Multicast geo-distribution control
draft-rekhter-geo-distribution-control-03

Huajin Jeng, Jeffrey Haas, Yakov Rekhter, Jeffrey Zhang
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A MULTICAST CONTENT DELIVERY SERVICE MODEL

- **Content Distribution Controller (CDC)**
  - Apply content-access policy
  - Determine content delivery method (e.g. multicast vs. unicast)
- **Multicast Distribution Network Controller (MDNC)**
  - Determine, maintain, and communicate a global-view of multicast distribution access footprint
  - Maintain and distribute multicast-distribution restriction policies (stipulated by CDCs) to Multicast Edge Routers
- **Edge Routers (ERs)**
  - Network access routers of the IP Network infrastructure (R₄, R₅, R₆ in following diagrams)
  - Multicast capable Ers are responsible for enforcing multicast-distribution restriction policies
TWO PROBLEMS TO BE SOLVED

Ability of content-provider to determine content-receiver network destination areas where multicast-delivery option is available at a given current time period.

Ability of content-provider to restrict multicast delivery of a given content on a designated multicast channel (S,G) to exclude a set of content-receiver network destination areas

- This is to support compliance with geo-restriction ("black-out") requirements that frequently exist for certain categories of live-event content distribution
MULTICAST DISTRIBUTION REACHABILITY SIGNALING

Content-Server

1. Multicast Distribution Network Controller

2. MRZ={X, Y}

3. MRZ={X, Y}

Content-Server

Zone X

Zone Y

Zone Z

Content-Receive

Content-Receive

MRZ={(null)}

MRZ={X, Y}

MRZ={X, Y}

R0

R1

R2

R3

R4

R5

R6
MULTICAST DISTRIBUTION REACHABILITY CONTROL

**Content-Server**

- **MRZ=\{X, Y\}**

**Content-Distribution Controller**

- Content Source Request (C)
  - Content Source (C) = (S,G)

**Multicast Distribution Network Controller**

**Content-Server**

- **MRZ=\{X, Y\}**

**Content-Distribution Controller**

- Content Source Request (C)
  - Content Source (C) = (S,G)

**Multicast Distribution Network Controller**

**Content-Receivers**

- Zone X
- Zone Y
- Zone Z

**Content-Receivers**

- Zone X
- Zone Y
- Zone Z
MULTICAST DISTRIBUTION REACHABILITY CONTROL

Content-Server

MRZ= \{X, Y\}

Content Distribution Controller

Join (S,G)

R_0

R_1

R_2

R_3

R_4

R_5

R_6

Multicast Distribution Network Controller

Zone X

Zone Y

Zone Z

Content-Server

MRZ= \{X, Y\}

Content Distribution Controller

Join (S,G)

R_0

R_1

R_2

R_3

R_4

R_5

R_6

Multicast Distribution Network Controller

Zone X

Zone Y

Zone Z

Content-Source Request (C)

Content Source (C) = (S)

Content-Receiver

R_0

R_1

R_2

R_3

R_4

R_5

R_6

Multicast Distribution Network Controller

Zone X

Zone Y

Zone Z

Content-Receiver
MULTICAST DISTRIBUTION REACHABILITY CONTROL

Content-Server

Multicast Distribution Network Controller

Zone X

Zone Y

Zone Z

Content-Request (C)

Content (C)

MRZ = \{X, Y\}

Join (S, G)

Join (S, G)

Join (S, G)

Join (S, G)

Content-Distribution Controller

R₀

R₁

R₂

R₃

R₄

R₅

R₆
MULTICAST DISTRIBUTION REACHABILITY SIGNALING

(Refer to charts in slides #4~7)

- Each ER (R₄, R₅, R₆) is aware of the multicast reachability status for each subscriber (“content receiver”) zone (IP destination prefix) that it serves
  - It’s permissible that an ER might have a mixture of some multicast-enabled zones and some non-multicast enabled zones

1. Each ER announces (“signals”) to the MDNC its list of multicast-enabled zones

2. The MDNC maintains the list of all multicast-enabled zones in the network and announces the list to CDCs of CP/CDN customers who subscribe to content-multicast services

3. The CDC keeps this list for use in selecting content distribution method in response to requests for content it manages
MULTICAST DISTRIBUTION REACHABILITY SIGNALING

(Refer to charts in slide #4~7)

4. The CDC selects an available multicast-channel (S,G) for multicast distribution of Content C
   - In response to a request for Content C from a user in zone X which is multicast-enabled the CDC returns the multicast channel (S,G) as the “source address” for the content

5. The user issues a multicast Join (S,G) message to its serving ER $R_1$.
   - and receives a replicated multicasted copy of C from the network

6. In response to a request for Content C from a user in zone Z which is not multicast-enabled the CDC returns the unicast address S as the “source address” for the content

7. The user issues a content request to source S.
   - and receives a replicated unicasted copy of C from server S

8. 

9. 
MULTICAST DISTRIBUTION EXCLUSION SIGNALING

1. MEZ(S,G) = {Y}
2. MEZ(S,G) = {Y}
3. MEZ(S,G) = {Y}
4. MEZ(S,G) = {Y}

Content-Server

Multicast Distribution Network Controller

R0

R1

R2

R3

R4

R5

R6

Content-Server

Content-Receiver

Zone X

Zone Y

Zone Z

Content-Receiver
MULTICAST DISTRIBUTION EXCLUSION CONTROL

Content-Server

MEZ(S,G) = {Y}

Content-Distribution Controller

Join (S,G)

Content-Source Request (C)

MEZ(S,G) = {Y}

Content-Distribution Controller

Join (S,G)

Multicast Distribution Network Controller

Join (S,G)

Zone X

Zone Y

Zone Z

Content-Receiver

MEZ(S,G) = {Y}

Content-Distribution Controller

Join (S,G)

Multicast Distribution Network Controller

Join (S,G)

Zone X

Zone Y

Zone Z

Content-Receiver

MEZ(S,G) = {Y}

Content-Distribution Controller

Join (S,G)

Multicast Distribution Network Controller

Join (S,G)

Zone X

Zone Y

Zone Z

Content-Receiver
MULTICAST DISTRIBUTION EXCLUSION SIGNALING

Content-Server

Multicast Distribution Network Controller

Content-Server

Multicast Distribution Network Controller

Content-Receiver

Zone X

Zone Y

Zone Z

Content-Receiver

Zone X

Zone Y

Zone Z

Content-Receiver
MULTICAST DISTRIBUTION EXCLUSION SIGNALING

(Refer to charts in slides #10~12)

- The CDC selects an available multicast-channel (S,G) for multicast distribution of Content C
- Assuming that Content C has geo-restriction rule that excludes zone Y from receiving the Content C, the CDC links this exclusion policy to multicast channel (S,G) as long as this channel is being used to distributes C

1. The CDC announces (“signals”) the exclusion policy for (S,G) to the MDNC
2. The MDNC distributes the exclusion policy to the (multicast enabled) ERs
   - For signaling processing efficiency, the MDNC can limit the distribution of a given exclusion policy to those ERs serving the zones affected by that policy
3. ER $R_5$ which is the serving access router for zone Y records the exclusion rule for enforcement
MULTICAST DISTRIBUTION EXCLUSION SIGNALING

(Refer to charts in slides #10~12)

5. The CDC denies any request for Content C from any user in exclusion zone Y

6. ER R₅ will ignore Join (S,G) messages from any user in exclusion zone Y who attempts to access Content C by learning about (S,G) through illegitimate means and issuing an Join (S,G) message to the network

7. When multicast channel (S,G) is no longer used for C, the CDC removes the exclusion policy on (S,G), and signals to the MDNC
   - The MDNC withdraws the exclusion policy in its signaling to the (multicast enabled) ERs

8. ER R₅ which is the serving access router for zone Y removes the exclusion rule from enforcement
STATUS & REQUEST

draft-rekhter-geo-distribution-control-00 now split into the following three:

- **draft-rekhter-geo-distribution-control-03**
  - General problem & proposal description
  - Seeking Mboned review & adoption

- **draft-rekhter-mdrs-00**
  - BGP procedures with new SAFI for multicast reachability signaling
  - Seeking IDR review & adoption

- **draft-rekhter-mdcs-00**
  - BGP Flow-spec extensions for geo-restriction information signaling
  - Seeking IDR review & adoption
BACKUP SLIDES
SIGNALING MULTICAST DESTINATION REACHABILITY

What:
- Content receivers with multicast connectivity from the ER.

To Whom:
- Content Distribution Controllers (CDC)

How:
- The receivers are encoded as IP prefixes
- The prefixes are sent in BGP using the IPv4 or IPv6 AFI and a new MCAST-REACH SAFI (TBD)
- draft-rekhter-mdrs in IDR
LIMITING DISTRIBUTION OF MULTICAST REACHABILITY TO INTERESTED BGP SPEAKERS

- Only the CDCs are interested in the new MCAST-REACH reachability.
- Provisioning AFI/MCAST-REACH only sessions from each ER to each CDC does not scale well.
- Constrained Route-Target distribution (RFC 4684) is used to control distribution of MCAST-REACH destinations toward interested CDCs:
  - CDC is provisioned with a Route-Target for each AFI. The RT is not reused elsewhere.
  - CDC distributes the RT into RTC.
  - ERs attach RT to MCAST-REACH reachability.
SIGNALING MULTICAST DISTRIBUTION CONTROL IN BGP

Why:
- While the CDC can block a particular content request, a receiver may obtain enough information through other means to join the relevant multicast channel – the ERs need to be able to block the multicast join request based on geo-restrict information.

What:
- Particular multicast content as (S,G) and whether the content is included or excluded on a per-zone basis.

To Whom:
- Interested ERs
How:

- Using BGP Flow-spec (RFC 5575) encoding.
  - Source goes in source prefix, Group goes in destination prefix.
  - AFI is IPv4 or IPv6. New SAFI, MCAST-FLOWSPEC (TBD).
- Included/Excluded content for a zone is signaled with an Included Route-Target or an Excluded Route-Target for each zone.
  - Receiver ports are associated with zones.
- draft-rekhter-mdcs: IDR
**SIGNALING MULTICAST DISTRIBUTION CONTROL IN BGP**

How:

- MCAST-FLOWSPEC routes are compiled into applicable policy on the receiving router. For example, on an ER, only policy matching zones for attached ports is necessary.

- When a subscriber tries to access content from a given port (PIM or IGMP join), the MCAST-FLOWSPEC policy is. If the port’s zone matches inclusive or exclusive Route-Targets, the appropriate policy is applied and the join is either permitted or ignored.
  - A default policy of accept or reject may limit the number of routes that must be distributed.
Example policy from draft:

- Consider an ER in Manhattan that has a port that is provisioned with the following import RTs: <include-manhattan, exclude-manhattan, include-nyc, exclude-nyc, include-east, exclude-east, include-usa, exclude-usa>

- When the ER receives a Flow Spec route with <exclude-nyc, include-manhattan, include-usa> RTs, the ER first try to match "include-manhattan" or "exclude-manhattan" (the first ones on the list) - and the result is "include-manhattan". Therefore, the (S, G) carried in the Flow Spec route is allowed on that port of the ER.
LIMITING DISTRIBUTION OF MULTICAST DISTRIBUTION CONTROL

- Only some ERs may be interested in specific MCAST-FLOWSPEC routes.
- A Route-Target could be assigned for interested ERs according to internal provisioning decisions.
- MCAST-FLOWSPEC routes will have these RTs added.
- Constrained Route-Target distribution is used to limit the flooding of the routes.
  - Static RTC can be used to provision the ER targets in RTC.
  - In some (most?) circumstances, the zone RTs could be used for RTC purposes