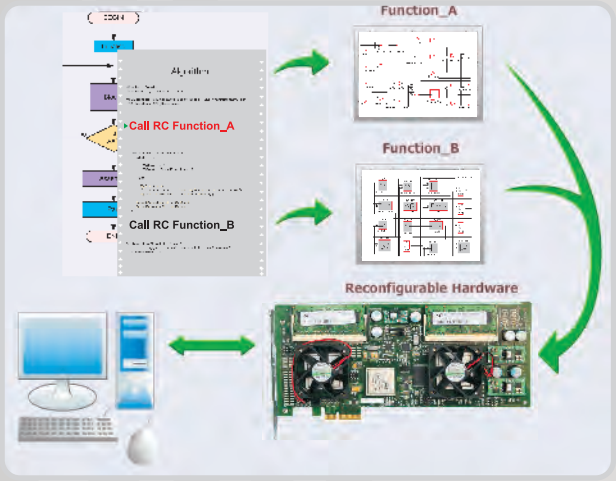
HTDG
HARDWARE TECHNOLOGY DEVELOPMENT GROUP

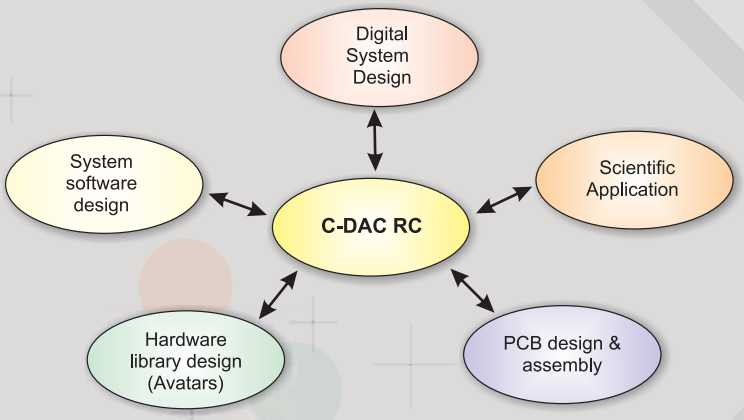
C-DAC's Reconfigurable Computing Solution for Accelerating Applications

A Green Computing & Eco-friendly Initiative
FCC & CE Compliant

Introduction

Typically to solve a problem, application software is run using the processing power of CPU. It may happen that some of the applications take very long time to complete. Reconfigurable Computing (RC) is an interesting paradigm to accelerate applications by targeting algorithms into programmable hardware, consisting of Field Programmable Gate Arrays (FPGA). By adding RC to the compute system, the computing power of the system is enhanced by many folds, which in-turn, reduces the application run time. A number of Scientific & Engineering applications can find this RC technology useful. To name a few: satellite networks with adaptive communication algorithms, Financial modeling, Encryption/Decryption and Pattern recognition.





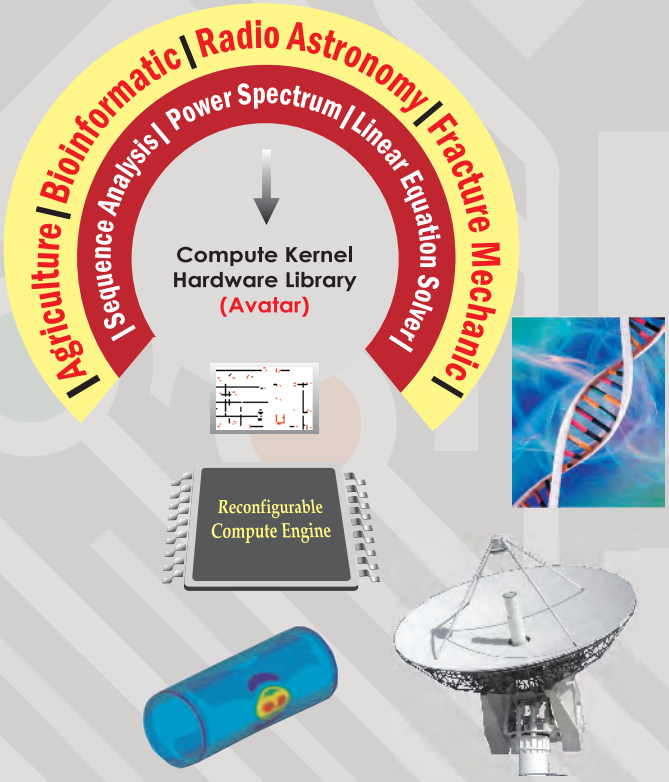
C-DAC's Expertise

C-DAC has pioneered the RC technology for HPC in India through its state-of-the-art design of hardware, system software and hardware libraries ('Avatars'). Avatars are dynamically changeable circuits, corresponding to the compute intensive routines of the application code. C-DAC with its expertise in RC is capable of providing accelerated solutions for a wide spectrum of scientific and engineering areas.

Applications

Scientific and engineering applications in the areas of fracture mechanics, radio astronomy and bioinformatics are ported on RC, providing up to 240X speedup compared to purely software based solutions.

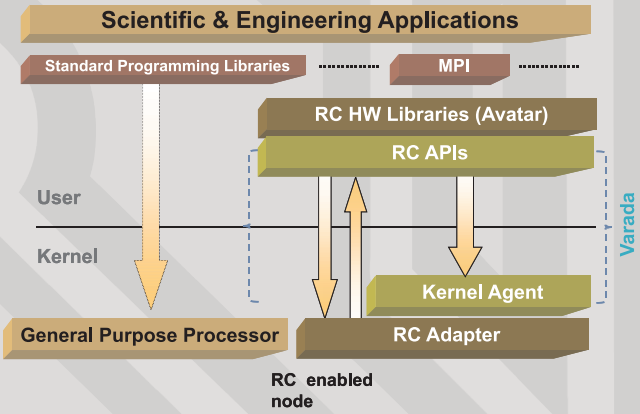
- Bioinformatics sequence search solution using RC, gave 240 times faster results.
- C-DAC's own fracture mechanics code, having double precision Cholesky factorization and forward-backward substitution steps, ported on RC provided 16X speedup.
- High speed data acquisition and signal processing solutions designed for Very Long Baseline Interferometry (VLBI) and power spectrum in radio astronomy replaced a sizable computing cluster.
- Double precision matrix multiplication implemented on RC performed better than Intel math kernel library.



The RC solution primarily consists of two components: RC hardware and the programming environment- Varada.

RC Hardware Features

- 12 Million gate FPGAs for porting compute intensive portions of application
- Standard bus interface like PCI/PCI-X/PCI Express
- Onboard high-speed memory
- PCI Express low profile form factor allowing it to be used in 1U servers
- Low power consumption of 25W
- FCC and CE compliant



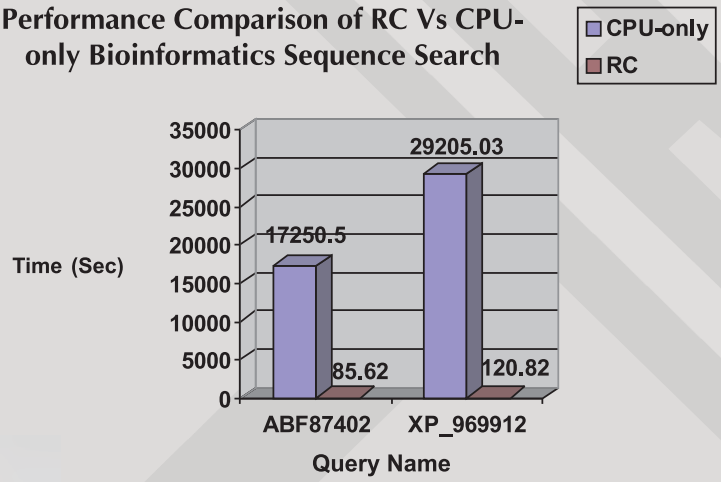
Varada: Programming Environment for RC

- Simple interface for hardware interaction
- Access controls for runtime reconfiguration
- C/C++ support
- APIs for 64-bit Linux / Windows
- Provision for pooling compute engines from multiple RC hardware in a single system, with on-demand allocation of compute engines

Multi-RC Solution

C-DAC's RC with its remarkable computing capabilities when added to a server dramatically increases the computing power. Due to its small size, multiple such RC cards can be plugged into a server resulting in many-fold increase in performance. The number of cards that can be added is only limited by the number of slots available in that server. Further performance gain is achieved by interconnecting such multiple RC enabled servers. A huge FPGA resource generated through the above configurations can help in solving grand challenge problems.

Performance Comparison of RC Vs CPU-only Bioinformatics Sequence Search



For two sample sequence searches against swissprot database, the RC based search was found to be around 200 times faster than a CPU-only solution.

In addition to increasing application performance by many folds, C-DAC's RC offers tremendous savings on power and space as compared to other technologies for application acceleration.

C-DAC's RC is a perfect solution for accelerating applications through 'Avatars' in areas as varied as life science to astrophysics.

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