           Content Distribution Network Interconnection (CDNI) Requirements
                    draft-ietf-cdni-requirements-03

Abstract

   Content Delivery Networks (CDNs) are frequently used for large-scale
   content delivery. As a result, existing CDN providers are scaling up
   their infrastructure and many Network Service Providers (NSPs) are
   deploying their own CDNs. There is a requirement 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. The Content Distribution Network
   Interconnection (CDNI) working group has been chartered to develop an
   interoperable and scalable solution for such CDN interconnection.

   The goal of the present document is to outline the requirements for
   the solution and interfaces to be specified by the CDNI working
   group. This draft is a work in progress and requirements may be
   added, modified, or removed by the working group.

Requirements Language

   The key words "High Priority", "Medium Priority" and "Low Priority"
   in this document are to be interpreted in the following way:

   o "High Priority" indicates requirements that are to be supported by
      the CDNI interfaces. A requirement is stated as "High Priority"
      when it is established by the working group that it can be met
      without compromising the targeted schedule for WG deliverables, or
      when it is established that specifying a solution without meeting
      this requirement would not make sense and would justify re-
      adjusting the WG schedule, or both. This is tagged as "[HIGH]".

   o "Medium Priority" indicates requirements that are to be supported
      by the CDNI interfaces unless the WG realizes at a later stage
      that attempting to meet this requirement would compromise the
      overall WG schedule (for example it would involve complexities
      that would result in significantly delaying the deliverables).
      This is tagged as "[MED]".

o "Low Priority" indicates requirements that are to be supported by
   the CDNI interfaces provided that dedicating WG resources to this
   work does not prevent addressing "High Priority" and "Medium
   Priority" requirements and that attempting to meet this
   requirement would not compromise the overall WG schedule. This is
   tagged as "[LOW]".

Status of this Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

   Internet-Drafts are working documents of the Internet Engineering
   Task Force (IETF). Note that other groups may also distribute
   working documents as Internet-Drafts. The list of current Internet-
   Drafts is at http://datatracker.ietf.org/drafts/current/.

   Internet-Drafts are draft documents valid for a maximum of six months
   and may be updated, replaced, or obsoleted by other documents at any
   time. It is inappropriate to use Internet-Drafts as reference
   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on December 7, 2012.

Copyright Notice

Table of Contents

1. Introduction

   The volume of video and multimedia content delivered over the
   Internet is rapidly increasing and expected to continue doing so in
   the future. In the face of this growth, Content Delivery Networks
   (CDNs) provide numerous benefits: reduced delivery cost for cacheable
   content, improved quality of experience for end users, and increased
   robustness of delivery. For these reasons CDNs are frequently used
   for large-scale content delivery. As a result, existing CDN
   providers are scaling up their infrastructure and many Network
   Service Providers (NSPs) are deploying their own CDNs. It is
   generally desirable that a given content item can be delivered to an
   End User regardless of that End User's location or attachment
   network. However, the footprint of a given CDN in charge of
   delivering a given content may not expand close enough to the End
   User's current location or attachment network to realize the cost
   benefit and user experience that a more distributed CDN would
   provide. This creates a requirement 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. The Content Distribution Network Interconnection
   (CDNI) working group has been chartered to develop an interoperable
   and scalable solution for such CDN interconnection.

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

   The goal of the present document is to document the requirements for
   the CDNI solution and interfaces. In order to meet the timelines
   defined in the working group charter, the present document
   categorizes the CDNI requirements as "High Priority", "Medium
   Priority", and "Low Priority".

1.1. Terminology

   This document uses the terminology defined in section 1.1 of
   [I-D.davie-cdni-framework].

2. CDNI Model and CDNI Interfaces

   For convenience Figure 1 from [I-D.davie-cdni-framework] illustrating
   the CDNI problem area and the CDNI protocols is replicated below.

```
       --------
      /        \
      |   CSP  |
      \        /
       --------
         *
         *
         *                            /\
         *                           /  \
     ---------------------      |CDNI|      ----------------------
    /     Upstream CDN     \    |    |     /    Downstream CDN     \
    |      +-------------+ | Control Interface| +-------------+      |
    |******* Control    |<======|====|=======>|   Control   *******|
    |*     +------*----*-+ |    |    |     | +-*----*------+     *|
    |*          *     *   |    |    |     | |  *     *          *|
    |*     +------*------+ | Logging Interface| +------*------+     *|
    |* ***** Logging    |<======|====|=======>|   Logging   ***** *|
    |* *   +-*-----------+ |    |    |     | +-----------*-+   * *|
    |* *     *         *  | Request Routing  |   *          *    * *|
.....*...+-*---------*-+ |    Interface     | +-*---------*-+...*.*...
. |* * *** Req-Routing |<======|====|=======>| Req-Routing *** * *| .
. |* * * +-------------+.|    |    |     | +-------------+ * * *| .
. |* * *                  .  CDNI Metadata  |                * * *| .
. |* * * +-------------+ |.   Interface      | +-------------+ * * *| .
. |* * * | Distribution|<==.===|====|=======>| Distribution| * * *| .
. |* * * |             | |  .  \  /       | |             | * * *| .
. |* * * |+---------+   | |  .   \/        | | +--------+| * * *| .
. |* * ***| +---------+| |   ....Request......+---------+ |*** * *| .
. |* *****+-|Surrogate|*********************|Surrogate|-+***** *| .
. |******* +---------+| |  Acquisition     | |+----------+ *******| .
. |     +-------------+ |                  | +-------*-----+     | .
. \                   /                    \        *           / .
.  ---------------------                    ---------*-----------  .
.                                                    *             .
.                                                    * Delivery    .
.                                                    *             .
.                                            +--*---+              .
...............Request............................| User |..Request..
                                             | Agent|
                                             +------+
```
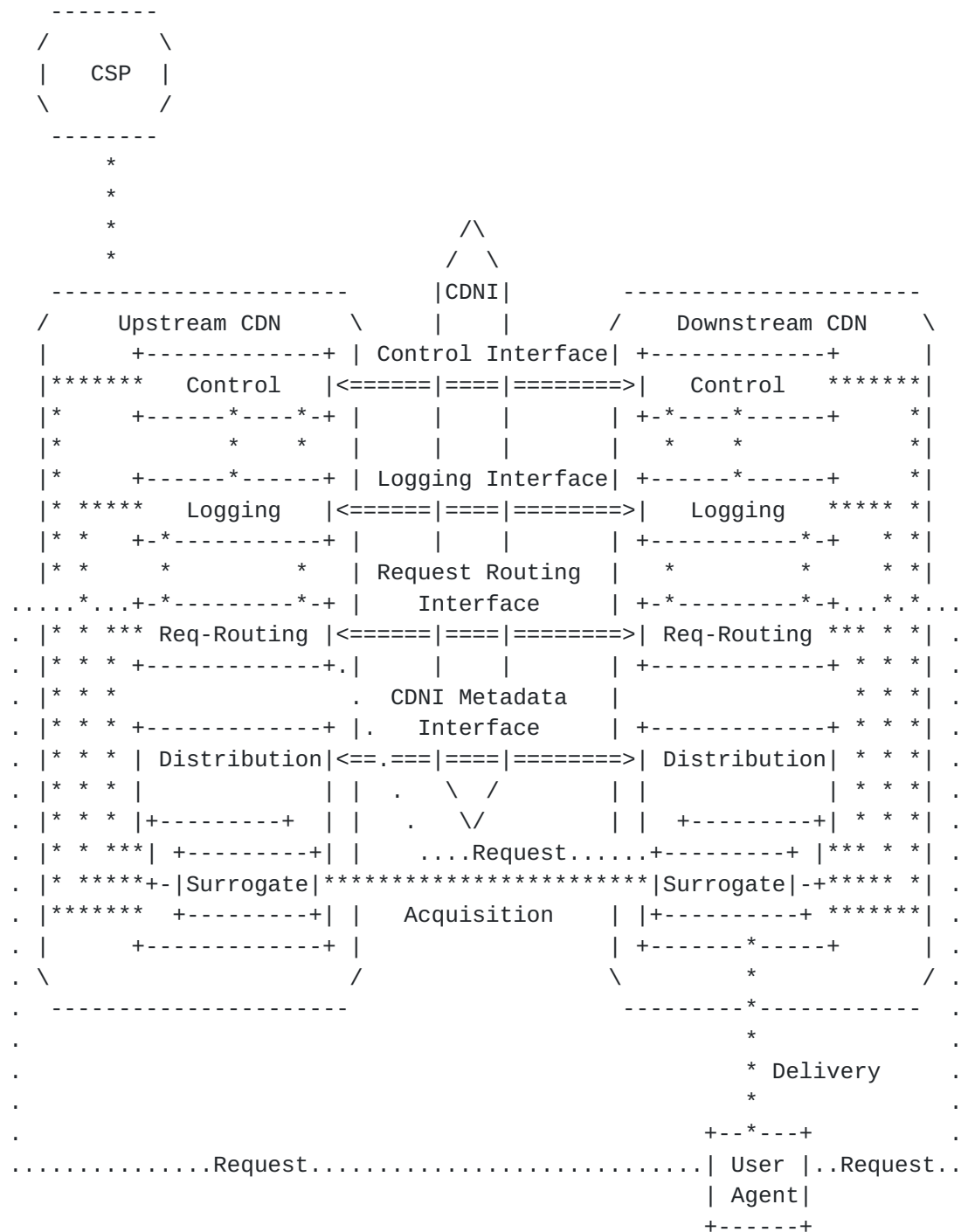
    <==> interfaces inside the scope of CDNI

    **** interfaces outside the scope of CDNI
    .... interfaces outside the scope of CDNI

                  Figure 1: CDNI Model and CDNI Interfaces

3. **Generic CDNI Requirements**

   This section identifies generic requirements independent of the
   individual CDNI interfaces. Some of those are expected to affect
   multiple or all interfaces.

   GEN-1   [MED] Wherever possible, the CDNI interfaces should reuse or
            leverage existing IETF protocols.

   GEN-2   [HIGH] The CDNI solution shall not require a change, or an
            upgrade, to the User Agent to benefit from content delivery
            through interconnected CDNs.

   GEN-3   [HIGH] The CDNI solution shall not require a change, or an
            upgrade, to the Content Service Provider to benefit from
            content delivery through interconnected CDNs.

   GEN-4   [HIGH] The CDNI solution shall not require intra-CDN
            information to be exposed to other CDNs for effective and
            efficient delivery of the content. Examples of intra-CDN
            information include surrogate topology, surrogate status,
            cached content, etc.

   GEN-5   [HIGH] The CDNI solution shall support delivery to the user
            agent based on HTTP [RFC2616]. (Note that while delivery and
            acquisition "data plane" protocols are out of the CDNI
            solution scope, the CDNI solution "control plane" protocols
            are expected to participate in enabling, selecting or
            facilitating operations of such acquisition and delivery
            protocols. Hence it is useful to state requirements on the
            CDNI solution in terms of which acquisition and delivery
            protocols).

   GEN-6   [HIGH] The CDNI solution shall support acquisition across
            CDNs based on HTTP [RFC2616].

   GEN-7   [LOW] The CDNI solution may support delivery to the user
            agent based on protocols other than HTTP.

   GEN-8   [LOW] The CDNI solution may support acquisition across CDNs
            based on protocols other than HTTP.

   GEN-9   [MED] The CDNI solution should support cascaded CDN
            redirection (CDN1 redirects to CDN2 that redirects to CDN3)
            to an arbitrary number of levels beyond the first level.

   GEN-10   [MED] The CDNI solution should support an arbitrary topology
            of interconnected CDNs (i.e. the CDN topology cannot be
            restricted to a tree, a loop-free topology, etc.).

   GEN-11   [HIGH] The CDNI solution shall prevent looping of any CDNI
            information exchange.

   GEN-12   [HIGH] When making use of third party reference, the CDNI
            solution shall consider the potential issues associated with
            the use of various format of third-party references (e.g.
            NAT or IPv4/IPv6 translation potentially breaking third-party
            references based on an IP addresses such as URI containing
            IPv4 or IPv6 address litterals, split DNS situations
            potentially breaking third-party references based on DNS
            fully qualified domain names) and wherever possible avoid,
            minimize or mitigate the associated risks based on the
            specifics of the environments where the reference is used
            (e.g. likely or unlikely presence of NAT in the path). In
            particular, this applies to situations where the CDNI
            solution needs to construct and convey uniform resource
            identifiers for directing/redirecting a content request, as
            well as to situations where the CDNI solution needs to pass
            on a third party reference (e.g. to identify a User Agent) in
            order to allow another entity to make a more informed
            decision (e.g. make a more informed request routing decision
            by attempting to derive location information from the third
            party reference).

      GEN-13

   GEN-14   [HIGH] The CDNI solution shall support HTTP Adaptive Bit Rate
            (ABR) content.

[4](#). **CDNI Control Interface Requirements**

   The primary purpose of the CDNI Control interface is to initiate the
   interconnection across CDNs, bootstrap the other CDNI interfaces and
   trigger actions into the Downstream CDN by the Upstream CDN (such as
   delete object from caches or trigger pre-positioned content
   acquisition). We observe that while the CDNI Control interface is
   currently discussed as a single "protocol", further analysis will
   determine whether the corresponding requirements are to be realized
   over a single interface and protocol, or over multiple interfaces and
   protocols.

CNTL-1   [HIGH] The CDNI Control interface shall allow the Upstream
          CDN to request that the Downstream CDN (and, if cascaded
          CDNs are supported by the solution, that the potential
          cascaded Downstream CDNs) perform the following actions on
          an object or object set:

          *   Mark an object or set of objects and/or its CDNI
               metadata as "stale" and revalidate them before they are
               delivered again

          *   Delete an object or set of objects and/or its CDNI
               metadata from the CDN surrogates and any storage. Only
               the object(s) and CDNI metadata that pertain to the
               requesting Upstream CDN are allowed to be purged.

CNTL-2   [HIGH] The CDNI Control interface shall allow the Downstream
          CDN to report on the completion of these actions (by itself,
          and if cascaded CDNs are supported by the solution, by
          potential cascaded Downstream CDNs), in a manner appropriate
          for the action (e.g. synchronously or asynchronously). The
          confirmation receipt should include a success or failure
          indication. The failure indication is used if the
          Downstream CDN cannot delete the content in its storage.

CNTL-3   [HIGH] The CDNI Control interface shall support initiation
          and control by the Upstream CDN of pre-positioned CDNI
          metadata acquisition by the Downstream CDN.

CNTL-4   [MED] The CDNI Control interface should support initiation
          and control by the Upstream CDN of pre-positioned content
          acquisition by the Downstream CDN.

CNTL-5   [LOW] The CDNI Control interface may allow a CDN to
          establish, update and terminate a CDN interconnection with
          another CDN whereby one CDN can act as a Downstream CDN for
          the other CDN (that acts as an Upstream CDN).

CNTL-6   [LOW] The CDNI Control interface may allow control of the
          CDNI interconnection between any two CDNs independently for
          each direction (i.e. For the direction where CDN1 is the
          Upstream CDN and CDN2 is the Downstream CDN, and for the
          direction where CDN2 is the Upstream CDN and CDN1 is the
          Downstream CDN).

CNTL-7   [LOW] The CDNI Control interface may allow bootstrapping of
          the Request-Routing interface. For example, this can
          potentially include:

                 *   negotiation of the Request-Routing method (e.g. DNS vs
                     HTTP, if more than one method is specified)

                 *   discovery of the Request-Routing protocol endpoints

                 *   information necessary to establish secure communication
                     between the Request-Routing protocol endpoints.

      CNTL-8   [LOW] The CDNI Control interface may allow bootstrapping of
               the CDNI Metadata interface. This information could, for
               example, include:

                 *   discovery of the CDNI Metadata signaling protocol
                     endpoints

                 *   information necessary to establish secure communication
                     between the CDNI Metadata signaling protocol endpoints.

      CNTL-9   [LOW] The CDNI Control interface may allow bootstrapping of
               the Content Acquisition interface. This could, for example,
               include exchange and negotiation of the Content Acquisition
               protocols to be used across the CDNs (e.g. HTTP, HTTPS,
               FTP, ATIS C2).

      CNTL-10 [LOW] The CDNI Control interface may allow exchange and
               negotiation of delivery authorization mechanisms to be
               supported across the CDNs (e.g. URI signature based
               validation).

      CNTL-11 [LOW] The CDNI Control interface may allow bootstrapping of
               the CDNI Logging interface. This information could, for
               example, include:

                 *   discovery of the Logging protocol endpoints

                 *   information necessary to establish secure communication
                     between the Logging protocol endpoints

                 *   negotiation/definition of the log file format and set of
                     fields to be exported through the Logging protocol, with
                     some granularity (e.g. On a per content type basis).

                 *   negotiation/definition of parameters related to
                     transaction Logs export (e.g., export protocol, file
                     compression, export frequency, directory).

5. **CDNI Request Routing Interface Requirements**

   The main function of the Request Routing interface is to allow the
   Request-Routing systems in interconnected CDNs to communicate to
   facilitate redirection of the request across CDNs.

   REQ-1   [HIGH] The CDNI Request-Routing interface shall allow the
            Downstream CDN to communicate to the Upstream CDN coarse
            information about the Downstream CDN ability and/or
            willingness to handle requests from the Upstream CDN. For
            example, this could potentially include a binary signal
            ("Downstream CDN ready/not-ready to take additional requests
            from Upstream CDN") to be used in case of excessive load or
            failure condition in the Downstream CDN.

   REQ-2   [MED] The CDNI Request-Routing interface should allow the
            Downstream CDN to communicate to the Upstream CDN aggregate
            information to facilitate CDN selection during request
            routing, such as Downstream CDN capabilities, resources and
            affinities (i.e. Preferences or cost). This information
            could, for example, include:

            *   supported content types and delivery protocols

            *   footprint (e.g. layer-3 coverage)

            *   a set of metrics/attributes (e.g. Streaming bandwidth,
                 storage resources, distribution and delivery priority)

            *   a set of affinities (e.g. Preferences, indication of
                 distribution/delivery fees)

            *   information to facilitate request redirection (e.g.
                 Reachability information of Downstream CDN Request
                 Routing system).

            [Note: Some of this information - such as supported content
            types and delivery protocols- may also potentially be taken
            into account by the distribution system in the Upstream CDN
            for pre-positioning of content and/or metadata in the
            Downstream CDN in case of pre-positioned content acquisition
            and/or pre-positioned CDNI metadata acquisition.]

   REQ-3   [MED] In the case of cascaded redirection, the CDNI Request-
            Routing interface shall allow the Downstream CDN to also
            include in the information communicated to the Upstream CDN,
            information on the capabilities, resources and affinities of
            CDNs to which the Downstream CDN may (in turn) redirect

requests received by the Upstream CDN. In that case, the
CDNI Request-Routing interface shall prevent looping of such
information exchange.

REQ-4   [LOW] The CDNI Request-Routing interface may allow the
        Downstream CDN to communicate to the Upstream CDN aggregate
        information on CDNI administrative limits and policy. This
        information can be taken into account by the Upstream CDN
        Request Routing system in its CDN Selection decisions. This
        information could, for example, include:

        *   maximum number of requests redirected by the Upstream CDN
            to be served simultaneously by the Downstream CDN

        *   maximum aggregate volume of content (e.g. in Terabytes)
            to be delivered by the Downstream CDN over a time period.

REQ-5   [HIGH] The CDNI Request-Routing architecture and interface
        shall support efficient request-routing for small objects.
        This may, for example, call for a mode of operation (e.g.
        DNS-based request routing) where freshness and accuracy of
        CDN/Surrogate selection can be traded-off against reduced
        request-routing load (e.g. Via lighter-weight queries and
        caching of request-routing decisions).

REQ-6   [HIGH] The CDNI Request-Routing architecture and interface
        shall support efficient request-routing for large objects.
        This may, for example, call for a mode of operation (e.g.
        HTTP-based request routing) where freshness and accuracy of
        CDN/Surrogate selection justifies a per-request decision and
        a per-request CDNI Request-Routing protocol call.

REQ-7   [HIGH] The CDNI Request-Routing architecture shall support
        recursive CDNI request routing.

REQ-8   [HIGH] The CDNI Request-Routing architecture shall support
        iterative CDNI request routing.

REQ-9   [MED] In case of detection of a request redirection loop, the
        CDNI Request-Routing loop prevention mechanism should allow
        routing of the request by avoiding the loop (as opposed to
        the request loop being simply interrupted without routing the
        request).

REQ-10 [MED] The CDNI Request-Routing protocol should support a
        mechanism allowing enforcment of a limit on the number of
        successive CDN redirections for a given request.

REQ-11   [LOW] The CDNI Request-Routing protocol may support a
         mechanism allowing an Upstream CDN to avoid redirecting a
         request to a Downstream CDN if that is likely to result in
         the total redirection time exceeding some limit.

REQ-12   [HIGH] The CDNI Request-Routing protocol shall allow the
         Upstream CDN to include, in the query to the Downstream CDN,
         the necessary information to allow the Downstream CDN to
         process the redirection query. This could, for example,
         include:

         *   information from which the location of the user-agent
              that originated the request can be inferred (e.g. User
              Agent fully qualified domain name in case of HTTP-based
              Request Routing, DNS Proxy fully qualified domain name in
              case of DNS-based Request Routing)

         *   requested resource information (e.g. Resource URI in
              case of HTTP-based Request Routing, Resource hostname in
              case of DNS-based Request Routing)

         *   additional available request information (e.g. request
              headers in case of HTTP-based Request Routing).

REQ-13   [LOW] The CDNI Request-Routing protocol may also allow the
         Upstream CDN to convey information pointing to CDNI metadata
         applicable (individually or through inheritance) to the
         requested content. For illustration, the CDNI metadata
         pointed to could potentially include metadata that is
         applicable to any content, metadata that is applicable to a
         content collection (to which the requested content belongs)
         and/or metadata that is applicable individually to the
         requested content.

REQ-14   [HIGH] The CDNI Request-Routing interface shall allow the
         Downstream CDN to include the following information in the
         response to the Upstream CDN:

         *   status code, in particular indicating acceptance or
              rejection of request (e.g. Because the Downstream CDN is
              unwilling or unable to serve the request). In case of
              rejection, an error code is also to be provided, which
              allows the Upstream CDN to react appropriately (e.g.
              Select another Downstream CDN, or serve the request
              itself)

         *   redirection information (e.g. Resource URI in case of
              HTTP-based Request Routing, equivalent of a DNS record in

case of DNS-based Request Routing).

6. CDNI Metadata Distribution Interface Requirements

The primary function of the CDNI Metadata Distribution interface is
to allow the Distribution system in interconnected CDNs to
communicate to ensure Content Distribution Metadata with inter-CDN
scope can be exchanged across CDNs. We observe that while the CDNI
Metadata Distribution protocol is currently discussed as a single
"protocol", further analysis will determine whether the corresponding
requirements are to be realized over a single interface and protocol,
or over multiple interfaces and protocols. For example, a subset of
the CDNI metadata might be conveyed in-band along with the actual
content acquisition across CDNs (e.g. content MD5 in HTTP header)
while another subset might require an out-of-band interface &
protocol (e.g. geo-blocking information).

META-1   [HIGH] The CDNI Metadata Distribution interface shall allow
          the Upstream CDN to provide the Downstream CDN with content
          distribution metadata of inter-CDN scope.

META-2   [HIGH] The CDNI Metadata Distribution interface shall
          support exchange of CDNI metadata for both the dynamic
          content acquisition model and the pre-positioning content
          acquisition model.

META-3   [HIGH] The CDNI Metadata Distribution interface shall
          support a mode where no, or a subset of, the Metadata is
          initially communicated to the Downstream CDN along with
          information about how/where to acquire the rest of the CDNI
          Metadata (i.e. Dynamic CDNI metadata acquisition).

META-4   [MED] The CDNI Metadata Distribution interface should
          support a mode where all the relevant Metadata is initially
          communicated to the Downstream CDN (i.e. Pre-positioned
          CDNI metadata acquisition).

META-5   [HIGH] Whether in the pre-positioned content acquisition
          model or in the dynamic content acquisition model, the CDNI
          Metadata Distribution interface shall provide the necessary
          information to allow the Downstream CDN to acquire the
          content from an upstream source (e.g. Acquisition protocol
          and Uniform Resource Identifier in Upstream CDN- or rules to
          construct this URI).

META-6   [HIGH] The CDNI metadata shall allow signaling of one or
          more upstream sources, where each upstream source can be in
          the Upstream CDN, in another CDN, the CSP origin server or
          any arbitrary source designated by the Upstream CDN. Note
          that some upstream sources (e.g. the content origin server)
          may or may not be willing to serve the content to the
          Downstream CDN, if this policy is known to the Upstream CDN
          then it may omit those sources when exchanging CDNI
          metadata.

META-7   [HIGH] The CDNI Metadata Distribution interface shall allow
          the Upstream CDN to request addition and modification of
          CDNI Metadata into the Downstream CDN.

META-8   [HIGH] The CDNI Metadata Distribution interface shall allow
          removal of obsolete CDNI Metadata from the Downstream CDN
          (this could, for example, be achieved via an explicit
          removal request from the Upstream CDN or via expiration of a
          Time-To-Live associated to the Metadata).

META-9   [HIGH] The CDNI Metadata Distribution interface shall allow
          association of CDNI Metadata at the granularity of
          individual object. This is necessary to achieve fine-grain
          Metadata distribution at the level of an individual object
          when necessary.

META-10   [HIGH] The CDNI Metadata Distribution interface shall allow
          association of CDNI Metadata at the granularity of an object
          set. This is necessary to achieve scalable distribution of
          metadata when a large number of objects share the same
          distribution policy.

META-11   [HIGH] The CDNI Metadata Distribution interface shall
          support multiple levels of inheritance with precedence to
          more specific metadata. For example, the CDNI Metadata
          Distribution protocol may support metadata that is
          applicable to any content, metadata that is applicable to a
          content collection and metadata that is applicable to an
          individual content where content level metadata overrides
          content collection metadata that overrides metadata for any
          content.

META-12   [HIGH] The CDNI Metadata Distribution interface shall ensure
          that conflicting metadata with overlapping scope are
          prevented or deterministically handled.

   META-13 [HIGH] The CDNI Metadata Distribution interface shall
            provide indication by the Downstream CDN to the Upstream CDN
            of whether the CDNI metadata (and corresponding future
            request redirections) is accepted or rejected. When
            rejected, the CDNI Metadata Distribution protocol Must allow
            the Downstream CDN to provide information about the cause of
            the rejection.

   META-14 [HIGH] The CDNI Metadata Distribution interface shall allow
            signaling of content distribution control policies. For
            example, this could potentially include:

            *   geo-blocking information (i.e. Information defining
                geographical areas where the content is to be made
                available or blocked)

            *   availability windows (i.e. Information defining time
                windows during which the content is to be made available
                or blocked; expiration time may also be included to
                remove content)

            *   delegation whitelist/blacklist (i.e. Information
                defining which Downstream CDNs the content may/may not
                be delivered through)

   META-15 [HIGH] The CDNI Metadata interface shall be able to exchange
            a set of well-accepted metadata elements with specified
            semantics (e.g. start of time window, end of time window).

   META-16 [HIGH] The CDNI Metadata interface shall allow exchange of
            opaque metadata element, whose semantic is not defined in
            CDNI but established by private CDN agreement.

   META-17 [HIGH] The CDNI Metadata Distribution interface shall allow
            signaling of authorization checks and validation that are to
            be performed by the surrogate before delivery. For example,
            this could potentially include:

            *   need to validate URI signed information (e.g. Expiry
                time, Client IP address).

   META-18 [LOW] The CDNI Metadata Distribution interface may allow
            signaling of CDNI-relevant surrogate cache behavior
            parameters. For example, this could potentially include:

            *   control of whether the query string of HTTP URI is to be
                ignored by surrogate cache

                    *   content revalidation parameters (e.g. TTL)

7. **CDNI Logging Interface Requirements**

   This section identifies the requirements related to the CDNI Logging
   interface. We observe that while the CDNI Logging interface is
   currently discussed as a single "protocol", further analysis will
   determine whether the corresponding requirements are to be realized
   over a single interface and protocol, or over multiple interfaces and
   protocols.

   LOG-1   [HIGH] The CDNI logging architecture and interface shall
            ensure reliable logging of CDNI events.

   LOG-2   [HIGH] The CDNI Logging interface shall provide logging of
            deliveries and incomplete deliveries to User Agents performed
            by the Downstream CDN as a result of request redirection by
            the Upstream CDN.

   LOG-3   [MED] In the case of cascaded CDNs, the CDNI Logging
            interface shall allow the Downstream CDN to report to the
            Upstream CDN logging for deliveries and incomplete deliveries
            performed by the Downstream CDN itself as well as logging for
            deliveries and incomplete deliveries performed by cascaded
            CDNs on behalf of the Downstream CDN.

   LOG-4   [HIGH] The CDNI Logging interface shall provide logging of
            distribution performed by the Upstream CDN as a result of
            acquisition request by the Downstream CDN.

   LOG-5   [HIGH] The CDNI Logging interface shall support batch/offline
            exchange of logging records.

   LOG-6   [MED] The CDNI Logging interface should also support
            additional timing constraints for some types of logging
            records (e.g. near-real time for monitoring and analytics
            applications)

   LOG-7   [HIGH] The CDNI Logging interface shall define a log file
            format and a set of fields to be exported through the Logging
            protocol, with some granularity (e.g. On a per content type
            basis).

   LOG-8   [HIGH] The CDNI Logging interface shall define a transport
            mechanisms to exchange CDNI Logging files.

   LOG-9   [MED] The CDNI Logging interface may allow a CDN to query
            another CDN for relevant current logging records (e.g. For
            on-demand access to real-time logging information).

   LOG-10   [LOW] The CDNI Logging interface may support aggregate/
            summarized logs (e.g. total bytes delivered for a content
            regardless of individual User Agents to which it was
            delivered).

   LOG-11   [LOW] The CDNI Logging interface shall support logging of
            performance data for deliveries to User Agents performed by
            the Downstream CDN as a result of request redirection by the
            Upstream CDN. Performance data may include various traffic
            statistics (the specific parameters are to be determined).
            The CDNI Logging interface shall support the Upstream CDN to
            indicate the nature and contents of the performance data to
            be reported by the Downstream CDN.

   LOG-12   [MED] The CDNI Logging interface shall support logging of
            consumed resources (e.g. storage, bandwidth) to the Upstream
            CDN for deliveries where content is stored by the Downstream
            CDN for delivery to User Agents. The information logged may
            include the type of storage (e.g., Origin, Intermediate,
            Edge, Cache) as well as the amount of storage (e.g., total
            GB, GB used, per time period, per content domain) all of
            which may impact the cost of the services.

   LOG-13   [MED] In the case of cascaded CDNs, the CDNI Logging
            interface shall support the Downstream CDN to report consumed
            resources (e.g. storage, bandwidth) to the Upstream CDN where
            content is stored by the Downstream CDN itself as well as
            logging for storage resources when content storage is
            performed by cascaded CDNs on behalf of the Downstream CDN.

   LOG-14   [HIGH] The CDNI Logging interface shall support logging of
            deleted objects from the Downstream CDN to the Upstream CDN
            as a result of explicit delete requests on via the CDNI
            Control interface from the Upstream CDN.

   LOG-15   [HIGH] The CDNI Logging interface shall support extensibility
            to allow proprietary information fields to be carried. These
            information fields must be agreed upon ahead of time between
            the corresponding CDNs.

   LOG-16   [HIGH] The CDNI Logging interface shall support the exchange
            of extensible log file formats to support proprietary
            information fields. These information fields must be agreed
            upon ahead of time between the corresponding CDNs.

8. **CDNI Security Requirements**

   This section identifies the requirements related to the CDNI
   security. Some of those are expected to affect multiple or all
   protocols.

   SEC-1 [HIGH] All the CDNI interface shall support secure operation
          over unsecured IP connectivity (e.g. The Internet). This
          includes authentication, confidentiality, integrity protection
          as well as protection against spoofing and replay.

   SEC-2 [HIGH] The CDNI solution shall provide sufficient protection
          against Denial of Service attacks. This includes protection
          against spoofed delivery requests sent by user agents directly
          to a Downstream CDN attempting to appear as if they had been
          redirected by a given Upstream CDN when they have not.

   SEC-3 [MED] The CDNI solution should be able to ensure that for any
          given request redirected to a Downstream CDN, the chain of CDN
          Delegation (leading to that request being served by that CDN)
          can be established with non-repudiation.

   SEC-4 [MED] The CDNI solution should be able to ensure that the
          Downstream CDN cannot spoof a transaction log attempting to
          appear as if it corresponds to a request redirected by a given
          Upstream CDN when that request has not been redirected by this
          Upstream CDN. This ensures non-repudiation by the Upstream
          CDN of transaction logs generated by the Downstream CDN for
          deliveries performed by the Downstream CDN on behalf of the
          Upstream CDN.

   SEC-5 [LOW] The CDNI solution may provide a mechanism allowing an
          Upstream CDN that has credentials to acquire content from the
          CSP origin server (or another CDN), to allow establishment of
          credentials authorizing the Downstream CDN to acquire the
          content from the CSP origin server (or the other CDN) (e.g.
          In case the content cannot be acquired from the Upstream CDN).

9. **IANA Considerations**

   This document makes no request of IANA.

   Note to RFC Editor: this section may be removed on publication as an
   RFC.

10. Security Considerations

   This document discusses CDNI security requirements in Section 8.

11. Authors

   This document reflects the contributions from the following authors:

   Francois Le Faucheur

      Cisco Systems

      flefauch@cisco.com

   Mahesh Viveganandhan

      Cisco Systems

      mvittal@cisco.com

   Grant Watson

      BT

      grant.watson@bt.com

12. Acknowledgements

   This document leverages the earlier work of the IETF CDI working
   group in particular as documented in [I-D.cain-request-routing-req],
   [I-D.amini-cdi-distribution-reqs] and [I-D.gilletti-cdnp-aaa-reqs].

   The authors would like to thank Gilles Bertrand, Christophe Caillet,
   Bruce Davie, Phil Eardly, Ben Niven-Jenkins, Agustin Schapira, Emile
   Stephan, Eric Burger, Susan He, Kevin Ma, and Daryl Malas for their
   input. Serge Manning along with Robert Streijl, Vishwa Prasad, Percy
   Tarapore, Mike Geller, and Ramki Krishnan contributed to this
   document by addressing the requirements of the ATIS Cloud Services
   Forum.

13. References

13.1. Normative References

   [I-D.davie-cdni-framework]
              Davie, B. and L. Peterson, "Framework for CDN
              Interconnection", draft-davie-cdni-framework-01 (work in
              progress), October 2011.

   [I-D.ietf-cdni-problem-statement]
              Niven-Jenkins, B., Faucheur, F., and N. Bitar, "Content
              Distribution Network Interconnection (CDNI) Problem
              Statement", draft-ietf-cdni-problem-statement-06 (work in
              progress), May 2012.

   [I-D.ietf-cdni-use-cases]
              Bertrand, G., Emile, S., Burbridge, T., Eardley, P., Ma,
              K., and G. Watson, "Use Cases for Content Delivery Network
              Interconnection", draft-ietf-cdni-use-cases-06 (work in
              progress), May 2012.

   [RFC2616] Fielding, R., Gettys, J., Mogul, J., Frystyk, H.,
              Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext
              Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999.

13.2. Informative References

   [I-D.amini-cdi-distribution-reqs]
              Amini, L., "Distribution Requirements for Content
              Internetworking", draft-amini-cdi-distribution-reqs-02
              (work in progress), November 2001.

   [I-D.cain-request-routing-req]
              Cain, B., "Request Routing Requirements for Content
              Internetworking", draft-cain-request-routing-req-03 (work
              in progress), November 2001.

   [I-D.gilletti-cdnp-aaa-reqs]
              "CDI AAA Requirements,
              draft-gilletti-cdnp-aaa-reqs-01.txt", June 2001.

Authors' Addresses

    Kent Leung (editor)
    Cisco Systems
    170 West Tasman Drive
    San Jose, CA 95134
    U.S.A.

    Phone: +1 408 526 5030
    Email: kleung@cisco.com

    Yiu Lee (editor)
    Comcast
    One Comcast Center
    Philadelphia, PA 19103
    U.S.A.

    Email: yiu_lee@cable.comcast.com