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A DESIGNING OF STABLE ROUTE SELECTION FOR DISTRIBUTED SYSTEMS USING BGP

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Abstract --- Border Gateway Protocol (BGP) is currently the only inter-domain routing protocol deployed in the Internet. Route instability is an important contributor to data plane unreliability on the Internet and also incurs load on the control plane of routers. In this paper analysis how route selection schemes can avoid these changes in routes. Modifying route selection provides a better tradeoff between stability, deviation from operators preferred routes, and availability of routes. We also propose a new approach, Stable Route Selection (SRS), which uses flexibility in route selection to improve stability without sacrificing the availability and with the controlled amount of deviation. By minimizing the packet loss, delay and route overhead we can improve the stability of the routes .SRS is a promising approach to safely stabilize route selection.
Keywords — SRS (Stable Route Selection), Routing protocol, Autonomous system, Convergence overhead, Internet, BGP (Broader Gateway Protocol).

I. INTRODUCTION

The Internet is a global, decentralized network comprised of many smaller interconnected networks. Networks are largely comprised of end systems, referred to as hosts, and intermediate systems, called routers. Information travels through a network on one of many paths, which are selected through a routing process. Routing protocols communicate reachability information and ultimately perform path selection. A network under the administrative control of a single organization is called an autonomous system (AS). The process of routing within an AS is called intra domain routing, and routing between ASes is called inter domain routing. The dominant inter domain routing protocol on the Internet is the Border Gateway Protocol (BGP).

BGP has been deployed since the commercialization of the Internet. BGP generally works well in practice, and its operational simplicity and resilience have enabled it to play a fundamental role within the global Internet, despite providing no performance or security guarantees. Unfortunately, the limited guarantees provided by BGP sometimes contribute to serious instabilities and outages. While many routing failures have limited impact and scope; others may lead to significant and widespread damage. As a result, most Internet traffic was routed to this small Internet Service Provider (ISP).

The main mechanism for improving stability in BGP is route flap damping (RFD), which filters routes that have a short-term update rate above some threshold. Unfortunately, this seemingly simple strategy creates two serious problems. RFD creates pathological conditions that slow convergence. RFD also worsens availability—the fraction of time that a router has a route to a destination—by occasionally shutting off all available routes. The goal of this paper is a principled evaluation of the design space of stabilizing BGP by modifying route selection.

II. PRELIMINARIES

This paper proposes a new technology Stable Route Selection (SRS), is a new approach to stabilizing BGP that improves the stability by reducing delay, Packet loss, route overhead without risk of reducing availability.

A. *Border Gateway Protocol:*

Broader gateway protocol (BGP) is currently the only internet routing protocol used to maintain connectivity between autonomous systems. The protocol is often classified as a path vector protocol, but is sometimes also classed as a distance-vector routing protocol. The Border Gateway Protocol makes routing decisions based on paths, network policies or rule-sets configured by a network administrator, and are involved in making core routing decisions. BGP may be used for routing within an AS. In this application it is referred to as Interior Border Gateway Protocol, Internal BGP or iBGP. In contrast, the Internet application of the protocol may be referred to as Exterior Border Gateway Protocol, External BGP or EBGP.

B. *Process of BGP:*

The operation of BGP router is simple. For each destination it learns advertised routes from its neighbors. It selects one such a route to use according to their root selection policy as well as its own local destination to other neighbors. For our assumption, we select one node as a destination *d*. A route is specified as a sequence along path to *d*. Each router *r* at any given time has selected either one route to *d*. At any moment in time, each link in the network is either up or down .Over time, link states change or routers may respond by changing their selected routes and passing messages between neighbors. This process consist of two important constraints one is the message propagation and routing decision take a negligible amount of time relative to a time between a link state changes this condition is called batching. Second condition is path consistency. At a given moment if for each router r_1 that has currently selected some path $r_1 \ldots\ldots r_k$, the path passes several “sanity checks” indicating that it is actually a valid path.

- All links in the path are currently up (i.e., not failed).
- The neighboring router has selected the same path, i.e., $r_2 \ldots\ldots r_k$,
- r_2 is currently advertising this route to .
- r_k is the destination d .

We require that path consistency holds at any time, except during convergence events. Any classic path vector routing Protocol, BGP included, will converge to path consistency. There are three main advantage is interruption rate, deviation, availability. An interruption is the event that the path selected by some AS changes. Availability is defined as a particular source-destination pair as the fraction of time that the source has a route to a destination. Deviation measures the extent to which a particular route selection strategy differs from an operator preferred paths.

C. Steps to Stabilize BGP:

Steps to reducing interruption rate relative to standard BGP.

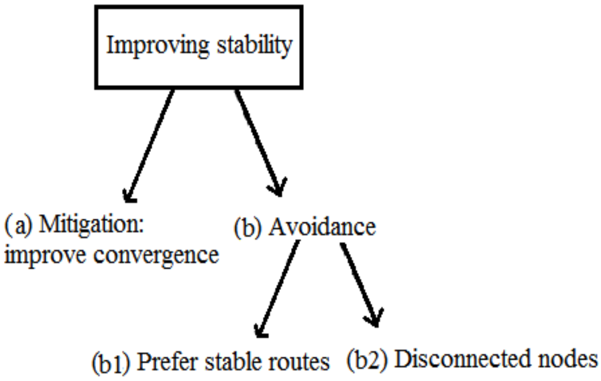

Fig. 1 Steps to Stabilize BGP

There are two cases (a) Policy changes by improving the re-convergence process, (b) Avoiding re convergence event. Within the avoidance approach there are two approaches: (b1) Select a stable path (i.e.) it fails less often, (b2) selecting no path that are disconnected from source to destination. These three approaches require qualitatively different sacrifices ranging from free to severe. Approach (a) is the most attractive because it improves stability without compromising other objectives. The two remaining approaches directly imply tradeoffs: (b1) results in nonzero deviation, and (b2) is an extreme approach that sacrifices availability. In the limit, a network where all nodes are disconnected has no interruptions, but also has zero availability. Note that (b2) is not equivalent to RFD's strategy of shutting off (damping) unstable routes. Damping a route causes BGP to select another route, as long as an alternate undamped route is available. They characterize the tradeoff spaces places limits on what can and cannot be accomplished with these three approaches.

III. STABLE ROUTE SELECTION

Stable route selection avoids instability by using flexibility in route selection to select more stable routes. Initially, paths that have been stable recently are likely to be stable in future. SRS gives tunable weight to paths recent stability as part of the BGP decision process thus gives a tradeoff between stability and amount of deviation from preferred paths.

A. Fitting SRS in to BGP:

BGP's *decision process* allows operators to customize route selection to conform to goals such as traffic engineering or economic relationships. The BGP decision process consists of the sequence of steps shown in Table I, which select a route based on *attributes* contained in the BGP route announcements.

Step	Action
1.	Highest local preference
2.	Lowest AS path length
3.	Lowest origin type
4.	Lowest MED
5.	eBGP over iBGP-learned
6.	Lowest IGP cost
7.	Lowest router ID

Table.1 BGP decision process

The output of each step is a *set* of routes that are equally good according to that and every previous step. By adding, modifying, or filtering attributes in update messages, operators can control the specific route selected to reach a particular destination. We insert the SRS heuristic as an additional step between Steps 1 and 2 of the BGP decision process. SRS selects the best route based on a combination of Steps 2–7 and a heuristic for predicting route stability. An alternate design would have placed SRS before the first step, like flap damping. We chose to place SRS after the Local Preference step to ensure that the highest-level routing preferences, such as preferring customer routes over provider routes, are always maintained, even during SRS's delay period. This has at least two benefits. First, it provides a useful guarantee to operators. Second, it is possible for a violation of the Local Preference step to reduce availability for other ASs. In particular, ASs typically has business relationships with other ASs classified as providers, customers, or peers; a route advertised by a provider or peer is exported only to customers. If an AS were to select a provider route over a customer route, it would block the export of the route to other providers and peers, potentially disconnecting them from the destination. Although this case may be uncommon, it is our primary concern to ensure high availability. Despite the restrictions imposed on SRS by being subordinate to Local Preferences, in our simulations, sufficient flexibility remains to significantly improve stability.

B. *Interaction With iBGP:*

iBGP differs from eBGP in that it lacks general-purpose loop detection. This causes an unfortunate interaction with choosing routes based on timing. Because routers within an AS will receive announcements at slightly different times, if iBGP routes were chosen in a way dependent on timing, they may select different best paths, potentially causing forwarding loops. SRS could adopt a similar approach, but this limits its choice of available routes. An alternative is that instead of placing SRS after local preference in the decision process, it can be implemented by adjusting local preference values .Assuming some separation between local preference values used by the operator, SRS can still respect the operator's values by making adjustments only at a finer granularity. The single router within an AS that receives a route via eBGP would adjust the local preference value, and then propagate the route into iBGP. Other routers within the AS would select routes based on the local preference value rather than directly applying SRS. This implementation approach has the advantages of: 1) converging to a consistent route selection decision, thus avoiding forwarding loops; and 2) forcing propagation into iBGP of some routes that are preferred by SRS but might otherwise be suppressed.

C. SRS Heuristic:

The SRS heuristic is inserted between Steps 1 and 2 of the BGP decision process (Table I). The heuristic has one main Parameter, a delay δ. We will write SRS (δ) to indicate the value; SRS with the parameter omitted refers to SRS (δ). SRS uses a procedure, pref(p_1,p_2) , that implements Steps 2–7 in Table I. pref(p_1,p_2) returns "first" if path is more preferred according to Steps 2–7, "second" if is more preferred, or "equal" if they are equally preferred. SRS then decides which of two paths (p_1,p_2) should be selected as follows.

1) If p_1 has been up for time $\geq \delta$ and pref(p_1,p_2) = "first", then select p_1 .
2) Otherwise, if p_2 has been up for time $\geq \delta$ and pref(p_1,p_2) "second", then select p_2 .
3) Otherwise, if one of p1and p2 is currently selected, keep that route.
4) Otherwise, if one of p1and p2 has lower AS path length, select that route.
5) Otherwise, select the route that has been up for the longest time.

The intuition behind this choice of steps is as follows. Steps 1 and 2 select preferred routes, as long as they are not recent advertisements. This step assumes that recently advertised routes are more likely to be withdrawn soon and provides a tradeoff in the parameter δ. SRS(0) is equivalent to the decision procedure , while SRS(∞)gives no consideration to preferred routes, reserving maximum flexibility for stability. The strategy of sticking with the current choice (Step 3) and then using a "longest uptime" strategy if that choice fails (Step 5) has been used in many contexts from page replacement to peer-to-peer systems and is a good heuristic for stability since past behavior is frequently correlated with future behavior . The shortest-path step (Step 4) is useful to limit path length when running SRS(∞) , but is less important when $\delta < \infty$ since this strategy eventually returns to the most preferred routes that are presumably reasonably short. In simulations, we found that inserting Step 4 for SRS (∞) slightly improved stability as well.

IV. MODULES

In the proposed method our modules are classified in to network formation, path consistency, path selection and SRS with BGP

A. Network formation:

The simulation is done in ns2 simulator on Linux machine. Because, it focuses on the link stability and route lifetime, no route overhead was considered in simulation. In 3000 X 500 m^2 area, mobile nodes exist. System used square area to increase average hop length of a route with relatively small nodes. Every mobile node is moving based on mobility data files that were generated by mobility generator module. The transmission range is fixed at 250 units. 20 nodes of them have destinations and try finding routes to their destination nodes. Maximum speed of node is set to 10 m/sec. All nodes do not stop moving, and the simulation time is 500 sec. The number of nodes is varying from 50 to 150 and six road side unit.

B. Path consistency:

The second condition we impose is path consistency. We say paths are consistent at a given moment if for each router r1 that has currently selected some path r1, . . . , rk, the following are true: (1) all links (ri, ri+1) are up, (2) r2 selected the path r2, . . . , rk and is advertising this path to v1, and (3) the ultimate node rk is the destination D. We require that path consistency holds at any time, except during 3 convergence batches. Modulo timing differences, any classic path vector routing protocol, BGP included, attempts to satisfy path consistency.

C. *Path selection:*

We introduce mechanisms for path selection when the energy of the sensors in original primary path has dropped below a certain level. This allows us to distribute energy consumption more evenly among the sensor nodes in the network. Number of hope counts is also identified by using this method. The Energy Efficiency of the individual node is increased by this path selection method.

D. SRS with BGP:

BGP's decision process allows operators to customize route selection to conform to goals such as traffic engineering or economic relationships. Select a route based on attributes contained in the BGP route announcements. The output of each step is a set of routes that are equally good according to that and every previous step. By adding, modifying, or filtering attributes in update messages, operators can control the specific route selected to reach a particular destination.

V. SIMULATION RESULTS AND DISCUSSION

This section presents the results of our simulation. We are using NS-2 simulator for simulation. Improvements to convergence cannot obtain a large improvement in our environment. This conclusion is surprisingly robust under various message propagation delay distributions, but convergence overhead can be larger due to policy misconfiguration and withdrawals by origin Ass. SRS only slightly increases mean path length, and stability-aware routing can obtain significant improvements in stability even under limited deployment scenarios. Our simulations showed that a single AS deploying the protocol could obtain a mean of 1.8X reduction in interruption rate for itself. This improved roughly linearly with the fraction of ASs running the stable route selection protocol, until the full 5X reduction in the interruption rates is obtained with full deployment.

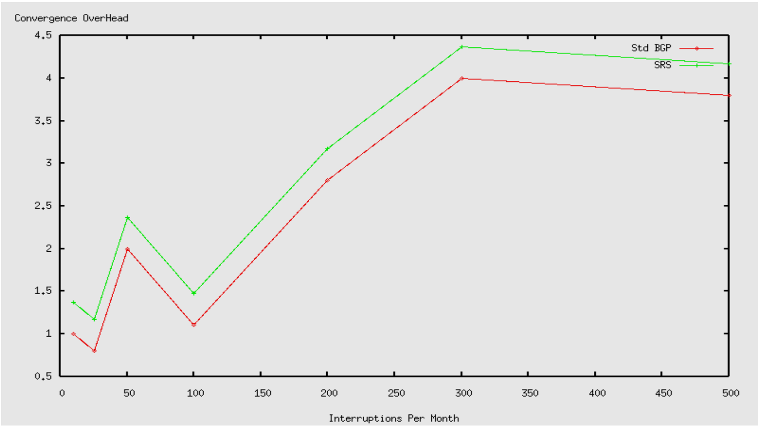

Fig.2: Convergence Overhead

Fig.2 shows the interruption rate of standard BGP and SRS along with their convergence – which transition from the initial to the final path in each path in each batch without any path exploration process. Fig. 3 shows the increasing the delay of links, or the heterogeneity of delays across links, has been associated with worsening of routing convergence times. We found that increasing link delays increases convergence time. However, varying the variance of links, and varying the mean delay of links, only changed convergence overhead slightly.

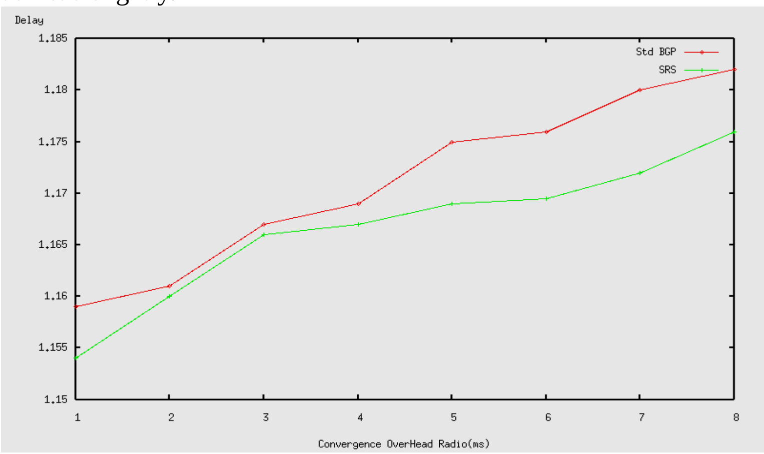

Fig.3: Link Delay

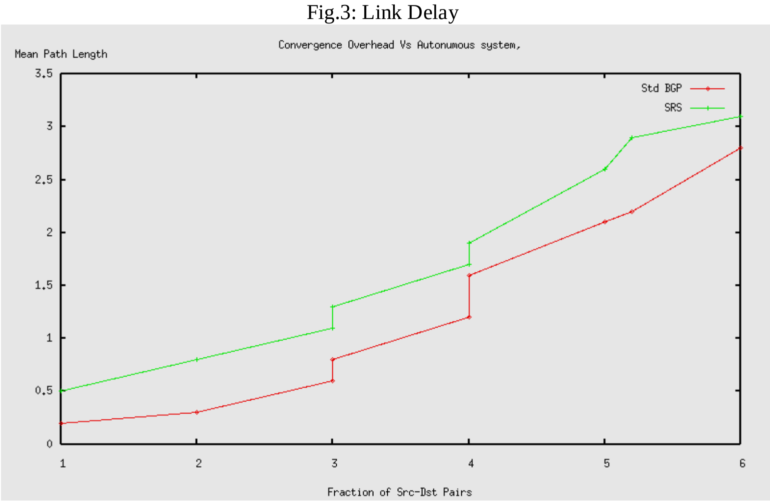

Fig.4: Path length

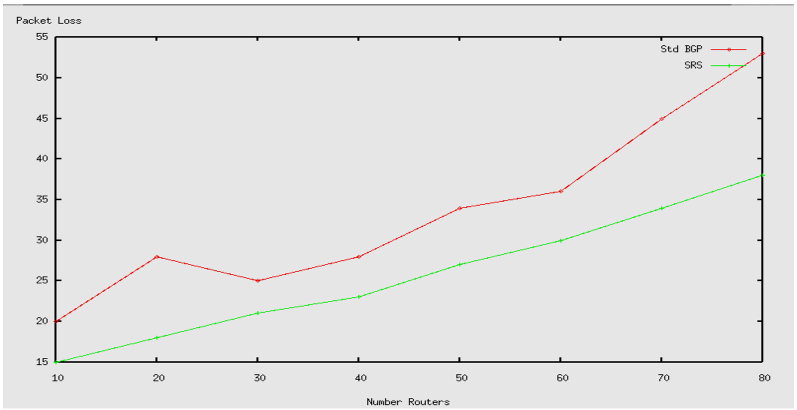

Fig.5: Packet loss

Fig.4 shows the path length path lengths in this environment are constrained by the hierarchical nature of the AS graph when business relationships are satisfied: We found that a hypothetical strategy that always preferred longest paths would have mean path length just 32% longer than Standard BGP. Fig.5 shows Packet loss is typically caused by network congestion. When content arrives for a sustained period at a given router or network segment at a rate greater than it is possible to send through, then there is no other option than to drop packets. if we reduce the packet loss we can achieve a better stability performance.

VI. CONCLUSION

We conclude that in this paper we introduce a technique for improving stability in BGP. The main contribution was the design and evaluation of Stable Route Selection scheme. Stable Route Selection (SRS) approach that has the goal of safely stabilizing routing: Unlike RFD, it does not reduce availability. Instead, SRS uses flexibility in route selection to prefer more stable paths, causing some deviation from operators' preferred routes, but returning to those preferred routes quickly after periods of instability. Experimental and large-scale simulation results show that SRS achieves a significant improvement in control-plane overhead and data-plane reliability with only a small deviation from preferred routes.

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