APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

U.S. ARMY RDECOM

Emerging Computing Architectures

ARL open campus

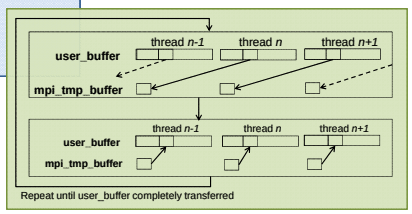
S&T Campaign: Computational Sciences
Advanced Computing Architectures

James Ross, (410) 278-9556
James.a.ross176.civ@mail.mil

Research Objective

- Develop novel algorithms and methodologies to exploit pervasive parallelism in emerging architectures
- Discover novel ways to develop models and algorithms targeting emerging architectures such as neuromorphic and quantum annealing

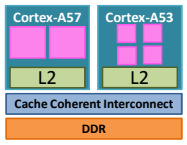
```
float invcbrt( float a )
{
   float k = 1.33333333f;
   int j = *(int*)&a;
   int s = 0x80000000 & j;
   j &= 0x7fffffff;
   float c = 0.33333333f * (*(float*)&j);
   int y = 0x54a2fa8e - 683 * (j >> 11);
   float x = *(float*)&y;
   x *= k - c*x*x*x;
   x *= k - c*x*x*x;
   x *= k - c*x*x*x;
   int r = (s | (*(int*)&x));
   return *(float*)&r;
}
```



Novel methods are needed to exploit emerging computing capacity

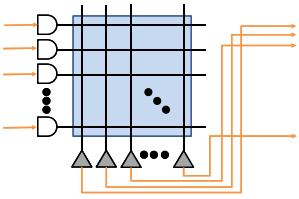
Challenges

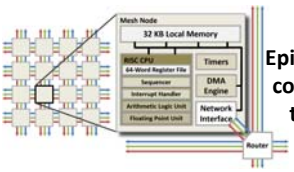
- Gap between hardware capability and software utility
- Neuromorphic and Quantum algorithm development with weak programming models
- Lack of dynamic code re-factoring for unknown processor capacity determined at run-times



ODROID big.LITTLE ARM processor configuration for high performance and low power

NS1e low-power neuromorphic development platform



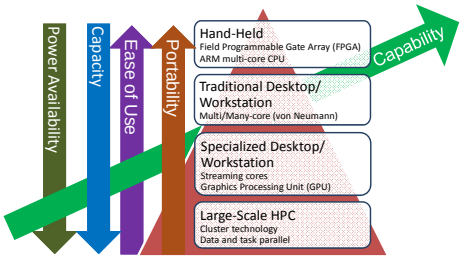


Epiphany many-core processor technology

ARL Facilities and Capabilities Available to Support Collaborative Research

- Novel low-power architecture development platforms (ARM big.LITTLE, Adapteva Epiphany, IBM TrueNorth)
- Large-scale heterogeneous resources including Xeon Phi and GPU clusters
- New architectural features on multi-core CPU clusters

Large-scale GPU-CPU heterogeneous clusters



Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Neuromorphic hardware and emulation models for feasibility studies
- Quantum annealing computing cycles on adiabatic systems (D-Wave)
- Machine learning expertise for large-scale Army application investigation and transition

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED