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Intelligent Power Management over Large Clusters

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Motivation

- Strong desire to power down computers when not in use, to save power (money)
- Latest releases of Condor support remote startup and shutdown of computing resources
  - Condor Rooster
- We want to exploit this
  - But go further to save more power

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Motivation

- We have over five years of Condor history to mine

Total Time used by Condor	47 years, 18 days, 4 hours, 45 minutes, 31 seconds

(Data from main Condor Submit computer – others exist)

- For every 1 second of useful time we require ~3 seconds through Condor

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Aims

- Reduce Power Consumption
- Produce no impact on interactive machine users
- Produce no impact on Condor users
- Provide auditing on computing time used
- On a cycle-scavenging Condor system.

- All These Things can be done using Condor
  - So What's new?

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What's Wrong With Condor?

- Nothing – Condor is "too good", but…
  - With a good administrator all this can be done
  - With plenty of time this can be done
- Put another way
  - Administrators are busy people
  - They have plenty of other tasks to do other than monitor and tweak Condor which gets along with things just fine
- Most users don't know enough Condor
  - Can't specify preferences over resources
  - Only 3 users had done this at Newcastle – and one got it wrong

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Power Saving in Condor

- Each worker is given a power rating (watts) and a PUE value
  - This needs to be added to the worker description
- Can rank computers based on ‘efficiency’

  Rank = kflops / (PUE * watts)
  - This needs to be added into the user submission
  - And merged with their rank if present

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Agility™

- Arjuna's Agility is a Cloud Computing Platform
- Support structuring of the Cloud into federated sub-clouds through Service Agreements
- User configured (or implemented) policies can be installed to manage the interaction via Service Agreements
- Data sharing between entities through authorized routes

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Agility™

- Using Agility to provide intelligent management between parts of Condor
- Adding in Rank
- Deciding if a user has the right to power up computers
- Monitoring activity and looking for anomalous behavior
- Behavior is modified by the addition of new policies
  - A Service Agreement change will be accepted only if no Policy rejects it and at least one Policy accepts it
- Audit individuals' worker usage for potential billing

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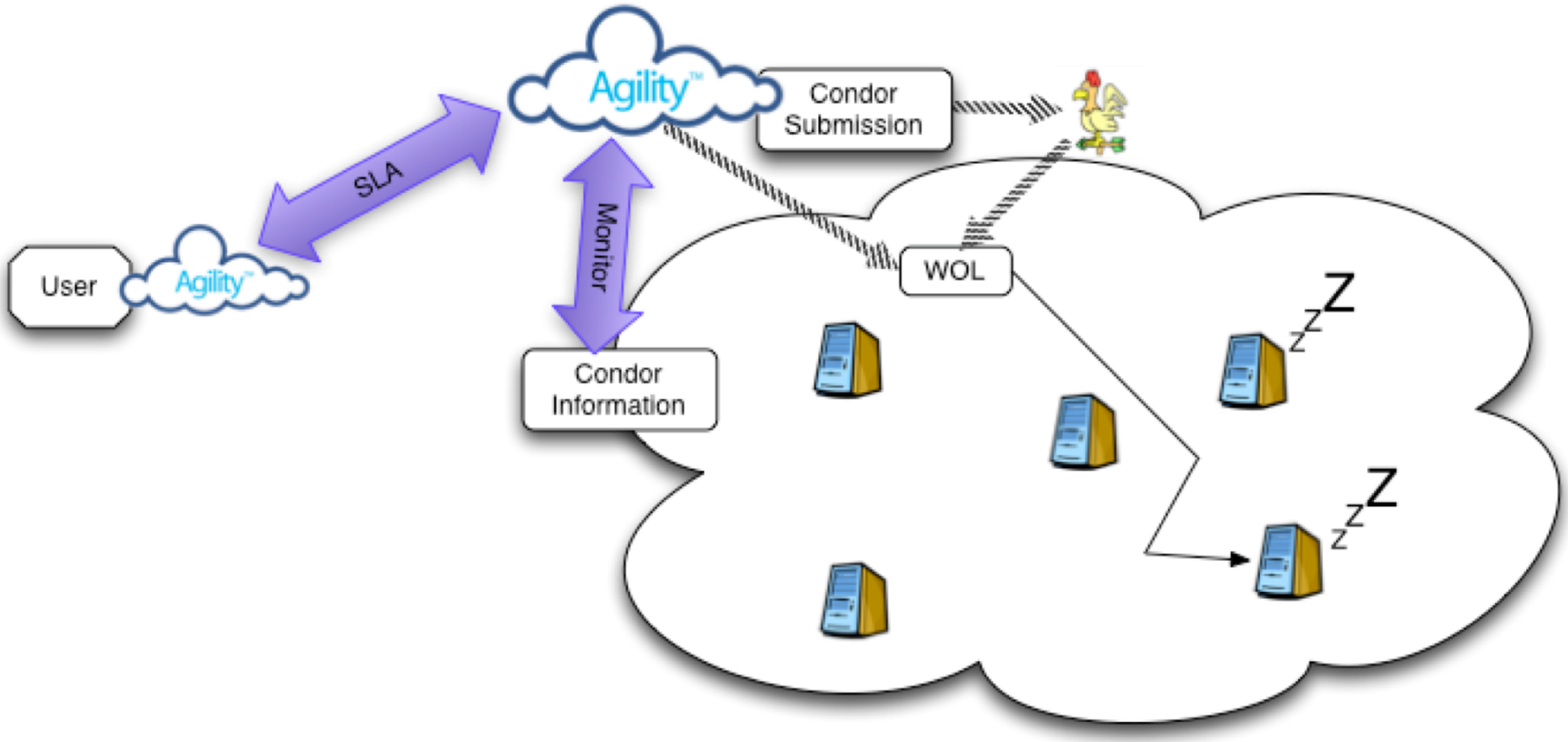
Agility™
Condor Submission
SLA
Monitor
User
Agility™
Condor Information
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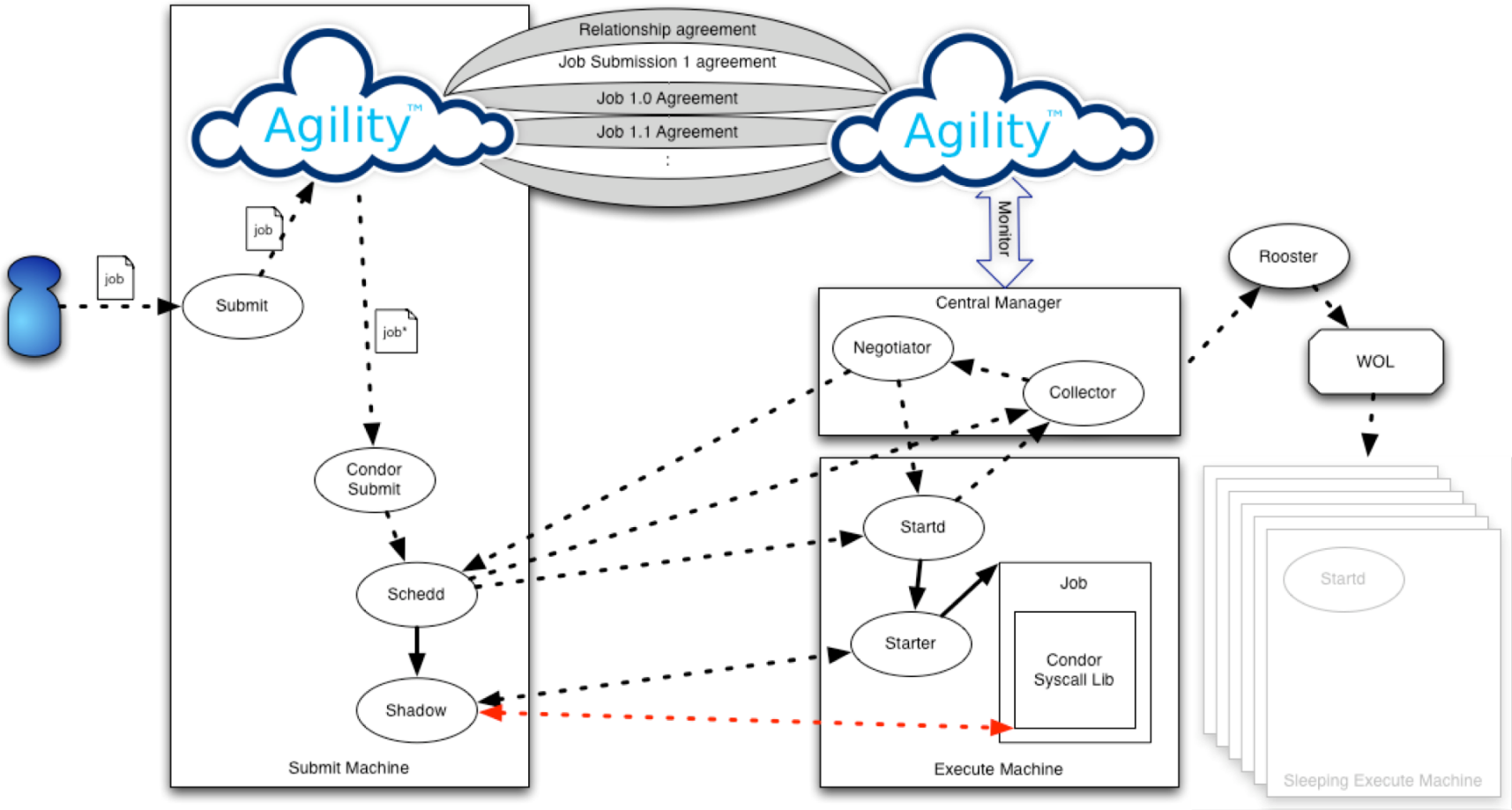
Relationship agreement
Job Submission 1 agreement
Job 1.0 Agreement
Job 1.1 Agreement
:
Agility™
Agility™
Monitor
job
job
Submit
job*
Condor Submit
Schedd
Shadow
Submit Machine
Central Manager
Negotiator
Collector
Rooster
WOL
Startd
Job
Starter
Condor Syscall Lib
Execute Machine
Startd
Sleeping Execute Machine

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Defined Policy

- Favor Energy efficient computers
  - Unless user states otherwise
- Prioritize submissions
  - Professors over PhD's
- Mark Rogue jobs
  - Jobs that have executed for too long
  - Jobs that have been restarted too many times
  - Jobs incorrectly submitted
- Backlog reduction
  - Modify above policy to deal with backlogs
- Auditing
  - Provide auditing for all jobs (per –user, -group, -school, -faculty, university)

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Conclusion

- Condor is good
  - Most users aren't as good
  - They need tooling to automatically monitor and tweak the setup
- This along with preferring power efficient computers and turning off computers can save a lot of energy (and money)

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