# Building a Super Computer

from open source

by

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## Proof Of Concept

Contents

- A proof of concept super computer was created in 2015 (Supercomputer.io)
- Used Epiphany-III 16-core processor (32 GFLOPS with 8Gbps interface)
  - note early Parallella tests did not use the 8Gbps oh i/f
- Can start small with little cost (<£100) and grow as required
- Not restricted to MPMD architecture

# Changing Environment

Contents

- Existing technologies (MPI, OpenCL, OpenMP) are maturing
- The advocates for competing tools are coming together OpenHPC
- But the environment is changing. See for example
  - Simon McIntosh-Smith's recent presentation
  - M. Mitchell Waldrop's recent essay The chips are down for Moore's law
- New approaches are required

# New Software Stack

Contents

- The Epiphany chip has been proven with many of the available HPC tools:
  - MPI / OpenCL - COPRTHR SDK
  - OpenMP - OMPi
  - OpenSHMEM - James Ross, David Richie
  - Even SLURM for cluster management - see forum post
- The Parallel Architectures Library plan to rewrite maths, blas, dsp and fft libraries from the ground up
  - aim to be portable and run on multiple device types
  - what the PAL libraries lack in industry wide support they make up

for in boldness of purpose

Parallel Architectures Library

# Building the System

**Contents**

- System Requirements - for <u>Parallella</u> based system
- Building Open Hardware fpga - <u>8Gbps link</u> to <u>Epiphany-III</u>
- Parallella Yocto Build - taylor made distribution using <u>Yocto</u>
  - meta-exotic - generic build of non-native code
- Testing the System - rapid testing cycle: automation possible

System Requirements

# System Requirements

**Building the System**

- Need to keep up to date with the lates
  - interrupt driven <u>oh</u> elink i/f
  - new update kernel drivers and late
    eSDK or PAL libraries
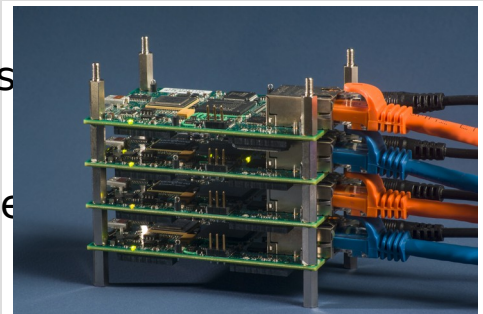
- Easy method of distributing the software to the cluster
- Would like easy extension of fpga, kernel and software
- Would like to build Epiphany software on the build machine

# Future Work

Contents

In no particular order:

- Built in support for PAL libraries
- Cluster management tool like SLURM
- Update of meta-exotic for gcc 5.x tools and adding gdb
    - also prove with another processor (RISK-V)
- North / south direct Epiphany connection
- Updating the various repositories that make up https://github.com/peteasa/parallella/wiki takes time

Contributors or sponsors for this work are always welcome!

@paracpg #parapg on Twitter        Peter on GitHub

The End

# Additional Material

Contents

Architectures

Using Multiple Cores

SC.References

Online copy at https://peteasa.github.io/parapg/parapg.html

# SC.References

Additional Material

Andreas Olofsson

Andreas Olofsson, Tomas Nordström, Zain Ul-Abdin "Kickstarting high-performance energy-efficient manycore architectures with Epiphany" 2014 48th Asilomar Conference on Signals, Systems and Computers

David A. Richie

David A. Richie and James A. Ross "OpenCL + OpenSHMEM Hybrid Programming Model for the Adapteva Epiphany Architecture", OpenSHMEM 2016, Third workshop on OpenSHMEM.

Elias Kouskoumvekakis

"RISC-V port to Parallella", Google Summer of Code 2016

M. Mitchell Waldrop

article: "The chips are down for Moore's law", Nature weekly journal of science, 2016

Michael J Flynn

"Some Computer Organizations and Their Effectiveness", IEEE Transactions on Computers. Vol. c-21, No.9, September 1972

Simon McIntosh-Smith

slides: "It's the end of the world as we know it ...", University of Bristol HPC Research Group, 2015

wikipedia

various articles