

**CORPORATE HEADQUARTERS**1750 Elm Street Suite 101  
Manchester, NH 03104

T +1.603.643.9300 F +1.603.623.1623

**RESEARCH & DEVELOPMENT**35 South Main Street  
Hanover, NH 03755

T +1.603.643.9300 F +1.603.643.2215

[www.renesys.com](http://www.renesys.com)**9 SEPTEMBER 2005 12:00 EDT**

# Impact of Hurricane Katrina on Internet Infrastructure

By James Cowie, Alin Popescu and Todd Underwood

This report covers the effect on Internet routing, as observed by the Renesys GRADUS global Internet monitoring infrastructure, of the landfall and aftereffects of Hurricane Katrina. It contains an overview of the condition of network assets to and through the region prior to Katrina. It describes, in some detail, the network impact of Katrina's landfall and the 24 hours following. Finally, it contains some information about the recovery, as seen from a network perspective, in the intervening days.

## Context

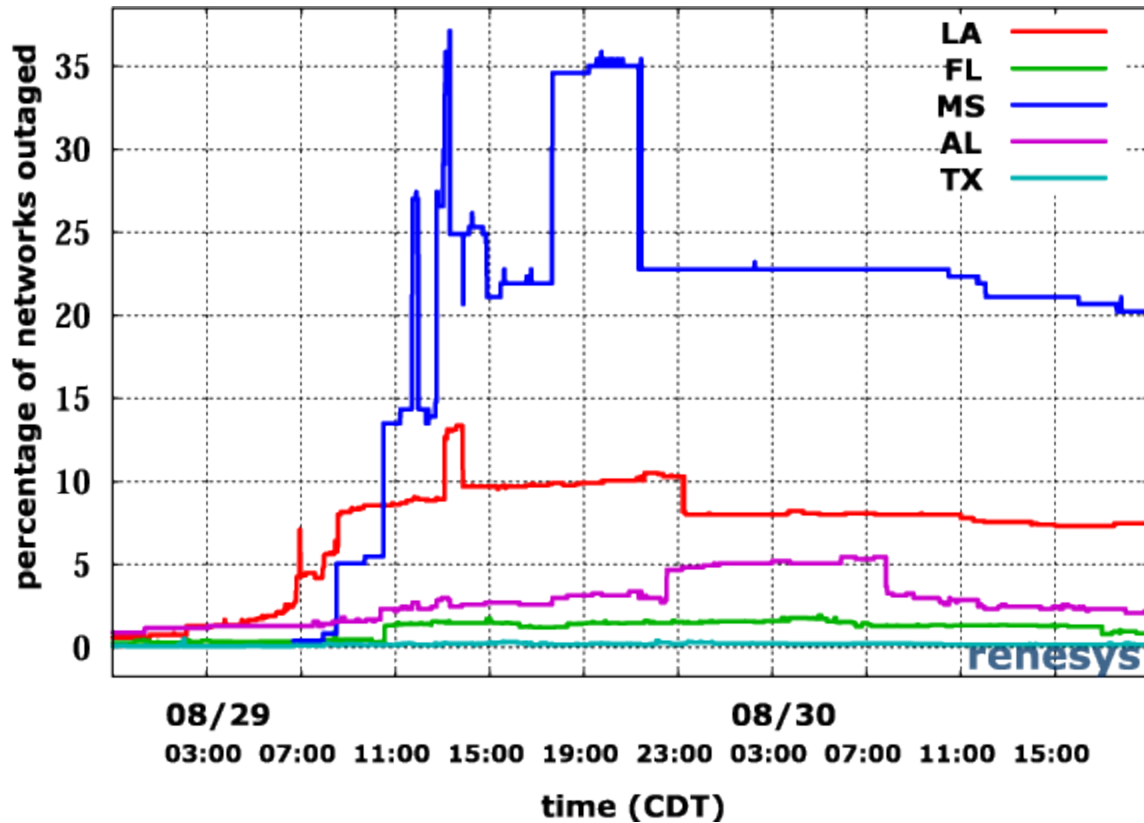
The US Gulf Coast is home to nearly ten million people, but is not historically a major crossing point for Internet infrastructure. Nonetheless, a number of organizations have large Internet data centers in the New Orleans area, including Level 3 Communications and a multi-tenant building at 650 Poydras St, formerly owned by Enron, containing multiple tenants including directnic.com, zipa.com and others.

In addition to the colocation and datacenter facilities in the area, the fiber route from Atlanta to Houston also traverses Louisiana. This route is important in the long-haul transport networks of the US and it serves as one common way to route traffic from the Southeast to the Southwest and West. Fortunately, the majority of fiber in this path does not go as far South as New Orleans, but rather travels along I-12 north of Lake Pontchartrain through Baton Rouge, or even further North than that. In many cases, fiber to and through New Orleans is either a spur from fiber through Baton Rouge, or part of an alternate path along the coast across from

Founded in 2000, Renesys Corporation provides global Internet monitoring and analysis services that allow Internet-dependent businesses to maintain secure and reliable Internet connections. The Renesys GRADUS services provide an end-to-end view of the paths through which application data flow, giving organizations unprecedented power to detect and troubleshoot performance problems that could reduce their revenue, customer satisfaction and employee productivity. Renesys's real-time monitoring services operate 24/7, can be accessed from any computer with Internet connectivity and do not require the installation or configuration of additional hardware.

Renesys Corporation's patent pending technology for monitoring global Internet routing is based on five years of pioneering research in the intricacies of global Internet routing and protocols. Renesys is a privately held company with offices in Manchester, NH, Hanover, NH and Washington, DC.

Tallahassee and Mobile. There appear to be few, or no, long-haul fiber builds that contain a single Atlanta-Houston path that traverses New Orleans. The possible exception to this is Qwest, who did see an outage on 29 Aug at approximately 10am for their Houston to Atlanta path due, reportedly, to fuel outages in the affected area.



*Illustration 1: Percentage of outaged, globally routed networks in the affected area, by state, for the 36 hours surrounding Katrina's landfall. Percentage of previously globally routed networks geolocated to each state = 100%.*

Consistent with these observations, Renesys saw no significant impacts on global Internet routing, other than the purely local losses of edge routes to networks local to the affected areas. The routes for long-haul traffic traversing the region do not seem to have been significantly affected, other than those of Internet2, who rely on Qwest as a transport provider.

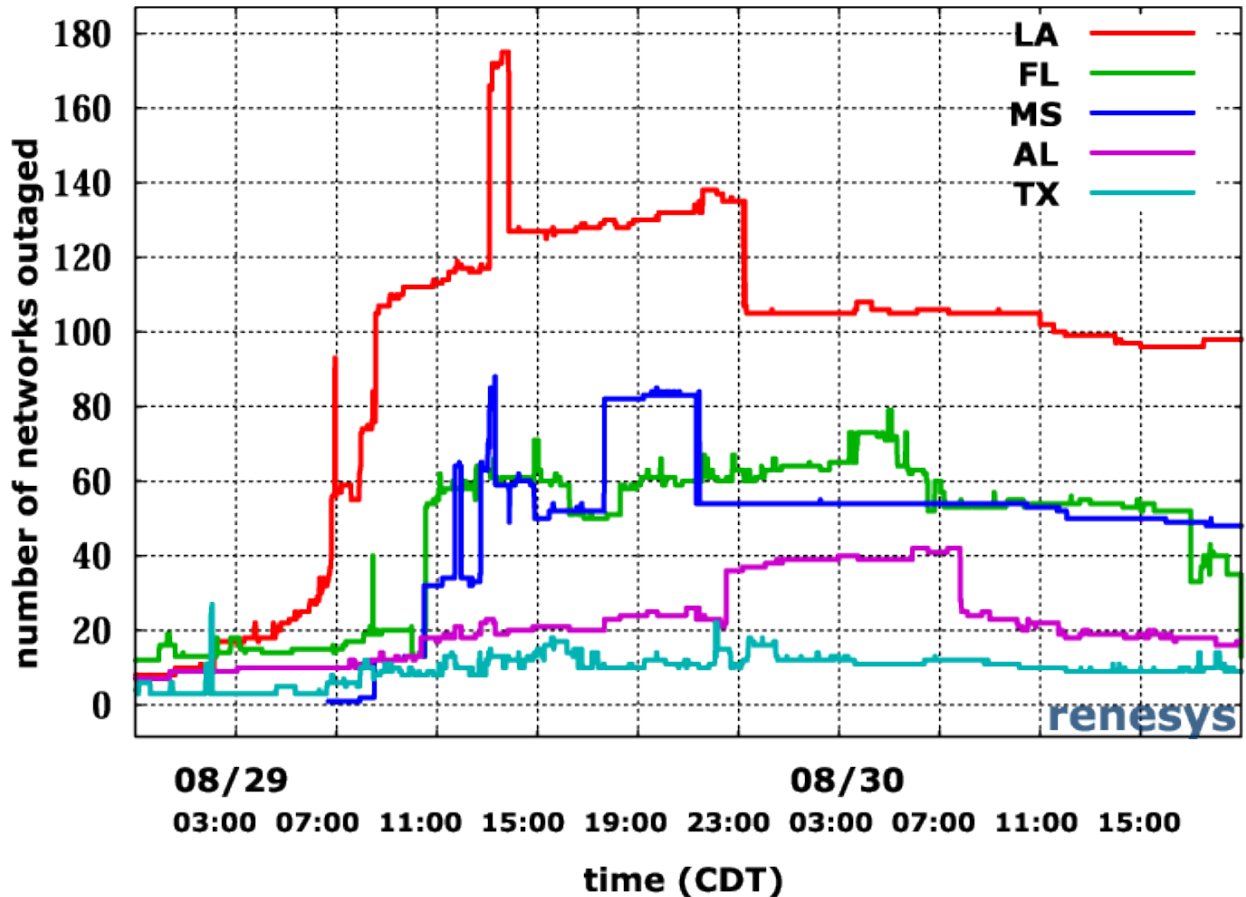


Illustration 2: Number of outaged, globally routed networks in the affected area, by state for the 36 hours surrounding Katrina's landfall.

## Regional Impacts

Local networks have, of course, been very significantly impacted. During the overnight hours of 29 August, prior to first landfall at 05h30 CDT, Louisiana networks began to suffer outages. By 10am CDT, approximately 8% of all customarily routed networks that Renesys geolocates in Louisiana were experiencing some form of outage. That number did not decline substantially after an initial period of recovery (see accompanying chart, and further information in the Recovery section below).

Mississippi networks were affected somewhat later, with first outages appearing around 8am CDT on 29 August (second landfall at approximately 10am, on the Louisiana border). The total number of networks affected in Mississippi was lower, but represented a higher percentage of the state's overall Internet presence - approximately a third of Mississippi's customarily routable netblocks were outaged at the storm's peak. Recovery has been very slow, and approximately 20% of

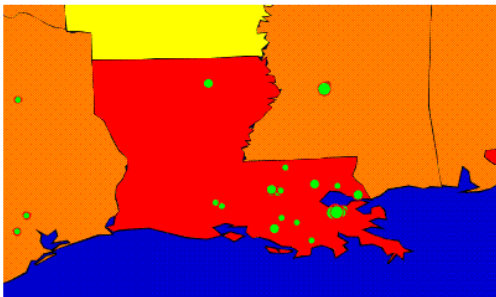
Mississippi's netblocks were still outaged 72 hours after the landfall. Between 5 and 10% of Mississippi's netblocks were still outaged 10 days after the landfall.

## Recovery

A substantial number of the networks that were outaged as part of the Katrina aftermath recovered relatively quickly, with many seeing restored service during the night and many more by the following morning. By morning on the 30<sup>th</sup> August, hundreds of networks that were unreachable overnight saw restored service. In some cases, this was due to restored service by local providers.

### Louisiana Report: Network Outages over the past 2 hours

19:23:36 UTC 08 Sep 2005



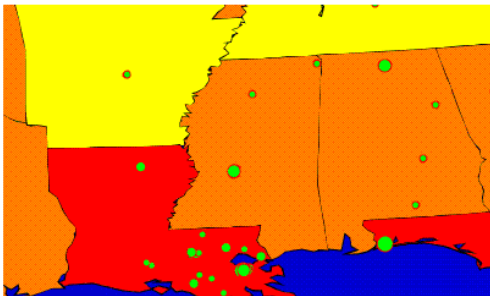
Country	Network	State	Zip
USA	BELLWETHER TECH CORP LA 70113 (12.152.100.0/23)	LA	70113
USA	BELLWETHER TECH CORP LA 70113 (12.152.102.0/23)	LA	70113
USA	BELLWETHER TECH CORP LA 70113 (12.152.104.0/23)	LA	70113
USA	Datacom LA 70583 (12.166.205.0/24)	LA	70583
USA	Datacom LA 70583 (12.166.206.0/24)	LA	70583
USA	McDermott International Inc LA 70112 (131.184.0.0/16)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.13.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.147.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.180.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.184.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.78.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.93.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.95.0/24)	LA	70112
USA	McDermott International Inc LA 70112 (131.184.96.0/24)	LA	70112
USA	Comcast CSB LLC LA 70113 (67.20.160.0/16)	LA	70113

Illustration 3: Map and partial listing of outaged networks that geolocate to Louisiana as of September 8. Corresponding maps for Alabama, Mississippi and Florida follow.

In other cases this was due to moving network service to other providers. For example, 63.106.38.0/24, which was previously advertised by Orthodontic Centers of America, AS30652, reappeared as advertised by IBM Business Recovery Service, AS12169. It is surprising to note how few of the networks in the region saw any service restored through disaster recovery services such as this.

### Mississippi Report: Network Outages over the past 2 hours

19:33:53 UTC 08 Sep 2005

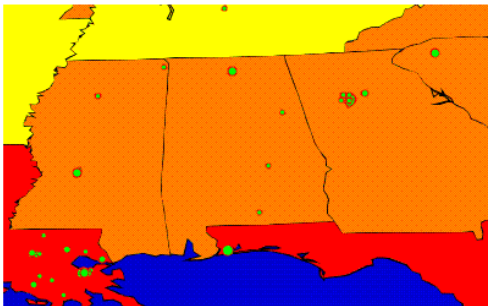


Country	Network	State	Zip
USA	CommuniGroup of Jackson MS 39201 (65.183.96.0/20)	MS	39201
USA	WATER VALLEY INTERCHANGE MS 38965 (64.49.18.0/24)	MS	38965
USA	TriState Education initiative MS 38852-4375 (192.149.138.0/24)	MS	38852-4375
USA	Arch Communications MS 39157 (208.251.18.0/24)	MS	39157
USA	AIR2LAN Inc MS 39216 (216.212.214.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.215.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.216.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.217.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.218.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.219.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.220.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.221.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.222.0/24)	MS	39216
USA	AIR2LAN Inc MS 39216 (216.212.223.0/24)	MS	39216

However, maps and lists on this page indicate that the recovery quickly stalled. These data, current as of the issuing of this report, demonstrate that network outages continue throughout the region. Although hundreds of networks saw service restored, well over 134 networks in the Louisiana, Mississippi and Alabama remain unreachable.

**Alabama Report: Network Outages over the past 2 hours**

19:27:30 UTC 08 Sep 2005



Country	Network	State	Zip
USA	National Aeronautics and Space Administration AL 35812 (131.110.0.0/16)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (192.112.4.0/24)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (192.112.5.0/24)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (192.112.6.0/24)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (192.112.7.0/24)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (192.58.26.0/24)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (198.119.128.0/19)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (198.119.160.0/20)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (198.119.176.0/20)	AL	35812
USA	National Aeronautics and Space Administration AL 35812 (198.119.177.0/24)	AL	35812
USA	USAF HQ ACCSCSTD AL 36114 (198.218.10.0/24)	AL	36114
USA	ALAWEB Internet Services AL 36420 (208.162.57.0/24)	AL	36420
USA	ITCDeltaCom AL 36207 (209.168.179.0/24)	AL	36207

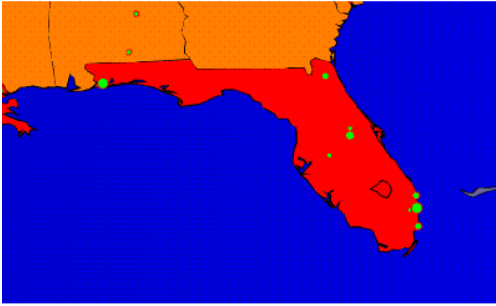
Louisiana still has over 100 networks that were previously globally reachable that have not reappeared on the Internet since Katrina struck. Mississippi and Alabama both fared somewhat better, but each still has over a dozen previously connected networks that are currently unreachable. (See graphs below. Slightly lower numbers on graph are due to only charting networks that were affected in the immediate aftermath of Katrina. Networks that were outaged for the first time after midnight CDT on August 30 are not graphed).

The picture for Florida is complicated by network outages from other parts of the state for unrelated causes. Nevertheless, Florida still has several dozen outaged networks that appear to be in the affected region (Pensacola, in particular). Notable groups of networks currently outaged, as of the issuing of this report, include:

- National Aeronautics and Space Administration (NASA) networks in AL
- Network Telephone Company in Pensacola, FL
- Air2LAN wireless service provider in MS
- Over 100 networks in LA, including networks belonging to McDermott International, Louisiana Department of Health and Hospitals, Petroleum Communications, CenturyTel Internet Holdings, infinity Data Systems, Cox Business Service

## Florida Report: Network Outages over the past 2 hours

19:28:08 UTC 08 Sep 2005



Country	Network	State	Zip
USA	Priority Networks FL 33139 (63.239.4.0/24)	FL	33139
USA	Priority Networks FL 33139 (63.239.2.0/24)	FL	33139
USA	Network Telephone Corporation FL 32501 (216.107.64.0/23)	FL	32501
USA	Network Telephone Corporation FL 32501 (216.83.226.0/24)	FL	32501
USA	AT&T ITS FL 32746 (192.128.135.0/24)	FL	32746
USA	Digital Systems Management FL 33803 (192.138.187.0/24)	FL	33803
USA	AMNET US FL 33065 (205.211.207.0/24)	FL	33065
USA	AMNET US FL 33065 (209.124.96.0/19)	FL	33065
USA	Network Telephone Corporation FL 32501 (209.159.32.0/22)	FL	32501
USA	Network Telephone Corporation FL 32501 (209.159.36.0/22)	FL	32501
USA	Network Telephone Corporation FL 32501 (209.159.40.0/22)	FL	32501
USA	Network Telephone Corporation FL 32501 (209.159.48.0/21)	FL	32501
USA	Network Telephone Corporation FL 32501 (209.159.56.0/21)	FL	32501
USA	Network Telephone Corporation FL 32501 (216.107.100.0/23)	FL	32501
USA	Network Telephone Corporation FL 32501 (216.107.106.0/23)	FL	32501
USA	Network Telephone Corporation FL 32501 (216.107.108.0/23)	FL	32501
USA	Network Telephone Corporation FL 32501 (216.107.110.0/23)	FL	32501

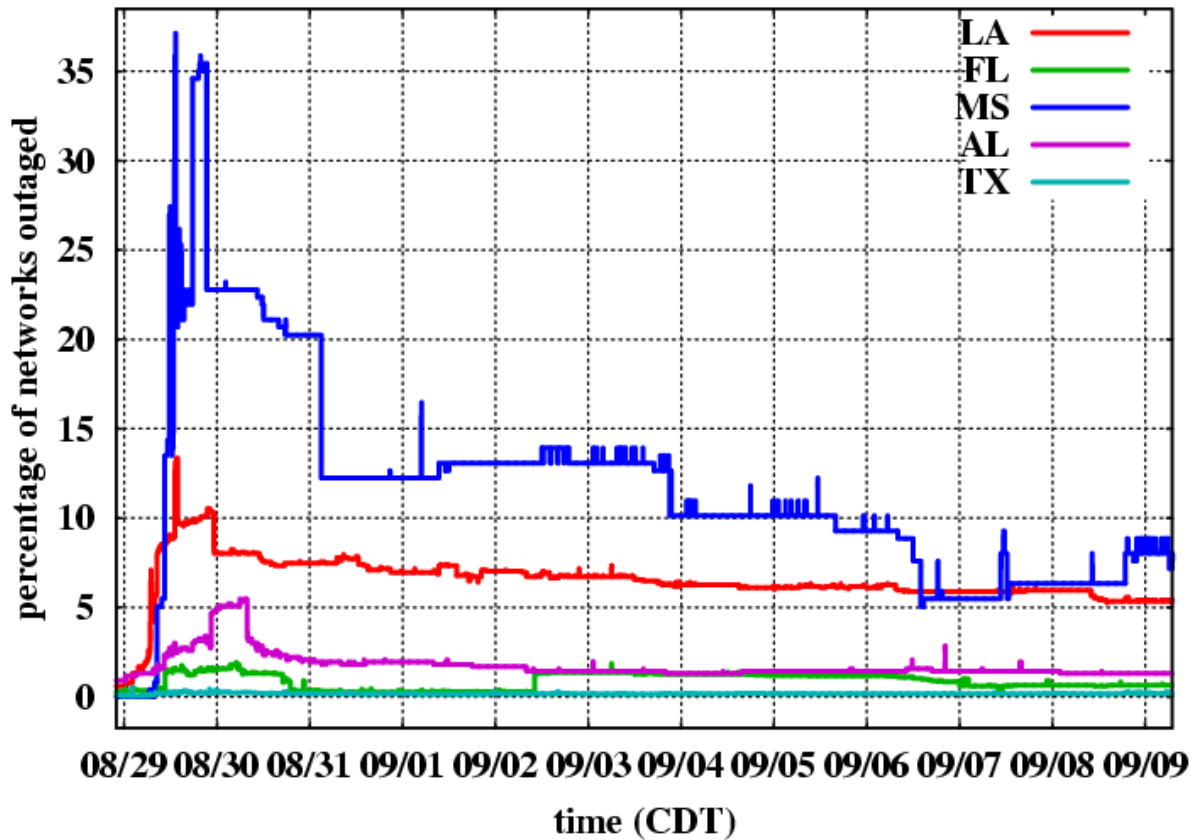
## Summary

Recovery efforts continue, but obviously, with a significant portion of the city of New Orleans under water and without reliable power or transportation, many Louisiana-based outages will not be fixed for the foreseeable future.

Both Louisiana and Mississippi suffered a significant loss of Internet access during the hours following Katrina's landfall. Alabama and Florida were also affected measurably, though to much lesser degrees. The routing recovery process has been very slow, and even after the routes reappear in global tables, traffic to and from these networks will certainly be significantly below normal for weeks or months due to continuing power outages at the edge network locations.

Some degree of additional route instability is to be expected in the region as the process of restoring service gets underway. However, these effects will affect geographically well-localized routes similar to those impacted during Katrina's landfall, and at this time Renesys does not anticipate additional impacts on domestic or global Internet routing outside the Gulf Coast region due to this event. Unlike the northeastern blackout of 2003, or Manhattan outages of September 11, 2001, there did not appear to be significant delayed instability as the result of generator failure or fuel exhaustion. With the exception of Network Telephone Company in Pensacola, for the most part outages occurred early and remained.

Network services for many were restored quickly after the event, but many networks in the affected region, especially those in Louisiana, have been unreachable for a prolonged period of time. These networks may not see service restored for some time to come, unless they can be brought back online at disaster recovery sites outside of the region.

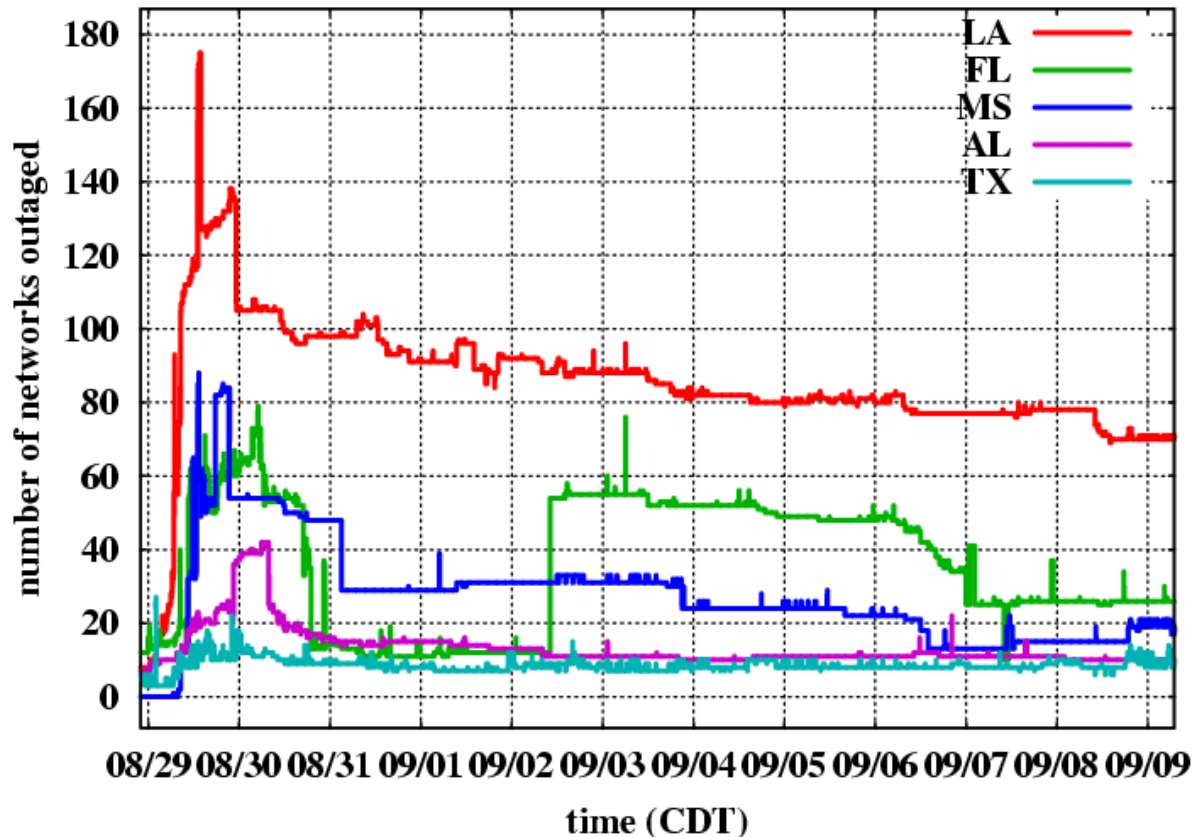


*Illustration 4: Percentage of outaged, globally routed networks by state in the affected region over the entire 10-day period since Katrina's landfall. Note the early recovery followed by extended outages, especially in Louisiana and Mississippi.*

## Methodology and Limitations

Renesys correlates Internet data from a large number of diverse global sources in order to develop a consensus view of the impact of any event on Internet routing. By interpreting this global consensus view with geographic information derived from registry and DNS information, we can distinguish purely local effects, such as the loss of individual networks in a region, from more global effects, such as the loss of an entire path or set of paths. Geolocation, the process of assigning a single location to each routable network, is an inherently imperfect task, as a typical network in the global routing table may contain hundreds, thousands, or even tens of thousands of IP addresses. A large network routed through Baton Rouge whose service footprint covers Louisiana may never actually leave the global routing table, even though service to customers in New Orleans and surrounding parishes may be severely disrupted. Another network may simply be registered in Virginia, but deployed in Louisiana. In general, geolocation challenges result in undercounts of local effects, and overcounts of global effects. We have worked to minimize these

impacts, but outaged network counts in each region should be interpreted as lower bounds on the total number of local enduser networks that are being affected.



*Illustration 5: Number of outaged, globally routed networks by state in the affected region. Note the sharp uptick in outages in Florida four days after Katrina's landfall. This is Network Telephone Company in Pensacola, who were outaged during the initial event, restored service and then appeared to experience another outage on Sept 2.*

## References/Further Reading

[http://www.renesys.com/resource\\_library/blackout\\_results.html](http://www.renesys.com/resource_library/blackout_results.html) Compare this event to the 2003 power blackout in the Northeastern US.

<http://www.directnic.com/katrina.php> and <http://mgno.com/> DirectNIC, a New Orleans-based DNS and hosting company, provided a play-by-play of their (ultimately successful) attempts to maintain service during the outage.

<http://katrina.cnt.org/wordpress/> Emergency wireless communications effort by volunteers.

<http://www.nytimes.com/2005/09/06/business/06telecom.html> Bellsouth to face \$400m-600m in damages

[http://www.boingboing.net/2005/09/04/katrina\\_impact\\_on\\_ab.html](http://www.boingboing.net/2005/09/04/katrina_impact_on_ab.html) Qwest fiber  
outage hits Internet2. And  
<http://www.indiana.edu/~ovpit/presentations/icitp/img025.gif> which is the  
corresponding Qwest fiber map.