Initiatives in 100 GE for Fermilab R&D

Large Scale Network – May 8, 2012

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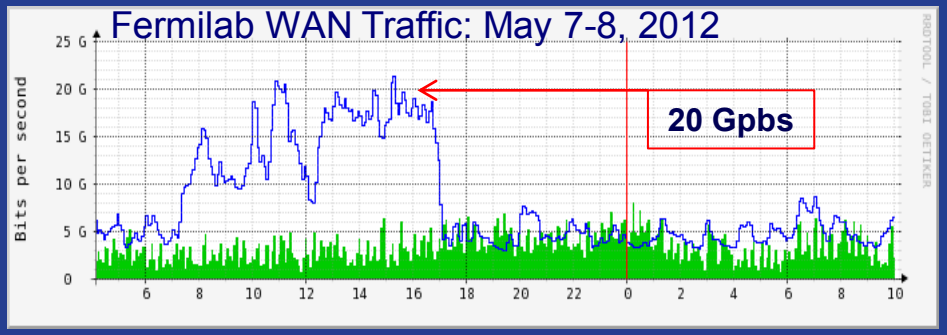
Overview

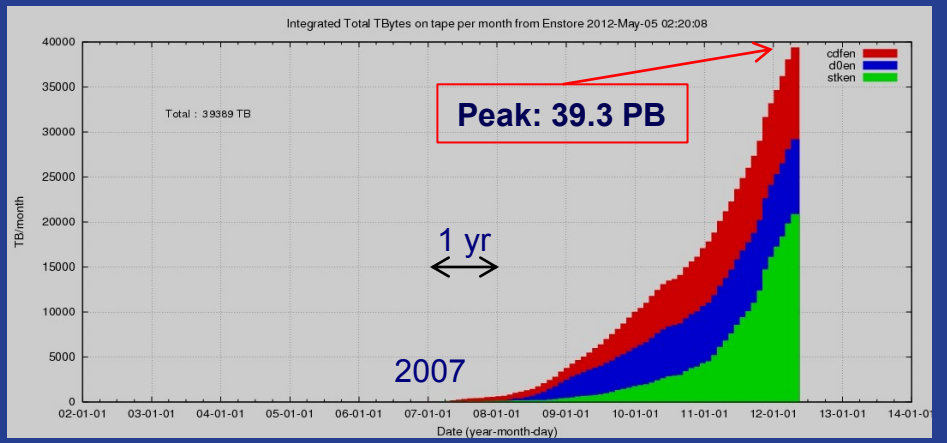
- Fermilab's interest in 100 GE
- Results from the ANI testbed
- Future program
- 100 GE infrastructure at Fermilab

Fermilab Users and 100 GE

- Decades long dependence on sustained, high speed, large and wide-scale distribution of and access to data
  - High Energy Physics community
  - Multi-disciplinary communities using grids (OSG, XSEDE)
- Figures of merit
  - 40 Petabytes on tape, today mostly coming from offsite
  - 140Gbps LAN traffic from archive to local processing farms
  - LHC peak WAN usage at 20-30 Gbps



Compact Muon Solenoid (CMS) routinely peaks at 20-30 Gbps.



Data on Enstore tape archive

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Goals of 100 GE Program @fermilab

- End-to-end experiment analysis systems include a deep stack of software layers and services.

- **Need to ensure these are functional and effective at the 100 GE scale.**
  - Determine and tune the configuration to ensure full throughput in and across each layer/service.
  - Measure and determine efficiency of the end-to-end solutions.
  - Monitor, identify and mitigate error conditions.

High Throughput Data Program (HTDP) at Fermilab

- **Mission**: prepare the Computing Sector and its stakeholders for the 100GE infrastructure and put Fermilab in a strategic position of leadership.
- Establish collaborations with stakeholders, computing facilities, scientific communities, and institutions, to coordinate a synergistic program of work on 100GE.
- The program includes technological investigations, prototype development, and the participation to funding agency solicitations.
- The ANI has been the major testbed used since last year in close partnership with ESNet

Ongoing Program of Work

- 2011: ANI Long Island MAN (LIMAN) testbed.
  - Tested GridFTP and Globus Online for the data movement use cases of HEP over 3x10GE.
- 2011-2012: Super Computing 2011.
  - Demonstration of fast access to ~30TB of CMS data from NERSC to ANL using GridFTP.
  - Achieved 70 Gbps
- Currently: ANI 100GE testbed.
  - Tuning parameters of middleware for data movement: xrootd, GridFTP and Globus Online.
  - Achieved ~97Gbps
- Summer 2012: 100GE Endpoint at Fermilab
  - Plan to repeat and extend tests using CMS current datasets.

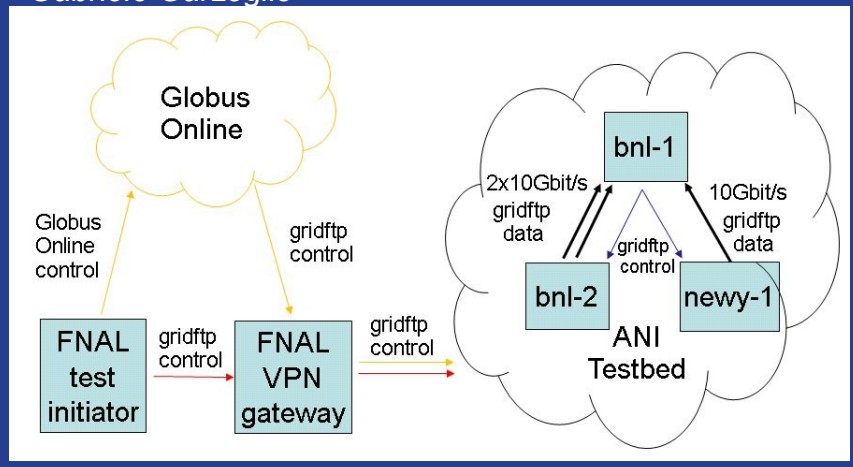
Experience on the ANI LIMAN Testbed

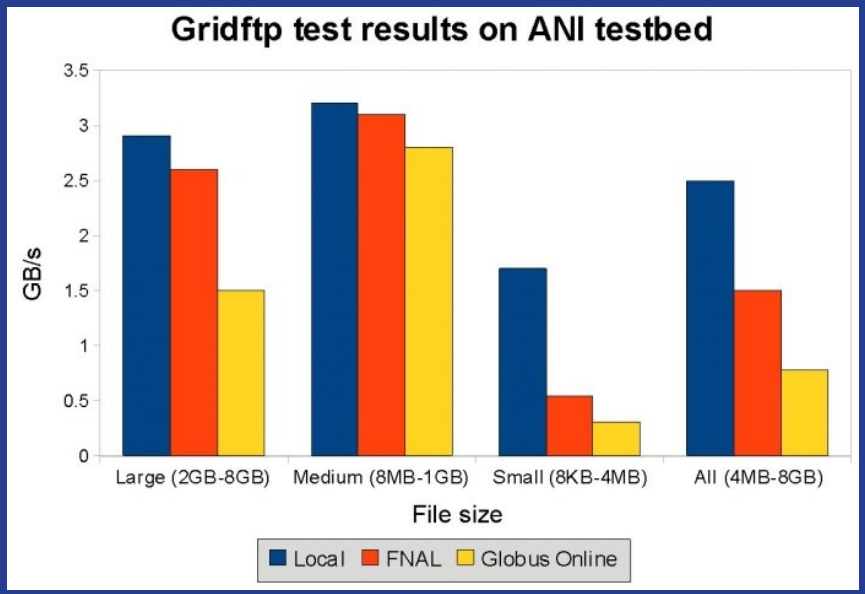
Work by Dave Dykstra w/ contrib. by Raman Verma & Gabriele Garzoglio

- Testing with GridFTP using 3x10GE in preparation for 100GE on ANI Testbed.

- Characteristics:
  - 300GB of data split into 42,432 files (8KB – 8GB; varied sizes).
  - Aggregated 3 x 10Gbit/s link to Long Island test end-point.

- Results:
  - Almost equal throughput for Globus Online (yellow) as for direct GridFTP (red) for medium-size files.
  - Increased throughput by 30% through increasing concurrency and pipelining on small files.
  - Auto-tuning in Globus Online works better for medium sized files than for large files.





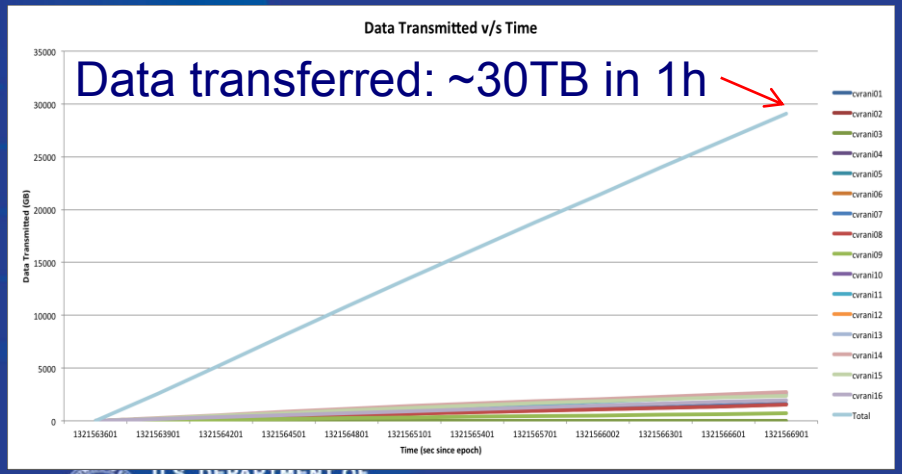
Super Computing 2011

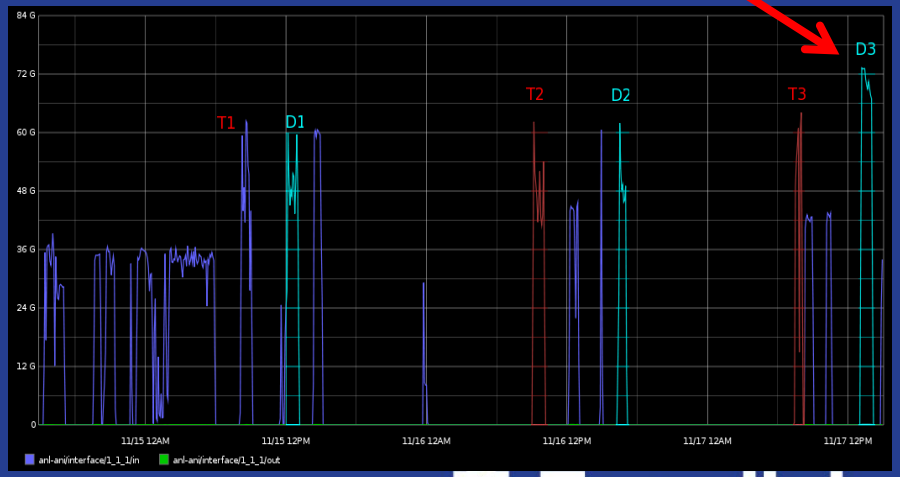
- Test transfer of CMS experiment data between NERSC and ANL over 100 GE network.

- Characteristics:
  - 15 server / 28 client nodes (multi-cores, 48 GB RAM, 10Gbps)
  - 2 globus-url-copy (GUC) clients / server

Work by Parag Mhashilkar, Gabriele Garzoglio (Fermilab) and Haifeng Pi (UCSD)

	GUC/ core	GUC streams	GUC TCP Window Size	Files/ GUC	MAX BW	Sustain BW
T1	-	-	-	-	-	-
D1	1	2	Default	60	65	50
T2	1	2	2MB	1	65	52
D2	1	2	2MB	1	65	52
T3	4	2	2MB	1	73	70
D3	**4**	**2**	**2MB**	**1**	**75**	**70**





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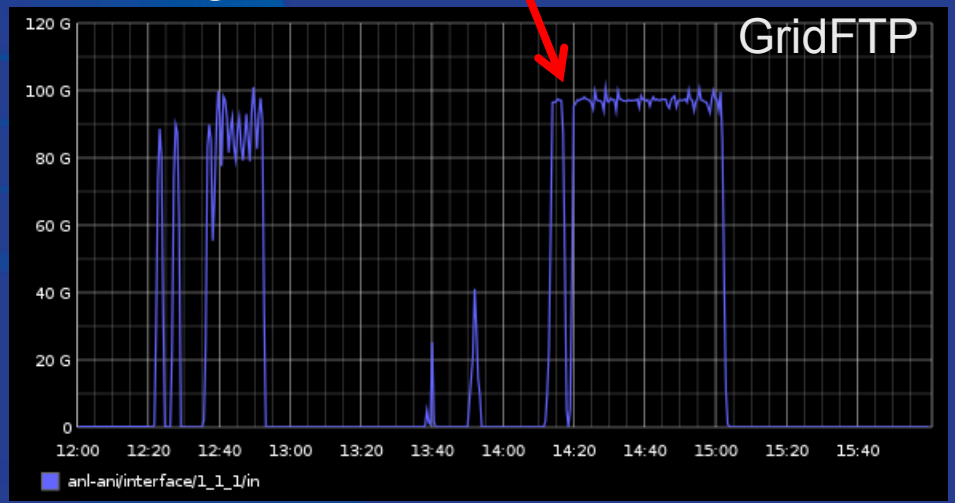
Using the ANI 100G Testbed

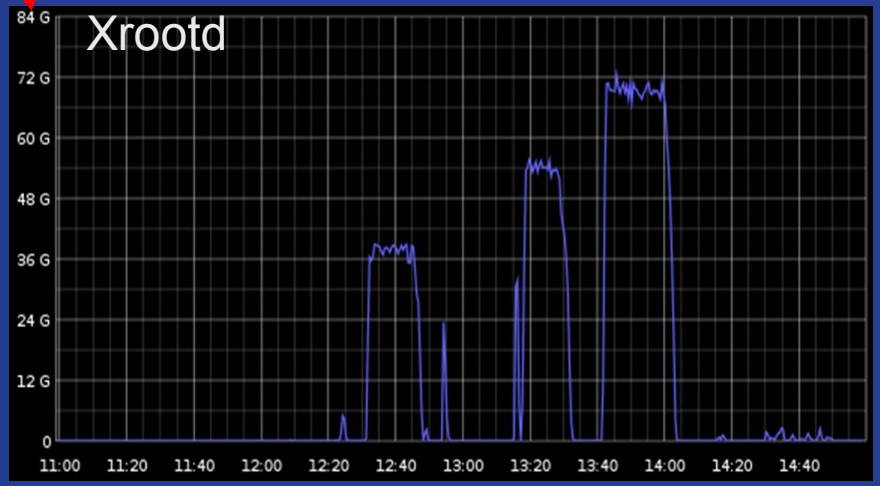
- Data Movement over Xrootd, testing LHC experiment (CMS / Atlas) analysis use cases.
  - Clients at NERSC / Servers at ANL
  - Using RAMDisk as storage area on the server side
  - Challenges
    - Tests limited by the size of RAMDisk
    - Little control over xrootd client / server tuning parameters
- Achieved 97 Gbps with limited testing of GridFTP

Work by Hyunwoo Kim (Fermilab)

# Clients	Input File [illegible] MB	Input File 1 GB	Input File 2 GB	Input File 4 GB
1	~[illegible]	~18 Gbps	~26 Gbps	~32 Gbps
2	~22 Gbps	~[illegible]	~ 40 Gbps	~56 Gbps
4	~42 Gbps	~56 Gbps	[illegible]	~77 Gbps
8	~60 Gbps	~75 Gbps	~80 Gbps	-

Increased Throughput



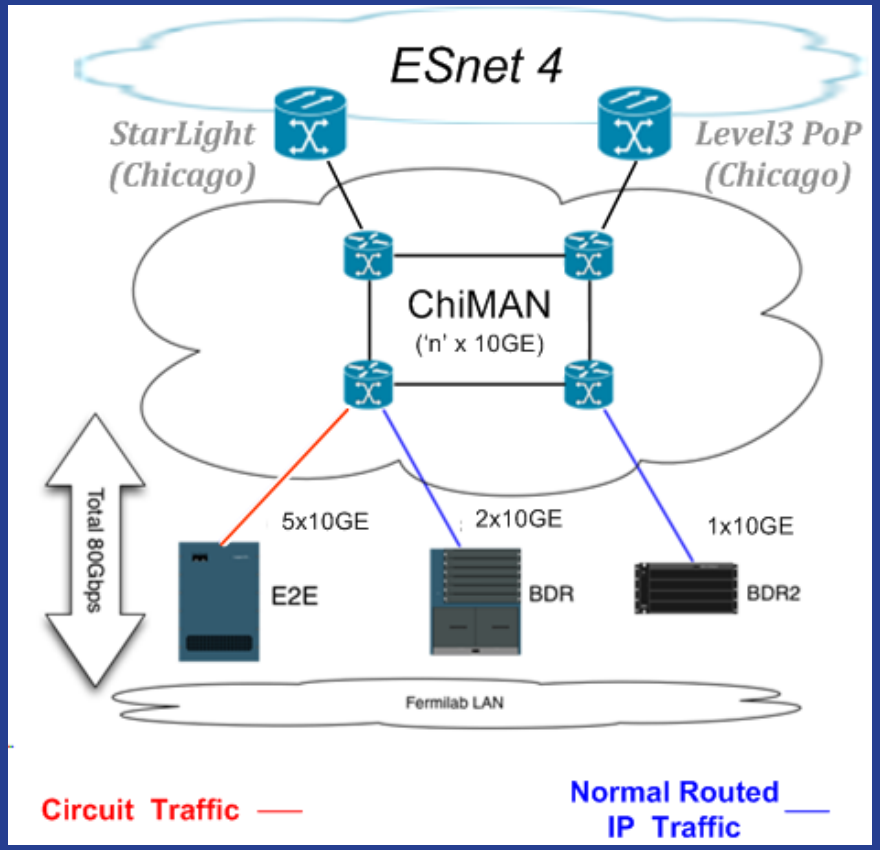


Current Plans & Constraints

- ANI 100G testbed
  - Current time window: until Aug 2012
  - Complete tests of Xrootd, GridFTP, and Globus Online
  - Test Squid for condition data access
- Without an ANI extension, we'll delay or cancel the testing of technologies used by other Fermilab stakeholders:
  - Luster, IRODS, CVMFS, dCache.
  - This would mean an increased risk to the stakeholders.
- 100GE production endpoint coming to Fermilab (see next slides)
  - Expecting 100 GE capabilities in summer 2012.
  - Creating a local testbed connecting to ANI.
  - Continue testing of middleware technologies defined by stakeholders.

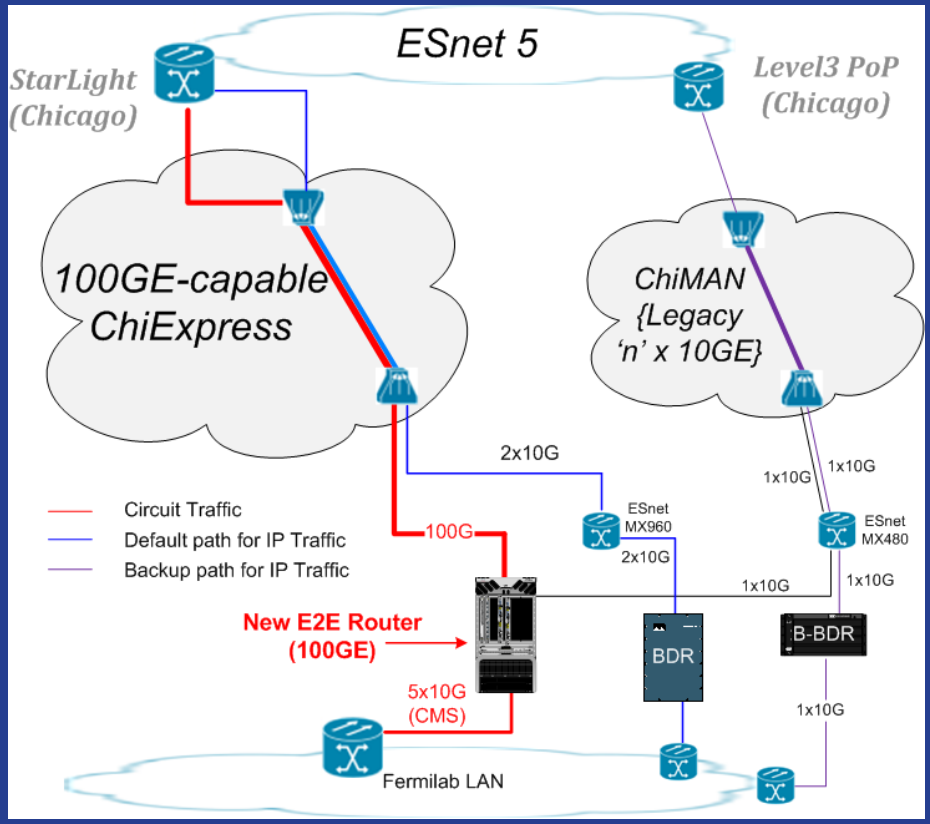
Current Fermilab WAN Capabilities

- Metropolitan Area Network provides 10GE channels:
  - Currently 8 deployed
- Five channels used for circuit traffic
  - Supports CMS WAN traffic
- Two used for normal routed IP traffic
  - Backup 10GE for redundancy
  - Circuits fail over to routed IP paths



100GE WAN capability is coming

- ESnet deploying 100GE MAN as part of ESnet5
  - One 100GE wave for FNAL
  - Also 2x10GE channels for routed IP traffic
- 100GE wave will be used to support circuit traffic
- Legacy 10GE MAN will remain for diversity
  - Backup routed IP path
  - One 10GE circuit path, too



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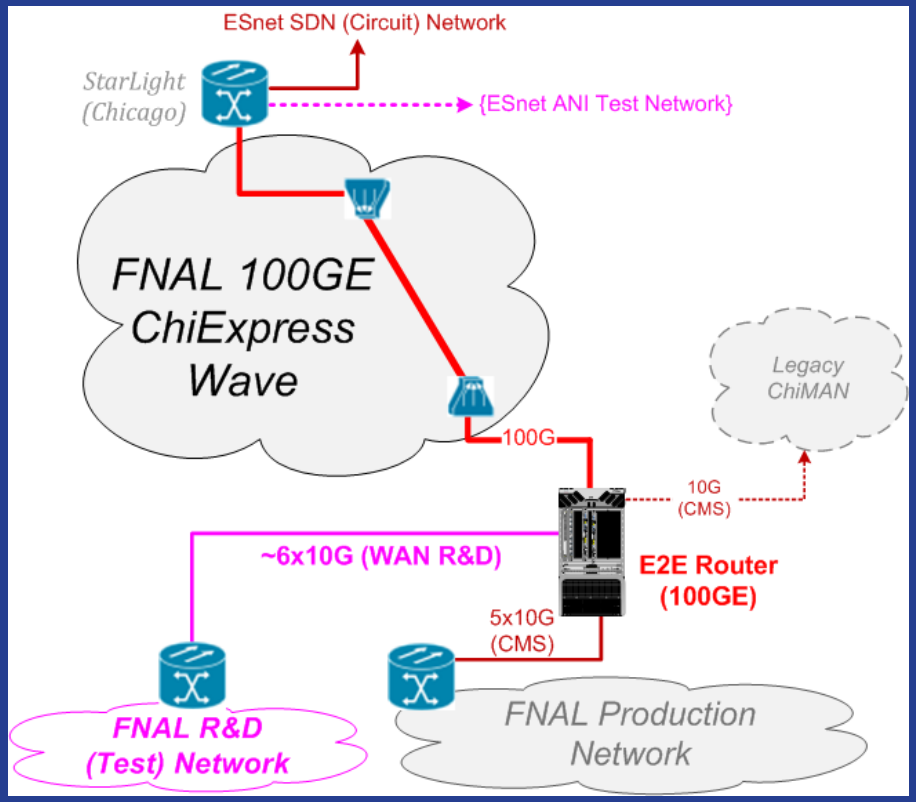
Use of 100GE Wave for FNAL R&D

- 100GE wave will support 4x10GE circuit paths
  - Excess capacity available for WAN R&D activities
- Planning ~6 x 10GE link to FNAL R&D network
  - Network will host 10GE test/development systems
  - Possibly 40GE systems later
- Anticipate WAN circuit into ESnet ANI test bed



Summary

- Fermilab has a program of work to test 100GE network for its scientific stakeholders
- The collaboration with ANI and ESNet has been central to this program
- The current timeline for ANI is not sufficient to evaluate all technologies of interest to the Fermilab stakeholders
- Fermilab will have 100GE capability in the summer 2012 – planning for involvement with ANI