The HTCondor-CE

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HTConodr / Arc-CE Workshop, February 2016

HTCondor-CE

- In summer 2013, OSG began an evaluation of its choice of CE technology.
  - Did we want to keep the same technology? Try a new one?
- One of the more intriguing possibilities: *Could we construct a CE from a special configuration of HTCondor?*
  - We'll get to the technical aspects later, but this was a unique opportunity: **no new dependency** on an external team.

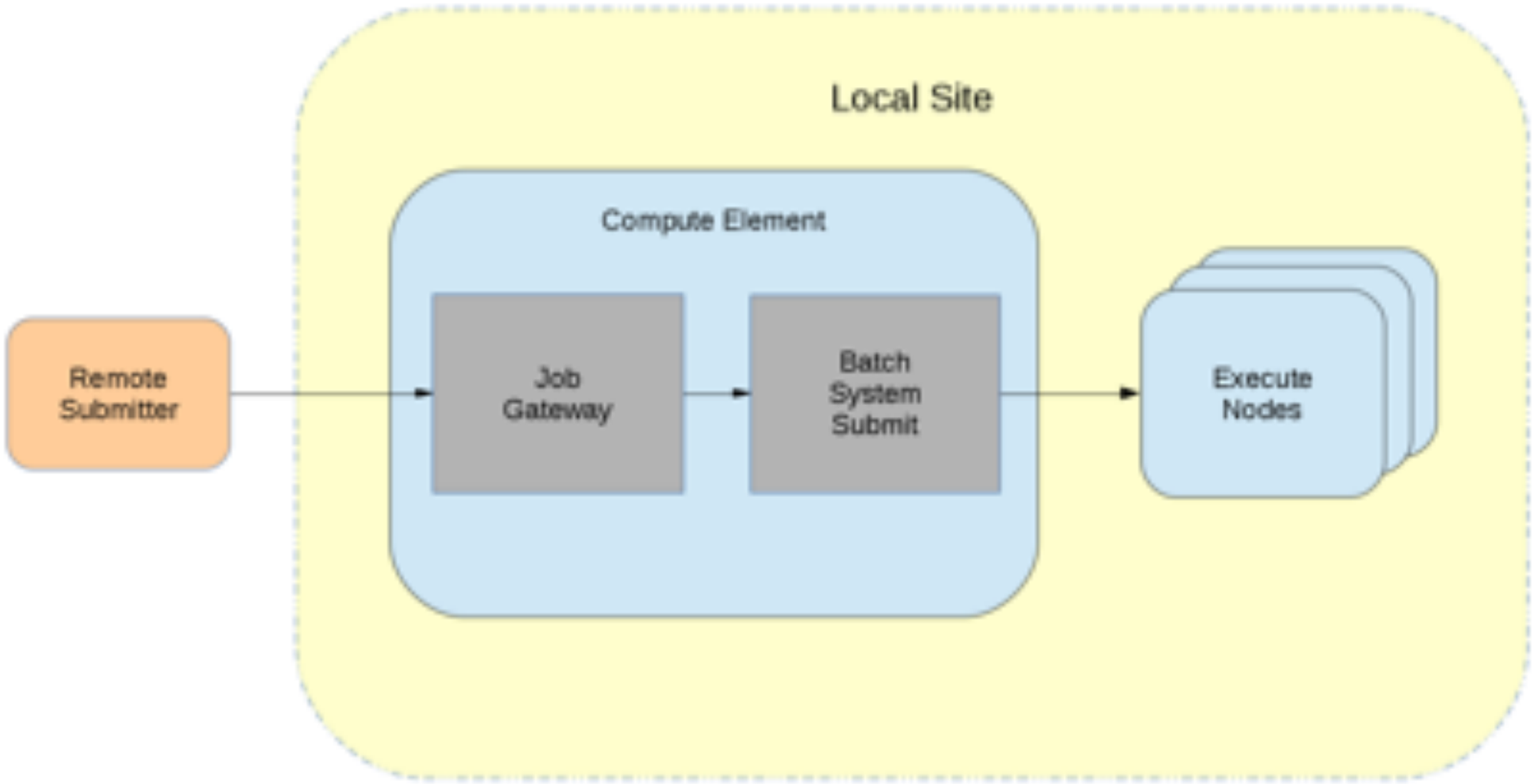
Out of this work came the HTCondor-CE

What’s in a CE?

- A CE must:
  - Expose a **remote API** for resource acquisition.
  - Provide authentication and **authorization**.
  - Interact with the **resource layer** (batch system).

Note we deal with resource acquisition and provisioning, *not* job submission!

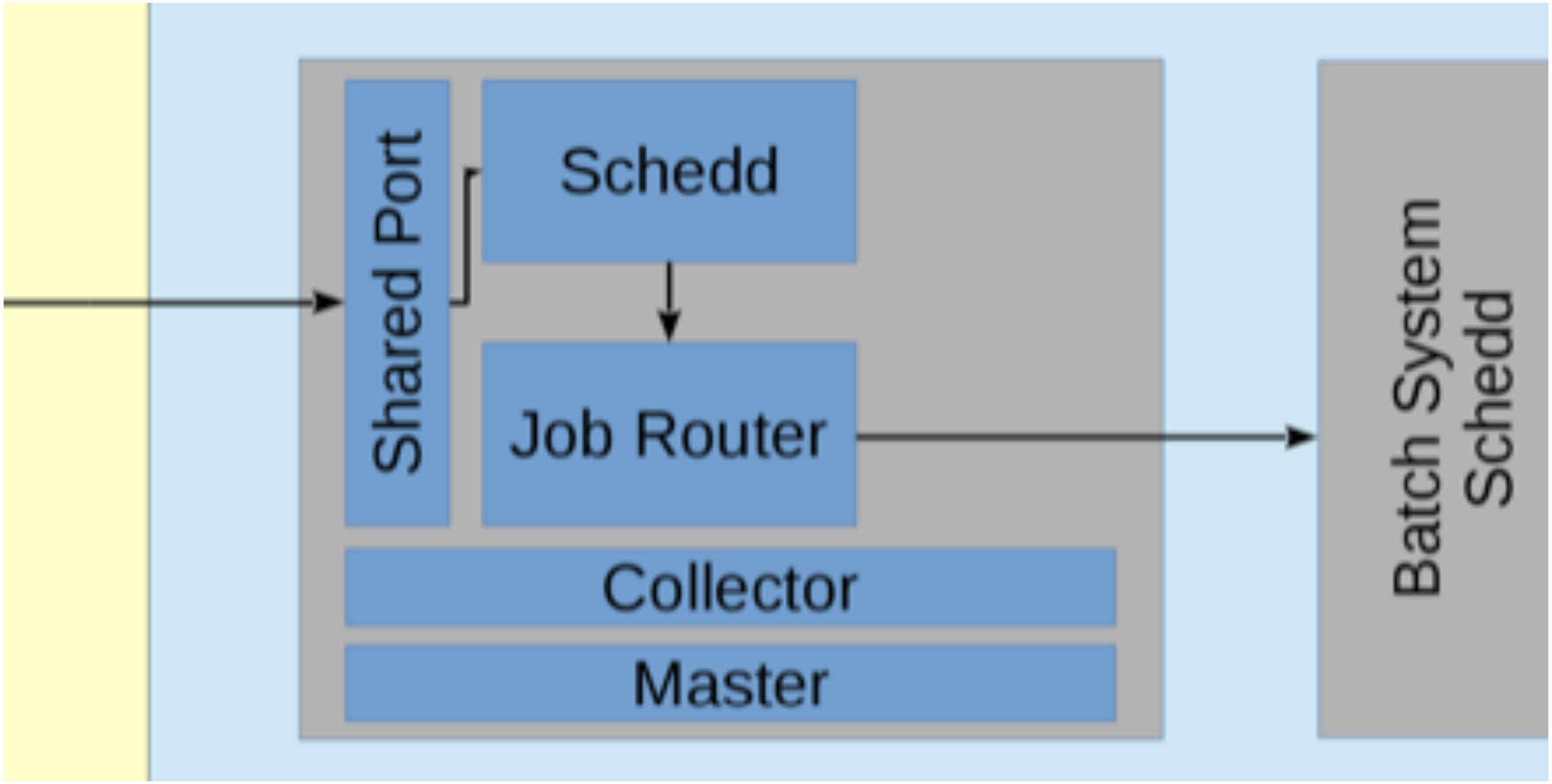
Anatomy of a Compute Element (CE)



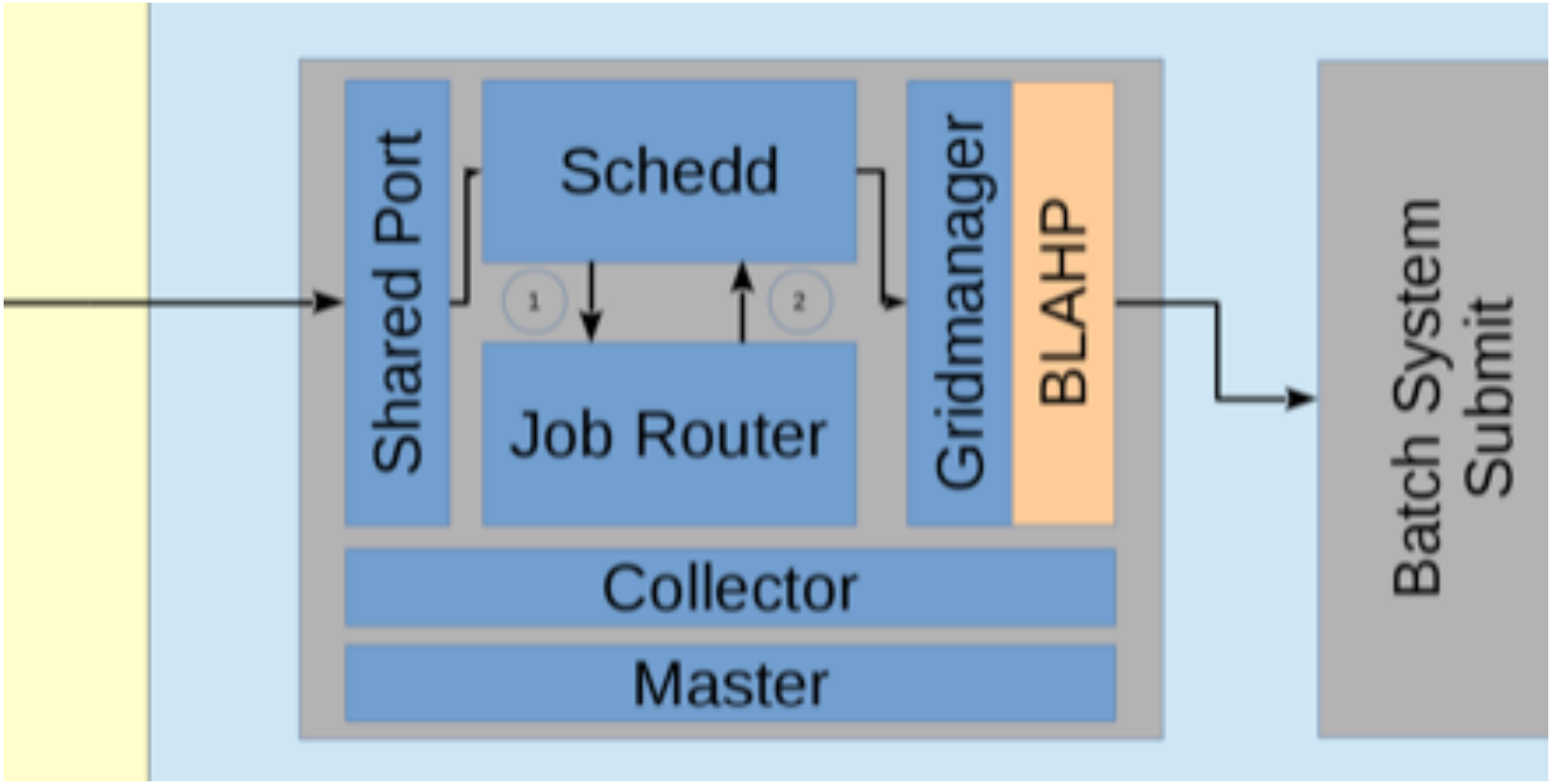
HTCondor-CE

- HTCondor already has many of the pieces necessary:
  - Remote job submission is possible.
  - Extensive authentication and authorization system (including GSI).
  - Grid universe integration with blahp (same underlying component as CREAM) allows submission to other batch systems.
  - JobRouter provides transformation
- Simply need to put things together!

Anatomy of HTCondor-CE: HTCondor Batch System



Anatomy of HTCondor-CE: Non-HTCondor Batch System



HTCondor-CE

- Special configuration of HTCondor.
  - (Mostly - historically shipped a few custom ClassAd functions.)
- Installs small wrappers around condor CLI (i.e., **condor_ce_status** sets a few config variables and calls **condor_status**).
- Runs a complete set of condor daemons:
  - Port 9619 (instead of 9618).
  - Configs from `/etc/condor-ce` instead of `/etc/condor`.
  - Separate `condor_master` process and Linux service (`condor-ce`).

Running Daemons

bbockelm — root@red-gw1:~ — ssh hcc-briantest — 150×25

```
condor      2495  0.0  0.0 103072  7080 ?        Ss   Feb18   0:25 condor_master -pidfile /var/run/condor-ce/condor_master.pid
root        2518  0.1  0.0  24524  6100 ?        S    Feb18  15:46  \_ condor_procd -A /var/lock/condor-ce/procd_pipe -L /var/log/condor-ce/ProcLog -R
condor      2519  0.0  0.0 102368  4604 ?        Ss   Feb18   9:16  \_ condor_shared_port -f -p 9619
condor      2521  0.8  1.0 400144 175800 ?       Ss   Feb18 114:32  \_ condor_collector -f -port 9619
condor      2523  0.5  0.4 176504 66132 ?        Ss   Feb18  80:29  \_ condor_schedd -f
condor      2524  1.4  0.6 205100 100888 ?       Ss   Feb18 192:16  \_ condor_job_router -f
condor      2742  0.0  0.0  97504  7620 ?        Ss   Feb18   0:27 condor_master -pidfile /var/run/condor/condor_master.pid
root        2750  0.1  0.0  24616  6116 ?        S    Feb18  16:29  \_ condor_procd -A /var/run/condor/procd_pipe -L /var/log/condor/ProcLog -R 100000
condor      2751  0.2  0.6 200520 101812 ?       Ss   Feb18  33:56  \_ condor_schedd -f
cmsprod  3033878  0.0  0.0  94604  8152 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821805.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3041926  0.0  0.0  94604  8184 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821815.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3041927  0.0  0.0  94604  8196 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821814.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3043312  0.0  0.0  94604  8184 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821825.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3056870  0.0  0.0  94604  8184 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821848.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3057151  0.0  0.0  94584  8184 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821849.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3061095  0.0  0.0  94604  8176 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821852.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3066118  0.0  0.0  94600  8176 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821857.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3070732  0.0  0.0  94600  8132 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821864.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3073572  0.0  0.0  94604  8144 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821866.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3078308  0.0  0.0  94600  8136 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821886.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3084233  0.0  0.0  94600  8180 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821888.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3092091  0.0  0.0  94600  8172 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821889.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3099541  0.0  0.0  94604  8176 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821897.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3105248  0.0  0.0  94600  8140 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821932.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
cmsprod  3107777  0.0  0.0  94604  8148 ?        SN   Feb26   0:01  |   \_ condor_shadow -f 5821943.0 --schedd=<129.93.239.132:39830?addrs=[2600-900-6
```

JobRouter

- The JobRouter is responsible for taking a job, creating a copy, and changing the copy according to a set of rules.
  - When running in HTCondor, the copy is inserted directly into the site batch schedd.
  - Each chain of rules is called a “route” and is defined by a ClassAd.
- Once the copy has been created, attribute changes and state changes are propagated between the source and destination jobs.
- JobRouter directly accesses the schedd’s transaction log: most efficient way of mirroring jobs!

Example HTCondor Job Route

Cameron has an HTCondor pool and she wants CMS jobs submitted to her CE to be forwarded to her pool and requesting x86_64 Linux machines and setting the attribute “foo” on her routed job to “bar”. All other jobs should be submitted to the pool without any changes.

```
JOB_ROUTER_ENTRIES = [ \
          name = "condor_pool_cms"; \
          TargetUniverse = 5; \
          Requirements = target.x509UserProxyVOName =?= "cms"; \
          set_requirements = (Arch == "X86_64") && (TARGET.OpSys ==
"LINUX"); \
          set_foo = “bar”; \
     ] \
     [ \
          name = “condor_pool_other”; \
          TargetUniverse = 5; \
          Requirements = target.x509UserProxyVOName =!= "cms"; \
     ]
```

Documentation: https://twiki.opensciencegrid.org/bin/view/Documentation/Release3/JobRouterRecipes

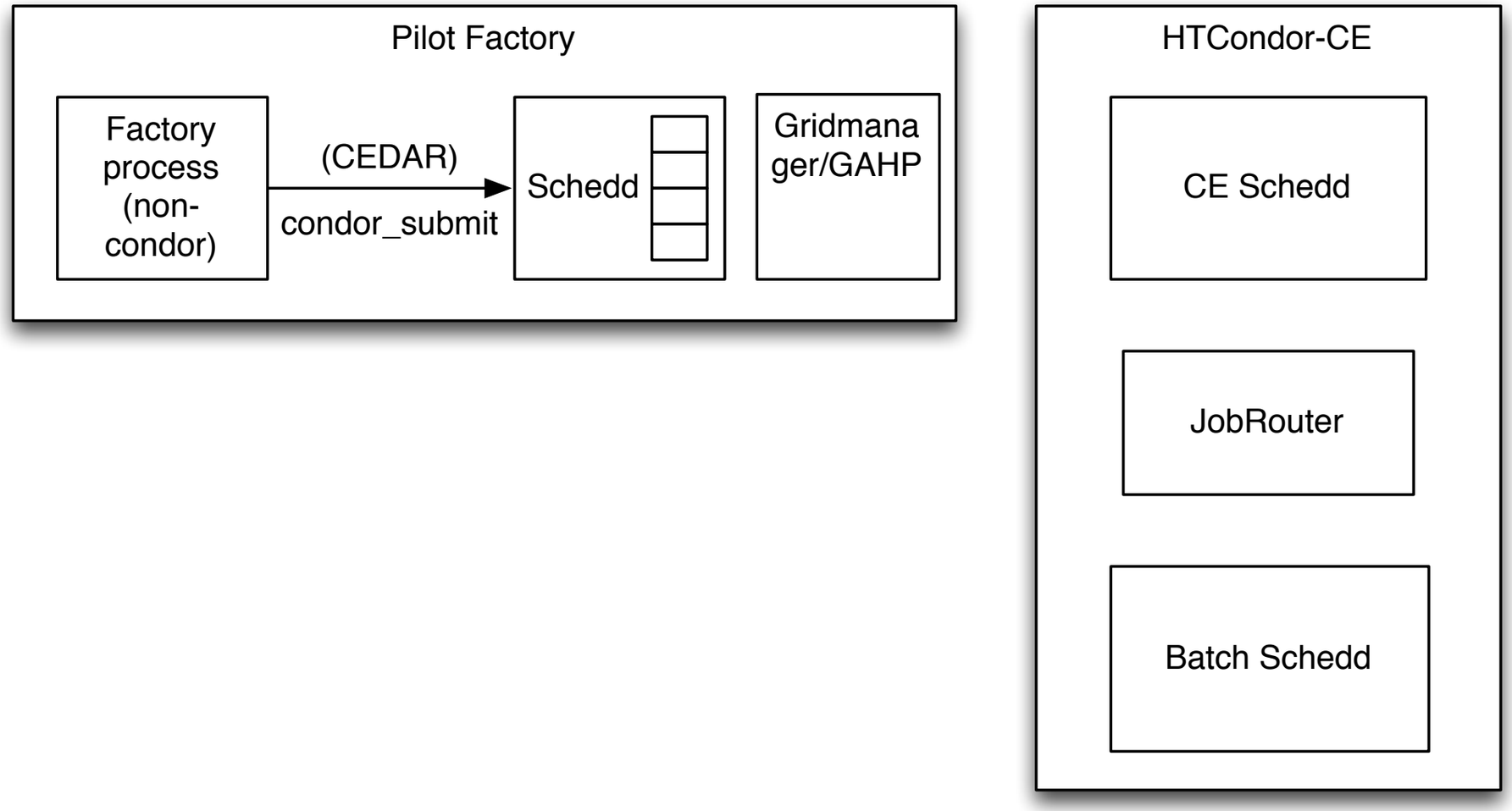
Example PBS Job Route

Cameron has a PBS pool and she wants CMS jobs submitted to her CE to be forwarded to her pool. All other jobs should be submitted to her pool without any changes

```
JOB_ROUTER_ENTRIES = [ \
          name = "pbs_pool_cms"; \
          TargetUniverse = 9; \
          GridResource = "batch pbs"; \
          Requirements = target.x509UserProxyVOName =?= "cms"; \
] \
[ \
          name = "pbs_pool_other"; \
          TargetUniverse = 9; \
          GridResource = "batch pbs"; \
          Requirements = target.x509UserProxyVOName =!= "cms"; \
]
```

Documentation: https://twiki.opensciencegrid.org/bin/view/Documentation/Release3/JobRouterRecipes

Where does a pilot go?



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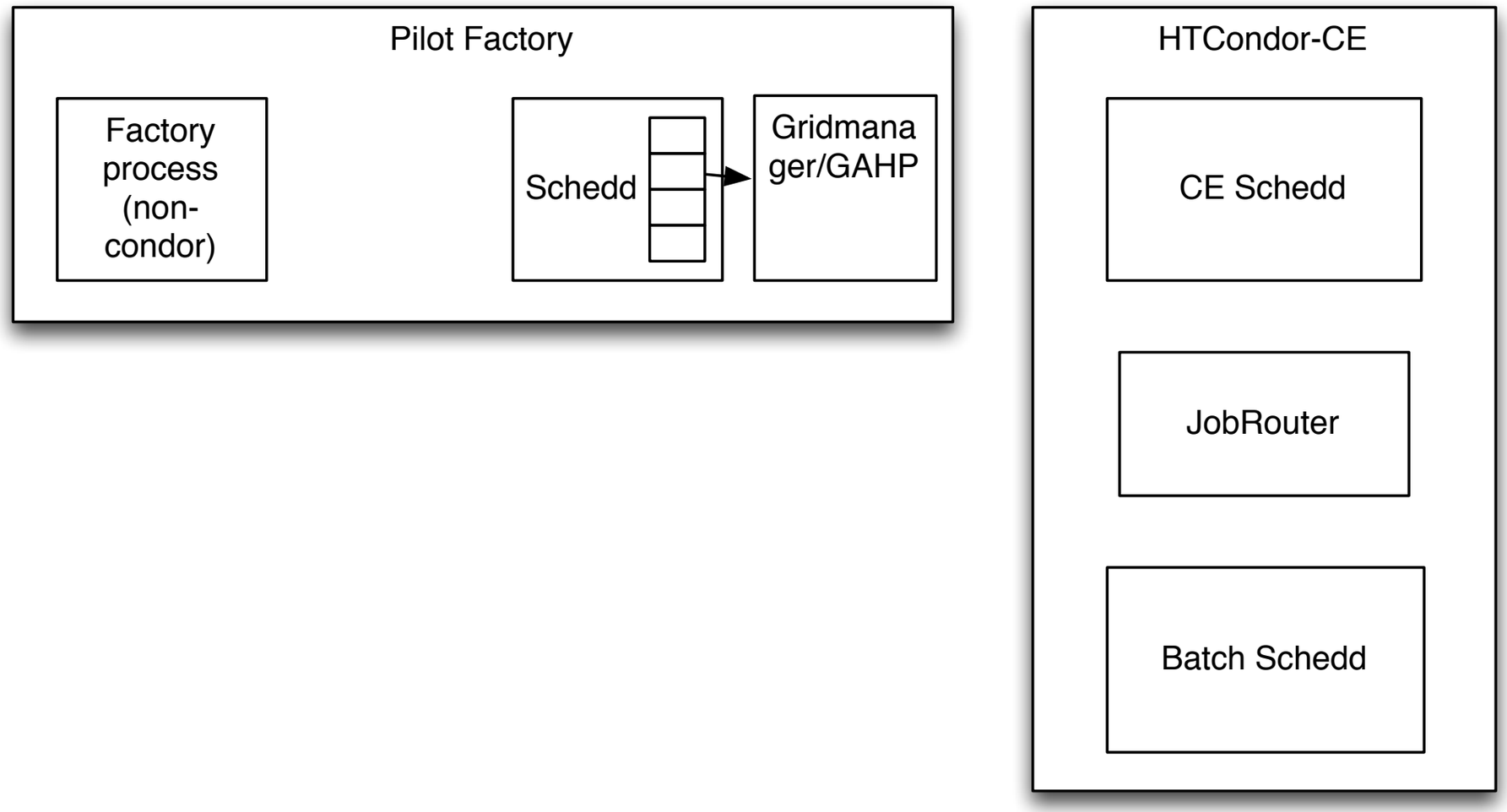
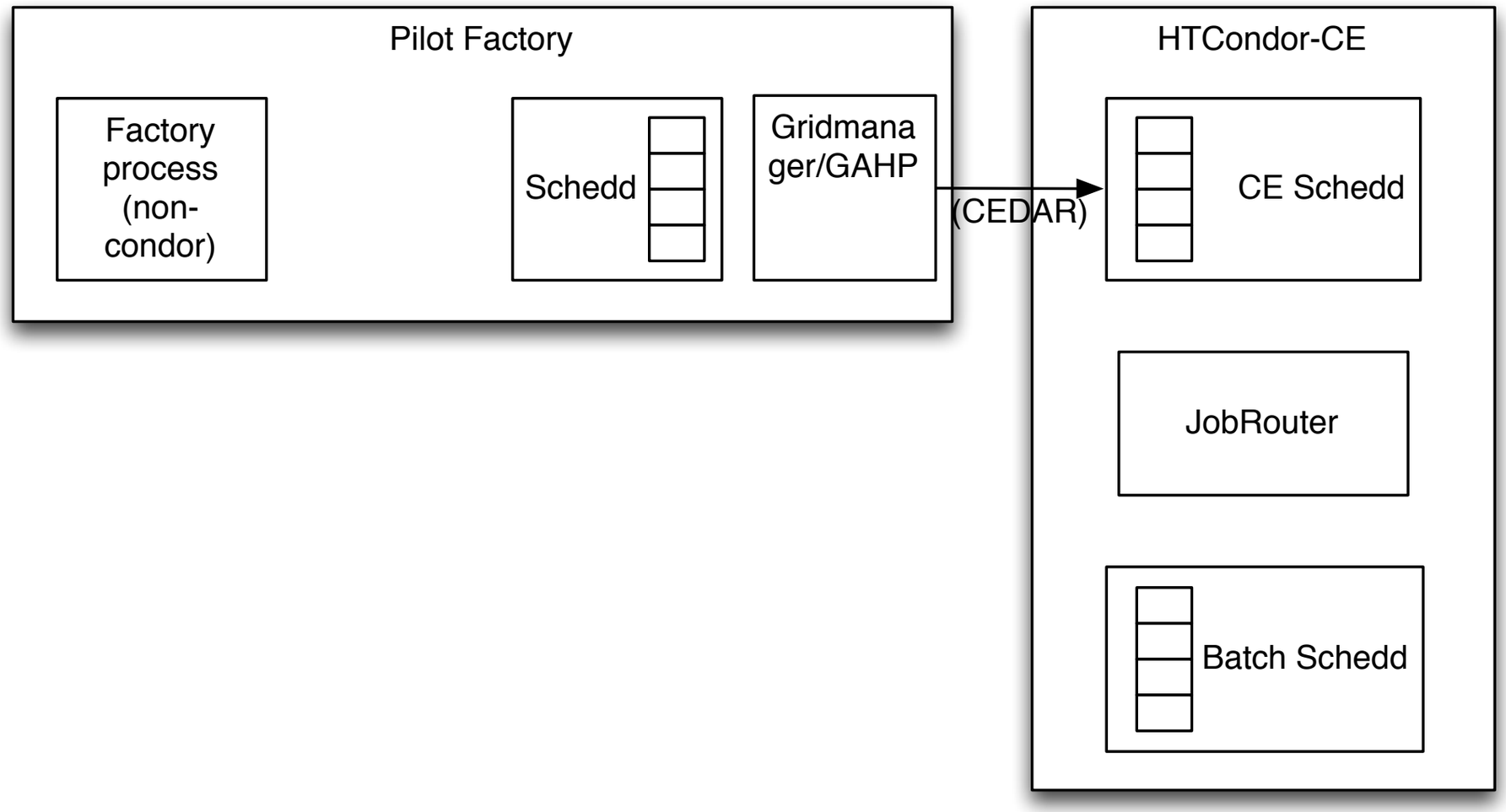
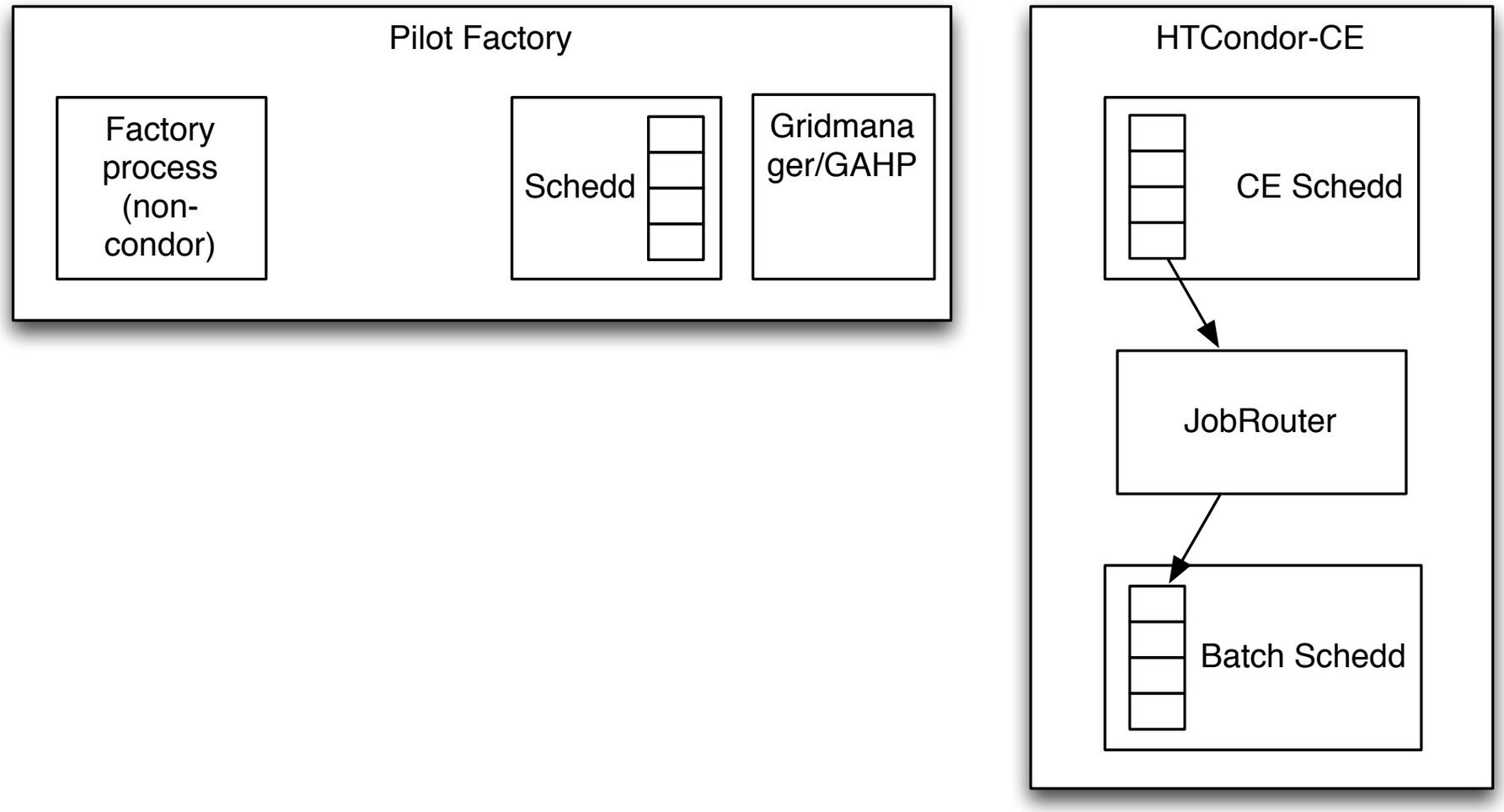


Where does a pilot go?



Where does a pilot go?



Client Tools

- **condor_ce_trace**: Test each step of job submission individually; determine where failures may occur.
- **condor_ce_run**: Run a single job against a remote host (either local or through batch; great for debugging!).
- **condor_ce_ping**: Test authorization for various actions (read, write, administer).

condor_ce_trace

bbockelm — bbockelm@hcc-briantest:~ — ssh hcc-briantest -v — 188×35

```
[bbockelm@hcc-briantest ~]$ condor_ce_trace red.unl.edu
Testing HTCondor-CE collector connectivity.
- Failed ping of collector on <2600:900:6:1101:5054:ff:fe76:711a:9619>.

******************************************************************************
2016-02-28 11:07:05 Failed to ping <2600:900:6:1101:5054:ff:fe76:711a:9619>;
authorization check exited with code 1. Re-run the command with '-d' for more
verbose output.
******************************************************************************
[bbockelm@hcc-briantest ~]$ condor_ce_trace tusker-gw1.unl.edu
Testing HTCondor-CE collector connectivity.
- Successful ping of collector on <129.93.227.123:9619>.

Testing HTCondor-CE schedd connectivity.
- Successful ping of schedd on <129.93.227.123:9619?noUDP&sock=5472_8b22_23>.


    [
        Machine = "tusker-gw1.unl.edu";
        CondorPlatform = "$CondorPlatform: X86_64-CentOS_6.6 $";
        Name = "tusker-gw1.unl.edu";
        MyType = "Scheduler";
        MyAddress = "<129.93.227.123:9619?noUDP&sock=5472_8b22_23>";
        CondorVersion = "$CondorVersion: 8.3.5 Apr 06 2015 $"
    ]
Submitting job to schedd <129.93.227.123:9619?noUDP&sock=5472_8b22_23>
- Successful submission; cluster ID 3071635
Resulting job ad:
    [
        BufferSize = 524288;
        NiceUser = false;
        CoreSize = -1;
        CumulativeSlotTime = 0;
        OnExitHold = false;
        RequestCpus = 1;
```

condor_ce_ping

bbockelm — bbockelm@hcc-briantest:~ — ssh hcc-briantest -v — 107×24

```
[bbockelm@hcc-briantest ~]$ condor_ce_ping -pool tusker-gw1.unl.edu -name tusker-gw1.unl.edu -table ALL
         Instruction Authentication Encryption Integrity Decision Identity
               ALLOW            GSI       none       MD5    ALLOW uscmsPool018@users.opensciencegrid.org
                READ           none       none      none    ALLOW unauthenticated@unmapped
               WRITE            GSI       none       MD5    ALLOW uscmsPool018@users.opensciencegrid.org
          NEGOTIATOR            GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
       ADMINISTRATOR            GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
                OWNER           GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
               CONFIG           GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
               DAEMON           GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
     ADVERTISE_STARTD           GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
     ADVERTISE_SCHEDD           GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
     ADVERTISE_MASTER           GSI       none       MD5     DENY uscmsPool018@users.opensciencegrid.org
[bbockelm@hcc-briantest ~]$
[bbockelm@hcc-briantest ~]$
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[bbockelm@hcc-briantest ~]$
[bbockelm@hcc-briantest ~]$
```
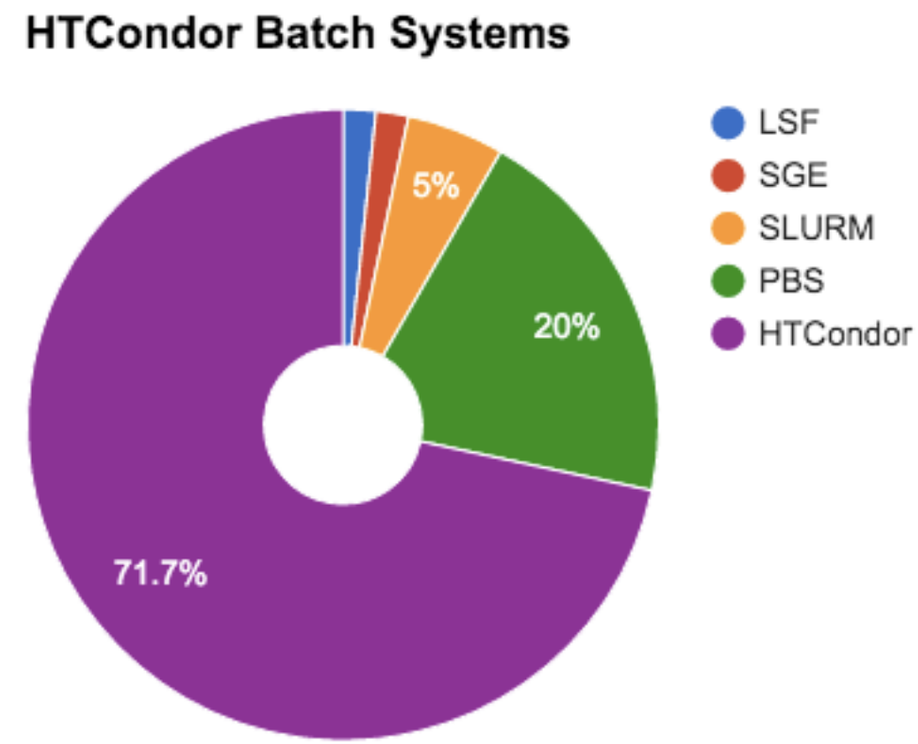
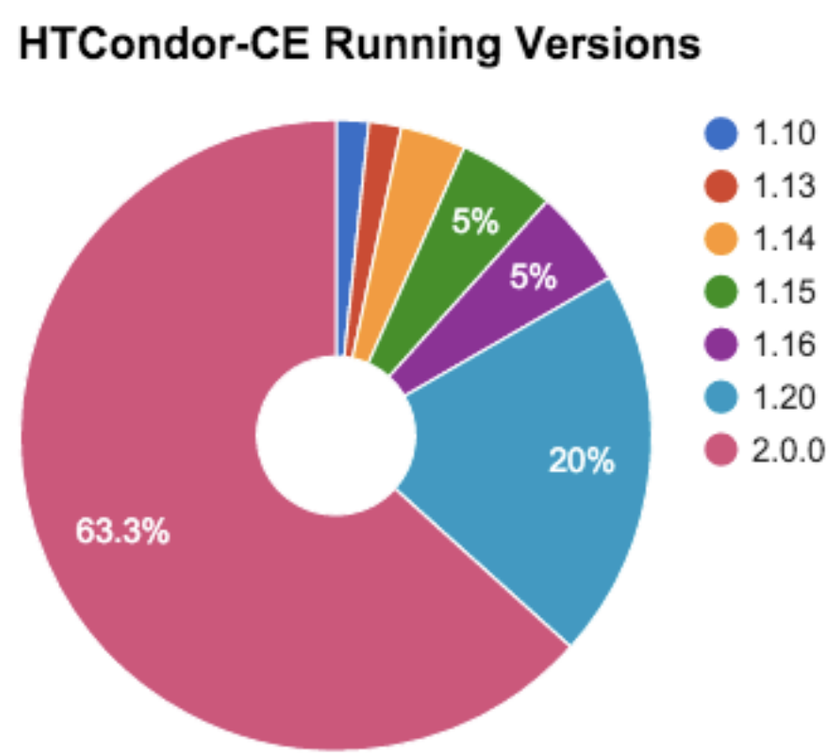

Deployment in OSG

- Latest version is 2.0.0.
- 60 CEs registered with the central collector.
  - 60% are on the latest version.
  - 70% are HTCondor





Interaction Examples

condor_ce_status

bbockelm — root@red-gw1:~ — ssh hcc-briantest — 187×31

```
[root@red-gw1 ~]# condor_ce_status
Worker Node          State     Payload ID      User       Scheduler                      Job Runtime BatchID    BatchUser  Jobs   Pilot Age
red-c0801.unl.edu    Unclaimed                                                           0+00:00:03  5823965.0  glow         5   0+00:56:39
red-c0801.unl.edu    Unclaimed                                                           0+00:29:05  5823965.0  glow         5   0+00:55:41
red-c0801.unl.edu    Unclaimed                                                           0+00:29:07  5823965.0  glow         5   0+00:55:42
red-c0801.unl.edu    Unclaimed                                                           0+00:09:04  5823965.0  glow         5   0+00:55:43
red-c0801.unl.edu    Unclaimed                                                           0+00:34:04  5823965.0  glow         5   0+00:55:44
red-c0801.unl.edu    Unclaimed                                                           0+00:55:45  5823965.0  glow         5   0+00:55:45
red-c0801.unl.edu    Unclaimed                                                           0+00:55:46  5823965.0  glow         5   0+00:55:46
red-c0801.unl.edu    Unclaimed                                                           0+00:55:39  5823965.0  glow         5   0+00:55:39
red-c0803.unl.edu    Unclaimed                                                           0+09:15:38  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18730904.0      zcx        login01.osgconnect.net         0+04:01:14  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18710260.0      zcx        login01.osgconnect.net         0+04:01:14  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18726288.0      fbdescamps login01.osgconnect.net         0+00:42:15  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   21597039.0      yx5        Q4@xd-login.opensciencegrid.org 0+00:12:41  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18739992.0      fbdescamps login01.osgconnect.net         0+02:42:52  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18712503.0      zcx        login01.osgconnect.net         0+05:25:24  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18742089.0      fbdescamps login01.osgconnect.net         0+01:24:06  5818978.0  osg         36   0+09:16:04
red-c0803.unl.edu    Claimed   18735888.6205   intoy      login01.osgconnect.net         0+03:45:53  5818978.0  osg         36   0+09:16:04
red-c0805.unl.edu    Unclaimed                                                           1+17:41:06  5822017.0  cmsprod    113   1+17:41:26
red-c0805.unl.edu    Claimed   7286.0          cmst1      vocms0311.cern.ch              0+08:17:49  5822017.0  cmsprod    113   1+17:41:26
red-c0805.unl.edu    Claimed   133368.61       cmsdataops cmssrv219.fnal.gov             0+06:10:47  5822017.0  cmsprod    113   1+17:41:26
red-c0805.unl.edu    Claimed   133336.50       cmsdataops cmssrv219.fnal.gov             0+04:23:40  5822017.0  cmsprod    113   1+17:41:26
red-c0805.unl.edu    Claimed   403904.7        cmsdataops cmsgwms-submit1.fnal.gov       0+07:17:03  5822017.0  cmsprod    113   1+17:41:26
red-c0807.unl.edu    Unclaimed                                                           1+18:50:51  5821966.0  cmsprod     77   1+18:51:14
red-c0807.unl.edu    Claimed   133729.66       cmsdataops cmssrv219.fnal.gov             0+05:37:57  5821966.0  cmsprod     77   1+18:51:14
red-c0807.unl.edu    Claimed   7222.4          cmst1      vocms0311.cern.ch              0+08:52:02  5821966.0  cmsprod     77   1+18:51:14
red-c0809.unl.edu    Unclaimed                                                           0+09:16:46  5818960.0  osg         51   0+09:17:10
red-c0809.unl.edu    Claimed   18741865.6      pkilgo     login01.osgconnect.net         0+01:43:19  5818960.0  osg         51   0+09:17:10
red-c0809.unl.edu    Claimed   18741545.0      zcx        login01.osgconnect.net         0+00:22:57  5818960.0  osg         51   0+09:17:10
red-c0809.unl.edu    Claimed   40764350.0      donkri     Q2@xd-login.opensciencegrid.org 0+00:06:18  5818960.0  osg         51   0+09:17:10
```

condor_ce_status -schedd

bbockelm — root@red-gw1:~ — ssh hcc-briantest — 188×35

```
[root@red-gw1 ~]# condor_ce_status -schedd -pool collector.opensciencegrid.org
Name                  Resource            Batch    CEVer CondorVer Uptime       Resource
T3SERV007.MIT.EDU  MIT_CMS_T3-CE1     Condor   2.0.0 8.4.3      18+04:36:43 condor T3SERV007.MIT.EDU T3SERV007.MIT.EDU:9619
atlt3gm.physics.arizona.edu Arizona_CE         Condor   2.0.0 8.4.4      10+19:42:52 condor atlt3gm.physics.arizona.edu atlt3gm.physics.arizona.edu:9619
bonner06.rice.edu           OSG-Rice           Condor   2.0.0 8.2.10      5+21:15:05 condor bonner06.rice.edu bonner06.rice.edu:9619
byggvir.princeton.edu       UNAVAILABLE        Condor   2.0.0 8.2.10      8+20:41:16 condor byggvir.princeton.edu byggvir.princeton.edu:9619
calclab-ce.math.tamu.edu    TAMU_Calclab       SLURM    2.0.0 8.2.10     10+17:56:05 condor calclab-ce.math.tamu.edu calclab-ce.math.tamu.edu:9619
carter-osg.rcac.purdue.edu  Purdue-Carter       PBS      1.20  8.2.10      5+15:16:53 condor carter-osg.rcac.purdue.edu carter-osg.rcac.purdue.edu:9619
ce01.brazos.tamu.edu        TAMU_BRAZOS_CE     SLURM    1.20  8.2.9       5+14:39:22 condor ce01.brazos.tamu.edu ce01.brazos.tamu.edu:9619
ce01.cmsaf.mit.edu          MIT_CMS            Condor   1.16  8.4.0       3+23:23:01 condor ce01.cmsaf.mit.edu ce01.cmsaf.mit.edu:9619
ce02.cmsaf.mit.edu          MIT_CMS_2          Condor   1.16  8.4.0       2+17:10:16 condor ce02.cmsaf.mit.edu ce02.cmsaf.mit.edu:9619
ce03.cmsaf.mit.edu          MIT_CMS            Condor   2.0.0 8.4.3      3+22:50:44 condor ce03.cmsaf.mit.edu ce03.cmsaf.mit.edu:9619
cms-ce1-osg.rcac.purdue.edu Purdue-Hadoop-HTCE Condor   1.20  8.2.10     8+13:33:40 condor cms-ce1-osg.rcac.purdue.edu cms-ce1-osg.rcac.purdue.edu:9619
cms-ce2-osg.rcac.purdue.edu Purdue-Hadoop-HT-PBS-CE PBS      2.0.0 8.4.3      3+18:18:03 condor cms-ce2-osg.rcac.purdue.edu cms-ce2-osg.rcac.purdue.edu:9619
cms-grid0.hep.uprm.edu      uprm-cms-ce        Condor   1.14  8.2.8      73+09:07:04 condor cms-grid0.hep.uprm.edu cms-grid0.hep.uprm.edu:9619
cms.rc.ufl.edu              UFlorida-CMS       PBS      2.0.0 8.4.3       5+10:50:58 condor cms.rc.ufl.edu cms.rc.ufl.edu:9619
cmsgrid01.hep.wisc.edu      GLOW               Condor   1.20  8.4.2      13+10:01:29 condor cmsgrid01.hep.wisc.edu cmsgrid01.hep.wisc.edu:9619
cmsgrid02.hep.wisc.edu      GLOW-CMS           Condor   1.20  8.4.2      14+04:00:35 condor cmsgrid02.hep.wisc.edu cmsgrid02.hep.wisc.edu:9619
cmsgrid03.hep.wisc.edu      GLOW-CONDOR-CE     Condor   1.20  8.4.2      23+17:30:32 condor cmsgrid03.hep.wisc.edu cmsgrid03.hep.wisc.edu:9619
cmsosgce.fnal.gov           cmsosgce.fnal.gov  Condor   2.0.0 8.2.8       3+21:47:21 condor cmsosgce.fnal.gov cmsosgce.fnal.gov:9619
cmsosgce2.fnal.gov          cmsosgce2.fnal.gov Condor   2.0.0 8.2.8       3+21:42:39 condor cmsosgce2.fnal.gov cmsosgce2.fnal.gov:9619
cmsosgce3.fnal.gov          cmsosgce3.fnal.gov Condor   2.0.0 8.2.8       3+21:33:19 condor cmsosgce3.fnal.gov cmsosgce3.fnal.gov:9619
cmsosgce4.fnal.gov          cmsosgce4.fnal.gov Condor   2.0.0 8.2.8       3+21:32:39 condor cmsosgce4.fnal.gov cmsosgce4.fnal.gov:9619
cmstest1.rcac.purdue.edu    Purdue-Hadoop-TestCE Condor 1.20  8.4.3      12+08:02:55 condor cmstest1.rcac.purdue.edu cmstest1.rcac.purdue.edu:9619
crane-gw1.unl.edu           Crane-CE1          PBS      2.0.0 8.3.5      11+15:17:02 condor crane-gw1.unl.edu crane-gw1.unl.edu:9619
gate02.grid.umich.edu       AGLT2_CE_2         Condor   2.0.0 8.4.3       4+22:31:20 condor gate02.grid.umich.edu gate02.grid.umich.edu:9619
gate03.aglt2.org            AGLT2_TEST_CE      Condor   2.0.0 8.4.3       6+10:56:32 condor gate03.aglt2.org gate03.aglt2.org:9619
gate04.aglt2.org            AGLT2_SL6          Condor   2.0.0 8.4.3       4+22:14:54 condor gate04.aglt2.org gate04.aglt2.org:9619
globus1.hyak.washington.edu Hyak_CE            PBS      1.15  8.2.9      11+10:45:15 condor globus1.hyak.washington.edu globus1.hyak.washington.edu:9619
gpce01.fnal.gov             gpce01.fnal.gov    Condor   2.0.0 8.2.8      46+04:12:17 condor gpce01.fnal.gov gpce01.fnal.gov:9619
gpce02.fnal.gov             gpce02.fnal.gov    Condor   2.0.0 8.2.8       2+22:12:33 condor gpce02.fnal.gov gpce02.fnal.gov:9619
gridgk01.racf.bnl.gov       BNL_ATLAS_1        Condor   1.10  8.2.7      24+01:25:15 condor gridgk01.racf.bnl.gov gridgk01.racf.bnl.gov:9619
gridgk08.racf.bnl.gov       BNL_ATLAS_8        Condor   1.16  8.2.8       9+16:46:50 condor gridgk08.racf.bnl.gov gridgk08.racf.bnl.gov:9619
gridtest02.racf.bnl.gov     BNL_Test_2_CE_1    Condor   2.0.0 8.2.8       8+16:49:42 condor gridtest02.racf.bnl.gov gridtest02.racf.bnl.gov:9619
hadoop-osg.rcac.purdue.edu  Purdue-Hadoop-CE   Condor   1.20  8.4.3       3+21:53:52 condor hadoop-osg.rcac.purdue.edu hadoop-osg.rcac.purdue.edu:9619
```

Job Query

bbockelm — root@red-gw1:~ — ssh hcc-briantest — 104×28

```
[root@red-gw1 ~]#  condor_ce_q

-- Schedd: red-gw1.unl.edu : <129.93.239.132:28464>
 ID      OWNER            SUBMITTED     RUN_TIME ST PRI SIZE CMD
1505510.0   fermilab        3/27 17:20   0+00:00:03 H  0   0.0  whoami
1506580.0   fermilab        3/27 21:28   0+00:00:03 H  0   0.0  whoami
1518799.0   fermilab        3/31 15:08   0+00:00:03 H  0   0.0  whoami
1802269.0   fermilab         6/2  10:12   0+00:00:04 H  0   0.0  whoami
1802270.0   fermilab         6/2  10:15   0+00:00:04 H  0   0.0  whoami
1923583.0   fermilab         6/24 13:16   0+00:00:04 H  0   0.0  whoami
1923788.0   fermilab         6/24 14:27   0+00:00:04 H  0   122.1 whoami
2670540.0   glow            12/11 05:40   0+06:51:44 C  0   195.3 glidein_startup.sh
2677852.0   glow            12/12 03:59   0+00:21:17 C  0   195.3 glidein_startup.sh
2738000.0   glow            12/30 18:39   0+00:47:40 C  0   9.8  glidein_startup.sh
2738113.0   glow            12/30 19:17   0+00:15:26 C  0   14.6 glidein_startup.sh
2738114.0   glow            12/30 19:17   0+00:15:26 C  0   14.6 glidein_startup.sh
2738115.0   glow            12/30 19:17   0+00:15:28 C  0   12.2 glidein_startup.sh
2738145.0   glow            12/30 19:25   0+00:20:40 C  0   12.2 glidein_startup.sh
2741874.0   glow            12/31 23:13   0+00:23:46 C  0   17.1 glidein_startup.sh
2741880.0   glow            12/31 23:16   0+00:22:10 C  0   14.6 glidein_startup.sh
2744310.0   glow             1/1  17:57   0+00:22:01 C  0   14.6 glidein_startup.sh
2753580.0   glow             1/3  06:10   0+00:22:49 C  0   14.6 glidein_startup.sh
2758819.0   glow             1/3  21:37   0+00:24:41 C  0   14.6 glidein_startup.sh
2758843.0   glow             1/3  21:42   0+00:21:44 C  0   14.6 glidein_startup.sh
2758845.0   glow             1/3  21:42   0+00:20:45 C  0   17.1 glidein_startup.sh
2759289.0   glow             1/3  23:46   0+00:22:44 C  0   293.0 glidein_startup.sh
2759291.0   glow             1/3  23:46   0+00:24:26 C  0   293.0 glidein_startup.sh
```

Why Consider this CE?

- If you are using HTCondor for batch:
  - One less software provider - same thing all the way down the stack.
  - HTCondor has an extensive feature set - easy to take advantage of it (i.e., Docker universe).
- Regardless, a few advantages:
  - Can scale well (up to at least 16k; maybe higher).
  - Declarative ClassAd-based language.
- But disadvantages exist:
  - Non-HTCondor backends are finicky outside PBS and SLURM.
  - Declarative ClassAd-based language.

Conclusions

- We believe the HTCondor-CE is a drastically different approach to the classic CE.
  - It brings quite a few concepts forward from the underlying HTCondor system.
  - It has special advantages for HTCondor sites, especially in terms of support and existing knowledge.
- Explicitly supported by the OSG, but we've seen a few external sites pop up recently.
- We hope to work with a wider community!