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Title: Parallel Random-Access Model (PRAM)-On-Chip

Research Objectives:

- Advance the PRAM-On-Chip framework, including
 - development/study of compiler, simulation & debugging tools
 - study & facilitate study by others of programmability, application domains & algorithms
 - study “micro” basic problems & “macro” system ones
 - extract parallelism&performance from popular APIs (maximum effort with fraction of requested funding received)

Significant Results:

- simulated program executions have shown dramatic performance gains over conventional processor architectures
- macro: see Approach. Micro: hardware implementation of Fetch&Add; extension of the 1946 “von-Neumann” program-counter+stored-program apparatus, coupled with parallel programming semantics; interconnection networks
- patents, journal (!) and conference publications. (Patent requires: utility, novelty&non-obviousness). Expression of disbelief by experts (“PRAM is unrealistic”) supports non-obviousness, in when it is not-so-obvious...

Approach

The PRAM-On-Chip approach:

- starting point: PRAM (parallel random-access model) – easiest available model for parallel algorithms&thinking; huge knowledge based developed by numerous researchers in 80’s&90s.
- conceived&developed highly parallel explicit multi-threaded (XMT) on-chip processor architecture for faster single task completion.
- despite broad interest the PRAM generated: wasn’t possible to build “virtual PRAM” parallel machines using multi-chip multiprocessors.
- Recall: “PRAM is unrealistic” – a CS mantra!
- main insight: possible this decade if centered on a single chip. Rely on low-overhead coordination mechanisms

•Broader Impact:

- become the platform of choice for high end computing: whether uni-chip centered machine or multi-chip one
- finally remove the curse of programmability from parallel computing; main obstacle to cost-effectiveness & broad use
- impact biomedicine (drug discovery), national security, scientific computation, virtual reality, switch fabric control, popular APIs

Graphic:

