

# Optimizing Content Delivery Network Design

Andy Banta – Storage Janitor  
Powered by MagnitionIO



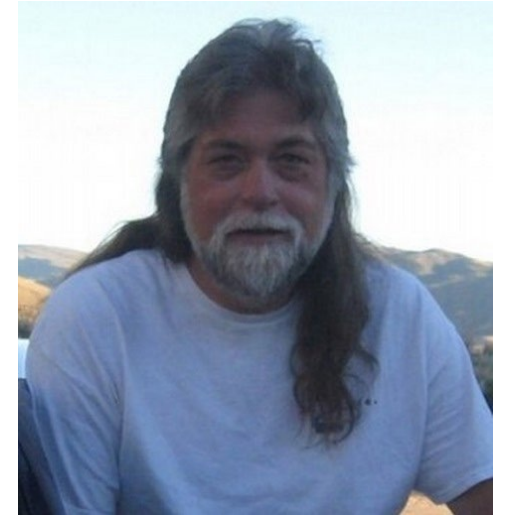
## COMPUTE, MEMORY, AND STORAGE SUMMIT

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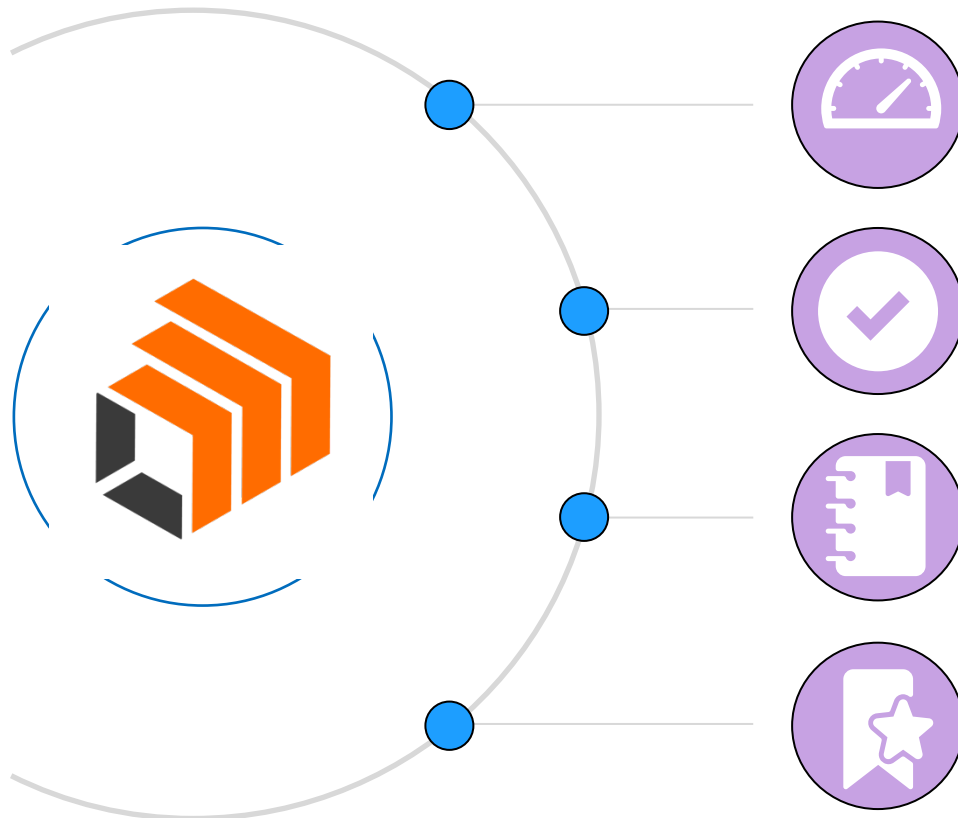
# Andy Banta

Magnition.io (Consultant)  
SolidFire (VMware development, acq. by NetApp)  
DataGravity (Container exploitation lead)  
VMware (iSCSI Tech Lead, IPO)  
Sun Microsystems (Initial Fibre Channel development)  
Patent, early distributed network projects, data acquisition  
@andybanta



# ABOUT MAGNITION

STORAGE PERFORMANCE, REINVENTED



## World's First Real-Time Data Placement Optimization

Patented technology is a first for the industry.

## Proven At-Scale, with Production Workloads

Use customer traces to fully test diverse workloads in real-time.

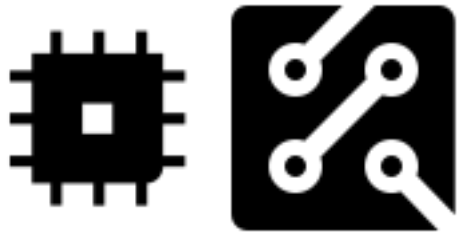
## Peer-Reviewed and Published in Leading Journals

Multiple industry articles published and reviewed.

## Award-Winning, Patented Technology

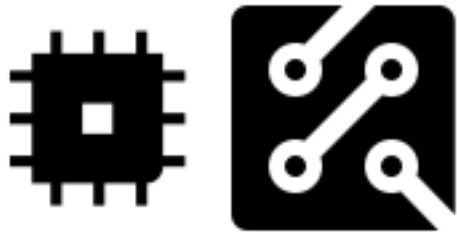
3-time award winner for innovative technology.

# Engineering simulation



# Engineering simulation

- Cheaper, faster, more flexible than system building
- Engineering design uses simulations, why not software?



# What is Content Delivery



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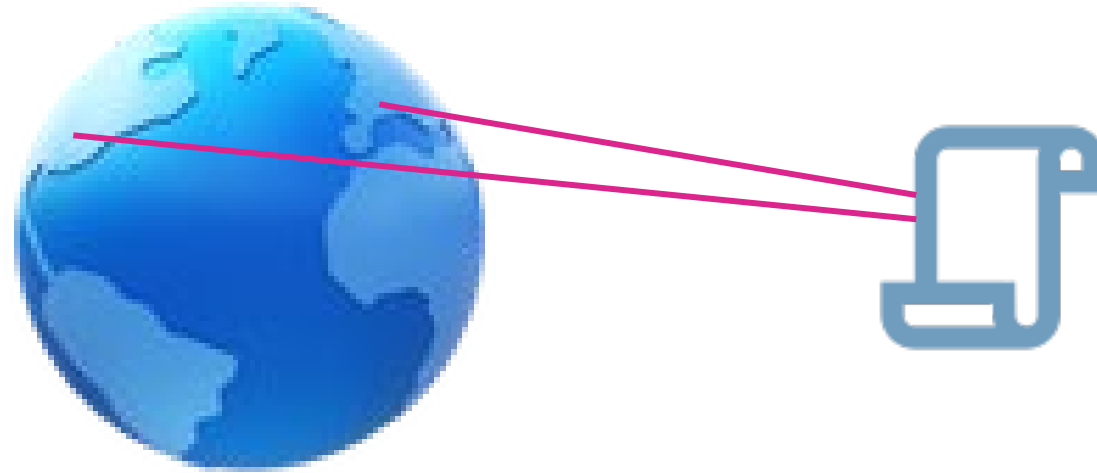
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# Content Delivery Networks

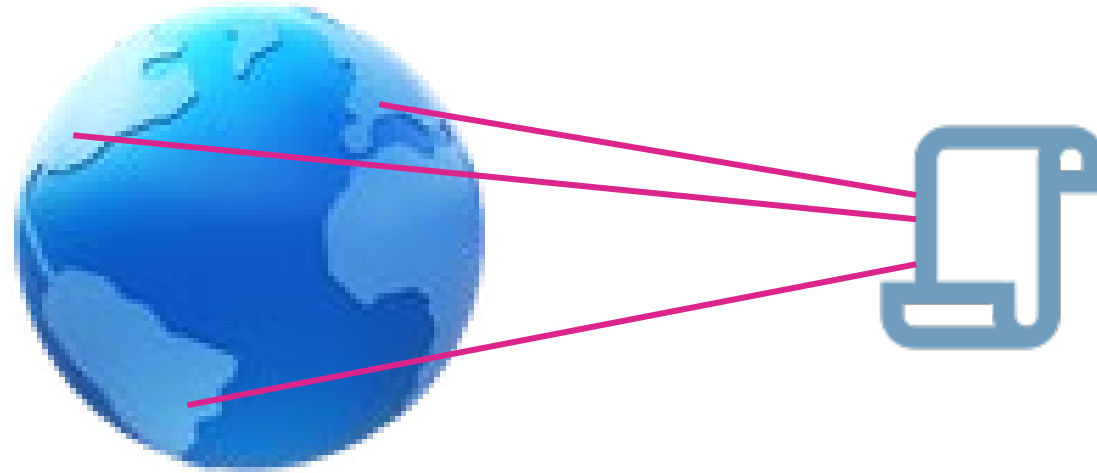


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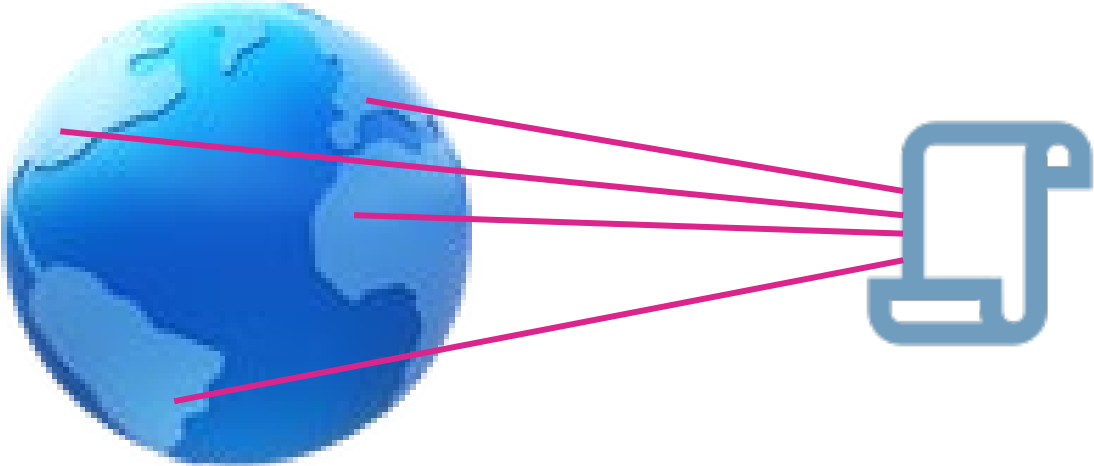




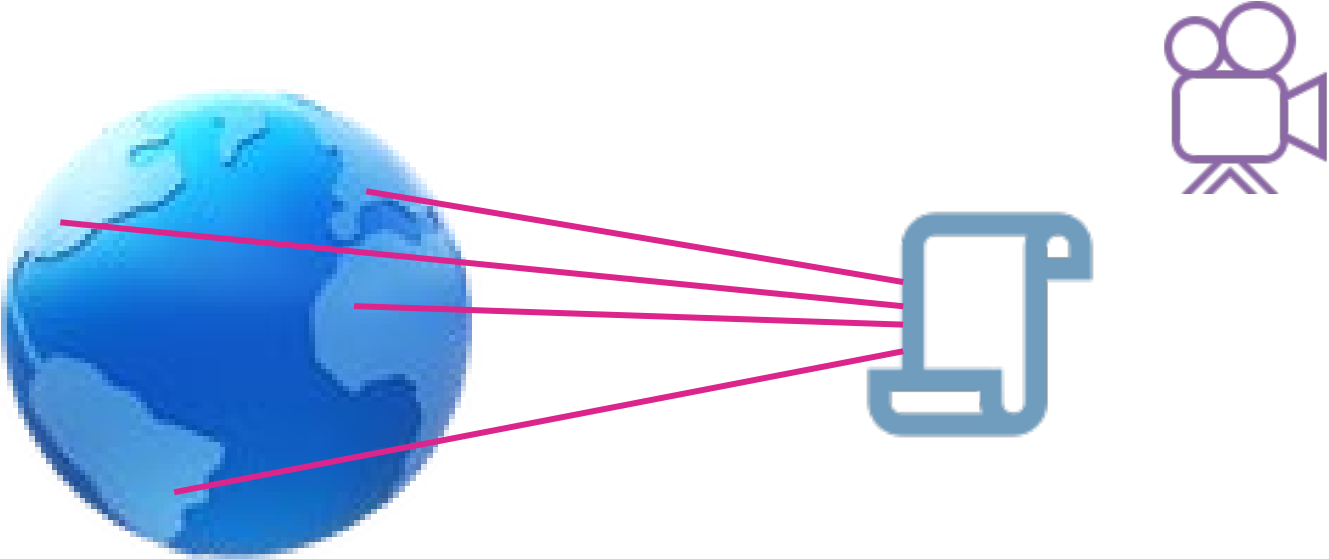
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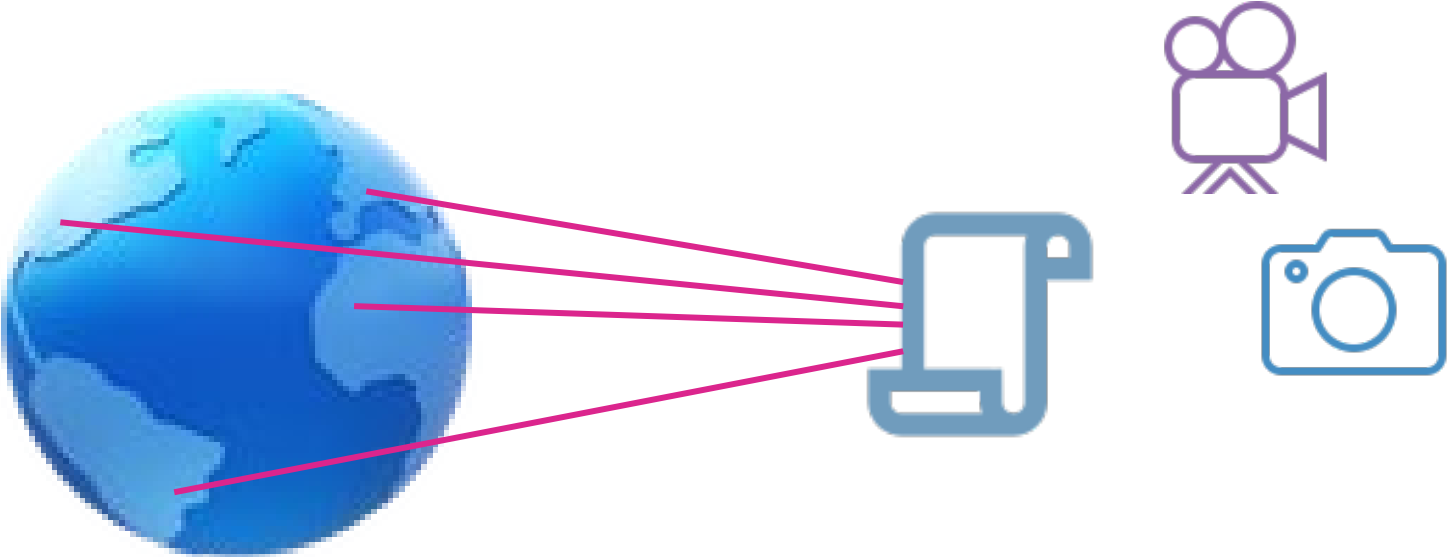
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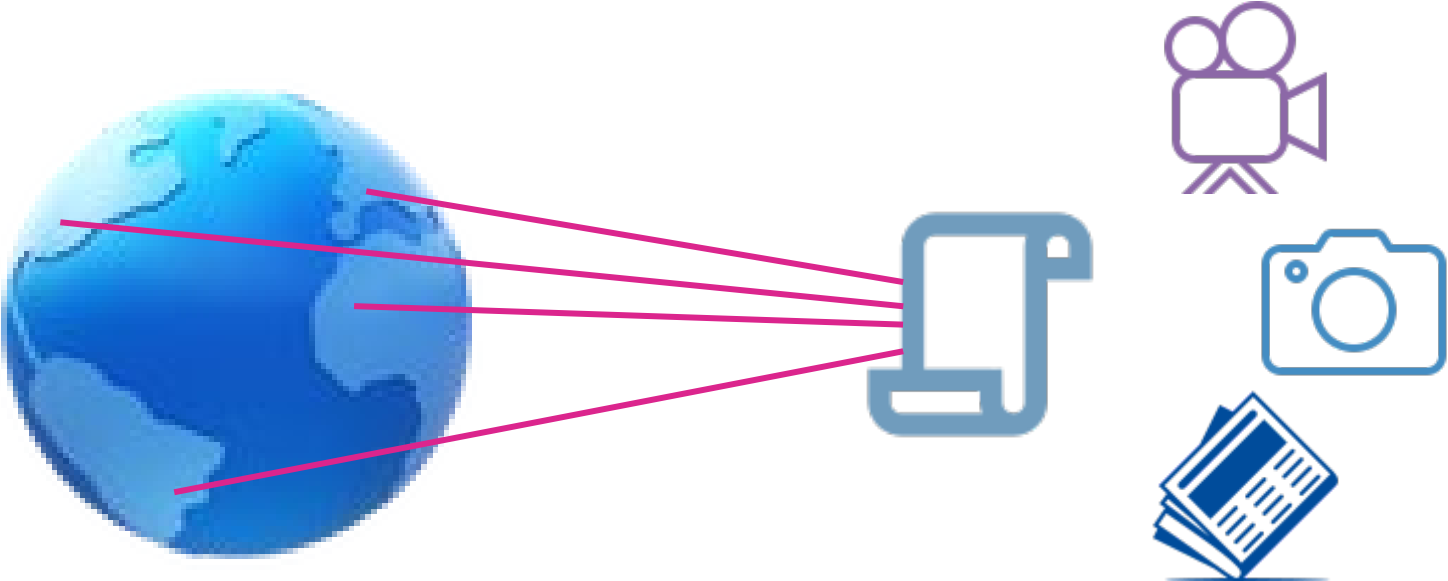
# Content Delivery Networks



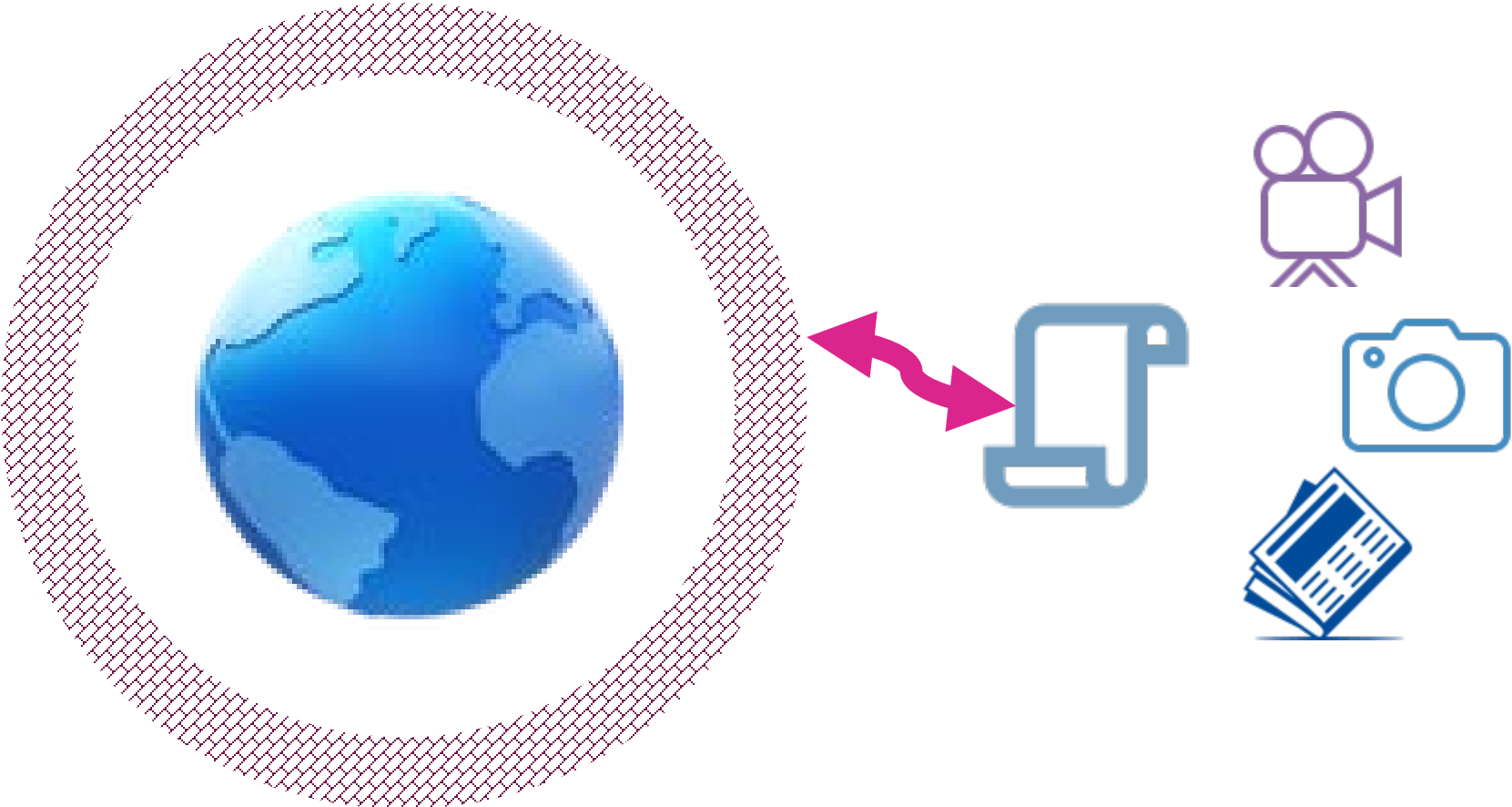
# Content Delivery Networks



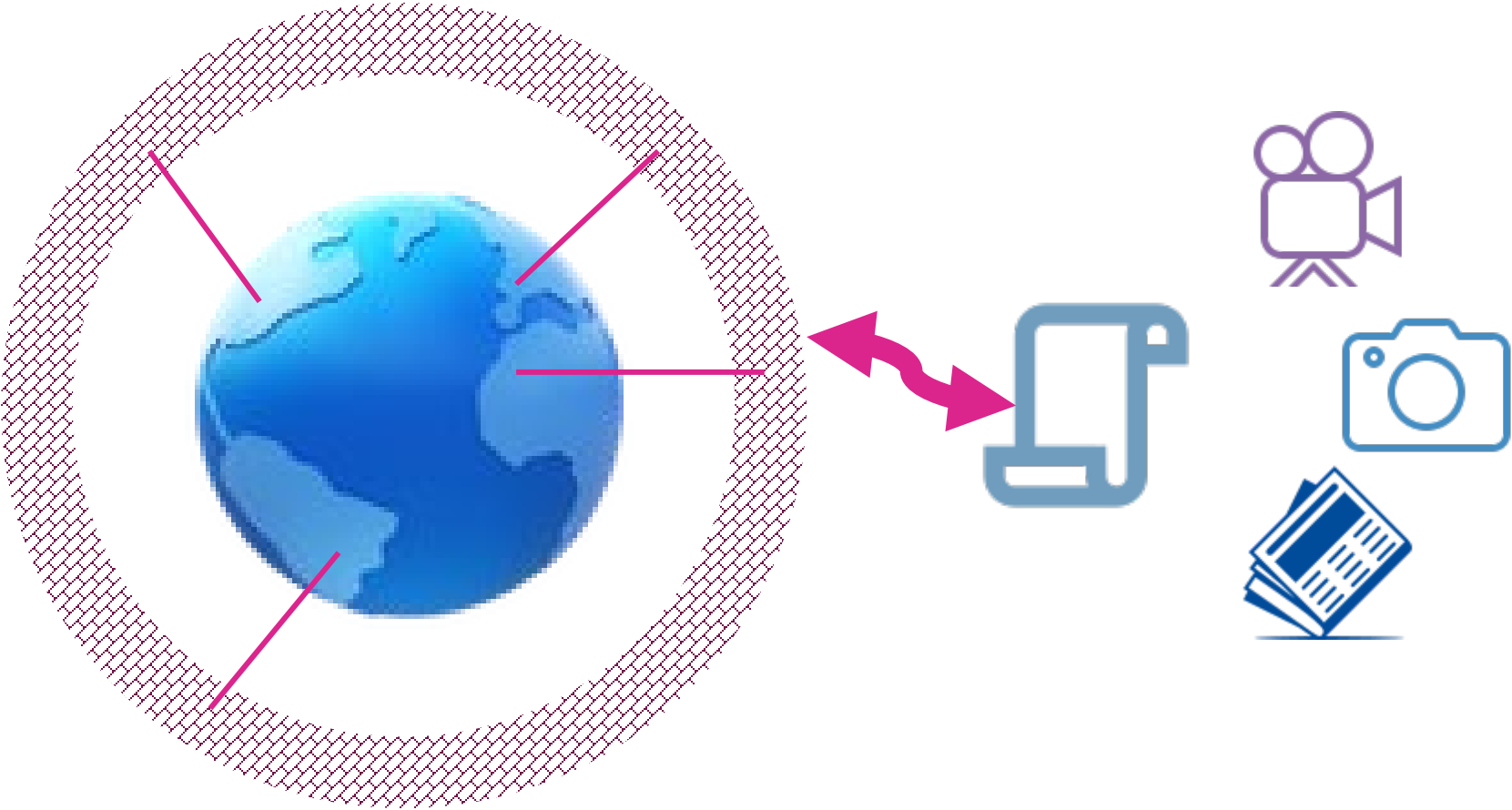
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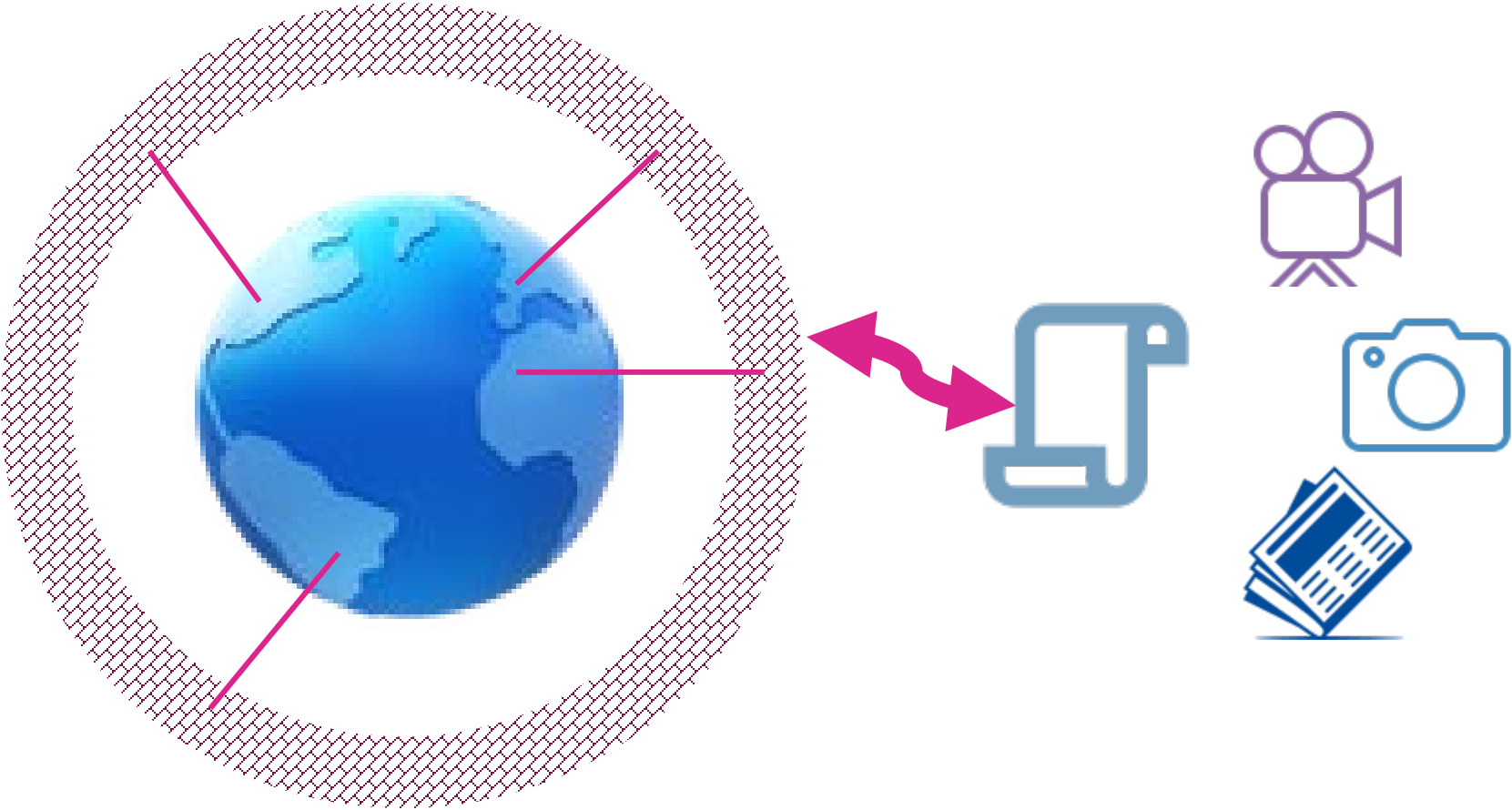
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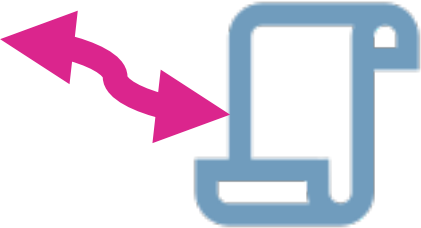
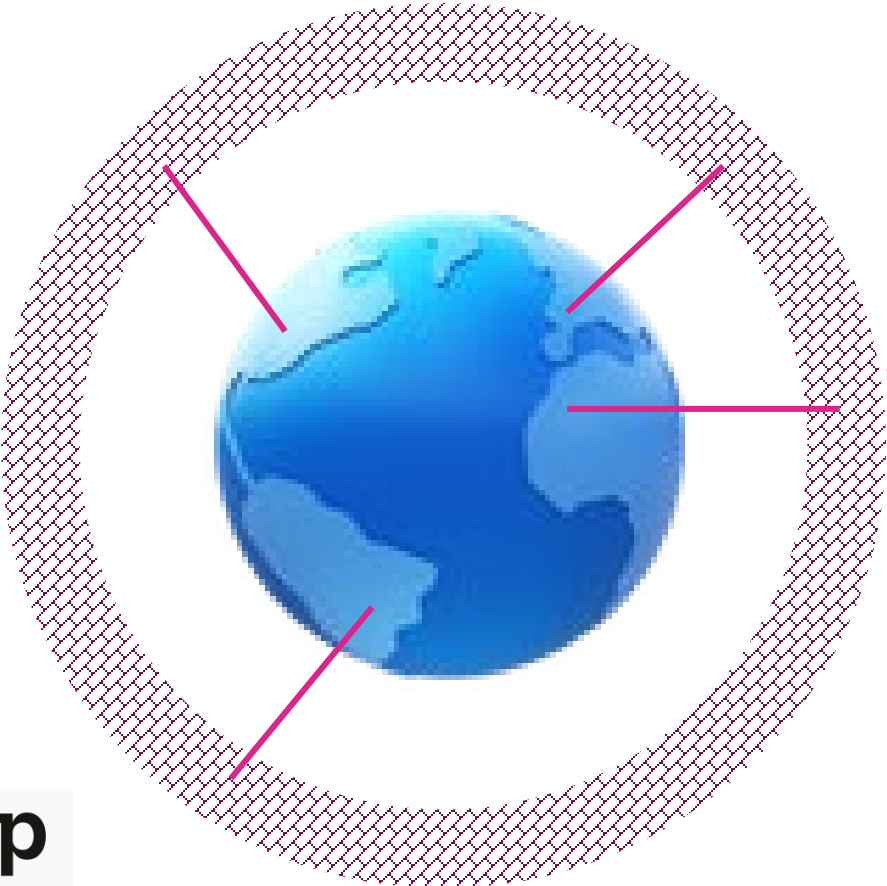


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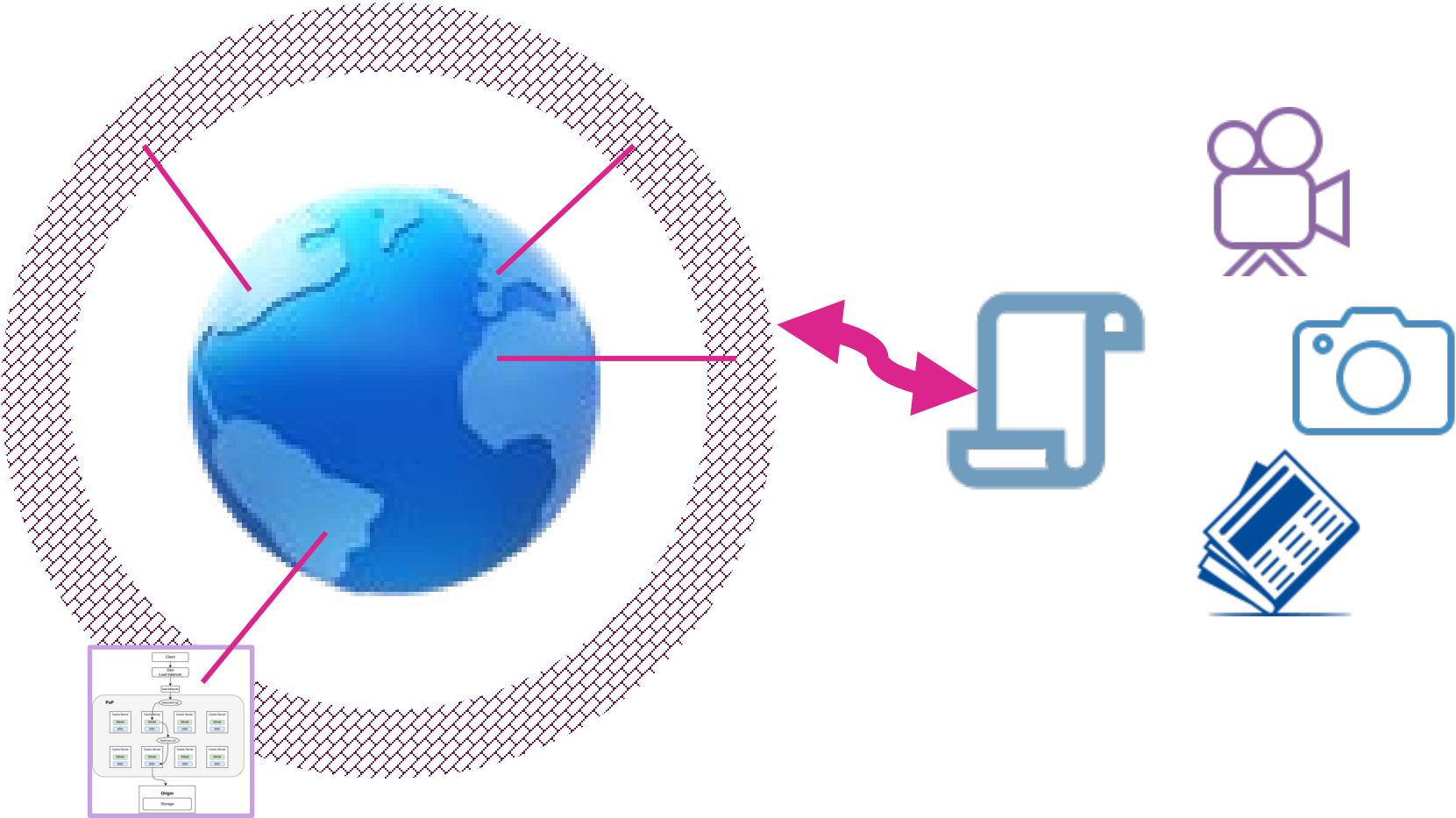




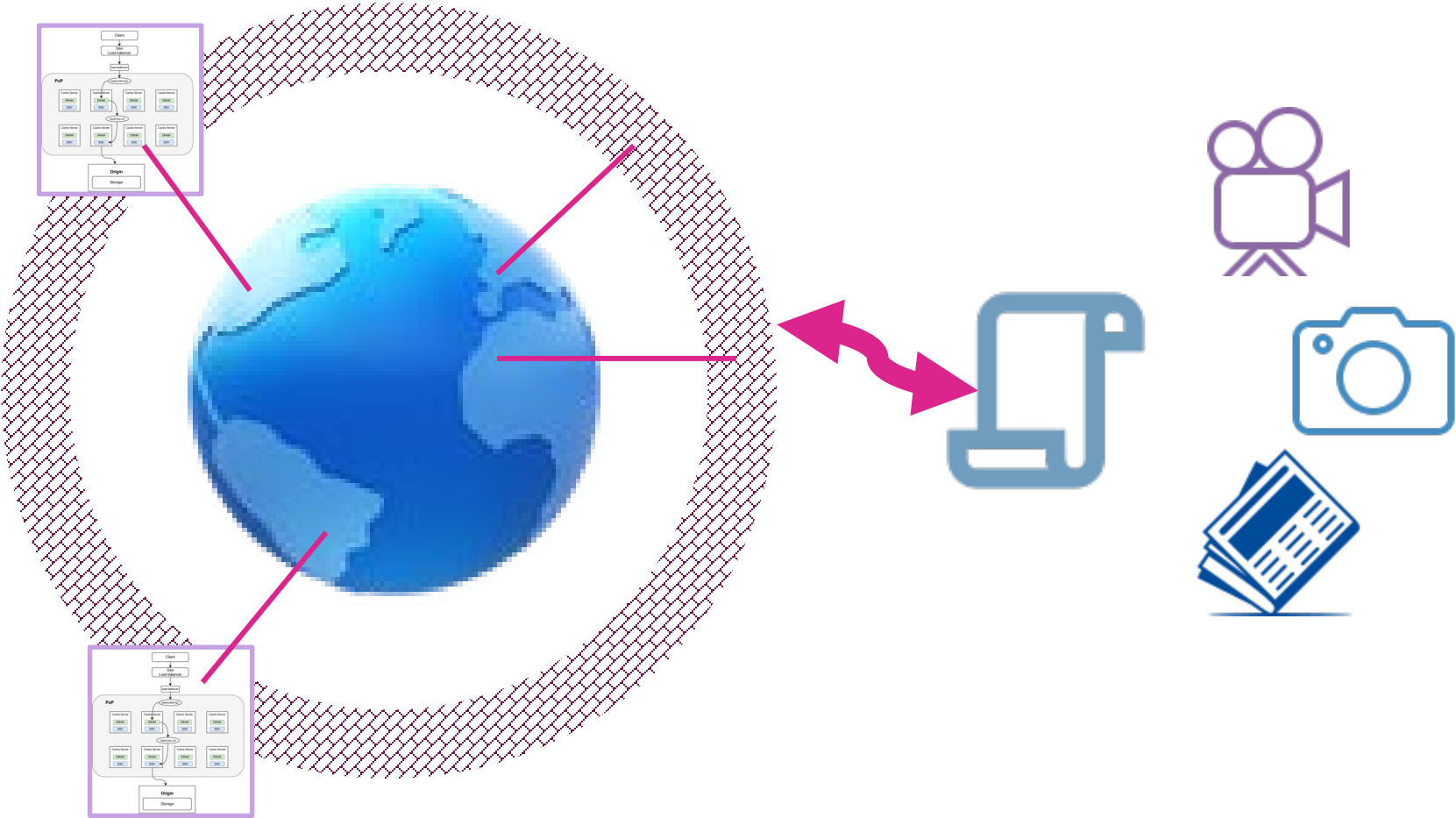
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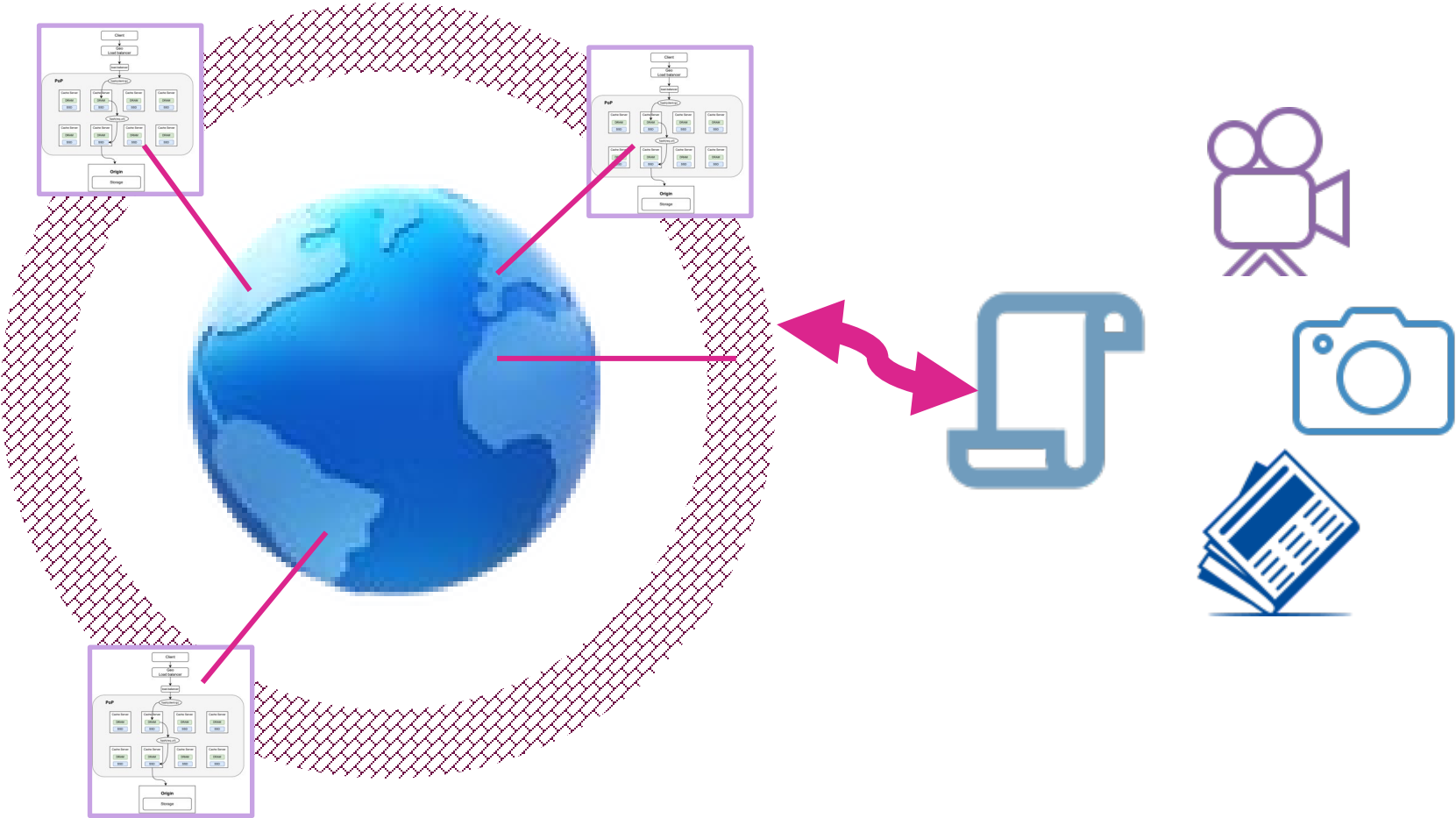
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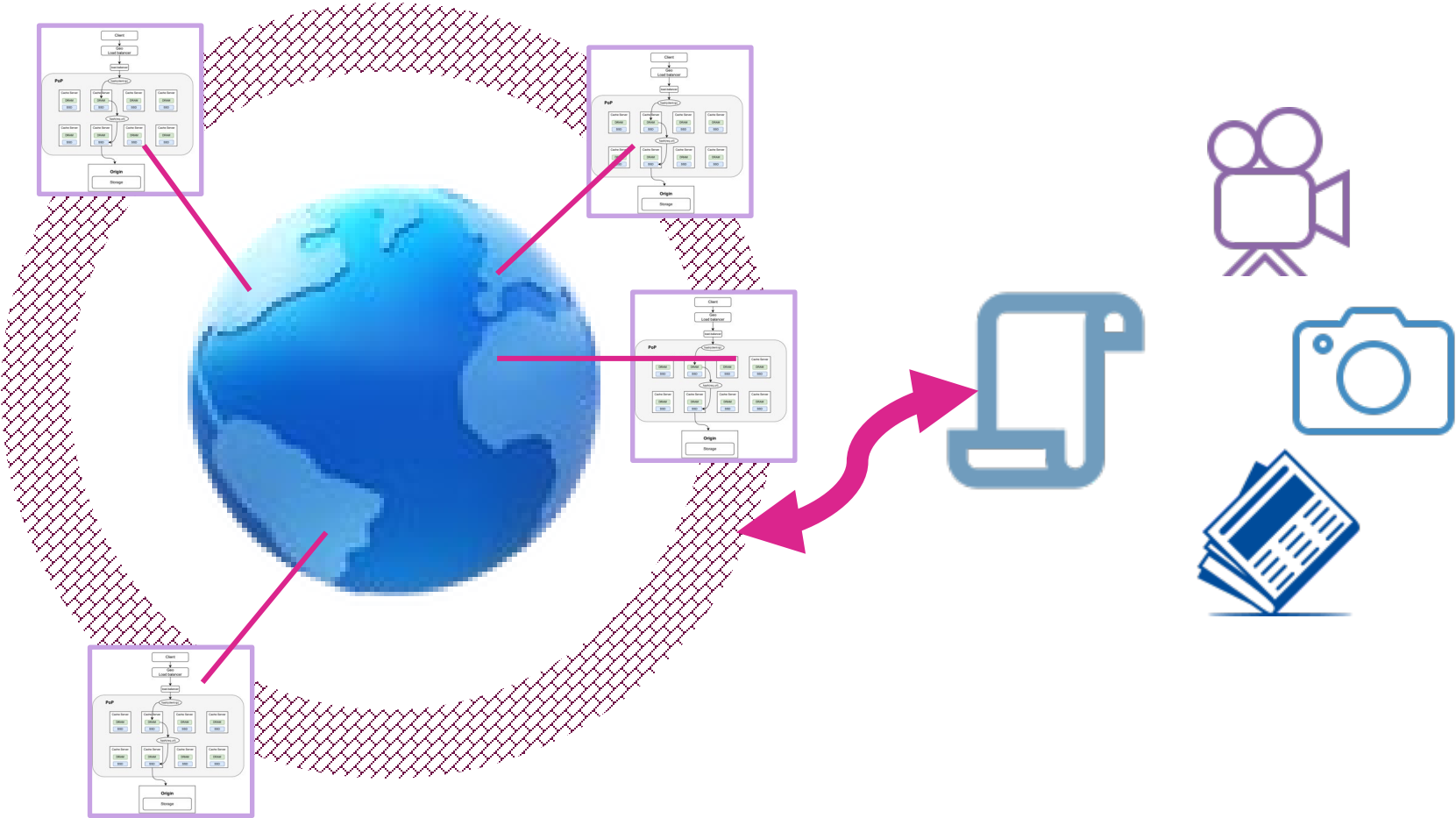
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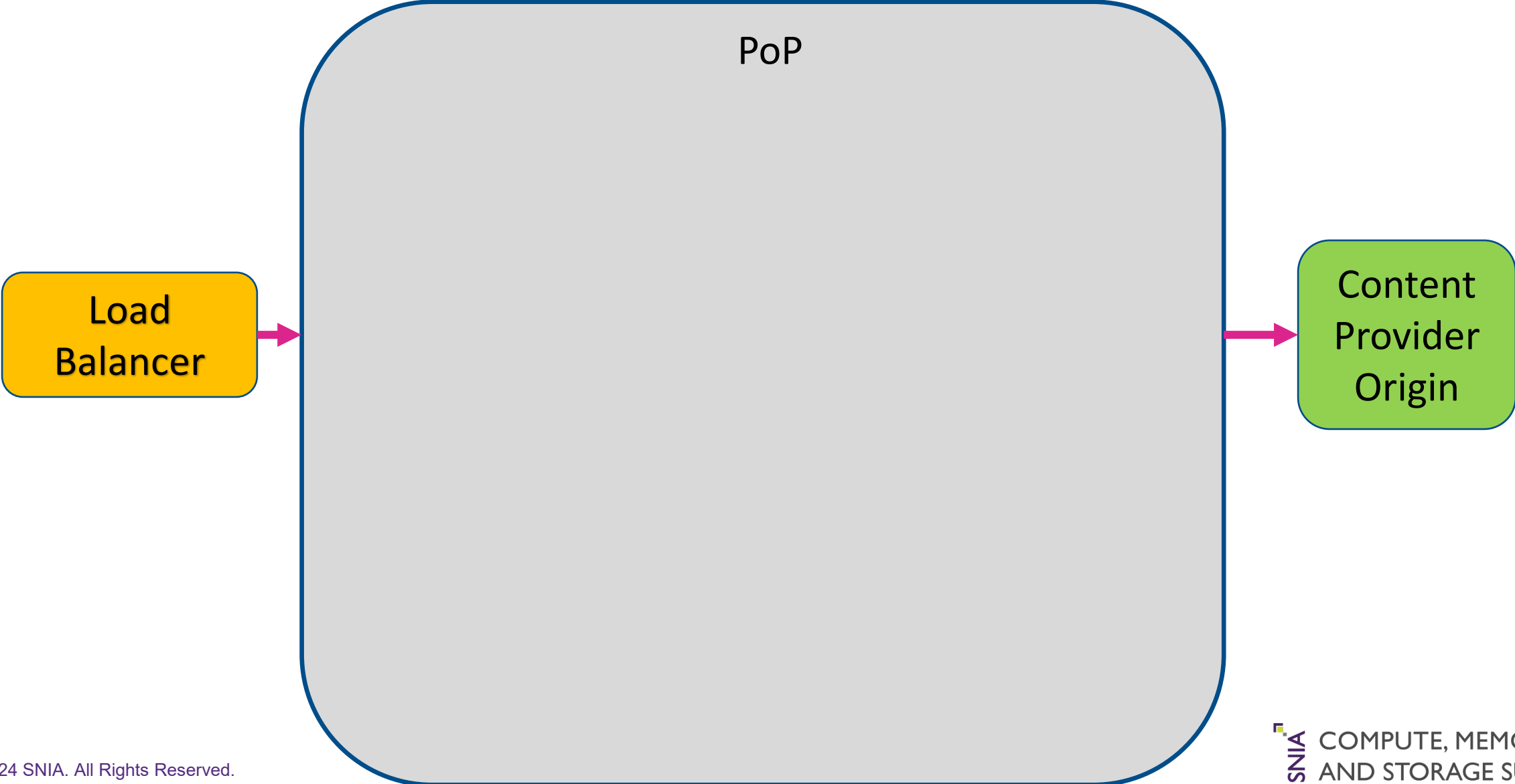
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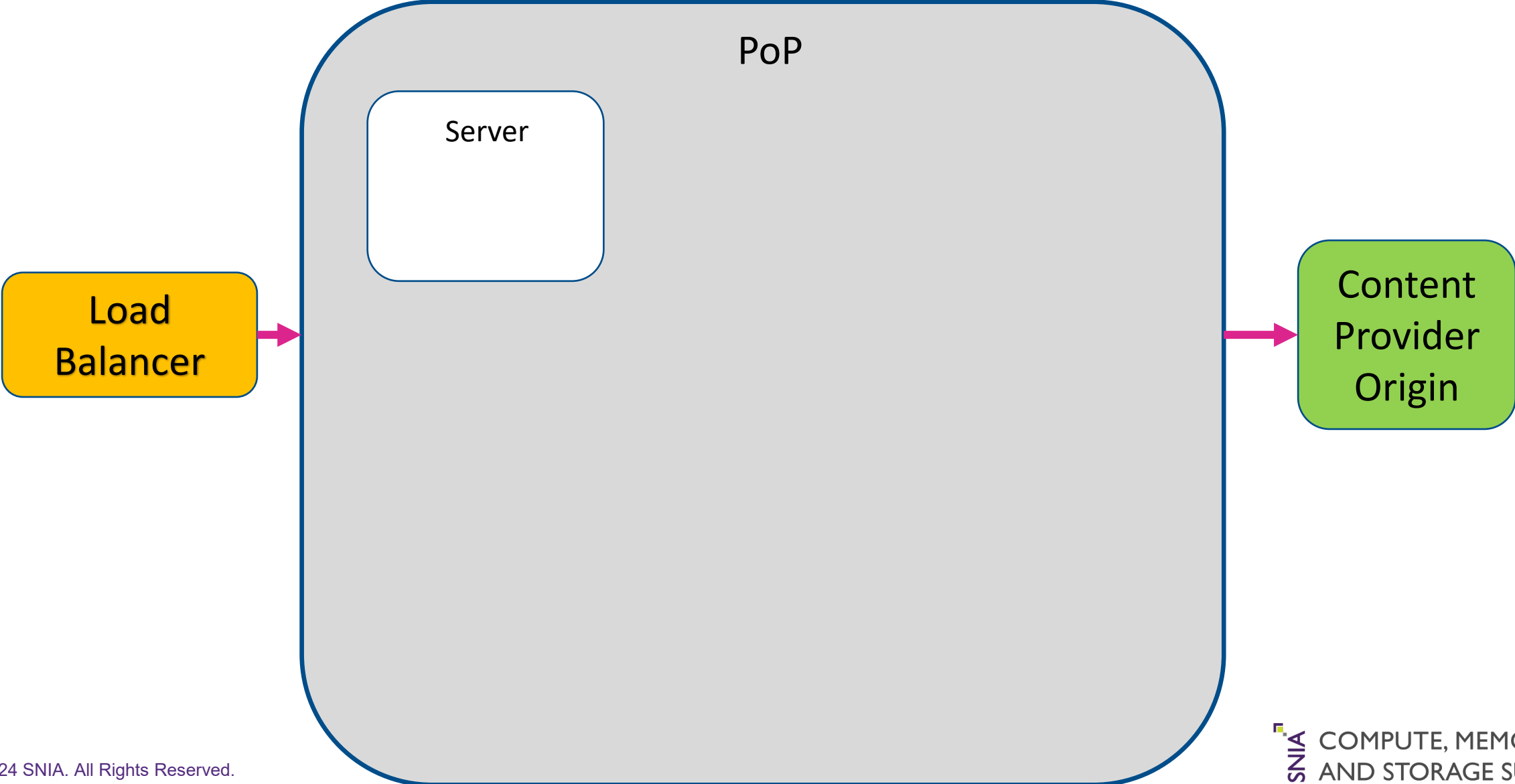
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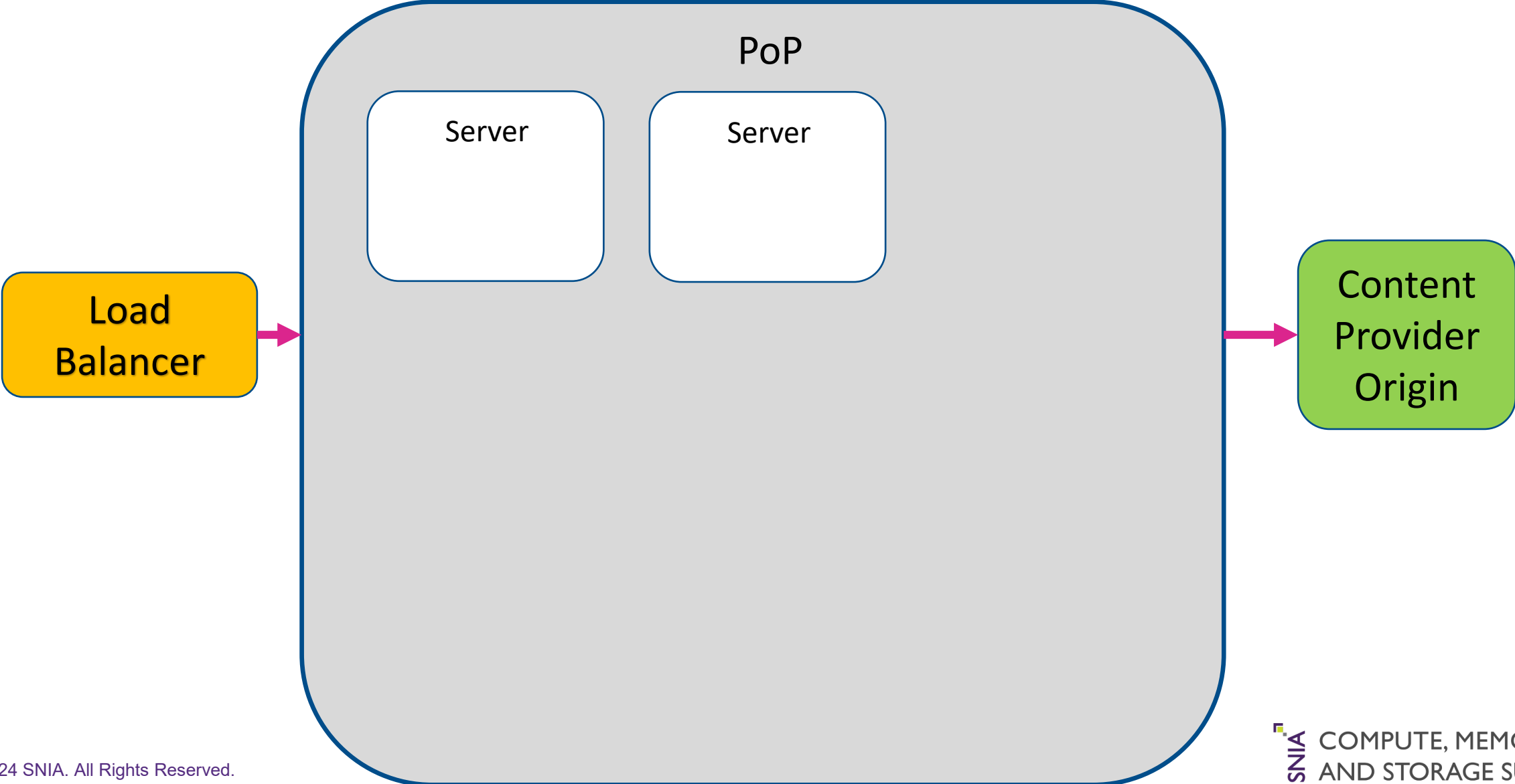
# CDN PoP



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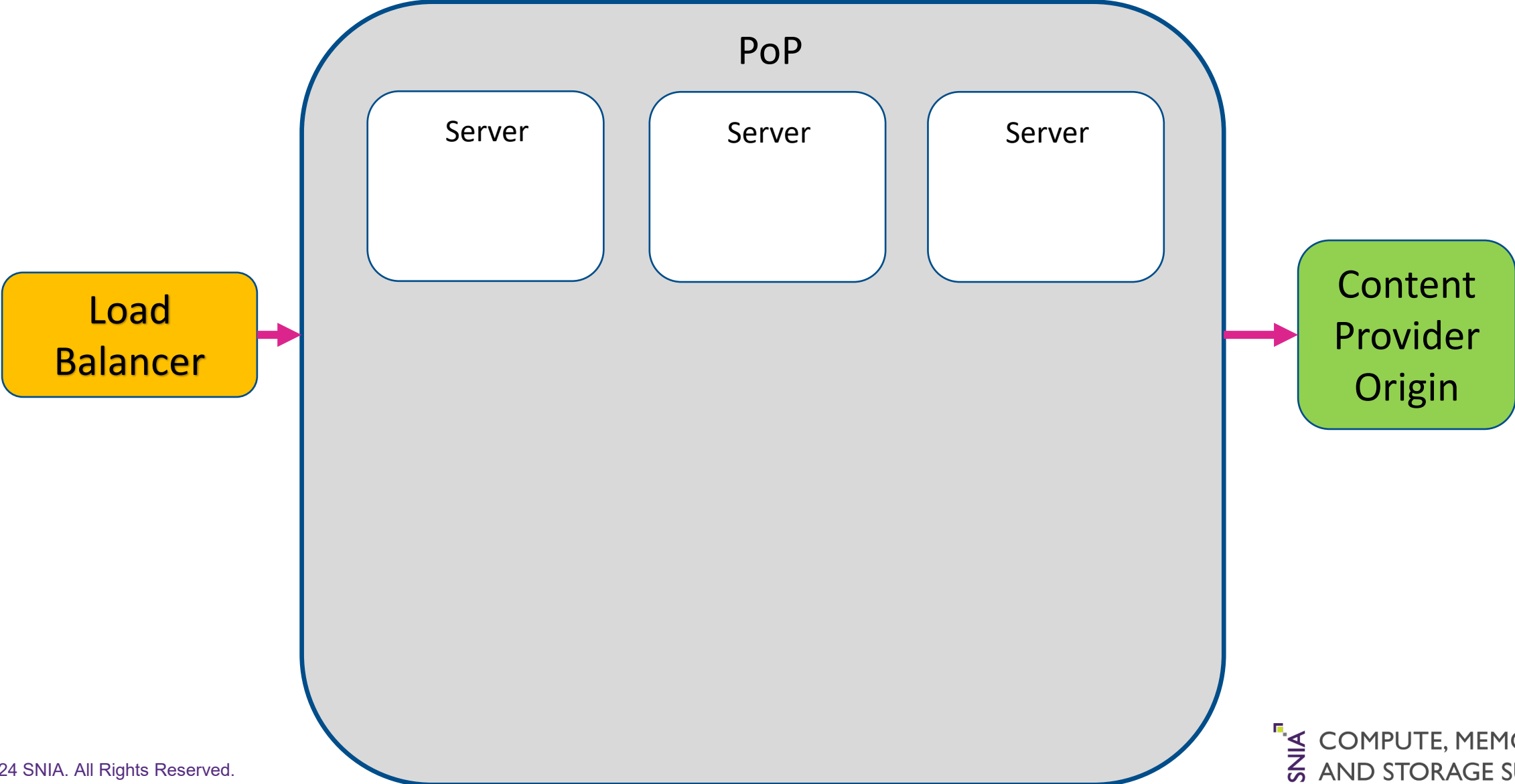


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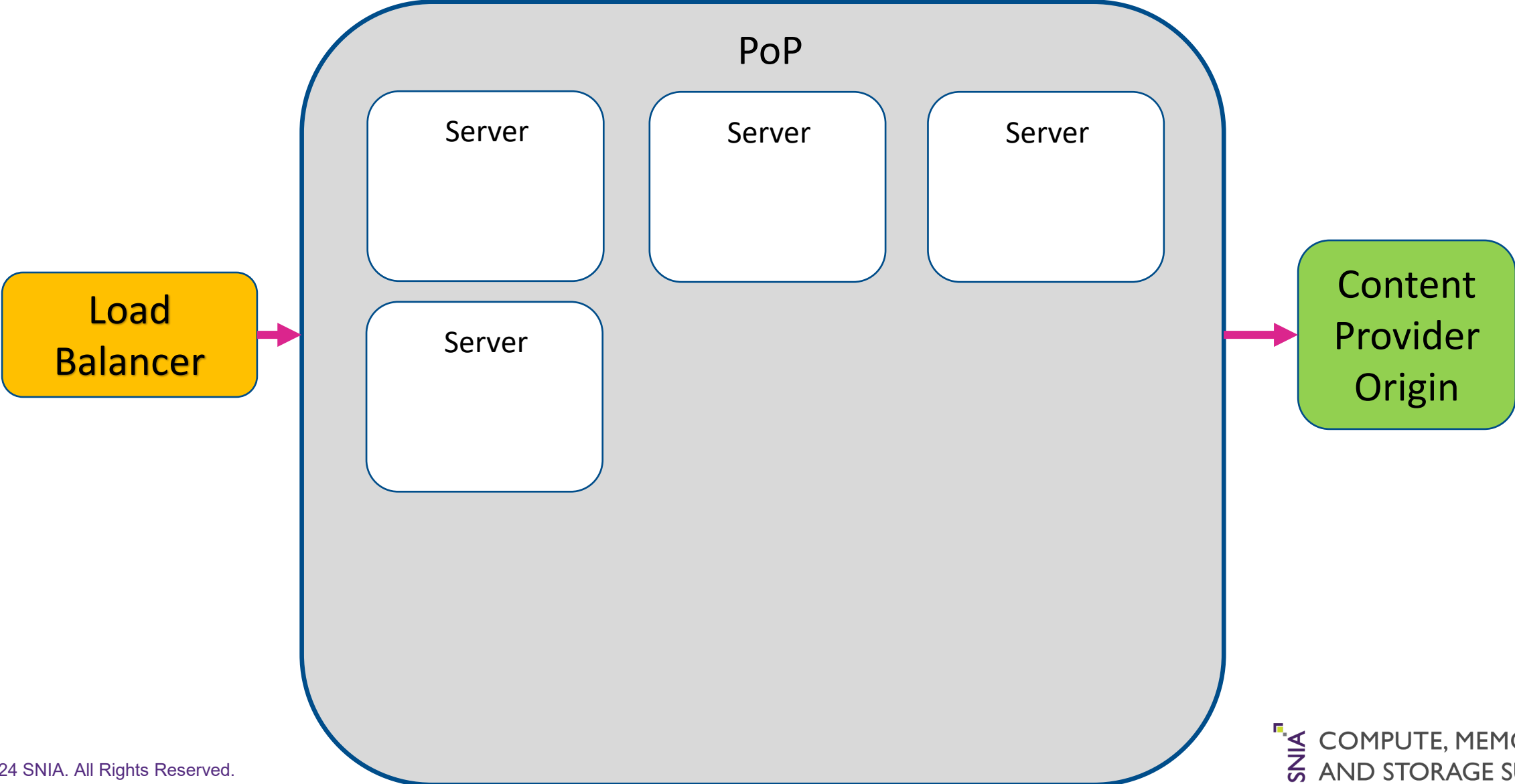




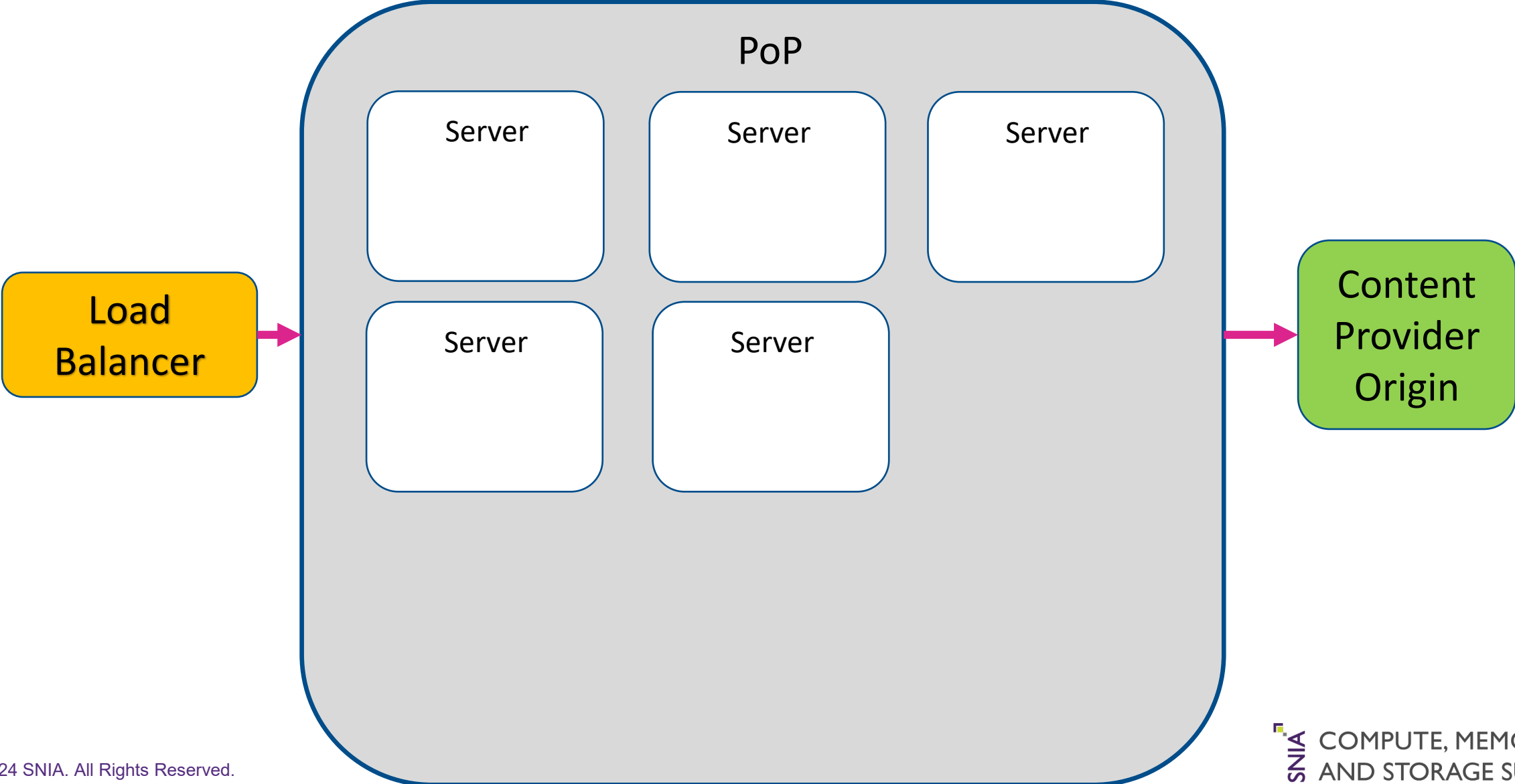
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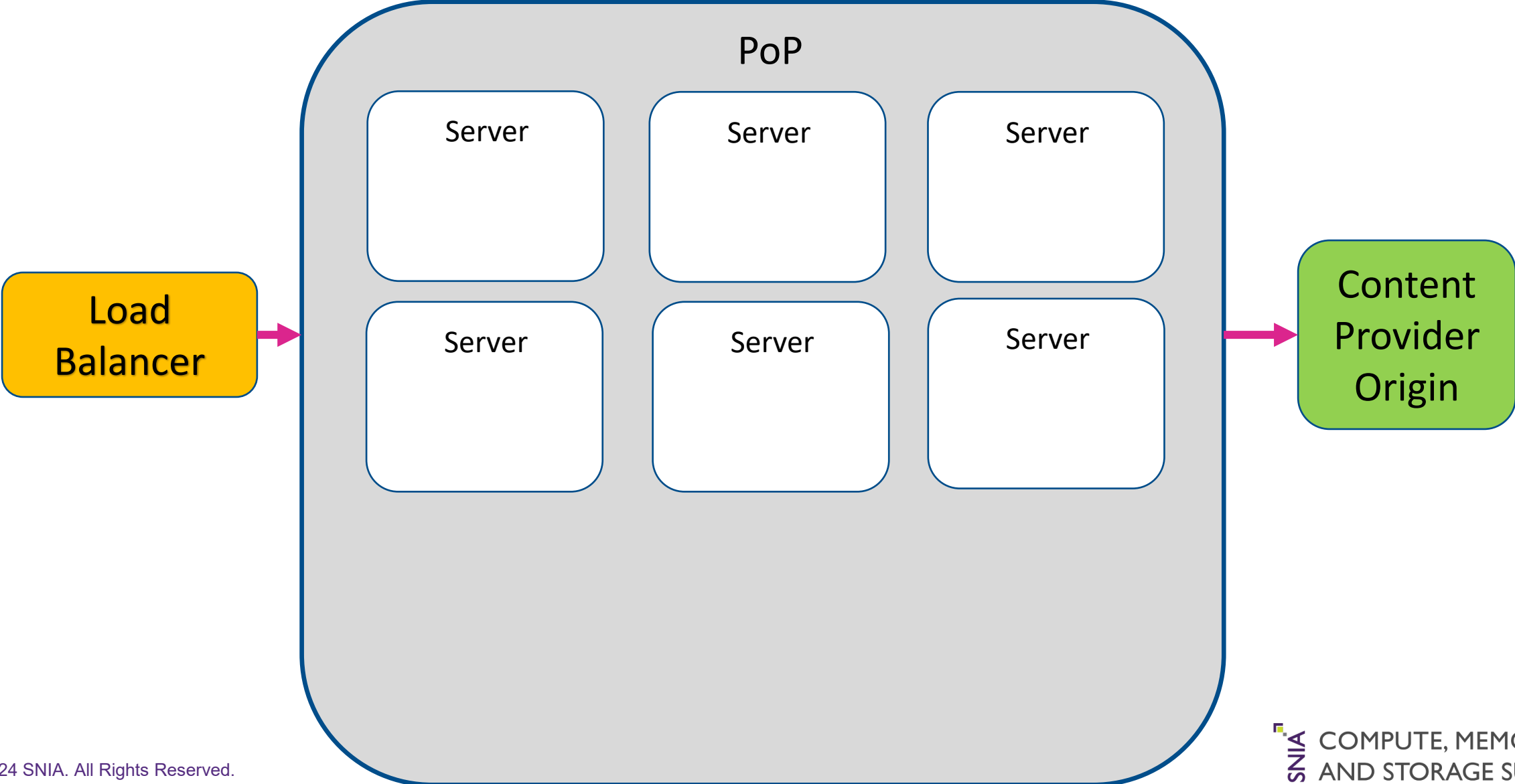
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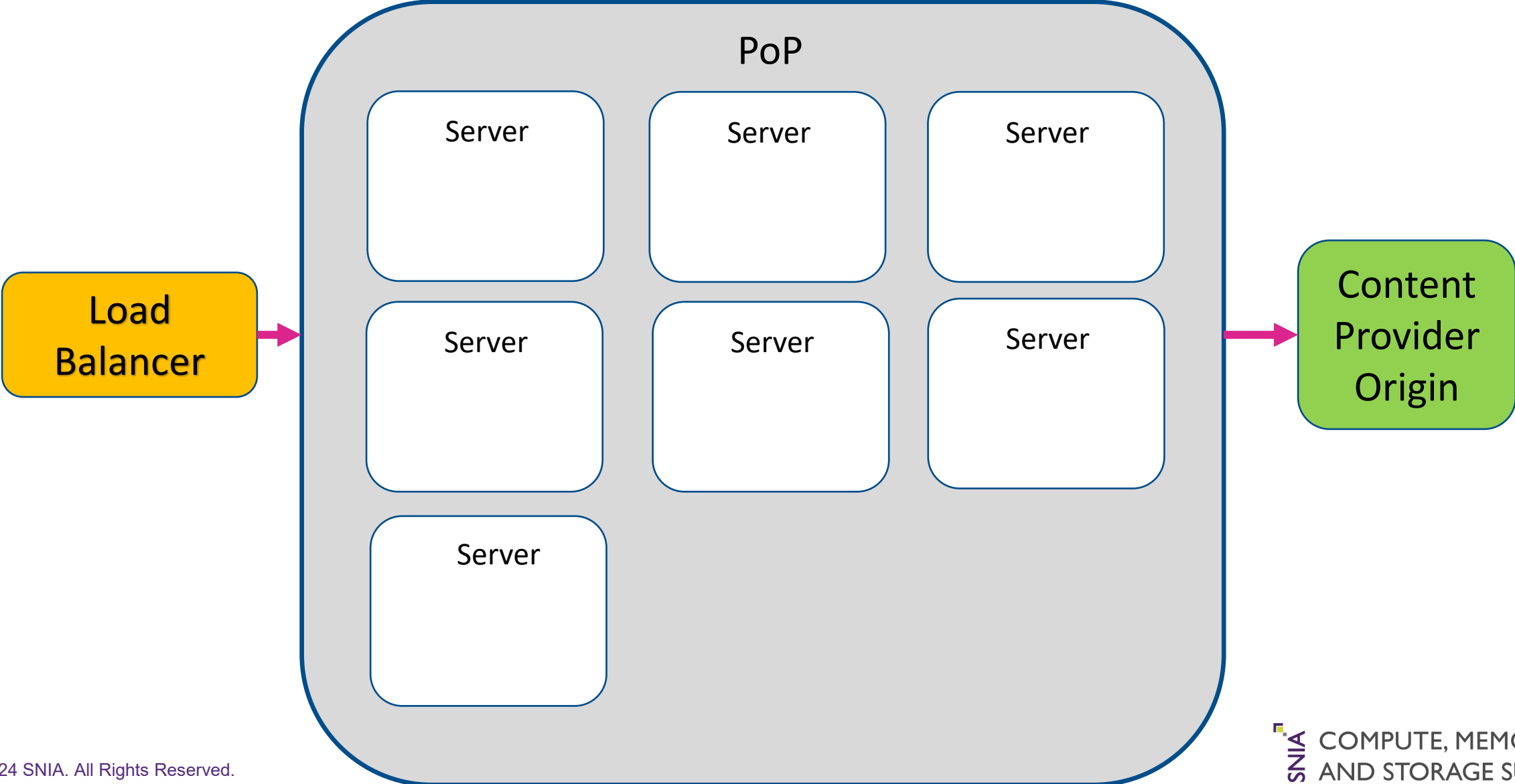
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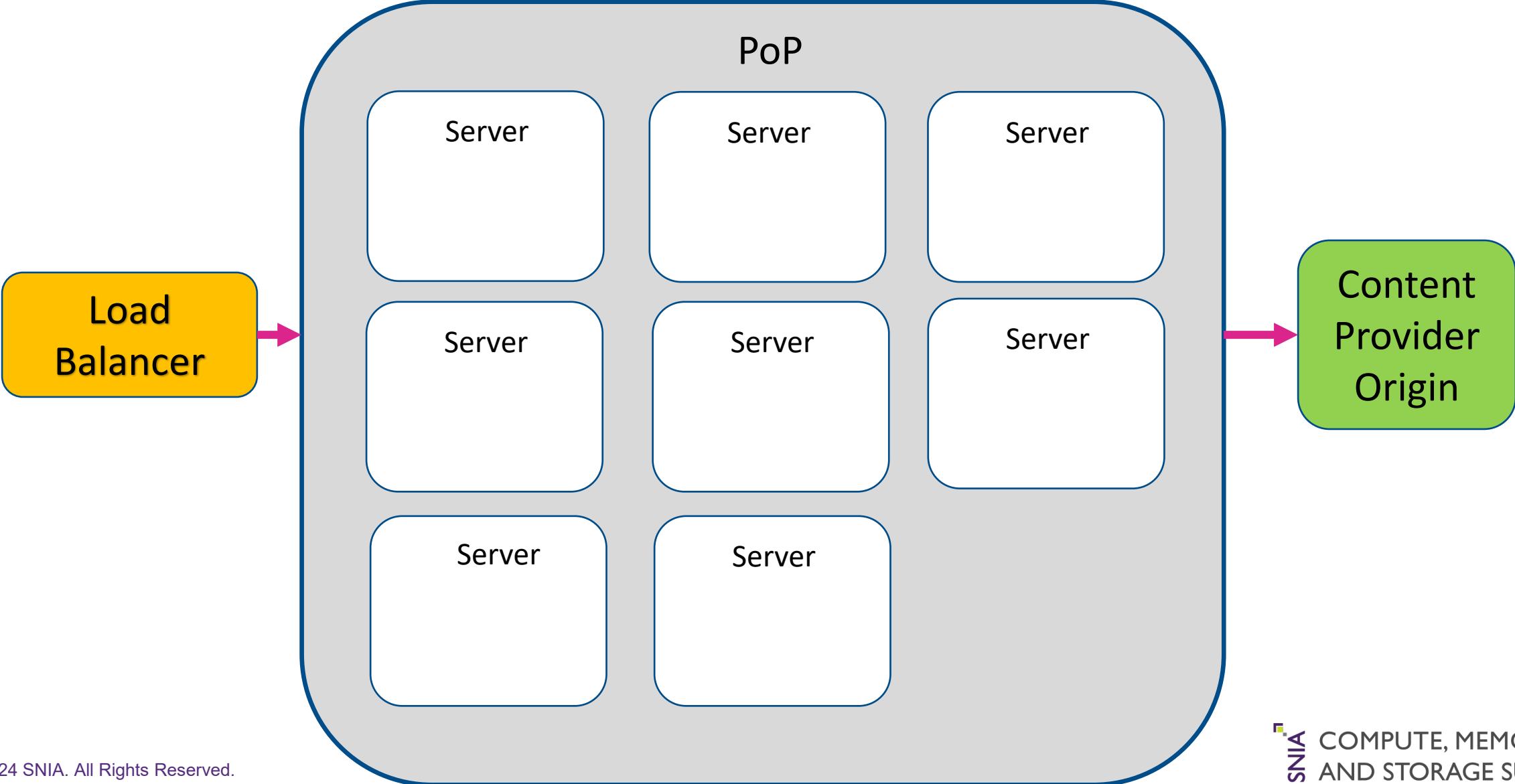
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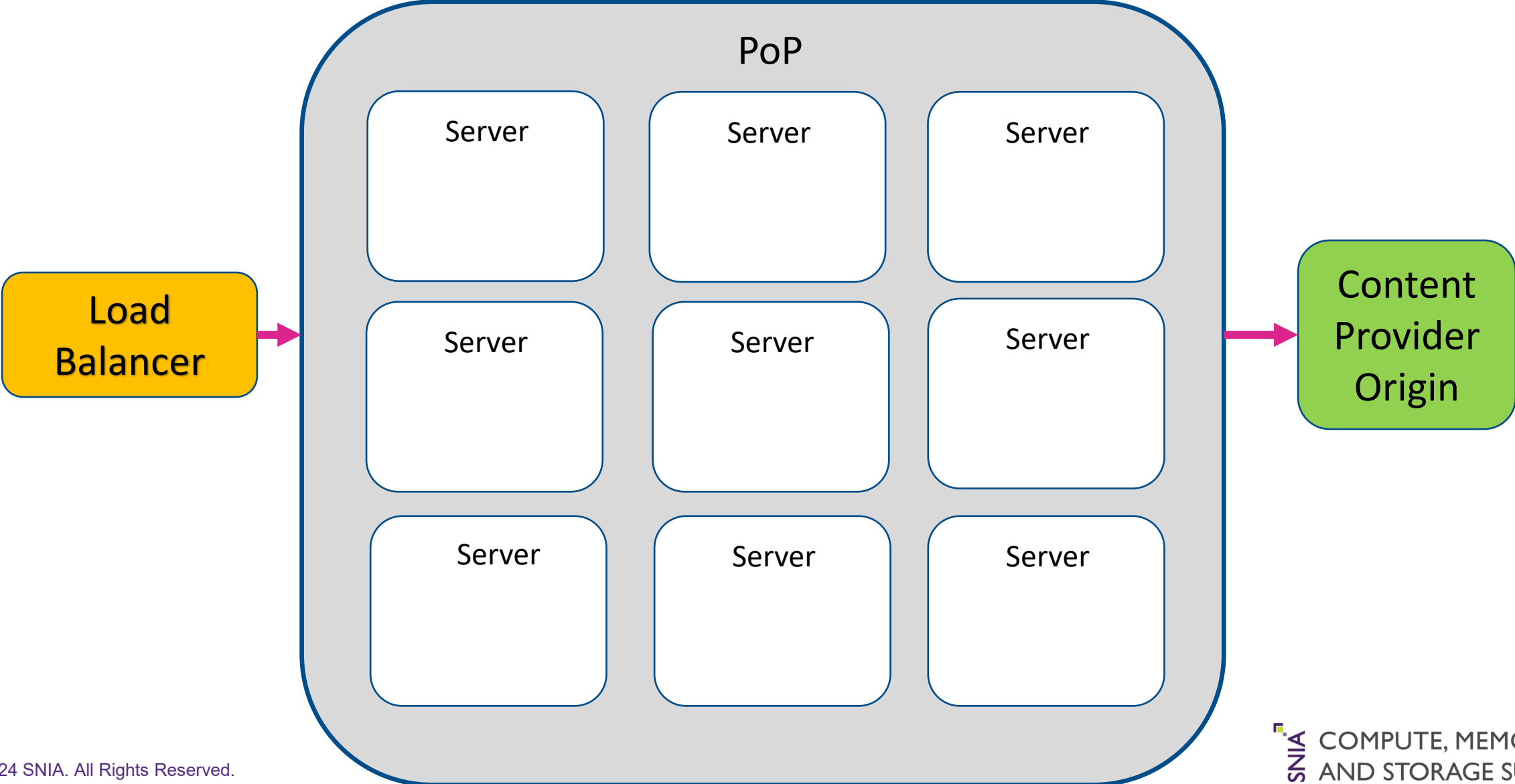
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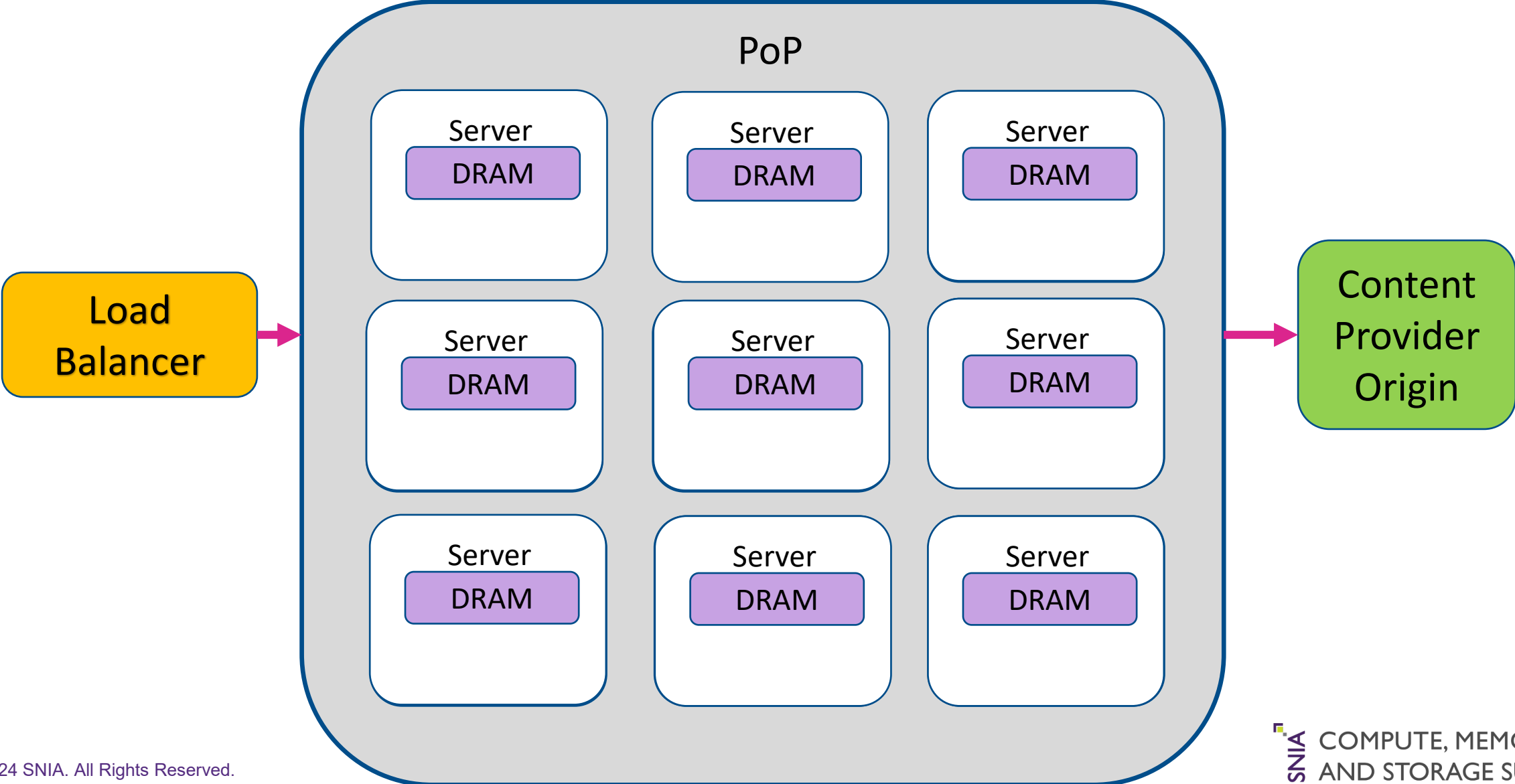
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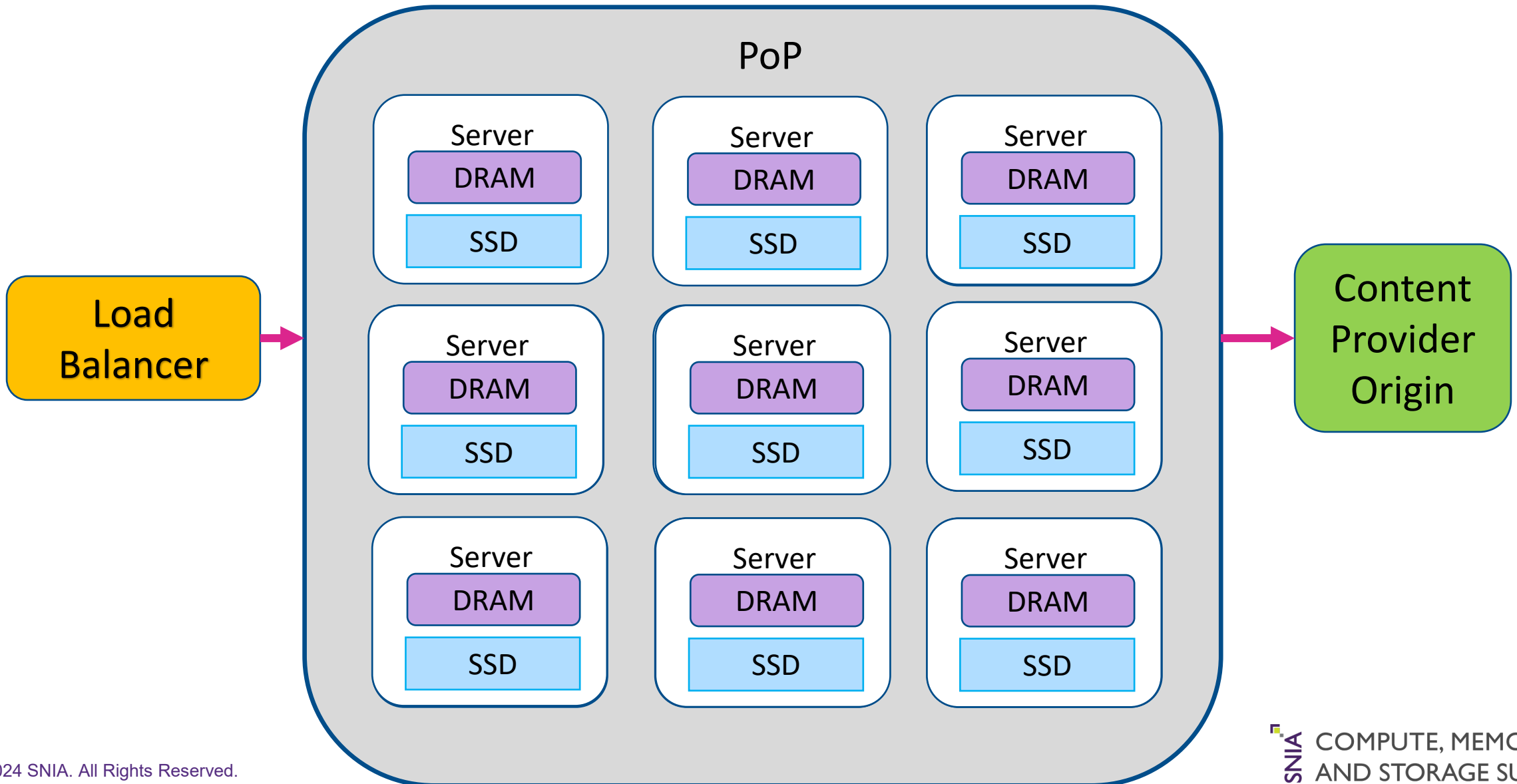


# CDN PoP – Compute + Memory

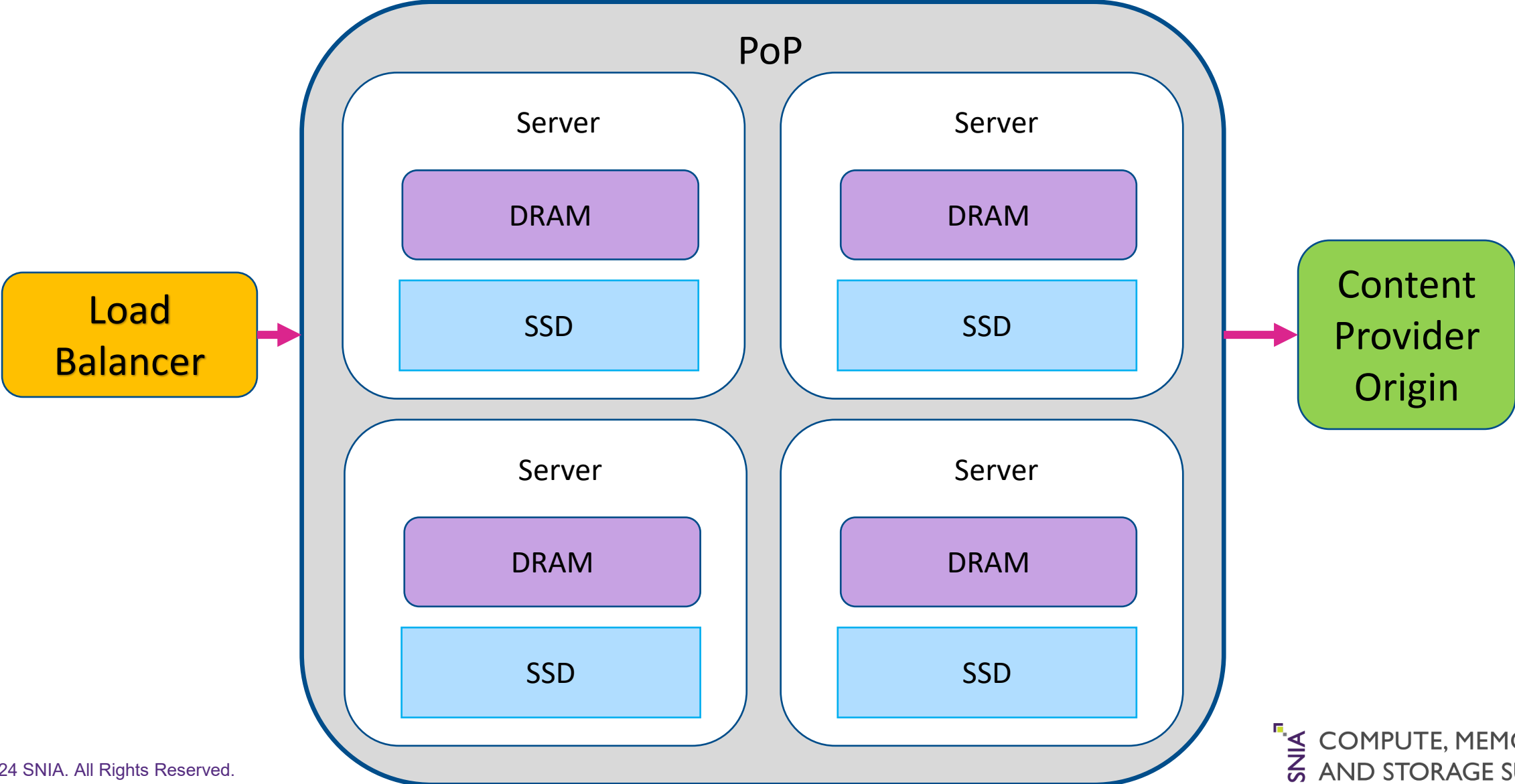




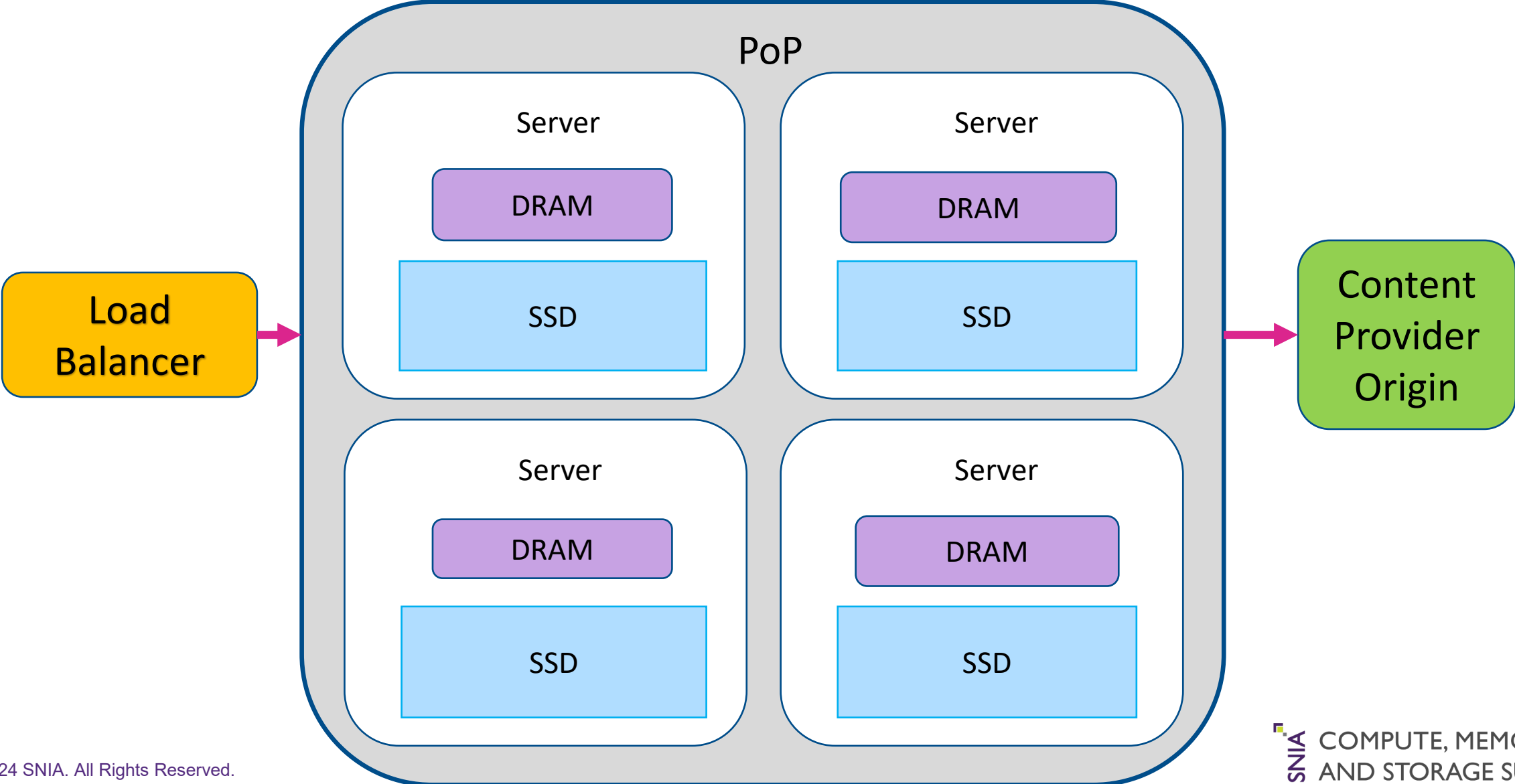
# CDN PoP – Compute + Memory + Storage



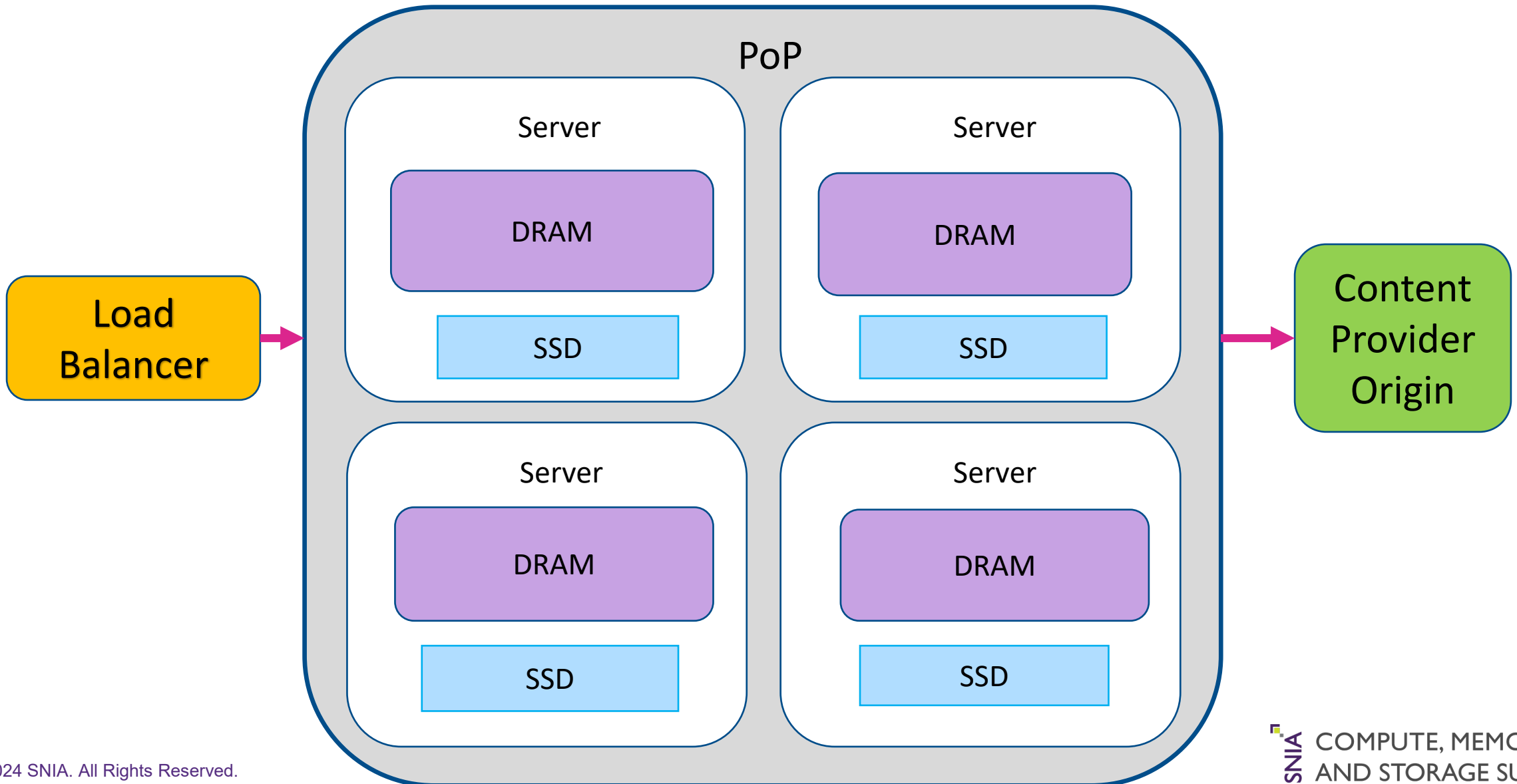
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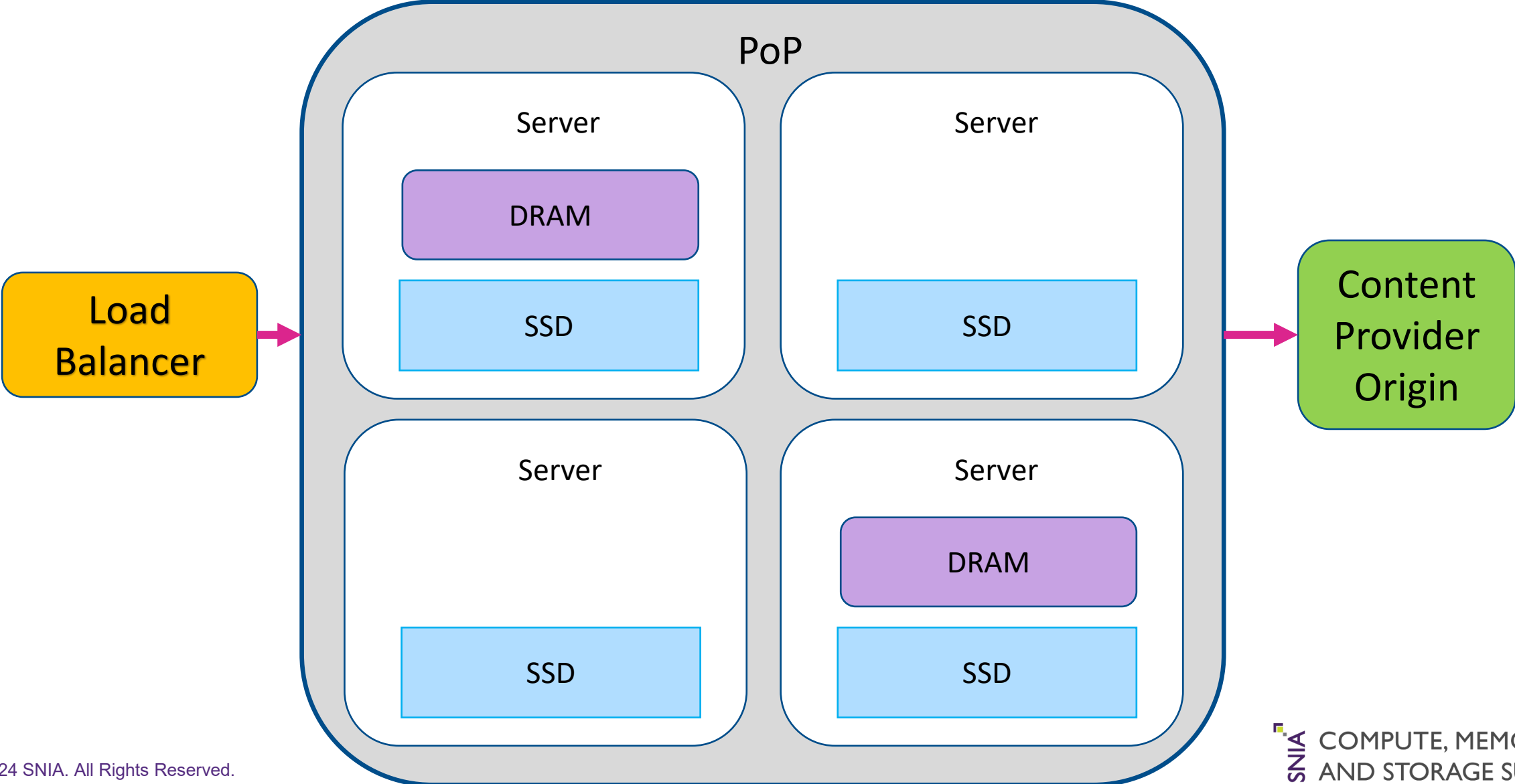
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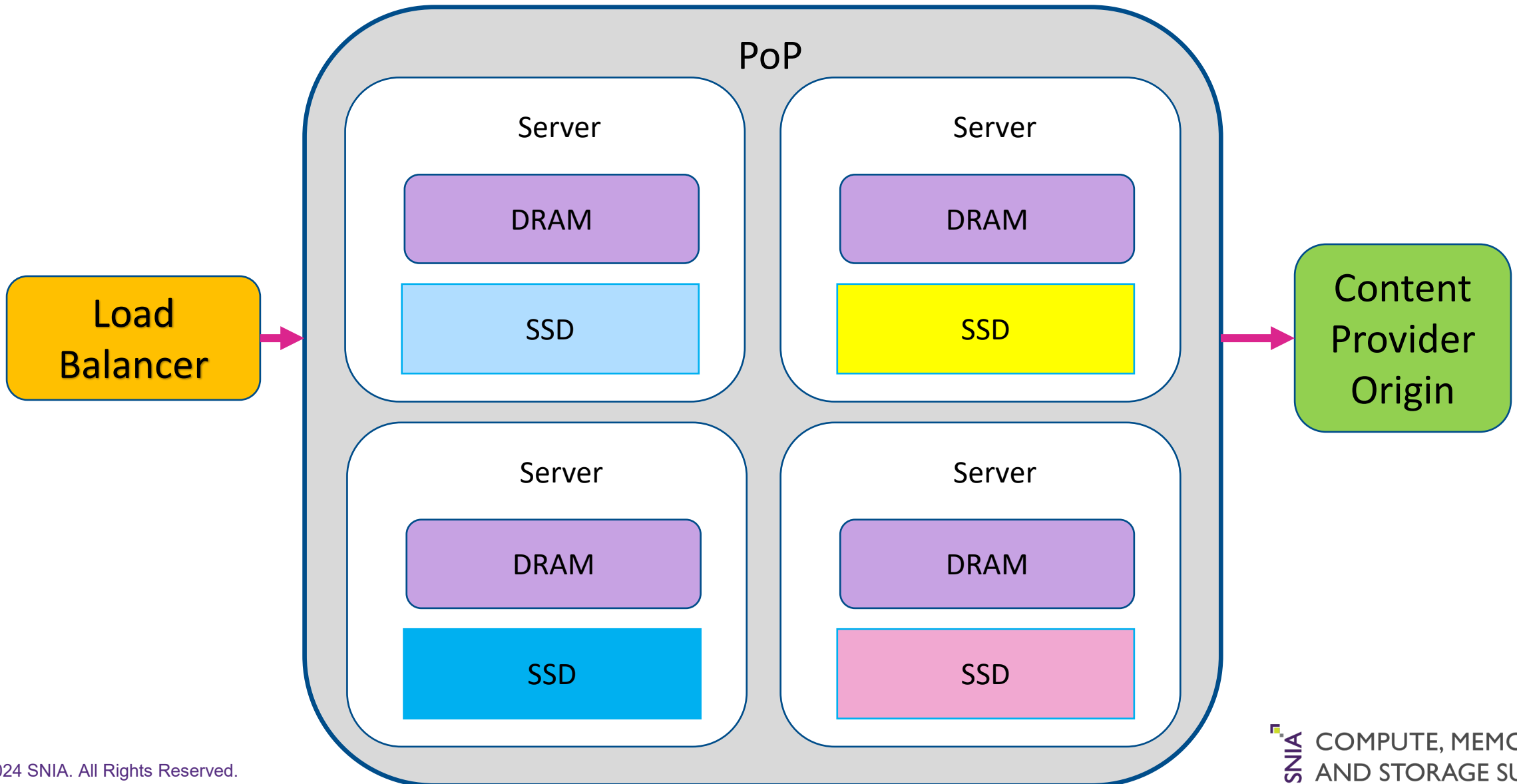
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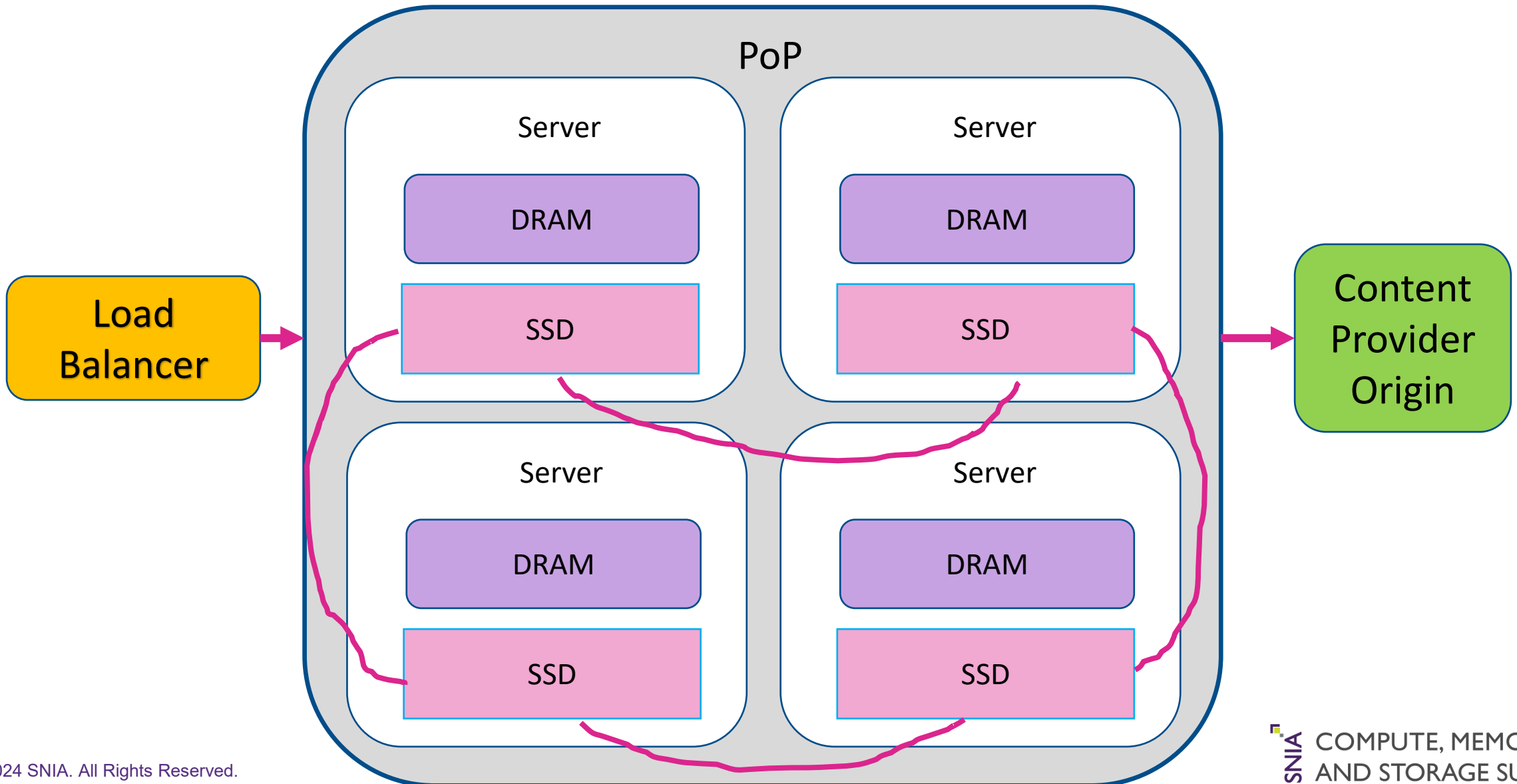
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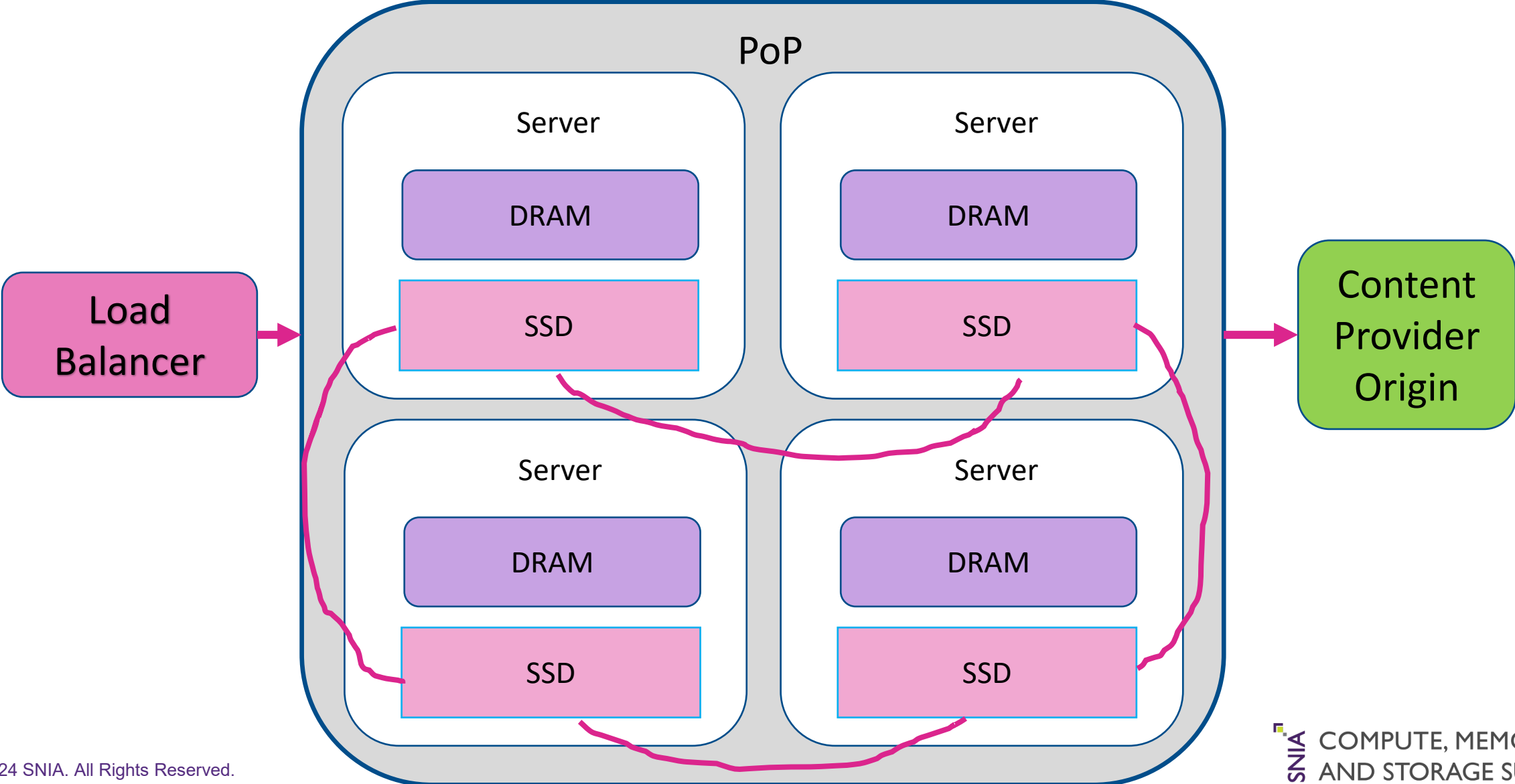
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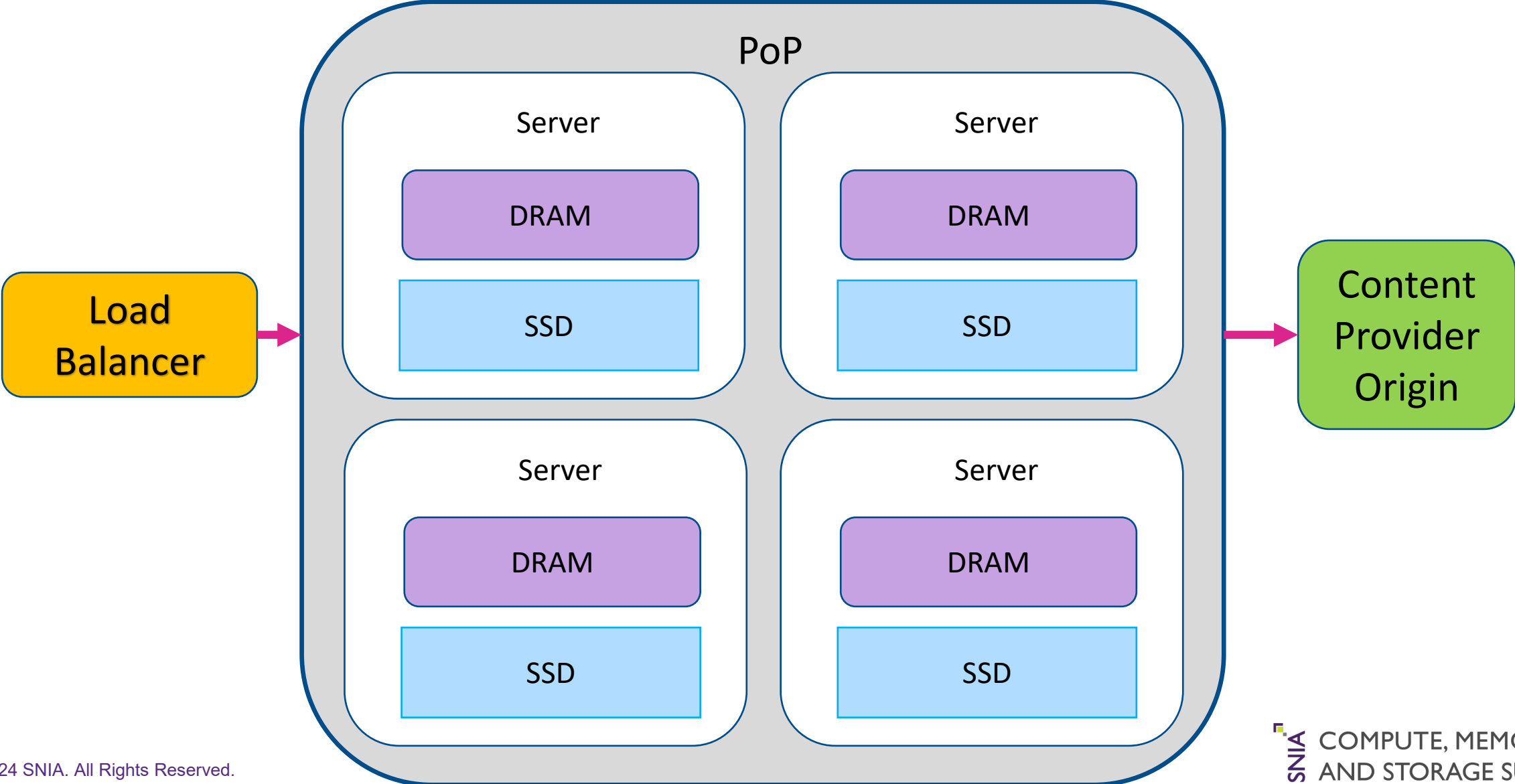


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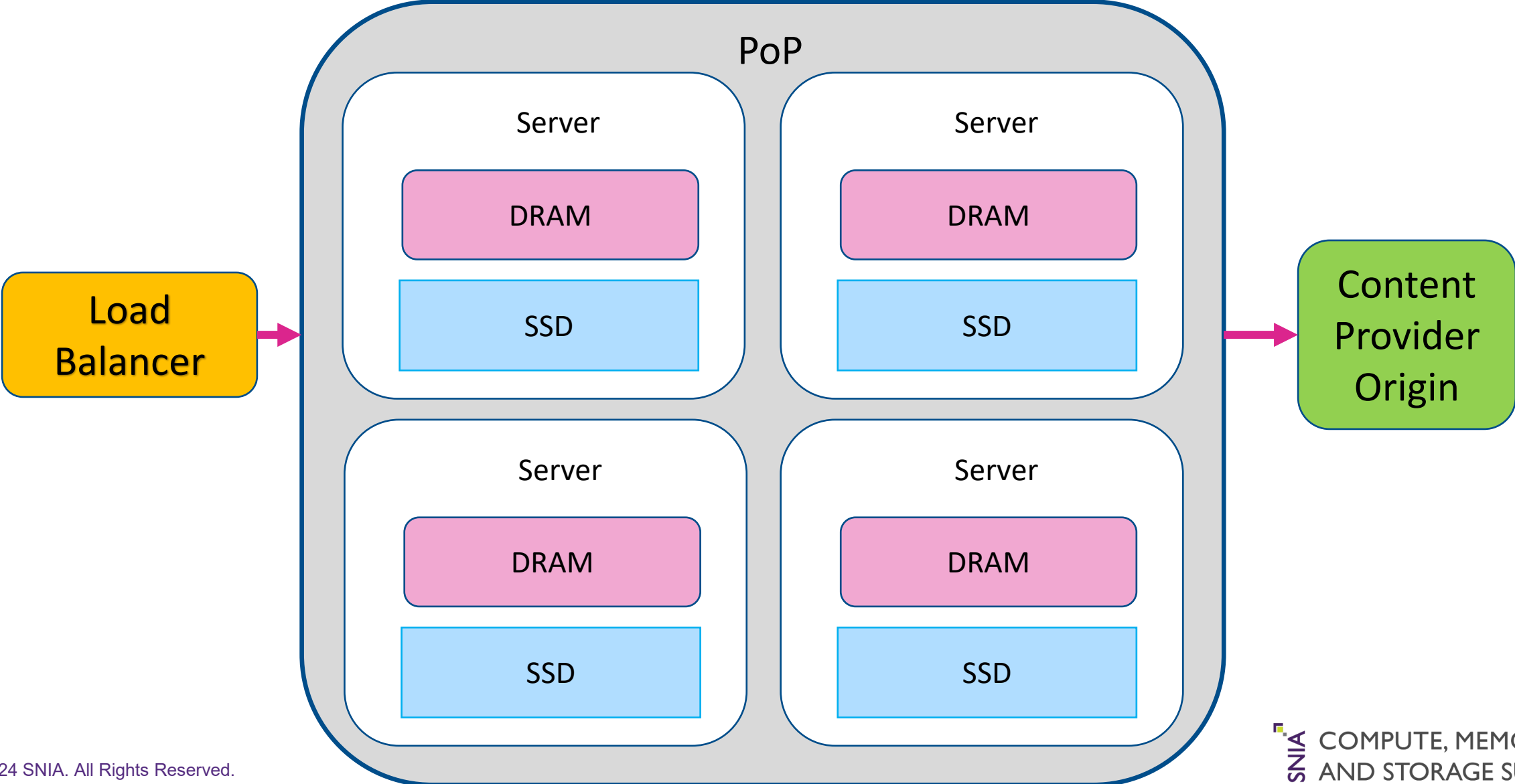




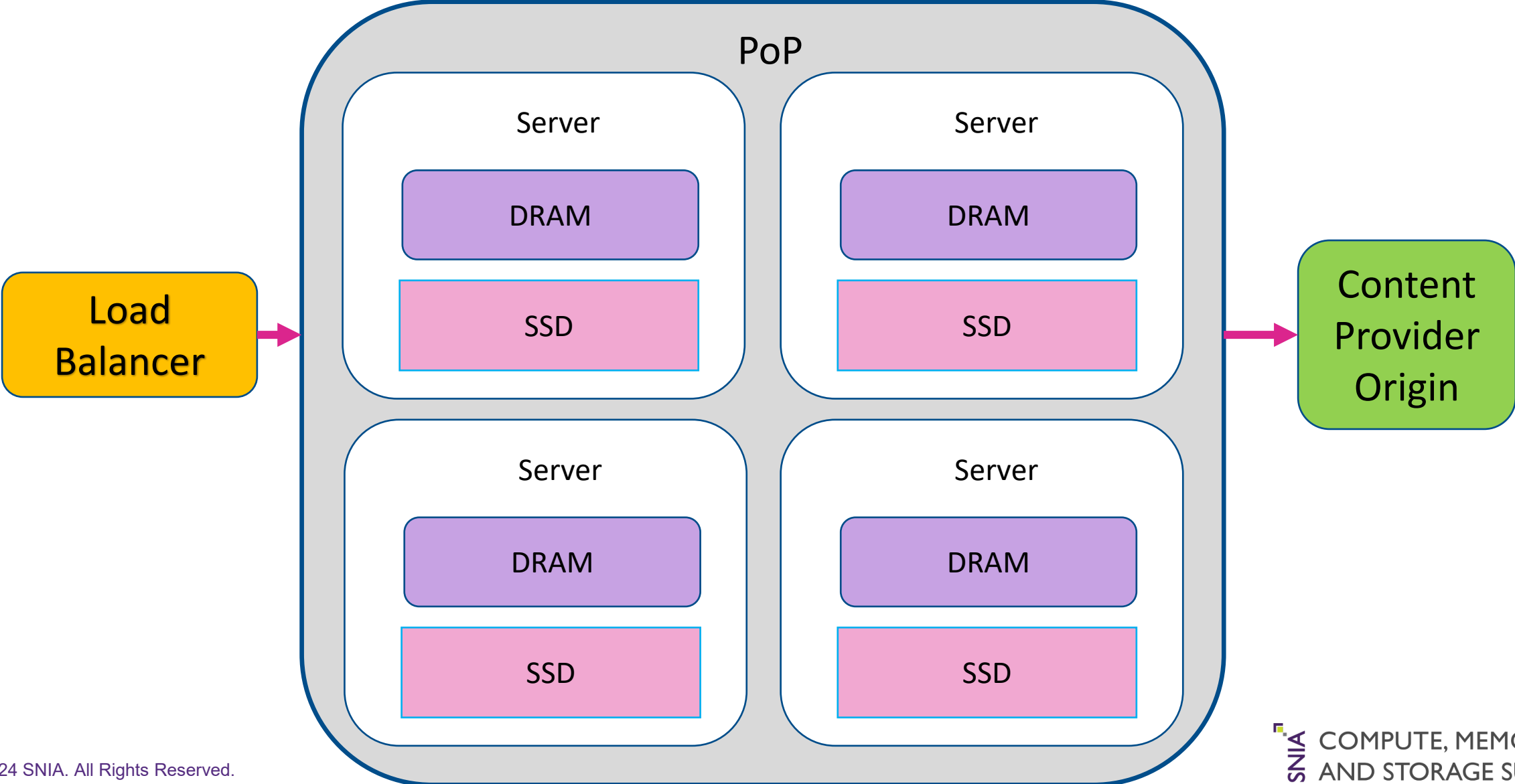
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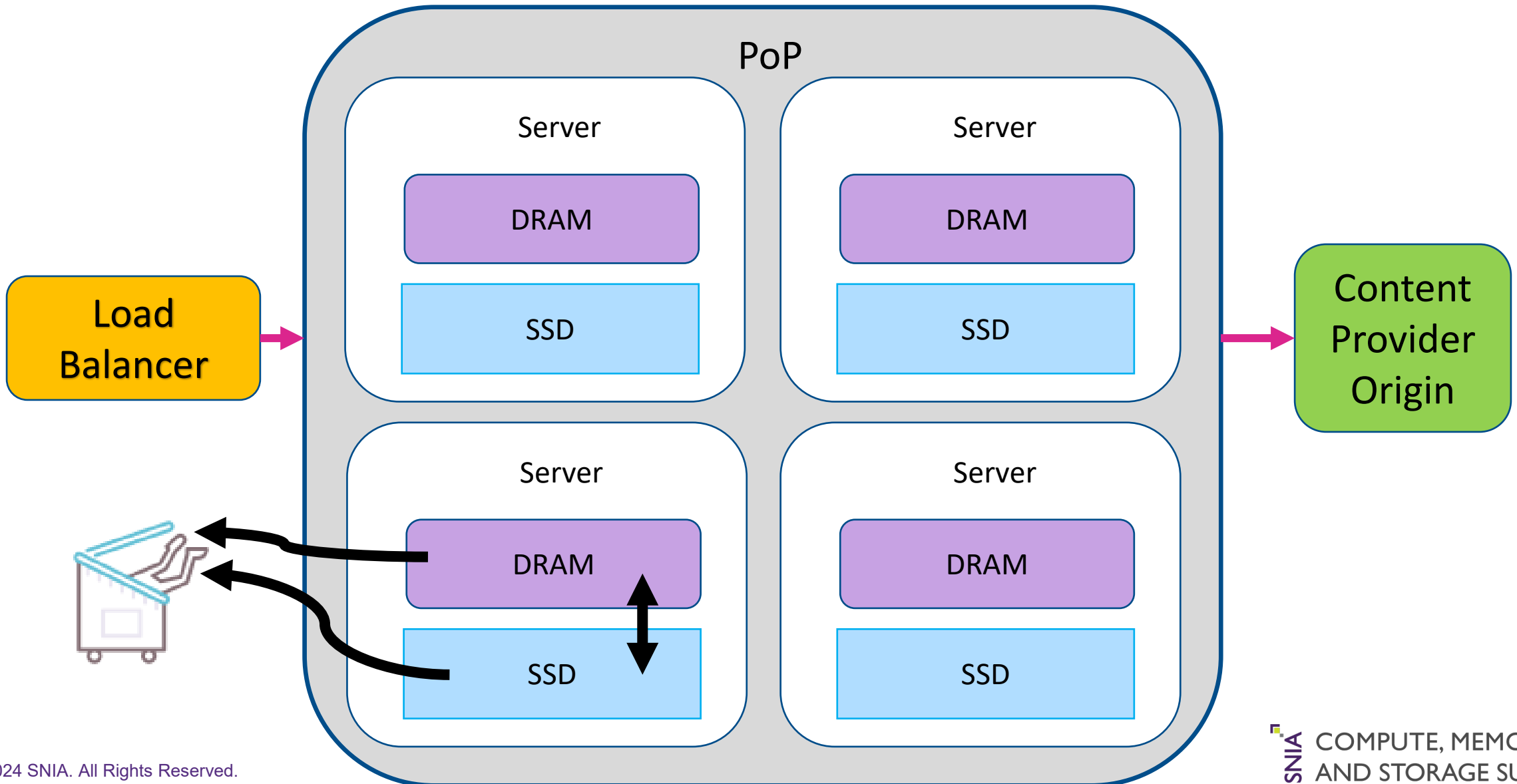
# CDN PoP – Compute + Memory + Storage



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# CDN PoP – Compute + Memory + Storage



# Optimization Nightmares



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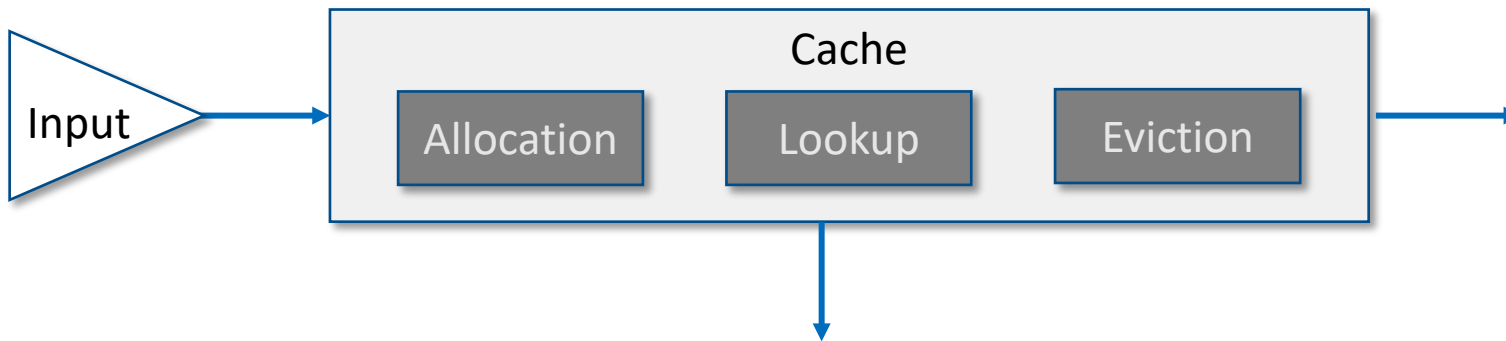
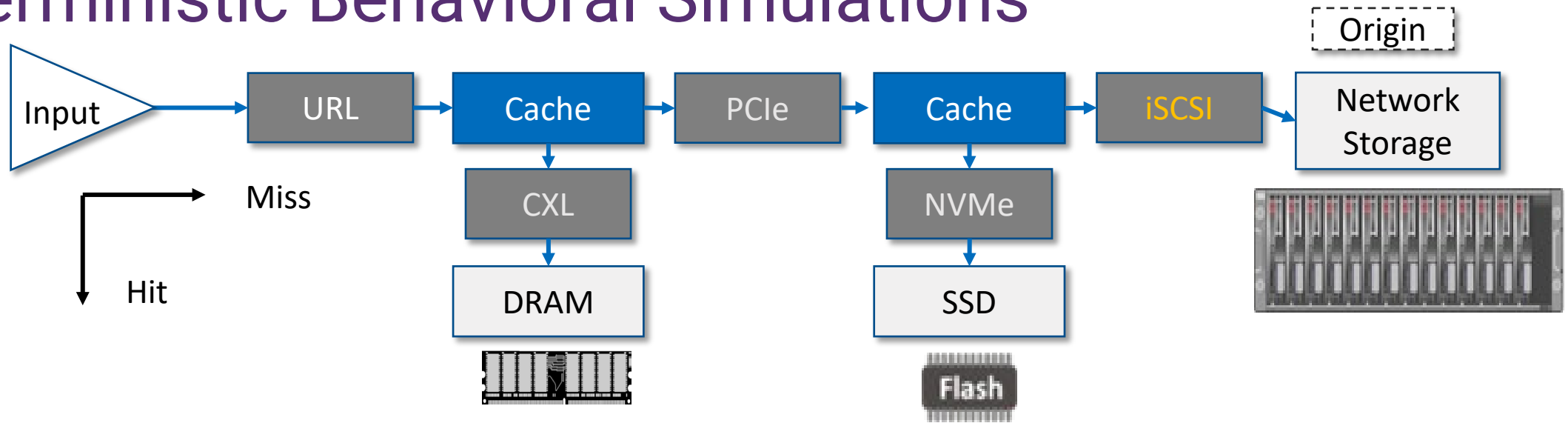
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# How to optimize all these factors

- ✦ Compose simulations of complex memory and storage
- ✦ Break the simulation into components
- ✦ Allows the components to be assembled like building blocks
- ✦ Provide reasonable but constrained set of variables
- ✦ Run simulations with synthetic data or actual IO traces



# Deterministic Behavioral Simulations



# Case Studies

- Cloudflare and Wikimedia
- Genuine workloads tested
- Variants of baseline algorithms
  - Number of L1 and L2 caches
  - Promotion and demotion policies
  - Eviction policies of L1 and L2
  - DRAM/SSD ratios
  - Load balancer algorithm
- ~125k variants, each run against a day's worth of traffic



# Variables

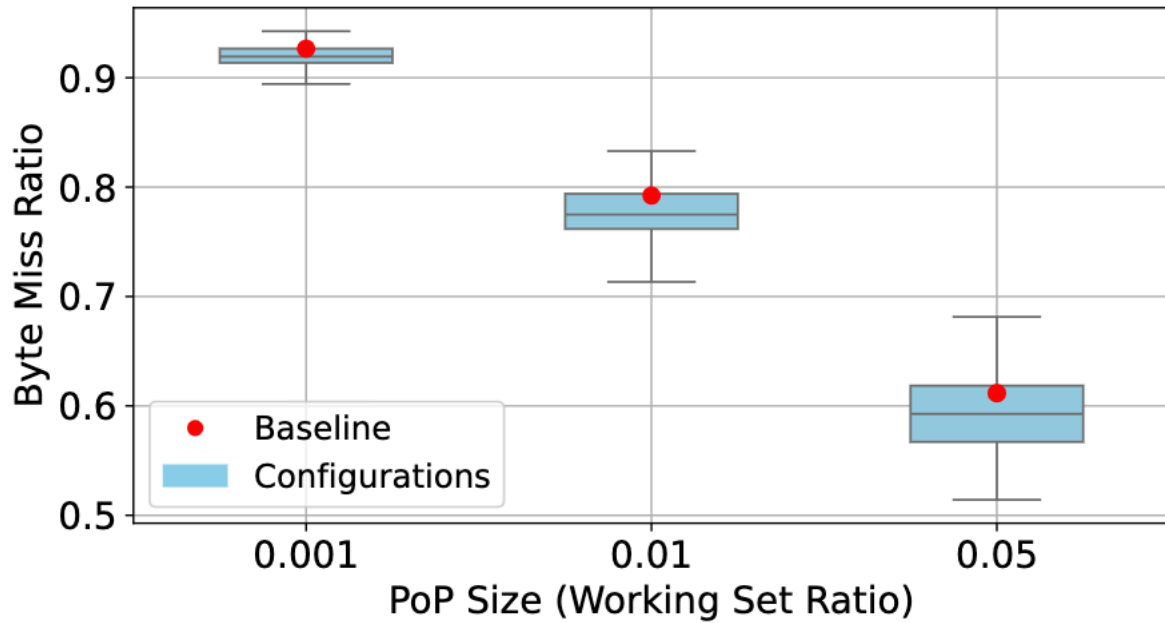
```
79 storage_capacity:
80 | value: [549755813888]
81 cache_size_ratio:
82 | value: [0.001, 0.005, 0.01, 0.1, 0.2, 0.3, 0.4, 0.5]
83 store_on_miss:
84 | value: ["false"]
85 store_from_origin:
86 | value: ["true"]
87 move_on_hit_source:
88 | value: ["false"]
89 move_on_hit_sink:
90 | value: ["false"]
91 move_on_hit_count:
92 | value: [1]
93 eviction_types:
94 | value: [FIFO, SIEVE, CLOCK, LRU]
95 eviction_methods:
96 | value: ["&lru_eviction_methods"]
97 page_size:
98 | value: [4096]
99 l2_server_lb:
100 | name: L2_SERVER_LOADBALANCER
101 selection_types:
102 | value: [USR_DEF_SELECTION]
103 selection_methods:
104 | value: ["&url_hash_lb_methods"]
105 l2_servers:
106 | value: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 30]
107 name: L2_SERVER
108 switch:
109 | value: [enable]
110 storage_media:
111 | value: [ssd_lite]
112 storage_capacity:
113 | value: [549755813888]
114 store_on_miss:
115 | value: ["false"]
116 store_from_origin:
117 | value: ["true"]
118 move_on_hit_source:
119 | value: ["false"]
120 move_on_hit_sink:
121 | value: ["false"]
122 eviction_types:
123 | value: [FIFO, SIEVE, CLOCK, LRU]
124 eviction_methods:
125 | value: ["&lru_eviction_methods"]
126 page_size:
127 | value: [4096]
128 pop_serializer:
129 | name: POP_SERIALIZER
130 data_mover:
131 | name: POP_L1_TO_L2_MOVER
132 | switch:
133 | value: [disable]
```

Wiki  
Topology

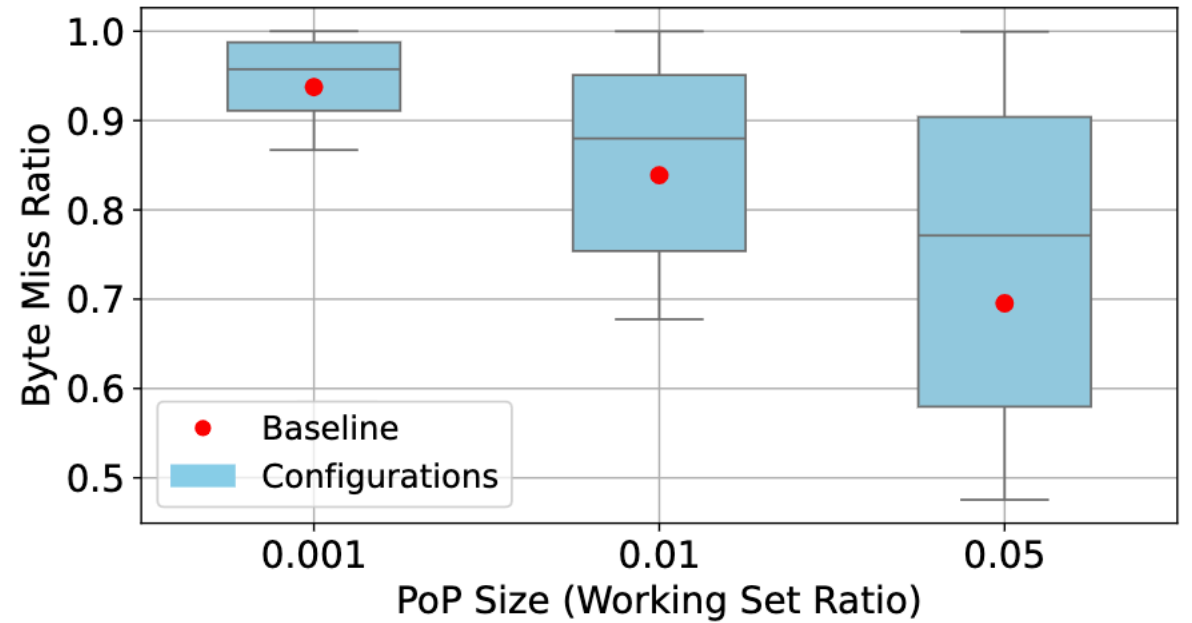
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93 eviction_types:
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95 eviction_methods:
96 | value: ["&lru_eviction_methods"]
97 page_size:
98 | value: [4096]
99 l2_server_lb:
100 | name: L2_SERVER_LOADBALANCER
101 selection_types:
102 | value: [LB_1_ON_1_WIRING_DEFAULT]
103 selection_methods:
104 | value: ["&url_hash_lb_methods"]
105 l2_servers:
106 | value: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 30]
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```

Cloudflare  
Topology

# Case Study Results

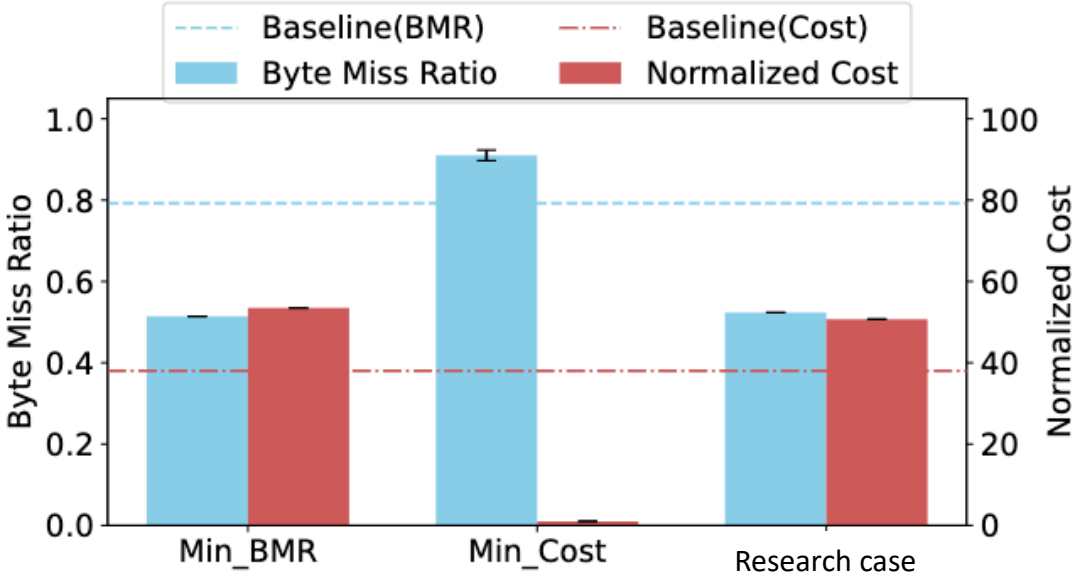


Wikimedia

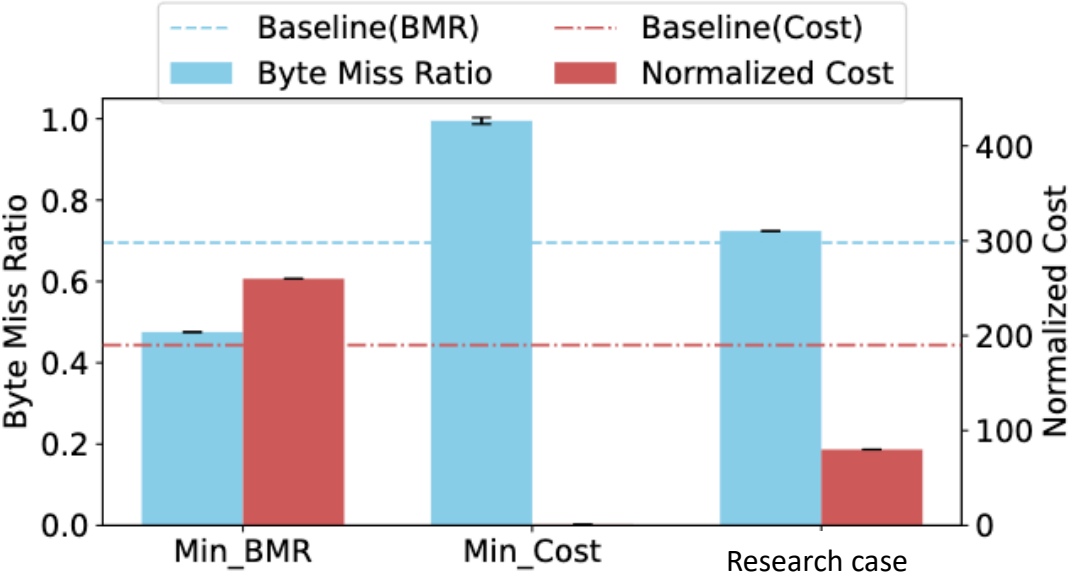


Cloudflare

# Case Study Results

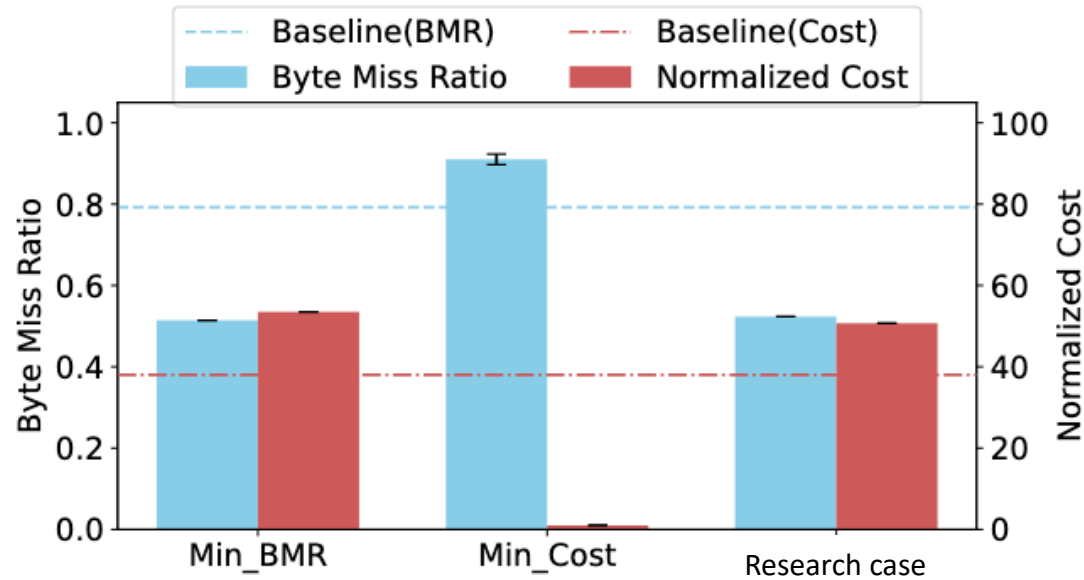


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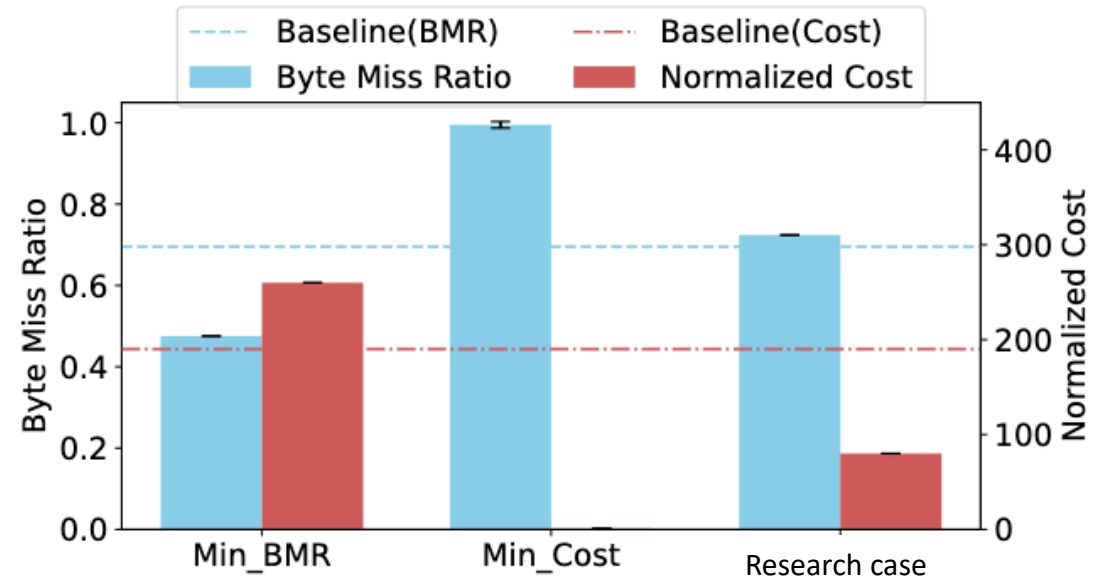
Cloudflare

# Case Study Results



Wikimedia

<https://cachemon.github.io/SIEVE-website/>



Cloudflare

# RESULTS WITH MAGNITION

PROVEN IN MARKET TODAY

As an example, a current customer has achieved the following measurable outcomes with Magnition:

Experiments **per day per engineer**:

- Without Magnition: **2**
- With Magnition: **50,000+**

Parameter variations tested **before prod release**:

- Without Magnition: **50**
- With Magnition: **1,000,000+**

Workload performance improvement using our products to find **optimal out-of-the-box settings: 10-50%+**



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# Transition Slide



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