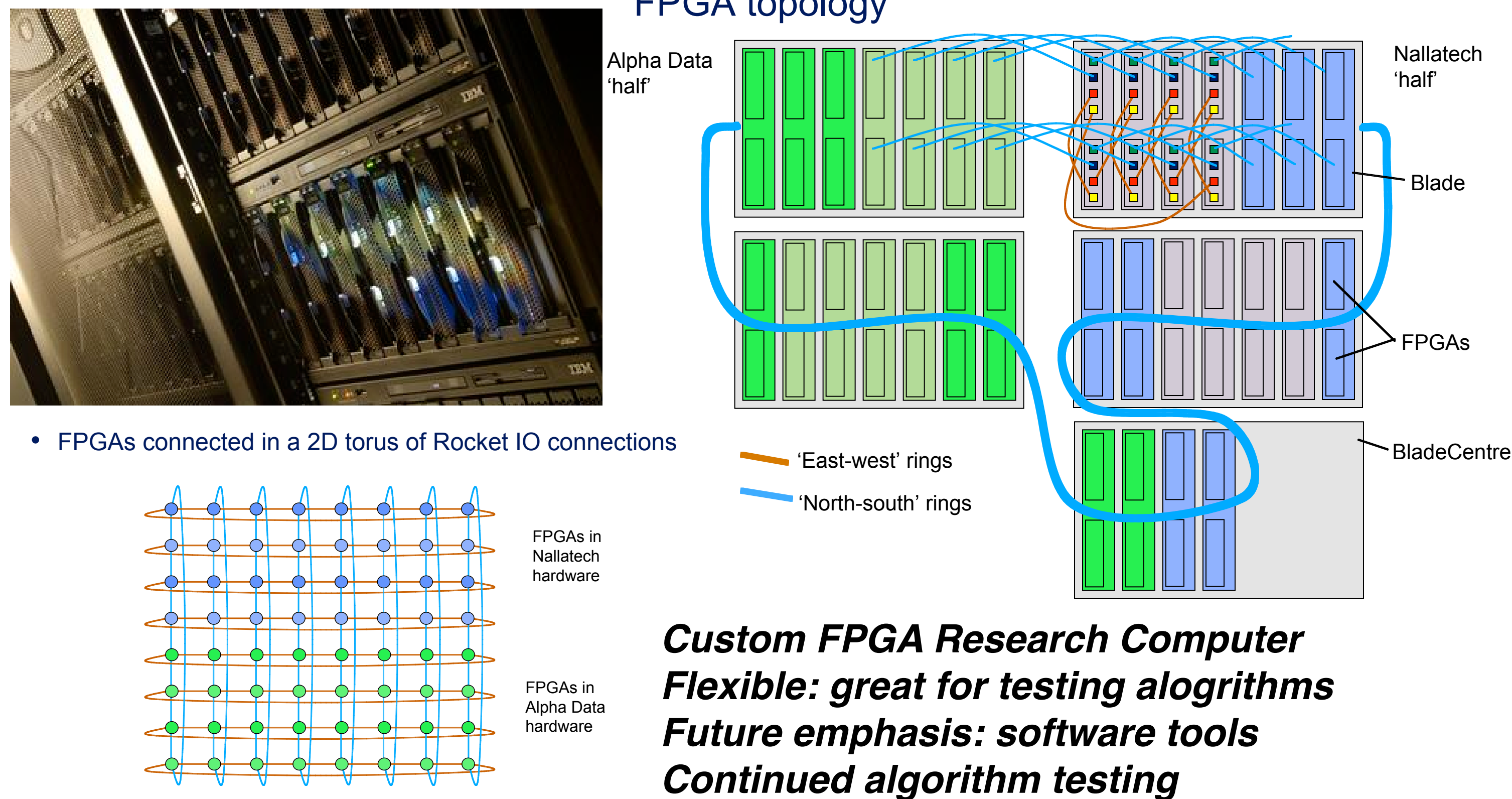


Experiences on 64 and 150 FPGA Systems

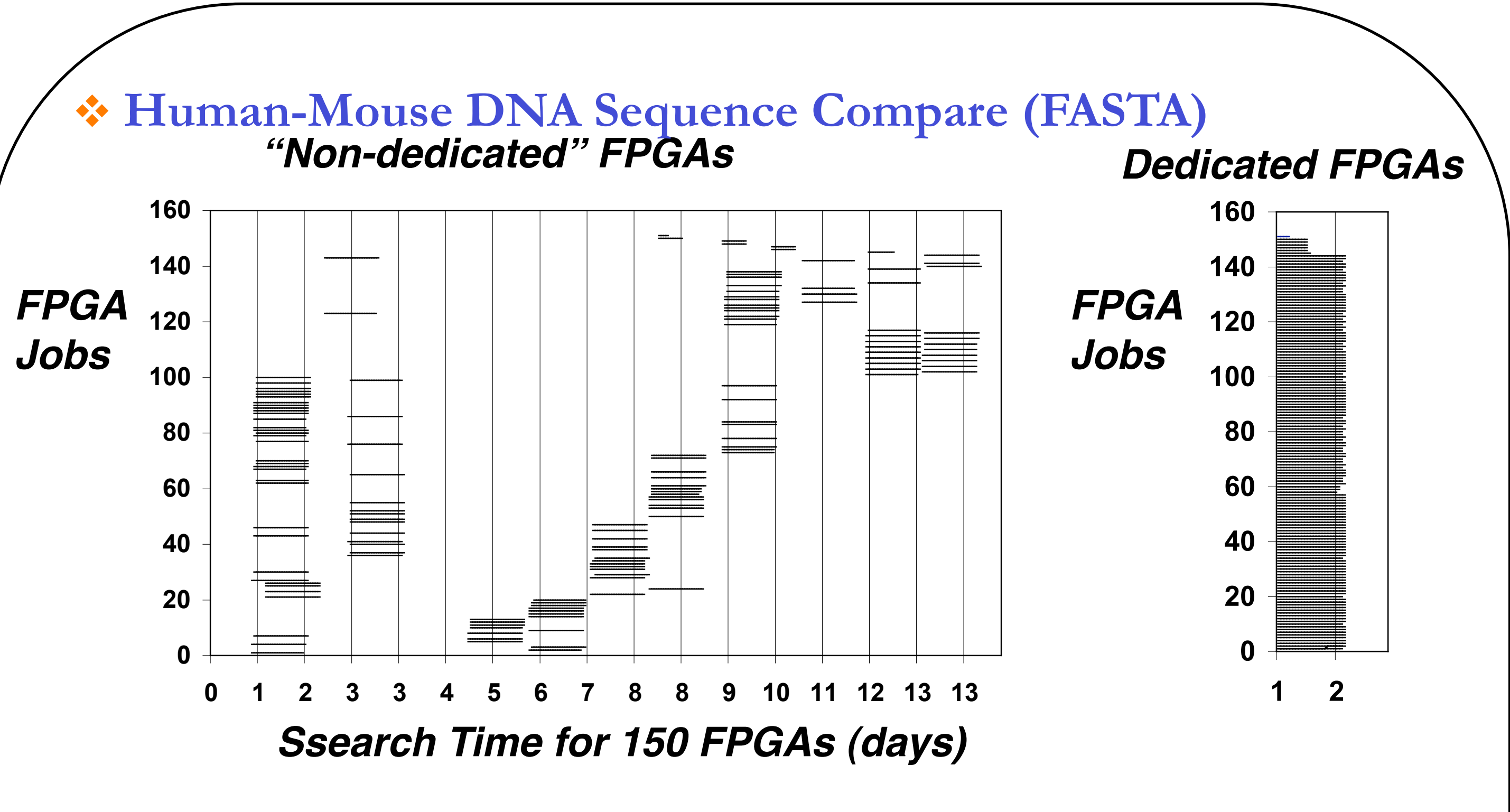
Olaf O. Storaasli, Oak Ridge National Laboratory
 Dave Strenski, Cray Inc.

EPCC "Maxwell": 64 Virtex4 FPGAs

32 Nallatech (DIME-C) & 32 Alpha Data (VHDL) FPGA topology



DNA Sequencing: Speedup on 150 FPGAs



DNA Characters: Human = 155 million, Mouse = 165 million

Total Compares = $155M \times 165M \times 106^2 \times 2$
 = 51×10^{15} Cell Updates

State-of-the-art: Giga Cell Updates per Second (GCUPS)

Sequential FPGA ==> 138 days (11,923,200 secs) ==> 4.3 TCUPS
 (51x10¹⁵/11,923,200 Tera CUPS)

Parallel (actual) ==> 12.9 days (1,114,560 secs) ==> 46 TCUPS

Parallel (dedicated) ==> 1 day (86,400 secs) ==> 605 TCUPS

Compared to one 2.2 GHz Opteron

1 Opteron ==> 20 years (242 mos.)

1 FPGA ==> 5 months

150 Opterons ==> 6 weeks

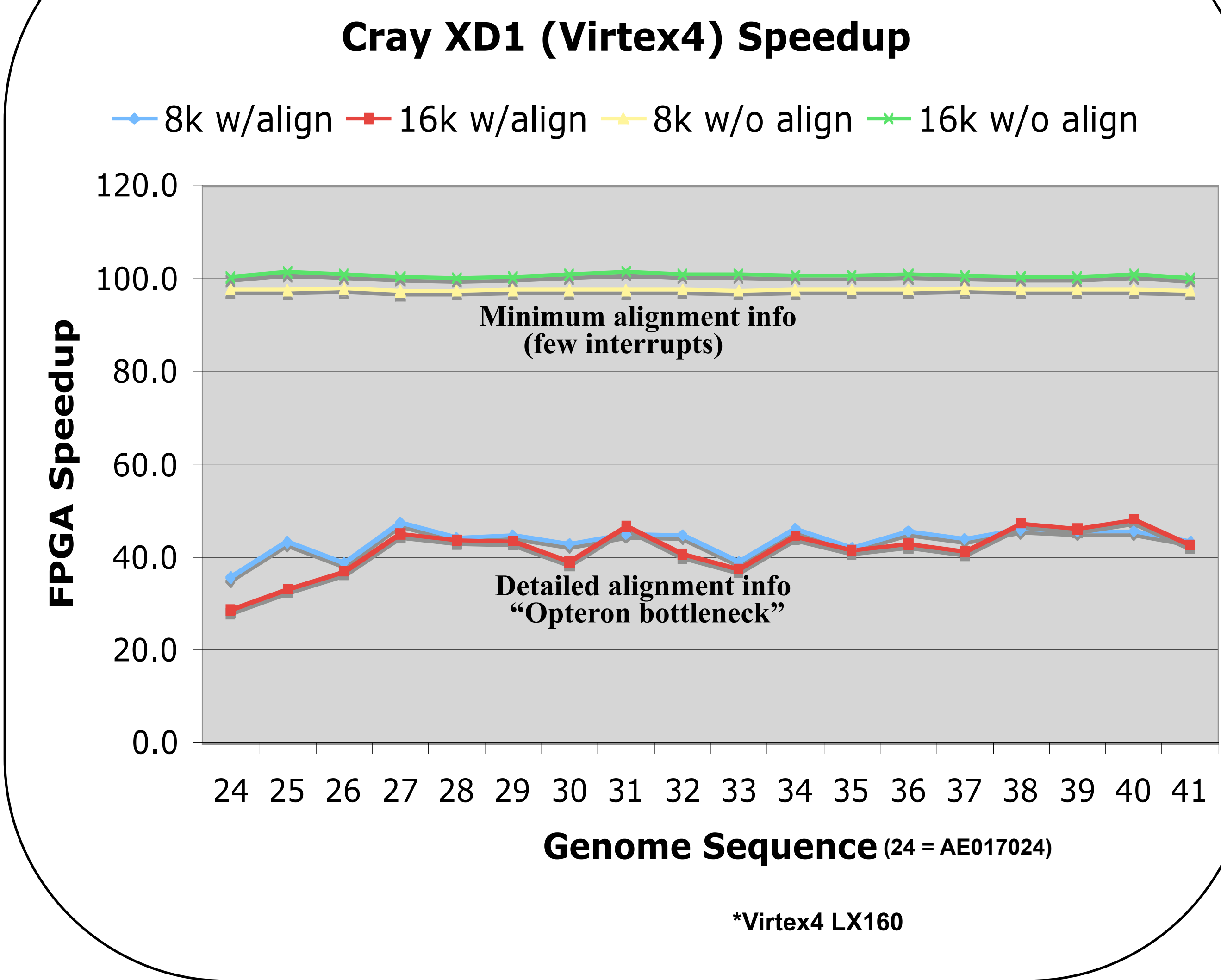
150 FPGAs ==> 1 day ==> 49X speedup (VirtexII)

==> 7,350X faster than 1 Opteron (VirtexIIs)

==> 14,700X faster than 1 Opteron (Virtex4s)

Cray XD1 FPGA Speedup over 2.2 GHz Opteron

Bacillus anthracis DNA sequencing: 8k vs. 16k query sizes



NRL Cray XD1: 150 FPGAs

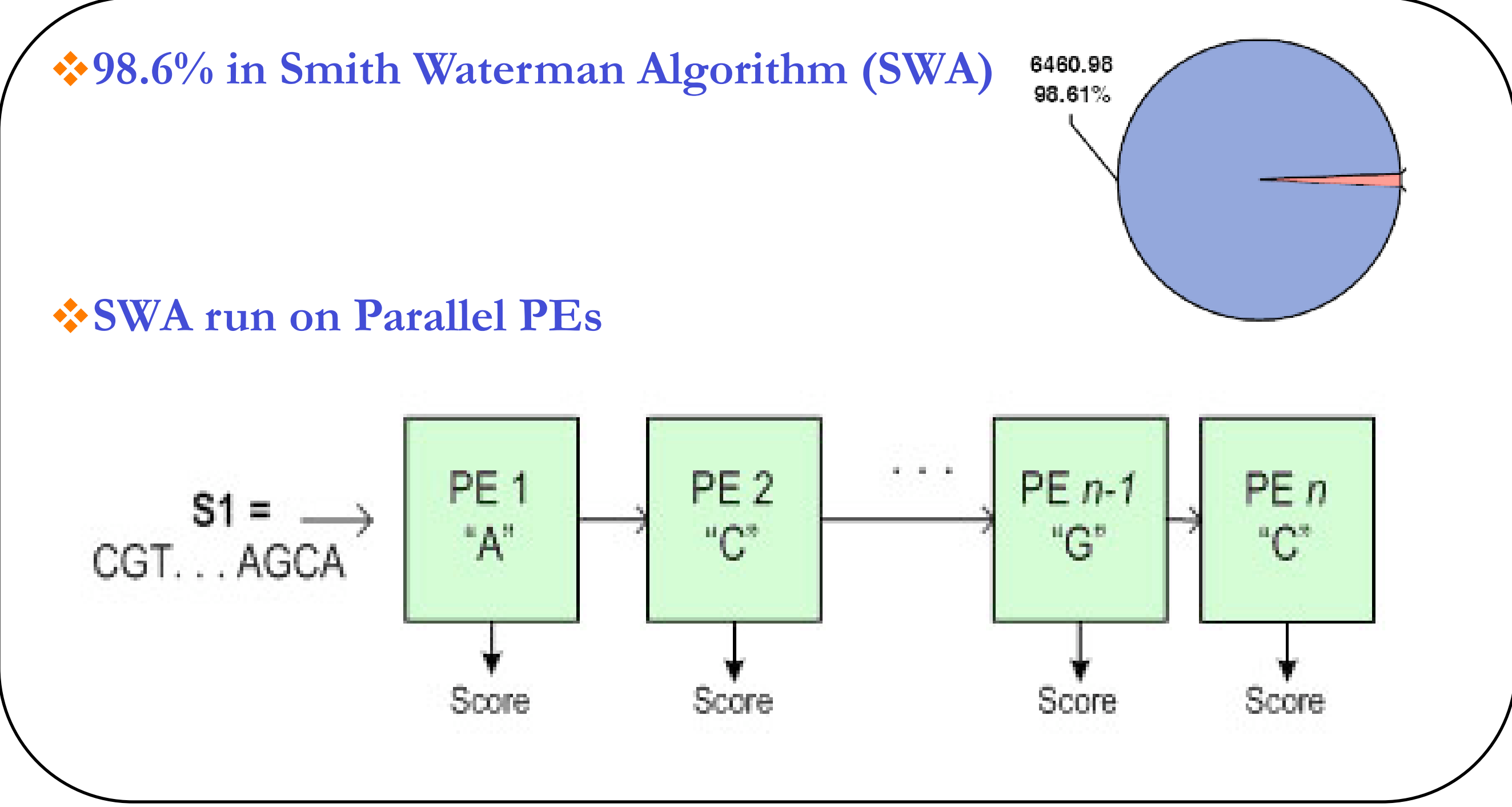
ORNL Tiger: 6 VirtexII Pro 50

CRAY Pacific: 6 Virtex4 LX160

NRL: 144 VirtexII + 6 LX160



FASTA Ssearch34 Algorithm



Observations

Best FPGA Speedup:

- Minimize alignment output (2.5X faster)
- More FPGAs: 500/7350X faster w 5/150 FPGAs
- Newer FPGAs: Virtex4 2X faster than VirtexII

Conclusions => Future Work

- 100x speedup over 2.2GHz Opteron
- Scalable for multiple FPGAs: ~500X for 5 FPGAs, 7,350 for 150 FPGAs
- Plan DRC (Virtex-4 LX200s) => Cray XT5h



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