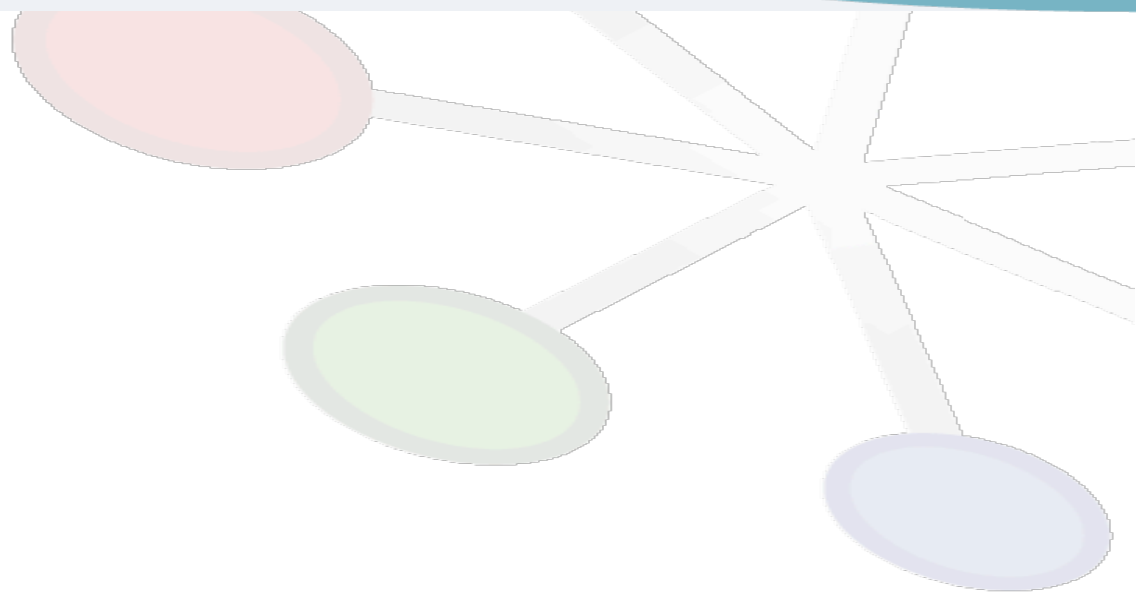# LHCb DIRAC

COMMUNITY GRID SOLUTION ™

LHCb session @ WLCG workshop

LHCb

- Extended physics scope
  - Charm physics in addition to beauty
  - Trigger rate increased: 3000 evt/s to 4500 evts/s
- Higher energy
  - 15% higher multiplicity
- Pileup
  - Slightly higher than 2012 (4 10^{32} cm^{-2}s^{-1} instead of 3.5 for same number of bunches)
    - ... but much better than early 2011
- Reconstruction SW
  - Better tracking than 2011
- Consequences:
  - More tracks, therefore more CPU time for reconstruction
  - More combinatorics, therefore more CPU time for stripping
- Higher compression
  - Less space used but slightly more CPU for writing
- Stripping also MC data (space reduction, not CPU!)

○ **Reconstruction:**

    ❑ **average 25 HS06.s (expected 12), some tails**

    ❑ **Memory: some spikes due to the heap for some events**

        ☆ **Is it possible to allow temporary spikes in memory?**

        ☆ **It is released at the end of the event**
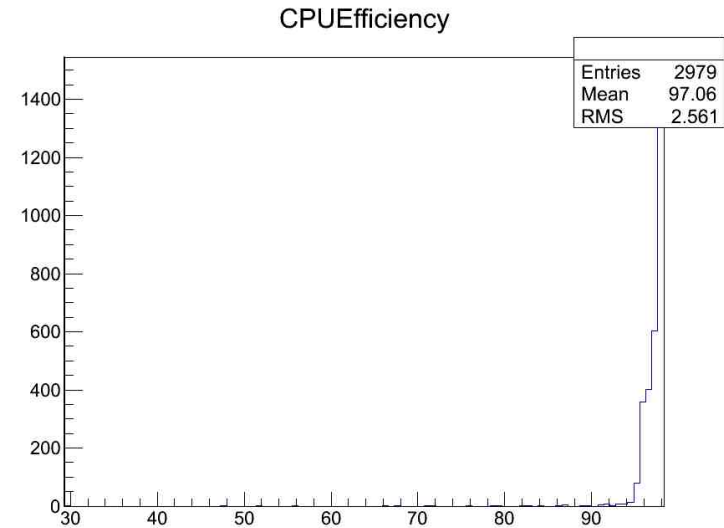
○ **Stripping:**

    ❑ **average 3 HS06.s (expected 1.2)**

    ❑ **High memory consumption:**

        ☆ **mostly due to ROOT buffers (100 MB per output stream, 14 streams…), but also complexity of the application (800 algos!)**

        ☆ **Needs around 3.5 GB**

        ☆ **Working on reducing the memory footprint**

   ❄ **Hopefully this is going to go down (but code from physicists! ;-)**

○ **Reconstruction is the most demanding**
- ❑ **After a lot of effort on reconstruction SW**
- ❑ **50,000 events per file (3GB): 1.5 MHS06.s**
  - ☆ **For a 10 HS06 core, this means 42 hours**

○ **WN normalisation**
- ❑ **We need to know how much time is left in the queue**
- ❑ **WN normalisation is required**
  - ☆ **Estimated by DIRAC**
  - ☆ **Why isn't it published?**
  - ☆ **Each batch system is different, each site is different**
  - ☆ **We also need it for our internal accounting**
    - ❄ **Should be identical to the normalisation used for accounting**

○ **Memory**
- ❑ **What counts is whether the process is swapping**
- ❑ **Instantaneous VM usage is not necessarily a good metrics**
- ❑ **In any case only the offending process should be killed**
  - ☆ **Catchable signal, allowing recovering information**

CPU for reconstruction
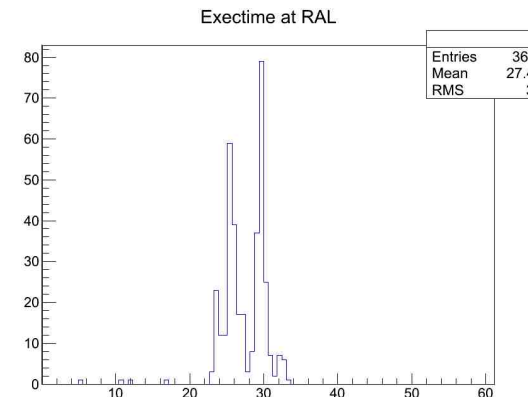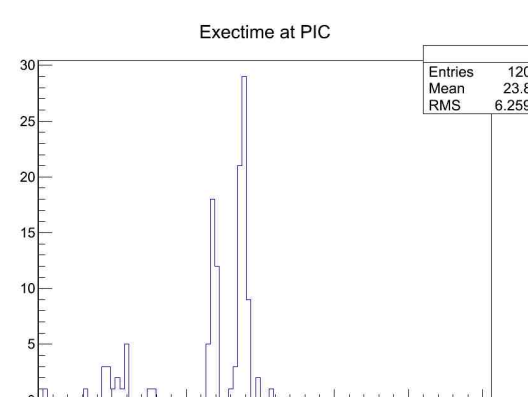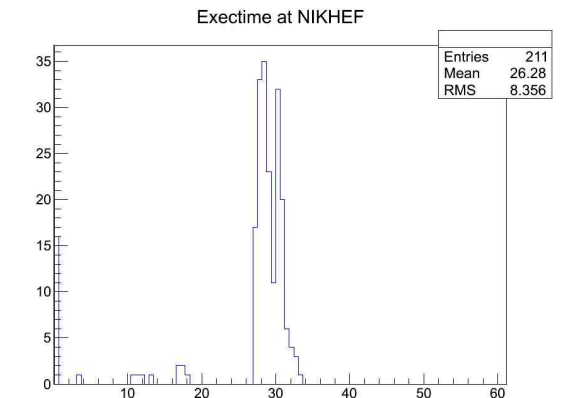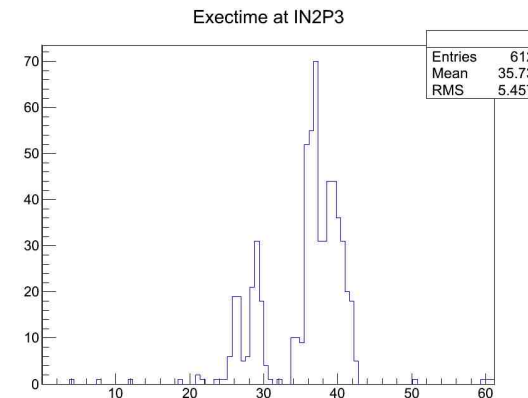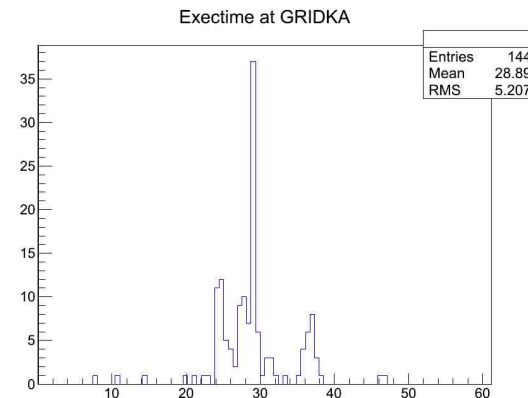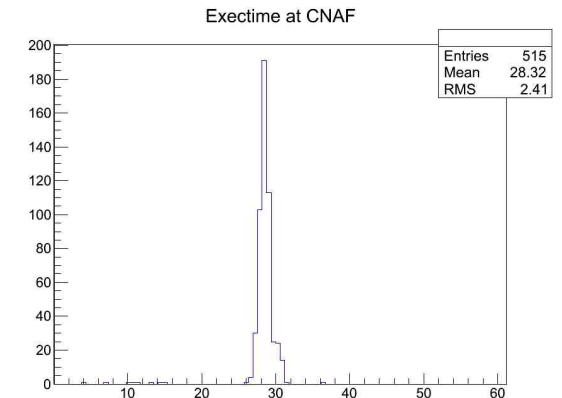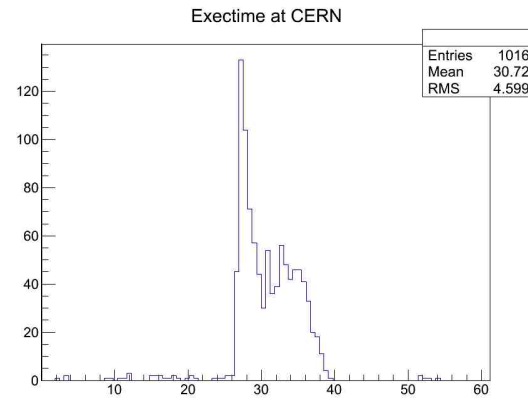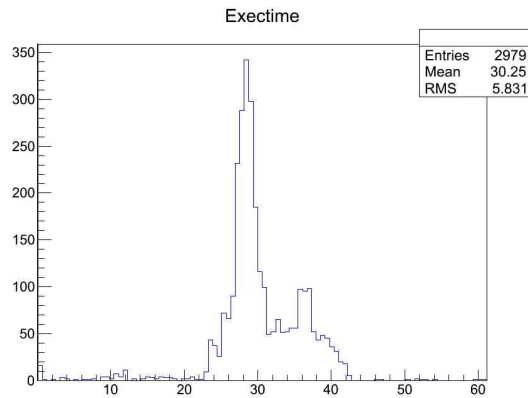
- Maximum 45 hours
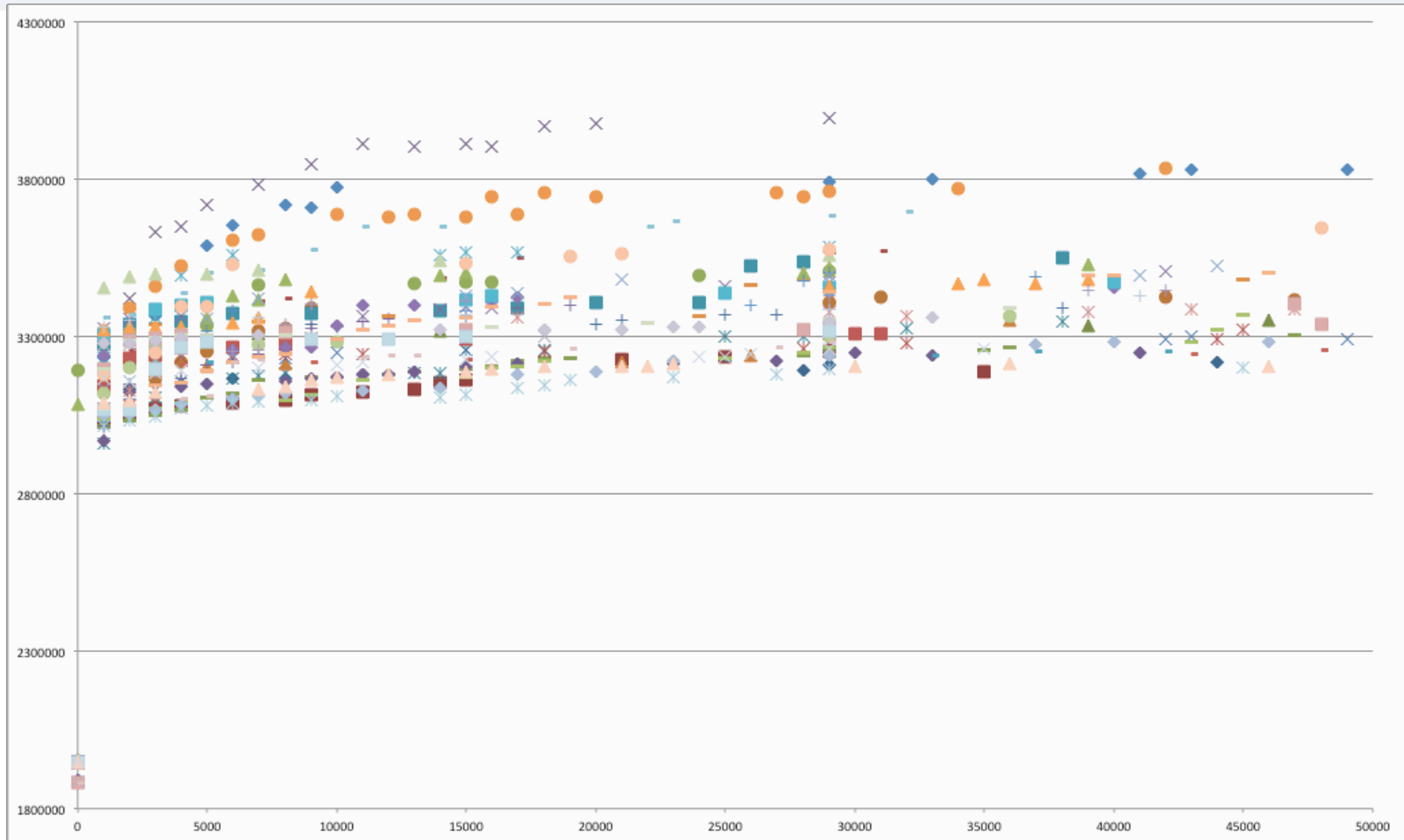 - CERN & IN2P3
- 10% to be added for monitoring appl.

- ❍ **Application: < 2 GB**
- ❍ **Jump by ~1.5 GB due to ROOT buffers (14 output streams)**
- ❍ **Slow increase related to event buffer usage (large events)**

LHCB @ WLCG WORKSHOP

- o **Condition DB**
  - ❑ **Currently at each Tier1, replication using 3D (Oracle streams)**
  - ❑ **Distribution moved to snapshots on CVMFS and web portal**
  - ❑ **No longer needed but at CERN**
  - ❑ **However new mount point for CVMFS /cvmfs/lhcb-conddb.cern.ch (faster distribution): request sent to sites**
- o **LFC**
  - ❑ **We still need it!**
  - ❑ **This is the only scalable replica catalog we have commissioned**
  - ❑ **Going to test functionality and scalability of the DIRAC File Catalog**
    - ✩ **Migration plan is not an easy task**
    - ✩ **Therefore not in production before 2013!**
  - ❑ **Should check if scalability and reliability can be ensured all at CERN (continuity of service)**
    - ✩ **If successful, possibly decommission Tier1 LFCs**
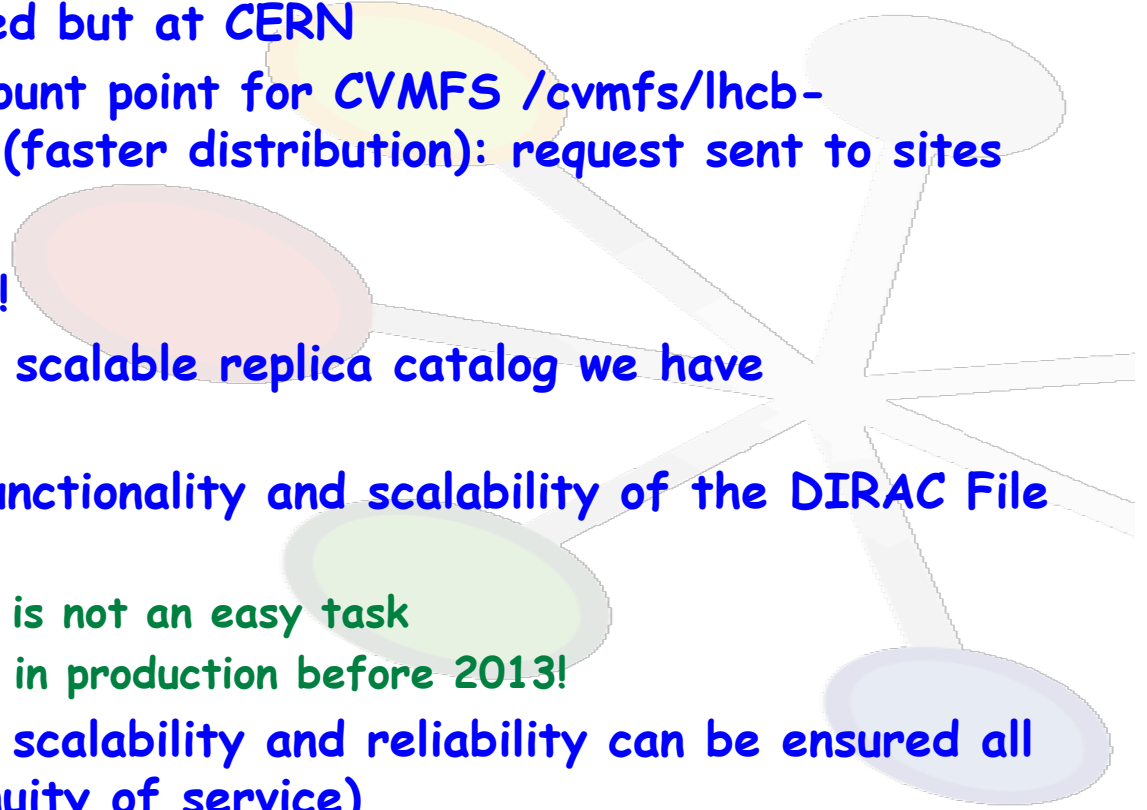
- CVMFS is a very successful experience!
  - Brilliant example of simplification (that works!)
  - Last problem fixed and deployed at CERN within less than one week (cache corruption pb)!
- Thanks to developers and to sites who have adopted it already!
  - Remember you can also decommission our NFS deployment area ;-)
- We would like that ALL sites move to CVMFS!
  - Simple to put in place and configure
  - Reduces considerably the local support
  - How can we achieve this? Does it require coordination/help between sites?

- Currently use: Castor (CERN, RAL), dCache (KIT, IN2P3, NL-T1, PIC), StoRM (CNAF)
- DIRAC heavily relies on SRM
  - As does the current FTS implementation
- Simplification in Space tokens
  - LHCb-Tape, LCHb-Disk, LHCb-USER
- Issues with custodial storage usage
  - DIRAC stager is "job-driven"
    - Files are staged when jobs are submitted
    - Jobs can be matched by pilot only when file is staged
  - Currently pinning for a fixed time (24 hours)
    - Implement internal "cache management"
  - Depends heavily on the cache configuration and job rate
    - Not trivial to tune
  - Can we simplify the cache architecture (up to 3 sets of pools at some sites: write, recall and read pools)?
  - StoRM (CNAF) by far the most flexible:
   - All spaces located on the same set of disk servers (across)

- o **Disk server reliability is an issue**
- o **Larger and larger disk space per server**
  - ❑ **Many files unavailable when a server does offline**
  - ❑ **Several cases of very long unavailability**
    - ✫ **Up to irrecoverable data**
- o **Two cases:**
  - ❑ **Replicated data**
    - ✫ **This is mostly an operational issue:**
      - ❊ **Flag files in LFC**
      - ❊ **If server irrecoverable: remove files and replicate from other sites**
      - ❊ **Else: re-enable when server is back**
  - ❑ **Temporary files**
    - ✫ **Created by jobs, waiting for being merged into larger files**
    - ✫ **Single instance of these files**
      - ❊ **As jobs produce many streams, it is almost impossible to re-create these files: just lost for physics**
- o **Should servers be more robust?**
 - ❑ **Or T0D2 spaces for scratch space? (investigated on EOS)**
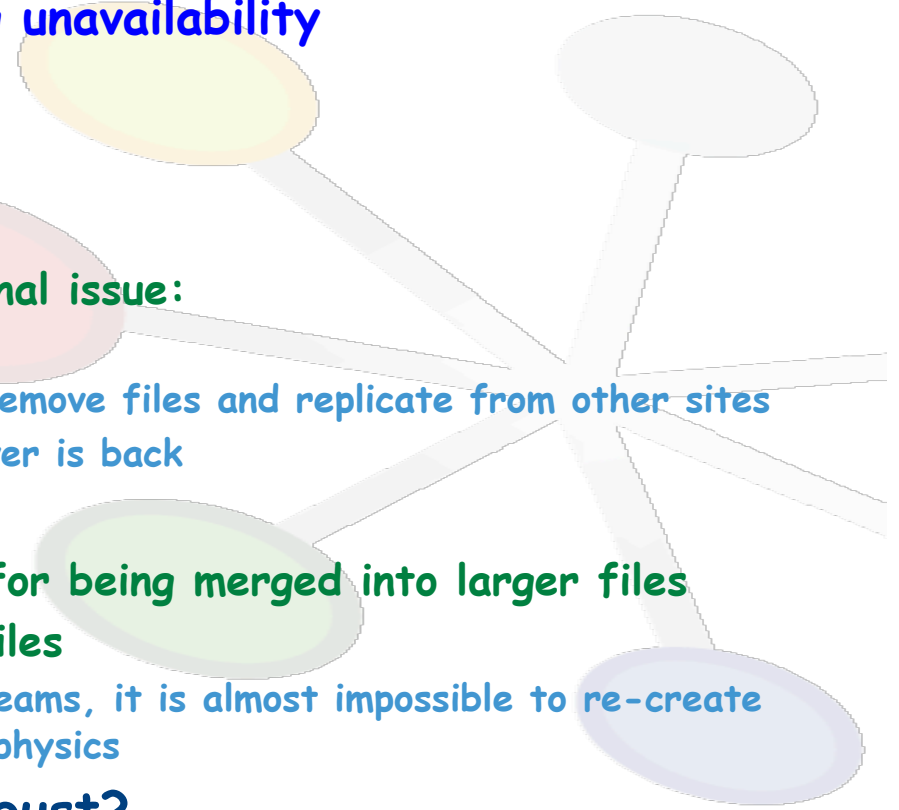
Storage and Catalog synchronization

o **Storage monitoring**
- ❑ **Keep storage usage per directory, and link to datasets**
- ❑ **Accounting as a function of time (per site, dataset…)**
  - ☆ **C.f. CHEP talk on DMS**
- ❑ **Study the use of DIRAC FC (integrated storage usage)**
  - ☆ **Avoids need to browse LFC (twice a day)**

o **We don't use (yet) the messaging from SEs**
- ❑ **Not available for all technologies (Castor, StoRM)**
  - ☆ **Requires quite some development in DIRAC**
  - ☆ **Currently DIRAC replica manager ensures consistency**
    - ❋ **But cannot avoid data loss or irrecoverable errors**

o **SE <-> LFC consistency**
- ❑ **First consistency on storage space usage**
  - ☆ **Between LFC accounting and site dumps**
    - ❋ **Site dumps provided weekly by most sites**
- ❑ **If discrepancy, investigate further**
 - ☆ **No way to get an exact match (no instantaneous picture)**
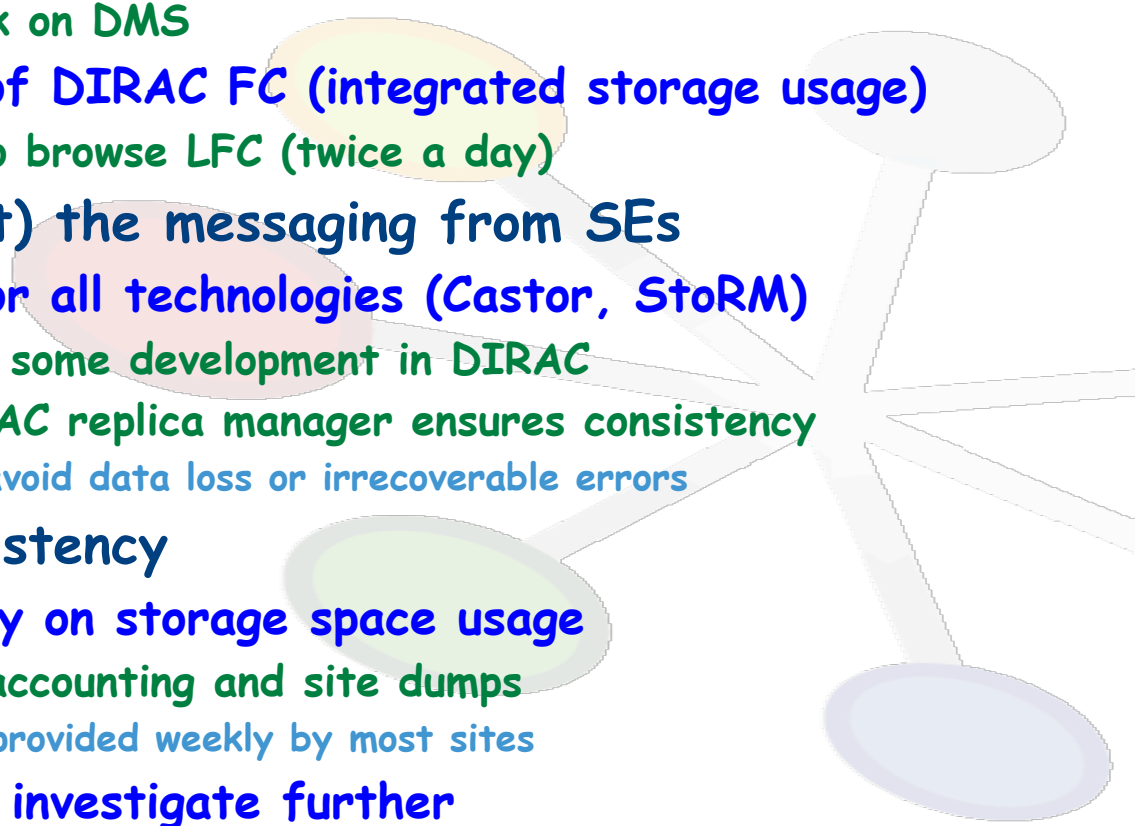
- Moving to direct CREAM submission
  - When done: no need for gLite WMS any longer
  - Mostly internal operational issue: tune pilot submission parameters
- Matching throttling
  - Avoid too many jobs of a specific type to run / start at a site
  - Not match jobs from pilots if:
    - ☆ Too many jobs running of that type
    - ☆ Another job was started within a time interval (typically 20-30 seconds)
  - This may be a problem if pilots all start in bunches!
    - ☆ We need to implement a (random or educated guess) delay and retry in the pilots
    - ☆ Currently quite some pilots don't match jobs
- Batch system priority
  - Issues depending on batch system, very long jobs can:
    - ☆ Reduce priority (LSF @ CERN, CNAF)
    - ☆ Increase priority (SGE at IN2P3)
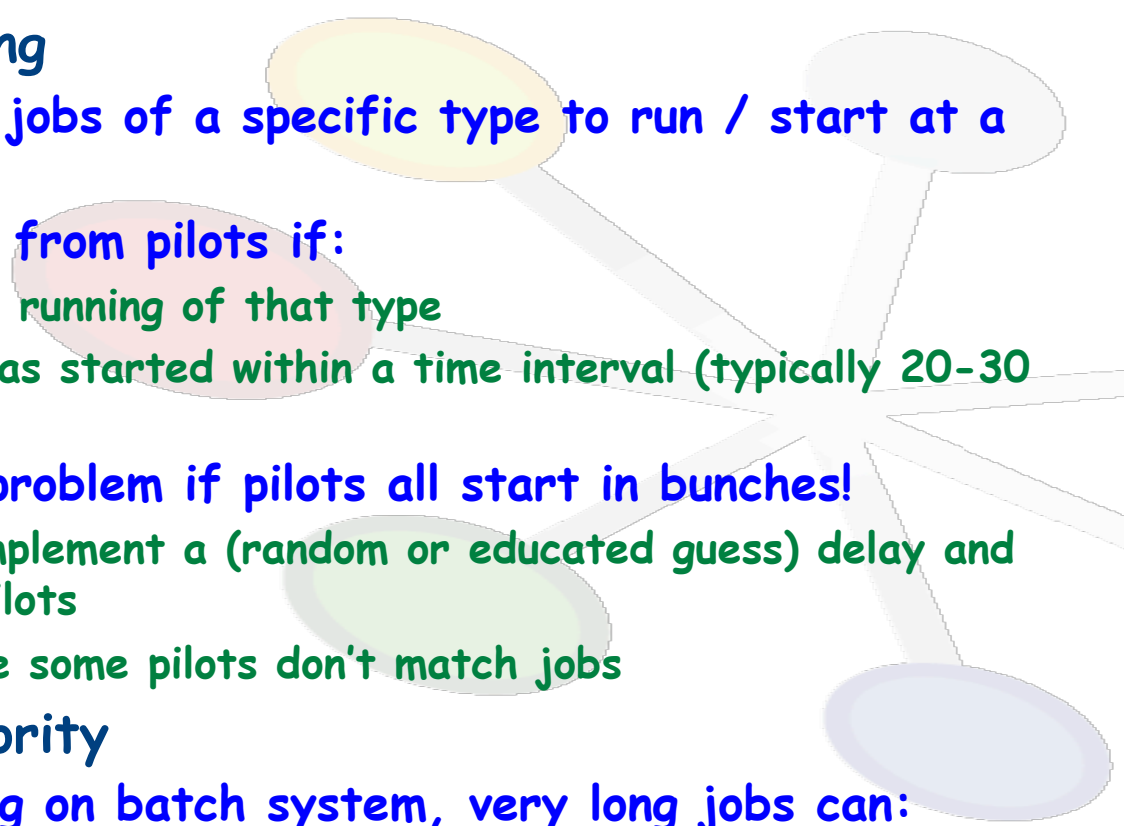
- CPU work and power:
  - What we know best is the "work" to be achieved
  - Some knowledge on how long it should take (reprocessing, restripping)
  - Less well know is "when"!
    - ☆ Application readiness
    - ☆ MC needs coming in bursts
    - ☆ Analysis concentrated before major conferences
  - Power is therefore for the peak, not for the average
- Tier1 requests and pledges
  - We make global requests (CPU and disk)
  - Sites make pledges (from their budget and LHCb importance from a local perspective)
  - Then we expect it matches!
  - CPU/disk/tape ratios should match at all sites
    - ☆ Useless to get all disks at a site with less CPU!
  - What should we do when a site cannot fulfill expectations?
    - ☆ Or delay installation of pledges
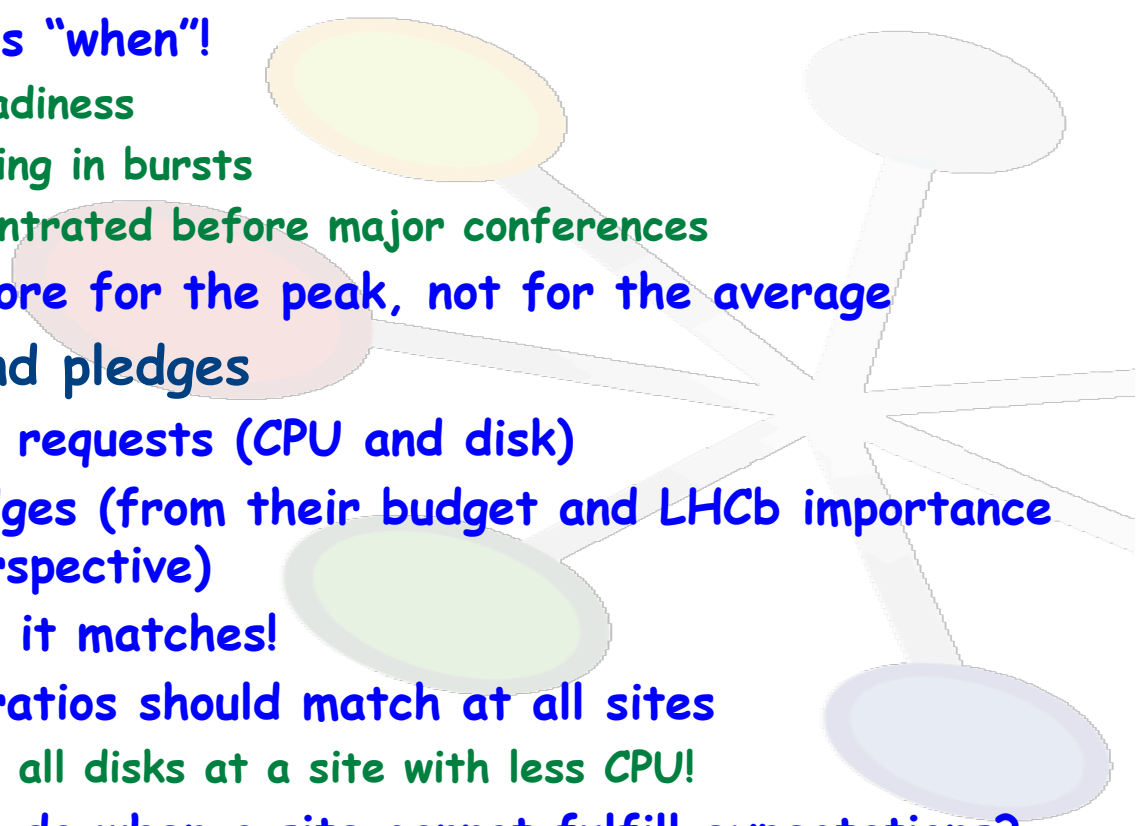
o **LHCb is quite happy with all sites' responsiveness and stability**

     o **Warm thanks to everybody!**

o **However…**

o **The system is fragile!**

- ❑ **Small hiccoughs can have severe consequences**
- ❑ **Quite manpower intensive to follow all sites**
  - ☆ **LHCb has a centralised operations team**
  - ☆ **Only LHCb people at Tier1s**

- ❑ **The more we can simplify, the better, however…**
  - ☆ **Don't forget any change requires software changes and should be well prepared and scheduled (SRM, LFC,…)**