Demonstration of Standard IPTV Content Delivery Network Architecture Interfaces

Prototype of standardized IPTV unicast content delivery server selection mechanisms

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Abstract— **In this document we suggest a demonstration of standard SIP/RTSP based Content Delivery Networks (CDN). The intended use of SIP based CDNs is in the scope of IMS based IPTV architectures that are being standardized in the Open IPTV Forum [1], ESTI-TISPAN and the ITU-T. The system includes a central server (Content Delivery Network Controller) analyzing all received content delivery requests. The Content Delivery Network Controller chooses the cluster of servers a request should be redirected to. The choice is made depending on client location, content availability, location and servers' global load. Each cluster is controlled by a Cluster Controller that would make the choice of the final VoD server to deliver the content, based on a fine grained analysis of the load of the VoD servers it manages. The system proves the feasibility of the standards and highlights the flexibility of SIP [1] interfaces when coupled with RTSP [2] to organize redirections within a CDN.**

Keywords: IPTV, CDN, VoD, load balancing, SIP, RTSP, IMS

I. INTRODUCTION

The success of IPTV services highly depends on the quality experienced by the end user. The quality of experience is closely related to the quality of service parameters of the provider's network and service infrastructure. Considering the high bandwidth requirements of IPTV services and geographical dispersion of end users, supplying an acceptable quality level is a complex task for providers. This is why CDN architectures are currently used by major internet content providers.

A CDN (Content Delivery Network) is a set of geographically spread content servers with the aim to increase scalability and availability of contents. The servers of a CDN are hierarchically structured and communicate using a redirection mechanism. The redirection policy of a CDN is the key element to achieve the scalability objective.

Many network equipment vendors propose CDN solutions to operators and online content providers. The solutions are often based on proprietary interfaces and equipment. The lack of standard interfaces associated to the CDN architectures makes the choice of one solution quite risky: the evolution of a CDN infrastructure often relies on the chosen CDN solution provider. The compatibility with another solution is rare.

A standard specification of CDN interfaces was initiated in the Open IPTV Forum [1] and is making its way through major SDO's like ETSI-TISPAN and ITU-T SG13. Orange Labs has actively contributed to the specification in order to guarantee that future CDN solutions are compatible with Orange IPTV architecture requirements.

This demonstration is hence a prototype of the CDN specification in the Open IPTV Forum standards regarding IMS based IPTV architectures. It demonstrates the ability to perform request redirection using a standard SIP interface. It also shows how this is combined with a standard RTSP interface which is the de facto standard protocol for unicast media streaming.

In this document we first introduce the functional architecture that our prototype relies on. We then describe the technical architecture of the demonstration, and the use cases associated with it; we finally conclude with the objectives and provide the logistical requirements to set-it up.

II. FUNCTIONAL ARCHITECTURE

According to [1], A standard CDN consists of 3 functions:

- CDN Controller: first point of contact in a Content Delivery Network. This is where all client requests are redirected by a service platform to initiate a content delivery session. It analyses a client's location, media availability and CDN servers' load, and redirects the request to the appropriate Cluster Controller or to another CDN Controller if no Cluster Controller can be assigned.
- Cluster Controller (CC): a server managing a set of Media Servers generally placed in the same geographic location. When a Cluster Controller receives a request from the CDN Controller, it performs a second level of request filtering, to decide which particular Media Server will provide the media content to a client. When the choice is made the request is assigned to a specific Media Server called Content Delivery Function (CDF).
- Content Delivery Function (CDF)/Media Server: A server where the media content is stored and from which it is delivered. It is the lower element in the CDN's hierarchy, controlled by the CC and providing media flow directly to the client.

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As indicated in Fig.1; when a CDN Controller receives a request for a media, it analyses a client's location, media availability and cluster load. It passes the request to the chosen CC which selects a CDF. This decision of the CC depends on media availability and server load. The whole process uses SIP signaling to initiate the content delivery session except between the CC and the CDF where RTSP is used. Once the session is created the user interacts directly with the Cluster Controller to start streaming the content. This enables the CC to monitor the load of each of its servers. SIP interfaces provide a powerful tool for signaling forwarding, negotiation and redirection as in the case of conversational services.

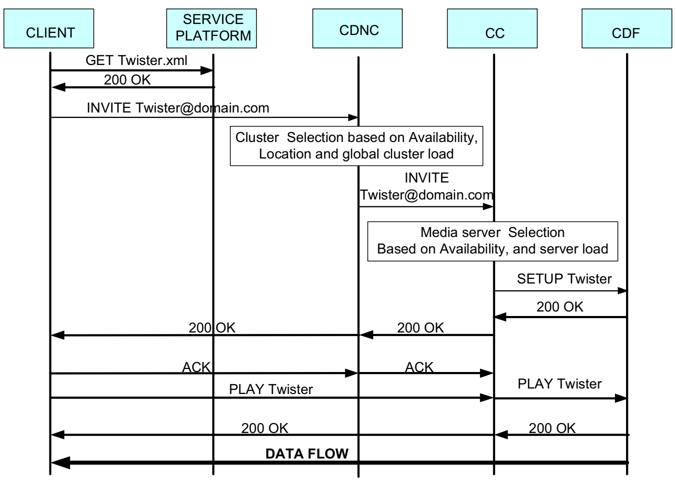

Fig.1. Call flow for session initiation and data transmission

Note that the architecture allows to separate session control information from data flow: the former is transmitted via the control servers (CDN Controller, CC), the latter goes directly from the media server to a client.

III. TECHNICAL ARCHITECTURE OF THE DEMONSTRATION

The demonstration prototype includes 9 machines performing the following roles (Fig.2):

- An IPTV client including a web browser, SIP/RTSP signaling handler and a media player.
- A web server simulating an IPTV service platform provides a list of available media contents and redirects the user requests to the CDN Controller.
- A CDN Controller that relies on an internal CDN database to fetch the information for request analysis. The choice of a cluster is based on a metric taking into account the cluster load (total streamed bandwidth and number of served clients). The CC with the smallest metric is chosen among 2 clusters.
- 2 CC's to select among 4 CDF's distributed among 2 clusters

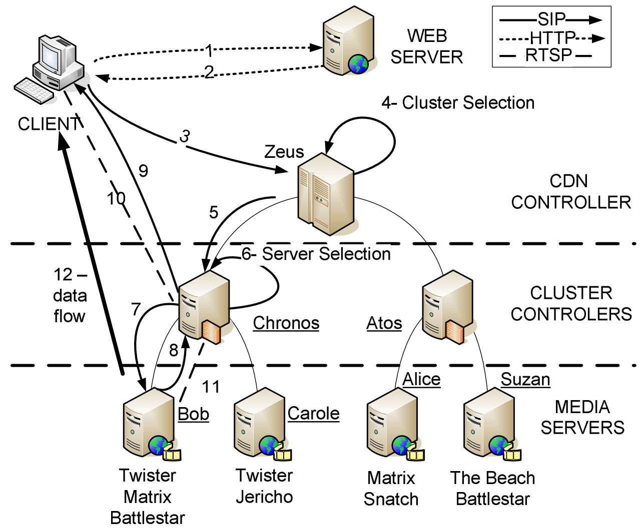

Fig.2.Demonstration architecture structure and behavior.

To present the architecture in action we use a simple model of the CDN architecture. The client fetches a media list from a web server. To request a Media content, the client issues a request to the CDN Controller. The content distribution is intentionally chosen to accommodate use cases of popular contents (available on all clusters: Matrix, Battlestar), long tail contents (available on a single server: Jericho), and local content (available in one cluster: Twister).

The demonstration sows how the architecture manages successive requests for media contents and how the redirection allows choosing the appropriate Media Clusters/Servers. In the beginning, as no clients are being served, a request is processed considering only client’s location and media availability. As soon as some CDFs become “congested”, their values in our metric will rise and other CDFs will be chosen instead. This causes a load balancing behavior that redirects new requests to others CCs and CDFs consequently. When none of servers can handle a request (e.g. error, congestion, and unavailable media) an error message is returned to the client. The same behavior is expected when the same pattern is applied to a larger scale.

IV. CONCLUSION

This demonstration proves that an IPTV service provider can rely on a standard architecture to achieve load balancing, geo-targeted request routing. It also proves the feasibility of the standards developed in the Open IPTV Forum.

Having standard CDN interface allows the service providers to rely on different manufacturers to build their CDN. The equipment vendors can still differentiate their solutions by enhancing the redirection and assignment policy implemented in the CDNC and CC.

V. REFERENCES

[1] Open IPTV Forum Architecture specifications v1.1 (wwwmopeniptvforum.org), Jan 2008
[2] RFC 3261, "SIP: Session Initiation Protocol", June 2002
[3] RFC 2326, "Real Time Streaming Protocol", April 1998