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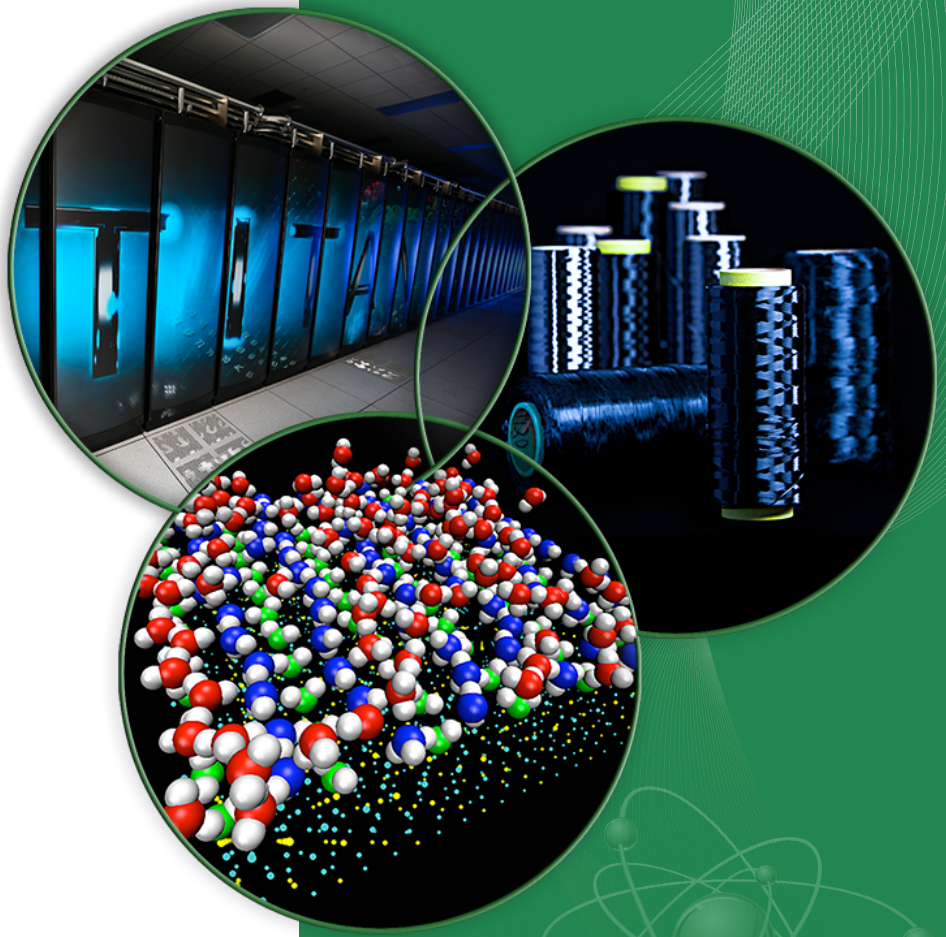

Lustre Tuning and Advanced LNET Configuration

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Outline of Presentation

- Kernel module options
  - Tuning recommendations from Lustre manual
  - Tuning recommendations from OLCF experience
- Multi-rail LNET configurations
- Complex LNET routing configurations
- Lustre client, router, and server tuning options

Kernel Module Tuning

- The tunings applicable to a host depends on that host's role. A client will be tuned differently than a router, which would be tuned differently than a server.
- There are some tunings that are applicable to each of these roles.

What modules and what options?

- The main modules to look at are lnet, and the transport layer (most commonly ko2iblnd or ksocklnd). Other modules we'll look at are libcfs and ptlrpcd.
- How can we pass options to these modules?
  - First, check what parameters can be passed using modinfo <module_name>, e.g. *modinfo lnet*.
  - These parameters are listed within the appropriate module.conf file under /etc/modprobe.d/

    options module_name param=option param2=option2

    Example: *options ko2iblnd peer_credits=63*

What are good values to use?

- Often, the default values for parameters are reasonable to use.
- The following values are from the Lustre documentation and OLCF experimentation.
- Unfortunately, there may need to be a trial and error period to find appropriate parameter values for different networks.

Module: lnet

- Arguably the most important lnet parameter is the *networks* or *ip2nets* param.
  - The *networks* parameter maps a network interface to an LNET subnet
    - Format: options lnet networks=LNET(interface),LNET(interface),...
    - Example: options lnet networks=tcp0(eth1),o2ib(ib0)
  - This can be a problem to manage with large networks with many hosts. The *ip2nets* parameter allows for a single configuration file across the network
    - Format: Each node identifies the locally available networks based on the listed IP address patterns that match the node's local IP addresses.
    - Example: options ip2nets="o2ib0(ib0) 10.10.[0-1].*"
      This would put all clients on the 10.10.{0,1}.* networks on o2ib0

Module: lnet routing

- Routing is defined through a module parameter to lnet as well.
  - The *routes* parameter specifies a semi-colon separated list of router definitions.
    - routes=dest_lnet [hop] [priority] router_NID@src_lnet; \
      dest_lnet [hop] [priority] router_NID@src_lnet
  - An alternative syntax consists of a colon separated list of router definitions:
    - routes=dest_lnet: [hop] [priority] router_NID@src_lnet \
      [hop] [priority] router_NID@src_lnet
  - Example:
    - options lnet networks="tcp0(eth0)" routes="o2ib0 1 10.10.10.2@tcp0; o2ib0 1 10.10.10.3@tcp0"

Routing example

- Setup:
  - one TCP client,
  - one router (TCP & Infiniband connections)
  - servers(MGS,MDS,OSS) on an InfiniBand fabric.
- The LNET router has two NIDs:
  - 192.168.1.2@tcp0
  - 10.13.24.90@o2ib0
- The lustre.conf file for the client includes:
  - options lnet networks="tcp0(eth0)" routes="o2ib0 192.168.1.2@tcp0"
- On the router nodes:
  - options lnet networks="o2ib0(ib0),tcp0(eth0)" forwarding=enabled
- On the server nodes:
  - options lnet networks="o2ib0(ib0)" routes="tcp0 10.13.24.90@o2ib0"

Remaining LNET routing parameters

- auto_down
  - Default Value = 1
- avoid_asym_router_failure
  - Default value: disabled
- live_router_check_interval
  - Default value: 60
- dead_router_check_interval
  - Default value: 60
- router_ping_timeout
  - Default value: 50
- check_routers_before_use
  - Default value: off

Module: libcfs

- Module params:
  - libcfs_console_ratelimit
  - libcfs_console_max_delay
  - libcfs_console_min_delay
  - libcfs_panic_on_lbug
  - cpu_npartitions
    - Ex: options libcfs cpu_npartitions=4
  - cpu_pattern:
    - Ex: options libcfs cpu_pattern="0[0-3] 1[4-7] 2[8-11] 3[12-15]"
- Examples of cpu partitioning:

http://www.eofs.eu/fileadmin/lad2012/09_Gregoire_Pichon_Bull_Lustre_SMP_scalability.pdf

Module: ptlrpcd

- max_ptlrpcds
  - options ptlrpcd max_ptlrpcds=32
- ptlrpcd_bind_policy
  - options ptlrpcd ptlrpcd_bind_policy=3

Module: ko2iblnd

- Option “timeout”:
  - Suggested value: 100
- Option “credits”:
  - Suggested value: 2560
- Option “peer_credits”:
  - Suggested value: 63
- Option “concurrent_sends”:
  - Suggested Value: 63
- Option “fmr_pool_size”:
  - Suggested value: 1280
- Option “fmr_flush_trigger”:
  - Suggested Value: 1024
- Option “ntx”:
  - Suggested value: 5120

Module: ksocklnd

- Option “sock_timeout”:
  - Suggested value: 100
- Option “credits”:
  - Suggested value: 2560
- Option “peer_credits”:
  - Suggested value: 63

- Check /proc/sys/lnet/peers for indications of queued send requests

Client Tuning

- lctl set_param osc.*.checksums=0
- lctl set_param timeout=600
- lctl set_param at_min=250
- lctl set_param at_max=600
- lctl set_param ldlm.namespaces.*.lru_size=2000
- lctl set_param osc.*OST*.max_rpcs_in_flight=32
- lctl set_param osc.*OST*.max_dirty_mb=64

Server Tuning

- lctl set_param timeout=600
- lctl set_param ldlm_timeout=200
- lctl set_param at_min=250
- lctl set_param at_max=600
- OSS:
  - lctl set_param obdfilter.*.read_cache_enable=1
  - lctl set_param obdfilter.*.writethrough_cache_enable=1

Summary

- Common modules
  - lnet, libcfs, ptlrpcd, ko2iblnd/ksocklnd
  - What and how to tune
  - LNET routing
- Client tuning
- Server tuning

Resources

- Lustre Software Manual
  - https://build.hpdd.intel.com/job/lustre-manual/lastSuccessfulBuild/artifact/lustre_manual.xhtml
- Jason Hill - “LNET Configuration”
  - http://lustre.ornl.gov/ecosystem/documents/LustreEco2015-Tutorial2.pdf
- “LNET Router Resiliency and Tuning”
  - http://cdn.opensfs.org/wp-content/uploads/2015/04/Lustre-Network-Router-Config_Fragalla.pdf
- “Manage Lustre for the Cray Linux Environment”
  - http://docs.cray.com/books/S-0010-5203//S-0010-5203.pdf
- Doug Oucharek – “Taming LNET”
  - http://downloads.openfabrics.org/Media/IBUG_2014/Thursday/PDF/06_LNet.pdf

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