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OFED in HPC and Beyond

Actionable Market Intelligence for High Performance Computing

Intersect360 Research

- Advisory service, research and consulting for HPC
- Addison Snell (CEO), Chris Willard (Chief Research Officer), Laura Segervall, Sue Gouws Korn
- Inclusive methodologies for technology and usage
- Syndicated research reports
  - Market sizing and forecasting
  - Technology trend analysis
  - End-user research
- Custom studies, client-specific services
- Weekly podcast with HPCwire's Michael Feldman

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Agenda

- OFED in HPC
  - Where it's used
  - Where it might also be used
  - Where it could be used but isn't
- OFED in data center
  - Enterprise computing vs. HPC
  - High Performance Business Computing
- Cloud computing and OFED
- GPU computing and OFED

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OFED

- RDMA / fabric optimization for performance efficiency, utilization, facilities optimization

- Works with multiple fabrics, but typically associated with InfiniBand

- Probably in use with most IB / RDMA implementations, but user may be unaware

- Only two mentions of OFED out of 263 sites with over 1,400 named middleware packages used*

- Less than 1% incidence of middleware mentioned!

- We will use IB penetration as a proxy for OFED use

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Things I've Heard This Week

- "As an application developer, if I don't have to go out to the kernel, I won't."

- "We use the entire OFED stack, but the end user doesn't see it."

- "We use every bit [of OFED], but we don't look at it that way."

- OFED is supposed to provide a benefit of efficiency in datacenters, but it can be hard to install and may not yet be viewed as "standard."

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HPTC Market and Forecast*

- 2010 total market: $17.4B, ~17% growth from 2009
  - Growth from recessionary 2008 and 2009
  - Strong Q4 2010
  - Servers are $6.6B (38%); next largest categories are software, storage
- Expecting continued strong growth in 2011 before moderating for rest of forecast period
- 2011 and 2012 growth strongest in industry sectors: U.S. government and academic spending may be constrained by federal and state budgets

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Interconnect Usage in HPC

Type	System[1]	Storage[2]	LAN[3]	All Locales
Ethernet 1G	217	114	155	486
Ethernet 10G	38	39	65	142
Ethernet - Unspecified	14	20	28	62
Ethernet - wireless	0	0	2	2
Ethernet 100M	22	8	12	42
Total Ethernet	291	181	262	734
InfiniBand - unspecified	85	21	20	126
InfiniBand 10G	19	9	6	34
InfiniBand 20G	52	12	13	77
InfiniBand 40G	20	2	9	31
Total InfiniBand	176	44	48	268
Fibre Channel	5	66	4	75
Myrinet	34	0	2	36
Proprietary	28	0	0	28
Quadrics	8	0	0	8
SCSI	0	2	0	2
Number of Mentions	**542**	**293**	**316**	
Number of Sites	**273**	**179**	**217**	

1, 3: Multiple responses per site.
2: Eight storage systems reported both Fibre Channel and Ethernet for their storage networks.
These are counted twice rather than as a combined entity of Fibre Channel and Ethernet.
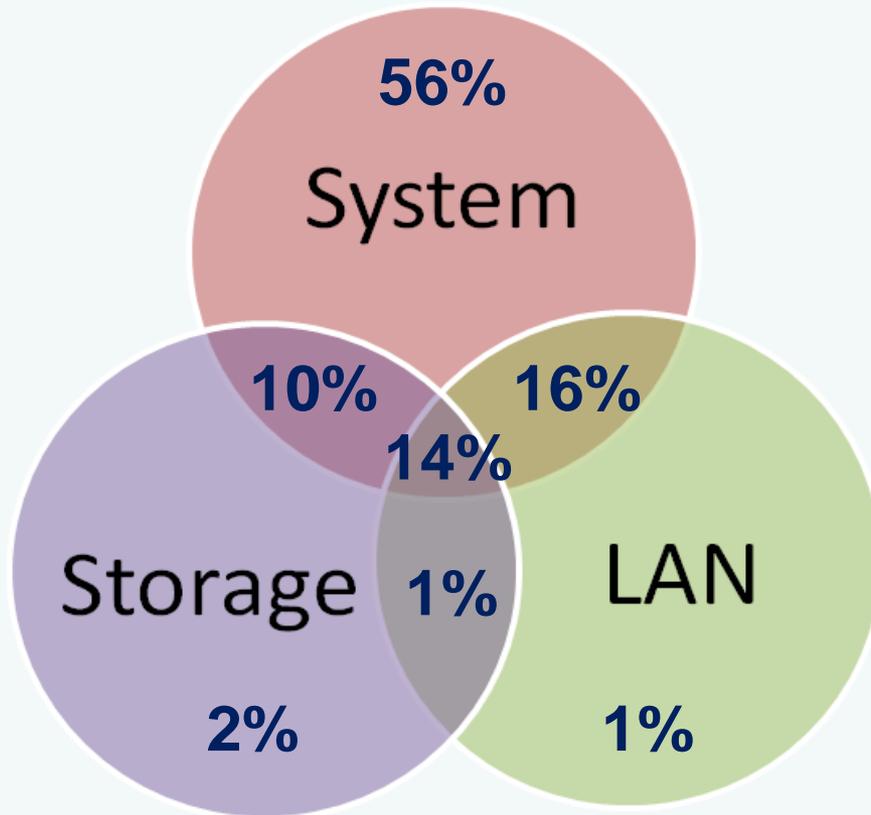
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HPC System Interconnects by Year

Interconnects used on x86 Cluster and Blade Systems by Year of Last Modification
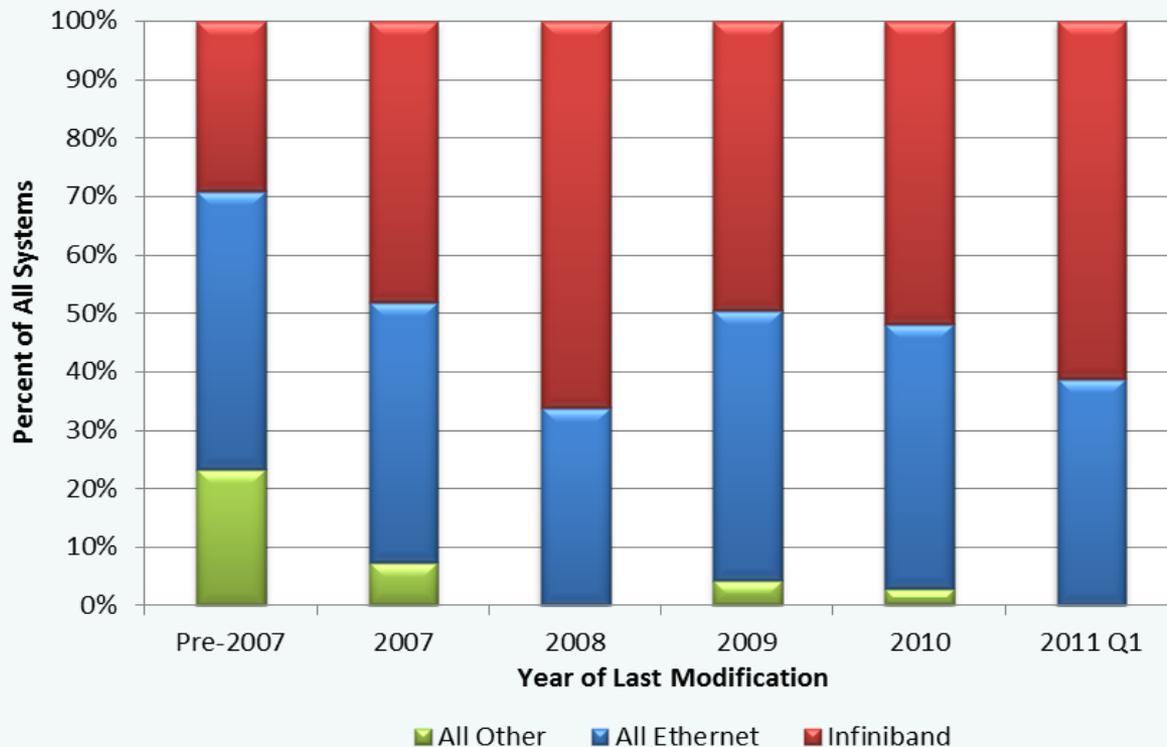
- **Ethernet usage relatively steady**
- **IB usage grew at expense of proprietary interconnects**

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HPC InfiniBand Usage Distribution

56%
System

10%   **16%**

14%

Storage   **1%**   LAN

2%   **1%**

- 96% of IB usage involves the system interconnect
- But storage and even LAN IB usage is growing: 40% of IB users have it in multiple locales
- In storage IB competes with both Ethernet and FC
- IB must expand beyond HPC systems to grow

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HPC Ethernet Usage Distribution

14%
System

2%   17%

35%

Storage   14%   LAN

1%   16%
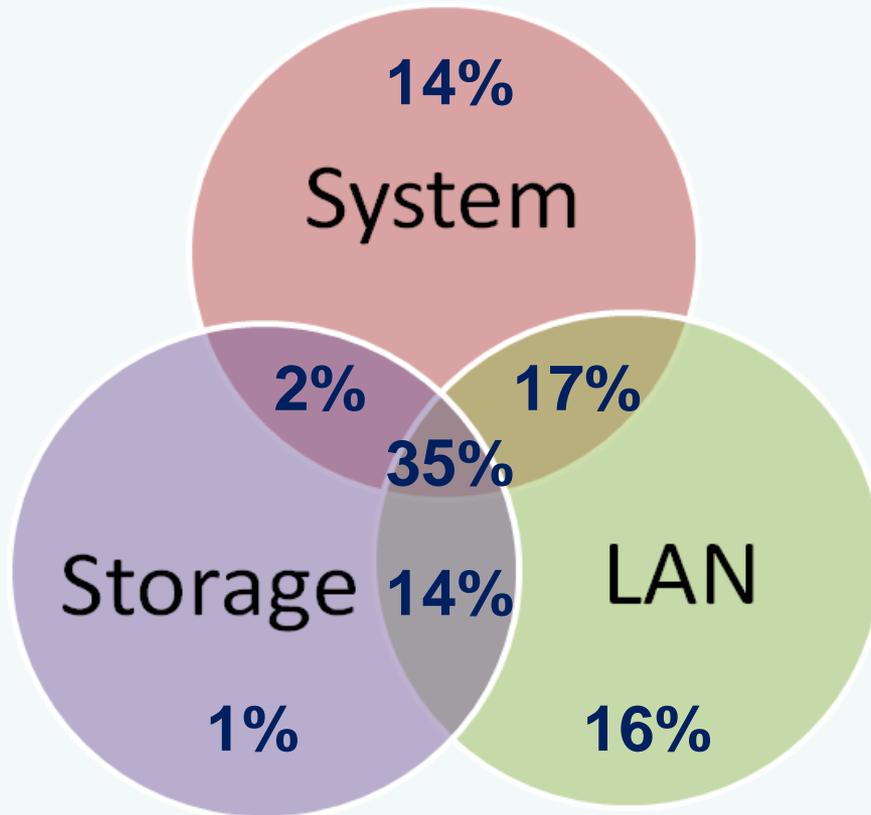
- 83% of Ethernet usage involves the LAN

- Over one-third of respondents have a converged Ethernet fabric

- To grow its penetration, OFED has to target heterogeneous and all-Ethernet environments

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HPTC vs. HPBC

- High Performance Technical Computing:
  - Science and engineering applications
  - Top verticals: Academic, gov't lab, defense, manufacturing, bio, energy
- High Performance Business Computing:
  - Complex event processing, business optimization, virtual environments, ultrascale business computing
  - Top verticals: Financial services, online games (MMORPGs), retail, internet, DCC&D
- Previous slides reflected more HPTC than HPBC

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IB and OFED in HPBC and Datacenter

- Ethernet usage is much more common
  - Focus on IT standards
  - Even HPBC doesn't tend to associate with "HPC"
  - Financial services is a major HPBC area, but even their latency-sensitive trading applications tend to be on Ethernet, not InfiniBand
- In HPC: "Once you solve the problem, it is no longer interesting. Solve the next problem."
- In enterprise datacenters: "Once you solve the problem, for heaven's sake, please don't touch it."

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HPBC in Financial Services

- Taxonomy published February 2011
- Finance applications in four categories:
  - Trading (both high-frequency and algorithmic trading)
  - Risk management
  - Pricing and valuation
  - Business and economic analytics
- Users are more complicated than "banks"
  - Most are multi-line businesses
  - "Finance" even includes some government
- Nearly $1B in 2010 server revenue (preliminary)

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"What cloud models are you evaluating?"

PUBLIC
13.7%

4.1%

PRIVATE
19.2%

20.5%

5.5%

15.1%
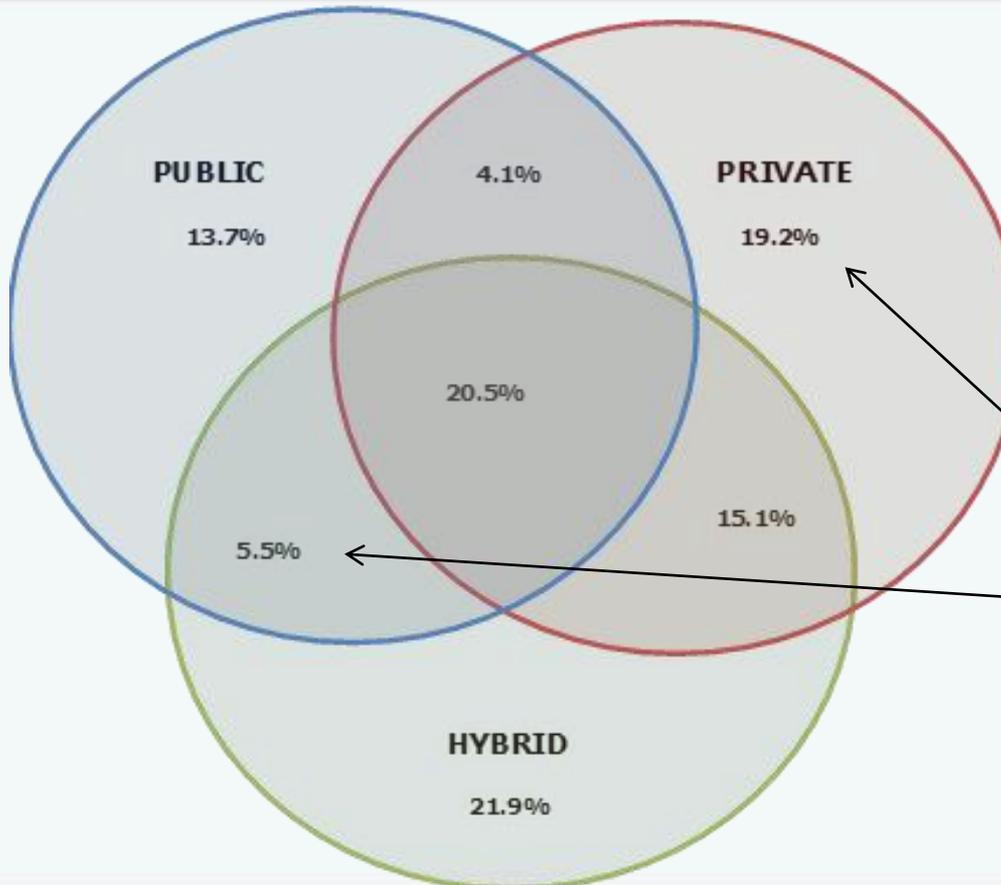
HYBRID
21.9%

- About half of respondents in 2010 survey are evaluating or using cloud
- Few large scale deployments
- More private/hybrid than public

How to read this chart:
- 19.2% evaluating private, but not public or hybrid
- 5.5% evaluating public or hybrid, but not private
- 20.5% evaluating all three
- 43.8% (total) evaluating public
- 63.0% (total) evaluating hybrid
- 58.9% (total) evaluating private

Cloud Barriers

1. Security: Keeping data (IP) safe; safeguarding
2. Result quality: Reproduceability, validation
3. Data transfer: Moving large data efficiently
4. Operational: Working cloud into a workflow
5. Managerial: SLAs, getting internal buy-in

Some barriers are more addressable by technology than others. For OFED, consider how you can improve timely, reliable access to data (and therefore insight).

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GPU Computing

- China: #1 and #3 systems on November Top500 list
- Traditional barriers: programming, latency, applications, pace of development.
- Still more testing than full-scale deployment BUT
- Increasing levels of interest in creating applications
- Ultimately, speed wins

Looking forward:
Intel MIC, AMD Fusion, NVIDIA Project Denver

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Interesting Dynamics in Middleware

- $400M+ market in 2010
- Major system/component vendors (e.g. Intel, IBM)
- Growing number of independent vendors:
  - Platform Computing
  - Adaptive Computing
  - Bright Computing
  - Univa

The OFED Opportunity

HPTC $17.4B	HPBC ~$5B	Non-HPC Datacenter Approx. $80B
		LAN
		Storage
① IB Systems		Ethernet Systems

1. Conscious usage on HPC IB systems.

The OFED Opportunity

HPTC $17.4B	HPBC ~$5B	Non-HPC Datacenter Approx. $80B
		LAN
		Storage
② ↑ ① IB Systems		Ethernet Systems

2. Expand to Ethernet and heterogeneous systems.

Based on 2010 total market revenues. Source: Intersect360 Research

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The OFED Opportunity

HPTC $17.4B	HPBC ~$5B	Non-HPC Datacenter Approx. $80B
		LAN
③		
↑		Storage
②		
①		Ethernet Systems
IB Systems		

3. Expand to converged fabrics.

The OFED Opportunity

HPTC $17.4B	HPBC ~$5B	Non-HPC Datacenter Approx. $80B
		LAN
③		Storage
②	④	Ethernet Systems
① IB Systems		
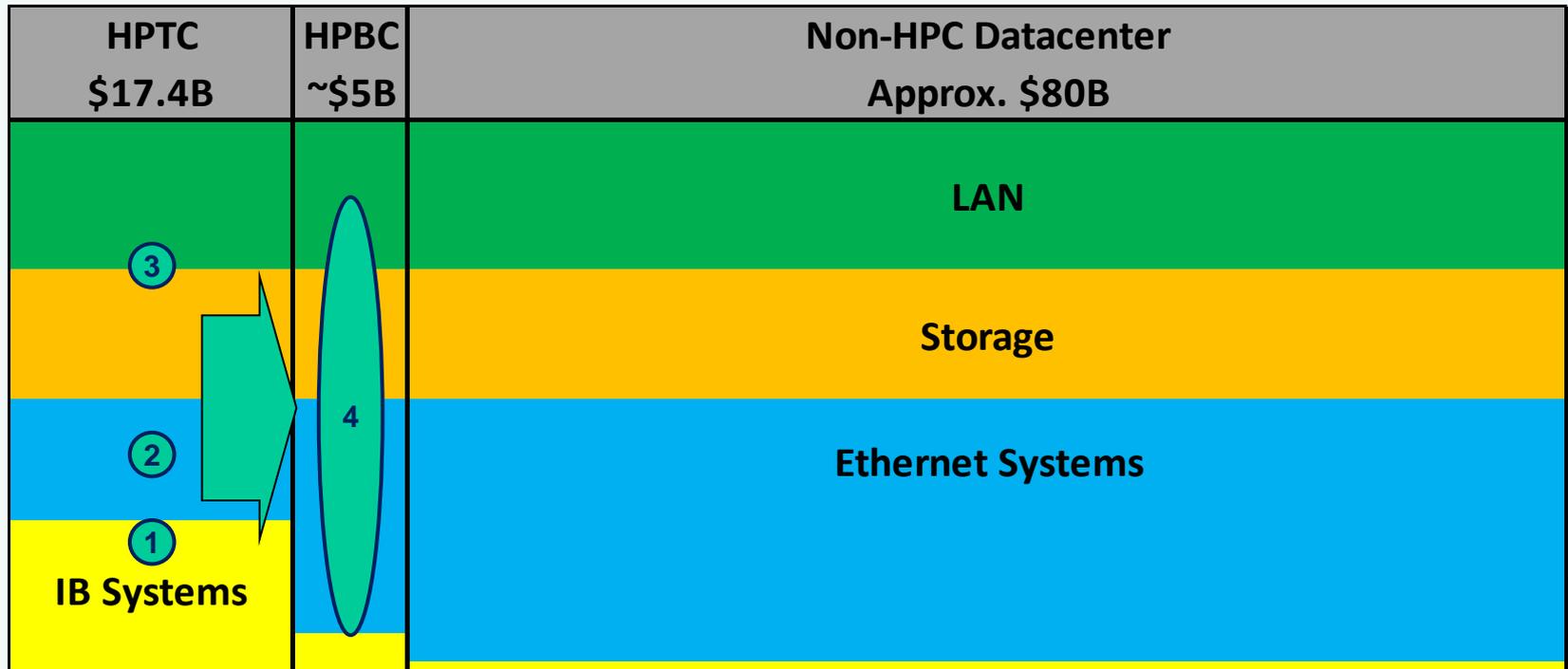
4. Incorporate HPBC application areas.

The OFED Opportunity

| HPTC $17.4B	HPBC ~$5B	Non-HPC Datacenter Approx. $80B
		LAN
③		Storage
②	4	5
①		Ethernet Systems
IB Systems		
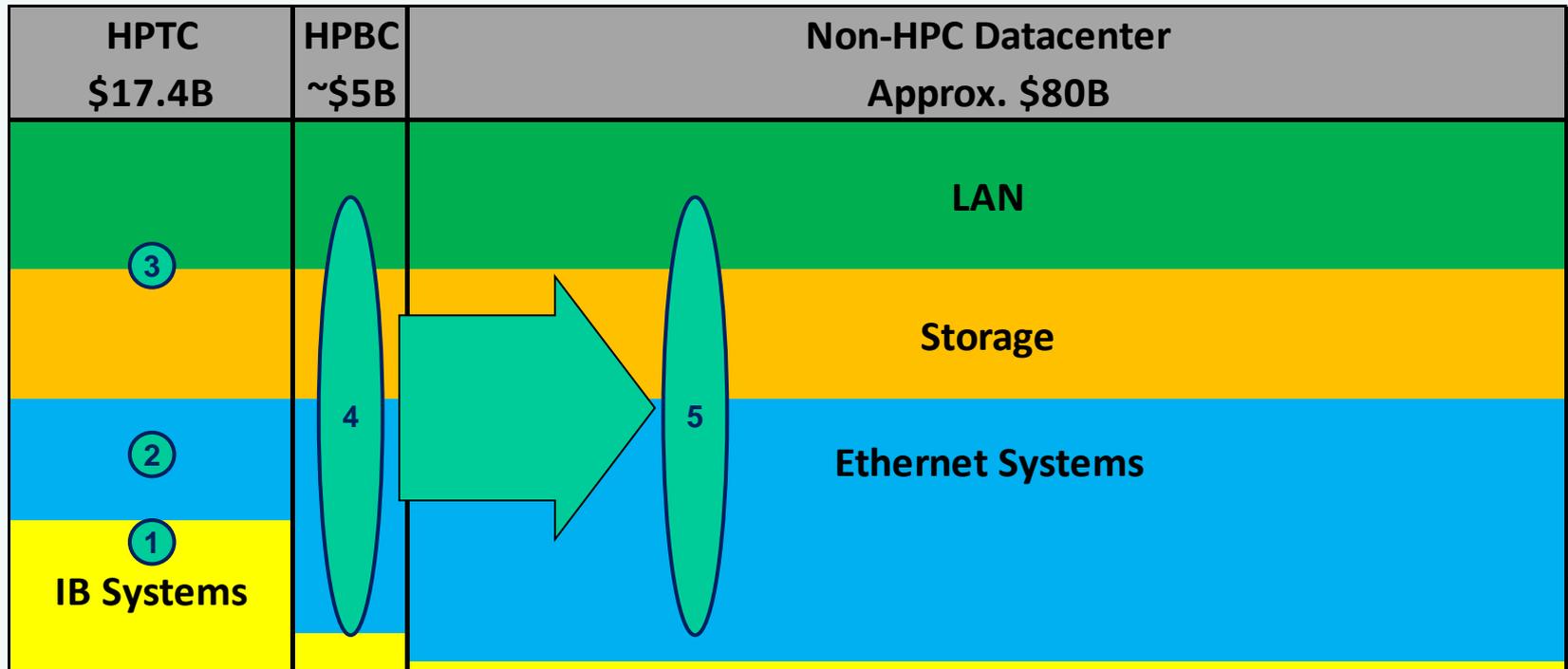
5. Address the non-HPC datacenter.

The OFED Opportunity

- OFED/IB opportunities in storage, HPBC, datacenter
- Consider branding OFED as distinct from InfiniBand
  - Leveraging opportunity in mixed-interconnect sites
  - Focus on high-throughput, regardless of fabric
- Most cloud deployments will be private or hybrid
  - OFED can be a cloud optimization tool
  - But the "cloud" space is crowded. Partner?
- GPU computing can be an opportunity: Capitalize on awareness of importance of efficiency
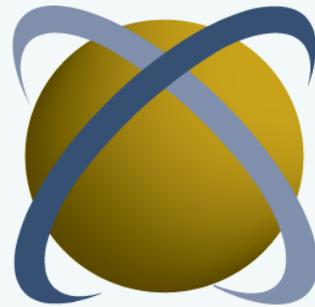
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