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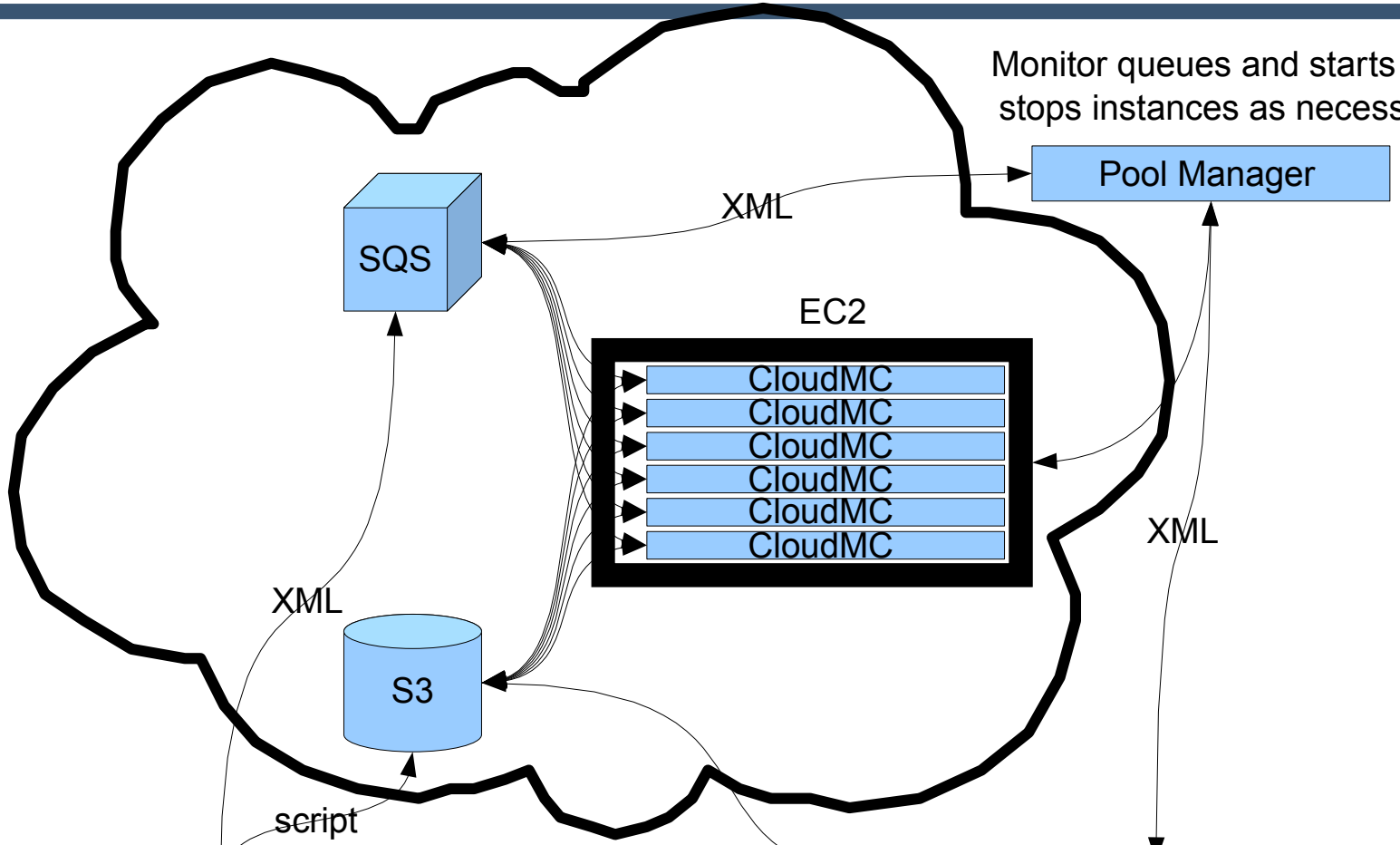
Belle Cloud Computing Update

Recall

- Investigating cost of cloud computing for generating Monte Carlo data
  - make Belle II less expensive
- Created an automated system to use Amazon EC2 resources to generate Monte Carlo data

Architecture



Cloud runs

- We generated 1 million events for Belle experiment 61, using 160 cores
  - Was quite rushed, apologies to Jean Wicht
  - $1.16/$10^4$ events
- Took the results to CHEP
  - Ask for the video to see Martin at his best :)
- Iterative improvement of software, then
  - 1.5 Million event run ($0.78/$10^4$ events)
  - Asked Amazon for access to more CPUs
  - 10 Million event run ($0.76/$10^4$ events)

CPU Time – 1.5M run

Number of events: **1,473,818**

Nett time taken: 22 hours

Total Instance Hours: 135.14

Largest number of instances used simultaneously: 20 [160 cores]

Cost of CPU Time: **USD108.11**

CPU Time – 10M run

Number of events: **10,000,998**

Nett time taken: 18 hours

Total Instance Hours: 906

Largest number of instances used simultaneously: 100 [**800 cores**]

Cost of CPU Time: **USD724.80**

- If we scale to 8000 cores, 10^9 events takes ~38 days (depends on tx time)

Data Transfer – 10M run

Inbound transfer: 45GB – USD0.18 (special price – would normally be USD4.50)

Results (outbound transfer): 234GB – USD39.78

Cost of storage: USD1.42/day

- Bottlenecks in Data Transfer to and from KEK
  - Connection limits, poor TCP tuning at both ends, rate limiting at Amazon

Streams	Up	Down	Location
1	1038KB/sec	211KB/sec	bwg58.bnet.kek.jp
1	2700KB/sec	1904KB/sec	Amazon EC2

Comparison

- EC2: US0.76/10^4 events
- Cluster based on 8-core machines: US0.76/10^{4*} events (assuming 3 years of running and 400W power)
  - Plus cooling
  - Plus rack space
  - Plus staffing

*VWO

Other Providers...

- Have run HEPSPEC on Amazon cloud instances
- Can use this to benchmark other providers

Conclusion

- EC2 Scales to 800 cores, no problem
- Costs USD0.76/10^4 events
- It's time to start getting serious
  - Making a relationship with Amazon
  - Improving the code

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