# Big PanDA integration with Titan LCF.

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#### Outline

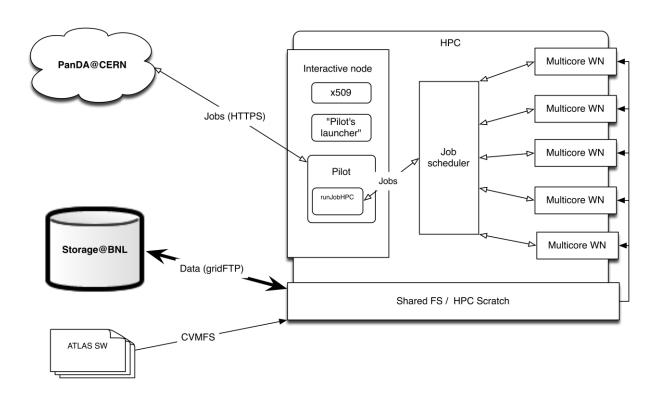
- Titan LCF specialty
- BigPanDA architecture for Titan
- PanDA Pilot changes
- Backfill
- Titan allocation policy
- Occupation algorithm. Initial testing.
- Issues.

## Titan LCF specialty

- Titan Cray XT7
  - 18,688 nodes
  - node: 16 core, 32 + 6 GB RAM (2GB per core)
- Parallel file system shared between nodes, recently upgraded: project workspace 100TB quota (30 PB total capacity)
- Highly restricted access:
  - One-Time Password Authentication;
  - No network connection with worker nodes;
- 3 layers of nodes:
  - Interactive nodes: user interactive login;
  - Service nodes: job setup operations, managed through PBS/Torque directives;
  - Worker nodes: job executions, managed through ALPS (Application Level Placement Scheduler);
- Limitation on number of jobs in scheduler for one user
- Special data transfer nodes (high speed stage in/out)
- System naturally designed for parallel execution

## BigPanDA architecture for Titan

- Pilot runs on HPC interactive node
- Pilot interacts with local job scheduler (PBS)
- Number of executing pilots number of available slots in local scheduler (???)



#### PanDA Pilot changes

- Native PanDA pilot was successfully started on Titan interactive nodes.
  - Correct definition of PanDA queue was needed.
- Main modification was performed for payload execution part: runJobTitan.py module was developed based on runJob.py module.
  - Method, which call payload execution was changed for run and collect results of job execution through PBS;
  - Interface with PBS job manager was implemented by using SAGA API
- Some minor modifications of cleanup procedures was done (subdirectories cleanup).
- Proper setup and execution of MPI jobs through ALPS.
- Function for collecting information about available resources for backfill was implemented
  - Full PanDA workflow on Titan was done.

## Opportunistic job backfill on Titan

- As a first step a simple algorithm was implemented:
  - Pilot queries MOAB scheduler about unused transient resources
  - Information about available resources returns in a format that includes a number of currently unscheduled nodes and period of their availability
  - Pilot chooses the largest available block of free nodes and generates appropriate job submission parameters taking into account Titan's scheduling policy limitations

## Titan scheduling policy

 Job's wall-time limit depends on number of requested nodes.

Min Nodes	Max Nodes	Max Walltime (Hours)	Aging Boost (Days)	
11,25	_	24.0	15	
3,75	11,249	24.0	5	
313	3,749	12.0	0	
125	312	6.0	0	
1	124	2.0	0	

For example one can't request 100 nodes (1600 cores) for more than two hours (regardless of declared period of backfill availability)

#### Initial backfill tests on Titan

Submitted	Account	Nodes	Cores	Wait	Walltime limit	Runtime	State	Completed
Mar, 04 16:26	CSC108	6	96	0.00	1:59:00	0,01	Completed	Mar, 04 16:27
Mar, 04 16:52	CSC108	185	2960	0.07	5:59:00	0,02	Completed	Mar, 04 16:58
Mar, 04 17:32	CSC108	608	9728	0.01	11:59:00	0,02	Completed	Mar, 04 17:34
Mar, 04 17:45	CSC108	578	9248	0.01	11:59:00	0,03	Completed	Mar, 04 17:47
Mar, 04 17:51	CSC108	1,649	26,384	0.00	11:59:00	0,03	Completed	Mar, 04 17:53
Mar, 04 18:03	CSC108	636	10176	0.01	11:59:00	0,02	Completed	Mar, 04 18:05
Mar, 04 18:09	CSC108	740	11840	0.13	11:59:00	0,02	Completed	Mar, 04 18:18
Mar, 04 18:21	CSC108	577	9232	0.00	11:59:00	0,03	Completed	Mar, 04 18:22
Mar, 04 18:25	CSC108	596	9536	0.04	11:59:00	0,02	Completed	Mar, 04 18:28

- "Backfill capture" is almost instantaneous!
- No competition for the resource?
- More studies are planned

#### Issues

There are two scenarios of using resources:

- 1. Using MPI ("natural" payloads for HPC):
  - Unpredictable size of output (output size may changes with number of involved cores)
- 2. "Multiple Simultaneous Jobs"
  - 100 simultaneous jobs in one submission;
  - Job occupy minimum one node (not core);
  - Significant redesign of Pilot (to take care about set of PanDA jobs, against one)