IDR WG
IETF 102

Susan Hares and John Scudder
IDR Co-chairs

Jie Dong (WG Secretary)
Note Well

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  • BCP 9 (Internet Standards Process)
  • BCP 25 (Working Group processes)
  • BCP 25 (Anti-Harassment Procedures)
  • BCP 54 (Code of Conduct)
  • BCP 78 (Copyright)
  • BCP 79 (Patents, Participation)
  • https://www.ietf.org/privacy-policy/ (Privacy Policy)
Thursday (18:10-19:10pm)

0) Agenda bashing (5)

1) Update on merger of RLP and eOTC drafts for route leaks solution [Kotikalapudi Sriram] (8)
   draft-ietf-idr-route-leak-detection-mitigation (solution)/
   draft-sriram-idr-route-leak-solution-discussion-00 (design discussion)

2) BGP Model for Service Provider Networks [Keyur Patel] (8)
   draft-ietf-idr-bgp-model/

3) BGP Extra Extended Community [Jakob Heitz] (8)
   draft-heitz-idr-extra-extended-community/

4) BGP Neighbor Autodiscovery [Ketan Talaulikar] (8)

5) Requirements for BGP Neighbor Autodiscovery (15)
   [Randy Bush] provides LSVR [8]
   Discussion [7]
Route leaks solution

• Open questions about semantics, syntax
• Semantics - Space/Information Trade-off
  – Design A – Design option A
  – Design B – Design Option B
  – Sriram’s talk. Chairs believe we are close.
• Syntax – Attribute or Community?
  – Option 1: Proceed with Attribute Approach
  – Option 2: Use (Large) Community Approach
  – Needs development.
Autodiscovery

• Multiple proposals in multiple groups
  – Overlapping functionality
  – Ranging from minimal to maximal

• Clear to chairs that
  – The WG has great interest in the topic
  – There is no consensus on the requirements

• Ideally chairs would have prepared a full comparison of all proposals
  – It’s an imperfect world, we’re going with what we have today
  – Possible interim
BGP Data Model

• NMDA is requirement for all new Models
  – draft-idr-bgp-model-03.txt – is NMDA
  – Replaces the old model
• Going to WG LC at end of today’s meeting
• Original draft
  – Authors may publish as historical work product, but little interest
Session II: Friday, 11:50-13:20, 7/20/2018

- 0) Agenda bashing and Chair's slides (10)

- 1) LOCAL_PREF Overloaded = Overwritten [Alexander Azimov] (5)

  2) Updates to BGP Signaled SR Policies [Dhanendra Jain] (8)
  draft-ietf-idr-segment-routing-te-policy

- 3) YANG data model for BGP Segment Routing Extensions [Dhanendra Jain] (8)
  draft-dhjain-spring-bgp-sr-yang

- 4) BGP-LS Extend for Inter-AS Topology Retrieval [Aijun Wang] (10)
  draft-wang-idr-bgpls-inter-as-topology-ext

- 5) Distribution of Traffic Engineering (TE) Policies and State using BGP-LS
  [Ketan Talaulikar] (10)
  draft-ietf-idr-te-lsp-distribution
Session II: Friday, 11:50-13:20, 7/20/2018

6) Flexible Algorithm Definition Advertisement with BGP Link-State
   [Ketan Talaulikar] (5)
   draft-ketant-idr-bgp-ls-flex-algo

   BGP Link-State Extensions for Seamless BFD [Ketan Talaulikar]
   draft-li-idr-bgp-ls-sbfd-extensions/

7) Applying BGP flowspec rules on a specific interface set [Jeff Haas] (5)
   draft-ietf-idr-flowspec-interfaceset/

8) Segment Routing Policies for Path Segment and Bi-directional Path [Cheng Li] (15)
   draft-li-idr-sr-policy-path-segment-distribution/

   SR Policies for Path Segment and Bi-directional Path in BGP-LS [Cheng Li]
   draft-li-idr-bgp-ls-sr-policy-path-segment/

9) BGP-LS Extensions for Advertising Path MTU [Zhibo Hu] (10)
   draft-zhu-idr-bgp-ls-path-mtu/
See you at IETF 103
Route Leaks Solution
Merger of RLP and eOTC Drafts

ietf-idr-route-leak-detection-mitigation-09


IDR Working Group Meeting, IETF-102
July 2018

Acknowledgements: The authors are grateful to many folks in various IETF WGs for commenting, critiquing, and offering very helpful suggestions (see acknowledgements section in the draft.)
Draft Merger Efforts

• Authors from the two drafts met in Chicago (March 2017) and in London (March 2018)
• Support and encouragement from IDR Chairs John and Sue, and Ignas
• Productive authors’ meeting in London (IETF 101) followed by substantial discussions via email
• Authors happy to report on convergence to a merged solution and draft
Merged Solution and Design Discussion Drafts

- Merged Solution:

- Design Discussion:
**Format of RLP Attribute**

Optional Transitive Attribute

---

**Design A**
*(original RLP)*

<table>
<thead>
<tr>
<th>ASN: N</th>
<th>RLP: N</th>
</tr>
</thead>
</table>

---

**Most Recently Added**

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**Design B**

<table>
<thead>
<tr>
<th>ASN: N</th>
</tr>
</thead>
</table>

---

**Most Recently Added**

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<table>
<thead>
<tr>
<th>ASN: 2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ASN: 1</th>
</tr>
</thead>
</table>

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**Least Recently Added**

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- **eOTC**: Design B with only one ASN in the attribute is the original eOTC

---

**UP**: RLP = 0  **DOWN/LATERAL**: RLP = 1
## Comparison / Tradeoffs

<table>
<thead>
<tr>
<th></th>
<th>Design A (Original RLP)</th>
<th>Design B</th>
<th>Original eOTC (Design B with only one ASN)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functionality</strong></td>
<td>Detect multiple leaks</td>
<td>Detect multiple leaks</td>
<td>Can’t detect multiple leaks</td>
</tr>
<tr>
<td></td>
<td>Provide up link info also</td>
<td>Only down/peer info</td>
<td>Lack of differentiation in some cases</td>
</tr>
<tr>
<td><strong>Detection / mitigation strength</strong></td>
<td>Best</td>
<td>Very good</td>
<td>See above</td>
</tr>
<tr>
<td><em><em>Memory use</em> (per update)</em>*</td>
<td>~ 136 bytes</td>
<td>~ 72 bytes</td>
<td>~ 32 bytes</td>
</tr>
</tbody>
</table>

* *Assume average 4 hop AS path*
Design B: Example

Propagates a customer-learned "leaked" route to avoid unreachability.

Leaks a peer route; or

Propagates a customer-learned route to avoid unreachability.

AS7 sees a choice between update with one distant RLP violation vs. update with two closer RLP violations and one distant.
Alexander’s scenario:
Avoid Persistent Oscillation Possibility

P1, P2 are aware of eOTC/RLP. P0, P3, P4 may or may not be.

Route 1: q {P0 X S} [S]

Route 2: q {P3 P1 P0 X S} [P3 S]

Decision Policy (Algorithm):
• Route 1 clearly violated [S].
• Based on the route-leak detection theorem, violation of [S] applies to Route 2 also.
• [P3] in Route 2 is expected (good).
• Given both routes are in violation of the same RLP, P2 prefers the customer route.

(There is stable convergence.)
Examine Provider Route vis-à-vis Customer’s

• If customer route is a leak, and alternative route via provider includes the customer AS in the path, then prioritize customer route over the provider route.

* Stated simply here. See formal statement and explanation in the drafts.
Next Steps

• Request WG feedback on Design A vs. Design B

  ➢ How much utility for the additional information in the RLP attribute in Design A?
    o Indicating when update is sent to transit provider

• Request WG feedback on Attribute vs. Community

• Prepare a finalized version for WGLC
Backup slides
The only possible way that \([X]\) is not violated in \(r_2\) is if the path from \(B\) to \(C\) consists of C2P links only. But that would violate the “No cycle of customer-provider relationships” requirement [Gao-Rexford].
Route-Leak Detection Theorem

The “Gao-Rexford” Stability Conditions


• Topology condition (acyclic)
  – No cycle of customer-provider relationships

Route-Leak Detection Theorem: Let it be given that ISP A receives a route r1 from customer AS C and another route r2 from provider AS B (for the same prefix), and both routes r1 and r2 contain AS C and AS X in the path and also contain [X] in their RLP/eOTC. Then, clearly r1 is in violation of [X]. It follows that r2 is also necessarily in violation of [X].

Proof: Let us suppose that r2 is not in violation of [X]. That implies that r2’s path from C to B to A included only P2C links. That would mean that there is a cycle of customer-provider relationships involving the ASes in the AS path in r2. However, any such cycle is ruled out in practice as a necessary stability condition [Gao-Rexford]. QED.
**Route-Leak Mitigation Rules**

**Rule 1:** If ISP A receives a route r1 from customer AS C and another route r2 from provider (or peer) AS B (for the same prefix), and both routes r1 and r2 contain AS C and AS X (any X not equal to C) in the path and also contain [X] in their RLP, then prioritize the customer (AS C) route over the provider (or peer) route.
(Rationale: This rule is based on the theorem (slide 8). See detailed rationale in Section 3.1 in [1].)

**Rule 2:** If ISP A receives a route r1 from peer AS C and another route r2 from provider AS B (for the same prefix), and both routes r1 and r2 contain AS C and AS X (any X not equal to C) in the path and also contain [X] in their RLP, then prioritize the peer (AS C) route over the provider (AS B) route.
(Rationale: See illustration below. See detailed rationale in Section 3.1 in [1].)

Illustration of Rule 2

Default Route-Leak Mitigation Policy

• Given a choice between a customer route versus a provider (or peer) route,
  ▪ if no route leak is detected in the customer route, then prioritize the customer over the provider (or peer);
  ▪ else (i.e., when route leak is detected in the customer route) and the conditions of Rule 1 apply, then too prioritize the customer over the provider (or peer);
  ▪ else (i.e., when route leak is detected in the customer route and the conditions of Rule 1 DO NOT apply), then prioritize the provider (or peer) over the customer.

• Given a choice between a peer route versus a provider route*,
  ▪ if no route leak is detected in the peer route, then prioritize the peer over the provider;
  ▪ else (i.e., when route leak is detected in the peer route) and the conditions of Rule 2 apply, then too prioritize the peer over the provider;
  ▪ else (i.e., when route leak is detected in the peer route and the conditions of Rule 2 DO NOT apply), then prioritize the provider over the peer.

* Operator MAY override (the second bullet) to prefer provider route over peer route.
Examples Showing Policy in Action (1 of 2)

Scenario 1
- Preferred route: q {4 3 2 1}

Scenario 2
- Preferred route: q {5 3 2 1}

Scenario 3
- Preferred route: q {4 3 2 1}

Legend:
- **Green** – not violation
- **Red** – violation
- **Purple** – can’t tell

AS does not participate in RLP and/or Propagates a route that violates RLP.
Examples Showing Policy in Action (2 of 2)

Scenario 4

Legend:

Green – not violation
Red – violation
Purple – can’t tell

AS does not participate in RLP and/or Propagates a route that violates RLP

Preferred route: q \{4 3 2 1\}
(Rules 1 and 2 not applicable)

n

q

1

[1]

2

[1]

3

[3 1]

4

[4 3 1]

5

[4 3 1]

6

Preferred route: q \{4 3 2 1\}
(Rules 1 and 2 not applicable)

Legend:

Green – not violation
Red – violation
Purple – can’t tell

AS does not participate in RLP and/or Propagates a route that violates RLP

Preferred route: q \{4 3 2 1\}
(Rules 1 and 2 not applicable)

Legend:

Green – not violation
Red – violation
Purple – can’t tell

AS does not participate in RLP and/or Propagates a route that violates RLP

Preferred route: q \{4 3 2 1\}
(Rules 1 and 2 not applicable)
Design A – RLP Attribute

- Insert $<\text{ASN}, 1>$ if sending to Customer or Peer
- else, insert $<\text{ASN}, 0>$
Design B – RLP Attribute

- Insert <ASN> if sending to Customer or Peer
- else, insert nothing

- AS1
  - P1 originated by AS1
  - RLP = <AS1>
  - RLP = <AS1> → AS4
  - RLP = <AS1> → AS3 (C2P)
  - AS3 detects leak; prefers alternate path

- AS2
  - AS2 leaks it
  - RLP = <AS1> (P1)

- AS3
  - RLP = <AS4> <AS1>

- AS4
  - p2p
  - RLP = <AS4> <AS1>

Route Leak Detected/ Mitigated 😊
BGP Yang Model
draft-ietf-idr-bgp-model

Keyur Patel
Mahesh Jethanandani
Susan Hares
Status

- BGP Yang Model is now NMDA compatible
- Removed dependencies on OpenConfig models
IETF NMDA

- RFC 8342
  + --config
    | rw mtu (intended datastore)
    | r  mtu (in operational state datastore)
Extensions

• Provide extensions for additional features
  – In draft-keyuupdate-bgp-extensions-00
  – BGP signaled VPLS
  – BGP EVPN
  – options for L2VPN address families
Next Step

• WGLC
Feedback and questions
eXtra eXtended Community (XXC)

• Why Extended Community?
  • Easier to enhance than to invent brand new.

• 24 octets. Why fixed length?
  • Easier to enhance Extended Community code.

• Why bigger?
  • Easier to auto-derive by combining multiple existing identifiers:- reduce configuration.
New Transitivity

Coarse grained, to prevent accidental distribution to the entire Internet, but still covers major use cases. Use route-policy for fine grained distribution.

- **Administration Transitive**
  - Non-Transitive, except when session is configured as “Same-Admin”

- **One Time Transitive**
  - For your neighbor only
  - Link-Bandwidth and LLGR_STALE could use this.
RT Constraint

<table>
<thead>
<tr>
<th>AFI</th>
<th>(2 octets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFI</td>
<td>(1 octets)</td>
</tr>
<tr>
<td>origin AS</td>
<td>(4 octets)</td>
</tr>
<tr>
<td>XXC value</td>
<td>(24 octets)</td>
</tr>
</tbody>
</table>

Applies to routes with only this AFI/SAFI
Not necessarily a Route Target
XXC only. Not for Extended Community
XXC Types

- AS-Specific (4 octet AS only)
- IPv4-Address-Specific
- IPv6-Address-Specific
- EVPN

Type/sub-type copied from Extended communities.
Just a suggestion. Can structure it differently.
Sub-Type not optional, unlike in RFC 4360.
EVPN XXC Sub-Types

- EVI Route Target
- ES-Import Route Target
- ESI-EVI Route Target
- Overlay Route Target

New size allows the use of the complete Ethernet Tag ID and ESI.

The new EVPN Route Targets are to be used in addition to the existing Route Targets, not as a replacement.
draft-xu-idr-neighbour-autodiscovery-09

Xiaohu Xu, Chao Huang, Guixin Bao (Alibaba)
Ketan Talaulikar, Satya Mohanty (Cisco Systems)
Kunyang Bi, Shunwan Zhuang (Huawei)
Jeff Tantsura (Nuage Networks)
Nikos Triantafillis
Jinghui Liu (Ruijie Networks)
Zhichun Jiang (Tencent)
Shaowen Ma (Juniper Networks)
Problem Statement

• BGP is used as the only routing protocol in DCs using RFC7938 design

• Operational complexity involved in provisioning of hop-by-hop per link eBGP peering between BGP nodes

• When doing peering using loopbacks (e.g. due to ECMP links or when using IPv6 link-local addresses or unnumbered links) need to also provision static route for reachability
Requirements

• Need a neighbour discovery mechanism that runs on top of IPv4/IPv6
  • Is media independent; works on IPv4, IPv6 and dual stack
  • Needs to support authentication mechanism for security purposes

• Keep it simple and focus on current BGP requirements
  • We have LLDP and BFD widely deployed; leverage them
  • Make mechanism extensible for signalling of information for BGP

• Auto-discovery and bootstrap for BGP TCP Sessions between directly connected nodes

• Separate discovery and liveness for BGP neighbours
  • Discovery and maintenance of adjacency is the core part
  • Use of liveness mechanism is optional; continue to leverage BGP KA, BFD and Fast External Failover features

• Minimal changes for integration with BGP Peer FSM and no changes in BGP protocol operations
What does this draft propose?

• Automated neighbour discovery using UDP Hello Messages on a per link basis for directly connected neighbours only
• Signalling of peering address and ASN so that BGP Peering session can be automatically initiated with discovered neighbour
• BGP session can be setup using loopbacks and reachability established via peering route setup that points over the links over which neighbour is discovered
• Minimal changes to the BGP Peer FSM and no change to BGP route processing
Hello Message Format

• Uses UDP port 179 and sent to link-local multicast address
• Can be used over either IPv4 or IPv6 addresses
Important TLVs

• Peering Address TLV
  • Indicates one or more IPv4 and/or IPv6 peering address(es) to be used
  • Optionally can indicate which AFI/SAFI to be used for which Peering

• Link Attributes TLV
  • Indicates link addresses and link identifiers for describing the link endpoint (so information is learnt for exporting via BGP-LS)
  • Can perform subnet and other policy checking before session setup

• Neighbour TLV
  • Signals discovered neighbours and their adjacency status (1-way, 2-way, reject and established)
  • Used to indicate to neighbour whether the BGP TCP session can be initiated (i.e. when both sides have accepted each other)
Optional TLVs

• Local Prefix TLV
  • Indicates the prefix route to be programmed after neighbour discovery goes to 2-way state to ensure reachability for the neighbour’s peering address
  • Required when peering is to be done using loopback interface; not required when doing peering with interface addresses

• Accepted ASN TLV
  • Indicates the list of ASNs to which peering session would be established – local policy

• Cryptographic Authentication TLV
  • Carries the SA ID and authentication information
Adjacency State Machine

• Initial State
  • Initial state when a neighbour is detected

• 1-way State
  • When router accepts the peer and includes it in its own hello message

• Reject State
  • When router rejects the peer due to detection of some config mismatch or violation of local policy

• 2-way State
  • When router detects itself in the neighbour’s hello; now ready for TCP session establishment step
  • Adds peering route for the neighbour over the link (i.e. when using loopbacks for peering)
  • Creates the BGP Peer State context for discovered peer and triggers the BGP Peer FSM

• Established
  • When the BGP TCP session is established
Session Management

• Once established, session management is performed as per BGP FSM
• Liveness detection via Keepalives & Hold timer
  • BFD and Fast External Failover also works when enabled
• Established BGP session is NOT brought down due to adjacency hold timer expiry by default
  • This may be optionally enabled in cases where required
• Adjacency hold timer expiry used to clean-up BGP Peer state after the session goes down for auto-discovered peer
Peering Route

• Required only when peering is done using loopback interfaces
• Route programmed with higher Admin Distance than normal BGP routes to prevent oscillation (in case the peering route is also learnt via BGP itself)
• When there are multiple links between neighbours then peering route will have ECMP paths over each of them
• BGP NH for the neighbour resolved over this peering route for reachability
• No need for programming static route or running another protocol when doing Peering over loopback addresses
Next Steps ...

- WG adoption call ongoing in IDR
- Solicit WG review and comments/inputs/feedback
Link Discovery and Liveness

What do we really need?

Randy Bush <randy@psg.com>
Application
Presentation
Session
Transport
Network
Data Link
Physical

We Are Here
IIJ is Building a Second Medium Scale Data Center (MSDC) in Shiroi/Chiba Capacity of 6k Racks
How Can We Route In Something of This Scale?
OSPF OK to 500 Nodes
IS-IS good to 1,000

Limited Because They Repeatedly Flood Everything
Your Clos on IS-IS or OSPF
BGP Is Great as Updates are Infrequent
BGP Scales Because It Signals Only Changes

So BGP has become common in MSDCs
ECMP can be Very Wide
32, 64, even 128
The Problem is Topology Discovery
Two Kinds of Standards

**Union** – the accumulation of all the features anybody wanted

**Intersection** – only those things everybody absolutely had to have

Either Tony Hoare or Klaus Wirth – I can not find the quote <blush>
IETF asks the ITU

Q: So you add features until the “NO”s stop

A: We don’t like to think of it that way
Must Haves

• Discover Nodes and Links

• Discover Link Encapsulations:
  • IPv4, IPv6, MPLS4/6, ...

• Maintain Layer-2 Liveness

• Northbound API to BGP-SPF
Security?

• Datacenter Ops seem not to think of security at this layer (or any!)

• We need Authentication. Maybe Integrity?

• One of the things which are likely to drive PDU size over 1,500
Non-Features

• Routing Data, BGP-SPF does that

• Access to IGP Databases, This is discovery and liveness, not routing

• Just want the Link

• Transport, not our job
Desiderata

- Discovery & Liveness for BGP-SPF
- Simple but usable in Massively Scalable networks of >10,000 nodes
- May be useful for other applications
- Simple
- Extensible (e.g. authentication, cost)
- Simple
- No IPR
Why Simple?

We are here to produce easily understood, implementable, and securable standards, not build résumés.
Why Simple?

A high goal of software engineering is to remove the need for features. It's a vital part of designing for simplicity, even invisibility. -- Rob Pike
Candidates?

- LLDP and its children
- IS-IS link discovery
- Edge Control Protocol (Alvaro)
- BGP Neighbor Autodiscovery
- Link State Over Ether
LLDP

- IEEE Protocol
- IPR over 1,500 bytes
- A bit complex
- Won’t go through a switch (feature or bug?)
- Beacons, not KeepAlives
- Viable but
IS-IS Discovery

- IETF now has control
- Complex enough that BGP-LS was invented so normals could get the link state database
- IS-IS not commonly implemented on MSDC devices, so would need to profile and develop
Edge Control Protocol

• It is a transport controlled by IEEE
• A Reliable layer two transport, on top of LLC
• Has flow control, reliable, non-reorder, ... transport
• used for EVP and PD/CSP
• Reinventing TCP over 802.1
BGP Neighbor
Autodiscovery

• IETF protocol
• Very new
• Needs the peering address to get the peering address
• AS Based, can not use other idents
• Not really discovery at all, configuration
• No liveness
Link State Over Ether

- Custom made for the job
- Very bare bones, brutally simple
- Only does discovery and liveness
- New, therefore risky
- But so is BGP-SPF
- No measurement or monitoring tools
<table>
<thead>
<tr>
<th></th>
<th>LLDP</th>
<th>IS-IS</th>
<th>ECP</th>
<th>BNA</th>
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<tr>
<td><strong>Discovery</strong></td>
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Discussion