

RONNIEE

Express



A Dramatic Shift in Network Architecture

Presented by:

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Under NDA until February 25, 2014

- ❑ Headquartered in the Silicon Valley
- ❑ Founded in 2012 as a result of more than 5 years of research and development operations
- ❑ Assembled a very skilled and experienced A-class team in engineering and management with proven track records and success stories
 - ❑ *Antonella Rubicco* – Founder and CEO
 - ❑ *Emilio Billi* – Founder and Chief Technology Officer
 - ❑ *Stephen Ozoigbo* – Chief Strategy Officer
- ❑ Employees – Under 25

U.S. Patents filed

Intellectual Property

- ❑ #61786560 - Massive parallel petabyte scale storage system architecture
- ❑ #61786537 - PCIe non-transparent bridge designed for scalability and networking enabling the creation of complex architecture with ID based routing
- ❑ #61786551 - Low-profile half length PCI Express form factor embedded PCI express multiport switch and related accessories

Why the need for a fundamental shift in network architecture?



- ❑ Conventional architectures to move stored data are still based on design concepts that have been largely unchanged since the advent of storage, using single-threaded sequential communication processes
- ❑ The huge disparity between computing power and storage performance has created a massive I/O performance gap in the enterprise as well as Big Data, HPC and data centers
- ❑ The emergence of enterprise SSD technology has simply shifted the storage I/O bottleneck from the storage device to the interconnection between storage and the CPU, exposing the limitations of conventional PCI Express and other flash architectures
- ❑ Scale-out systems today require end-to-end synchronization of metadata, or offer a limited number of ingress/egress networking ports

Competition from traditional network standards

Ethernet

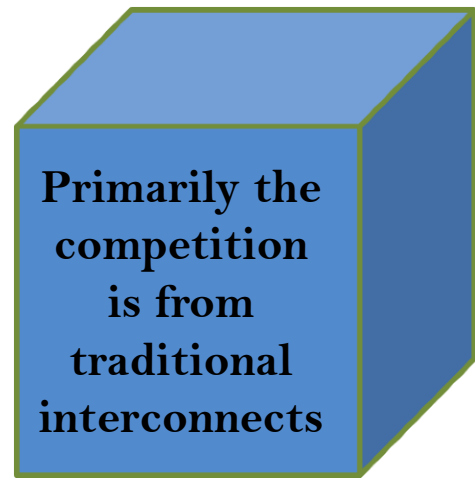
- ☐ Very well established
- ☐ Many clustering topologies used
- ☐ **Relatively high cost** (above Gigabit Ethernet)
- ☐ **Very high latency**
- ☐ **High power** (above Gigabit Ethernet)
- ☐ Needs additional adapter cards (above Gigabit Ethernet)

Infiniband

- ☐ Established in supercomputing systems
- ☐ Driver model exists
- ☐ **Very expensive**
- ☐ **High power**
- ☐ Not as widely available as Ethernet or PCIe
- ☐ Requires additional adapter cards

Standard PCIe

- ☐ It's everywhere
- ☐ It's the standard for the server I/O interface
- ☐ **It is not a real fabric, just a connect**
- ☐ **It does not scale**



A new High-Performance Cluster Interconnect based on a disruptive pure memory mapped communication paradigm

The In Memory Network

*A re-architected Network Interface Card
Merging Storage and Compute*



- ❑ A new 'Brain Inspired' Interconnection Fabric providing low latency CPU to CPU and IO to IO traffic via a next generation Network Interface Card
- ❑ A revolutionary extension of PCI Express memory mapping features
- ❑ A multi-dimensional network topology with A3CUBE's patent pending distributed non-transparent bridging (dNTB) architecture
- ❑ RONNIEE Express fabric extends the standard PCIe architecture, introducing a new architecture based on a globally shared memory container that makes clusters, expansion boxes and shared-I/O applications easy to develop and deploy

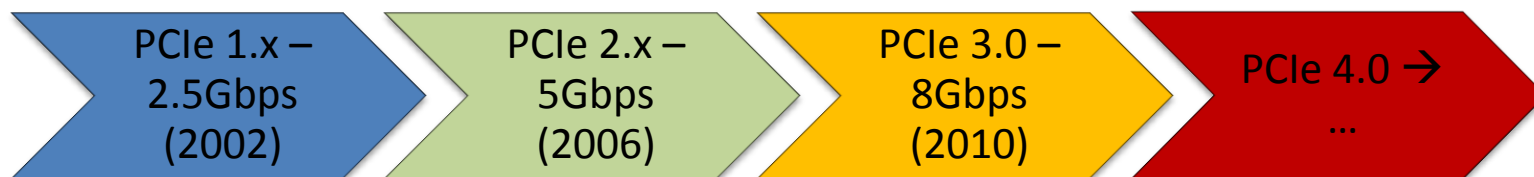
Why RONNIEE Express is more powerful than PCIe as a network fabric



- ❑ RONNIEE Express is the first multi-dimensional interconnection technology with high bandwidth, low latency, continuous availability and linear scalability for exascale out storage
- ❑ A revolutionary RAID-less storage architecture for hyper-scale data systems based on an innovative “In-Memory” network design approach, enabling bottleneck-free storage in HPC, Big Data, and the datacenter for vastly improved storage performance and vastly lower TCO
- ❑ Creates scale out storage that can deliver hundreds of gigabytes of throughput and millions of IOPS with massive linear scalability in both storage capacity and bandwidth
- ❑ *Extends PCIe, adding features to enable a real interconnection fabric, not just a simple interconnect*

Why use PCI Express as starting point for a cluster interconnect

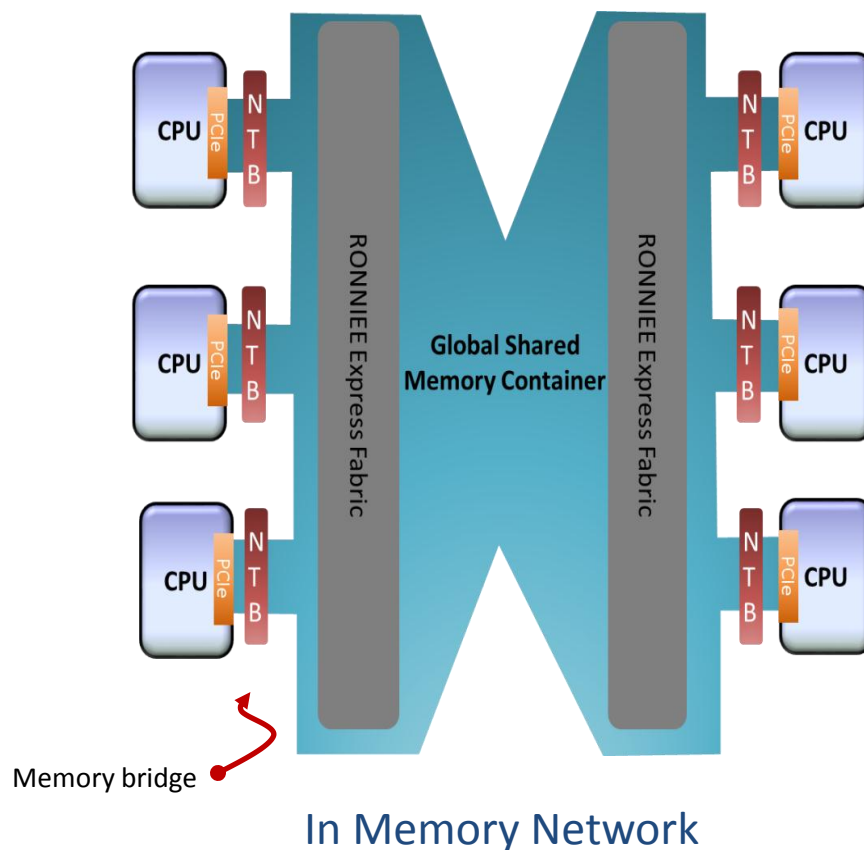
- ❑ PCIe is ubiquitous and has a well developed ecosystem
- ❑ PCI Express standards have seen continuous development
- ❑ PCIe 2.x and 3.0 offer enormous scalable bandwidth compared with Infiniband and 100 Gb/s Ethernet



- ❑ PCI Express is the “de-facto” I/O interconnect on 90% of the CPUs/Chipsets
- ❑ Using only PCIe inside the network avoids the overhead of bridging to and from multiple protocols

Why RONNIEE Express is different and so powerful?

- ❑ The RONNIEE Express NIC uses memory as the main communication paradigm
- ❑ With PCIe you can have direct access to memory using “memory windows”
- ❑ A3CUBE’s unique NIC architecture uses these “memory windows” to create a shared global memory container that permits direct communication between:
 - ❑ *Local CPUs and remote CPUs*
 - ❑ *Memory to memory*
 - ❑ *Local and remote I/O*



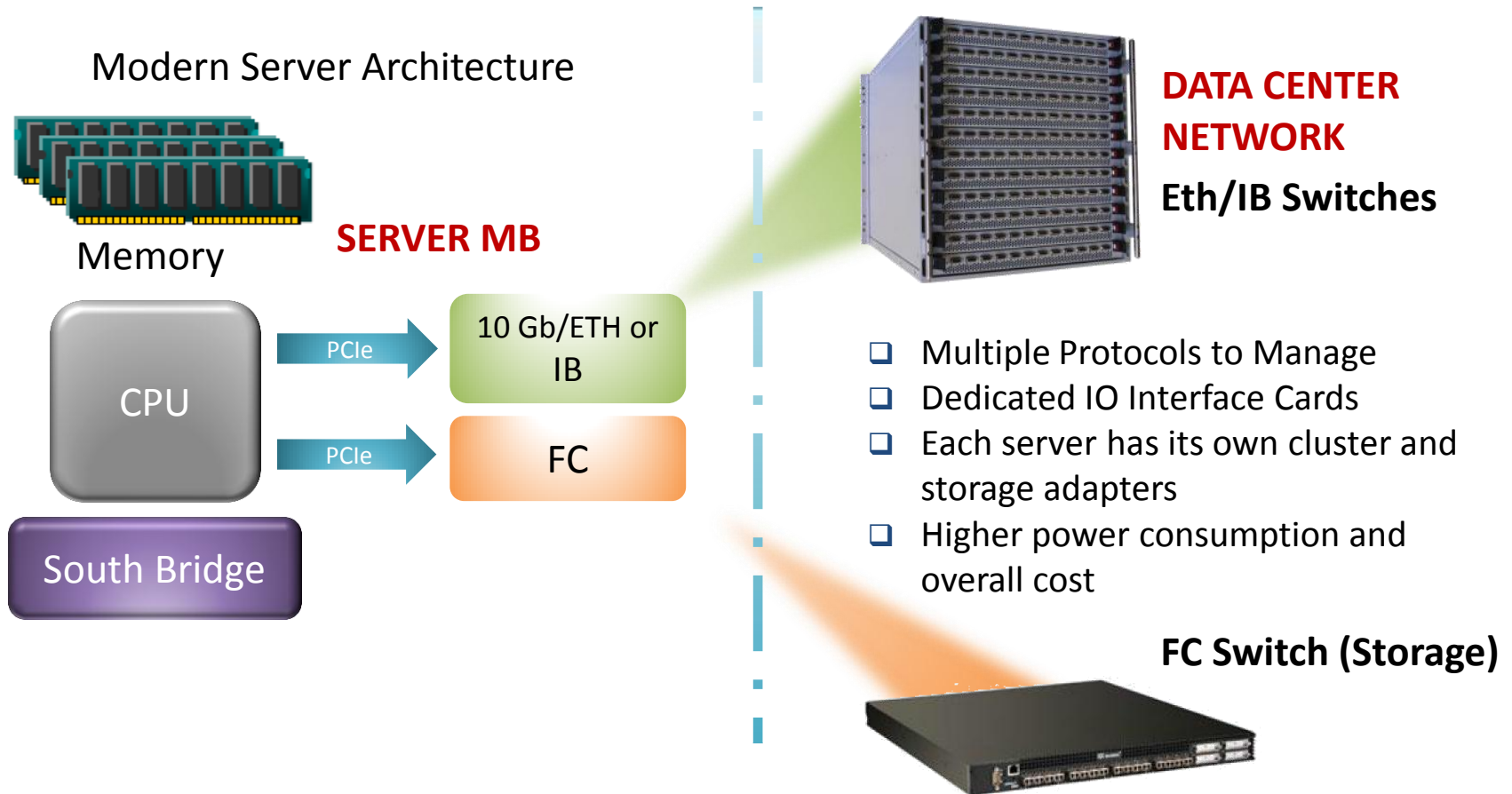
ByOS The Operating System for Parallel Storage

ByOS is designed to provide a **Massively Parallel Supercomputing Experience** applied to data access and computing

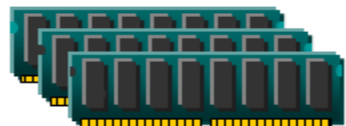


- ☐ Highly parallel architecture with intelligent relationship between available CPUs and I/O
- ☐ Leverages supercomputing's massively parallel design concepts for exascale data access and computing
- ☐ Bottleneck-free no-metadata server architecture
- ☐ Scaling of capacity and I/O independently

Current Cluster and Datacenter Architectures



Modern Server Architecture with RONNIEE Express NIC



Memory



CPU



South Bridge

SERVER MB

PCIe

PCIe

Other servers



RONNIEE Express Fabric



IOs / Storage

- ❑ Shared memory model using Non-Transparent Bridging
 - ❑ *Removes the latency penalty for bridging to other protocols*
- ❑ High bandwidth connections between hosts
- ❑ Integrated DMA, RDMA, QoS and advanced flow control
 - ❑ *Communicates with I/O devices directly with PCIe*
- ❑ PCIe integrated in CPUs and chipsets

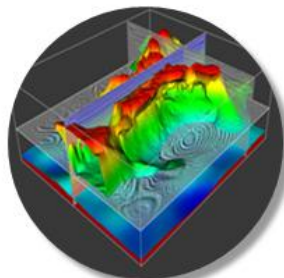
A memory mapped unified fabric with multi-dimensional local to remote direct communication

RONNIEE Express Use Cases

Building Blocks For



Big Data / Datacenter



High-Performance
Computing



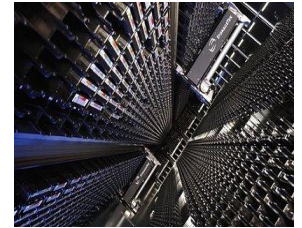
Biotech



CFD



High End Routers



Parallel Storage



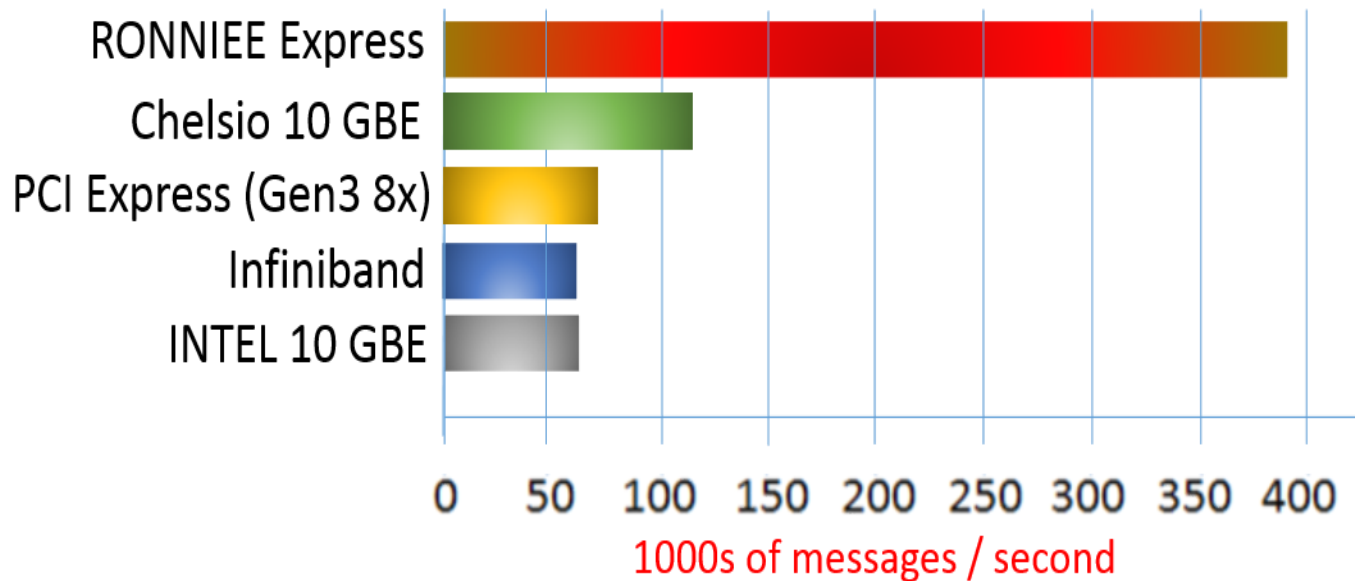
Embedded
Computing



Redundant
Servers

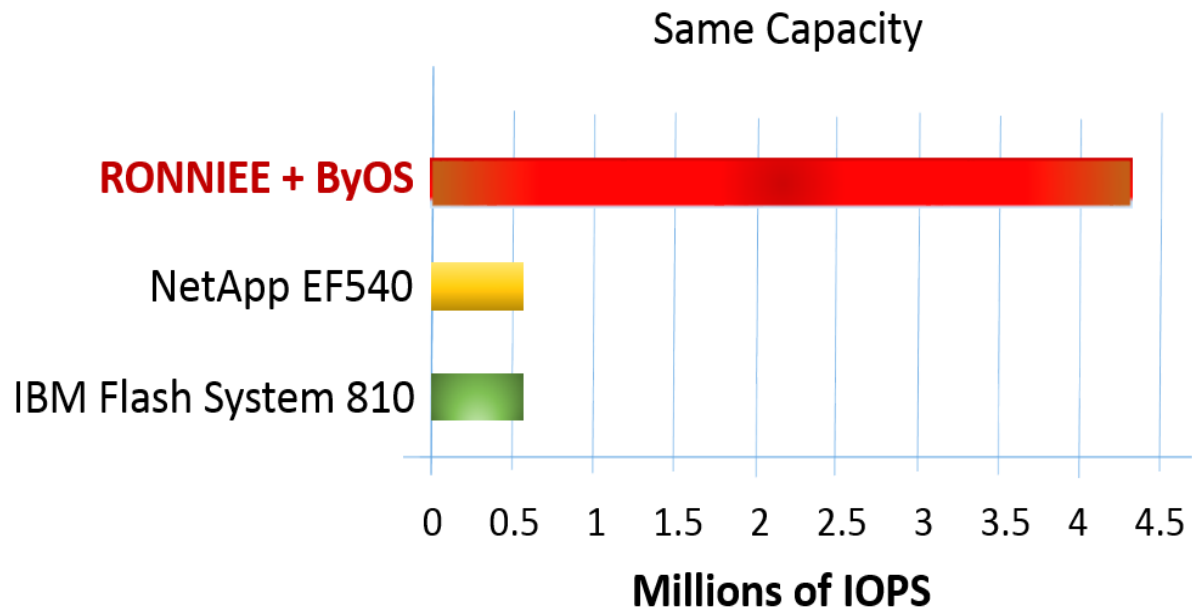
RONNIEE Express new standard in performance

Benchmark example:
Extreme performance



RONNIEE Express a new standard in performance

Benchmark example applied to storage:
Unmatched IOPS



RONNIEE Express topology advantages

	10Gbe Network	RONNIEE Express pure 3D	RONNIEE Express Switch
Power consumption	~ 170 KW	110 KW	75 KW
Power consumed for cooling	60.9 KW	39.4 KW	26.8 KW
Total Power consumed	230.9 KW	149.4 KW	101.8 KW
Cost per Kwh	10 cents	10 cents	10 cents
Cost per year	\$202,232	\$130,850	\$89,220
CO2 emitted per year	458 tons	297 tons	212 tons

Using these figures: Network Power Saving

- For 10,000 nodes over a year the A3CUBE RONNIEE Express 3D solution typically saves close to \$70,000. **In a five-year period this saving rises to \$350,000**
- The RONNIEE Switch solution typically saves close to \$113,000. **In a five-year period this saving rises to \$565,000**
- Reduced power consumption also leads to a decrease in the carbon footprint. In a five-year period the 10,000 nodes with RONNIEE 3D, when compared to a typical 10Gbe Network, lead to a **reduction of 805 tons in CO2 emissions** and RONNIEE Switch lead to a **reduction of 1,230 tons in CO2 emissions**

Thank You



- ❑ Unmatched cost/performance by providing an affordable solution for high-end applications and use cases
- ❑ New Standard of bandwidth and latency; support for an efficient IPC paradigm, through use of non-transparent shared memory; IO virtualization in a multi-host environment
- ❑ RONNIE Express is the new data plane designed to accelerate Big Data, HPC and I/O intensive applications

Questions?