FLEX 10K vs. On-Chip RAM Performance

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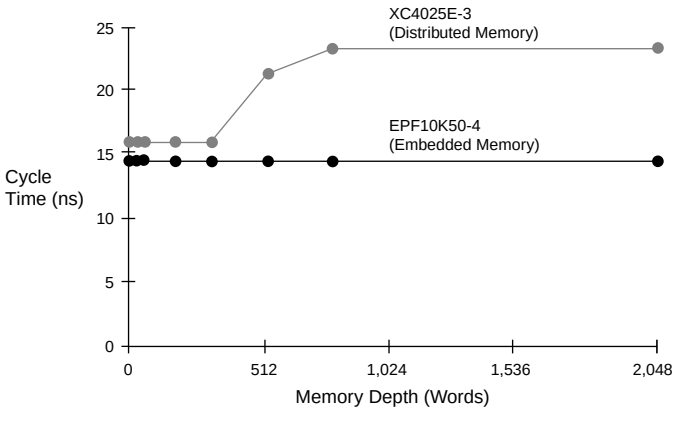
Programmable logic on-chip RAM is implemented differently by different device manufacturers, which directly impacts on-chip RAM performance. For example, FLEX 10K embedded array blocks (EABs) provide larger RAM blocks with built-in control and decode circuitry for fast, consistent performance in a wide range of memory configurations. In contrast, FPGAs have small RAM blocks that are distributed across the entire device. Connecting this distributed RAM to form larger, more useful blocks decreases performance and uses more routing resources. Detailed analysis shows that FLEX 10K on-chip RAM is both faster and more predictable than that of the Xilinx XC4000E family.

On-Chip RAM Performance

FLEX 10K on-chip RAM performs better than that of the XC4000E family at any memory depth. FLEX 10K performance is consistent across memory depths of up to 2,048 words.

Embedded vs. Distributed Memory Cycle Time



The data above was compiled by Altera Applications with each device dedicated solely to RAM usage.

Embedded Array Provides Predictable Performance

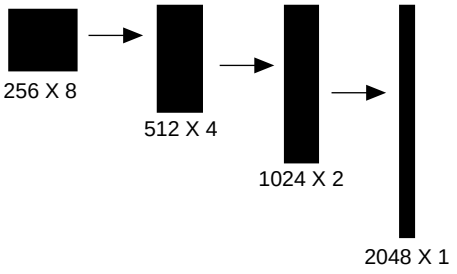
When designing with FLEX 10K devices, designers will consistently obtain the performance results shown in the graph above because each EAB is *pre-routed* for maximum performance. Therefore, no additional routing delay is incurred, regardless of what percentage of device resources is used for RAM.

In contrast, the XC4000E RAM system performance can be significantly lower than the benchmark results shown above unless optimal routing resources and contiguous CLBs are available. The additional CLBs that the XC4000E family requires for RAM bits and RAM address decoders all affect performance. Since logic and memory compete for the same routing resources and CLBs, it is impossible to optimize for both logic and memory.

Flexible RAM Size

Each FLEX 10K EAB can be configured as predictable, high-speed 2048 x 1, 1024 x 2, 512 x 4, or 256 x 8 RAM. In contrast, XC4000E RAM blocks are small and can only be configured as either a 32 x 1 or a 16 x 2 building block. To create deeper and wider RAM configurations with XC4000E devices, designers must connect many CLBs.

Identical, Predictable Performance for Different FLEX 10K EAB Configurations



Routing Resources

Each FLEX 10K device provides consistent performance when implementing a 2K block of RAM in its EAB. The performance of XC4000E routing lines differs significantly from device to device. For example, longline delays in the XC4025E can be 360% slower than the longline delays found in the XC4003E. Slower routing resources affect logic and memory in segmented FPGAs.

Conclusion

FLEX 10K devices offer on-chip RAM with performance comparable to high-speed, off-chip monolithic SRAM. EABs provide a high-performace, flexible method of implementing small register files to large data buffers in networking applications within a single FLEX 10K device. Segmented FPGA architectures such as that of the XC4000E family integrate even simple RAM functions with limited performance and flexibility.

The documents listed below provide more detailed information. Part numbers are in parentheses.

Product Information Bulletins

PIB 20 *Benefits of Embedded RAM in FLEX 10K Devices (A-PIB-020-01)*
PIB 21 *Implementing Logic with Embedded Arrays in FLEX 10K Devices (A-PIB-021-01)*

Application Notes

AN 52 *RAM Functions in FLEX 10K Devices (A-AN-052-01)*
AN 69 *Implementing Register Files in FLEX 10K Devices (A-AN-069-01)*

You can request these documents from:

- Altera Express fax service at (800) 5-ALTERA
- World-Wide Web at **http://www.altera.com**
- Your local Altera sales representative