GET THE MOST FROM YOUR HOST

BEST PRACTICES FOR MULTI TENANT DATA CENTER MIGRATION

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The purpose of this eBook is to help you gain an understanding of the physical infrastructure, design requirements and strategic considerations that must precede a successful multi tenant data center deployment. For all the advantages possible from a multi tenant data center migration, it's equally possible to realize negative results if these practices are not observed.

As a dedicated partner and trusted expert for networks all over the world, CommScope knows how to deploy multi tenant data center infrastructure right—and, unfortunately, we've seen more than once what can happen when it happens wrong. That's why we're putting this information in your hands right now—because your next multi tenant data center move is an important one.

For this reason, CommScope has teamed with data center industry expert Donough Roche from Datacentrs, Inc. and other industry leaders in our MTDC Advisory Board to offer this eBook, Get the Most from Your Host. This eBook addresses best practices in the eight stages of planning, designing, migration and Day Two operations of an enterprise's data center assets in an MTDC environment.

Explore the chapters below to learn more about best practices for each stage of developing a multi tenant data center.

1. Defining IT requirements
2. MTDC planning and what to ask for
3. Migration planning
4. Define scope/RFP to the MTDC
5. Designing a successful migration
6. Data center fit-outs and installation
7. Migration
8. Day 2 operations

BEST PRACTICE

1 Defining IT requirements

YOUR FIRST STAKEHOLDER DISCUSSION IS THE MOST CRITICAL

For a multi tenant data center (MTDC) migration to succeed, the first thing deployed isn't a server rack—it's a discussion about the enterprise's IT requirements. Depending on the kind of enterprise, this discussion may include any number of key stakeholders from within their own organization, including but not limited to the CIO, CTO, Data Privacy/Security office, data center manager, data center planner, data center engineers, facilities manager, IT manager, storage engineers or other roles connected to the daily operation and management of the enterprise's IT structure.

In addition to these internal stakeholders, successful execution of an MTDC migration must also include consultation with seasoned veterans in the MTDC space—often brought in from outside the enterprise since internal staff often lack up-to-date expertise in the opportunities and challenges that come with MTDC deployment. Together, they can complete a thorough and dependable profile of their IT requirements.

REQUIREMENTS TO CONSIDER

Here are some of the likely strategic and tactical considerations that should inform the enterprise's formulation of its IT requirements.

- **Current and future state of the data center.** This should include the current state of the data center—its load, scale, capabilities and cost structure—as well as the same values projected outward along a three- to five-year plan timeline. The future state should be estimated according to known and anticipated factors like organic growth in the business, the impacts of any M&A activity, consolidation efforts and so forth.
- **Network design requirements.** This includes how to physically integrate the enterprise's data center with the MTDC. Connectivity, bandwidth and latency requirements will often lead to a discussion of geographical location, which we explore in detail below.
- **Map to the MTDC's capabilities.** Based on the current and future state of the data center and its network design requirements, a request for information (RFI) should be issued to the MTDC under consideration and any capability or resource gaps between the two documents should be identified and addressed.

The first mistake you can make

One of the earliest stumbling blocks—and one of the most easily avoided—is the failure to include one or more stakeholders in initial IT requirements decisions, forcing latestage changes that add cost and delay to the migration.

Keep in mind that an MTDC migration is the beginning of along relationship. It's a process that most enterprises will do only once, and few will do more than a couple of times.

Chances are your enterprise has never done it before and therefore requires specialized insight from a consultant who understands and works with the challenges of MTDC migration every day.

REQUIREMENTS TO CONSIDER continued

- **Geographical location.** While physical distance continues to shrink as a limiting factor for offsite data center processing, it does still matter on several technical levels:
  - **Latency.** This is the "lag" time in response between remote servers. Lower latency means more responsive network connectivity, and many next-generationapplications require low latency in order to run at optimal levels. Among otherfactors, physical distance is an important part of measured latency between theMTDC and outside connections and provides diversity of desired connections.
  - **Connectivity.** Most MTDCs provide connectivity to multiple carriers, but it'simportant to know if the MTDC under consideration meets your particularcarrier's connectivity requirements, offers connectivity to them on premises.
  - **Access.** How your assets are stored and accessed impacts both management and security. Many enterprises will require a caged environment for their assets that prevents unauthorized access. At the same time, IT management staff must be able to access the racks when needed, which calls into play how far away the MTDC is from the enterprise's location, as well as the hours of access offered by the MTDC. Some offer limited regular hours for access, while others may provide 24/7 availability but charge a premium. The right balance will be determined by these IT requirements.
  - **Data sovereignty.** This is a regulatory question that relates to how different countries govern the handling of certain kinds of digital data. For example, some countries require that any data including personal information about that country's citizens must be stored on physical infrastructure located within that country.

- **Political stability.** A related issue is the political and regulatory variables that may exist in a particular jurisdiction. While this includes the stability of the country itself, it also includes less dramatic but equally important legal issues, such as energy or currency stability, among others.
- **Geophysical risk profile.** Determination must be made about the suitability (or potential unsuitability) of specific locations with regard to potential geophysical activity like earthquakes, volcanoes, flooding, extreme cold, extreme heat, tsunamis, etc.

IT requirements are the first, crucial step

With the inclusion of all IT requirements across all key stakeholders, we can now move to the next step in the process.

It's important to remember that the first asset put into play during a successful MTDC migration is the insight and expertise of the people who will make it happen.

In the next chapter, we will take a closer look at the planning required to ensure the enterprise's expectations for speed, capacity and economy are met—in good times and bad.

Dig into your IT requirements now—or you may end up digging into your real estate later

Knowing your IT requirements is important even if an MTDC migration isn't in your immediate future.

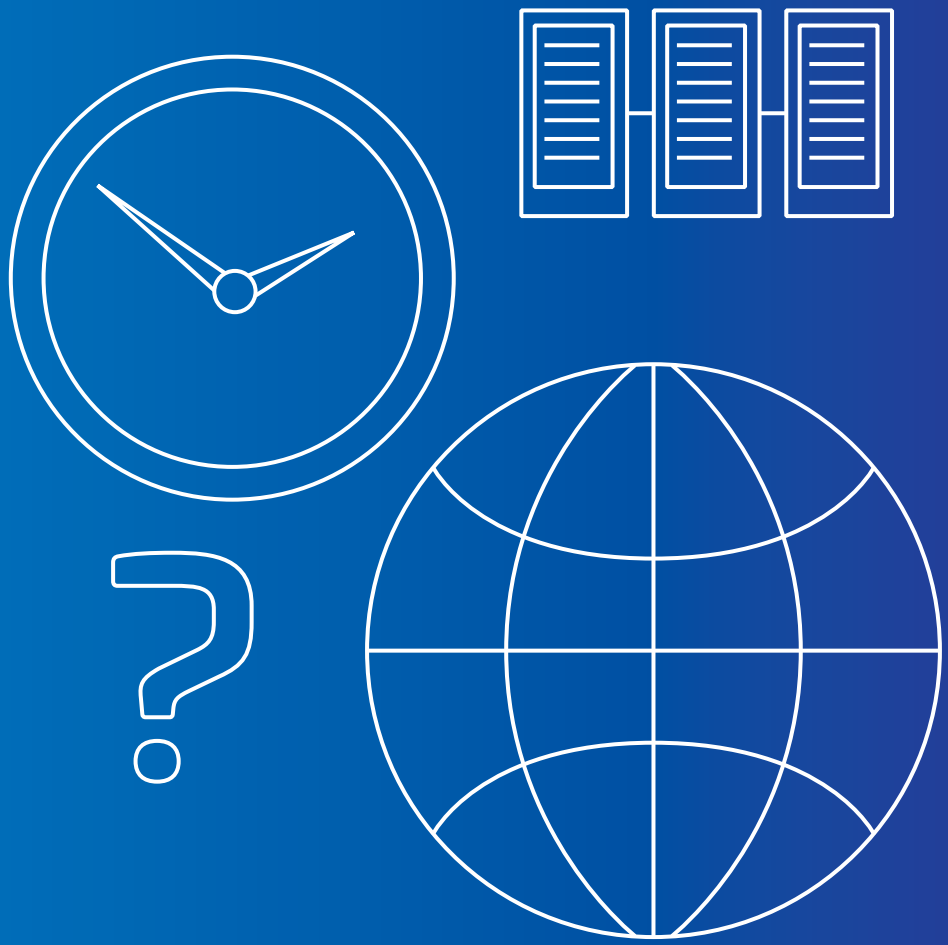
One enterprise that had moved into hosted space realized too late that they had seriously misjudged how much space they needed, and had no contiguous space to grow into. Additional space was available only in an adjacent hall, and they were strapped for fiber connectivity—and had no contiguous space to add it.

Worse, while the network core was in one building and their expansion in another, their existing physical connections were via buried conduit that had to be excavated and extended to reach the newly expanded area.

A better grasp of their initial IT requirements would have led them to pull a larger, highercapacity cable when it was installed, which would have cost very little extra. As it was, however, the only recourse was to spend five weeks ripping up the parking lot to lay the new fiber.

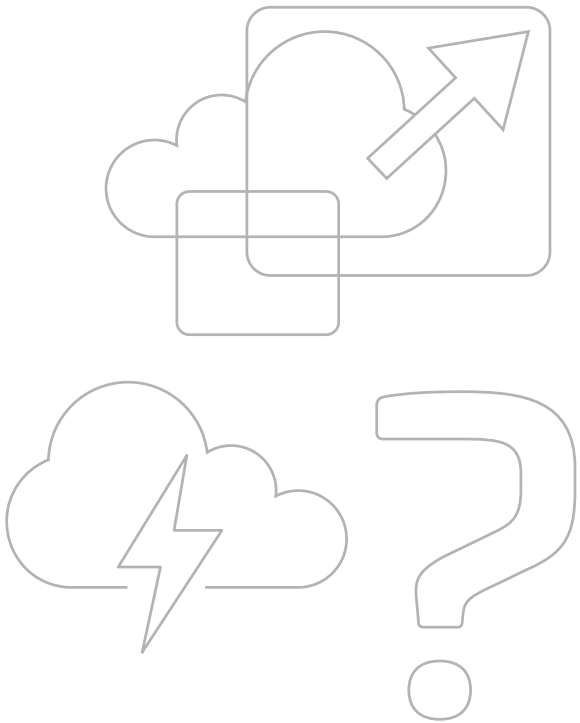
BEST PRACTICE

2 MTDC planning and what to ask for



YOU KNOW WHAT YOU NEED— NOW SEE HOW THE MTDC CAN PROVIDE IT

Beyond the strategic considerations of an enterprise's IT requirements, there are many business-critical tactical elements that come into play. Knowing your data center needs is the first step, but understanding how the multi tenant data center (MTDC) will meet those needs is just as important—and much more granular in its details. This discovery phase must involve the internal stakeholders as well as representatives from the MTDC under consideration, because it involves subjects that can have less-obvious but far-reaching impacts on every aspect of data center operations and the overall health of the enterprise.



THE QUESTIONS EVERY ENTERPRISE NEEDS TO ASK

In the planning phase, the enterprise's stakeholders need to know these particulars before moving ahead.

1. **What are the size, capacity, and expansion opportunities?** One of the main reasons enterprises migrate to MTDC environments is a lack of available onsite space and resources. Therefore, it's important to know about available square footage, power capacities, and the physical layout of the MTDC space the assets are to occupy. Is there room to expand? Does the MTDC allow for reconfiguration of halls or other parts of the structure to accommodate such expansion, if needed?

2. **What's the disaster plan?** No place is immune to disasters of one kind or another. The enterprise must learn about the MTDC's disaster recovery plan and decide if it is aligned with the enterprise's needs. What will the MTDC do if grid power fails or carrier connectivity is interrupted? How do the MTDC's disaster plans mesh with the enterprise's disaster recovery and business continuity planning?

3. Does the MTDC have, or plan to have, multiple locations? Larger enterprises that may be undergoing simultaneous migration in multiple markets, states or countries would be well advised to look at MTDC providers that can offer continuity of service levels across multiple locations. This is also a consideration for enterprises anticipating entry into new markets.

4. What about the ownership, capitalization and stability? MTDCs are thriving, dynamic environments. Global MTDC capacity is growing fast, but this also means M&A activity is typically high. The enterprise should gauge the prospective MTDC's likelihood of being part of an acquisition—and how that might affect existing contracts. This is of particular interest when considering a smaller MTDC.

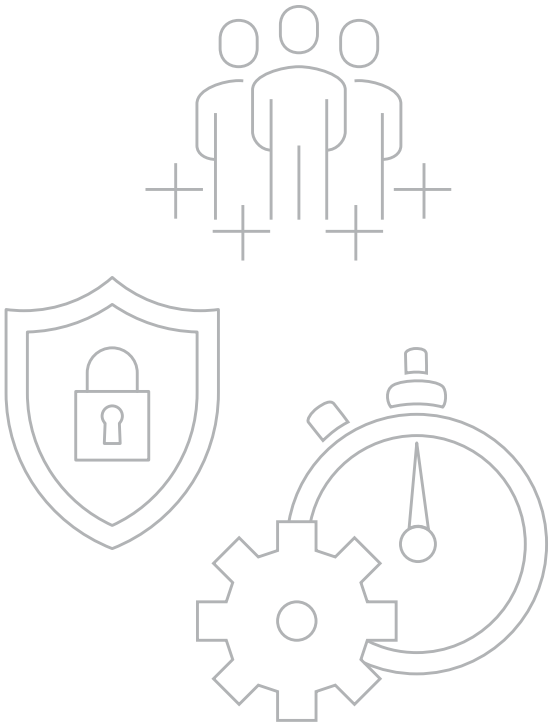
5. How do operational cost factors measure up? A large part of an enterprise's MTDC management budget is devoted to electrical power, which can be a highly variably priced commodity. There is also the question of connectivity costs to carriers, cloud providers, content delivery networks and so forth.

6. How long is the lease? Not long ago, 15-year lease terms were the norm in the MTDC space, which can be a daunting prospect for an enterprise undergoing its first migration. Fortunately, five-year (or shorter) leases are common now. When considering lease length, stakeholders should figure in their equipment refresh cycles and how they line up with the lease terms. It may provide a valuable option to move to another MTDC if the timing is right.

7. Is the MTDC as reliable as your own data center should be? The MTDC should be able to promise reliability and availability levels consistent with the enterprise's IT requirements—and provide documentation that proves it.

8. What are the staffing levels? The number and roles of those working onsite at an MTDC can vary widely. Depending on the IT requirements, an enterprise must find out if the MTDC under consideration offers sufficient staffing levels and appropriate functions, such as:

- **Operations staff:** Are they on duty 24/7?
- **Security:** Are there adequate staff, security measures and best practices in place to prevent unauthorized access of the enterprise's data center assets?
- **Remote hands:** Offsite help is to be expected, but what SLAs exist to guarantee remote hands' performance? Are they available for moves, adds and changes (MACs), as well as Day Two work, if needed?



9. Wholesale or retail? What type of space do you need? The biggest difference between wholesale and retail space in an MTDC is the size of the space and degree of infrastructure flexibility. In a wholesale arrangement, a single customer may rent several floors or even an entire building, whereas a retail space houses multiple smaller customers sharing a common core infrastructure. So, which is best for you?

Start by considering your compute/storage requirements. If you just need a few hundred off-the-shelf servers, retail is probably your better option. For a larger platform, the resources and customization services of a wholesaler may be a better fit.

Next, what type of connectivity do you need between the meet-me room and your space? Both environments support high-performance internal and external cross-connects, but wholesale allows more flexibility in terms of redundancy, fiber density and breakout options.

Finally, what are your power requirements? Most wholesale providers have a minimum requirement for power usage while retail facilities usually impose power limits to ensure there's enough for all customers.

Q&A MEANS BETTER LONG-TERM QA

When an enterprise decides to migrate its data center assets to an MTDC, it's not like any other vendor relationship. The enterprise is trusting its most valuable infrastructure to a new partner—one that works in an industry with which most enterprises are not very familiar.

Getting the right MTDC—in the right place, with the right SLA and at the right cost—can be a complex process. But the fact is that nothing less rigorous will do. MTDCs comprise a dynamic, changing market that is chasing new technologies and new efficiencies, making yesterday's assumptions unreliable.

In the next chapter, we'll see how the relationship moves ahead as the discovery phase gives way to the migration planning itself.

ASKING QUESTIONS NOW HELPS MAKE SURE YOU'RE NOT QUESTIONING YOUR DECISIONS LATER

Choosing an MTDC that can help manage power and rack space is critical.

Some enterprises continue to deploy standard 208/120V power distribution in the MTDC—which doesn't deliver enough power per receptacle to support higher power density environments like blade servers, cloud computing and virtualization. MTDCs that offer leading-edge solutions, like the option for 400/230V power distribution, can help their customers meet the challenges around higher power densities that exceed 10 kilowatts per rack.

Investing in a relationship that offers more flexibility in power distribution—even if that extra power isn't needed right away—can head off potentially expensive corrective measures.

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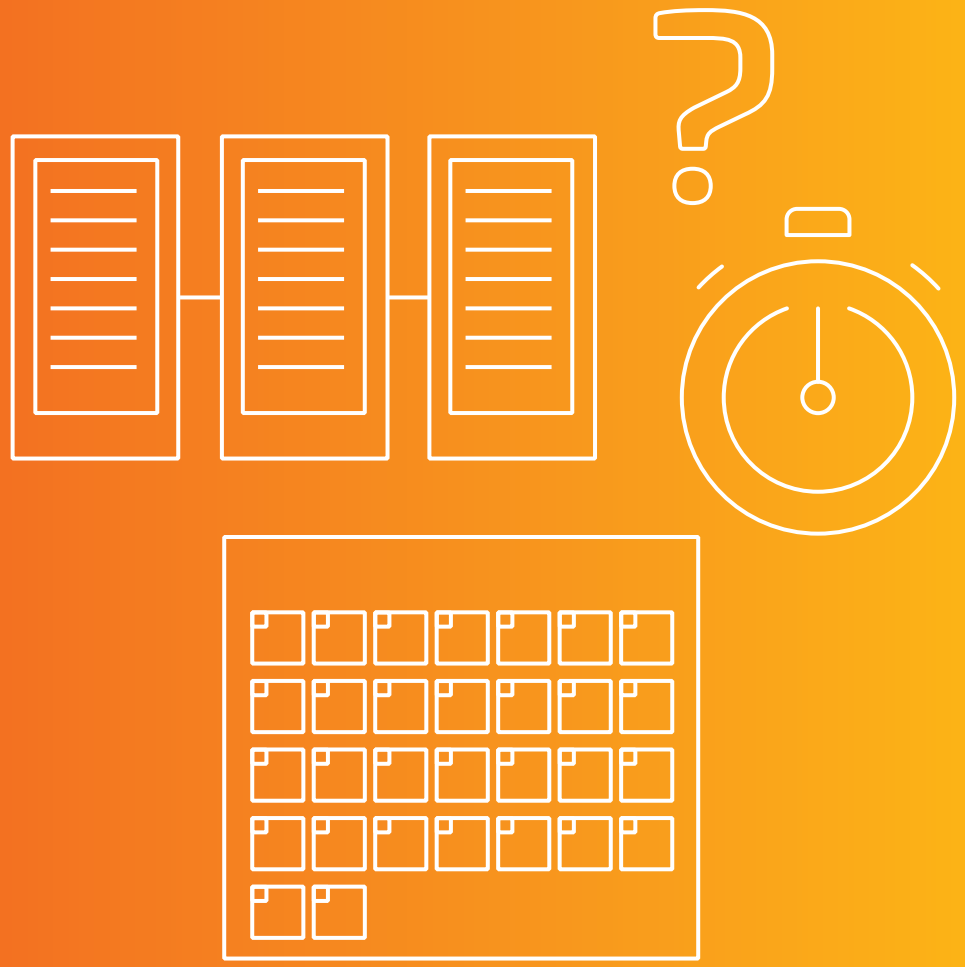
3

Migration planning



KNOW WHERE YOU'RE GOING BEFORE YOU START THE JOURNEY

Once key organizations and stakeholders have met to establish IT requirements—and basic research about the marketplace has been completed—it's time to move to the next phase of the process: migration planning. To create a smooth transition to a multi tenant data center (MTDC), investigating how the migration might take place is a critical step before sending out the actual request for proposal (RFP). It's important to know the scope of work and target completion dates before the project is started so as to anticipate any possible challenges before they occur.

AN IN-DEPTH LOOK AT MAKING THE MOVE

To make a successful move to a multi tenant data center, it's important for every detail to be considered and understood, and any gaps in coverage identified. If your company doesn't have the proper resources to complete this step, it is strongly recommended to utilize a well established external consultant that fully understands and has gone through this process.

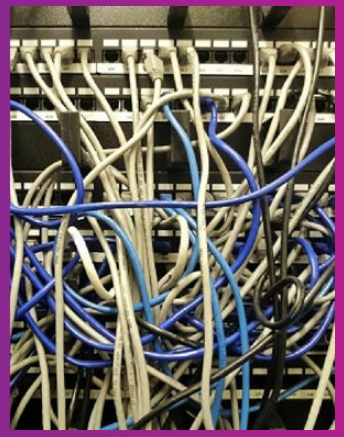
1. When must this migration be completed? Scheduling data center migrations requires coordination with ALL applications and lines of business stakeholders. Do you have a hard date as to when the migration must begin? Is there some critical event driving this date, such as the need to get out of a facility? Is there a contingency plan or rollback if the date is unachievable? Are there any upcoming IT freezes?
2. How long do you have to complete the migration? Some migrations can happen during a single planned event while others must be staggered over weeks. Are there firm dates for when the migration must be complete? Are existing service level agreements (SLAs) driving this?
3. What should move and what should be replaced? Just like moving your house, an inventory must be taken of what will move and what should be retired or scrapped. It may make more sense to replace equipment that is nearing the end of its life rather than move it to the multi tenant data center and then, have to replace it a few months later. While there are no hard-and-fast rules, hardware that is no longer under a service contract may be an ideal candidate for replacement.

Tales from the Trenches

In the movies, if a hero cuts the wrong wire, the bomb explodes and the bad guys win. It's no different in the data center. After all the migrations in which CommScope has been involved, we understand that the lack of knowing which cable goes where can be the biggest challenge. A well-documented structured cable solution can be invaluable in these situations. Trace and tag where a network is down hard is the worst-case scenario. The good news is it is completely preventable and the technologies are as abundant as ever.

It's 4 p.m. The conference bridge has 13 people on it. The call started at 10a.m. this morning. The network operations center, network engineering, sales engineering, provisioning and the end user—everyone is angry. Everyone is confused. And everyone is asking questions.

The poor IT guy on site tags and traces yet another cable. Why? Because there wasn't a structured cabling plan in place. There was no documentation. And the cage looks like the back of a dorm room Xbox hookup. You can spend a little time on the front planning and documenting a cable plant or you can spend as much time and money on the outages as it costs on the back end.



AN IN-DEPTH LOOK AT MAKING THE MOVE continued

4. What steps will be taken to ensure zero downtime during the migration? Often times network and system designs have built-in high-availability and redundant connections to stay online with enough bandwidth to "bridge the gap." Sometimes, failover is inevitable. Will there be parallel operations in place to ensure zero downtime with failover capability during the migration? Are business continuity plans in place for extended downtime or slower-than-expected throughput during the migration? Is there a rollback plan that includes coordination of hardware and software systems?
5. Is there a network set-up and testing plan to ensure that the migration will be successful? Has a test environment been set up—and is there a contingency and remediation plan in place in case difficulties are encountered? Specific issues such as connector contamination can sometimes derail an otherwise flawlessly executed migration. Do you have access to ALL test reports from the installation on hand to reference if troubleshooting is required?
6. Where will the new facility be in relation to the current data center? Depending on where the multi tenant data center will be located, making last-minute arrangements to visit the facility can be costly. Travel and shipping /logistics could involve anything from walking across the road to requiring air travel and freight. If the new facility is located far from the current data center, have the logistics of sending staff on-site been accounted for? Could the provider deliver on-site management if needed
7. Who will perform the actual migration? There are companies dedicated to the highly-specialized tasks of moving servers and storage. For complex and mission-critical moves, hiring a professional company that is familiar with the multi tenant data center is highly recommended.

Creating a blueprint for success

Giving serious thought to how the migration should be implemented— along with contingency plans on what to do if something goes awry— can be the difference between a successful move and a complete disaster.

In the next chapter, we will explore some of the details enterprises should consider before signing with a new multi tenant data center.

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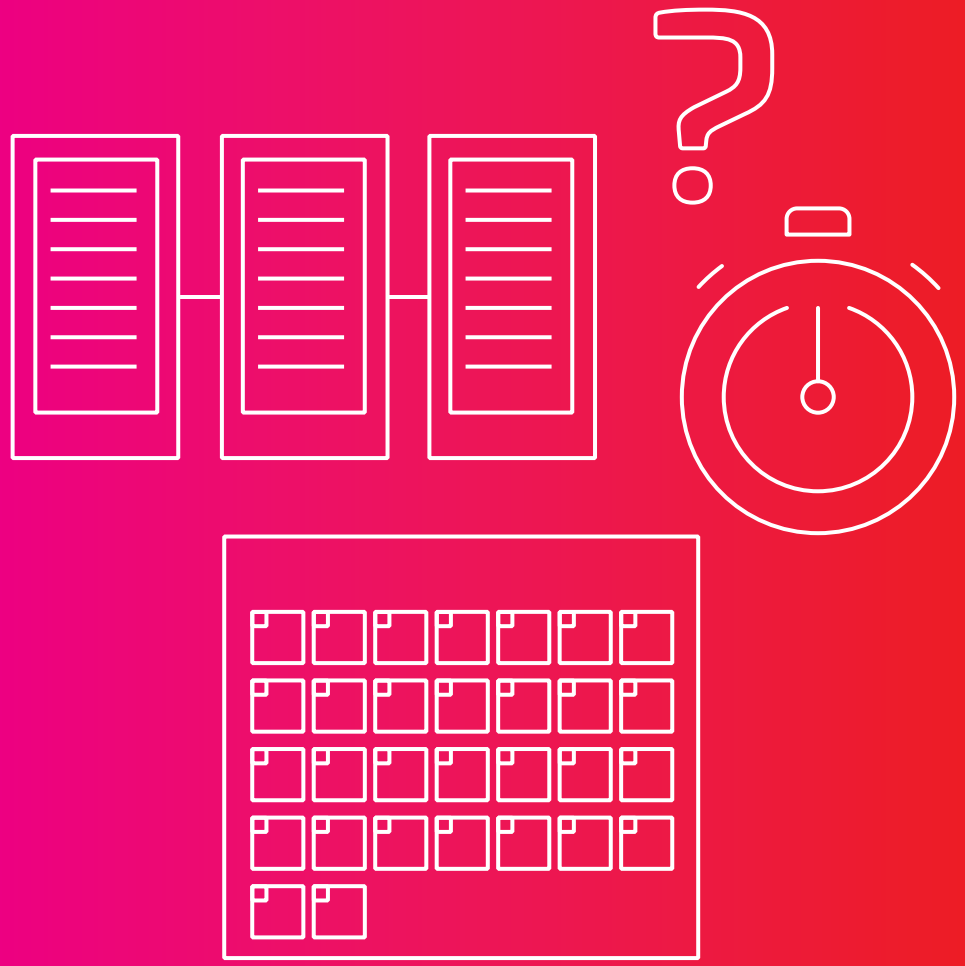
4 Define scope/RFP to the MTDC



DIVE INTO THE NITTY-GRITTY IN ORDER TO QUALIFY POTENTIAL MULTI TENANT DATA CENTERS

Once the scope and objectives of the migration planning have been defined, the next step is developing a request for proposal (RFP) to be submitted to the potential multi tenant data centers (MTDCs). While the financial terms of the contract are obviously very important, there are many other essential factors that must be taken into account. Based on the complexity and critical nature the following is a list of objectives that should be considered when developing an RFP to ensure that the needs of the new data center can be met today and in the future.

A THOROUGH REQUEST FOR PROPOSAL (RFP) CAN HELP YOU FIND THE MULTI TENANT DATA CENTER THAT BEST FITS WITH YOUR ENTERPRISE

The old saying that "there's no such thing as a stupid question" applies here. Be sure to include even the most basic or obvious questions to assure that any potential multi tenant data center can accommodate your needs such as:

1. **Capacity.** Can your future multi tenant data center comfortably provide adequate power and space for your existing data center? Based on your desired rack density, and your kW/ rack requirements, can the MTDC support it? Do they have a minimum load per rack? How about a maximum load, and does this fit with your requirements?
2. **Scalability.** While it's important to know if your future multi tenant data center can handle your current size and capacity, it's also essential to know if it can provide additional space and power if needed. How easy is it to add capacity as your needs grow? What is the increment for growth or moving if applications are offloaded to the cloud? Can you be guaranteed contiguous space? If not, where will the new cabinets be located?
3. **Network connectivity.** Does the multi tenant data center have enough network capacity, and requested cloud and carrier connections?

A THOROUGH REQUEST FOR PROPOSAL (RFP) CAN HELP YOU FIND THE MULTI TENANT DATA CENTER THAT BEST FITS WITH YOUR ENTERPRISE continued

4. **Services.** What types of services are available? Do you have access to remote hands? If not, is it possible to bring in your own Remote Hands service provider? Are there multiple providers allowed to do business in the building or are you restricted to the MTDC provider's services? Can you get test and validation services to ensure applications will run properly before migration? It is also important to identify which services are available to ensure future moves, adds and changes (MAC) can be properly implemented. What can be done by internal IT staff? What must be done by contractors or your company's IT personnel?
5. **Physical mechanical, electrical and plumbing (MEP) designs and reliability.** How are the power feeds and back-up generators configured? Does the facility have a redundancy scheme, such as (N, N+1, 2N, 2[N+1]), which are in line with your availability/uptime requirements? What is their typical planned and unplanned downtime? Are there restrictions or conditions on how you run your equipment? Is the facility truly dual-corded to the rack?
6. **Access to space.** Can you visit the facility 24/7 if needed? If not, how quickly can a site visit be scheduled?

A THOROUGH REQUEST FOR PROPOSAL (RFP) CAN HELP YOU FIND THE MULTI TENANT DATA CENTER THAT BEST FITS WITH YOUR ENTERPRISE continued

7. **Response time.** What is the maximum response time in your service level agreement (SLA)? Does it meet your minimum requirements? Are the response times reasonable and acceptable?
8. **Operations capabilities.** Do the available multi tenant data center services match your needs?
9. **Builds.** Does the multi tenant data center offer services for moves, adds and changes (MAC) to your network? If not, consider how to provide them. Should contractors be used? Will that cause problems or delays? Is there an additional management fee charged if you bring in your own MAC team?
10. **Meet-me rooms.** How is access to the meet-me room handled? What is the setup on primary versus secondary? Is there a third? Is the meet-me room "managed" or passive?
11. **Fiber connectivity.** How are these configured? Are redundant facilities and connections available in the event of a fiber cable cut?
12. **Compliance certifications.** What certifications have been obtained by the multi tenant data center? Do they meet your corporate requirements?

A THOROUGH REQUEST FOR PROPOSAL (RFP) CAN HELP YOU FIND THE MULTI TENANT DATA CENTER THAT BEST FITS WITH YOUR ENTERPRISE continued

13. **Staffing qualifications.** What is the certification process and training for IT and facilities staff? Is this adequate?

14. **Security procedures and staffing.** What are the access procedures and processes? What certification process and training are required for the security staff?

15. **Connectivity.** There are a number of connectivity considerations that should be examined. This range of external and internal communications include:

    - **Carriers –** Which carriers are co-located in the multi tenant data center?
    - **Cloud –** Which cloud providers are co-located in the multi tenant data center?
    - **WiFi –** Is this available from the cage?
    - **Cellular –** Is this available from the cage? Does the multi tenant data center have an in-building wireless (IBW) system in place to ensure mobile/cellular connectivity to all providers?
    - **Meet-me-room –** How is connectivity provided? Do they offer path diversity?
    - **Diversity –** Are diverse paths available throughout the facility from each carrier?
    - **Exchange availability –** Can connectivity be made available to a co-located global exchange if required?
    - **Finance/ads/peering –** How are connections made?
    - **Pathways and access spaces –** Are these pathways secure or open? Are there adequate pathways in place to support cabling infrastructure? Does the facility have available conduits for cage-to-cage connectivity if required? Are dedicated pathways available for your network or are they shared amongst others?

A THOROUGH REQUEST FOR PROPOSAL (RFP) CAN HELP YOU FIND THE MULTI TENANT DATA CENTER THAT BEST FITS WITH YOUR ENTERPRISE continued

16. **Electrical distribution method and voltage.** Are all voltage options available (e.g. 480/208/120V in North America and/or 400/230V outside of North America)? How is power distributed to the cage?
17. **Access to cage.** What are the current rules/guidelines for who has access to the cage? Do you agree with them? Do third-party contractors need to be on an approved list before being granted access? Are there any labor/union considerations?
18. **Metrics/reporting/remote views.** How are the activity, performance metrics and service level agreements (SLAs) reported? Can such reports be produced on demand?
19. **Service charges.** Are there additional charges for project management/ supervision/ access to cage when staff or contractors are on site? What activities trigger additional charges?
20. **Sustainability.** Are the multi tenant data center's sustainability objectives, commitments and metrics in line with your company's?
21. **Efficiency.** What metrics are used for power usage effectiveness (PUE), water usage efficiency (WUE) and other formal programs? How are these reported? What mechanisms are in place if these objectives are not met? Does the MTDC offer a PUE cap that limits your energy bill liability in the event the MTDC operates their facility inefficiently?

Spending more time prior to making a move can save valuable time down the road

The more questions asked before making a move can help substantially in a data center's long-term success.

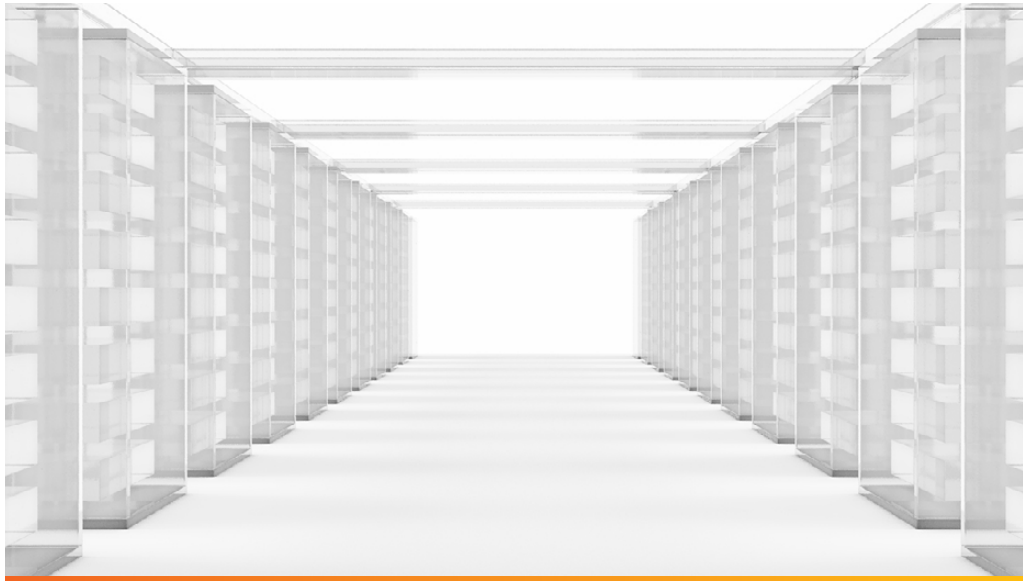
When one enterprise needed additional space for its data center, it moved its expansion into an adjacent building and connected the two cages using fiber cable. Unfortunately, the enterprise didn't consider what it would do if it needed to expand later on. By not planning for additional expansion, it wasn't long before the enterprise was out of capacity and needed more fiber connectivity.

To fix the issue, the company needed to tear up the parking lot between the two buildings and bury a new conduit system at a substantial cost, which also included a five-week delay for construction. Had the enterprise simply asked itself "what if" and had pulled a larger cable during the construction, it would have had sufficient fiber connectivity and a trouble-free data center expansion.

A THOROUGH REQUEST FOR PROPOSAL (RFP) CAN HELP YOU FIND THE MULTI TENANT DATA CENTER THAT BEST FITS WITH YOUR ENTERPRISE continued

22: Service level agreements (SLAs) What Service Level Agreements do you expect? Know what your equipment needs to operate and ensure that the SLAs being offered match your requirements, especially with respect to HVAC temperature/humidity fluctuation durations. Ensure that SLAs still apply during facility maintenance activities. Understand ifyour dual-corded equipment will be required to operate on a single cord during electrical maintenance. How many times per year? Is this acceptable to your operations?

23: Energy Costs: how is energy provided? Is it billed separately metered or is usage included in the rent amount? Typically retail colocation providers (smaller footprints) will charge an all-in price for rent that includes energy usage and any efficiency calculations. Larger wholesale MTDC are more likely to support the metered approach so that your energy bill is separate and based on actual usage plus measured PUE.



GET READY TO TAKE ACTION

Once the request for proposals (RFP) is complete, it's time to move to the next stages of the process, which we'll cover in the next chapters.

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5 Designing a successful migration

SPACE EXPLORATION

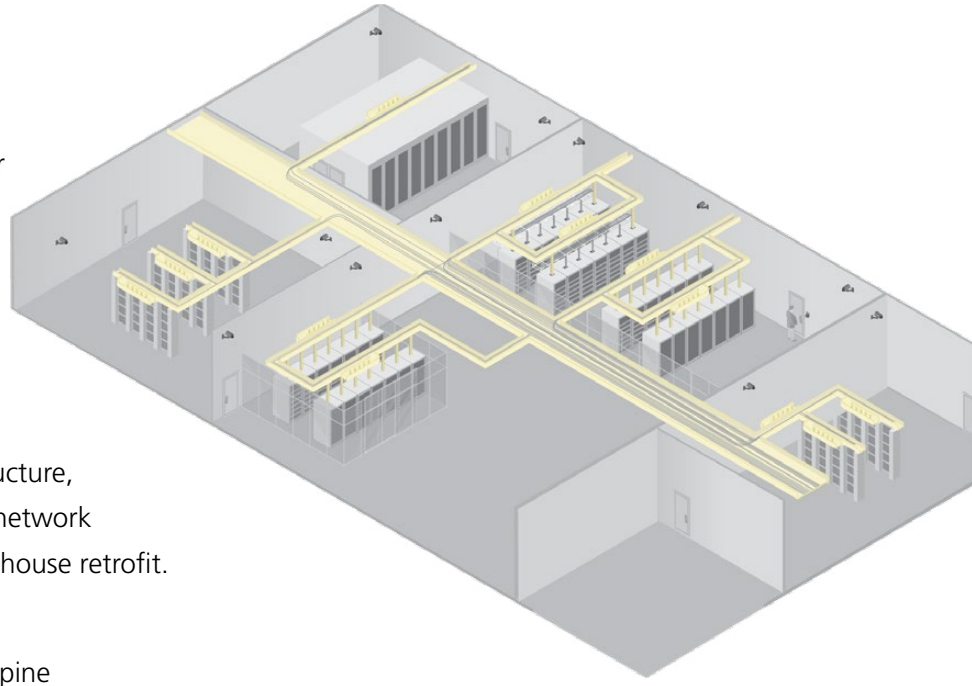
Until now, the bulk of the work has been theoretical and preparatory. It has focused on the planning and vital considerations that inform a successful multi tenant data center (MTDC) migration. Now, however, is the time to get practical and explore the physical space and its ability to adapt itself to the ever-evolving world of infrastructure. Creating and implementing your data center migration are discussed here.

IT'S A (SOMEWHAT) DIFFERENT WORLD IN THERE

While many multi tenant data center (MTDC) design challenges have similarities to those surrounding an enterprise-owned and -operated data center build-out, their offerings and solutions can be subtly different. For instance:

- **Floor space and the future.** Because MTDC space is leased, it's hard to predict the availability of adjacent space if and when the footprint must increase in the future. Unlike a data center on premises, you have much less control over your neighbors—and how close they are. This is why some tenants will lease adjacent space even though they may not build it out for a year or two.
- **Square footage costs.** In an MTDC, physical footprint is one of the main determinants of cost; floor space expenses may lead to higher-than-expected rack densities in order to reduce the overall footprint to meet a budgetary objective.
- **Cloud demand.** Technology advances and business needs are driving more applications to the cloud—making it difficult for enterprises to forecast whether they will host some applications on their own hardware (as virtualized or private cloud applications) or move them to a public cloud provider. Private, public, and hybrid cloud designs are vastly different. This decision will impact how much space, connectivity, and power will be needed.
- **Management.** Data center management is always a challenge, but an MTDC's location and configuration make it less accessible, which is part of the security benefit to hands-on,in-person administration. Remote management capabilities may be needed, along with the cost and learning curve they present.

Beyond these challenges, you should also consider the various operational factors that may not have been variables prior to your multi tenant data center (MTDC) migration decision. These include:



- **Network uptime**

  Availability, of course, is the purest currency of value in your data center. When your infrastructure is offsite at an MTDC, you need assurances that the host offers sufficient redundancy services to ensure your required levels of availability—for example, providing redundant and diverse path cabling to ensure connectivity resiliency to peering partners, cloud and service providers.

- **Architecture review**

  Since an MTDC migration often comes as a result of expanding data center infrastructure, the move presents an attractive opportunity to consider and implement alternative network architectures and technologies that would otherwise have been prohibitive as an in-house retrofit. Some examples of these opportunities include:

  - Moving from a three-tiered hierarchical switching architecture to a two-tier leafspine architecture, which would need to accommodate "any-to-any" connectivity of a true network fabric design
  - Rolling out entirely new architecture such as hyper-converged architecture, which virtualizes IT hardware in software, including storage—removing the need for a standalone storage area network (SAN)
  - Transitioning from a top-of-rack design to a middle- or end-of-row design to increase switch port utilization and reduce costs and the amount of switch management required

- **Standards and compliance**

  Even with all the regulation currently in place, not every multi tenant data center (MTDC) adheres to exactly the same standards on some issues. While some standards must be universally observed within a jurisdiction (such as cable fire safety ratings or local codes for twisted-pair copper and fiber-optic cables) other factors, such as cable performance and connectivity, do not. To understand what level of compliance the MTDC provides, refer to the standards published under TIA-942-B, ISO/IEC 11801-5, CENELEC EN 50600-4-2 and EN 50173-5. Together, these industry standards define compliance in:

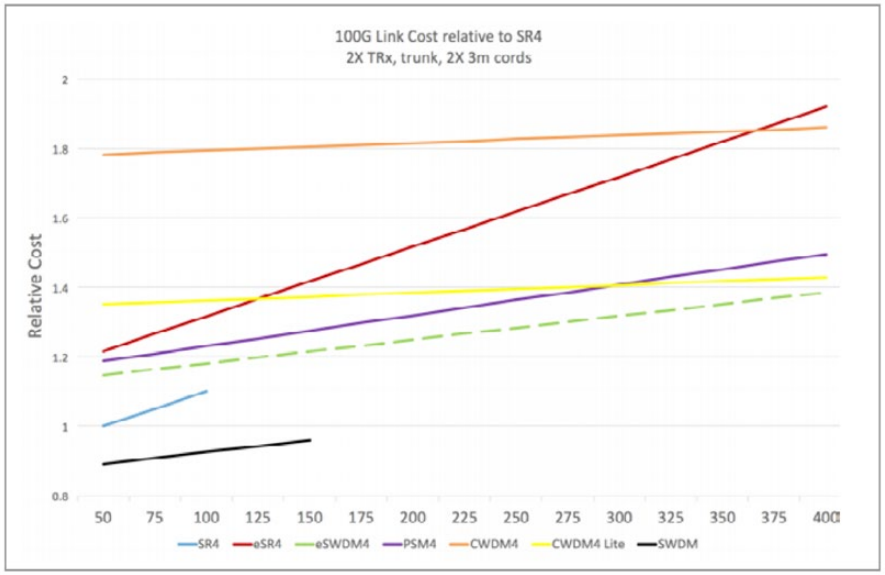
  - Recommended media and fiber connection types
  - Cable routing
  - Levels of redundancy
  - Cabinet size recommendations
  - Cable pathways and routing
  - Power separation guidelines

- **Network capacity planning**

  The data center design must account for the transmission interface speed it will need on day one as well as anticipate required speeds in the future. This part of the plan needs to include consideration for:

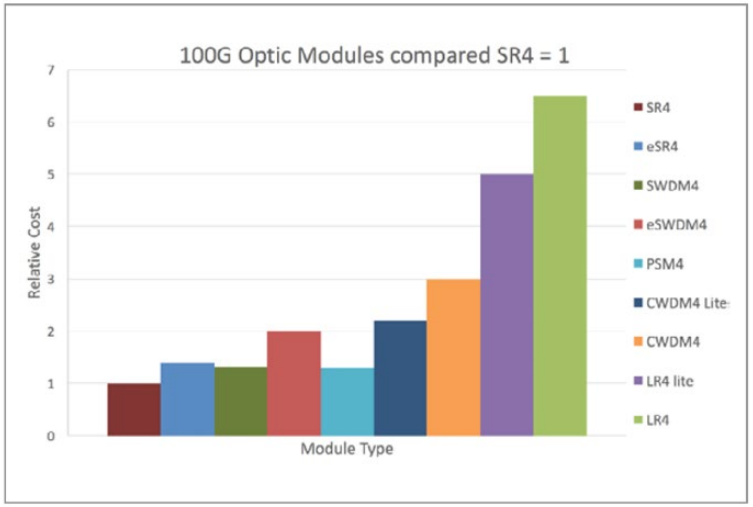
  - **Link distances.** Data center connectivity requires a great number of links within relatively short distances, which makes lower-cost multimode fiber and the associated optoelectronics an attractive option. However, the fiber must be able to support projected speeds in the future. Laser-optimized multimode fiber (LOMMF) is required to support future speeds at shorter distances—and noncompliant variants may not be up to the task. At longer distances (more than 500 meters) singlemode fiber technology offers higher capacity and greater link lengths, though typically at higher initial cost and power requirements.
  - **Network topology.** Depending on scale and layout, the multi tenant data center (MTDC) may centralize equipment in one location or distribute it across the facility. Topology considerations like this bear on the number and length of possible links.

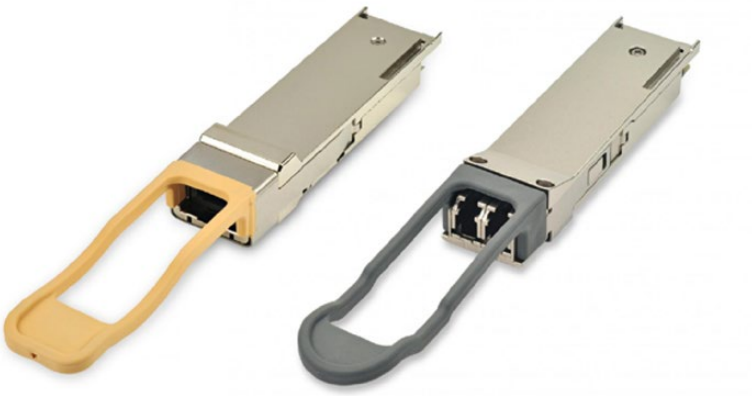
- **Network capacity planning continued**
  - **Total channel cost.** Link modeling to determine costs mustinclude the entire channel, including transceivers, trunks and patchcords. There are several ways to model these costs; the first image shown here provides guidance on appropriate link lengths based on topology. In this example, the model reveals that the costs of channels A and B are equal at a length of approximately 230 meters. With the link length established, you can now select the lower-cost solution.
  - When the average channel length is known, making an accurate cost comparison between link types is easier. Using data resources such as the chart in second figure, the process of evaluating relative total channel costs is fairly straightforward. The first figure compares the costs (transceivers, trunks and patch cords) of various 100GBASE links, from 50 to 300 meters in length. This model also compares 100GBASE-SWDM4 duplex optics with OM5 cabling to 100GBASE-SR4 using OM4. Among other things, it shows that the SWDM/OM5 option provides much lower total capital cost. The use of OM5 fiber enabled extended 100G support for SWDM4 transceivers. The recent announcement of 100G eSWDM4 to 400 meters on OM5 now rivals that of short-reach singlemode data center optics like PSM4.



While the cost of any link is length dependent, some have an inherently higher cost due to an increased number of fibers, and this difference must be accounted for in the comparison. It is also important to understand that tools such as those shown below apply to enterprise data centers. They cannot, however, be used reliably to compare link costs within a hyperscale environment. This is due to the extreme size and bandwidth requirements of these facilities.

- **Other transmission considerations.** In some cases, the channel distance may be so short that length is not the critical variable determining cost. In these instances, the decision regarding the best transmission medium typically comes down to other factors, such as:
  - **Link speeds.** Every multi tenant data center (MTDC) should have its own migration roadmap that anticipates the IT needs of the organization and the infrastructure required to support it. The links' transmission medium must support those speeds—now and in the future.
  - **Channel OpEx.** Operational cost considerations should include an evaluation of the personnel, processes and vendor relations required to support the link transmission medium. Each kind requires specialized expertise and standards familiarity for optimal support—cost items that should be accounted for prior to selection of the medium.
  - **Infrastructure life cycle.** Ideally, the IT infrastructure will be able to support multiple generations of technology in order to defer costly rip-and-replace upgrades.





Optical Transceivers

- **Cable routing and management**

  Proper design of cable routing and cable management is particularly critical in a hosted environment, where additions and changes (independent of your planning and designing) may be implemented by third parties. Clear, well-marked pathways—along with adequate space reserved specifically for cable management—will help ensure that changes to the cabling can be accommodated. The specific areas to address include:

  - **Fiber raceway.** These should be designed and sized to accommodate current and anticipated demand. There are planning tools, such as CommScope's FiberGuide® fiber raceway design tool, to make this a relatively simple thing to do. It can design horizontal and vertical components, supports and exits, and then generate a bill of material in order to build it. Network architectures such as leaf-spine, with its mesh connectivi ty requirements, drive the need for more connectivity between racks.
  - **Copper cabling containment.** Like fiber, copper cabling containment also requires thoughtful planning. Such containment may include wire baskets, tray or ladder racks. Each has a hang load that must be observed. Additionally, where power cables are run in the same containment, power separation guidelines must also be observed.
  - **Network racks and cabinets.** The design must include adequate space for properly routing patch cords and cables. Server cabinets based on a 600 millimeter (23-5/8 inch) wide footprint don't offer this accommodation and thus require more careful consideration when connecting servers. Networking cabinets used in middle- or end-of-row architectures should be at least 800 mm (31-1/2 in.) wide—with 1000 mm cabinets optimal to accommodate patch cords and high fiber-count cables as well as providing adequate ventilation for switches.

Tales from the Trenches

Patch cord management may seem like a minor concern, but it's actually a major headache if not managed properly.

For example, a global transactional law firm was managing a site-to-site storage area network (SAN) migration. Trouble struck at 3 a.m.—on a Sunday (of course)—all because of one improperly labeled and routed patch cord that was mistakenly unplugged by a site engineer.

This broke access to data that had already cut over and could no longer be accessed from its previous location—so, as overseas markets opened, andinternational users tried to access this vital data, they found only "DATA UNAVAILABLE" instead—for six long hours.

This disaster clearly demonstrates how important it is to have cabling and connectivity covered in a migration plan.

- **Horizontal and vertical cable management.** Rack space should also be allocated for horizontal cable management to allow proper routing of patch cords within the rack, as well as to adjacent racks. While high-density racks and their reduced cable management are a temptation here, they can be a problem when it comes to adds and changes down the road since they make it hard to make changes without disrupting adjacent circuits. Some cabinets also come with integrated vertical management, or it can be provided with separate vertical cable managers bolted to the network rack.
- **Remote management and automated infrastructure management (AIM).** As previously mentioned, multi tenant data center (MTDC) migration means an increased reliance on remote management. Such management tools can track and report on network performance, latency and application performance, among other metrics. To gain detailed insight into the network's physical connectivity in real time, however, requires an automated infrastructure management (AIM) solution that can automatically document, monitor, and track every connection occurring in the physical layer.

The advantage of an AIM solution is that it can detect unauthorized changes or connections in structured cabling, such as a removed patch cord or a new attached device. An AIM solution (such as CommScope's imVision® AIM solution) can facilitate audits and reporting of changes over time—a particularly useful capability when changes in an MTDC are often performed by unsupervised third parties. It can also display an end-to-end circuit trace to any port—a useful tool when troubleshooting a broken link. Of course, an AIM solution should support standard patch cords to ensure all changes are properly monitored and documented.

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BEST PRACTICE

6 Data center fit-outs and installation

GETTING PHYSICAL

Now that the design has been established, it's time to get into the physical requirements of the actual fit-out and installation in the multi tenant data center (MTDC). At this point, you will need to keep a close eye on the space and ensure the containment, racks and cabling can all be installed—and that your staff and contractors will have physical access to the new hosted location.

Layouts and limitations

All the design factors covered in the previous chapter now come into play. The space and layout available to you will impose certain limitations your installing technicians will need to know and respect. These include:

- **Hang loads.** Your copper and fiber-optic cabling containment must be designed and rated to accommodate your infrastructure for the duration of your tenancy at the multi tenant data center's (MTDC's). The hang loads, or the weight your containment is expected to bear between support points, must not be exceeded. This goes for ladder racks, wire baskets, cable trays and other containment.

  Hang load standards are published by organizations such as NEMA (in North America) and IEC (globally), which containment manufacturers are required to observe in their product labeling. MTDCs often offer services around designing and installing properly supported structures for power and cable management.

- **Transmission distances.** As explained in the previous chapter, link distances and required speeds will determine what kind of transmission media is appropriate. For example, IEEE 802.3 standards for Ethernet over copper, whether 10 Mbps or 10 Gbps, are limited to runs of no more than 100 meters in total length. When it comes to multimode and singlemode fiber-optic runs, Ethernet applications may possibly be supported beyond IEEE guidelines, as is the case with CommScope's SYSTIMAX® optical fiber portfolio.

  It's important to determine overall transmission distance and channel insertion loss from the point of interface at the cage to the transmission equipment in the multi tenant data center's (MTDC's) meet-me room. Such links typically use singlemode fiber, but overall insertion loss will help determine what kind of optical transceivers will be needed at the cage. MTDCs may have a registered communication distribution designer (RCDD) available who can design for existing and future network requirements.

- **Secure cable runs.** The connection between your interface in the cage to the meetme room may be located in a dedicated, secure conduit that is accessible only at its endpoints; or it may be located in a shared or communal fiber containment tray that runs through a publicly-accessible part of the MTDC's facility. Be aware of any risks of potential unauthorized access to this sensitive infrastructure.

Getting Around

Apart from the physical appointments of the cage and containment of interfacing cable, there is also the matter of access in the multi tenant data center (MTDC) itself—not only during design and installation, but also afterward. Here are some physical access questions you will want to consider:

- **Personnel access.** How do authorized personnel access the MTDC facility? What is the process to add someone you trust to the access control list? Is security managed by a keypad, ID card, key fob, or other technology that avoids time-consuming manual verification of credentials?
- **Deliveries Materials will often come and go from an MTDC facility.** What is their process for handling them? Is there a secure, dedicated or isolated space for the receiving, shipping and short-term storage of such materials? Is it of adequate size, and is there an additional charge for tenants who use it? Is the area available 24 hours a day or only during business hours? Or does using it require a pre-scheduled booking?
- **Pathways and spaces.** For your technicians and contractors, what spaces are accessible—and during what hours—for routine or emergency work? Do certain areas require advance scheduling to access?
- **Work rules, MOPs and scheduling.** What policies, rules and methods of procedure (MOPs) does the MTDC enforce? If certain areas or times of day are off limits, are there exceptions or compromises in the event of an emergency? How will the MTDC address your expectations of access if they conflict with their policies? This is an important factor during cut-over, as it's common for this to occur during off hours to minimize disruption. It's also worth checking to see how the MTDC handles work scheduling, the limits they impose and their policy for dealing with last-minute schedule changes.

Tales from the Trenches

It's tempting to reduce footprint (and costs) as much as possible in an MTDC migration. But it's also possible to be penny wise and pound foolish.

Once, a large enterprise had run out of space to add data center capacity and opted to migrate to an MTDC rather than build out additional space. The enterprise's staff had always carefully planned access and space requirements for both horizontal and vertical cabling—but outsourcing their MTDC cabinet and cabling design didn't turn out as well.

To reduce footprint, all connectivity was installed in two cabinets without provisioning for cable management. The fiber cabinet contained 42 1U sliding shelves and whenever one shelf was opened, it would catch on adjacent shelves and pull them out as well. This forced technicians to spend more time making simple changes, and, ultimately, to add another rack with proper cable management at the end of the row.

Overall, the costs involved in redesigning and re-cabling erased the initial savings from a more compact footprint.

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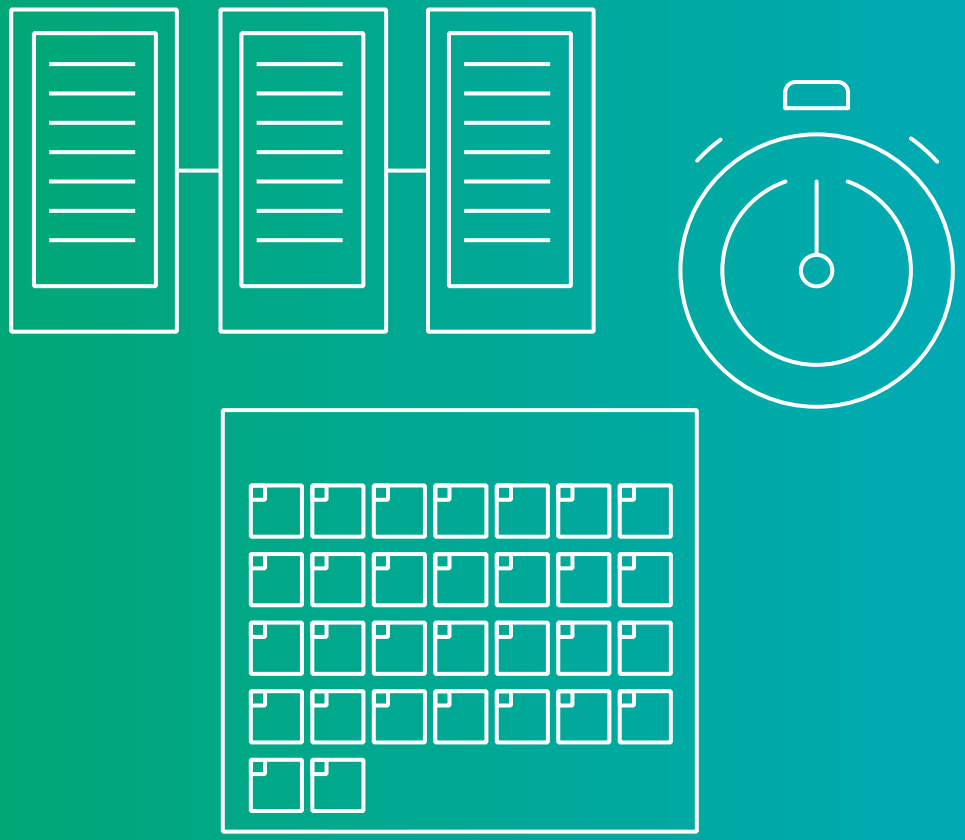
BEST PRACTICE

7 Migration time



PLANNING AND MOVING—GETTING TACTICAL

With the design, fit-out and logistics all squared away, the time has come for the actual data center migration to begin. This phase takes two forms: migration planning (the checklist that will guide and document the move) and the physical migration of assets themselves.

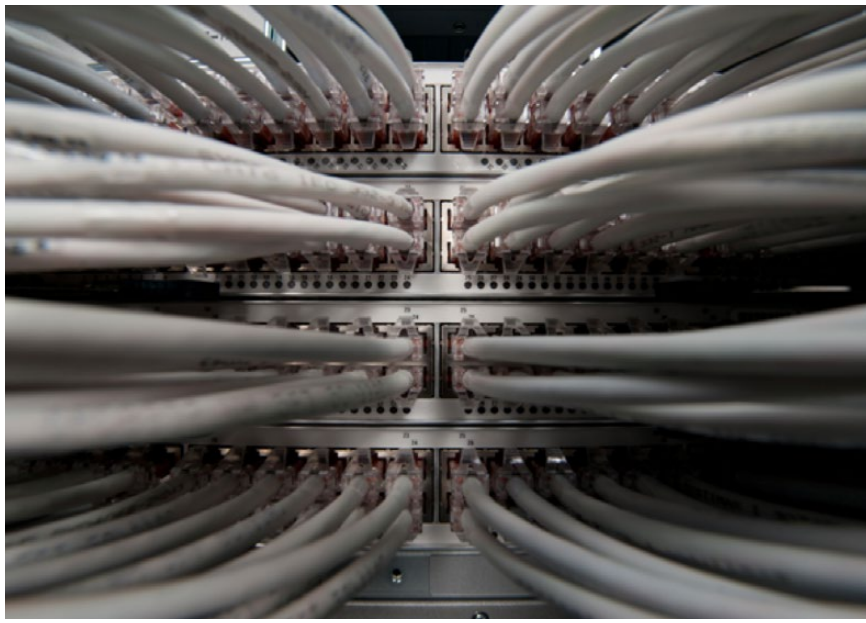
Planning

With all strategic factors already worked out in previous stages, it's time to build a tactical, ground-level execution plan that will set you up for a successful move. Here's what a good plan will consider and anticipate.

- **Timing.** When will the migration occur? Chances are you will have to deal with business-critical services that must be available at certain times, so plan your timing to meet those deadlines. Is there a long holiday weekend you can exploit for extra time if needed? Is there an opportunity at the end of the business' fiscal year to take systems down for a while? Know when you can take your assets down—and when they must be back up to ensure continuity.
- **Duration.** A related issue is the migration's expected duration. If you need data and services at 8 a.m. Monday morning, when must you begin in order to be confident you'll be ready on time? Depending on the scale of the migration, it could be hours or days before everything is in place. If the duration exceeds available downtime, consider breaking the migration into multiple phases.

Planning continued

- **Contingencies.** Relocating equipment can introduce all kinds of surprises. Make sure you're ready with timely access to spare parts and staff with appropriate expertise.
- **Equipment.** List which physical assets are actually being moved, replaced or decommissioned. You may find you have equipment that is at the end of its useful service life or has reached the end of its upgrade path, making it a candidate for replacement. You may also have equipment that is application-specific, making it must-have for legacy applications. Each piece of equipment should be clearly identified and labeled with its manufacturer's name and model number, serial number, OS system and version, media access control address (MAC) and last service date.
- **Documentation.** Your inventory list should include all server types (such as web, application, proxy, mail and protective DMZ list servers, for instance); plus all routers and switched, storage, uninterruptable power supplies (UPS), power distribution units (PDUs), firewalls and modems. Each component should have documentation indicating:
  - IP addresses (internal IP network addresses as well as externally-assigned IP addresses)
  - DHCP IP addresses reserved for specific equipment
  - Internal and external DNS entries referencing IP addresses in the data center
  - Firewall access control lists (ACLs) and their associated IP addresses



Planning continued

- **Applications.** The services running on your hardware will also need complete accounting and thorough documentation—these are just as important as the hardware they run on.
- **Operations.** Does your multi tenant data center (MTDC) migration strategy call for parallel operation between old and new deployments? Or will there be a specific cutover date? It's not uncommon for such an arrangement to be used for a while to ensure total continuity. If maintaining a parallel operation, how long will both be expected to operate that way? Mapping out the plan helps define roles and responsibilities for onsite technicians. If making a gradual move, the addition of a project manager to coordinate its stages will also help technicians know what is expected—and when.
- **Testing.** The network setup and testing plan that was constructed earlier in the process (see Chapters 1, 2, and 3) now comes into play for the move. All the participants in that plan should be providing input against this checklist. Testing includes each layer of the network stack, following the same process one would use to troubleshoot a network problem.
- **Physical proximity of the MTDC.** Migration complexity increases with distance. Proximity determines how quickly and reliably materials and personnel can get where they are needed. Does it involve a quick drive across town or a flight across the country? Distance could mean the difference between a response measured in hours versus one measured in days.
- **Personnel.** Know in advance who will be onsite at your data center and at the MTDC to support the actual migration. Contact any equipment vendors who have service contracts with you, as they may need to have representatives present as well. And, of course, ensure your entire IT staff and all vendors are at "battle stations" and available for the duration of the migration.

Moving

The moving plan is ready. The strategy is in place. Everyone's ready to make the move at last. Here are factors to watch for when the trucks pull up and the equipment is on the loading dock.

- **Logistical hazards.** The clock is ticking. Every minute counts during this phase. Be ready to deal with circumstances that can slow or halt your move, such as transportation shutdowns, highway closures, extreme weather conditions or the unexpected unavailability of key personnel due to illness or other reasons.
- **Go/no-go decisions.** Each stage of the checklist must account for this decision to proceed to the next stage, or to roll back the migration due to unforeseen challenges.
- **Change management.** Sometimes called "change control," this is the process of verifying the compatibility of systems after the physical migration, such as confirming new code will run on older hardware or vice versa.
- **Staffing and control.** The personnel planning mentioned above also plays a role in the move itself. Complex migrations can benefit from a dedicated project manager who can coordinate serial tasks such as taking an application offline, then bringing it back online in the multi tenant data center (MTDC), as well as parallel taskssuch as migrating multiple applications to a single server.
- **Security.** The physical premises and the network itself may be vulnerable during the move. Many required network security policies can complicate a migration, so the equipment and network must be properly configured so it is protected during transit and cut-over. There are low-tech security issues to consider, as well; getting accidentally locked out of a server cage can bring a migration to a sudden halt as well.
- **Remediation.** Ideally, the move will go smoothly and cut-over won't present any problems. However, you should always have a remediation plan in place to address any unpleasant surprises—especially after working hours. If you followed the contingency recommendations above, you should also already have contacted equipment suppliers and technology vendors to ensure that parts and personnel will be available if needed.

As with the strategic pre-work you've accomplished so far, accounting for these tactical considerations will help ensure an uneventful move and a smooth migration.

BEST PRACTICE

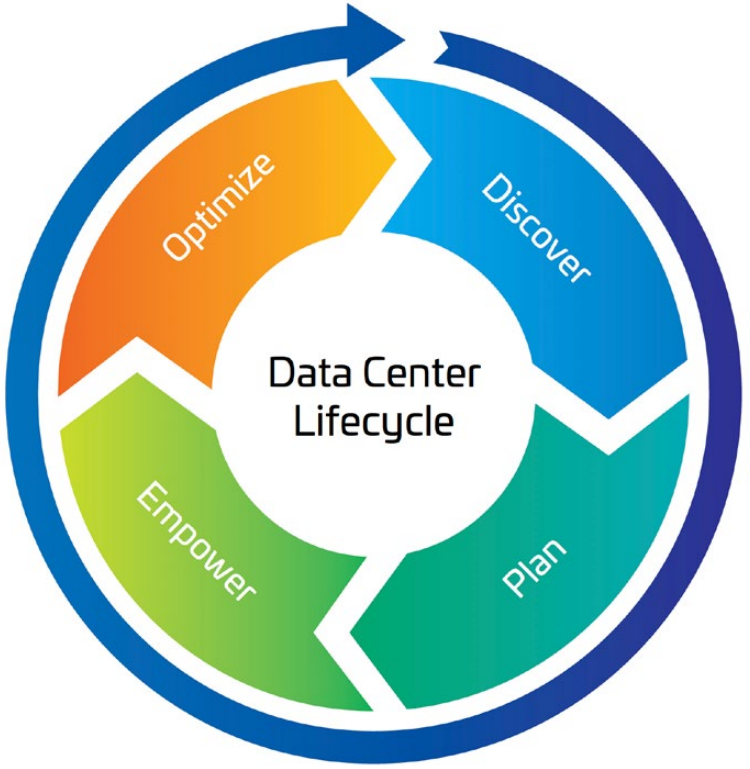
8 Day 2 operations

THE NEW BUSINESS AS USUAL

With the migration of your equipment, applications and data now complete, it's time to settle into the new routine of maintaining your data center infrastructure within the framework of the multi tenant data center (MTDC) environment. Some of these factors will feel familiar to anyone who has managed an in-house data center, but there are some important differences in the MTDC world. These are the issues your technicians must be ready to address.

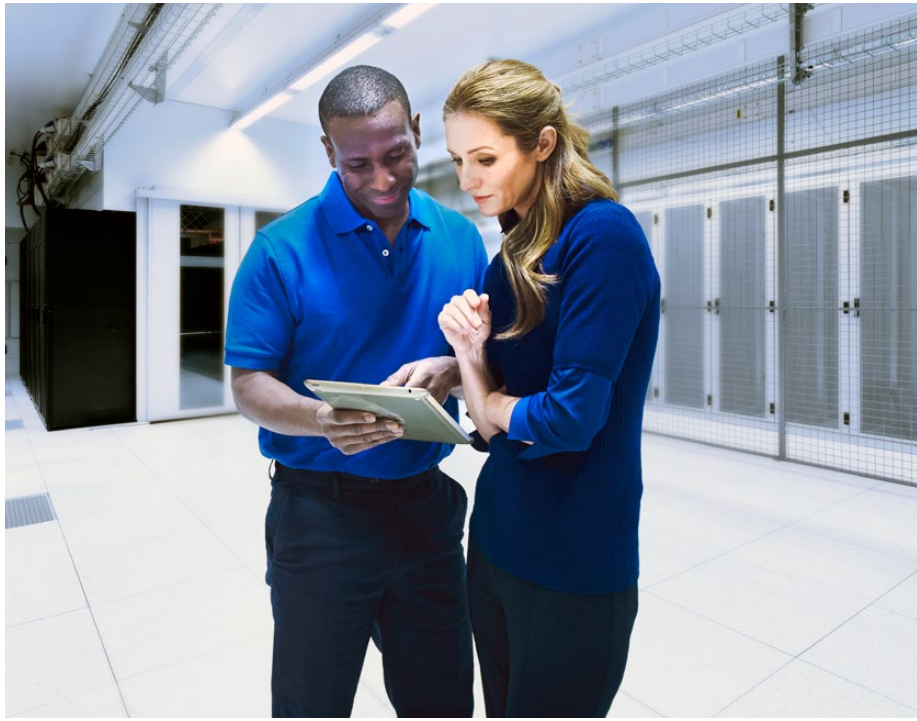
- **Compliane and audits.** Audits are tools used to measure whether data center performance is compliant with expectations. Audits depend on accurate audit trails—the reports and documentation of network connectivity, such as those automatically generated by automated infrastructure management (AIM) solutions. Some can deliver real-time information and periodic reports of all activity on the physical layer: the adds, moves and changes of connected devices, right down to the specific ports and cables involved.
- **Break/fix.** If an incident occurs that interrupts service, do you have the tools in place for troubleshooting and remedying the fault? An established, documented troubleshooting process is necessary for on-site technicians to address problems quickly. If this process documentation is not located with the hardware, it should be easily accessible nearby in case technicians are not familiar with your MTDC site. This process should include a checklist of information to confirm and actions to take. Again, an AIM solution can be an invaluable tool in reducing downtime by providing up-to-date connectivity documentation.

- **Access control and approved personnel lists.** Does your multi tenant data center (MTDC) have your list of authorized technicians? In controlled-access environments like MTDCs, manual security checks can waste precious time. Make sure your list is current and that you follow a process for adding and removing names promptly. It's also important that approved personnel have the keys and codes they need to access equipment floor areas and the cages themselves.
- **Emergency notifications.** Maintain a list of the personnel to be notified in the event of a network emergency. You will likely have different names on call for different kinds of problems—or different levels of severity.
- **Remote hands on call.** Ensure you have a plan for getting technicians to the trouble day or night. If contracting with an outside support vendor (or the MTDC itself), confirm that their working hours align with your expectations. If you need 24/7 availability, you may have to source it yourself. Also, establish an escalation policy so responding technicians know who to contact if they can't resolve the incident themselves.
- **Know where your applications live.** Some applications are not responsive to break/fix operations and, if they go down after business hours, it's helpful to know application locations to create policies directing what time service can be performed.



8 Day 2 operations

- **Plan for expansion.** Early on, it's smart to consider how growth—planned or unplanned—can be accommodated by the multi tenant data center (MTDC). Do you have extra room to grow in your current cage? Is adjacent space available, or likely to become available? If you needed to add more space but can't do it contiguously, how will the MTDC handle the necessary interconnects? The MTDC should offer guidance on how these growth issues are handled there.
- **Contingencies.** If there is a major event at the MTDC facility or in your cage, what are the contingency plans for keeping the network and applications running? Enterprise business continuity practices (BC) don't change just because you're subbed out the maintenance to your MTDC operator. BC application strategies like Active-Active, Production-DR failover, Service Provider redundancy, and Cloud elasticity adhere to the same fundamentals and should be used.
- **Lifecycle management.** You're in the MTDC because your network has evolved—and that won't change now that you're migrated. Keep track of your equipment lease agreements, depreciation and maintenance. Be mindful of the eventual need to phase in new equipment, and staff accordingly. A good MTDC vendor is a true partner in this endeavor, helping you realize new potential and efficiencies as they become available.



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GET THE MOST FROM YOUR HOST

Best practices for multi tenant data center migration

The purpose of this eBook is to help you gain an understanding of the physical infrastructure, design requirements and strategic considerations that must precede a successful multi tenant data center deployment. For all the advantages possible from a multi tenant data center migration, it's equally possible to realize negative results if these practices are not observed.

For this reason, CommScope has teamed with data center industry expert Donough Roche from Datacentrs, Inc. and other industry leaders in our Multi Tenant Data Center Advisory Board to offer this eBook, Get the Most from Your Host. This eBook addresses best practices in the stages of planning, designing, migration and Day Two operations of an enterprise's data center assets in an multi tenant data center environment.

Explore the chapters below to learn more about best practices for each stage of developing a multi tenant data center.

1. Defining IT requirements
2. MTDC planning and what to ask for
3. Migration planning
4. Define scope/RFP to the MTDC
5. Designing a successful migration
6. Data center fit-outs and installation
7. Migration
8. Day 2 operations

For more information on enhancing your data center, reach out to one of our experts here.

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