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SOS10 Panel Session:

Challenges in Data-Intensive Computing

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Maui, 07 March 2006

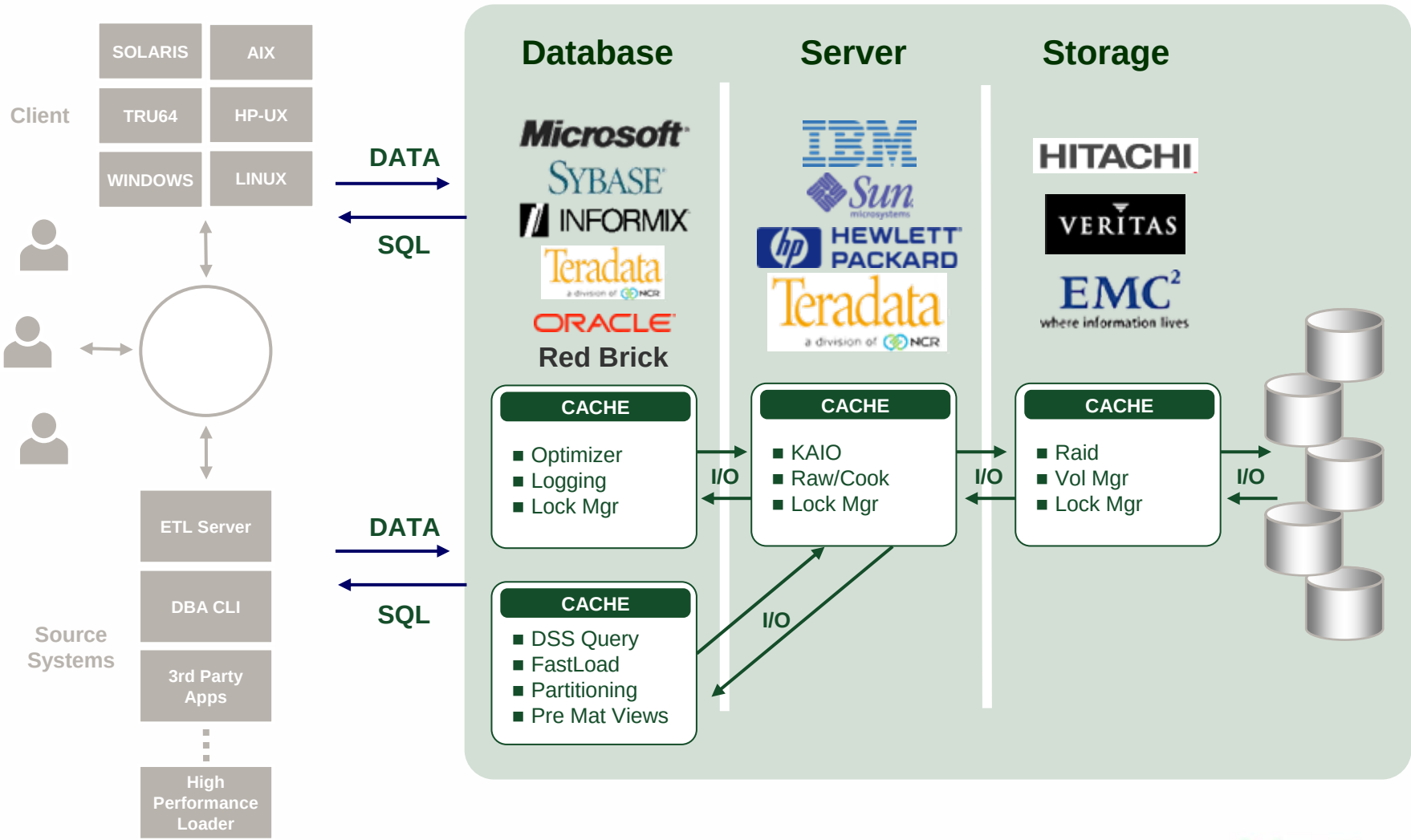
Peta-Scale Data-Intensive Computing is a Reality in Commercial IT shops Today

- This is driven by the need to understand customers and manage the business “at the sub-transaction level’
- Examples:
  - Wireless Telephone Companies
  - Web Stores
  - Credit/Financial Analysis
  - Retailers
  - ISPs

The “Within Application” Approach

- Business Intelligence demands drive the industry towards specialized database/storage blades
  - focus of virtualization centered on the analytic DB
- Systems will be highly-specific
  - Tuned to meet the performance needs of applications versus general purpose “virtualization”

The Database Status Quo



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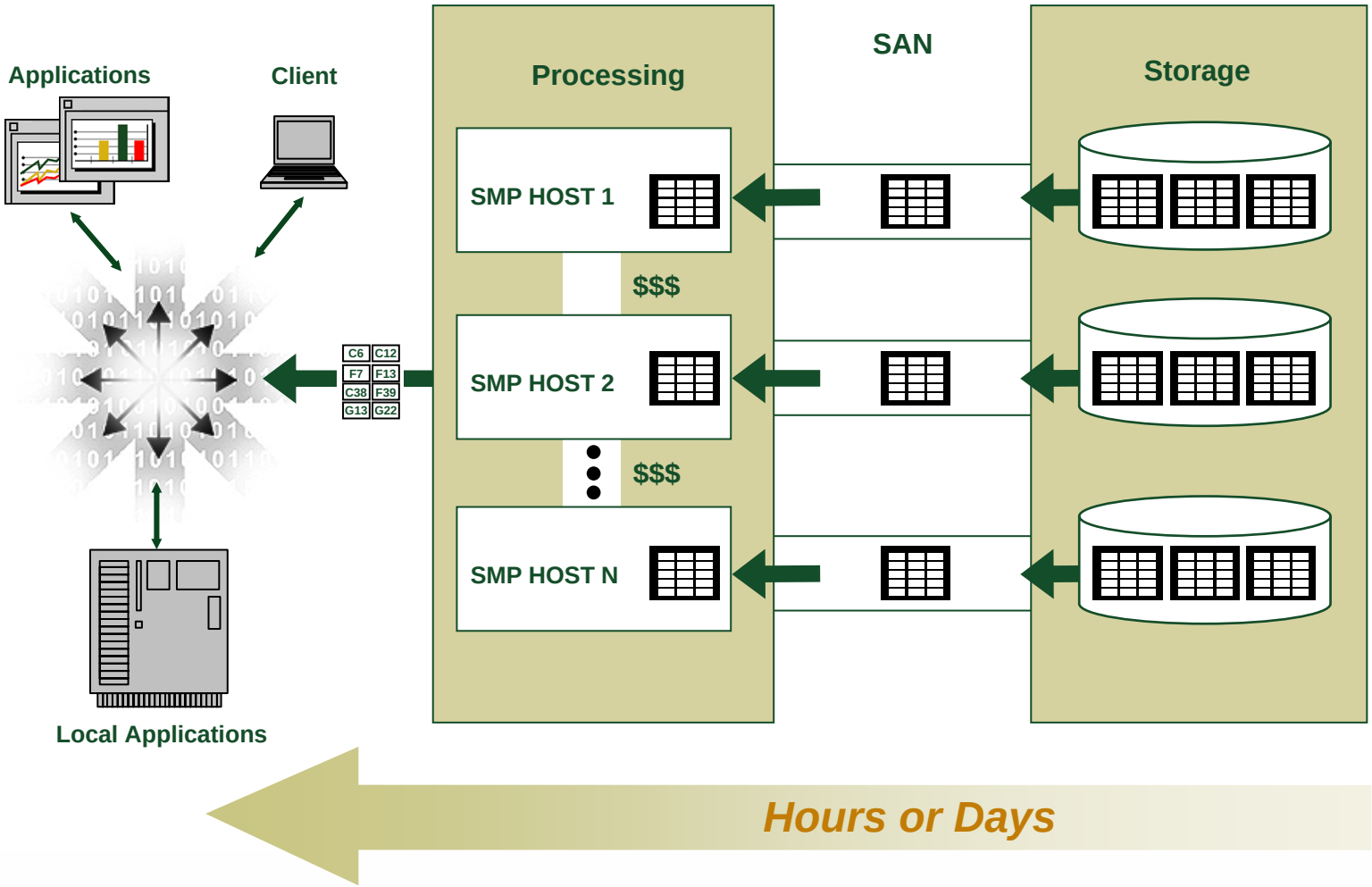
Data Flow – The Traditional Way



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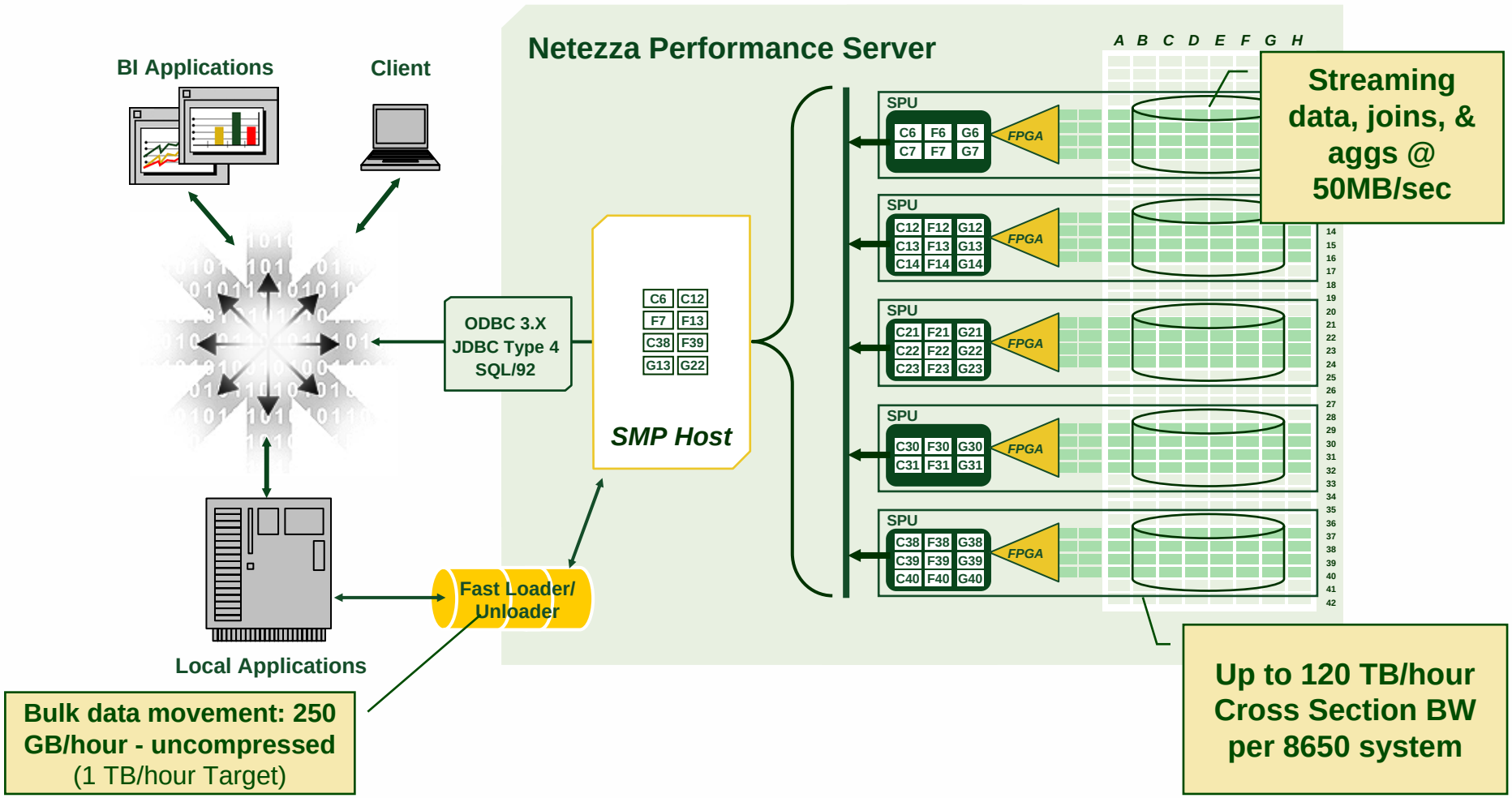
What is Needed Now?

Well, if moving all the data to the processors doesn't do the job…

Then why not move the processors to where the large data resides?

It is hard to do this in a data-intensive way when not working within the application

Streaming Data Flow



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Netezza Found Clues In Late ’90s Computer Science Research

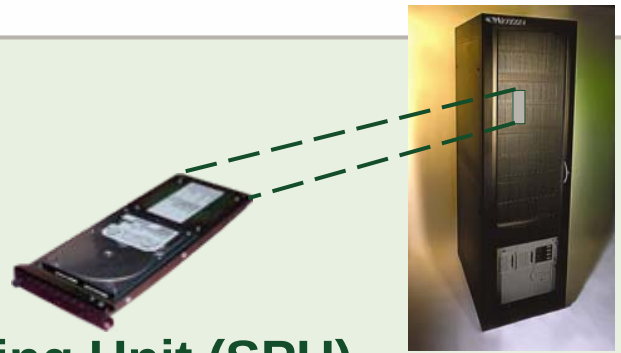
- **Active Disk architectures**
  - Integrated processing power and memory into disk units
  - Scaled processing power as the dataset grew
- **Decision support algorithms offloaded to Active Disks** to support key decision support tasks
  - Active Disk architectures use stream-based model ideal for software architecture of relational databases

In Netezza’s NPS® System: “Snippet Processing Units” take streams as inputs and generate streams as outputs

A Closer Look Inside

Netezza Performance Server

Gigabit Ethernet



Snippet Processing Unit (SPU)

Snippet Queue

PowerPC
Query Engine
Joining
Sorting
Grouping

Main Memory

Streaming
Record Processor
Project
Restrict
Disk
Control

Transaction/Lock
Manager

Replication
Manager

Primary

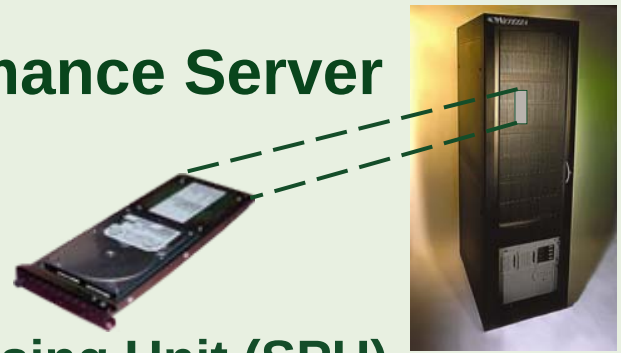
SPU
Swap

Mirror

Dual
Disk

Active Disks as Intelligent Storage Nodes

Netezza Performance Server

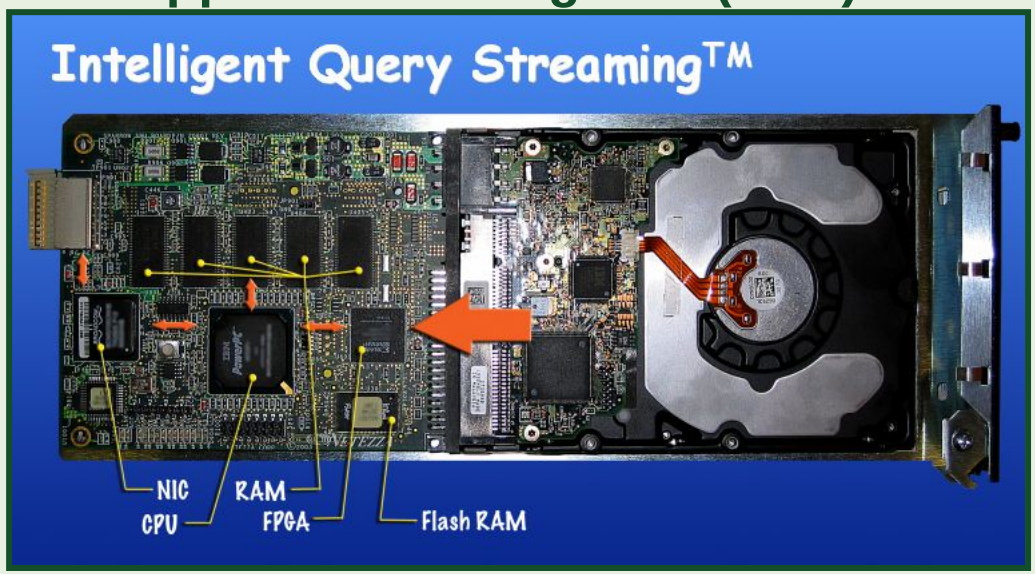


Netezza added:

- Highly optimized query planning
- Code generation
- Stream processing

Result: 10X to 100X performance speedup over existing systems

Snippet Processing Unit (SPU)



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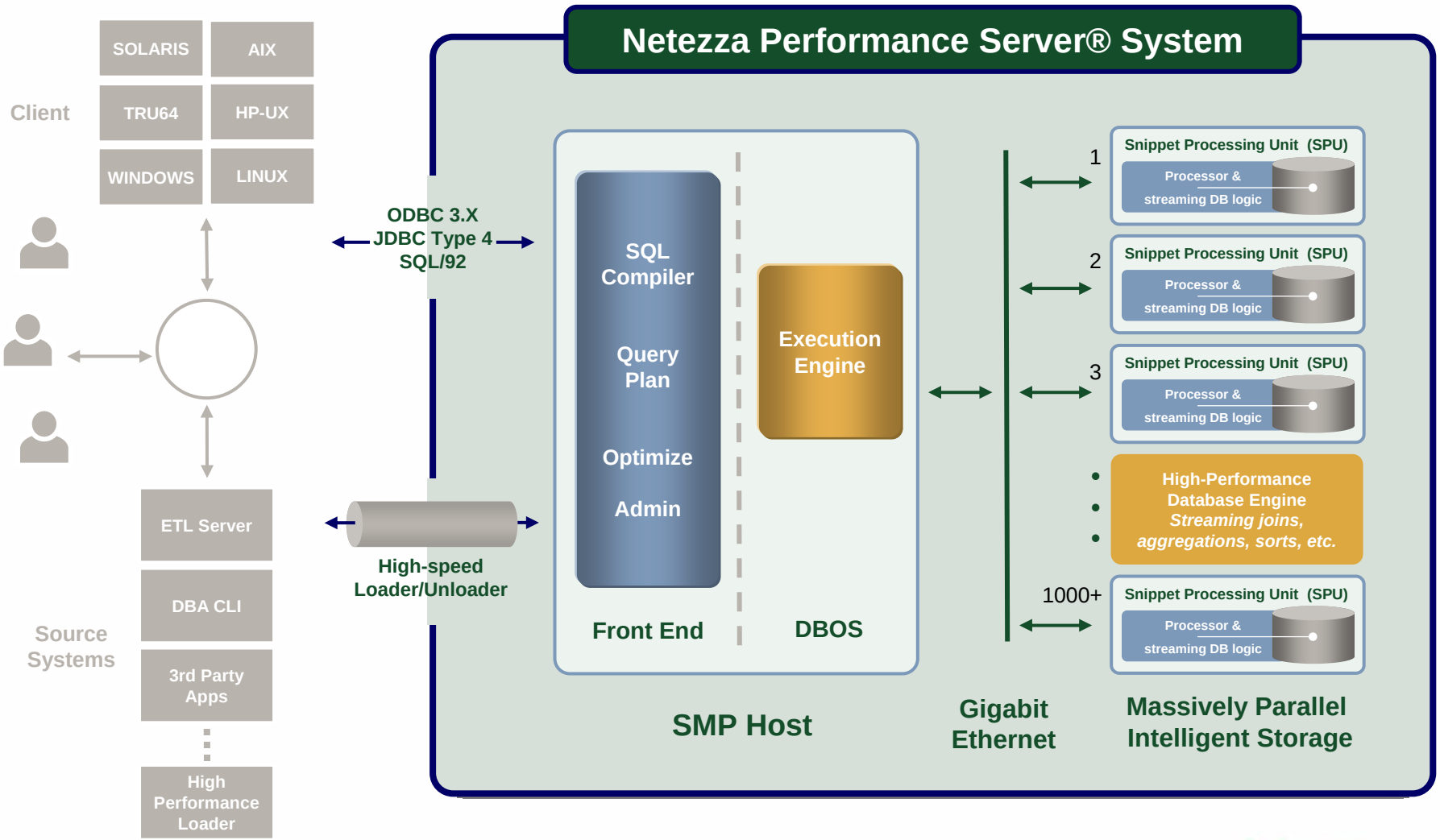
Asymmetric Massively Parallel Processing® *Architecture*



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Binary Compiled Queries Executed on Massively Parallel Grid

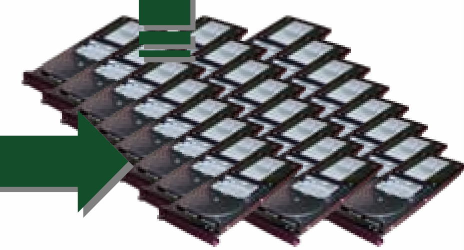
```
select c_name, sum(o_to  rice)  ice from customer, orders
where o_orderkey in (s  t l_orde  ey from lineitem2 where
o_orderkey=l_orderkey an  l_shipda  ='01-01-1995' and
l_shipdate
c_name;" t
```

```
/********* Code ******  */

void GenPlan1(CPlan *plan, char *bufStarts,char *bufEnds, bool
lastCall) {
    //
    // Setup for next loop (nodes 00..07)
    //
    // node 00 (TScanNode)
    TScanNode *node0 = (TScanNode*)plan->m_nodeArray[0];
    // For ScanNode:
                TScan0 *Scan0 = BADPTR(TScan0*);
                CTable *tScan0 = plan->m_nodeArray[0]->m_result;
    char *nullsScan0P = BADPTR(char *);
    // node 01 (TRestrictNode)
    TRestrictNode *node1 = (TRestrictNode*)plan->m_nodeArray[1];
    // node 02 (TProjectNode)
    TProjectNode *node2 = (TProjectNode*)plan->m_nodeArray[2];
    // node 03 (TSaveTempNode)
    TSaveTempNode *node3 = (TS   mpNode*)plan->m_nodeArray[3];
    // For SaveTemp Node:
    TSaveTemp3 *SaveTemp3 =   PTR(TSav   mp3*);
    CTable *tSaveTemp3 = node3->m_resul
    CRecord
    // node
…
```

```
10110101010101010101111101 0  010100100101010111010101001011110101
0100101011110110100101010101110101011001010101010111110100100101
0101010101010101010010101001111110101010101010101001010101010010
1001011010011111111010101010100110100101010101001010101010100101
01010101010010101010100111010101010101010101010…
```

```
 c_name            |   price
-------------------+-----------
 Customer#000000796 | 318356.97
 Customer#000001052 | 293680.56
 Customer#000001949 | 215280.98
 Customer#000002093 | 282531.93
 Customer#000005656 | 335297.31
 Customer#000005861 | 233691.03
 Customer#000006002 | 267000.92
 Customer#000006343 | 595819.82
 Customer#000006532 | 442254.91
….
real     0m0.552s
user     0m0.010s
sys      0m0.000s
```



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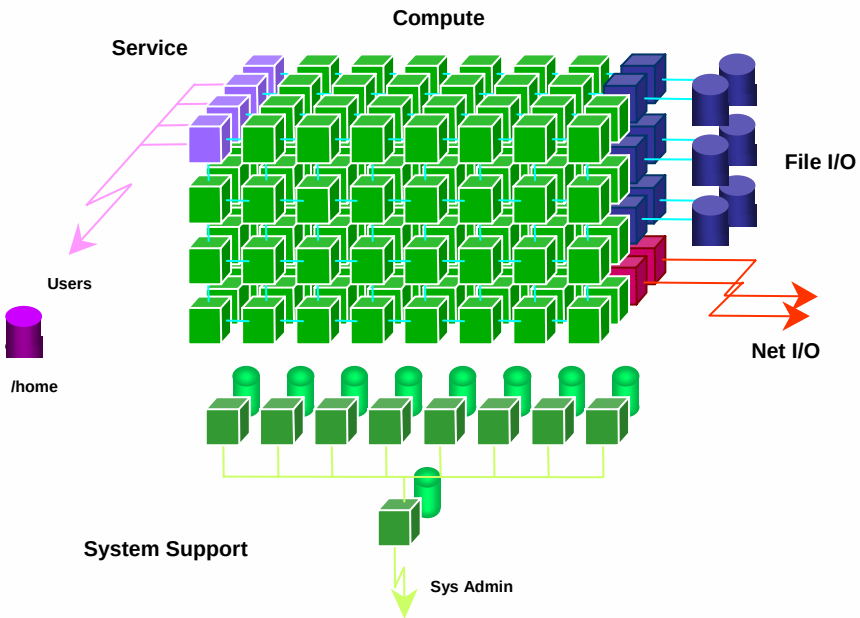
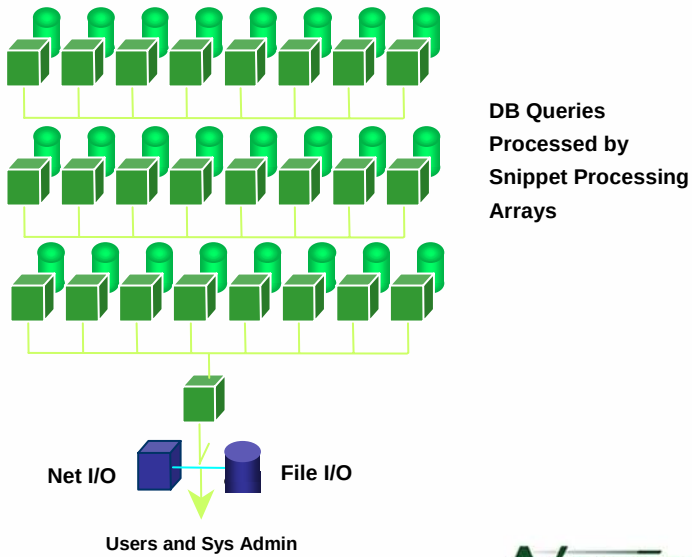
It's All About Scaling, Streaming and Asymmetry

- Sandia: TeraFLOP → PetaFLOP
  - Specialized Node Function
  - Linux + light weight kernels
  - System Interconnection is "secret sauce" for high BW low latency MPP performance gains



- Netezza: TeraByte → PetaByte
  - Specialized Node Function
  - Linux + light weight kernels
  - Storage/processor/DB integration is "secret sauce" for streaming query processing MPP perf gains



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Thank You