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Use Cases for Content Distribution Network Interconnection
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Abstract

This document depicts use cases for content delivery network (CDN) interconnection based on Orange experiments. The use cases are divided in the two following categories. Category 1 use cases present situations that require a footprint extension for existing CDNs. Category 2 use cases include additional situations where CDN interconnection would be desirable in a longer term.

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Table of Contents

1. Introduction

This document depicts use cases for content delivery network (CDN) interconnection based on Orange experiments. The use cases are divided in the two following categories. Category 1 use cases present situations that require a footprint extension for existing CDNs. Category 2 use cases include additional situations where CDN interconnection would be desirable in a longer term.

The present document complements [I-D.watson-cdni-use-cases]. The two drafts will be merged during the next weeks.

1.1. Terminology

Except for the terms defined below, we adopt the terminology described in [RFC3466], [RFC3568], and [RFC3570].

Problem statement draft [I-D.jenkins-cdni-problem-statement] defines a set of terms. Below we recall only the terms used in the memo.

Content Service Provider (CSP):

Provides Content Services to Users. A CSP may own the content made available as part of the Content Service, or may license content rights from another party.

Content Service:

The service offered by a CSP. The Content Service encompasses the complete service which may be wider than just the delivery of items of Content, e.g. the Content Service also includes any middle-ware, key distribution, program guide, etc. which may not require any direct interaction with the CDN.

Content Distribution Network (CDN) / Content Delivery Network (CDN):

A type of network in which the components are arranged for more effective delivery of content to User Agents.

Content Delivery Service

Set of services offered to CSPs for delivering their contents through a single Content Delivery Network or a federation of Content Delivery Networks.

CDN Service Provider (CDSP):

An administrative entity who operates a CDN over a NSP or over the

Internet.

CDN federation

Set of CDNs that maintain a CDNI relationship to one another. The federation of CDNs can interconnect CDNs operated by the same CDSP or operated by distinct CDSPs.

Authoritative CDN (aCDN):

The CDSP contracted by the CSP for delivery of contents by this CDN or by its downstream dCDNs.

Downstream CDN (dCDN):

A CDSP which is contacted by an aCDN to achieve the delivery of content to users.

Access CDN

A CDN that is the connected to the end-user's access and has information about the end-user's access capabilities and profile.

Delivering CDN

The CDN that delivers the requested content asset to the end-user. In particular, the delivering CDN can be an access CDN.

CDN Interconnection(CDNI):

Relationship between two CDNs that enables a CDN to provide content delivery services on behalf of another CDN. It relies on a set of interfaces over which two CDNs communicate in order to achieve the delivery of content to users by one CDN (the downstream CDN) on behalf of another CDN (the upstream CDN).

1.2. Acronyms

[Ed. Note: List of acronyms to be updated later]

- ISP
- NSP
- STB
- PC

- QoS QoE VoD WiFi 3G

2. High Level Use Cases for Multi-CDN Systems

The prevalent use cases for CDNI are presented according to the CDSPs main reason for interconnecting their CDNs. They are classified according to their level of priority for the CDSPs.

The CDNI model helps at building a federation of Content Delivery Networks that collaborate, allowing Content Delivery Service Providers to offer Content Service Providers a set of consistent delivery services throughout the CDN Federation. Let's take an example. CDSP A and B respectively operate CDNa and CDNb. They establish a CDNI relationship for building a CDN federation CDNa-b that consists of CDNa and CDNb. CDSP A reaches an agreement with content service provider CSPa. CDSPa services rely on the CDN federation CDNa-b. Meanwhile, CDSP B reaches an agreement with content service provider CSPb. These services also rely on the CDN federation CDNa-b.

2.1. Footprint Extension Use Cases

2.1.1. CDN Interconnection inside one CDSP

A Large Content delivery service provider (CDSP) operates the CDNs of a set of subsidiaries from different countries, and these CDNs can rely on different CDN solutions. To provide a consistent service to his customers on its whole footprint, in certain circumstances, the CDSP needs to make its CDNs interoperate.

Note that currently, the distribution of some content is restricted. For instance, distribution rights for audiovisual content are often negotiated per country.

[Ed. Note: FIGURE TO BE INCLUDED]

Figure 1: [Ed. Note: Legend to be added]

2.1.2. CDN Interconnection between CDSPs

Several CDSPs have a geographically limited footprint (e.g., a country), or do not serve all end-users in a geographic area. Interconnecting CDNs enables CDSPs to provide their services beyond their own footprint by relying on other CDNs.

End-users in various countries access TV shows episodes. The CSP that distributes the TV show asks a French CDSP to deliver the serie to several countries. The French CDSP make an agreement with an external CDSP that covers North Africa to provide a CDN service for France and North Africa.

This use case applies to other types of contents like automatic software updates (browser updates, operating system patches, or virus database update...).

2.2. Additional Potential Use Cases

2.2.1. CDN Interconnection for CDN Overload Handling

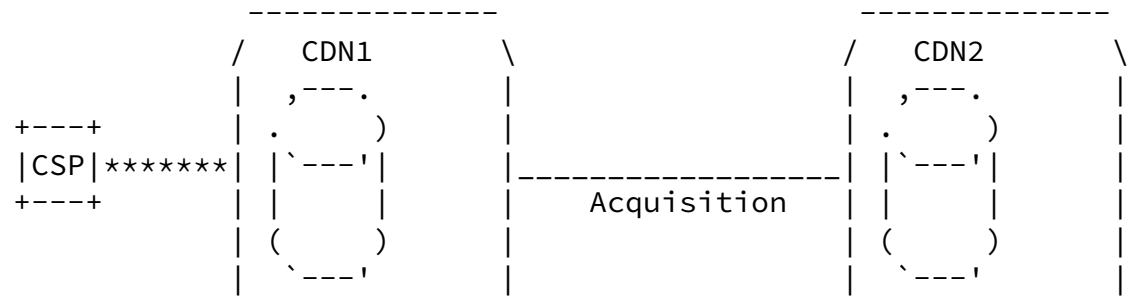
The support of prime time traffic load requires overdimensioning the

CDNs. However, prime time of content distribution may differ between two CDNs. Therefore, two CDNs may benefit from dimensioning savings by using resources of the other CDN during the prime time.

During a traffic peak, a CDSP redirects some traffic load toward another CDSP (for instance, geographically close).

2.2.2. CDN Interconnection for CDN Resiliency

It is important for CDNs to be able to guarantee service continuity during partial failures (e.g., failure of a set of surrogates). In partial failure scenarios, a CDSP could redirect some requests toward another CDN. This downstream CDN must be able to serve the redirected requests or, depending on traffic management policies, to forward these requests to the CSP origin server.



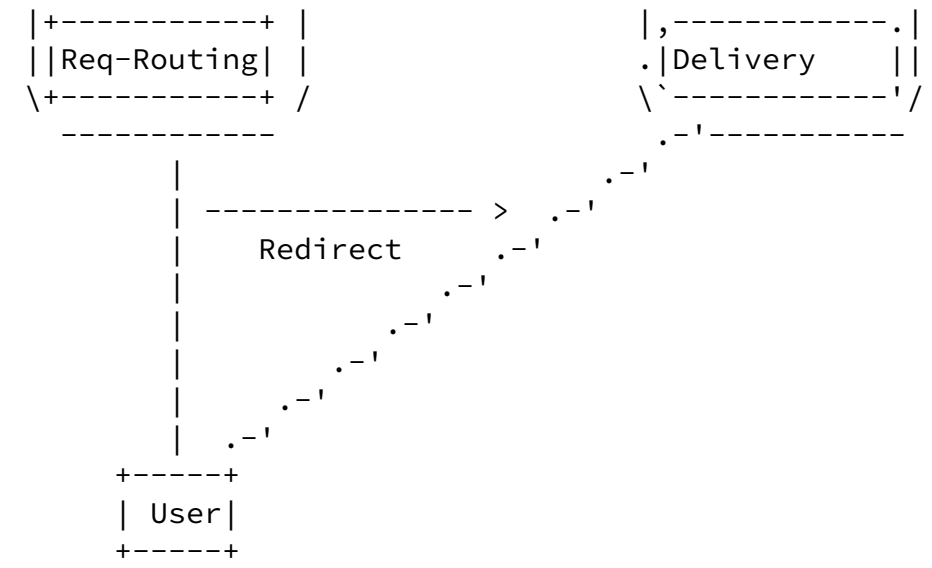


Figure 3: Example of CDN Interconnection for failure resiliency

2.2.3. Inter-Silos CDN Interconnection inside one CDSP

ISPs deployed platforms per service or per network technology. They are deploying CDNs or enhancing existing platforms to CDN. It is desirable in certain circumstances to share the content or the resources among these CDNs.

It is desirable to have the ability to provide content to different terminals and through different access technologies, possibly served by different CDNs. As depicted in Figure 2, an end-user can use his tablet to download a VoD through WiFi (1) from CDN1 and then switch to 3G network (2), which is served by CDN2. The end user should be able to access the selected VoD content through any access network technology. Consequently, every considered CDN must have access to this VoD content. One way to proceed consists in having an ingestion interface among the CDNs to access the content.

Replication of the requested VoD content in the CDN serving the terminal (a) enables controlling the QoS of the VoD distribution to the terminal used by the end-user. In another situation, the serving of the CoD without replication (b) will save storage resources.

The end-user's experience improves thanks to an increase of the

number of situations where the end-user can access the service.

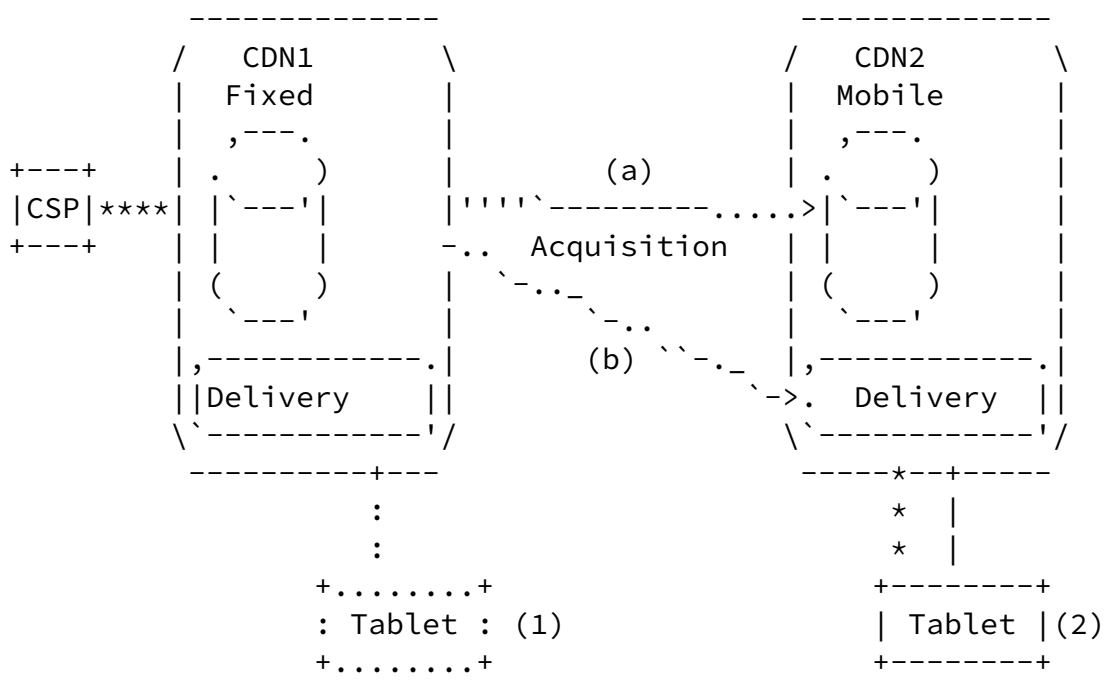


Figure 2: Example of Inter-Silos CDN Interconnection

3. Experiment with Existing CDN Solutions and Lessons Learned

3.1. Description of the Experiments

To illustrate the realism of the short term scenario described in previous sections, we present here the summary of some of our CDNI experiments. These experiments will be further detailed in a separate draft.

We have interconnected two CDNs (CDN A and CDN B)operated by different subsidiaries of a large CDSP. The CDNs cover two different countries henceforth referred to as Country A and Country B. The CDNI experiment supported the services of two CSPs (CSP A and CSP B).

In our first experiment, CSP A has an agreement with CDN A for content delivery to end-users located in Country A and Country B. CDN A has an agreement with CDN B, so that CDN A can delegate to CDN B the delivery of content from CSP A to end-users located in Country B. When CDN A receives a content request related to CSP A and from an

end-user in Country B, it redirects the end-user to the appropriate content on CDN B. If CDN B does not have a local copy of the requested content yet (cache miss), CDN B ingests the content from CDN A. If CDN A does neither have a local copy of the requested content, it requests it from the CSP's origin servers before sending it to CDN B.

In our second experiment, CSP B has an agreement with CDN B for content delivery to end-users located in Country A and Country B. CDN B has an agreement with CDN A, so that CDN B can delegate to CDN A the delivery of content from CSP B to end-users located in Country A. When CDN B receives a content request related to CSP B and from an end-user in Country A, it redirects the end-user to the appropriate content on CDN A. If CDN A does not have a local copy of the requested content yet (cache miss), it requests the content directly from the CSP's origin servers.

The differences between the two experiments above are the ingestion operations and the roles of CDN A and B, which rely on CDN solutions from different vendors.

3.2. Gaps in Existing Solutions and Need for Specifications

Our experiments have shown that the current CDN technologies suffer from the following limitations.

- The content management policies must be defined manually.
- The target URLs for the request redirection must also be defined manually.
- The content ingestion worked only in pull mode...

To address more sophisticated scenarios, we consider that common interfaces are required for request routing among interconnected CDNs and for the exchange of content distribution metadata.

4. Acknowledgments

The authors would like to thank the contributors of the EU FP7 OCEAN project for valuable input and discussions.

5. IANA Considerations

This memo includes no request to IANA.

6. Security Considerations

CDN interconnect, as described in this document, has a wide variety of security issues that should be considered. For example, every interconnected CDN should be able to assess if it must serve a delegated request or if this request is delegated by a non-allowed CDN. The CDNs should also be protected so as to avoid being overwhelmed by delegated requests. This document focuses on the technical use cases for CDN interconnect, and therefore, does not analyze the threats in details.

7. References

7.1. Normative References

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

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