BGP Color-Aware Routing (CAR)

draft-dskc-bess-bgp-car-02

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BGP Color-Aware Routing

• Define BGP based routing solution to establish end-to-end intent-aware paths across a multi-domain network environment
  – Intent: Example – low-latency path between two PEs

• Color represents intent in signaling
  • draft-ietf-spring-segment-routing-policy
  • draft-ietf-idr-segment-routing-te-policy
• E3, C1 is a Color-Aware BGP route in underlay that provides intent-aware path to E3.
BGP CAR Overview (Refresher)

• New SAFI in BGP
  – Need ability to signal multiple instances of the same prefix for each color (i.e., intent)

• Solution draft v01 described the following aspects
  – Desired Data Model
  – Multiple encapsulations, their signaling and validation
  – Efficient and extensible NLRI
  – Handling of multiple color domains
  – Route resolution & steering mechanisms
  – Scale Analysis
CAR NLRI Proposal

- **NLRI Key – E, C**
  - E : IPv4 or IPv6 Endpoint Prefix (Network-wide Unique)
  - Color : 32-bit value (same as SR-TE Policy)

- Color distinguishes per-intent instances of same prefix
- Color also indicates intent provided by route
- Color is consistent across devices within a “color domain”
- Color is same as in BGP Color Extended-Community
CAR NLRI – E, C

• Simplest data model, precise

• Identical routing semantics as BGP IPv4/v6, BGP-LU
  – Efficient route processing, storage
  – No need for VPN import/export or RD rewrite at each underlay hop

• Inherently provides ECMP-aware/backup paths at every hop
  – Faster, localized convergence

• Most efficient for subscription
  – [E, C] direct lookup
Path Availability & Domain-local Convergence

- (E, C) NLRI provides ECMP or backup paths at each hop (single label entry)
- Localized convergence with Next-Hop Self
  - E.g., 231 failure is handled locally within domain, churn is not propagated beyond 212 and 211
- BGP ADD-PATH at T-RR for redundant path availability
Multiple Color Domains

• Network domains where color-intent mappings are different

• Local-Color-Mapping (LCM) Extended Community
  − Optional, only used if routes go across a color domain boundary
  − Color re-mapped and rewritten into receiving domain’s color at a color domain boundary
  − Color Ext-Comm sent with service routes also gets re-mapped in parallel

• CAR NLRI (E, C) is preserved e2e

• E (Prefix) is unique in inter-domain transport network (e.g., PE)
  − Makes E, C unique even if C is local to a color domain
Encapsulations

• Multiple encapsulations supported for a CAR route
  − Signaled via Non-Key TLVs
    > MPLS Label(s), Label-Index, SRv6 SID(s) etc.
  − Separate “label” values for different encapsulations
  − Beneficial for co-existence, migration & interworking
    > Efficient signaling, operational simplicity
Extensible, Future-Proof NLRI Encoding

• New SAFI allows opportunity for better NLRI design
  – No need to inherit constraints of current SAFIs, e.g., single MPLS label field in NLRI

• Encode a NLRI (Route) Type

• Encode a key length

• Encode non-key TLVs

• Variable part in NLRI; rest in Attribute
  – Provides packing efficiency for BGP updates
CAR Next-Hop Resolution

• Resolution is recursive and color-aware
  – (E, C) via (N, C)

• (N, C) provided by other color-aware mechanisms
  – SR Policy, IGP Flex-Algo, or BGP CAR itself

• Resolution may also be mapped to legacy mechanisms
  – RSVP-TE
  – IGP/LDP
  – BGP-LU
Updates (v02)

• **VPN CAR** - Extends CAR to VPN service layer
  - CE – PE BGP Color-aware routing
  - E2E encapsulation (e.g., CE – CE)

• RFC 4364 semantics
  - VPN RD, RT(s), Import/Export

• **CAR NLRI** requires new **SAFI**
  - Straightforward extension of CAR NLRI - *(RD : E, C)*
    > Where RD is regular VPN RD
  - No overloading of RD for both VPN & Color separation
VPN CAR Illustration (Simplified)
Updates (v02)

• Describe usage of Anycast SID
  – Convergence, Recursion
  – Anycast SID for transit, e.g., ABRs
  – Anycast SID for PEs (with common service labels)

• Clarify path availability & convergence
  – Covered in earlier slide

• Added J. Guichard as co-author
Next Steps

• Continue to address use-cases & requirements listed in problem statement
• Request collaboration & review from Working Group
• Problem statement drafts merge effort is ongoing