GUIDE

DATA CENTER MODERNIZATION VS. COLOCATION

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INTRODUCTION

Information technology leaders today must continuously evaluate how to deliver services to their users with speed and reliability. The complexity in that service delivery model has grown exponentially and continues to evolve rapidly with the development of the Internet of Things (IoT). At the core of service delivery for any information technology (IT) department is their data center; the investments made in the hardware, software, physical infrastructure, security, location, and ongoing operational policies in their data center all have a significant impact on the quality and responsiveness of service delivery to their users.

Thoughtful placement of computing workloads is a critical strategy to enabling responsive service delivery to users[1], and many organizations have adopted public cloud as a component of their portfolio. While early public cloud predictions prophesized the demise of the on-premise data center, both industry experts and owners now agree that a hybrid strategy that balances cloud and on-premise infrastructure is critical for success in today's environment.

Because of the pace and scale that IT teams work at today, decisions surrounding their data center can be difficult, especially in regard to retaining data center infrastructure on-premise vs. outsourcing to a colocation facility. Successful evaluation of these two options considers:

- An organization's technology profile
- Modernization costs to upgrade the existing on-premise data center and the associated savings/ benefits
- Colocation cost, including rental, remote hands, connectivity, migration cost, and more
- Latency for application and service delivery to users
- Uptime and reliability

This guide intends to help information technology leaders understand the factors to consider when evaluating the modernization of on-premise data centers as compared to outsourcing to a colocation facility. Both options have the potential to offer significant benefits when planned, designed, and executed correctly. An organization's successful decision process should include a complete analysis on how to properly evaluate the benefits and risks of both options.

1. Optimizing Placement of Computing Workloads, LEDG 2019.

EVALUATING COLOCATION FACILITIES

The colocation data center market expects to grow at 14% CAGR between 2019 and 2026. Most organizations interested in considering colocation space should have options to compare, while organizations in metropolitan areas will have several available facilities to review. The growth of colocation illustrates the easy part of a colocation evaluation for IT organizations: space. However, the challenge for most organizations is in evaluating different colocation providers, their offerings, and the true cost of migrating to an outsourced facility. The quality of information you get from a colocation facility will be dictated by how thoroughly you prepare for the inquiry process. A basic list of information to prepare in advance of a pricing inquiry includes:

1. Quantity of cabinets – day one and projected growth
2. Density per cabinet (kW per rack)
3. Audit and compliance requirements
4. Need for remote hands
5. Connectivity requirements - Cross connects, cloud on-ramps
6. Latency requirements of critical applications
7. Contract term requirements (length, SLA for uptime, etc.)

DID YOU KNOW?

Most organizations today have latency requirements for critical applications. For example, in healthcare the latency of the Electronic Health Record (EHR) system is a critical metric for successful use of the application and is typically measured in milliseconds. When moving a data center offsite, latency has the potential to increase and should be considered as part of the decision-making process.

Understanding Costs

Costs for colocation facilities typically divide into two categories: Monthly Recurring Costs (MRC) and Non-Recurring Costs (NRC). An evaluation of both cost categories, as well as institutional costs of migrating to a colocation facility, are essential to accurately calculate the expense of moving your data center to colocation.

Calculating the cost per cabinet MRC at a colocation facility is typically transparent and often includes the power and cooling needed to support that cabinet. Colocation facilities will often have different MRC charges based on the density profile of the cabinet, with the MRC increasing for higher density equipment. Many owners focus their cost evaluation on the cost per cabinet MRC, but it is important to evaluate all MRC and NRC fees to develop a full cost perspective. Example cost components of a colocation rental agreement and associated migration include:

Remote Hands

The utilization of onsite technicians for hands-on support of your equipment, or remote hands, is important when your data center is offsite. Remote hands work can include cabling and wiring, racking and stacking, inventory auditing, tape swapping in storage devices, and other options. The work is billed hourly or contracted per 'bundle' of hours. A bundle could be as little as two hours per month to as much as 10 hours per month. At $150 per hour, this service increases the monthly cost up to $1,500 or more depending on the size of the environment.

Connectivity

It is critical that an organization thoroughly evaluate connectivity costs when developing a financial model for colocation facility expenses. Each telecommunications provider that you need to connect to at the colocation facility will require a monthly cross-connect fee (MRC) of $100-$250. This basic connectivity can be simple, but additional requirements of cloud connections can escalate this cost quickly.

For example, if you need a direct connection to Amazon Web Services (AWS), you first need to evaluate if your colocation provider has the direct-connect, or cloud on-ramp, in their facility. If they do not, you will first pay a cross-connect fee in your colocation facility so you can connect to a separate facility that has the AWS direct-connect. To make the connection and enable data transport between your colocation facility and the AWS direct-connect location, you could require a 10Gb metropolitan area network connection. At the AWS direct-connect location, charges include a cross-connect fee (MRC) for both the meet-me-room (connecting you from the metro connection to the colocation facility) and a second cross-connect (MRC) fee to connect to AWS. Potential costs associated with your cloud on-ramp connections can be summarized below in Figure 1.

Build Out Costs

The build-out of your space in a colocation facility can be a considerable expense and will vary based on your provider and your preferences. For example, some colocation provides lease raw whitespace with available power and cooling. Your organization will be responsible for all costs to build out the whitespace to your preferences, including the procurement of cabinets, containment, power distribution, structured cabling, security, and more.

Certain colocation providers will offer to build out this space on your behalf and charge the cost back to you over the lifecycle of your lease. However, with the trend toward shorter lease contracts in colocation facilities, this is not typically attractive for owners.

FIGURE 1

Location	Purpose	MRC
Your Colocation Facility	Cross connection to two network providers	$500
Your Colocation Facility	Cross connection to 10Gb metro network	$250
Your Colocation Facility	10Gb metro network connection to AWS direct-connect facility	$3,000
AWS Direct-Connect Colocation	Cross connect from 10Gb metro network at meet-me-room	$250
AWS Direct-Connect Colocation	Cross connect to AWS	$250
	Total Monthly Recurring Charge	**$4,250**

Swing Equipment

Moving to a colocation facility requires complex migration planning. Your existing data center needs to remain operational while the new data center in the colocation facility is built out, brought online, and tested. To minimize the disruption of moving systems and applications, most organizations procure swing equipment for the colocation facility. Swing equipment enables some or all of your data center environment to be replicated at the colocation site and run in parallel with your current facility. Swing equipment typically includes networking, storage, and computing and, once tested and validated, allows your organization to steadily migrate workloads to the colocation facility without a dramatic 'lift and shift' effort.

Organizations evaluating the financial impact of moving to a colocation facility need to include swing equipment into their cost model, as the equipment is procured before the current data center shuts down in order to enable an efficient migration between the two facilities.

Move Costs

While swing equipment is part of your new IT environment, most organizations still choose to physically move a portion of their IT assets from the current data center to the colocation facility. To minimize operational risks, owners often move current assets during multiple off-hours segments. The criticality of data center equipment requires that specialized resources are engaged to support these move efforts. To correctly represent these costs, an organization should consider:

1. Moving/transportation cost (transportation, logistics planning, etc.)
2. Overtime costs for staff to support off-hours moves
3. Remote hands (see above) if relying on colocation facility for rack and stack
4. Insurance costs associated with moving IT assets

DID YOU KNOW?

Few organizations have on-staff resources to lead the planning and migration efforts for an on-premise data center to a colocation facility. These resources need to oversee the physical infrastructure requirements (power, cooling, structured cabling, security, etc.) with the colocation provider and the organization's technology migration requirements. Companies that leverage their internal staff for this complex, time-consuming planning effort risk overburdening their team members with the combination of their day-to-day responsibilities and the migration planning. If moving to a colocation facility, consider engaging a third-party resource that has experience in colocation migration to help facilitate the effort.

EVALUATING THE MODERNIZATION OF DATA CENTERS

Many experts predicted that the growth of the public cloud signified the end of the on-premise data center. However, while public cloud spending is increasing, **data center spending is not decreasing**, illustrating the value companies are still placing on on-premise infrastructure. In a recent survey, **over 60% of data center operators planned modernization projects for their on-premise data centers in the coming year**.

Technologies like virtualization and hyperconvergence and adoption of public cloud for a portion of computing workloads have reduced the physical footprint of many on-premise data centers. This footprint reduction leaves data centers overprovisioned; they have more physical space than they require for their IT rack footprint. However, the IT equipment associated with virtualization or hyperconverged infrastructure introduces a different density profile into a data center environment. Most legacy data centers currently support lower density (less than 5kW per rack) workloads. Modern computing comes with higher density, power, and cooling needs leaving organizations with a challenge – they have plenty of square footage in their data center, but their current physical infrastructure (power, cooling) cannot meet the demands of their IT equipment. Many organizations look to colocation facilities as a solution. However, organizations should consider modernizing the existing data center, especially since many overestimate the cost of doing so.

When considering modernization, organizations should begin by identifying two characteristics of their data center: stranded capacity and technology consolidation.

Stranded Capacity

To determine if your data center has stranded capacity, calculate the total IT load (measured either at the rack PDU level or at the output of the UPS) as compared to the total capacity of critical infrastructure (power, cooling). In a legacy data center, the capacity of critical infrastructure can be several times greater than the IT load, indicating stranded capacity.

For example, if the original design for your data center was 500kW with N+1 redundancy, you will have two 500kW UPS systems and six or more 30-ton perimeter CRAC units that distribute air through a raised floor plenum. If your current IT load is 250kW or 50% of your design condition, you have an over-provisioning of power and cooling in your data center.

To provide cooling in an N+1 configuration to an IT load of 250kW, a data center should theoretically only require 4 (four) 30-ton CRAC units. In most legacy data centers, inefficiencies in airflow management and challenges supporting high-density heat loads have led data center operators to over-cool their space. In other words, most data center operators in this situation are still running all six CRAC units, wasting energy and increasing maintenance costs.

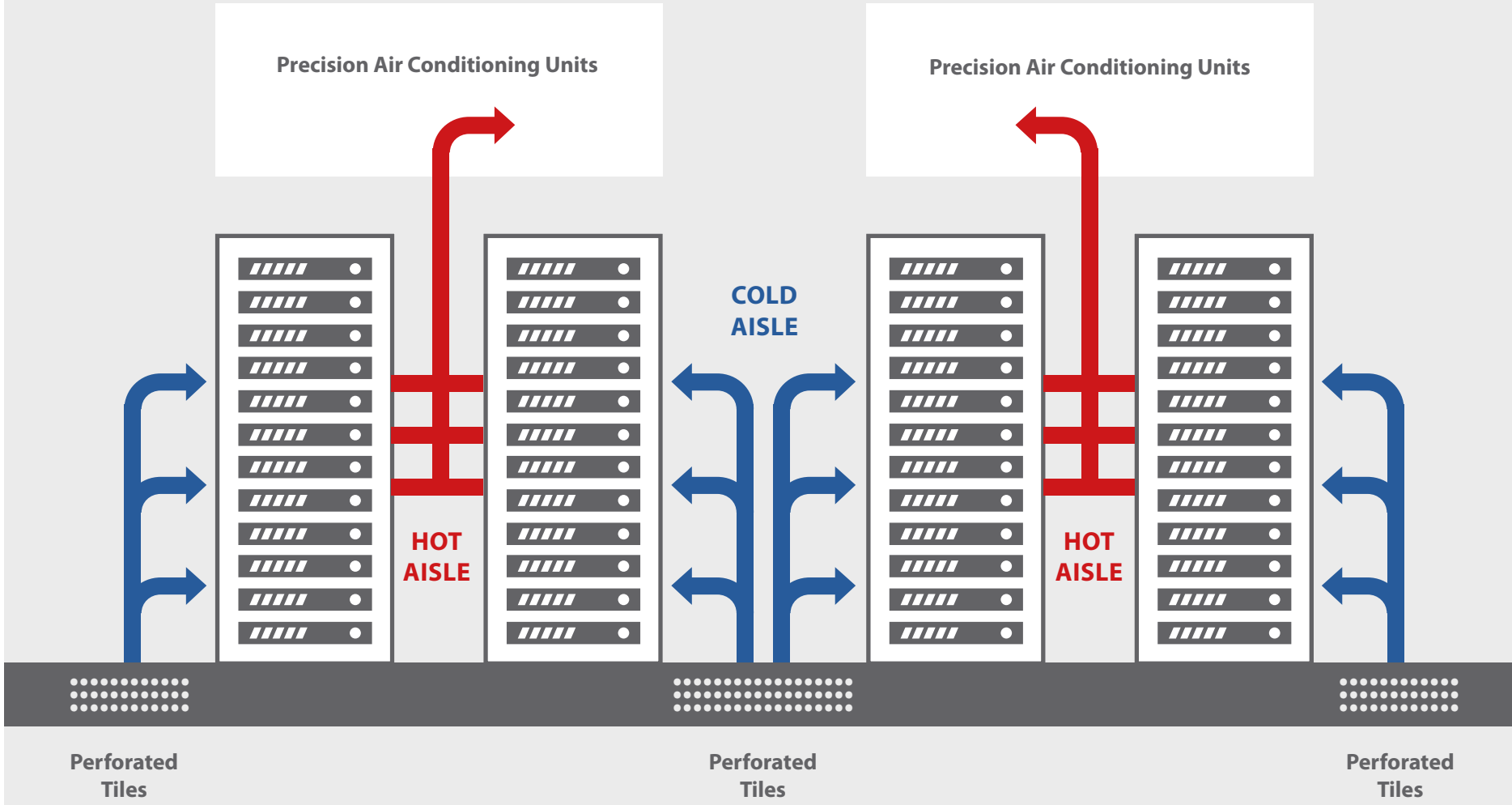
Technology Consolidation

Data centers over five years old have experienced a dramatic change in technology deployed in the environment. Virtualization and flash storage technologies have both become pervasive in today's data center, decreasing the required footprint for computing and storage environments. When determining if your data center is a candidate for modernization, understanding the current and expected state of technology consolidation is critical. With each consolidation project, the total rack footprint of the data center can decrease, which frees up available whitespace for modernized data center infrastructure. However, because legacy cooling architectures – like perimeter, downflow CRAC units with flooded returns – are not designed to support high-density workloads, data center operators can't take advantage of the space reduction gained through technology consolidation. Instead, they spread the technology out between multiple racks to minimize the density per rack or over-supply cooling to cover hot spots.

In an optimized data center environment, technology does not need to be distributed to minimize density. Data center operators considering modernization should determine the total number of rack footprints that would be required if density and cooling constraints were not limiting factors. This provides the baseline for space allocation needs during modernization.

FIGURE 2

LEGACY DATA CENTER COOLING EXAMPLE



Modernization Strategies

An organization should assess each data center to determine its most effective modernization strategy. At a minimum, most legacy data centers will benefit from selective improvements to cooling, airflow management, and power distribution. For organizations with stranded capacity in their data centers, these upgrades are not a significant capital expenditure.

Cooling and Airflow Management

Providing effective cooling to higher density computing workloads requires a different strategy than the legacy data center example shown in figure 2. However, because rack footprints have decreased through virtualization and flash storage implementations, data centers that modernize their cooling systems can often decrease their total footprint while simultaneously improving their strategy.

In the previous example, a data center with 250kW of IT load is running six 30-ton CRAC units, or 630kW of cooling. Also, due to the limitations of the cooling system, racks have not been consolidated to limit the amount of heat load in a given rack footprint. If the data center limited rack density to 3.5kW per rack, this would require 72 IT equipment racks to support the 250kW of IT load. (250kW IT Load ÷ 3.5kW/rack).

A modernized cooling strategy - like in row cooling with hot aisle containment - would enable the data center to consolidate down to 25 racks at a density of 10kW per rack (250kW IT Load ÷ 10kW/rack). Using aisle containment is an industry best-practice for airflow management to effectively separate supply and return air streams in the data center. In row cooling locates the cool air supply and hot air return where needed at the server inlet and exhaust, respectively, minimizing fan energy required and maximizing the temperature of the return air at the cooling unit. A sample 24" wide chilled water in row cooling unit provides 50kW of cooling capacity when utilized in conjunction with hot aisle containment as show below in Figure 3.

FIGURE 3: SAMPLE CHILLED WATER IN ROW COOLING PERFORMANCE TABLE

Entering Chilled Water Temperature	Return Temperature	Chilled Water Delta T	Sensible Net Capacity
45°F	90°F Dry Bulb	12°F	51.2kW

Five in row cooling units outlined above would be required to support the 250kW of IT load. To create N+1 capacity, deploy six in row cooling units such that if a single cooling unit were to fail, the remaining five units could effectively maintain the environment within the ASHRAE TC9.9 recommended range.

Modernizing the cooling strategy significantly decreases the total square footage requirements of the IT equipment and associated cooling systems. In the legacy example, square footage allocation for IT equipment and cooling systems was:

Qty	System	Square Footage Each	Total
72	IT Equipment Racks	8.0sqft[1]	576 ft^2
6	30 Ton CRAC Units	33sqft[2]	198 ft^2
		Total	**774 ft^2**

1 – assumes 24" wide x 48" deep IT equipment rack
2 – assumes 132" wide x 36" deep CRAC unit

Note – the square footage allocation represents equipment dimensions only and not associated clearances for equipment installation and removal, maintenance, ADA compliance, etc.

In the modernized data center example, the square footage allocation for the same 250kW of density would be:

Qty	System	Square Footage Each	Total
25	IT Equipment Racks	8.0sqft1	200 ft^2
6	Chilled Water In Row Cooling	7sqft2	42 ft^2
		Total	**242 ft^2**

1 – assumes 24" wide x 48" deep IT equipment rack
2 – assumes 24" wide x 42" deep In Row Cooling Unit

Modernizing the cooling system in the data center requires three times less total gross square footage for IT equipment racks and cooling systems than a legacy data center. More importantly, it provides the ability to support higher rack densities required by today's virtualized systems and does so with the same N+1 redundancy as the original legacy design. By making selective investments in upgrading the cooling systems that are energy efficient and able to support modern computing workloads, the lifecycle of the data center extends by ten or more years.

Power Distribution

In legacy data center environments with a raised floor plenum, power was traditionally distributed under the floor to IT equipment racks. The challenge that many data centers face is that technology refresh cycles have required new branch circuits to be run from Power Distribution Units (PDUs) to IT racks to support modern computing, storage, and networking equipment. What was originally 30 Amp, Single Phase circuits to each rack have been replaced with 50 Amp or 60 Amp, Three Phase circuits required to support high-density equipment now installed in the same rack footprint.

When new circuits are installed under the floor to equipment racks, the legacy, unused power connections are not often removed. This creates congestion and complexity under the raised floor; the congestion creates air blockages for the perimeter CRAC system, and the generations of power cabling make it difficult for data center managers to understand which circuits are for which rack. In the data center environment where predictability is a key component to delivering system uptime, an unmanaged power distribution system presents a risk to data center reliability.

To support the rapid refresh cycles of modern IT equipment, data center operators today require flexibility in their power distribution system. A modernization effort that includes new IT equipment racks and cooling systems should also consider the implementation of overhead power distribution or overhead busway as shown in Figure 4. There are several advantages to installing power distribution overhead, including general accessibility, the ease of adding and removing circuits to support IT refresh and creating a more predictable distribution scheme for your ongoing operations. When designed and installed correctly, a strategy like overhead busway can further reduce the footprint requirements of the data center because it will not require any floor space.

FIGURE 4: OVERHEAD BUSWAY IN DATA CENTER EXAMPLE

Conclusion

Many data center owners today are faced with the difficult challenge of determining their strategy for the next ten or more years. The availability of colocation space is increasing, and the right facility can provide excellent reliability, security, and room for expansion. For owners considering colocation, it is essential to prepare thoroughly before your search process to ensure that you will be able to predict costs and latency for critical applications accurately. For owners with stranded capacity in their data center, a thoughtful modernization strategy can increase reliability, decrease data center footprint, and extend the lifecycle of the facility. Most owners overestimate the cost of modernization – if you are considering upgrades to your facility, leverage internal or external expertise to assess your existing infrastructure, your technology profile, and to develop a plan for upgrades without impact to operations.

ABOUT

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