The Economic Benefits of the Dell Infrastructure Blocks in a vRAN Network Deployment

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EXECUTIVE SUMMARY

Global communication service providers (CSPs) are deploying 5G cloud-native networks. Cloud-native technology offers CSPs many of the benefits already realized in public cloud data centers: scalability, flexibility, and service agility. However, the migration from closed proprietary networks to cloud-native networks has significant challenges that must be overcome to reap the rewards of cloud-native technology. Many CSPs, today, rely on large telecom vendors to provide end-to-end network solutions, which are well understood. As CSPs move to cloud-native network solutions they now must take on the challenges of designing, integrating, and operating open, heterogeneous network architecture. To reduce risk, accelerate rollouts of cloud-native technology, and decrease operating expenses, Dell Technologies is providing Dell Telecom Infrastructure Blocks, a use case focused, pre-engineered, preintegrated, and prevalidated solution that combines Dell's hardware with several partners' cloud platform software. The first release of Infrastructure Blocks using Wind River as a cloud platform partner will target vRAN network deployments.

Dell Telecom Infrastructure Blocks for Wind River reduce risk, accelerate network deployments, and decrease life-cycle operations expenses. This is a result of Dell's integrated and pretested solution designed for vRAN RAN environments combined with Dell's worldwide customer support and professional services organization that helps CSPs deploy network infrastructure and provide 24 X 7 ongoing support.

ACG has developed a detailed model that demonstrates the TCO benefits of Infrastructure Blocks. We modeled a Tier 1 vRAN network and compared the network deployment and operations for two scenarios, with Infrastructure Blocks and without Infrastructure Blocks. Our results show 34% OpEx savings over five years and an ROI of 109%.

Cloud-Native Networks: Benefits and Challenges

Cloud-native networks offer scalability, flexibility, service agility, and bring the benefits realized in cloud data centers to large-scale telecom networks. However, these benefits come at a cost:

- CSPs are used to deploying network solutions that are tested and integrated by large telecom vendors, and they depend on those vendors for network deployment and life-cycle management.
- Traditional network solutions are closed systems that do not provide the benefits of a telco cloud, but do support Day 0, Day 1, and Day 2 operations tasks. The transition to cloud-native networks will result in an operations paradigm shift, which could be challenging to navigate.
- Cloud-native architectures require operators to integrate and manage multiple, complex components: compute, storage, networking hardware, and the cloud-native software platform running on top of the hardware.
- CSPs need to deploy cloud infrastructure in highly distributed networks that consist of central data centers, regional data centers, edge data centers, and cell sites. In such networks there can be tens of thousands of edge locations that operate as mini cloud data centers.
- The management of a highly distributed cloud-native network is more challenging than managing clouds deployed in large, centralized data centers.
- These factors result in requirements for new skill sets for all components of the operation's life cycle, which can be costly and labor intensive.

It is clear to most CSPs that the transition to cloud-native networks is a necessary step to ensure future profitability and growth in a very competitive industry. The question is how the transition to a cloud-native network can be done most effectively. The goals of this transition should be:

- Reduce risk
- Accelerate roll-outs of cloud-native networks
- Decrease network operations expenses
- Arrive at an end-state where cloud-native networks enable quick rollout of new, profitable services

Value Proposition of the Dell Telecom Infrastructure Blocks

Dell Technologies recognizes the challenges of deploying cloud-native network infrastructure and has developed Dell Telecom Infrastructure Blocks, a fully engineered solution with Dell PowerEdge servers integrated with cloud software platforms, to help simplify life-cycle management of large cloud-native networks. Infrastructure Blocks are targeted at specific use cases, including RAN, edge, and packet core. The first Telecom Infrastructure Blocks release provides an integrated solution with Wind River, targeted at vRAN networks. An overview of Infrastructure Blocks is presented in Figure 1.

Telecom Infrastructure Blocks are pre-integrated and tested, shipped to customers, and can be deployed quickly with or without Dell's Professional Services. Dell is building on its Telecom Multi-Cloud Foundations framework, its supply chain operations, customer support and professional services offerings to develop a portfolio of use case focused, pre-engineered, preintegrated, prevalidated solutions with its cloud platform software partners. Dell provides a single point of support for life-cycle operations for both the servers and the cloud platform, eliminating finger pointing and reducing CSPs' vendor management complexity.

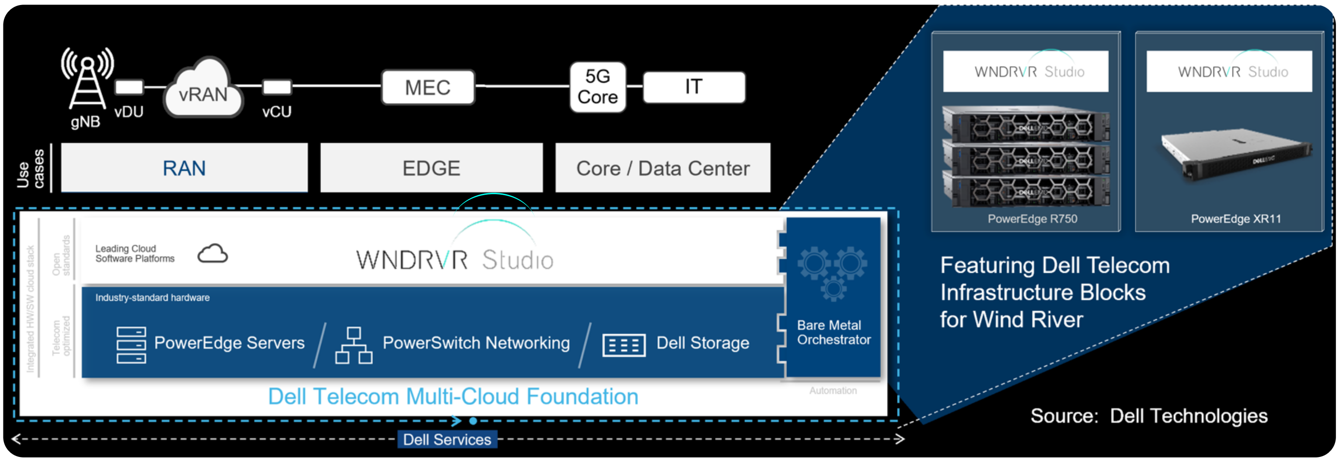

Figure 1. Dell Telecom Infrastructure Blocks

Dell Telecom Infrastructure Blocks reduce risk, accelerate network deployments, and decrease life-cycle operations expenses:

Day 0 Benefits: Infrastructure Blocks provide solutions for specific use cases, which include RAN, packet core, and edge. Infrastructure Blocks are pre-engineered, preintegrated, and prevalidated using field proven design guidelines to meet the requirements of the specific use case. They include design guidance on how to configure Infrastructure Blocks for small, medium, and large configurations to streamline design and planning processes across a range of scale points. Dell Services can validate custom configurations through its Dell Open Telecom Ecosystem Lab to meet operators' unique requirements.

Day 1 Benefits: Factory integration of all hardware and software eliminates the need to configure hardware and software onsite or in a configuration center. Dell Services can provide configurations to address operators' requirements through a Dell Second Touch facility. Network deployment is accelerated by the integration between Dell Bare Metal Orchestrator (BMO) and Wind River Conductor, which automates the deployment of Dell's hardware and integrated cloud platform. BMO automates configuration and deployment of solutions across an entire network of distributed data centers, which improves the speed of deployment and reduces configuration errors. Integration with Wind River Conductor through Dell Bare Metal Orchestrator Modules, included with Infrastructure Blocks, automates deployment and life-cycle management from bare metal through CNF. This is especially important in large, complex networks with hundreds of edge data centers and tens of thousands of servers.

Day 2 Benefits: The Dell Bare Metal Orchestrator, Bare Metal Orchestrator Modules, and Wind River Studio provide ongoing life-cycle automation of cloud infrastructure operations. Some of the key benefits of Infrastructure Blocks in Day 2 operations are:

- Release compatibility tracking and governance
- Release testing and integration
- CI/CD pipeline integration and automation

Dell Professional Services provides custom integration into a CSP's CI/CD pipeline, providing the CSP with validated updates to the cloud platform infrastructure that pass directly into the CSP's cloud-native application development process. Bare Metal Orchestrator automates the detection and remediation of configuration drift to eliminate configuration errors that can impact SLAs and reduce time spent on configuration and performance management. Dell provides ongoing technical support with a one-call support model for the full solution, including simplifying fault management and eliminating finger pointing between vendors.

Day 0, Day 1, and Day 2 benefits are summarized in Figure 2.

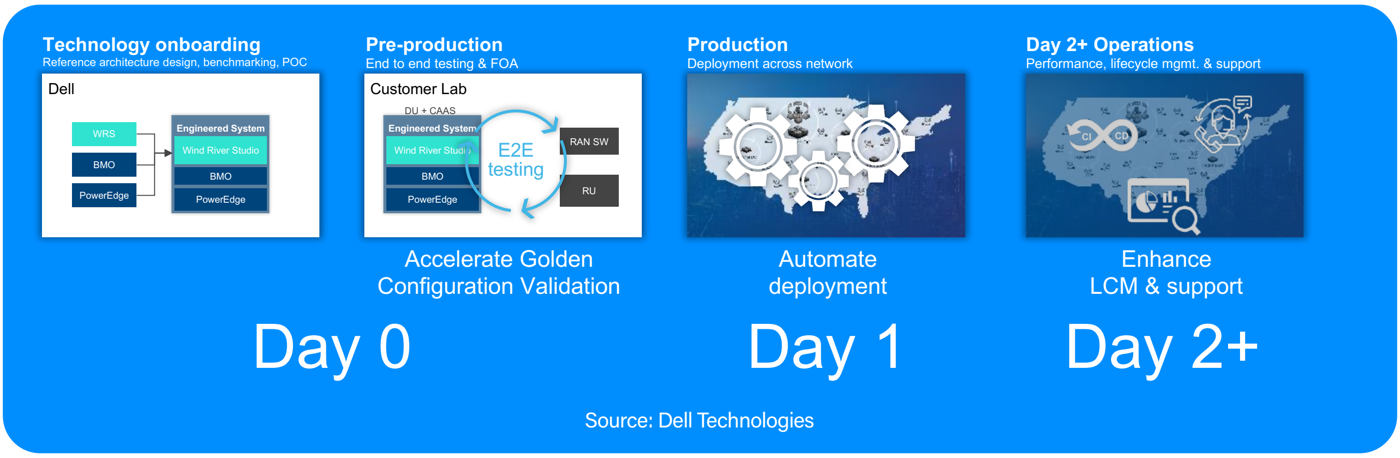

Figure 2. Day 0, Day 1, and Day 2 OpEx Benefits

Total Cost of Ownership Model Assumptions

Our total cost of ownership (TCO) model represents a 5G vRAN network that is typical of a Tier 1 European CSP or a large region in North America. We model four types of cell sites over five years: dense urban, urban, suburban, and rural cell sites. Our model uses an S-curve or Logistics Function[1] to grow the number of cell sites over a five years. The number of sites is presented in Table 1.

Cell Site Type	Initial Number of Sites	Final Number of Sites
Dense Urban	5,000	10,000
Urban	10,000	15,000
Suburban	2,000	4,000
Rural	1,000	2,000

Table 1. Numbers of Cell Sites in Different Geographies

[1] https://en.wikipedia.org/wiki/Logistic_function.

The number of sectors for each radio carrier is presented in Table 2[2].

Radio Carrier	Dense Urban	Urban	Suburban	Rural
100MHz 64X64	6 Sectors	3 Sectors	N/A	N/A
100MHz 32X32	N/A	N/A	3 Sectors	N/A
20MHz 4X4	9 Sectors	9 Sectors	3 Sectors	3 Sectors
800MHz mmWave	3 Sectors	N/A	N/A	N/A

Table 2. Radio Carriers for Each Type of Cell Site

For dense urban, urban, and suburban sites we assume that the CU and DU are centralized in DU and CU edge data centers. For rural sites we assume that the CU is centralized, and the DU is located at the cell site near the radios. We also assume that the Dell BMO control servers are deployed in central data centers serving the entire RAN. The numbers of data centers are presented in Table 3. The numbers of central and CU pool data centers are static, but we assume DU pool data centers will grow from 300 to 500 over five years. Data center growth uses an S-Curve.

Data Center	Initial Quantity	Final Quantity
Central	1	1
CU Pool	10	10
DU Pool	300	500

Table 3. Number and Type of Data Centers

The ACG Business Analytics Engine (BAE)[3] compares two scenarios:

- With Dell Telecom Infrastructure Blocks
- Without Dell Telecom Infrastructure Blocks

An overview of the BAE model is illustrated in Figure 3. The inputs consist of network architecture, unit expense, and OpEx assumptions. The BAE vRAN model calculates the number of servers based on the growth of cell sites and the radio carriers. This demand drives the number of servers in CU and DU pools. The BAE calculates servers using the following approach:

[2] If the entry reads N/A it means none of the specified carriers are deployed in the cell sites.

[3] https://www.acgbae.com/

- Each type of cell site has a combination of radio carriers as specified in Table 2
- Radio carriers drive the configuration of vDU and vCU components where each vDU and each vCU has a specific number of processor core requirements based on the type and number of carriers at each cell site
- As cell sites grow, vDU and vCU components also increase; the growth in processor core requirements drives the increase of servers

The number of servers calculated in the BAE model is presented in Table 4. The number of servers drives the TCO expenses for both scenarios[4].

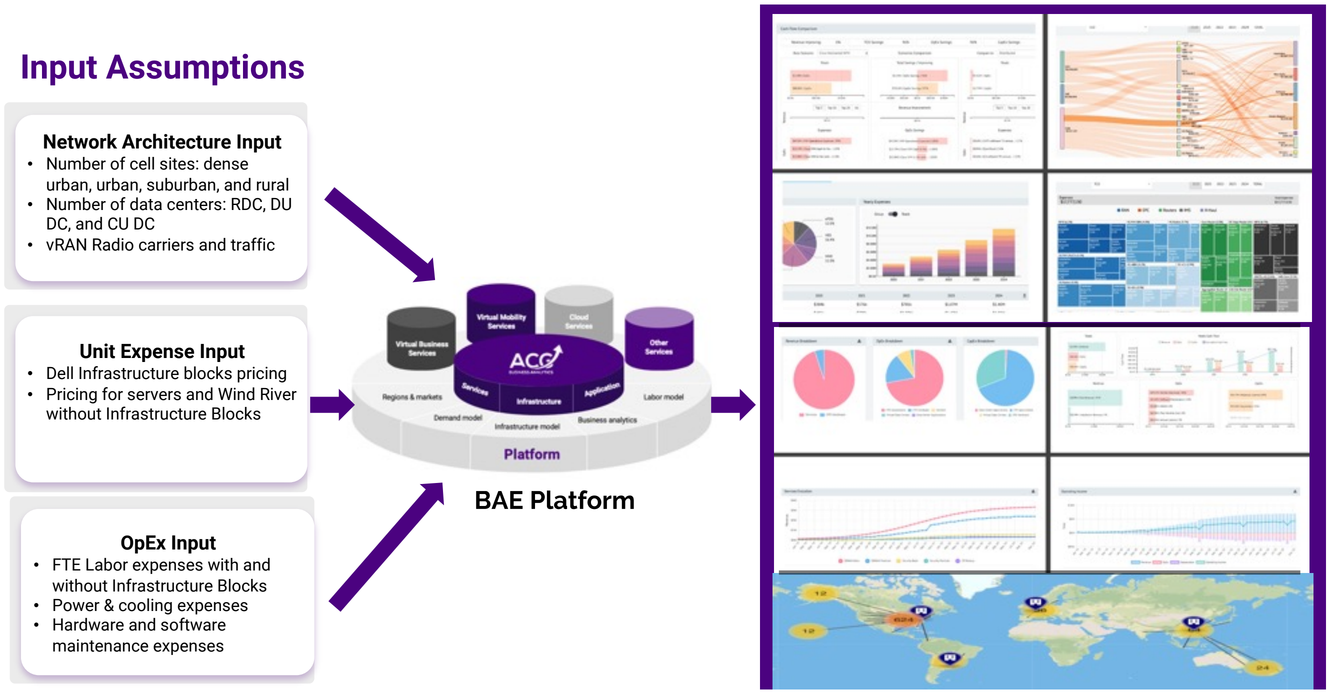

Figure 3. ACG Business Analytics Engine

Data Center	Server Name	2022	2023	2024	2025	2026
DU Data Center	Dell XR 11	31512	36668	45898	52272	54000
CU Data Center	Dell R750 Large	1080	1240	1530	1720	1780
Central Data Center	BMO Control Server	180	180	180	180	180

Table 4. Number of Servers in All Edge and Central Data Centers Calculated in BAE Model

4 For more details on our VRAN model, refer to "Accelerating Cloud-Native Deployments and Economic Returns."

Overview of Labor OpEx Assumptions

In our TCO model we account for Full Time Equivalent (FTE) labor hours for Day 0, Day 1, and Day 2 tasks. The model considers fixed FTEs where the number of hours required for a task is independent of the size of the network and the number of servers managed. We also consider variable FTEs where the labor hours scale up based on the size of the network and the number of servers because some labor tasks are not dependent on the network scale while other activities scale directly with the size of the network. In some categories of FTEs, we model both fixed and variable components, because in some cases a fixed number of FTEs is required regardless of the network size; however, FTEs also need to be added as the network scales up.

The categories of FTE labor and the assumptions for fixed and variable hours of effort are presented in Table 5. A description of the tasks and the drivers for Infrastructure Blocks savings are presented in Table 6. There are multiple categories of labor for Day 0, Day 1, and Day 2 activities. Table 5 specifies both the fixed and variable components of labor in hours. Fixed FTE hours are functions that require a basic level of effort regardless of the size of the network. For example, lab test and certification or reference architecture design are primarily driven by fixed numbers of FTEs. Variable labor hours are tasks that are dependent on the number of servers in the network. These are functions that scale up based on network size. Some categories of labor have both fixed and variable components. In small networks with 50–100 servers it is important to consider the fixed components of labor that are required regardless of the size of the network. The variable components of labor dominate the labor expenses as the network grows and the number of servers increases into the thousands.

Day 0 and Day 1 activities are nonrecurring. These activities are done once when the network is planned and deployed. For example, Day 1 cloud platform installation requires 320 nonrecurring FTE hours and an additional 6 FTE hours per server for the scenario without Infrastructure Blocks. We estimate the Dell Infrastructure Blocks will provide an 80% savings in this activity, which reduces both the fixed and variable hours. Because this is a Day 1 activity, the hours are nonrecurring. As servers are added to the network, additional one-time labor expenses are needed per server.

Day 2 activities are ongoing and are recurring throughout the network life cycle. An example of a Day 2 activity is fault management. This activity is dependent on the size of the network and the number of servers and uses variable labor hours of four hours per server per year. Fault management is an ongoing activity; it is a recurring task that scales based on the size of the network and the number of servers. These FTE labor assumptions are key to driving the TCO savings of the Dell Infrastructure Blocks solution.

	Without Infrastructure Blocks		With Infrastructure Blocks		
	Fixed	Variable per server	Fixed	Variable per server	
FTE	**hours**	**hours**	**hours**	**hours**	**Savings**
Day 0 Reference Arch Design	480	0	240	0.0	50%
Day 0 Benchmarking	240	0	120	0.0	50%
Day 0 POC	960	0	192	0.0	80%
Day 0 Detailed Design	1920	0	384	0.0	80%
Day 0 Test & Certificate	10800	0.0	2160	0.0	80%
Day 1 Procurement	240	0.5	120	0.25	50%
Day 1 Hardware Installation	160	4.0	80	2.0	50%
Day 1 Cloud Platform Installation	320	6.0	64	1.2	80%
Day 1 Network Testing	160	4.0	32	0.8	80%
Day 1 Documentation	240	0.0	120	0.0	50%
Day 2 Engineering and Planning	480	0.5	240	0.3	50%
Day 2 Procurement	240	0.1	120	0.05	50%
Day 2 Test & Certificate	10800	0.0	2160	0.0	80%
Day 2 Hardware Upgrades	320	0.5	160	0.3	50%
Day 2 Software Upgrades	480	1.0	96	0.2	80%
Day 2 CI-CD Pipeline Integration	960	0.0	192	0.0	80%
Day 2 Fault Management	0	4.0	0	1.4	65%
Day 2 Performance Management	0	2.0	0	0.7	65%
Day 2 Configuration Management	0	1.0	0	0.5	50%

Table 5. FTE Tasks with Fixed and Variable Labor Hours

Task	Description	Infrastructure Blocks Benefits	Savings
Day 0 Reference Arch Design	High-level design of the cloud infrastructure architecture.	Hardware and software architecture is already predefined in Infrastructure Blocks so architects only need to focus on use case and environmental details.	50%
Day 0 Benchmarking	Initial design work requires benchmarking with alternative approaches.	An integrated Dell/Wind River solution provides engineers and architects with data required for benchmarking, which simplifies this process.	50%
Day 0 POC	Proof of concept requires that systems be tested and integrated in a lab before deployment.	Dell's pre-integration and pre-testing greatly simplifies the POC.	80%
Day 0 Detailed Design	Detailed design specifies detailed configurations for each regional and edge data center based on the use case requirements.	Pre-engineered, preintegrated, and prevalidated Infrastructure Blocks simplify detailed design because engineers only need to focus on the specifics of their network and data centers but not on cloud and hardware design and configuration.	80%
Day 0 Test and Certification	Before initial hardware and cloud software is deployed in the network the configurations need to go through test and certification in the lab before being deployed in the network.	Infrastructure Blocks are pre-tested, which dramatically reduces the time required for software test and certification. Optional integrations with the CSP's CI/CD pipeline processes and offloading of test processes to Dell OTEL further streamline Day 2 test and certification processes.	80%

Day 1 Procurement	Procurement teams are responsible for purchasing and delivering all hardware and software.	A single point of contact with Dell simplifies procurement of cloud software integrated with hardware.	50%
Day 1 Hardware Installation	Installation, wiring, and testing of hardware on site.	Infrastructure Blocks provide turnkey solutions that simply hardware installation.	50%
Day 1 Cloud Platform Installation	Installation and configuration of cloud software on hardware infrastructure.	Pre-engineered, preintegrated, and prevalidated Infrastructure Blocks simplify cloud software installation, which can be complex and time consuming without Infrastructure Blocks.	80%
Day 1 Network Testing	End-to-end testing of the network cloud platform and hardware configurations after installation.	Infrastructure Blocks are pretested before they are shipped, which dramatically reduces on-site testing.	80%
Day 1 Documentation	Documentation of the hardware and cloud platform configuration.	Standard Infrastructure Blocks and Customer Information Questionnaires allow CSPs to simplify documentation using boiler plate text for much of the configurations.	50%
Day 2 Engineering and Planning	Ongoing engineering and planning of the cloud platform to support the network.	Infrastructure Blocks simplify engineering because they are standard units designed for specific network use cases.	50%

Day 2 Procurement	Ongoing procurement of hardware and cloud software.	A single point of contact with Dell simplifies procurement of cloud software integrated with hardware.	50%
Day 2 Test & Certification	All major hardware and software releases need to go through test and certification before being deployed in the network.	Infrastructure Blocks are pretested, which dramatically reduces the time required for software test and certification. Optional integrations with the CSP's CI/CD pipeline processes and offloading of test processes to Dell OTEL further streamline Day 2 test and certification processes.	80%
Day 2 Hardware Upgrades	Ongoing upgrades of hardware.	Infrastructure Blocks are engineered systems with roadmaps that define hardware and software enhancements that will be delivered as turnkey solutions to simplify planning and implementation of hardware upgrades.	50%
Day 2 Software Upgrades	Ongoing upgrades of software.	Infrastructure Blocks provide turnkey solutions, which simplifies software upgrades.	80%
Day 2 CI-CD Pipeline Integration	Ongoing continuous integration and deployment of software.	Infrastructure Blocks are designed to support CI-CD pipelines.	80%
Day 2 Fault Management	Ongoing troubleshooting and remediation of problems.	Dell's extensive design and integration testing minimizes design and interoperability issues to reduce fault and performance management issues for the cloud stack. BMO automates	65%

		the detection and remediation of hardware configuration drift to further reduce fault and performance issues. Dell's single point of contact simplifies support processes when fault and performance management issues occur. When problems occur, zero-touch provisioning from bare metal up to CNF accelerates problem remediation.	
Day 2 Performance Management	Ongoing system performance management and tuning.	Infrastructure Blocks are pre-engineered for high performance. Design guidance simplifies the deployment of the cloud stack at scale. BMO reduces issues due to configuration drift. Dell's single point of contact simplifies performance management.	65%
Day 2 Configration Management	Ongoing provisioning and system configuration.	Factory integrated Infrastructure Blocks simplify configuration and provisioning. Automated deployment and upgrades that align with an operator's approved configurations and ability of the BMO to automate the detection and remediation of configuration drift ensure a consistent, approved configuration across the CSP's landscape.	50%

Table 6. Key Areas of Labor Savings Due to the Dell Telecom Infrastructure Blocks

Infrastructure Blocks TCO Savings

Using our TCO model and the detailed network assumptions we compared two scenarios, with Infrastructure Blocks and without Infrastructure Blocks. We modeled network growth over five years. Our TCO model showed a five-year cumulative OpEx savings of 34% and an ROI of 109%. The results are presented in Table 7.

	With IBs	Without IBs	Savings	ROI
Five-Year Cumulative OpEx	$107 Million	$163 Million	$55.8 Million 34% Savings	109%
One-Year OpEx	$31.1 Million	$41.5 Million	$10.4 Million 25% Savings	57%

Table 7: Comparison of Two Scenarios with Infrastructure Blocks and without Infrastructure Blocks

Figure 4 presents a breakdown of the five-year cumulative OpEx of the two. Figure 5 provides the cost differences between scenarios. Fault management, performance management, and cloud platform installation are the largest drivers of TCO savings because Dell provides a preintegrated, tested, and validated solution, and a single point of contact for support. The Infrastructure Blocks solution is specifically designed for a vRAN network, which provides significant labor savings in these key areas.

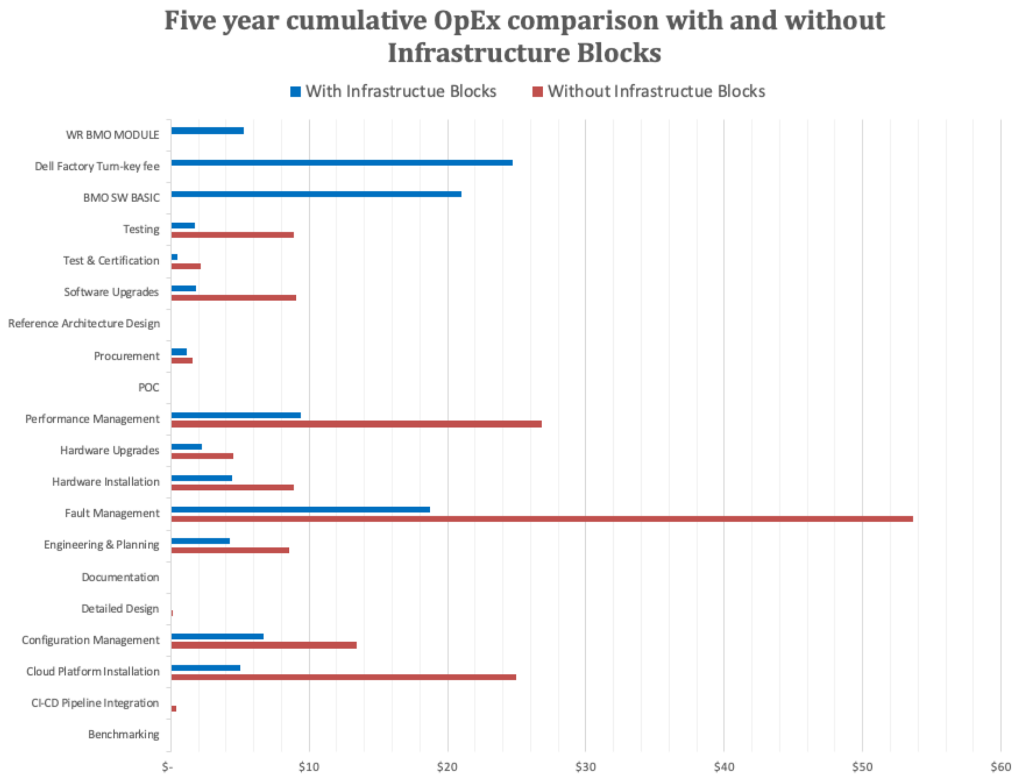

Figure 4. Five-Year Cumulative OpEx Breakdown Comparison of Two Scenarios with Infrastructure Blocks and without Infrastructure Blocks

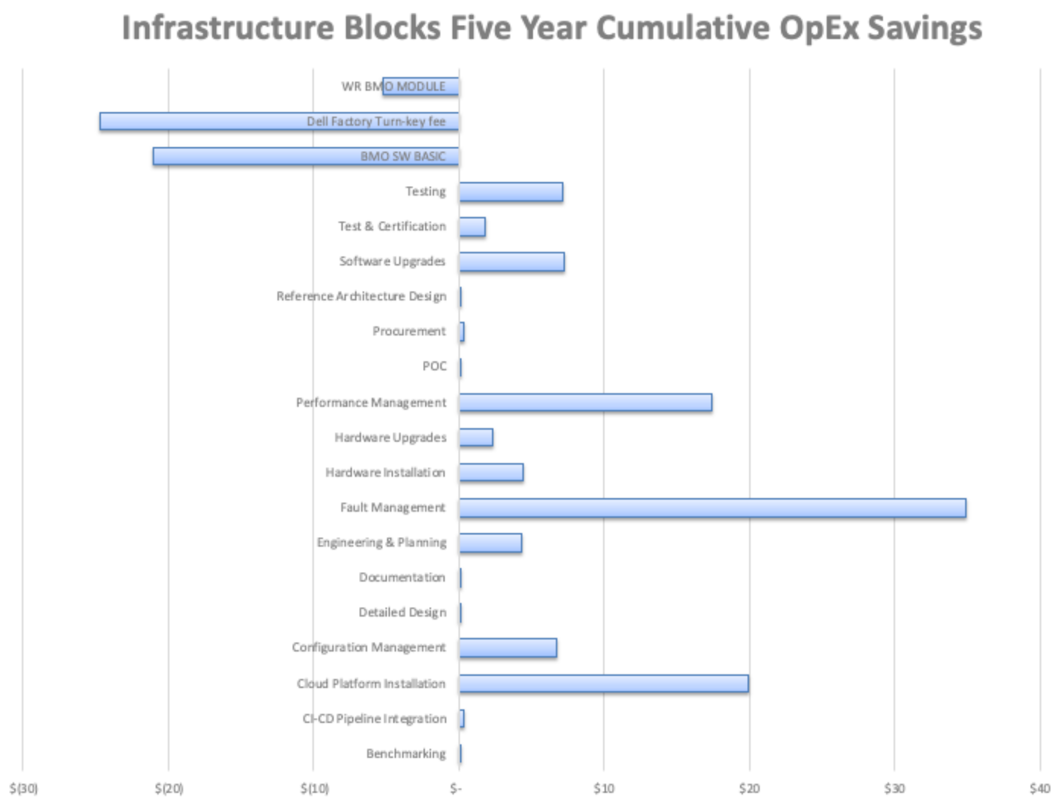

Figure 5. Five-Year Cumulative OpEx Breakdown Comparison of the OpEx Differences between the Two Scenarios

The number of FTEs (Figure 6) required to manage the cloud-native infrastructure over five years drives FTE expenses. It should be noted that different FTEs have different labor rates. There is not a direct mapping between the total number of FTEs and the FTE expenses, but the number of FTEs provides a view of the size of the organization required to manage a distributed cloud-native network infrastructure in the vRAN network. Infrastructure Blocks reduces labor and decreases the number of FTEs required to manage the cloud-native infrastructure across distributed edge data centers.

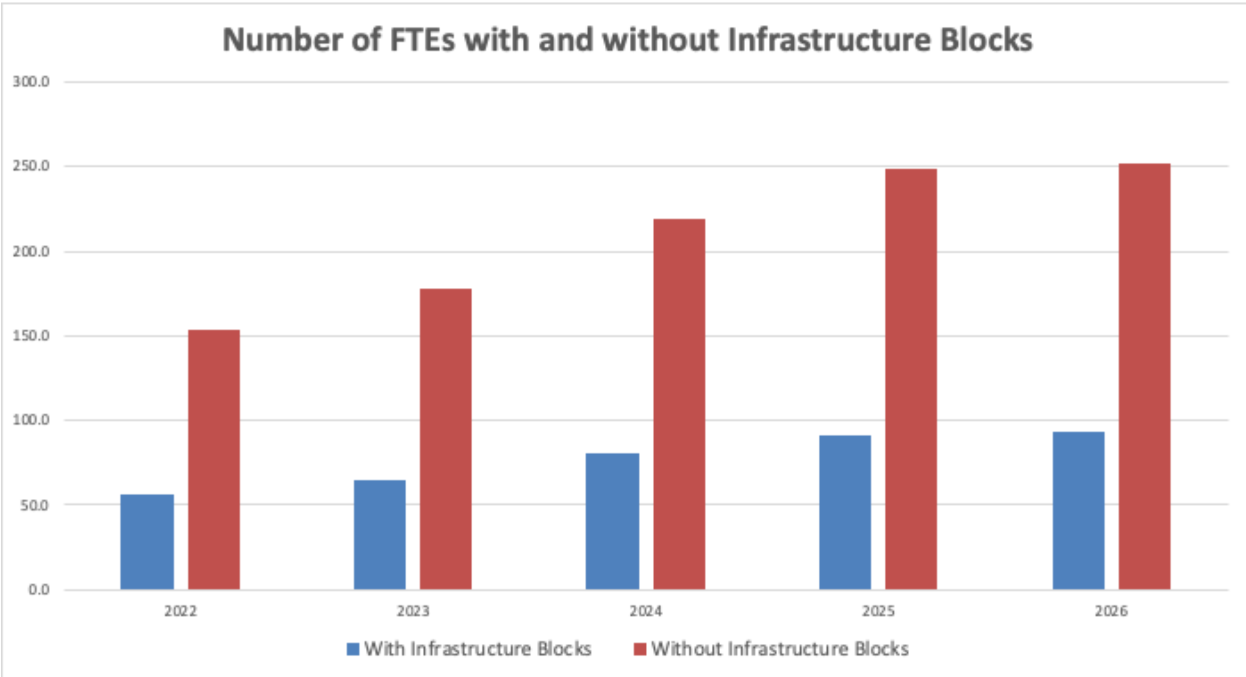

Figure 6. Comparison of the Number of FTEs over Five Years for Both Scenarios

Conclusion

The Dell Telecom Infrastructure Blocks for Wind River provide a use case focused, pre-engineered, preintegrated, and prevalidated solution combining Dell's hardware with several partners' cloud platform software. In a large, distributed network there are significant challenges in network planning, integration, testing, and support. The detailed TCO model shows the OpEx benefits of Infrastructure Blocks for a Tier 1 vRAN network. Infrastructure Blocks reduce risk, accelerate network deployment and decrease life-cycle operations expenses. Our TCO model shows a five-year cumulative OpEx savings of 34% and an ROI of 109% for networks using the Dell Telecom Infrastructure Blocks.