WHITE PAPER

BEST PRACTICES TO AUTOMATE AND ACCELERATE YOUR CONTENT DELIVERY

Get dramatic improvements by optimizing CDN Origin Storage
# TABLE OF CONTENTS

**Introduction** ................................................................. 3
   You May Be Losing Money, Customers, and Opportunity, and Not Even Realize It ........................................ 3

**CDN Basics and the Importance of Origin Storage** .................................................. 4
   A Word on Multi-CDN Workflows .................................................. 5

**Challenges and Best Practices for CDN Origin Storage** ........................................... 6
   Challenge: Manual Management and Operations .................................................. 6
   Best Practices: CDN-Focused Automation .................................................. 6
   Challenge: Inefficient Content Upload .................................................. 7
   Best Practices: Flexible Upload .................................................. 7
   Challenge: Single Point of Failure .................................................. 7
   Best Practices: Redundancy for High Availability ........................................ 7
   Challenge: Geography .................................................. 8
   Best Practices: Get Close to Your Audience ........................................ 8
   Challenge: Technology Fragmentation .................................................. 8
   Best Practices: Performance for Delivery .................................................. 8
   Costly, Complex Migration .................................................. 9
   Best Practices: Automated Content Migration ........................................ 9
   Customization .................................................. 9
   Best Practices: Integrated, Tested, Supported ........................................ 9

**Cohesive Limelight Solution** ........................................................................... 10
   CDN-Focused Automation .................................................. 10
   Redundancy for High Availability .................................................. 10
   Geographic Proximity to Audience .................................................. 10
   Tightly Integrated with High-Performance CDN ........................................ 10
   Open and Flexible .................................................. 10
   Automated Migration .................................................. 11
   Flexible Upload From Sites Worldwide .................................................. 11
   Integrated, Tested, Supported .................................................. 11
   Using or Considering Multi-CDN .................................................. 11

**Conclusion and Recommendations** ................................................................. 12

**About The Orchestrate Platform** ................................................................. 12

**About Limelicht Networks** ................................................................. 12

**Figures**

   - Figure 1: Delivery on Cache Hit. Requested asset is found in edge cache ........................................ 4
   - Figure 2: Delivery on Cache Miss with External Origin Storage ........................................ 5
   - Figure 3: Delivery on Cache Miss with Limelight Origin Storage ........................................ 10
INTRODUCTION

YOU MAY BE LOSING MONEY, CUSTOMERS, AND OPPORTUNITY, AND NOT EVEN REALIZE IT

Over half of all internet traffic is now carried by CDNs (Content Delivery Networks), and many more companies are considering a CDN. In particular, online video, rich web media, file downloads, gaming, and e-commerce content can benefit from a CDN. And the stakes are high. Today’s digital audience will abandon a video that rebuffers 3 times, a website that takes more than 3 seconds to load, a file download that takes too long to complete.

CDN delivery improves performance, but a CDN is only as strong as its weakest link. In many CDN environments, CDN origin storage is the weakest link, a critical but underappreciated element of the content delivery chain. The right origin storage can dramatically improve response time, reliability, overall cost and management overhead.

This paper introduces the basic concepts, explores challenges, and outlines best practices for CDN origin storage. It illuminates ways that origin storage can have a significant positive or negative impact on online delivery performance and therefore on user experience. It also explores impact on business operations, staff resources, and capital or operational expenses.
CDN BASICS AND THE IMPORTANCE OF ORIGIN STORAGE

The open internet by itself could not handle the demands of today’s traffic, amounting to billions of video streams, rich web pages, file downloads, game updates, online shopping pageviews, and more every day. Enter content delivery networks, which make the modern internet possible by improving the performance and reliability of digital delivery.

CDNs use edge caching of popular content—replicating popular assets to multiple locations around the edges of the Internet. By storing content in multiple geographically-distributed locations, users can access content from a site that is close to them, rather than needing to go to a single location that may be far away.

The fastest digital content delivery response generally takes place on what is called a cache hit. Cache hit means the asset is found in edge cache and can be retrieved and delivered quickly without having to go back to the original storage location of the content. As shown in Fig. 1: Delivery on Cache Hit, an audience member requests an asset (1), the CDN finds the asset in edge cache and delivers it (2).

![Figure 1: Delivery on Cache Hit. Requested asset is found in edge cache.](image)

However, there will be many cases where the requested content is not in edge cache – a cache miss. This content needs to be retrieved from the origin storage system that contains the requested content. A cache miss may happen for a number of reasons – it may be the first time the asset has been requested and therefore it is not already in cache, the asset may be less popular and has been automatically aged out of the cache, it may have been intentionally purged from cache, it may have been defined as an asset not to be cached, or other reasons.
On cache miss, the CDN needs to retrieve the asset from origin storage. As shown in Fig. 2: Delivery on Cache Miss, an audience member requests an asset that is not in edge cache (1). The CDN requests the asset from origin storage (dotted line below 2). Origin storage processes the request and serves the asset to the CDN (solid line below 2). Then the CDN can deliver it to the audience member (3).

![Figure 2: Delivery on Cache Miss with External Origin Storage.](image)

Requested asset is not found in edge cache.

Note: Fig. 2 shows origin storage that is external to the CDN, requiring request and delivery to traverse the open internet.

All told, there are billions of cache misses per day.

**A WORD ON MULTI-CDN WORKFLOWS**

Some companies spread their content delivery across multiple CDN vendors, a practice known as multi-CDN. However, the probability of a cache miss is generally higher in multi-CDN environments. As content is divided across multiple CDNs, a given asset is less likely to be found in a given vendor’s cache. Origin storage is a more important factor in multi-CDN environments. Best practices become more of a challenge because of this diverse nature.
CHALLENGES AND BEST PRACTICES FOR CDN ORIGIN STORAGE

Origin storage is a critical component of any CDN infrastructure, but it can be complex to efficiently deploy and maintain. Depending on how it’s implemented, origin storage can cost time, resources, and money while delivering poor customer experience. Fortunately, if you know the secrets it’s easy to do right.

CHALLENGE: MANUAL MANAGEMENT AND OPERATIONS

According to Gartner, “Talent has now been recognized globally as the single biggest issue standing in the way of CIOs achieving their objectives.”

If that’s the case in your organization, it’s critical that you deploy your talent for the highest benefit. Cost-benefit decisions often hinge on what may be unique advantages for your business vs. what may be available on the open market. It makes sense to develop unique capabilities. However in the case of CDN origin storage, some companies select general-purpose storage, then end up spending significant resources on application-specific development, management and optimization.

BEST PRACTICES: CDN-FOCUSED AUTOMATION

One of Gartner’s recommendations is “considering customers, citizens, vendors and partners as extensions (and digital accelerators) of the talent platform”. A vendor skilled in CDN best practices can automate key tasks associated with CDN setup, content upload, content distribution, management and delivery. Benefits of such automation include more efficient use of staff time and resources, and higher quality delivery performance to users.

Best practices include:

- Investigate storage solutions that are already optimized for CDN origin storage workflows
- Automate labor-intensive tasks in the content delivery workflow
CHALLENGE: INEFFICIENT CONTENT UPLOAD
Uploading large amounts of content into storage can be time-consuming and expensive. Certain limitations can make the overall process worse. If upload sites do not have high-speed access and are far from the storage location, upload times can increase exponentially. If high-speed file transfer protocols to upload content to the storage are limited or not available, workflow productivity and success rate can suffer. Impact can include additional staff overhead, lengthy delays before content is available, failed uploads, and higher costs of bandwidth and fees.

BEST PRACTICES: FLEXIBLE UPLOAD
The highest efficiency upload uses high-speed links to a nearby location and an optimized file transfer protocol. Many organizations want to upload from multiple locations using different protocols. A solution that can operate at scale is required.

Best practices include:

- Align your organization’s content source locations with storage upload locations
- Accelerate upload with high-speed access
- Explore whether your organization’s preferred upload protocols are supported

CHALLENGE: SINGLE POINT OF FAILURE
The estimated cost of an unplanned outage is $9,000 per minute⁵. Businesses are in a constant struggle to avoid such an outage.

In early 2017, a cloud storage outage cost an estimated $150 million to the S&P 500 alone⁴. The total impact including small and medium business was far higher. Even though this outage took place in a single location in the Eastern US, the impact was global. However, the losses and the global impact were preventable. The companies impacted by this outage relied on a single storage location—a single point of failure. When that storage location became unavailable, the businesses' digital services lost key functionality. With no backup or failover in place, the service outage became catastrophic.

Without redundancy, if one storage location fails, the entire content delivery value chain goes down.

BEST PRACTICES: REDUNDANCY FOR HIGH AVAILABILITY
Eliminating a single point of failure—and the risks associated—requires the practices of redundancy, automatic failover, and in the case of content delivery, geographic distribution. These are well known, tried-and-true practices, but they may not be easy to implement without significant expenditure of resource. Selecting a proven, tested solution with built-in redundancy can save organizations manpower and time, while providing exceptional user experience to the desired audiences.

Storage failover needs to be rapid, reliable, and robust. If it takes your team significant time and effort to detect the issue and implement the failover procedures, the impact to your business could be significant.

Best practices include:

- Establish redundancy practices to ensure high availability
- Automate the failover process to minimize impact
- Consider a vendor that offers these capabilities integrated with its solution
**CHALLENGE: GEOGRAPHY**

Where is your audience located? Whether you’re targeting a limited geography or a global audience, the location of origin storage matters. Latency routinely jumps an order of magnitude from in-region to intercontinental—from tens of milliseconds to hundreds. Throughput can also be affected: “with standard TCP connections the round trip time between client and server (i.e. ping time) imposes an upper limit on maximum throughput.” So, geographical placement of origin storage is an important factor in delivering a high-quality user experience.

If you’re relying on a single origin storage location or region, it could be halfway around the world from much of your audience. In addition to sheer distance, both the request and the retrieval may be hampered by internet traffic routing, network hops, time spent waiting in router queues, and other delays. Delivery will be sluggish at best, and may experience unacceptable delay or failure.

**BEST PRACTICES: GET CLOSE TO YOUR AUDIENCE**

Placing content close to your audience is a fundamental CDN concept for improving performance. Best practices for origin storage adopt this same concept, and replicate content in multiple geographic locations that are close to the audience that will be requesting the content. Ideally, this replication should be automated to minimize manual intervention and the possibility of errors. These practices provide better response time and availability while minimizing overhead.

Best practices include:

- Distribute content in redundant location in multiple geographies
- Align geographic distribution based on audience location profiles

**CHALLENGE: TECHNOLOGY FRAGMENTATION**

Abandon rates are a KPI for most digital businesses. 78% of people will stop watching online video if it rebuffers three times. Similar stats exist for file downloads, web online shopping, gaming, and other payloads. Slow retrieval from origin storage is a frequent contributor to slow performance.

For both signaling and content planes, latency becomes cumulative. Delay can be introduced by server load, congestion on the open internet, traversing multiple networks, authentication, device queue latency, reroutes, and outages. With each link or handoff, compounding impacts can hamper user experience. In addition, management complexity, service issues, and expense can also be affected.

**BEST PRACTICES: PERFORMANCE FOR DELIVERY**

To minimize abandon rates, recognize the impact that origin storage can have. Plan to access content from origin storage with minimal technology fragmentation.

Best practices include:

- Integrate content origin technology with delivery networks
- Minimize the number of provider handoffs end-to-end
- Integrate proven high-performance providers in the delivery chain, and minimize reliance on the open internet
COSTLY, COMPLEX MIGRATION
Migrating content from one storage platform to another can consume significant resources. It’s not just the cost of the migration itself, it’s also the time and effort involved in managing migration. You may have a large library of videos, many files to deliver, a website with many assets, a lot of items in your online store, or a lot of files in your gaming system. How do you know which ones to move and in what order? The staff time drain can be significant, involving data gathering, traffic reporting and analysis, determining which assets to move and in what order, setting up the process, managing the migration, developing necessary scripts or other code, and monitoring progress—all with manual operations and oversight involved.

BEST PRACTICES: AUTOMATED CONTENT MIGRATION
Best practices for streamlining content migration center around improving efficiency via automation. In migrating content, automation can eliminate the overhead involved, especially if intelligent processes can be applied.

Best practices include:
• Identify which assets to migrate based on audience demand
• Automate migration of identified assets
• Automate placement and replication of content in regions where your audience is concentrated

CUSTOMIZATION
It could cost an organization $500,000 to implement multi-region stability with high availability and best practices7. For example, a large cloud storage provider offers a detailed document with general design principles, best practices and guidance for architecting solutions on their platform. But in the end, you need to spend your resources to design, architect, build, test, and deploy an origin storage solution.

The opportunity cost may be even more significant than the cost of the storage. Designing, building, deploying and managing a custom CDN storage consumes significant resources. Those are resources that won’t be available for higher-value projects that set you apart from your competition, achieve key business objectives, and improve your efficiency.

BEST PRACTICES: INTEGRATED, TESTED, SUPPORTED
Improved total cost of ownership, time to market, delivery quality, reliability, and customer satisfaction can all result from deploying a proven solution. In addition, the freedom to allocate resources to higher-value projects converts opportunity cost into opportunity. Finally, where customization is required, it’s faster, more efficient and more reliable to customize a proven platform than to build a custom solution from scratch.

Best practices include:
• Before building a custom solution on generic storage, identify alternative projects you could deploy those resources on, and calculate the opportunity cost
• Explore turnkey solutions that are already optimized for CDN origin storage
• Consult on a project basis with experts in CDN origin storage
COHESIVE LIMELIGHT SOLUTION

Limelight Origin Storage Services are optimized for the unique needs of CDN origin storage. Process automation saves staff time and resources and reduces errors. Delivery automation ensures exceptional user experience, with best-of-breed performance and resiliency on origin storage retrieval. Tight integration with the Limelight Orchestrate Platform, including PoP collocation and private fiber network transport, combines with intelligent best-site serving to provide the highest possible performance on cache miss.

CDN-FOCUSED AUTOMATION

Limelight automates key operations specific to the unique needs of CDN origin storage, so you can spend your time and resources on higher value tasks that are unique to your business.

REDUNDANCY FOR HIGH AVAILABILITY

At no extra cost, Limelight applies high-availability best practices to both populating content and delivering it.

- When ingesting content, Limelight automatically replicates it to multiple storage locations based on customer-selected policies.
- When retrieving content from storage, Limelight serves it from the best-performing location. If there is an issue, the system will automatically detect issues and failover to an alternative storage location.

GEOGRAPHIC PROXIMITY TO AUDIENCE

Placing content closer to the audience is a primary way CDNs accelerate content delivery. Limelight extends this concept to origin storage, with a menu of regional replication policies to choose from. Choose policies based on where your target users are concentrated, and Limelight does the rest, distributing content automatically to the appropriate worldwide storage locations.

TIGHTLY INTEGRATED WITH HIGH-PERFORMANCE CDN

Tight integration of origin storage with the content delivery infrastructure improves delivery performance. Limelight Origin Storage is collocated in many of the same Points of Presence as the edge devices that are delivering content. Our private fiber backbone network transfers content faster than the open internet, whether for replication or delivery.

OPEN AND FLEXIBLE

Limelight’s technology stack is platform-agnostic. Unlike other vendors, Limelight doesn’t employ custom scripting languages, non-standard authentication modules, or other tricks to lock you in to a vendor. Limelight views a customer relationship as a partnership.
AUTOMATED MIGRATION

Limelight’s unique Intelligent Ingest automates the migration of content from current storage to Limelight’s high-performance Origin Storage via HTTP. Intelligent Ingest has two modes, which can be combined for flexibility.

- **Load on Demand**—Automates upload based on audience requests. When content that is not already in cache is requested, it will be accessed from the legacy origin storage system and delivered to the user, and also added to Limelight Origin Storage system. Content is automatically migrated to Limelight Origin Storage based upon popularity and user demand without any manual intervention. Load on Demand lets you specify limits like maximum concurrency and bandwidth, so you do not overwhelm the legacy storage system with transfer requests.

- **Manifest Upload**—Automates upload based on a list of content you provide. By creating a manifest of content to be transferred from the legacy storage system to Limelight Origin Storage, you can easily migrate all your content or just a selected portion of it, without major interruption to your workflow. To protect your legacy storage system from being overwhelmed by transfer requests, you can easily configure total migration time and control the ingest rate up to 10 TB/day.

FLEXIBLE UPLOAD FROM SITES WORLDWIDE

In addition to Intelligent Ingest that automates content migration, Limelight offers worldwide upload locations and multiple upload methods, all at no extra cost. Upload methods include a web-based GUI, Limelight’s API which supports multi-part uploads, Aspera, and legacy protocols including FTP, SCP, SFTP, RSYNC, and FTP-SSL.

Simply upload your content to a nearby location. Limelight automatically replicates the content based on your policies. Your content is transferred across Limelight’s private fiber backbone to Origin Storage locations that are close to your users. No matter where your content is created, Limelight makes it fast and easy to automatically position content in storage locations close to where it will be delivered.

INTEGRATED, TESTED, SUPPORTED

Limelight has made a significant investment in developing, testing, and optimizing the world’s leading CDN origin storage system. Limelight Origin Storage is a proven turnkey solution that can be easily configured to support any content delivery workflow. And if you have complex workflow challenges, Limelight’s Advanced Services team can become a valuable extension of your team. Limelight’s experts can analyze your existing workflow, optimize your storage configuration, and train your team—reducing costs to you and accelerating your time to market.

USING OR CONSIDERING MULTI-CDN?

For those companies that are using or considering deploying multiple CDN’s, Limelight has the ideal origin storage solution. Origin storage is even more important in a multi-CDN environment, because there’s a significantly higher chance of cache miss on a given request. Limelight Origin Storage can be used in a multi-CDN workflow as the origin storage for all of your CDNs. With Limelight Origin Storage, you get the benefits of workflow automation and flexibility, high performance and availability at global scale, and a private fiber network for transfer and handoff to over 900 peering partners for delivery to other CDN’s.
CONCLUSION AND RECOMMENDATIONS

Origin storage is a critical yet often underappreciated element of the CDN value chain. The quality of content delivery and user experience—the reason companies use a CDN in the first place—can suffer greatly due to poorly optimized origin storage. Typical cloud storage is not optimized for content delivery workflows. Developing these critical CDN capabilities on top of general-purpose storage requires significant time and effort that can drain staff and financial resources that could be much better spent elsewhere.

Limelight Origin Storage Services are optimized for the unique requirements of global content delivery through the Limelight Orchestrate Platform or a multi-CDN environments. They can save resources while providing exceptional audience experience. The solution integrates best practices, including CDN-focused automation, redundancy, geographic content distribution, automatic best-site serving with failover, automated migration, and tight integration with delivery infrastructure.

Limelight Networks has worked with many of the largest brands in the world to implement CDN origin storage. Whether you currently use Limelight CDN or not, we invite you to learn how you could gain significant efficiency and performance with Limelight Origin Storage by signing up for a free trial at limelight.com.

ABOUT THE ORCHESTRATE PLATFORM

The Limelight Orchestrate Platform is built upon a global, private backbone network with the speed, capacity, and availability to deliver the experiences today’s audiences demand. This industry-leading Platform includes integrated content delivery, web acceleration, origin storage, video management, cloud security, and support services. The unique combination of global private infrastructure, advanced software, and expert services surpasses other CDNs, to enable today’s and tomorrow’s workflows and put audience experience first.

ABOUT LIMELIGHT NETWORKS

Limelight Networks Inc., (NASDAQ: LLNW), a global leader in digital content delivery, empowers customers to better engage online audiences by enabling them to securely manage and globally deliver digital content, on any device. The company’s award winning Limelight Orchestrate™ platform includes an integrated suite of content delivery technology and services that helps organizations secure digital content, deliver exceptional multi-screen experiences, improve brand awareness, drive revenue, and enhance customer relationships — all while reducing costs. For more information, please visit www.limelight.com, read our blog, follow us on Twitter, Facebook and LinkedIn and be sure to visit Limelight Connect.

1 Cisco white paper “The Zettabyte Era: Trends and Analysis”, June 2017
2 The Gartner CIO Agenda 2016
3 Ponemon Institute
4 Estimate by cyber-risk startup Cyence Inc.
5 Global ping statistics from wondernetwork.com
6 “The Surprising Effect of Distance on Download Speed”, httpwatch.com referencing Aladdin Nassar
7 451 Research