Multicast geo-distribution control

draft-rekhter-geo-distribution-control-00

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Problem 1: can the customer receive content via multicast

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

  This is especially critical for the successful introduction of multicast service since multicast enablement of global network infrastructure (which entails network equipment hardware/software/configuration updates) will not be flashed cut network-wide but rather will be phased in by areas over some extended period of time

Problem 1: can the customer receive content via multicast

Why not just annotate unicast routes for the customers?

- Those routes are not guaranteed to be in any specific protocol. For example, may be in an IGP or BGP.
- Unicast routes for customer networks usually represent aggregated networks. More specific prefixes that represent subsets of customers who could/could not receive multicast traffic would bias unicast forwarding.

Problem 2: implementing broadcast blackouts

- 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

"In broadcasting, the term blackout refers to the non-airing of television or radio programming in a certain media market. It is particularly prevalent in the broadcasting of sports events, although other television or radio programs may be blacked out as well."

http://en.wikipedia.org/wiki/Blackout_(broadcasting)

Problem 2: implementing broadcast blackouts

Why shouldn't CPE provide this filtering?

- CPE devices may be tampered with. Such tampering may include interception of signaling information that may otherwise be useful for limiting content distribution.
- E.g. http://m.computerworld.com/s/article/9224838/Ore._man_convicted_for_helping_thousands_steal_Internet_service

Geo-Distribution Control Signaling Design – Functional Components

- Content Distribution Controller (CDC)
  - Part of the Content Provider or CDN infrastructure
  - Responsible for applying content-access policy (in particular geo-restriction rules)
  - Responsible for determining the appropriate content delivery method (in particular multicast vs. unicast)
- Multicast Distribution Network Controller (MDNC)
  - Part of the IP Network infrastructure
  - Responsible for determining, maintaining, and communicating a global-view of multicast distribution access footprint
  - Responsible for maintaining and distributing of any multicast-distribution restriction policies (stipulated by CDCs) to Multicast Edge Routers
- Edge Routers (ERs)
  - Network access routers of the IP Network infrastructure (R_4, R_5, R_6 in following diagrams)
  - ERs that are multicast-enabled are capable of and responsible for enforcing multicast-distribution restriction policies

Multicast Distribution Reachability Signaling

(Refer to charts # 9 through 12)

- Each ER (R_4, R_5, R_6) 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

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 # 9 through 12)

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.

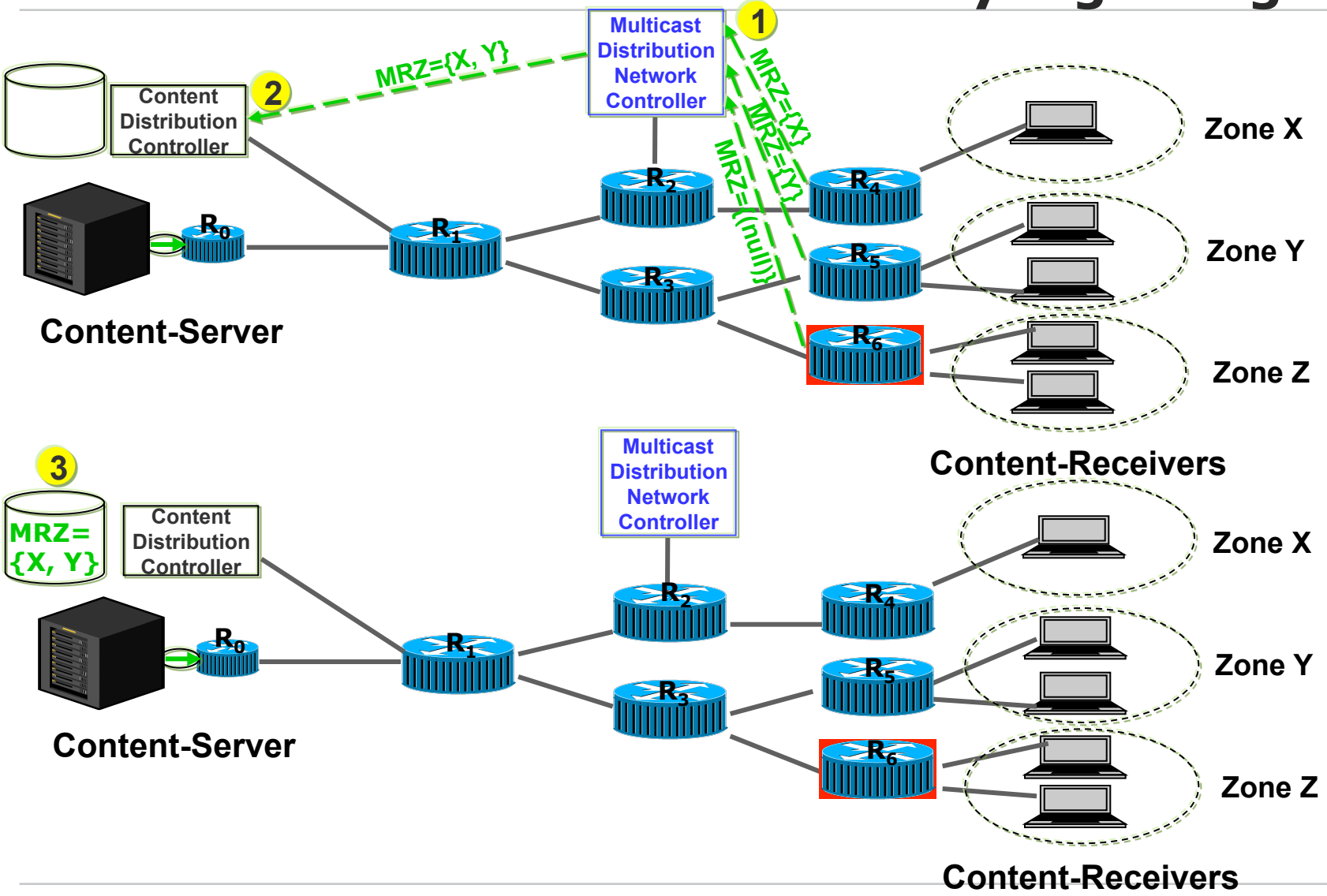
6 and receives a replicated multicasted copy of C from the network

7 ▪ 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

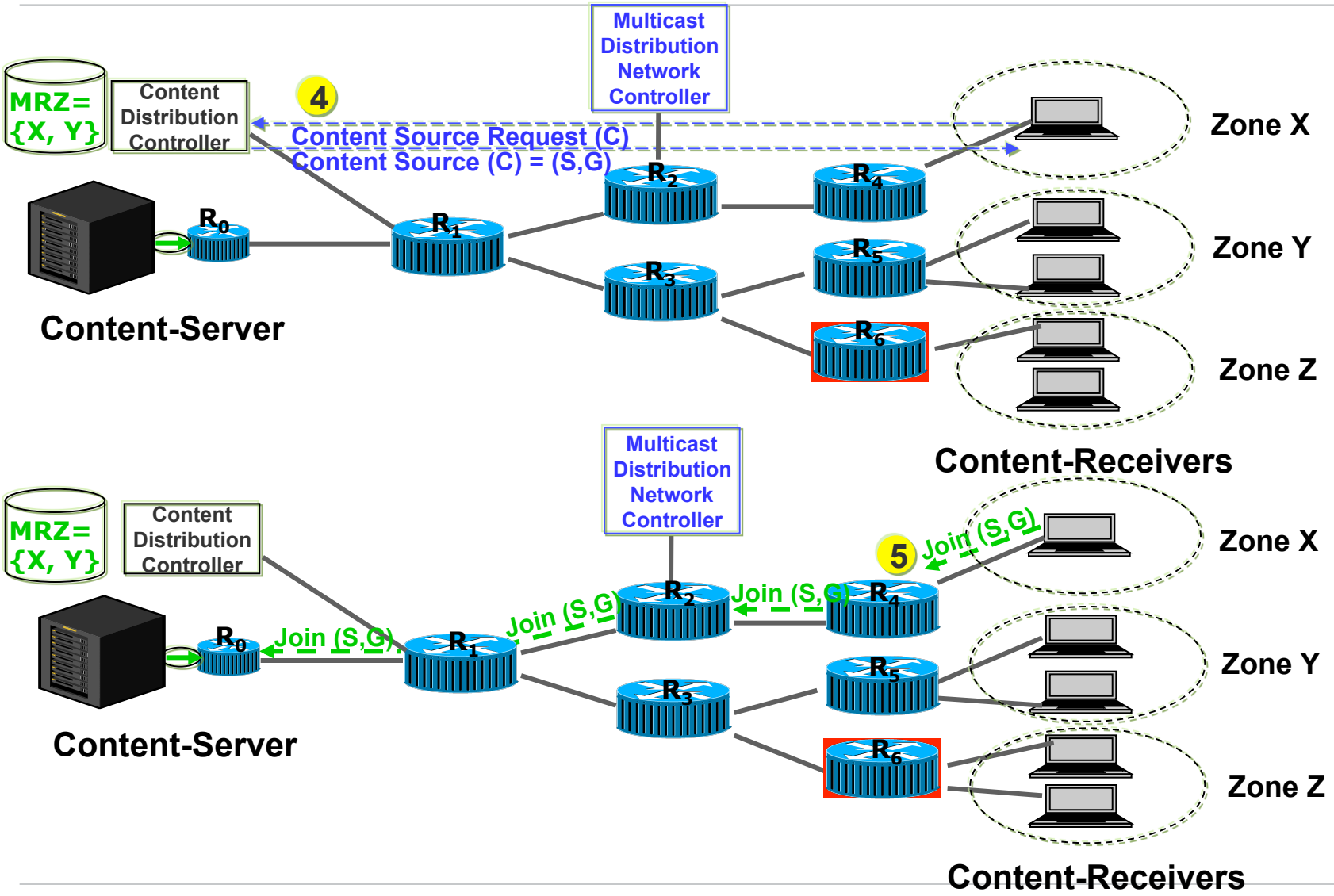
8 ▪ The user issues a content request to source S.

9 and receives a replicated unicasted copy of C from server S

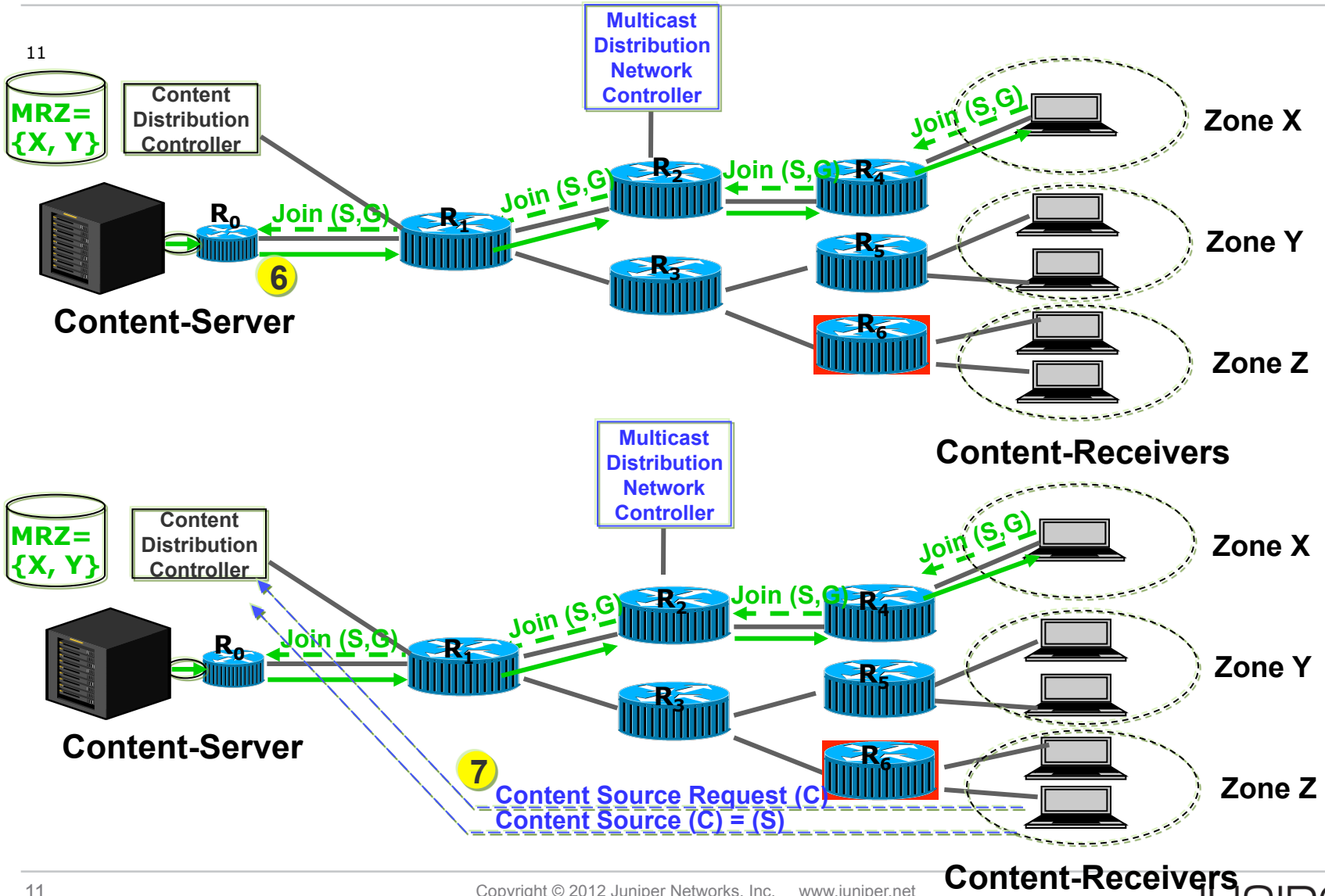
Multicast Distribution Reachability Signaling



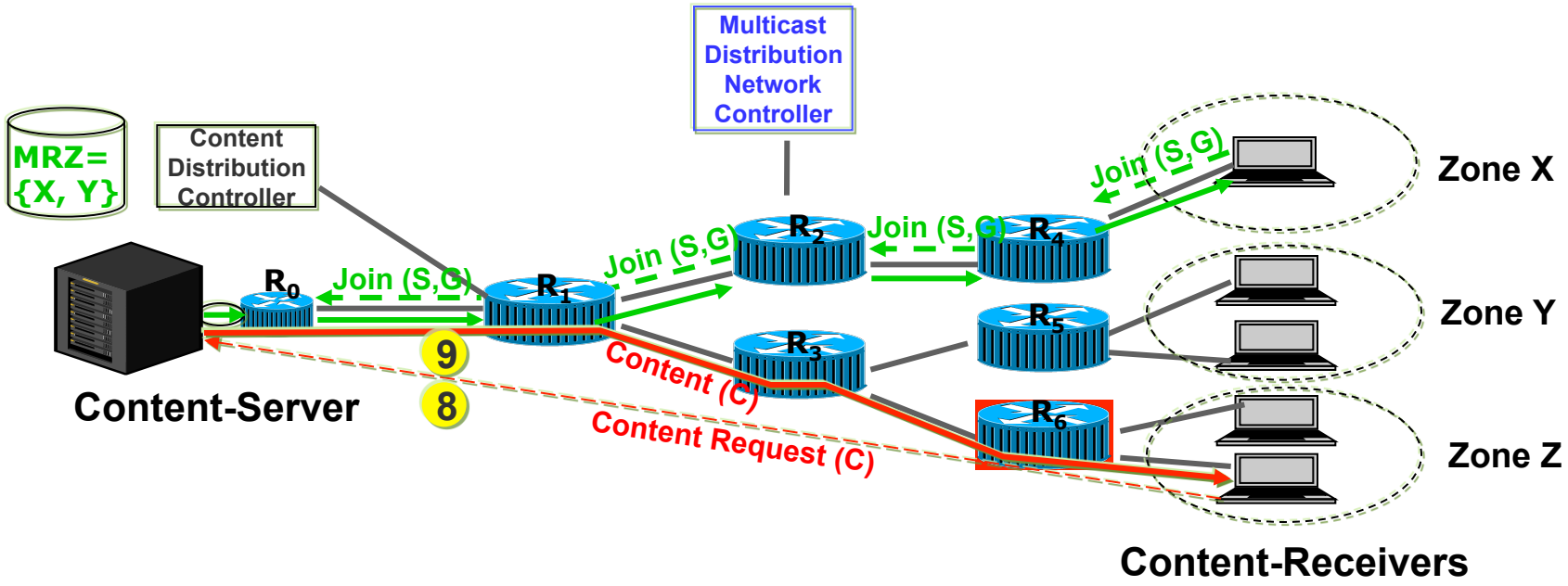
Multicast Distribution Reachability Control



Multicast Distribution Reachability Control



Multicast Distribution Reachability Control



Multicast Distribution Exclusion Signaling

(Refer to charts # 15 through 17)

- The CDC selects an available multicast-channel (S,G) for multicast distribution of Content C

1. 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
2. The CDC announces ("signals") the exclusion policy for (S,G) to the MDNC
3. 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
4. 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 # 15 through 17)

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

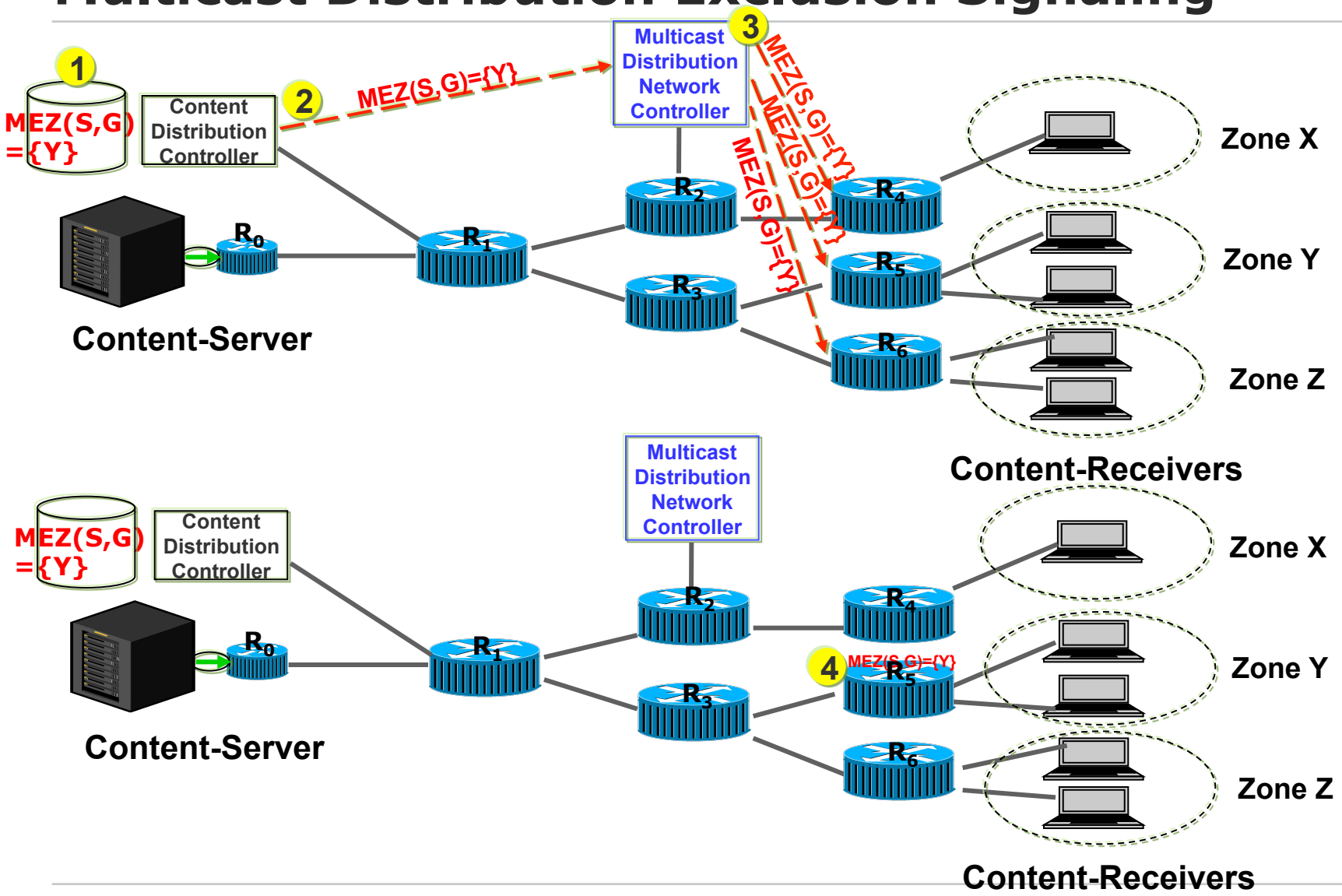
6 ▪ ER R_5 will ignore Join (S,G) messages from any user in exclusion zone Y who attempts to access Content C by learning about (S,G) through illegitimate means and issuing an Join (S,G) message to the network

7 ▪ When multicast channel (S,G) is no longer used for C, the CDC removes the exclusion policy on (S,G),
8 and withdraws the exclusion policy on (S,G) in its signaling to the MDNC

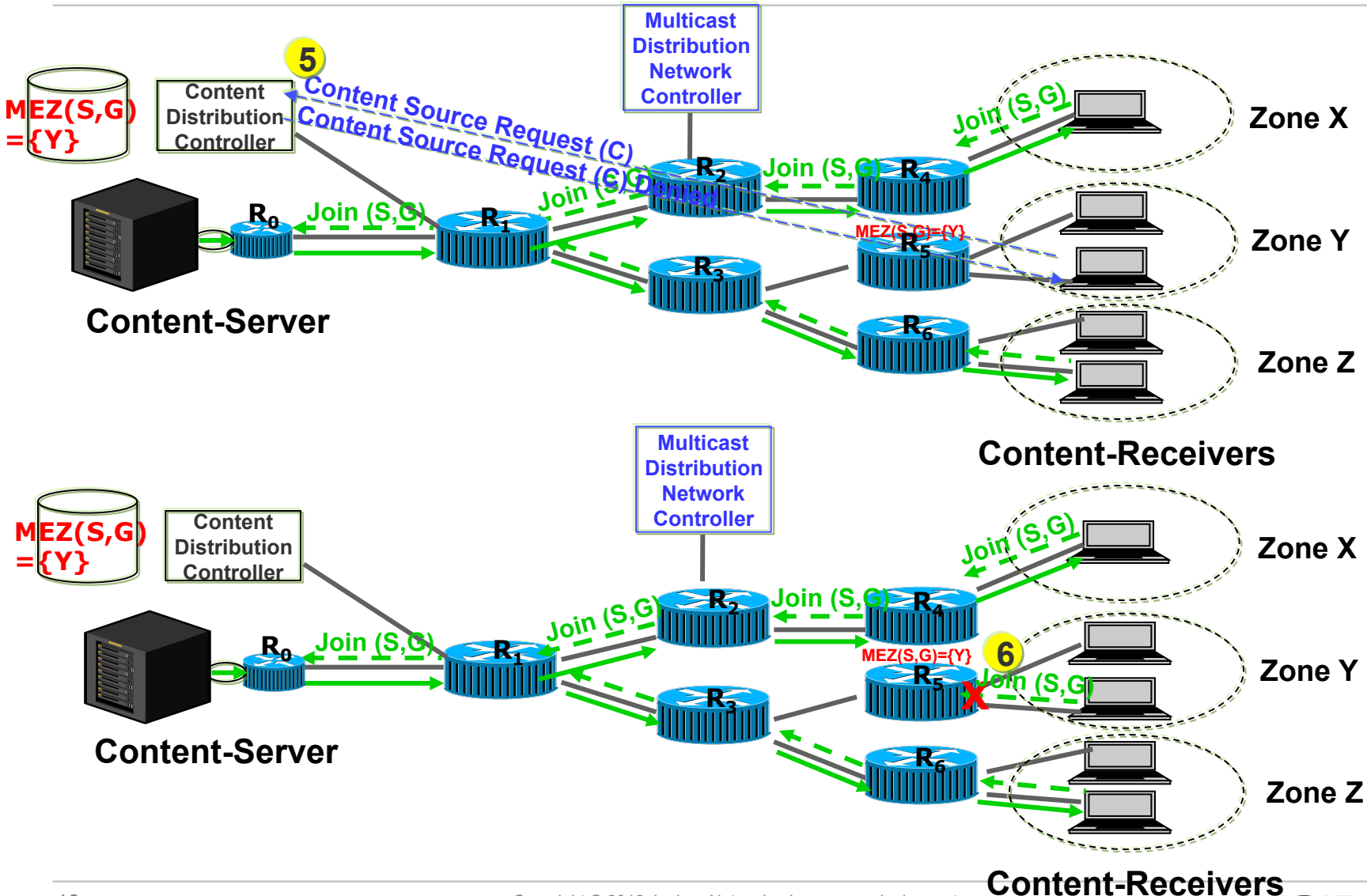
9 ▪ The MDNC withdraws the exclusion policy in its signaling the (multicast enabled) ERs

10 ▪ ER R_5 which is the serving access router for zone Y removes the exclusion rule from enforcement

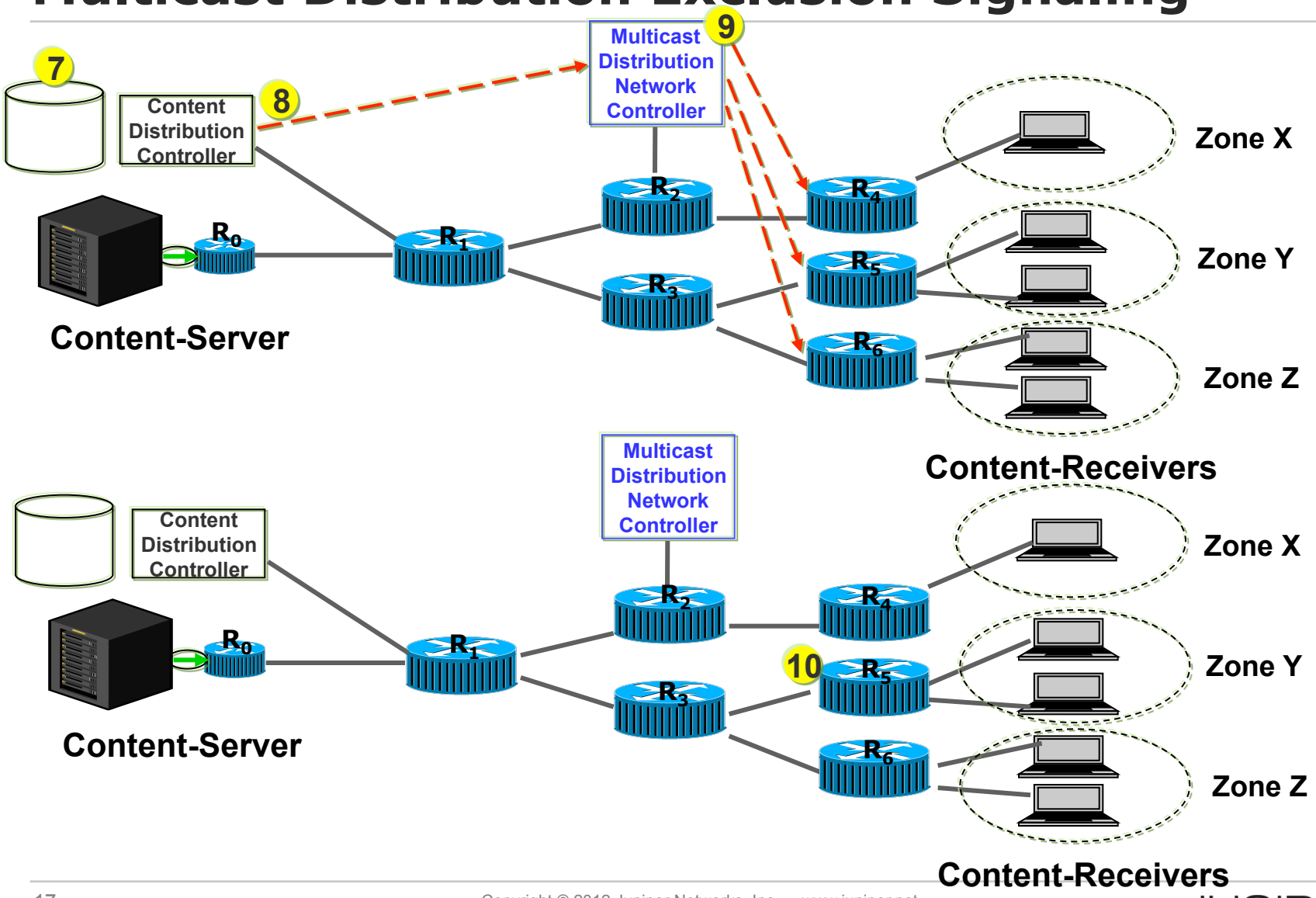
Multicast Distribution Exclusion Signaling



Multicast Distribution Exclusion Control



Multicast Distribution Exclusion Signaling



Signaling multicast destination reachability in bgp

What:

- Subscribers with multicast connectivity from the ER.

To Whom:

- Content Distribution Controllers (CDC)

How:

- The subscribers are encoded as IP prefixes
- The prefixes are sent in BGP using the IPv4 or IPv6 AFI and a new MCAST-REACH SAFI (TBD).

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 control distribution of MCAST-REACH destinations toward interested CDCs:
  - CDC is provisioned with a Route-Target for each AFI. The RT is not re-used elsewhere.
  - CDC distributes the RT into RTC.
  - ERs attach RT to MCAST-REACH reachability.
  - Necessary implementation changes:
    - Apply RTC filtering to non-VPN reachability.
    - Emit RTC route for this non-VPN RT.

Signaling Multicast Distribution Control in BGP

Why:

- “Multicast distribution control signaling is intended to enforce exclusion/inclusion policies of a content provider, and specifically to prevent a subscriber from accessing a particular multicast channel carrying a particular content provided by the content provider if the subscriber obtained the information about this channel through some illegitimate means.”
  (draft-rekhter-geo-distribution-control-00)
- Restricted multicast content is only delivered to ERs that need it rather than delivering the stream to an ER which would have to drop it.

Signaling Multicast Distribution Control in BGP

What:

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

To Whom:

- Interested ERs

Signaling Multicast Distribution Control in BGP

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.
  - Possible issue when number of zone+(include or exclude) targets is larger than BGP Update?
- Subscriber ports are associated with zones.

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.

Signaling Multicast Distribution Control in BGP

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.
  - ERs advertise their targets in RTC.
  - In some (most?) circumstances, the zone RTs could be used for RTC purposes?

everywhere