I. INTRODUCTION

Routing overlays have the potential to circumvent Internet pathologies to construct faster and more reliable paths. However, they have yet to become ubiquitous because they do not incorporate mechanisms for finding and negotiating with mutually advantageous peers: nodes in the overlay that can benefit equally from each other. Surprisingly, mutually-advantageous peers exist in the Internet and can support a latency-reducing overlay. To find these mutually advantageous peers, we exploit the embedding error in network coordinates. The short "detour" paths and the surprisingly long pathological paths in the Internet are not well captured by coordinates because these edges violate the triangle inequality. By remembering these edges with high embedding error, nodes can discover helpful peers.

Internet coordinates like GNP and Vivaldi give each host a coordinate so that the distance between coordinates predicts the latency between hosts. Coordinate systems use metric spaces, where the triangle inequality (AB+BC≥AC) cannot be violated. However, the policies and pathologies of Internet routing permit such violations, leading to embedding error.

In this project, we investigated the quality of alternate paths over the default path in the Internet. In the first part of the work we made various comparisons in between the optimal and default paths. The fraction of alternate paths which performed better than the default path or worse than the default path were studied and a cumulative distribution function was plotted. Next, we investigated the distribution of additional number of hops in the alternate path. Here, hops means hops on the imaginary overlay network involving only the nodes in the data set. It is presented in form of a histogram. We found that (according to the data set provided) most of the lower latency paths have an additional hop count of 4. Next we studied only one hop detour paths and compared them with the optimal and the default paths. The intention was to study how closely the one-hop detour paths performed with respect to them. In the second part of the project we studied the effect of BGP policies in Internet routing. We have analyzed whether such violations could be the reasons why better paths are not chosen. The data set we used for these measurement studies are taken from [1-2].

The rest of the report is organized as follows. In Section II, we present the study of default versus alternate paths in the given data set. In Section III we discuss the effect of BGP policies on choosing optimal routing paths. We conclude in Section IV.

II. STUDY OF DEFAULT AND ALTERNATE PATHS IN THE INTERNET

This section describes the optimality of alternate paths and its comparison with default paths.

A. Latency Comparison of Default and Alternate Paths

In this subsection, we find out of ratio and difference of the default and optimal alternate path and plot its CDF with the fraction of such paths.
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According to our observation, about 97% of the paths had an alternate optimal path. This value is quite interesting as the given data is concerned. It shows that only 3% of the default paths in the internet are optimal. The rest 97% of the paths have a can be improved by taking into account additional hops. These additional hops decrease the latency compared to the default path. A similar study is presented in [3].

B. Additional hops in Optimal Routing Path

In this subsection we analyzed the distribution of the number of additional hops in the optimal path. We observed that majority of the alternate optimal paths required three additional hops. In the bar chart in Figure 4, 1 means a direct link, 2 means a single hop detour and so on.

Here too as we found that the number of default paths which is already optimal is just more than 3%. Here we show the distribution of the rest 97% which we stated in the previous subsection. One hop-detour is about 14%, two hop detours are about 23% and it is maximum at the 3 hop detours, about 27%. The data is represented by the histogram below.

C. One Hop Detour Paths

In this subsection we tried to find the sub-optimal routing paths by rerouting through only one hop alternate paths. We analyzed the CDF of ratio between one hop detours with optimal and default routes. Obviously, the ratio is higher in case of default paths compared to the optimal paths.

III. EFFECT OF BGP POLICIES IN INTERNET ROUTING

In this sub-section we concentrate on BGP routing policies. We focused mainly on the scenarios where BGP does not take the optimal routing paths. For such cases we analyzed whether the alternate paths are valid according to the peer relationship policies of BGP. As a major chunk of one-hop detour paths is invalid, this is one of the main reasons for BGP choosing sub optimal paths for routing. There is also a fraction...
of paths which is unknown because of lack of data in the data set.

Figure 6: The Pie chart shows the distribution of the given dataset; where about 34% data had missing default path data. Among the rest 66%, about 90% paths could be bettered by a 1 hop detour.

Among the paths we saw betterment in terms of latency; we studied how many of them actually followed BGP policies. This is interesting as from this study we can see how much of the optimal paths in the internet are restricted simply due to complex BGP policies.

Number of paths among the above following BGP policies is about 47%. So in 47% cases, the one-hop detour paths were complying BGP policies. The rest 53% even though they did not comply with BGP rules, but they improved path latency over the default paths.

Figure 7: Histogram showing division of the paths following or violating BGP policies.

IV. CONCLUSION

Thus in brief we looked at the anomalies caused in route selection in the internet. In most of the cases as we saw the default path selected in the Internet did not perform better that alternate optimal paths that were possible to build. For example more than 90% paths could be bettered by taking alternative detours, for the given dataset. We looked both at multihop alternate paths and single hop alternate paths. Then we considered BGP policies and how it affected choosing better paths in the Internet. We saw in 53% cases we could have built a better path than the default path but the BGP policies were restricting them.

REFERENCES