Persistency Management in CEP

Hybrid Approach for Gamification Systems

Philipp Herzig, SAP AG, 09.07.2013
Introduction
Context in CEP [EN11]

- Temporal
  - Fixed Interval, Event Interval, Sliding fixed interval, sliding event interval

- Spatial
  - fixed, entity, event

- Segmentation-oriented
  - attribute list, partition identifier, stratification

- State-oriented
  - entity-based [OSS+11]
  - ontology-based [TRP12]
Application Scenario
Gamification System
Requirements

• Flexibility
  • Logic, Rule Language, Entity Behavior must be easy to change

• Real-time pattern detection
  • Detection of user situations at least in soft real-time

• Persistency
  • User progress has to be stored for later retrieval and update

• Analyzeability (e.g., ex-post or ad-hoc queries)
  • The success of gamification should be analyzeable across various dimensions such as time, users, or groups

• Managebility
  • Persisted data has to be managed over the entire lifecycle (e.g., anonymization, backup aggregation, composition)
## Solution Approaches

<table>
<thead>
<tr>
<th>Requirement</th>
<th>CEP/BRMS</th>
<th>Database</th>
<th>Hybrid System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Real-Time Event Correlation and Detection</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Persistency</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Analyzability</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Manageability (e.g., Backup, Anonymization)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Gamification Platform
Hybrid Approach (based on [OSS+12])

Example

<table>
<thead>
<tr>
<th>LHS Types</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Simple Event / Event Rule</td>
<td>( e_1 \rightarrow \ldots )</td>
</tr>
<tr>
<td>(b) Boolean event correlation</td>
<td>( e_1 \land e_2 \rightarrow \ldots )</td>
</tr>
<tr>
<td>(c) Temporal event operators</td>
<td>( e_1 \text{ during } e_2 \rightarrow \ldots )</td>
</tr>
<tr>
<td>(d) Event Aggregation</td>
<td>( \frac{1}{n} \sum_{i=0}^{n} e_i^{\text{value}} &gt; 20 \land e_2 \rightarrow \ldots ), ( n = \text{sizeof}(\text{window}) )</td>
</tr>
<tr>
<td>(e) Event with Context</td>
<td>( e_1 \land \mathcal{P}_{t,U_i} \geq 20 \rightarrow \ldots )</td>
</tr>
<tr>
<td>(f) Context only</td>
<td>( U_i \land (b_{i1} \lor b_{i2}) \rightarrow \ldots )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RHS Types</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>(g) Multiple Events</td>
<td>( \ldots \rightarrow e_2, e_3 )</td>
</tr>
<tr>
<td>(h) Multiple Data (e.g., Point or Badge)</td>
<td>( \ldots \rightarrow p_{i1}, b_{i2} )</td>
</tr>
<tr>
<td>(i) Multiple Data and Events</td>
<td>( \ldots \rightarrow p_{i2}, b_{i1}, e_2, e_3 )</td>
</tr>
</tbody>
</table>
Hybrid Approach

Example

```plaintext
1 rule "AddedBuddyAndAddedTag"
2   when
3       $addBuddy : EventObject(type=='addBuddy', $playerid:playerid) from entry-point eventstream
4       $addTag : EventObject(type=='addTag', playerid==$playerid) from entry-point eventstream
5   then
6       updateAPI.givePoints($playerid, 'Experience', 1, 'TestReason');
7 end

10 rule "tenBuddies"
11   when
12       p : Player($playerid : uid)
13       eval(queryAPI.hasPlayerMission($playerid, 'I Have Got Buds!') == true)
14       eval(queryAPI.getPointsForPlayer($playerid, 'Buddies').getAmount() >= 10)
15   then
16       updateAPI.completeMission($playerid, 'I Have Got Buds!');
17       update($p); //only in synchronous mode
18 end
```
Hybrid Approach
Synchronous Communication
Hybrid Approach
Asynchronous Communication
Hybrid Approach
Experimental Setup

- 46 Production/ECA Rules

<table>
<thead>
<tr>
<th>RHS</th>
<th>LHS</th>
<th>(a)-(d)</th>
<th>(e)-(f)</th>
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</thead>
<tbody>
<tr>
<td>(g)</td>
<td>1</td>
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</tr>
<tr>
<td>(h)-(i)</td>
<td>15</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

\[ 2^n \text{ Users} \times 0.67 \frac{\text{Events}}{\text{User} \times s} \times 300s = 201 \times 2^n \text{ Events.} \]

- with \( n = 3, \ldots, 12 \) \( \Rightarrow \) \((8, 16, \ldots, 4096) \) → experimental users
- equals: \((7 \times 10^5, 1.3 \times 10^6, \ldots, 3.5 \times 10^8) \) → “real users”
Hybrid Approach
Experimental Results

(a) Response Time Median
(b) Response Time Max

(a) 8 User
(b) 32 User
(c) 256 User
(d) 1024 User
Hybrid Approach
Experimental Results

(a) Slow Response Times (>500ms) – Relative

(b) Space–Time Tradeoff

- Sync
- Sync Local
- Async
- CEP Only

- Median Response Time Sync–Async in ms
- Memory Usage in 1 MiB
Open Challenges
Transaction Strategies

- EPN Scenarios?

- Strategies
  - One Call per LUW
    - API strategy (all locked)
    - High Concurrency (trade-off strategy, no read locks => stale data; dirty/phantom reads)
  - Multiple Calls for LUW
    - Client Orchestration (i.e., Rule Engine is Client and has to handle rollbacks)
    - High Performance (i.e, compensation manager records and rolls-back transactions)

=> rule base with all inverse operations necessary!
Thank you

Philipp Herzig
SAP AG / SAP Research
Chemnitzer Straße 48
01148 Dresden
Appendix
## Existing Platforms (Overview 1)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Bunchball</th>
<th>Badgeville</th>
<th>Bidgoor</th>
<th>Gigya</th>
<th>IActionable</th>
<th>Punchtab</th>
<th>OpenBadges</th>
<th>UserInfuser</th>
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<tbody>
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<td>Complex Rules</td>
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<td><strong>UI Widgets</strong></td>
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<td>YES (Javascript)</td>
<td>YES (Javascript)</td>
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<td><strong>Level of Integration</strong></td>
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## Existing Platforms (Overview 2)

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<tr>
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<th>UserInfuser</th>
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<tr>
<td><strong>Game Mechanics</strong></td>
<td>Challenges-/Missions</td>
<td>Standard Points</td>
<td>Virtual Currency</td>
<td>Single non-redeemable point metric</td>
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<td>Player Levels</td>
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<td>Social Network Integration</td>
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</tbody>
</table>
Gamification Platform
Example Rule

```java
rule "newUser"
  when
    $evt : EventObject(type=="new_user") from
    entry-point eventstream
  then
    GamificationEvent ge = new GamificationEvent();
    ge.setType("createPlayer");
    ge.setPlayerId($evt.getPlayerId());
    ge.put("logonname", $evt.get("logonname"));
    bus.publish(ge);
    retract($evt);
end
```
Gamification Platform
Existing Types

(a) BPM & Frontend
   - Sales Process
   - Order Process
   - Inquiry
   - Quotation
   SOA Perspective

(b) Legacy System

(c) Message Broker
   - Inquiry Service
   - Quotation Service
   - CEP
   - Frontend
   EDA Perspective
• **Frontend Integration**
  • Support for various platform and technologies
  • Generic generation of UI widgets
  • Current solutions are limited to the generation of HTML5 „components“

• **Analytics**
  • Analytical support the monitoring phase of the gamification cycle
  • Simple measures
    • Revisits
    • Participation rate
  • Complex measures (Higher-order constructs)
    • Engagement Levels
    • Game-theoretical algorithms (estimate payoff matrices)
Related Work

- **OpenSource**
  - UserInfuser
  - OpenBadges

- **General Purpose Platforms (Closed Source)**
  - Badgeville
  - Bunchball

- **Specific Platform (Closed Source)**
  - IActionable
  - Gigya
  - Bigdoor
  - Punchtab
  - etc…
Current Approaches

- **Open source**
  - Simple game mechanics programmatically
  - Remote storage for game mechanics
  - Translation of traditional achievement systems, e.g., Xbox Live, iOS GameCenter

- **Closed source space**
  - Hardly documentation available
  - Striking marketing promises
  - However projects report large integration projects
  - Tight coupling of application with gamification platform
  - Data Silos
  - SaaS offerings
  - Strong focus on consumer and web applications