Optimized access to the Public Internet

The Public Internet is a largely unmanaged collection of interconnected networks with each backbone network owner managing its own connectivity and capacity individually. The original design requirement, recalling its origins in defense research, was for a highly resilient and robust network. That led to the development of the routing methodology for the IP packets, which is based on the shortest path between the origin and destination gateways. However, this is a logical “shortest” path rather than anything distance-related because it is calculated by the routers by assessing the number of networks between their location and the required destination server. This routing protocol (known as Border Gateway Protocol or BGP) is utterly indifferent to congestion, packet loss or latency. It assumes that the higher level applications will take care of these issues by resending packets as necessary. However, real-time applications such as voice suffer significantly if packet loss starts to rise above very low levels, latency increases or excessive jitter is present.

A superior approach to IP routing across the Public Internet is to develop a method of measuring the packet loss, latency and jitter to each distant gateway on the internet across multiple Tier 1 backbones. The system then creates an IP routing plan which over-rides normal BGP routing to use the best performing path rather than the shortest path. The measurements are repeated continually and the routing modified as required to provide the best available performance to that distant gateway. In effect, the system can identify and choose the best performing backbone for each distant server in the Internet and modify that choice as performance conditions change.

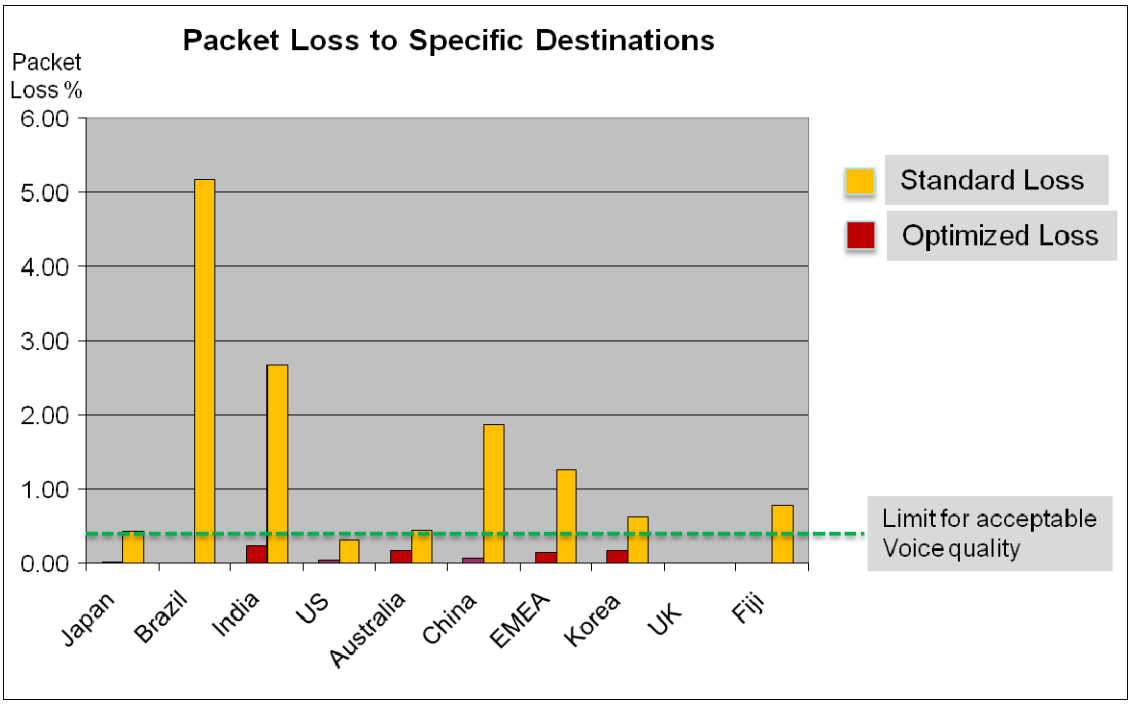
Arbinet developed such a system back in 2005, and after a recent major upgrade in functionality, organized extensive tests of the system from London, using eight Tier 1 backbones, and compared the optimized path with the normal routing path. The tests showed a significant 88% reduction in packet loss across the whole internet routing table as summarized in the table below. It should be noted that the traditional routing performance was itself measured over those eight backbones – a far better performance than would be seen if the more typical situation of enterprise or operator access to only one or two backbones had been used. The Arbinet algorithms used were set to optimize for packet loss as the highest priority with jitter and latency as second and third level priorities respectively.

	Traditional Internet Routing	Optimized Internet Routing	Difference in Performance
Packet loss	1.27%	0.14%	88% reduction
Round-Trip-Time	191.21ms	162.38ms	15% reduction
Jitter	13.21ms	2.99ms	77% reduction
Throughput	0.383 Mbit/s	1.618 Mbit/s	300% improvement

As can be seen, there are improvements in all key measures of quality, and a significant improvement in throughput of the connections. This is as a result of fewer re-transmissions of lost packets.

Although the service improvements across the entire Internet are significant, they hide even greater improvements to certain destinations where the normal routing chooses a path that is heavily congested, and stays with that path consistently. The Optimized solution identifies the packet loss and selects and routes via a better performing path to the country or region. This is shown in the following chart that

shows the packet loss for a range of destinations using both the normal routing and the optimization techniques.



Impact on Voice over IP (VoIP)

As an indication of the impact on real-time services such as voice calls, it is possible to calculate the Mean Opinion Score (MOS) for a typical call, by analysis of packet loss, latency and jitter. This score is a subjective measure of audio quality, and a good quality long distance call is normally judged by listeners as having a score of 4.0 or above. Using these measurements, the MOS score for a typical voice over IP call can be calculated as:

- Normal BGP Routing – MOS Score = 3.69 (Adequate voice quality)
- OptimizedIP Routing – MOS Score = 4.06 (Good voice quality)

As mentioned before, this is across the whole internet – certain destinations had very high packet loss using traditional routing (up to 8%) which would have resulted in voice calls that were almost unintelligible. Optimization techniques brought these destinations up to the standard required.

OptimizedIP[SM]

OptimizedIP [SM] is a part of the core routing technology used by Arbinet as it routes VoIP traffic for leading carriers and network operators across the globe. The OptimizedIP [SM] solution is available as part of the Arbinet suite of data and voice products and services, both as a standalone application for integration into a provider's own IP infrastructure and as a quality optimized Internet service in London, New York, Los Angeles and Hong Kong.