LARGE DATA

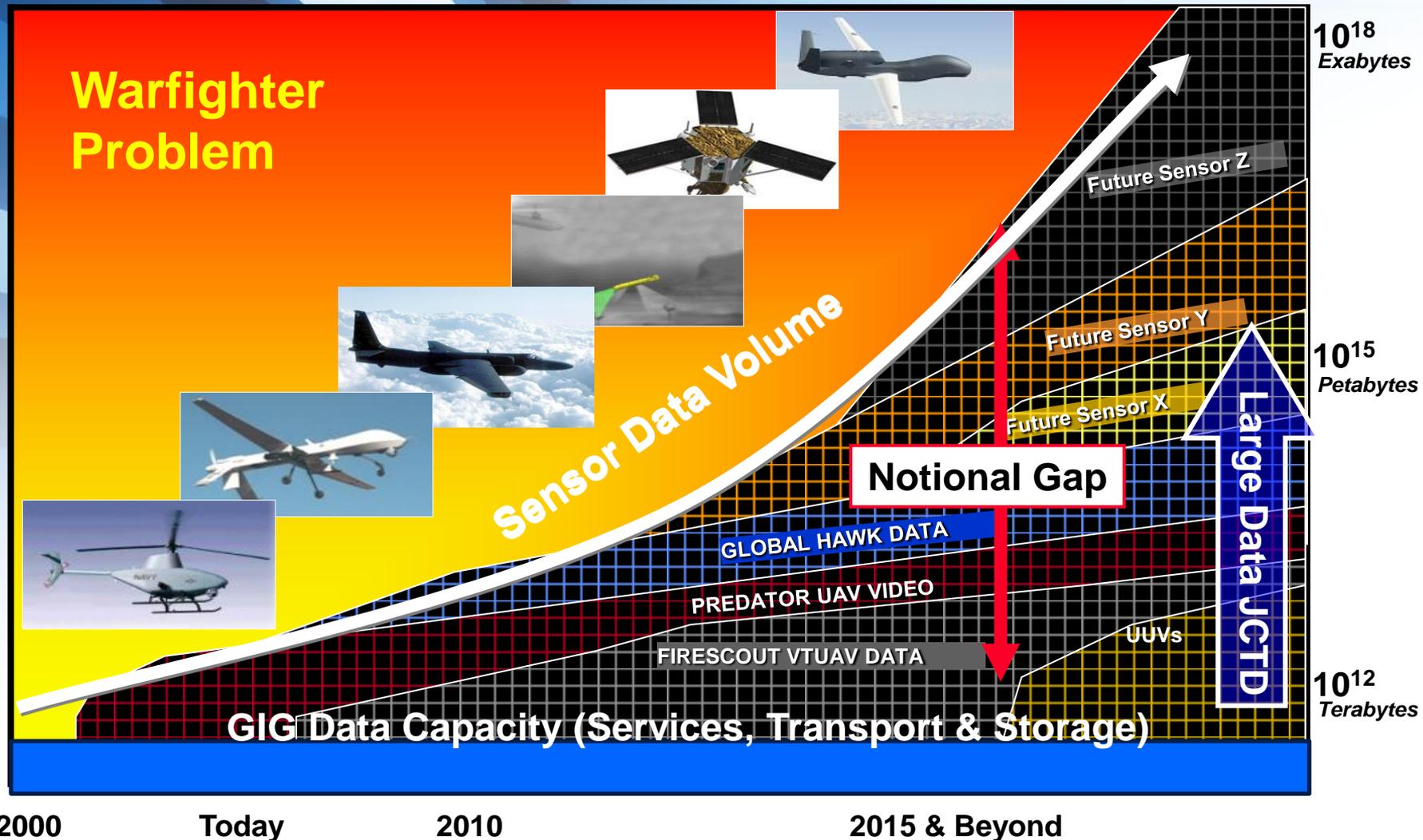**Joint Capability Technology Demonstration**
OSD (RFD) – USSTRATCOM – NRL – NGA – INSCOM – DISA

Warfighter Problem

LD JCTD Concept of Operations

Standard 2-Rack Node

ETH SWITCH

IB WAN GATEWAY

IB SWITCH (2)

BLADE SERVERS (10)

HEAD BLADE SERVERS (2)

DISK STORAGE

DUAL STORAGE CONTROLER

DISK STORAGE
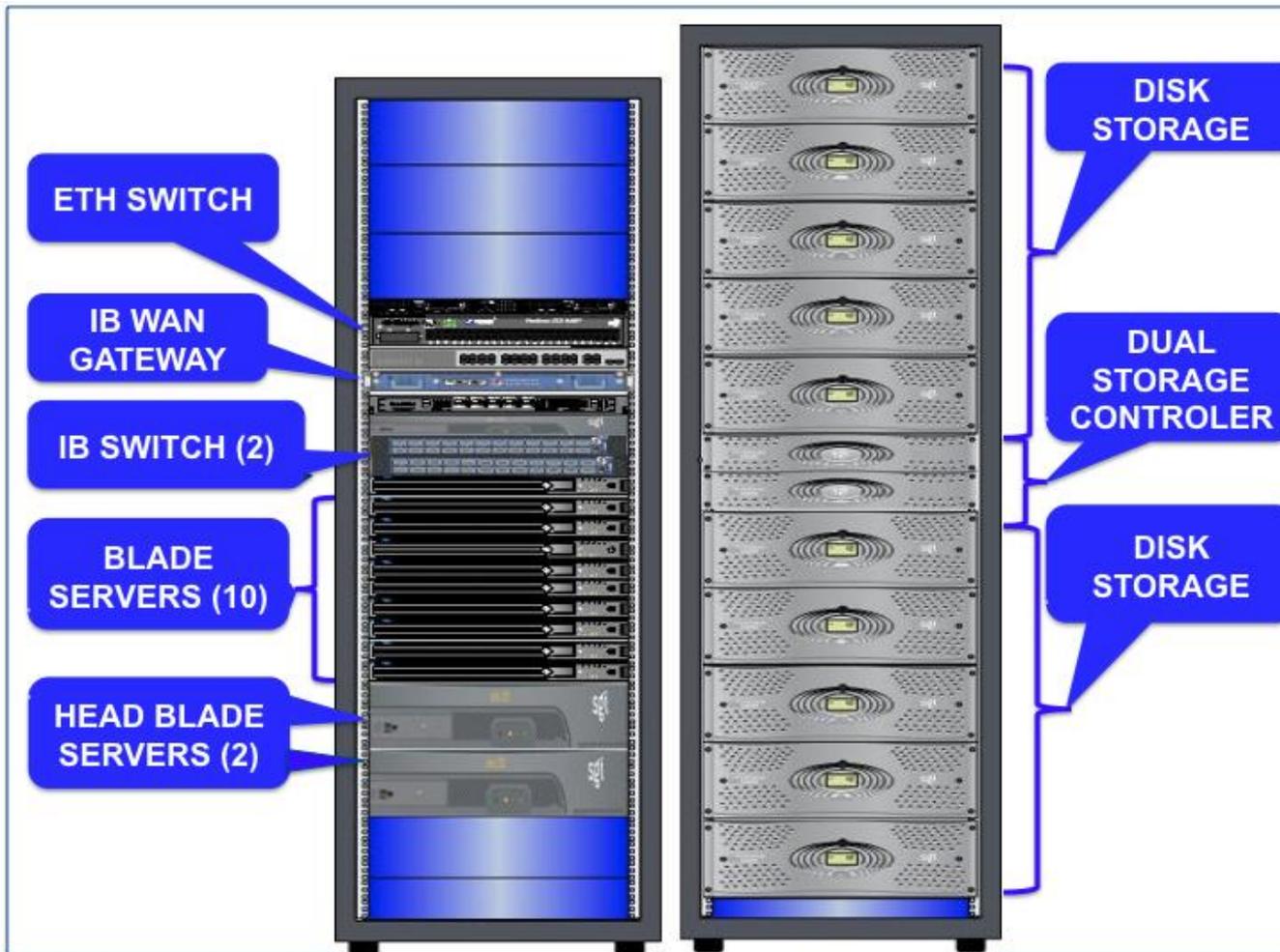
- **Scalable & Flexible**
- **Extremely Dense**
- **High Performance**
- **Low Latency**
- **Open Standards**
- **Open Systems**
- **Open Source**
- **Commodity Parts**

Why the LD JCTD works

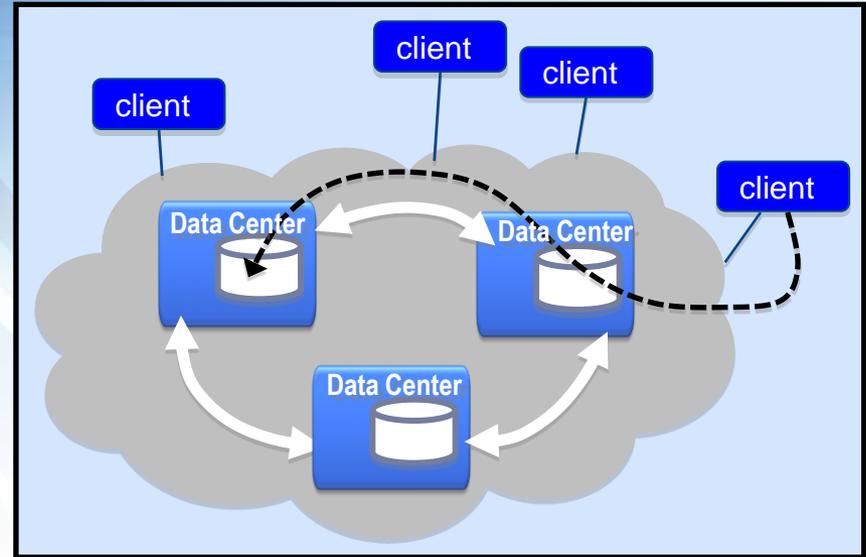**The LD JCTD demonstrated the use of RDMA and a clustered Global File System over long distances to create a globally accessible storage and compute cloud**

- **Data available to clients anywhere in the world**
- **Remote clients may disconnect at will**
- **Centralized apps available to clients**
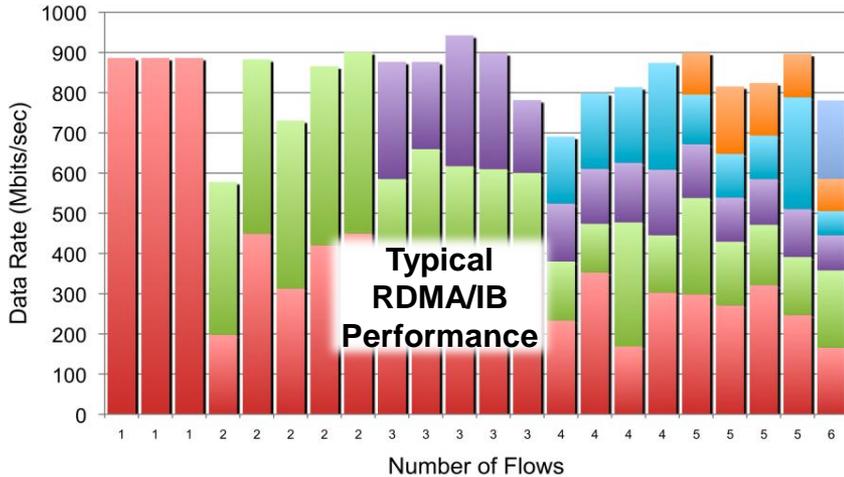
Global File System

+

RDMA interconnect

1. *LD JCTD used RDMA and parallel file systems to build multiple scalable, cost effective data centers*
2. *LD JCTD extended RDMA over a high bandwidth WAN to virtualize the data centers*
3. *Clients connect to virtual data center via cost effective, low bandwidth (1 Gbps) IP networks*

LD JCTD used standards-based COTS technology and components to demonstrate a secure, cloud computing infrastructure operating over the DISN
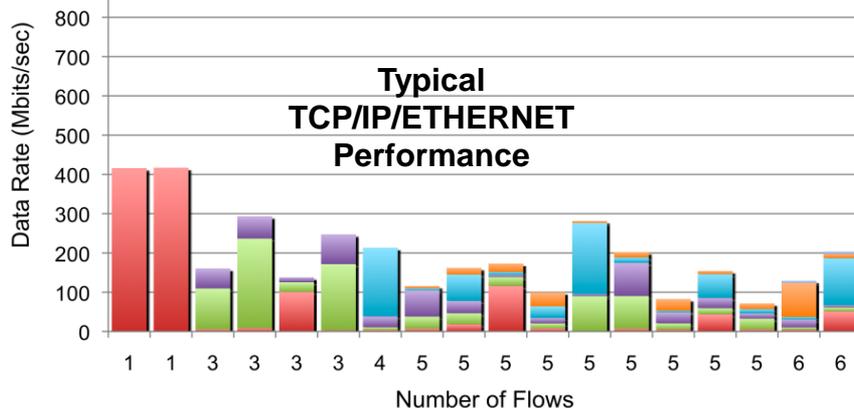
LD Network Performance

TESTS ON 1 Gbps CIRCUIT (~8000 miles) [~13,000 fiber miles]
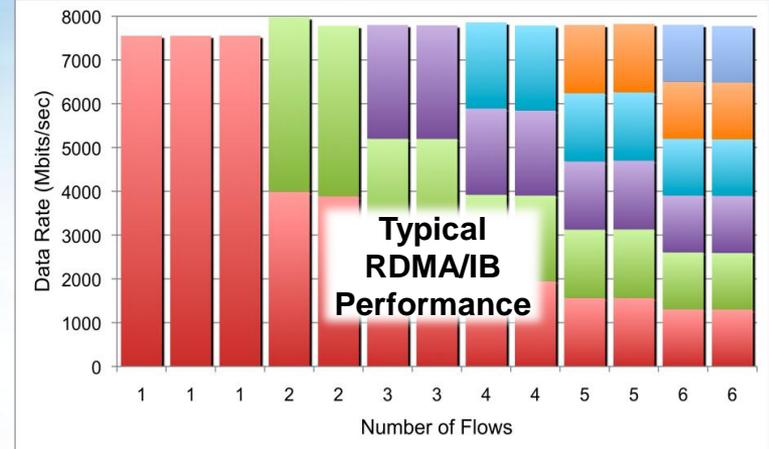
TESTS ON 8 Gbps CIRCUIT (~1200 miles) [~2000 fiber miles]

- **RDMA/Infiniband (IB) provides highly efficient use of available bandwidth**
- **IB scales well with multiple, concurrent data flows**
- **RDMA/IB performance ≥ 80%**
- **TCP/IP performance ≤ 40%**
- **RDMA CPU usage estimated 4x less**
- **IB is lossless and provides "fair share" of bandwidth**

LD JCTD – What Does It Mean?

Standard DVD = 4.7 GB   1 Hr of WAOS* raw data = 1 TB
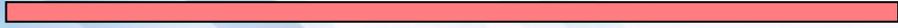
- 5 Mbps (Home Connection)
  - DVD — **2.1 Hrs**
  - WAOS — **18.5 Days**
- OC-3 (155 Mbps – decent business connection)
  - DVD — **4 Min**
  - WAOS — **14 Hrs**
- 1 Gbps (Standard GIG/DISN LAN)
  - DVD — **37.6 Seconds**
  - WAOS — **2.2 Hrs**
- 10 Gbps (OC-192 – 8 Gbps effective)
  - DVD — **4.7 Seconds**
  - WAOS — **16.7 Min…** *still too slow…*

Shared File Systems and Distributed SAN structure – no "FTP" latency
- DVD
- WAOS
Nearly instant ≤ 5 seconds effective remote access time

LD File System Performance

Test 1: File System-to-File System Data Results: 91%-99% of Max Theoretical Data Transfer Rate

Network Type	Pt-to-Pt Connection Line Rate	Type of File Transfer (Single or Multiple)	Results Achieved: % of Theoretical/ Max Rate (MBps)
MAN (2.5 ms latency)	OC-192	Single file	62.8%
			590.6
		Aggregate Multiple Simultaneous Files	99.6%
			935.7
WAN (~2000 fiber mi; 34.5 ms latency)	OC-192	Single File	59.1%
			555.2
		Aggregate Multiple Simultaneous Files	91.1%
			856.4
Long Haul WAN (~13,000 fiber miles; 206 ms latency)	Partial OC-48	Single File	86.0%
			182.3
		Aggregate Multiple Simultaneous Files	94.6%
			200.7

• Maximum Theoretical Data Transfer Rate for OC-192 = 939.7 MBps; for Partial OC-48 = 212.0 MBps; 1 MB = 1,048,576 bits (2^20)

Test 2: Remote Access Results:
User "accessing" vs. "copying" file from remote file system to local workstation

- RDMA-enabled
- Access "as if local" to large ISR files over MAN/WAN/Long Haul WAN
- Matches local performance
- Saves **99.9%** of time over "copy to local storage & open"!

Test 3: Data Stream Results:
File System-to-User Workstations

- OC-192 Link:
  - -- MAN: 808 MBps (85.9% Max)
  - -- WAN: 759 MBps (80.8% Max)
- OC-48 Partial Link:
  - -- LH Wan: 160 MBps (75.4% Max)

Lustre file system enables remote access and/or very rapid file delivery to user applications