

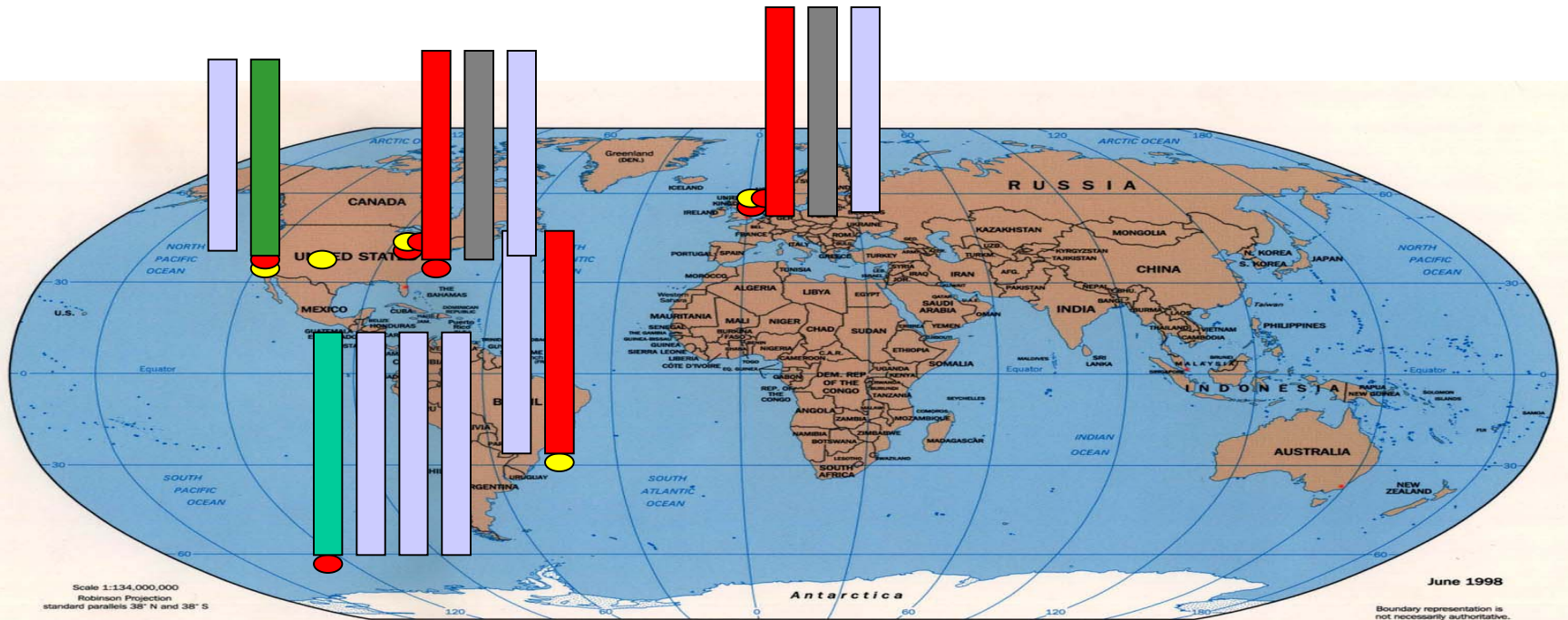
# Global Access to Large Distributed Data Sets using Data Webs Employing Photonic Data Services

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# Distributed Data – More and More Discoveries will be Across Databases



- ❑ Pearson's Law: The usefulness of a column of data varies as the square of the number of columns it is compared to.

# Data Grids vs. Data Webs

What is more valuable: other peoples' cycles or data?

Browsing &  
Casual  
Exploration

Data Webs

- Searching
- Exploration
- Casual correlation

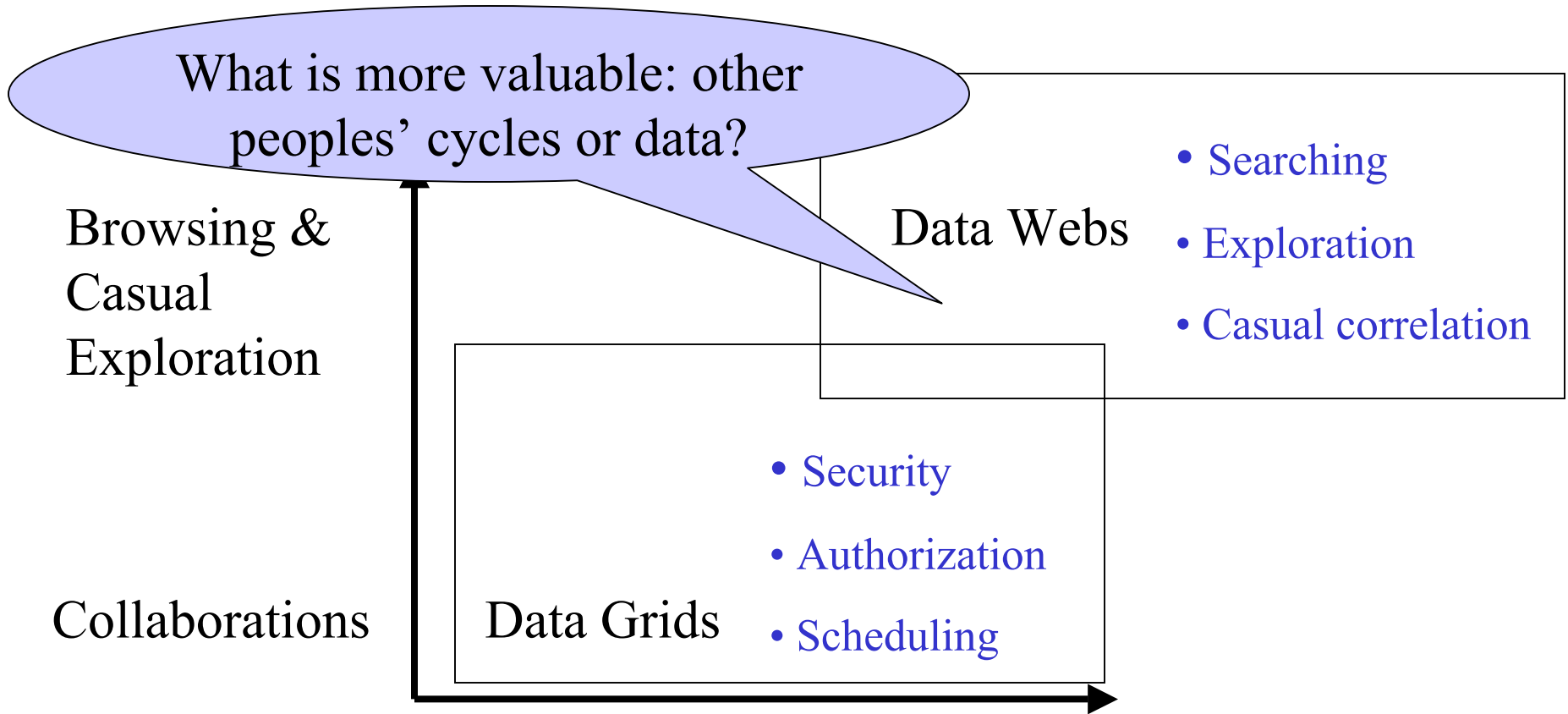
Collaborations

Data Grids

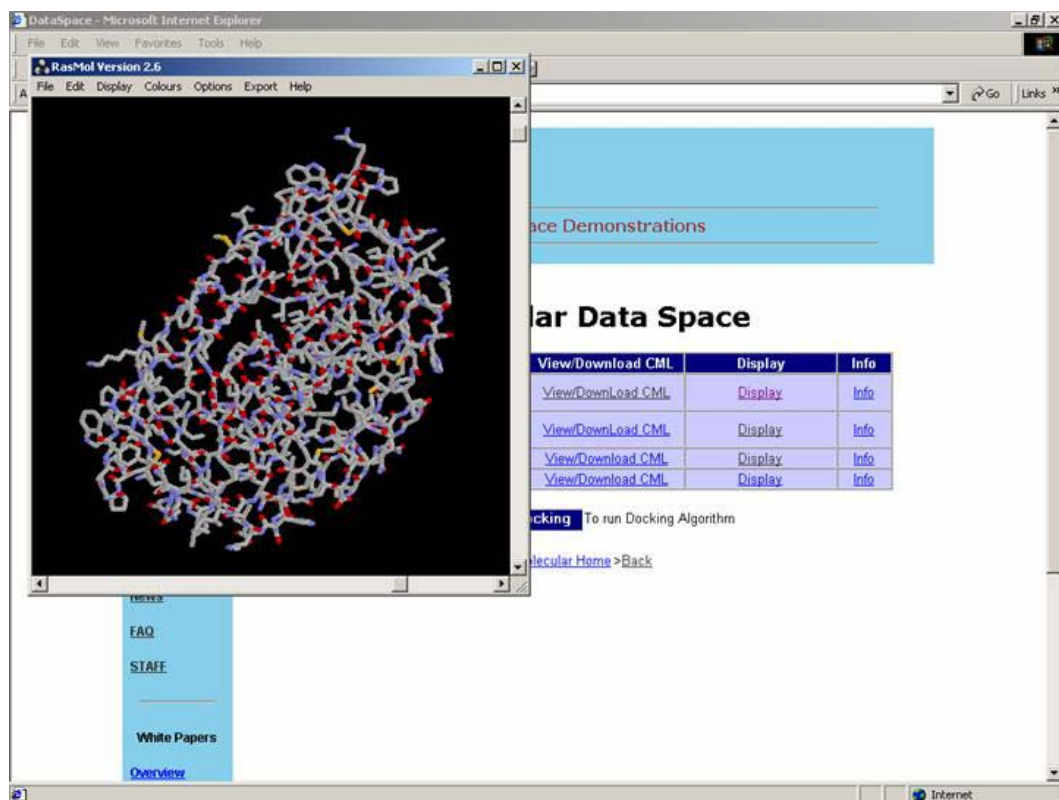
- Security
- Authorization
- Scheduling

Distributed  
Computer

Web Based  
Computing



# Example 1. Photonic DataSpace



Photonic DataSpace

- ❑ Data intensive computing over photonic networks
- ❑ Interactive exploration of remote Gigabyte size data sets
- ❑ Specialized transport and merging over light paths

# Example 2. Molecular DataSpace

Select one or more structures and press **Submit** to view, download, visualize a Docking Algorithm.

The screenshot displays the Molecular DataSpace interface. It features two main panels: 'Protein Structure Data' on the left and 'Small Organic Compounds' on the right. Each panel has a search bar with a 'Go' button and a list of entries. In the 'Protein Structure Data' panel, the entry '103m - SPERM WHALE MYOGLOBIN H64...' is highlighted. In the 'Small Organic Compounds' panel, the entry 'd102d - PROPAMIDINE...' is highlighted. Below the panels, there are two buttons: 'Submit' and 'Clear'. The 'Submit' button is accompanied by the text 'Click here to View Structure, View or download files'. The 'Clear' button is accompanied by the text 'Clear Selection'.

**Submit** Click here to View Structure, View or download files

**Clear** Clear Selection

[Molecular Home](#)

- ❑ Replication of the protein data bank (PDB).
- ❑ Chemical libraries of small organics molecules.
- ❑ How do you overlay other peoples data on your own?
- ❑ with distributed data mining.

# The Photonic Data Services Stack

6. Data Web Applications

5a. Data  
Web Serv

5b. Soap/XML  
Services

5c. Data Grid  
Services

4. Transport – TCP, UDP, SABUL, ...

3. IP

2. Photonic Path Serv. – ODIN, THOR, ...

1. Physical

# Photonic Data Services - Status

- ❑ Developed reliable, friendly hybrid TCP/UDP protocols (Layer 4 - SABUL)
- ❑ Developed striped Sabul (P-SABUL)
- ❑ Linked Layer 2 Path Services (ODIN and Thor) with Layer 4 Transport Services (SABUL, P-SABUL)
- ❑ Developed high performance distributed data services (Lambda Joins - Layer 5)
- ❑ Developed photonic applications (Layer 6)

# Key Data Web Protocols & Services

1. Data & metadata **selection** (DWTP, SQL)
  - using XML metadata, range queries & sampling
  - based upon Data Web Transport Protocol (DWTP)
2. Data **transport** (DWTP)
  - DWTP and XML/SOAP
3. Data **merging** by universal key
  - globally unique distributed keys (UCKs) for joining distributed data
4. Data **analysis** and mining (PMML)
  - using algorithms for clustering, regression, etc.



# Layer 5. Data Services – Moving Records

Approach	Implementations	Challenges
SOAP/XML	Multiple	Scales poorly
Data Web Transfer Prot.	UIC/LAC DWTP Servers	Emerging technology
Grid Services	GLOBUS	File-based (not records)
JDBC, ODBC	Multiple	Different goals

# Data Web Transfer Protocol (DWTP)

- ❑ interoperates & supports SOAP/XML-based web services
- ❑ protocol designed for data
- ❑ supports data, metadata, and keys
- ❑ separates control from data channels
- ❑ can subset data by rows or columns
- ❑ mechanisms for sampling, merging data by key, working with missing values

# Example: DWTP Session

- ❑ Discover DWTP server containing appropriate data using web services
- ❑ DSTP client connects to DWTP server
- ❑ retrieve data set metadata using TCP
- ❑ set data set
- ❑ retrieve attribute metadata using TCP
- ❑ retrieve 25 columns of data using 20% subset of rows using SABUL

# Experimental Results: PDS Data Services (Layer 5)

Rand %	Match %	Time (sec)	Data Rate Mb/s
2	99	66.3	434
10	92	65.7	438
20	82	64.2	449
33	79	65.1	442

- ❑ Best effort lambda join (distributed join)
- ❑ Experiments between Chicago and Amsterdam using 10 Gb/s link (cpu bound)

# Layer 4. Transport – Moving Bits

Approach	Implementations	Challenges
Improve TCP	Multiple	Will it scale?
Striped TCP	GridFTP, P.Sockets	Improve Performance
Reliable, Friendly UDP (TCP control)	SABUL, FAST, TSUNAMI	Make friendly
Striped UDP	P-SABUL	Interface to parallel I/O

# Layer 4 - Comparing Reliable UDP & Striped TCP

Data Set (MBs)	GridFTP (Mb/s)	SABUL (Mb/s)
100	94.9	527
500	246	476
1000	324	506
2000	315	506

□ Experiments between Chicago and  
Amsterdam over OC-12

# Layer 4- PDS Data Transport: Striped Reliable UDP Chicago - Amsterdam

TCP Stream	GridFTP	SABUL Stream 1	SABUL Stream 2	SABUL Stream 3	Striped SABUL Stream
4.36 Mb/s	324 MB/s	902.8 Mb/s	902.9 Mb/s	907.1 Mb/s	2712.8 Mb/s

□ Three node cluster in Chicago connected to three node cluster in Amsterdam connected with 10 Gb/s link