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

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Sep. 24, 2014

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CDNs Concepts

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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.

CDNs Functionalities

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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)

Cloud-based CDNs

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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

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... as a Service

- CDN-as-a-Service concept: a "CDN" service integrated in a Cloud manager allowing EEUs 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

MCN CDN Concept

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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

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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 EEUs.

=> Brings cloud computing advantages to the telco world.

MCN Services

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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.

CDNaaS Goals within MCN

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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

Architecture

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Service Lifecycle

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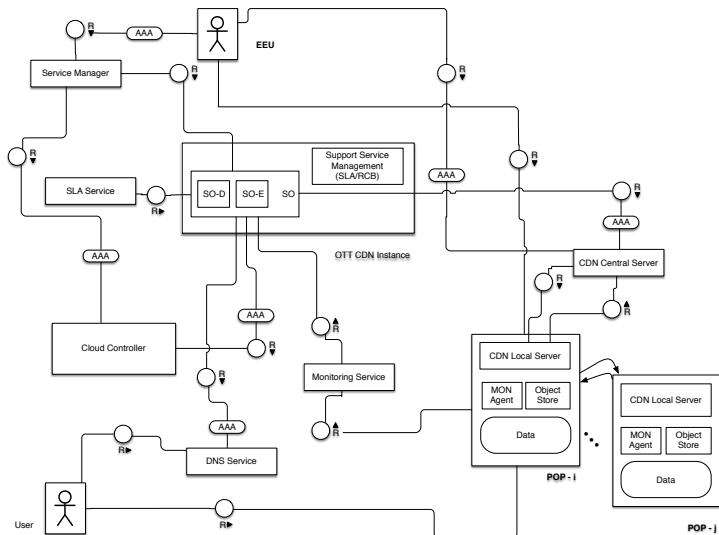
CDNaaS' lifecycle's model is based on the global MCN lifecycle:

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

# Use Case: Digital Signage Service   ZHAW

DSS?

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/CDNaaS Integration

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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

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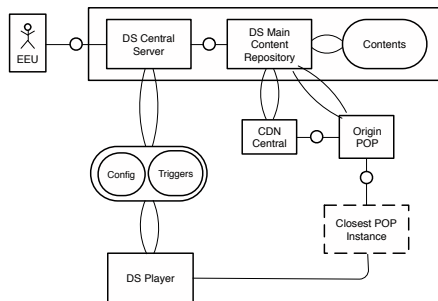
Conclusion

- 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

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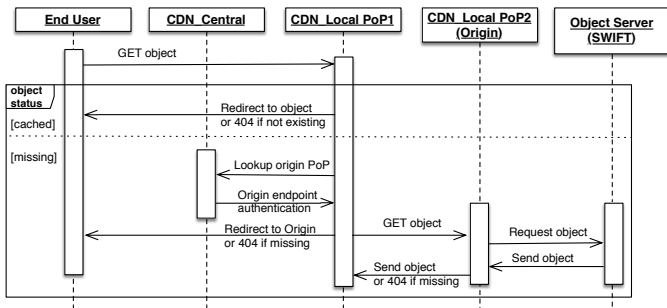
Content Retrieval by End User

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