SRECON APAC

The AWS Billing Machine and Optimizing Cloud Costs

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Ryan Lopopolo

stripe

Our mission is to increase the GDP of the internet

Stripe builds economic infrastructure for the internet. Businesses of every size—from new startups to public companies—use our software to accept payments around the world.

⁉️ OPTIMIZING COSTS

💰 📉

Ryan Lopopolo

Why are we here? To optimize costs! But really to turn our cost optimization problem into an observability problem.

I did my market research and it showed me that a good talk has lots of emoji.
There are 50 slides and 109 emoji in this talk. We're gonna move quick.

The Cloud Aligns

Cost 🔄 Performance

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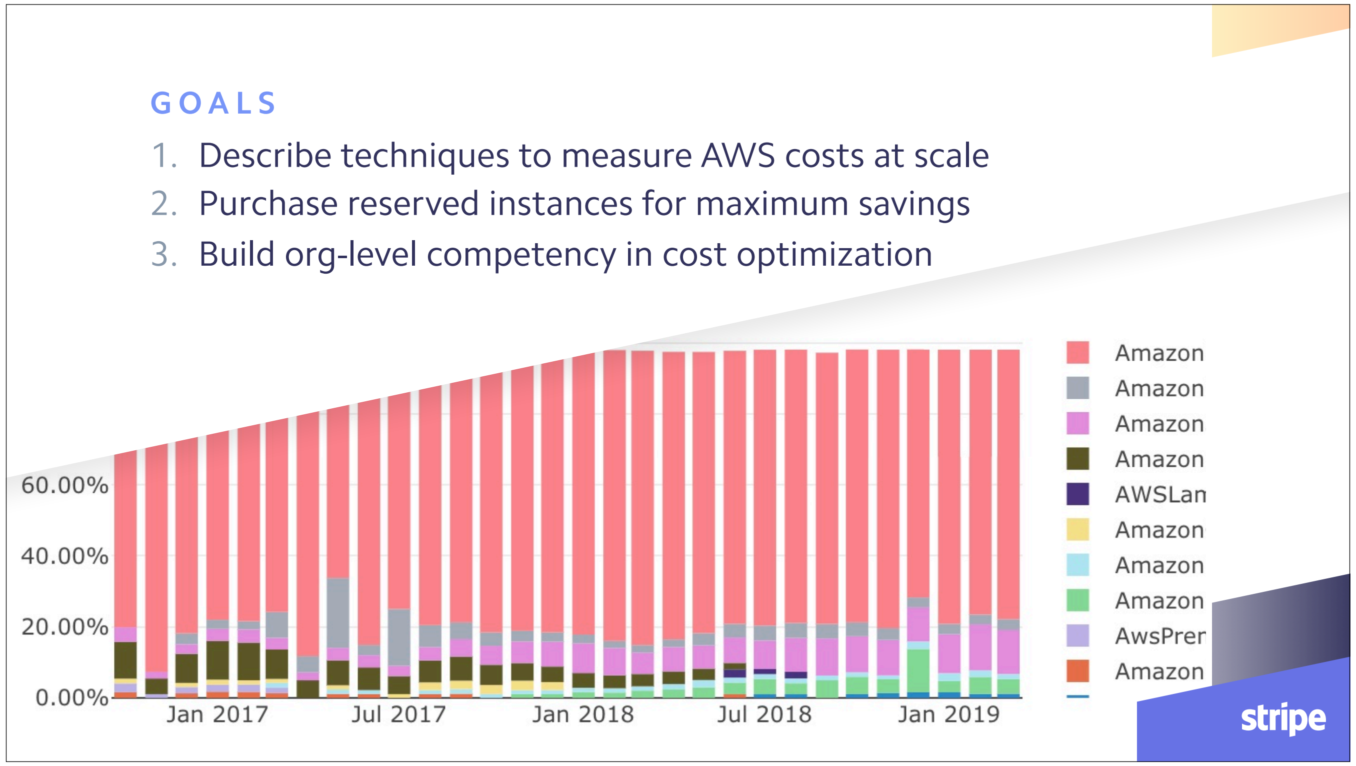
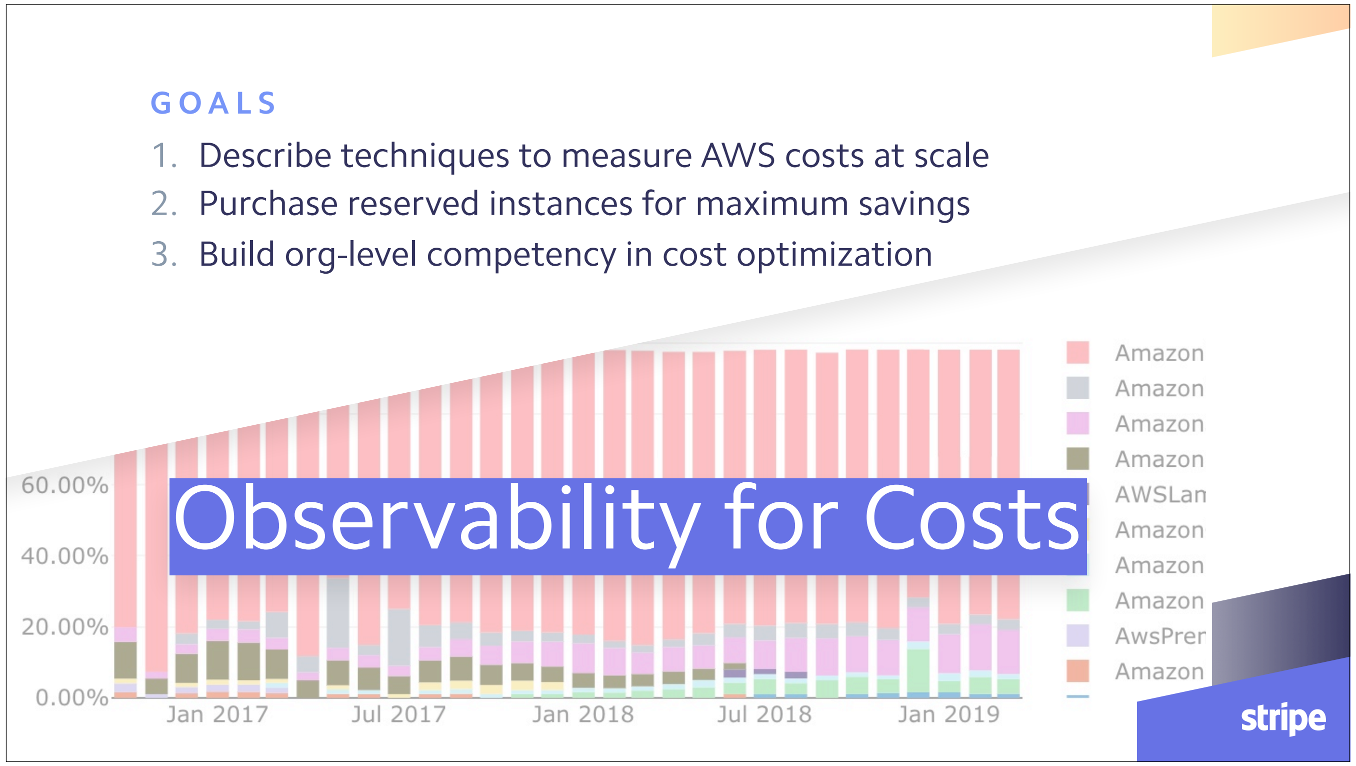
Metered infrastructure resources enable us to tune performance and cost at the same time



GOALS

1. Describe techniques to measure AWS costs at scale
2. Purchase reserved instances for maximum savings
3. Build org-level competency in cost optimization

Observability is a mindset for thinking about systems and we're going to apply Observability to our infrastructure costs.



GOALS

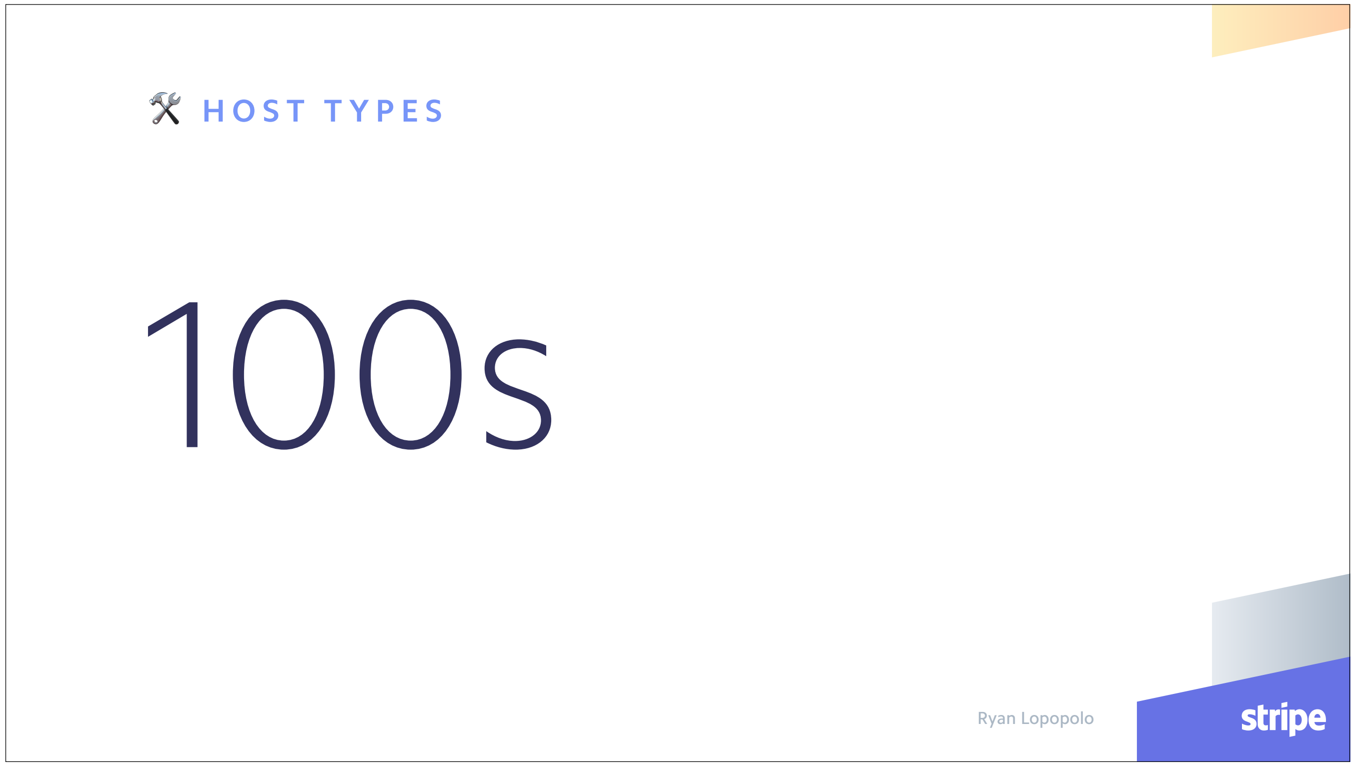
1. Describe techniques to measure AWS costs at scale
2. Purchase reserved instances for maximum savings
3. Build org-level competency in cost optimization

Observability for Costs

We have a chart on this slide and that's important because what we're doing here is providing observability for our cloud spend. Remember that in the cloud cost and performance are aligned. Just like we measure the p99 latency of our API with charts and metrics, so to do we use charts and metrics to measure costs and gain insight into the behavior of our infrastructure.

Can you guess which color is EC2?

📈 Scale



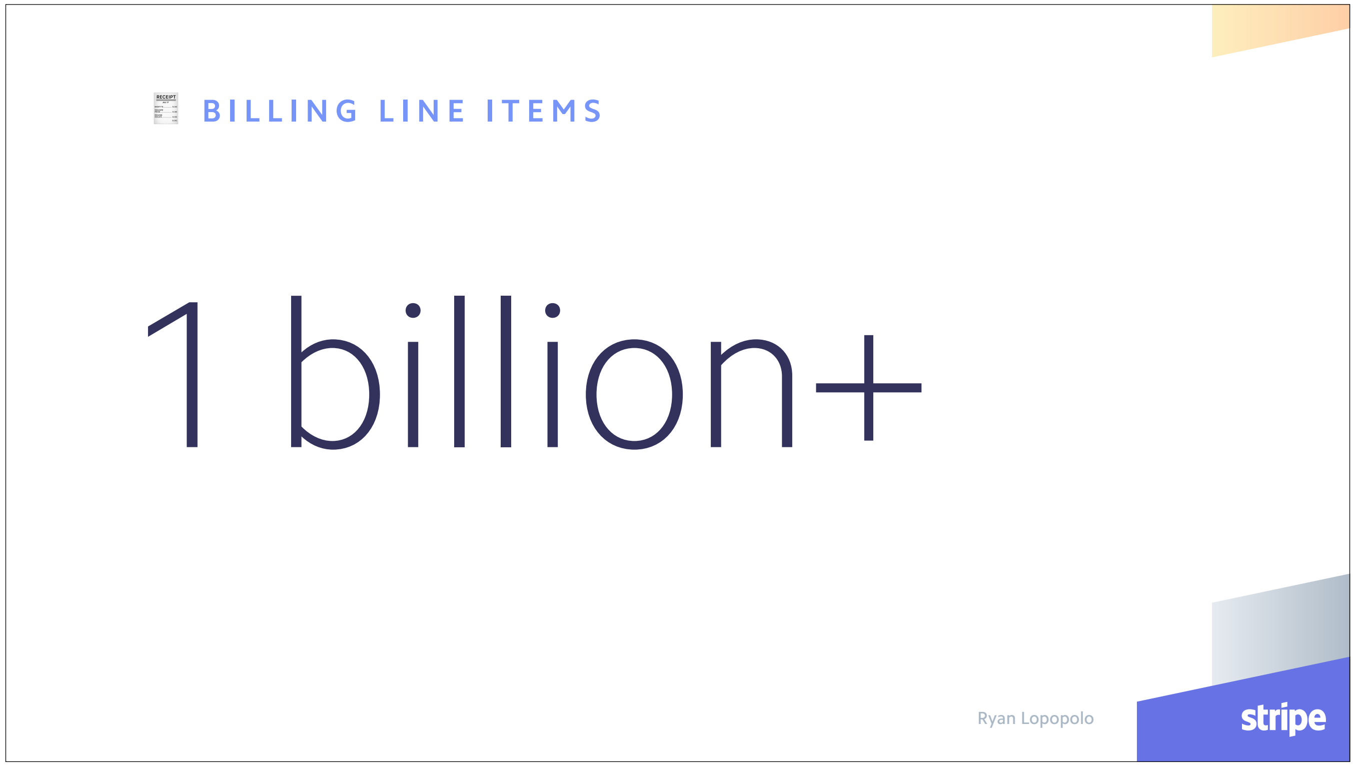
🛠 HOST TYPES

100s

Unique workloads that run on EC2 instances. ~puppet roles.

🖥 SERVERS

Many 😂



BILLING LINE ITEMS

1 billion+

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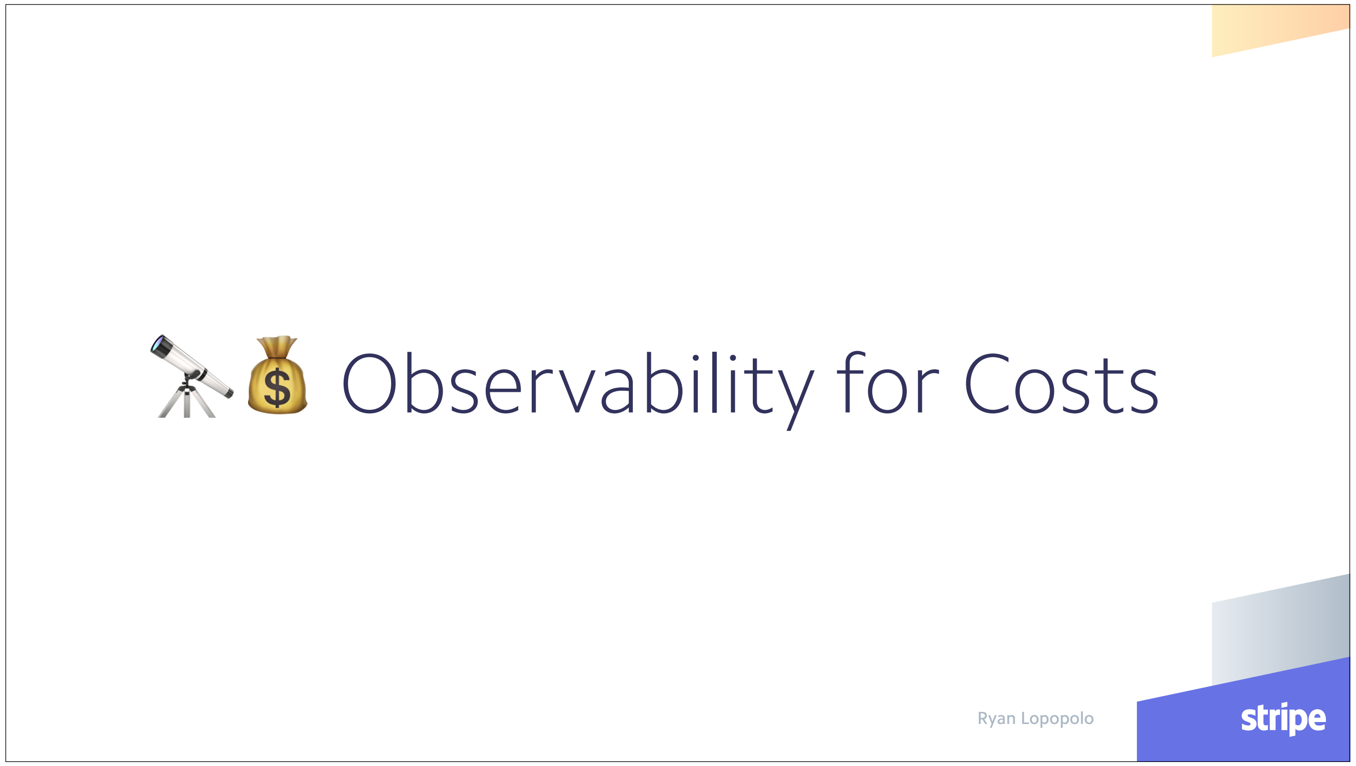
One line item per hour per SKU. Just like on prem you have a SKU for your R640 database server, in AWS every resource you buy has a SKU. S3 GB-Month or X-Ray traces stored.



🔭💰 Observability for Costs

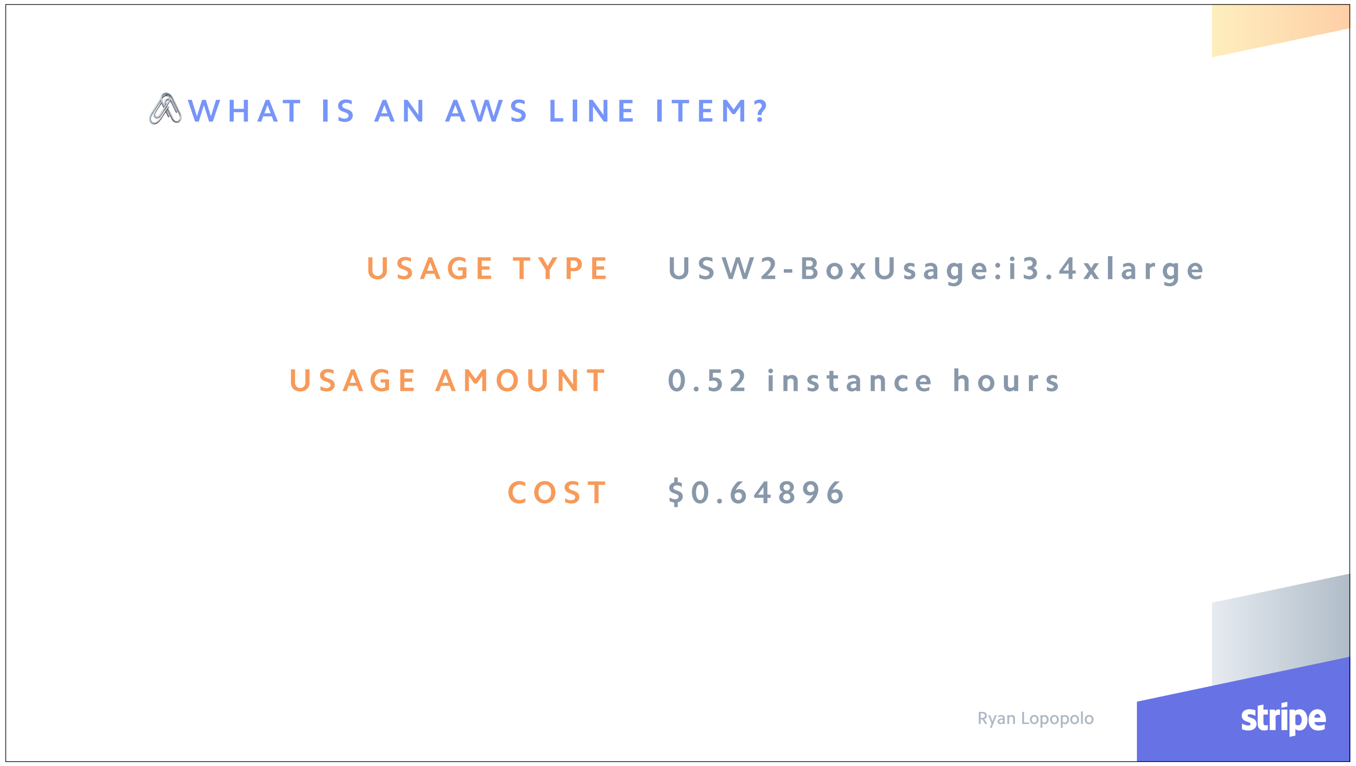
Ryan Lopopolo

We need a metrics source.

📚 Cost & Usage Report

https://aws.amazon.com/aws-cost-management/aws-cost-and-usage-reporting/

The Cost & Usage Report is a cost log containing hourly line items for your usage of every AWS product and SKU.

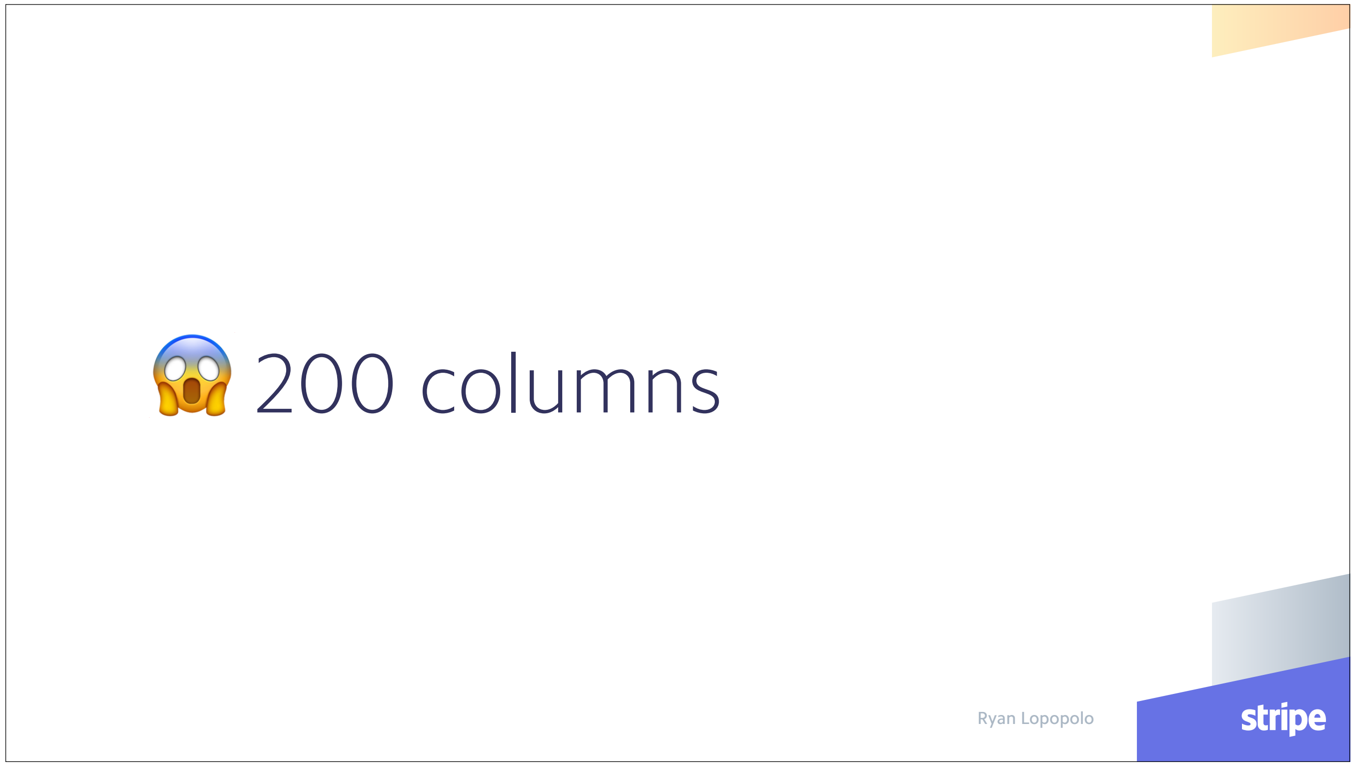


WHAT IS AN AWS LINE ITEM?

USAGE TYPE	USW2-BoxUsage:i3.4xlarge
USAGE AMOUNT	0.52 instance hours
COST	$0.64896

Ryan Lopopolo

We use these columns when constructing cost edges for our cost attribution pipeline.



😱 200 columns

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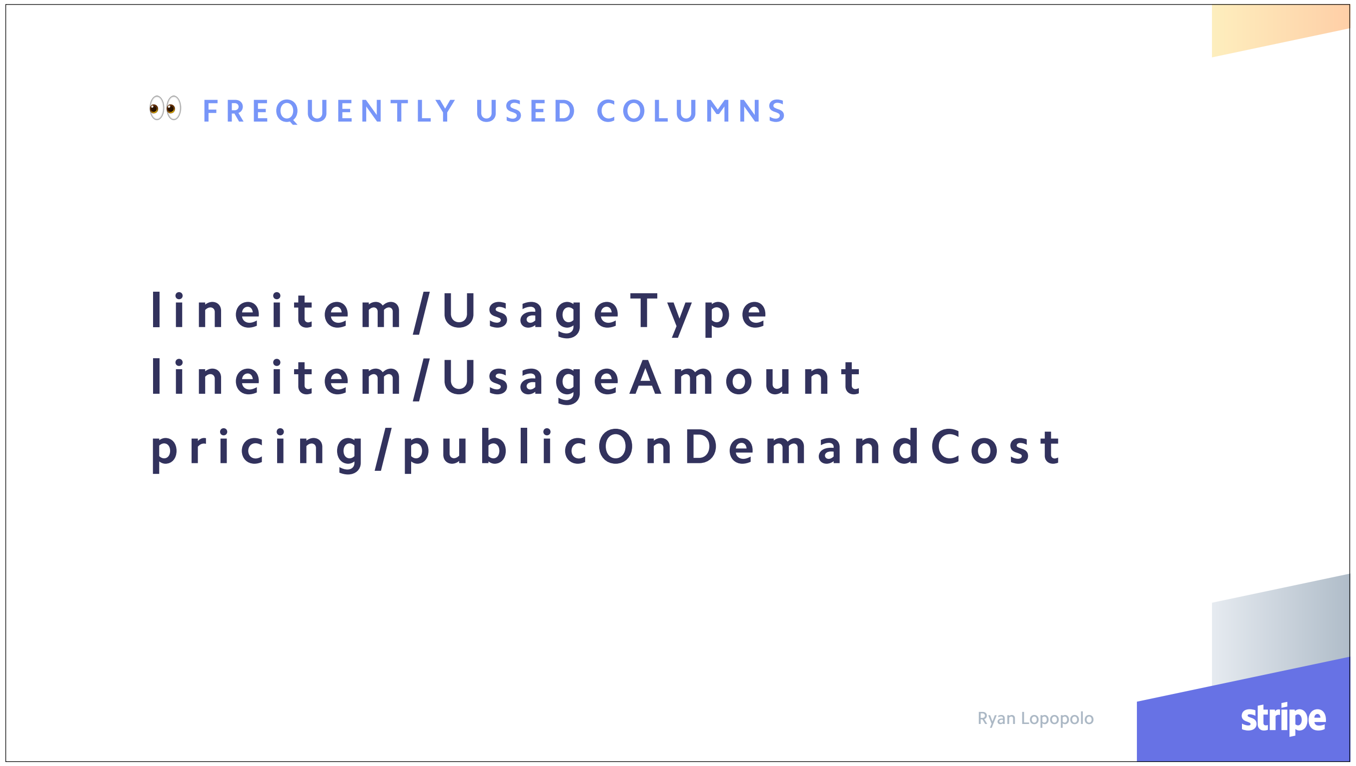
Load this into Redshift. We have an ETL that loads the report into one table per month and refreshes the data daily.

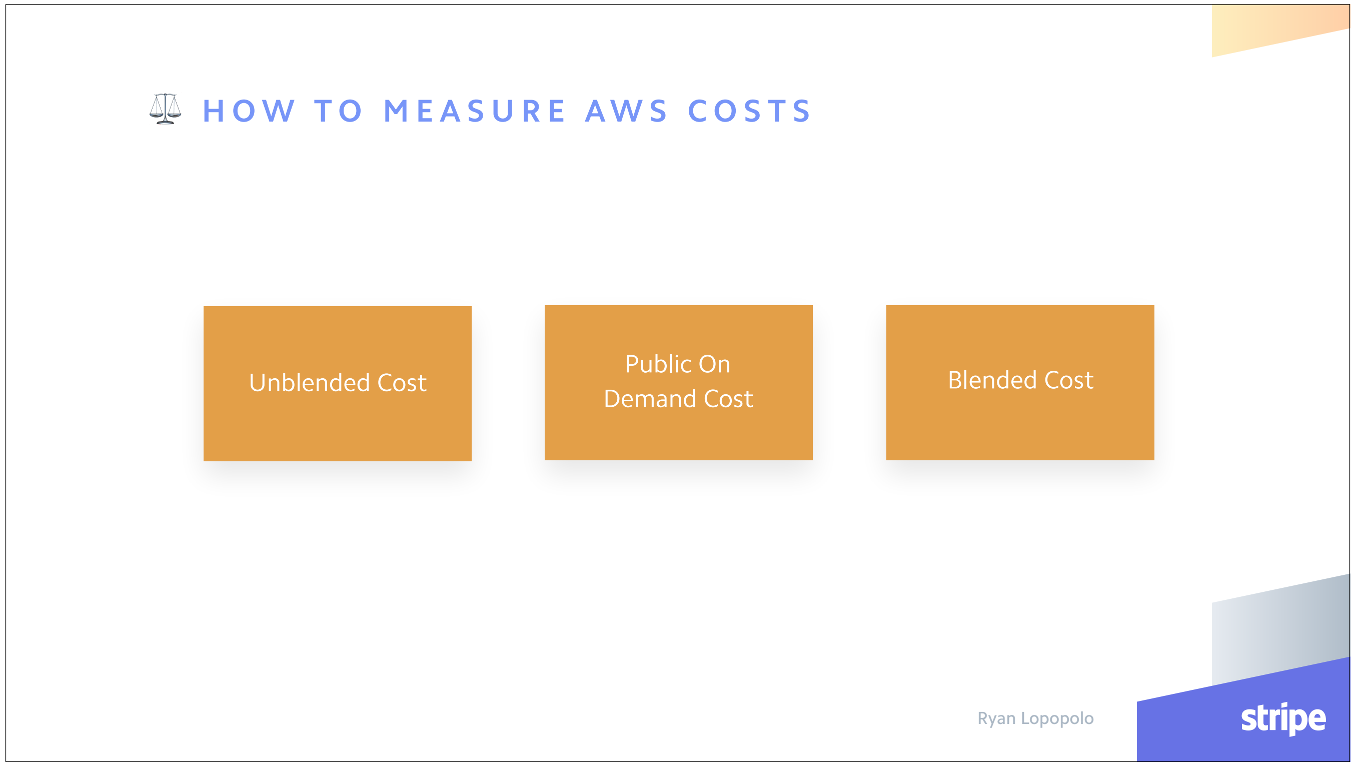


👀 FREQUENTLY USED COLUMNS

lineitem/UsageType
lineitem/UsageAmount
pricing/publicOnDemandCost

Ryan Lopopolo

We use these columns when constructing cost edges for our cost attribution pipeline.



⚖️ HOW TO MEASURE AWS COSTS

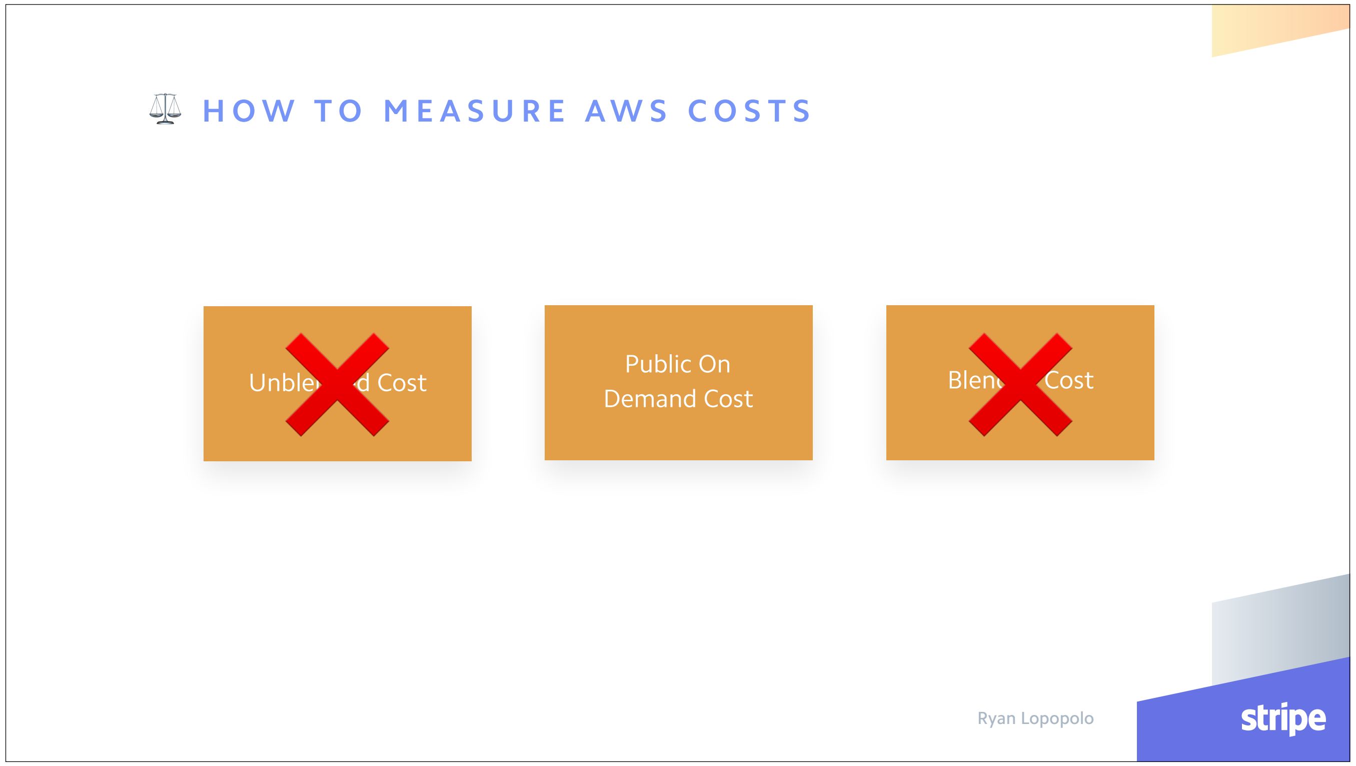
Unblended Cost

Public On Demand Cost

Blended Cost

Ryan Lopopolo

Three different mechanisms that AWS uses to report costs in the Cost & Usage Report.



⚖️ HOW TO MEASURE AWS COSTS

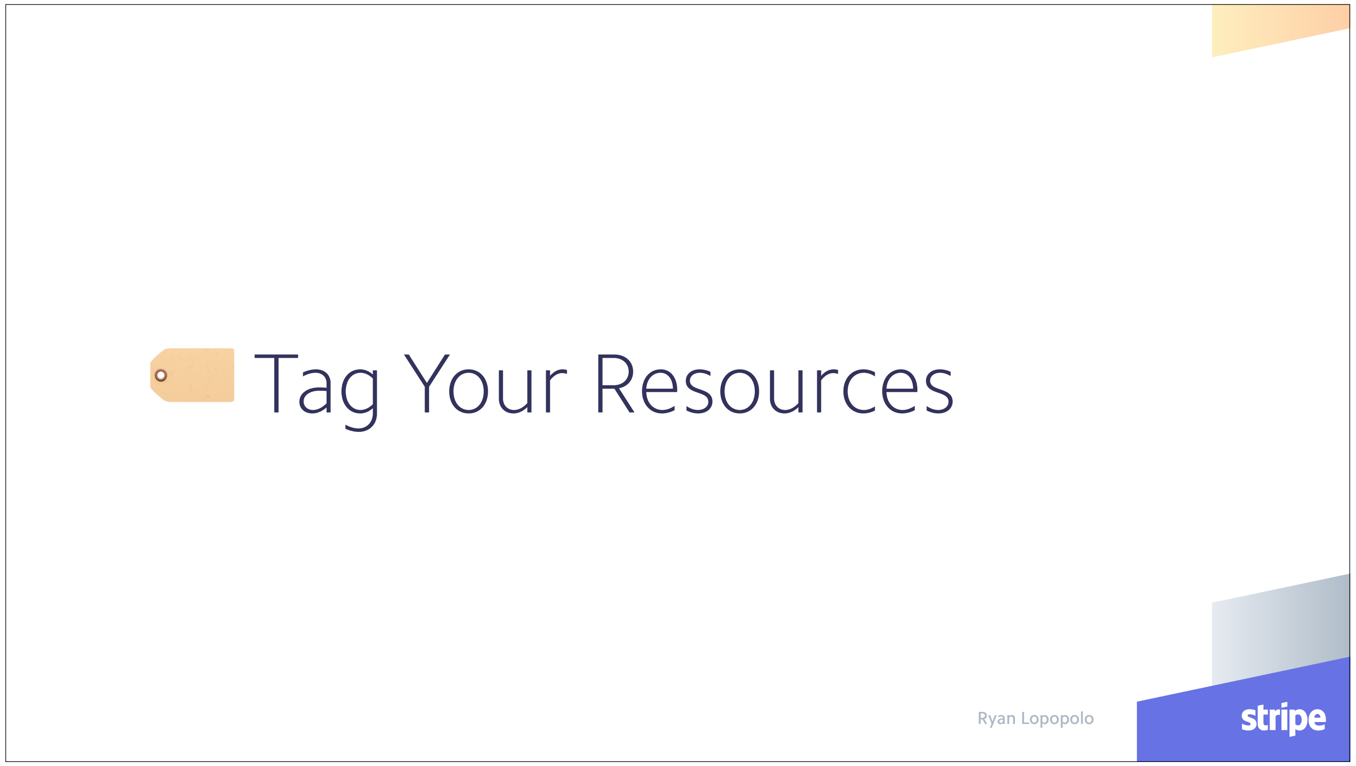
~~Unble d Cost~~

Public On Demand Cost

~~Blen Cost~~

Ryan Lopopolo

Public on demand cost because it does not vary with RI coverage, all team's costs are directly comparable regardless of instance family.



🏷 Tag Your Resources

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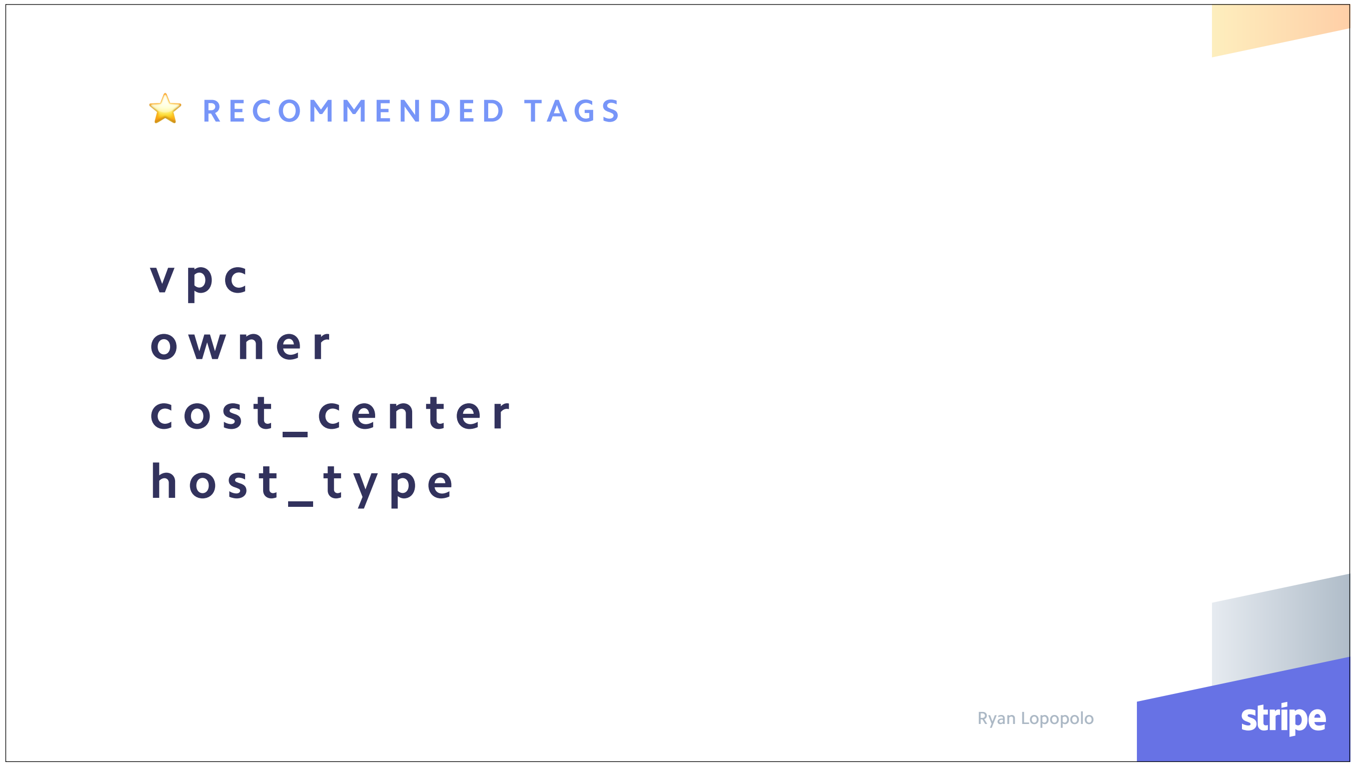
AWS can pass through user-defined tags through to the CUR. Use this to help bucket your spend!



RECOMMENDED TAGS

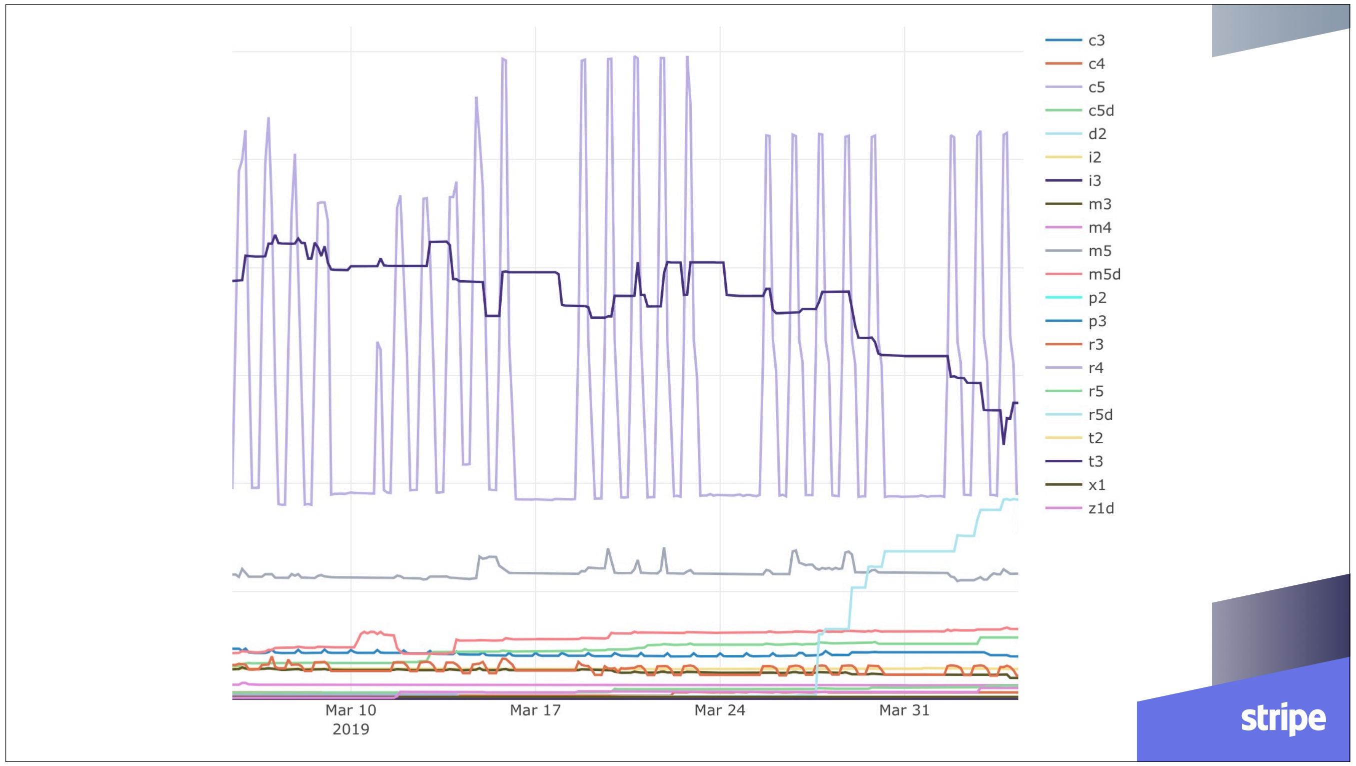
vpc
owner
cost_center
host_type

Ryan Lopopolo

Increasing levels of granularity. Include these for the same reason you denormalize tags in your online metrics time series: querying normalized data is hard.

These tags enable us to attribute spend to different workloads, teams, infrastructure, and products. "Showback reporting"

🐄 How Many? What Type?



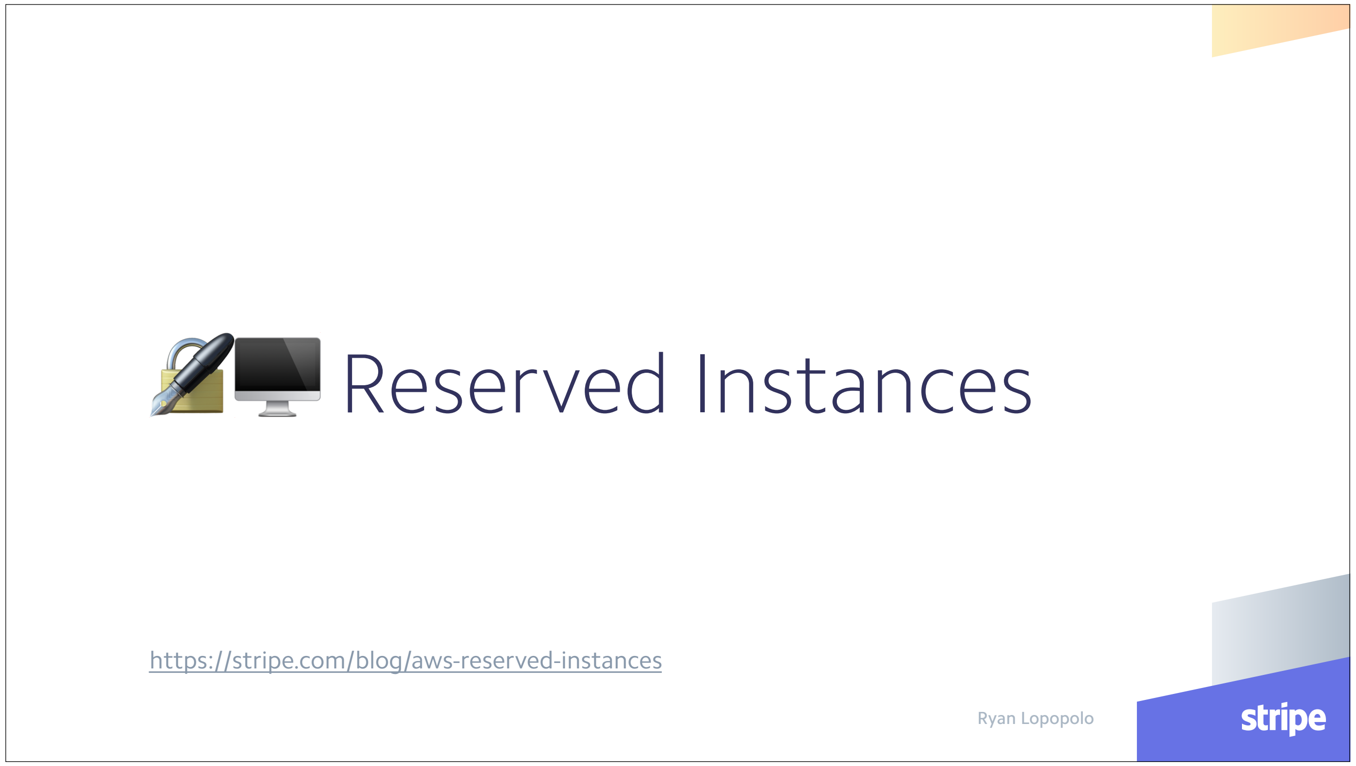
Instance family instead of instance type – cut down on metric cardinality

Having to care about instance type *and* instance size gives us an N^2 classification problem. How do we avoid that? Note about i3 / r5d trend.

👕👚 xlarge equivalents

Ryan Lopopolo

Instance type has high dimensionality. Take advantage of the linear scaling of costs within an instance type to normalize usage and costs to a single size. We pick xlarge.
AWS also exposes a normalization factor in the CUR.
This makes reporting for costs and usage comparable across teams with similar workloads.



🔏🖥️ Reserved Instances

https://stripe.com/blog/aws-reserved-instances

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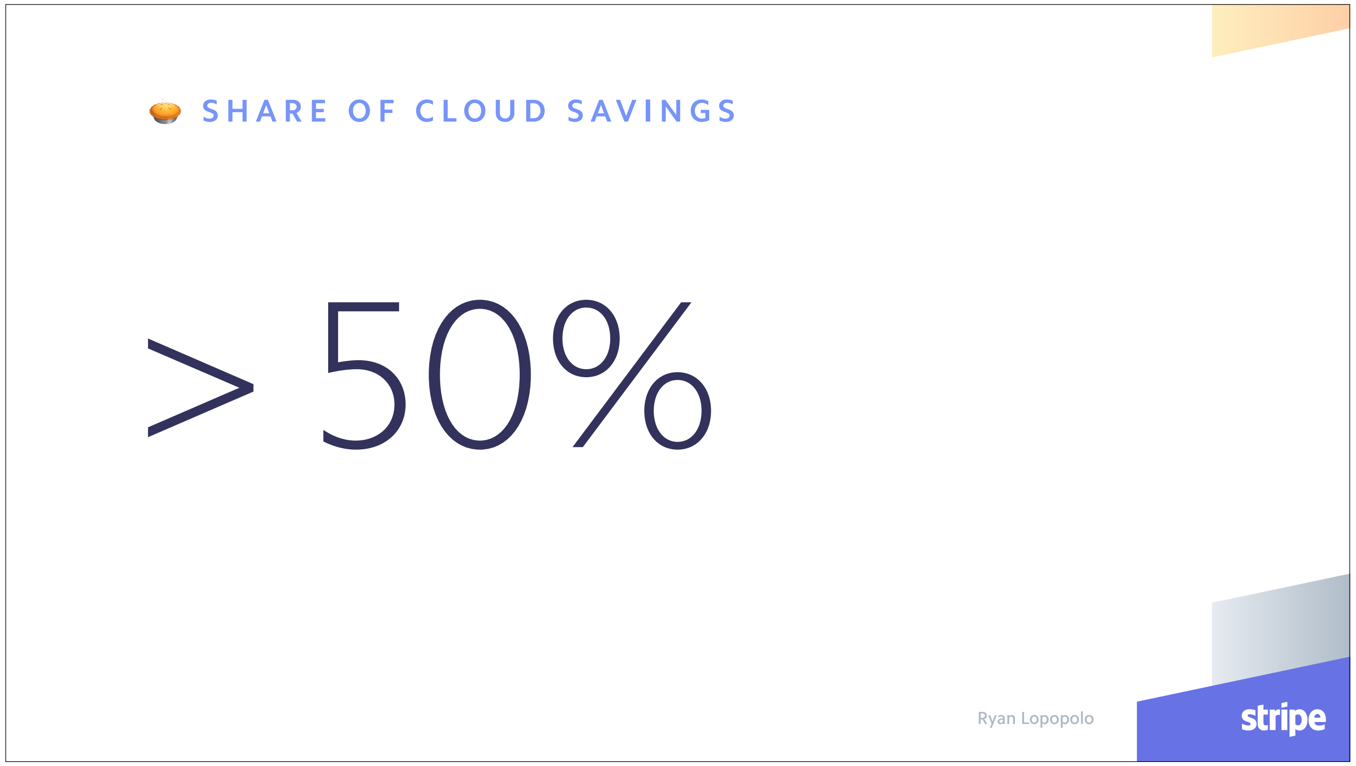
What does that mean?



🥧 SHARE OF CLOUD SAVINGS

> 50%

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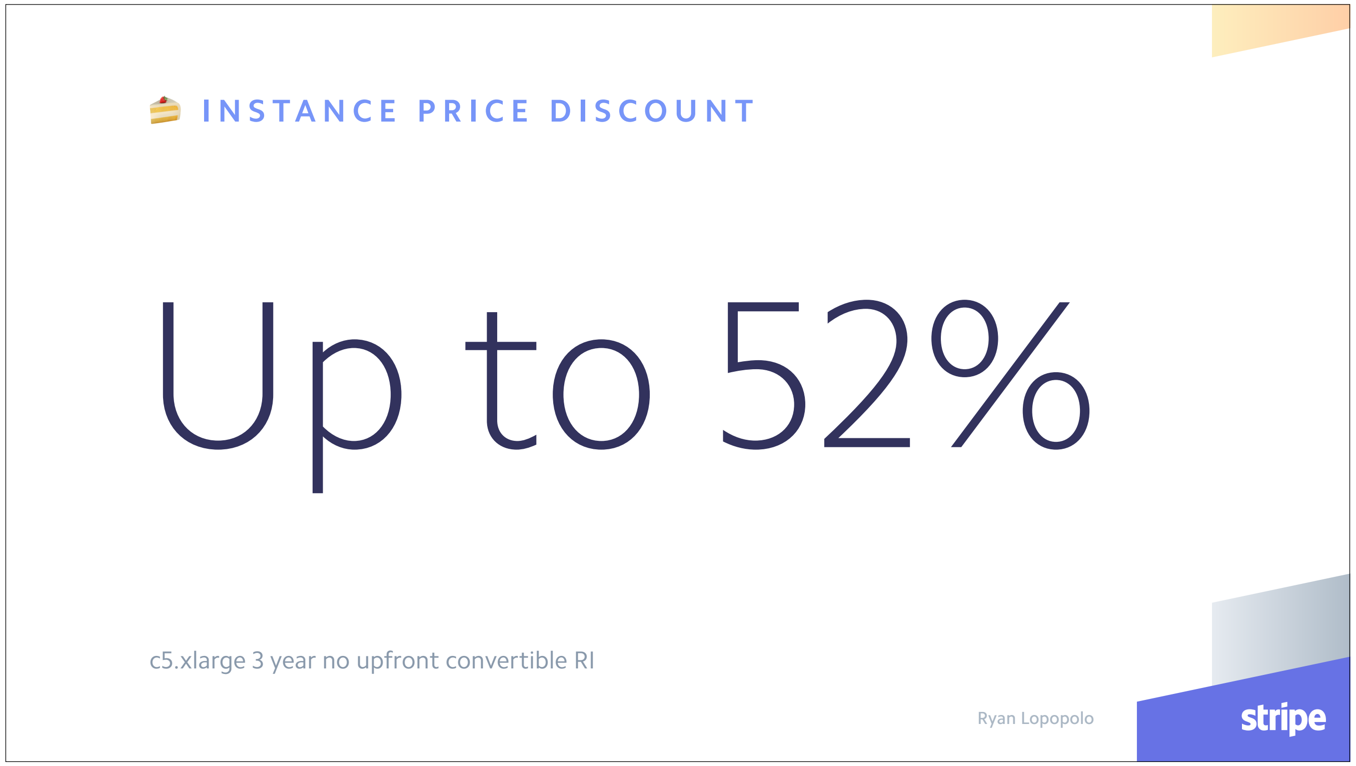
Reserved instances account for more than 50% of potential cloud savings.



🍰 INSTANCE PRICE DISCOUNT

Up to 52%

c5.xlarge 3 year no upfront convertible RI

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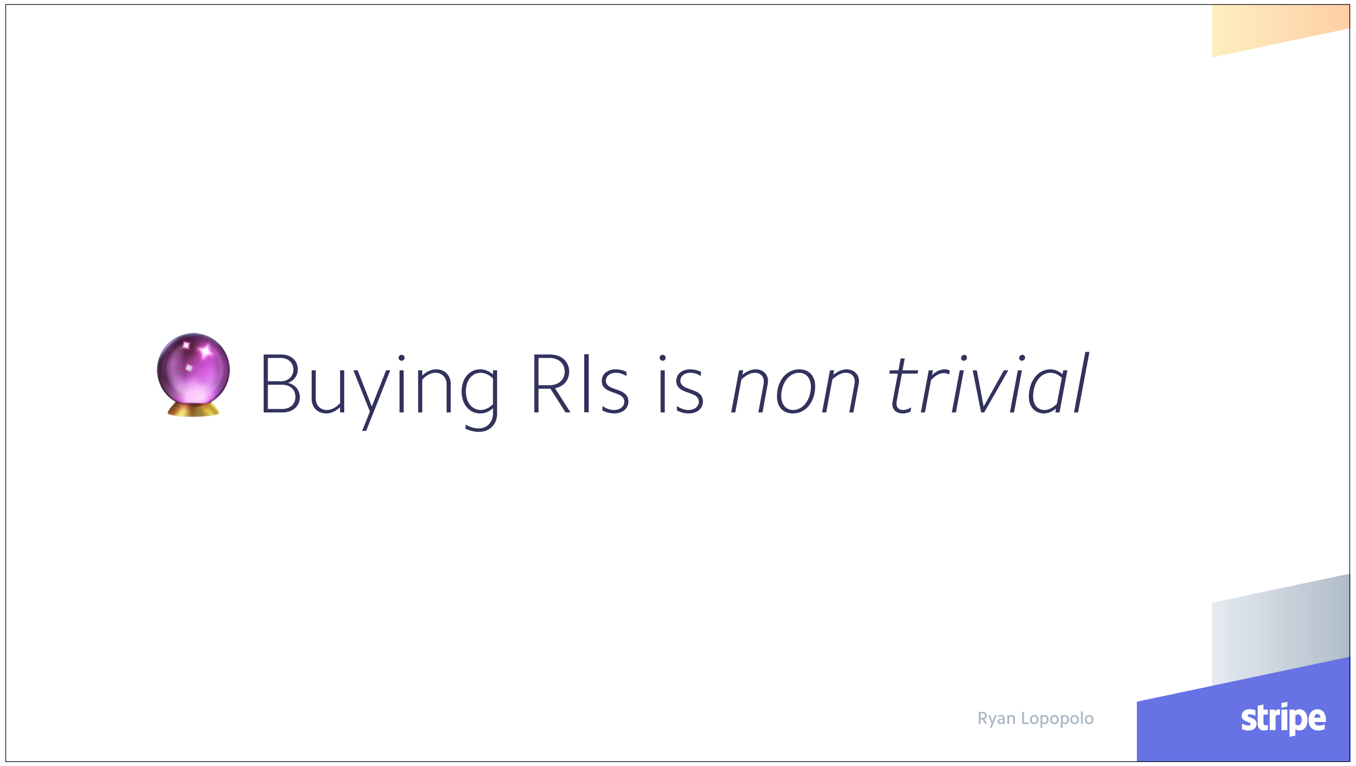
Discounts compared to on demand usage are more than 50%



🔮 Buying RIs is *non trivial*

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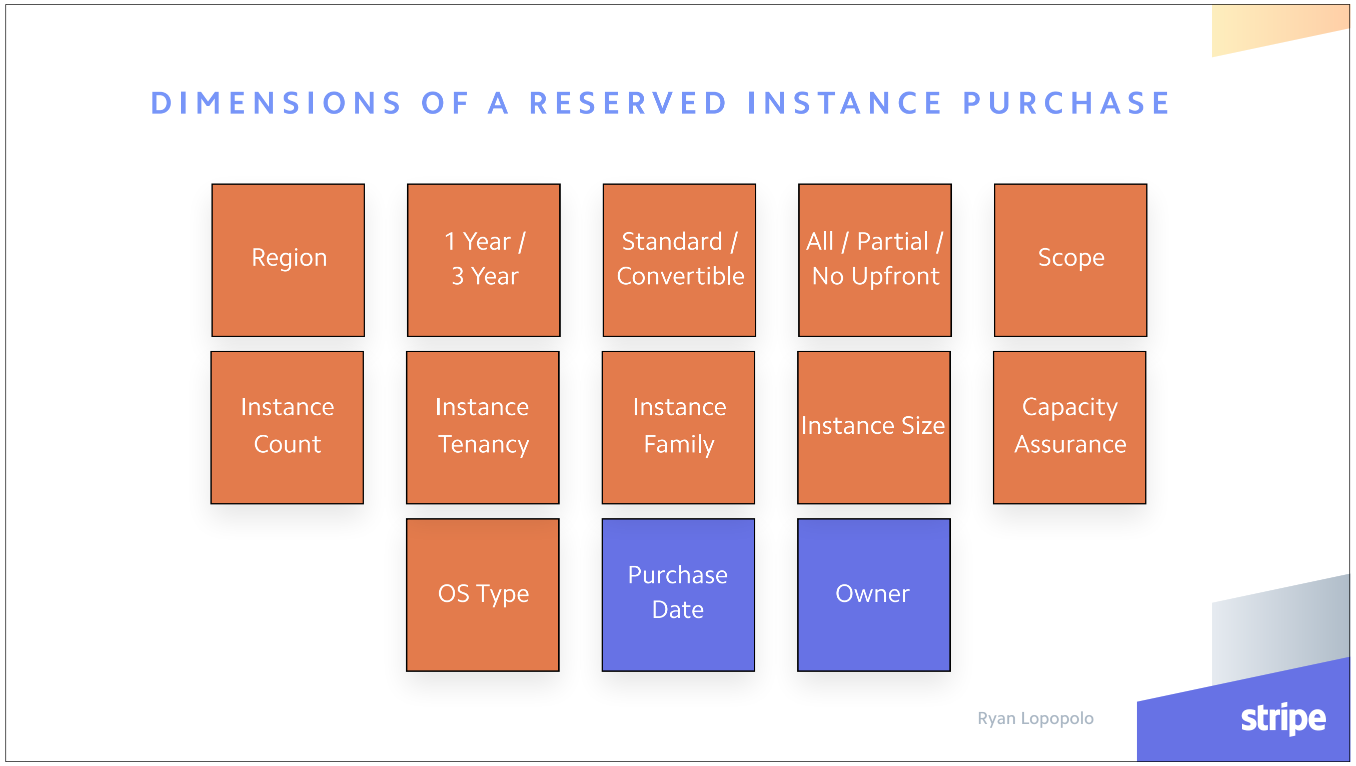
Deciding which and how many RIs to buy, is a non-trivial exercise that lies between cloud strategy, bin packing, and capacity planning. The problem has a *high dimensional search space*.



DIMENSIONS OF A RESERVED INSTANCE PURCHASE

Region

1 Year / 3 Year

Standard / Convertible

All / Partial / No Upfront

Scope

Instance Count

Instance Tenancy

Instance Family

Instance Size

Capacity Assurance

OS Type

Purchase Date

Owner

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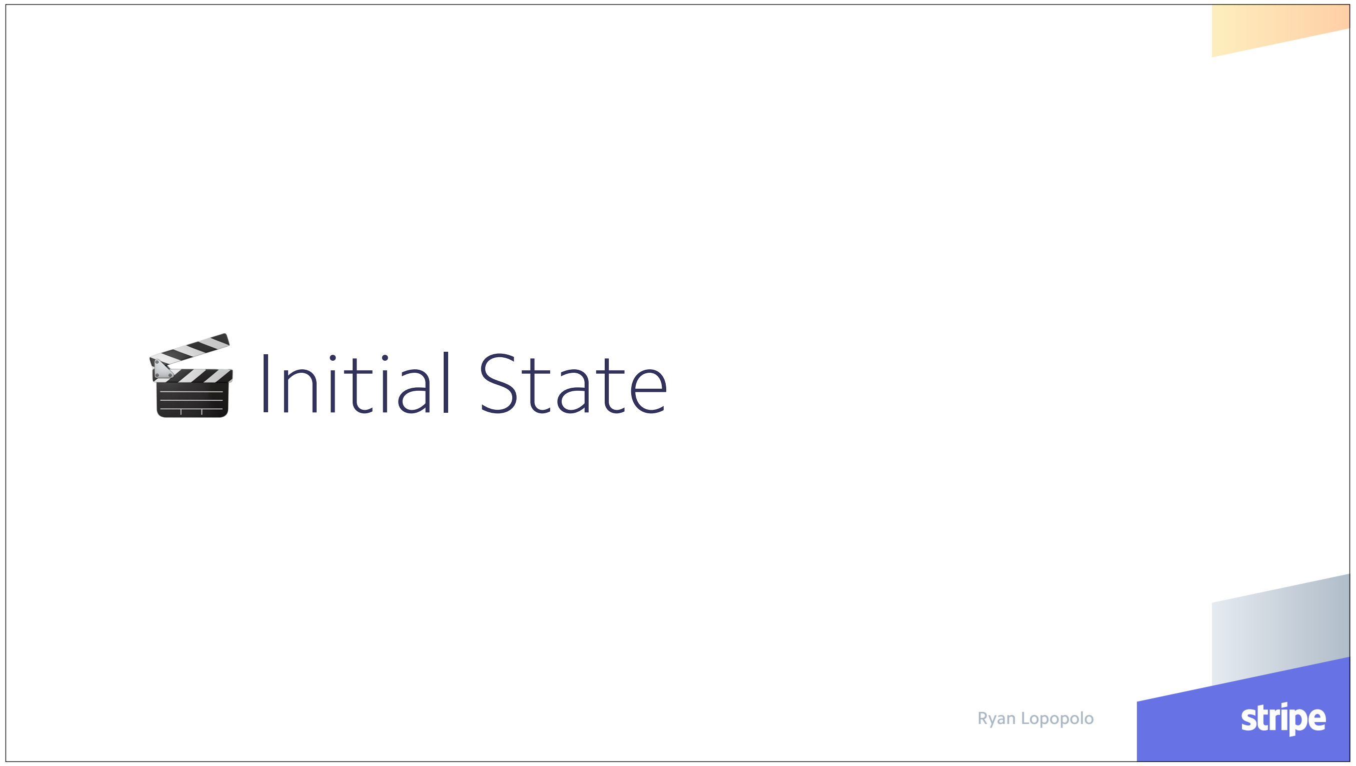
How can we limit the search space?

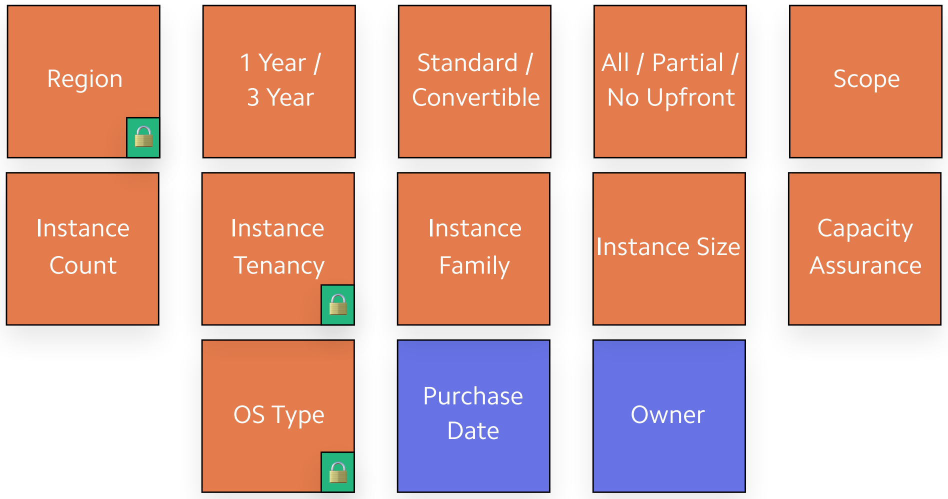


🎬 Initial State

Ryan Lopopolo

Before we get started, you should already know what region your servers are in, what OS they run, and whether or not you use dedicated instances.

DIMENSIONS OF A RESERVED INSTANCE PURCHASE



Region 🔒

1 Year / 3 Year

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Instance Size

Capacity Assurance

OS Type 🔒

Purchase Date

Owner

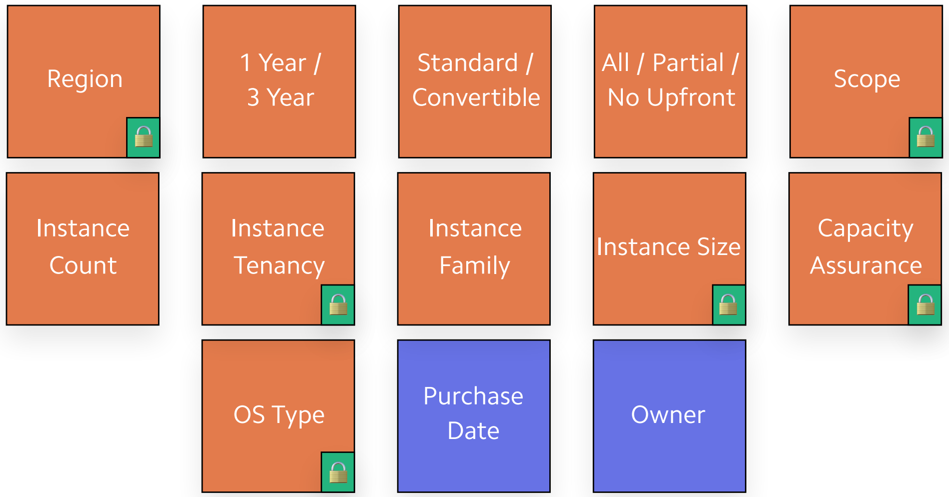
🗺️ Use Regional Scope

Ryan Lopopolo

Regional scope gets us instance size flexibility at the expense of capacity assurance. Capacity assurance only works at the edges: you need to have more RIs than servers to reserve capacity. One of our goals is to never have unutilized RIs, so we feel comfortable making this trade-off.

Instance size flexibility lets us choose xlarge size and have it cover all of our instances

DIMENSIONS OF A RESERVED INSTANCE PURCHASE



Region 🔒	1 Year / 3 Year	Standard / Convertible	All / Partial / No Upfront	Scope 🔒
Instance Count	Instance Tenancy 🔒	Instance Family	Instance Size 🔒	Capacity Assurance 🔒
	OS Type 🔒	Purchase Date	Owner	

💸 Engage the Finance Team

https://hyperbo.la/w/engineering-finance-partnership/

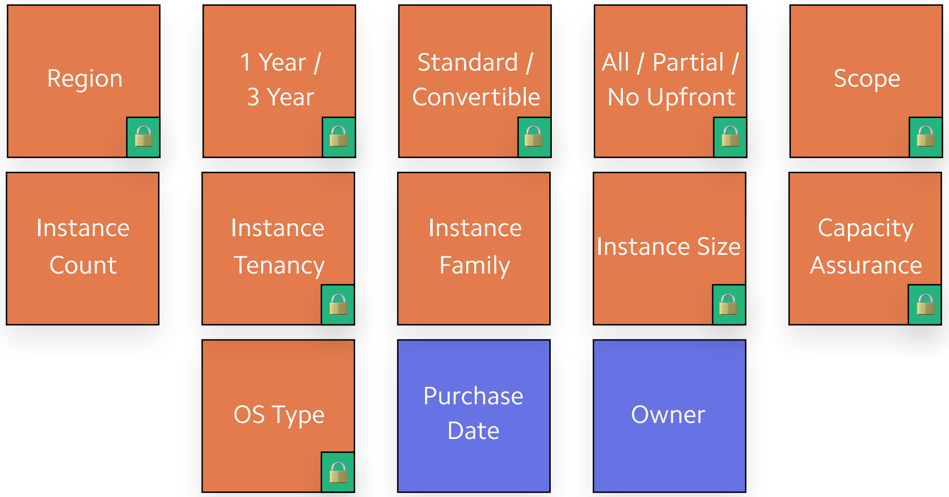
Ryan Lopopolo

RIs are an engineering AND finance decision. We're committing to spending lots of money for potentially a long time.

Contract term, ability to exchange vs. maximum discount, and payment plan depend on the financial health of your company, appetite for vendor risk, and willingness for capital outlays. Finance is best equipped to make these choices, so we'll delegate these decisions to them.

At Stripe, we choose 3 year, convertible, no upfront RIs.

DIMENSIONS OF A RESERVED INSTANCE PURCHASE



Region 🔒	1 Year / 3 Year 🔒	Standard / Convertible 🔒	All / Partial / No Upfront 🔒	Scope 🔒
Instance Count	Instance Tenancy 🔒	Instance Family	Instance Size 🔒	Capacity Assurance 🔒
	OS Type 🔒	Purchase Date	Owner	

🕹️ When? How Many?

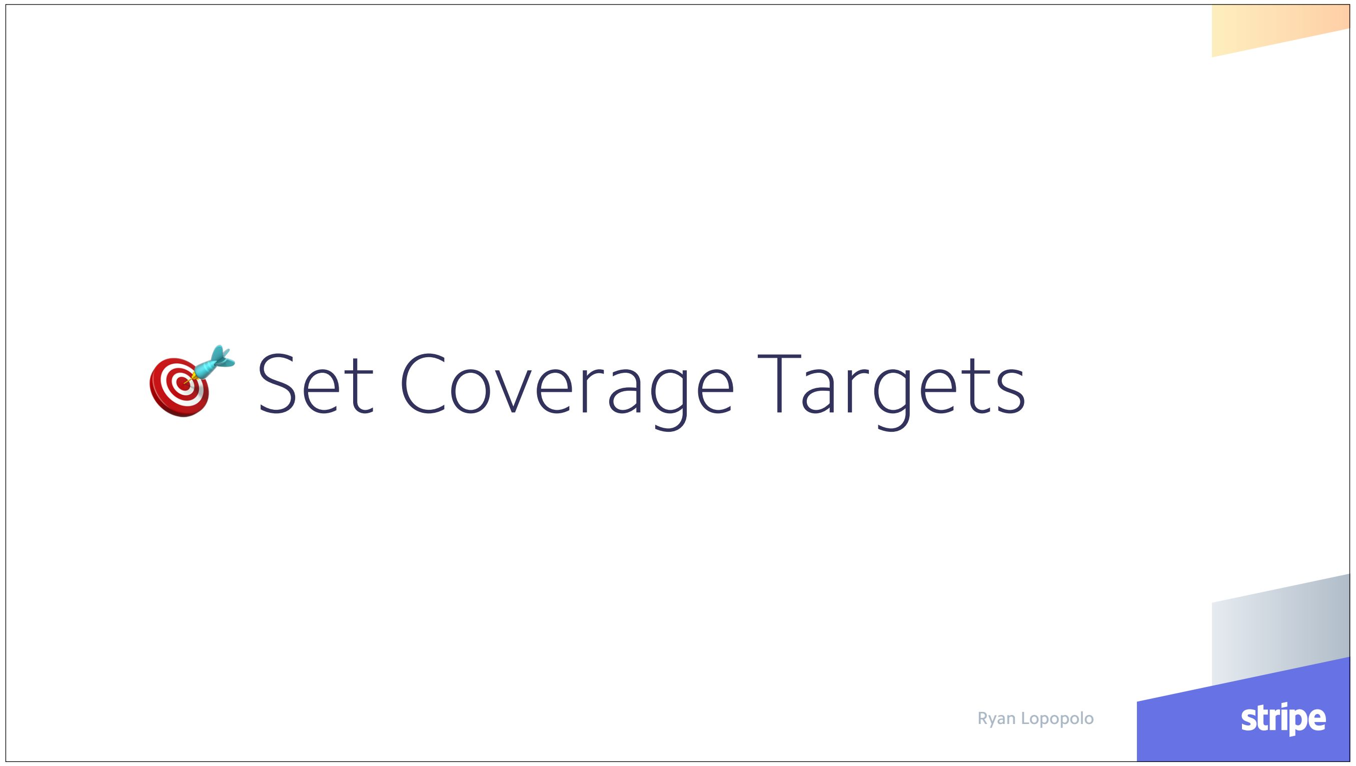
Ryan Lopopolo

Our remaining step is to know when to buy RIs and how many to buy.

⚙️ Automate w/ a Batch Job

Ryan Lopopolo

Analyze the Cost & Usage Report to take snapshots of the fleet and true up your RI position to meet your coverage targets.



🎯 Set Coverage Targets

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A coverage target means saying *for c5 instance family, have an RI apply to 90% of the instances*. Coverage targets are useful because they provide metrics by which Efficiency Engineering can measure their performance. They also help make costs more predictable, which Finance greatly values.

🔔 Fire Alerts For Purchases

Ryan Lopopolo

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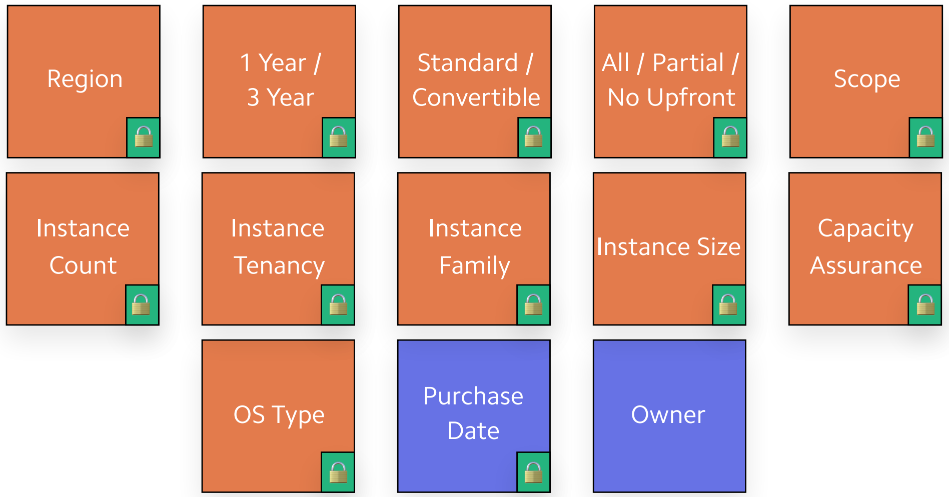
Once we have computed the difference between our coverage targets and actual coverage, we trigger alerts to kick off a (manual) purchase. To make sure we aren't constantly alerting, we have an *acceptable coverage band* of 10% around our coverage target. Only fluctuations outside of this band trigger a purchase or conversion.

DIMENSIONS OF A RESERVED INSTANCE PURCHASE



Region 🔒

1 Year / 3 Year 🔒

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Instance Count 🔒

Instance Tenancy 🔒

Instance Family 🔒

Instance Size 🔒

Capacity Assurance 🔒

OS Type 🔒

Purchase Date 🔒

Owner

Ryan Lopopolo

🔌💡 Ownership

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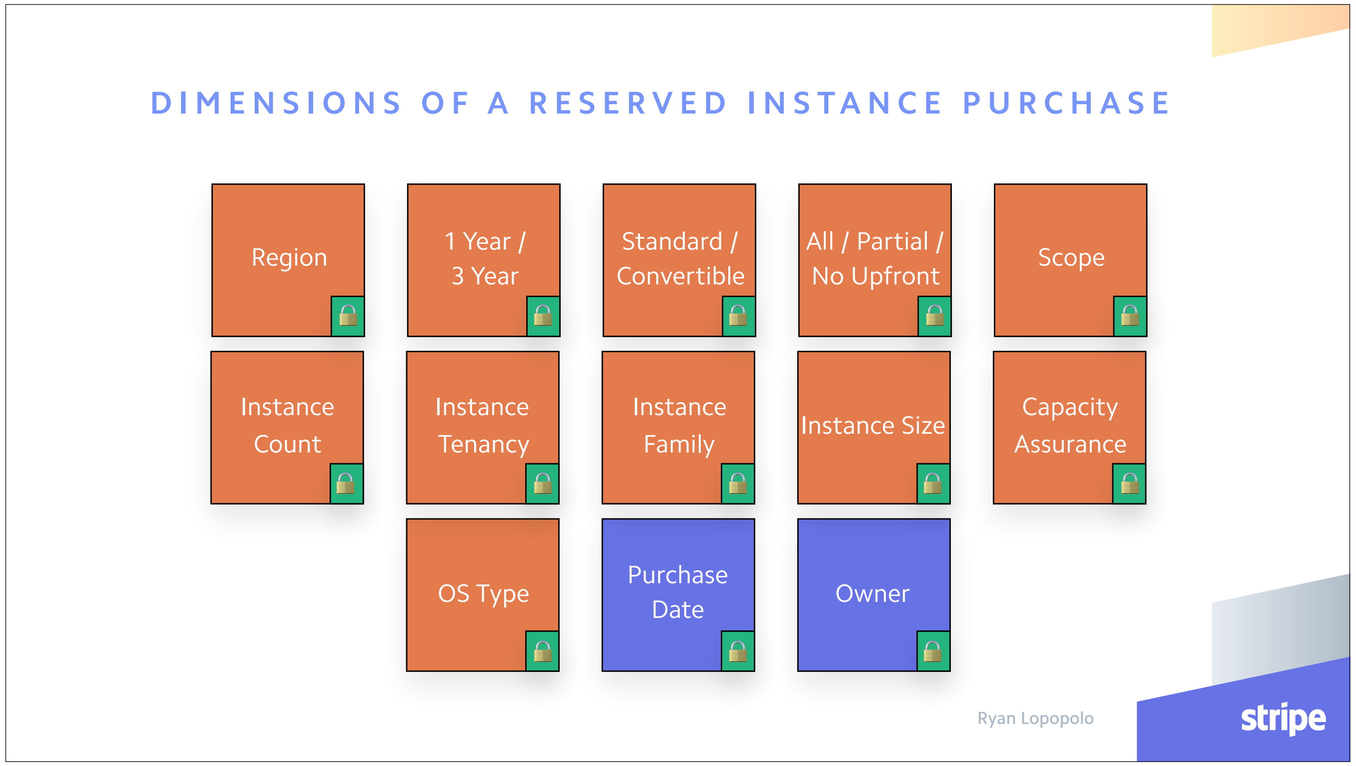
RIs are allocated globally across all accounts in your AWS Consolidated Billing Organization. Distributed ownership means you under purchase if you purchase at all. Stripe manages RIs centrally with an Efficiency Engineering team which ensures a single team is accountable.



DIMENSIONS OF A RESERVED INSTANCE PURCHASE

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Instance Count	Instance Tenancy	Instance Family	Instance Size	Capacity Assurance
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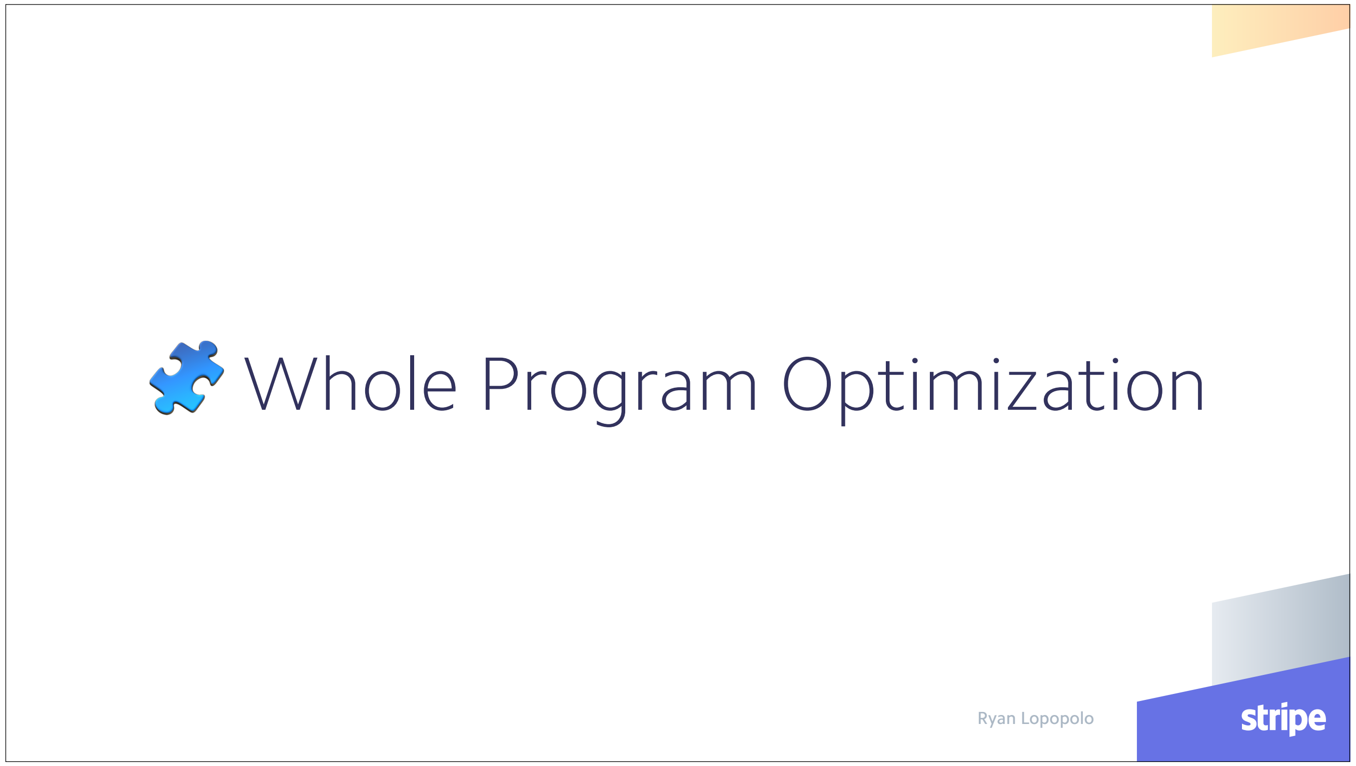
🤔 Cost Competency

Ryan Lopopolo

Building competency in cost optimization is a technical *and* a cultural problem. Let's take a look at some examples of how we've solved cost optimization with engineering effort.



🧩 Whole Program Optimization

Ryan Lopopolo

Cost management is a global optimization problem just like buying RIs. Efficiency Engineering owns optimizing the entire cloud stack as a single unit. Let's take a look at some whole program optimizations.

Which, when, where?

📦 Instance Right-Sizing

Ryan Lopopolo

Process of picking the right server for a workload. Goldilocks, servers instead of bears. Remember, performance and cost are aligned in the cloud. Too small and we're wasting performance. Too large and we're wasting cost.

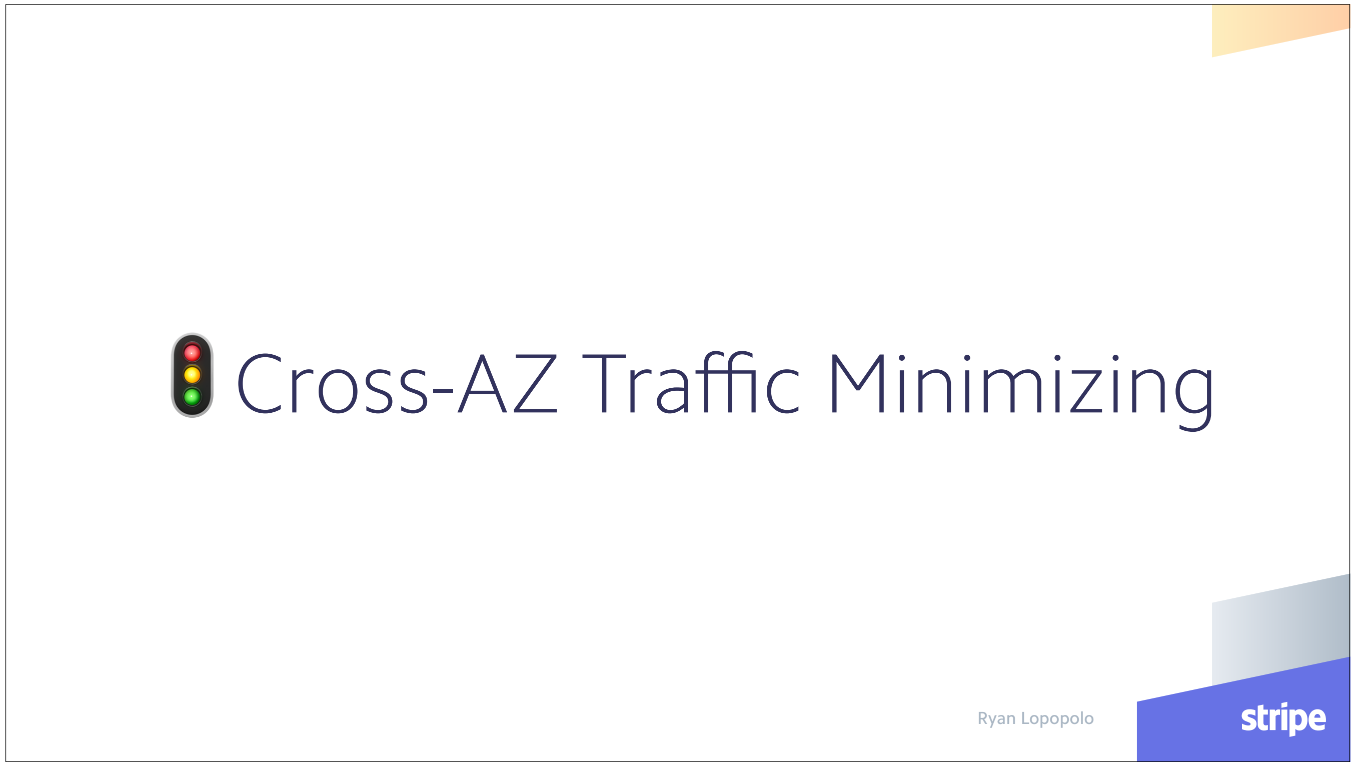
A global inventory of SKUs by workload makes it easier to know you're using the right instances for those workloads. We realized we didn't need the disk capacity that i3 instances provide for our S3-backed Hadoop workloads, so we migrated from i3s to r5ds. This got us faster and cheaper cores.

🚧🏗 CI Autoscaling

Ryan Lopopolo

The cheapest server is one that's turned off. Scheduled scaling of CI workers to align with engineering working hours in our global engineering offices in a follow the sun pattern.

CI team, finance, and efficiency engineering collaborated on this decision to balance the trade-offs between cost and QoS.



🚦 Cross-AZ Traffic Minimizing

Ryan Lopopolo

When you don't use AZ-aware HDFS, having clusters span multiple AZs doesn't buy you additional reliability. Consolidated clusters to single AZs. Cut costs by half by eliminating cross-AZ HDFS network traffic.

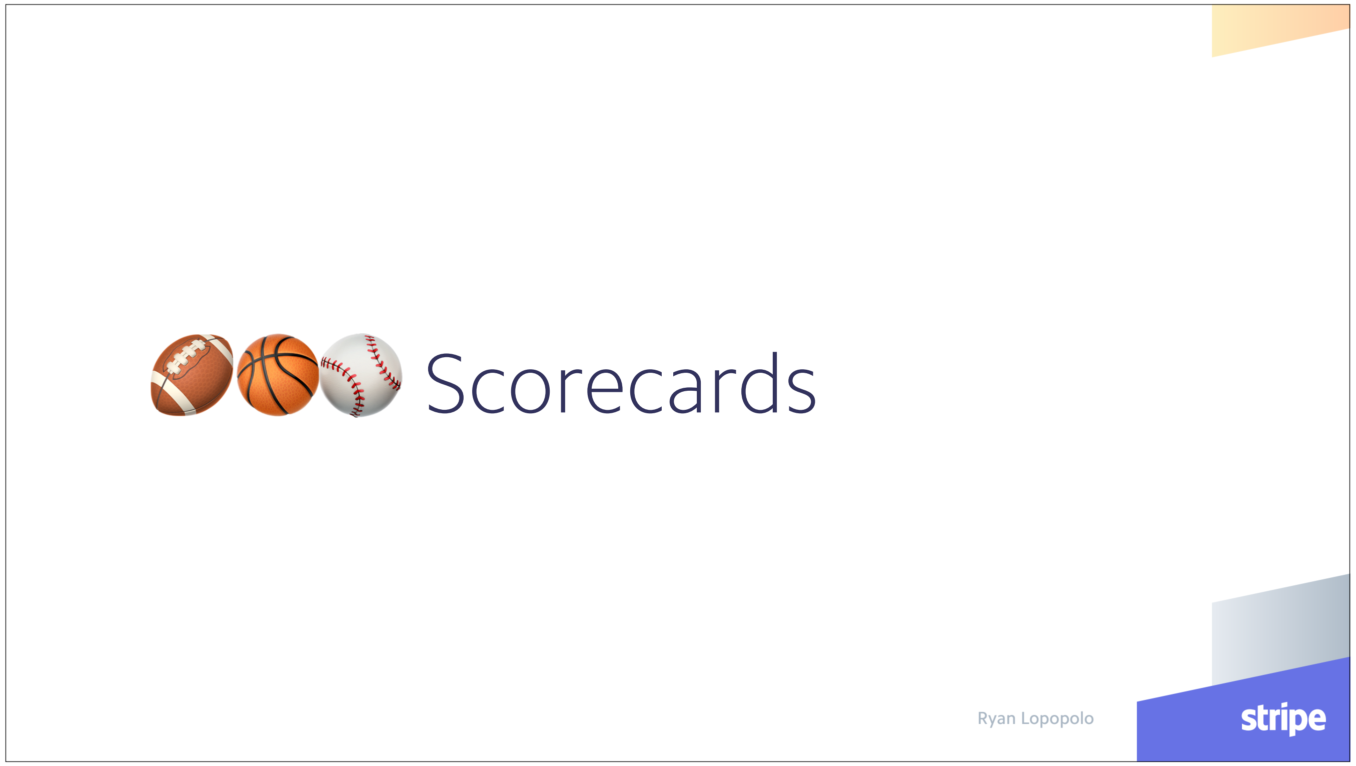
An engineer made this optimization after discovering the split between compute and network costs for their clusters using a CUR metrics time series that we embedded in SignalFX.

🚀 Organizational Change

https://lethain.com/guiding-broad-change-with-metrics/

Ryan Lopopolo

The *system* is more than just code and infrastructure. To be effective, Efficiency Engineering needs to change the culture of your organization so cost management is a first class concern when building products and infrastructure.



🏈🏀⚾ Scorecards

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Scorecards for costs allow teams to independently optimize their resource usage.

- Monthly snapshot of each team and product's consumption of shared infra services and AWS spend, published on company-wide metrics platform
- Velocity-triggered nudge email alerts that go to on call and management.

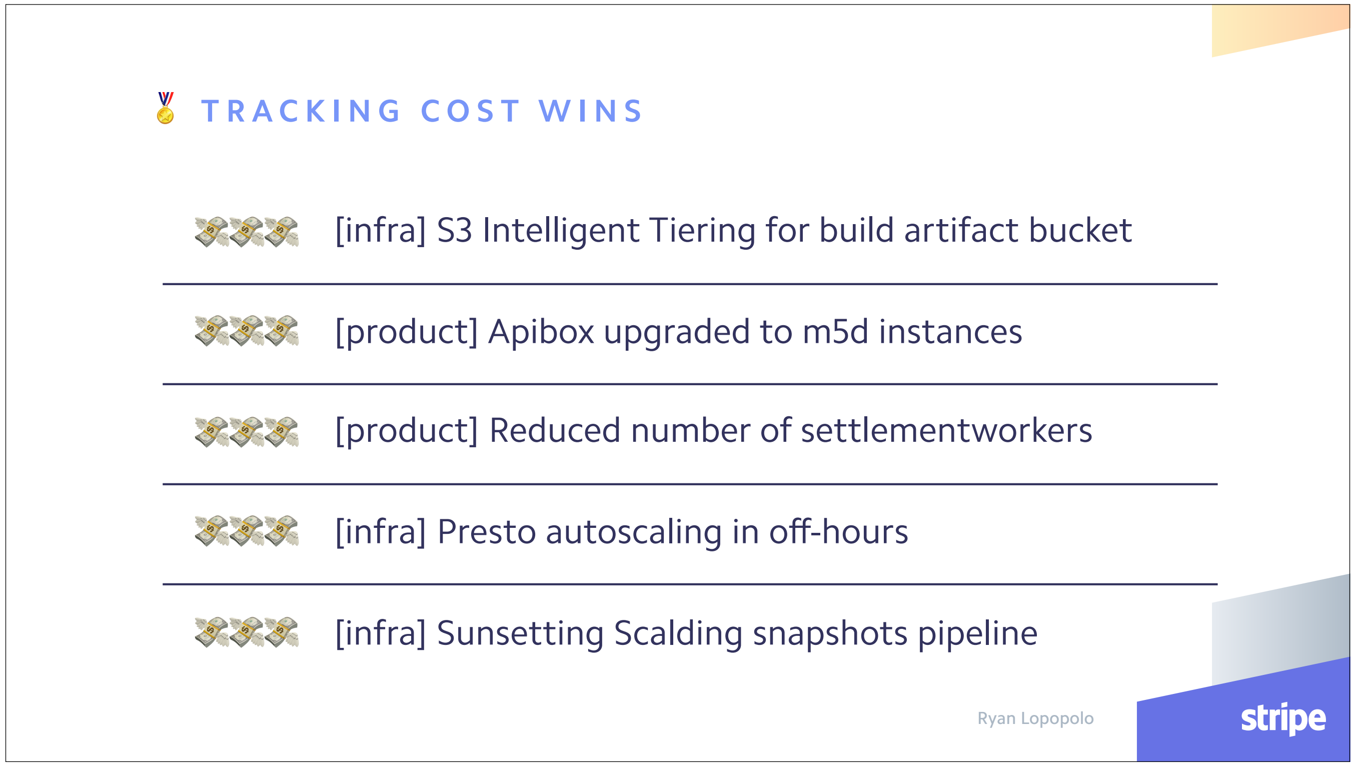
Efficiency Eng can manipulate the scorecards to influence infrastructure choices, e.g. make jobs that run on an updated kube cluster artificially cheaper.

Product Attribution

Ryan Lopopolo

Extend scorecards to attribute costs of infra to the products they support. Treat the infrastructure as a flow network and pump infra costs out to product sinks.

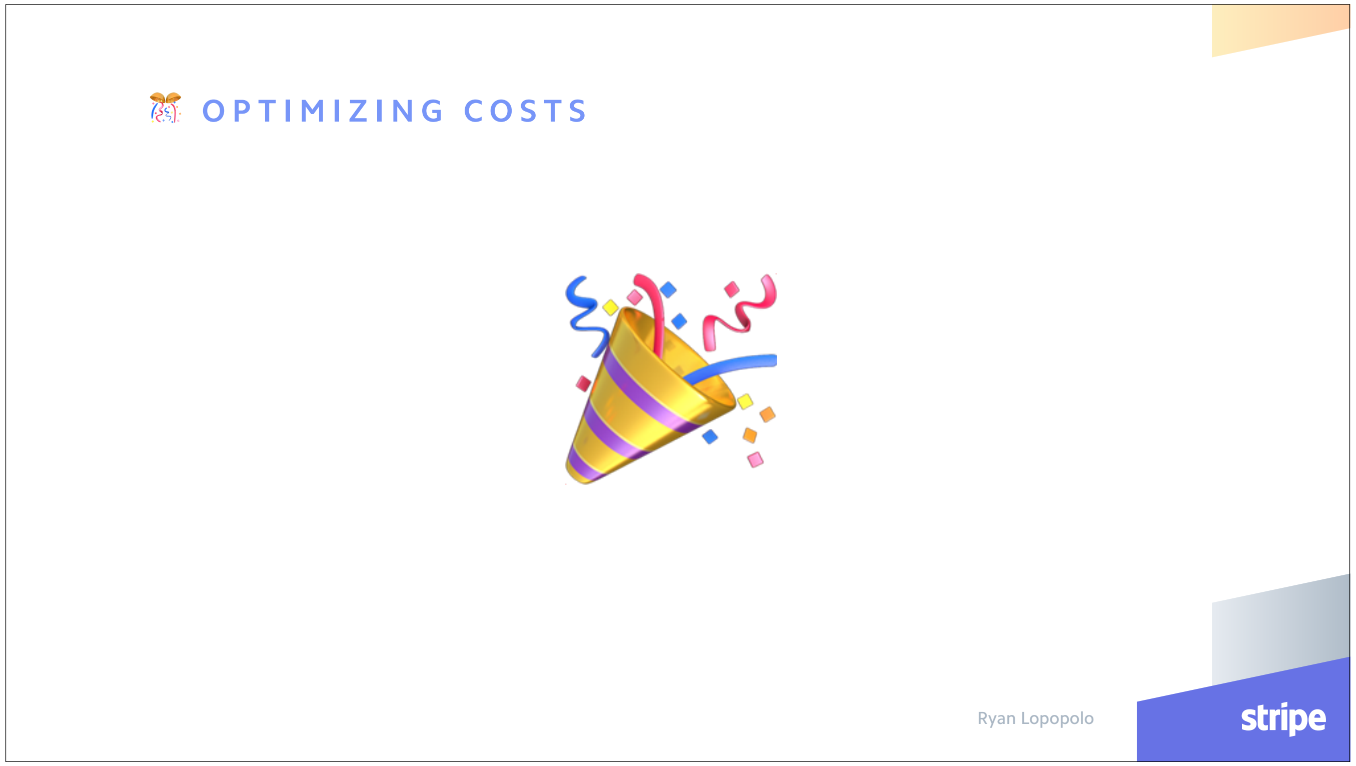
This is the most exciting part of changing the culture of your org because it has knock on effects on how other teams outside of engineering operate. When you know the margin associated with the infra for specific products, sales can price deals, marketing can tailor go to market strategies, and engineering can select features for development all with the goal of maximizing margin.



🎖 TRACKING COST WINS

💸💸💸	[infra] S3 Intelligent Tiering for build artifact bucket
💸💸💸	[product] Apibox upgraded to m5d instances
💸💸💸	[product] Reduced number of settlementworkers
💸💸💸	[infra] Presto autoscaling in off-hours
💸💸💸	[infra] Sunsetting Scalding snapshots pipeline

Part of embedding cost management in the culture of your organization is rewarding optimization behavior. We do that by creating a durable log of all optimizations, no matter how small, published on our company-wide metrics server.



OPTIMIZING COSTS

Ryan Lopopolo

Recap:

- Use the CUR to track, categorize, and attribute costs
- Buy Reserved Instances – 50% off!
- Undertake both technical and cultural initiatives to make good on the promise of optimizing costs

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Slack me at @lopopolo