CPU Efficiency

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WLCG GDB, 5th March 2008

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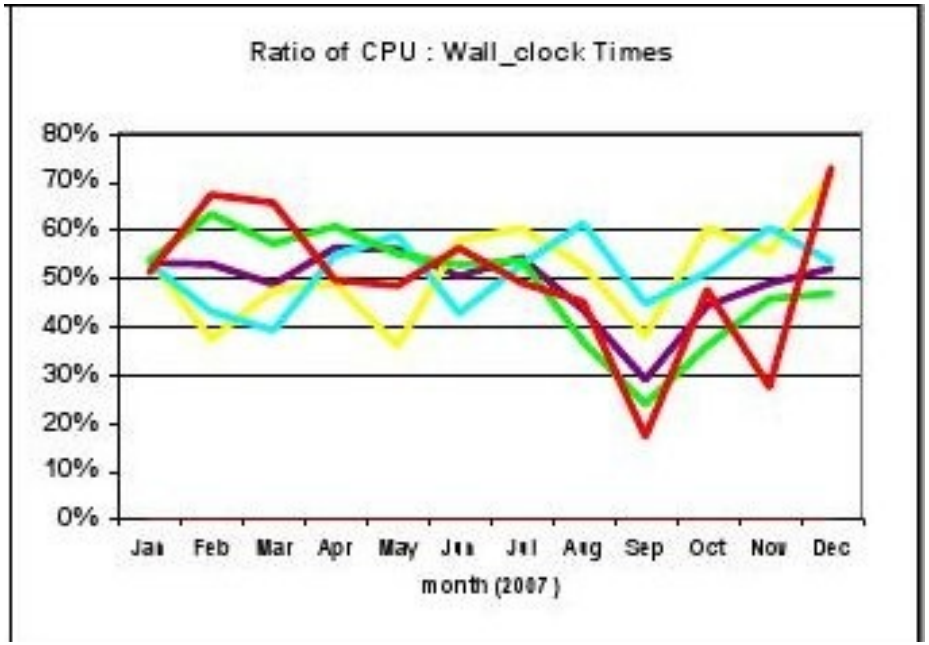
Outline

Job efficiency (CPU/Wall time) for CERN in 2008



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Possible Reasons - I

- Error trapping in SEAL
  - Hitting eg. LHCb jobs which got stuck in the system

--> Fixed

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Possible Reasons - II

- Job Overhead
  - Middleware overhead
    - Measure the overhead for a “hello world” job; calculate minimum cpu time for 85% efficiency
      - Is 30,000 8 minute jobs sensible? This also causes heavy load on the batch system.
    - Sandbox timeouts were 5h15. Being improved at CERN: maximum wait is now just...

      ... 1h15 minutes!!!

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Possible Reasons - III

- Job Overhead
  - Data fetch/upload overhead
    - Local SE<->local disk
      - Job recall from tape (shouldn't happen!)
      - Optimum policy for reading from SE or from local disk
        - » Will depend on fraction of data read
        - » Need instrumentation in experiment framework to measure the data copy overhead
    - WN<->remote SE
      - Need instrumentation in experiment framework to understand time spent here.

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Possible Reasons - IV

- Pilot Job Framework overheads
  - "wasted time" between "joblets"?
    - Can be up to 10 minutes in some cases for one framework. Worker node is idle in this time.
    - Need instrumentation of framework to measure
      - Time to start first joblet
      - Time between joblets
      - Added in DIRAC 3.
  - Does this explain difference between site and experiment view of efficiency?
    - Or do experiments only measure efficiency for successful joblets? This would introduce a bias

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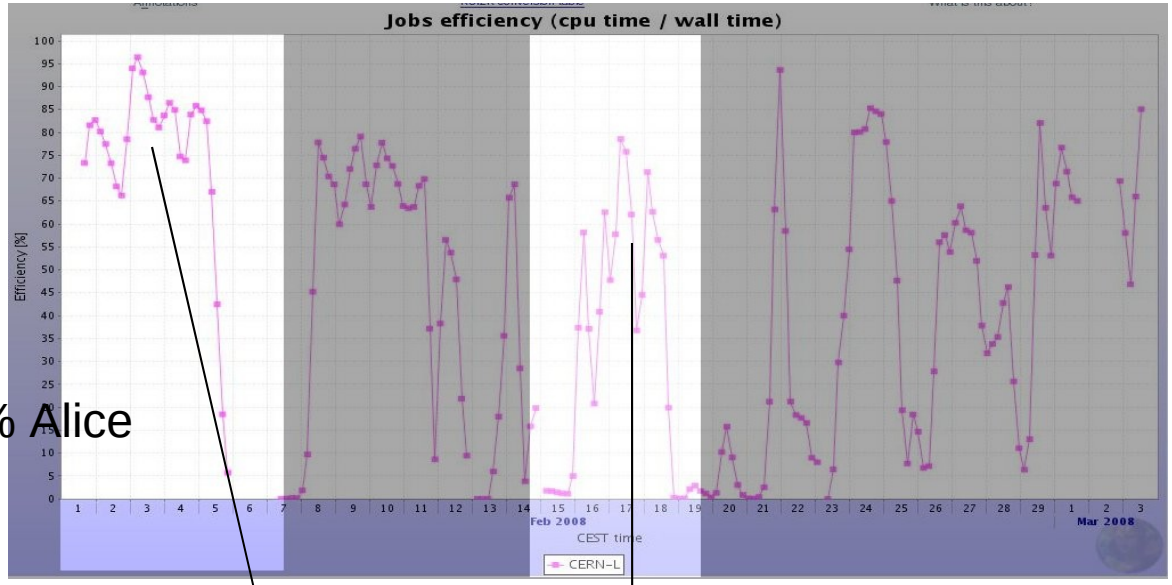
Possible Reasons - V

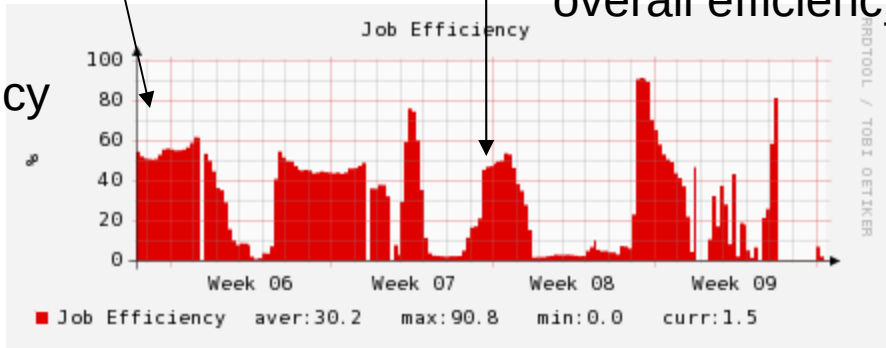
Example: Alice joblet efficiency in the past 4 weeks



70%-90% Alice

50-60% Alice
overall efficiency slightly less

Overall efficiency
50% only



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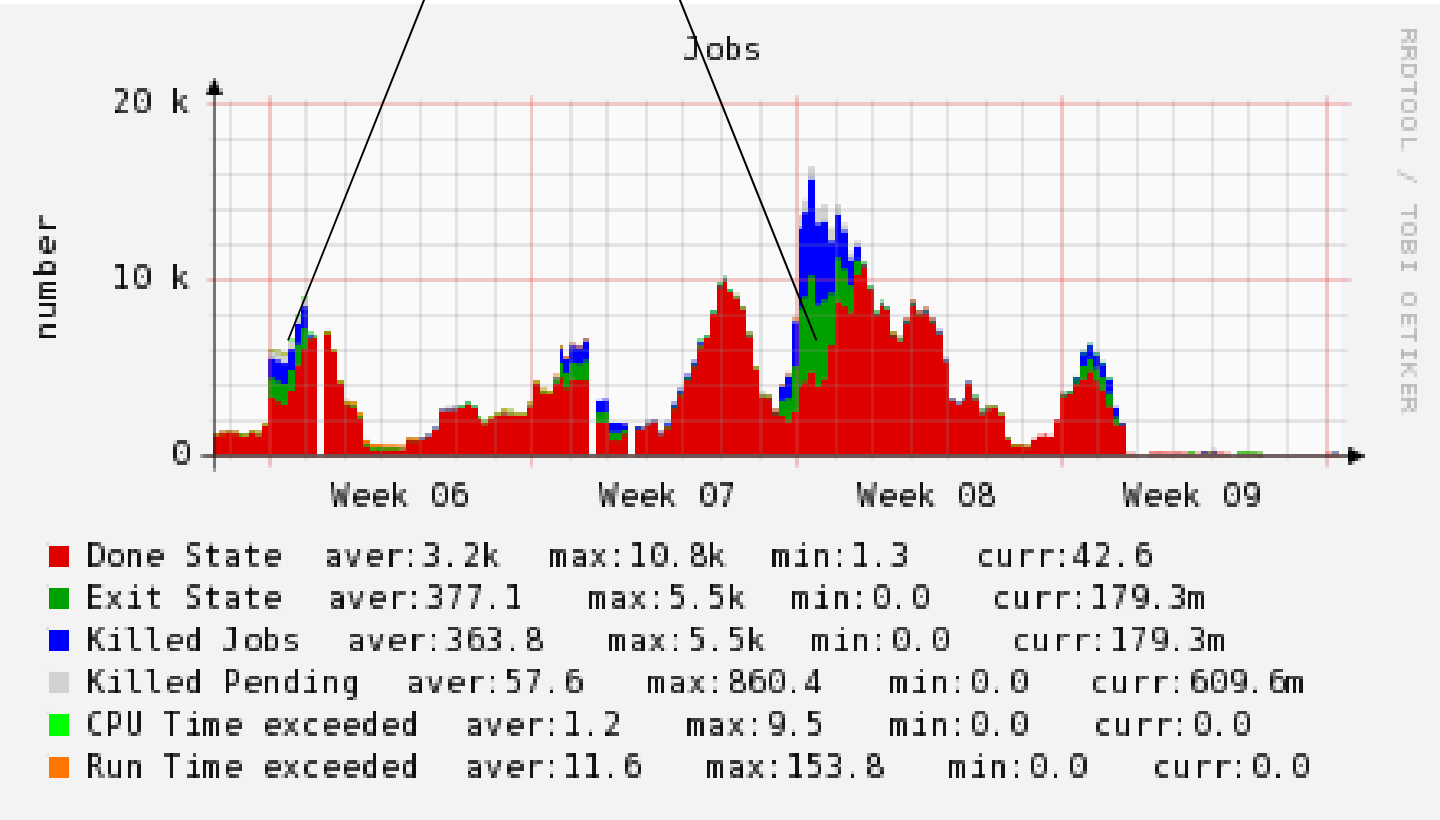
Possible Reasons - VI

Example: ALICE production jobs in the past 4 weeks

Significant number of killed and exited jobs: - are they counted ?
- what happened to them ?
- need instrumentation of FW



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Possible Reasons - VII

- Naturally inefficient (I/O bound) jobs
  - Real world example from LHCb
    - Read 20GB of input data
    - Extract raw data within 288.94s of CPU time
    - Write out 1.6GB of output data (WAN transfer to Rutherford)
    - Estimated theoretical wall time: 31min
    - Maximum of 15% CPU/Wall time possible.
- What fraction of the overall workload do these represent? How can they be scheduled to improve overall efficiency?
  - Tag jobs as I/O bound? How is this passed from WMS to local scheduler?
  - Overall cpu/wall time ratio would not be improved, but sites can schedule I/O intensive jobs to improve box efficiency.
  - Schedule network optimized ?
  - Sites could provide dedicated queues for CPU bound jobs with more powerful machines behind

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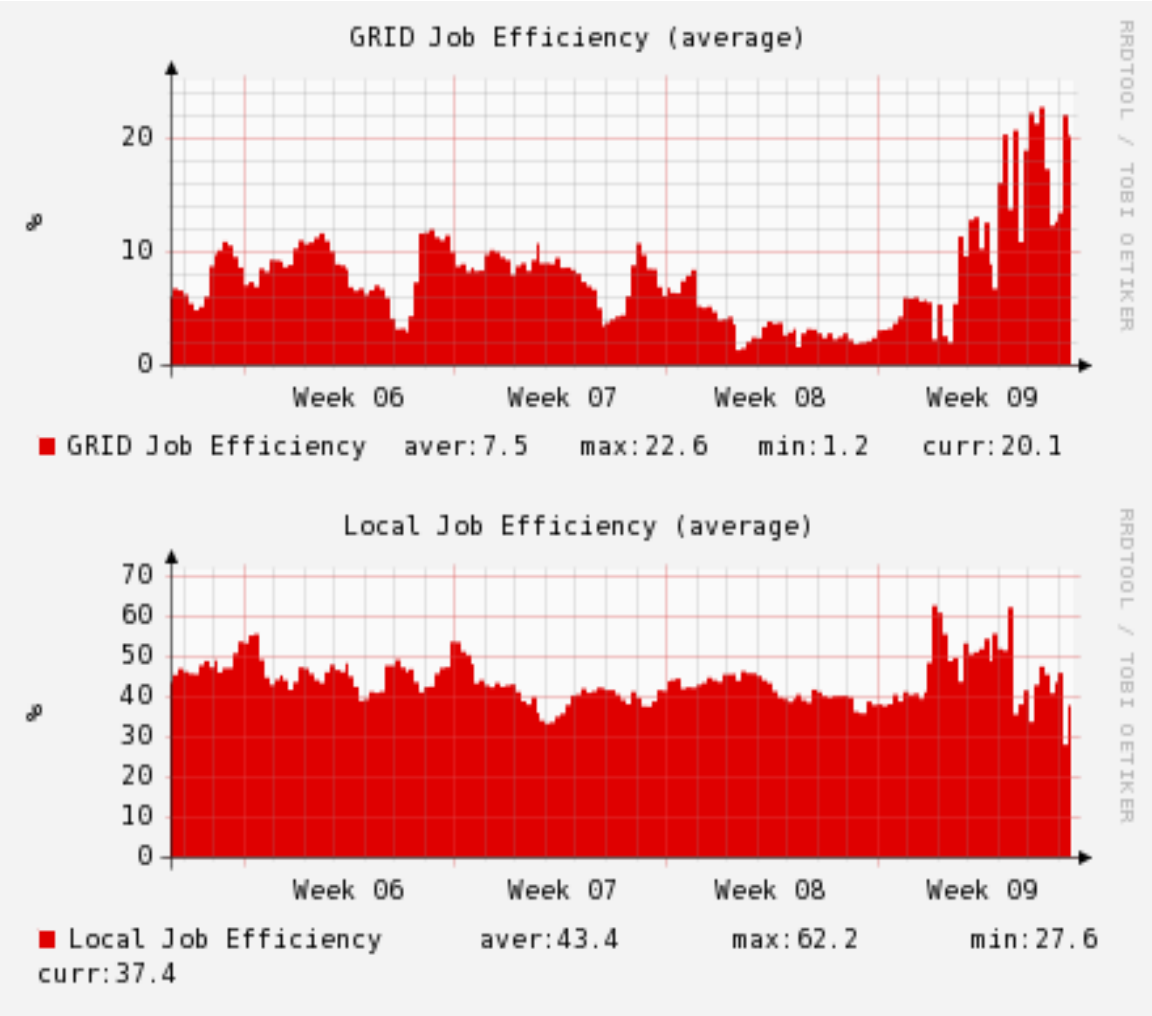
Grid/Local job comparisons



Local jobs appear to be more efficient for CMS and ATLAS.

For LHCb and Alice Grid jobs are more efficient than local jobs

Why ?

Need to instrument the experiment frameworks

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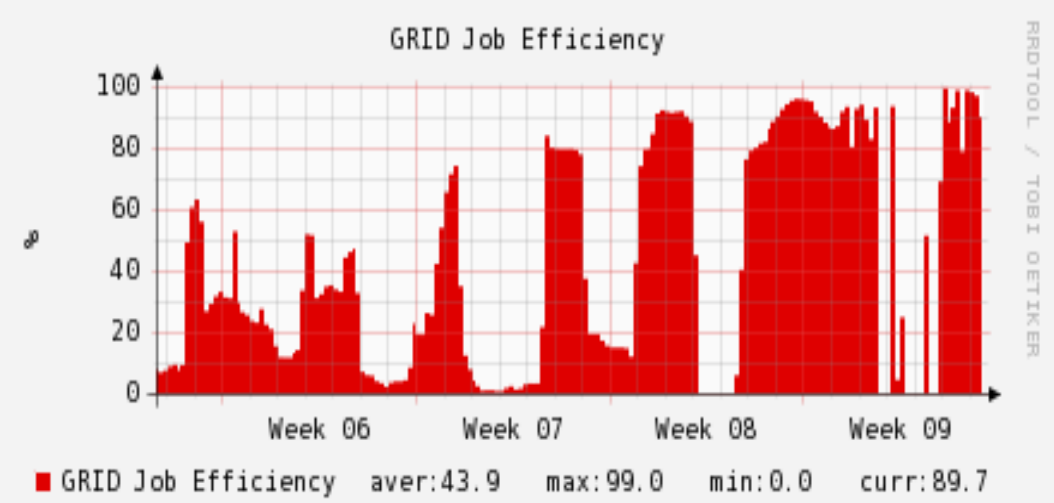
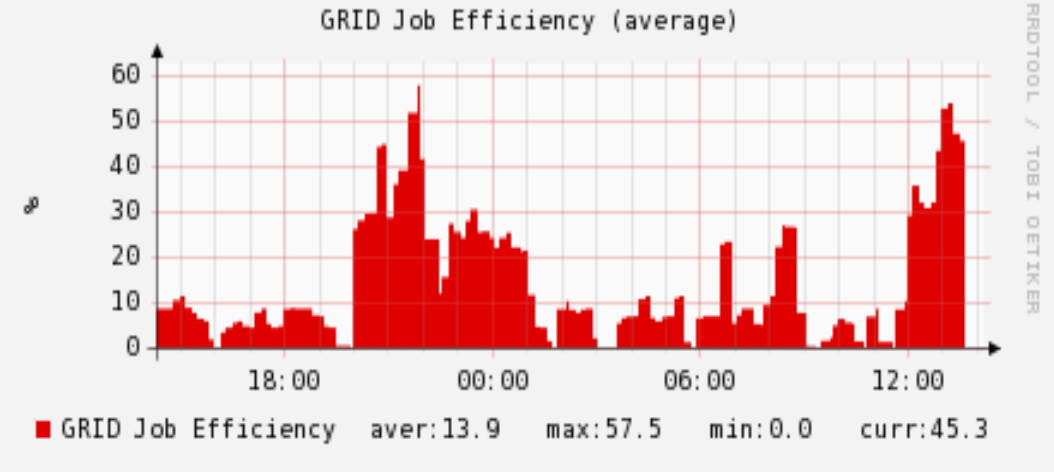
Grid Production/User jobs





LHCb production jobs clearly improved over the last 4 weeks.

Good! But why ?

Other LHCb grid jobs less efficient. Why ?

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More information needed from expts

Key Message:

- need instrumentation so we understand where these differences come from.

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Proposals

- Instrumentation in experiment frameworks to
  - Time job is waiting for data
  - Time between end of one joblet and start of the next
  - Other?
  - Agree common logging format by when?
  - Implement by when? April?
- Remove biases in experiment measurements of efficiency. All jobs should be considered.
- Review in May and June GDBs before and after CCRC

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Conclusions

- There is not one single reason for bad CPU/Wall time ratios. There are improvements, but will they be permanent ? We need to find out where exactly the time is spent.
- This can only be done together with the experiments.

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Acknowledgements

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