Astronomical Data Analysis Software and Systems X
ASP Conference Series, Vol. 238, 2001
F. R. Harnden Jr., F. A. Primini, and H. E. Payne, eds.

AstroRoute

P. Fernique

Centre de Données astronomiques de Strasbourg (CDS), Strasbourg, France

D. Durand

Canadian Astronomical Data Centre (CADC), Victoria, Canada

Abstract. The Internet is now the most commonly used medium for the exchange of data between data centres. However the quality of this network of networks is completely outside the astronomical community's control: the routing rules for each country and the technologies deployed depend on various interests generally far from astronomical concerns. In order to get actual measurements of the fluctuating network flow rates between some astronomical Web sites, the CDS has developed a tool called AstroRoute. Its goal is to supply, on an hourly basis, a measurement of the network quality between astronomical Web sites over the world.

1. AstroRoute

AstroRoute is a system to get measurements about the connectivity and the quality of the network between astronomical web sites. It is an initiative and a development of the CDS (Centre de Données astronomiques de Strasbourg) with the help of D. Durand from the CADC (Canadian Astronomical Data Center). Several other institutes collaborate : the Observatoire de Paris/Meudon, ISO, ATNF (Sydney), NOAO, STScI, and CFHT. This project started in June 2000.

2. AstroRoute Working Principle

There exists a lot of network tools to test network quality, but the main problem is that the tests are generally done from one single site—the tester's own host machine. In order to obtain more reliable results, AstroRoute is based on a set of distributed agents which test synchronously a list of targets in order to measure the network connectivity and the bandwidth between any pair of agent/web site in the AstroRoute system. So, it becomes possible to know the authority that should be contacted in case of network problem or bad performances (local, campus, and national network instance) and to build convincing arguments for future upgrades.

To implement this principle, AstroRoute is based on two elements: a main site and some agents. The main site controls all agents: it synchronizes their clock reference, sends the list of astronomical Web sites to be tested and compiles

their results. Each agent tests individually these web sites and sends regularly a report to the main site. The resulting data set can be browsed on the main site with a classical web interface.

2.1. A Couple of Technical Points

The agent and main site software are written in Perl in order to keep a good portability. The system is designed to take into account bandwidth less than 200 kilobytes per second. The reports sent by the agents to the main site use a simple SMTP mail. By default, the tests are done hourly, and the reports are sent daily. The result browser is a classical HTML application. It is also possible to use a more powerful Java applet.

3. The Network Measurements

AstroRoute should provide network measurements reproducing a current web usage. This is why the tests are simple HTTP URLs providing a static file or image. With these tests AstroRoute records three measurements for each pair agent/web-site:

- The delay required to establish a network connection between the agent and the site. It means the time required for the DNS address resolution and the time to open an HTTP TCP session.
- The HTTP flow rate. This measurement requires a test URL providing a file larger than 100 KB.
- The failure frequency.

	Agent(s)		
	NOAO us 123 tests	CADC ca 414 tests	CDS fr 681 tests
ADAC.Tokyo.jp	1.3s/24.0k/4%	0.8s/18.7k	0.7s/15.3k/2%
ADC.Greenbelt.us	0.2s/112.0k/2%	0.3s/59.7k	0.3s/>60.1k/1%
ADS.Cambridge.us	1.2s/1%	0.2s/1%	0.5s/1%
ATNF.Sydney.au	3.8s/15.6k/5%	1.2s/19.1k/1%	1.6s/17.2k/2%
CADC.Victoria.ca	2.2s/64.6k/2%	0.0s/>258.5k/0%	1.4s/35.0k/1%
CDS.Strasbourg.fr	3.0s/36.1k/5%	0.9s/22.0k/0%	0.0s/>225.4k
CFHT.hawaii	0.8s/54.5k	0.2s/53.9k/0%	0.4s/32.4k/0%
ESO.Garching.de	0.6s/30.6k/6%	0.5s/24.7k/0%	0.5s/>76.8k/2%
Gemini.Arizona.us	0.3s/>195.3k/4%	0.5s/52.5k/7%	0.4s/38.4k/14%
IPAC.Pasadena.us	0.2s/>138.0k	0.1s/>109.8k	0.3s/41.0k/0%
ISO.Vilspa.es	0.6s/27.9k/4%	0.7s/26.1k/2%	0.3s/>80.8k/2%
IUCAA.Pune.in	0.7s/8.7k/7%	1.3s/10.2k/6%	1.8s/7.7k/4%
ObsPM.Meudon.fr	0.5s/4.6k/6%	0.6s/20.7k/0%	0.2s/>65.5k/1%
STScI.Baltimore.us	1.3s/98.2k	0.3s/62.4k/0%	0.4s/69.9k/0%
XMM.Leicester.uk	0.5s/10.5k/5%	0.5s/>11.9k	0.5s/>14.2k/1%

Table 1. Excerpt of agents/Web sites pair matrix: time connection, flow rate in kilobytes/sec, and success rate.

4. Global Trends

AstroRoute has been running for six months, and interesting global trends can be seen:

- **Various impact of the peak hours:** The difference between the peak hours and the off-peak hours is very important between European sites and US sites. The bandwidth can be divided by a factor of two or three at 17hr GMT. On the other hand, the access quality to Japan (ADAC) or Australia (ATNF) is not really dependent of time.

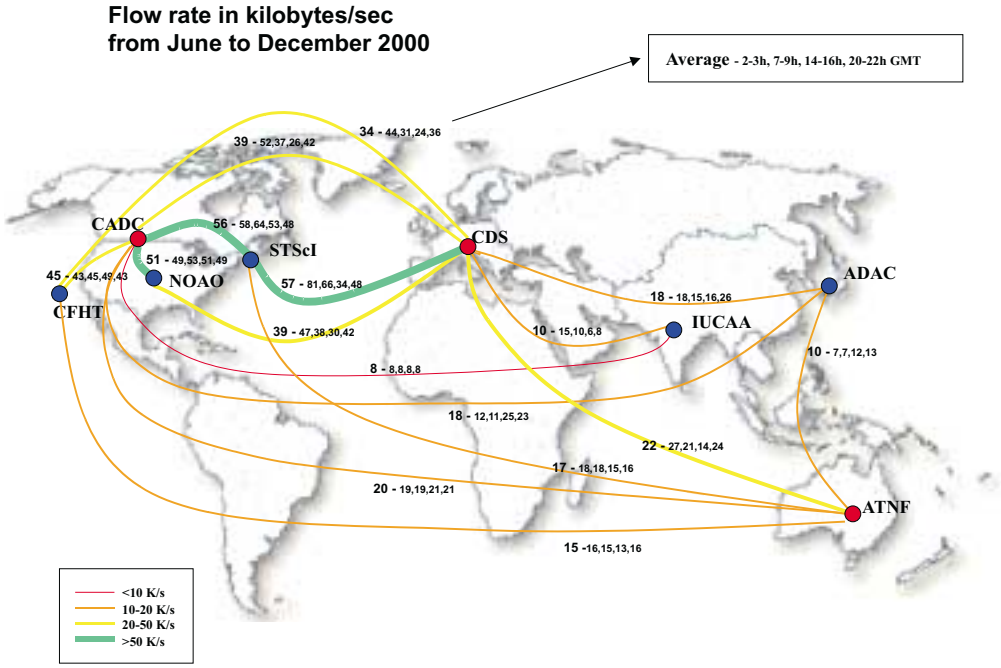
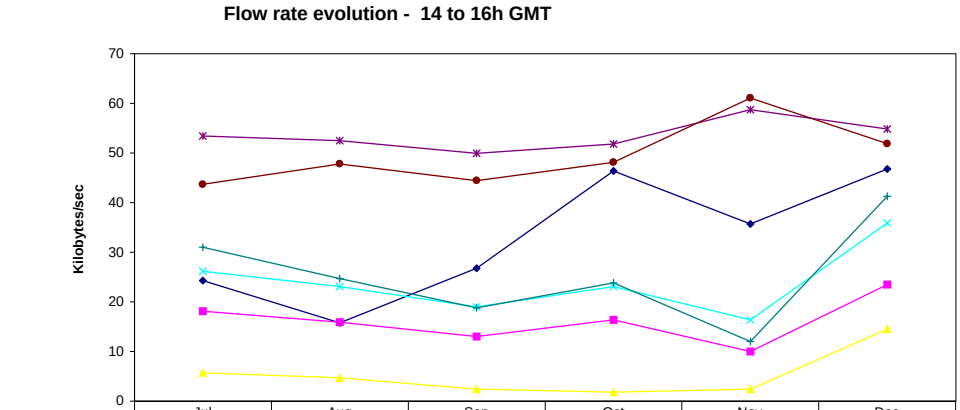


Figure 1. Bandwidth world map.

- **Increasing global quality in "switchback:"** Globally the bandwidth of Internet grows but this longterm tendency results from alternation of regular decrease and sudden improvements (Figure 2).
- **Protectionism of routing policy:** Network agencies seem to keep the bandwidth for local hosts since their network is loaded. For example, it is easy to reach the ISO Center at Vilspa (Spain) from Strasbourg (France) even if European network is loaded, but it is very difficult for an American host to do the same thing at the same time. We can find other examples for the US routing policy specially concerning the Eastern sites.



	Jul	Aug	Sep	Oct	Nov	Dec
CDS - STScI	24,3	15,8	26,8	46,4	35,7	46,8
CDS - ADAC	18,1	15,9	13	16,4	10	23,5
CDS - IUCAA	5,7	4,7	2,4	1,8	2,4	14,5
CDS - CFHT	26,2	23,1	19	23,1	16,4	35,9
CADC - STScI	53,4	52,5	49,9	51,8	58,7	54,8
CADC - CFHT	43,7	47,8	44,4	48,1	61,1	51,9
CADC - CDS	31	24,7	18,8	23,8	12	41,3

Figure 2. Flow rate evolution.

5. Conclusions

The AstroRoute results can be accessed from CDS via the AstroRoute main page[1]. The objective is now to extend the set of participating sites to obtain meaningful world-wide long term statistics, critical to assess the needs for this key infrastructure in the context of rapid development of interconnection between astronomical on-line resources.

[1] `http://simbad.u-strasbg.fr/astroroute.pl`