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

April 8, 2003

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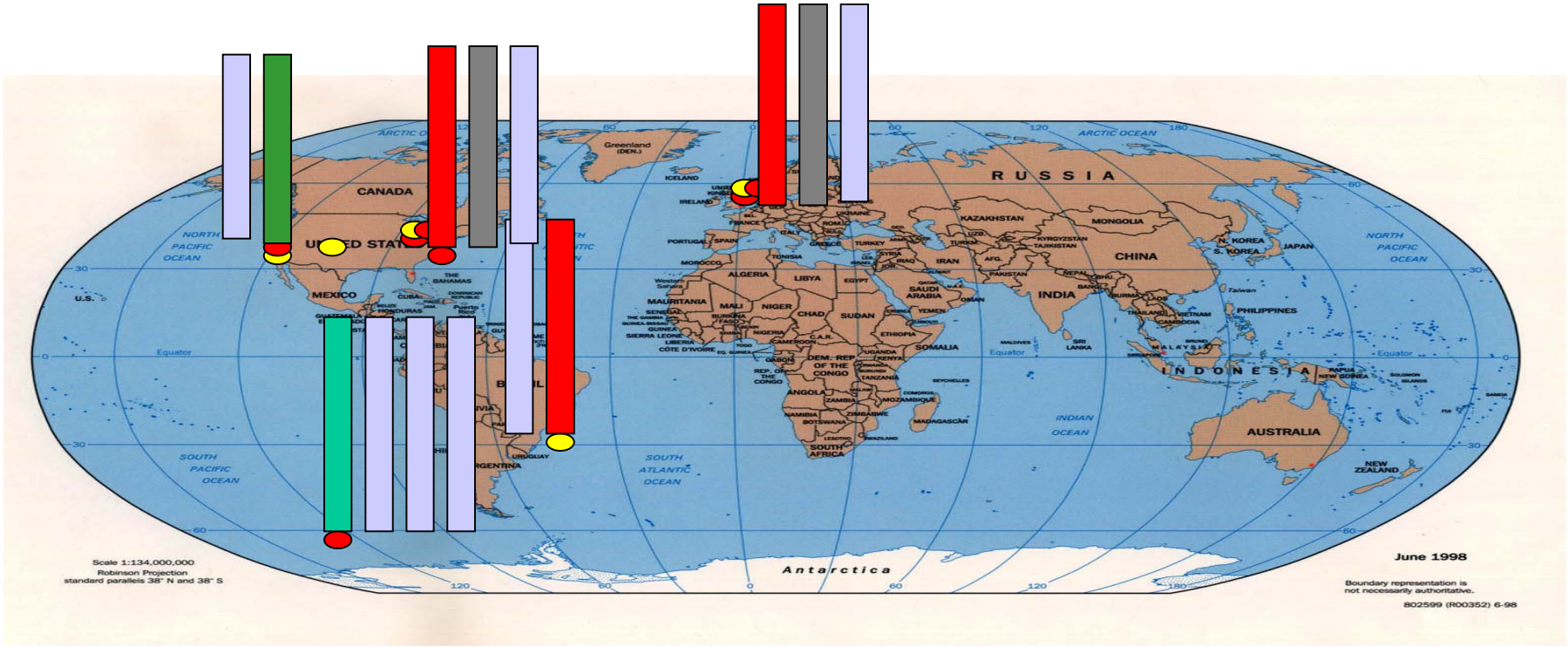
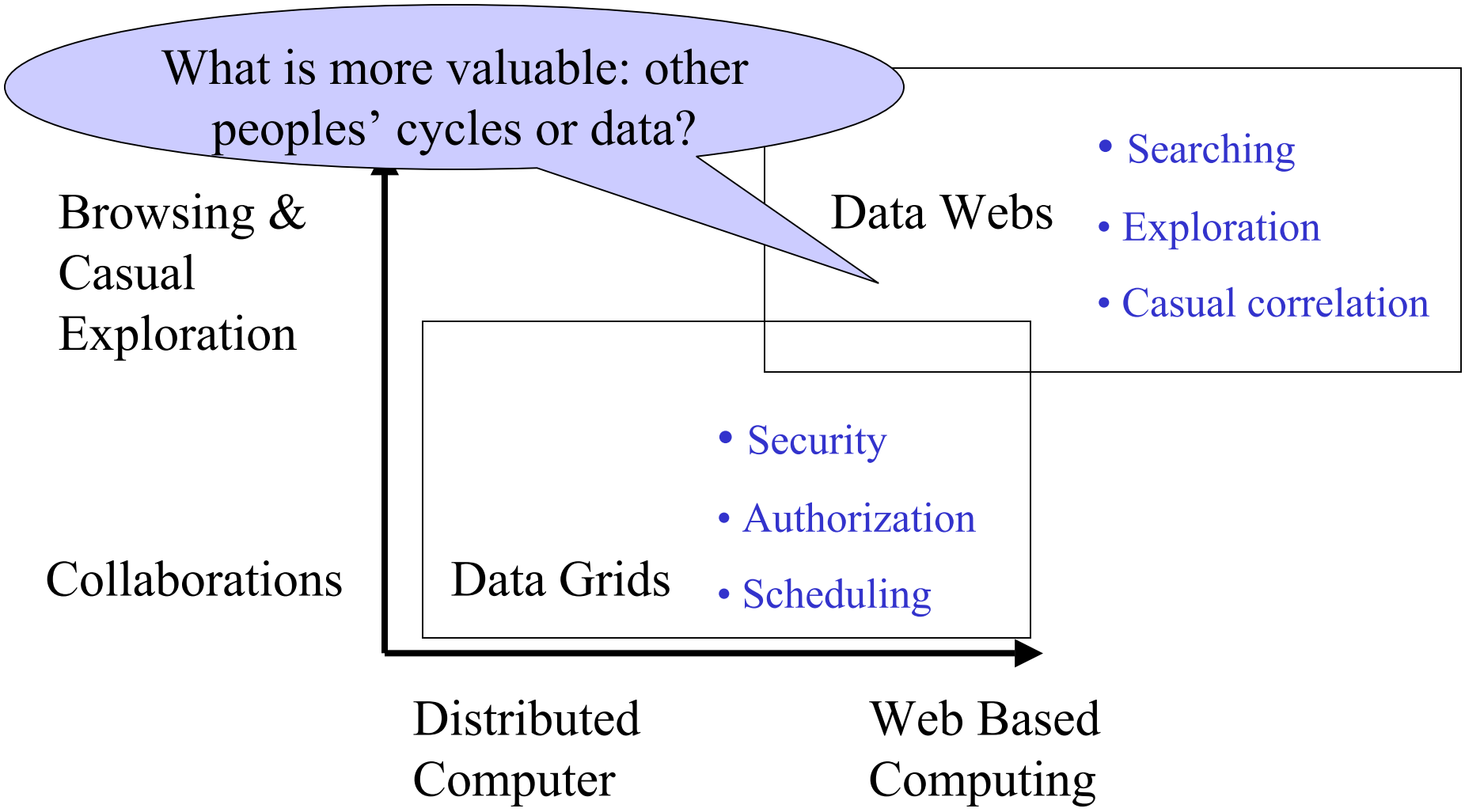
Distributed Data – More and More Discoveries will be Across Databases

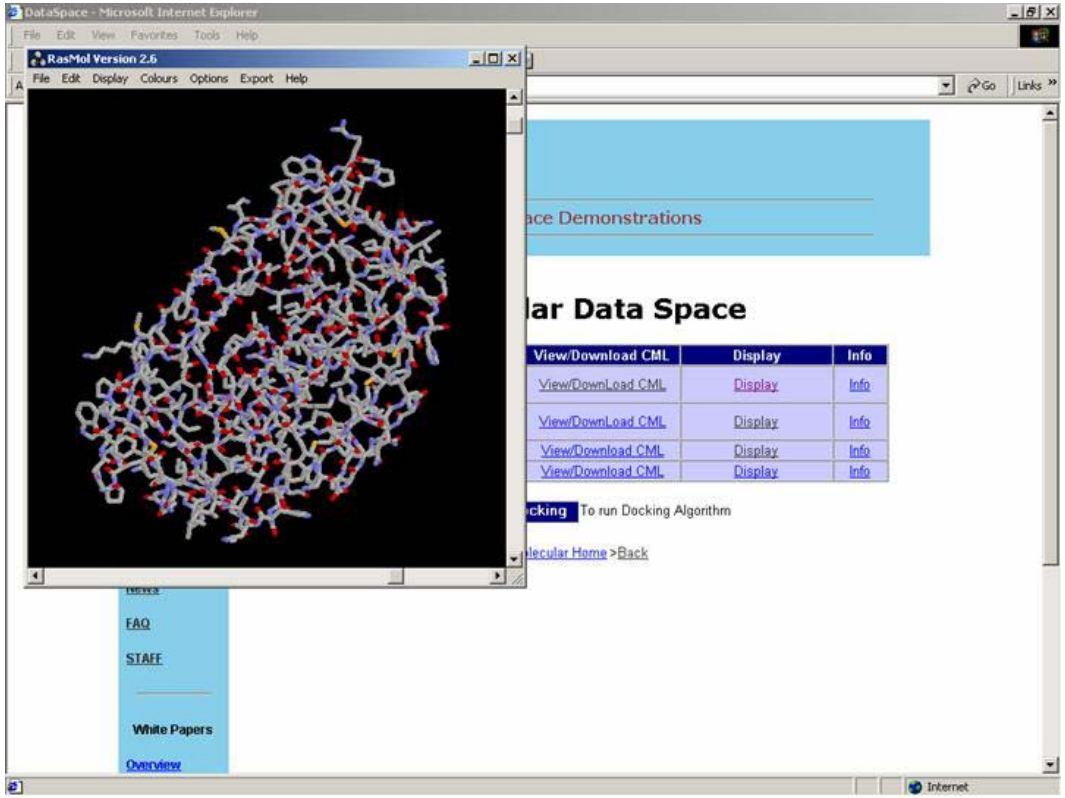


- Pearson's Law: The usefulness of a column of data varies as the square of the number of columns it is compared to.

Data Grids vs. Data Webs



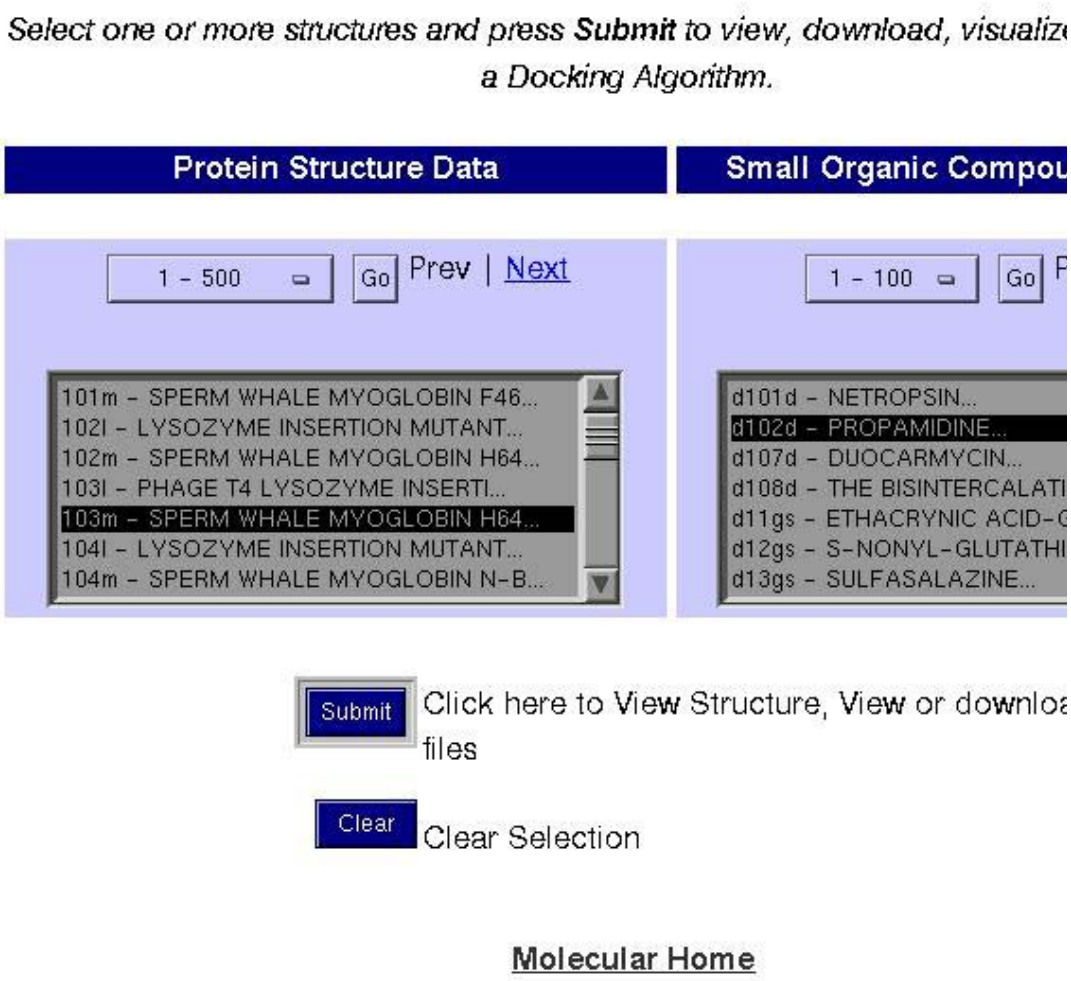
Example 1. Photonic DataSpace



Photonic DataSpace

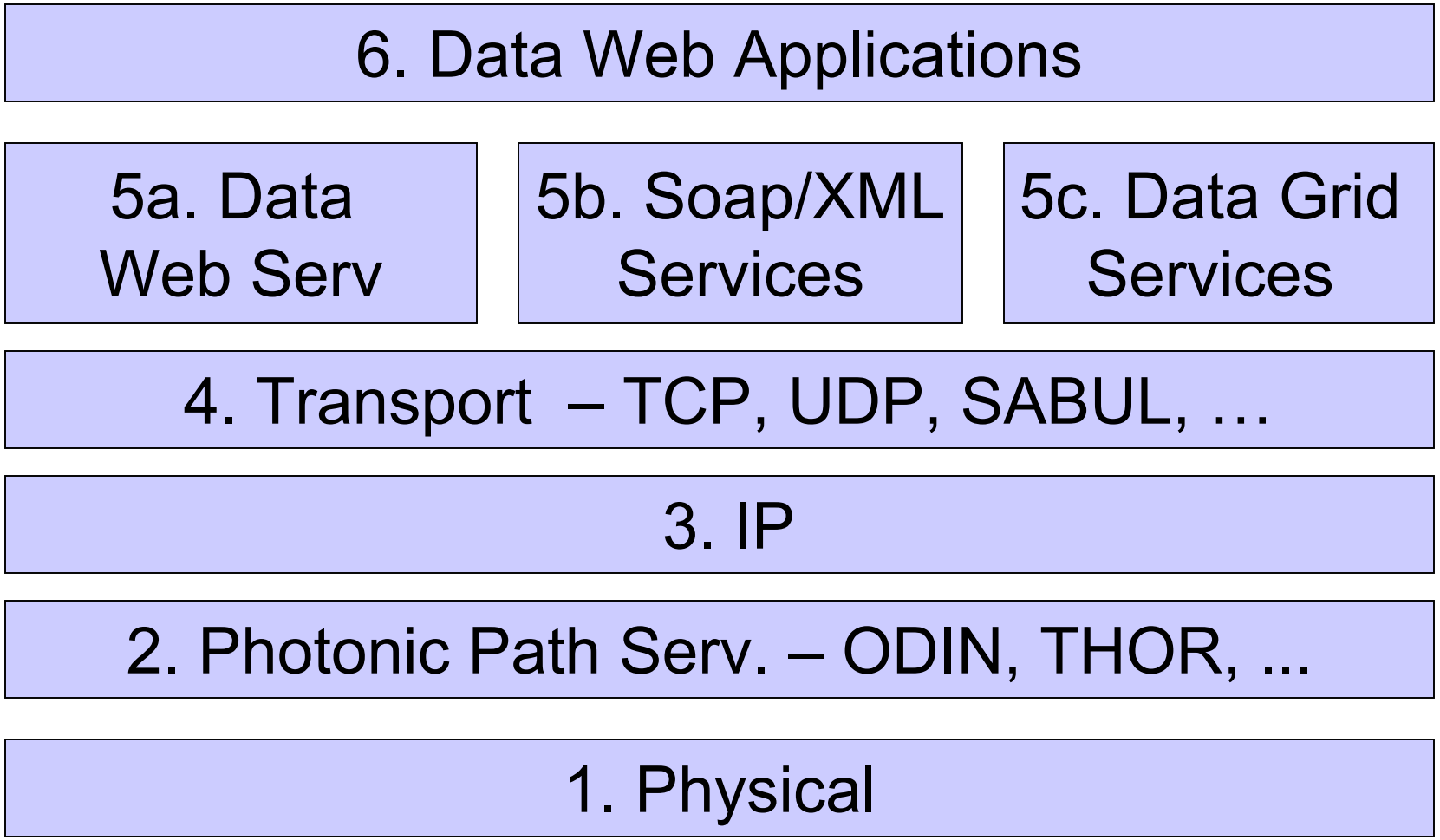
- Data intensive computing over photonic networks
- Interactive exploration of remote Gigabyte size data sets
- Specialized transport and merging over light paths

Example 2. Molecular DataSpace



- 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



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, PSockets	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