

# Best practices for evaluating and implementing a multi-CDN strategy



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## Purpose

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The following is intended as a best-practice guide for companies focused on web performance, with particular attention to those currently evaluating or implementing a multi-CDN strategy (often called CDN Federation).

At Citrix, we focus heavily on strategies and solutions for multi-platform content and application delivery. Many of our clients are global retail, media, and technology companies that leverage our expertise and tools to provide the best-possible performance to their respective customer bases worldwide.

Through working with hundreds of clients, we've learned much about the strategy and process of evaluating, selecting, configuring, and optimizing a content delivery ecosystem of data centers, clouds, and CDNs. We're constantly measuring real-time performance across all major clouds and CDNs as they are seen by billions of users behind over 44,000 ISP networks in every country in the world.

In this paper, we share our perspective on the state of content and application-delivery platforms, as well as best practices for establishing a content delivery ecosystem, based on what we've learned from our many client engagements.

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# The web has evolved, and performance is king

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Running a global, high-performance web platform has never been more challenging. Web operators must contend with tuning site delivery to perform equally well from Beijing to Boston, Savannah to Sao Paulo. Site owners must also deal with accelerating device proliferation and social-media-induced traffic spikes. While website performance now influences whether a quarter's revenue numbers are made or missed, it is also difficult to stay a step ahead of your customers' expectations. Today's online content creators need to manage expectations for a global internet user base that now reaches almost 3.6 billion people<sup>1</sup>.

The explosion of the mobile web is even more astounding. According to real-time data from GSMA Intelligence, there are 5 billion mobile subscribers worldwide<sup>2</sup>. Moreover, mobile internet users aren't cutting web operators any slack. Nowadays people expect mobile sites to load as quickly as on their computers.

## Content provider considerations

Multichannel access methods for websites are not the only items a content owner must consider; demographics and the purpose of the site also come into play. The majority of shoppers state that they will leave a page if it takes more than three seconds to load. For the largest e-commerce or media properties, this can mean millions of dollars in lost revenue.

## Performance means business

Improving performance not only increases a site's conversion rates, but it can also have a significant impact on search-engine rankings. Google includes overall site speed as part of their page-rank algorithm.

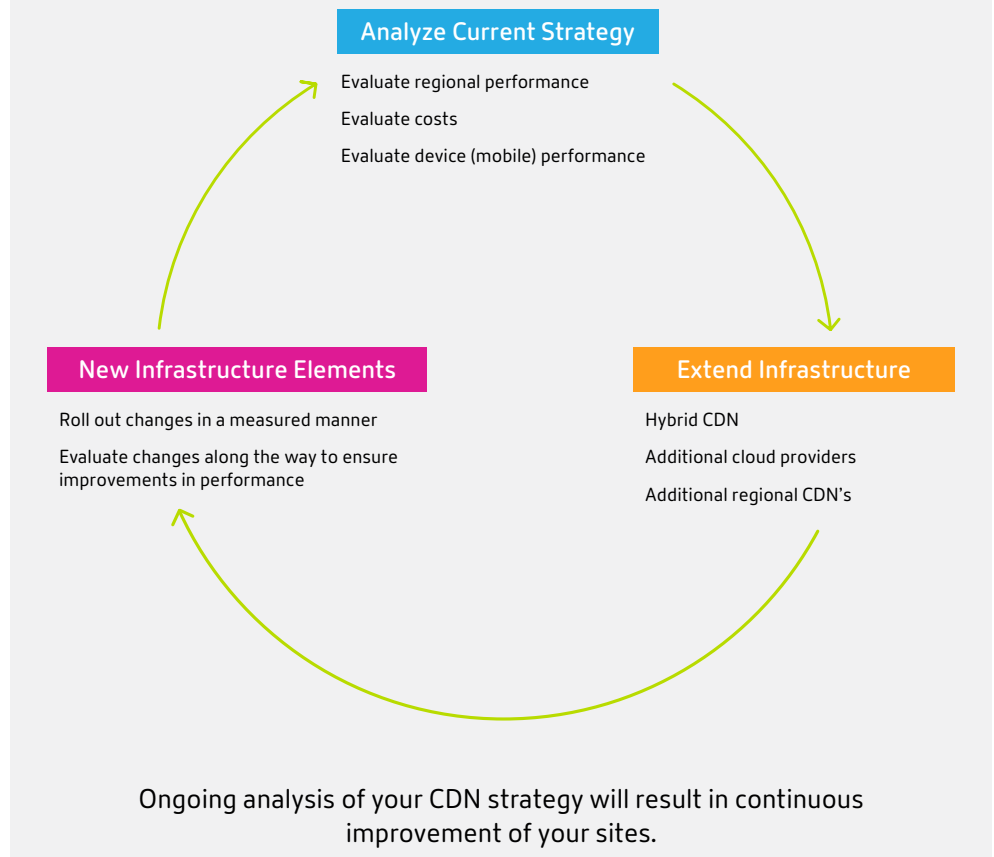
Improving your web or mobile applications' performance is an ongoing process. Simple methodologies we recommend to all our customers to meet availability and performance goals are:

1. Monitor and measure your current strategy
2. Make informed decisions about extending infrastructure
3. Mitigate your risks as you implement changes
4. Rinse and repeat.

The global internet now reaches almost 3.6 billion people.

-United Nations ITU

## Virtuous cycle of application improvement



## Delivery platforms: reasons for a multi-CDN strategy

In response to these increasing performance demands, there's been a significant wave of innovation in content delivery platforms. This has largely taken the form of more vendors coming to market with increasing levels of specialization. One thing is clear, however. Adding delivery partners increases performance and provides significant value. **In audit after audit, Citrix data shows that clients can lower latency using multiple CDN federation as compared with single-CDN use.**

As CDN providers specialize to address specific audience locales, demographics, and content and device types, the market has become increasingly complex. This trend will likely continue. It does, however, require online managers to navigate a convoluted and rapidly evolving provider landscape in order to get the coverage and performance they need.

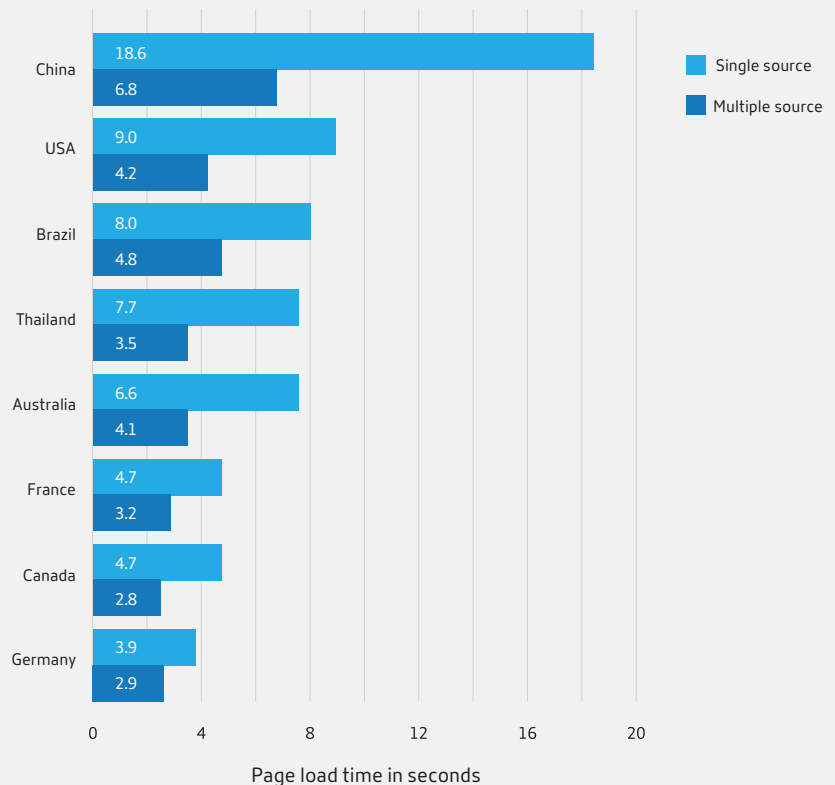
### A hybrid approach

The assorted CDN providers have varying strengths and weaknesses with regard to their peering/paid transit with ISPs and backbone networks. CDN providers also have differing levels of features and performance for different traffic types.

While a single provider may offer a "good enough" service to most audiences most of the time, content providers have learned that no single platform can offer the best performance everywhere, all of the time, for all traffic types.

As a result, many content providers are now moving toward a hybrid approach to content delivery services. They are taking this action in order to develop and improve their performance capabilities, avoid vendor lock-in, and ensure they can maintain the flexibility they need to continue to keep up with their end users' demands. In addition, as they expand their businesses to new geographies or more dynamic applications, they need local partners to ensure excellent performance for their new customers.

### Single vs. multiple CDN comparison



Throughout the world, multi-CDN strategies improve performance

EuroNews, a leading online news outlet, deployed a federated CDN solution to allow their site to be more effective in China. They saw a regional 60% reduction in page load times, as well as a 22% reduction in their page-bounce rates.

### Selecting a strategy

So, which platform partners are the best ones to choose, based on your markets and the demographics of your user population? **The best solution is actually to use several providers that, when combined, offer a fully rounded delivery solution on a global scale.** This ensures a 24/7 best-of-breed coverage for all your customers, leveraging the strengths of the providers and minimizing their weaknesses.

The sections below will help you formulate the questions you need to ask in order to establish the most optimal mix of platform providers for your specific business goals and effectively take advantage of the delivery options available to you. Your business is unique, so don't expect a one-size-fits-all set of answers. Instead, consider the specifics of your business and how web performance applies to you and your customers.

### Eliminating the single point of failure

It would be remiss if we left this section without talking about the other obvious advantages of a multi-CDN solution. Performance is a great goal, but removing

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your single point of failure (SPOF) is an equally laudable benefit. Any system architect knows that a SPOF will eventually knock you offline. While CDNs are built to be redundant and have certainly improved over the past 10 years, there can be no doubt that CDNs have occasional technical challenges that can affect website performance. By moving your mobile app or web property to a multi-CDN delivery strategy, you make your entire system more resistant to failure.

To take advantage of annual rate drops, an enterprise must have realistic options; in other words, multiple CDN partners.

### Negotiating from strength

Lastly, by adopting a multi-CDN approach, you provide your business executives leverage when negotiating CDN rates. This is no small matter. CDN companies, like all companies, want to maximize their value by resisting price decreases. CDN transit rates for new contracts have declined 15 percent to 25 percent each year, according to Dan Rayburn of StreamingMedia.com. To take advantage of annual rate drops, an enterprise must have realistic options; in other words, multiple CDN partners. There are CDNs that meet this requirement.

## Two rules for effective hybrid CDN

### Rule #1: Own your origin.

To have the ability on your site to allow multiple CDNs to cache your content, you must first understand your current delivery ecosystem. The business logic that may live on parts of the CDN has to be pulled back and implemented at the origin. Here are four important things to look for with regard to this issue:

1. Establish your origin outside of the CDN itself. If your CDN does not allow its storage to be used as third-party origin storage, best practices would be to have multiple origins (at least a primary and a failover). Multiple geo-located origins may be good for larger sites or mobile apps with high data needs (online gaming for instance). These origins can be load balanced as well for performance and availability. An example of this strategy would be a company that executes origins on the east and west coasts of the U.S., Europe, and Asia.
2. Limit the number of features you utilize with a specific CDN. Put the intelligence in your origin, where possible; that's your value proposition. Attempt to use CDNs only for delivery. By pulling the business logic back into the origin and performing these tasks yourself, you have set the table for multiple CDN delivery.
3. Limit the use of CDN origin storage. This will have to be replicated across multiple CDNs if you use it. Rather, opt for using cloud storage in multiple locations or set up your storage to be near your own origin(s).
4. Make sure all your content uses best practices for caching. As well, ensure all the CDNs you choose respect caching headers correctly.

### Caching best practices

Caching is a long and complex topic, but the following rules are a good start:

- Usually the first 90 percent of content is easy to cache; it's the last 5 percent to 10 percent that's tricky. Focus on the 90 percent first.
  - Spend time reviewing the site and categorizing content. This will help when you need to set cache rules.
  - Know what your audience is looking at, by object. Fav.ico is usually the

Consider domain sharding to be able to take better advantage of your CDNs.

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most requested component, and then comes the logo and CSS, JS and page furniture. Tackle these first.

- Be cognizant of pages that are made up of components. Simply not caching anything in the /homepage directory because the base HTML is dynamic. One strategy that many sites have deployed is domain sharding. This is simply the act of creating and using separate CNAMEs or domain names within the page, and allowing the browser to download the different resources from different domains. We talk about this a little more below, in case this is a strategy you have deployed on your web property.
- Rarely are images not cacheable or are cacheable for short periods of time. Image TTLs should be 30+ days. Remember, they are referenced from source HTML, so if you update the HTML with a new name for the image, the image will update instantly.
- If you have country-specific sites that sit on different hostnames — for example, uk.foo.com, de.foo.com or www.foo.co.uk and www.foo.de — see if you can put all the objects on the same host. The company logo or the basic page structure may be the same for every site. It will drastically help with your cache-hit rate if you can share across different sites. Remember, the customer will not see the URL for the object; they will only see the base page.
- The more you can cache, the faster you can be. Bear in mind, there are three types of content:
  - **Static** – It never changes and is delivered to everyone the same. This content is highly cacheable.
  - **Dynamic** – It's generated, usually from a database, but it's delivered the same as static content. For example, in a search for black trousers, more than one person can see a search for black trousers. Cache this content aggressively using query strings.
  - **Personalized content** – An example would be your bank statement, specific to you. This is content that cannot be cached since there is presumably only one viewer.
- Set cache rules on the origin, and have the CDN honor them. This way you remain in control of what is cached and for how long.
  - An added benefit of this strategy is that when you get too much load on the web servers, crank up the TTL on your objects, and watch the traffic drop for your origin server.
- If you can use versioning in your URL structures (UNIX timestamp can be useful), you can max out your object TTLs and not worry about having to purge to change content.
- Configure your origins for optimal hybrid CDN use.
  - Turn on GZIP – It will reduce your data center outgoing bandwidth, which means you always do the middle mile compressed.
  - Ensure you honor “If Modified Since” (IMS) requests at the origin; an IMS request is cheaper in bandwidth than a full GET.
  - CDNs love persistent connections (PCONN). Make sure you turn them on at the origin, and pipeline your HTTP requests. Remember you have

### Best practice

A number of our clients are focusing on an emerging standard: “3 seconds or less to load any page.” Is this metric, or something like it, a useful one for your business?



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at least 2 TCP connections. Origin -> CDN Server and CDN Server to End User. A PCONN = more delivered in one round trip = less latency impact and larger round-trip payload.

- Fully qualify your hostnames in source code. This will allow you to break up your content more easily if you want to domain shard or if you want to deliver using different services (for example, dynamic content via the dynamic service, static content by the cheaper static service).
- Make sure your local load-balancers are not load balancing by client IP. Do it by session or some other layer 7 mechanisms. Remember, you will see an aggregation of TCP connections (as requests come via the CDN).
- Separate the SSL components. Virtually all CDNs have bigger HTTP footprints than HTTPS footprints. Be deliberate and conservative in what you put over the smaller, and usually more expensive, SSL platform.
  - If you have to use SSL, use an efficient certificate; for example, SAN or Wildcard Certs. It will reduce cost and headaches in the long run.
- Prepare your Intrusion Detection System (IDS). Some CDNs can trigger them (including firewalls and other devices) due to pipelining.

### Best practice

Use a consistent object across your old and new platform to see how your architecture behaves; full pages can change, making qualitative analysis difficult.

### Rule #2: Know your traffic.

Is it HTTP, HTTPS, large file or Video? Knowing your traffic type, and what mechanisms make it perform better is critical because that will largely determine your caching capabilities. There are other factors, as well. For instance, large file delivery is usually improved dramatically by increased throughput. So, if that's your use case, then optimize for that by selecting CDNs that have great throughput in the markets you care about. Likewise, if HTTPS small object is the majority of what you want to optimize, it pays to understand that and federate your networks to that end.

### Focus on the important key performance indicators for your business

When considering business requirements, think granularly. Remember that in different countries, you will have different constraints and opportunities. You might even have different requirements, depending on the type of media or time of day. While your existing providers might have placed constraints on either cost or performance, put those limitations aside, and determine what your business needs to succeed in each market.

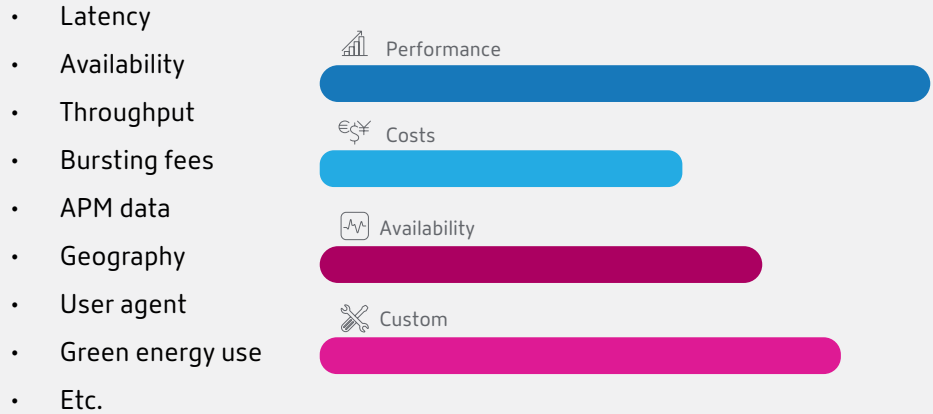
Next, investigate what your users actually experience. The results may surprise you. You need to know the range of your performance for every audience in every context. Where are your success stories? Where are your failures? How do you measure them consistently? For example, a number of our clients are focusing on an emerging standard of “3 seconds or less to load any page.” Is this metric, or something like it, a useful one for your business?

### Measure the right thing

If you are using only server-side experience measurement today, we suggest looking at actual user performance results, as well. Server-side metrics can tell you about load and latency on the servers, but they offer little insight into the actual customer experience. In order to make the best decisions about content delivery partners and platforms, you need to be armed with true visibility into your

customers' experiences, around the globe. Only Real User Measurements (RUM) can take the guesswork out of how your site is performing in different locations across different networks.

### Determine your business KPIs



### RUM

Real User Measurements (RUM) are the standard for true visibility into how end users are experiencing a webpage or mobile app in different global locations through more than 40,000 ISPs.

This may seem like a lot of work, but the analysis is worth the effort. Citrix has found that the companies that take the time to analyze the complete user experience of their customers have a greater success rate in choosing the best delivery partners. This allows the company to effectively optimize its mix of data center, CDN, and cloud partners to achieve the best results. For example, a leading media company was able to boost overall response time 62 percent by leveraging a fine-tuned mix of delivery networks.

Finally, as you evaluate performance, be sure to define your success parameters. Are you focused on improving response time, increasing conversion, lowering bounce rates, or all three? Whatever your company's specific metrics are, determine them up front, and then track them. By doing this, you will have data at the ready, to prove whether your platform partners are living up to their promises.

## Choose the best delivery partners for your business

Selecting the right set of delivery partners is a complex undertaking. It depends on the geo-location of your target audience, your performance needs, your price/performance goals, and the current capabilities of your cloud and delivery providers.

### Start with the customer

We suggest starting with the needs of your most important audience: your customers. What are the best delivery options for those customers to access your webpage, mobile application, or the content they want to see? The best option for one customer, however, will not necessarily hold true for the next. And it might change depending on how they navigate through a site and access different types of content.

Thanks to the wealth of content delivery choices available today, companies are increasingly able to optimize their specific delivery price/performance strategy to suit their specific business objectives. For example, a company may want to focus

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on driving down costs in the Chinese market. Meanwhile, due to a new product launch, they want to maximize performance in India — all without compromising their application performance in the U.S.

Apply your business metrics from the start. Companies often spend a lot on a top-tier cloud service, without the ability to evaluate the “performance effect” on their customers’ experience.

Citrix performs literally billions of measurements a day on all cloud and CDN platforms. These measurements give us unique visibility into the regional delivery of these services.

We determined that certain cloud services serve up content from less than optimal locations over half the time, due to the internet being such a fluid environment when delivering content.

### Best practice

To attain maximum performance, you need a mix of partners and a decision engine that will intelligently choose the right delivery partners and/or clouds, at the right time, to deliver content quickly and cost effectively.

### Audit and execute

Today, there are a variety of provider ecosystem options that offer ongoing insight into the price/performance reality.

For a functional and technology perspective, perform a functional audit of how your content distributors are working with you today. Where is the business logic located? What features are you using? Which of these are common to all of your partners and which are unique? There is a common misperception that each configuration is unique and switching costs can be insurmountable. **While sometimes switching is complicated, if you follow the advice given in the previous section, you can escape vendor lock-in.**

When taking inventory of your providers, pay particular attention to business logic you may have already pushed to the cloud. When working in a multivendor environment, it is critical to have consistency across the platforms. If you are using technologies that are specific to a provider, consider moving to industry-standard technologies that allow you to become vendor neutral.

### As always, consider ROI

It is also important to ensure that the ROI you are gaining from using each provider is worth the cost of the services. Also, don’t forget the cost of supporting them. Be sure to consider moving business logic back to your own architecture should you need to, as there can be significant benefits to doing this. Remember, your delivery partners ideally should be doing the heavy lifting for you. Your application architecture should focus on the higher-value transactions; effectively, your service providers are the muscle and your architecture the brain.

### Load balancing

Finally, if you are moving to a multi-CDN environment, make sure you have a system to load balance effectively between providers. As a business, the objectives for utilizing this type of architecture are likely a blend of several factors. Cost, performance, and availability could all be metrics you want to be able to evaluate when choosing how an end user should be served. To make the most of your investment, ensure you have a system that allows you to make automated, real-time decisions on how a customer should be served — with the objectives of the business in mind.

For Citrix clients, this is achieved through the integration of Citrix Intelligent Traffic Management (ITM), a highly programmable global-load balancer. Customers use ITM to combine cost, location, and real-time CDN measurements from Citrix Radar to automatically balance loads for optimal performance.

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## Key questions to ask when evaluating delivery partners

What to ask	Be sure to listen for
<b>Content delivery</b>	
Does your service use a rules engine?	Look for dynamic decision-making, not hard-coded rules that force inefficiencies into your content delivery.
What sort of dynamic load balancing does the provider use?	Watch out for round robin or pure geo-location. The internet is logical, not geographical, and changes over time. Ensure that providers have a method that allows for this.
How are you able to control content outside of normal operations?	Ensure you have methods to remove, as well as update, the content outside of regular day-to-day business practice. Displaying the wrong message can be damaging to your brand.
<b>Performance measurement</b>	
Do they offer their own data or rely on a third party?	Third-party data can be useful for benchmarking, but beware of providers who have their own data on which to base ROI/performance. You will want untainted data to audit the results.
Do they use data from your actual users for measuring performance?	Actual user data is the best data to rely on, as users are the ones judging your site or application. Server-side and agent-based metrics have their place, but your end users are paramount.  Using an evidence-based model to determine your partners is the best method.  Monitoring should be used as you roll out changes to ensure performance. Real-time monitoring is obviously much better.
<b>Services and flexibility</b>	
Can they work with multiple clouds, CDNs, and data centers?	Beware of any vendors using proprietary technologies. This will limit your ability to use other vendors.
Do they offer evaluation, configuration, and optimization services?	You will likely want to leverage their specific expertise in selecting and setting up your solution.
How are you able to configure the system?	Ensure there is an option for you to manage some of the services yourself. Hidden maintenance costs can reduce your ROI.
<b>Rollout</b>	
What do they recommend as a deployment strategy?	An uneducated rollout can be disastrous. Ensure they are flexible and will be on hand should you require their help. You are the expert in your system, but they are the experts in theirs.

## What to ask

## Be sure to listen for

### Operational support

How will they support you on a day-to-day basis and in an emergency?

You are relying on them to deliver your content on your behalf, 24/7/365. Ensure they have multiple communication and escalation lines you can interact with.

Will they train your support teams?

Using a multi-provider strategy adds complexity when locating a problem. Having your support teams educated on how to recognize which provider may have caused the problem shortens potential user impact.

## Mitigate risk as you roll out

Once you have selected the best providers for your specific delivery needs, you will need to configure and program them to work together. Ensure you mitigate the risks of deployment. Up-to-the-minute, actual user monitoring data plays an integral role here.

### Don't isolate the deployment team

Make sure you and the surrounding business units understand the broader impact of working with a particular content platform. Look at the entire corporate architecture, not just your business unit's web operations. Many organizations have business units that operate at different layers of the application architecture.

Be sure to review the plan with all teams that could be affected by your choice of architecture, including customer care, content editors, and your application development teams. Look for the quick fixes that have become established practices within these groups. These can lead to unpleasant surprises. For example, one group might be maintaining a tremendously large file for some reason, but it can impact the integration and flexibility of your new platform. Perhaps it is time they found a better way.

### Recommendations

- Prepare your QA and development environments to include CDN vs. non-CDN testing, and inform your developers. This way, they are not surprised when they do an update and see that something hasn't changed.
- Have a suitable publishing methodology (for example, unique URLs, purging, time delay), and make sure everyone knows about it.
- Ensure you have an understanding with the marketing or creative department on how long their updates will take. There is no reason why all their requirements can't be met.

### Use your existing benchmarks, and track throughout the rollout

Based on the ecosystem audit you completed as preparation, initiate testing early and continue it as you roll out the new service. Many systems during an integration phase need to be tweaked and retested. Monitoring this period can provide valuable information you can act on quickly. **Also, remember to base some of your tracking on a consistent single object that you will transition to your new environment.** Unlike pages, which often change during integration, tracking an object will give you a more quantitative before and after comparison.

### Best practice

Moving to the cloud means you will have to adjust the test environments. Ensure you spend time setting these up before you start integrating the new environments.

## Best practice

Initiate your testing early, and continue to run it as you roll out the new service. Preparing for this can reduce costly delays in implementation/integration later on.

Ramp your new architecture slowly. Your new architecture will not have seen live use yet. Caches may not have been populated, or you may not have seen how the application behaves once real-user load is applied.

## Review your test environment

Moving to the cloud means your test environments will need to be adapted. Ensure you spend time setting these up before you start integrating the new environments.

Be methodical as you bring new providers online (or remove providers). **When bringing a new provider online, do it gradually.** This will give you time to evaluate the new architecture, as well as to ensure you do not impact your existing delivery system. For example, there may be cases in which your new content provider may not already have the content on its servers. This can cause unnaturally high request rates from their servers as they first begin to populate with content. This same caution needs to be applied to removing providers. Sometimes providers become redundant geo-wise. At other times, costs can dictate that a provider needs to be removed. Either way, the same rules apply.

Many companies program their load balancers to gradually ramp up a subset of their traffic toward the new provider, while actively measuring load, response times, and performance, using end-user monitoring tools. An intelligent load balancer configuration will not send the new provider more traffic than it can handle, and, should it slow down, will route customers back to the original platform, ensuring minimal end-user impact.

Citrix has guided many clients through the addition of new providers. Users of Citrix ITM global server load balancing service typically begin by pushing 5 percent of their traffic to the new provider at first, increasing to 10 percent, and so on. We also recommend implementing an automated user-feedback mechanism into ITM so that if end users are affected by the change, you can automatically roll back to the original architecture while the issue is being resolved.

## Strategies for bringing on a new provider

- Reduce your DNS Time To Live (TTL) on the site for a week beforehand. Five minutes should really be the maximum TTL. If you have a DNS TTL of 30 days, do not be surprised if it doesn't propagate for that period of time.
  - After a week, change the DNS entry/CNAME to Citrix/CDN.
  - Keep the DNS TTL short, around 1 day.
  - Complete your testing and integration work.
  - Once happy, lengthen your DNS TTL (or have Citrix in the resolution chain). This way, you can always roll back quickly. A slightly larger DNS bill is better than having no shop online during Friday at lunchtime.
- Take the lowest risk integration first; cache nothing.
- Use opt-in caching by configuring on the origin.
  - Remember, your web server logs will be a good indicator of how well you are doing; they should shrink.
- If you use logs for reporting, make sure you set them up with the CDN to be delivered. Be aware you might not get them as quickly as you get them from your own web server. If this is a problem for your site, you may need to look at using CDN APIs to get closer to real-time reporting.
- Always have a production and a pre-production version of the config on the CDN. Also make sure people know which one is which.

- Clever authentication schemes on your pre-production site usually cause testing headaches, as the CDN can't get access to a secured backend. If you need to do this, try using a single server of the CDNs by spoofing your host file and then matching requests up to your origin. For example, look in the server logs for the IP and the request you made. A good way to do this is to attach a query string with some text you can search for. You can then add this IP into your ACLs on your firewall. Note: this is a hack and works, dependent on which CDN you use. Alternatively, use the CDN's staging network if they have one.

### Best practice

Ramp your new architecture slowly. Your new architecture will not have seen live use cases yet. Caches may not have been populated; or you may not have seen how the application behaves once real-user load is applied.

### Tips for good CDN relations

- If you have a fantastic cache hit rate and you have really small origin architecture, don't purge everything all at once. A CDN can take the origin down as it revalidates/obtains the content again. The CDN essentially carries out a DDoS attack on your origin with requests.
  - To ensure that over-purging does not take your origin down, make sure that your CDN includes a mid-tier or origin shield to prevent accidental self-inflicted DDoS.
- When debugging, start from the origin and work back to the CDN. Most CDNs are great at doing exactly what you tell them. The chances are it's probably something you configured on the origin that caused the CDN behavior to occur.
  - Check each server instance if you are getting intermittent behavior on a CDN. Cluster synchronization is a good "gotcha" and should be tested from the outside in. Just testing on the box doesn't necessarily help; follow the same path that a request would take.
- If you have a problem with some content, provide the CDN's customer care department, if you can, with the following information. It will really help them:
  - The URL you are looking at (not just a screen dump).
  - Your public IP address.
  - The server you are talking to (do a dig or nslookup).
  - If you are using a private VPN or are on a network with a proxy, tell them that it may be the proxy in your office is having a moment.
  - If you know how to use curl, send them one. HTTP headers are what CDNs run on.

### Best practice

Use of an intelligent load balancer will ensure avoiding sending the new provider more traffic than it can handle, and should the new provider slow down, it will route the customers back to your original platform, ensuring minimal end-user impact.

## Conclusion: It's a journey, and Citrix can help

Performance optimization is an ongoing exercise. Customers are becoming more demanding, the internet is becoming more complex, and delivery platforms are becoming increasingly specialized. Moving to a hybrid model is not a one-time project, but a new way for you and your website to operate.

If you are evaluating the performance benefits of an intelligent load-balancing solution and monitoring how end users are being affected by your architectural strategy, Citrix can help. ITM is our global server load-balancing solution, and it gives you the ability to precisely control the balance between performance and costs for every web transaction. ITM is even more powerful when paired with Citrix Radar, the real-user monitoring solution for real-time performance optimization. Citrix makes

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Citrix makes billions of measurements with Radar every day; there is no more comprehensive resource for measuring cloud, CDN, and data center performance.

billions of measurements with Radar every day; **there is no more comprehensive resource for measuring cloud, CDN, and data center performance.**

With its products and team of delivery solution experts, Citrix can:

- **Give you a clear picture of your global user experience.**  
Radar will tell you what is really happening on your sites, help you plug the holes in your user experience, and supplement your server-side metrics.
- **Help you choose the best delivery platforms for your business.**  
Working with Citrix consultants, you can determine if your platform partners are worth the cost, and better understand which delivery platforms best suit your business.
- **Mitigate risk as you roll out.**  
Thanks to Citrix's Real User Monitoring and load balancing, you can confidently gauge your new content partners' performance and have a fall back, in case of failure.
- **Tune and improve your users' experiences.**  
Citrix makes it easy to monitor and manage your platforms, so as the internet changes, your users' experiences — wherever they are in the world — are protected.

We hope this guide proves useful as you evaluate an upgrade to your delivery ecosystem. A great way to get started is to [sign up for a free Citrix Radar account](#). Deploy the Radar tag to see how your traffic could be improved by either deploying a multi-CDN solution or extending your current multi-CDN solution.

Sources:

1. "New data visualization on Internet users by region and country, 2010-2016," ITU
2. "Number of mobile subscribers worldwide hits 5 billion," GSMA, 2017



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