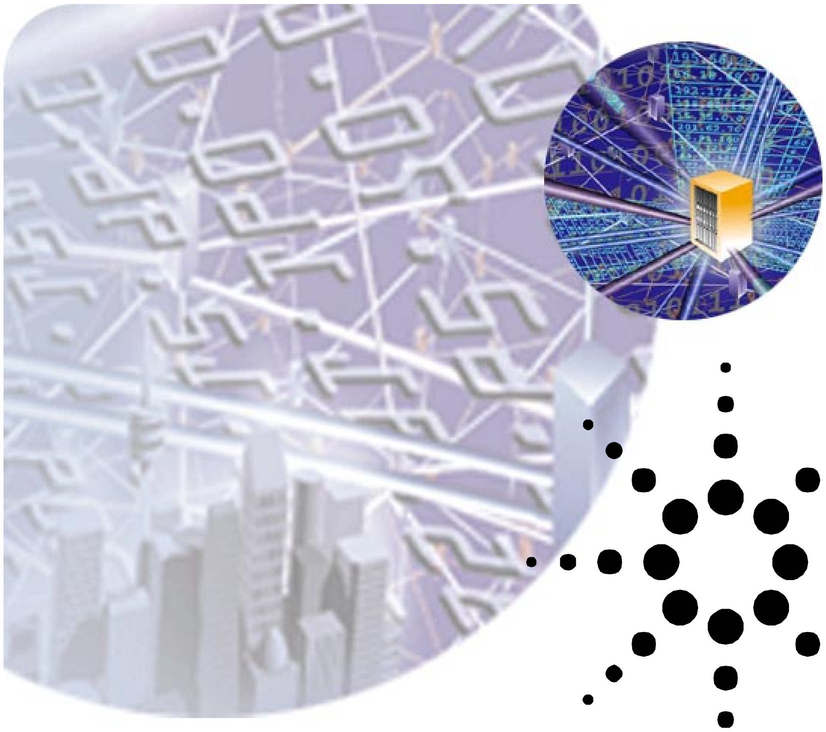


What is Routing Instability?

Agilent Technologies RouterTester Application Note

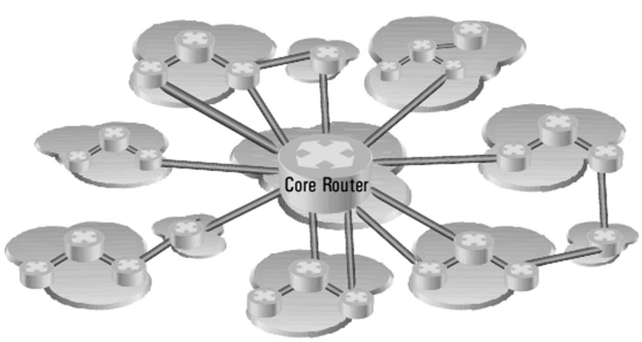


Figure 1: BGP peering sessions

Introduction

Routing instability refers to the rapid change of network reachability and topology information, and results in a large number of routing updates that are passed to the core Internet routers. Peer border routers at the boundary of each autonomous system (AS) exchange reachability information to destination IP address blocks using the Border Gateway Protocol (BGP-4). Backbone routers at public exchange points commonly have thirty or more external (interdomain) peers. Routing information shared between BGP peers occurs in two forms: advertisements and withdrawals. A route advertisement indicates that a router has either learned of a new reachable network, or has made a policy decision to prefer a new route to a particular network destination. Route withdrawals are sent when a router determines that a network is no longer reachable through the previously advertised next hop interface.

Routing tables within core Internet routers currently contain upwards of 80,000 routes. Adding to this complexity, routers in the Internet core exchange a total of between three and six million routing prefixes each day, and a single BGP update typically contains multiple route advertisements and withdrawals. As illustrated in Figure 1, routers experience a wide fluctuation of active

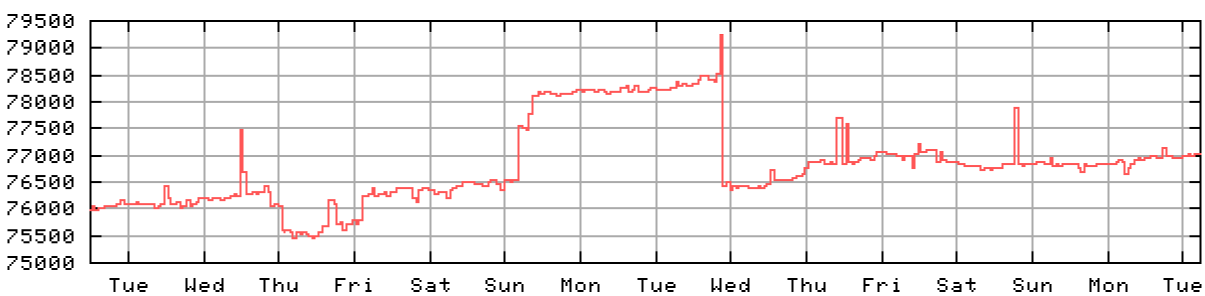
BGP addresses, and the flow of routing update information tends to be extremely bursty. Core Internet routers have been known to receive bursts of route updates at rates exceeding several hundred prefix announcements per second. In fact, data has shown that on at least one occasion, the total number of updates exchanged at the Internet core exceeded 30 million per day!* High levels of routing instability places a larger demand on a router's CPU, and can frequently lead to problems in memory consumption and queuing of packet processing. The frequency and size of BGP routing updates can consume a significant amount of resources within the router, causing increasing levels of packet loss and delay.

A carrier-class router must be able to forward traffic at wire speed, while managing topology changes to routes not currently in use. Determining the routing stability of a core Internet router involves measuring the impact of the routing updates on the forwarding performance of the router. A well-behaved router should not penalize traffic intended for stable routes in the presence of a number of unstable routes. The forwarding ability of the router should be tested under two dimensions:

- the number of peer sessions in use
- the number of route changes processed per unit of time

Testing Routing Stability Using Using RouterTester

The objective of this test scenario is to measure the effect of routing fluctuations on the forwarding performance of the router. To place stress on the routing table and processing capabilities of the router under test, routing traffic is generated into the same interfaces as traffic currently transiting the router. During traffic generation, a group of routes are advertised and withdrawn at a specified rate. These routes do not overlap with any routes being used in the forwarding data, and therefore do not affect the forwarding decision of the router. Because the goal is to measure the impact of the routing updates on the forwarding performance of the router, a baseline measurement (i.e. stable routing table) should first be attained so that relative performance metrics can be achieved.



Source: http://www.telstra.net/ops/bgptable.html

Figure 2: Fluctuation of active BGP addresses within one AS over 14 days

* Note: Labovitz, Craig, Robert Malaan, and Farnam Jahanian (1998), "Internet Routing Instability", IEEE/ACM Transactions on Networking (Oct), vol 6, no. 5, 515-528.

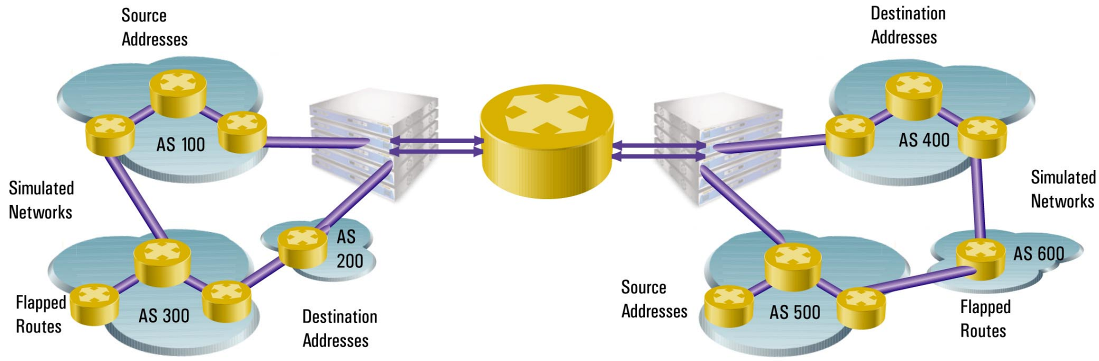


Figure 3: Routing instability

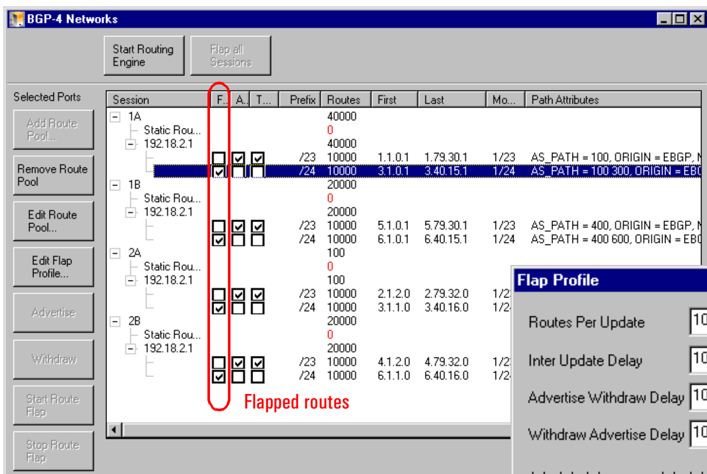


Figure 4: Route pools

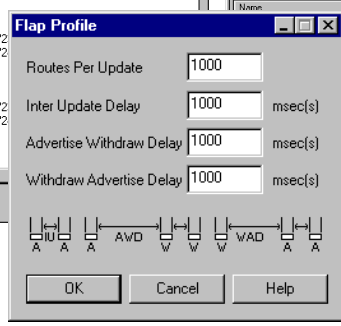


Figure 5: Flap profile

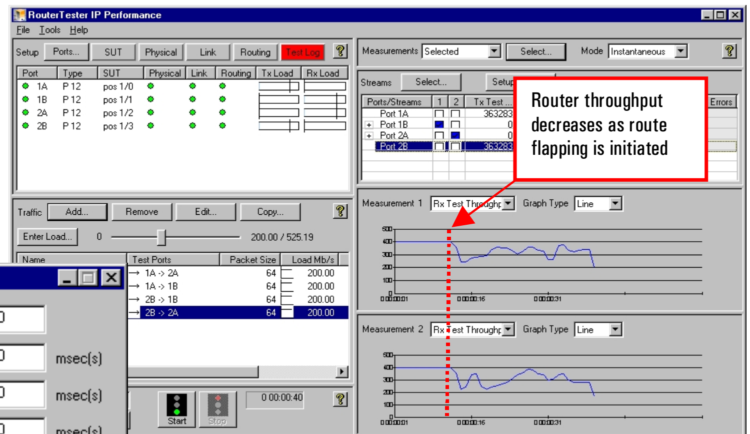


Figure 6: Performance measurements

Basic test steps

- From each test port on RouterTester, BGP-4 is used to advertise the reachable simulated networks behind each interface on the router under test. The router under test subsequently adds these routes to its routing and forwarding tables.
- Traffic streams (originating from networks in AS 100 and 500) are configured to be generated through the router under test. Destination addresses (in AS 200 and 400) are selected so as to exercise a given number of routes with a given prefix length distribution (eg. 10,000).
- As shown in Figure 4, a specific set of routes (in AS 300 and 600) are configured to be flapped during traffic generation. The unstable routes do not overlap with those routes over which data will be forwarded. As shown in Figure 5, 1000 routes per second will advertised, then withdrawn, during consecutive 10 second intervals.
- The pre-configured traffic streams are then generated through the router under test.
- Performance metrics for the test streams are measured in real-time to determine baseline statistics for the router.
- Route flapping is then initiated.
- As shown in Figure 6, as the routing processor in the router under test is bombarded by the routing updates, the effect of this routing instability on the forwarding performance of the router is measured in real-time.
- By varying the number of peering sessions in use and number of route changes processed per unit of time, the router's performance capabilities and limitations amidst topology instabilities can be determined.

Agilent Technologies RouterTester

RouterTester provides true Internet-scale testing through realistic routing protocol support, multi-stream wire-speed traffic generation and real-time analysis, and multi-port scalability. RouterTester is set to grow as the testing needs of the carrier class router industry evolve to meet the challenges of scale and Quality of Service within the Internet.

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