ATLAS Google Project.

Peering attempt between Google Cloud and LHCONE

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on behalf of the ATLAS Google Project

Project overview

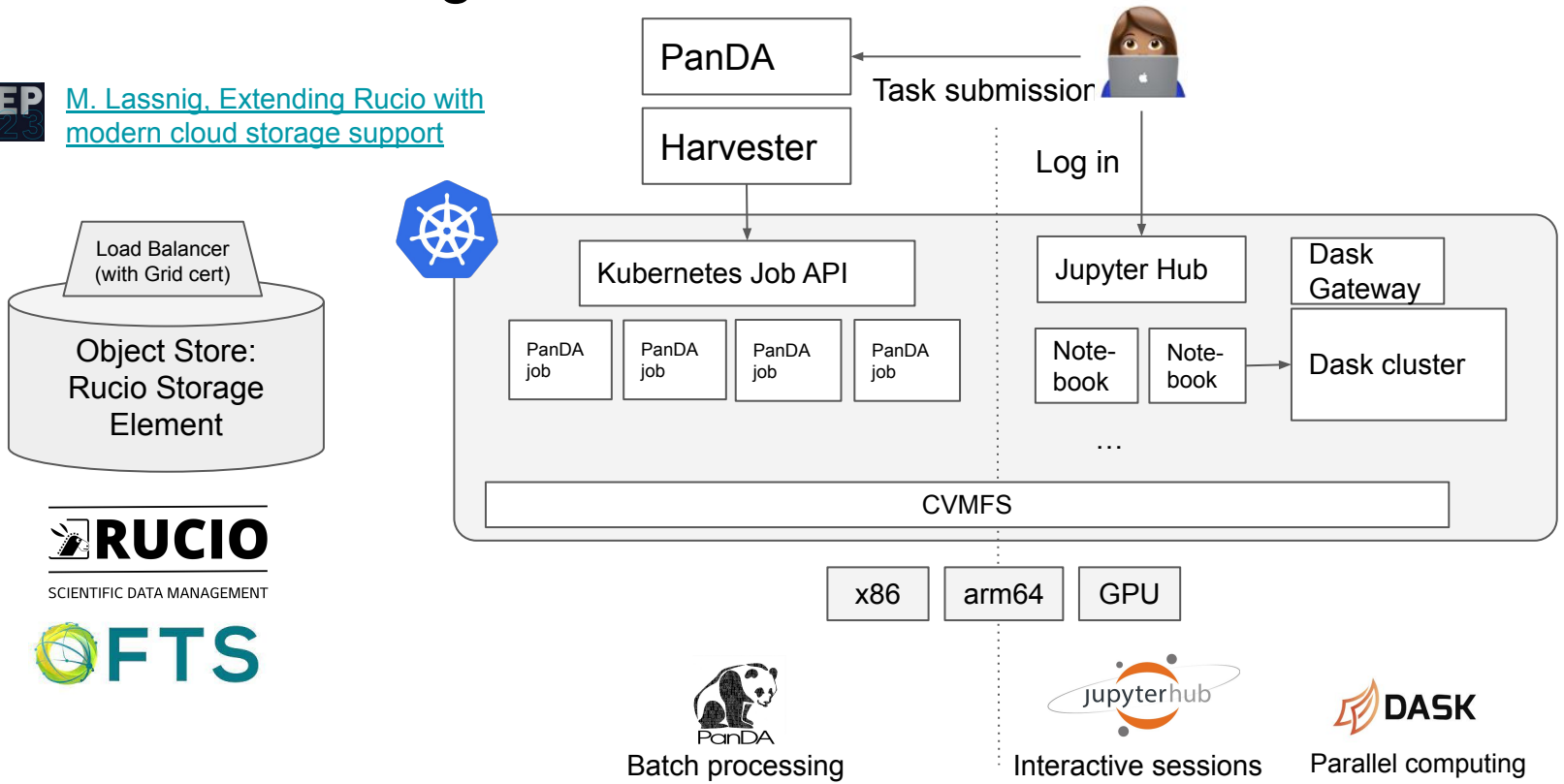
ATLAS Google Project overview

- 15 month project (July 22- Sept 23, now finished): demonstrate feasibility of running a fully-fledged ATLAS site (compute+storage) on Google Cloud
- Additional tracks for Total Cost of Ownership and R&D activities
- Subscription Agreement for the US Public Sector: fixed monthly bill for variable resource consumption over the duration of the contract
  - Duration, scale and cost negotiated before project
  - Freedom to use resources flexibly
  - No extra charge if you run over, but resource usage is reviewed periodically and at the end of the contract
- TCO document started to be circulated
  - Discussion planned in appropriate meetings (ATLAS International Computing Board, WLCG Management Board,...)

Cloud native integration

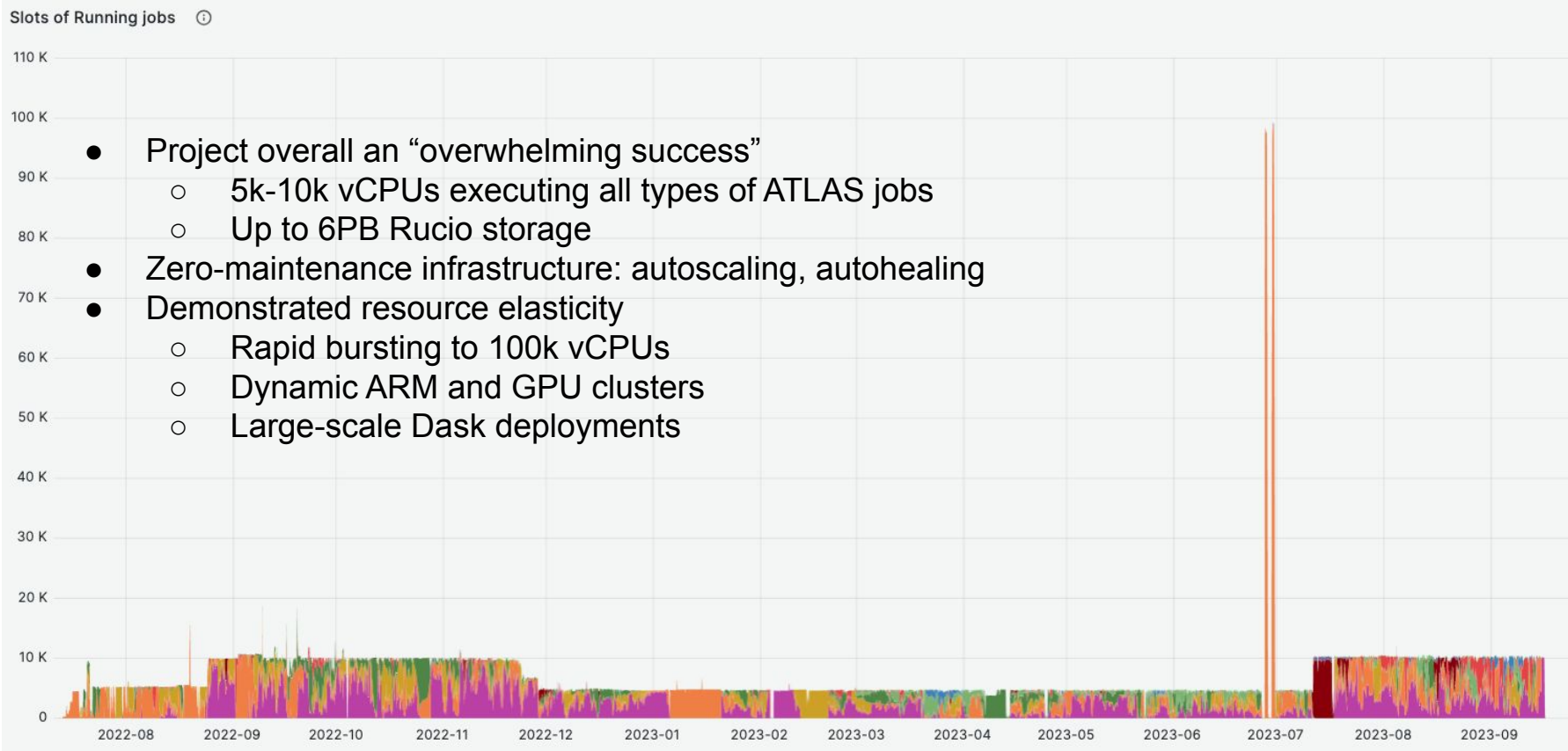
F. Barreiro Megino, Accelerating science: the usage of commercial clouds in ATLAS Distributed Computing

M. Lassnig, Extending Rucio with modern cloud storage support



R. Taylor, A grid site reimagined: building a fully cloud-native ATLAS T2 on Kubernetes

Highlights



- Project overall an “overwhelming success”
  - 5k-10k vCPUs executing all types of ATLAS jobs
  - Up to 6PB Rucio storage
- Zero-maintenance infrastructure: autoscaling, autohealing
- Demonstrated resource elasticity
  - Rapid bursting to 100k vCPUs
  - Dynamic ARM and GPU clusters
  - Large-scale Dask deployments

Network discussion

Current data routing: Google Premium Tier

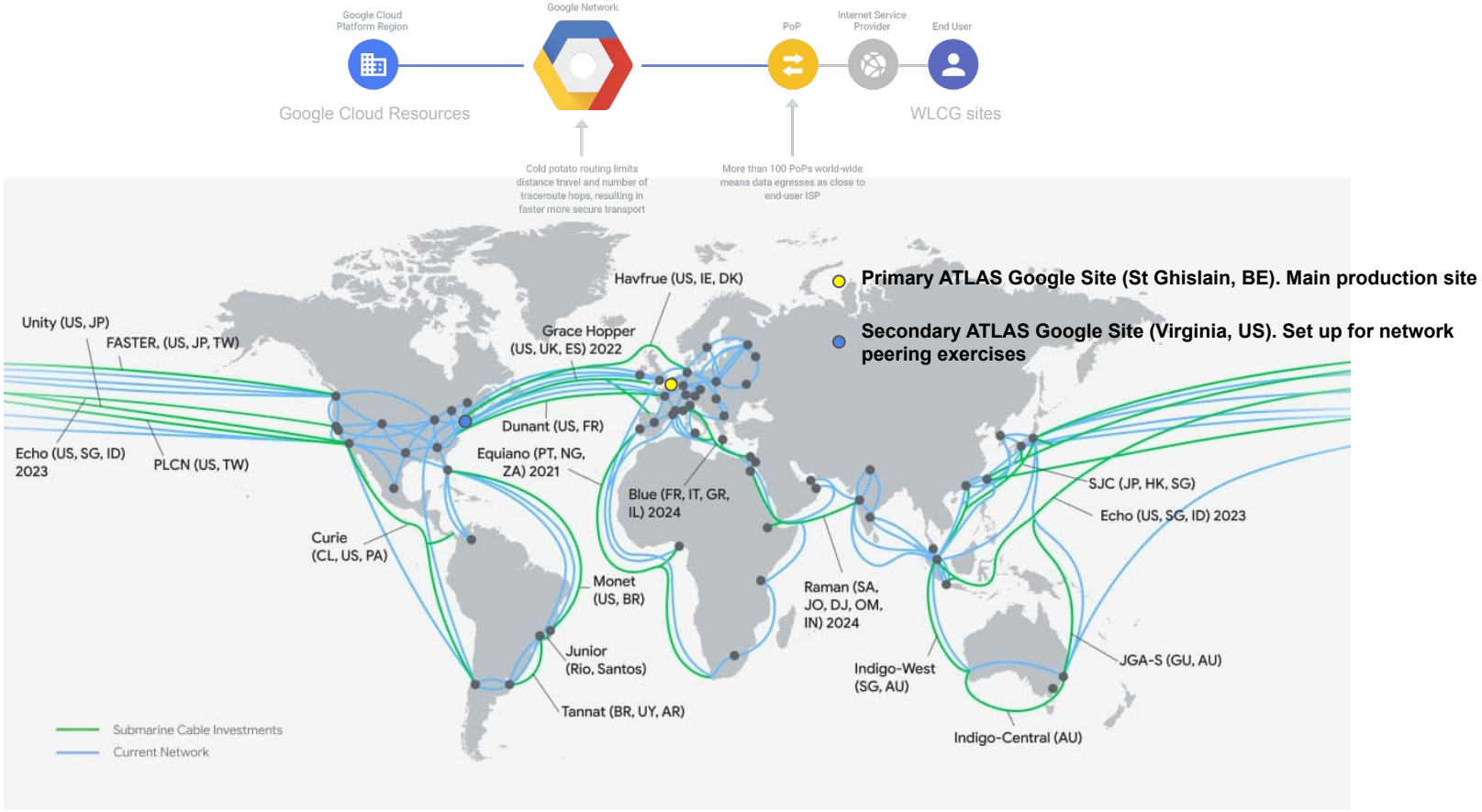
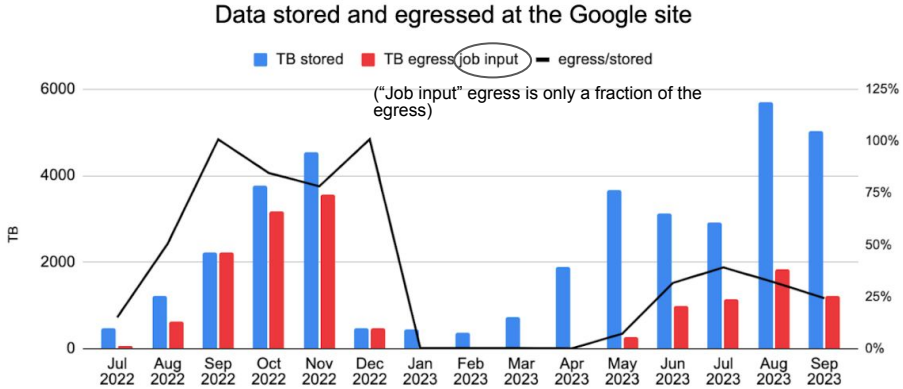
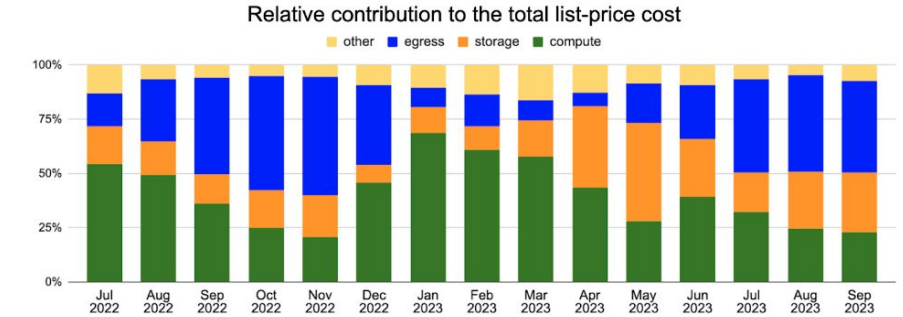


Image from https://cloud.google.com/about/locations

What's the problem then?





Images extracted from ATLAS Google Project TCO document

Ingress is free, but
internet egress is charged at a high $/GB rate.

Different retention and distance strategies evaluated over the project lifetime in Rucio

Storage strategy impacts on egress volume. When leaving egress unthrottled, it can dominate the list-price cost.

We don't pay list-prices in the Subscription Agreement, but the list-price cost can influence the negotiation of the next contract.

Additionally, some sites incur extra costs from their ISP when receiving large data volumes from outside the LHCONE

What would we like to do?

- Partnered with ESnet towards the last months: peer ATLAS Google site with LHCONE (not a single site!)
- “Cloud Interconnect” in the same region as the ATLAS Google Site
  - Bridge with fixed dedicated bandwidth. Fixed cost + reduced $/GB rate
  - Data leaves Google Network immediately into ESnet (or the science network you would be working with)
  - Leverage the ESnet/LHCONE network to transfer the data

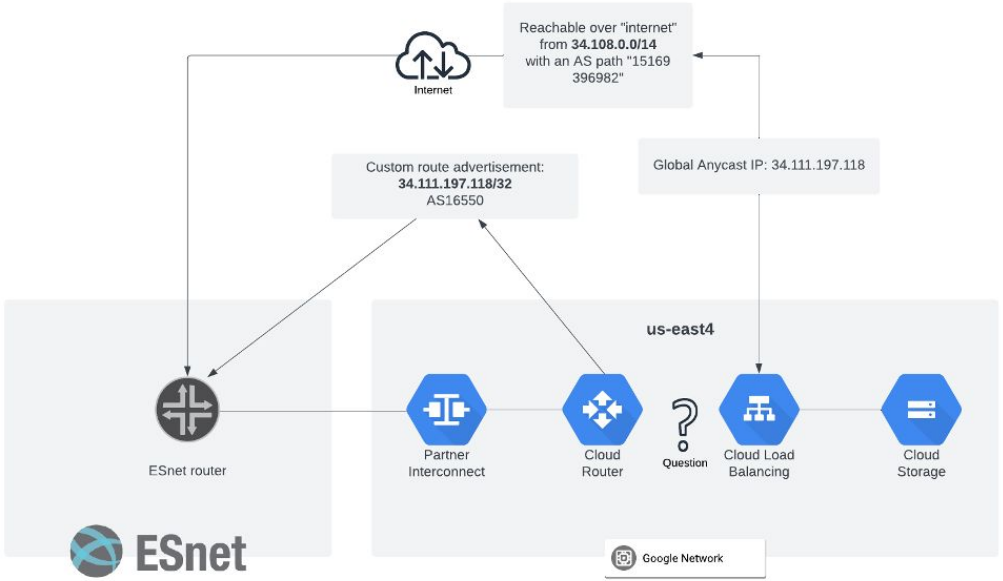


Diagram by Jay Stewart (ESnet)

- LHCONE requirement to only transfer LHC data and is based on allowing a specific list of (external) IP ranges
- Only storage needs to be peered
- Plan was to “pinhole” announce the /32 IP range into LHCONE via ESnet’s CC bridge

Interconnect observations and challenges

1. Special network devices (Global Load Balancers) are incompatible, placing additional requirements on the DDM/Rucio integration (e.g. run self-managed gateway service on a VM with the Grid cert)
2. Low-level traceroute/transfer tests with a simple VM/IP failed as well
3. Google “Interconnect” is designed to connect on-prem data center with your cloud organization: it only supports private IP address spaces
    - Other cloud providers might support public IP addresses
    - Google acknowledged existing request to support public IPs
4. Private IPs can not be used in a distributed environment like LHCONE
5. Alternative options to explore (e.g. Bring Your Own IP), but there does not seem to be an extreme optimism

Conclusions

- ATLAS Google project completed recently with very positive technical results
- TCO study highlighted the potential cost of egress
- Interest to leverage LHCONE to reduce (not eliminate) these costs and avoid hitting sites' commodity internet connection
- Tests with ESnet showed that the solution is not straightforward
  - Google Interconnect technology designed for bridging two data centers together through private IPs, e.g. Google resources with a University/Lab
  - Possibilities depending on each cloud provider
  - Adding cloud resources to the LHCONE requires more experience and work
- Further projects will require more detailed planning and possibly hiring additional support option to speed up support interactions