

Building Resilient Serverless Systems

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- Partner, Symphonia
- 20+ yrs experience in govt, healthcare, travel, ad-tech
- Intent Media, RoomKey, Meddius, SAIC, Booz Allen



O'REILLY®

Programming AWS Lambda

Build and Deploy Serverless
Applications with Java



Early
Release

RAW &
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John Chapin & Mike Roberts

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What is Serverless?

Understanding the Latest Advances in
Cloud and Service-Based Architecture



Mike Roberts
& John Chapin



re·sil·ience

The ability to recover readily from adversity.



The ability of **your service** to **continue operating** when the source of failure is **beyond your control.**



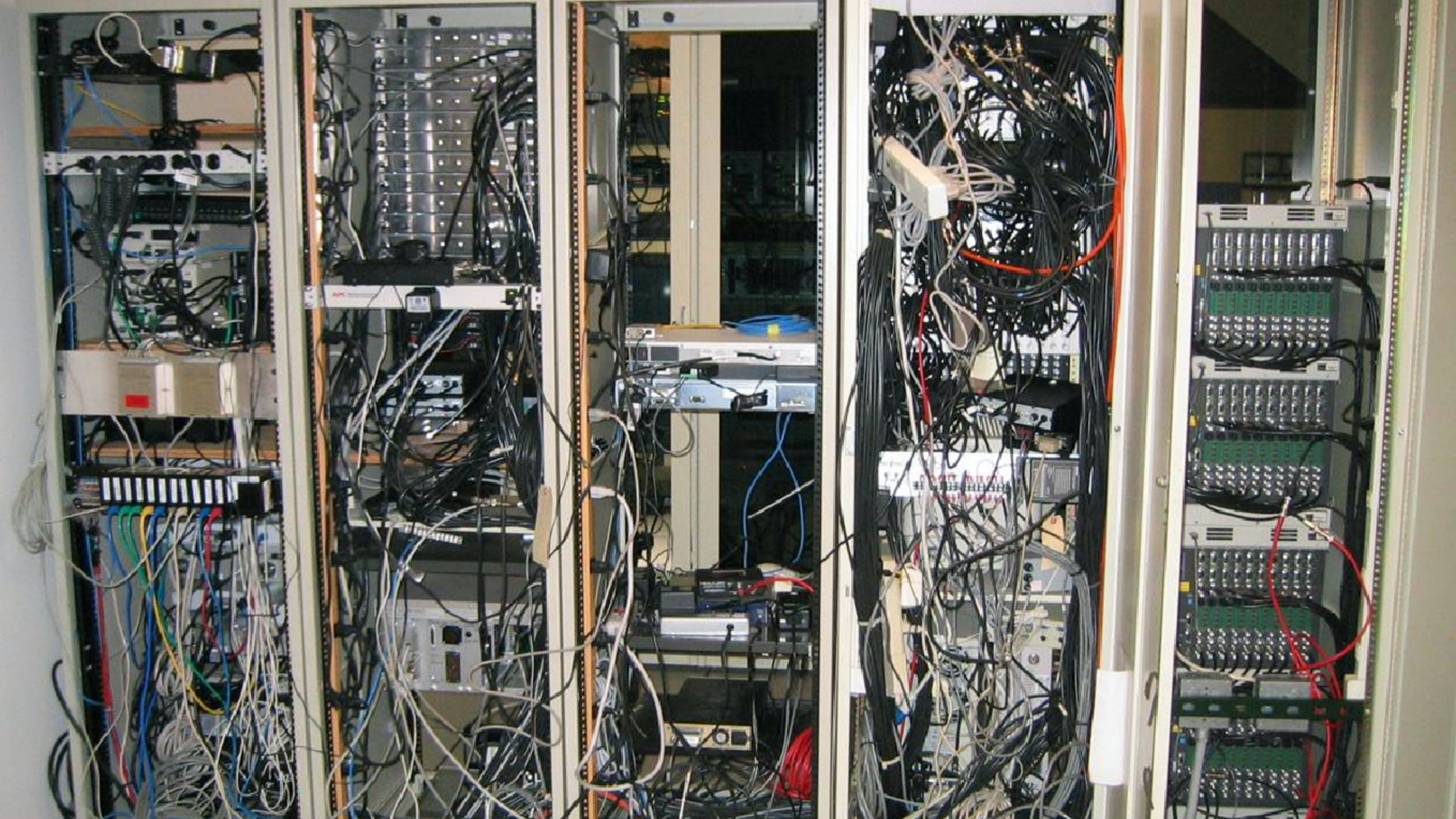














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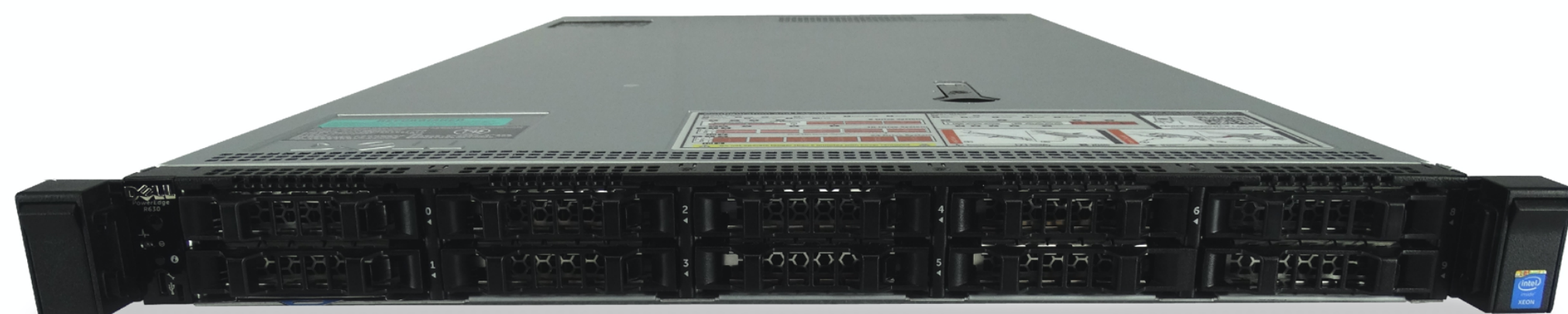
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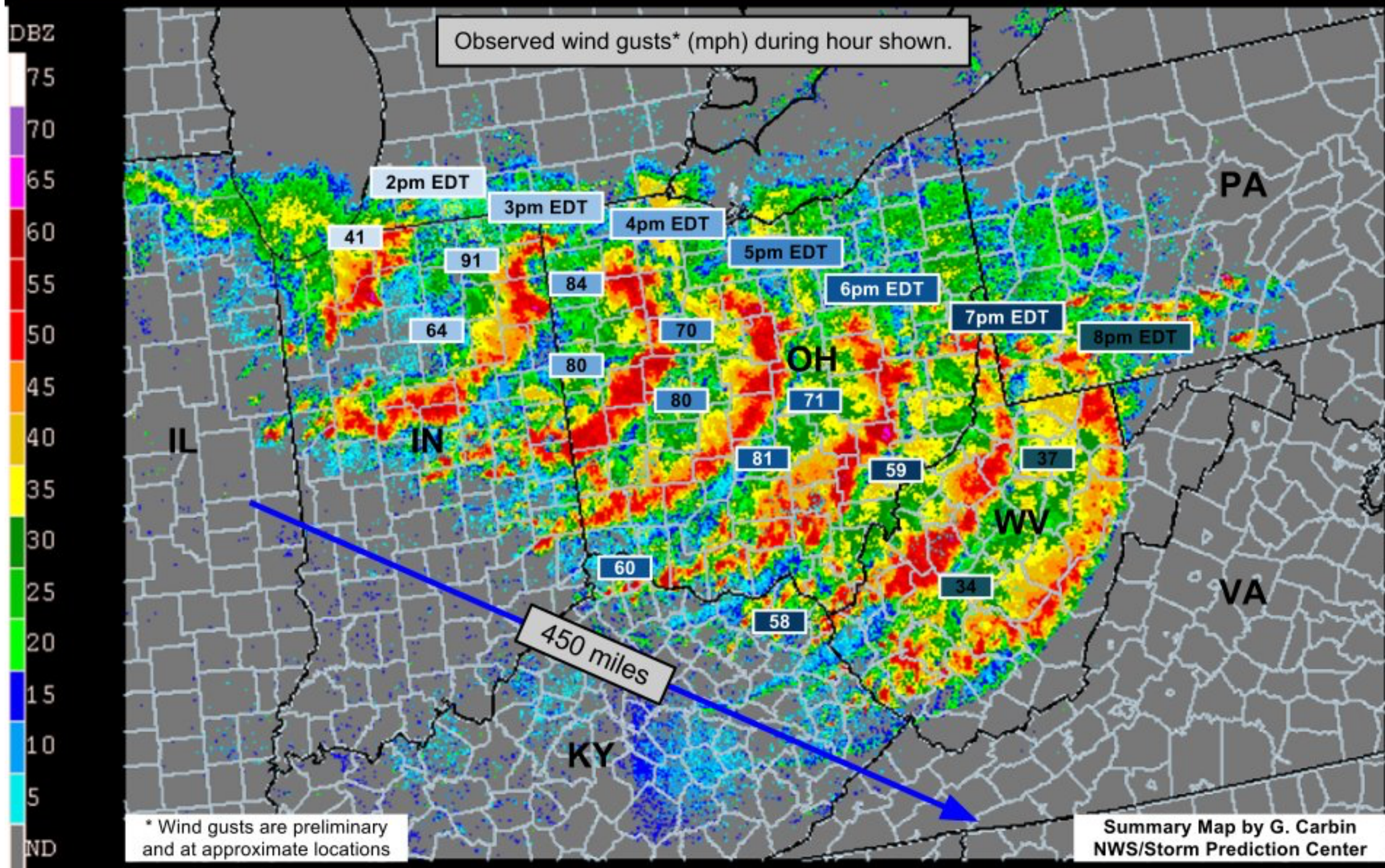








June 29, 2012 Midwest/Ohio Valley Derecho
Radar Imagery Composite Summary 18-00 UTC
~450 miles in 6 hours / Average Speed ~75 mph





“Failures are a given and everything will eventually fail over time ...”

–Werner Vogels, T-Shirt Enthusiast



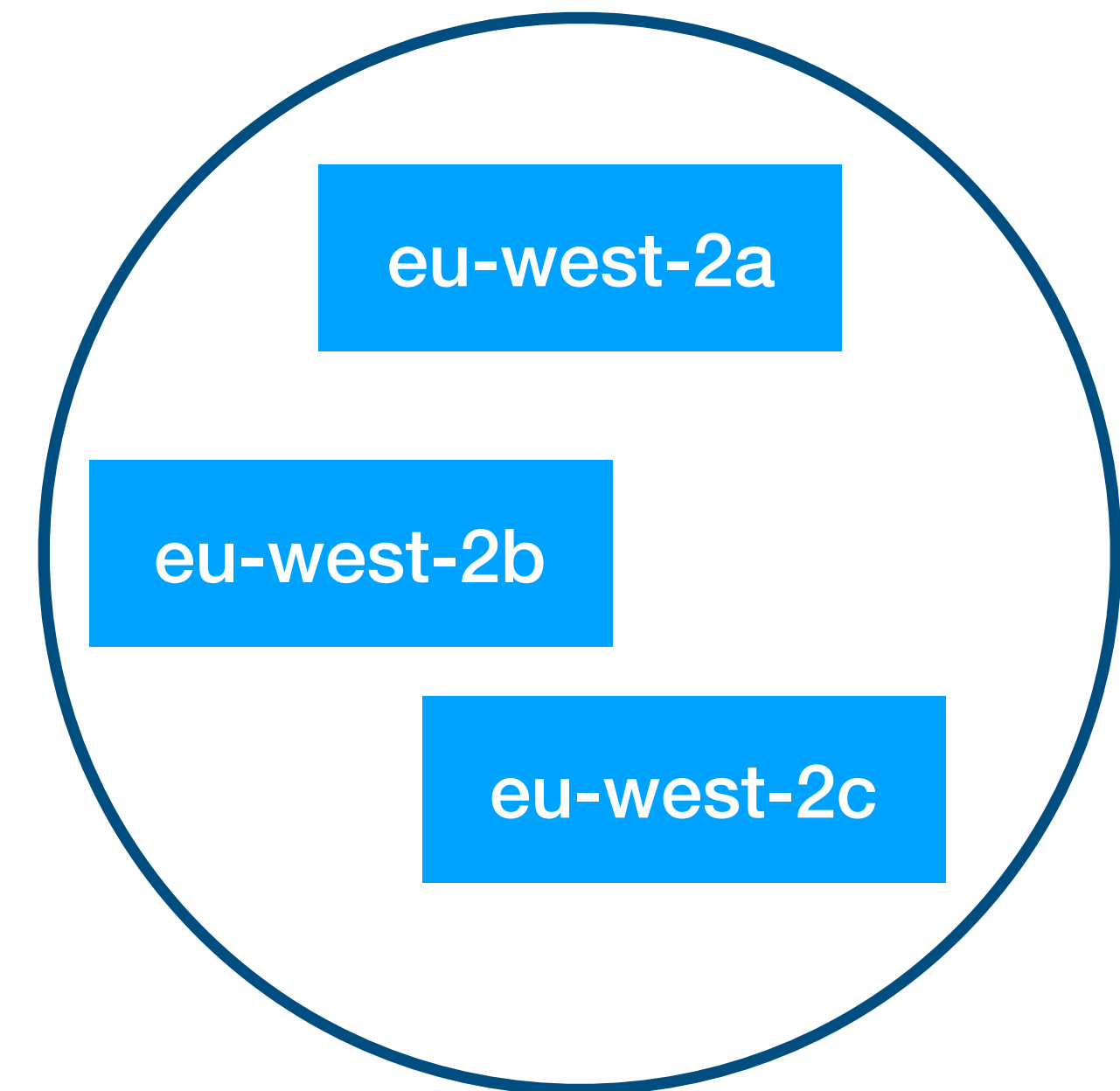
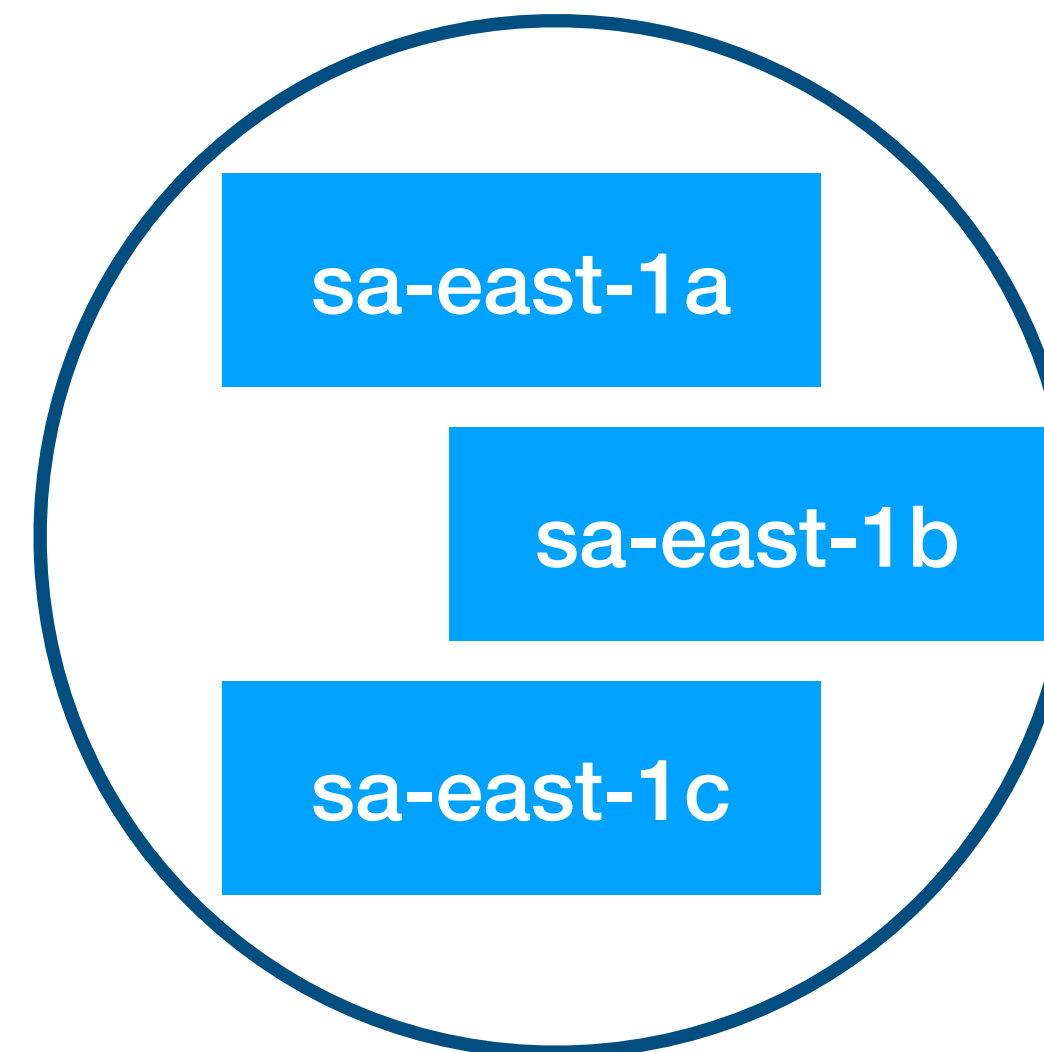
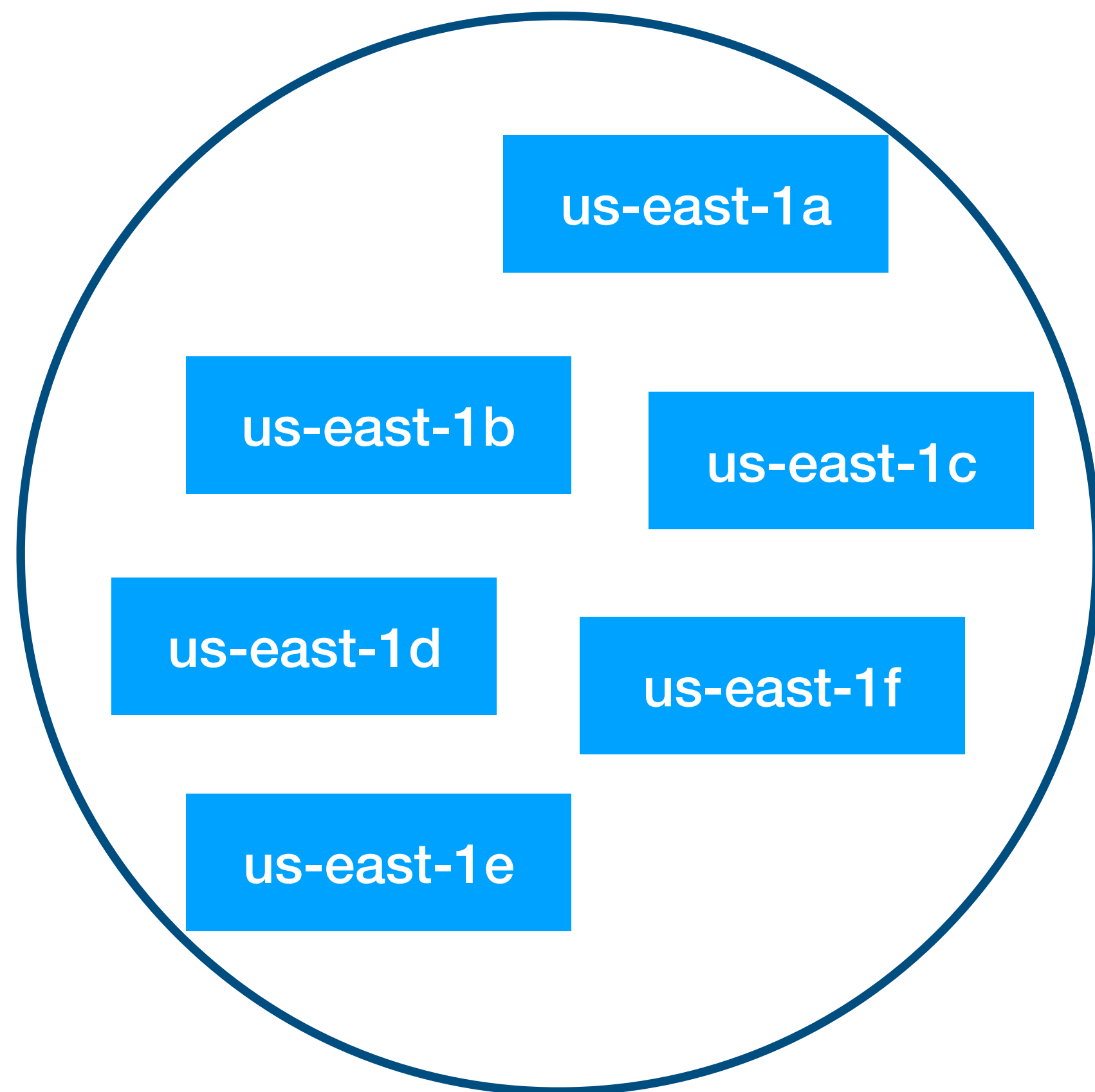
(<https://www.allthingsdistributed.com/2016/03/10-lessons-from-10-years-of-aws.html>)

Werner on Embracing Failure

- Systems will fail. At scale, systems will fail a lot.
- Embrace failure as a natural occurrence.
- Limit the blast radius of failures.
- Keep operating.
- Recover quickly (automate!)

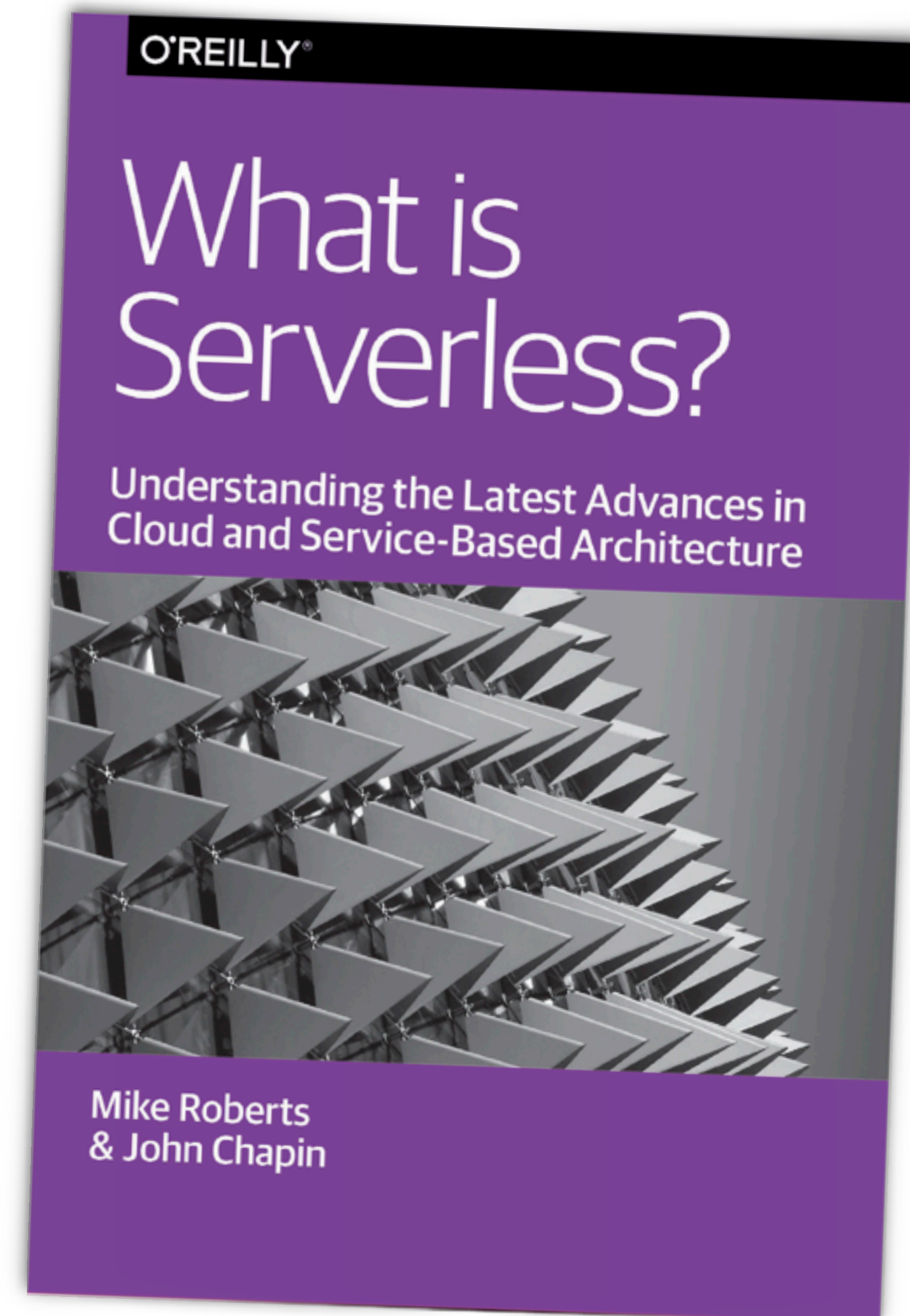


AWS isolation mechanisms



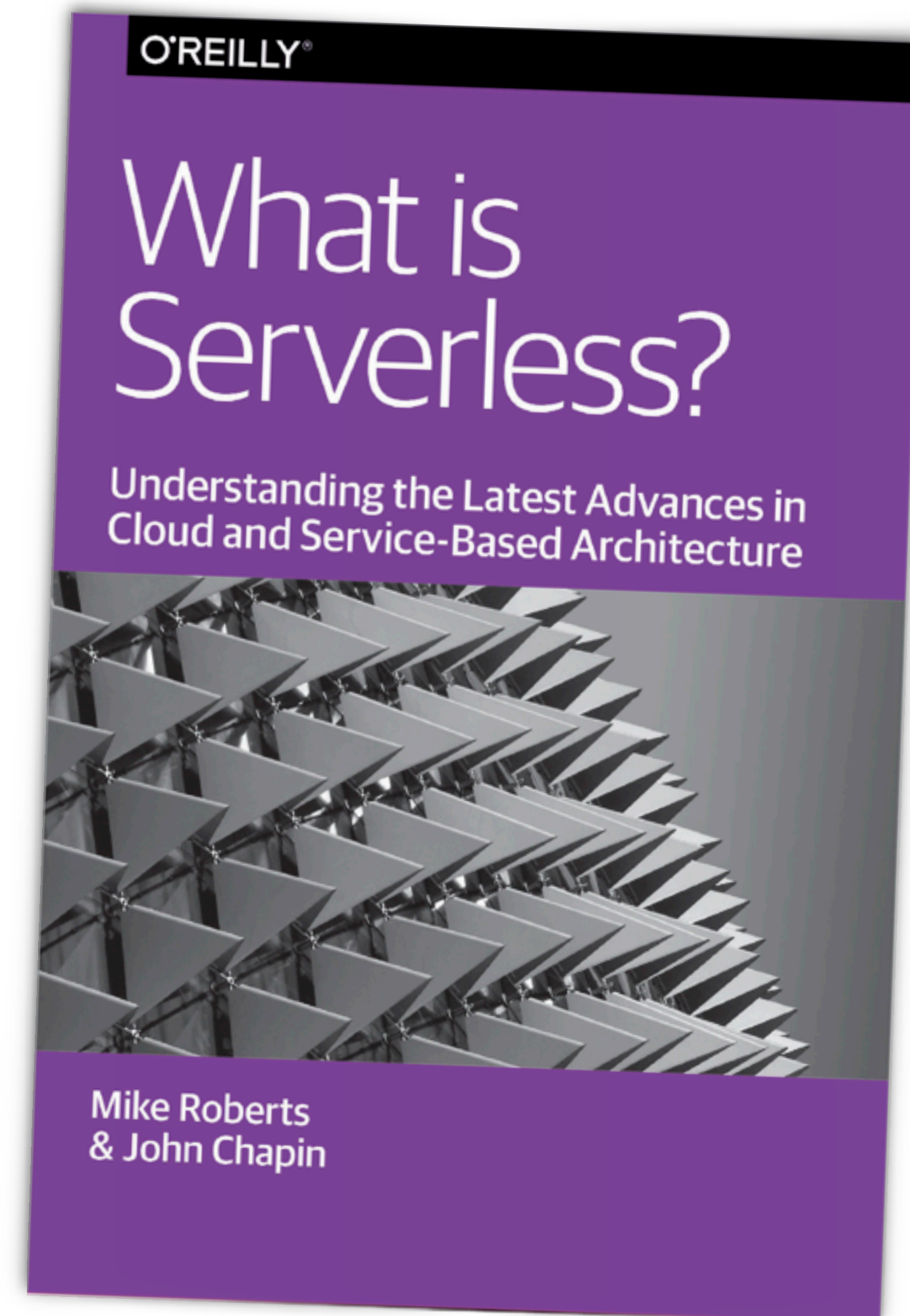
Serverless = FaaS + BaaS!

- FaaS = Functions as a Service
 - AWS Lambda, Auth0 Webtask, Azure Functions, Google Cloud Functions, etc...
- BaaS = Backend as a Service
 - Auth0, Amazon DynamoDB, Google Firebase, Parse, Amazon S3, etc...



Serverless attributes

- No managing of hosts or processes
- Self auto-scaling and provisioning
- Costs based on precise usage (down to zero!)
- Implicit high availability



Failures in Serverless land

- Serverless is all about using vendor-managed services.
- Two broad classes of failures:
 - Application failures (your problem, your resolution)
 - Service failures (your problem, but not your resolution)
- What happens when those vendor-managed services fail?



Mitigation through architecture

- We have no control over resolving acute vendor failures.
- Plan for failure, architect and build applications to be resilient.
- Take advantage of:
 - Vendor-designed isolation mechanisms (like AWS regions).
 - Vendor services designed to work across regions (like Route 53).
- Take advantage of vendor-recommended architectural practices, like the AWS Well-Architected Framework's Reliability Pillar:
<https://d1.awsstatic.com/whitepapers/architecture/AWS-Reliability-Pillar.pdf>



Serverless resiliency on AWS

- Regional high-availability = services running across multiple availability zones in one region.
 - With EC2 (and other traditional instance-based services), it's our problem.
 - With Serverless (Lambda, DynamoDB, S3, etc), AWS handle it for us.
- Global high-availability = services running across multiple regions.
 - We can architect our systems for global high-availability.
 - The Serverless cost model is a huge advantage!



Serverless resiliency on AWS

- Event-driven Serverless systems with externalized state mean:
 - Little or no data in-flight when a failure occurs
 - Data persisted to reliable systems (like Kinesis, DynamoDB or S3)
- Serverless continuous deployment means:
 - No persistent infrastructure to re-hydrate
 - Highly likely to be a portable, infrastructure-as-code approach



Not just resiliency

- Regional infrastructure is closer to regional users
- Because Serverless is "pay per request", total costs are similar
- Infrastructure-as-code minimizes incremental work in deploying to new region
- Automated multi-region deployment keeps infrastructure up-to-date



Serverless makes it possible to architect for resiliency to vendor failures, without multiplying costs, while improving the end user experience.

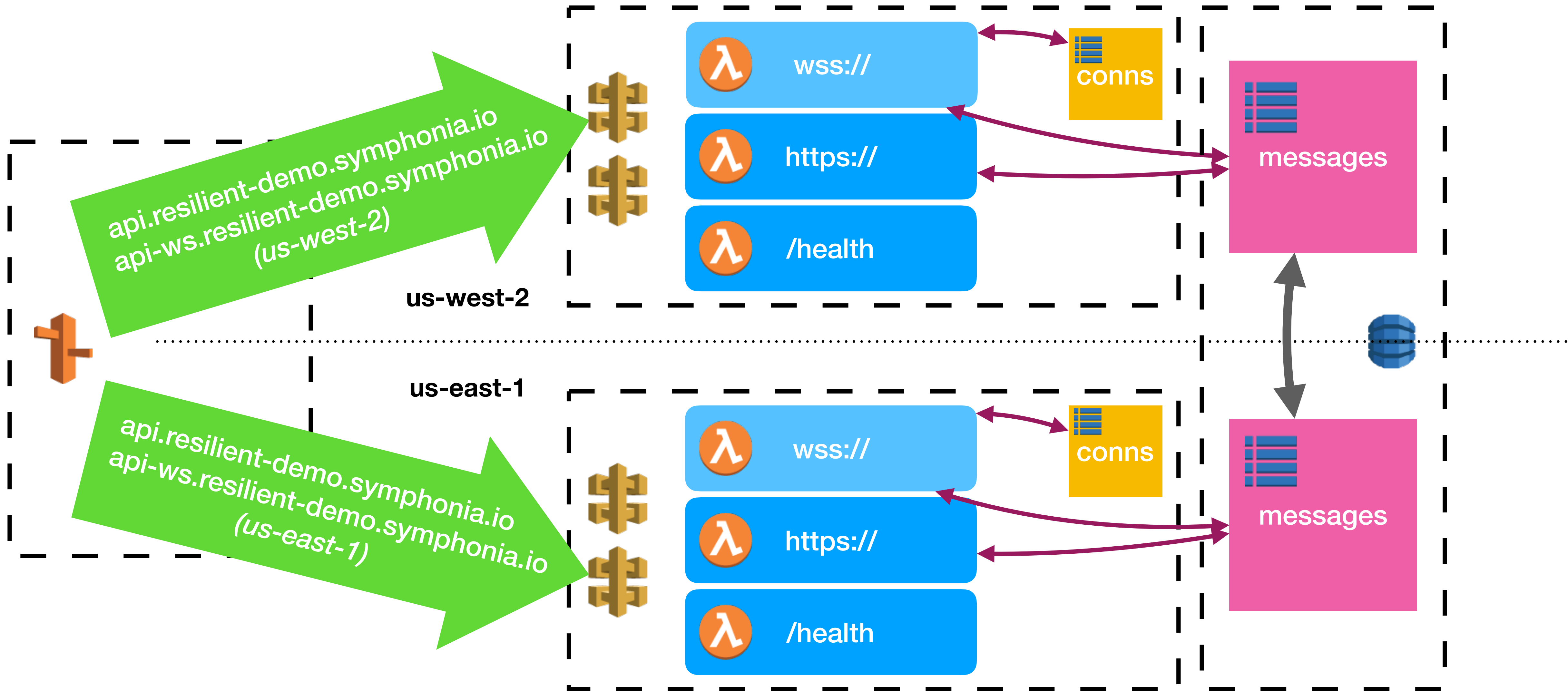
Demo



Overview

- Chat application with a global, highly-available API
- <https://github.com/symphoniacloud/resilient-serverless-systems>
 - Serverless Application Model (SAM) template
 - Lambda code (Java)
 - Build system (Maven)
 - Elm front-end





Request flow

- DNS lookup for **api.resilient-demo.symphonia.io**
- Route 53 responds with IP address for
 - lowest latency regional API Gateway endpoint
 - that has a passing health check (HTTP 2xx or 3xx from /health endpoint)
- Request traverses regional API Gateway to regional Lambda
- Regional Lambda writes to regional DynamoDB table
- DynamoDB replicates data to all replica tables in other regions, last write wins



Simulating failure

- Alter us-east-1 health check to return HTTP error status
- Observe HTTP request routed to us-west-2 instead
- Observe DynamoDB writes propagated from us-west-2 back to us-east-1



Rough edges

- DynamoDB Global Tables not available in CloudFormation
- ~~API Gateway WebSockets + Custom Domains not available in CloudFormation~~
- Can't add new replicas to DynamoDB global tables after inserting data
- SAM not compatible with CloudFormation Stack Sets



Additional approaches

- Multi-region deployment via Code Pipeline
<https://github.com/symphoniacloud/multi-region-codepipeline>
- CloudFront Origin Failover
https://docs.aws.amazon.com/AmazonCloudFront/latest/DeveloperGuide/high_availability_origin_failover.html
- Global Accelerator (for ELB, ALB, and EIP)
<https://aws.amazon.com/global-accelerator/>



AWS Resources

- James Hamilton's "Amazon Global Network Overview"
<https://www.youtube.com/watch?v=uj7Ting6Ckk>
- Rick Houlihan's DAT401: Advanced Design Patterns for DynamoDB
<https://www.youtube.com/watch?v=HaEPXoXVf2k>
- <https://aws.amazon.com/blogs/compute/building-a-multi-region-serverless-application-with-amazon-api-gateway-and-aws-lambda/>
(Magnus Bjorkman, November 2017)
- <https://aws.amazon.com/blogs/database/how-to-use-amazon-dynamodb-global-tables-to-power-multiregion-architectures/>
(Adrian Hornsby, December 2018)
- <https://aws.amazon.com/blogs/compute/announcing-websocket-apis-in-amazon-api-gateway/>
(Diego Magalhaes, December 2018)



Symphonia resources

- [Programming AWS Lambda](#) - Our upcoming full-length book with O'Reilly.
- [What is Serverless?](#) Our 2017 report, published by O'Reilly.
- [Serverless Architectures](#) - Mike's de-facto industry primer on Serverless.
- [Learning Lambda](#) - A 9-part blog series to help new devs get started.
- [Serverless Insights](#) - Our email newsletter covering all things Serverless.
- [The Symphonium](#) - Our blog, featuring technical content and analysis.



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