Remote Computing Enablement and You

LC User Meeting

December 8th, 2020

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Deputy Program Lead
RCE Lead, LLNL
theer@llnl.gov
Remote Computing Enablement and You

Agenda

• The *What, Why* and *Who* of RCE
• Foreach thrust area
  • What is/was the starting state?
  • What did/are we achieving?
  • What’s on the horizon?
Putting the “C” in RCE

The single biggest problem in communication is the illusion that it has taken place.

- George Bernard Shaw

Cooperativeness is not so much learning how to get along with others, as taking the kinks out of ourselves so that others can get along with us.

- Thomas S. Monson

The real art of conversation is not only to say the right thing at the right place but to leave unsaid the wrong thing at the tempting moment.

- Dorothy Nevill
RCE Mission

Attempt to make the remote HPC user experience as close as possible to the local user experience to maximize productive utilization of computing resources across the NNSA HPC simulation complex.

The RCE team, formed in May of 2019, is comprised of many members from multiple disciplines and management strata across the Sandia, LANL, and LLNL HPC centers.

RCE came about as a confluence of events
— Trinity at LANL, Sierra at LLNL, and of course the eventual arrival of El Capitan at LLNL
— Center of Excellence (CoE) efforts
— Ongoing semi-disparate multi-lab meetings
  • Common Computing Environment (CCE)
  • Tri-Lab Data Movers (TDM) telecon
  • User oriented meetings (e.g. Tri-Lab Remote Computing Preliminary Planning Meeting of 5/2019)
— NNSA HQ desire to further multi-lab cooperation to aid remote user bases

ASC FOUS leads at the three sites have programmatic responsibility

RCE focuses on attainable deliverables in measured tempos that deliver real benefits to the HPC Tri-Lab user community
The Problem Space is Huge

Where to focus effort?

- SMEs are best able to identify problem areas and low-hanging fruit (read: *slam dunks*).
  - Data transfer tools lack of ubiquity
  - Network bottlenecks
  - Gateways and what could be done to *dissolve* them

- Check-ins with user community (either unsolicited or user-driven)

- Identify projects that our in our normal charter (and thus already budgeted at some level)

- Some efforts *do* require an influx of money and/or more strategic planning

- Tri-Lab management (and HQ) help agree upon cooperative efforts and priority

RCE has achieved best success by shedding light in certain areas and enabling the *conversation*
The Problem Space is Huge

How to focus effort?

- Fluid working groups address items, tasks, projects

Q) How do you eat an elephant?

A) One bite at a time

A) Parallelize. Many bytes simultaneously

RCE Working Groups, Dec 2020

rce-doc
rce-network
rce-auth
rce-ci
rce-storage

HPC approved

Tri-Lab working groups meet via Webex, use email reflectors, and have Mattermost discussions
RCE Categories and Examples
Current Grouping of Identified Areas of Interest

- Hardware needs that require multi-lab coordination
  - 100Gb DISCOM encryptors
  - Gitlab server hardware (and licensing)

- Identify SME efforts requiring multi-lab coordination
  - Tuning / chasing network maladies (e.g. dropped packets, buffer overflows, etc.)

- Reduce barriers to effective remote code development
  - Eliminate gateways
  - Find opportunities for unified authentication

- Identify software gaps
  - Data xfer tools
  - VNC

- Multi-lab meetings
  - Hone to reduce repetition and increase SME coverage/involvement

- User support / Documentation
  - Continued efforts on Sarape, hpc.llnl.gov, hpc.sandia.gov, hpc.lanl.gov

- Strategic
  - Gitlab Continuous Integration across the NNSA Tri-Lab HPC complex
### Example Area For Improvement

**Category: Reduce Barriers to Remote Code Development**
Kerberos cross-realm ssh authentication

<table>
<thead>
<tr>
<th>Network Type</th>
<th>LLNL</th>
<th>LANL</th>
<th>SNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open “collaborative”</td>
<td>CZ: No gateway</td>
<td>Turquoise: wtrw.lanl.gov</td>
<td>OHPC: No gateway</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closed/classified</td>
<td>SRD: No gateway</td>
<td>Red: red-wtrw.lanl.gov</td>
<td>SCN: No gateway</td>
</tr>
</tbody>
</table>

**NOTE:** rows across institutions do NOT imply the network types have the same definition/restrictions.
## Example Area For Improvement

Category: Reduce Barriers to Remote Code Development

Kerberos cross-realm ssh authentication

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As experienced in 2019 (pre-RCE)
# Example Area For Improvement

**Category: Reduce Barriers to Remote Code Development**

Kerberos cross-realm ssh authentication

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### Example Area For Improvement

Category: Reducing Barriers to Code Development

**Reduce/Remove gateway hosts**

<table>
<thead>
<tr>
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As experienced in 2019 (pre-RCE)
Example Area For Improvement (Achieved)
Category: Reducing Barriers to Code Development
Reduce/Remove gateway hosts

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## Example Area For Improvement

**Category:** Reducing Barriers to Code Development  
**Reduce/Remove gateway hosts+++**

<table>
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<td>Turquoise: wtrw.lanl.gov</td>
<td>OHPC: No gateway</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open “restrictive”</td>
<td>RZ: No gateway</td>
<td>RE (restricted enclave): No gateway</td>
<td>SRN: srngate.sandia.gov</td>
</tr>
<tr>
<td>Closed/classified</td>
<td>SRD: No gateway</td>
<td>Red: No gateway</td>
<td>SCN: No gateway</td>
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</tbody>
</table>

**On the RCE Horizon**

1. Entirely new HPC network enclave  
2. Removal of gateway machine  
3. Cross-realm trust model
What is needed today is for the ESN managed equipment to be upgraded to support remote computing at higher speeds to absorb pressures from platforms currently in service to the tri-lab community.

- Tri-Lab ASC Program Directors plus ASC Program Mgr NNSA

Sept. 2019
Example Area for Improvement
Category: WAN Networking
Secure Tri-Lab DISCOM Network Performance
RCE driven network improvements

- These two projects are currently budgeted and underway
- 10x improvement in bandwidth for both frontend and data transfer networks
- Red lines are classified networks
- Note importance of leveraging iHPC unclassified footprint
Example Area for Improvement
Category: Identify Software Gaps
Unify endpoint choices and data transfer mechanisms

As experienced in 2019 (pre-RCE)
Example Area for Improvement
Category: Identify Software Gaps
Classified Tri-Lab DISCOM WAN Data Transfer, **file system to file system**

- At either LLNL or LANL connecting to SNL:
  
  ```
  hsi2lynx “cd sync_dir; put -R source_dir”
  OR
  pftp2lynx <...>
  ```

- At either LANL or SNL connecting to LLNL:
  ```
  rsync -av source_dir/ cslic.llnl.gov:target_dir
  OR
  scp -r source_dir cslic.llnl.gov:target_dir
  OR
  sftp
  ```

- At either LLNL or SNL connecting to LANL:
  ```
  rsync -av --rsh='ssh red-wtrw.lanl.gov ssh' source_dir/ redcap.lanl.gov:target_dir
  OR
  scp -r source_dir red-wtrw.lanl.gov:redcap:target_dir
  ```

As experienced in 2019 (pre-RCE)
Example Area for Improvement

Category: Identify Software Gaps
Classified Tri-Lab DISCOM WAN Data Transfer, file system to file system

Classified High Bandwidth Data Movement

- pftp2redcap
- hsi2lanl, htar2lanl, pftp2lanl
- pftp2cslic
- hsi2llnl, htar2llnl, pftp2llnl
- pftp2 lynx
- hsi2smss, htar2smss, pftp2smss

Documented on hpc.llnl.gov
Example Area for Improvement
Category: Identify Software Gaps
Unclassified Tri-Lab iHPC WAN Data Transfer, file system to file system

Unclassified High Bandwidth Data Movement

- pftp2<RE_clstr>
  - hsi2lanl, htar2lanl, pftp2lanl

- pftp2rzslig
  - hsi2llnl, htar2llnl, pftp2llnl

- pftp2<clstr>
  - hsi2smss, htar2smss, pftp2smss

- Not decided at this time
- May require special budget allocations (e.g. DTNs)
FY21 Goal: Tri-Lab HPC Center GitLab Continuous Integration
Mirror Repositories – Open Restricted Enclave

More local Gitlab CI info and How-To at lc.llnl.gov/confluence
Huge thanks to all the RCE participants at the labs!

Reference:
- sarape.sandia.gov (remote accounts)
- hpc.llnl.gov (remote access How-To’s)
- lc.llnl.gov/confluence (gitlab CI)
- **LC Hotline** – *any* question
- RCE issues/feedback:
  - Todd Heer [theer@llnl.gov](mailto:theer@llnl.gov)
<table>
<thead>
<tr>
<th>Source</th>
<th>LLNL EN*</th>
<th>LLNL CZ</th>
<th>LLNL RZ</th>
<th>LLNL SCF</th>
<th>LANL Turquoise</th>
<th>LANL Yellow</th>
<th>LANL Red</th>
<th>SNL OHPC</th>
<th>SNL IHPC</th>
<th>SNL SRN</th>
<th>SNL SCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLNL CZ</td>
<td>no gw</td>
<td>no gw</td>
<td>wtrw</td>
<td>ihpc-gate via LLNL RZ/CZ</td>
<td>no gw</td>
<td>via LLNL RZ/CZ</td>
<td>srgate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LLNL RZ</td>
<td>no gw</td>
<td></td>
<td>wtrw</td>
<td>ihpc-gate</td>
<td>no gw</td>
<td>no gw</td>
<td>srgate</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>LLNL SCF</td>
<td>no gw</td>
<td></td>
<td></td>
<td></td>
<td>no gw</td>
<td></td>
<td>srgate</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>LANL Turquoise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>no gw</td>
<td>srgate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANL Yellow*</td>
<td>no gw</td>
<td></td>
<td>wtrw</td>
<td>-</td>
<td>no gw</td>
<td>ihpc-gate</td>
<td>srgate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANL Red</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>no gw</td>
<td>srgate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNL OHPC</td>
<td>no gw</td>
<td></td>
<td></td>
<td></td>
<td>wtrw</td>
<td>ihpc-gate</td>
<td>srgate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNL IHPC</td>
<td>no gw</td>
<td>no gw</td>
<td>wtrw</td>
<td>ihpc-gate</td>
<td>no gw</td>
<td>-</td>
<td>srgate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNL SRN*</td>
<td>no gw</td>
<td></td>
<td>wtrw</td>
<td>ihpc-gate</td>
<td>no gw</td>
<td>no gw</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNL SCN</td>
<td>no gw</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>no gw</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*desktops live here

NOTES:
- When filling out above, make sure to include the possibility of two or more gateways in the single cell if the source site has an outbound gateway and the destination site has another. Each cell is intended to illustrate only SSH gateway hosts and does not consider authentication types or requirements, and may yet serve as a springboard for those more involved

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### HPC Cluster Resource Examples

<table>
<thead>
<tr>
<th>Gateway Name</th>
<th>Owning Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>wtrw</td>
<td>LANL</td>
</tr>
<tr>
<td>ihpc-gate</td>
<td>LANL</td>
</tr>
<tr>
<td>red-wtrw</td>
<td>LANL</td>
</tr>
<tr>
<td>izhpc-sandia.gov</td>
<td>Sandia</td>
</tr>
<tr>
<td>srgate</td>
<td>Sandia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LLNL CZ</th>
<th>lassen (ATS)</th>
<th>oslic</th>
<th>catalyst</th>
<th>corona</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLNL RZ</td>
<td>rzansel (ATS)</td>
<td>rzslc</td>
<td>rztopaz</td>
<td>rztrona</td>
</tr>
<tr>
<td>LLNL SFC</td>
<td>sierra (ATS)</td>
<td>cslic</td>
<td>jade (CTS)</td>
<td>zin</td>
</tr>
<tr>
<td>LANL Turquoise</td>
<td>badger (ba-fe, CTS)</td>
<td>grizzly (gr-fe, CTS)</td>
<td>woodchuck</td>
<td>kodiak (ko-fe)</td>
</tr>
<tr>
<td>LANL Yellow</td>
<td>trinitite (tt-fey)</td>
<td>capulin (Cray xcs0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANL Red</td>
<td>trinity</td>
<td>fire (CTS)</td>
<td>ice (CTS)</td>
<td>cyclone (CTS)</td>
</tr>
<tr>
<td>SNL OHPC</td>
<td>testbeds</td>
<td>solo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNL IHPC</td>
<td>ihpc-sandia.gov</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNL SRN</td>
<td>mutrino, vortex</td>
<td>lynx</td>
<td></td>
<td></td>
</tr>
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<td>SNL SCN</td>
<td>Sky Bridge</td>
<td>Chama</td>
<td>Uno</td>
<td>Ghost</td>
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<tr>
<td></td>
<td>lynx-s</td>
<td>Pecos</td>
<td>Jemez</td>
<td>Cayenne</td>
</tr>
</tbody>
</table>
RCE Authentication Working Group

- realvnc functionality was tested and validated from SNL to LLNL

- LANL configured testing for access without red-wtrw in the secure
  - SNL to LANL had no issues
  - LLNL to LANL has some issues (solved during 10.17 testing)!

- SNL is standing up a git repo with CI in iHPC
  - we will need common auth for this!

- LANL is working on plan for common-auth by reorganization of resources and working to coordinate between non-HPC groups to provide the needed mechanisms.
  - Many of the resources (such as the KDC) currently live outside of the LANL HPC network making this a challenge to change/update.

- LLNL is looking at multiple options for common auth with SNL/LANL
  - currently have 6 options - trying to narrow down to best one(s)
  - will provide us with updates

- We all agreed on some sort of MOU Tri-Lab Agreement document
  - Catherine Hinton will lead drafting this document
RCE combines SMEs in the know, people with budget authority, various levels of interested management, and people who know people across the three institutions.

SMEs are best able to identify problem areas and low-hanging fruit:
- Data transfer tools lack of ubiquity
- Network bottlenecks
- Gateways and what could be done to dissolve them

Seek to identify projects that our in our normal charter (and thus already budgeted)

Some efforts do require an influx of money

Management creates priorities and supports these cooperative efforts

Check-ins with users (either unsolicited on our part or user-driven)

RCE ultimately achieves its best success by shedding light in certain areas and enabling the conversation.
GitLab CI

https://lc.llnl.gov/confluence/display/GITLAB/GitLab+CI