



UPC at NERSC/LBNL

Kathy Yelick

NERSC/LBNL and U.C. Berkeley



**NATIONAL ENERGY RESEARCH
SCIENTIFIC COMPUTING CENTER**

**Advancing Computational Science of Scale—
Producing Real Results**



Overview of NERSC Effort



Three components:

1) Compilers

- Portable compiler infrastructure (UPC->C)
- Explore optimizations: communication, shared pointers
- Transfer technology to other UPC compilers

2) Runtime systems for multiple compilers

- Allow use by other languages (Titanium and CAF)
- And in other UPC compilers, e.g., Intrepid
- Performance evaluation: influence machine vendors

3) Applications and benchmarks

- Currently looking at NAS PB
- Evaluating language and compilers
- Plan to do a larger application next year

NERSC UPC Compiler

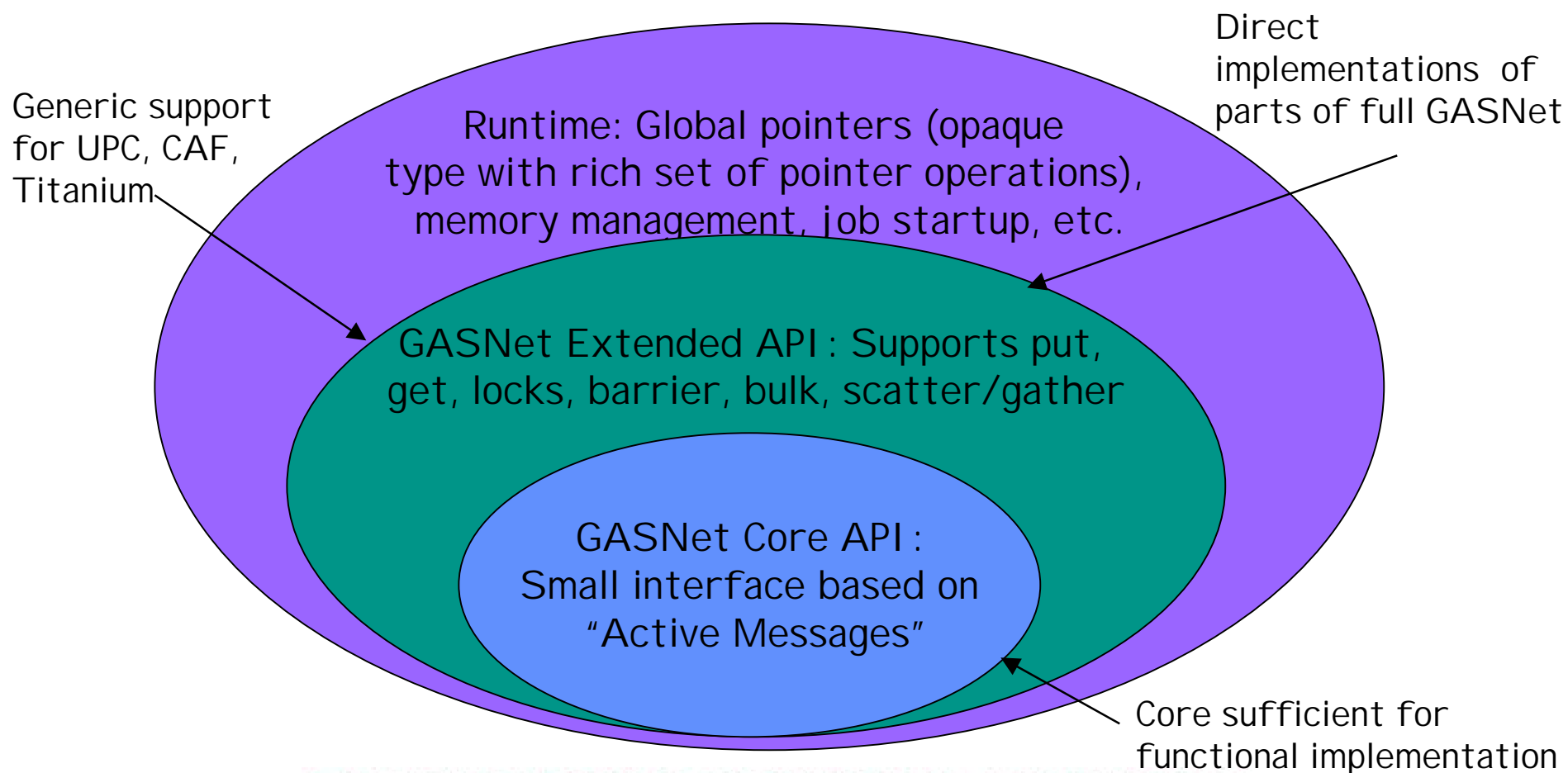


- **Personnel**
 - **Costin Iancu**
 - **Wei Chen is starting this summer**
- **Funded by DOE/UPC**
- **Complementary to Intrepid effort**
 - **Intrepid**
 - **gcc-based compiler will generate assembly**
 - **Probably better serial performance**
 - **NERSC compiler**
 - **Open64 using C backends (currently)**
 - **Easier to port**
 - **Better framework for high level optimizations**

Portable Runtime Support



- Developing a runtime layer that can be easily ported and tuned to multiple architectures.

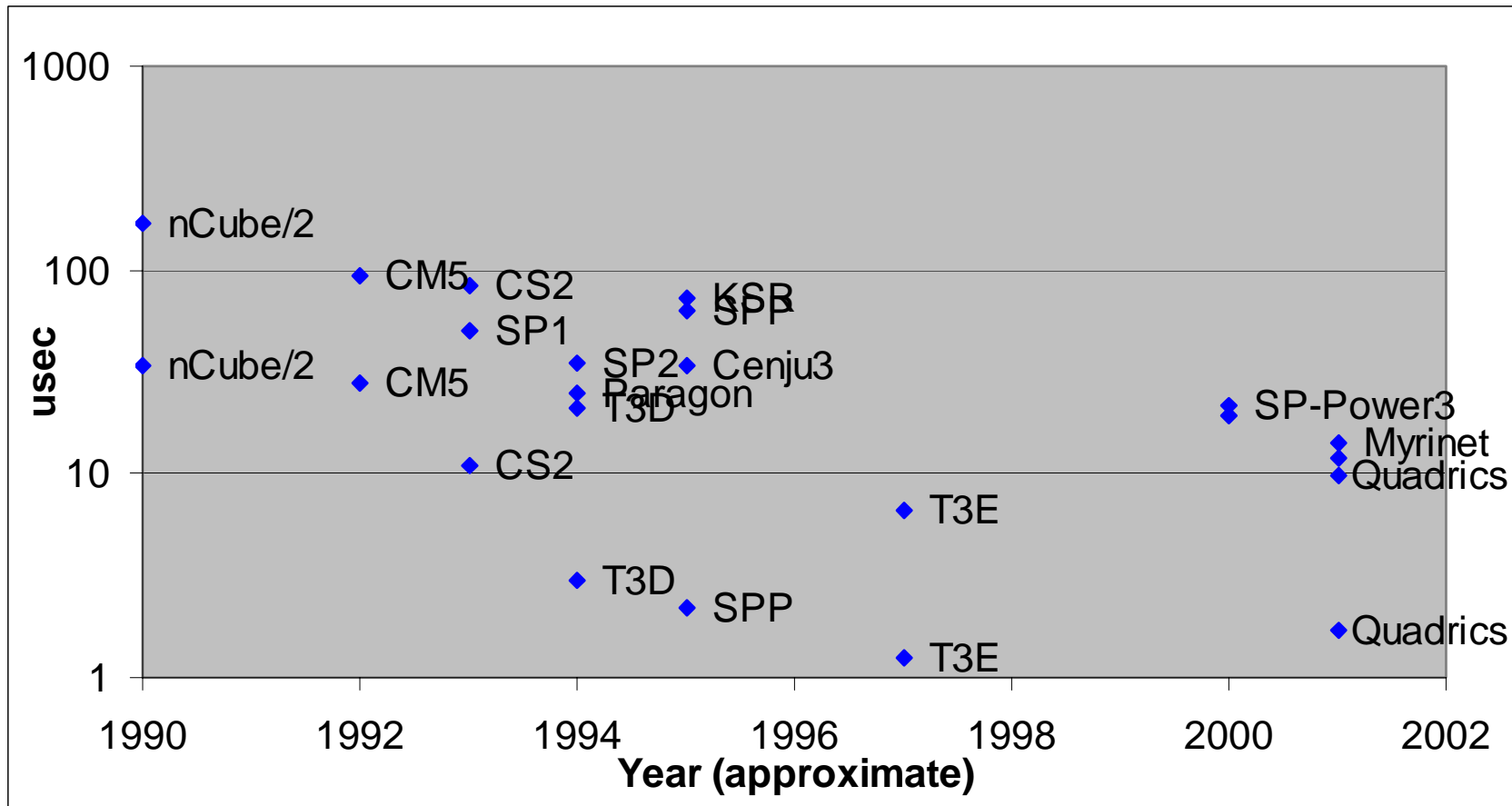


Runtime and GASNet



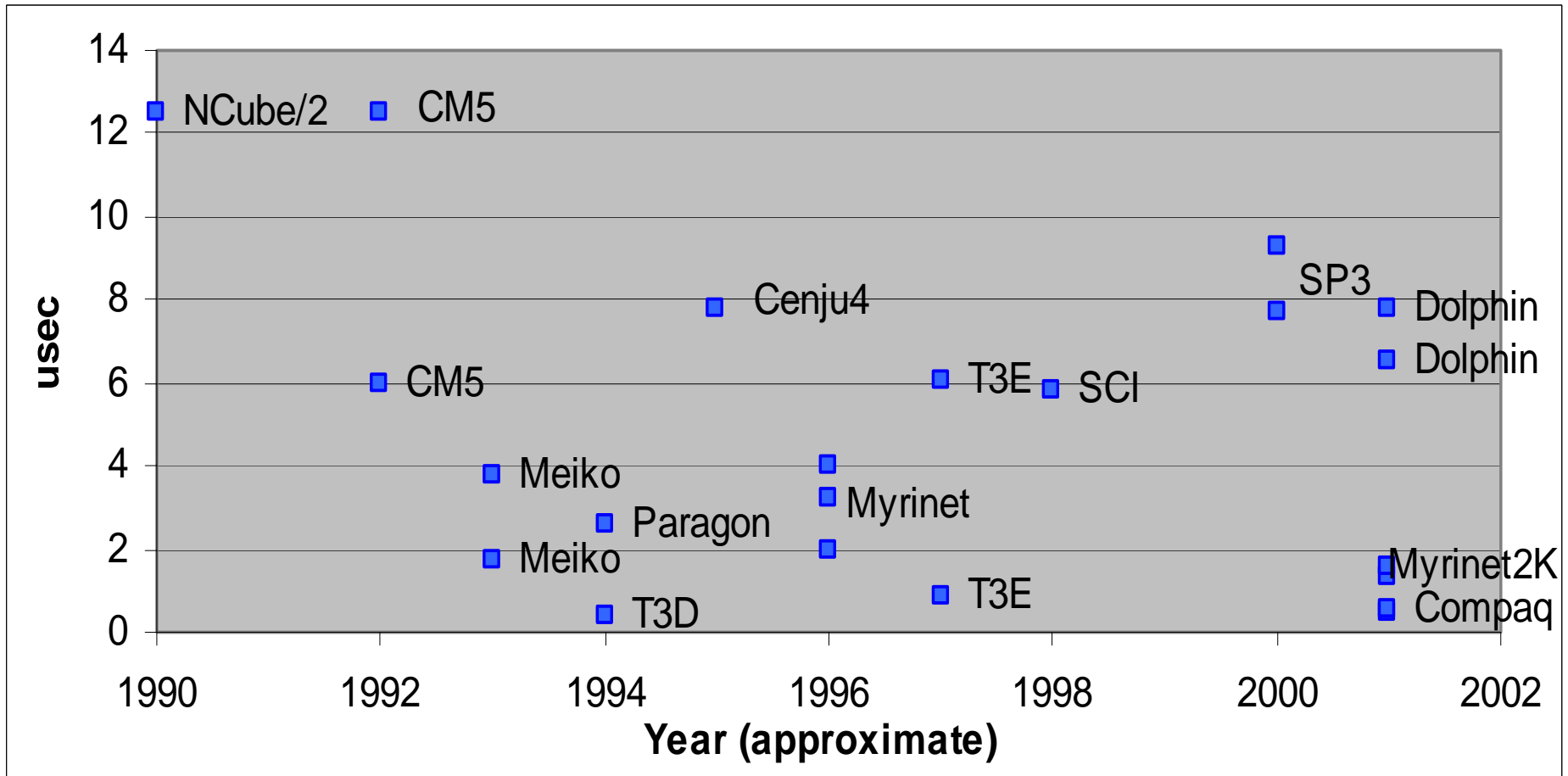
- **Personnel**
 - **Dan Bonachea – Specification and reference implementation of GASNet, Dolphin**
 - **Jason Duell – Quadrics and reference runtime**
 - **Mike Welcome – IBM SP**
 - **Christian Bell – Myrinet**
 - **Paul Hargrove –VIA, Infiniband, etc.**
- **Funding**
 - **NSA: PC Clusters (Quadrics and Myrinet, VIA,...)**
 - **UPC/DOE: IBM SP, Quadrics/Compaq**
 - **PModels/DOE: GASNet spec and MPI implementation, generality (CAF, Ti), language/library extensions (I/O, collectives,...)**

End to End Latency Over Time



- Latency has not improved significantly
 - T3E (shmem) was lowest point

Send Overhead Over Time



- **Overhead has not improved significantly; T3D was best**
 - **Lack of integration; lack of attention in software**

Applications Approach



- **Requirements for Applications outside UPC group**
 - **At least one very good compiler**
 - **Portability**
- **Our strategy**
 - **Evaluate compilers to identify performance programming**
 - **Focus on medium-sized application/benchmarks this year**
- **Longer term, identify large application**
- **Personnel: Parry Husbands**
- **Funding: DOE/UPC**

Agenda



Agenda

- **9:00 Coffee and pastries**
- **9:30 Overview of UPC work at LBNL - Kathy Yelick**
- **9:45 UPC Compiler - Costin Iancu**
- **10:15 Communication Optimizations (Titanium) - Jimmy Su**
- **10:30 Memory Models (Titanium experience) - Wei Chen**
- **10:45 Break**
- **11:15 Benchmarking communication layers - Mike Welcome**
- **12:00 Lunch**
- **1:30 GASNet - Dan Bonachea**
- **2:30 UPC Runtime - Jason Duell**
- **3:15 Break**
- **3:30 Infiniband - Paul Hargrove**
- **4:00 Applications - Parry Husbands and Kathy Yelick**