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HTCondor-CE at PIC

J. Flix, C. Acosta*

EGI Conference 2019, 6-8 May 2019, Amsterdam

IFAE 25 years 1991-2016 Institut de Física d'Altes Energies

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*Disclaimer!

The talk and the work was done by my colleague C. Acosta, which is very helpful and welcoming feedback and technical questions that I won't be able (most likely) to answer

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Introduction

Multi-VO site

- 82% of PIC computing resources for Tier-1 (ATLAS, CMS, LHCb)
- 7% Tier-2 ATLAS (IFAE site)
- ~10% for: Tier-0 Magic, Tier-3 ATLAS and other smaller VOs

PIC site is fully puppetized (3.8.7 → 4.10.10 soon)

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Introduction

- PIC and IFAE sites (IFAE co-located in PIC) were Grid sites based in CREAM-CE and Torque/Maui batch system
- Torque 4.2.10 and Maui 3.3.1 were a general solution for many Grid sites basically because CREAM-CE+Torque are well implemented
- Many issues for not trusting in Torque/Maui for the future:
  - Maui and Torque branches 2 and 4 were not supported for the long term
  - Scalability issues
  - Need of new features (cgroups for instance, docker and singularity integration)
  - IPv6 compatibility
  - RSS memory report
  - CREAM-CE end of life 2020!
- Other options (free, highly scalable, etc.)? Slurm or **HTCondor**
- HTCondor is the natural solution for Grid sites considering its versatility and that it is the default batch system for important Grid Sites (CERN, RAL, most of the OSG sites)

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HTCondor at PIC

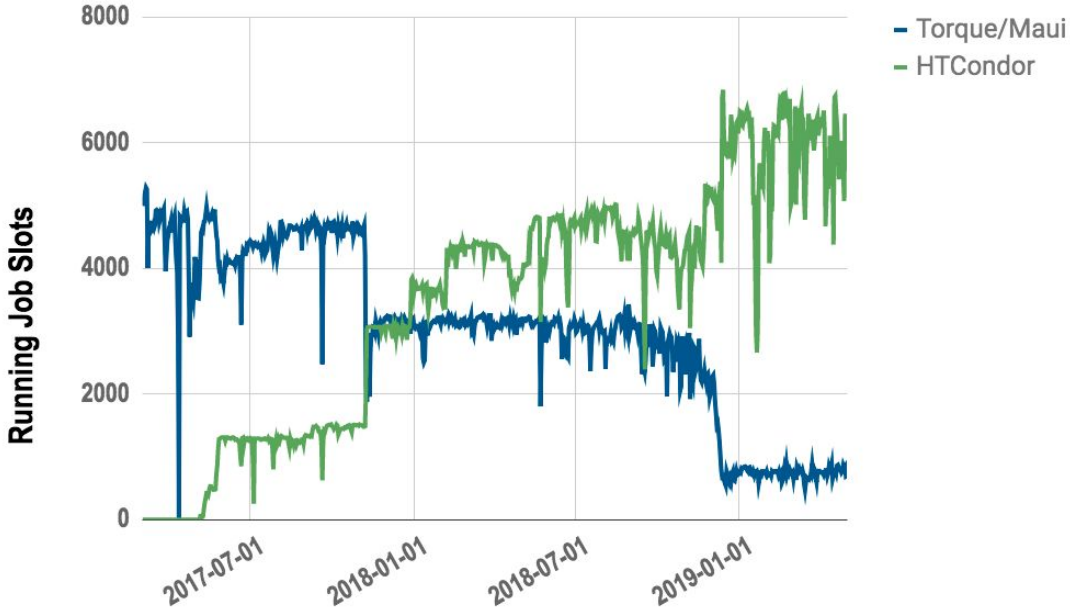
The machines in the HTCondor pool are defined by the daemons running in it

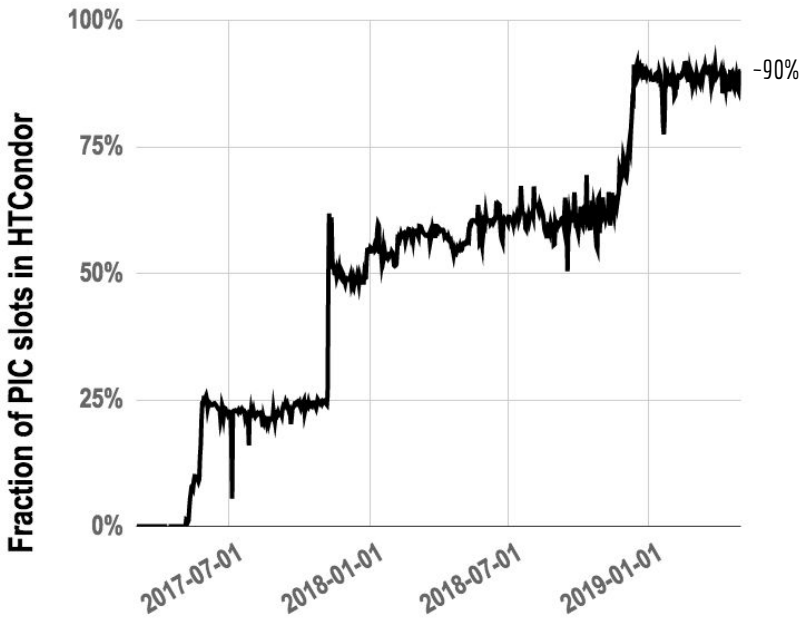
Relevant HTCondor daemons:

- **condor_master**: responsible for controlling the rest of daemons
- **condor_collector**: takes the information from an HTCondor pool
- **condor_negotiator**: makes the matching between ClassAds jobs and ClassAds machines
- **condor_schedd**: controls the queue and one can queries/modify it with several commands. The condor_schedd generates a **condor_shadow** process for each matching
- **condor_startd**: defines an execute machine (WNs). The **condor_starter** daemon is the one that starts the job when condor_startd is ready

HTCondor at PIC

- At April 2019, the HTCondor pool at PIC consists in a pool of around 7300 CPU-cores and ~100 kHS06; Shrinking partition of ~11 kHS06 in Torque/Maui for small VOs… soon to be integrated into HTCondor





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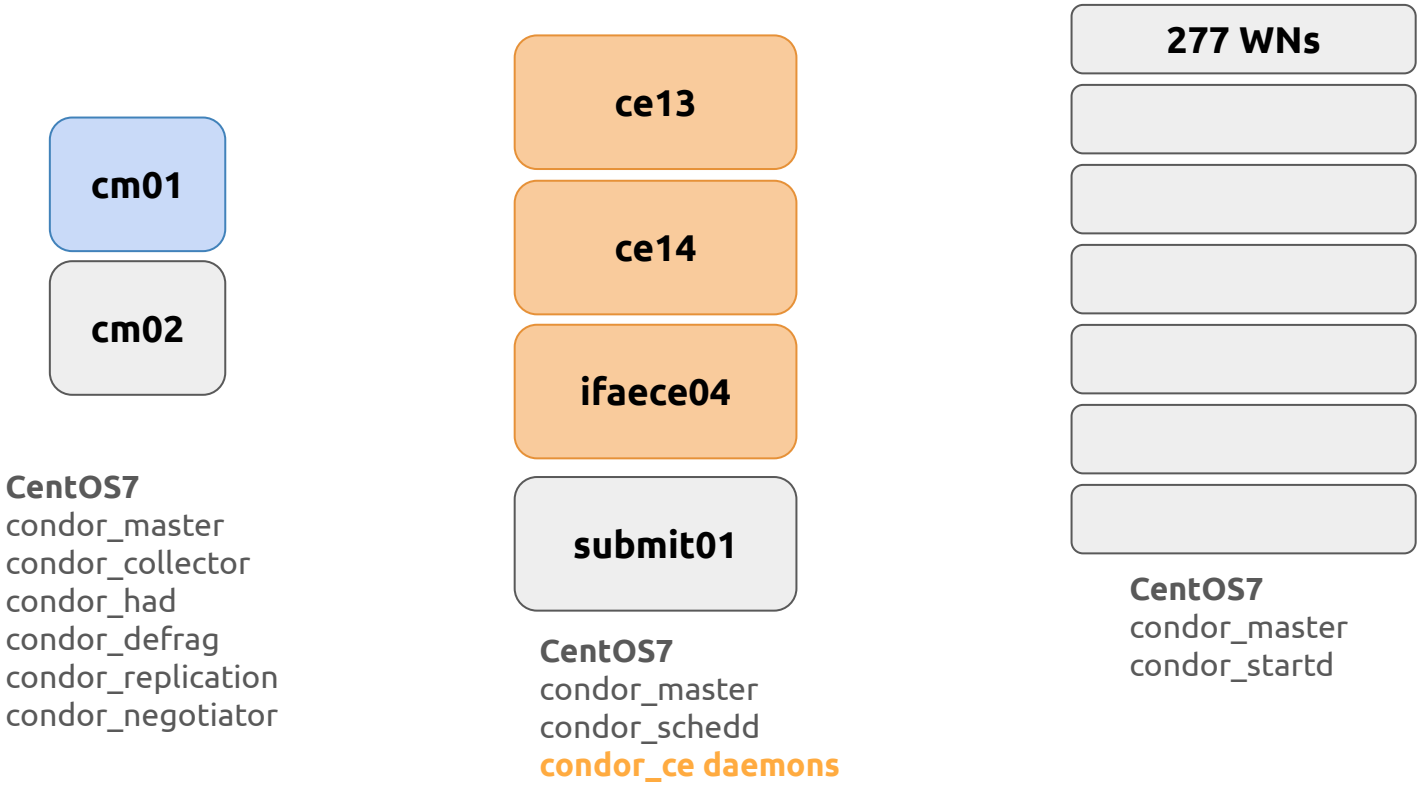
HTCondor at PIC

- At April 2019, the HTCondor pool at PIC consists in a pool of around 7300 CPU-cores and ~100kHS06
- Current version: Stable 8.8.1 (migrating to 8.8.2 soon)
- We have 2 Central Managers (CMs - HA), 277 Worker Nodes, 1 local schedd and 3 HTCondor-CEs (let's talk about them later)



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HTCondor at PIC

Central Managers

- 2 CM in high availability at PIC
- Priority and Fair-Share
  - Establish % of use for each VOs using GROUP_QUOTA_DYNAMIC
  - GROUP_ACCEPT_SURPLUS allows groups to use more of their quota and accept new matching even if the group is over quota (GROUP_AUTOREGROUP)
  - Define GROUP_NAMES and priority factors
  - GROUP_SORT_EXPR to consider first highprio, then mcore, etc… for the negotiator
- Defrag daemon
  - condor_defrag to drain machines and to obtain a hole for next mcore job (similar concept as mcfloat used in previous Torque/Maui configuration)
- Condor_gangliad
  - Several metrics are directly submitted form HTCondor to Ganglia

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HTCondor at PIC

Execute Machines

- Dynamic slots configuration
  - Slots created due to jobs requirements (cpu)
- MOUNT_UNDER_SCRATCH
  - Very helpful: the job believes that /tmp and /var/tmp are in execute directory
  - Issue with glexec solved
- PID_NAMESPACES and cgroup
  - PID_NAMESPACES: same process ID number space for all job processes
  - cgroup to limit memory (soft) and use of procs
- Tag inclusion in startd configuration
  - Adding tags to WNs (WN="IPv6" e.g. in STARTD_ATTRS)
- Node Health Check to check if a WN is healthy (HW issues, CVMFS working, etc)
- WN grid configuration: CVMFS, Machine Job Features, singularity, etc.

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HTCondor at PIC

Local Schedd

- We are in the process to integrate local users, since grid jobs have been running in HTCondor through HTCondor-CEs for a while
- 1 local schedd available for local users
  - Automatic mapping to an Accounting Group according to job Owner using JOB TRANSFORM
  - As CERN does, we create “flavours” to select the maximum walltime and other limits of the jobs (like memory, for example)
  - Established default requirements (1 cpu, 2 GB/cpu of RAM, 15 GB/cpu of disk)
  - Allowing remote submission from dedicated UIs
  - Creating documentation and training our users

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CEs for HTCondor

- 3 CEs were evaluated

CREAM-CE

- Well know and integrated with all our resources
- Doubt about its support (finally, the end-of-life was published)
- Not really ready for HTCondor (old scripts) and a complex configuration based in YAIM

ARC-CE

- Easy to configure (just one configuration file /etc/arc.conf) and widely use by Nordugrid and RAL
- Delay in query responses in our test environment
- We installed it and used in production with HTCondor for a while

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CEs for HTCondor

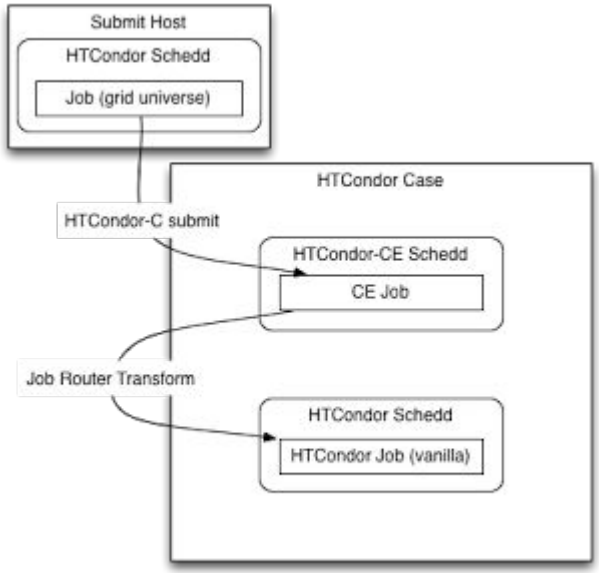
- 3 CEs were evaluated

HTCondor-CE

- It is just using HTCondor, in fact, uses HTCondor binaries and seems to be the most logical option if your batch system is HTCondor
- HTCondor-CE widely used in OSG sites but missing EGI features
- CERN interest turned to change things for us…
- New elements to interconnect PIC to HPCs rely on HTCondor

HTCondor-CE at PIC

- Current CEs setup: 2 HTCondor-CEs for Tier-1 (ATLAS, CMS, LHCb) and 1 HTCondor-CE for ATLAS Tier-2
- Current version: 3.2.1 (first time including bdii extension from htcondor repos)



- 2 set of condor daemons in the CE, the ones related to your condor pool and the ones from the HTCondor-CE
- JobRouter is the one which transform the job from the HTCondor-CE queue to the local condor queue

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HTCondor-CE at PIC

JobRouter

- Very powerful tool, it transforms the job according to request requirements (adding one requirement to the job, the job can be routed by this new tag that points to a specific WN, e.g.)
- According to the x509UserProxyVOName, the job is routed and the GROUP_NAME is established (mandatory for FairShare)
- Easy to make syntax mistakes, treat the configuration file carefully!
- JOB_TRANSFORM allows us to map users to Accountings Groups and create easier routes

HTCondor-CE at PIC

JobRouter

- Example of a route:

```
   [ \
    name = "Cms_Condor"; \
    MaxIdleJobs = 2000; \
    TargetUniverse = 5; \
    set_LivAcctSubGroup = ifThenElse(NumberCpus > 1 ,"_mcore","_score");\
    eval_set_AccountingGroup = strcat(LivAcctGroup, LivAcctSubGroup, ".", Owner); \
    Requirements = x509UserProxyVOName == "cms"; \
    set_Requirements = WN_property == "default"; \
    eval_set_NumberCpus = ifThenElse(xcount is undefined, orig_RequestCpus, ifThenElse(xcount
isnt undefined, xcount, 1));\
    set_PICScaling = "$$(PICScaling:1)"; \
    set_JobMemoryLimit = (6144*NumberCpus); \
    set_PeriodicRemove = (JobStatus == 2 && (CurrentTime - EnteredCurrentStatus) > 360000) ||
(JobStatus == 4 && (CurrentTime - EnteredCurrentStatus ) > 3600*24*2) ||
ifThenElse(ResidentSetSize isnt undefined, ResidentSetSize > JobMemoryLimit*1024, false); \
   ] \
```

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HTCondor-CE at PIC

Publication

- One old issue related to EGI integration but CERN worked to create htcondor-ce-bdii package
- In the past, we built all our htcondor bdii package but the htcondor-ce-bdii package was released for first time in HTCondor repo from version 8.8.1

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HTCondor-CE at PIC

Authorization/Authentication

- HTCondor-CE uses GSI-based authentication and authorization and you can easily use an Argus server as we did with CREAM-CE

```
# cat /etc/grid-security/gsi-authz.conf
globus_mapping /usr/lib64/libgsi_pep_callout.so argus_pep_callout

# cat /etc/grid-security/gsi-pep-callout-condor.conf
pep_ssl_server_capath /etc/grid-security/certificates/
pep_ssl_client_cert /etc/grid-security/condorcert.pem
pep_ssl_client_key /etc/grid-security/condorkey.pem
pep_url https://argus.pic.es:8154/authz
pep_timeout 30 # seconds
xacml_resourceid http://authz-interop.org/xacml/resource/resource-type/htcondor-ce
```

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HTCondor-CE at PIC

Authorization/Authentication

- HTCondor-CE uses GSI-based authentication and authorization and you can easily use an Argus server as we did with CREAM-CE

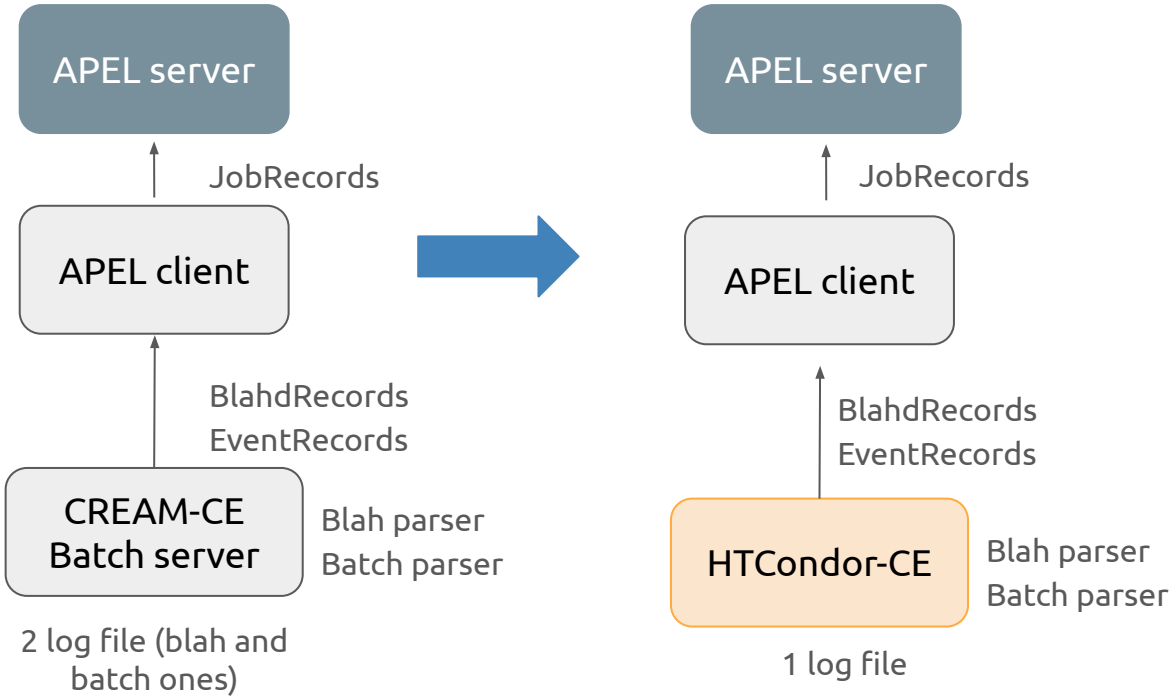
```
resource "http://authz-interop.org/xacml/resource/resource-type/htcondor-ce" {
    obligation "http://glite.org/xacml/obligation/local-environment-map" {
    }

    action ".*" {
        rule permit { pfqan="/atlas/Role=lcgadmin/Capability=NULL" }
        rule permit { pfqan="/atlas/Role=lcgadmin" }
        rule permit { pfqan="/atlas/Role=pilot/Capability=NULL" }
        rule permit { pfqan="/atlas/Role=pilot" }
        rule permit { pfqan="/atlas/Role=production/Capability=NULL" }
        rule permit { pfqan="/atlas/Role=production" }
        rule permit { pfqan="/atlas/Role=software/Capability=NULL" }
        rule permit { pfqan="/atlas/Role=software" }
        rule permit { pfqan="/atlas/Role=NULL/Capability=NULL" }
        rule permit { pfqan="/atlas" }
[...]
```

HTCondor-CE at PIC

APEL integration

- It was the first stopper to put HTCondor-CEs in production
- We create our own APEL integration based in CREAM-CE/Torque scheme



HTCondor-CE at PIC

APEL integration

- It was a difficulty to solve in order to put HTCondor-CEs in production
- We created our own APEL integration based in CREAM-CE/Torque schema
- We use a condor_history query to create our accounting records in text files
- PICScaling is the cputmult used to normalize the CPU
- Adding and changing scripts
  - Apel-parsers and apel-lib pacakges installed in the CE
  - Changes in /etc/apel/parser.cfg file
  - Modify the apelparser script
  - Add htcondor.py and htcondorce.py parsers
- This solution is thought to work using our environment -> Stephen Jones is working in a general solution for any site

https://twiki.cern.ch/twiki/bin/viewauth/LCG/HtCondorCeAccounting
https://github.com/apel/apel/releases
https://wiki.egi.eu/wiki/Preview_Repository#Updates_Released

HTCondor-CE at PIC

CE management

- You can use the same commands as condor (condor_ce_q, condor_ce_history for instance)

```
# condor_ce_q


-- Schedd: ce14.pic.es : <193.109.175.230:13903> @ 04/24/19 17:12:19
OWNER      BATCH_NAME     SUBMITTED   DONE   RUN    IDLE   HOLD  TOTAL JOB_IDS
lhpilot007 ID: 4980889   4/20 03:58      _      _      _      _     25 4980889.0-24
lhpilot007 ID: 4980895   4/20 03:58      _      _      _      _     25 4980895.0-24
lhpilot007 ID: 4980896   4/20 03:58      _      _      _      _     25 4980896.0-24
[...]
atpilot012 ID: 5029317   4/24 17:09      _      1      _      _      1 5029317.0
atpilot012 ID: 5029318   4/24 17:09      _      1      _      _      1 5029318.0
atpilot012 ID: 5029319   4/24 17:09      _      1      _      _      1 5029319.0
atpilot012 ID: 5029320   4/24 17:09      _      1      _      _      1 5029320.0
lhpilot007 ID: 5029321   4/24 17:11      _     24      _      _     24 5029321.0-23
atpilot012 ID: 5029322   4/24 17:12      _      _      _      1      1 5029322.0

Total for query: 5135 jobs; 3885 completed, 0 removed, 233 idle, 968 running, 49 held, 0
suspended
Total for all users: 5135 jobs; 3885 completed, 0 removed, 233 idle, 968 running, 49 held, 0
suspended
```

HTCondor-CE at PIC

CE management

- You can use the same commands as condor (condor_ce_q, condor_ce_history for instance)
- There are different log files stored for all the daemons in /var/log/condor-ce (JobRouterLog, SchedLog and AuditLog are important to check)
- AuditLog kepts for 90 days information about what is happening in the queue, new jobs, transfer files, proxies, etc.

HTCondor to exploit HPC resources

HTCondor for BSC

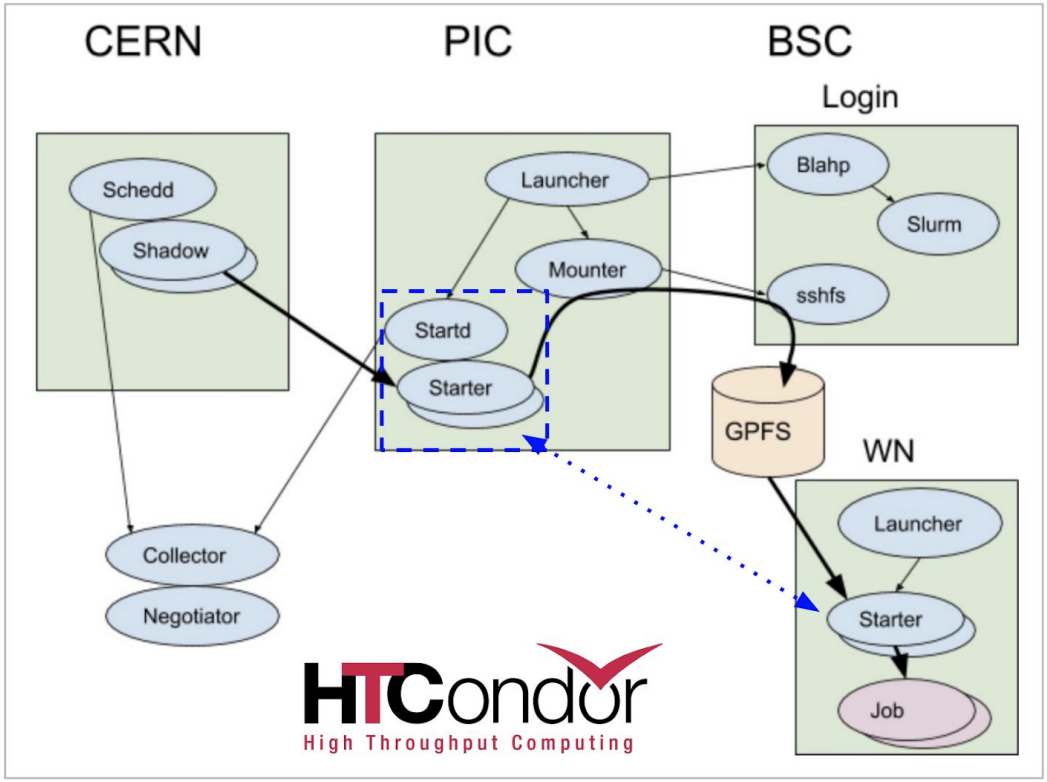
Main idea: a **bridge node** at PIC which allows access to **starter** processes running in the BSC nodes, mirroring **starter** at PIC

Input sandbox, status, etc, **passed as .tar files** via gpfs from bridge to WN

The **startd** process remains at PIC, where it can be accessed to **negotiate** by CMS/PIC Central Managers

From a functional perspective, **the node at BSC has joined the HTCondor pool at PIC**

See more details in the backup slides



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PIC experience so far...

- HTCondor (and HTCondor-CE in extension) is a free software with a dynamic team working continuously to always improve it
- User support and extensive documentation available
- Once you get a stable configuration, HTCondor-CEs works fine without any remarkable issues
- Easy to play with HTCondor-CE as works with the same concepts as HTCondor
- HTCondor and HTCondor-CE flexibility allow us to test and implement new features: PIC-CIEMAT federation, connect to cloud resources (HelixNebula, AWS), interfacing to HPCs (collaboration PIC with HTCondor developers)
- Some issues and bugs, but HTCondor developers very proactive and helpful
    - Dual-stack issue with High Availability
    - condor_annex bug reported (to connect resources with AWS)
    -
- Lack of documentation supporting HTCondor-CE+EGI resources

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Questions?

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