Back to the Future: NAS as a Data Architecture

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We've Been Here Before

- NAS has been around for 20+ years
- Actually, we're <u>still</u> here
- NAS hasn't changed that much
  - Files
  - POSIX
  - Handful of protocols
  - Protocol evolution has been measured
  - Vastly better ease-of-use

The Changing Processing World

- New processing architectures
  - More horizontal
  - More object-oriented
  - More distributed
  - More ubiquitous
- Are data persistence architectures keeping pace?

The Changing Application World

- First: data was about transactions about world artifacts
  - Banking, inventories, telco billing
- Now: data often <u>is</u> the artifact
  - Desktop publishing, especially digital media
- Next: data is about <u>states</u> of artifacts

The Changing Data World

- More zeros
  - More TB (or PB)
  - More files
- More, different types of access rights
  - Ownership no longer follows legal boundaries
  - Everything online all the time
- Keep that data!

Some Things Never Change...

- Data is still the core of processing
- Cost of maintenance is always too high
  - Always too complex to manage data
- Data is almost never near all the processing sites
  - If it is, there are too many copies
- Recovery is ever more important

Integration

- Solutions exist for many of these problems
    - Sometimes more than one
    - Some are pretty good, others aren't
    - Some are mature, others distinctly aren't
- Most users will need more than one
    - Most of them don't work with others
- Integration will be crucial

NAS Architecture

- Shares semantics of <u>data</u>
- Fine-grained: files, not devices
- Strongly heterogeneous
- Inherently virtualizes storage
  - NAS operations operate on <u>data</u>, not devices
  - Simpler for humans – and code
  - Most NAS architectures virtualize away devices

Blocks vs. NAS

- Can block storage address these data problems? Of course!
- NAS can solve them more effectively
  - Shared data semantics allow storage to be higher function, more versatile
  - Deployed solution architectures have better "division of labor"
  - Easier to offer heterogeneous access without resorting to lowest common

Technology Keeps Moving

- Massive application of VLSI
- Cost and value realignment of fundamental components
  - Memory – Disk – Tape
  - CPU – Network – Storage
  - Networks – Backplanes – Interconnects
- Software capabilities continue to grow
  - Particularly important: common

Performance

- Three dimensions
  - Throughput (MB/sec)
  - Latency (elapsed ms/operation)
  - Efficiency (μs of CPU per operation)
- NAS latency already at par with blocks
- Two components of throughput
  - Pipe width – 1 Gbit NAS vs. 2 Gbit FC
  - Parallelization (pNFS and other efforts)

Efficiency

- The NAS performance issue has been efficiency – particularly on the client
  - TCP/IP is vastly less efficient than SCSI
    - More semantics to implement with less hardware
  - TCP/IP efficiency was 10-20x lower than SCSI
  - Gap is now ~20% (tolerable) for key apps

Technological Convergence

- Modern NAS has clear value in ease-of-use and resultant TCO

- Improved security removes a major barrier to adoption

- Efficiency unlocks NAS values
  - NAS will be compelling when VLSI enables TCP/IP efficiency on par with SCSI/FC
  - Particularly true if HW encryption is included

Concurrent Transitions

- There are two separate transitions:
  - Transport changes from dedicated storage (FC) to commodity (IP)
    - iSCSI adoption is making IP-based storage much more common
    - Forces consideration of security for IP
  - Semantic changes from blocks to NAS
- Transport changes will tend to enable or accelerate the

Architectural Realignment

- Disk, tape and memory economics will cause persistence hierarchy changes
  - Much more memory, slightly less disk and tape
    - Make no mistake, we <u>will</u> still have tape
    - Probably some new ways of using tape too
  - NAS will be the way the hierarchy is addressed
- Combining NAS semantics and

APIs

- New or changed APIs driven by:
  - New application architectures
  - Higher function persistence systems
  - Changes in programming models
- Data persistence may well be embedded into new runtimes
  - Java runtimes
  - .Net classes

What Does This Mean?

- VLSI networking will overcome the primary obstacle to NAS deployment

- Security will get considerable attention

- The architectural shift from blocks to NAS will enable more sophisticated data persistence solutions

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