Research track 2: Data transfer and access

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Outline

- Introduction
- CSC108 operations on Titan
- Running on the new DTN farm
- Outlook and Plans

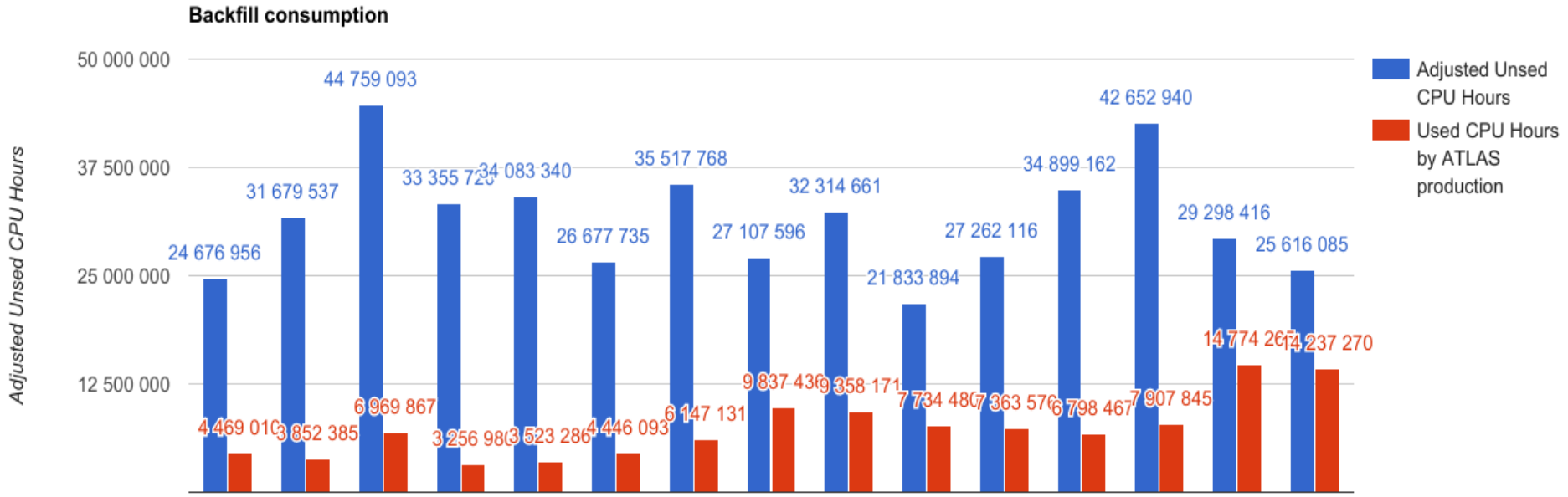
Topics in the proposal for RT2

- Workload run-time IO optimization
  - IO related effects that can affect workload execution time and have negative impact on OLCF infrastructure
    - Workload startup
    - Workload run time IO
    - Luster MDS overload
- Move pilot operations to DTNs at OLCF
- FTS3 at ORNL
  - 3rd party transfers, etc. Pre and Post (workload execution) data management. Asynchronous IO data management for workload .

Overview of the current status

- Many issues outlined in the proposal are addressed
- Placement of ATLAS software on NFS allowed to avoid Luster MDS overload during AthenaMP/Geant4 startup and operation.
  - Current payload IO operations are within Luster operational limits (Study by Sarp Oral – RT4)
  - Can run ATLAS production simulations in parallel on up to 6000 nodes (96k cores)
- Change in pilot launcher logic (non-blocking launcher) allowed us to remove pilot's stage-out phase from the critical path and improved backfill utilization efficiency. Data stage-out does not affect anymore our ability to capture free resources on Titan
    - New launcher operational since July 2016
    - Large effect - allowed us to exceed 7M core-hours per month with backfill utilization efficiency of ~19%
- Pilots operations were moved to DTNs (twice!)
    - New DTN farm became available in February 2017
- The move to the new DTN farm allowed us to exceed ~10M core hours per month
    - For March and April of 2017 ATLAS resource utilization on Titan exceeded 14M core hours and backfill utilization exceeded 30% .
    - That puts us on track to reach and exceed 100M core hours in 2017

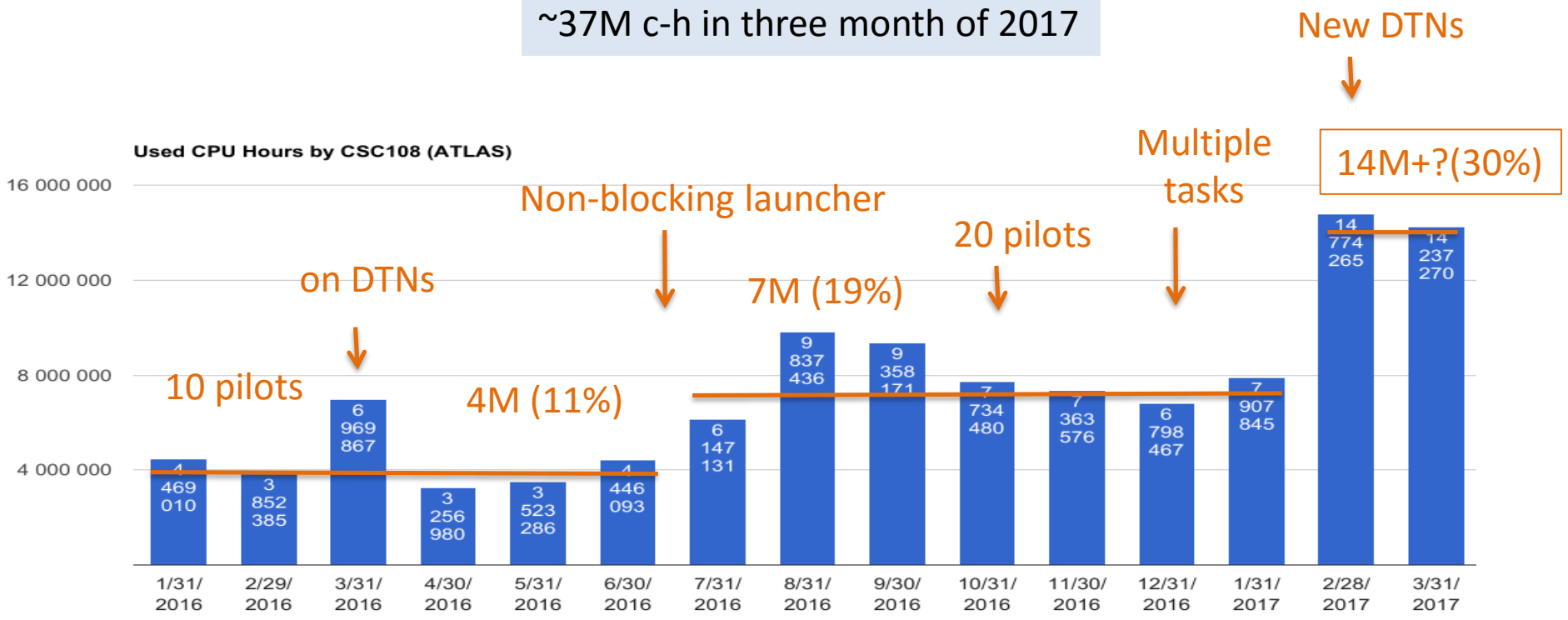
CSC108 performance overview



Running ATLAS production simulations 24/7 since 9/2015
Pure backfill mode. No allocation. Lowest priority on Titan
Steadily increasing CPU consumption and backfill utilization efficiency

Evolution of CSC108 performance on Titan

~74M core-hours in 2016
~37M c-h in three month of 2017



Running ATLAS production simulations 24/7 since 9/2015
Pure backfill mode. No allocation. Lowest priority on Titan
Steadily increasing CPU consumption and backfill utilization efficiency
Increases are directly related to improvements in data transfer operations

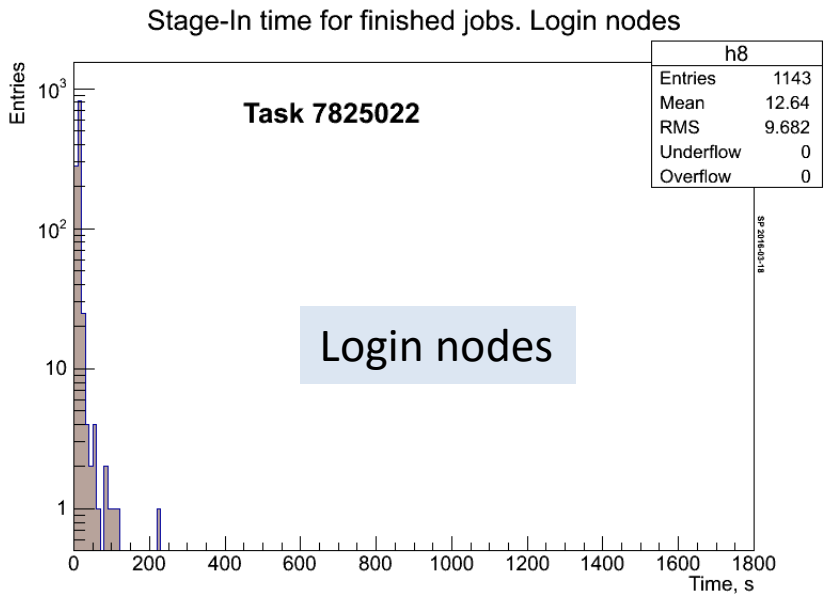
Running on DTNs

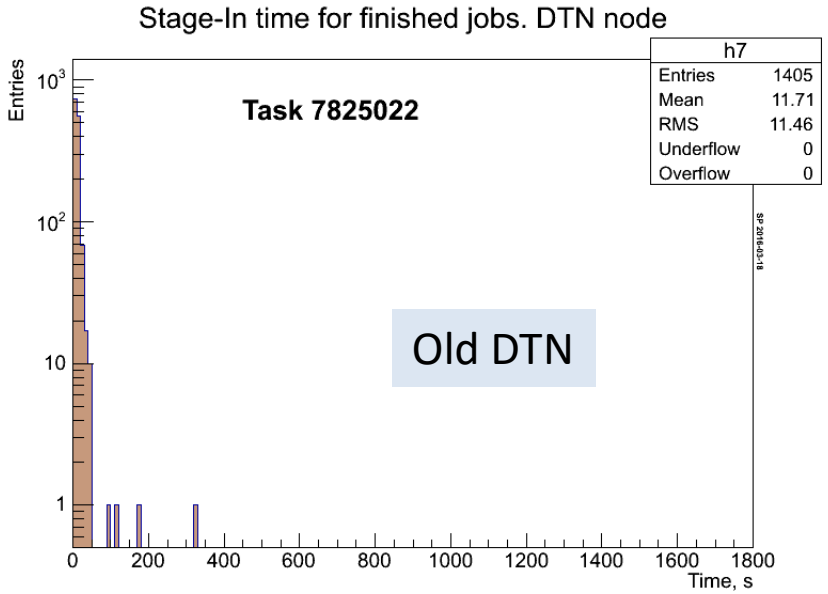
- Pilot operations were moved to DTN cluster in March of 2016.
  - No big improvement in resource utilization or backfill utilization efficiency
  - Data transfer performance was no better than on login nodes
  - Reports of DTN overload at peak ATLAS (CPU bound?)
    - Limited number of total number of pilots to 20 (5 per DTN)

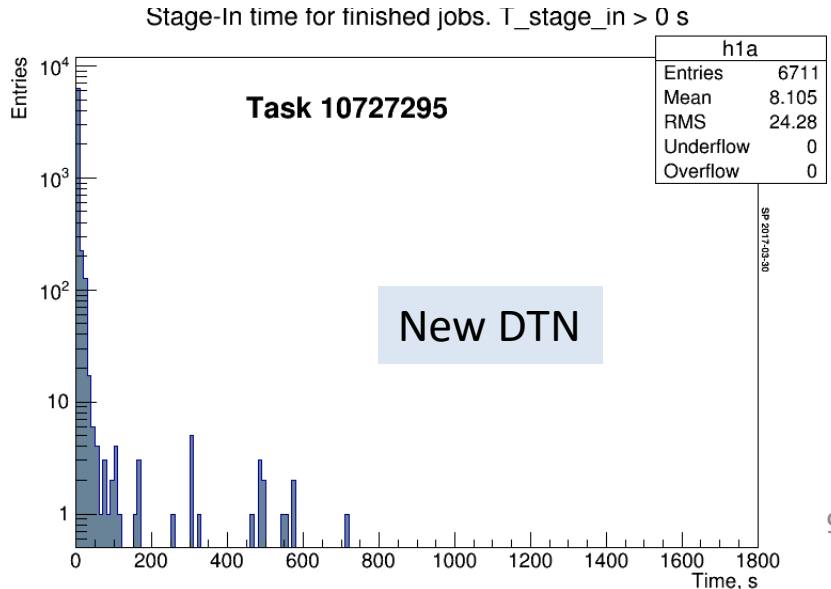
Running on the new DTN cluster

- In February 2017 operations were moved to the new DTN cluster
  - New CPUs, more bandwidth
  - Updated version of the GFAL client libraries installed
  - Big jump in Titan resource utilization (14M core hours) and backfill utilization efficiency (33%) in the first month of running
  - Better data transfer performance than on old DTNs
  - Performed study of the CPU loads on the new DTNs
  - Based on SAR data no CPU overload on the new DTNs was observed so far
    - Average CPU load on the utilized DTNs is light and varies from 1% to 6% over the period of observation. Observed peak load ~30%
    - Steady state ATLAS production. On average ~9k Titan cores used, with max peak of ~70k cores and several peaks at ~30k cores

Data transfer on DTN (I). Stage-in.

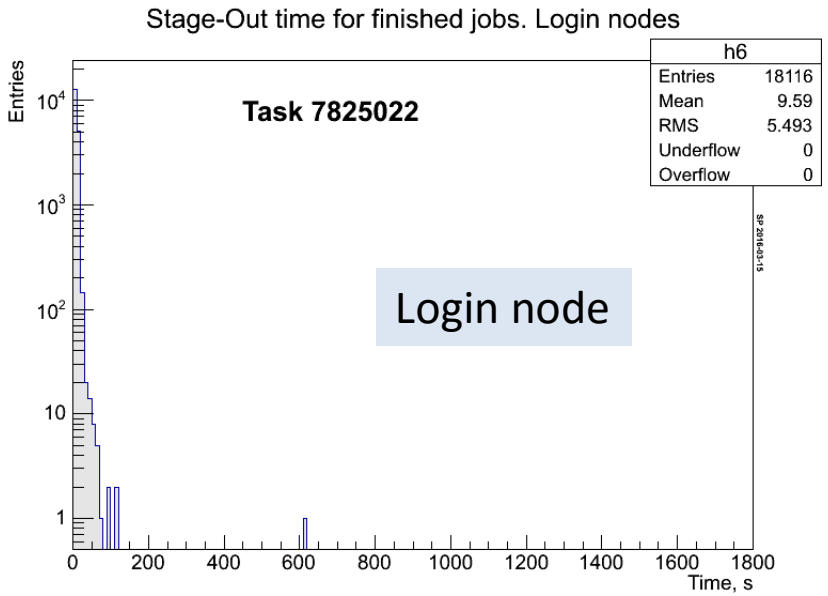


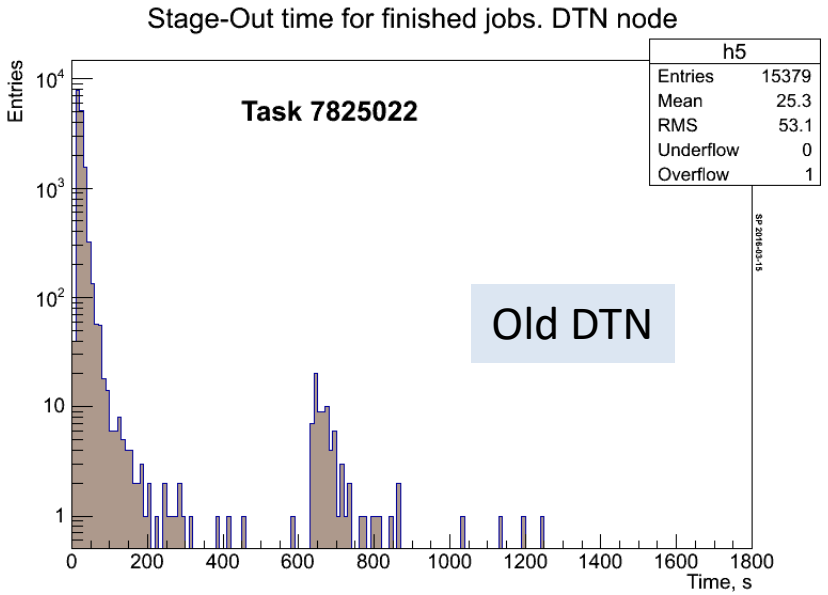


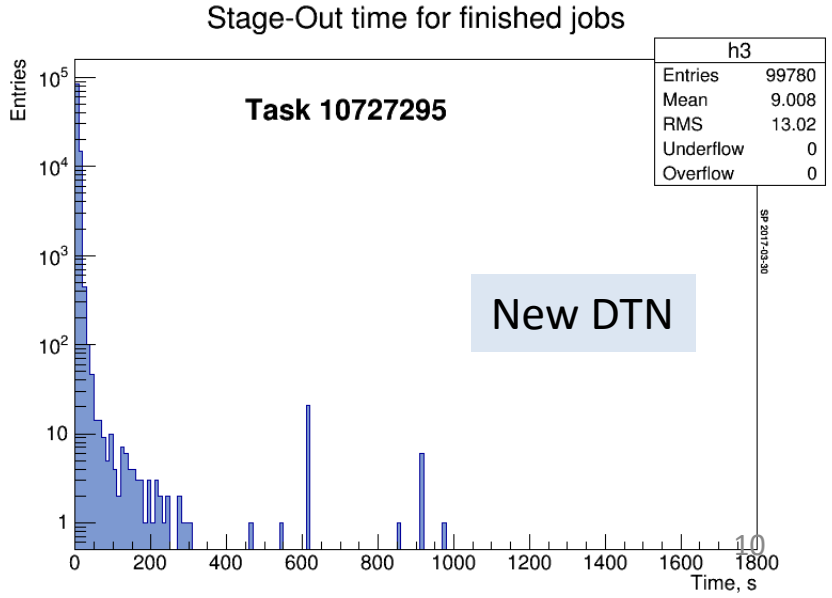


- Stage-in on the new DTN nodes seems to be faster
- This affects backfill capture speed

Data transfer on DTN (II). Stage-out.

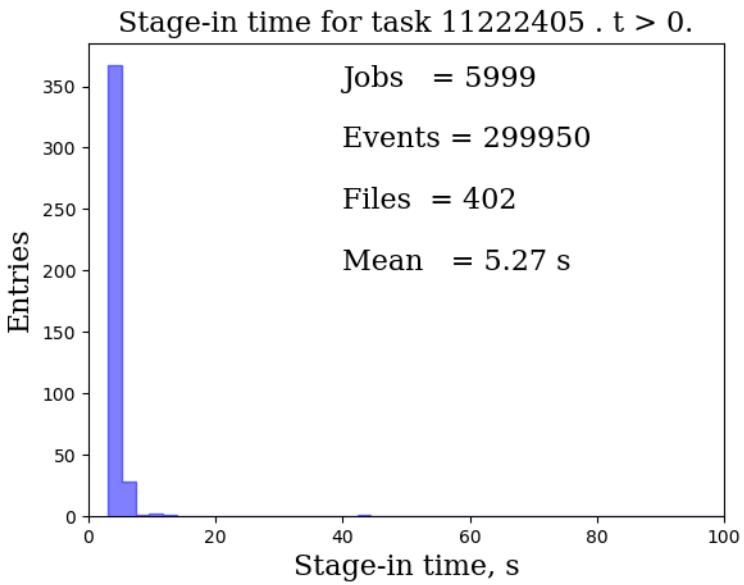


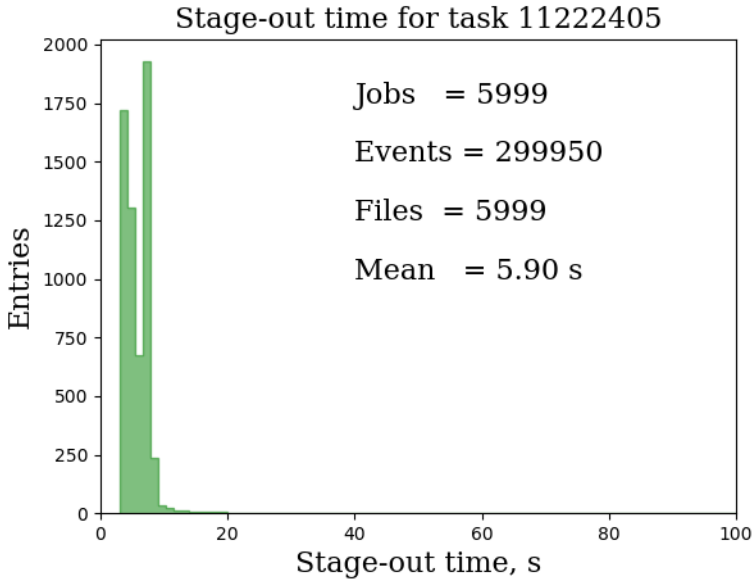




- Stage-out on the new DTN nodes seems to be faster as well
- This improves

Data transfer times for resent task





Recent task 11222405 with 50 events per job

Outlook and plans

- CSC108 backfill utilization currently directly depends on data transfer properties
- What can be done with current setup
  - Increase number of pilots ? Increase maximum number of ranks per submission? Increase limit of stage out pilots in pilot launcher? IMHO “Yes” to all of these questions
  - Number of ranks was increased from 300 to 350. What are the improvements?
  - What are the optimal numbers? What are optimal load levels on DTNs under these conditions?
- New edge service Harvester is under development in ATLAS
  - New architecture should help to improve overall performance on Titan and data management in particular
  - Parallel data transfer instead of current sequential transfer model
  - Asynchronous IO
    - Stage-in ahead of time based on assigned tasks information?
    - Multiple stage-out sites to improve robustness of the stage-out?
  - Larger number of ranks per job – IO implications for start up, output?
- ATLAS Event Service (Yoda) deployment on Titan
  - Short duration backfill – potentially larger jobs – IO issues?
  - Implication of larger number of smaller files for Luster?
  - Local merging?
- Integration of Harvester with NGE
  - Need for allocation? Large, long running jobs, sequential jobs ?
- Containers on Titan?
  - Configurations , IO performance, start-up times, etc. NERSC experience with Shifter was positive.