CDNI WG S. Previdi, Ed.
Internet-Draft F. Le Faucheur
Intended status: Standards Track Cisco Systems, Inc.
Expires: April 26, 2012 A. Guillou
SFR
J. Medved
Juniper Networks, Inc.
October 24, 2011

CDNI Footprint Advertisement
draft-previdi-cdni-footprint-advertisement-00

Abstract

This document describes the use of BGP for Content Delivery Networks (CDNs) in order to advertise information about footprint and connectivity to footprint in the context of CDNI.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Table of Contents

1. Introduction

The IETF CDN Interconnection (CDNI) Working Group is chartered to develop specifications for interconnecting standalone CDNs so that their collective CDN footprint can be leveraged for the end-to-end delivery of content from Content Service Providers (CSPs) to End Users.

[I-D.jenkins-cdni-problem-statement] outlines the problem area that the CDNI working group is chartered to address. [I-D.bertrand-cdni-use-cases] discusses the use cases for CDN Interconnection and [I-D.davie-cdni-framework] discusses the technology framework for the CDNI solution and interfaces.

When an upstream CDN (uCDN) receives a request from a user, it has to determine what is the downstream CDN (dCDN) to which the request is to be redirected. This CDN selection decision can take into account various criteria such as administrative preferences (for example based on the commercial arrangements between the uCDN and candidate dCDNs including associated request handling costs) and/or such as whether candidate CDNs are have caches that are topologically close to the user and capable of handling that request. Therefore, as discussed in section "Dynamic Footprint Discovery" of [I-D.davie-cdni-framework], there are situations where being able to dynamically discover the set of requests that a given dCDN is willing and able to serve is beneficial. As also discussed in [I-D.davie-cdni-framework], this information could be potentially provided by the dCDN in response to a query by the uCDN, or the information (or its changes) could be spontaneously advertised by the dCDN.

The proposal outlined in this document makes use of Multiprotocol-BGP (MP-BGP [RFC4760]) in order for CDNs and/or ISPs to advertise their footprint information as well as for CDNs to advertise their connectivity to these footprints. In addition CDNs use MP-BGP advertisements to represent their interconnectivity.

2. CDNI Mesh and MP-BGP

CDNI enables CDNs to communicate in order to deliver content in a collaborative mode. In this document, we refer to a CDNI Mesh as the set of CDNs participating into CDNI and using MP-BGP sessions between them in accordance with the approach defined in this document. A CDNI Mesh has no requirements in terms of topology, i.e.: the mesh can be partial, full or hierarchical.

CDNI Mesh will make use of Multiprotocol-BGP (MP-BGP [RFC4760]) for

the exchange of footprint and connectivity information.

We define a new Address Family (CDNI-AF, TBD) and a new NLRI that will carry either CDN Footprint or CDN Connectivity advertisements. The NLRI will have a NLRI type (i.e.: CDNI-footprint and CDNI-connectivity) so to distinguish footprint and connectivity advertisements.

The advantage of using a separate address family is to isolate CDNI information from regular BGP-4 Internet information so to not compromise in any way the security and reliability of the current BGP information exchange used for IP network layer routing.

The advantage of having separate footprint and connectivity information is that a CDN needs not originate (and update) footprint information each time there's a change in the way a CDN is connected to other CDNs. E.g.: if all footprint information was to be exchanged between CDNs, it would consist of a very large amount of prefixes advertised (and re-advertised) each time a CDNI interconnection changes in the CDNI Mesh.

When an existing CDN connection is removed or when a new connection between two CDNs is established, the only advertisements that need to be updated are the ones concerning the connectivity.

While the footprint information is expected to be relatively stable, the CDN Mesh (i.e.: the connectivity between CDNs) and the connectivity between the CDN and the footprints may be impacted by network events. Also, the connectivity between CDNs may be affected by the CDN selection policy which may be modified relatively frequently.

CDNI Connectivity advertisements allow the CDNI Mesh to scale by adapting easily to topology changes. In fact, just a few number of connectivity advertisements are used by each CDN which makes the CDNI MP-BGP scheme very scalable.

3. CDNI Information

The CDNI Information is of two types:

Footprint Information, stored in the CDNI (MP-BGP) Footprint Database.

Connectivity Information, stored in the CDNI (MP-BGP) Connectivity Information Database.

3.1. Footprint Information

Footprint Information (FI). The CDN Footprint Information refers to the set of prefixes (with all their BGP attributes) that the CDN is capable of, and willing to deliver content to in a given region and or in a given Autonomous System. Note that a CDN may be capable and willing to serve content to more than one footprint.

Example: if CDN-A delivers content to ISP-A users, then CDN-A footprint consists of all prefixes owned and connected to ISP-A.

Footprint Information is therefore inferred from the BGP-4 Internet database. It is assumed that the CDN will have a BGP-4 feed with Internet prefixes that are necessary in order for the CDNI Mesh to operate and from which it will be able to derive the different footprints.

The CDN will maintain a database with footprint information that is separate from the regular IP BGP database. The CDNI footprint information database uses the CDNI-AF MP-BGP address family.

In addition, a CDN may want to advertise to other CDNs part or all of its footprint information. For example, a CDN may want to give a better granularity of the prefixes of its footprint (e.g.: longer masks) or may want to add more attributes (e.g.: communities and extended communities) to its footprint information. Therefore the CDN is capable of originating Footprint Advertisements (from its CDNI Footprint Database) and send them to its neighbors of the CDNI-Mesh.

The CDNI Footprint Information Database includes footprint information inferred by the BGP-4 (Internet) database as well as footprint information explicitely advertised by neighboring CDNs.

3.2. Connectivity Information

Connectivity Information refers to how the CDN is connected to a footprint (and to which footprints). This information needs to be advertised by the CDN to the rest of the CDNI Mesh so that every CDN knows which CDN is connected to which footprints.

It has to be noted that by "connectivity" we do not intend physical direct connectivity between the CDN and the footprint but rather the ability to deliver content to the footprint. Connectivity Advertisements are sent through MP-BGP and using CDNI-AF advertisements.

Connectivity Information is stored in the CDNI Connectivity Database which contains the information originated by the CDN and the

information received from the other CDNs in the CDNI Mesh.

4. CDNI MP-BGP

This section describes the CDNI Footprint and Connectivity Information in the CDNI MP-BGP databases. Two databases are used:

CDNI Footprint Database that contains footprint that is either derived from BGP-4 Internet table or received from other CDN through CDNI Footprint Advertisements.

CDNI Connectivity Database that contains the advertisements made by each CDN describing how they are connected to footprints.

4.1. CDNI MP-BGP Footprint Information and Advertisements

Footprint information first comprises IP prefixes as known in the BGP-4 database and that need to be translated into the CDNI-AF format and stored in the CDNI Footprint database. BGP-4 information is inserted in the CDNI Footprint database and all BGP attributes of each original route are preserved (e.g.: AS_PATH, MED, Communities, Extended Communities). In addition, a CDN may add more attributes to the CDNI Footprint database routes.

As discussed earlier, a CDN may want to explicitly advertise footprint information to the CDNI-Mesh (as explained in Section 3.1). When it does so, this information is also incorporated by the in its CDNI Footprint database by a CDN receiving these advertisments. However, it is expected that a CDN acquires most of the footprint information from the BGP-4 Internet table. So we expect limited usage of footprint advertisements between CDNs.

For example, a CDN (or ISP) may originate MP-BGP footprint advertisement including a Community attribute representing the location of the prefixes or the type of user connectivity (e.g.: fiber vs. cable vs. dsl vs Mobile3G vs Mobile 4G). Alternatively, such information could be delivered initially by the ISP in the BGP-4 database.

4.1.1. CDNI Footprint Attributes: Footprint Identifier

Footprints are associated to Autonomous Systems. Therefore, the identifier of a footprint is its Autonomous System Number (ASN). When the CDN creates the CDNI Footprint database, it will assign to each prefix, a new (TBD) Extended Community carrying the Footprint Identifier.

Footprint Identifier is derived from the Autonomous System Number (ASN) of the original route. When inferring the CDNI footprint information from the regular BGP-4 Internet database, the footprint identifier is derived from the first ASN in the AS_PATH of the prefix.

The role of the Footprint Identifier is to group all prefixes part of the same footprint under a unique identifier. This allows a CDN to claim connectivity to the footprint by just specifying the FI rather than each individual prefix of the footprint.

Footprint Identifier may also be used in order to describe a finer granularity than the ASN. Example: a CDN or an ISP participating into the CDNI Mesh, may want to originate footprint advertisement with a Footprint Identifier describing a region of its footprint (e.g.: an ISP may have multiple peering points in different locations and may want to partition its footprint so to represent geographical groups.)

For that purpose multiple Footprint Identifiers are used (e.g.: a footprint representing Los Angeles area and another footprint representing New York City area). These two footprints MUST be understood as part of the same ISP but representing different groups of prefixes.

Using separate Footprint Identifiers (one for LA prefixes and one for NYC prefixes) allows the CDNI Mesh to handle the footprints separately even if they belong to the same ISP. Footprint Identifier MUST be unique across the CDNI Mesh and therefore are numbered using the ISP AS numbers followed by additional bit space allowing more footprint identifiers per ISP.

4.1.2. CDNI Footprint Attributes: Origin_AS_PATH

A new MP-BGP attribute (TBD) is defined and called Origin_AS_PATH. This attribute contains the prefix AS_PATH value that is present on the CDNI footprint database.

The Origin_AS_PATH is used when a CDN originates a CDNI Footprint Advertisement. The AS_PATH of the new advertisement follows the BGP rules (i.e.: it is created with the CDN ASN and further updated at each AS hop) while the Origin_AS_PATH contains the AS_PATH of the original prefix.

4.1.3. Multihomed Prefixes

In some cases, a given prefix may be part of different footprint if it represents a customer connected to two separate ISPs. In some

cases it is useful to preserve this information and allow both prefixes advertisements in the BGP database. However, due to BGP Path Selection rules, when a BGP speaker receives two or more advertisements for the same prefix, it selects one and ignore the others.

In order to prevent this to happen a Route Distinguisher may be used in the advertisement so that, from a BGP selection perspective, the prefix advertisements are not considered being equal.

4.2. CDNI MP-BGP Connectivity Information and Advertisements

Once footprint information is known in the CDNI Mesh, each CDN should advertise its connectivity to the footprints it has access to. The CDN maintains a MP-BGP CDNI Connectivity Database with entries describing its connectivity to footprints.

4.2.1. CDNI Connectivity Prefix

When a CDN wants to advertise its footprint connectivity it originates a MP-BGP advertisement containing a prefix and a set of attributes. The prefix it uses MUST be a prefix in the address space owned by the CDN. A CDN willing to advertise different set of footprints connectivity may use different prefix advertisements each with its set of attributes.

The Connectivity prefix(es) the CDN originates may contain any standard MP-BGP attribute and it MUST contain a newly defined attribute: Connected Footprints.

4.2.2. CDNI Connectivity Attribute: Connected Footprints

Connected Footprints attribute describes the set of Footprint Identifiers (FIs) the CDN claims connectivity to.

The Connected Footprint attribute (CF) is a set of Footprint Identifiers which means a set of Extended Communities as defined in Section 4.1.1.

The propagation of CDN Connectivity advertisements throughout the CDNI Mesh is done according to standard MP-BGP rules and the inter-CDN connectivity will be reflected in the MP-BGP attributes (e.g.: AS_PATH will describe the different CDNs the advertisement traversed during its propagation in the CDNI Mesh thus describing the inter-CDN connectivity).

4.2.3. CDNI Connectivity Advertisement Attributes: Origin_AS_PATH

The CDNI Connectivity Advertisement contains a new (TBD) attribute called Origin_AS_PATH that contains the AS_PATH value describing the distance (expressed in AS Hop Count) between the CDN and the advertised connected footprint.

This attribute will allow remote CDNs to understand how this CDN is distant (or close, in terms of AS hop count) to the footprint.

The regular AS_PATH attribute of the Connectivity Advertisement is updated during its propagation in the CDNI Mesh so to prevent BGP message loops (according to BGP rules).

5. CDNI Topology Example

The figure below gives an example how CDNs collaborate and how they create their CDNI Footprint and Connectivity databases.

```
                    +--------------------------------------------+
                    |           CDNI (partial or full) Mesh      |
       /\           +--------------------------------------------+
       ||               |           |           |           |
       ||           +-------+   +-------+   +-------+   +-------+
   connectivity     | CDN 1 |   | CDN 2 |   | CDN 3 |   | CDN 4 |
   advertisements   +-------+   +-------+   +-------+   +-------+
                        |           |     ___/   \       /  |
   _____________________|___________|____/_______|_____/____|_____
                        |           |  /         |   /      |
       /\          +-------+   +-------+   +-------+   +-------+
       ||          | ASN 1 |   | ASN 2 |   | ASN 3 |   | ASN 4 |
       ||          +-------+   +-------+   +-------+   +-------+
   footprint           |           |           |           |
   advertisements  +--------------------------------------------+
                   |                Internet                    |
                   +--------------------------------------------+
```

Figure 1: Footprint and Connectivity Advertisements

In the figure above 4 CDNs are connected to a set of 4 different footprints. Each CDN is capable of inferring the footprint information from the BGP-4 Internet table and will create a CDNI Footprint Database where a Footprint Identifier will be assigned to each prefix of the footprints. The Footprint Identifier to each prefix will be assigned based on the ASN of the prefix.

In addition, each CDN advertises its connectivity to the footprint.

All CDNI information (footprint and connectivity) is then known in the entire CDNI Mesh.

6. CDNI MP-BGP Operations

Connectivity advertisements and, when necessary, Footprint Advertisements consist of MP-BGP update messages CDNs advertise to the CDNI Mesh (following standard MP-BGP propagation rules).

Footprint consists of prefixes known in the CDNI Footprint Database (MP-BGP). CDNs advertises these prefixes and can use standard BGP attribute to attach more information to these prefixes. In addition a new Extended Community Type is defined so to convey the Footprint Identifier that associate each prefix to a given footprint.

Connectivity advertisements are originated using one or more prefixes the CDN will use in order to convey the description of its connectivity to a footprint. The prefix has the solely purpose to convey the connectivity information of the CDN (i.e.: the prefix itself is not to be used for routing or selection purposes). The footprint connectivity of a CDN is expressed in the Extended Community Attribute type "Connected Footprint" which consists of the set of Footprint Identifiers the CDN is connected/have access to. The Extended Community being additive, more than one Footprint Identifier is allowed in the CDN Connectivity advertisement.

Also, the Origin_AS_PATH attribute reflects how the CDN is effectively distance/close to the footprint from a network layer perspective.

MP-BGP sessions are established between CDNs. MP-BGP requires an Autonomous System (AS) number that is unique across all CDNs. Therefore each CDN participating into the CDNI Mesh MUST have a unique AS number.

6.1. Internal and External MP-BGP Sessions

CDNs establish external MP-BGP sessions with each others. The MP-BGP session has to be established using the BGP Capabilities specifying the speaker is capable of MP-BGP and for the CDNI Address Family. In each of the CDNs at least one MP-BGP speaker will be available ensuring connectivity to the CDNI Mesh.

Internal MP-BGP sessions can be used inside a CDN for propagating footprint and connectivity advertisements. Same mechanisms such as route reflectors and/or confederations can be used internally to a CDN.

A CDN that is operated by an ISP may use the same ASN than the one currently used by the ISP.

6.2. CDNI MP-BGP NLRI

Two types of CDNI NLRIs are defined: footprint and connectivity.

6.2.1. CDNI Footprint NLRI and Attributes

This CDNI NLRI Type (TBD) describes footprint information which consists of an IPv4 or IPv6 address prefix. CDNI Footprint Advertisement includes following information (note well that in this section we do not aim to describe in details the format of the NLRI bur rather focus on the kind of information it should contain):

```
      RD:ipv4 or RD:ipv6 addresses
      BGP attributes such as: AS_PATH, NEXT_HOP, MED,
                              Community, ExtCommunity.
      Origin_AS_PATH
      Footprint Identifiers
```

where:

RD is the Route Distinguisher of the route. When used, it allows to distinguish among multiple advertisements of the same prefix (for the multihomed case). The RD is present in CDNI NLRI using CDNI-AF with SAFI value set to 128.

Origin_AS_PATH contains the AS_PATH value that is present in the CDNI Footprint Database for this prefix.

Footprint Identifier describes to which footprint this prefix belongs to. The footprint Identifier represents the ASN of origin of the prefix.

Footprint NLRIs are propagated in the CDNI Mesh according to standard MP-BGP rules and MP-BGP attributes such as AS_PATH, NEXT_HOP, MED, Local Preference, etc, are updated and used according to the standard MP-BGP mechanisms. For example, AS_PATH is updated and checked so to avoid messaging loops.

6.2.2. CDNI Connectivity NLRI and Attributes

The CDNI Connectivity NLRI Type (TBD) describes how the CDN connects to a given footprint. Each CDN originates one or more prefixes whose purpose is to convey attributes describing how the CDN can reach the footprint. The Connectivity advertisment includes following information:

RD:ipv4 or RD:ipv6 addresses
BGP attributes such as: AS_PATH, NEXT_HOP, MED,
                        Community, ExtCommunity.
Origin_AS_PATH
Connected Footprints

where:

RD is the Route Distinguisher of the route. When used, it allows to distinguish among multiple advertisements of the same prefix (for the multihomed case). The RD is present in CDNI NLRI using CDNI-AF with SAFI value set to 128. It has to be noted that the CDNI Advertisements makes no use of the route distinguisher and therefore it has to be set to all zero.

BGP attributes convey information related to the connectivity of the CDN to the footprint.

Origin_AS_PATH contains the AS_PATH that describes how the CDN is connected to the footprint (i.e.: what is the AS hop count).

Connected Footprints describe which footprints the CDN has connectivity to.

7. Example of CDNI Mesh

In this section an example of a CDNI Mesh is described as well as the CDNI Information that will be originated.

```
      +-------------------------------------------+
      |           CDNI (partial or full) Mesh     |
      +-------------------------------------------+
          |           |         |           |
      +-------+   +-------+   +-------+   +-------+
      | CDN 1 |   | CDN 2 |   | CDN 3 |   | CDN 4 |
      |       |   | AS600 |   | AS700 |   |  /    |
      |       |   +-------+   +-------+   |/      |
      |       |       |   ____/   |      /|       |
      |       |       |  /        |    /  |       |
      |       |   +-------+   +-------+   |       |
      | AS100 |---| AS200 |---| AS300 |---| AS400 |
      +-------+   +-------+   +-------+   +-------+
         |           |           |           |
   192.168.10/24     |    192.168.30/24      |
                     |                       |
               192.168.20/24           192.168.40/24
```

Figure 2: CDNI Mesh Example

We assume different Autonomous Systems (representing different ISPs) with their own prefix space. We also assume four CDNs that are, for some of them, on their own AS while others share the AS of their ISP (which describe the case where the CDN is managed by the ISP). The Internet is represented by the interconnectivity of the Autonomous System.

7.1. CDNI Footprint Information and Advertisements

Footprint information will be inferred by each CDN from the BGP-4 database. For example, the CDNI Footprint Database in CDN4, located in Autonomous System 400, is as follows:

```
              IPv4 prefix:                 192.168.10/24
              AS_PATH:                     300 200 100
              CDNI Footprint Identifier:   100:000

              IPv4 prefix:                 192.168.20/24
              AS_PATH:                     300 200
              CDNI Footprint Identifier:   200:000

              IPv4 prefix:                 192.168.30/24
              AS_PATH:                     300
              CDNI Footprint Identifier:   300:000

              IPv4 prefix:                 192.168.40/24
              AS_PATH:
              CDNI Footprint Identifier:   400:000
```

where:

IPv4 Prefix is the footprint prefix information.

AS_PATH is the existing BGP AS_PATH attribute (from the BGP-4 database) containing the set of ASNs the update has traversed in the Internet.

CDNI Footprint Identifier represents the footprint as a whole. All prefixes part of the same footprint will share the same Footprint Identifier. For CDNI purposes, CDN4 may want to advertise more information about the inferred footprint so to tell the CDNI Mesh more information about location of the footprint. For example, part of the address space 192.168.40/24 is located in NYC, part is located in Chicago and part in LA. CDN4 may originate new CDNI Footprint Information such as:

```
                IPv4 prefix:                 192.168.40.64/26
                AS_PATH:
                CDNI Footprint Identifier:   400:001

                IPv4 prefix:                 192.168.40.128/26
                AS_PATH:
                CDNI Footprint Identifier:   400:002

                IPv4 prefix:                 192.168.40.192/26
                AS_PATH:
                CDNI Footprint Identifier:   400:003
```

When CDN4 sends out the above advertisements, it will have to update both the AS_PATH attribute (in order to prevent BGP message loops as well as the Origin-AS_PATH attribute so to preserve the original AS_PATH. Therefore the advertisements CDN4 will send out will be as follows:

```
                IPv4 prefix:                 192.168.40.64/26
                AS_PATH:                     400
                CDNI Footprint Identifier:   400:001
                Origin_AS_PATH               400

                IPv4 prefix:                 192.168.40.128/26
                AS_PATH:                     400
                CDNI Footprint Identifier:   400:002
                Origin_AS_PATH               400

                IPv4 prefix:                 192.168.40.192/26
                AS_PATH:                     400
                CDNI Footprint Identifier:   400:002
                Origin_AS_PATH               400
```

When the advertisement is received by the CDNI Mesh neighbors it will also be propagated. For example, CDN3 may receive these advertisements and send them to CDN2. At CDN2 the advertisements will contain following information:

```
IPv4 prefix:                  192.168.40.64/26
AS_PATH:                      300 400
CDNI Footprint Identifier:    400:001
Origin_AS_PATH                400

IPv4 prefix:                  192.168.40.128/26
AS_PATH:                      300, 400
CDNI Footprint Identifier:    400:002
Origin_AS_PATH                400

IPv4 prefix:                  192.168.40.192/26
AS_PATH:                      300 400
CDNI Footprint Identifier:    400:002
Origin_AS_PATH                400
```

where the AS_PATH attributes reflect the path taken by the advertisement in the CDNI-Mesh while the Origin_AS_PATH reflects the AS_PATH the prefix had at its point of origin (ASN 400).

7.2. Connectivity Information and Advertisements

Connectivity advertisements have the dual purpose of describing the CDN connectivity to the footprint and the connectivity to other CDNs. For example, CDN4 connectivity advertisement will describe the footprint connectivity to Footprint Identifiers 400:001, 400:002 and 400:003. The following is the advertisement CDN4 will send to its MP-BGP neighbors:

```
IPv4 prefix:           192.168.4.4/32
AS_PATH:               400
Connected footprints: 400:001, 400:002, 400:003
```

where:

IPv4 Prefix is the IPv4 address identifying the CDN (or part of it) in the CDNI Mesh.

AS_PATH contains the AS numbers this update traversed (including the AS where this connectivity advertisement has been originated).

Connected Footprints contains the set of footprint identifiers this CDN is directly connected to.

*** Editor's Note: a mechanism in order to express preference or costs to footprints is needed: either through a ranking sequence or through explicit preference cost or weight.

Alternatively, CDN4 may want to advertise 3 distinct Connectivity Advertisements for each of the footprints its connected to:

```
IPv4 prefix:          192.168.4.1/32
AS_PATH:              400
Connected footprints: 400:001

IPv4 prefix:          192.168.4.2/32
AS_PATH:              400
Connected footprints: 400:002

IPv4 prefix:          192.168.4.3/32
AS_PATH:              400
Connected footprints: 400:003
```

Each prefix will carry a different Footprint Identifier so that CDN4 can separate these advertisements.

Each CDN may also advertise a set of communities representing the capabilities of the CDN. It is possible for a transit CDN to manipulate the set of communities during its propagation. Example: a CDN, prior to propagate the connectivity advertisement of another CDN, may strip one or more capabilities from the original advertisement. This will allow to enforce a given path selection by upstream CDNs.

8. Compliance with CDNI Requirements

[I-D.ietf-cdni-requirements] outlines the requirements for the solution and interfaces to be specified by the CDNI working group. This section identifies the relevant requirements from that document and discusses compliance by the solution proposed in this document.

[Editor's Note: Text is to be added when requirements-03 is available. This needs to discuss the requirements labeled R27, R28, R29 and R30 as of requirements-02].

9. IANA Considerations

none

10. Security Considerations

This draft does not affect the BGP security model.

11. Acknowledgements

The authors would like to recognize Bruce Davie for his contributions.

12. References

12.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4760] Bates, T., Chandra, R., Katz, D., and Y. Rekhter, "Multiprotocol Extensions for BGP-4", RFC 4760, January 2007.

12.2. Informative References

[I-D.bertrand-cdni-use-cases]
Bertrand, G., Stephan, E., Watson, G., Burbridge, T., Eardley, P., and K. Ma, "Use Cases for Content Delivery Network Interconnection", draft-bertrand-cdni-use-cases-02 (work in progress), July 2011.

[I-D.davie-cdni-framework]
Davie, B. and L. Peterson, "Framework for CDN Interconnection", draft-davie-cdni-framework-00 (work in progress), July 2011.

[I-D.ietf-cdni-requirements]
Leung, K. and Y. Lee, "Content Distribution Network Interconnection (CDNI) Requirements", draft-ietf-cdni-requirements-01 (work in progress), October 2011.

[I-D.jenkins-cdni-problem-statement]
Niven-Jenkins, B., Faucheur, F., and N. Bitar, "Content Distribution Network Interconnection (CDNI) Problem Statement", draft-jenkins-cdni-problem-statement-02 (work in progress), March 2011.

Authors' Addresses

Stefano Previdi (editor)
Cisco Systems, Inc.
Via Del Serafico 200
Rome 00191
IT

Email: sprevidi@cisco.com

Francois Le Faucheur
Cisco Systems, Inc.
Greenside, 400 Avenue de Roumanille
Sophia Antipolis 06410
FR

Email: flefauch@cisco.com

Allan Guillou
SFR
40-42 Quai du Point du Jour
Boulogne-Billancourt 92659
FR

Email: allan.guillou@sfr.com

Jan Medved
Juniper Networks, Inc.
1194 N. Mathilda Ave.
Sunnyvale, CA 94089
US

Email: jmedved@juniper.net