[544] BigQuery Cost Management

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Learning Objectives

- describe the relationship between BigQueries two billing models (capacity and on-demand)
- manage and inspect BigQuery costs

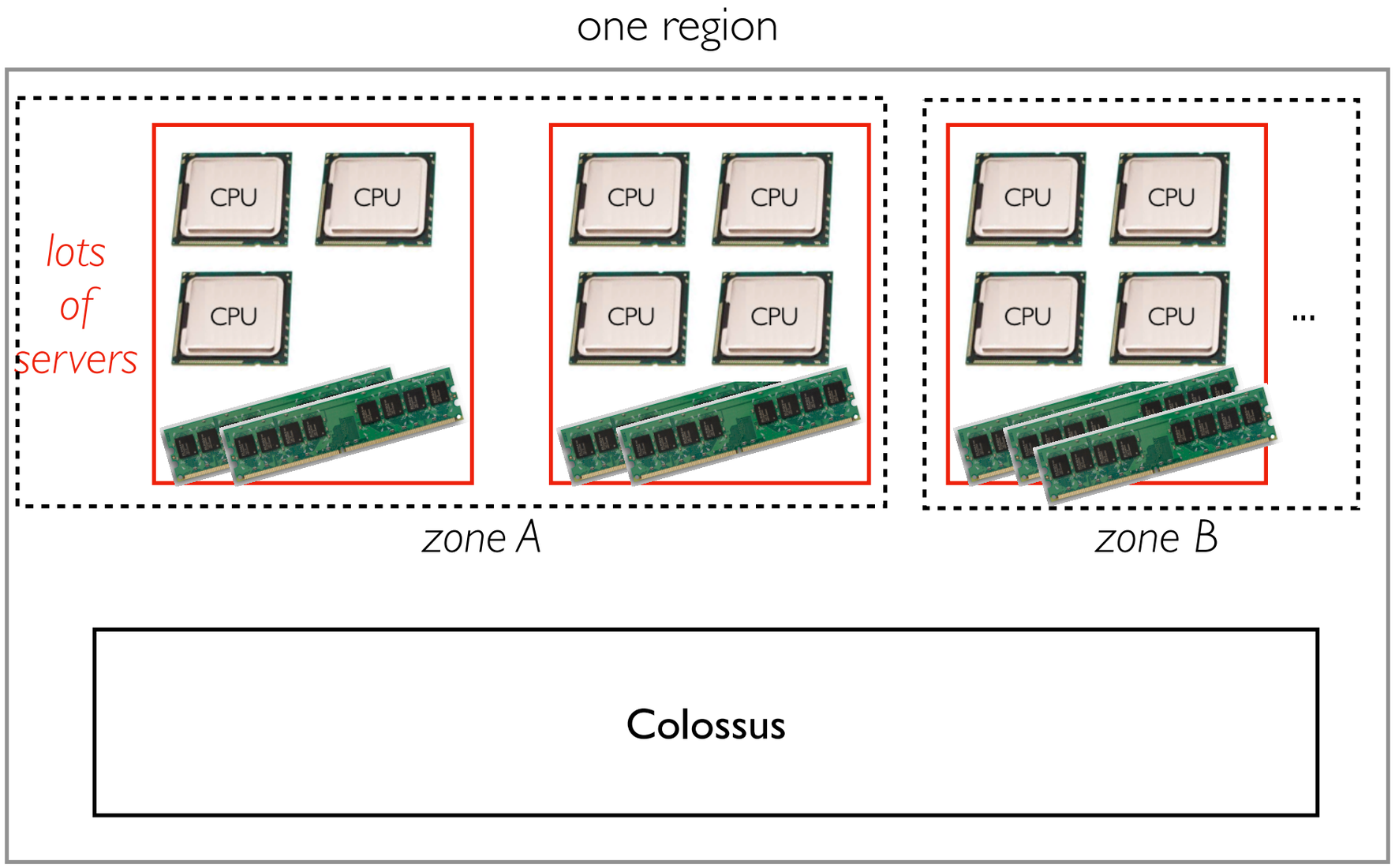
Outline

Billing Models

Optimization

Resources

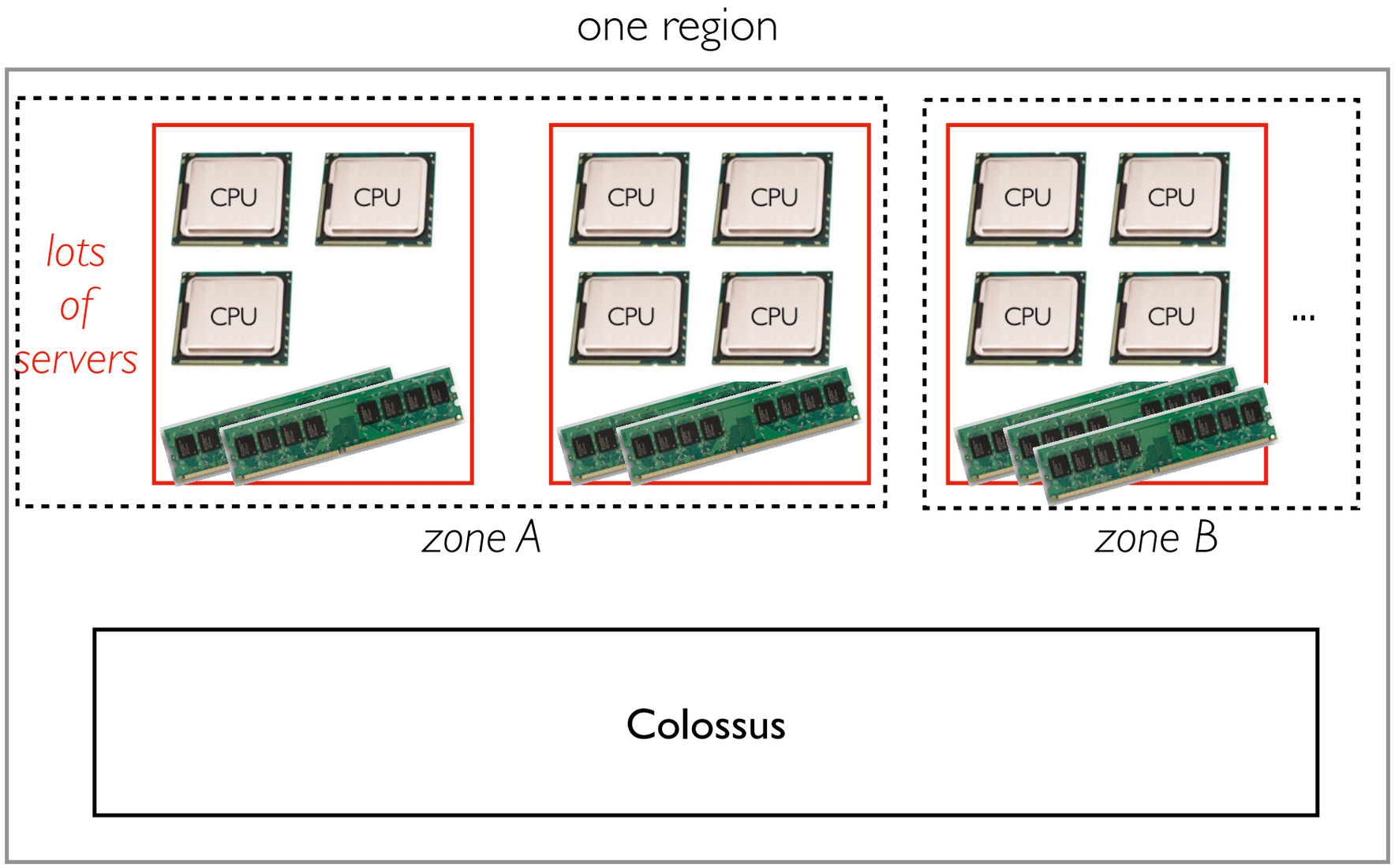
other regions...



- Query engine: Dremel running on many servers with lots of CPU+RAM
- Storage engine: Capacitor files in Colossus file system
  (not clear if Dremel+Colossus servers are co-located on same machines)

Resources

other regions...



Resources

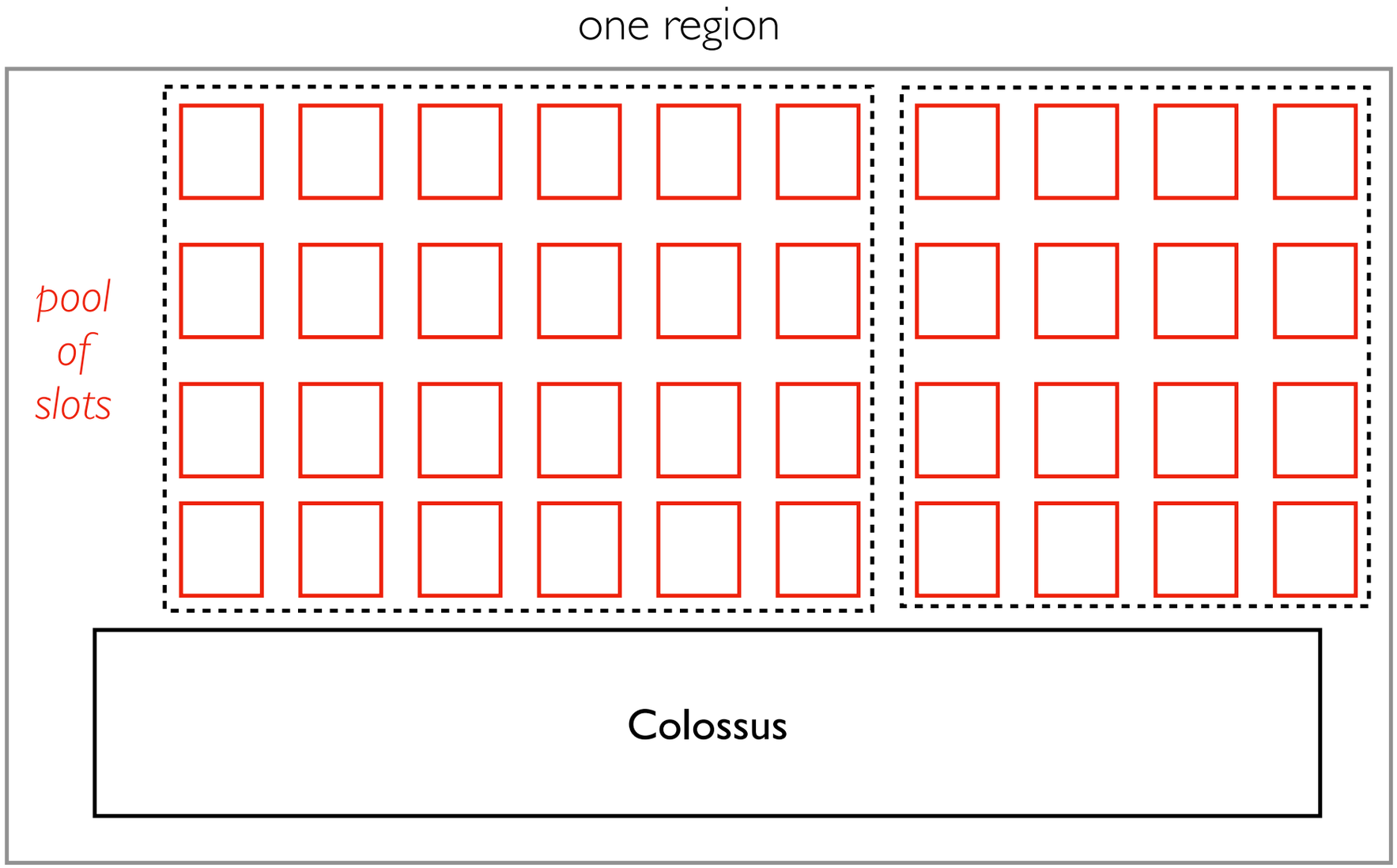
capacity billing

- compute/memory
- Colossus storage
- Colossus I/O

on-demand billing

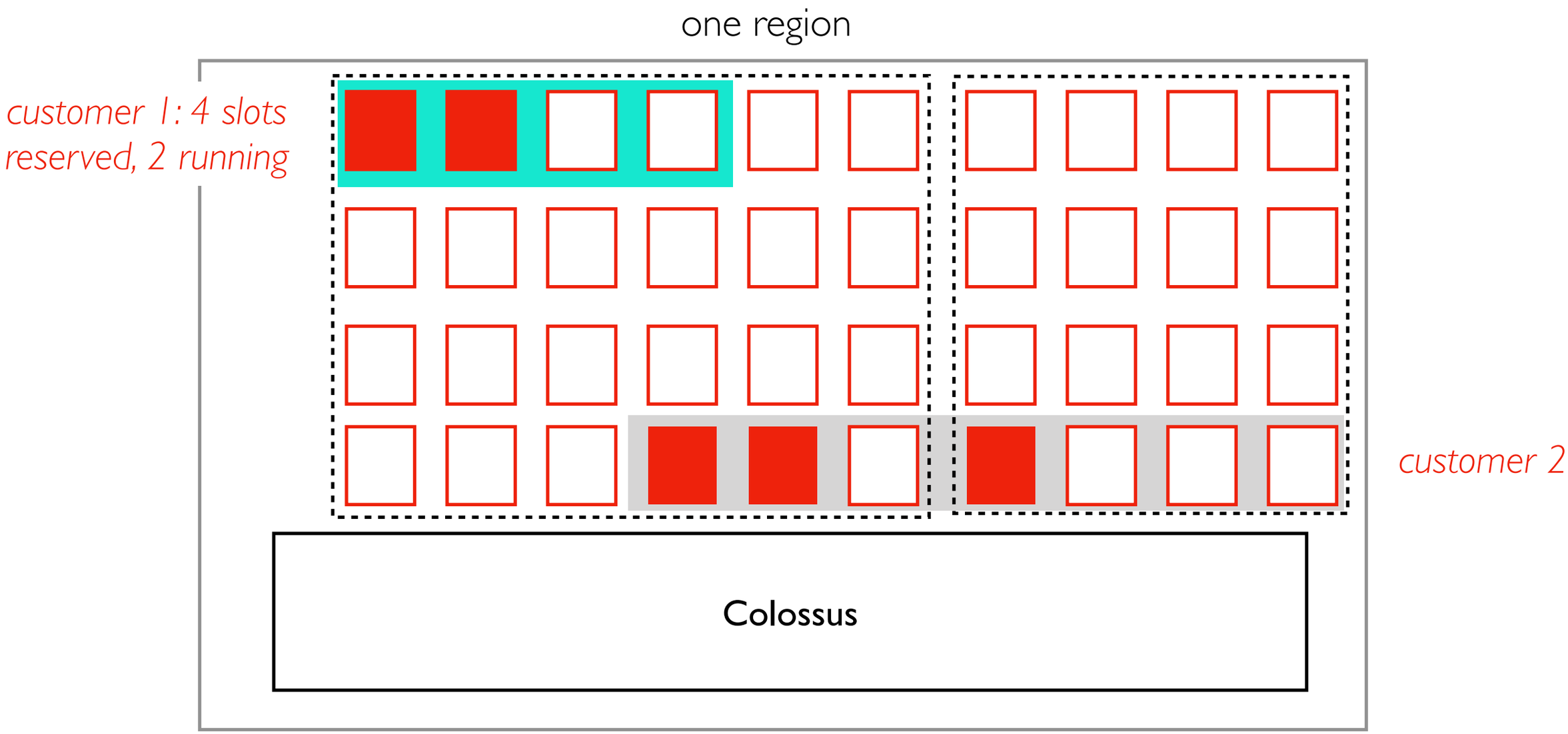
BigQuery Slots

other regions...



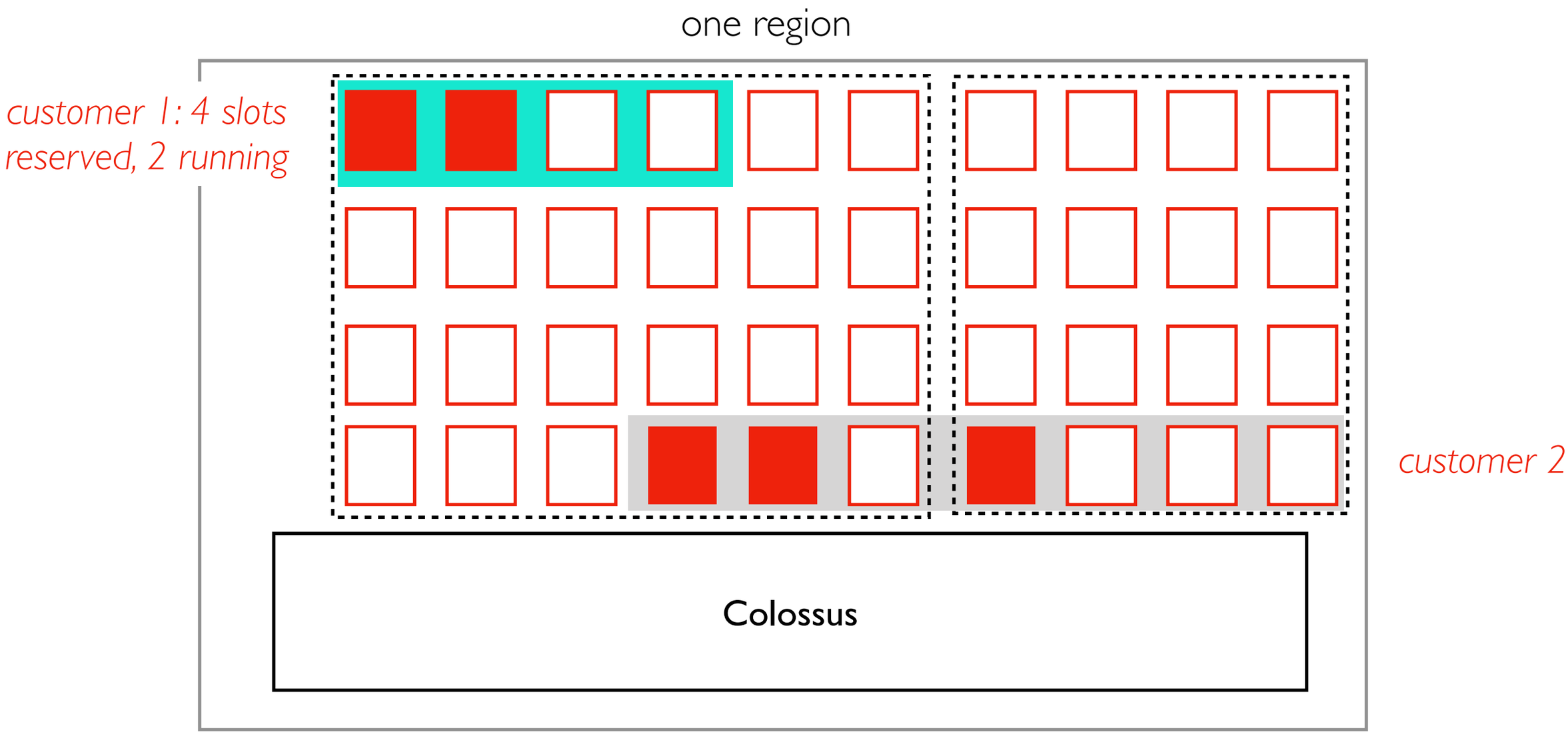
- the compute and memory resources of the servers are broken down into a pool of "slots"
- a slot has approximately ½ cores and 1 GB of RAM
- if newer servers get added with faster CPUs or different core/memory ratios, the exact resources can change a bit

Billing Model 1: Capacity Pricing (compute based)



- customers can pay a fixed rate for slot capacity (about $0.96 for 1 slot day)
- whether or not they use the slot does not affect the cost
- reservations aren't fixed to one location (execution will ideally happen near the data).
- *slightly more expensive than the e2-medium instances we used this semester, which have 2x compute and 4x memory resources (but not free Colossus I/O). But VMs are IaaS and BigQuery is PaaS.*

Billing Model 1: Capacity Pricing (compute based)

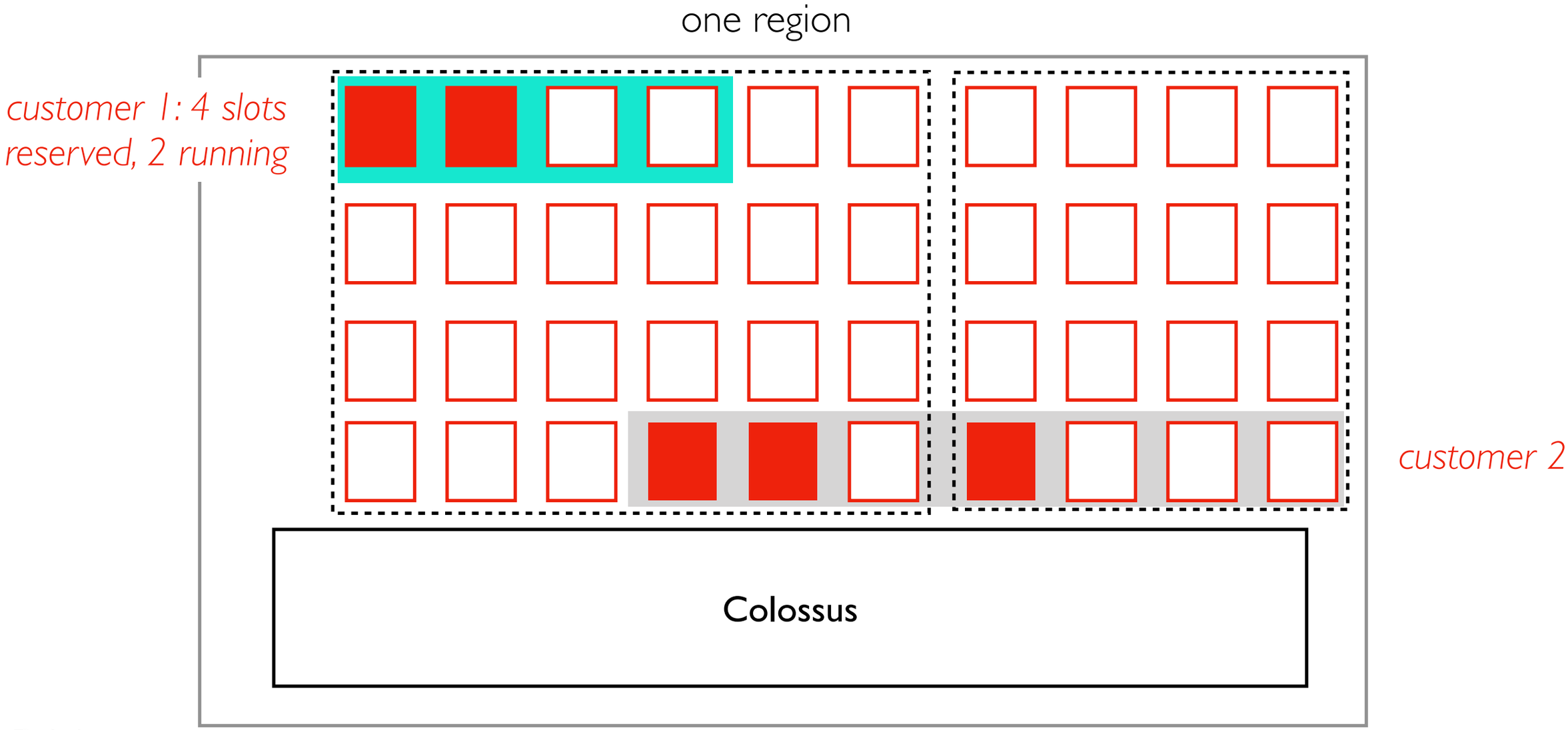


Excess capacity cases:

- not reserved
- reserved, but not currently used

Billing Model 2 (On-Demand) draws from this excess...

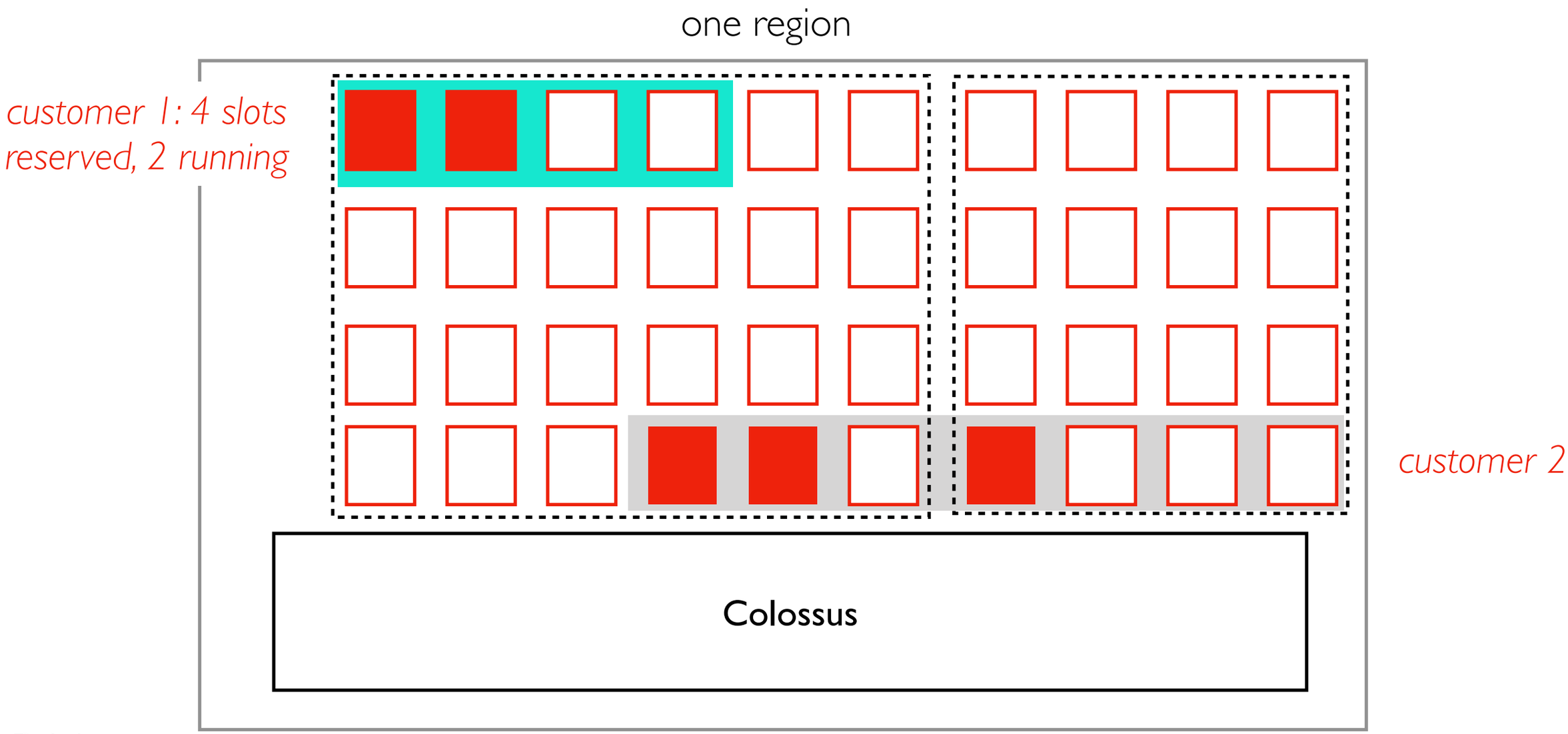
Billing Model 2: On-Demand Pricing (I/O based)



Pricing:

- pay for Colossus I/O after free tier (about $6.25/TB)
- slots (compute/memory) are free
- use whatever is left over from capacity-based usage (up to 2000 slots!)
- preemptible: a task running in a slot can be interrupted (if a reservation is suddenly needed or new on-demand jobs start -- want to share capacity between these fairly)

Billing Model 2: On-Demand Pricing (I/O based)



Pricing:

- pay
- slots
- use
- preemptible: a task running in a slot can be interrupted (if a reservation is suddenly needed or new on-demand jobs start -- want to share capacity between these fairly)

BigQuery tasks are atomic and idempotent so we have exactly-once semantics. Don't want interrupted and restarted tasks to cause duplicate results.

2000 slots!)

Comparison

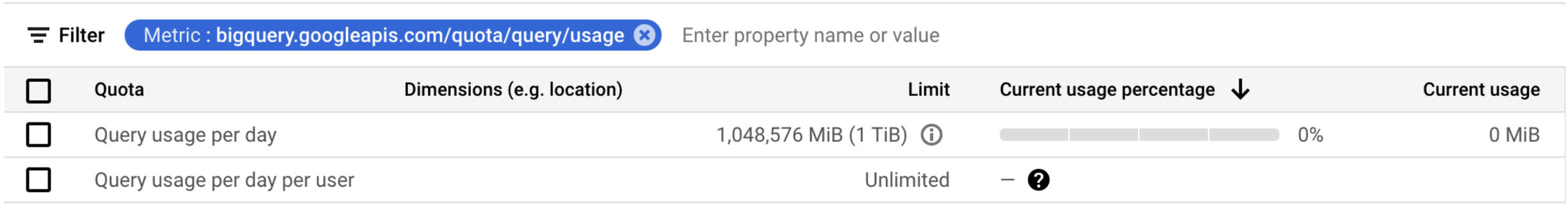
Capacity Billing

- very predictable costs
- very predictable performance (other customers don't affect you)
- discounts if commit to buying lots of cores for a long time (e.g., a year)
- pay when using nothing
- can't use lots of resources for a short while

On-Demand Billing

- pay-as-you-go: use nothing, pay nothing
- if resources are available, you can use 1000 cores at once -- very fast!
- how to make sure you don't accidentally spend more than intended?

Estimating/Capping On-Demand Costs



Options:

- Limit per day:
  https://console.cloud.google.com/iam-admin/quotas

- Estimate before run:
  `job_config=bigquery.QueryJobConfig(dry_run=True)`

- Set max per query:
  `bigquery.QueryJobConfig(maximum_bytes_billed=200*1024**2)`

- See most expensive queries:
  `cs320-f21.region-us.INFORMATION_SCHEMA.JOBS_BY_PROJECT`

Demos

Outline

Billing Models

Optimization

Partitioning

A	B	C	D
5/1/23	1	2	3
5/1/23	4	5	6
5/2/23	7	8	9
5/2/23	10	11	12

A	B	C	D
5/1/23	1	2	3
5/1/23	4	5	6

A	B	C	D
5/2/23	7	8	9
5/2/23	10	11	12

- each unique value in a partition column corresponds to a partition (basically a mini table)
- WHERE filters can limit which mini tables need to be read (saving I/O cost)
- limited options for types (e.g., ints, dates)
- only works well when substantial data per partition

Clustering

A	B	C	D
5/1/23	1	2	3
5/1/23	4	5	6
5/2/23	7	8	9
5/2/23	10	11	12

A	B	C	D
5/1/23	1	2	3

B range: 1 to 1

A	B	C	D
5/2/23	10	11	12

B range: 10 to 10

A	B	C	D
5/2/23	7	8	9
5/1/23	4	5	6

B range: 4 to 7

- semi sorted: sub files are non overlapping on cluster key, but no order within file
- all types, combinations of columns possible
- some queries will be cheaper because they can look at subset of files

Clustering

clustered

A	B	C	D
5/1/23	1	2	3
5/1/23	4	5	6
5/2/23	7	8	9
5/2/23	10	11	12

A	B	C	D
5/1/23	1	2	3

B range: 1 to 1

A	B	C	D
5/2/23	7	8	9
5/1/23	4	5	6

B range: 4 to 7

A	B	C	D
5/2/23	10	11	12

B range: 10 to 10

- some min ratio of data is clustered
- don't want few new rows to force total reorg

A	B	C	D
5/2/23	5	1	2
5/1/23	12	3	4

unclustered

Demos