# Company

- 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
- *Antonella Rubicco* – Founder and CEO
- *Emilio Billi* – Founder and Chief Technology Officer
- Employees – 25

## Intellectual Property

**U.S. Patents filed**

- #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

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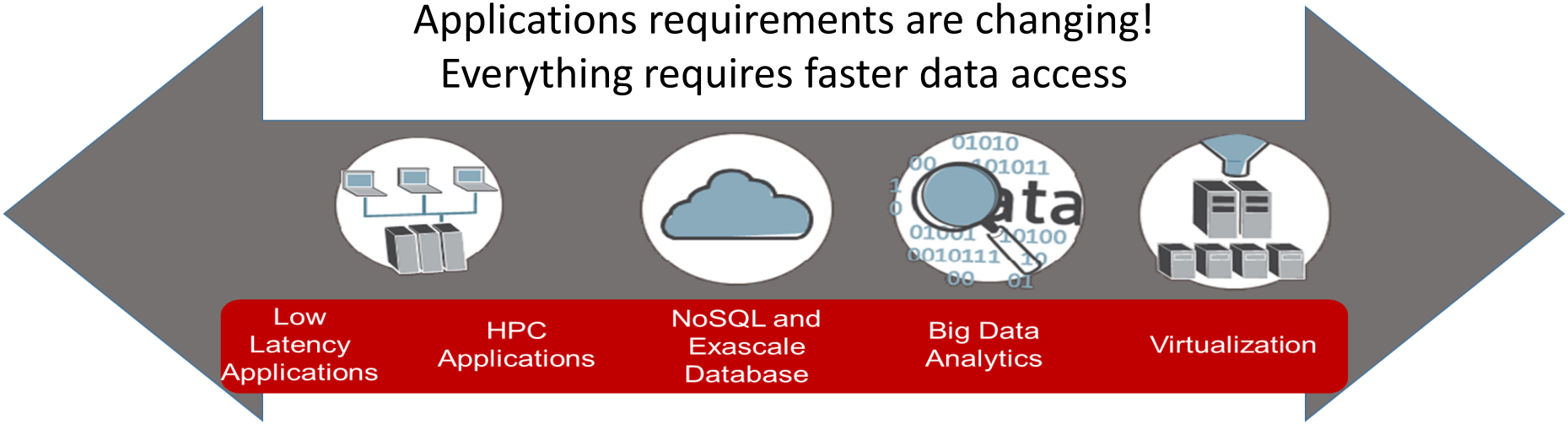
# Balancing Application Efficiency and Performance

Applications requirements are changing!
Everything requires faster data access




Local Storage Acceleration solutions

**In Memory**
**SSDs**
**PCIe SSDs**
**…**

Linearly scale I/O Capacity and Performance

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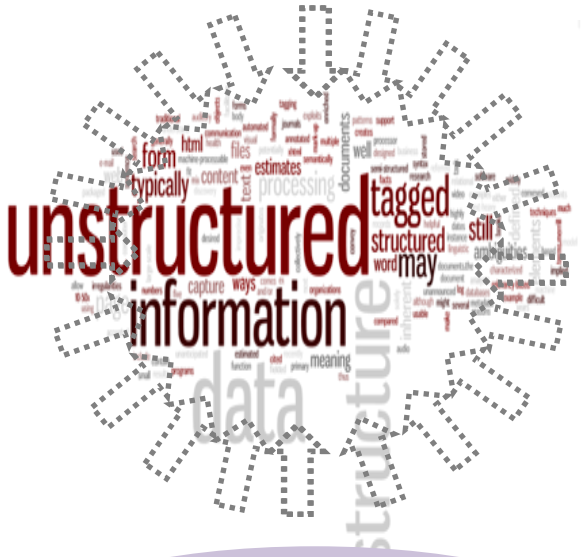
# Unstructured Data Challenges

The applications & software are Parallel, the storage is NOT





There is a need for a new parallel approach to Data that will fit with emerging software approaches

Exabyte's of Data per Day are generated and must be stored and analyzed

All of them use a **massive parallel** scale out approach to store and analyze DATA

| Today Data is "Unstructured Data" | Software solutions for "Unstructured" | Scale out Bottleneck |
|---|---|---|

*"Every time you have a real bottleneck to solve, you have to find a new architecture"*
(Dr. Steve Chen : New Blue Earth Roundtable Association conference, November 11, 2009, Zurich, Switzerland)

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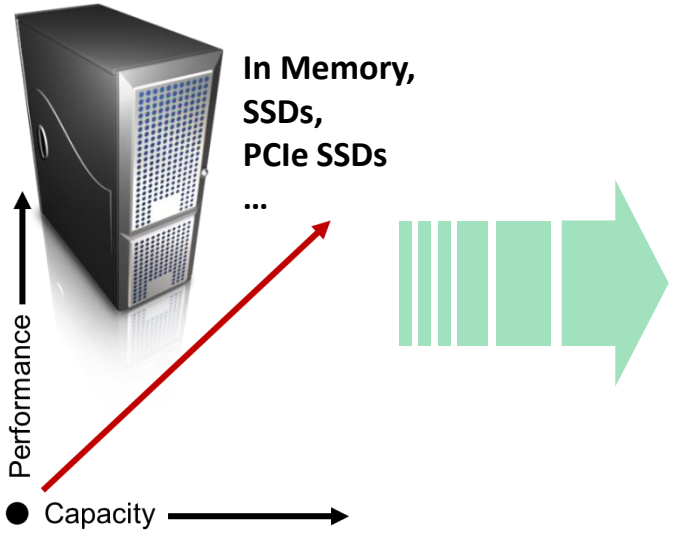
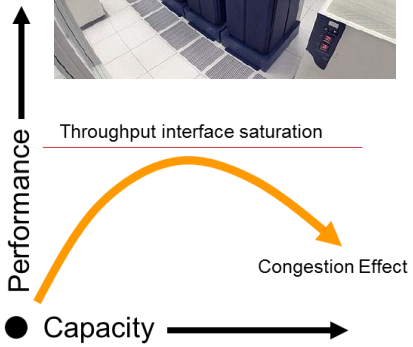
# The Scale Out Acceleration Problem

- Storage doesn't scales linearly
- It is easy to increase capacity but it is difficult to scale in performance
- Adding capacity is only one dimension, the systems managing those disks/SSDs need to scale as well

**Local Storage Acceleration solutions**




**Scale OUT Solution**



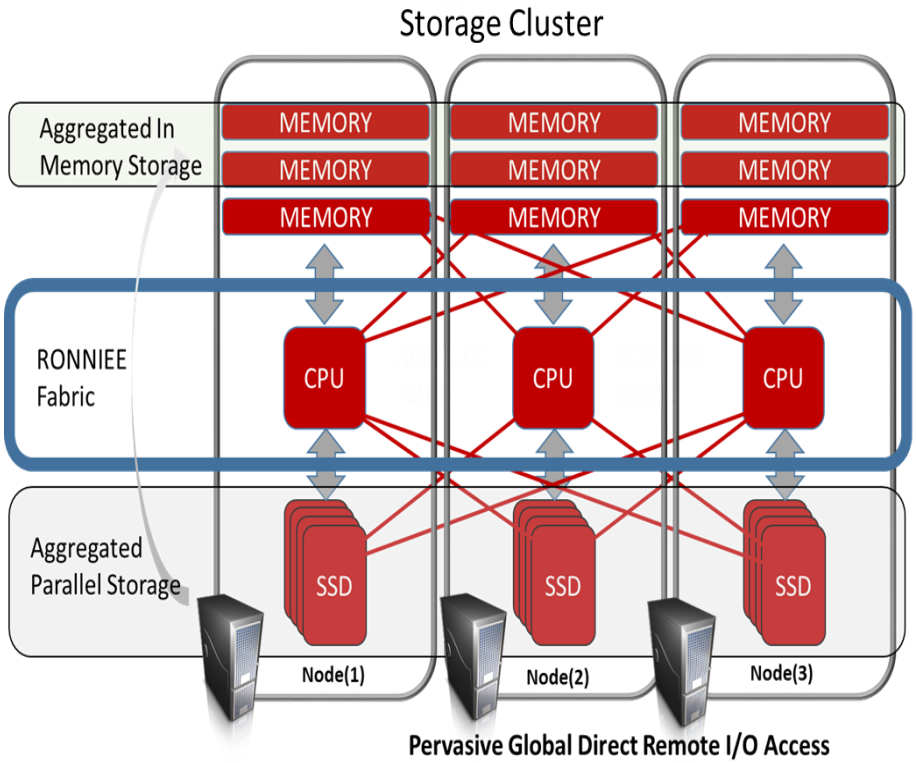

- Metadata synchronization creates bottlenecks
- Throughput scalability is very difficult
- Intern node latency creates IOPS scalability issues
- Not designed for intense IO application needs

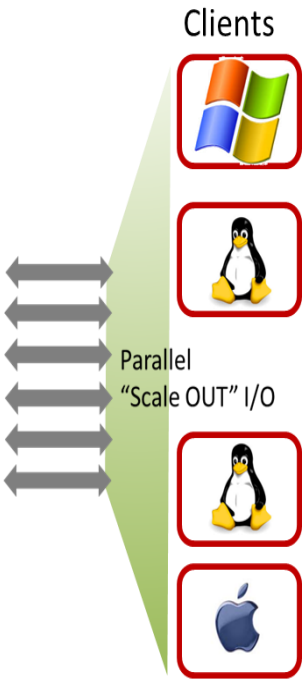
Bringing the performance from inside the server to the entire cluster

# Introducing Fortissimo Foundation

## Clustered Pervasive Global Direct Remote I/O

**Opening access to all the resources in the cluster as if they were local**




- Eliminate Metadata synchronization
- Linear Throughput scalability
- Direct remote I/O and ultra low latency inter node communication solves the IOPS scalability problem
- Designed to support today and tomorrow's intense IO application needs

Local CPU to remote memory latency <800 nano seconds!
(including operating system and software overhead)

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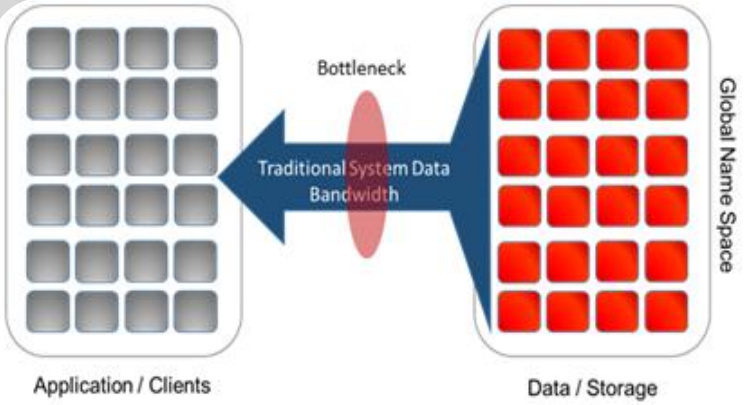
# Fortissimo Foundation Benefits vs. Traditional Scale Out

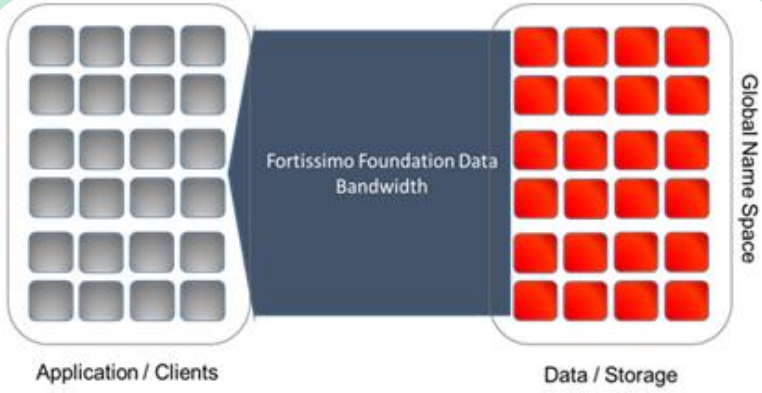
## Traditional Scale OUT storage Aggregated Read Bandwidth




**Storage Controllers with pool of disks connected (Scale OUT)**

| | |
|---|---|
| Scalability | 🔴 |
| Performance | 🔴 |
| Management | 🔴 |
| Availability | 🔴 |
| Cost | 🔴 |

## Fortissimo Foundation Aggregated Read Bandwidth




**Fully Parallel Approach**

| | |
|---|---|
| Scalability | 🟢 |
| Performance | 🟢 |
| Management | 🟢 |
| Availability | 🟢 |
| Cost | 🟢 |

# Targeted Applications

*Fortissimo Foundation Eliminates the challenges and cost in building systems for these applications*

## NoSQL Based Applications

Redis, Neo4j, Cassandra, CouchDB, mongoDB, membase, riak

Up to 100x speedup with "in Memory" acceleration

## Hadoop Based Application

hadoop

Up to 100x speedup with "in Memory" acceleration.
Lower Capex
Easiest to manage

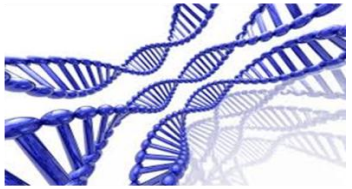
## I/O Intense Applications

- **Multimedia applications**
- **Scientific Applications**
- **Large dataset computation**
- **IO intense MPI applications**
- **Virtualization**

## Targeted Market Segments

Oil and Gas

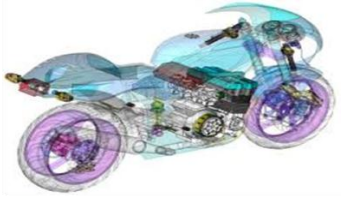

Data Analytic



Bio-medics and Biotech

Financial

Multimedia production and deployment



Manufacturing

# Targeted Applications

Fortissimo Foundation can be configured and tuned to efficiently support any workload

## NoSQL Based Application

Redis Neo4j Cassandra CouchDB mongoDB membase riak

Up to 100x speedup with "In Memory" acceleration

**>10X performance or <10X Less Hardware**

Less hardware
Less CAPEX
Less OPEX
Less complexity
Simplicity

## Solve the Performance and Scaling problem

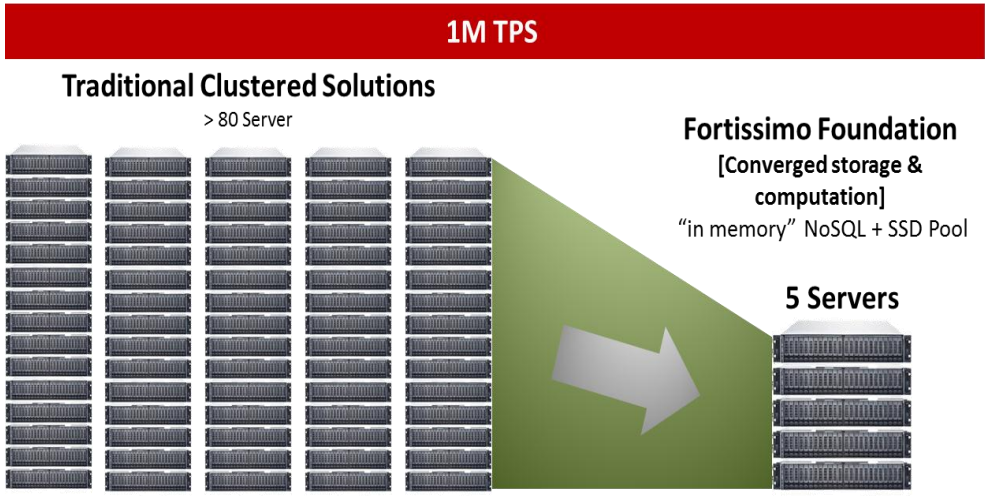
The convergence of storage, DRAM memory and data availability features, permit s easy linearly scalability

## Eliminate deploying complex infrastructures

Everything is optimized, simplicity, inter node communication , memory merging, storage merging is managed using a simple GUI.

## Easy to manage and tune

## Optimizes performance



# Targeted Applications

Fortissimo Foundation can be configured and tuned to efficiently support any workload

**Hadoop Based Application**


Up to 100x speedup with "in Memory" acceleration.
Lover Capex
Easiest to manage

Big data is becoming increasingly important for all enterprises

- Standard Hadoop solutions (hardware level) are too complex to be easily deployed
- Standard Hadoop solutions (hardware level) require the understanding of parallel and HPC architectures
- Hadoop requires Computing-Merged storage (see. Cloudera hardware best practice) No existing storage system is really designed for Hadoop

## Key Points

- **Fortissimo Foundation** provides an easy, ready to use storage and converged platform for Hadoop, engineered to work seamlessly within Hadoop design requirements
- Eliminates the scalability weaknesses within Hadoop (Remove name node, no single point of failure, HA built in policies)
- Accelerates HDFS using direct "in memory" communication

  Acceleration using DRAM on read and write operations (no customization required)
- **Eliminates complexity in managing , optimization and deploying**

# Targeted Applications

Fortissimo Foundation can be configured and tuned to efficiently support any workload

## I/O Intense Applications

- **Multimedia applications**
- **Scientific Applications**
- **Large dataset computation**
- **IO intense MPI applications**
- **Virtualization**

- I/O intense infrastructures and clusters are really complex to deploy
- The needs for optimized architectures require carefully chosen hardware and software to bring them together correctly

## Fortissimo Foundation

- Turn Key solution for intense IO applications
- Eliminates complexity in deploying clustered MPI and HPC storage converged solutions
- Fully converged computing and scalable storage platform with native MPI and merged storage
- Scalable In memory capability (put your data in multi-terabytes of memory without any application changes)
- Ultra fast NAS for existing cluster solutions with parallel data access and scale out "in memory" caching (provide acceleration to existing infrastructure without extra costs)

# Targeted Applications

Fortissimo Foundation can be configured and tuned to efficiently support any workload

## I/O Intense Applications

- Multimedia applications
- Scientific Applications
- Large dataset computation
- IO intense MPI applications
- **Virtualization**

- Optimized Virtualization storage strategy is the key for VMs performance
- Traditional storage is not designed to allow VMs to extoll bare metal performance and is complex to manage

## Fortissimo Foundation

- Simplify VMs storage deployment
- Accelerate VMs using sophisticated built in memory caching
- Connect to the Host server with standard protocols
- Optimize VMs performance with both faster VMs operation and faster storage data access
- Supports NAS and converged architectures [ NAS or converged (Hypervisor & storage run together]

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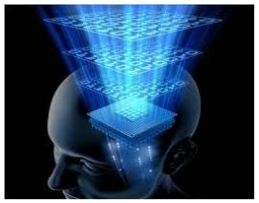
# Fortissimo Foundation

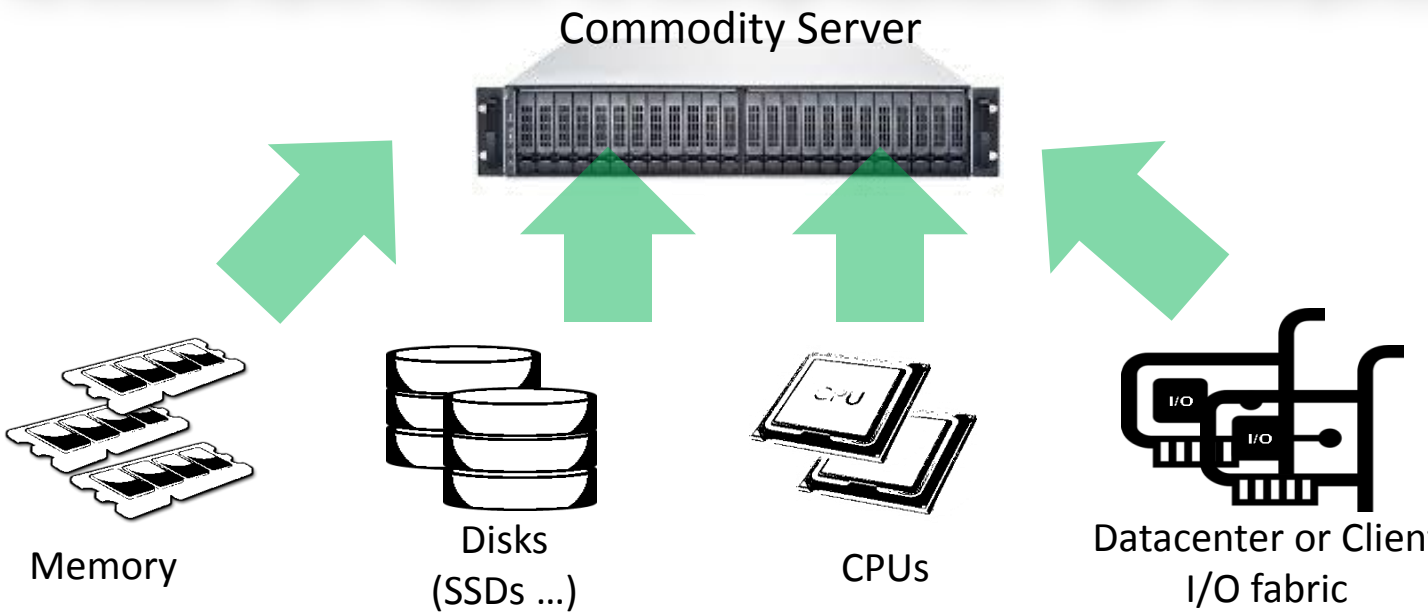
**RONNIEE NIC**

**RONNIEE Express Data Path Accelerator**



**Fortissimo Foundation**

***The RONNIEE Express Platform: The Ultra High Performance Hyper-converged Ecosystem***

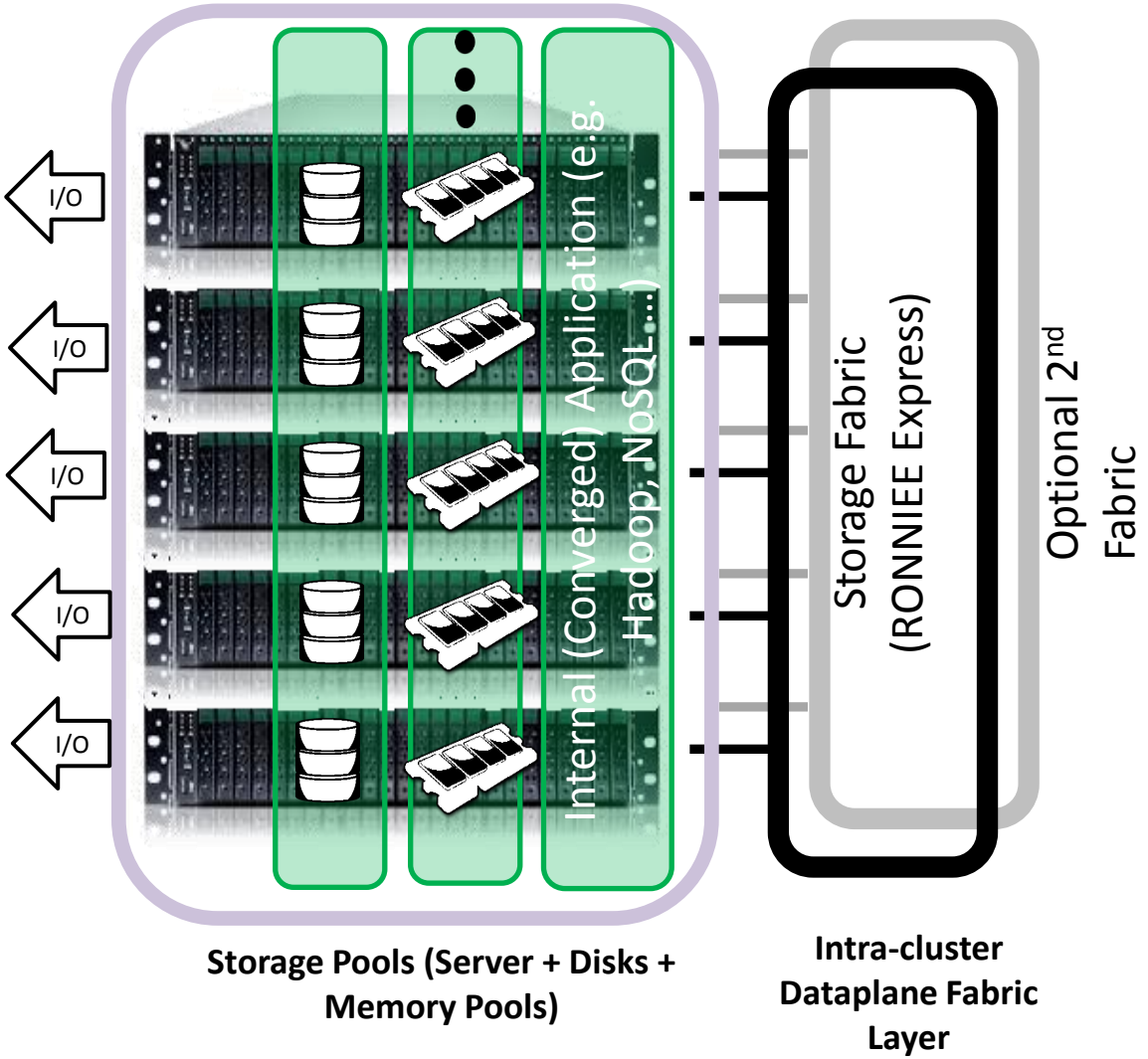



Extremely Flexible, Highly configurable, OPEN Platform

# Fortissimo Foundation

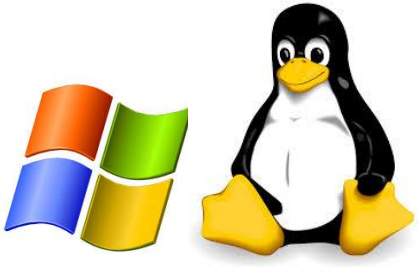
## Ultra High Performance Hyper-converged Ecosystem

- Massively scalable Global name space
- **Unique Aggregation of Storage & RAM Memory for a new level of performance (non coherent)**
- **Single unified OPEN platform across many applications**
- Concurrent parallel I/O to data access
- Elimination of "metadata synchronization" (I/O can scale with the number of nodes without metadata overhead)
- Supporting converged application in the same machine



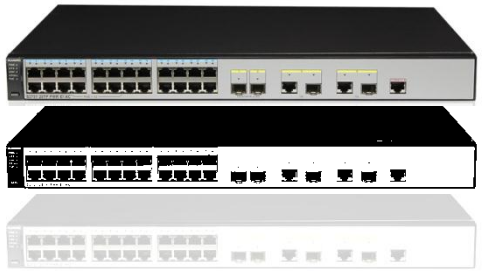
# The RONNIEE Express Platform

## Simple integration into the existing data center infrastructure



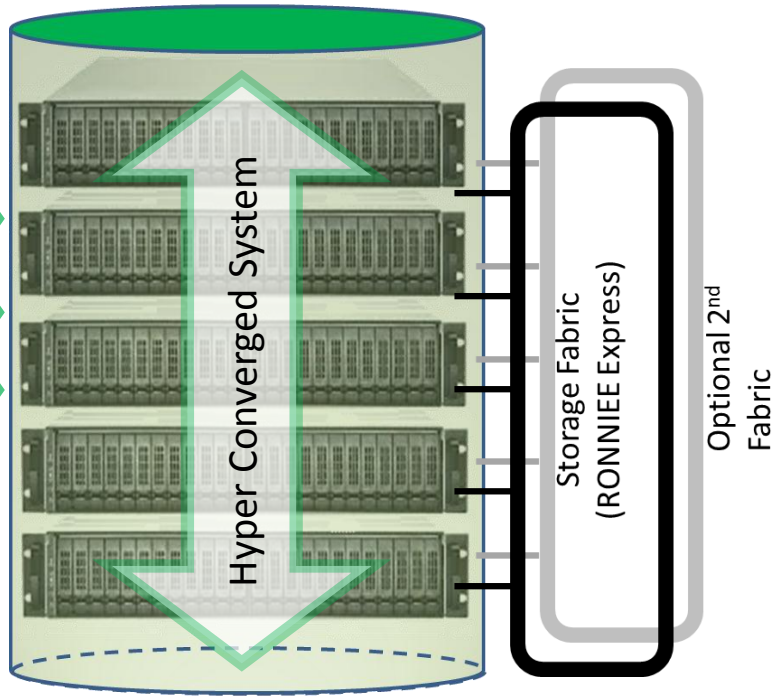
Datacenter External User Application Layer

**NFS, CIFS, FTP, HTTP**



(Existing Datacenter Fabric) Parallel I/O

Fortissimo Parallel Clustered Solution




- Each storage pool exports a shared interface for storage
- I/O to users scales linearly with the number nodes

Intra-cluster Data Path Accelerator

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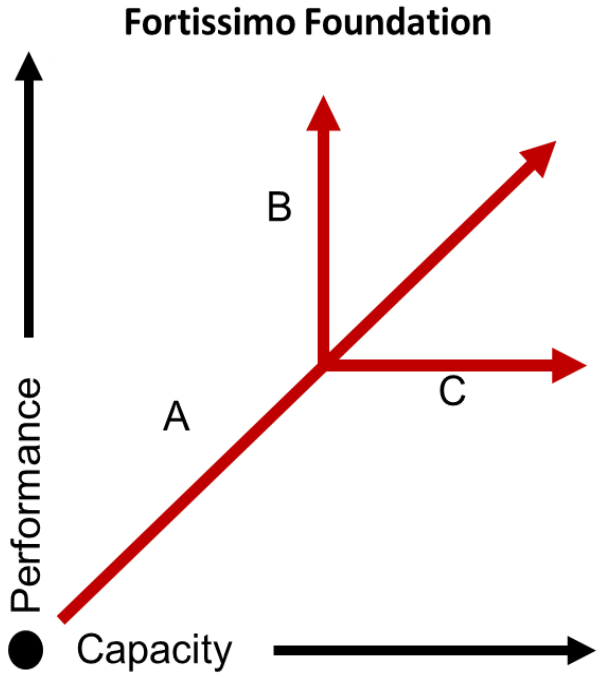
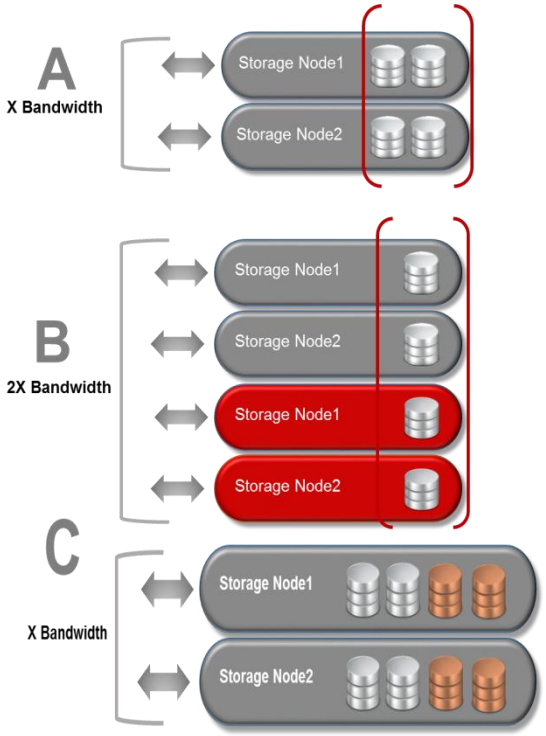
# True Linear Scaling and Flexibility

| Scalability | Flexibility |
|---|---|



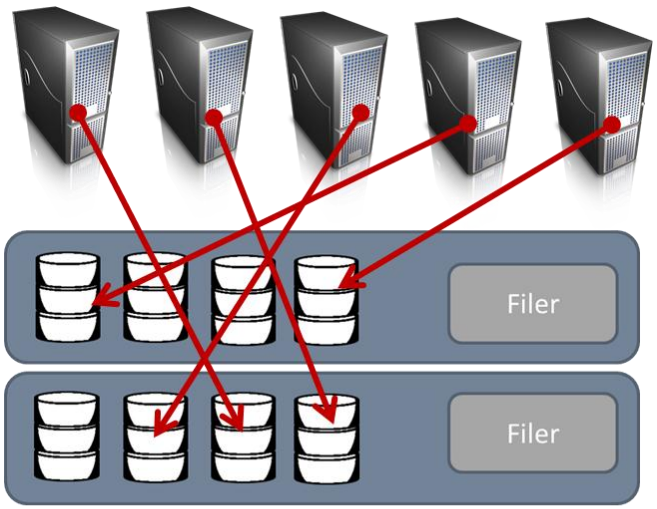

**Scenarios (A):** performance levels are acceptable, but want to double the capacity.
Just double the drives to each server, and eliminate performance degradation. **(See Config C)**

**Scenarios (B)**: OK with the capacity (A) , but want to double performance, just distribute the drives among 4 servers (C), rather than 2 servers, in that case the capacity does not change but the performance of the storage doubles.



# Fortissimo Foundation Simplicity

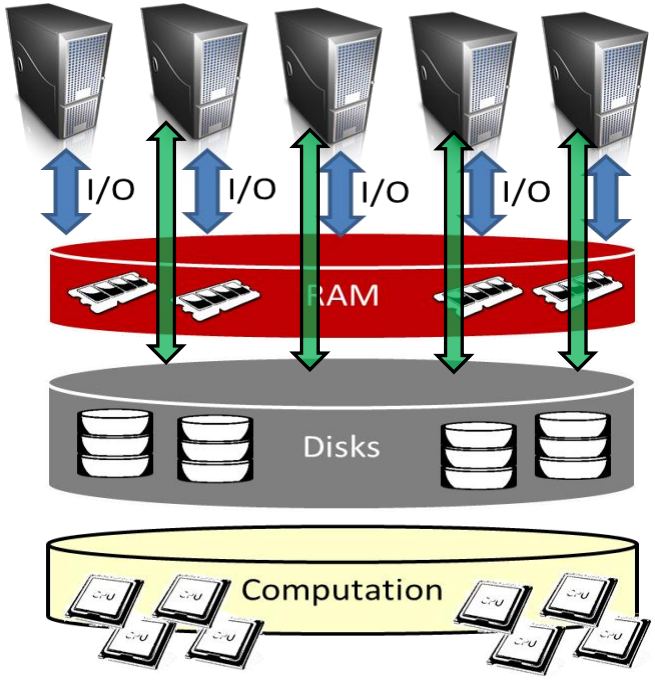
## Traditional Storage




Traditional Storage

- Multiple RAID, volumes, File Systems
- Single Volume up to 100 TB
- No throughput scalability
- No performance scaling
- Complex management
- Not optimal for modern applications

**Fortissimo Foundation**: Remarkably simple, extremely powerful




- Global Optimization of all resources
- Scalable Throughput and IOPS
- Memory and Storage aggregation
- Direct Parallel Data access
- Converged computation
- Investment protection/cost savings

# The Hardware Secret Sauce

## RONNIEE Express "In Memory" Scale Out Fabric

### An ultra low latency Data Plane

**All enterprise storage solutions have a data plane:**

- EMC uses Infiniband & Ethernet
- NetApp uses Infiniband, Ethernet & FC
- **DSSD uses PCIe**

- ✓ No direct remote CPU to CPU communication using load and store operation
- ✓ **Only RDMA support**
- ✓ No direct full memory access at hardware level

**A3CUBE uses enhanced PCIe with a unique direct "in memory" communication (RONNIEE Express)**

- ✓ RONNIEE Express Provides unique direct memory access to local and remote resources
- ✓ Bypassing the OS Kernel
- ✓ **Not limited to RDMA** but includes all the memory operations

PIO Data Transfer (Local and Remote)

DMA Data Transfer (Local and remote)

Interrupt Model (Local and Remote)

Peer to Peer support (Remote)

Hardware driven operation

- ✓ **This enables:**
- ✓ Very dense and scalable flash array [with tons of IOPS] connected together
- ✓ Scale Out RAM Memory up to petabytes
- ✓ No Kernel OS involvement in communication stack
- ✓ **Scalability and density is orders of magnitude larger than any other existing and coming solutions**

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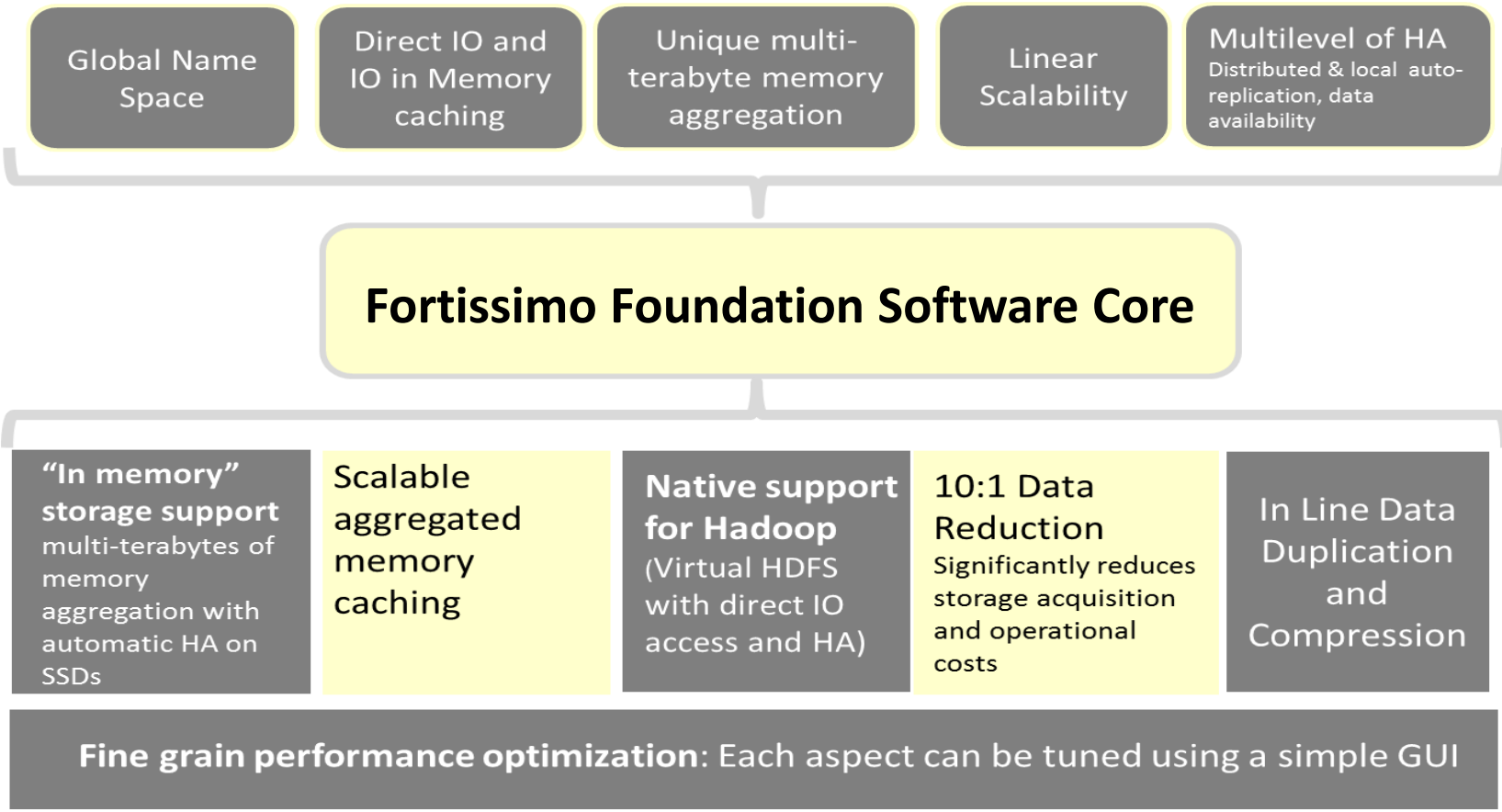
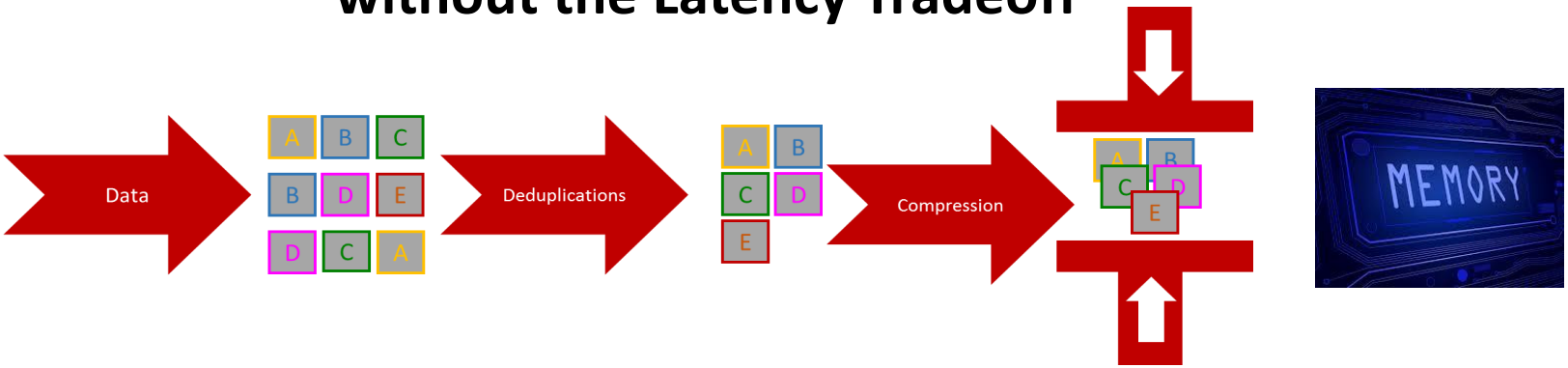
# The Art of Integrating Software and Hardware

- A3CUBE's Fortissimo Foundation represents a step forward in filers introducing a software/hardware defined storage architecture
- Complete integration of direct remote IO communication provided by RONNIEE Express

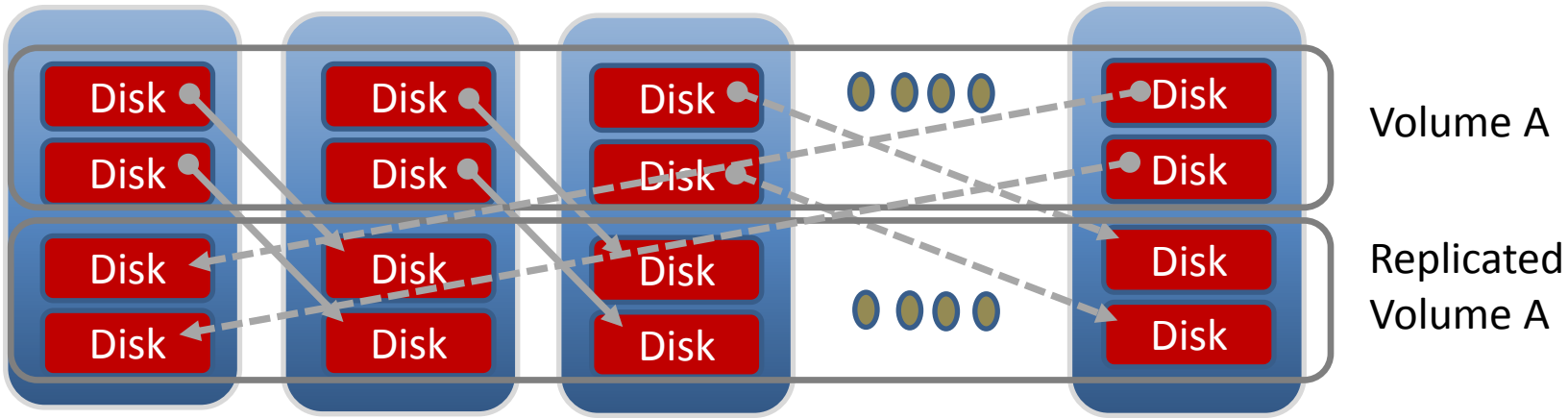


# Inline Data Deduplication and Data Compression in Memory without the Latency Tradeoff




## Multi-level Data Replication for Maximum Reliability

A sophisticated circular replication mechanism provides non symmetrical scalable replication of a single brick in aggregate volumes. This mechanism permits scaling in any number of nodes having at least a copy of the data on a secondary server




Replication is hardware assisted using our multi-copy function (No overhead or added latency)

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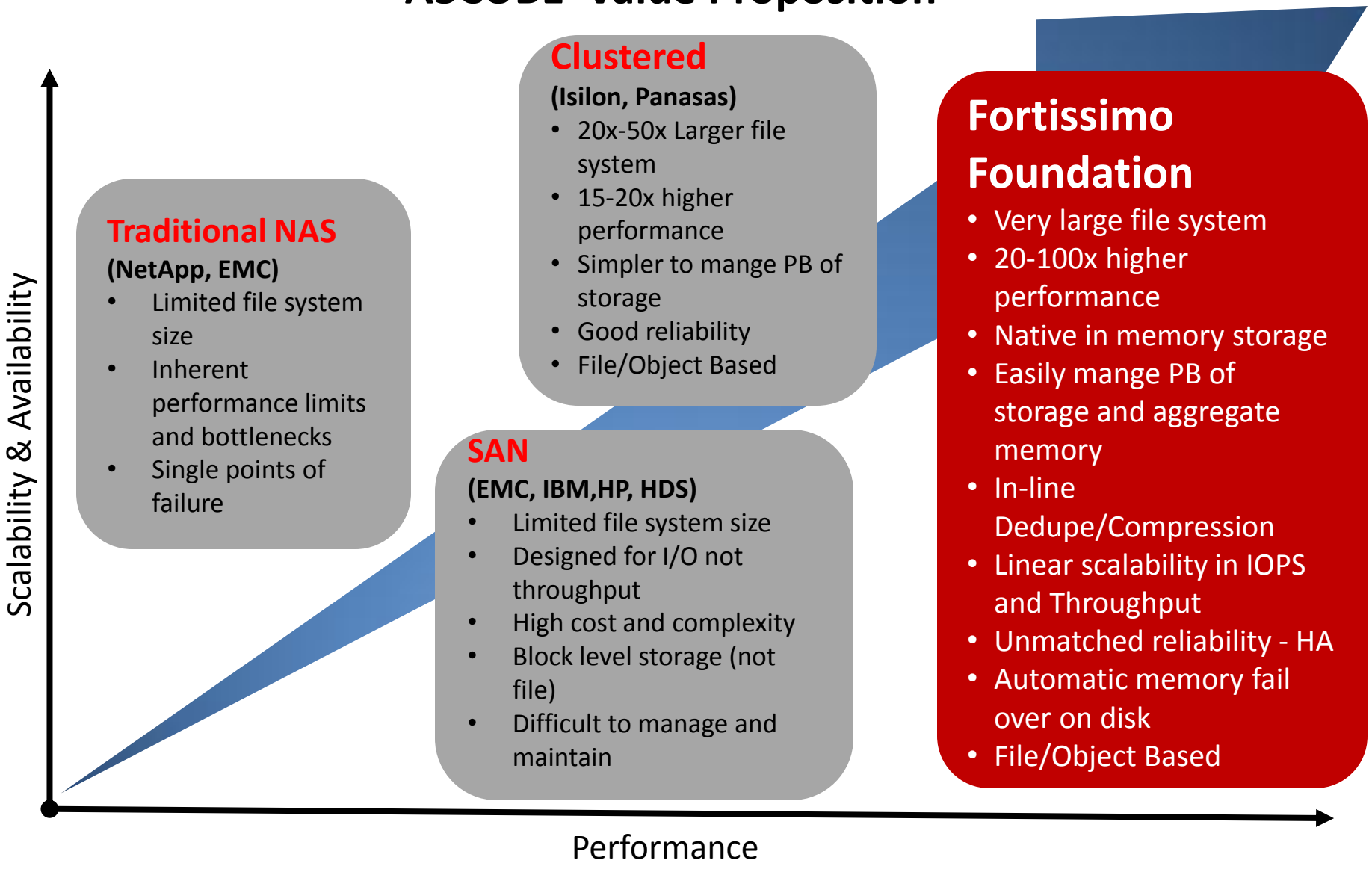
# A3CUBE Value Proposition



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# Disruptive Benefits Brought to the Enterprise

**The RONNIEE Express Platform enables the datacenter to achieve orders of magnitude increases in application performance at a dramatically lower operating cost**

- New levels of workload efficiency lowering CAPEX and maximizing ROI
- Adds real-time capabilities to existing Hadoop, NoSQL, Database and Map Reduce systems
- Supports all traditional communication paradigms - NFS, CIFS, iSCSI and TCP/IP for seamless integration into existing environments
- OPEN Platform built on commodity servers, available PCIe connectivity and industry standard operating systems


# Thank You

## Technical Details

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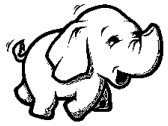
# Unique flexible and Open Platform

## Hadoop Applications



Hadoop Provides a complete approach to analytics in a very large scale

Opens up new ways of gaining insight and identifying opportunities for business

Hadoop is designed to address the rise of unstructured data

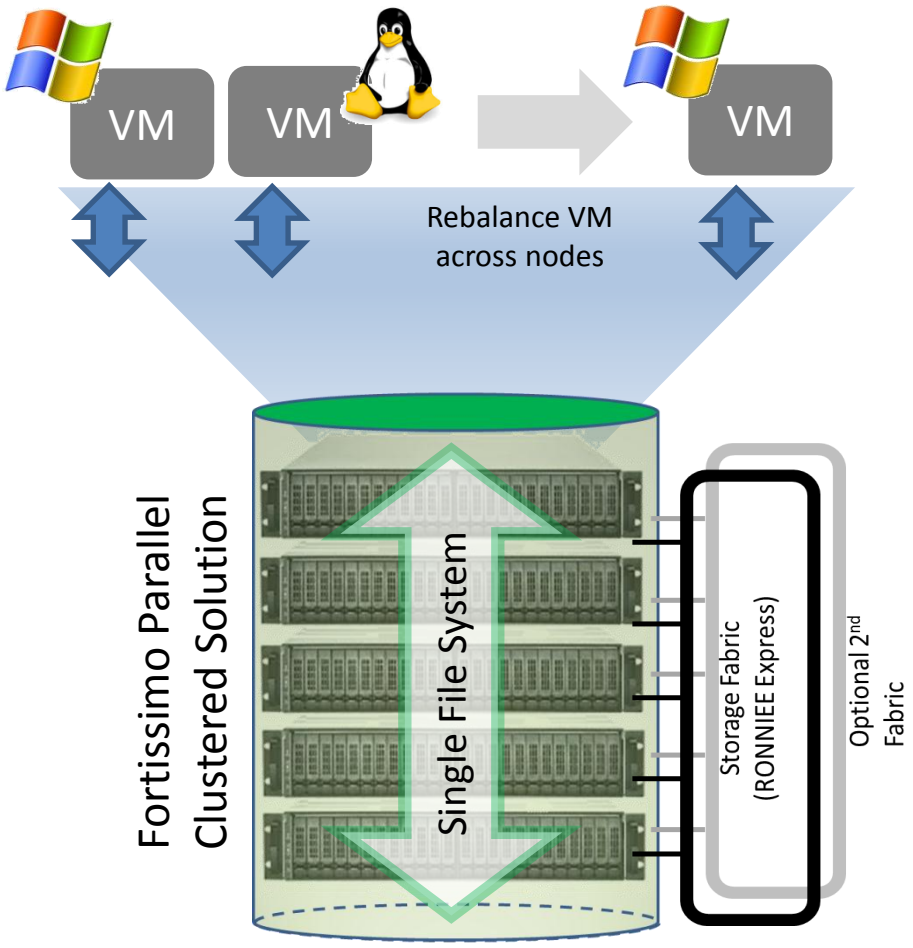
Over The last 5 years we have seen destructive data growth, more than 80% of this grow is unstructured

| | Standard Hadoop Approach | | Fortissimo Benefit |
|---|---|---|---|
| 1 | **Dedicated storage infrastructure** (Socket based , High Latency) | → | **Scale Out Storage Flexible Platform** (Multiple Application & workloads) |
| 2 | **Single Point of Failure** (Name Node) | → | **No Singe Point of Failure** (Distributed name node) |
| 3 | **Lacking Data Protection** (No Replication, Snapshots, Backup) | → | **Different level of End-to End data Protection** (Replication, HA, Local and multimode data protection …) |
| 4 | **Poor storage efficiency** (3x Mirroring) | → | **Different level of Optimization** |
| 5 | **Manual Import Export** (No Protocol Support) | → | **Multi Protocol** (Industry standard protocols, NFS , CIFS, HTTP, HDFS) |
| 6 | **Complexity** (Complex to deploy manage and configure) | → | **Automatized system deploying and configuration** (Industry easiest system to configure) |
| 7 | **No Acceleration built in** | → | **Multi Level Acceleration** (Hardware Data Path Acceleration, In memory multilevel of caching, Up to 100x faster operations) |

# Unique Flexible and Open Platform

## Virtualization
## (NAS and Converged Scenarios)

- Rapidly deploy and consolidate storage
- Setup and deploy multi terabyte clusters in minutes
- VM direct access to memory caching
- Scalable memory Caching (form Giga to 100s of Terabyte and more)
- Hardware driven data access with our global unified storage enables ultra-fast VM migrations
- Supports NAS and converged architectures
- Maximize efficiency and lower cost
- Compressive data protection across all nodes

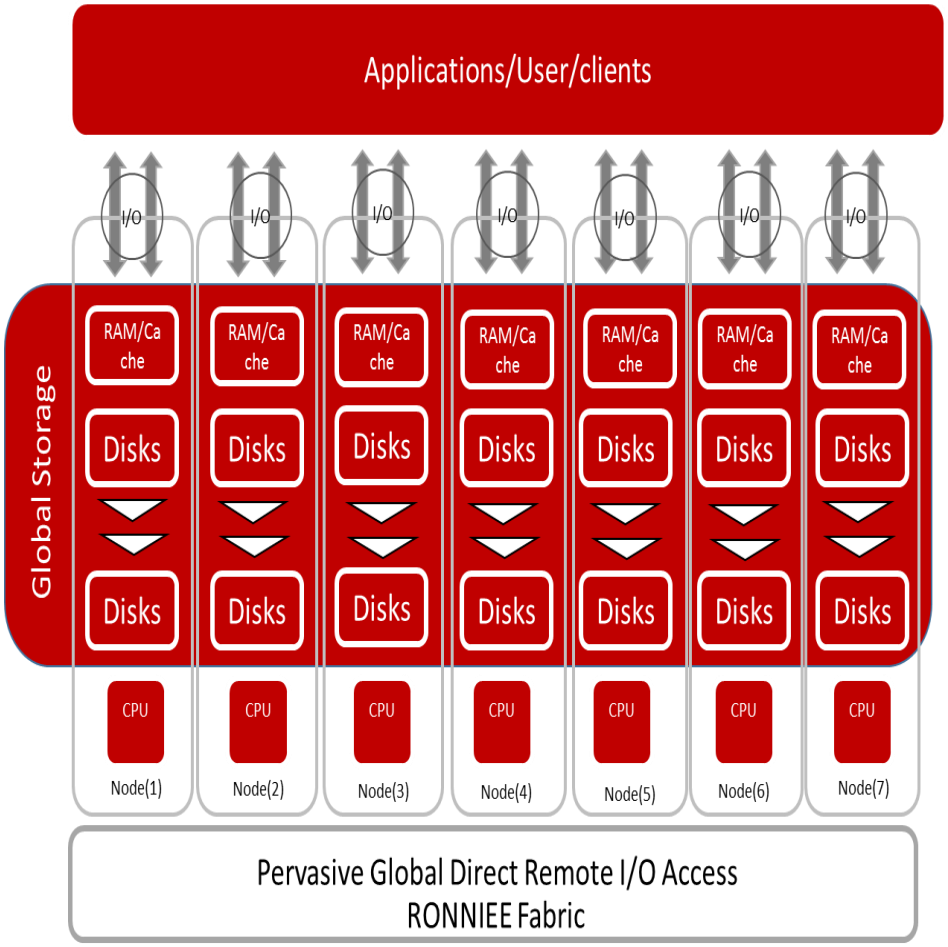


# A3CUBE's Fortissimo Foundation Anatomy

A3CUBE's Fortissimo Foundation is a Clustered Parallel Filer that aggregates multiple storage bricks over A3CUBE's remote direct memory and pervasive local to remote IO access, into one large scalable parallel network file system

## Key Design Considerations

- **Capacity and Performance Scaling**
  Scalable beyond Peta Bytes and 100s of Mega IOPS
- **I/O Throughput Scaling**
  Clustered I/O Schedulers
  Advantage of pervasive direct IO transport (Remote Load and Store operations)
- **Reliability**
  Non Stop Storage, No Meta Data, multiple HA
- **Ease of Manageability**
- **Memory aggregation and pervasive memory cashing**
- ✓ **Support for Deduplication and Data Compression**



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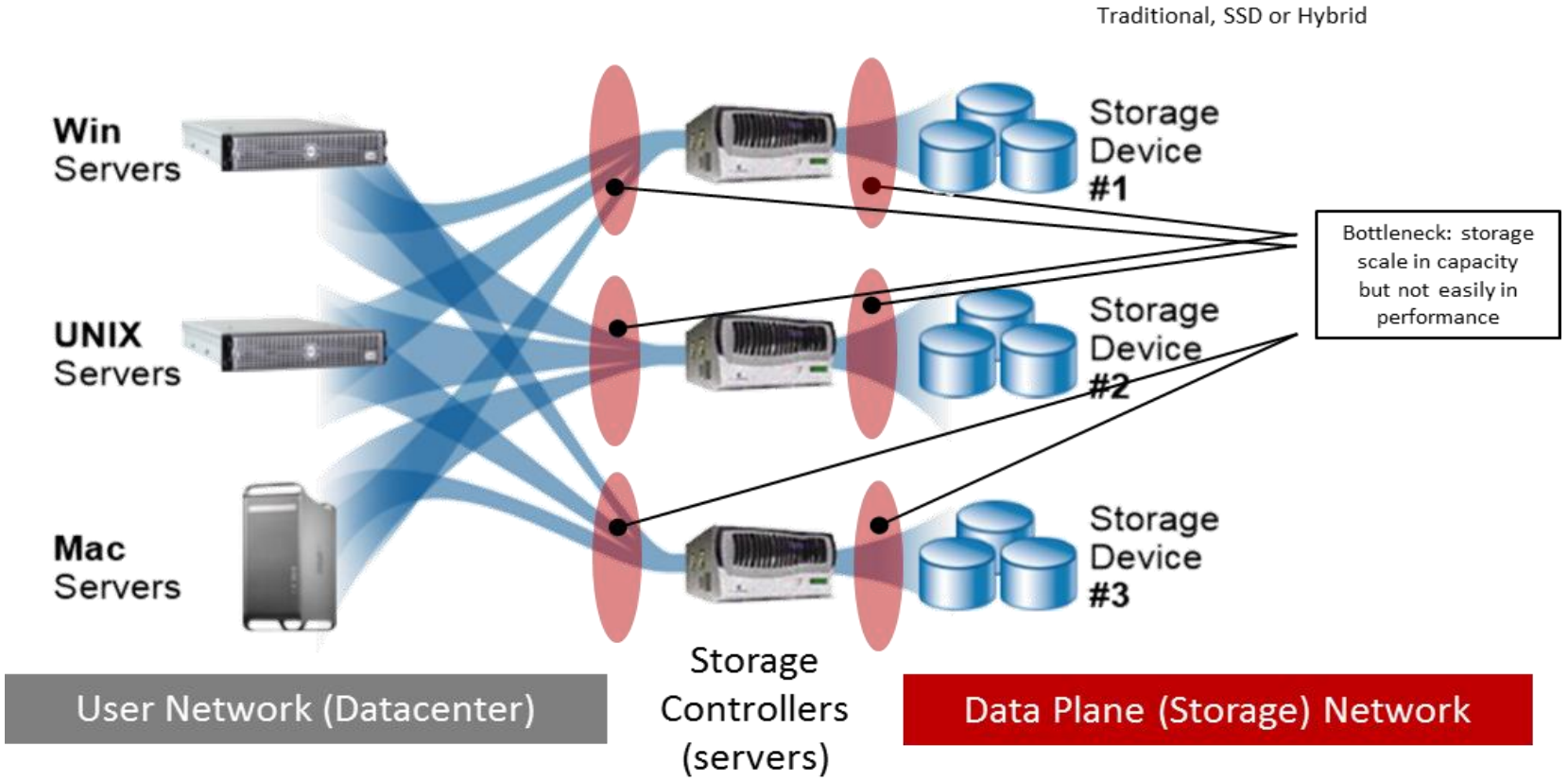
# Traditional Storage: Great for Traditional Data, not Good for Unstructured Data




Data volumes are expected to grow 44x by 2020

**Growth in unstructured data will be 3x structured data**

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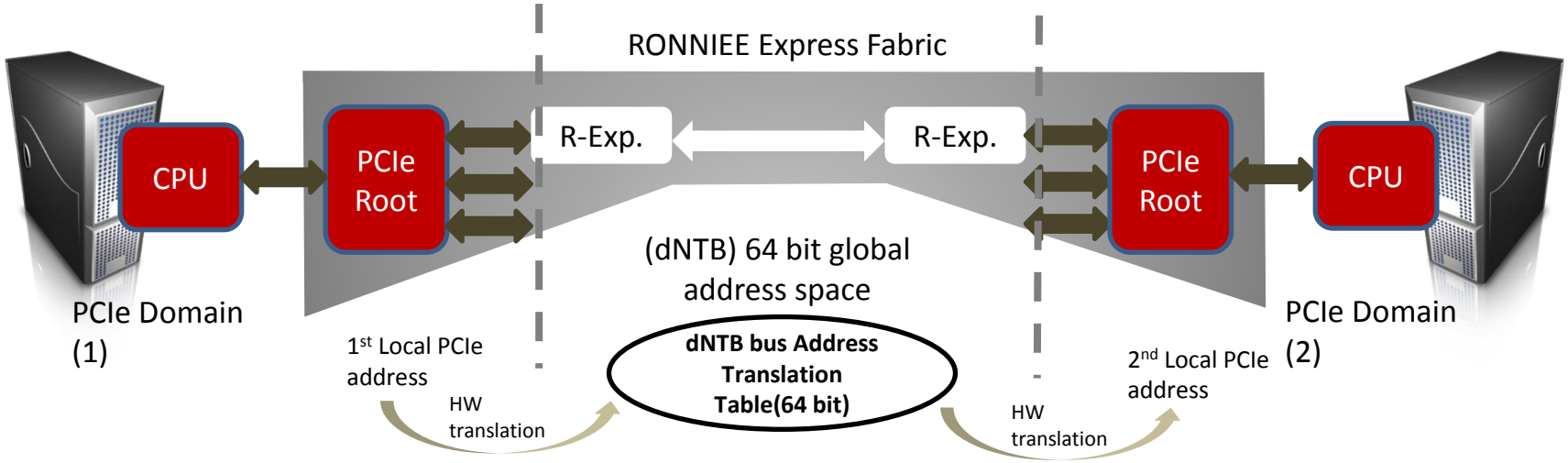
# What is RONNIEE Express

## Extending PCIe connectivity without PCIe: Introducing Distributed Non Transparent Bridging

PCIe bus memory transactions are converted into corresponding (distributed non transparent memory bridging) dNTB memory mapped transactions allowing physically separated PCIe buses to appear as one

**RONNIEE Express allows direct mapping of memory accesses from the I/O bus of a local machine to the I/O bus and into the memory of a remote machine**

**Memory to memory operations are driven by Hardware**



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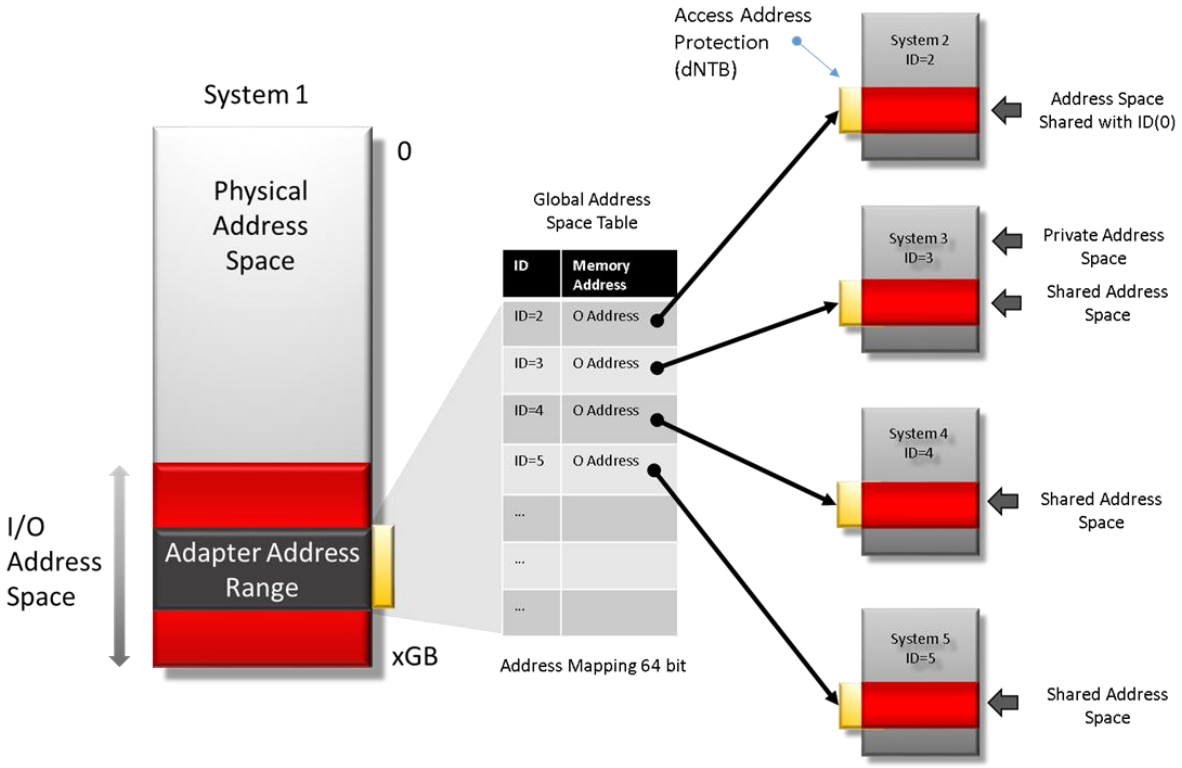
# RONNIEE Express "in Memory Scale Out" Fabric

## More in Detail

- The RONNIEE Express technology implements a remote shared memory approach in the data transfers between processors
- An application can map into its own address space, a memory segment actually residing on another node
- Read and write operations from or to this memory segment are automatically and transparently converted by the hardware in remote operations
- Memory segments are dynamically managed by the RONNEE Express MANAGER



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# RONNIEE Express Platform: The Evolving & Open Platform