ServerSet III and MXT Technology

Sected Memory Management

- Indirect "virtual" mapping of main memory
  - Multi-step access to reference data:
    1. Access Translation Table Entry, decode and parse sector addresses
    2. Access data from sector
    3. Update Translation Table Entry if changes

- Sector Translation Table
  - Direct mapped 16B entry, per 1KB real memory block
    (size = real memory / 1KB * 16)
  - Uncompressed entries encoded with flags and up to 4 address pointers to 256B sectors for storing data, associated with a 1KB block, but less than 121 bits
  - Compressed entries encoded to contain actual compressed data when less than 121 bits (64:1 compression)

- Sectored Region
  - Memory contains a "sea" of 256B sector stored as a linked list.
  - List address pointers exist in unused sectors (i.e., as sectors are consumed, the linked list shrinks)
  - Sectors may be shared by adjacent block data to reduce fragmentation.
ServerSet III and MXT Technology
Unsectored Memory Management

- **Direct mapping of main memory**
  - Requires one-step access to reference data:
    1. Access data from relocated direct mapped data address.
  - Lowest latency access to performance sensitive data structures.

- **Sector Translation Table**
  - Unused "holes" in table are redefined as sectored memory to eliminate wasted space.

- **Un-Sectored Region**
  - Selectable as 0-4 independent regions (32KB - 256MB) beginning at 32KB aligned addresses.
  - Contain only uncompressed data.
ServerSet III and MXT Technology
Compression Technology

- Variation of Ziv-Lempel algorithm (LZ77 or LZ1) modified for parallel single pass loss-less compression.
- Compresses replicate strings of 2 or more bytes or "raw" characters within 1KB block yielding 1:1 - 64:1 compression ratio.
  - Raw character = (0, databyte)
  - String = (1, primary len, position, secondary len)
  - Encoded length (2-12 bit) and position (2-10-bit)
  - CRC-32 protected compressed block
- Each of four engines compress one byte/cycle of a 1/4 block (256B).
- Four dictionaries are incrementally filled and compared to new byte every cycle.
- Emerging strings may occur within any dictionary and are tracked for the longest occurance.
- Strings are encoded and packed into an output buffer with CRC-32 appended to the end of the buffer when complete.
ServerSet III and MXT Technology
Real-World Compression

![Graph showing compression ratio for different workloads on various platforms.](image)
ServerSet III and MXT Technology
Performance Overhead for SPEC CINT2000 Benchmarks
Intel XEON (256K L2), 512MB System

Execution Time Relative To Compression OFF Case

<table>
<thead>
<tr>
<th>Case</th>
<th>MIN (PARSER)</th>
<th>MAX (VORTEX)</th>
<th>MEDIAN</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPRESSION ON</td>
<td>1.007</td>
<td>1.031</td>
<td>1.013</td>
<td>1.015</td>
</tr>
<tr>
<td>COMPRESSION OFF</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>
ServerSet III and MXT Technology

System Cost Leverage

<table>
<thead>
<tr>
<th>System Performance</th>
<th>System Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$13,081</td>
<td>2,304 MB effective memory (1152 physical)</td>
</tr>
<tr>
<td></td>
<td>2 800 MHz. proc 100 MHz. FSB</td>
</tr>
<tr>
<td></td>
<td>2 9.1 GB SCSI drives</td>
</tr>
<tr>
<td>$7,103</td>
<td>1,792 MB effective memory (896 physical)</td>
</tr>
<tr>
<td></td>
<td>1 550 MHz. proc 100 MHz. FSB</td>
</tr>
<tr>
<td></td>
<td>1 9.1 GB SCSI drive</td>
</tr>
<tr>
<td>$13,001</td>
<td>2 10/100 Ethernet ports</td>
</tr>
</tbody>
</table>

System Performance

- MXT
- Stock

- $13,081
  - 1,664 MB memory
  - 1 550 MHz. proc 100 MHz. FSB
  - 1 9.1 GB SCSI drive
  - 2 10/100 Ethernet ports
- $7,103
  - 1,792 MB effective memory (896 physical)
  - 1 550 MHz. proc 100 MHz. FSB
  - 1 9.1 GB SCSI drive
  - 2 10/100 Ethernet ports
- $13,001
  - 2,304 MB effective memory (1152 physical)
  - 2 800 MHz. proc 100 MHz. FSB
  - 2 9.1 GB SCSI drives
  - 2 10/100 Ethernet ports
ServerSet III and MXT Technology

Conclusion

- Proven technology that empowers consumers to efficiently utilize their memory investment.
- Logical step in the pervasion of ubiquitous compression techniques.
- IT professionals routinely experience $1000's on systems ranging from High density servers to large memory enterprise servers.
- Technology well suited to other memory intensive applications too (disk controllers, laptops, etc.)