

ESnet capacity requirements: Projections based on historical traffic growth and on documented science requirements for future capacity

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ESnet future total and European traffic

- *Over the next five years DOE Office of Science (SC) collaborations will result in several hundred Gb/s of European traffic**
 - ESnet requirements reviews for all SC programs support the conclusion that network traffic will continue to grow at historical rates for at least the next five years due to
 - Upgrades at the Large Hadron Collider (LHC)
 - Rising data intensity in multiple disciplines (for example in photon science and climate)
 - New collaborations and facilities (for example ITER)
 - Further, both historical trends and future science requirements indicate that US – European traffic will grow at approximately the same rate of overall traffic

* There are also specific requirements for bandwidth to the Asia Pacific region but these are not included in this analysis

Office of Science Program Areas

- Office of Science (SC) network Requirements Reviews (the reviews are organized by the SC Program Offices)
 - Basic Energy Sciences (BES: materials sciences, chemistry, geosciences)
 - Biological and Environmental Research (BER: genomics, Earth biochemical systems and climate)
 - IPCC (Intergovernmental Panel on Climate Change) special requirements review (BER)
 - Fusion Energy Science (FES: plasma physics)
 - Nuclear Physics (NP: fundamental properties of matter)
 - Advanced Scientific Computing Research (ASCR: applied mathematics, computer science, and high-performance networks)
 - High Energy Physics (HEP: fundamental interactions of matter and energy, the nature of space and time)
 - Belle-II experiment special requirements report (HEP)
- Review reports: <http://www.es.net/about/science-requirements/>

ESnet future total and European traffic

- Traffic estimates from ESnet requirements reviews, by Office of Science program area
- Traffic to Europe is a portion of the total (“WAN”) (not in addition to)

Fusion Energy Sciences (2011)

	WAN	Europe	European traffic as % of total
near-term	3.20	1.30	41%
2-5 years	28.50	26.45	93%
5+ years	55.40	52.65	95%

Biological and Environmental Sciences (2012)

	WAN	Europe	European traffic as % of total
near-term	7.0	3.2	46%
2-5 years	106.0	52.4	49%
5+ years	1430.0	604.4	42%

Basic Energy Sciences (2010)

	WAN	Europe	European traffic as % of total
near-term	30.8	5.0	16%
2-5 years	177.6	25.9	15%
5+ years	2736.9	269.2	10%

Advanced Scientific Computing Research (2012)

	WAN	Europe	European traffic as % of total
near-term	11.5	0.7	6%
2-5 years	222.0	21.1	10%
5+ years	2295.0	214.8	9%

Nuclear Physics (2011)

	WAN	Europe	European traffic as % of total
near-term	11.3	5.5	48%
2-5 years	27.2	12.6	46%
5+ years	66.1	42.0	63%

High Energy Physics (2013 est.)

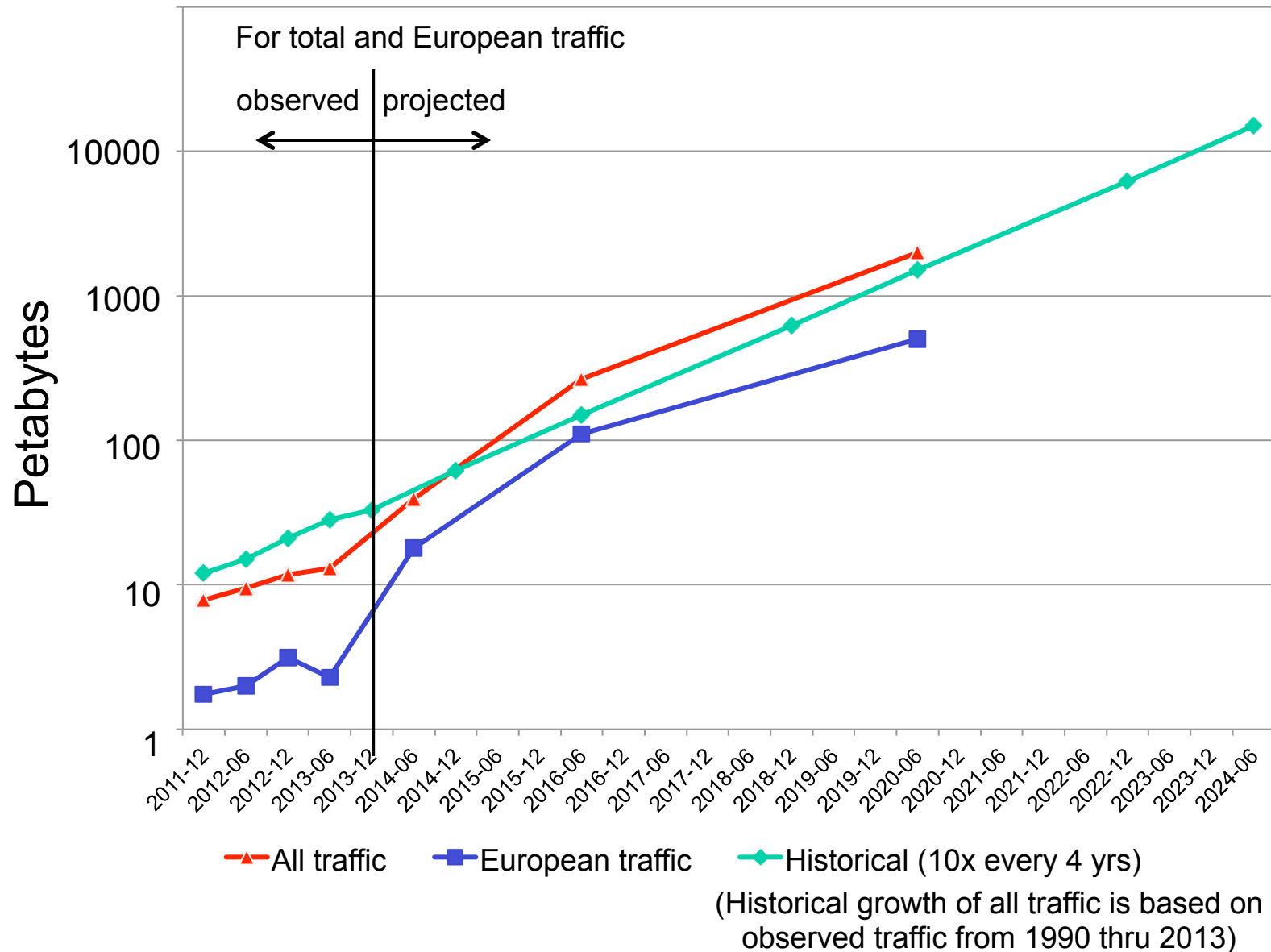
	WAN	Europe	European traffic as % of total
near-term	69.0	43.4	63%
2-5 years	314.0	214.4	68%
5+ years	760.0	484.0	64%

Totals

	WAN (Gb/s)	Europe (Gb/s)	European traffic as % of total
near-term	132.89	59.10	44%
2-5 years	875.37	352.90	40%
5+ years	7343.38	1666.95	23%

Science projection compared to historical traffic

Total volume in bytes of traffic handled by ESnet per month



ESnet future total and European traffic

- The predicted traffic from the ESnet science requirements reviews tracks the historical trend almost perfectly, except for being a bit above the historical projection beyond 2015
- That the science projection is larger than historical projection is consistent with a lag in the science community achieving what they have predicted – an issue that we have seen in the past
 - That is, while science estimates of required *bandwidth* are typically fairly accurate, the estimates tend to be somewhat optimistic in terms of *when* they will achieve their projected bandwidth

Methodology

- Each science requirements report was analyzed for traffic projections for each experiment and collaboration described in the report
 - The traffic projections were aggregated for the Office of Science program area of the report and the monthly data volume calculated from this
- Where European traffic requirements were not specifically given for collaborations that had a European component, they were estimated from the fraction of the collaboration that was in Europe
- Although the dates of the reports differ by up to several years, this was not taken into account: All the dates of the traffic projections were assumed to be 2012
- For experiments/collaborations where a human was directly involved in generating the network traffic (such as a scientist operated instrument) the traffic duty cycle was adjusted to a fraction of the day for calculating traffic volume