oneAPI Technical Advisory Board Meeting

December 16, 2020

Virtual Meeting

Agenda

Duration	Topics
10 minutes	oneAPI: how we got here, where we are going
40 minutes	Break out sessions
5 minutes	Closing

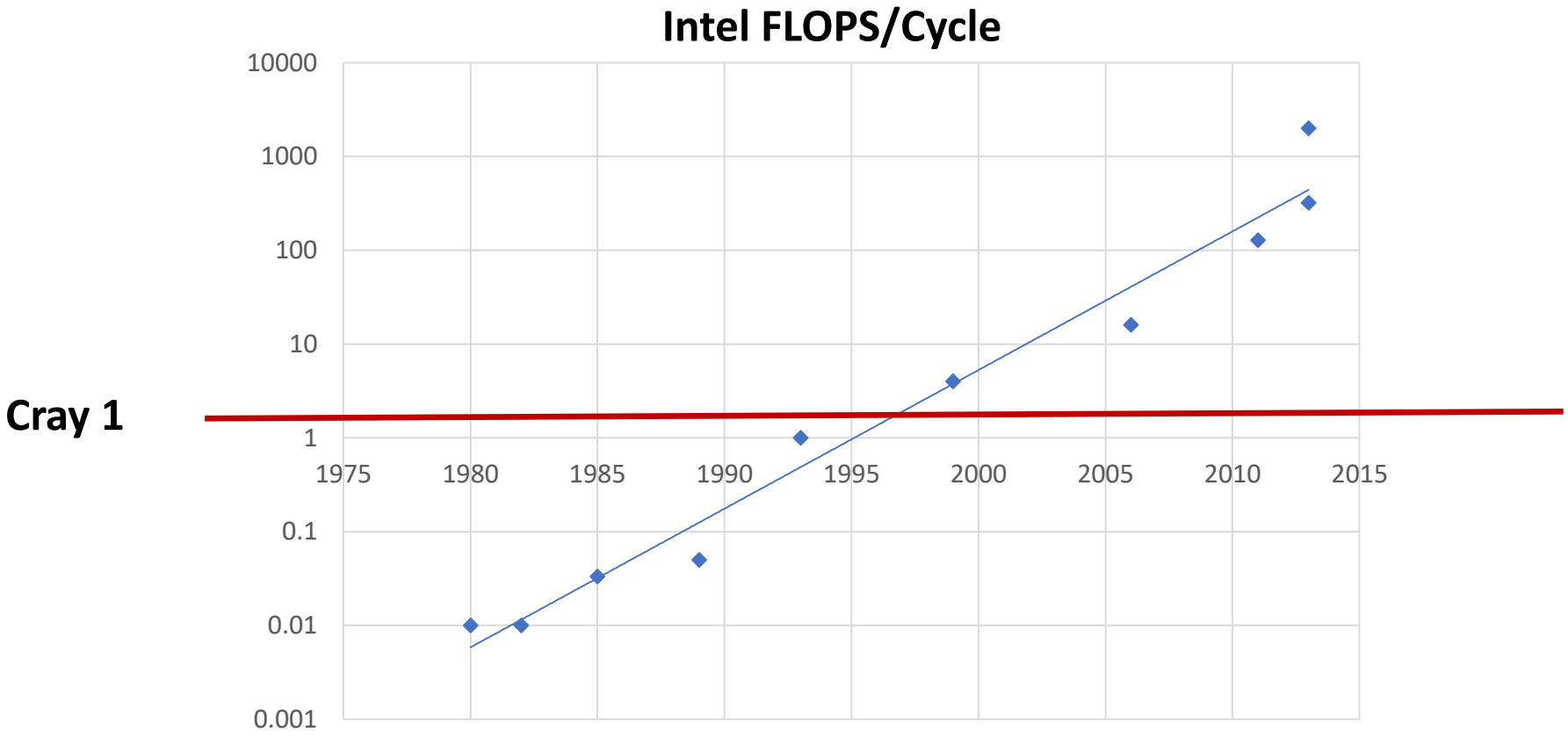
Welcome and Thanks

- A unique opportunity to steer the parallel programming ecosystem

- A problem worth solving
  - Multi-architecture, avoiding lock-in to 1 specific hardware architecture
  - Direct and library-based programming
  - Extending existing models
  - Performant

- Your leadership, input, and feedback is critical

Moore's Law and compilers



2007: LIBOR loop nest

```
for (path=0; path<npath; path++) {
   ...
  for(n=0; n<Nmat; n++) {
    ...
    for (i=n+1; i<N; i++) {
      lam  = lambda[i-n-1];
      con1 = delta*lam;
      v   += (con1*L[i])/(1.0+delta*L[i]);
      vrat = exp(con1*v - lam*(sqez-0.5*con1));
      L[i] = L[i]*vrat;
    }
    ...
  }
}
```

Outer loop parallel

Inner loop sequential

http://people.maths.ox.ac.uk/~gilesm/codes/libor_old/libor_as.c

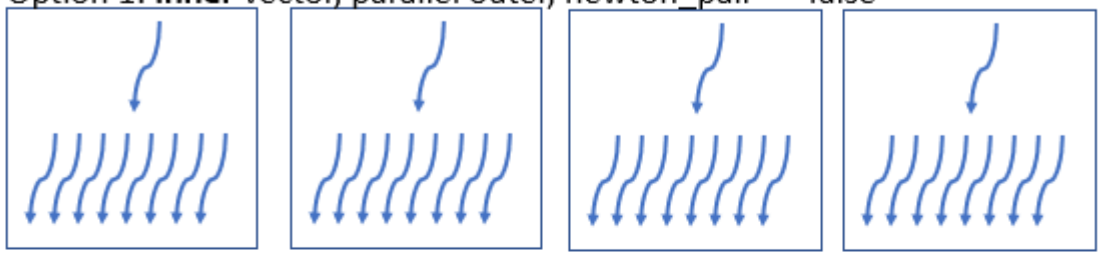
2017: SIMT vs Threads & vectors

CHARMM (Bio) Force-Field from Baseline LAMMPS

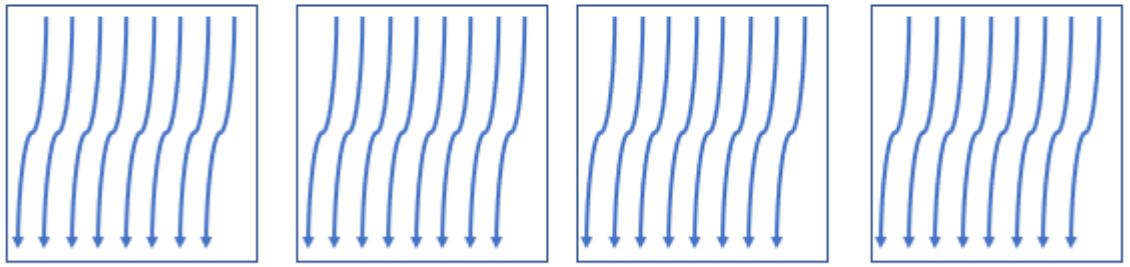
```
for (ii = 0; ii < inum; ii++) {
  i = ilist[ii];
  . . .
  for (jj = 0; jj < jnum; jj++) {
    j = jlist[jj];
    . . .
    if (rsq < cut_bothsq) {
        . . .
        if (newton_pair) {
           f[j][0] -= . . .
        }
    }
  }
  f[i][0] += . . .
}
```

	GPU	CPU
1. Inner	92.71%	84.61%
2. Outer	100.00%	84.61%
3. Privatize	66.97%	100.00%
4. Atomic	91.21%	59.14%

Option 1: **Inner** vector, parallel outer, newton_pair == false



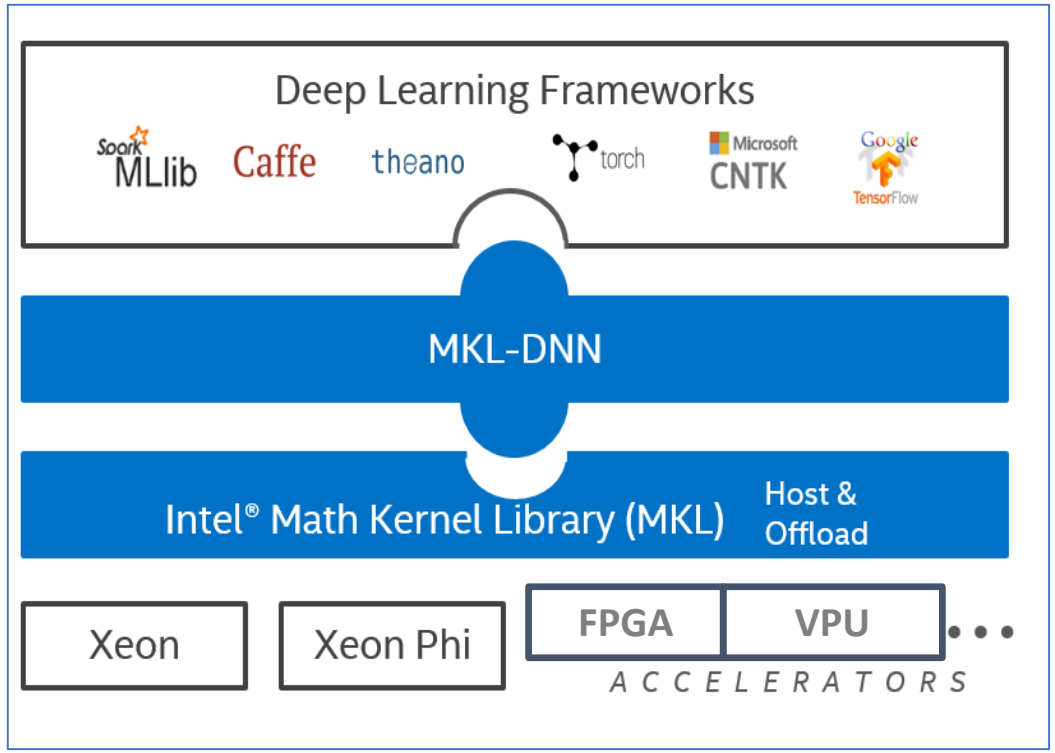
Option 2: **Outer** vector, newton_pair == false

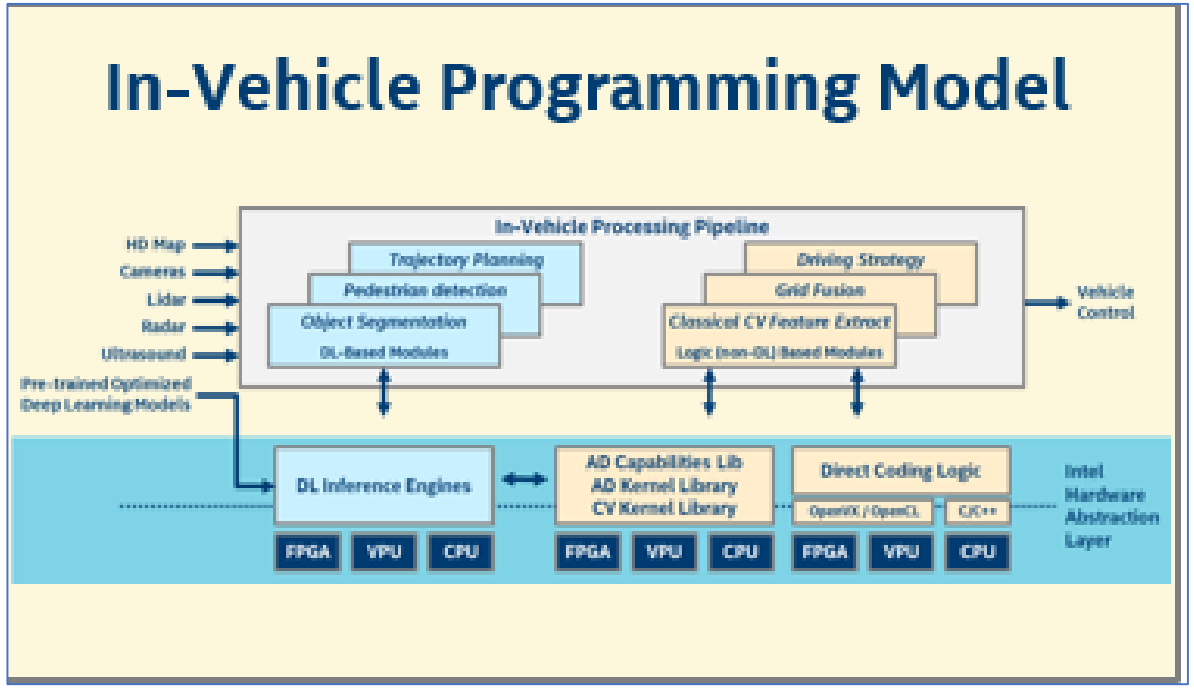


Option 3: **Privatize,** inner vector, parallel outer, newton_pair == true

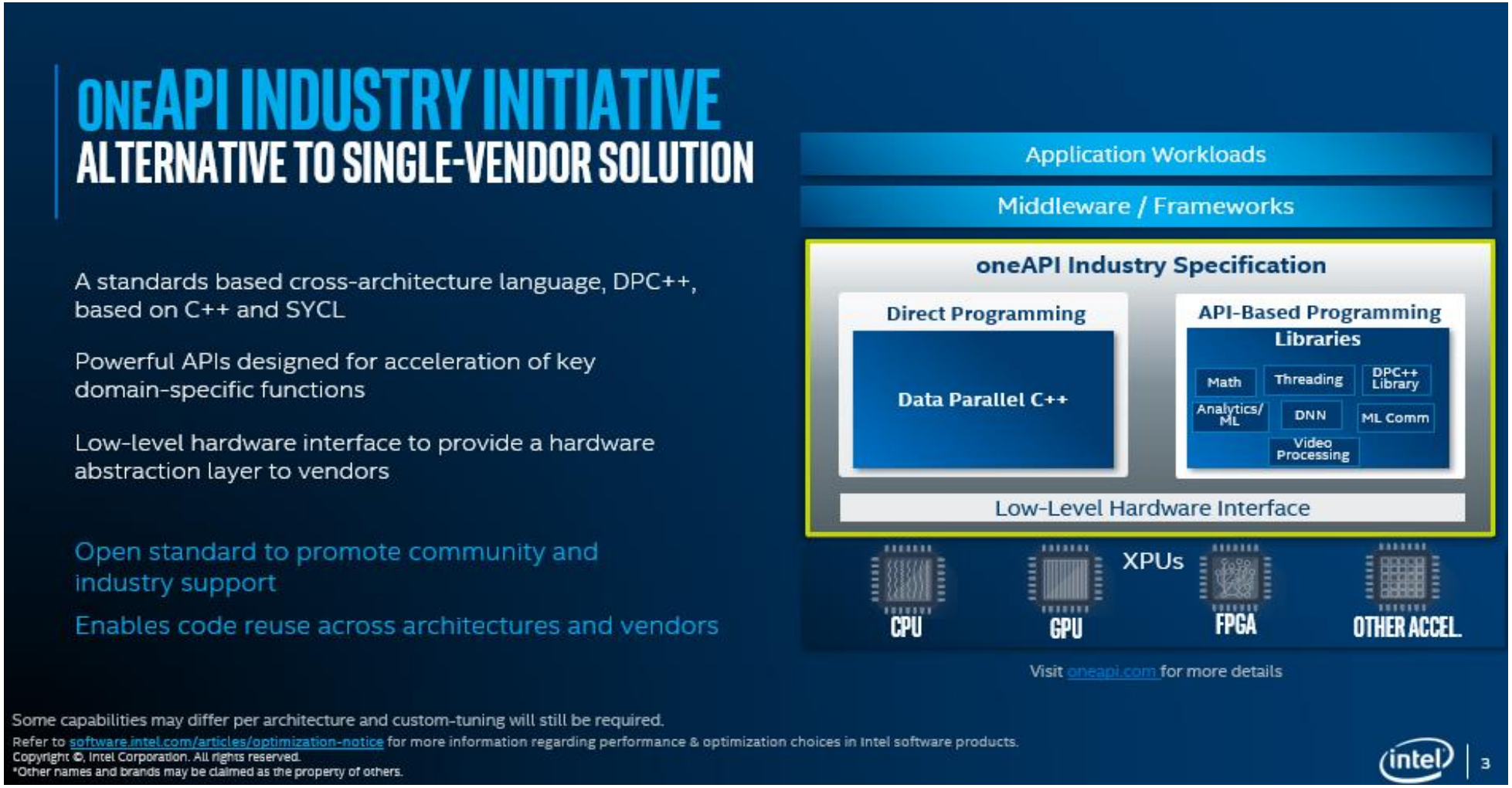
Option 4: **Atomic**, inner vector, parallel outer, newton_pair == true

2017: API programming and direct programming





2019: oneAPI


ONEAPI INDUSTRY INITIATIVE
ALTERNATIVE TO SINGLE-VENDOR SOLUTION
A standards based cross-architecture language, DPC++, based on C++ and SYCL
Powerful APIs designed for acceleration of key domain-specific functions
Low-level hardware interface to provide a hardware abstraction layer to vendors
Open standard to promote community and industry support
Enables code reuse across architectures and vendors
Application Workloads
Middleware / Frameworks
oneAPI Industry Specification
Direct Programming
Data Parallel C++
API-Based Programming
Libraries
Math
Threading
DPC++ Library
Analytics/ ML
DNN
ML Comm
Video Processing
Low-Level Hardware Interface
XPUs
CPU
GPU
FPGA
OTHER ACCEL.
Visit oneapi.com for more details
Some capabilities may differ per architecture and custom-tuning will still be required.
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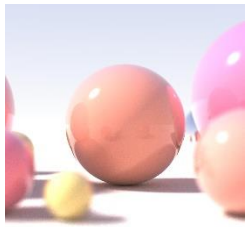
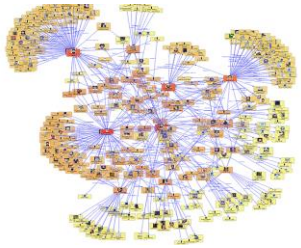
2021: Issues to address

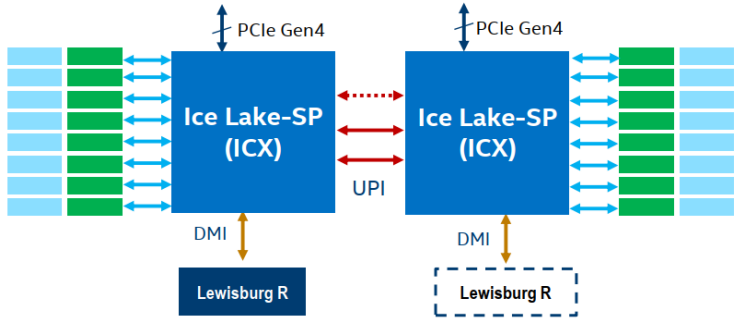
Irregular parallelism





Distributed computing

NUMA



Give the break out information