A Case for CDN-as-a-Service in the Cloud:  
A Mobile Cloud Networking Argument

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1. Introduction to Content Distribution Networks
   - CDNs Funding Principles
   - CDNs in the Cloud

2. MCN CDNaaS
   - Mobile Cloud Networking
     - Goals and Principles
     - Lifecycle of a Service
   - Goals
   - Architecture
   - Use Case: Digital Signage Service

3. Conclusion
Motivation

- Heavy demand on content services led to availability issues.
- Dimensioning services for maximum throughput is not economically viable.

Content Distribution Networks emerged to solve this issue by offering mechanisms to distribute content in a large-scale environment in a timely manner.

Actors

- **Provider**: Provides the CDN.
- **Enterprise End User (EEU)**: Uploads and Manages Content on a CDN.
- **End User (EU)**: Retrieves Content.
Points of Presence

The Provider manages a list of Points of Presence (POP). Each EEU has a POP designated as its Origin Server and a number of surrogate servers which replicate and serve content.

Functionalities

Is considered a CDN an architecture which provides these typical functionalities to the actors.

- Request Redirection and Content Delivery (route a request to the proper POP)
- Content Replication (store the content in different servers)
- Management Services (monitor traffic and manage policies)
Limitations of traditional CDNs

- Dedicated CDNs from specialized companies typically have high static infrastructure cost
- Often statically provisioned: prone to under-/over-provisioning

Cloud-based CDNs?

- Uses resources from the Cloud (one or more datacenter(s) from one or more provider(s)) to create POPs.
- Exploits the scaling capabilities from the Cloud: add/delete POPs based on monitored usage.
- Takes advantage of the cloud management services: usage-based billing, real-time monitoring, fast provisioning.
Cloud-based CDNs

... as a Service

- CDN-as-a-Service concept: a "CDN" service integrated in a Cloud manager allowing EEUps to create and dimension their CDN on demand.
- This service can be used by multiples users on the same Cloud provider, exploiting the multi-tenancy attribute.

Open-Source?

- No obvious open-source cloud-based CDN solutions which can be delivered:
  - as-a-Service
  - through a cloud manager such as OpenStack
Our take: Create an Open-Source service to create and manage on-demand Cloud-deployed CDNs for multiple tenants.

- **Context:** Mobile Cloud Networking (MCN) EU FP7 project.
- **Requirement:** Follow MCN service lifecycle.
- **Technical Dependency:** Exploit OpenStack as the Cloud Manager.
MCN Goals

Extend the concept of cloud computing to traditional telco operators’ processes:

- Virtualizing the telco software stack: radio access network (RAN), evolved packet core (EPC), IP Multimedia System (IMS).
- Virtualizing support services: CRM systems, billing, content distribution.
- Enabling orchestration and management of these virtualized elements as needed by EEU.

=> Brings cloud computing advantages to the telco world.
MCN follows a service-oriented architecture: all functional elements are services, either atomic (composed of infrastructure resources) or composed (composed of other services). Each service is supported by:

- a **Service Manager (SM)**: Provides an external interface (API) for the service.
- a **Service Orchestrator (SO)**: Describes how the service is implemented, including scaling of the service. The SO is controlled by its corresponding SM.
Besides integration with the MCN framework, the main goals of the service are:

- Provision and Orchestrate a CDN follows Cloud Principles
  - on-demand
  - pay-as-you-go
  - automated scaling
- Allow a tenant to fine tune his CDN to suit business needs
- Monitor his CDN in real time to customize elasticity
- Exploit existing technologies for fast delivery
CDNaaS’ lifecycle’s model is based on the global MCN lifecycle:

1. Design: The EEU sends the CDN creation request with the chosen list of PoPs as parameter to the SM.
2. Implement: The SM requests a CDN SO instance for the EEU.
3. Deploy: An account is created by the CDN SO on the CDN Central Server, which then propagates the account creation to other PoPs.
4. Runtime and Operation: Monitoring sends periodical updates to the RCB engine.
5. Disposal: The EEU account on the Central Server is deleted, cascaded to Local Servers.
On-Demand Digital Signage Network (DSN) instance running in a MCN environment:

- Delivers video content, advertisements, and/or messages displayed on digital screens. Messages are targeted, partly by geographical location and distributed to *players*.
- Benefits from multi-tenant CDN with near-players PoPs to improve delivery speed.
DSS/CDN Simplified Flow

1. DSN Instantiation
2. CDN Registration, PoP Selection
3. Container Creation
4. Content Injection
5. Player Content Retrieval from nearest PoP
6. Playback of media contents
Conclusion

- An experiment with dynamic CDNs in a Cloud Environment
- Open-Source code base
- Demonstrated feasibility and possible integration in a Cloud Orchestration framework

Roadmap

- Dynamic Management Policy based on Runtime Metrics
- Service Level Agreement for Cloud-based CDNs
- Performance Evaluation
Backups
Interaction Scenarios

Content Retrieval by End User

1. GET request
2. Object Present? Return Object
3. Object missing?
   1. Ask Central Server for EEU’s Origin
   2. Simultaneously: Redirect User to Origin, Retrieve object for