Federating Distributed, Heterogeneous Content Distribution Actors

Ghida Ibrahim
Orange Labs/
Telecom ParisTech

Daniel Kofman
Telecom ParisTech
Agenda

• Introduction
• Main Challenge: How to enhance Telcos’ Positioning in the CDN Market
• Our Contribution
  ➢ Context & Goal
  ➢ Proposed Technical Solution
• Final Words and Work in Progress
Introduction

Content Distribution Value Chain
Introduction

Overview of the CDN Market

Market concentrated around a reduced set of Global CDNs

Local/Regional Actors, like Telcos, are targeting a better market positioning
Main Challenge: How to enhance Telcos positioning in the CDN Market?

Many Scenarios are possible, general examples:

Sc1: Upstream-Downstream Federation

Sc2: Federation of local actors
Main Challenge: How to enhance Telcos positioning in the CDN Market?

Many Scenarios are possible, general examples

Sc3: Orchestration of distributed CDN services

In Scenarios 2 & 3, the broker functional group has an important role

The role can be played by one of the CDNs or by a 3rd party
Our Contribution: Context and Goal

• We introduce a broker-based architecture for statically building and dynamically orchestrating large federations of content distribution actors (CDAs). Our ecosystem is composed of:

  ➢ Heterogeneous, highly distributed CDAs
  ➢ Content Providers and global CDNs
Technical Aspect: Control Architecture
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Broker

CDAs Repository

Federation Computation Engine

CSPs repository

Content Distribution Database

Load Distribution Database

Working CDAs Database

Content Ingestion Handler

Logs Registrar

Request Router

Event Notifier

SLAs Handler

From CDAs

From CSPs

From users
Technical Aspect: Control Architecture

Broker Role: 2 phases

Static/ pre-provisioning Phase:

- At t0, repeated each T
- Handled by the “Federation Computation Engine”
- Based on Inputs gathered from CDAs and CSPs
  - CDAs inputs: Capacity, Footprint (zones) and Price information
  - CSPs inputs: Target Footprint, Demand profile, Content characteristics
- Leads to outputs concerning content and load distribution policies within different working CDAs
Technical Aspect: Control Architecture

Broker Role: 2 phases

**Dynamic Phase**

- In \([t_0, t_0+T]\)
- Handled by the “Federation Control Engine”
- The Request Routing strategy is dictated by the output of the Static Phase
- The Broker subscribes to “CDAs” performance and adapts accordingly the static phase outputs
- The Broker maintains demand logs and uses them as inputs to re-perform the static phase at to+T
Final Words & Work in Progress

- Telcos could be better positioned in the CDN Market
- Flexible federation and services orchestration will significantly facilitate such better positioning
  - An **Advanced Brokering Architecture** represents in this context a major asset
- Standardization efforts should be focused on the definition of the functional and protocol architecture.
  - Includes data models and **Interfaces** to facilitate the autonomic orchestration to answer CSPs and external CDAs services requests.
- We are working on the design of decision making **Algorithms** required for dynamic CDN selection inside the federation and for resources orchestration
  - We consider different market relevant scenarios **different Points of View** can be adopted
- We will be glad to further detail our proposals and to contribute to the standardization process
Food For Discussion:
Is SDN as a technology relevant in a context of CDAs orchestration/ federation? Why? How?

Thank You
ghida.ibrahim@orange.com
Appendix

Static Phase: Decision Making Process

At t0 do{
  • Classify SPs in “SPs Repository” into Groups on Footprint and Technology features basis
  • Filter Groups per Footprint order (begin with groups with the smallest Footprint)
  • For each SP Group do {
      – Identify from “CAs Repository “ all Candidate actors / Foot(Actor) ≤ Foot(Group) & Feature(Actor) = Feature(Group)
      – Apply Mathematical Model, SPList: SPs in SP Group & CDNList: Candidate Actors
      – Remove Selected Candidates from “CAs Repository “
      – Store Selected Candidates Ids in the “Working CAs database”
      – Fill the “Content Distribution database” and the “load distribution database” with the computed content and load distribution Indicators
      – Go to Next SP Group }
  • Restore “CAs Repository” Initial Content }
Dynamic Phase: Decision Making Process

At $t$, $\geq t_0$, $\leq t_0 + T$ do 1 and 2{

1. Intercept Incoming Requests
   For each Req do {
       Identify the originating zone and the target content
       Access the “Load Distribution database” in order to Forward the Req to the adequate CA
   }

2. For each CA/ CA Id in “Working CAs database” do {
   - Track CA performance Level over his footprint zones
   - If (CA.PerfLevel (zone x) < L) {
       Generate Event(CA Id, zone x)
       Fetch the “Logs Registrar” for CA recent history ([t-T1,t])
       Identify the contents that have been the most recently delivered by CA to zone x
       Decrease the share of load handled by CA over zone x and corresponding to identified contents
       adapt the “Load Distribution database “ accordingly
       Redistribute the load among other actors that cover zone x based on their preference order
       adapt the “Load Distribution database” and the “content distribution database” if required accordingly
   }
}