The Economic Benefits of Accelerating the Introduction of New Technology with Dell Telecom Infrastructure Blocks for Wind River

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EXECUTIVE SUMMARY

Communications service providers (CSPs) are adopting Open RAN and virtualized Radio Access Network (vRAN) networks for a number of reasons. One of the more significant reasons is the ability to select the best components for a specific workload to reduce costs while accelerating innovation. Staying on the cutting edge of the technology curve while minimizing operations risk can have a significant impact on an operator's ability to compete while leveraging the benefits provided by open, disaggregated networks.

Dell Technologies is at the forefront of enabling CSPs to efficiently deploy Open RAN and vRAN networks at a global scale. Last year, Dell introduced Dell Telecom Infrastructure Blocks for Wind River to simplify the design, deployment, and management of a cloud platform based on Wind River Studio, which supports vRAN and Open RAN networks.

Telecom Infrastructure Blocks for Wind River are pre-integrated and tested solutions that combine Dell hardware and software with Wind River Studio. As part of the development process for Infrastructure Blocks, Dell works with its customers and Wind River to define a road map of new technology enhancements that include the latest software and hardware advancements to support vRAN and Open RAN deployments. Dell then works with Wind River to perform design and validation testing to ensure a highly performant, reliable, and resilient cloud platform to run Open RAN and vRAN workloads. These engineered systems help operators accelerate the introduction of new technology by offloading many of the design and integration tasks an operator or system integrator would otherwise have to perform to incorporate these new hardware and software advancements into the CSP's network. This empowers the CSP to quickly deploy new technologies to stay on the leading edge of the cost and innovation curve while minimizing operations risk.

This paper provides a methodology for examining the business impact of accelerating the introduction of new technology in vRAN and Open RAN deployments. It uses the transition from servers based on 3rd Gen Intel Xeon Scalable Xeon processors to 4th Gen Xeon Scalable processors with Intel vRAN Boost as an example of the impact accelerating the introduction of a new technology can have on a CSP's business and the role Infrastructure Blocks can play in that process. As with most technology transitions, feature enhancements occur across all components of the system. The transition to the next generation of Intel processor technology is no exception. There are improvements to processor technology, server design, new NIC and accelerator cards, cloud platform software, etc. All require design and integration testing to support vRAN and Open RAN networks. We look at how Dell Telecom Infrastructure Blocks for Wind River can help operators reduce the time it takes to introduce technology into their networks and the costs savings that can be realized by staying on the cutting edge of the technology curve.

Dell Telcom Infrastructure Blocks for Wind River include support for Dell PowerEdge R760, XR5610 and XR8000 servers. These servers provide the latest advancements in server design along with support 4th Gen Intel Xeon Scalable processors with vRAN Boost technology.

With the introduction of these next-generation PowerEdge servers, significant advancements have been achieved, resulting in reduced total cost of ownership (TCO) for networks. Dell Telecom Infrastructure Blocks offer a streamlined approach for CSPs to deploy these servers in production networks, further enhancing TCO reduction. This whitepaper explores the role of Dell Telecom Infrastructure Blocks can have in accelerating the introduction of new technologies using the transition from Dell PowerEdge XR11, which is based on 3rd Gen Intel Xeon Scalable processors, to the PowerEdge XR8000 servers in an Open RAN network as an illustrative example.

Infrastructure Blocks play a vital role in accelerating XR8000 server deployment by reducing time-to-market and streamlining life-cycle operations. These benefits encompass the entire deployment process, from design (Day 0) to deployment (Day 1) and ongoing operations (Day 2). On Day 0, Infrastructure Blocks provide pre-engineered, pre-integrated, and pre-validated solutions using Wind River Studio Cloud Platform software, tailored to specific use cases. They simplify design and planning processes by offering configuration guidance across

various scale points. Custom configurations can be validated through Dell's Open Telecom Ecosystem Lab. On Day 1, factory integration of hardware and software eliminates the need for on-site configuration, while automated deployment with Dell Bare Metal Orchestrator (BMO) and Wind River Studio Conductor accelerates network deployment and reduces errors. Integrations between Wind River Studio and the hardware provided by BMO Modules automate life-cycle management in large, complex networks with multiple edge data centers and servers.

The adoption of Infrastructure Blocks accelerates the realization of TCO benefits identified in previous studies. By reducing deployment time, CSPs can swiftly transition to next-generation XR8000 servers, resulting in cost savings and improved operational efficiency. Infrastructure Blocks also contribute to long-term TCO savings by reducing Day 2 labor expenses, including engineering, testing, configuration, and performance management. Our TCO model demonstrates cumulative TCO savings of 10% over five years and an impressive ROI of 322%.

Introduction

Dell is at the forefront of providing communication service providers (CSPs) with a cost-effective pathway to deploy virtualized Radio Access Network (vRAN) networks at scale worldwide. With the introduction of the next-generation PowerEdge XR5610 and XR8000 servers, significant performance improvements have been achieved, leading to reduced network total cost of ownership (TCO). Dell Infrastructure Blocks offer a streamlined approach for CSPs to deploy these new servers in production networks, further reducing network TCO. This whitepaper explores the benefits of Dell PowerEdge XR8000 servers in vRAN networks and the role of Infrastructure Blocks in accelerating their introduction into network deployments.

Benefits of Dell XR8000 Servers in vRAN Networks

Dell's XR8000 servers, powered by 4th Gen Intel Xeon Scalable processors, bring substantial performance improvements to vRAN networks. These servers effectively support both virtualized

Distributed Unit (vDU) and Centralized Unit (vCU) workloads, outperforming their predecessors. Notably, typical scenarios have demonstrated up to a 2X improvement on vDU workloads and an estimated 42% improvement on vCU workloads. Moreover, the innovative designs incorporated in these servers simplify operations in telecom environments, leading to a reduction in service disruptions and the number of on-site visits. Dell's Smart Cooling design ensures increased power efficiency, even in harsh environmental conditions. The XR8000 servers leverage existing telco cabinets and power infrastructure, significantly reducing network installation expenses.

Accelerating PowerEdgeXR8000 Deployment with Infrastructure Blocks

One key benefit of Dell Telecom Infrastructure Blocks is the reduction in the time it takes to first deployment. This accelerated timeline enables CSPs to swiftly transition to next-generation servers and realize the TCO benefits identified in previous studies ACG has written on both the TCO benefits of next- generation XR8000 servers[1] and Infrastructure Blocks in vRAN networks . With Infrastructure Blocks, Dell validates these new servers with the latest enhancements to Wind River Studio to deliver a fully validated cloud stack that leverages the latest software and hardware advancements. In its most recent release, Wind River Studio Cloud Platform runs on just a single, 4th Gen Intel Xeon Scalable Processor core to reduce hardware and power requirements.

Infrastructure Blocks play a crucial role in achieving this accelerated deployment by minimizing risk, expediting network deployments and reducing life-cycle operations expenses. These benefits encompass the entire deployment process, including Day 0 (design), Day 1 (deploy), and Day 2 (operate) operations. Specifically, the Day 0 and Day 1 benefits accelerate network deployments by reducing the time required for Day 0 and Day 1 tasks.

1 https://infohub.delltechnologies.com/section-assets/acg-dell-tco-benefits-of-dell%E2%80%99s-next-gen-telco-servers-2023-2

2 www. acgcc.com/reports/dramatically-simplifying-the-operation-of-csps-dis/

Day 0 Benefits: Infrastructure Blocks provide solutions for vRAN and Open RAN using Wind River Studio software. Infrastructure Blocks are pre-engineered, pre-integrated, and pre-validatedsystems using field proven design guidelines to meet the requirements of the specific use case. While the example in this paper focuses on the PowerEdge XR8000, Dell also offers Telecom Infrastructure Blocks for Wind River based on the PowerEdge XR5610 and XR11 servers. Design requirements for cell sites often vary based on location and anticipated capacity requirements. For example, in dense urban areas an operator may choose to deploy a centralized vCU and vDU configuration. In these scenarios the ability to scale capacity in an efficient manner becomes an important design criterion. In rural areas where capacity is not expected to grow much over time, a CSP may opt to deploy a distributed CU and DU model utilizing a single compact server to meet requirements over the life cycle of the system. By offering a range of telecom optimized servers, Dell provides CSPs with the ability to optimize their cell site design based on specific cell site requirements. Dell Services can validate custom configurations through its Dell Open Telecom Ecosystem Lab to meet unique operators' requirements.

Day 1 Benefits: Factory integration of all hardware and software eliminates the need to configure hardware and software on site or in a configuration center. Dell Services can also ship custom configurations to meet the unique operator's requirements through a Dell Second-Touch facility. Network deployment is accelerated through the integration between Dell Bare Metal Orchestrator (BMO) and Wind River Studio Conductor. This integration automates deployment and life-cycle management of the cloud platform from bare metal through the cloud software layer, bringing the cloud platform to a workload ready state. This simplifies configuration and deployment of the cloud platform across an entire network of distributed data centers, which improves the speed of deployment and reduces configuration errors. This is especially important in large, complex networks with hundreds of edge data centers and tens of thousands of servers.

A breakdown of Day 0 and Day 1 tasks, which accelerate deployment of next-generation servers, is provided in Table 1 and Table 2. These are the tasks that must be completed to deploy next-generation servers in production networks. ACG Research has performed hundreds of hours of interviews with CSPs through numerous engagements with Tier 1 and Tier 2 CSPs

across all major global markets to understand and model the time they spend on tasks associated with design, deployment, and management of their network. The savings are estimates based on the work ACG Research has performed with these operators.

ACG Research has developed a TCO model for Dell Technologies that enables them to work with their customers to analyze the impact of Telecom Infrastructure Blocks in their networks. In this model, the parameters listed in the table can be adjusted to align with the CSP's operating environment.

Day 0 Tasks	Description	Infrastructure Blocks Benefits	Total Labor Hours	Time to Complete Task without IB	Time to Complete Task with IB	Savings
Day 0 Reference Arch Design	High-Level design of the cloud infrastructure architecture. Hardware and	software architecture Is already pre-defined in Infrastructure Blocks so architects only need to focus on use case and environmental details.	480 hours without IB 240 hours with IB	1 month	0.5 month	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.	240 hours without IB 120 hours with IB	0.5 month	0.2 month	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.	960 hours without IB 192 hours with IB	1.5 months	0.7 months	80%

Day 0 Tasks	Description	Infrastructure Blocks Benefits	Total Labor Hours	Time to Complete Task without IB	Time to Complete Task with IB	Savings
Day 0	Detailed Design Detailed design specifies detailed configurations for each regional and edge data center based on the use case requirements.	Pre-engineered, pre-integrated, and pre-validated 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.	1920 hours without IB 384 hours with IB	1 month	0.5 month	80%

Table 1. Key Areas of Day 0 Labor Savings Due to the Dell Telecom Infrastructure Blocks

Day 1 Tasks	Description	Infrastructure Blocks Benefits	Total Labor Hours per Server	Time to Complete Task without IB	Time to Complete Task with IB	IB Savings
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.	0.5 hours without IB 0.25 hours with IB	1 month	0.5 month	50%
Day 1 Hardware Installation	Installation, wiring, and testing of hardware on site.	Infrastructure Blocks provide turnkey solutions that simply hardware installation.	4 hours without IB 2 hours with IB	2 Months	1.5 Months	50%

Day 1 Tasks	Description	Infrastructure Blocks Benefits	Total Labor Hours per Server	Time to Complete Task without IB	Time to Complete Task with IB	IB Savings
Day 1 Cloud Platform Installation	Installation and configuration of cloud software on hardware infrastructure.	Pre-engineered, pre-integrated, and pre-validated Infrastructure Blocks simplify cloud software installation, which can be complex and time consuming without Infrastructure Blocks.	6 hours without IB 1.2 hours with IB	3 Months	1 Months	80%
Day 1 Network Testing	End-to-end testing of the network cloud platform and hardware configurations after installation.	Infrastructure Blocks are pre-tested before they are shipped, which dramatically reduces on-site testing.	4 hours without IB 0.8 hours with IB	2 months	1 month	80%
Day 1 Documentation	Documentation of the hardware and cloud platform configuration.	Standard Infrastructure Blocks and Customer Information Questionnaires (CIQs) allow CSPs to simplify documentation using boiler plate text for much of the configurations.	240 hours without IB 120 hours with IB (Note above are fixed hours not variable by server)	0.5 month	0.2 month	50%

Table 2. Key Areas of Day 1 Labor Savings due to the Dell Telecom Infrastructure Blocks

Infrastructure Blocks accelerate the time to network deployment. Using our labor estimates and assumptions on the number of FTEs we developed the following Gantt charts showing next-generation server deployment times with and without Infrastructure Blocks. These Gantt charts are presented in Figure 1 and Figure 2. We estimate that Infrastructure Blocks will provide at minimum a six-month acceleration of XR8000 rollouts.

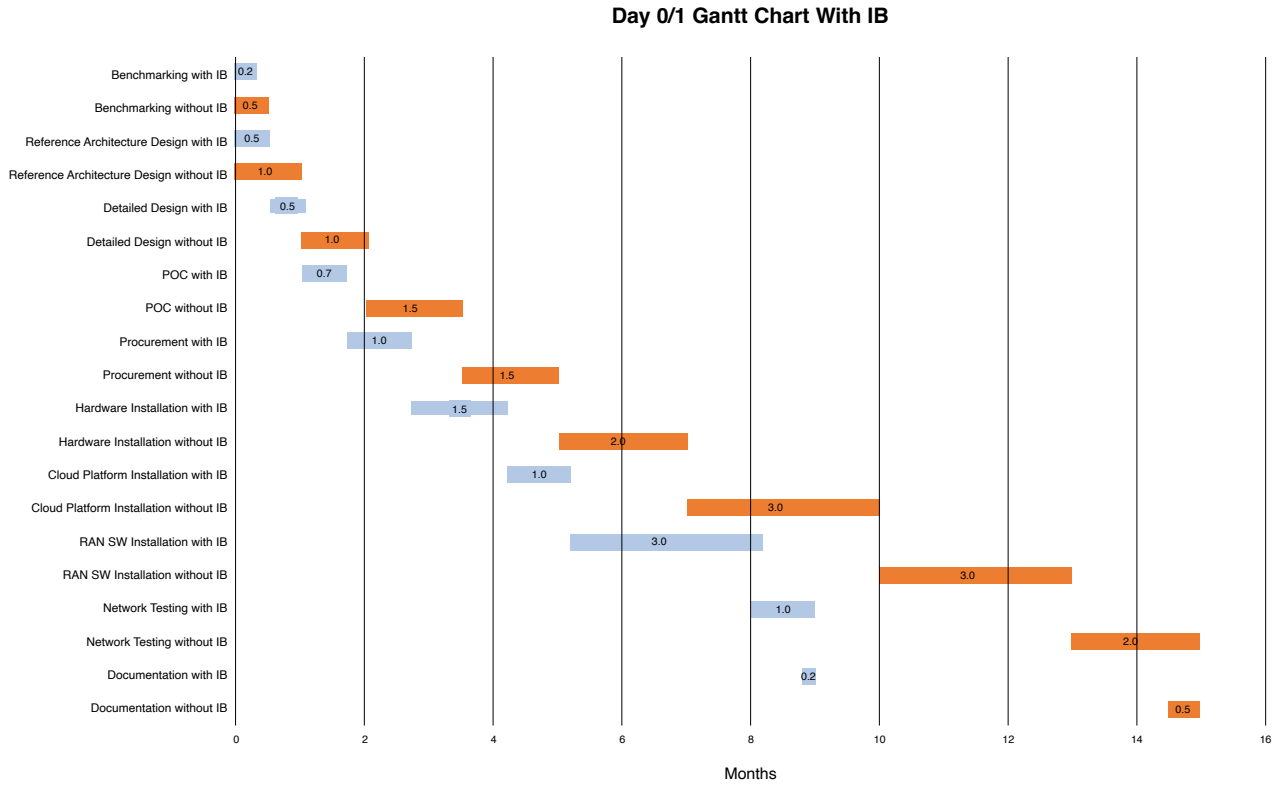

Figure 1. Gantt Chart Specifying the Timeline to Deploy Servers with and without Infrastructure Blocks

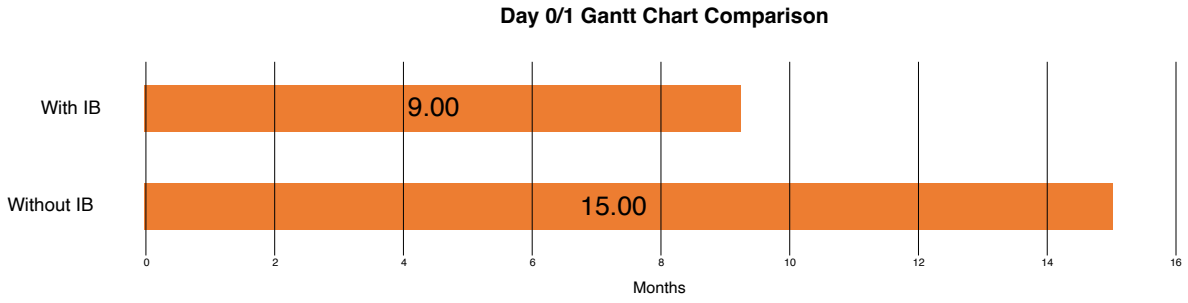

Figure 2. Gantt Chart Comparison of Deploying Servers with and without Infrastructure Blocks Shows a Six-Month Time Reduction

The adoption of Infrastructure Blocks expedites the realization of TCO benefits identified in previous studies. By reducing deployment time, CSPs can swiftly transition to next-generation technologies such as the XR8000 servers. The streamlined deployment process facilitated by Infrastructure Blocks allows CSPs to enjoy the cost savings and operational efficiencies sooner.

After servers are deployed and operational Infrastructure Blocks also reduces the Day 2 labor expenses. These Day 2 expense reductions contribute to long term TCO savings. The Day 2 expenses are presented in Table 3.

Task	Description	Infrastructure Blocks Benefits	Labor Hours per Server	Savings
Day 2 Engineering & Planning	On-going 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.	0.5 hours without IB 0.25 hours with IB	50%
Day 2 Procurement On-going	Procurement of hardware and cloud software.	A single point of contact with Dell simplifies procurement of cloud software integrated with hardware.	0.1 hours without IB 0.05 hours with IB	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 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.	10,800 hours without IB 2160 hours with IB (Note above are fixed hours not variable by server)	80%
Day 2 Hardware Upgrades	On-going 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.	0.5 hours without IB 0.25 hours with IB	50%

Task	Description	Infrastructure Blocks Benefits	Labor Hours per Server	Savings
Day 2 Software Upgrades	On-going upgrades of software.	Infrastructure Blocks provide turnkey solutions, which simply software upgrades.	1 hours without IB 0.2 hours with IB	80%
Day 2 CI-CD Pipeline Integration	On-going continuous integration and and deployment of software.	Deployment of software. Infrastructure Blocks are designed to support CI-CD pipelines.	960 hours without IB 192 hours with IB (Note above are fixed hours not variable by server)	80%
Day 2 Fault Management	On-going troubleshooting and remediation of problems.	Dell's extensive design and integration testing minimizes design and interoperability issues to reduce faults and performance management issues for the cloud stack. BMO automates 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 to CNF deployment accelerates problem remediation.	4 hours without IB 1.4 hours with IB	65%

Task	Description	Infrastructure Blocks Benefits	Labor Hours per Server	Savings
Day 2 Performance Management	On-going 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.	2 hours without IB 0.7 hours with IB	65%
Day 2 Configuration Management	On-going 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 BMO's ability to automate the detection and remediation of configuration drift ensure a consistent, approved configuration across the CSP's landscape.	1 hours without IB 0.5 hours with IB	50%

Table 3. Key Areas of Labor Savings Due to the Dell Telecom Infrastructure Blocks

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 50,000 high density cell sites. We assume that 25,000 cell sites use a distributed architecture with DUs located in the cell sites and CUs located centrally. The other 50% of the cell sites use a centralized DU architecture with DUs located in far edge data centers. The number of centralized and distributed sites is presented in Table 4. The cell sites grow from the initial value to the final value over five years.

Cell Site Type	Number of Cell Sites
Distributed DU	25,000
Centralized DU	25,000

Table 4. Numbers of Cell Sites

The number of sectors for each radio carrier is presented in Table 5.

Radio Carrier	Distributed DU	Centralized DU
100MHz 64X64	6 Sectors	6 Sectors
20MHz 4X4	9 Sectors	9 Sectors

Table 5. Radio Carriers for Each Type of Cell Site

We assume that Dell BMO control servers are deployed in central regional data centers serving the entire RAN. The numbers of data centers are presented in Table 6. 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 the five years.

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

Table 6. Number and Type of Data Centers

In our TCO model we use the ACG Business Analytics Engine (BAE)[3] to compare two scenarios:

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

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

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:

- Each type of cell site has a combination of radio carriers specified in Table 5
- 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 grow and the growth in processor core requirements drives the growth of servers

Cell sites with distributed DUs need less XR8000 servers than XR11 servers due to the DU performance improvements in the 4th Gen Intel Xeon Scalable processors. Based on the radio carrier requirements at each cell site we have calculated the number of servers required in each distributed DU cell site as specified in Table 7. For centralized DU deployments the DU servers are pooled in edge data centers and pooling further reduces the number of servers required.

	Number of Servers
PowerEdge XR11	3 Servers
PowerEdge XR8000	2 Servers

Table 7. Number of Servers Required in Each Distributed DU Cell Site for Each Generation of Technology

A key difference between the two scenarios is that we assume that Dell Telecom Infrastructure Blocks accelerate the deployment of next-generation servers. This is due to the ability of Infrastructure Blocks to accelerate the total time to complete Day 0 and Day 1 tasks from 15 months to 9 months, as illustrated above. The assumptions we use for the two scenarios are:

- With Infrastructure Blocks: XR11 servers are deployed for the first 9 months and then XR8000 servers are deployed for the following 51 months
- Without Infrastructure Blocks: XR11 servers are deployed for the first 15 months and then XR8000 servers are deployed for the following 45 months

The result of a six-month acceleration of XR8000 server deployment due to the Day 0 and Day 1 benefits of Infrastructure Blocks means the total number of servers deployed and managed over five years is reduced from 71,536 to 66,380. This decreases costs for hardware acquisition and cloud platform software support (cloud platform software costs are typically tied to the number of servers under management), power cooling, floorspace, and Day 0 through Day 2+ operations.

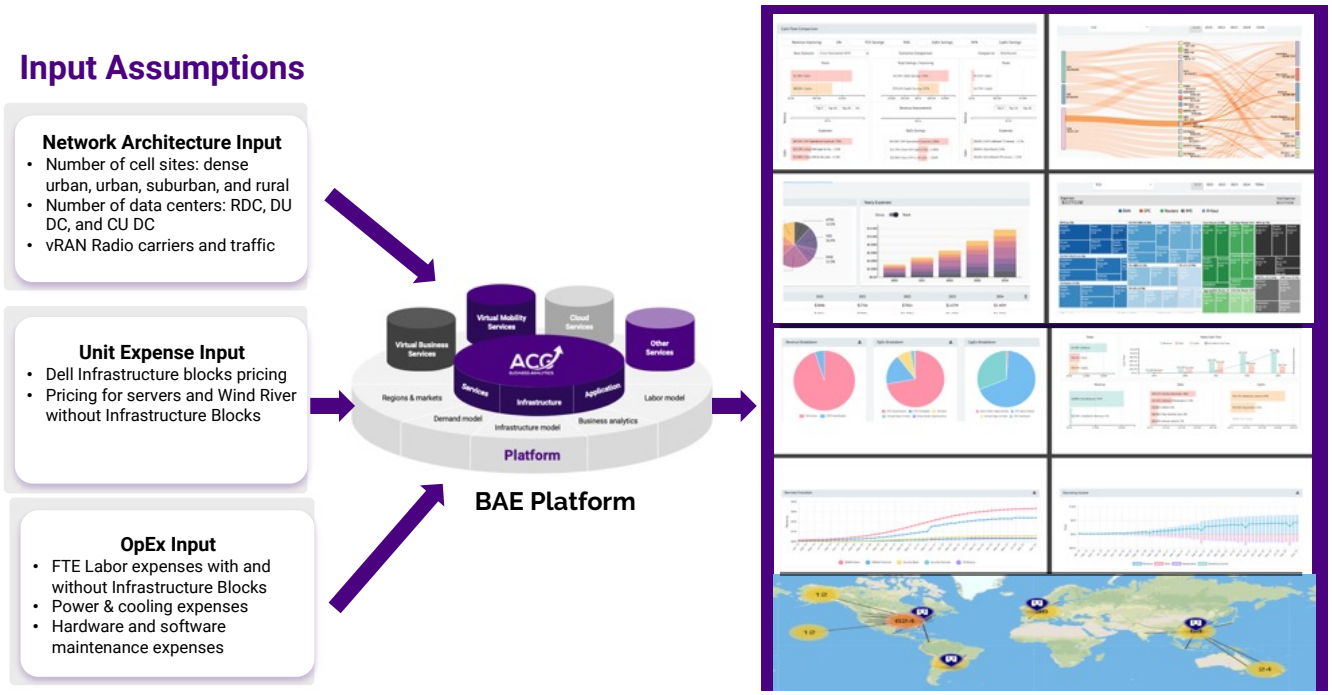

Figure 3. ACG Business Analytics Engine

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 TCO savings of 10% and an ROI of 322%. The results for the cumulative period are presented in Table 8.

	Without IBs	With IBs	Saving	ROI
Five-Year Cumulative TCO	$2.13 Billion	$1.91 Billion	$220 Million 10% Savings	322%
Five-Year Cumulative OpEx	$ 1.02 Billion	$879 Million	$139 Million 14% Savings	
Five-Year Cumulative CapEx	$1.11 Billion	$1.03 Million	$79.6 Million 7% Savings	
Man Months	11,576	3,743	7,834	

Table 8. Comparison of Two Scenarios: with Infrastructure Blocks and without Infrastructure Blocks

A breakdown of the five-year cumulative CapEx and OpEx comparison of the two scenarios is provided in Figure 4. These charts show that the largest drivers of TCO savings are server acquisition costs, cloud software support, fault management, cloud platform installation, and hardware support and maintenance. One reason for these savings is that fewer XR8000 servers are required than XR11 servers in the network because of the overall performance improvements provided by the 4th Gen Intel Scalable Xeon processors with vRAN Boost technology. Moving to the XR8000 more quickly accelerates these TCO advantages. The other key reason for the savings is that Dell provides a pre-integrated, tested, and validated solution specifically designed for a vRAN network with a single point of contact for support, which provides significant labor savings for Day 0 through Day 2 operations.

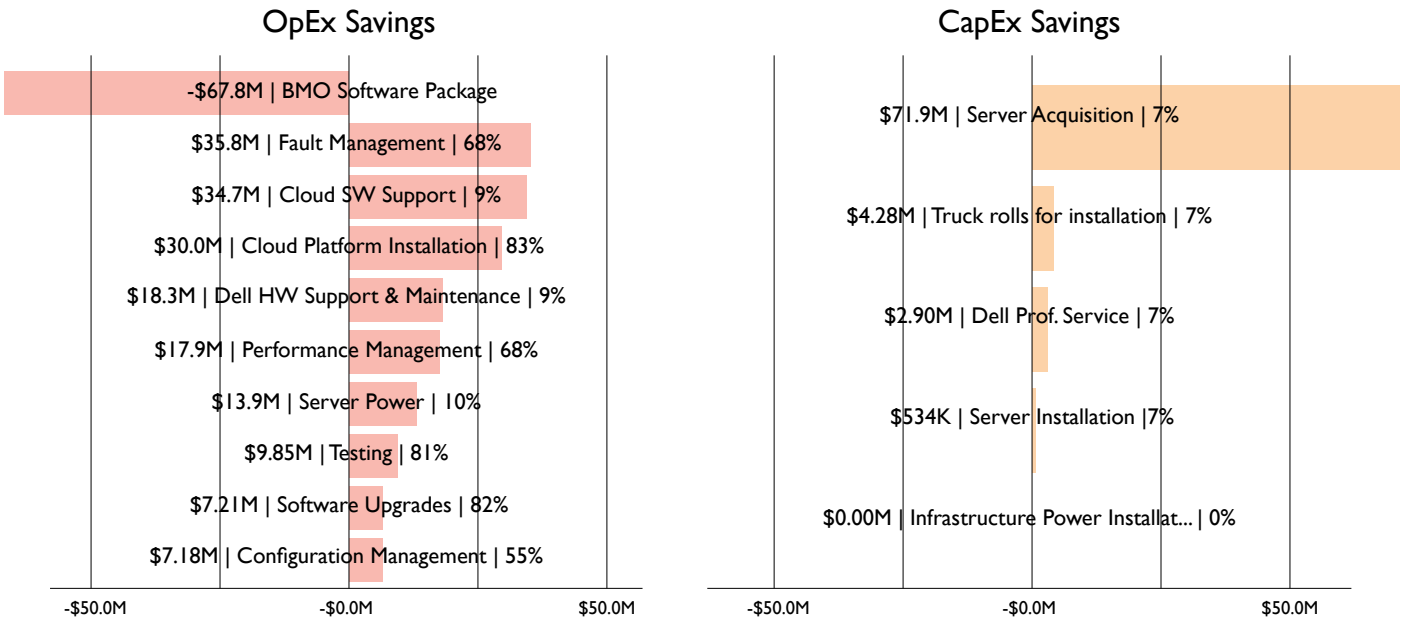

Figure 4. Five-Year Cumulative OpEx & CapEx Saving of Two Scenarios with Infrastructure Blocks and without Infrastructure Blocks

Power and cooling expenses and reduction in CO^2 emissions are another key area of savings. Power and cooling is reduced over the five years because of the reduction in the number of servers under management as well as the overall power efficiency of the newer server technology.

Sustainability has become increasingly important to CSPs worldwide. Last year, the GSMA made the first assessment of how the mobile industry is progressing toward net zero by 2050. A detailed report from GSMA highlights how many mobile operators (50) have committed to reducing their carbon footprint.[4] In the results we assume average North American power expenses. The results are presented in Table 9. The CO2 emissions savings translates to driving 38,622 gas powered cars for one year or 33,770 homes electricity use for one year[5].

[4] https://www.gsma.com/betterfuture/wp-content/uploads/2022/05/Moble-Net-Zero-State-of-the-Industry-on-Climate-Action-2022.pdf

[5] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

	Savings
Total Power & Cooling Savings (USA)	$20,850,000
Total Kwatt Hour Savings	244,904,762 Kilowatt Hours
Total CO^2 Emissions Savings	173,560 Metric Tons

Table 9. Five-Year Cumulative Power and Cooling Savings and CO^2 Emissions Savings

Conclusion

Dell Telecom Infrastructure Blocks offer CSPs a comprehensive solution for accelerating the introduction of new technology in vRAN and Open RAN networks. Leveraging Telecom Infrastructure Blocks expedites network deployment, minimizing risk and streamlining operations throughout the solution life cycle. By adopting Dell's innovative solutions, CSPs can achieve cost savings, improve network performance, and increase operational efficiency in their vRAN networks. The documented benefits include reductions in design and deployment time, power and cooling costs, server and cloud platform software support costs, and time spent on Day 0 to Day 2 operations tasks, resulting in substantial TCO savings.

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