EOS Mission Support Network Performance Report

This is a monthly summary of EMSnet performance testing -- comparing the measured performance against the requirements.

Highlights:

- Test results remain stable – **all "adequate" or better since December '03!**
- Results from the "Integrated" data calculations are now shown below. The "Integrated" results are generally lower that the sum of the median iperf thruput and the average MRTG. See the discussion on this topic below.

Ratings:

Rating Categories:

Excellent: **Total Kbps** > Requirement * 3
Good: 1.3 * Requirement <= **Total Kbps** < Requirement * 3
Adequate: Requirement < **Total Kbps** < Requirement * 1.3
Low: **Total Kbps** < Requirement.
Bad: **Total Kbps** < Requirement / 3

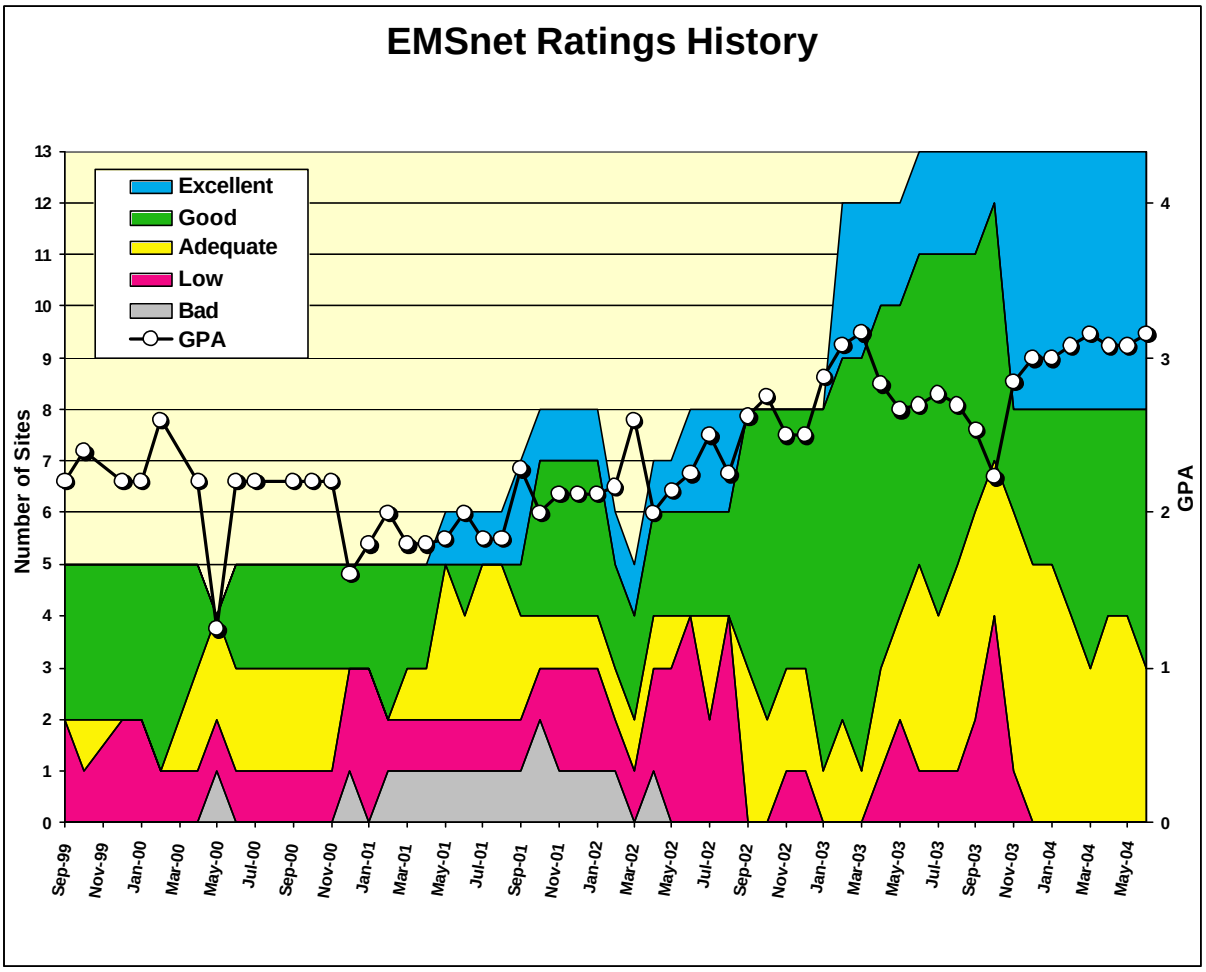
Where Total Kbps = User Flow + iperf monthly average

Ratings Changes:

Upgrades: ↑:
GSFC → **EDC**: Adequate → **Good**

Downgrades: ↓: None

Ratings History:



The chart above shows the number of sites in each classification since EMSnet testing started in September 1999. Note that these ratings do NOT relate to absolute performance -- they are relative to the EOS requirements. The GPA is calculated based on Excellent: 4, Good: 3, Adequate: 2, Low: 1, Bad: 0

Integrated Testing Results:

This month additional "integrated" results are presented for selected tests (in addition to the previous results).

Existing methodology: Overview

In the existing method, a circuit is characterized by combining the iperf "thruput' and MRTG "user flow". This is based on the concept that neither the thruput nor the MRTG can fully represent the capability of a circuit. On one hand, user flow alone is incompletete, since there may be low user demand during a measurement period. It would be unreasonable to infer circuit problems in this case (iperf would be much better). But if user flow is high, the iperf results will be reduced. And there are intermediate cases to consider as well. So the iperf must be combined with the user flow to accurately characterize the performance of a circuit.

The current method is to add the monthly median iperf thruput value to the adjusted monthly average MRTG value for the appropriate circuit. Two adjustments are made to the raw MRTG value obtained from the routers. First, since the iperf tests are counted in the MRTG totals, the raw MRTG value is reduced by the effect of the iperf tests on the MRTG. Second, since MRTG counts bytes on the circuit interface, while iperf measures TCP payload, the MRTG is discounted by 5% to represent the overhead of the lower protocol levels.

Existing methodology: Problems

First, it is not quite valid to add a median (iperf) to an average (MRTG). However, it was hoped that the distribution of values is "normal" enough so that the medians and averages are close together.

One possible problem situation occurs if the user flow is small and sporadic. In such a case it will only affect those iperf tests which occur during user flow. If this is less than half of the iperf tests, then the iperf median will not be much affected by the user flows. The iperf flows in this case would then be a good characterization of the circuit capacity. But the user flows could be significant over the period of a month. So adding them to the iperf values would overstate the circuit capability (as proof of this problem, this total occasionally exceeds the circuit capacity). But it is not clear how to correct this, when the only MRTG value is a single number representing a monthly average.

Integrated methodology: Overview

With the switch from NPAG to ENSIGHT, additional information is collected and available in the database. This additional information is used to derive a second estimate of the circuit performance.

The additional information is derived from netflow and cflowd statistics gathered from the routers (rather than MRTG). This data describes the flows between two IP address ranges during a period in question. It is used to estimate the user flow during each selected iperf test.

Again, the flow data must be adjusted before adding it to the iperf data. In this case the iperf packets are already excluded, so no adjustment is necessary on that account. The protocol adjustment is applied similarly to the case above. But an additional "Interference effect" is compensated for. This is based on the likelihood that significant user flows will likely last much longer than the 30 second iperf test period. While running, the iperf test will likely interfere with and thus temporarily reduce the user thruput. But for the rest of the time the user flow is unaffected. So the average flow rate obtained from netflow will overstate the user flow during the iperf period. This effect is thus estimated and counteracted.

One remaining problem is that the flows specified to netflow may not include all the relevant user flows. For example, EDOS flows are currently omitted from some destinations. This aspect is still being studied.

Results:

The following table summarizes the results of both methods:

Row	Source → Dest	Iperf	User flow	Total	Integrated
1	GSFC-PTH → EDC-PTH	205.0	172.9	377.9	370.2
2	GSFC-CSAFS → JPL-SEAPAC	6.00	0.84	6.84	6.16
3	LaRC DAAC → JPL-TES	39.74	5.09	44.83	39.75
4	GSFC-PTH → NSIDC	91.0	14.3	105.3	91.4
5	GSFC-CSAFS → NESDIS	2.93	0.22	3.15	2.93
6	GDAAC → LDAAC	49.0	22.4	71.4	60.6
7	GSFC-CSAFS → JAXA-EOC	2.03	0.62	2.65	2.13

Discussion:

In each case above, the "Integrated" value is lower than the "Total" obtained by adding the median monthly iperf to the adjusted average MRTG. Two factors are believed to contribute to these differences. One factor is that the integrated measurements may not include all the relevant user flows. In that regard, the Integrated measurements would be inferior to the old method. The other factor is that the old method inadequately compensated for the interference between the two measurements. In that regard, the Integrated measurements would be superior. Since both types of error tend to make the integrated measurements lower than the old Totals, it is not quite possible to determine what the best estimate of circuit capacity should be. But the true value is likely to be between the two calculations above. In row 1, it is believed that all user flows are accounted for. This case has a very small (2%) difference between the two methods. But other cases have a larger difference, and are thought to have some flows omitted.

It is planned to continue improving these techniques in the future.

EMSnet Sites
Network Requirements vs. Measured Performance

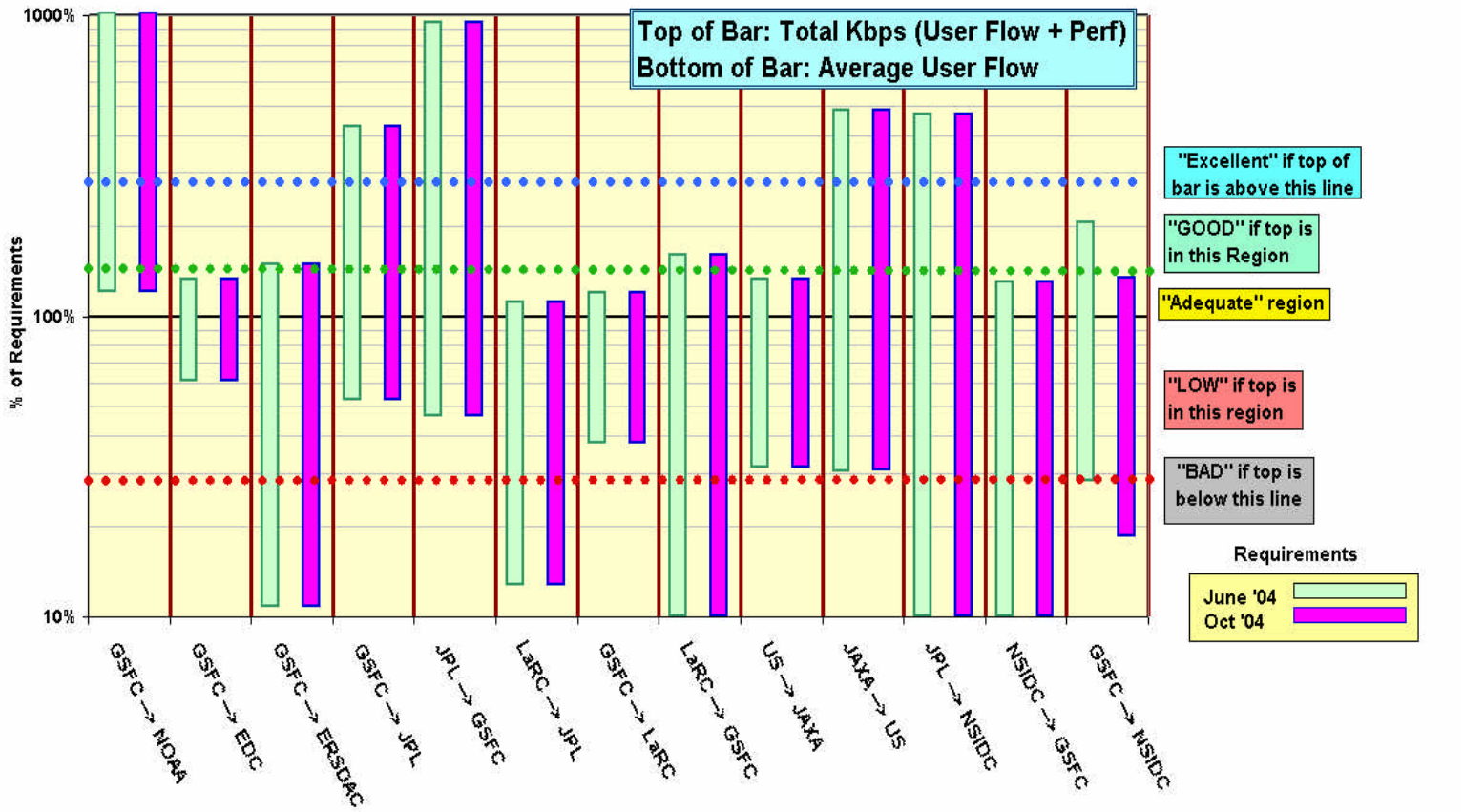
June 2004		Requirements (kbps)		Testing								
Source → Destination	Team (s)	Current Jun-04	Future Oct-04	Source → Dest Nodes	Raw MRTG	Perf → MRTG	Avg User Flow kbps	iperf Avg kbps	Total Avg kbps	Current Status re Jun-04	Prev Stat	Current Status re Oct-04
GSFC –> ASF	QuikScat, Radarsat	n/a	n/a	GSFC-CSAFS → ASF	30	21	7	1253	1260	n/a	n/a	n/a
ASF –> JPL	QuikScat, Radarsat	n/a	n/a	ASF → JPL-SEAPAC	253	22	218	1339	1557	n/a	n/a	n/a
GSFC –> NOAA	QuikScat	189	189	GSFC-CSAFS → NESDIS	314	73	225	2929	3154	Excellent	E	Excellent
GSFC –> EDC	MODIS, LandSat	285361	285361	GSFC-PTH → EDC DAAC	189200	6832	172908	204957	377865	GOOD	A	GOOD
GSFC –> ERSDAC	ASTER	568	568	GDAAC → ERSDAC	71	7	61	784	845	GOOD	G	GOOD
GSFC –> JPL	ASTER, QuikScat, MLS, etc.	1597	1597	CSAFS → JPL-SEAPAC	1025	134	840	6005	6844	Excellent	E	Excellent
JPL –> GSFC	AMSR, etc.	625	625	JPL-PODAAC → GDAAC	482	170	288	12233	12521	Excellent	E	Excellent
LaRC –> JPL	TES, MISR	40311	40311	LDAAC → JPL-TES	5705	331	5089	39745	44833	Adequate	A	Adequate
GSFC –> LaRC	CERES, MISR, MOPITT	59401	59401	GDAAC → LDAAC	24000	408	22392	48966	71358	Adequate	A	Adequate
LaRC –> GSFC	MODIS, TES	31784	31784	LDAAC → GDAAC	774	422	313	50689	51002	GOOD	G	GOOD
US –> JAXA	QuikScat, TRMM, AMSR	1986	1986	GSFC-CSAFS → JAXA	686	34	618	2028	2646	GOOD	G	GOOD
JAXA –> US	AMSR	512	512	JAXA → JPL-SEAPAC	205	39	156	2318	2473	Excellent	E	Excellent
JPL –> NSIDC	AMSR	1342	1342	JPL-PODAAC → NSIDC SIDADS	180	52	120	6205	6325	Excellent	E	Excellent
NSIDC –> GSFC	MODIS, ICESAT, QuikScat	13326	13326	NSIDC DAAC → GDAAC	634	140	462	16840	17302	Adequate	A	Adequate
GSFC –> NSIDC	MODIS, ICESAT, QuikScat	51157	78410	GSFC-PTH → NSIDC DAAC	16000	758	14442	90973	105414	GOOD	G	GOOD

Notes: Flow Requirements (from BAH) include TRMM, Terra , Aqua, QuikScat, ~~ADEOS II~~

*Criteria:		
	Excellent	**Total Kbps** > Requirement * 3
	GOOD	1.3 * Requirement <= **Total Kbps** < Requirement * 3
	Adequate	Requirement < **Total Kbps** < Requirement * 1.3
	LOW	**Total Kbps** < Requirement
	BAD	**Total Kbps** < Requirement / 3

Ratings Summary	Jun-04 Score	Reg Prev	Oct-04 Score
Excellent	5	5	5
GOOD	5	4	5
Adequate	3	4	3
LOW	0	0	0
BAD	0	0	0
Total	13	13	13
GPA	3.15	3.08	3.15

This graph shows two bars for each source-destination pair. Each bar uses the same actual measured performance, but compares it to the requirements for two different times (June '04, and October. '04). Thus as the requirements increase, the same measured performance will be lower in comparison.



Note that this chart shows that the performance to all sites meets current requirements

Also note that the interpretation of these bars has changed since Sept '01. The bottom of each bar is the average measured MRTG flow to that site (previously daily minimum). Thus the bottom of each bar indicates the relationship between the requirements and actual flows. Note that the requirements include a 50% contingency factor above what was specified by the projects, so a value of 66% would indicate that the project is flowing as much data as requested.

1) ASF Rating: **N/A**

Web Page: http://ensight.eos.nasa.gov/Networks/emsnet/ASF_EMS.shtml

Test Results:

Source → Dest	Medians of daily tests (mbps)				
	Best	**Median**	**Worst**	**User Flow**	**TOTAL**
GSFC-CSAFS → ASF	1.35	1.25	0.75	0.07	1.32
ASF → NESDIS	1.38	1.36	0.47	0.22	1.58
ASF → NSIDC	1.40	1.40	0.39		
ASF → GSFC-CSAFS	1.40	1.39	0.48		
ASF→ JPL-SEAPAC	1.38	1.34	0.55		

ADEOS Requirement: (Deleted)

Source → Dest	FY	Mbps	Rating
ASF → NESDIS	October '03	1.86	**Good**

Comments: On approx June 3, the JPL ? ASF circuit was reduced from 2 T1s to a single T1. The 1.32 mbps total from ASF → NOAA is as expected for a single T1 (1.54 mbps) circuit. The ASF outflows are comparable. Adding the MRTG outflow, the total slightly exceeds the circuit capacity. This is taken as an artifact of discrepancies in the process –- the small occasional user flows do affect individual iperf test results, but not the iperf median.

The requirement above is from ADEOS, and has been deleted. The remaining ASF requirements are very low, and mostly based on estimated ECS interDAAC queries, not production flows. These flow estimates are not considered reliable enough to use as a basis for testing, so the rating is "N/A". The rating would have remained "Good" vs. the October '03 requirement.

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2) GSFC → EDC: Rating: ↑ Adequate → **Good**

Web Page: http://ensight.eos.nasa.gov/Networks/emsnet/EDC.shtml `

Test Results:

Source → Dest	Medians of daily tests (mbps)					
	Best	**Median**	**Worst**	**User Flow**	**TOTAL**	**Integrated**
GSFC-PTH → EDC-PTH	214.9	205.0	187.7	172.9	377.9	370.2
G-DAAC→ EDC LPDAAC	204.0	168.4	114.1			

Requirements:

Date	mbps	Rating
June, October '04	285.4	**Good**

Comments:

The rating is based on testing between the GSFC performance test host ("GSFC-PTH"), located outside the ECS firewall and the EDC performance test host ("EDC-PTH"), also located outside the ECS firewall The comparison of the two results shows the effect of high levels of loading on the GDAAC and the ECS firewalls. This month the iperf was stable, but the MRTG user flow increased, and the total exceeds the requirement, by a 30% margin, so the rating improves to "Good"

A new "Integrated" measurement is presented above. It is derived from combining each iperf test with user flow data for the same time period. The two values are added for each test, with an adjustment to account for estimated "interference" between these two factors. The small difference between the integrated value and the sum of the adjusted monthly medians lends credibility to the adjustment techniques.

3) JPL:

Ratings: GSFC → JPL: Continued **Excellent**
JPL → GSFC: Continued **Excellent**
LaRC → JPL: Continued **Adequate**

Web Pages:

http://ensight.eos.nasa.gov/Networks/emsnet/JPL_SEAPAC.shtml
http://ensight.eos.nasa.gov/Networks/emsnet/JPL_PODAAC.shtml
http://ensight.eos.nasa.gov/Networks/emsnet/JPL_TES.shtml
http://ensight.eos.nasa.gov/Missions/terra/JPL_MISR.shtml

Test Results:

Source → Dest	Medians of daily tests (mbps)					
	Best	Median	Worst	User Flow	TOTAL	Integrated
GSFC-CSAFS → JPL-SEAPAC	6.26	6.00	3.26	0.84	6.84	6.16
LaRC DAAC → JPL-TES	40.42	39.74	23.89	5.09	44.83	39.75
LaRC DAAC → JPL-MISR (ftp)	19.98	17.05	10.30			
JPL-PODAAC→ GSFC DAAC	12.31	12.23	6.59	0.29	12.52	

Requirements:

Source → Dest	Date	mbps	Rating
GSFC → JPL combined	June '04	1.60	**Excellent**
JPL → GSFC combined	June '04	0.63	**Excellent**
LaRC DAAC → JPL-TES	June '04	30.6	**Adequate**
LaRC DAAC → JPL-MISR	June '04	18.5	**Adequate**
LaRC DAAC → JPL-Combined	June '04	49.1	**Low**

Comments:

GSFC → JPL: Performance on this circuit has been mostly stable since the BOP switchover on 15 August '02; well above the requirement; the rating remains "Excellent". The new "integrated" data here, like EDC, combines the iperf and user flow for each individual test. In this case it appears that the integrated value is substantially lower than the sum of the median iperf and average MRTG. This could perhaps indicate that some of the user flow is not being captured, or perhaps that adding the median iperf to the average MRTG overstates the true circumstances. This will be further evaluated in the future.

LDAAC→ JPL: Performance testing from LDAAC to JPL-TES has been stable at 40 mbps since testing was restored on Feb 29. Iperf testing to JPL-MISR has been blocked by JPL security, and has not recovered (working with POCs to restore). So the MISR results above are from ftp testing, which is limited to about half the typical iperf performance due to TCP window size and RTT factors. This ftp performance has also been stable. The integrated result in this case is also well below the sum of the median iperf and average MRTG.

Note: The measured thruput is above both the MISR and TES requirements, but below their combined value. However, the MISR requirement is open to some interpretation. The formal QA flow is only 9.7 mbps. But the science data also flows on the same circuit. This pushes the total MISR flow requirement to 18.5 mbps. When this 18.5 mbps MISR requirement is added to the 30.6 mbps TES requirement, the 49 mbps total requirement is higher than the measured performance, and also higher than the nominal circuit speed. Thus the rating remains "Low". But the rating would be "Adequate" based only on the formal QA requirement.

This configuration is based on a management decision to set the circuit capacity at this level to reduce cost, in the expectation that both projects' requirements are bursty and include contingency. Thus the actual requirements of both projects are expected to be met with this circuit capacity.

JPL → GSFC: The requirement from JPL to GSFC includes flows from NASDA and ASF which go via JPL, and includes GSFC and NOAA destinations. Since many of these flows were related to ADEOS, this requirement dropped substantially with the removal of ADEOS. The iperf flow increased abruptly from a stable 8 mbps to a stable 12 mbps on March 6, apparently due to a PVC change. The combined requirement is now only 0.63 mbps, and the combined 12.6 mbps thruput is more than 3 times that, so the rating remains "Excellent".

4) NSIDC:

Ratings: GSFC → NSIDC: Continued **Good**
NSIDC → GSFC: Continued **Adequate**

Web Page: http://ensight.eos.nasa.gov/Networks/emsnet/NSIDC_EMS.shtml

GSFC ←→ NSIDC Test Results:

Source → Dest	Medians of daily tests (mbps)					
	Best	Median	Worst	User Flow	TOTAL	Integrated
GSFC-PTH → NSIDC	91.6	91.0	30.9	14.3	105.3	91.4
GSFC-DAAC → NSIDC	91.3	89.3	23.7			
NSIDC → GSFC-DAAC	17.0	16.8	15.3	0.5	17.3	

Requirements:

Source → Dest	Date	mbps	Rating
GSFC → NSIDC	June '04	66.9	Good
NSIDC → GSFC	June '04	13.3	Adequate

Comments:

GSFC → NSIDC: The rating is based on testing from the GSFC-PTH to the NSIDC DAAC. This node is outside the GSFC ECS firewall, and has the same peaks and median, but higher worst values compared to the GDAAC. The performance is more than 30% above the requirement, so the rating remains "Good". Like JPL, the new "Integrated" results are substantially lower than the sum of the median iperf and average MRTG

NSIDC → GSFC: Performance from NSIDC to GSFC remains steady, and the rating remains "Adequate".

Other Testing:

Source → Dest	Medians of daily tests (mbps)				
	Best	Median	Worst	Requirement	Rating
JPL → NSIDC-SIDADS	6.21	6.21	4.19	1.08	Excellent
GSFC-ISIPS → NSIDC (ftp)	7.26	6.69	5.06		
GSFC-ISIPS → NSIDC (iperf)	34.85	34.35	17.74		
NSIDC → GSFC-ISIPS (iperf)	17.12	17.05	15.28		
LDAAC → NSIDC	4.93	4.79	4.63	0.07	Excellent
ASF → NSIDC	1.40	1.40	0.39	0.73	Good

Comments:

JPL → NSIDC-SIDADS: Performance has been very steady from JPL since the Aug '02 BOP switchover, exceeding the modest requirement.

GSFC-ISIPS ← → NSIDC: Performance of ftp pulls by NSIDC from ISIPS remains very steady at 7 mbps, apparently limited by ftp window size. The iperf results show that a single stream is indeed limited to about 7 mbps, limited by the window size on the ISIPS HP-UX machine. But multiple stream reverse iperf testing between the same machines in the same direction shows that the network is capable of much more thruput. Testing from NSIDC to ISIPS gets very similar thruput as NSIDC to GDAAC.

LDAAC → NSIDC: Thruput from LDAAC to NSIDC has been steady since August '03. The very low requirement produces a rating of "Excellent".

ASF → NSIDC: Thruput dropped about in half this month, due to the downgrade of ASF fro two to one T1. The median thruput is still more than 30 % above the LASP requirement, but not by a factor of 3 any more, so the rating drops to "Good" from "Excellent".

5) GSFC ←→ LaRC:

Ratings: GDAAC → LDAAC: Continued **Adequate**
LDAAC → GDAAC: Continued **Good**

Web Page: http://ensight.eos.nasa.gov/Networks/emsnet/LARC.shtml

Test Results:

Source → Dest	Medians of daily tests (mbps)					
	Best	Median	Worst	User Flow	TOTAL	Integrated
GDAAC → LDAAC	56.0	49.0	25.4	22.4	71.4	60.6
GSFC-PTH → LDAAC	58.8	47.9	14.9			
GSFC-PTH → LaTIS	58.8	48.6	17.1			
LDAAC → GDAAC	51.1	50.7	40.0	0.3	51.0	

Requirements:

Source → Dest	Date	Mbps	Rating
GDAAC → LDAAC	June '04	59.4	Adequate
LDAAC → GDAAC	June '04	31.7	Good

Comments: **GSFC → LaRC**: Performance from GDAAC to LDAAC was stable, but the requirement increased in May, dropping the rating to "Adequate". Testing from GSFC-PTH to LDAAC and from GSFC-PTH to LaTIS is very similar to testing from GDAAC to LDAAC. . Like JPL, the new "Integrated" results are substantially lower than the sum of the median iperf and average MRTG

LaRC → GSFC: Performance remains stable since the June '03 upgrade to meet the backhaul requirements. The FY '04 requirement jumped from 6.8 mbps to 31.7 mbps in Oct '03, to incorporate this backhaul of all LaRC science outflow via GSFC (which has apparently not started thus far). The thruput is more than 30% above this requirement, so the Jan '04 rating remains "good".

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6) NOAA NESDIS:

Rating: Continued **Excellent**

Web Page: http://ensight.eos.nasa.gov/Networks/emsnet/NOAA_NESDIS.shtml

Test Results:

Source → Dest	Medians of daily tests (mbps)					
	Best	Median	Worst	User Flow	TOTAL	Integrated
GSFC-CSAFS → NESDIS	2.93	2.93	1.61	0.22	3.15	2.93
ASF → NESDIS	1.40	1.40	0.39			
JAXA (NASDA) → NESDIS	1.61	1.59	0.49			

Requirements:

Source → Dest	FY	Mbps	Rating
GSFC-CSAFS → NESDIS	'04	0.19	Excellent

Comments: With the deletion of the ADEOS flows from ASF, the dominant flow to NOAA is Quikscat data, from GSFC CSAFS.

Like JPL, the new "Integrated" results are substantially lower than the sum of the median iperf and average MRTG But note that the 3.15 mbps total from CSAFS → NOAA exceeds the nominal 3.1 mbps for the 2 * T1 circuit. This shows the danger of adding together sampled medians. In this case the iperf tests are usually unaffected by the sporadic user flows, and normally get full circuit bandwidth. Adding the low but significant user flow then exceeds the circuit capacity. So the Integrated results may be more accurate in this case. Since the thruput is more than 3 times the FY '04 requirement, the rating is "Excellent".

Also note that the flow from NASDA is limited by the TCP window size of the NASDA test source, and the long RTT, and that the thruput from ASF dropped due to the switch from two to one T1 at ASF.

7) US ←→ JAXA (NASDA):

Ratings: GSFC → JAXA Continued **Good**
JAXA → US: Continued **Excellent**

Web Pages http://ensight.eos.nasa.gov/Networks/emsnet/NASDA_EOC.shtml
http://ensight.eos.nasa.gov/Networks/emsnet/JPL_SEAPAC.shtml
http://ensight.eos.nasa.gov/Networks/emsnet/GSFC_SAFS.shtml

Test Results:

Source → Dest	Medians of daily tests (mbps)					
	Best	Median	Worst	User Flow	TOTAL	Integrated
GSFC-CSAFS → JAXA-EOC	2.25	2.03	1.40	0.62	2.65	2.13
JAXA-EOC → JPL-SEAPAC	2.33	2.32	1.26	0.16	2.48	
JAXA-EOC → GSFC-CSAFS	1.44	1.41	0.90			

Requirements

Source → Dest	Date	mbps	Rating
GSFC → JAXA	June '04	1.99	Good
JAXA → US	FY '03, '04	0.51	Excellent

Comments: US → JAXA: Performance steady -- about as expected for the 3 mbps ATM PVC (using multiple TCP streams to mitigate the TCP window size limitation at JAXA). The requirements above were reduced in November '03, due to the removal of ADEOS flows. The thruput was stable this month, with the rating remaining "Good". Like JPL, the new "Integrated" results are substantially lower than the sum of the median iperf and average MRTG.

The requirement still includes 4 ISTs at JAXA for AMSR-E. Each IST has a requirement for 311 kbps, for a total of 1244 kbps. It could be questioned whether JAXA intends to operate all four of the ISTs simultaneously, or whether some ISTs are backups, in which case the network requirements would be reduced to a lower value.

JAXA → US: Performance continues very stable. The requirement was reduced in November '03 due to the removal of ADEOS requirements, increasing the rating to "Excellent".

Note: Since JAXA has not yet implemented testing with multiple tcp streams, performance to GSFC is limited by the TCP window size on JAXA's test machine, in conjunction with the long RTT. In order to reflect the actual capability of network, the rating is derived from testing from JAXA to JPL, which uses the same Trans-Pacific circuit, but has a shorter RTT, so will not be limited by the TCP window size. The Trans-Pacific circuit connects into the higher speed domestic EMSnet at JPL, which is not expected to be the limiting factor.

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8) GSFC → ERSDAC:

Rating: Continued **Good**

Web Page :http://ensight.eos.nasa.gov/Networks/emsnet/ERSDAC.shtml

Test Results:

Source → Dest	Medians of daily tests (kbps)				
	Best	Median	Worst	User Flow	TOTAL
GSFC → ERSDAC	792	784	495	61	845

Requirements:

Source → Dest	FY	Kbps	Rating
GSFC → ERSDAC	'03, '04	568	Good

Comments: Thruput since June '02, using the 1 mbps ATM connection had been very stable (except for a problem period from 12 November '02 to 3 Jan '03). The requirement was revised down from 668 kbps in November '03, so the total user flow plus iperf is more than 30 % over the requirement, and the rating remains "Good".