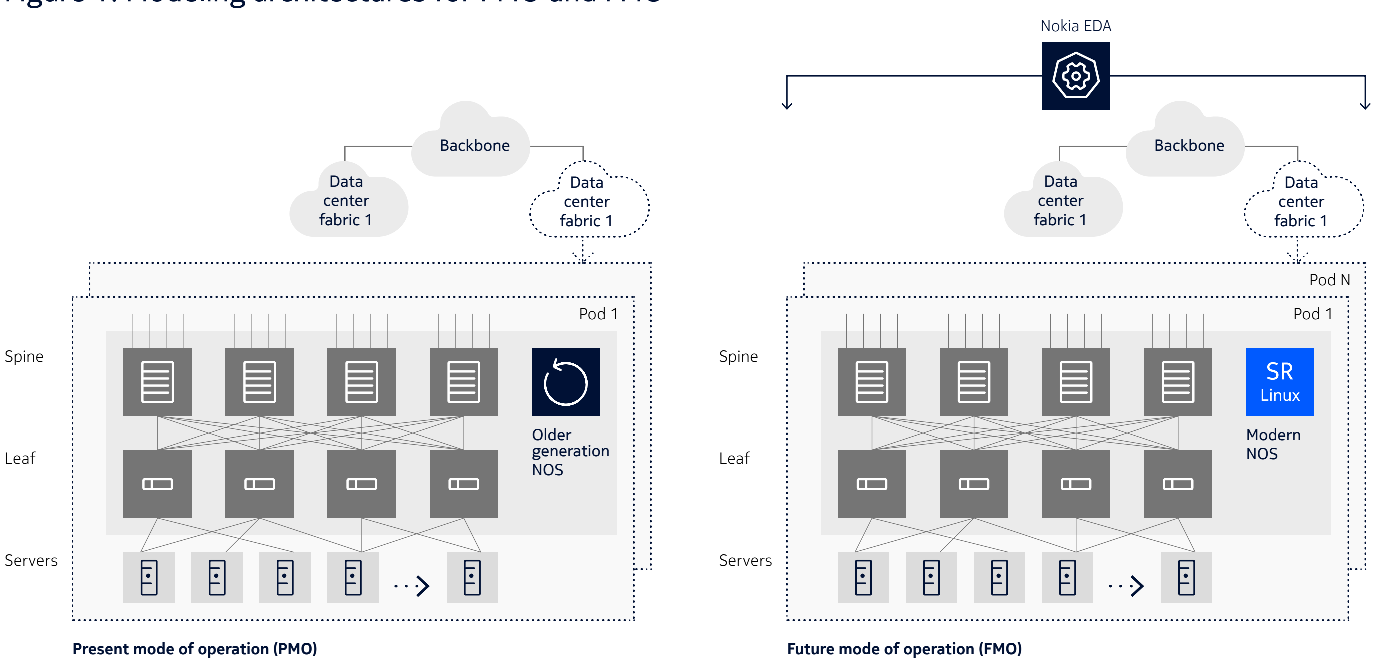
Modeling the data center architecture for PMO and FMO

In data centers, pods are units of compute, storage, and leaf-spine networking. The BCA models multiple pods along with the connectivity across model data centers, as shown in Figure 2.

The PMO models an existing leaf-spine data center architecture, which models 10GE/40GE (10GE access for servers and 40GE uplinks for spines) and/or 25GE/100GE (25GE access for servers and 100GE uplinks for spines). The PMO leaf-spine architecture is modeled using platforms based on older generation commercial off-the-shelf silicon, such as Broadcom Tomahawk.

The pods in the FMO are an evolution of the PMO leaf-spine architecture with platforms supporting higher capacity and higher port speeds. The FMO models a 10GE/25GE/100GE, 100GE/100GE or 100GE/400GE data center fabric. The FMO leaf-spine architecture is modeled using platforms based on the latest generations of commercial silicon.

Figure 1. Modeling architectures for PMO and FMO



The PMO assumes a limited level of automation, partly due to limited capabilities of the older generation of switch operating systems and the lack of required operations tools with the existing solution. The FMO assumes a next-generation data center fabric with a comprehensive set of tools that enhance simplicity and agility by adopting advanced NetOps capabilities to scale data center network operations.

The FMO is powered by the Nokia SR Linux NOS running on Nokia high-performance data center switching platforms and Nokia EDA. The BCA models a very comprehensive set of tasks by job function that are part of the Day 0, Day 1 and Day 2+ phases of the data center fabric operations life cycle. It models the operations efforts in hours and calculates the hours saved for two FMO scenarios:

- FMO 1 – Nokia SR Linux only
- FMO 2 – Nokia SR Linux and Nokia EDA.

The BCA uses Nokia hardware platforms and their associated capabilities – such as platform capacity, port density, product dimensions, power consumption – as a baseline to model the power cost, space cost and capacity increase when evolving from the PMO to the FMO.

Modeling the entire data center fabric operations life cycle

The BCA models a very comprehensive list of job functions and associated tasks that are part of the Day 0, Day 1, and Day 2+ phases of the data center operations life cycle. For example, planning is a job function in the Day 0 phase that includes tasks associated with planning, defining and reviewing data center design and project management requirements. Please refer to Appendix B for a summary of the modeled job functions and associated tasks.

The BCA assigns resourcing requirements for each individual task and calculates effort based on hours of work for the PMO and FMO scenarios. It determines the number of people and the time it takes in hours to complete the different tasks across the phases of the data center operations life cycle. The effort hours are then used to calculate effort savings in hours or the effort savings percent for the FMO scenarios compared to the PMO.

Job functions and associated tasks often require different skill sets. The BCA calculates effort savings for job roles based on three different skill set categories:

- Job role 1 – Level 1 operations
- Job role 2 – Level 2 operations
- Job role 3 – Engineer/Architect

The BCA assumes the type of job role for the different job functions and tasks across all operation phases to calculate the total amount of effort it takes for each job role. For example, let's assume it takes eight full time equivalent (FTE) employees 12 weeks to complete Day 0 design phase tasks. The BCA modeling provides the option to choose how much time is allocated to tasks such as requirements gathering, high level design (HLD), low level design (LLD) and deployment planning, and which job roles these tasks are associated with.

Online business case analysis tool

Nokia offers an online tool based on the BCA. It provides a high-level snapshot and a downloadable summary of key results using default input options, or users can customize their own model by configuring the inputs for the leaf-spine architecture and individual functions and tasks for Day 0, Day 1 and Day 2+ operations.

Optionally, customers can complete a request form for an operations saving assessment for their specific data center fabric environment.

BCA results

The operations savings results are derived from a sensitivity analysis across small, medium, and large data center fabric scenarios:

- Small: 1 data center with 3,200 servers and an operations team of 22 FTE
- Medium: 2 data centers with 6,400 servers per data center and an operations team of 30 FTE
- Large: 4 data centers with 12,800 servers per data center and an operations team of 54 FTE

Each FTE equates to the hours worked by one employee on a full-time basis. The net results from the sensitivity analysis indicate that increasing data center size does not have a significant impact on the operations savings that can be realized; that is the range of savings realized are similar across data center fabric of all sizes.

The results presented in the following sections apply to a medium data center fabric scenario. The BCA online tool provides options to model the small and medium scenarios as well as options to further customize inputs for the leaf-spine fabric design along with a wide range of inputs for job functions and operations tasks.

Cumulative effort savings across all tasks and operations phases

For an FMO based on the complete Nokia Data Center Fabric solution (with SR Linux and EDA), operations teams can realize **a cumulative effort savings of up to 40%**, over 4 years for all tasks associated across Day 0 design, Day 1 deployment and Day 2+ operations phases of the data center fabric life cycle.

The Nokia BCA models a complete and comprehensive set of job functions and associated tasks (as listed in the Appendix B), to calculate work effort measured in hours for all tasks and for every phase of the data center fabric life cycle as opposed to alternative approaches, which may only calculate work effort for a subset of phases of the fabric operations life cycle and only for a limited set of tasks within each phase. The Nokia approach offers a more complete indicator of savings that can be realized by operations teams.

Up to **40%**

cumulative effort savings over 4 years for all operational tasks

Figure 2. Cumulative savings over 4 years across all operations phases and job tasks

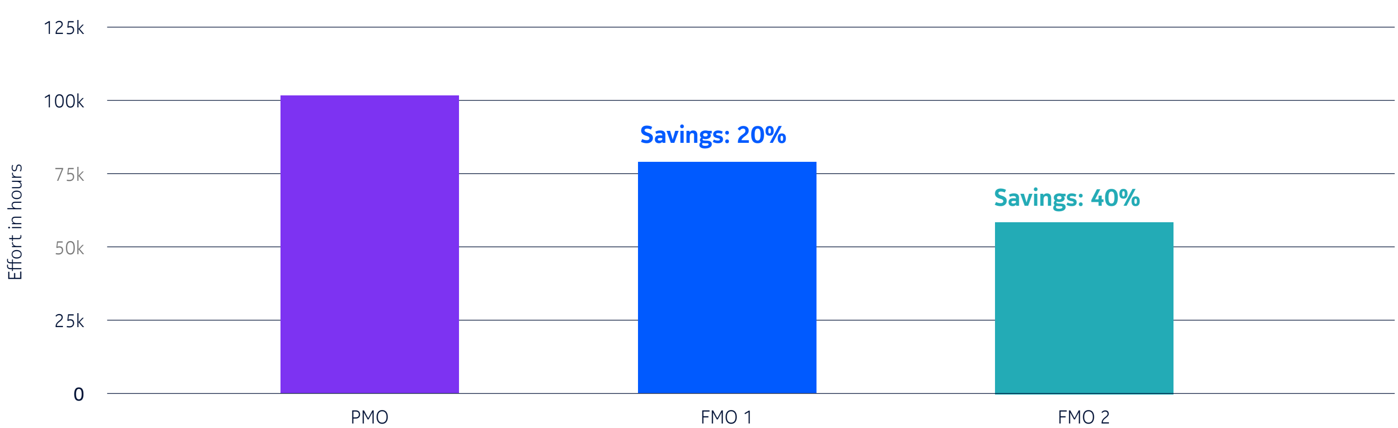


Figure 2 shows that over 4 years, the total effort for the PMO scenario is 104,217 hours. In comparison the total effort for the FMO 1 is 86,633 hours (20% savings over PMO) and the total effort for the FMO 2 is 62,728 hours (40% savings over PMO). The significantly lower number of hours for the FMO scenarios deliver significant savings over a 4-year period.

The BCA model provides additional insights related to work efforts and effort savings by year, by operations phase, by job functions/tasks and by job roles. These results are covered in the "Additional details on efforts and savings by year, by operations phase, job functions and jobs roles" section of this document.

Higher effort savings for specific tasks with SR Linux and EDA

Additional effort savings can be realized for specific job functions and tasks in the FMO scenarios. The FMO 1 (which implements Nokia SR Linux only) can provide effort savings of up to 43% for specific job functions and tasks within the Day 0, Day 1 and Day 2+ phases of the operations life cycle.

Table 1 lists specific job functions and tasks that offer the highest effort savings percent in each operations phase for the FMO 1 scenario.

Up to **43%**

effort savings for FMO 1 for specific tasks in the operations life cycle

Table 1. FMO 1: Highest savings for specific job functions and tasks in each operations phase

Phase	Job function and tasks	Savings (%)
Day 0	Design: High level design (HLD) – Integrations (investigations/demos/selection)	25%
Day 1	Onboarding and integration: In-service software integration with external OSS/BSS systems	20%
Day 2+	**Change management: Service change validation**	**43%**

The Day 2+ "Change management" function and associated "Service change validation" task provide the highest effort savings of 43% in the FMO 1 scenario. For a list of top three specific job functions/tasks and the related effort savings, please refer to Appendix A.

The FMO 2 (which implements SR Linux and EDA) can provide **effort savings of up to 60% for specific job functions and tasks** within the Day 0, Day 1 and Day 2+ phases of the operations life cycle.

Table 2 lists specific job functions and tasks that offer the highest savings percent in each operations phase for the FMO 2 scenario.

Up to **60%**

effort savings for FMO 2 for specific tasks in the operations life cycle

Table 2. FMO 2: Highest savings for specific job functions and tasks in each operations phase

Phase	Job function and tasks	Savings (%)
Day 0	High level design (HLD) – Integrations (investigations/demos/selection)	52%
Day 1	**Onboarding and integration: In-service software integration with external OSS/BSS systems**	**60%**
Day 2+	Change management: Service change validation	55%

The Day 2+ "Change management" function and associated "Service change validation" task provide the highest effort savings of 60% in the FMO 2 scenario. For a list of top 3 specific job functions/tasks in FMO 2 and the related effort savings, please refer to Appendix A.

Nokia SR Linux and EDA capabilities that contribute to effort savings

Effort savings in the FMO 1 and FMO 2 scenario are attributed to implementing Nokia SR Linux and Nokia EDA in the next-generation data center fabric. Appendix A lists the key SR Linux and EDA features that contribute to efforts savings along with the benefits of these features for the job functions and tasks in the FMO scenarios.

The key capabilities and associated business benefits are summarized below.

- The **open, extensible and programmable capabilities** of the Nokia SR Linux NOS and its **ground up, model-driven architecture** offer several benefits to data center operations teams.
  - Day 0 design – The SR Linux model-driven architecture, data model and a single API ensures HLD integration is simpler and more efficient. Ubiquitous and consistent access to the CLI and data ensures simpler, faster and more accurate HLD documentation and LLD test plans and execution.
  - Day 1 deployment – The open interfaces and ubiquitous and consistent access to the CLI and system data ensure faster and consistent plug-and-play integration and less customization with external systems. Self-signed security certificates and customizable Zero Touch Provisioning (ZTP) increase deployment speed and accuracy by eliminating manual per node configuration.
  - Day 2+ operations – Flexible scripting options and customizable monitoring ensure agile and lower risk changes to infrastructure and services, and faster and more accurate identification of any potential impacts during infrastructure change validation and service change analysis.
- Nokia EDA complements the Nokia SR Linux NOS by offering a unique **Digital Sandbox** that creates a digital twin, which provides a true emulation of the data center fabric as multiple containerized NOS instances.
  - The Digital Sandbox enables operations teams to increase agility, reduce risk and improve efficiency for planning, test, validation, implementation and troubleshooting tasks for the Day 0 design, Day 1 deployment and Day 2+ operations phases of the fabric life cycle.
- The **advanced data center fabric management and operations toolkit** provided by EDA helps NetOps teams to simplify their operations practices and job functions/tasks.
  - Day 0 design – The secure, automated and certified integration capabilities of EDA leverage open APIs to ensure faster, secure and flexible HLD integrations. Nokia-certified design intents (templates) provide best practice and more accurate LLD documentation. The Digital Sandbox provides physical and logical design maps, faster testing and clearer interpretation of test results.
  - Day 1 deployment – The automated intent-based approach of EDA ensures faster, more accurate and more secure configuration deployments. Stateful and filterable topology, intent deviation tracking and notification, and advanced telemetry ensure faster deployment and more capable software integration with external systems.
  - Day 2+ operations – Digital Sandbox validation, certified design intents, deviation detection and notification, and deployment automation enable faster, consistent and more reliable change management and validation for infrastructure and services. Visual and concise object association means faster and more accurate identification of potential impacts when making changes to infrastructure and services.

Overall, these key capabilities of the Nokia Data Center Fabric solution contribute significantly to the effort savings when migrating to a higher scale and capacity data center fabric as modeled by the BCA.

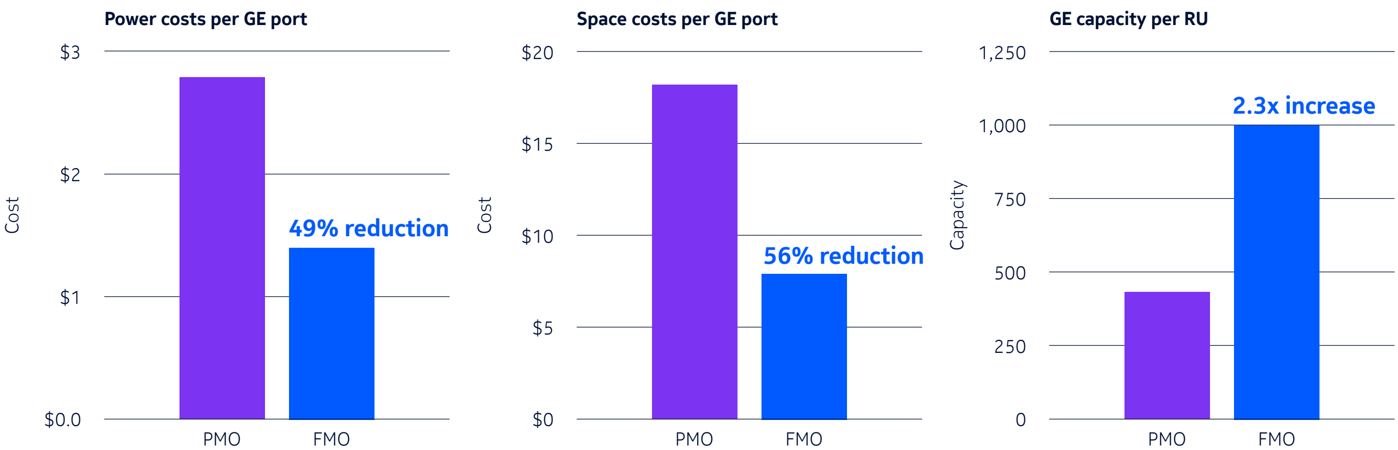
Power and space cost savings

While the BCA focuses primarily on savings related to Day 0, Day 1, Day2+ operations tasks, it also calculates the potential power and space cost savings and capacity increase that can be achieved when moving to a higher scale, next-generation leaf-spine fabric architecture.

As shown in Figure 3, evolving to a higher scale data center fabric in the FMO can provide **power and space cost savings per GE port of up to 49% and 56%, respectively, and a 2.3X times capacity increase for Gigabit Ethernet ports**.

This information may be helpful in internal business cases for CAPEX spend. The power and space cost savings and capacity increase are a result of evolving to next-generation data center switching silicon, which offers significant efficiencies compared to older generations of switching silicon.

Figure 3. Power and space savings



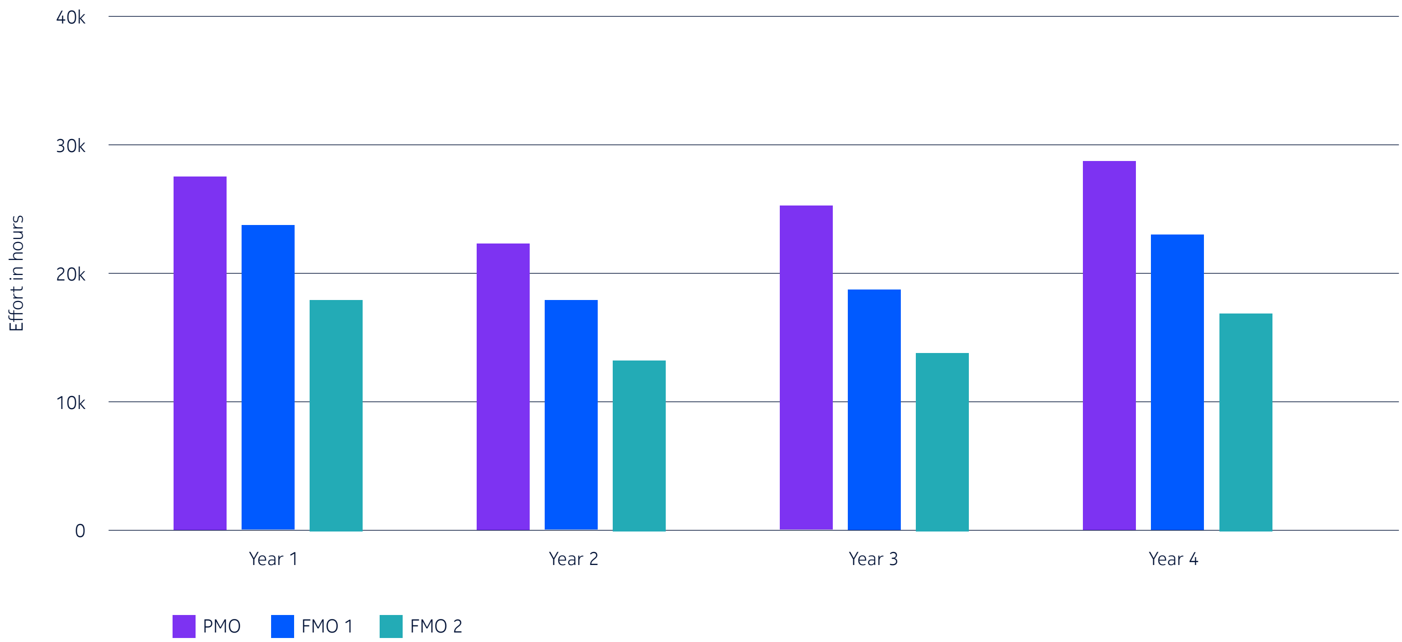
Additional details on effort and effort savings by year, by operations phase, job functions and jobs roles

The following sections provide additional details of the efforts and savings related to job functions and associated tasks and by job roles.

Effort savings by year

Figure 4 shows yearly effort in hours for Year 1 through to Year 4 of the analysis.

Figure 4. Effort by year



Modeling Scenario	Year 1	Year 2	Year 3	Year 4
PMO	27,472	22,440	24,684	29,621
SR Linux only	23,702	17,748	19,297	22,885
SR Linux and EDA	18,198	13,287	14,348	16,896

While there is an expected increase in operational costs in Year 1 associated with the design, deployment and operations of new data centers, the BCA results highlight that savings can be realized from the very first year for both FMO scenarios, as well as in all subsequent years.

FMO 2 offers savings (over the PMO scenario) of:

- 34% in Year 1
- 41% in Year 2
- 42% in Year 3
- 43% in Year 4.

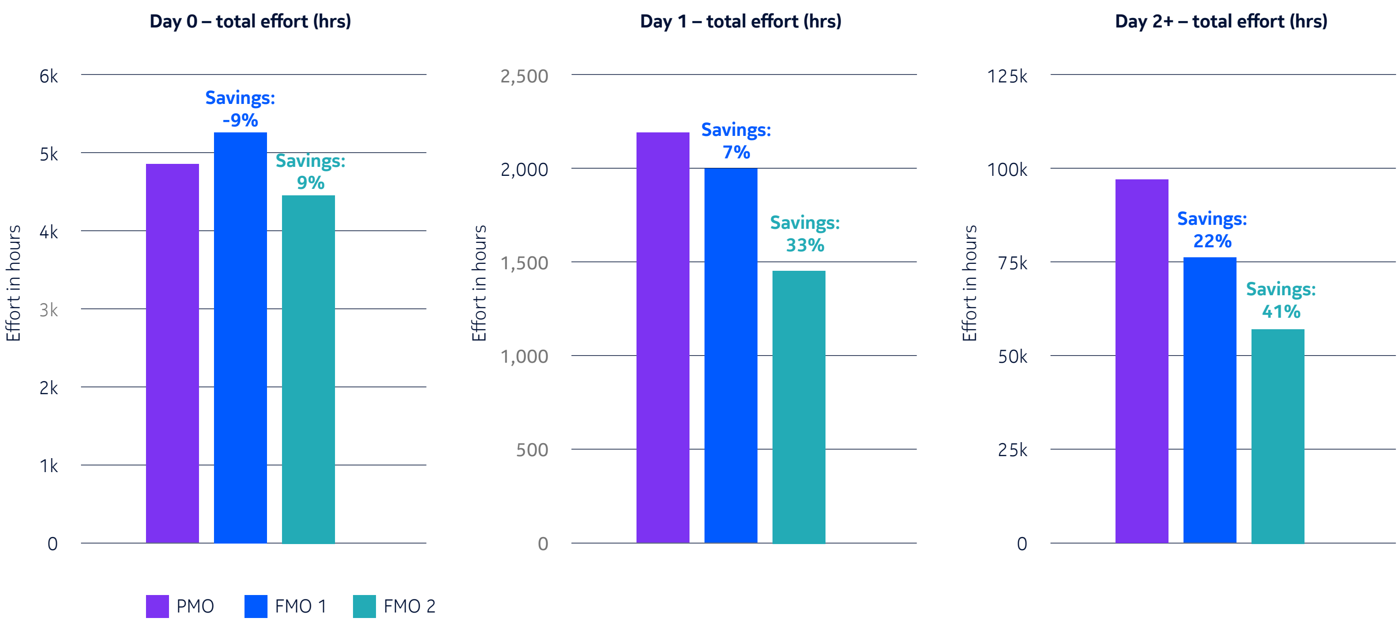
FMO 1 offers savings (over the PMO scenario) of:

- 14% in Year 1
- 21% in Year 2
- 22% in Year 3
- 23% in Year 4.

Cumulative effort savings for individual operations phases

Figure 5 shows cumulative effort savings for each phase of the data center fabric operations life cycle. Day 1 and Day 2+ phases show significant savings for the FMO 1 and FMO 2 scenarios.

Figure 5. Cumulative effort savings for individual operations phases



The Day 2+ phase offers the highest effort savings percent among operations phases. Over 4 years, the total effort in the Day 2+ phase for the PMO scenario is 97,145 hours. In comparison, the total effort in the Day 2+ phase for FMO 1 is 76,251 hours (22% savings versus PMO) and the total effort for FMO 2 is 56,830 hours (41% savings versus PMO).

The FMO 1 and FMO 2 scenarios in the Day 1 phase offer efforts savings of 7% and 33% respectively. For FMO 1, Day 0 savings are slightly negative, -9%, and FMO 2 has savings of 9%. This lower savings in operation effort during the design stage are an accurate reflection of the additional integration and training costs associated with implementing the new Nokia data center solution. These costs are not present in the PMO effort calculations because existing integrations would be reused for the new data center, and training would be minimal since the analysis assumes the previously operationalized technology is deployed for new data centers.

Total effort savings for FMO scenarios

Figure 6 shows total effort hours and the effort savings percent attributed to using FMO 1 and FMO 2 scenarios compared to the PMO. This is based on resourcing requirements for each individual task and corresponding work effort based on hours of work.

Figure 6. Effort savings for FMO scenarios

System	Year 1	Year 2	Year 3	Year 4
Day 2+	4,079	4,692	5,387	6,735
Day 1	155	0	0	0
Day 0	-464	0	0	0
Cumulative savings	14%	17%	19%	20%

	Year 1	Year 2	Year 3	Year 4
Day 2+	8,100	9,153	10,336	12,725
Day 1	718	0	0	0
Day 0	456	0	0	0
Cumulative savings	34%	37%	39%	40%

In the FMO scenarios, the Day 0 phases incur the upfront effort hours needed to migrate from a first-generation data center (e.g., PMO) to a next-generation data center (e.g., FMO). This includes initial training costs associated with adopting SR Linux and EDA. Despite the upfront Day 0 costs, the model indicates overall positive savings percent as early as Year 1—that is cumulative savings of 14% for FMO 1 and cumulative savings of 34% for FMO 2. Over a 4-year period, the savings for FMO 1 and FMO 2 increase to 20% and 40% respectively.

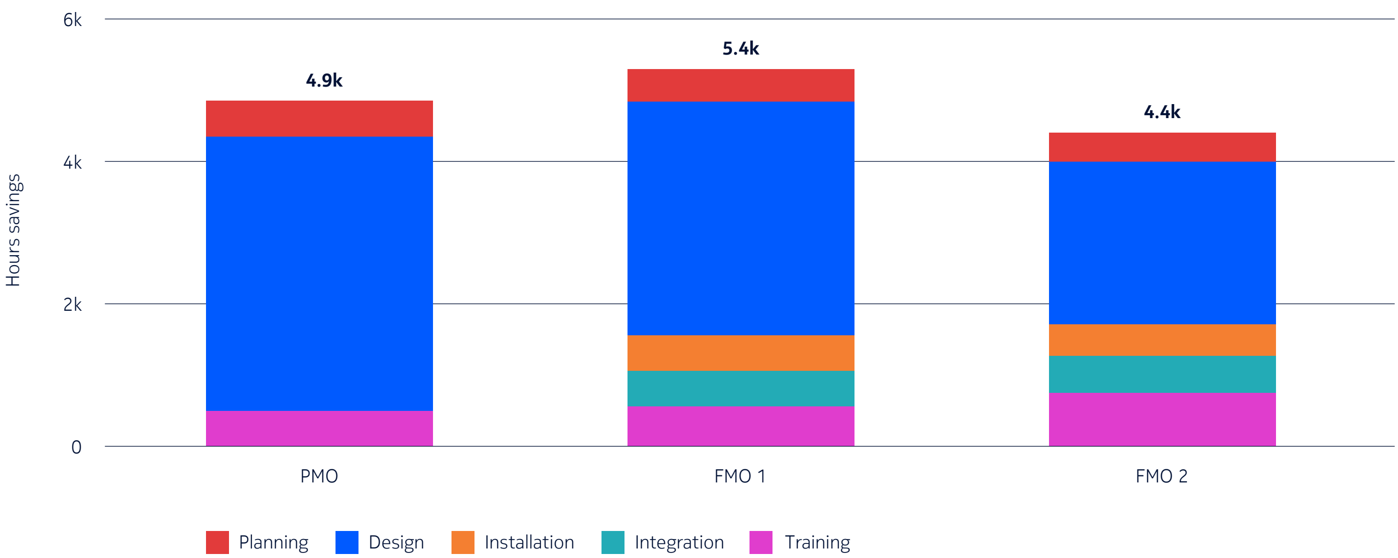
Total effort hours by job functions and associated tasks

This section shows the total effort in hours categorized by the modeled job functions and associated tasks for Day 0, Day 1 and Day 2+ phases. Refer to Appendix B for information on the complete list of job functions and associated tasks.

Figure 7 shows the total effort in hours by job functions and all associated tasks for the Day 0 design phase of operations. The FMO 1 and FMO 2 scenarios incur upfront effort hours related to integration and initial training costs.

The Design job functions in the Day 0 phase require maximum effort compared to other job functions in the Day 0 phase and include the HLD and LLD related tasks.

Figure 7. Total effort hours for Day 0 job functions and tasks

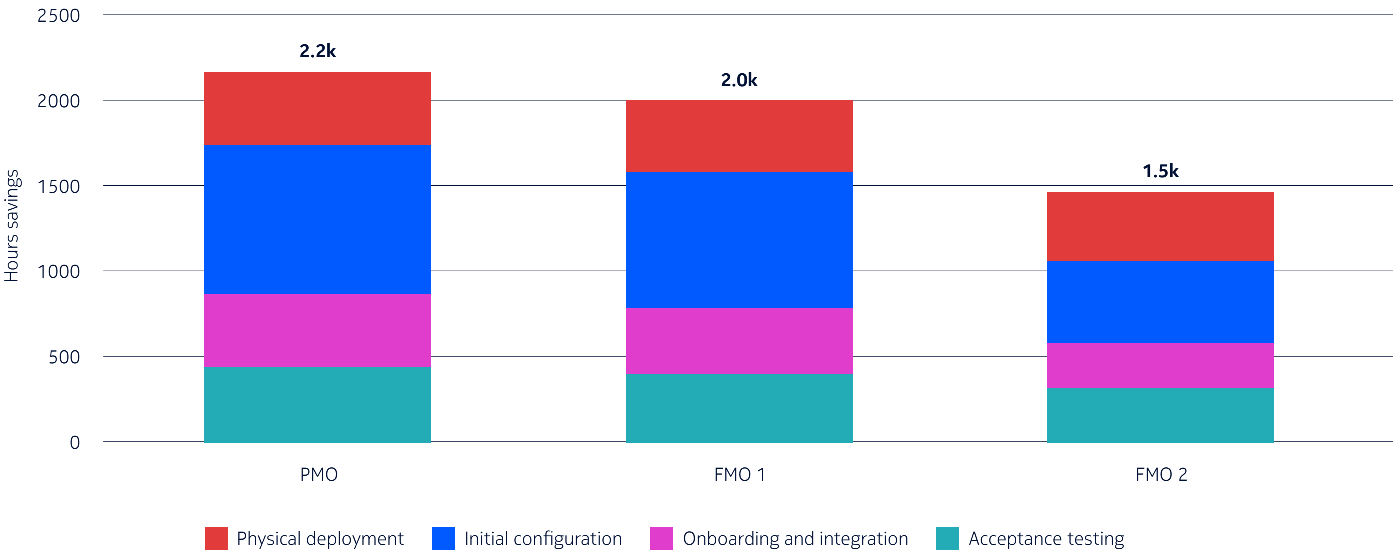


Job function/Task	PMO1	FMO 1	FMO 2
Planning	490	490	443
Design	3,917	3,356	2,324
Installation	0	490	539
Integration	0	535	715
Training	490	490	419
Total	4,896	5,360	4,440

The effort for Day 0 design job functions and tasks for the PMO is 3,917 hours. In comparison, the effort for the FMO 1 is 3,356 hours (14% savings compared to the PMO) and the effort for the FMO 2 is 2,324 hours (41% savings compared to the PMO).

Figure 8 shows the total effort in hours by job functions and all associated tasks for Day 1 deployment. The Configuration job functions require maximum effort compared to other job functions in the Day 1 phase and include ZTP infrastructure management, node configurations and other related tasks.

Figure 8. Total effort hours for Day 1 job functions and tasks



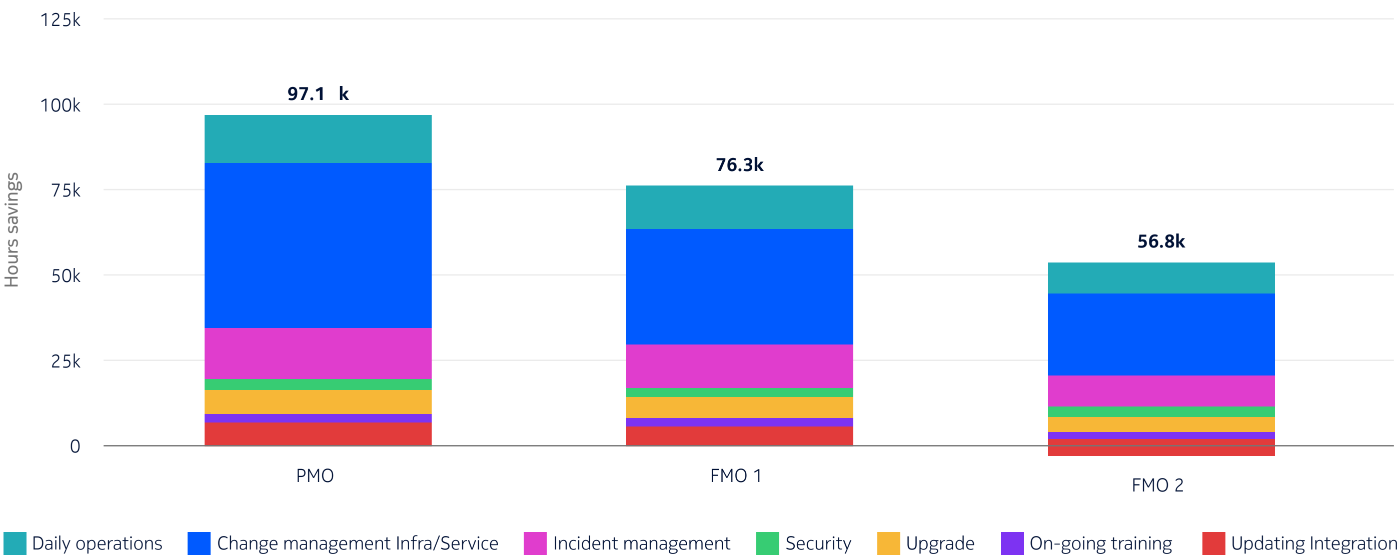
Job function/Task	PMO1	FMO 1	FMO 2
Physical deployment	435	435	409
Initial configuration	870	803	464
Onboarding and integration	435	383	270
Acceptance testing	435	400	316
Total	2,176	2,021	1,458

The effort for Day 1 configuration job functions and tasks for the PMO is 870 hours. In comparison, the effort for the FMO 1 is 803 hours (7% savings compared to the PMO) and the effort for FMO 2 is 464 hours (47% savings compared to the PMO).

Figure 9 shows the total efforts hours by job functions and tasks for Day 1 deployment. The efforts for Day 2+ job functions and tasks are significantly higher compared with those for Day 0 and Day 1.

The change management job functions for Day 2+ operations require maximum effort compared to other job functions for Day2+, and include infrastructure/service change validation, impact analysis and change provisioning (add/move/delete) tasks.

Figure 9. Total effort hours for Day 2+ job functions and tasks



Job function/Task	PMO1	FMO 1	FMO 2
Daily operations	14,572	12,194	8,990
Change management Infra/Service	48,572	34,612	24,777
Incident management	14,572	12,098	9,595
Security	2,914	2,841	1,992
Upgrade	6,800	6,025	4,512
On-going training	2,914	2,769	2,453
Updating integration	6,800	5,712	4,512
Total	97,145	76,251	56,830

The effort for change management job functions and tasks for Day 2+ in the PMO scenario is 48,572 hours. In comparison the effort for FMO 1 is 34,612 hours (29% savings compared to the PMO) and the effort for FMO 2 is 24,777 hours (49% savings compared to the PMO).

Cumulative effort savings based on job roles

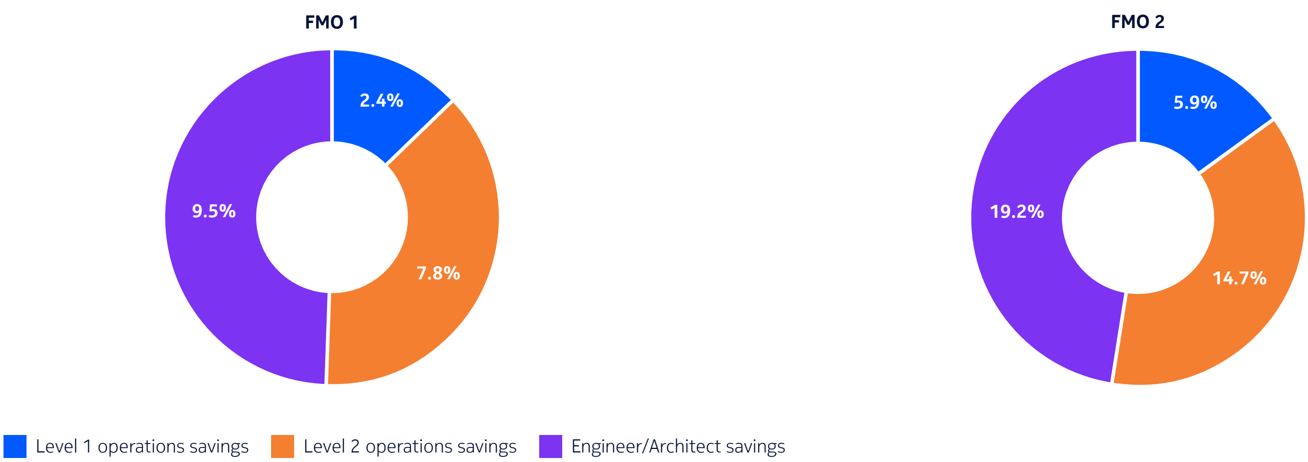
Each operation job function and its associated tasks require a particular skill set. As an additional level of detailed analysis, the BCA model calculates work effort and effort savings based on job roles for specific task. The model includes the following skill set job roles:

- Job role 1 – Level 1 operations
- Job role 2 – Level 2 operations
- Job role 3 – Engineer/Architect

The BCA assigns job role requirements for the different operations job functions and associated tasks within each phase of the operations life cycle. Job tasks are assigned to one of the job roles to calculate the total amount of effort to complete tasks by job roles.

The FMO scenario that implements SR Linux provides cumulative effort savings over 4 years of up to 20%. As shown in Figure 10, when mapped to job roles, 2.4% savings are realized for Level 1 operations job roles, 7.8% for Level 2 operations job roles and 9.5% for Engineer/Architect job roles.

Figure 10. Cumulative effort savings based on job roles



FMO 2 provides cumulative effort savings over 4 years of up to 40%. When mapped to job roles, 5.9% savings are realized for Level 1 operations job roles, 14.7% for Level 2 operations job roles and 19.2% for Engineer/Architect job roles.

These results can help provide guidance on current and future staffing requirements for different operations job roles.

Summary

This business case analysis shows the operations savings that can be realized when evolving to a next-generation data center fabric. Such a fabric offers better scalability and a comprehensive set of NetOps tools to simplify data center network operations and agility.

The operations savings in the FMO scenario of this analysis are attributed to implementing SR Linux and EDA. An architecture that implements both SR Linux and EDA can help maximize efficiencies and operations savings for all phases of data center operations, from Day 0 design, to Day 1 deployment and Day 2+ operations.

Learn more

Try the Data Center Fabric Business Case Analysis online tool: **Launch the tool**

To learn more about the Nokia Data Center Fabric solution:

- Visit the solution web page - Nokia Data Center Switching Fabric
- Read the brochure - Drive data center innovation with Nokia SR Linux
- Read the - SR Linux product description
- Visit the product web page - Nokia Event-Driven Automation (EDA)

Appendix A – Effort savings with SR Linux and EDA for specific tasks

SR Linux features that contribute to higher effort savings for specific tasks

Additional savings can be realized for specific job functions and tasks in the FMO 1 scenario. Nokia SR Linux offers several unique benefits compared to the PMO scenario.

The model assigns a specific weight (percent of total effort) for job functions in each operations phase. Additionally, the tasks associated with each job function are assigned a specific weight (percent of total effort per job function).

Table A1 shows the list of job functions/tasks and associated effort savings percent and effort savings hours along with the key SR Linux features that contribute to these savings in the FMO 1 scenario. For details on SR Linux features, please refer to the resources at the SR Linux web site.

Effort savings of 15% to 43% can be realized for specific job functions and tasks within the Day 0, Day 1 and Day 2+ phases of the operations life cycle.

Table A1: SR Linux features that contribute to higher effort savings for specific tasks

Phase	Rank	Job function and tasks	Savings (%)	Contributing SR Linux features	SR Linux benefits
Day 0	1	Design: High level design (HLD) – Integrations (investigations/ demos/selection)	25%	Model-driven data model and single API for all integrations	Integration is simpler and more efficient
Day 0	2	Design: High level design (HLD) – Documentation	25%	Ubiquitous and consistent access to CLI and data	Easily accessible data for efficient documentation
Day 0	1	Design: Low level design (LLD) – Lab test plan execution	15%	Ubiquitous and consistent access to CLI and data	Simpler, faster and more accurate testing
Day 1	1	Onboarding and integration: In-service software integration with external OSS/BSS systems	20%	Open interfaces with ubiquitous and consistent access to data	Faster and consistent “plug-and-play” integration with less customization
Day 1	1	Configuration: Per node customized configuration – generation	15%	Leverage self-signed security certificates and provide customizable ZTP	Faster customized deployment
Day 1	1	Configuration: Per node customized configuration – push to node	20%	Leverage self-signed certificates and customizable ZTP	Increase speed and accuracy by eliminating manual per node configuration
Day 2	1	Change management infrastructure: Service change validation	43%	Leverage flexible scripting options and customizable monitoring	Faster and lower risk service changes
Day 2	1	Change management infrastructure: Infrastructure change validation	43%	Leverage flexible scripting options and customizable monitoring	Faster and lower risk infrastructure changes
Day 2	1	Change management infrastructure: Service change impact analysis	33%	Leverage flexible scripting options and customizable monitoring	Faster and more accurate identification of service change impacts

EDA features that contribute to higher effort savings for specific tasks

Additional savings can be realized for specific job functions and tasks in the FMO 2 scenario. Nokia EDA offers several unique benefits compared to the PMO scenario.

Table A2 shows the list of job functions/tasks and associated effort savings percent and effort savings hours, along with the key EDA features that contribute to these savings in the FMO 2 scenario.

Effort savings of 35% to 60% can be realized for specific job functions and tasks within the Day 0, Day 1 and Day 2+ phases of the operations life cycle.

Table A2: EDA features that contribute to higher effort savings for specific tasks

Phase	Rank	Job function and tasks	Savings (%)	Contributing EDA features	EDA benefits
Day 0	1	High level design (HLD) – Integrations (investigations/ demos/ selection)	52%	Secure, automated and certified integration leveraging open APIs	Faster, secure and flexible integrations
Day 0	2	High level design (HLD) – Documentation	60%	Leverage Nokia certified design intents for best practice documentation	Faster and more accurate documentation
Day 0	3	Low level design (LLD) – Lab test plan execution	35%	Leverage Digital Sandbox for physical and logical design maps, and feedback from testing results	Faster testing and clearer interpretation of results
Day 1	1	Onboarding and integration: In-service software integration with external OSS/BSS systems	60%	Leverage stateful and filterable topology, with intent deviation tracking and advanced telemetry	Faster and more capable SW integrations
Day 1	2	Configuration: Per node configuration generation	50%	Automated intent-based custom configuration	Faster and more accurate custom configuration
Day 1	3	Configuration: Per node configuration – Push to node	50%	Leverage automated, secure and continuous configuration deployment	Faster and more accurate initial configuration
Day 2+	1	Change management infrastructure: Service change validation	55%	Leverage Digital Sandbox validation, certified design intents, deviation detection, and deployment consistency automation	Faster and more reliable service change validation
Day 2+	2	Change management infrastructure: Infrastructure change validation	55%	Leverage Digital Sandbox validation, certified design intents, deviation detection and deployment consistency automation	Faster and more accurate infrastructure change validation
Day 2+	3	Change management infrastructure: Service change impact analysis	46%	Leverage visual and concise object association	Faster and more accurate identification of service change impacts

Appendix B – Summary of operations job functions and tasks

The following tables list the operations job functions and associated tasks for each phase of the data center fabric life cycles modeled in this business case analysis.

Table B1: Day 0 Design job functions and associated tasks

Job functions	Associated tasks
Planning	• Planning, defining and reviewing data center fabric design requirements • Project management for Day 0 phase
Design	• High level design – Review and discuss general design requirements with teams involved – Investigate and select required features and demos – Investigate and select required integrations – Create high level documentation covering overall architecture and best practices for all operations phases • Low level design – Define the IP addressing plan – Lab configuration, test plan creation and execution, lab testing results documentations – Creation of use guides and as built/as deployed documentation
Installation planning	• Rack design – Power and HVAC design, conduit planning • Wire cables – Wiring design docs and cable map • Testing and Validation (Power on Self-Test – POST) for power, cabling, management reachability and ZTP checks
Integration	• Integration development and integration testing – Includes assurance, inventory/stats/ticketing, and provisioning
Training	• Create and deliver trainings for engineering and operations teams in the following areas – Nodal API – Fabric management – Fabric management API

Table B2: Day 1 Deployment job functions and associated tasks

Job functions	Associated tasks
Deployment	• Project management for deployment related tasks • Mounting equipment in racks (racking) and moving to data center for deployment (stacking) • Cabling installation
Configuration	• ZTP infrastructure management and creation/retrieval of golden configuration repository • Generate per node configurations and push configurations to the node
Onboarding and integration	• In-service software integration and interconnection to external OSS/BSS • In-service hardware integration and interconnection to external hardware systems
Acceptance testing	• Equipment testing • Configuration validation and system testing • Verify operational status of each device • Verify operational status of each service • Smoke testing (Checking core functionality, to ensure readiness for further testing) • Generating test report • Final acceptance

Table B3. Day 2+ Operations job functions and associated tasks

Job functions	Associated tasks
Daily operations	• Network monitoring to track network utilization, network traffic and network uptime • Manage events that may impact network users and network performance • Configuration management (configuration backups and maintenance)
Change management for infrastructure and service	• Infrastructure change validation, impact analysis and change provisioning (add/move/delete) • Service change validation, impact analysis and change provisioning (add/move/delete)
Incident management	• Fault validation, impact analysis and fault isolation • Corrective action validation and implementation
Security	• Periodic configuration audits • Periodic testing
Upgrade	• Upgrade planning, testing and execution • Post execution testing
On-going training	• Create and deliver on-going training for engineering and operations teams in the following areas – Nodal API – Fabric management – Fabric management API
Updating integration	• Assurance update/testing • Inventory/stats/ticketing updates and testing • Provisioning update and testing

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