Moving from a legacy to a cloud environment

Total cost of ownership analysis as validated by IDC

White paper

This Nokia white paper outlines the major costs that are involved in migrating from a legacy IT environment to a private cloud from Nokia. It then derives the improvements in the total cost of ownership (TCO) and calculates the return on investment (ROI) for the private cloud. To ensure rigor and applicability to the enterprise, this analysis model was formally validated by IDC.

Contents

Overview

Nokia and its ventures such as Nuage Networks are engaged with leaders in multiple enterprise and vertical industries on a broad array of cloud initiatives. As some organizations have decided to migrate to a cloud approach for strategic reasons, their top objective can best be summarized as "minimize time to cloud."

Many of these organizations are seeking the ideal inflection point where the costs of building a new private cloud can be balanced against the savings derived from replacing an existing legacy IT environment. After a series of discussions with the organizations—name brand large enterprises and industry thought leaders—a common set of considerations emerged. These considerations guided the construction of a financial justification for moving a legacy IT environment to the cloud. This justification is applicable across multiple architectures, products, and solutions that are deployed in large enterprises overall, especially verticals such as finance and healthcare.

As moving to a cloud architecture involves an upfront investment that should be balanced by reduced costs over time, the financial model that makes the most sense is a TCO model. By comparing the TCO of operating a legacy approach with that of moving to and operating a cloud approach, both an overall cost savings and an approximate time to break-even can be estimated.

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This white paper first discusses the analysis model as validated by the industry analyst group International Data Corporation (IDC). The paper then analyzes a prototype data center to calculate and present the general findings of the model and moves on to discuss the model's extensibility to other enterprise IT environments. Finally, concepts regarding how cloud professionals can use this information to analyze their own operations are provided.

Designing the private cloud analysis model

"Forest for the trees" model design

Moving to a cloud changes several variables at once as many organizations simply can't "see the forest for the trees." In other words, all the complexities make an analysis so daunting and time-consuming that busy IT professionals simply cannot spare the time.

In fact, moving to a cloud from a legacy model does change the overall orchestration, management, hardware, software and operations model. The change impacts almost every aspect of the core network and each data center other than facility considerations such as power, environmentals and cabling.

As a result, a true TCO analysis is very daunting to model much less calculate. However, if the focus is on comparing how TCO changes from legacy to private cloud, then the analysis is considerably simplified while keeping conclusions relevant and useful.

Specifically, a move to a private cloud will involve higher costs for the purchase and installation of the software needed to form the cloud and the implementation and migration of physical and virtual resources, and of course, applications. In fact, estimates for the cost to migrate an application from a legacy to a cloud environment range from 2.26[1] to 3.5[2] times the annual operating costs of the application.

These higher costs are balanced by lower costs in terms of being able to utilize a given percentage of commodity hardware, operations efficiencies and support cost reductions. For example, it is relatively easy to estimate how the support cost for legacy software—typically between 20 percent and 25 percent of the software's initial cost per year—will change in a cloud environment where open source support is typically around 15 percent per year.

Estimating the effort required for installation, to integrate into existing systems, and to migrate existing applications into a private cloud is very challenging. However, an approximation could be obtained by first expressing the cost of a past legacy forklift upgrade in terms of the operational budget and then estimating the multiplier that likely would be needed for a private cloud. For example, a Wikibon study calculated that the total cost of a storage forklift upgrade was actually 54 percent of the array's initial cost, with 17 percent alone being the migration cost.[3]

To simplify the process, this analysis takes the overall operational budget of the data center (eliminating costs that will be the same in either scenario such as facilities costs) and then provides a high-level breakout by the software or operational tasks performed. The breakout is then used to calculate the potential cost impacts—both increases as well as decreases—for a cloud environment.

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Not just any cloud – cloud requirements for the model

Many analyses assume that an entirely separate, redundant cloud approach will be built and then applications will be migrated to it. This assumption, while simple to articulate, does not reflect the realities of most enterprise data centers. Most enterprises need to get started on a cloud in parallel with operating their legacy environment.

1 IDC Custom Solutions Group, analysis based on interviewing over 400 enterprises (http://www.idc.com/prodserv/custom_solutions/pages/gms/business-sd.jsp).

2 Mark Tonsetic, "How to Explain Cloud Migration Costs to the CFO," CEB Blog, 2015 (https://www.cebglobal.com/blogs/how-to-explain-cloud-migration-costs-to-the-cfo/).

3 David Floyer, "The Cost of Storage Array Migration in 2014," Wikibon, 2014.

As a result, functional requirements for this private cloud analysis model are:

- **Overlay:** The most critical cost factor for the architecture is that it must not require forklift replacements of the environment to operate. It must sit on top (overlay) the existing infrastructure yet deliver full cloud capabilities.
- **Federation:** The private cloud must be able to "federate" multiple physical data centers into a single logical cloud.
- **Programmability:** The next most critical factor is programmability. It must enable software-based controls to be made across the entire software stack.
- **Orchestration:** The cloud must include consolidated orchestration up and down the software stack. It must be able to coordinate the provisioning of server resources, including virtual machines (VMs), network resources and storage.
- **Bare metal:** It must virtualize and consistently manage non-virtualized (bare metal) servers and applications.
- **Correlate virtual to physical:** It must correlate virtualized resources to the physical box on which they reside and provide real-time management capabilities.
- **Off-the-shelf components:** It must consist of off-the-shelf products and components with expert integration and customization work.

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Private cloud architectures that meet the above requirements are off-the-shelf today. Major components of a compliant architecture are:

- **Consolidated orchestration:** Consolidated orchestration is achieved using an open cloud platform such as OpenStack or CloudStack.
- **Software-defined networking (SDN):** A SDN approach that overlays existing networks and is fully programmable is required.
- **Federated IP/SDN:** Both SDN and physical Internet Protocol (IP) federation is required to build truly distributed clouds.
- **Top of rack switches/Gateways (packaged as hardware or software):** Top of rack switches and gateways are available in both appliance and VM form factors. For this architecture, these switches and appliances must be able to virtualize bare metal servers and applications.
- **Network management:** Some of the available network management platforms provide correlation and debugging for virtualized infrastructures.

This financial model is based on a private cloud architecture that can be built at any large enterprise today with a variety of commercial components from multiple vendors and many open source components from numerous projects and initiatives. In fact, an architecture that meets the above criteria, as well as the steps to build it, are described in a Nokia application note "Stairway to Cloud: 9-Step Blueprint to a Best Practices Private Hybrid Cloud for your Enterprise."

Analysis of a representative data center

Overview

As discussed in the previous section, this analysis focuses on the changed costs between a legacy and a cloud environment because baseline data center costs such as rent, power and environmentals are largely the same for both scenarios. For the representative data center, a $20M annual budget figure was chosen for the following reasons:

- Given that a significant Year 1 investment to implement the cloud is needed, this figure provides a basis for justifying the investment.
- Even if other gains are not realized, the gains in operating expenses (OPEX) over five years alone balance out the upfront investment.
- It is easy to customize the analysis for any higher budget figure using simple multiplication.

Simplifying assumptions

In the spirit of William of Ockham (perhaps most famous for “Ockham’s razor”), a limited number of assumptions were made. The purpose of the assumptions is to simplify the analysis of one of his most oft-quoted expressions, “With all things being equal, the simplest explanation tends to be the right one.”[4]

“With all things being equal, the simplest explanation tends to be the right one.”
William of Ockham

Overall, the assumptions are extensions of the cloud requirements for the model or cost assumptions. If there is uncertainty, then the assumptions conservatively favor the legacy scenario. The assumptions are:

1. **Forklift-free:** An SDN overlay approach is needed so no physical hardware upgrade is needed for private cloud. For large enterprises with custom appliances and devices (such as healthcare), only the costs of integration need to be factored rather than replacement costs.
2. **Facilities cost parity:** There are no significant changes to existing facilities or data center costs (such as rent, power and environmentals) so these costs can be disregarded.
3. **Security parity:** The same security approach applies to both scenarios; thus, security costs can be ignored. An enterprise-grade SDN overlay approach can fully utilize security appliances such as firewalls. This is a realistic assumption from a technical standpoint. In the long term SDN likely will decrease some security costs, so ignoring an impact on cost is conservative.
4. **Customization parity:** This cost refers to the ongoing customization and tuning of applications in response to end-user demand and cost optimization. In the long term, legacy code is probably more expensive to

4 William of Ockham, quoted in http://www.goodreads.com/author/show/85818.William_of_Ockham, 2015.

maintain. However, an organization that is migrating to open source as part of a private cloud will probably need to expend additional resources for training and experimentation in Year 1 and perhaps Year 2. Consequently, while open source customization should be much less expensive post-implementation (Years 3-5), an assumption that the costs will balance out overall is both realistic and conservative for most large enterprises. In short, the cost of ongoing customization of legacy products versus open source products is conservatively assumed to be the same; therefore, these costs do not need to be considered by most enterprises.

5. **Commodity hardware:** When implementing open source approaches along with SDN, the replacement of a significant percentage of expensive, proprietary legacy hardware with industry-standard hardware (commodity hardware) becomes a reality. Consistent with the assumption that the cloud will overlay an existing environment, the assumption is that end-of-life legacy hardware will be replaced with commodity hardware each year.
6. **Business neutral:** It is assumed that both approaches provide the same overall functionality; business benefits can also be disregarded. To drill down, this assumption conservatively ignores private cloud benefits of agility, flexibility and any resulting benefits. As a result, the positive impact of the private cloud on strategic or business initiatives is very conservatively left out of consideration.

Rule of thumb ratios

To simplify the analysis, several constants are derived as rule of thumb ratios. A rule of thumb is a principle that is not intended to be wholly accurate or precise across the board, but it does enable a quick and relatively reliable calculation or judgment to be made.[5]

By building rule of thumb ratios among costs in IT environments into the model, an analysis that is relatively accurate overall and independent of budget size can be created. In other words, if 50 percent of the total budget is allocated to a particular cost, then adjustments based on budget size are straightforward.

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The major ratios used in the model come from a variety of sources:

- **CAPEX to OPEX ratio:** Multiple industry sources appear to back up a legacy capital expenditures (CAPEX)/OPEX cost ratio of 20 percent/ 80 percent, respectively. However, this ratio is likely to vary for highly virtualized environments. A survey published in "Network World" found that the ratio of CAPEX to OPEX across 376 respondents was actually 47 percent/53 percent.[6] Accordingly, for this study an initial ratio of 20 percent/80 percent was selected. Applying the various aspects of

5 Wikipedia, "Rule of Thumb," 2015 (https://en.wikipedia.org/wiki/Rule_of_thumb).

6 John Dix, "Data Center Surprises," Network World, 2011 (http://www.networkworld.com/article/2179893/virtualization/data-center-surprises.html).

the model, the end cost was approximately 86 percent of the total cost. However, the CAPEX/OPEX ratio remained approximately the same at 20 percent/80 percent. This indicates that there is still significant upside to this model should virtualized OPEX savings approach the ratios reported in the "Network World" survey. Yet, data centers in areas with much lower wage scales could have a more CAPEX heavy ratio. In the end, this value is adjustable by the customer in the model.

- **Ratio of costs among infrastructure software categories:** An Amazon Web Services (AWS) TCO study listed exact costs by category for a virtualized solution.[7] Ratios were approximated from this study and validated based on IDC research of 450 enterprises with private cloud environments.[8]
- **SDN automation savings:** Nokia Bell Labs prepared a comprehensive case study of a Nuage Networks-based SDN implementation at a large, name brand financial institution. The case study calculated an overall labor savings rate of 52 percent due to automation, templates, and administrator productivity functions.[9] This number was rounded to 50 percent for the purpose of this study.
- **Increased rack utilization:** Legacy environments must provide server, network, and storage capacity in each rack for an unknown amount of application growth. As a result, most legacy racks are likely to be overprovisioned. This scenario is often described as "stranded assets" because these assets are essentially idle so they cannot be utilized by another application. By implementing the Nokia cloud architecture, rack utilization can be substantially increased by up to 40 percent. Actual customer trials at large financial institutions have in fact yielded an average increase of around 20 percent across the rack's server, network and storage resources.
- **Commodity enterprise-grade server, networking and storage:** A variety of sources listed that cloud/enterprise-grade commodity approaches typically are from 25 percent up to 50 percent less expensive than legacy gear.[10, 11, 12] Here is a discussion of each tier separately:
  - **Server:** Large enterprises may elect to run legacy applications such as databases and customer relationship management (CRM) systems on branded servers. Based on custom research, IDC estimates that organizations going to private cloud will see an average reduction in

7 Amazon, "TCO Comparison: Amazon WorkSpaces and Traditional Virtual Desktop Infrastructure (VDI)," 2013 (https://aws.amazon.com/blogs/aws/tco-comparison-amazon-workspaces-and-traditional-virtual-desktop-infrastructure-vdi/).

8 IDC Custom Solutions, 2016 (http://www.idc.com/prodserv/custom_solutions/pages/gms/business-sd.jsp).

9 Bell Labs, "TCO for SDN at a Major Bank," Alcatel-Lucent Study, 2013.

10 Jack Clark, "HP, Dell, and Cisco Face Threat of Cheap Servers From Their Suppliers," Bloomberg, 2014 (http://www.bloomberg.com/bw/articles/2014-10-02/hp-dell-cisco-face-threat-of-cheap-servers-from-their-suppliers).

11 John Abbott, "Brands under attack: no name system vendors on the rise as x86 evolves," 451 Group Research Note, 2014 (https://451research.com/powering-the-cloud).

12 Rob Sherwood, "White Box Switches Are So Much More Than CapEx Reduction," ONUG Blog, 2015 (https://opennetworkingusergroup.com/whitebox-is-so-much-more-than-capex-reduction/).

server hardware costs of 48 percent.[13] However, this analysis assumes a nearly complete overlay without upgrades. Thus, as a starting point, this analysis conservatively reduces the potential cost savings of server hardware down to 5 percent.

  - **Network:** For large enterprises, the core network is unlikely to change from legacy architectures in the near future. However, while the core network is expected to remain untouched, many data centers switching requirements will be met today with industry standard network hardware. Newer data center networking topologies will probably use more of these switches than legacy configurations. Based on custom research, IDC estimates that organizations going to private cloud see an average reduction in network hardware costs of 35 percent.[14] Given all of these customer-specific factors plus the discussion for server hardware, this analysis conservatively reduces the potential cost savings of industry standard data center switches down to 5 percent.
  - **Storage:** Using a similar line of reasoning as for server hardware, IDC estimates a reduction in storage costs of 46 percent.[15] Consistent with the ideas for server and network layers, this analysis conservatively reduces the potential cost savings of industry standard storage down to 5 percent.

- **Cost of a legacy forklift upgrade:** As stated earlier, these costs are significant. The Wikibon study referenced before found that storage migrations cost about 54 percent of the initial purchase cost of the storage unit with 17 percent being essentially labor.[16] However, a Hitachi Data Systems (HDS) study concluded that labor was approximately 70 percent of the cost of a storage upgrade/migration.[17]

  While even experts disagree on cost breakdowns for similar projects, the goal of this effort is to generalize a model that is usually applicable yet can be refined on a customer-by-customer basis. In that sense, as most enterprises depreciate on a 3-year schedule, up to about 33 percent of the hardware is being replaced each year with replacement costs typically less expensive per Moore's Law. As a result, a 25 percent increase was chosen as an estimate for hardware replacement (CAPEX) and a 50 percent increase over baseline installation and integration labor costs (OPEX) for legacy upgrades. As most enterprises depreciate over a 3-year cycle, only one forklift upgrade was built into the five-year model. Furthermore, to provide the most conservative figure for when the TCO of the cloud scenario would better that of legacy IT, the legacy IT forklift upgrade was deferred to Year 4.

13 IDC Custom Solutions, 2016 (http://www.idc.com/prodserv/custom_solutions/pages/gms/business-sd.jsp).

14 Ibid.

15 Ibid.

16 David Floyer, "The Cost of Storage Array Migration in 2014," Wikibon, 2014.

17 David Merrill et. al., "Reduce Costs and Risks for Data Migrations," HDS White Paper, 2012 (https://www.hds.com/assets/pdf/reduce-costs-and-risks-for-data-migrations-whitepaper.pdf).

- **Relative cost of a private cloud implementation:** Again, this is a very difficult cost to estimate as it includes not only implementation but also consolidation of IT silos into the private cloud. A study by the consulting firm CEB (formerly Corporate Executive Board) indicates that the cost to migrate a legacy application to a public cloud environment equals its operational costs for approximately 3.5 years.[18] Based on interviews with over 400 organizations adopting private cloud over the last two years, IDC calculates a migration cost as typically 2.26 times annual operation costs.[19]

  This is a five-year model and one of its advantages is that applications can be converted one at a time; hence, it is reasonable to assume a relatively constant conversion. A premium conversion range of 45 percent to 70 percent is used per year and can be obtained by using 2.26/5 years and then using 3.5/5 years. To be conservative, this model set the private cloud installation and integration at 170 percent of the cost of the baseline installation and integration labor costs for the legacy environment.

- **Relative cost of a new platform, overlay and management components:** This is a very difficult estimate as it will vary considerably from enterprise to enterprise. For example, an enterprise that already has initiatives in cloud and OpenSource software will have dramatically lower costs than one embarking on a private cloud journey from scratch. No studies were found that assessed the cost of migrating the overall platform, implementing the overlay, and upgrading the management environment. To be conservative, the same ratio as for installation and integration (70 percent) was used in the analysis.

- **Baseline support cost:** The support cost aggregates two major cost categories: 1) what the enterprise pays vendors for support of their products; and 2) the total cost of the enterprise support team, such as salaries, test lab and equipment. Most legacy enterprise support from vendors is around 20 percent to 25 percent of the software license cost.[20] However, looking at the total annual aggregate support cost, Accenture estimates this to be 55 percent to 60 percent of the license cost.[21] To create a conservative and reasonable estimate, the model assumes an aggregate support cost of 50 percent of the total OPEX budget. At a CAPEX/OPEX ratio of 20/80 (adjustable as stated above), this yields an aggregate support cost of 40 percent of the total budget.

18 Mark Tonsetic, "How to Explain Cloud Migration Costs to the CFO," CEB Blog, 2015 (https://www.cebglobal.com/blogs/how-to-explain-cloud-migration-costs-to-the-cfo/).

19 IDC Custom Solutions, 2016 (http://www.idc.com/prodserv/custom_solutions/pages/gms/business-sd.jsp).

20 Robert L. Mitchell, "Buried in software licensing," 2013 (http://www.computerworld.com/article/2483516/enterprise-applications/buried-in-software-licensing.html).

21 Accenture, 2014 (https://www.accenture.com/t20150523T024819__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_2/Accenture-How-Software-Maintenance-Fees-are-Siphoning-IT-Budget-Procurement-BPO.pdf).

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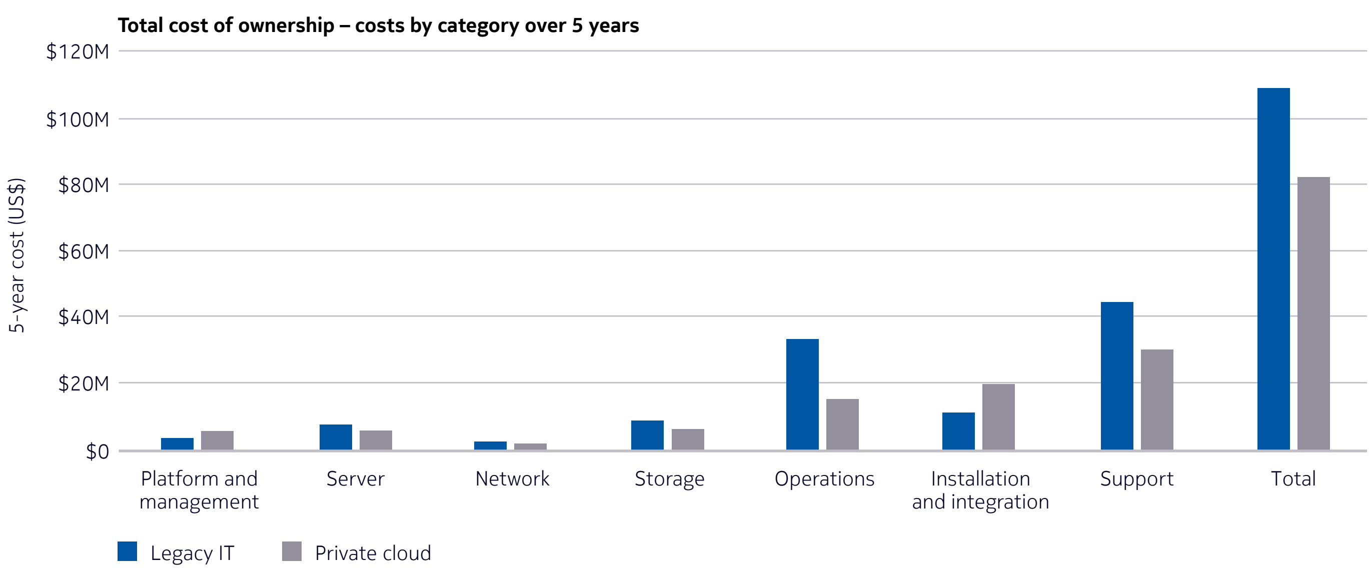
In summary, these rules of thumb are applicable and relevant to large enterprises, even those with special needs and requirements such as financial services and healthcare. Moreover, it is likely that most organizations will be able to reduce the private cloud costs for their migration by following a best practices blueprint and/or utilizing consultants that are familiar with private cloud approaches.

Model results

Taking the above assumptions and constants into account, the CAPEX and OPEX costs by subcategory and by year for five years was then calculated and put into a graph. To simplify the analysis, the time value of money was not factored.

Figure 1. Comparing the total costs by category of legacy IT with the new private cloud environment



From a CAPEX perspective, the net effect of leveraging open source software and commodity hardware decreases costs over the legacy scenario. This decrease comes at a price with much higher OPEX-related initial installation and integration costs to build the private cloud. Once built, however, the other OPEX costs—operations and support—are on the average less than the corresponding legacy costs.

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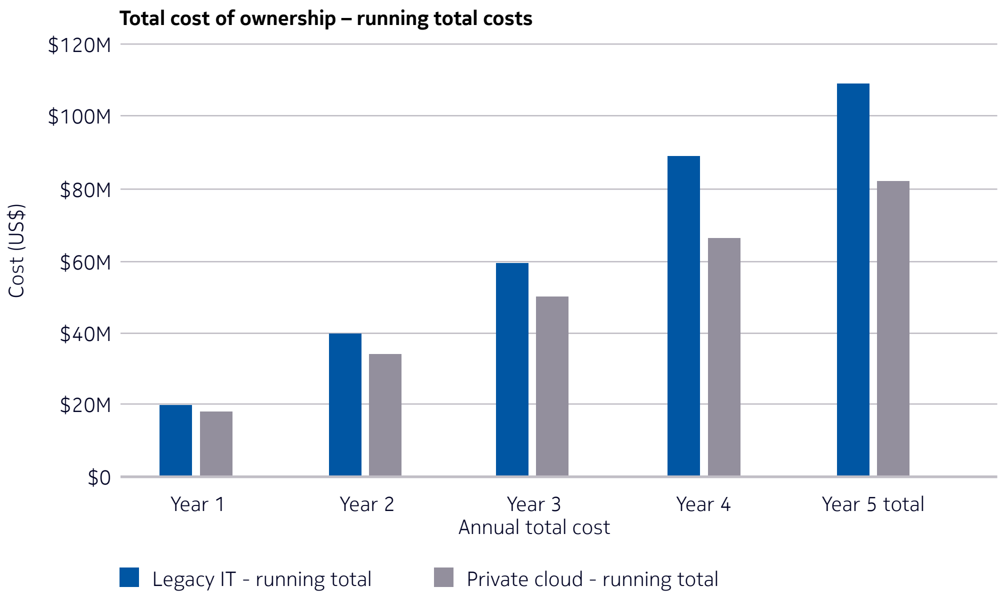
Figure 2. Comparing the total costs by year of legacy IT with the new private cloud environment



In Figure 2 the running total costs illustrate when the upfront private cloud investment can be justified overall and when the upfront installation and integration costs are recovered. Based on this model, the private cloud begins to be less expensive by the end of Year 1 and then much less expensive as overall costs decline and the legacy environment undergoes a forklift upgrade in Year 4.

From an overall perspective, the five-year TCO of the private cloud is 25 percent lower than that of the legacy environment. This is a strong financial return, even without attempting to estimate the more critical business advantages of a private cloud approach.

While the primary purpose of this white paper is to assess TCO, a discounted return on investment (ROI) of 138 percent was also calculated. The break-even period was 31 months. This break-even is well within the three-year investment cycle often employed at enterprises with a high reliance on technology investments as part of their core business.

Sensitivity analysis

As this paper proposes a TCO for cloud that is applicable across a wide range of environments, it is useful to explore the bounds of the analysis. Overall, the sensitivity of the model is low:

- **Technical risk of migration:** The ability to migrate a portion of the network and the data center gradually reduces migration risk significantly. However, as discussed above, many large enterprises cannot plan on a complete conversion to a private cloud. The primary factor is that some applications cannot easily, if ever, be converted to a cloud environment. Yet, because the envisioned cloud environment is able to virtualize bare metal applications, cloud benefits can be realized without migrating these applications. As a result, the technical risk of migration is reduced substantially.

- **Scale:** At its heart, the model is built leveraging simple ratios. As a result, a larger budget will still display the same relationship among costs, making sensitivity to scale very low.
- **Cost allocations:** Of all the assumptions, the items most likely to vary among environments are the percentages of costs for each CAPEX category (platform and management versus server versus network versus storage). Nonetheless, these are essentially treated the same in the model from a calculations perspective as different costs in CAPEX categories will not significantly impact results.
- **Support cost savings:** This variable is fairly sensitive as it is a very high percentage of the overall cost of the data center. A significant change in the overall support cost or the potential savings can impact the financial savings considerably.
- **Commodity hardware:** This model assumes that around 25 percent of server, network, and storage can utilize commodity hardware. If this assumption is not applicable, then the reduction is around 1 percent of the five-year TCO for each category.
- **Labor savings:** Based on a detailed study from Nokia Bell Labs, operations labor savings are estimated to be 50 percent. If the impact is negated, then a cost reduction for private cloud is in Year 3 with an overall TCO reduction of 17 percent. The model is moderately sensitive to this factor, but the strength of the labor savings figure is very high. Hence overall, sensitivity is low.

This issue is sensitive from a real world rather than a financial perspective. As with any project that forecasts increased productivity, the key question is: how do labor savings actually impact costs if the enterprise prudently retains all of their valued IT team? Here is where the study design becomes helpful. As the labor savings are relative to the legacy alternative, overall costs for the cloud can be calculated independent of a reduction in head count. For example, if each member of the cloud team becomes 50 percent more efficient then their time can be utilized elsewhere—and billed to another cost center in the enterprise. In this manner, private cloud costs are reduced even though actual head count may not be impacted.

Summary

This analysis began with an existing budget for a representative, relatively steady growth and legacy IT environment. By leveraging an existing budget and focusing on the net changes required to make it cloud-enabled, the model made analysis relatively straightforward yet fully relevant at the same time. The model was validated by IDC so the analysis is consistent with literally hundreds of enterprises that have already migrated to the cloud. In summary, the model is expected to be completely applicable to most large enterprises that are envisioning a move from a legacy approach to private cloud architecture.

In summary, based on this analysis, most large enterprises can cost effectively begin their private cloud implementation today.

Assessing model fit for your large enterprise

Some enterprise IT organizations have a mandate to minimize OPEX both in the short and long term. For these organizations, the overall implementation and integration costs are likely to be a hurdle. As a result, this model, while applicable, may require special planning and exceptions prior to break-even (for example, for Years 1 and 2).

The majority of enterprise IT organizations are taking a balanced approach to CAPEX and OPEX. Increases in one cost category that will drop overall costs are acceptable, especially when the ultimate outcome also provides superior business and technical capabilities. For these enterprises, cloud teams can easily apply this model to their environment by simply adjusting the base budget to their operating budget.

Furthermore, the biggest single cost of this cloud model—installation and integration—is set to a higher figure. As discussed earlier, the purpose of this pricing is to ensure the model's applicability to enterprise verticals such as finance where there are additional performance and security requirements, and healthcare where there are a number of special purpose appliances and devices that need to be integrated into the cloud. For enterprises without such special compliance and integration needs, the installation and integration cost figures can be specified more precisely and probably appreciably reduced. In addition, the cost implicitly assumes that the organization's IT staff will perform the work. A systems integrator that is expert with either or both OpenStack and CloudStack would probably minimize cost as well as decrease project risk.

Significant OPEX reductions occur by the end of Year 2. This is primarily the result of cloud efficiencies (especially those from SDN automation) and reduced support costs due to the use of open source software approaches. Over time, the use of commodity hardware to replace legacy gear also contributes to an overall TCO reduction of 25 percent over five years and a payback period within three years. In short, these results should fit the investment guidelines for most large enterprises.

Large enterprise-grade private clouds can be built today using off-the-shelf components. For most organizations having a five-year TCO reduction of 25 percent and less than a three-year break-even for a conservative scenario, the minimum criteria of financial return should be achieved. Most large enterprises can cost effectively begin their private cloud implementation today.

For an analysis that is tailored to your unique data center environment and vision for the cloud, contact your Nokia account or Nokia channel partner team.

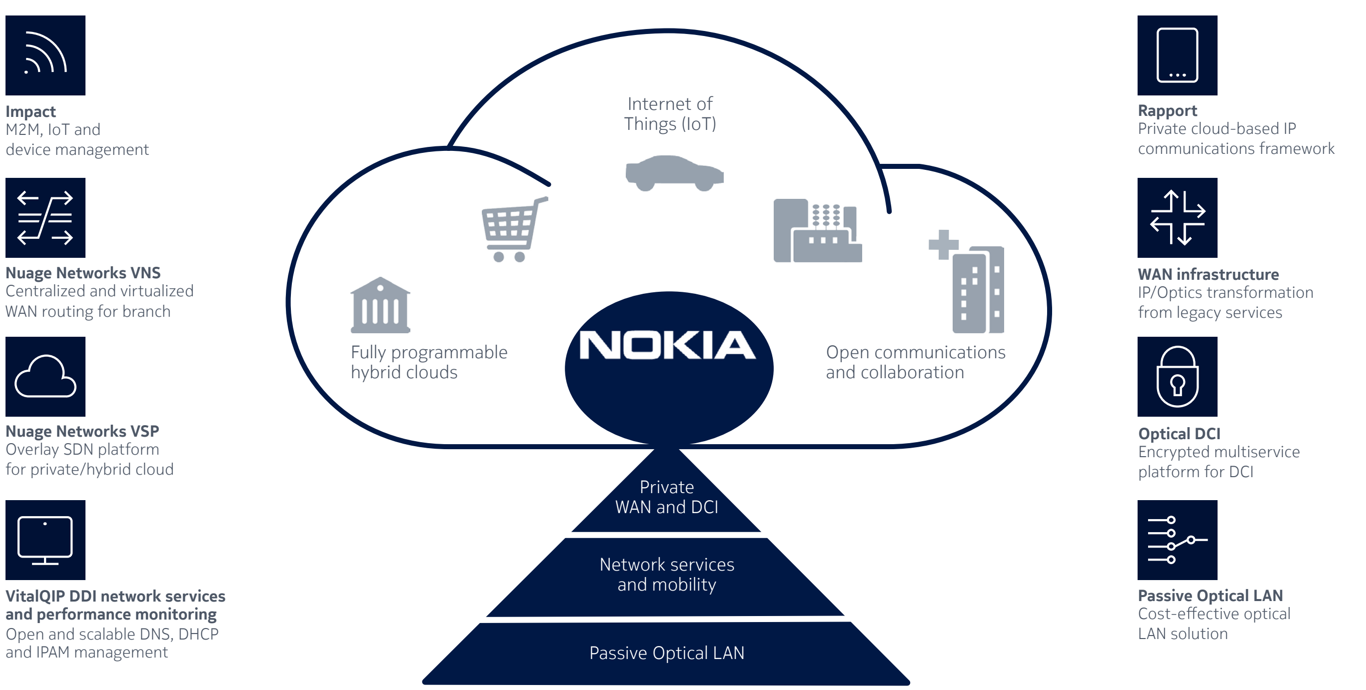
Nokia in the enterprise

What we bring to the enterprise

Nokia's success with telephone companies and mobile operators globally can overshadow its success with large enterprises. In fact, Nokia enjoys the privilege of working with half of the Forbes global top 50 enterprises.

As shown below, Nokia provides the fundamental infrastructure components needed to build a variety of robust cloud architectures that support a diverse set of enterprise applications and platforms. Building on a foundation of Passive Optical LAN (POL) components and a broad array of network services and IP routing and optical transport hardware, a scalable, reliable and secure private-hybrid cloud can be constructed.

Figure 3. Private-hydrid clouds for the global enterprise



Layering in the capabilities of SDN and software-defined WAN (SD-WAN) and DDI network services yields the ability to create fully programmable hybrid clouds. Adding in an IP communications framework removes silos and vendor lock-in for open communications and collaboration across the organization. Finally, with an Internet of Things and device management platform, true IoT clouds can be built.

While these capabilities apply to all large enterprises, Nokia is focusing on a few key verticals to accelerate its success. Currently, financial services, healthcare, automotive and retail are verticals that are widely benefiting from Nokia's products.

Acronyms

AWS	Amazon web services
CAPEX	capital expenditures
CRM	customer relationship management
DCI	Data Center Interconnect
DDI	DNS/DHCP/IPAM
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
HDS	Hitachi Data Systems
IDC	International Data Corporation
IoT	Internet of Things
IP	Internet Protocol
IPAM	Internet Protocol Address Management
LAN	local area network
M2M	machine to machine
OPEX	operating expense
ROI	return on investment
SDN	software-defined networking
TCO	total cost of ownership
VM	virtual machine
VNS	Virtualized Network Services
VSP	Virtualized Services Platform
WAN	wide area network

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