

ATLAS WAN Requirements at BNL

**Slides Extracted From Presentation Given
By**

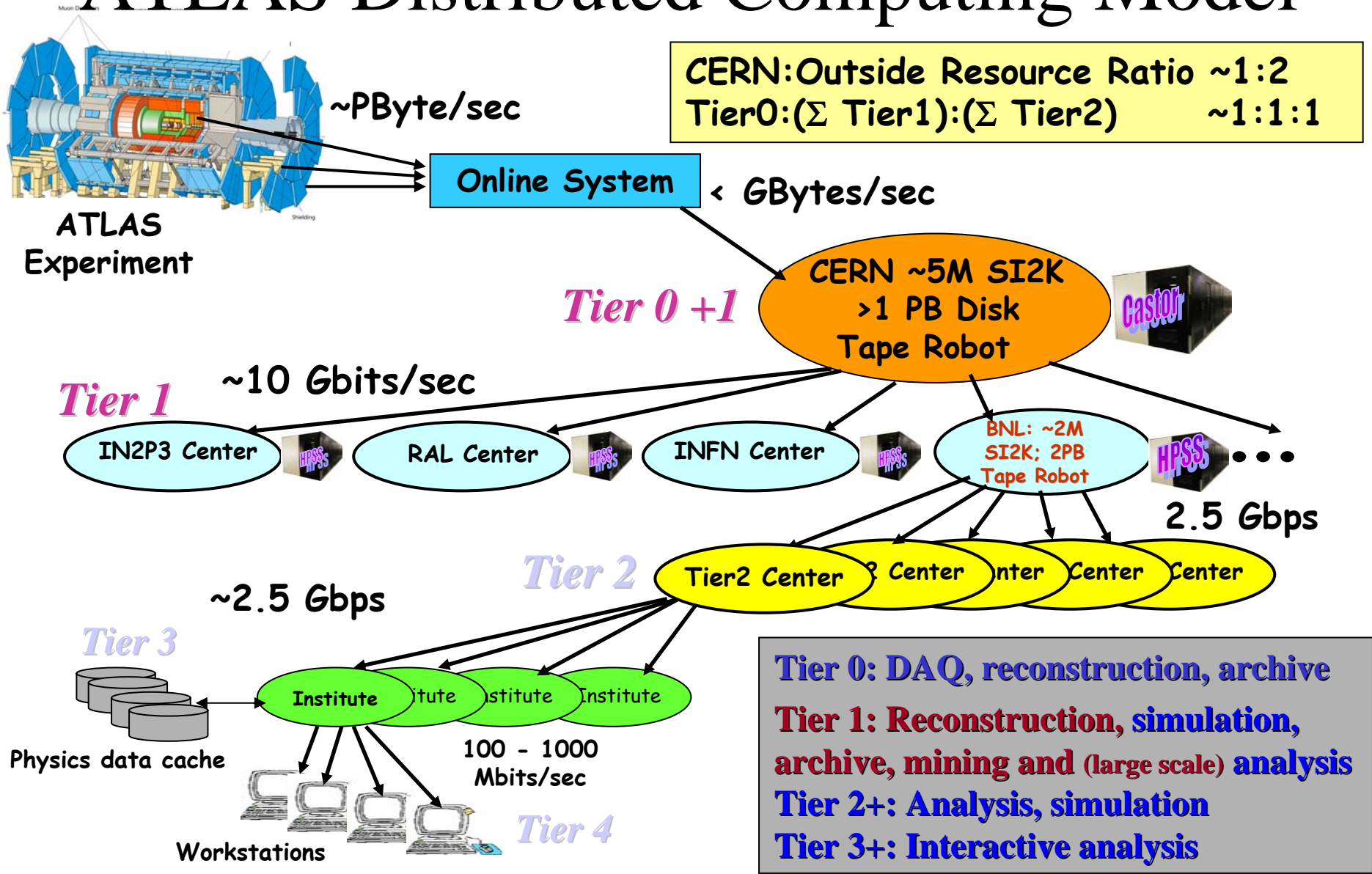
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13 December 2004

Primary Drivers of BNL WAN Requirement

- ❄ BNL has primary responsibility for two DOE programs which involve very large, internationally distributed collaboration and include distributed computing resources
 - ❑ The Relativistic Heavy Ion Collider (RHIC) for which it is the host institution
 - ❑ US Participation in the ATLAS experiment at CERN's Large Hadron Collider (LHC) for which it is the lead US institution for both the construction project and for computing facilities (US Tier 1 Center)
- ❄ For each project, BNL is responsible for:
 - ❑ Directly supplying at BNL a major computing facility for storage, production processing and analysis of data
 - ❑ Marshaling and integrating additional computing resources from a large number of institutions distributed around the world into a single coherent and effective *virtual computing facility* via the Grid and its underlying WAN infrastructure

ATLAS Distributed Computing Model



US ATLAS Tier 1 Computing Facility

❄ Functions

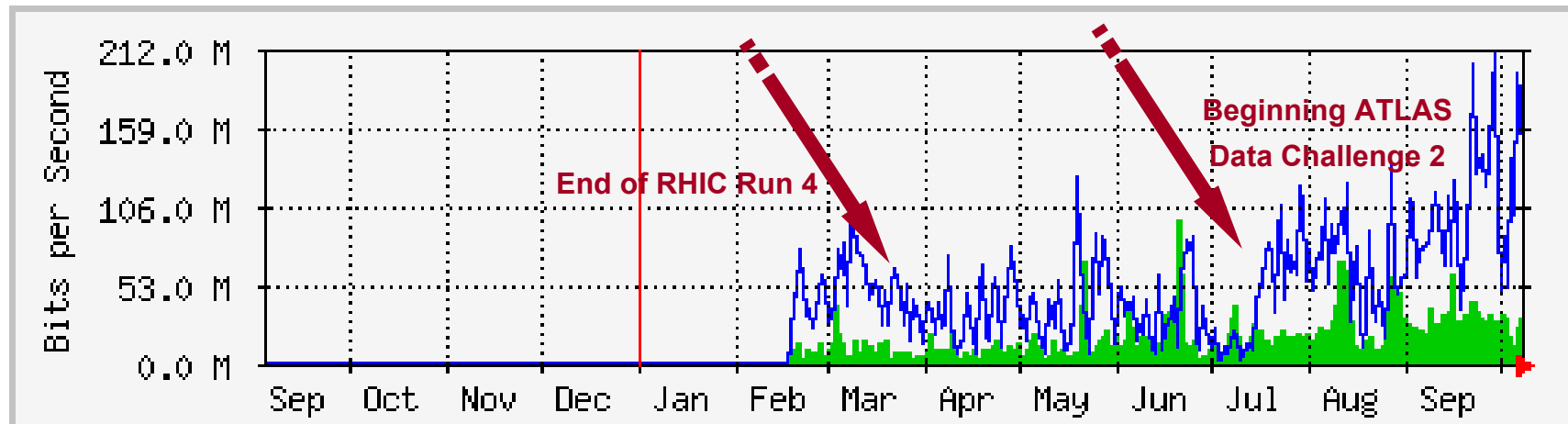
- ❑ Serve as primary U.S. ATLAS & ATLAS data repository
- ❑ Reconstruction $1/n^{\text{th}}$ of ATLAS data archived at BNL
- ❑ Programmatically select and distill reconstructed data
- ❑ Support “*Chaotic*” high level analysis by individuals
- ❑ Generate Monte Carlo data
- ❑ Supply technical support for smaller US computing resource centers

RHIC and ATLAS Capacities at BNL

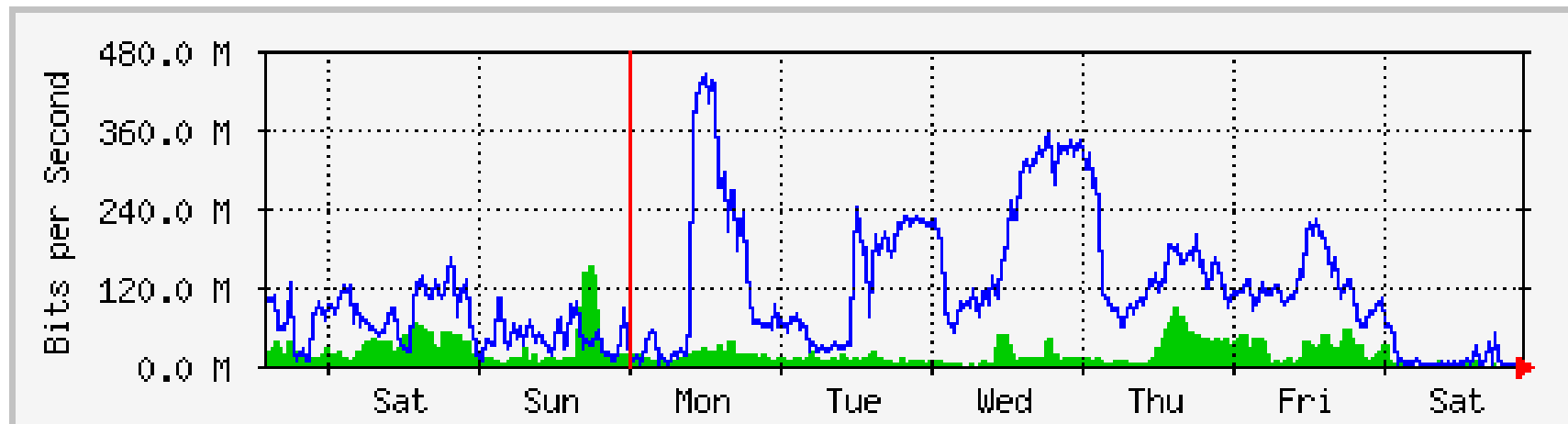
Year	2004	2005	2006	2007	2008	2009	2010
RHIC							
<i>CPU (kSPECint2k)</i>	1200	2999	3916	6122	8337	12025	15302
<i>Disk Volume (TBytes)</i>	400	818	1029	1478	1938	2705	3404
<i>Tape Volume (PBytes)</i>	4.5	5.6	11.2	11.2	22.5	22.5	44.9
ATLAS							
<i>CPU (kSPECint2k)</i>	205	302	842	1807	3930	6246	9720
<i>Disk Volume (TBytes)</i>	24	104	346	778	1730	2768	4324
<i>Tape Volume (PBytes)</i>	0.1	0.2	0.3	0.5	1.7	2.9	5.3
TOTAL							
<i>CPU (kSPECint2k)</i>	1405	3301	4758	7929	12267	18271	25022
<i>Disk Volume (TBytes)</i>	424	922	1375	2256	3668	5472	7729
<i>Tape Volume (PBytes)</i>	5	6	12	12	24	25	50

WAN Utilization

1 Day Average



30 Minute Average



Drivers of ATLAS WAN Requirements

❄ ATLAS Data Challenges

- ❑ Intended to exercise ATLAS application and Grid/production software, ATLAS computing model in context of current Grid hardware/middleware production versions (LCG, Grid3/OSG)
- ❑ DC1 completed Oct 03
- ❑ DC2 currently on going; Jun 04 => Jan 05
- ❑ DC3 will begin Feb 06

❄ LCG Service Challenges (robust data transfers stress WAN)

- ❑ Intended to stress test Grid services at maximum possible levels using advance R&D components where available
- ❑ Some detail on next page

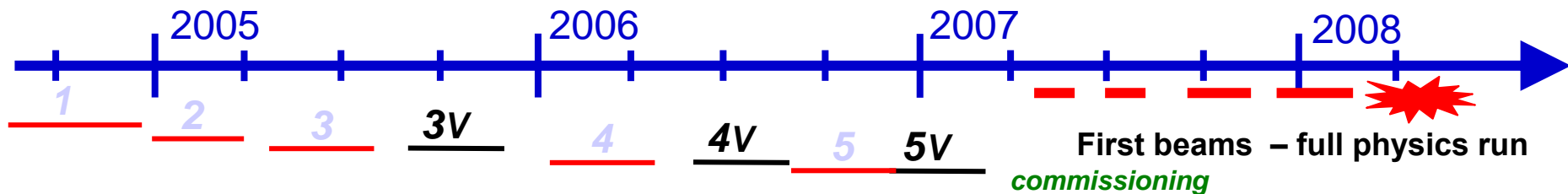
❄ ATLAS Startup and Operations

- ❑ Initial LHC operations currently scheduled for 2nd half of 2007
- ❑ First year of full LHC operations 2008

LCG Robust Data Transfer Service Challenges

(Les Robertson)

- * **Service Challenge 1 – Dec 04 – 2 weeks sustained**
 - Basic data transfer – 2 weeks sustained – 500 MB/sec disk => disk to Tier-1s
- * **Service Challenge 2 – Mar 05 – 1 month sustained**
 - Reliable file transfer service – 1 month sustained – 500 MB/sec Mass Store (disk) => Mass Store (disk)
- * **Service Challenge 3 – Jul 05 – 1 month sustained**
 - Acquisition/reconstruction/recording/distribution – Mass Store (disk + tape) – Mass Store (disk + tape)
 - Followed by Tier-0/1 model verification exercise
- * **Service Challenge 4 – Apr 06 – 1 month sustained**
 - As above but including ESD skimming and rates to 1.2 GB/sec at Tier-0
 - Followed by Tier-0/1/2 scaled full model verification
- * **Service Challenge 5 – Nov 06 – 1 month sustained**
 - As above but with rates to 2.5 GB/sec at Tier-0
 - Followed by Tier-0/1/2 100% full model verification



HEP/NP WAN Requirements at BNL

US ATLAS Tier 1 WAN Bandwidth Requirement Estimate (Mbits/sec)

Year	2004	2005	2006	2007	2008	2009	2010
Remote Site(s)							
Tier 0 (CERN)	52	105	349	874	1,747	1,747	3,494
Tier 1's (~2 Peer sites)	37	75	250	624	1,248	1,248	2,496
Tier 2's (5 USA satellite sites)	64	128	428	1,069	2,139	2,139	4,278
Tier 3-4 (150 Individual users)	95	190	632	1,581	3,161	3,161	6,322
Total	249	498	1,659	4,148	8,295	8,295	16,590

BNL HEP/NP WAN Bandwidth Requirement Estimate (Mbits/sec)

Year	2004	2005	2006	2007	2008	2009	2010
US ATLAS Tier 1 Req.	249	498	1,244	4,148	8,295	9,954	16,590
RHIC Computing Facility Req.	200	500	1,023	1,286	1,847	2,422	3,381
TOTAL	449	998	2,267	5,433	10,142	12,377	19,971
BNL HEP/NP Requirement	OC12	OC48	OC48	OC192	2 X λ	2 x λ	3 x λ

Qualitative Issues As Well

- ❄ Need to share effectively between a number of very different requirements (programs & services) – ***need differentiated services*** (be able to specify Quality of Service)
 - ❑ Long term programmatic bulk transfers (CERN => BNL, BNL => LBNL, BNL => Riken, etc.) – ***background activity?***
 - ❑ Short term programmatic bulk transfers (BNL => Tier 2's & Peer Tier 1's. etc.) – ***scheduled activity?***
 - ❑ High priority smaller chaotic transfers (Support for interactive analysis, calibration & metadata requests, etc.) – ***priority driven preemptive activity?***
- ❄ Need the ability to manage the network as a critical resource; much as resource scheduler/batch managers currently manage CPU resources in a multi-user environment
- ❄ MPLS/QoS project intended to address this need

WAN Dependence of Virtual Facilities

- ❄ Predictability and dynamic configurability are required to optimize use of network depended computing resources
- ❄ Greatly increased reliability and robustness of WAN is needed because of interdependency of distributed components of *Virtual Facilities*
 - ❑ WAN is coming to serve as the backplane of a global computer (or at least as the LAN of a tightly coupled global computing facility)
 - ❑ WAN failures imply *major* disruption of a large increasingly monolithic widely distributed computing facility