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Multicast Considerations in Support of CDN-I  
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## Abstract

This document examines the current capabilities of multicast to support content distribution in an environment involving multiple Service Providers joining together to form a Content Distribution Network Interconnection (CDN-I) Federation.

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## 1. Introduction

Content Providers (CP) are experiencing significant growth in demand for all types of internet-based content. A single "over-the-top" CP would require significant resources to deliver content that could be requested from anywhere in the world. Service Providers (SP) are taking advantage of this situation by forming Content Distribution Network (CDN) Federations for the purpose of distributing content on behalf of Content Providers (CP). There are several advantages to such CDN Federations:

- o CPs can simply contract with one or more SPs in a CDN Federation for delivery of their content. This enables CPs to concentrate on their main objective - creation of content.
- o SPs can expand their geographic reach via distribution agreements with Federation members without developing costly resources outside their local territories.

Multicast-based delivery mechanisms are a natural fit for content distribution in the proposed CDN Federations. The scope of this document is strictly focused on the interactions between CDN Federation members to support multicast-based content distribution. The purpose of this document is the detailed examination of applicable multicast techniques and the identification of detailed data/metadata/parameters that will have to be exchanged by CDN Federation members to enable multicast-based content distribution.

## 2. CDN Nomenclature

Terminology utilized to describe end-to-end user requests is described as follows.

There are many entities involved in distribution of the content from the CP all the way to the End User (EU). Figure 1 is a diagram depicting the basic logical relationships among the various roles involved in content delivery. Besides the CP and EU, the two remaining major entities are the two members of a CDN Federation - the Primary CDN Provider (P-CDN) and the Supporting CDN Provider (S-CDN) [A-0200003]. The relationships between these entities are as follows - see Figure 1.

1. The Content Provider owns the content and specifies conditions of delivery and use. The End User interacts with the CP (link 1 in the figure) for authentication and authorization, and to reach an agreement to obtain specific content (content selection, content purchase, acknowledgement of conditions of use). The CP has the legal right to distribute content and specify conditions for distribution.
2. The CP has an agreement and interacts with the P-CDN for deploying content (link 2).
3. The P-CDN in turn has an agreement with an S-CDN for deploying and distributing content (link 3).

4. The End User is attached to S-CDN for access and obtains the content from the S-CDN (link 4). The End User also interacts with the CP (link 1) as indicated above.

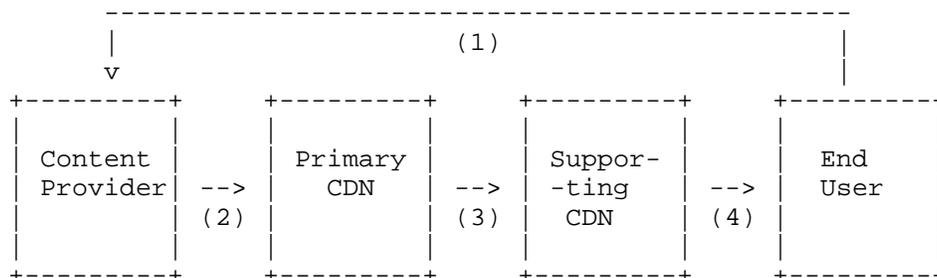


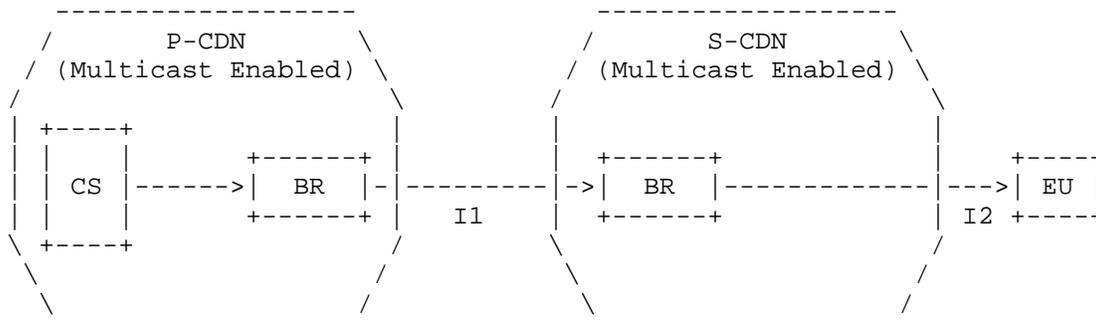
Figure 1 - Relationships in a CDN Federation

Note that all SPs in the CDN Federation can play the role of P-CDN (active relationship with a CP) as well as an S-CDN (attach EUs and distribute content from P-CDN to EUs).

### 3. Multicast Use Cases for a CDN-I Federation

Use cases involving multicast methods for distributing content in a CDN Federation have been described in [A-0200004].

### 3.1. Native Multicast Use Case



CS = Content Server  
BR = Border Router  
I1 = P-CDN and S-CDN Multicast Interconnection (MBGP or BGMP)  
I2 = S-CDN and EU Multicast Connection

Figure 1 - Content Distribution via End to End Native Multicast

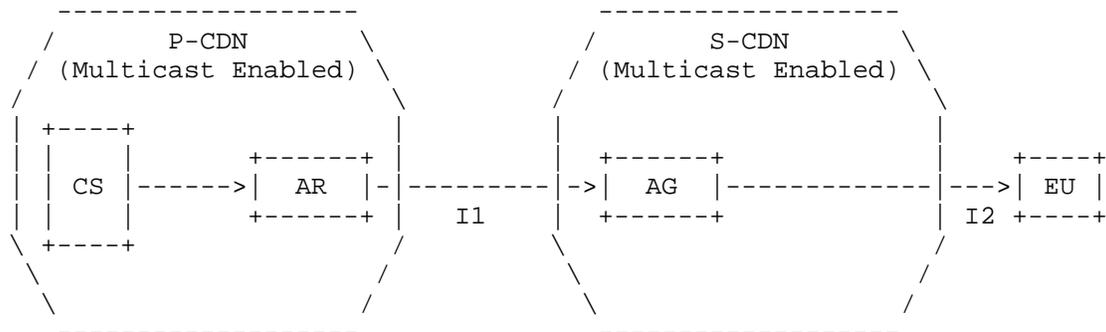
This case assumes that both CDN Providers as well as the interconnection between them and the connection between the EU and S-CDN are all multicast enabled.

A variation of this "pure" Native Multicast case is when the interconnection I1 between the CDNs is multicast enabled via a Generic Routing Encapsulation Tunnel (GRE) [RFC2784] instead of utilizing MBGP or BGMP protocols.

### 3.2. Automatic Multicast Tunneling Use Cases

In reality, the initial introduction of multicast may not be fully multicast enabled resulting in "Multicast Islands" requiring Automatic Multicast Tunnels (AMT) for enabling multicast connections between them [IETF-ID-AMT].

3.2.1. AMT Interconnection Between P-CDN and S-CDN

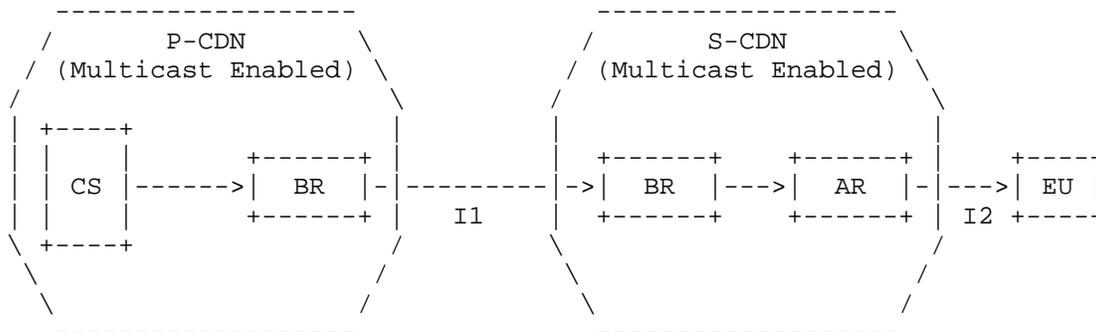


AR = AMT Relay  
AG = AMT Gateway  
I1 = AMT Interconnection between P-CDN and S-CDN  
I2 = S-CDN and EU Multicast Connection

Figure 3 - AMT Interconnection between P-CDN and S-CDN

This configuration assumes both CDN Providers are multicast enabled. Only the interconnection between them is not multicast enabled and hence, an AMT tunnel is established between them as shown in Figure 3.

3.2.2. AMT Tunnel Connecting S-CDN and EU



CS = Content Server  
 BR = Border Router  
 AR = AMT Relay  
 I1 = P-CDN and S-CDN Multicast Interconnection (MBGP or BGMP)  
 I2 = AMT Connection between S-CDN and EU

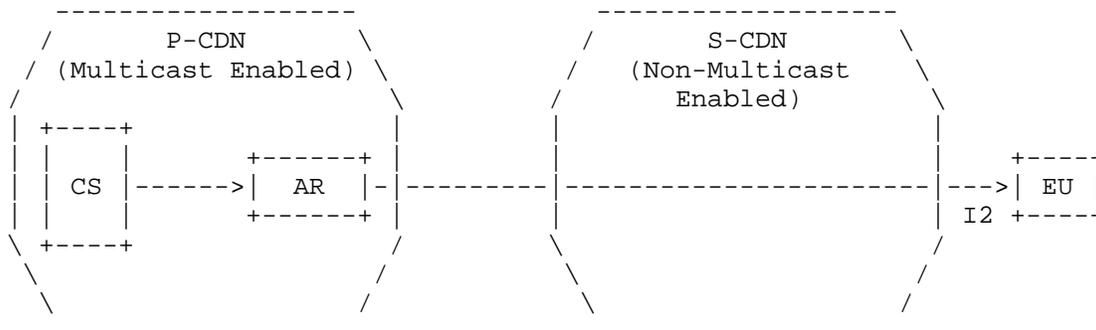
Figure 4 - AMT Tunnel Connecting S-CDN and EU

This case involves EU devices that are not multicast enabled. Hence an AMT Tunnel is established between the S-CDN AMT Relay and the EU device. This implies one tunnel per EU - potentially several AMT tunnels may need to be setup. Note that there could be configurations involving both situations described in 3.2.1 and 3.2.2.

3.2.3. AMT Tunnel Connecting EU to P-CDN Through Non-Multicast S-CDN

This Use Case assumes that EU attached to the non-multicast enabled S-CDN has a device populated with a client that establishes an AMT tunnel to the AMT Relay in the P-CDN.

This configuration is needed when the S-CDN is not multicast-enabled. This is the most "extreme" AMT case as the length of the tunnels as well as the number of tunnels can be large.



CS = Content Source  
 AR = AMT Relay  
 I2 = AMT Tunnel Connecting EU to P-CDN Relay through Non-Multicast Enabled S-CDN.

Figure 5 - AMT Tunnel Connecting P-CDN AMT Relay and EU

#### 4. Content Types Suitable for Multicast-based CDN

This section highlights applications and content types that are suitable for multicast-based delivery in a CDN Federation. Any unique aspects of specific applications/content types that require special attention are duly noted.

##### 4.1. Live Content

Live events and presentations such as live radio and sporting events are examples. Delivery is via simple multicast means.

Additional detail TBD

##### 4.2. "Delayed-Play" Download

This includes download of movies and software updates. Delivery is via repeated multicasting of content.

Additional detail TBD

##### 4.3. "Instant-Play" Download

This includes Video-on-Demand (VoD) and on-demand streaming. Delivery is via simultaneous repeated multicast of content segments.

Additional detail TBD

## 5. Evaluation of Native Multicast for CDN

Use Case 3.1 describes Native Multicast configurations. This is the "simplest" multicast case in that a single standard set of protocols supports end-to-end content delivery from the CP to EU via two or more fully multicast-enabled CDN Providers. It also provides for efficient use of bandwidth and resources.

Use Case 2a does deploy an AMT Tunnel for interconnecting two CDN Providers; the rest of the configuration is Native Multicast - this assumes that the EU devices are also multicast-enabled.

Thus existing Native Multicast capabilities need to be examined to determine their ability to fully support content distribution in a CDN Federation. A list of issues requiring examination is as follows:

- o Delivery - Identification and communication of {Source, Group} information and DNS information for provisioning across CDNs. Details to be provided.
- o Routing/Peering - Identification and acknowledgement of external IP addresses particularly when utilizing a GRE Tunnel for interconnecting CDNs. Details to be provided.
- o Back-Office Functions - Identification of appropriate data/metadata collected by Native Multicast to support usage of content for billing, settlements, logging, etc. Details to be provided.
- o Security - Determine ability of Native Multicast to deal with security risks such as bot attacks, denial of service, etc. Details to be provided.
- o Others - To Be Determined

## 6. Evaluation of AMT for CDN

Use Cases 3.2.1, 3.2.2, and 3.2.3 describe the possible configurations involving AMT Tunnels. The likeliest scenario is a combination of Use Cases 3.2.1 and 3.2.2.

Use Case 3.2.3 becomes problematic if the length of the AMT Tunnels connecting the EUs to the P-CDN AMT Gateway become prohibitively long.

In all cases, there may be a concern if the total number of AMT Tunnels required is large. The list of issues that need to be examined for the AMT scenarios to support content distribution in a CDN Federation includes all identified issues in the Native Multicast case:

- o Delivery - Identification and communication of {Source, Group} information and DNS information for provisioning across CDNs. Details to be provided.
- o Routing/Peering - Identification and acknowledgement of external IP addresses when utilizing AMT Tunnels for interconnecting CDNs. Details to be provided.
- o Back-Office Functions - Identification of appropriate data/metadata collected via AMT to support usage of content for billing, settlements, logging, etc. Details to be provided.
- o Security - Determine ability of AMT to deal with security risks such as bot attacks, denial of service, etc. Details to be provided.
- o Others - To Be Determined

These have to be separately investigated for the AMT cases. In addition, there may be a need to examine the scope of additional resources in terms of bandwidth capacity and additional network elements particularly for Use Cases 3.2.2 and 3.2.3.

## 7. Security Considerations

TBD

## 8. IANA Considerations

TBD

## 9. Conclusions

TBD

## 10. References

### 10.1. Normative References

[RFC2784] D. Farinacci, T. Li, S. Hanks, D. Meyer, P. Traina, "Generic Routing Encapsulation (GRE)", RFC 2784, March 2000

[IETF-ID-AMT] G. Bumgardner, "Automatic Multicast Tunneling", draft-ietf-mboned-auto-multicast-13, April 2012, Work in progress

### 10.2. Informative References

[A-0200003] P. Tarapore, "CDN Interconnection Use Case Specifications and High Level Requirements", ATIS Standard A-0200003, June 2011 (contact Nicole Butler at nbutler@atis.org using code IETF12 to receive a free copy before September 30, 2012)

[A-0200004] P. Tarapore and R. Sayko, "CDN Interconnection Use Cases and Requirements for Multicast-Based Content Distribution", ATIS Standard A-0200004, January 2012 (contact Nicole Butler at nbutler@atis.org using code IETF12 to receive a free copy before September 30, 2012)

## 11. Acknowledgments

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