Scaling Up to Your First 10 Million Users

(based on ARC 301 from re:Invent 2015)

Julien Simon
Principal Technical Evangelist
Amazon Web Services

julsimon@amazon.fr
@julsimon

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Pop-up Loft
TEL AVIV

What do we need first?

AWS building blocks

Inherently highly available and fault-tolerant services

- ✔ Amazon CloudFront
- ✔ Amazon Route53
- ✔ Amazon S3
- ✔ Amazon DynamoDB
- ✔ Elastic Load Balancing
- ✔ Amazon SQS
- ✔ Amazon SNS
- ✔ Amazon SES
- ✔ Amazon SWF
- ✔ …

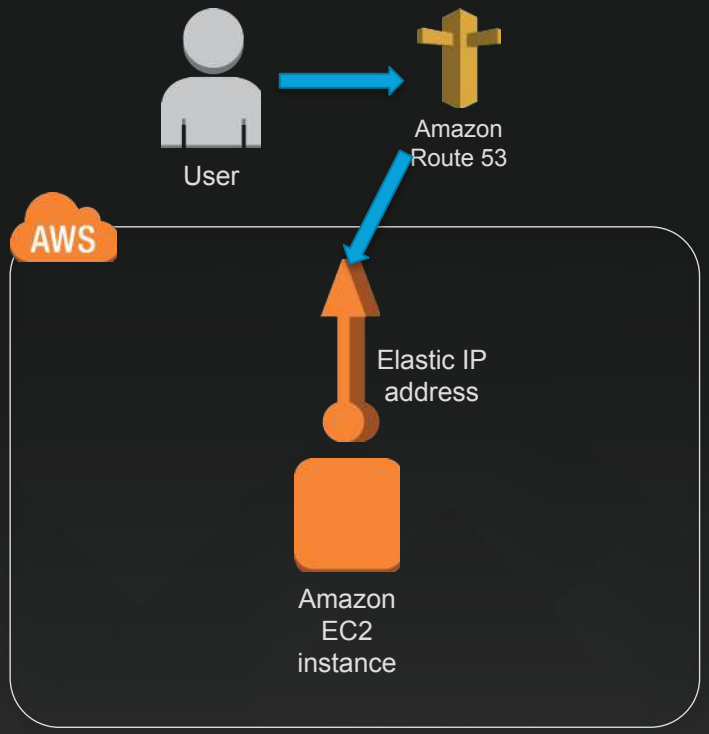
Highly available with the right architecture

- Amazon EC2
- Amazon Elastic Block Store
- Amazon RDS
- Amazon VPC

So let’s start from day 1, user 1 (you)

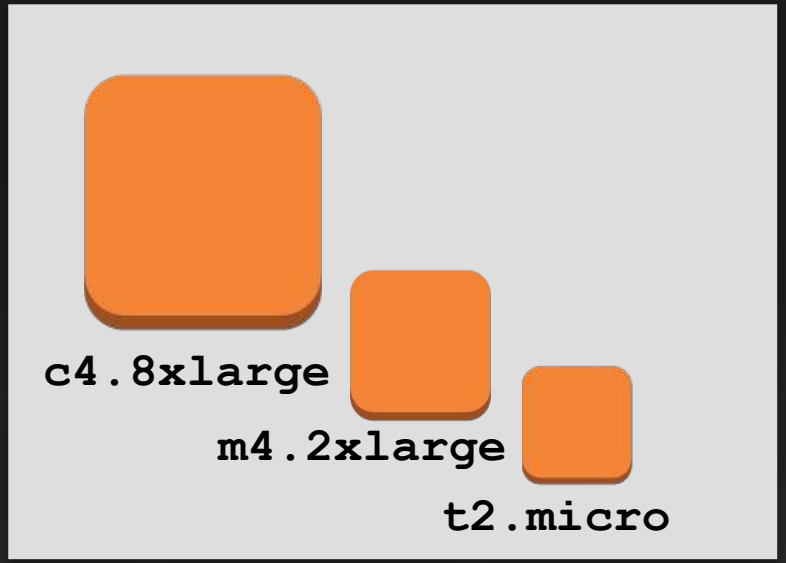
Day 1, user 1

- A single Amazon EC2 instance
  - With full stack on this host
    - Web app
    - Database
    - Management
    - And so on…
- A single Elastic IP address
- Amazon Route 53 for DNS



“We’re gonna need a bigger box”

- “Scale up”: simplest approach
- Can now leverage PIOPS
- High I/O instances
- High memory instances
- High CPU instances
- High storage instances
- Easy to change instance sizes
- Will hit a wall eventually



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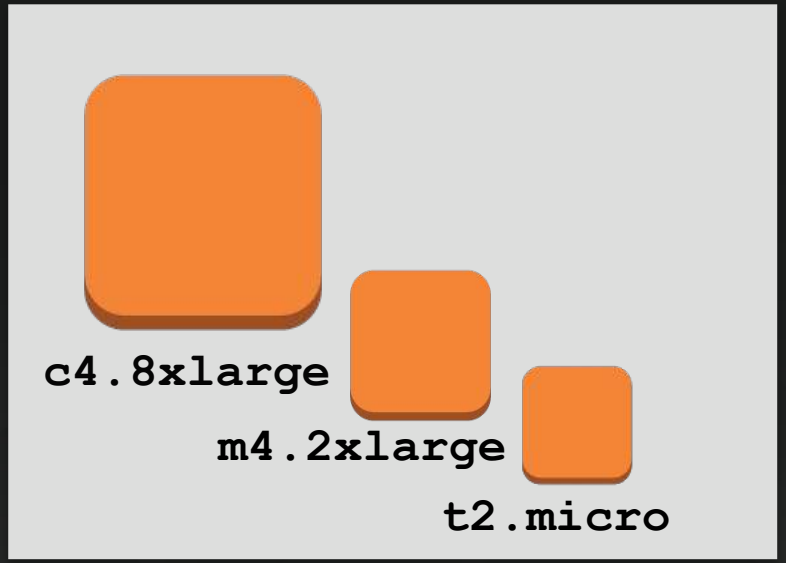
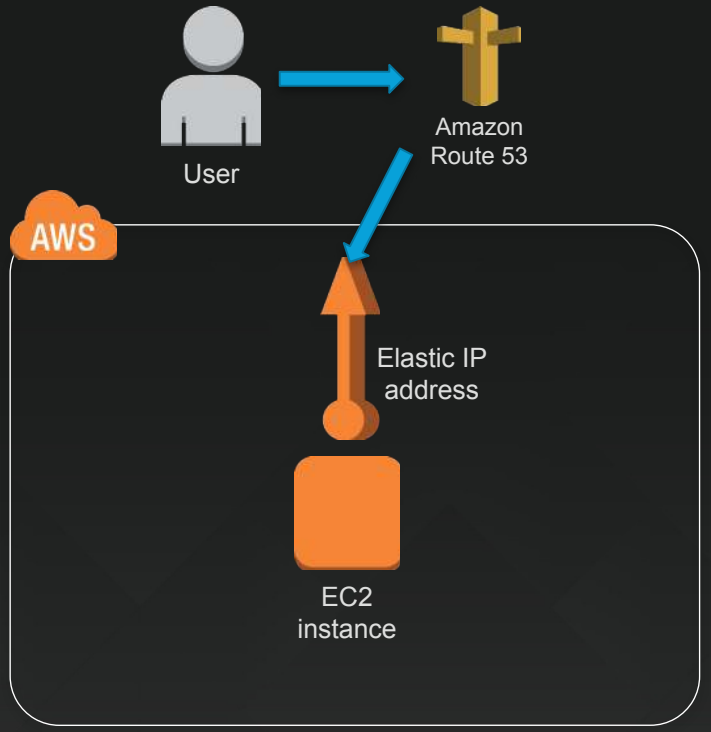


Day 1, user 1

- We could potentially get to a few hundred to a few thousand depending on application complexity and traffic
- No failover
- No redundancy
- Too many eggs in one basket



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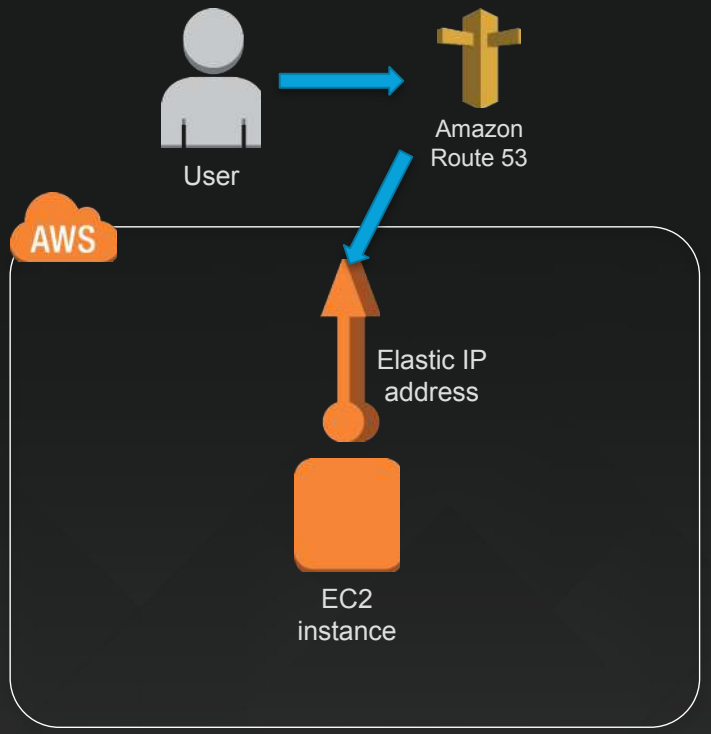
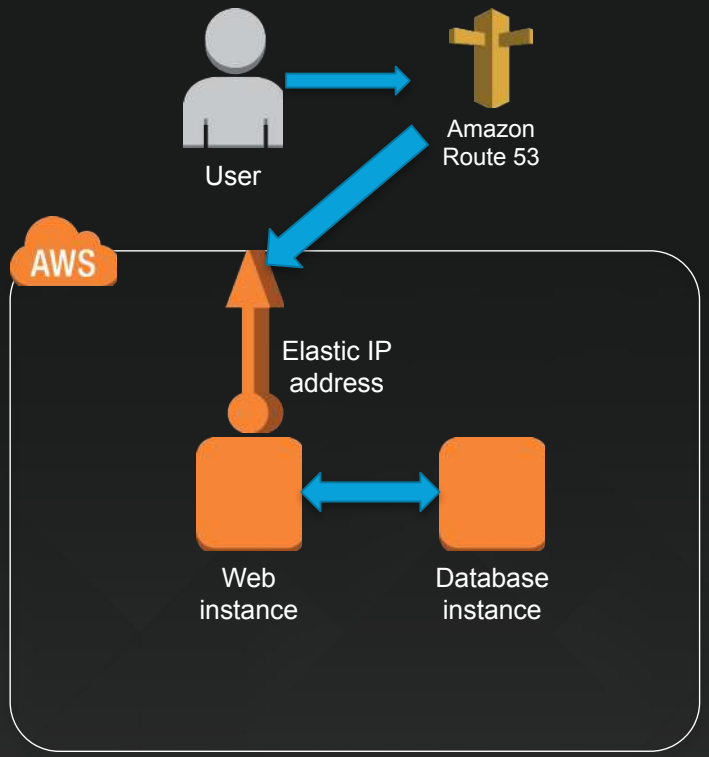


Day 2, user > 1

First, let's separate out our single host into more than one

- Web
- Database
  - Make use of a database service?



Database options

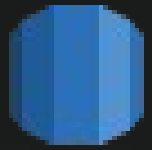
Self-managed

Database server on Amazon EC2

Your choice of database running on Amazon EC2

Bring Your Own License (BYOL)

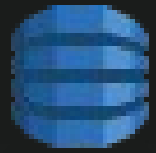
Fully managed



Amazon RDS

SQL Server, Oracle, MySQL, MariaDB, Aurora or PostgreSQL as a managed service

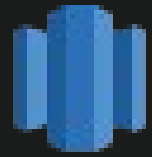
Flexible licensing: BYOL or license included



Amazon DynamoDB

Managed NoSQL database service using SSD storage

Seamless scalability Zero administration



Amazon Redshift

Massively parallel, petabyte-scale data warehouse service

Fast, powerful, and easy to scale

But how do I choose the DB technology I need? SQL? NoSQL?

Some folks won’t like this. But…

Start with (scalable) SQL databases

Why start with SQL?

- Established and well-worn technology.
- Lots of existing code, communities, books, background, tools, and more.
- You aren't going to break SQL DBs in your first 10 million users. No, really, you won't.*
- Clear patterns to scalability.

*Unless you are doing something SUPER weird with the data or you have MASSIVE amounts of it, but even then SQL will have a place in your stack.

Why might you need NoSQL from day 1?

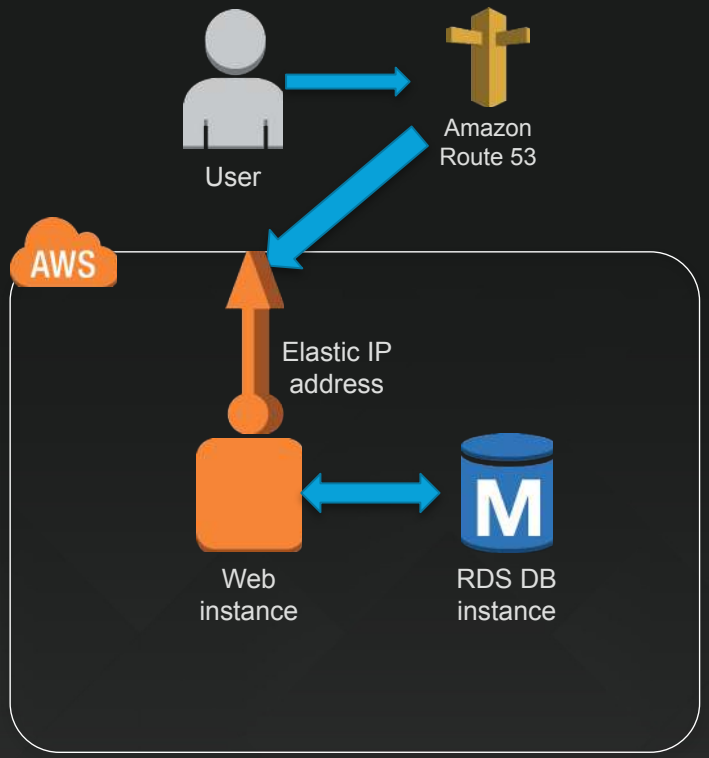
- Super low-latency applications
- Metadata-driven datasets
- Highly nonrelational data
- Need schema-less data constructs*
- Massive amounts of data (in the multi TB range)
- Rapid ingest of data (thousands of records/sec)

*Need != “It’s easier to do dev without schemas”

Users > 100

First, let's separate out our single host into more than one:

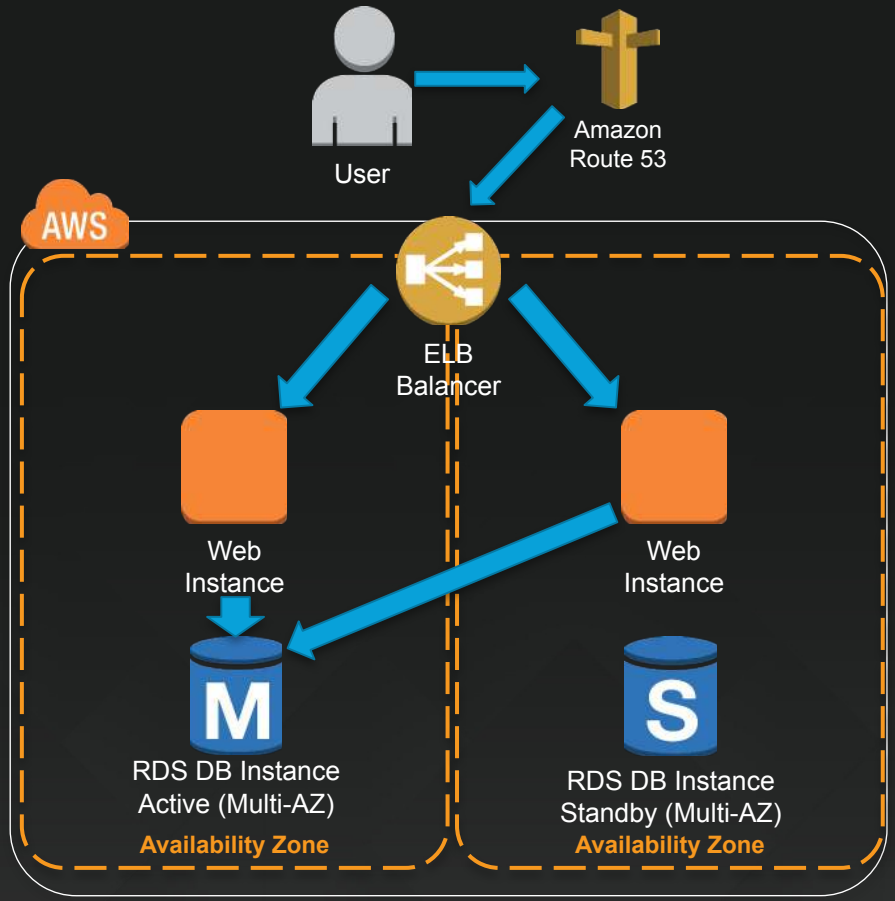
- Web
- Database
  - Use Amazon RDS to make your life easier



Users > 1000

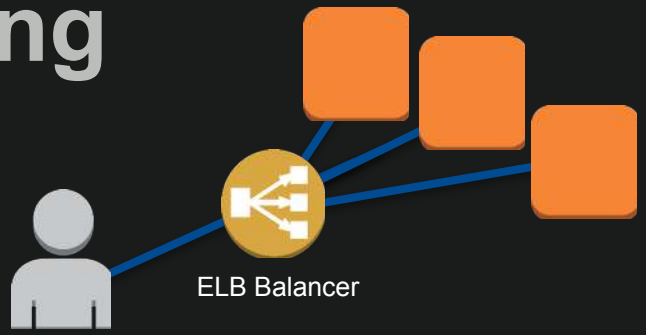
Next, let's address our lack of failover and redundancy issues:

- Elastic Load Balancing (ELB)
- Another web instance
  - In another Availability Zone
- RDS Multi-AZ



Elastic Load Balancing

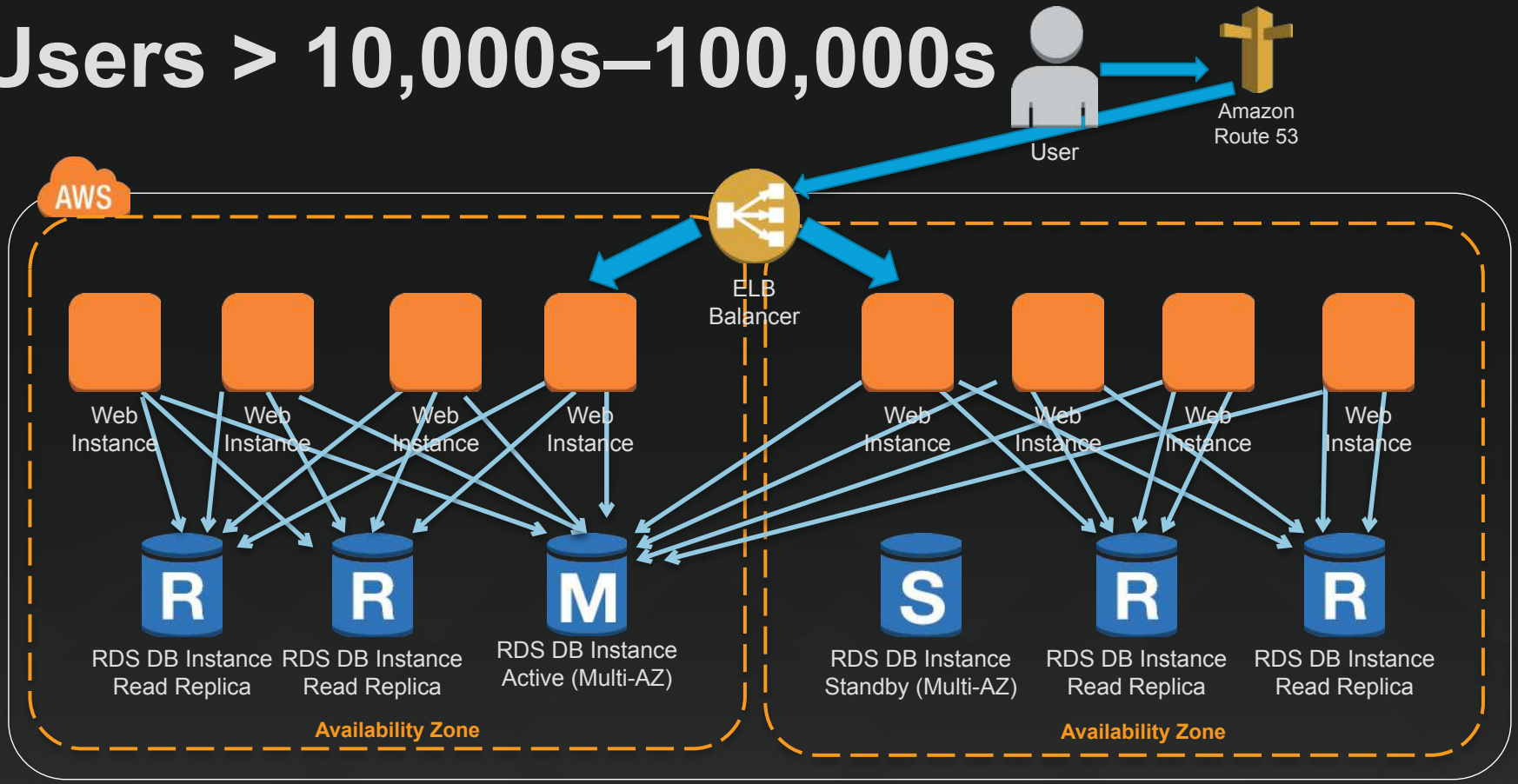
- Create highly scalable applications
- Distribute load across EC2 instances in multiple Availability Zones



Feature	Details
Available	Load balances across instances in multiple Availability Zones
Health checks	Automatically checks health of instances and takes them in or out of service
Session stickiness	Routes requests to the same instance
Secure sockets layer	Supports SSL offload from web and application servers with flexible cipher support
Monitoring	Publishes metrics to Amazon CloudWatch and can get logs of requests processed

Scaling this horizontally and vertically will get us pretty far (tens to hundreds of thousands)

Users > 10,000s–100,000s



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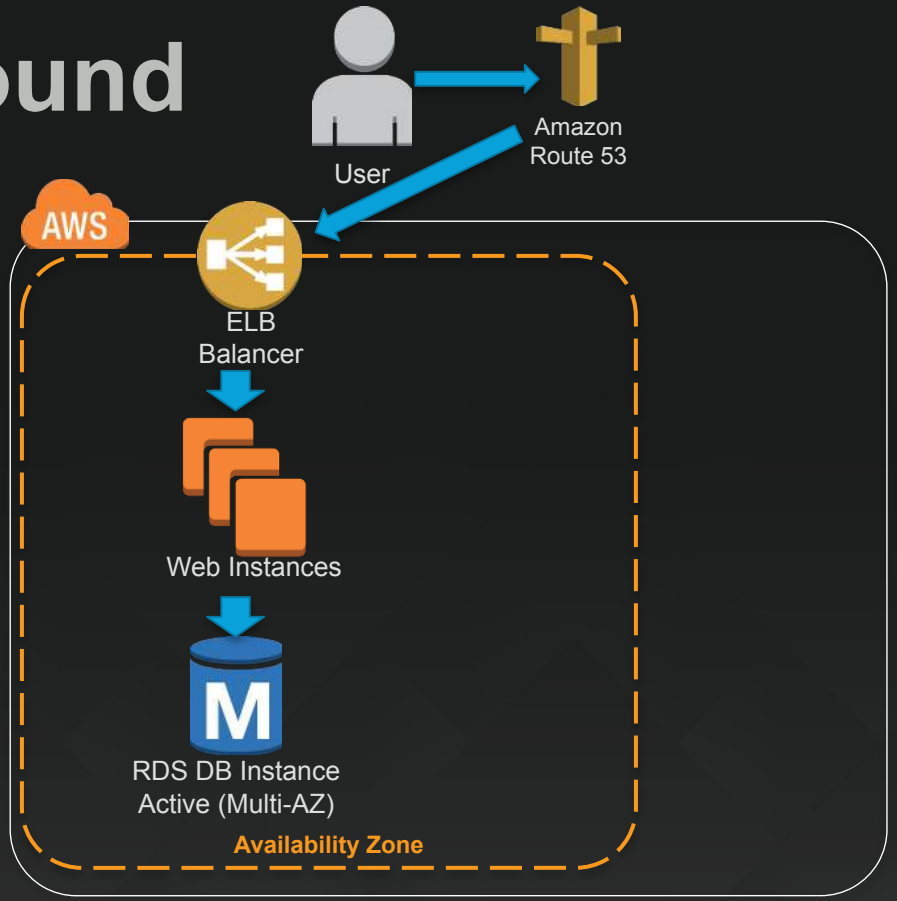
This will take us pretty far, but we care about *performance* and *efficiency*, so let's improve further

Shift some load around

Let's lighten the load on our web and database instances:

- Move static content from the web instance to Amazon S3 and Amazon CloudFront
- Move session/state and DB caching to Amazon ElastiCache or Amazon DynamoDB



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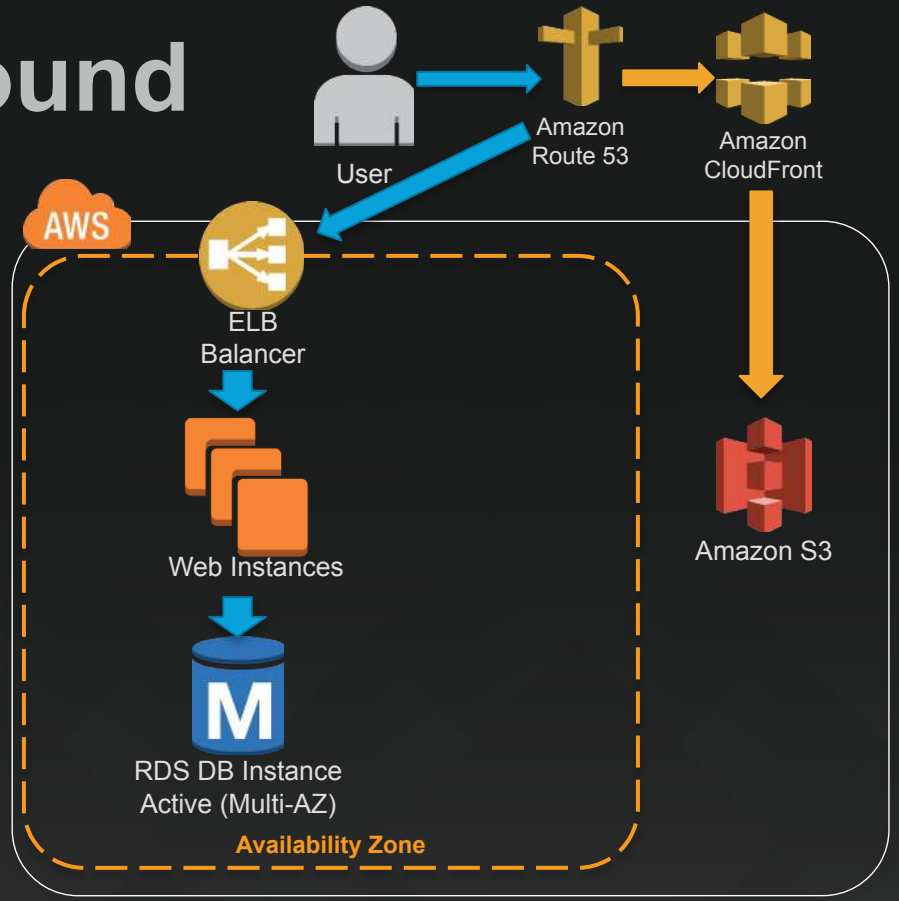

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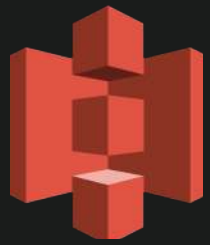
Amazon S3

Amazon S3 is cloud storage for the Internet:

- Object-based storage
- 11 9s of durability
- Good for things like the following:
  - Static assets (CSS, JS, images, videos)
  - Backups
  - Logs
  - Ingest of files for processing
- “Infinitely scalable”
- Objects up to 5 TB in size



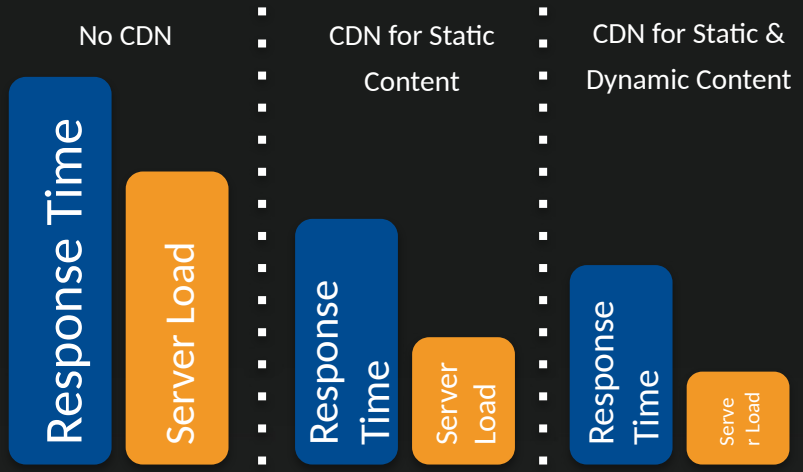
Amazon S3

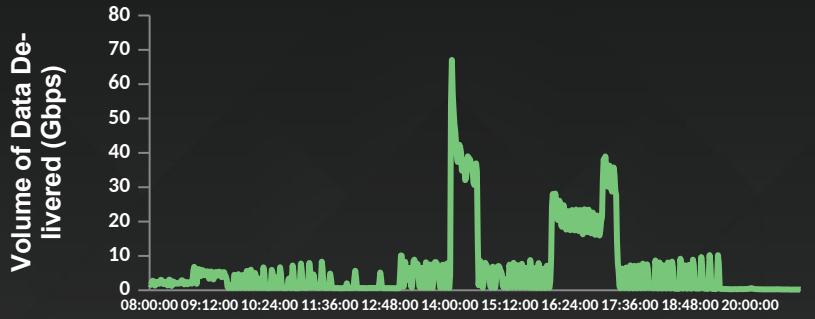
- Can host static websites
- Supports fine-grained permission control
- Ties in well with Amazon CloudFront
- Ties in with Amazon EMR
- Acts as a logging endpoint for S3, CloudFront, Billing, ELB, AWS CloudTrail, and more
- Supports encryption at transit and at rest
- Reduced redundancy is 1/3 cheaper
- Amazon Glacier for super long-term storage at 1/3 the cost of S3

Amazon CloudFront

Amazon CloudFront is a web service for scalable content delivery:

- Cache static content at the edge for faster delivery
- Helps lower load on origin infrastructure
- Dynamic and static content
- Streaming video
- Zone apex support
- Custom SSL certificates
- Low TTLs (as short as 0 seconds)
- Lower costs for origin fetches (between Amazon S3/Amazon EC2 and Amazon CloudFront)
- Optimized to work with Amazon EC2, Amazon S3, Elastic Load Balancing, and Amazon Route 53





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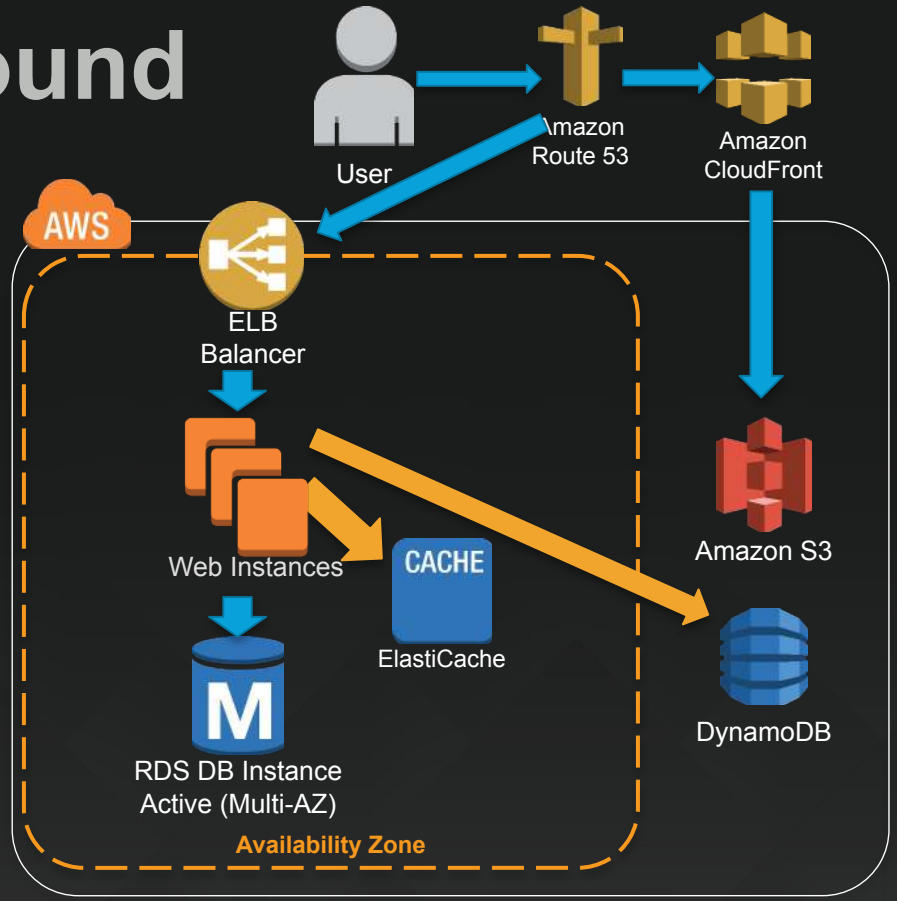
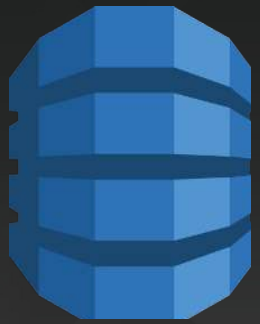


Amazon DynamoDB

- Managed, provisioned throughput NoSQL database
- Fast, predictable performance
- Fully distributed, fault-tolerant architecture
- JSON support
- Items up to 400 KB



Feature	Details
Provisioned throughput	Dial up or down provisioned read/write capacity
Predictable performance	Average single-digit millisecond latencies from SSD-backed infrastructure
Strong consistency	Be sure you are reading the most up-to-date values
Fault tolerant	Data replicated across Availability Zones
Monitoring	Integrated with Amazon CloudWatch
Secure	Integrates with AWS Identity and Access Management (IAM)
Amazon EMR	Integrates with Amazon EMR for complex analytics on large datasets

Amazon ElastiCache

- Hosted Memcached and Redis
  - Speaks same API as traditional open source Memcached and Redis
- Scale from one to many nodes
- Self-healing (replaces dead instance)
- Very fast (single digit ms speeds usually (or less))
- Local to a single AZ for Memcache, with no persistence or replication
- With Redis, can put a replica in a different AZ with persistence
- Use the AWS Auto Discovery client to simplify clusters growing and shrinking without affecting your application

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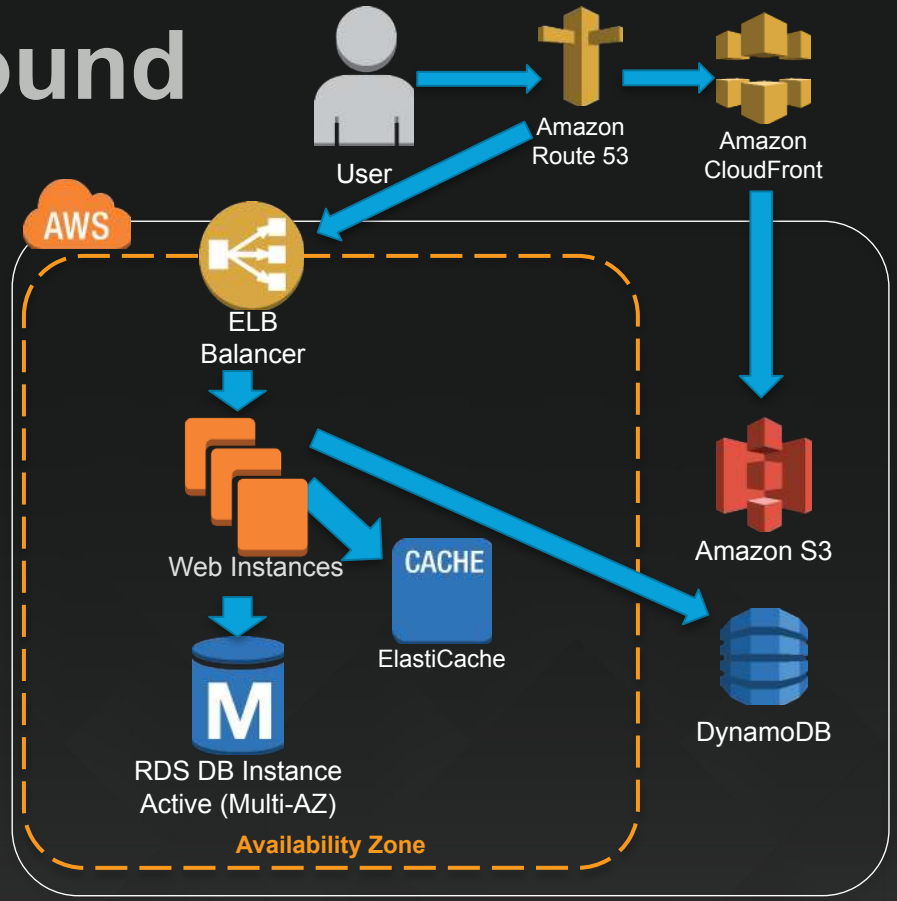
- Move dynamic content from the ELB balancer to Amazon CloudFront



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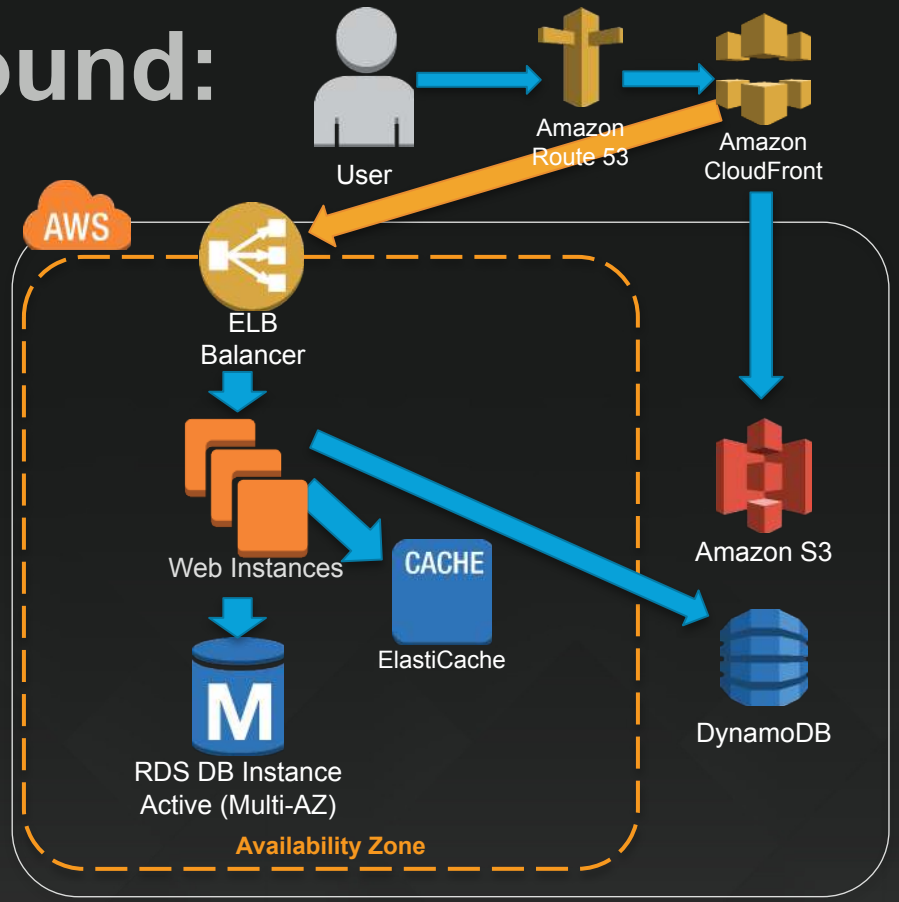

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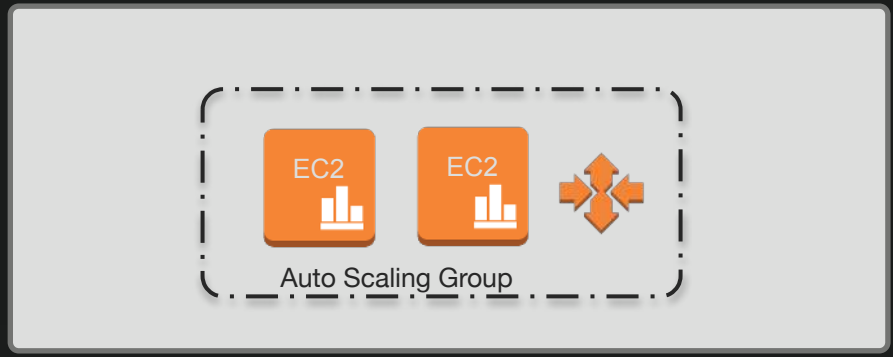
Now that our web tier is much more lightweight…

Auto Scaling!

Auto Scaling

Automatic resizing of compute clusters based on demand



Feature	Details
Control	Define minimum and maximum instance pool sizes and when scaling and cool down occurs.
Integrated with Amazon CloudWatch	Use metrics gathered by CloudWatch to drive scaling.
Instance types	Run Auto Scaling for on-demand and Spot Instances. Compatible with VPC.

aws autoscaling create-auto-scaling-group
--auto-scaling-group-name **MyGroup**
--launch-configuration-name **MyConfig**
--min-size **4**
--max-size **200**
--availability-zones **us-west-2c, us-west-2b**

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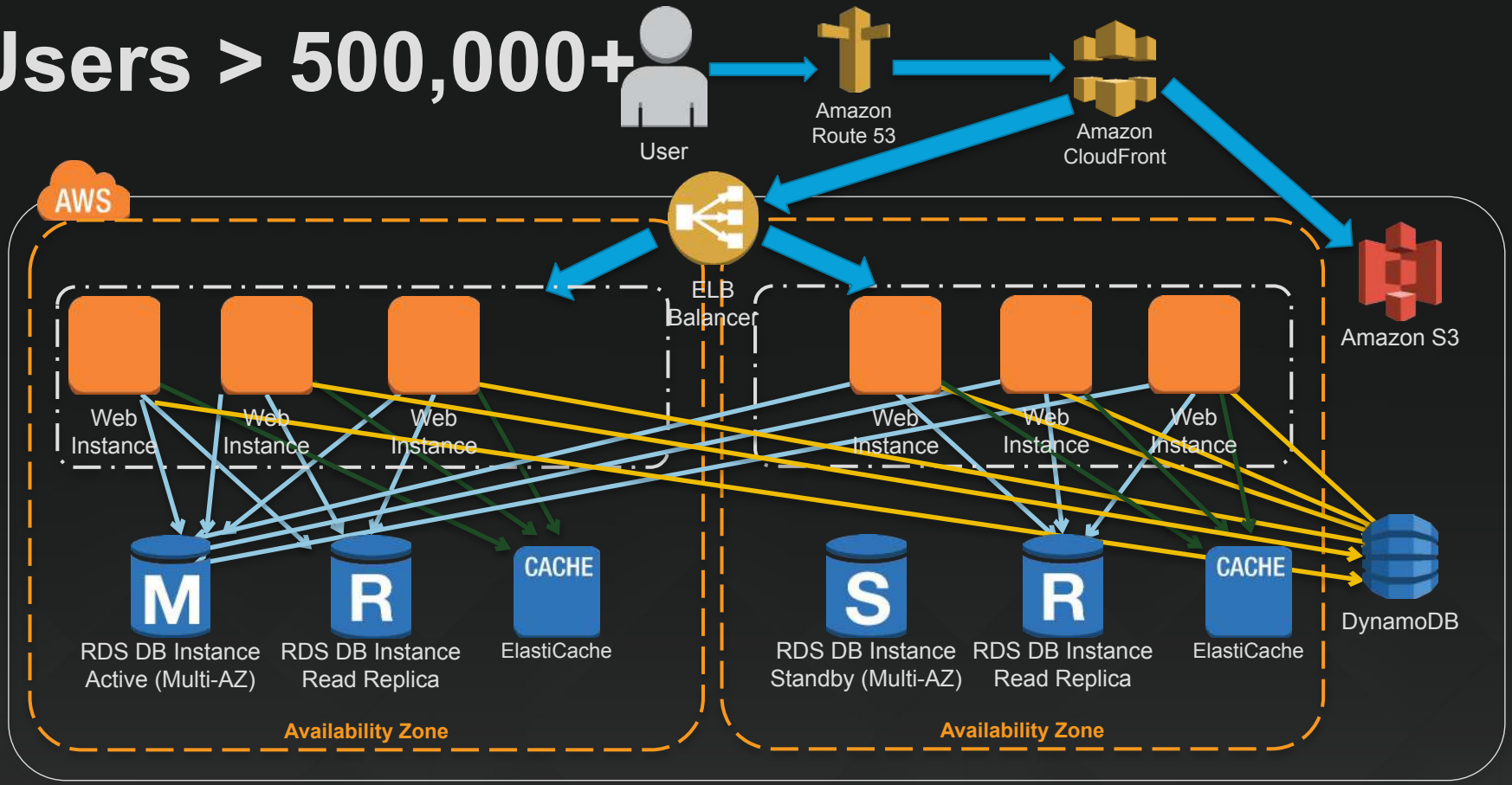
Users > 500,000+



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Use automation

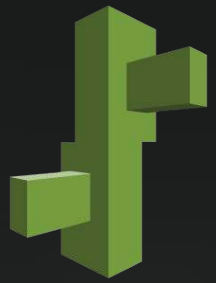
Managing your infrastructure will become an ever increasing important part of your time. Use tools to automate repetitive tasks:

- Tools to manage AWS resources
- Tools to manage software and configuration on your instances
- Automated data analysis of logs and user actions

AWS application management solutions

Higher-level services

Do it yourself



AWS
Elastic Beanstalk

AWS
OpsWorks

AWS
CloudFormation

Amazon EC2

Convenience

Control

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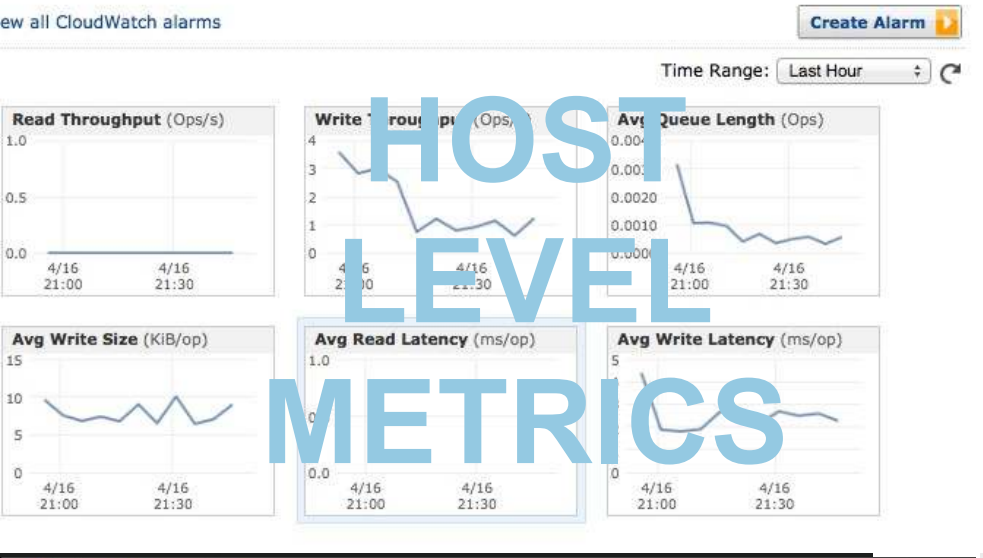
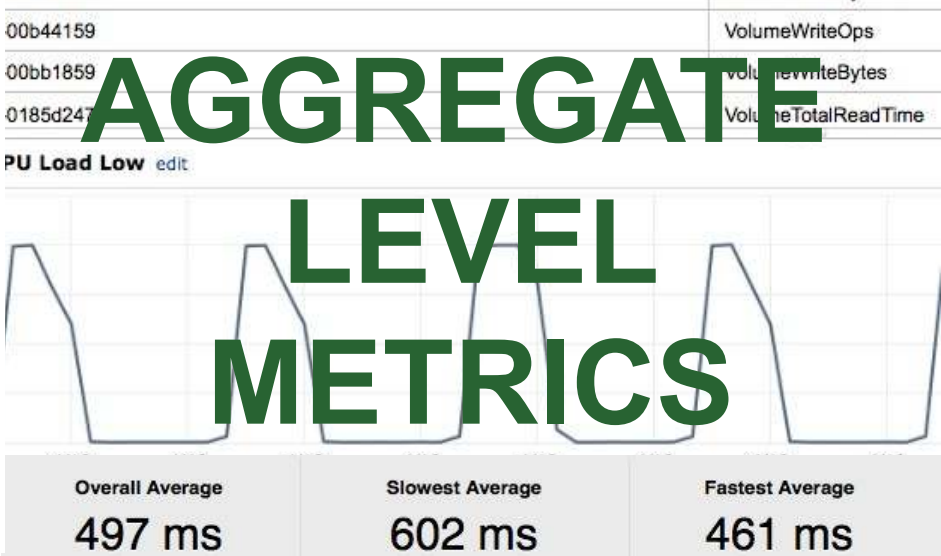
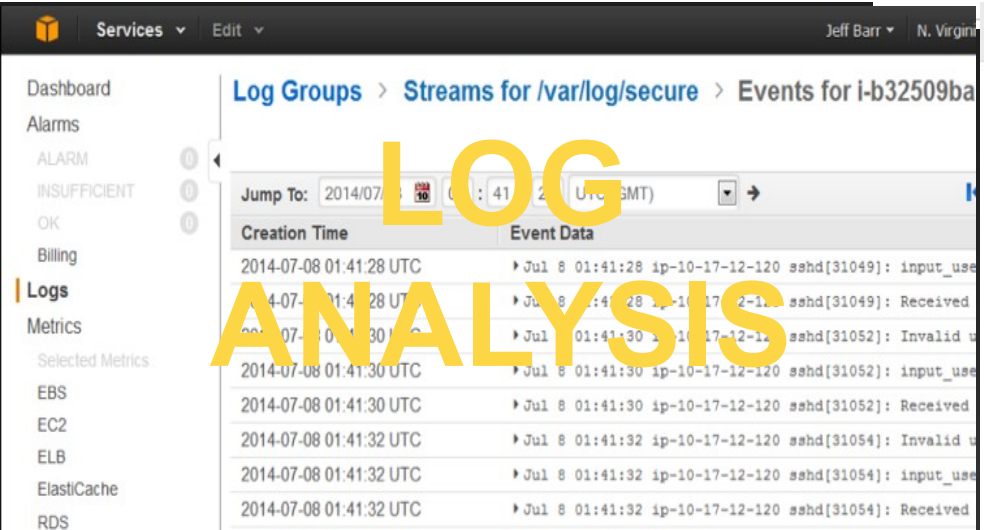
User > 500,000+

You'll potentially start to run into issues with speed and performance of your applications:

- Make sure you have monitoring, metrics, and logging in place
  - If you can't build it internally, outsource it! (third-party SaaS)
- Pay attention to what customers are saying works well vs. what doesn't, and use this direction
- Try to squeeze as much performance out of each service/component

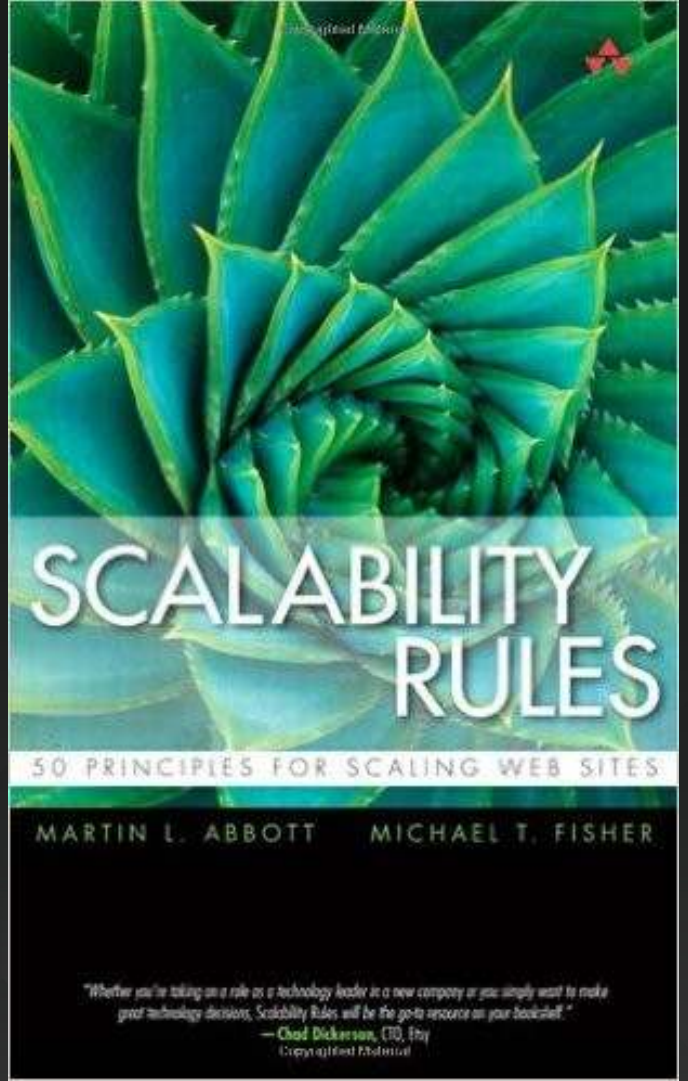

ew all CloudWatch alarms
Create Alarm
Time Range: Last Hour
Read Throughput (Ops/s)
Avg Queue Length (Ops)
Avg Write Size (KiB/op)
Avg Read Latency (ms/op)
Avg Write Latency (ms/op)
HOST LEVEL METRICS


VolumeWriteOps
VolumeTotalReadTime
PU Load Low edit
AGGREGATE LEVEL METRICS
Overall Average
497 ms
Slowest Average
602 ms
Fastest Average
461 ms


Services
Edit
Jeff Barr
Dashboard
Alarms
Billing
Logs
Metrics
EBS
EC2
ELB
ElastiCache
RDS
Log Groups
Streams for /var/log/secure
Events for i-b32509ba
Jump To:
Creation Time
Event Data
LOG ANALYSIS


500 ms
Mar 25
Apr 1
Apr 8
Apr 15
EXTERNAL SITE PERFORMANCE

There are more improvements to be made in breaking apart our web/app layer



SOA…what does this mean?

SOAing

- Move services into their own tiers/modules. Treat each of these as 100% separate pieces of your infrastructure, and scale them independently.

- Amazon.com and AWS do this extensively! It offers flexibility and better understanding of each component.

Loose coupling + SOA = winning

In the early days, if someone has a service for it already, opt to use that instead of building it yourself.

DON’T REINVENT THE WHEEL.

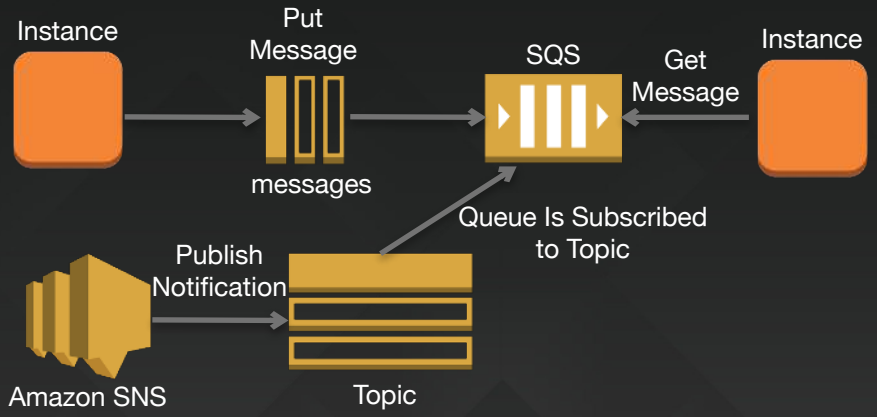
Examples:

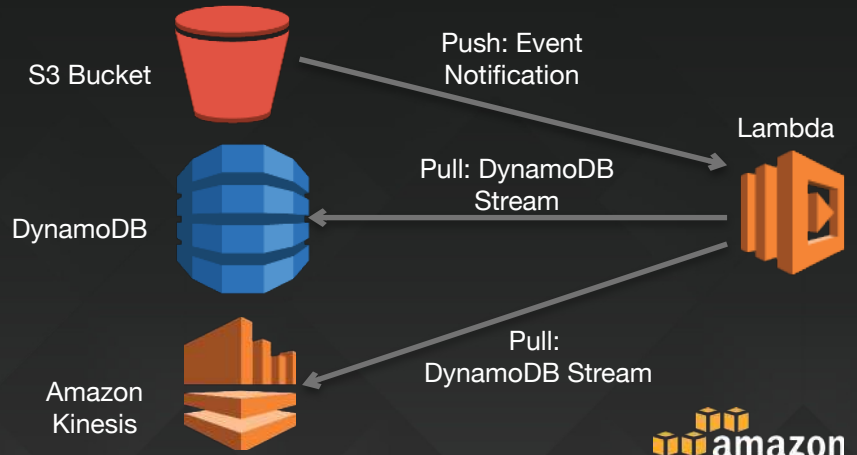
- Email
- Queuing
- Transcoding
- Search
- Databases
- Monitoring
- Metrics
- Logging
- Compute

Loose coupling sets you free!

The looser they're coupled, the bigger they scale

- Independent components
- Design everything as a black box
- Decouple interactions
- Favor services with built-in redundancy and scalability rather than building your own





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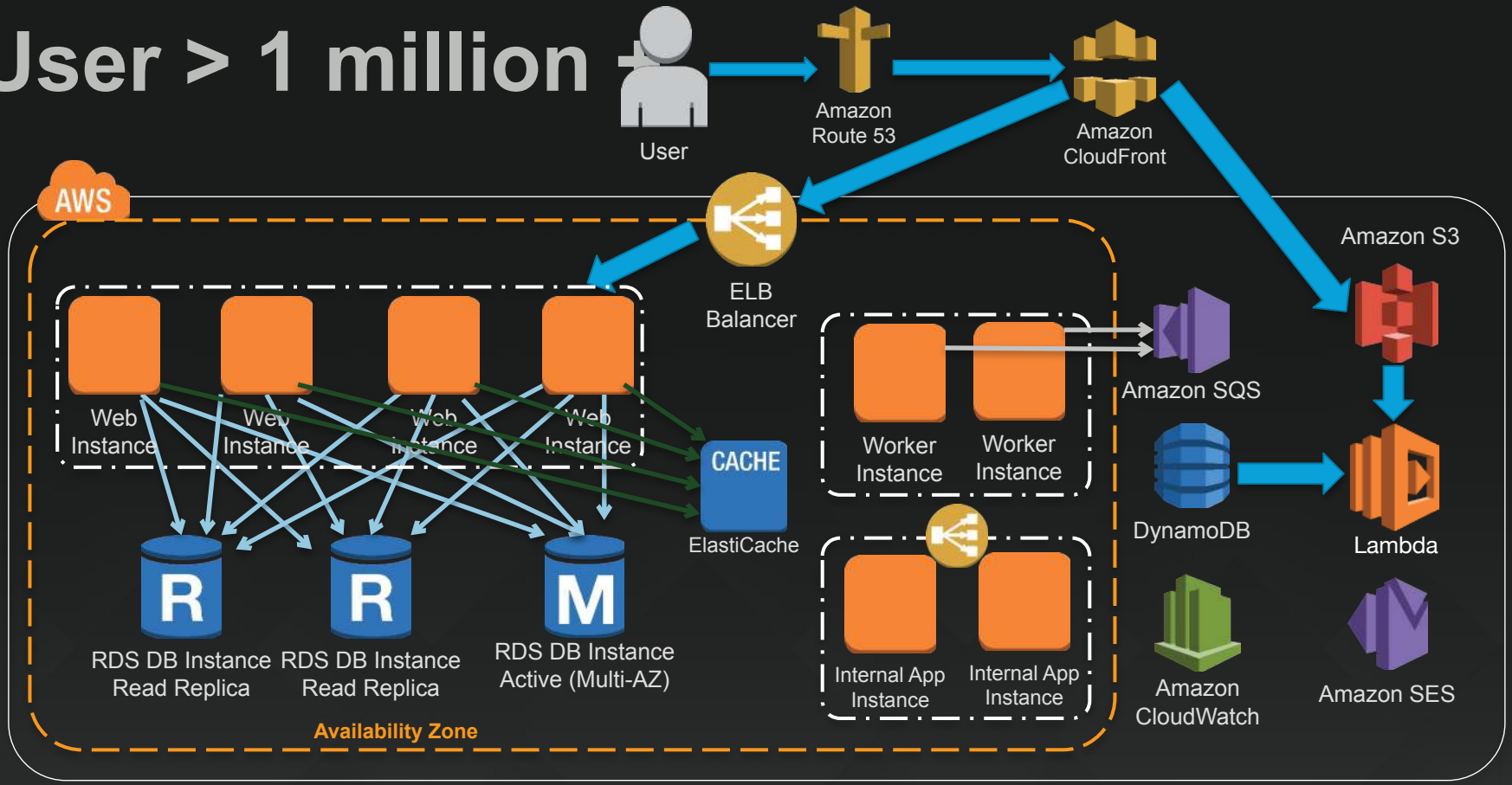
User > 1 million +

Reaching a million and above is going to require some bit of all the previous things:

- Multi-AZ
- Elastic Load Balancing between tiers
- Auto Scaling
- Service-oriented architecture
- Serving content smartly (Amazon S3/CloudFront)
- Caching off DB
- Moving state off tiers that auto scale

User > 1 million



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The next big steps

User > 5 million–10 million

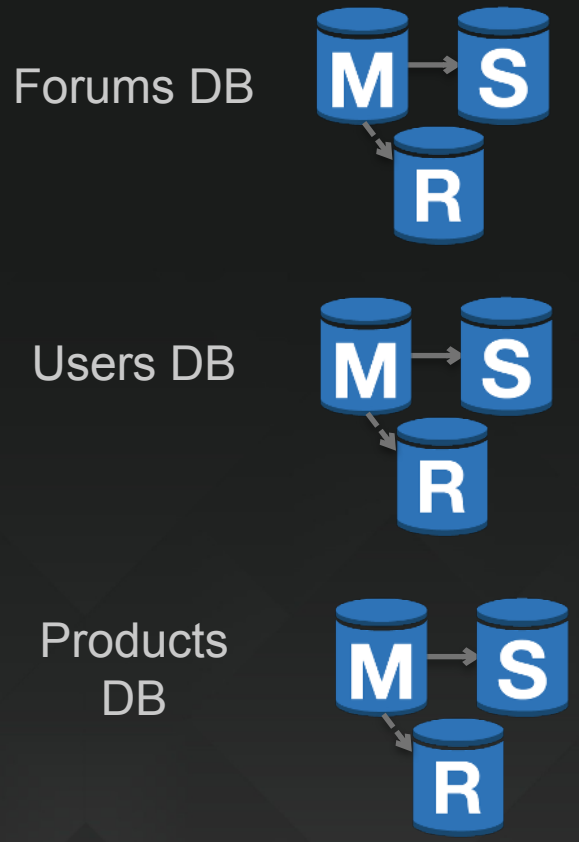
You'll potentially start to run into issues with your database around contention on the write master.

How can you solve it?

- Federation—splitting into multiple DBs based on function
- Sharding—splitting one dataset up across multiple hosts
- Moving some functionality to other types of DBs (NoSQL, Graph)

Database federation

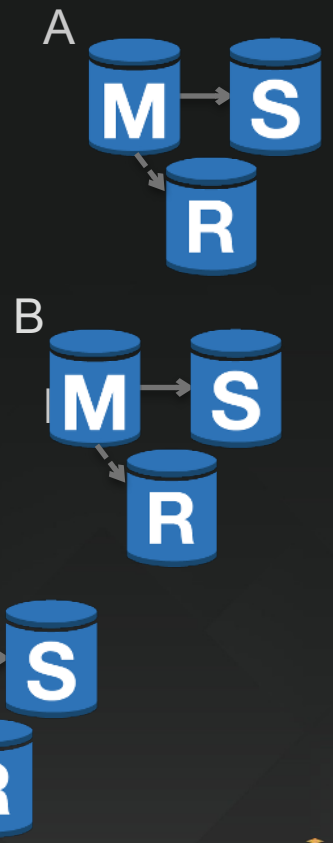
- Split up databases by function/purpose
- Harder to do cross-function queries
- Essentially delaying the need for something like sharding/NoSQL until much further down the line
- Won't help with single huge functions/tables



Sharded horizontal scaling

- More complex at the application layer
- ORM support can help
- No practical limit on scalability
- Operation complexity/sophistication
- Shard by function or key space
- RDBMS or NoSQL

User	ShardID
002345	A
002346	B
002347	C
002348	B
002349	A



Shifting functionality to NoSQL

- Similar in a sense to federation
- Again, think about the earlier points for NoSQL vs. SQL
- Leverage hosted services like DynamoDB
- Some use cases:
  - Leaderboards/scoring
  - Rapid ingest of clickstream/log data
  - Temporary data needs (cart data)
  - “Hot” tables
  - Metadata/lookup tables

DynamoDB

A quick review

A quick review

- Multi-AZ your infrastructure.
- Make use of self-scaling services—ELB, Amazon S3, Amazon SNS, Amazon SQS, Amazon SWF, Amazon SES, and more.
- Build in redundancy at every level.
- Start with SQL. Seriously.
- Cache data both inside and outside your infrastructure.
- Use automation tools in your infrastructure.

A quick review continued

- Make sure you have good metrics/monitoring/logging tools in place
- Split tiers into individual services (SOA)
- Use Auto Scaling as soon as you're ready for it
- Don't reinvent the wheel
- Move to NoSQL if and when it makes sense

Putting all this together means we should now easily be able to handle 10+ million users!

To infinity...

Next steps?

READ!

- aws.amazon.com/documentation
- aws.amazon.com/architecture
- aws.amazon.com/start-ups

START USING AWS

- aws.amazon.com/free/

amazon web services

Next steps?

ASK FOR HELP!

- forums.aws.amazon.com
- aws.amazon.com/premiumsupport/
- Your Account Manager
- A Solutions Architect

Thank You

Julien Simon
Principal Technical Evangelist
Amazon Web Services

julsimon@amazon.fr
@julsimon

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TEL AVIV