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Highly available HTCondor pools in Google Cloud

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Cloud HPC Toolkit Objective

"Make it **easy** for customers and partners to deploy **repeatable turnkey** HPC environments following Google Cloud's ~~HPC~~ **HTC best practices**"

01 | Open source and accepts contributions, open discussions and feature requests

02 | Uses open source multi-cloud tools (Terraform/Packer) and Ansible for configuration

03 | Supports scheduler and storage solutions from Google and partners

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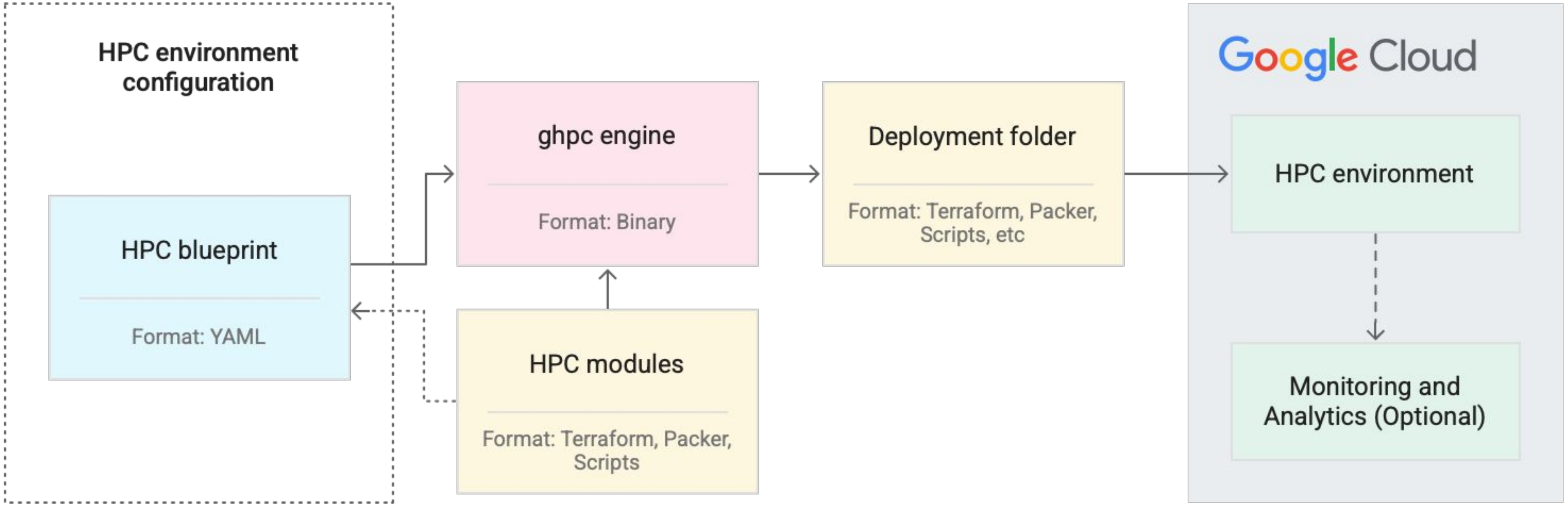
Cloud HPC Toolkit

https://cloud.google.com/hpc-toolkit


HPC environment configuration
HPC blueprint
Format: YAML
ghpc engine
Format: Binary
HPC modules
Format: Terraform, Packer, Scripts
Deployment folder
Format: Terraform, Packer, Scripts, etc
Google Cloud
HPC environment
Monitoring and Analytics (Optional)

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New Toolkit feature: simple deploy command

ghpc create blueprint.yaml

Creates a deployment (directory) from a blueprint. The directory contains:

- Terraform modules
- Packer "templates"
- Ansible plays and other scripts included with Toolkit or added by user

ghpc deploy deployment_directory

Automates execution of Terraform and Packer to deliver infrastructure with custom software and configuration.

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New Toolkit support for HTCondor

- Automated image building via deploy
- CentOS 7 + Rocky Linux 8 for all nodes; Windows for execute points
- IDTOKEN authentication for all nodes
- Support for Spot instances
- Simplified blueprint (very soon)
- Central Manager and Access Points in auto-healing instance groups (already the case for Execute Points)
- Nearly as soon: Support for N>2 machine configurations
    - CPU/GPU/Region/etc.

HTCondor
Software Suite

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Example: Auto-scaling HTCondor Pool Groups 1 and 2

```
vars:
  project_id:  ## Set GCP Project ID Here ##
  deployment_name: throughput-computing-talk
  region: us-central1
  zone: us-central1-c
  new_image_family: htcondor-10x

deployment_groups:
- group: primary
  modules:
  - id: network1
    source: modules/network/vpc
    outputs:
    - network_name

  - id: htcondor_install
    source: community/modules/scripts/htcondor-install
    settings:
      condor_version: 10.5.1

  - id: htcondor_install_script
    source: modules/scripts/startup-script
    use:
    - htcondor_install
```

```
- group: packer
  modules:
  - id: custom-image
    source: modules/packer/custom-image
    kind: packer
    use:
    - network1
    - htcondor_install_script
    settings:
      disk_size: $(vars.disk_size_gb)
      source_image_family: hpc-rocky-linux-8
      image_family: $(vars.new_image_family)
```

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Example: Auto-scaling HTCondor Pool Groups 1 and 2

```
vars:
  project_id:  ## Set GCP Project ID Here ##
  deployment_name: htcondor-pool
  region: us-central1
  zone: us-central1-c
  disk_size_gb: 100
  new_image_family: htcondor-10x

deployment_groups:
- group: primary
  modules:
  - id: network1
    source: modules/network/vpc
    outputs:
    - network_name

  - id: htcondor_install
    source: community/modules/scripts/htcondor-install

  - id: htcondor_install_script
    source: modules/scripts/startup-script
    use:
    - htcondor_install
```

```
- group: packer
  modules:
  - id: custom-image
    source: modules/packer/custom-image
    kind: packer
    use:
    - network1
    - htcondor_install_script
    settings:
      disk_size: $(vars.disk_size_gb)
      source_image_family: hpc-rocky-linux-8
      image_family: $(vars.new_image_family)
```

By itself, this blueprint would produce a generic HTCondor image for all pools in Cloud. The install script can be customized to include your applications.

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Example: Auto-scaling HTCondor Pool Group 3

```
- group: pool
  modules:
  - id: htcondor_base
    source: community/modules/scheduler/htcondor-base
    use:
    - network1

  - id: htcondor_secrets
    source: community/modules/scheduler/htcondor-pool-secrets
    use:
    - htcondor_base

  - id: htcondor_cm
    source: community/modules/scheduler/htcondor-central-manager
    use:
    - network1
    - htcondor_secrets
    - htcondor_base
    settings: …
```

```
- id: htcondor_execute_point
  source: community/modules/compute/htcondor-execute-point
  use:
  - network1
  - htcondor_secrets
  - htcondor_base
  - htcondor_cm
  settings:
    min_idle: 2
    …

- id: htcondor_access
  source: community/modules/scheduler/htcondor-access-point
  use:
  - network1
  - htcondor_secrets
  - htcondor_base
  - htcondor_cm
  - htcondor_execute_point
  settings: …
```

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Example Runner snippet

Modular nature of solution enables you to refactor this to adopt, e.g., Vault

```
- name: Fetch IDTOKEN to advertise execute point
  ansible.builtin.copy:
    dest: /etc/systemd/system/condor.service.d/token-fetcher.conf
    mode: 0644
    content: |
      [Service]
      ExecStartPre=gcloud secrets versions access latest \
          --secret {{ xp_idtoken_secret_id }} \
          --out-file /etc/condor/tokens.d/condor@{{ trust_domain }}
  notify:
  - Reload SystemD
```

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HTCondor on Windows

- Most challenges are my own inexperience automating Windows
- TJ has been a ***significant*** help!
- But you don't have to! Toolkit performs
  - Python installation
  - GPU driver installation
  - HTCondor installation
  - IDTOKEN fetching

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IDTOKENs

- "60% of the time, it works every time"
- Experience running commands as root on fresh install is poorer
- "**`condor_reconfig`**" becomes "**`systemctl reload condor`**"

```
UID_DOMAIN = c.toolkit-demo-zero-e913.internal
TRUST_DOMAIN = c.toolkit-demo-zero-e913.internal
use role:get_htcondor_central_manager

# due to https://tinyurl.com/htc-2023-trust
# this is a different configuration from

use role:get_htcondor_central_manager
UID_DOMAIN = c.toolkit-demo-zero-e913.internal
TRUST_DOMAIN = c.toolkit-demo-zero-e913.internal
```

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+RequireSpot just works

- Each Cloud Machine advertises its attributes (region, zone, *etc.*)
- With N=2, "1 is Spot, 1 is Not"
- N>2 becomes less HTCondor-native in terms of scheduling
- Initial work with Todd Miller to "hijack" Rooster mechanism to develop a true autoscaling signal is fruitful but early days

```
JOB_TRANSFORM_NAMES = SPOT_DEFAULT, SPOT_REQS

JOB_TRANSFORM_SPOT_DEFAULT @=end
   DEFAULT RequireSpot False
@end

JOB_TRANSFORM_SPOT_REQS @=end
   REQUIREMENTS ! unresolved(Requirements, "^CloudInterruptible$")
   SET Requirements $(MY.Requirements) && (CloudInterruptible is
My.RequireSpot)
@end

SUBMIT_REQUIREMENT_NAMES = REQSPOT
SUBMIT_REQUIREMENT_REQSPOT = isBoolean(RequireSpot)
SUBMIT_REQUIREMENT_REQSPOT_REASON = "Jobs must set +RequireSpot to either
True or False"
```

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Contributing back

- SchedD HA bug reported/resolved
- Filesystem mount order reported/resolved
- TRUST_DOMAIN missing from manual reported/resolved
- I owe TJ a PR for Windows "Error 1722"

```
   ----- The following addresses had permanent fatal errors -----
<htcondor-admin@cs.wisc.edu>
    (reason: 550 5.7.1 rejected by DMARC policy for google.com)

   ----- Transcript of session follows -----
... while talking to shale.cs.wisc.edu.:
>>> DATA
<<< 550 5.7.1 rejected by DMARC policy for google.com
554 5.0.0 Service unavailable
```

So many reports, I've been blocked!