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Lustre* Use of OFED and the Future

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#OFADevWorkshop

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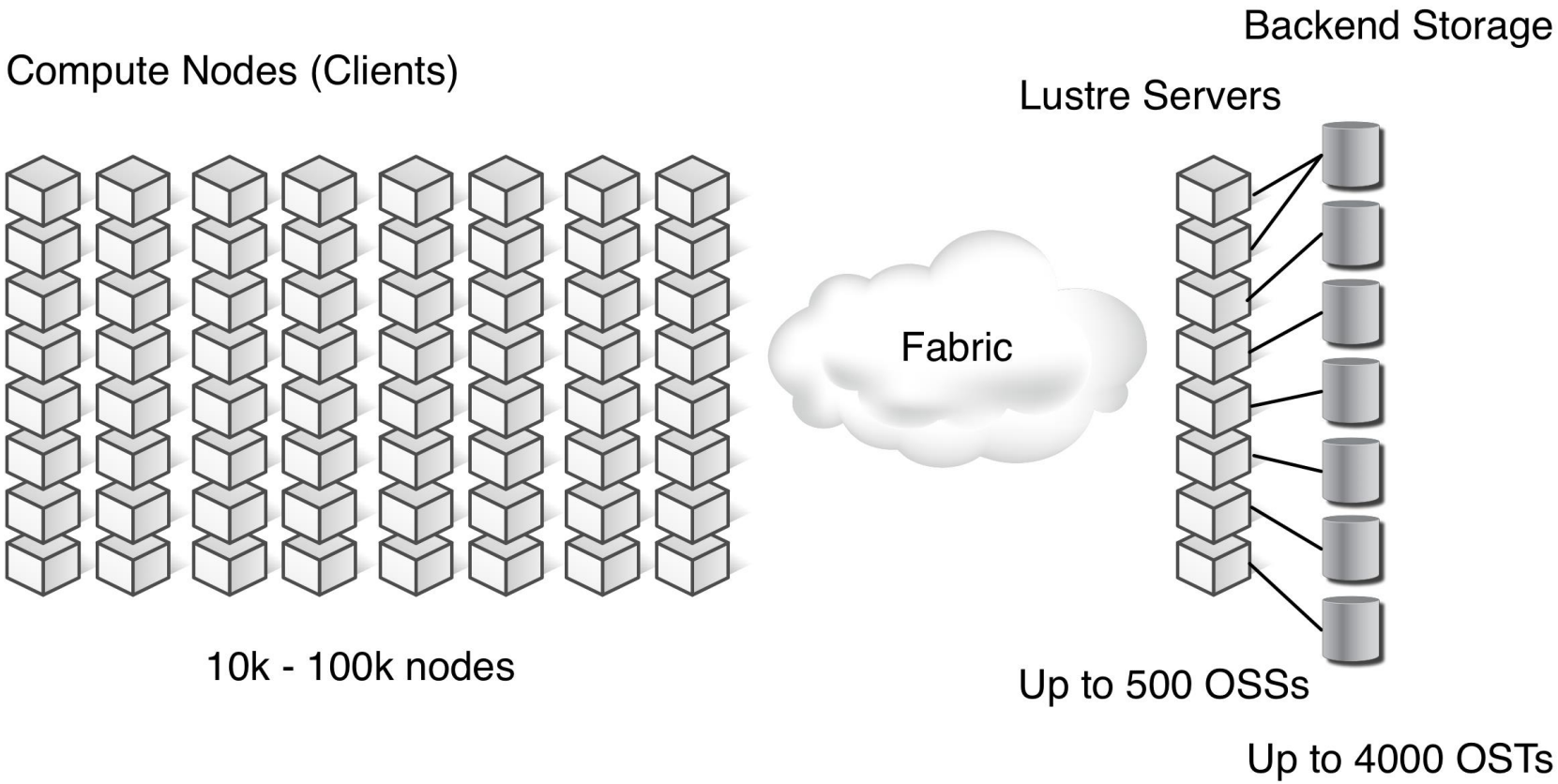
Overview

- Review of Lustre and future requirements on Fabric
- Summary of Requirements given at end
- A New Approach
  - Usually we see bottom-up style presentations
  - Trying top-down

50,000 ft View: The Product



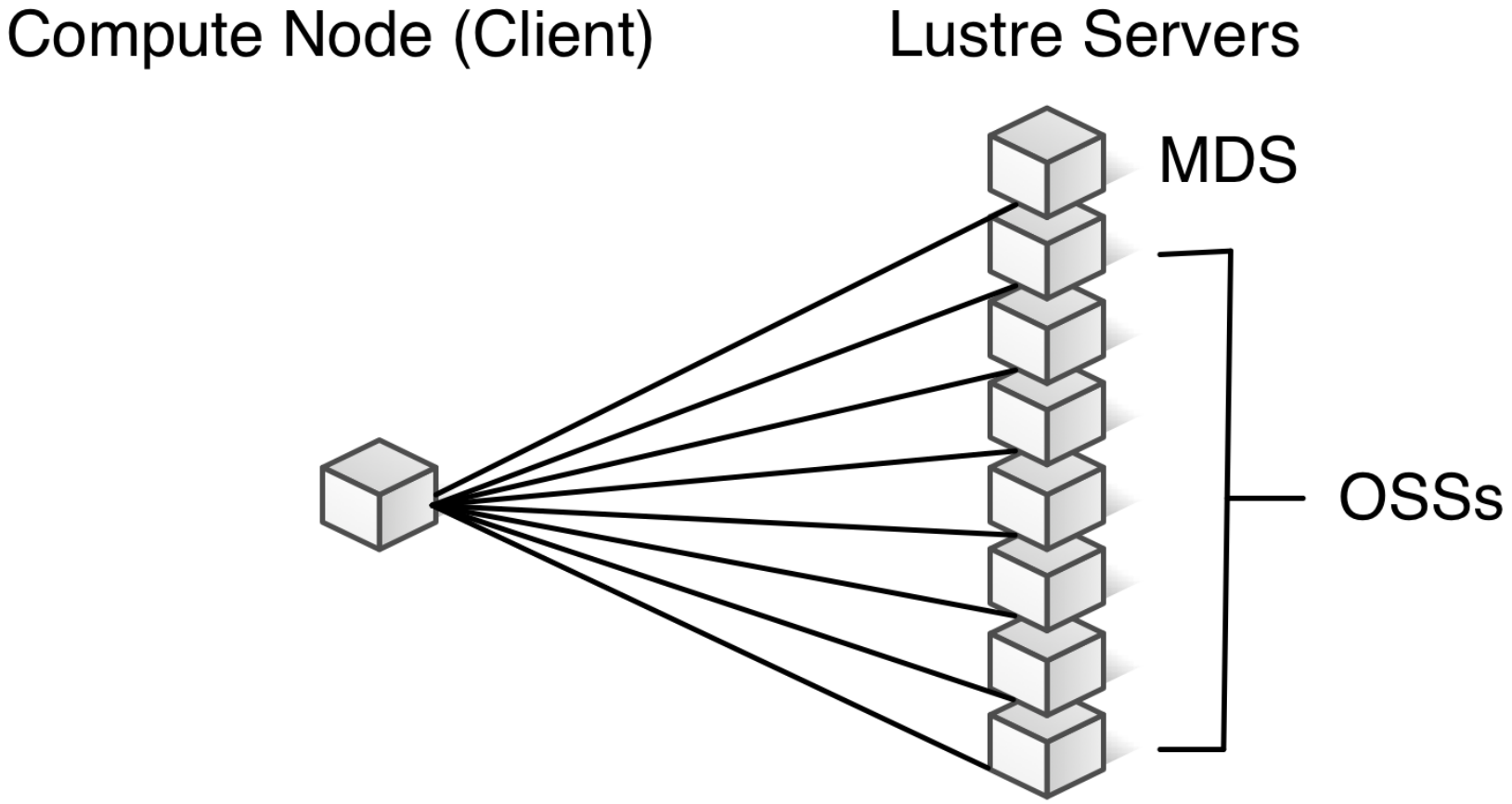
By the Numbers

	2012	2020
Nodes	10-100K	100K-1M
Threads/node	~10	~1000
Total concurrency	100K-1M	100M-1B
Object create	**100K/s**	**100M/s**
Memory	1-4PB	30-60PB
FS Size	10-100PB	600-3000PB
MTTI	1-5 Days	6 Hours
Memory Dump	< 2000s	< 300s
Peak I/O BW	**1-2TB/s**	**100-200TB/s**
Sustained I/O BW	**10-200GB/s**	**20TB/s**

Lustre Markets

- HPC
  - Core fan out -> Need equal access to Network Interface
- Enterprise
  - Security -> Encryption Support (IPSec-like)
  - Longer Distances (WAN) -> FMR or equivalent
- Cloud
  - VM Support by Fabric

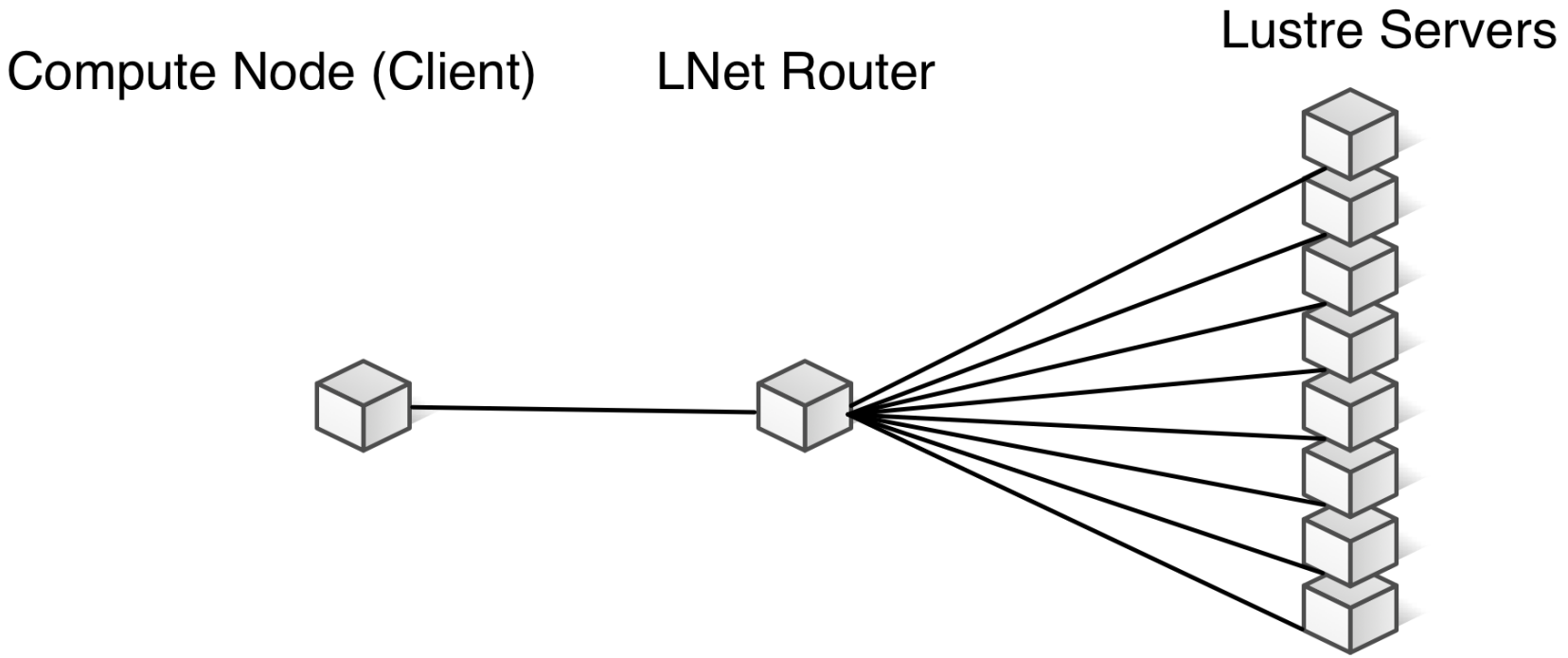
40,000 ft View: Client Server



Usage Pattern

- Striping
  - RAID0 Behaviour
- Peer Connections
  - Created on demand: RC QPs
  - Multiple Server Messages in Parallel
  - Monitor Connections via LNet Ping
- DNE : Multiple Meta-Data Servers
- Self Imposed Flow Control
  - Credits (for network) and Peer Credits (for each connection)
  - SLA with Fabric would be Great
  - Latency is OK, message loss is not

30,000 ft View: Getting Connected



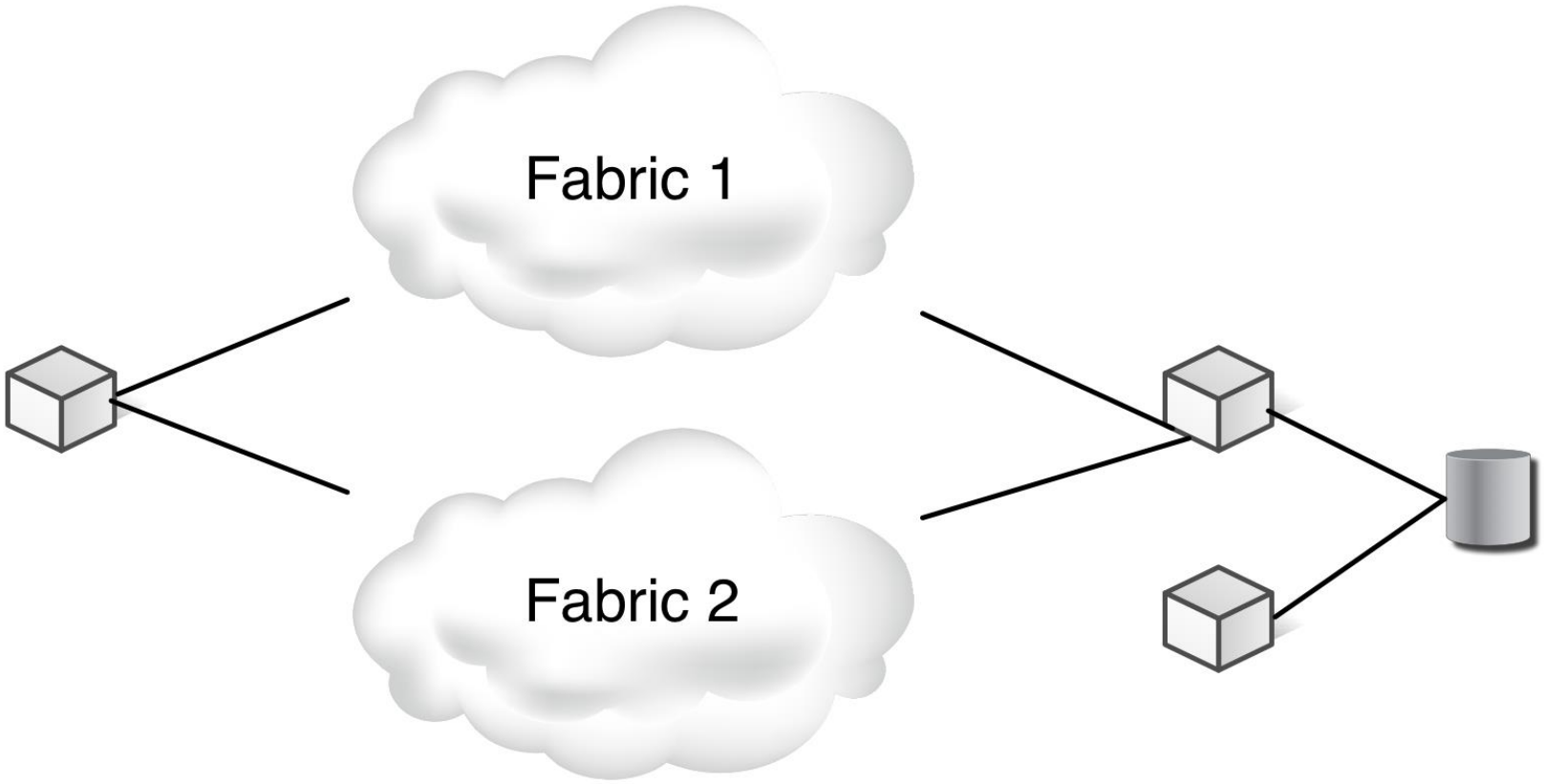
LNet Routing

- Why Route? (From ORNL paper: Network Contention and Congestion Control:Lustre Fine-Grained Routing – Matt Ezell)
  - Control **bandwidth** by varying the number of routers
  - Control **I/O paths** by selecting which routers to use
  - Control **route computation** by partitioning fabrics
  - If you are using multiple network types, you have to route traffic
- Required: Single OFED stack Optimized for all interfaces in router
  - Preferably upstream in kernel.org

Other Services

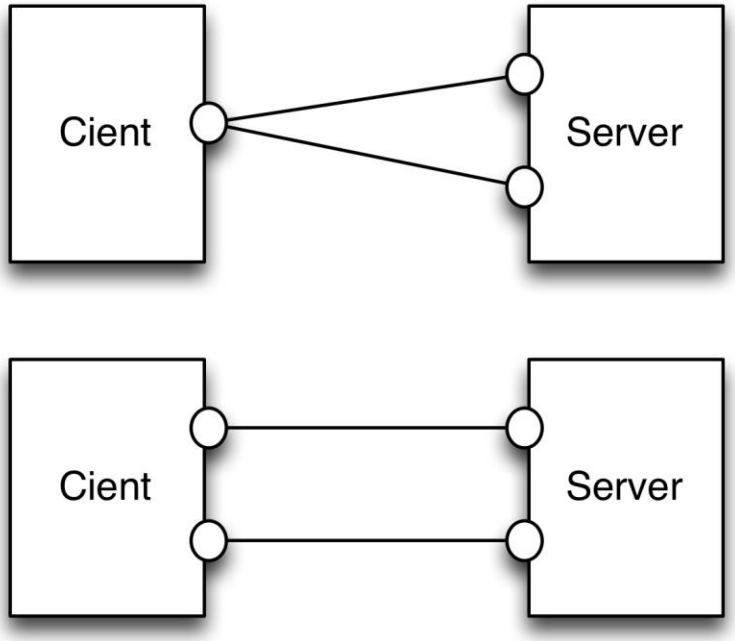
- Server Discovery
  - Use IPv4 (do not use IPoIB)
  - Can not support IPv6 any time soon (see 2012 LUG presentation: LNET Support for IPv6 is Long Overdue – Isaac Huang)
- Mostly Static Configuration
  - Painful for administration
  - Could really use DHCP for Cloud
  - Problem with Lustre/LNet and not fabric

20,000 ft View: Fault Handling



Channel Bonding

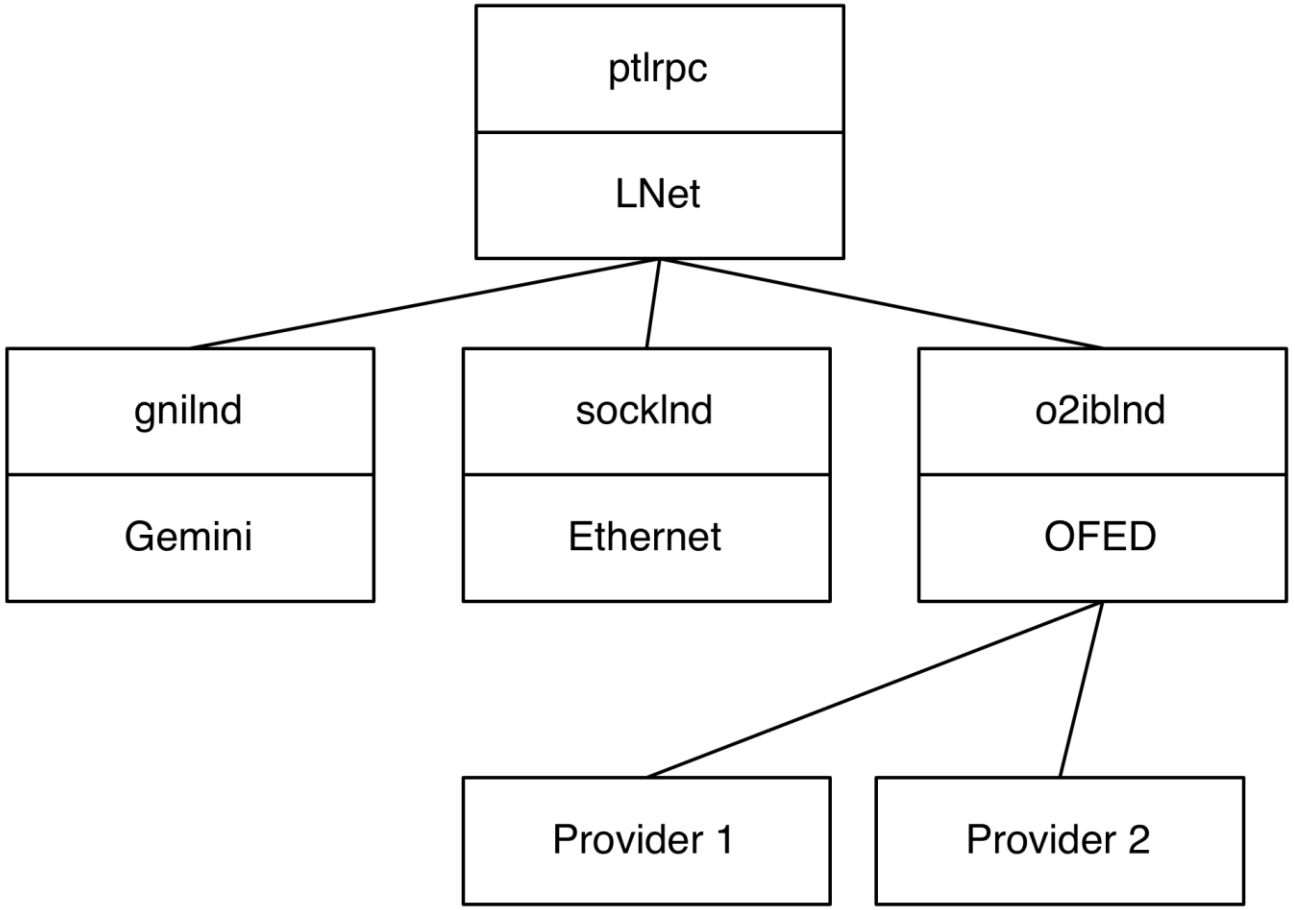
- Coming later this year
- Provides both:
  - Bandwidth
  - Redundancy
- Can Mix Fabrics supported by OFED
- Need: Good feedback when to abandon a pathway



Fault Handling

- Could use help with fault detection
  - Fault threshold passed in fabric
- Pings not good for scalable fault detection
  - See 2012 LUG paper: Lustre Ping Evictor Scaling in LNET Fine Grained Routing Configurations - Cray
  - Found a 4% - 11% reduction in throughput
  - Example: 25,000 clients, 360 OSSs, 4 OSTs per OSS:
  - 36M pings every 75s
- Need proper Health Network
  - High priority messaging in Fabric
- Packet arrival order: Does not matter to Lustre

10,000 ft View: Network Stack



OFED Usage

- Only PUTs Supported in o2iblnd
  - Therefore: only RDMA writes
  - Done to avoid limitations of RDMA reads
  - Need a way to manage RDMA read limitations
- Use Reliable Connections
  - Uses a lot of resources
  - Would be better if we could use Reliable Datagrams
- Choices:
  - <4k = Use Immediate
  - >4k = Use RDMA write

Runway: APIs used by o2iblnd

- ib_post_recv()
- ib_post_send()
- ib_poll_cq()
- ib_req_notify_cq()
- ib_create_cq()
- ib_destroy_cq()
- ib_mtu_enum_to_int()
- ib_destroy_fmr_pool()
- ib_create_fmr_pool()
- ib_fmr_pool_unmap()
- ib_fmr_pool_map_phys()
- ib_dereg_mr()
- ib_reg_phys_mr()
- ib_query_device()
- ib_dealloc_pd()
- ib_get_dma_mr()
- ib_alloc_pd()
- rdma_set_reuseaddr()
- rdma_resolve_addr()
- rdma_destroy_id()
- rdma_accept()
- rdma_connect()
- rdma_disconnect()
- rdma_create_qp()
- rdma_destroy_qp()
- rdma_bind_addr
- rdma_listen

Requirement Summary

1. Equal core access to Network Interface
2. Encryption support
3. Latency support -> FMR or equivalent
4. VM Support
5. SLA with Fabric
6. Single OFED stack Optimized for all supported interfaces. Preferably upstream (kernel.org)
7. Fault/Error Counters from Fabric
8. High Priority Messaging (Health Network)

Requirement Summary Cont

9. Control over RDMA read limitations from app
10. Support Reliable Datagrams

Thank You

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