SERVICE AND USER-BASED DISTRIBUTED SELECTION OF CONTENT STREAMING SOURCE AND DUAL ADAPTATION

DISEDAN PROJECT

Jordi Mongay Batalla
(Warsaw University of Technology - Poland)
Motivation

Consumer Internet Traffic (2012–2017) - Cisco VNI

<table>
<thead>
<tr>
<th>Year</th>
<th>File Sharing</th>
<th>Web Email and Data</th>
<th>Internet Video</th>
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<tbody>
<tr>
<td>2012</td>
<td>6,201</td>
<td>5,173</td>
<td>14,818</td>
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<tr>
<td>2013</td>
<td>7,119</td>
<td>6,336</td>
<td>19,855</td>
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<tr>
<td>2014</td>
<td>7,816</td>
<td>7,781</td>
<td>25,800</td>
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<tr>
<td>2015</td>
<td>8,266</td>
<td>9,542</td>
<td>32,962</td>
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<tr>
<td>2016</td>
<td>8,478</td>
<td>11,828</td>
<td>41,916</td>
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<tr>
<td>2017</td>
<td>8,667</td>
<td>14,494</td>
<td>52,752</td>
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DISEDAN: OBJECTIVES (1)

1. Streaming server
2. Multimedia Description Server (Service Provider Manager)
3. End User
4. Measurements
5a. HTTP request
5b. HTTP request

- Streaming server requests multimedia description file from Multimedia Description Server.
- Multimedia Description Server sends multimedia description file (content source 1, content source 2).
- End User requests content source 1.
- End User receives HTTP response.
- End User requests content source 2 (lower bitrate).
- End User receives HTTP response (lower bitrate).
DISEDAN will research on an effective solution for the multi-criteria hard problem of best content source selection, considering user context, servers availability and distribution mode. The new concept will be based on:

- a two-step server selection mechanism (at Service Provider and at End User) making use of innovative algorithms that consider context- and content-awareness
- a dual adaptation mechanism consisting of Media adaptation (also called media flow adaptation) and content source adaptation (by switching the streaming server) when the transmission suffers degradation.

→ DISEDAN proposes a solution that can be rapidly deployed in the market since it does not require complex architecture
PARTNERS

- Warsaw University of Technology
  - Jordi Mongay Batalla, Andrzej Bęben, Piotr Krawiec
- CNRS-LaBRI - University of Bordeaux
  - Daniel Négru, David Bromberg, Joachim Bruneau
- University “Politehnica” Bucharest
  - Eugen Borcoci, Sorin Zoican, Cristian Cernat, Radu Badea…
Service Provider side:

- Design **dynamic MPD creation method** to recommend clients the best content sources and representations
  - Gather information about content, context, server status and network conditions
  - Use Multicriteria Decision Analysis (MCDA), Evolutionary Multiobjective Optimization (EMO) or other AI algorithms to rank recommended candidates
MAIN RESEARCH CHALLENGES (2)

- **Client side:**
  - Design **content source selection method** to select the best content server (or servers) from the set of candidates recommended by SP
    - use measurements at client side
    - exploit MCDA
  - Design **dual adaptation mechanism** for smooth content playout under changing server/network conditions
    - content source adaptation
    - media adaptation

Istambul, 5th March 2014
MAIN RESEARCH CHALLENGES (3)

- Design **measurement methods** for client to monitor changing network/server conditions
  - Rate (average, instantaneous, variation, ...)
  - Buffer size (thresholds, avg, differential, ...)
  - Jitter of packet arrivals
  - round trip time

- **Derive models** for:
  - Evaluation of decision algorithms at client and SP
  - Playout buffer dimensioning
  - Dual adaptation mechanisms
## METHODOLOGY

<table>
<thead>
<tr>
<th>WP1: Management and dissemination</th>
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<tbody>
<tr>
<td>T1.1: Management</td>
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<td>T1.2: Dissemination</td>
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<tr>
<th>WP2: Specification of DISEDAN System</th>
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<tbody>
<tr>
<td>T2.1: System requirements identification and analysis of existing solutions at the SP side and user side</td>
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<tr>
<td>T2.2: Multi-criteria decision process algorithm</td>
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<td>T2.3: Specification of Dual adaptation mechanism</td>
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<td>T2.4: Media content servers selection and dual adaptation algorithms validation in large scale context</td>
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<th>WP3: Implementation and validation</th>
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<tr>
<td>T3.1: Two-phase server selection</td>
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<td>T3.2: Dual adaptation mechanism</td>
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<td>T3.3: Validation</td>
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<th>WP4: Integration and validation</th>
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<tr>
<td>T4.1: Integration of the system</td>
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<td>T4.2: Final validation of the system</td>
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Istanbul, 5th March 2014

**Methodology**

WP1

Requirements, constraints and assumptions

Analysis of the on-going research (objective 1) – Task 2.1

WP2

Analysis of the on-going research (objective 2) – Task 2.2

Implementation of two-phase selection for streaming parameters – Task 3.1

Validation – Task 3.3

WP3

Scalability analysis – Task 2.4

Implementation of dual adaptation mechanism – Task 3.2

Validation – Task 3.3

WP4

Dual adaptation capabilities (objective 3) – Task 2.3

Implementation of dual adaptation mechanism – Task 3.2

Validation – Task 3.3

Prototype – Task 4.1 & Taks 4.2

WP1

WP2

WP3

WP4

Integration & validation

Analysis of the on-going research (objective 1) – Task 2.1

Implementation of dual adaptation mechanism – Task 3.2

Validation – Task 3.3

Prototype – Task 4.1 & Taks 4.2

Requirements, constraints and assumptions

Implementation of dual adaptation mechanism – Task 3.2

Validation – Task 3.3

Prototype – Task 4.1 & Taks 4.2
FUNCTIONAL BLOCKS

Client

- Monitoring module
- MCDA algorithm
- Content source selection and Adaptation engine
- Player
- DASH

Service Provider

- MPD generator
- MCDA algorithm
- Monitoring module

Streaming server

- Streaming module
- Measurement probing
Istambul, 5th March 2014

**WUT Contribution - Client Side**

- **Measurement methods to monitor changing network/server conditions**
- **MCDA / EMO-like algorithms to select the best servers**

**Client**
- Monitoring module
- MCDA algorithm
- Content source selection and Adaptation engine
- Player
- DASH

**Service Provider**
- MPD generator
- MCDA algorithm
- Monitoring module
- Streaming module
- Measurement probing

**Streaming server**

**Dual adaptation mechanism**

**Implementation of DASH library which exploits proposed dual adaptation**
MCDA / EMO-like algorithms to recommend the best content sources and representations
- server load optimization
- maximize system utilization

Client

- Monitoring module
- MCDA algorithm
- Content source selection and Adaptation engine
- Player
- DASH

Service Provider

- MPD generator
- MCDA algorithm
- Monitoring module

Streaming server

- Streaming module
- Measurement probing
Adaptation decision based on various metrics to select the best server

QoE module
User Context characterization

Client

Monitoring module
MCDA algorithm
Content source selection and Adaptation engine
Player
DASH

Service Provider

MPD generator
MCDA algorithm
Monitoring module

Streaming module
Measurement probing

Streaming server

Implementation of DASH player with seamless handover

Istanbul, 5th March 2014
MPD generator considering inputs from multiple servers, not only multiple qualities

Client
- Monitoring module
- MCDA algorithm
- Content source selection and Adaptation engine
- Player
- DASH

Service Provider
- MPD generator
- MCDA algorithm
- Monitoring module
- Measurement probing

Streaming server
- Streaming module

Streaming module for VOD and Live and link to MPD

Content input
UPB CONTRIBUTION - CLIENT SIDE

Sets of metrics usable in monitoring. Monitoring procedures (partial) Monitoring DB spec., design and implementation

MCDA algorithms for server selection: analysis, solution selection, specification, simulation, implementation

Service Provider

MPD generator
MCDA algorithm
Monitoring module

User requirements identification for different user profiles

Streaming server

Streaming module
Measurement probing

Client

Monitoring module
MCDA algorithm

Content source selection and Adaptation engine

Player
DASH

Policies applicable for selection. Policies DB

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Client

- Monitoring module
- MCDA algorithm
- Content source selection and Adaptation engine
- Player
- DASH

Service Provider

- MPD generator
- MCDA algorithm
- Monitoring module
- Streaming module
- Measurement probing

Streaming server

SP requirements identification

Sets of monitoring metrics
Monitoring procedures
Monitoring DB spec., design and implementation

Policies applicable at SP for server selection.
Policies DB@SP

MCDA, EMO, etc. Algorithms for server selection

Istanbul, 5th March 2014
EVALUATION

Project’s results will be validated through:

- Simulative tests
  - assuming large scale scenarios

- Trials
  - in controlled environment (inside pilot island)
  - using Internet (between pilot islands)
Conferences and journals: More than 10 Rank A/B planned during the project

Cooperation with other projects, specially with CONCERT and MACACO projects, which is in the same thematic:
- Common workshop (tentative)

Two PhD:
- UPB - Radu Badea
- LaBRI - Joachim Bruneau

Training courses in academic academies

Presentation to industry: Orange, Vodafone, Cosmote, RomTelecom

Standardisation follow-up:
- IRTF
- DASH
THANK YOU!