

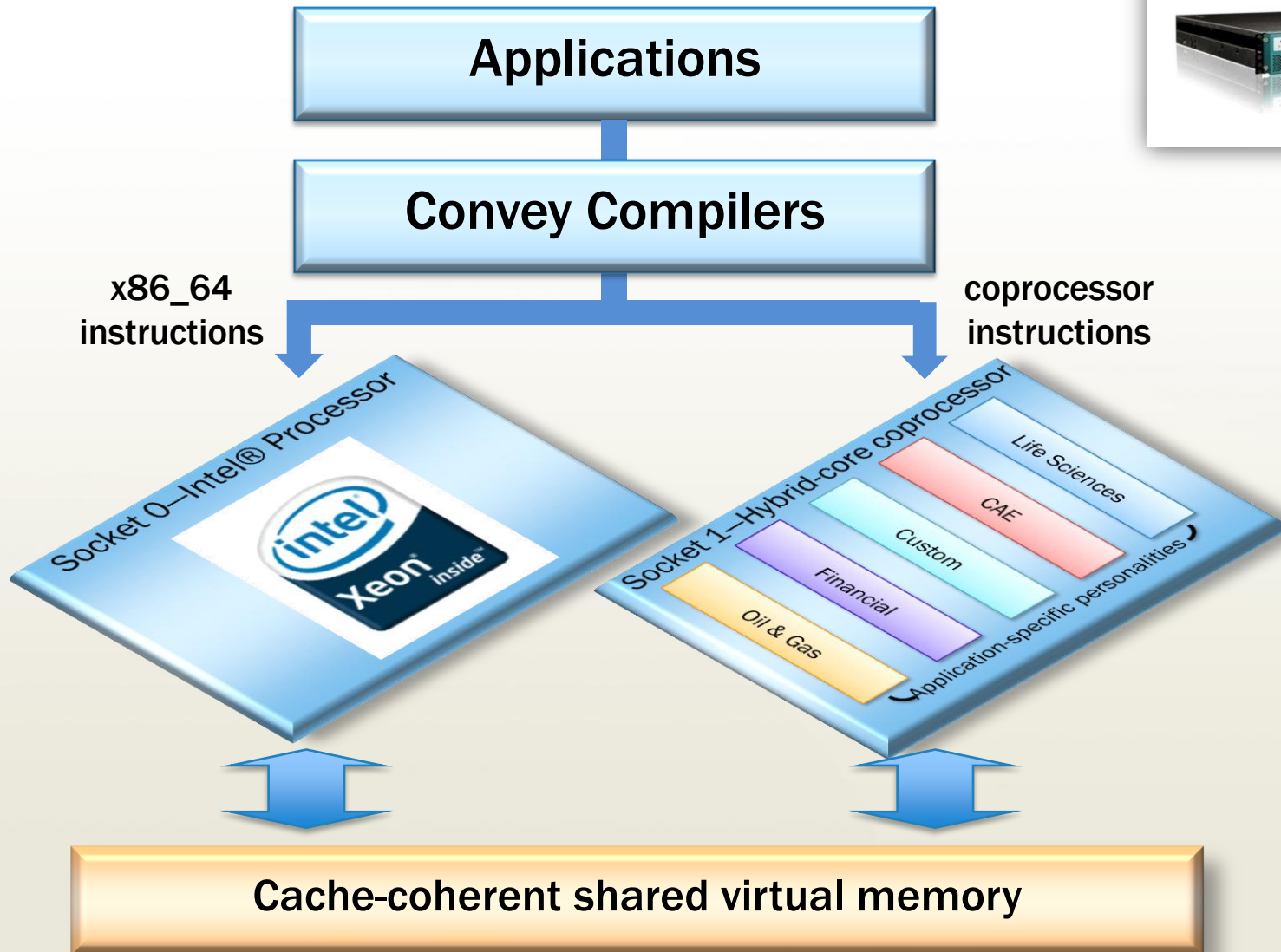


**CONVEY**  
computer™

**HPC FORUM**  
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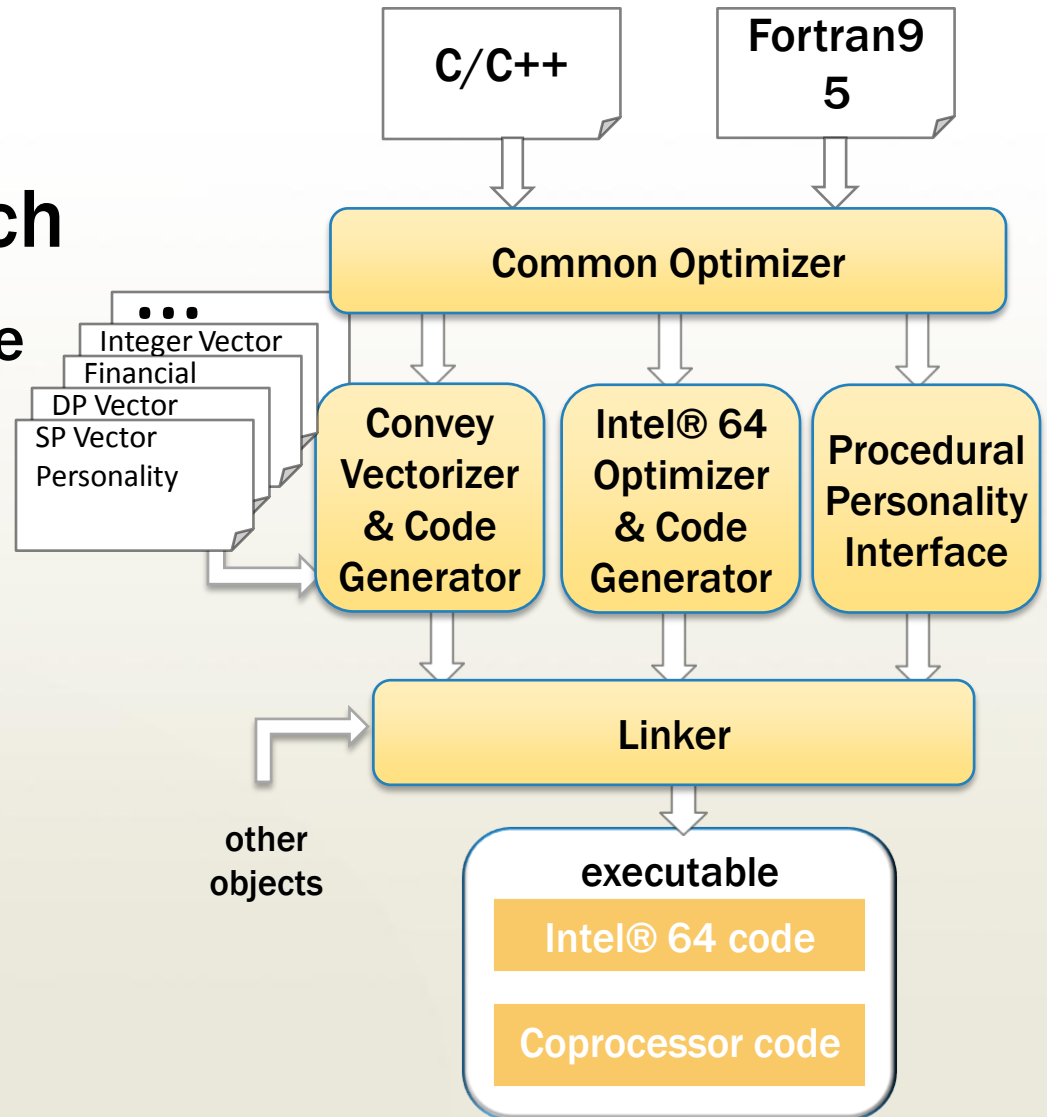
# HC-1 Hybrid Core Computing



# Compiler code generation techniques

- Convey uses a different approach

- Predefined machine state models (personalities)
- Focus on a single thread to run much faster
- Programmer productivity
  - “Dusty deck”



# Embedded global memory

- **Convey scales as the industry scales**
  - Leverage multi-core and many-core x86 technologies
  - Global shared 64 bit virtual memory
- **As the Convey architecture scales out ...**
  - Look at PGAS languages
    - UPC
    - Co-Array Fortran
  - Multi level vectorization and parallelism
- **Data placement directives are provided**
- **Data placement tool provided**

# Compiler Intermediate Format

- **Standards are important to customers**
  - ANSI C/C++
  - ANSI Fortran 95
- **Known style for writing vectorizable code**
- **Directives are available**
- **Tuned libraries are available**
- **Instruction sets by industry or customer**
  - Compiler utilizes specialized instructions when present
  - Predefined instruction sets provided by Convey

# Hybrid systems or processor extensions

```
File Edit View Terminal Tabs Help
$ make triad1.exe
icc -DUNDERSCORE -O -c mysecond.c
cnyf90 -o triad1.exe triad1.f -mcny_auto_vector -O2 -mcny_sig=sp -PHASE:w=0
-LNO:opt_report=3 mysecond.o
VECTORIZED STMT in MAIN_0 at 9
VECTORIZED STMT in MAIN_1 at 15
[kcollins@underdog Triad]$

external mysecond
double precision my
parameter (n=100000)
common a,b,c
real*4 a(N),b(N),c(N),s
real*8 t1,t2,gfps,gbps

s = 3.0
do i=1,N
  a(i) = 2.0
  b(i) = 2.0
enddo

t1 = mysecond()
do i=1,N
  c(i) = a(i)+s*b(i)
enddo
t2 = mysecond()
gbps = 2*N*1e-9/(t2-t1)
gbps = 12*N*1e-9/(t2-t1)

write(6,1000) t2-t1,gfps,gbps
1000 format(f5.2,' seconds'/
          f5.2,' Gflop/sec'/
          f5.2,' Gbyte/sec')
"triad1.f" 26L, 545C

Dump of assembler code from 0x4031ab to 0x4031d0:
0x0000000004031ab <MAIN_+219>:      cmpl    $0x0,8427174(%rip)      # 0xc0c858 <cny
$coprocessor_ok>
0x0000000004031b2 <MAIN_+226>:      movsd   %xmm0,0xffffffffffffe8(%rbp)
0x0000000004031b7 <MAIN_+231>:      mov     $0x1,%eax
0x0000000004031bc <MAIN_+236>:      movsd   %xmm0,0xffffffffffffe0(%rbp)
0x0000000004031c1 <MAIN_+241>:      mov     $0x800130,%rsi
0x0000000004031c8 <MAIN_+248>:      je      0x4031d3 <MAIN_+259>
0x0000000004031ca <MAIN_+250>:      test    %rsi,%rsi
0x0000000004031cd <MAIN_+253>:      jne     0x4033ad <MAIN_+733>
End of assembler dump.
(gdb) cont
Continuing.
[Switching to Thread 1084229952 (LWP 23911)]

Breakpoint 2, 0x0000000008001e0 in __cny_region_MAIN_1 ()
(gdb) disassemble 0x8001e0 0x800200
Dump of assembler code from 0x8001e0 to 0x800200:
0x0000000008001e0 <__cny_region_MAIN_1+176>: add.sq   %a10,%a9,%a10
0x0000000008001e8 <__cny_region_MAIN_1+184>: ld.fs    $(%a10),%v1
0x0000000008001ec <__cny_region_MAIN_1+188>: add.sq   %a8,%a9,%a8
0x0000000008001f0 <__cny_region_MAIN_1+192>: ld.fs    $(%a8),%v0
0x0000000008001f8 <__cny_region_MAIN_1+200>: mul.fs   %v1,%s2,%v1
0x0000000008001fc <__cny_region_MAIN_1+204>: add.uq   %a0,$0x58583a0 <_BLNK_+8000
0000>,%a8
End of assembler dump.
(gdb) █
```

# Run-time libraries

- **A shared high level math library is provided**
  - BLAS, LAPack, FFTs
  - Key routines are highly optimized
- **Unmodified programs can dynamically link Convey math library**
  - Optimized routines
  - Industry or customer specific instruction sets