Data Reorganization and Future Embedded HPC Middleware

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The Data Reorganization Forum

http://www.data-re.org

Join the mailing list discussion!

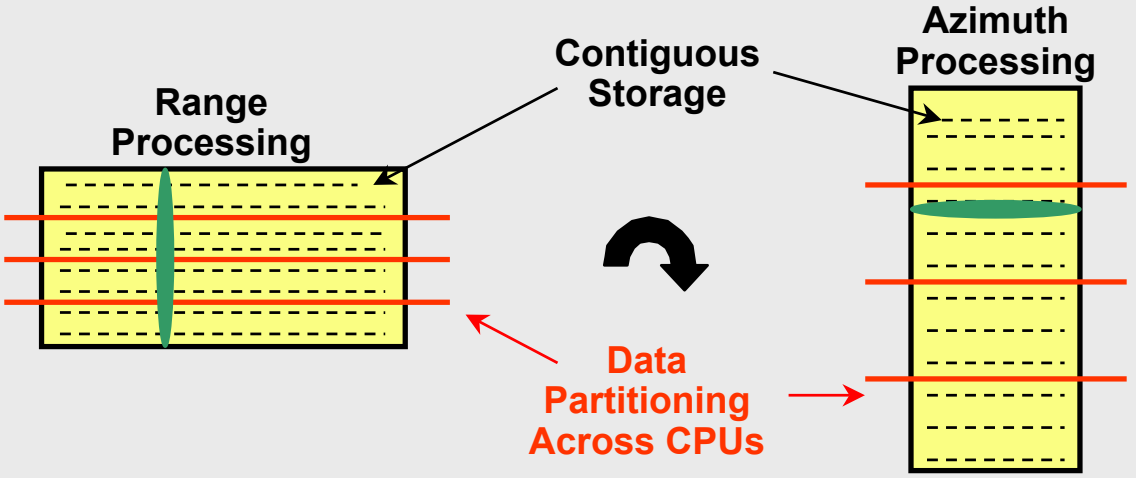
Goal: Final specification by June 2001

- **Broad community participation includes:**
  - **FFRDCs and Government/Defense Laboratories**
  - **Defense integrators**
  - **Commercial embedded multicomputer vendors**
  - **Commercial HPC tool vendors**
- **Examining API's, algorithms, and application requirements**

What Problems Does Data Reorg Try To Solve?

Data Partitioning and Redistribution Issues for Signal/Image Processing (SIP) Applications

- Block partitioning is most common
  - Whole problems stored in 1 memory for performance
- Data redistribution communication is “severe”
  - Prototypical example is matrix transpose in 2DFFT/SAR



Interface Scalability

Long-term future: higher-level / integrated / OO ???

Future Practice (with Data Reorg API)

- Programmer uses high-level partitioning services
- Middleware handles data partitioning details
- Data redistribution with a single high-level call
- Compute using VSIPL

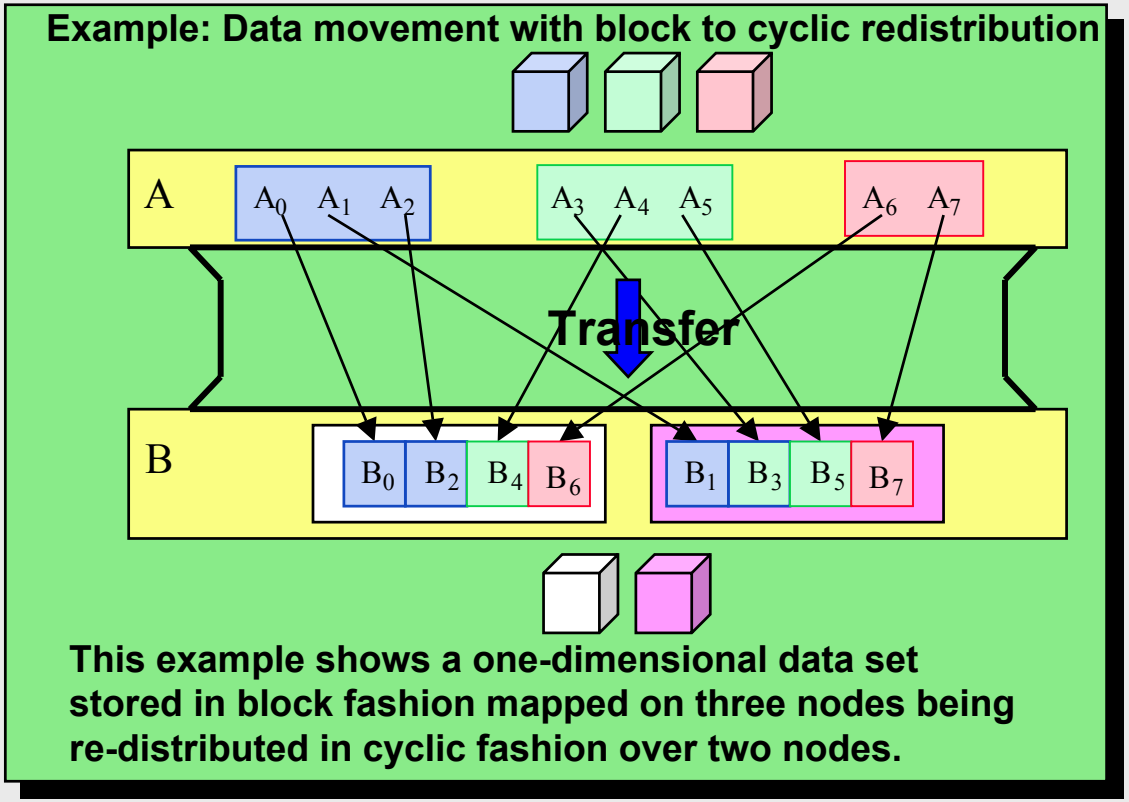
Easier to scale programming effort

State of the Art (current standard APIs)

- Programmer manually computes data partitioning
- Programmer manually redistributes data (MPI or MPI/RT)
- Compute using VSIPL

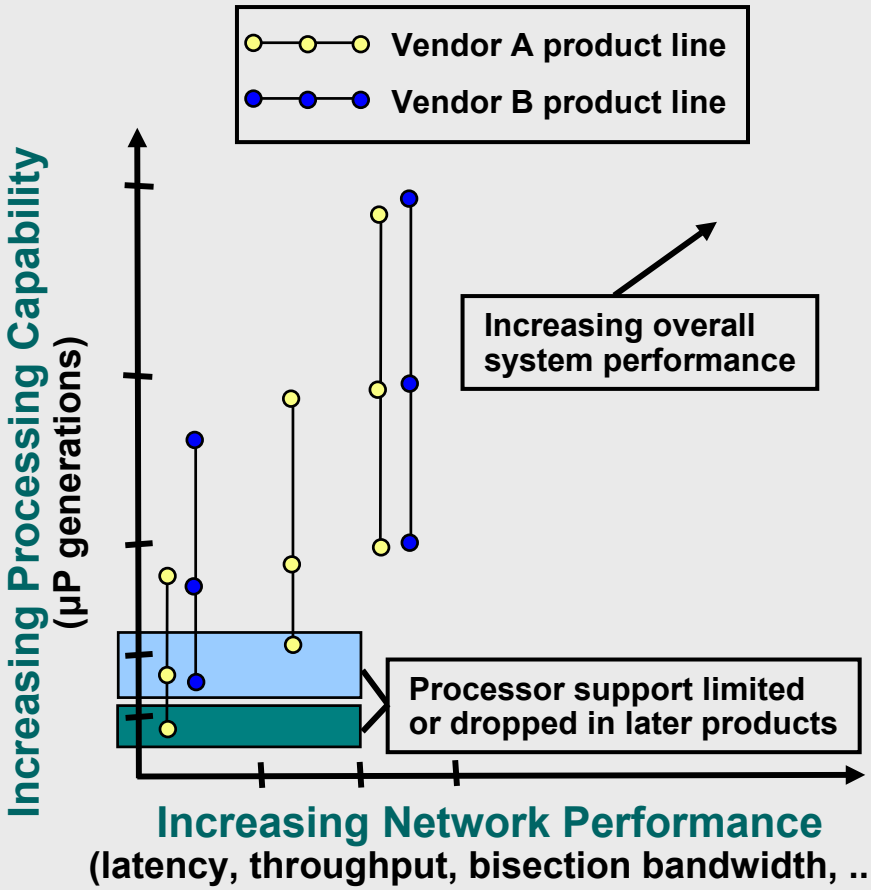
Hard to scale programming effort to large systems

Data Reorg Interface Example



- Application programmer uses DRI to move data
- DRI hides complex data movement from programmer

Model-Year Portability



Portable software leverages inevitable advances in COTS HPC technology

Defense system lifetimes: long
COTS HPC system lifetimes: short

"Point" solutions specific to a single vendor are long-term *cost ineffective*

Portable software with high performance is a powerful tool and is the ultimate goal

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Challenges to Achieving Consensus In A Committee Context

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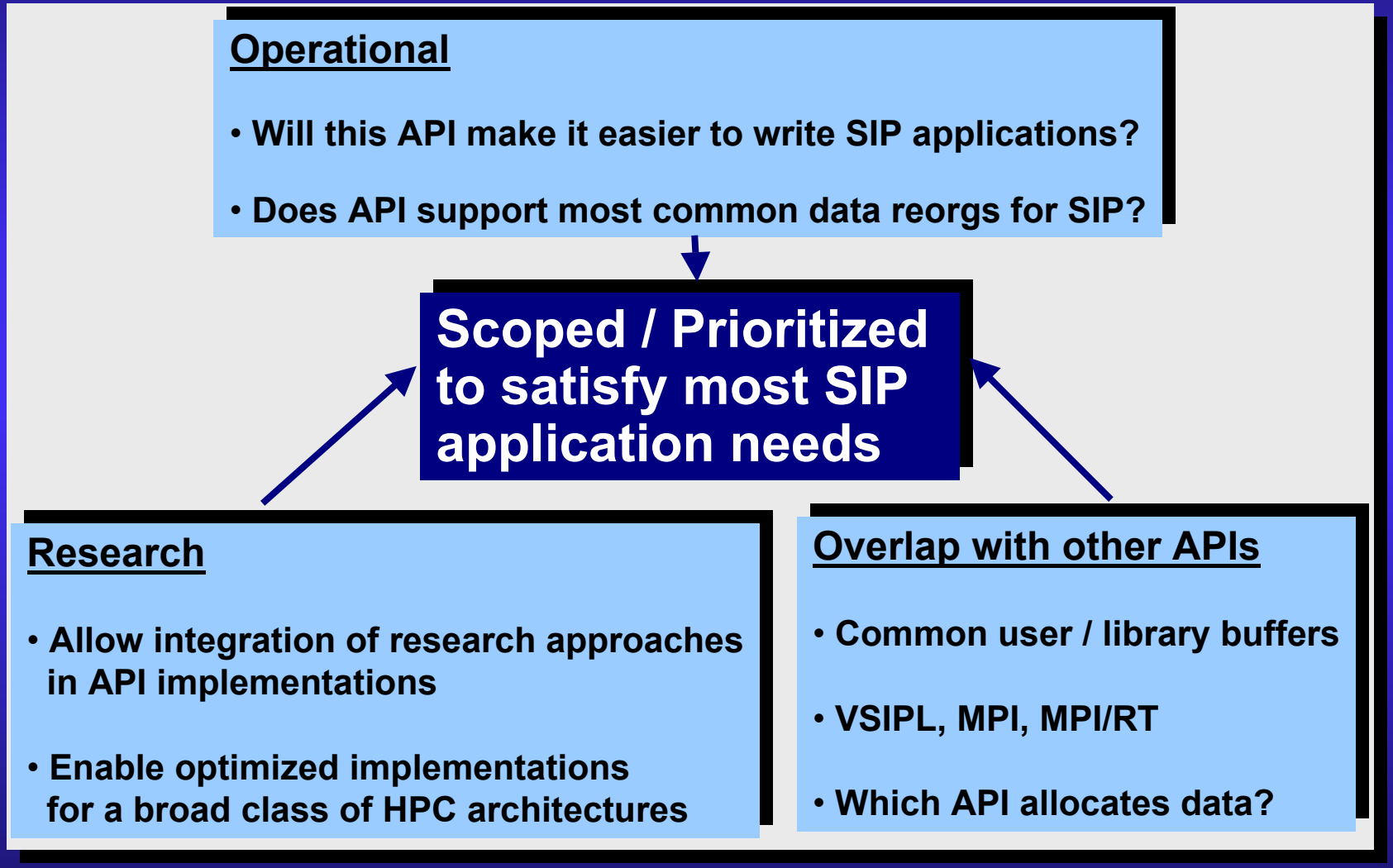
Three Areas of Concern



Data Reorg Committee Status

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Data Reorg
Objects and Implementation Approaches

CORE

- Uniquely part of Data Reorganization API
- Must be provided in all Data Reorg implementations
- Objects:
  - `DRI_Global_Data`
  - `DRI_Partition`
  - `DRI_Distribution`
  - `DRI_Layout`
  - `DRI_View`
  - `DRI_Overlap`

Data Reorg
Objects and Implementation Approaches

Standalone

- Functionality overlaps with other middleware
- Full implementation (without Middleware Adapter) gives a "pure" data reorg programming environment
- Objects:

Datatypes	DRI_Dataspec
Process Sets	DRI_Group
User and Library Memory	DRI_Bufferset
	DRI_Buffer_Id
Data Transmission Constructs	DRI_Channel

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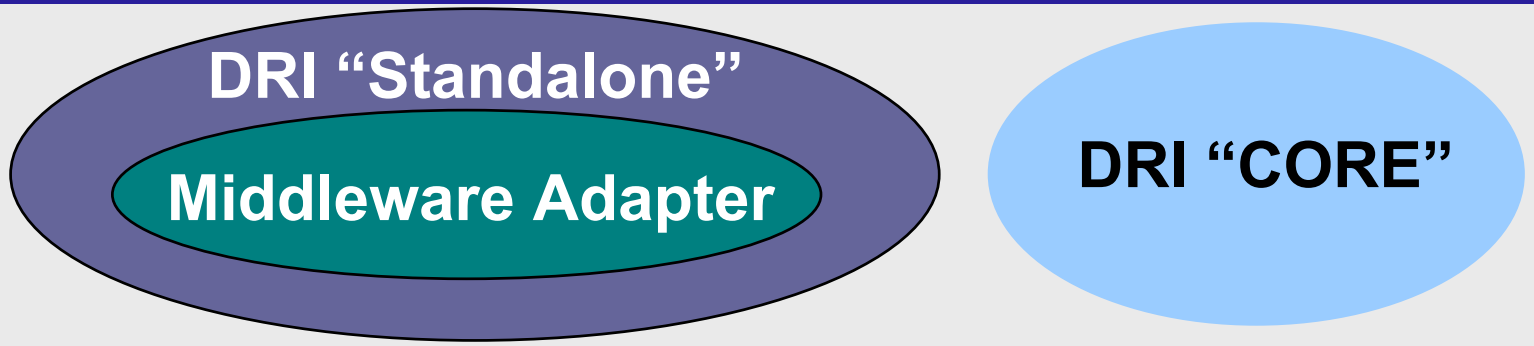
Data Reorg
Objects and Implementation Approaches



Middleware Adapter

- Defines a hybrid interface that leverages supporting middleware
  - MPI
  - MPI/RT
  - Mercury PAS
  - Sky SCL
- Objects:
  - Selected from "Standalone", depending on supporting middleware

Data Re-org Forum Plan

- Two more official meetings
- Several informal “working” meetings
  - Resolve issues with buffers and buffersets
  - Resolve issues with memory layouts and distributions

- Near-Term activities:
  - Establish CORE and Standalone Interfaces
  - Define MPI Middleware Adapter for Data Reorg
  - Final document detailing ideas and lessons learned

In the long term, the forum feels that a larger effort in this area would have substantial benefits for the high-performance embedded computing community