Artificial Intelligence Makes Smart BPM Smarter

Champions: KDDI Research, Orange, Sri Lanka Telecom
Participants: Trisotech, NEC
Key participants

Champions

KDDI Research

Orange

Sri Lanka Telecom

Participants

Trisotech

Orchestrating a brighter world

NEC
Smart BPM with **AI-assisted closed-loop operation** enables consecutive customer experience management.

**Main focus:**
- Achieving sustainability of closed-loop
- Controllable AI assures reliability of automation

**Customer journey management**
- Clear up what requirements should be reflected to infrastructure
- Analyzing GDPR effect

**Concept**
Challenges & issues

1. **Scalability of system**
   A knowledge database or a procedure is needed for handling a business process such as a network or retail operation. However, we face variety types of actions based on network/retail services.

2. **Tackling exceptions**
   Traditionally, an operator makes programs and shell scripts for automation. But, those only follow predefined workflows and cannot react to exceptional conditions.

**AI-assisted workflow engine** *(at TMF Live! 2017)*

**Finding best way to interact with AI and human** *(at TMF Live! Asia 2017)*

3. **(Focus area) Service lifecycle Orchestration**
   that includes Plan/Deliver/Deploy/Operate functionality
Concept model about interaction between AI and human

We propose...

- **“AI support system”** works as a **Secretary** for operator.
- **“AI orchestrator”** generates **lifecycle operation workflow**

1. Receive alarms and logs
2. Data collection for probe
3. Recommend - Failure situation
4. Desired topology
5. Topology constraint
6. Workflow Generation
7. Recommend workflow
8. Execute recovery
9. Provide feedback from operator

Other management systems (Inventory and trouble ticket)
Demonstration Environment

Operator

Decision Mgmt tool

AI Support System/Console

Configuration System

Alarm mgmt system

OpenStack

Ansible

Simulated broadband service

VNF (vRouter)

VNF (vNAT)

VNF (vFW)

Internet

Level3 Resource
Trouble Management

Survey and
Analyze Resource
Trouble

Locates
Resource Trouble

Resolves
Resource Trouble

Resolves
Resource Trouble

Closed
Resource Trouble

Console

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Simulated broadband service

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Internet

Operator

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Demonstration Environment

Current topology

Desired topology

Compare

Simulated broadband service
Demonstration Environment

Workflow Generation

Current

Desired

Updating workflow
Workflow Generation Mechanism of AI orchestrator

Update state data

Workflow:
- Compile
- Compare
- State-Space Search
- Execute

States & constraints

Delta of each state

Find a state transition order which doesn’t break any constraints

Instance repository

Target System

pluggable executors
- Nova
- Neutron
- MANO
- Ansible
- DSC

Update state data

Model repository

 Compile

Compare

State-Space Search

Execute

Model repository

pluggable executors

Target System
We extend TOSCA’s declarative workflow specification

**TOSCA’s Declarative workflow**

- Generate workflow by **topological sort** of dependency
- Each node has one state mainly **for state mgmt.**

**New definition of Declarative workflow**

- Generate workflow by **state-space search** with constraints
- Each node has multi-states **for workflow generation**

**Topological Sort**

- Basic workflow can be generated (e.g. Initiation, Termination)

**State-space search**

- Advanced workflow can be generated (e.g. recovery without service-interruption)
Example of recovery workflow generation

Constraint: At least either of “FG” is active

Constraint: All “CP” in the FG are active

Creating new NW, before deleting old NW

deleting old NW

Current topology

Desired topology

Recovery workflow

Creating new NW, before deleting old NW

Creating new NW, before deleting old NW

Desired topology

Current topology

Constraint: At least either of “FG” is active

Constraint: All “CP” in the FG are active

Creating new NW, before deleting old NW

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Creating new NW, before deleting old NW

Deleting old NW
Example of recovery workflow generation (Cont.)

Generated workflow

Now the NW is temporarily created redundantly for safe recovery without service-interruption.
The related applications are mapped to the **Resource Process management** and knowledge management in TAM.

**ABE** regarding to input & output parameters of each AI are mapped to the **Service Specification** and **Resource Specification** in SID.
Lessons learned

For enabling consecutive customer experience management...

“Controllable AI” is key technology to sustain automated operation in future network

DMN and Model-based workflow generation assist us to understand AI. (which makes “fixed closed-loop” to “controllable closed-loop”)

Need more discussion

1. Feedback mechanism into AI to improve accuracy.
   Clarification of business process and role for feedback.
   E.g., Who should review the output results offered by AI? (system/network expert, AI expert, etc.)

2. Improvement of business process and Application framework.

3. Meta model for AI.
   Current input and out data to/from AI is undefined format depending on implementation.

4. API between AI and other management systems

5. Metrics for AI.
   No judgement criteria regarding output results from AI.
   Expand applicable domain (e.g., customer journey)
Appendix
### Enabling Technology: Artificial Intelligence (AI)

- Artificial Intelligence" is applied when a machine mimics "cognitive" functions
- One of the two most dominating technology concepts driving business innovation today (the other is Blockchain)
- SmartBPM Catalyst introduced an AI-Assisted Workflow as an operating solution for SDN in Nice last year

<table>
<thead>
<tr>
<th>Support AI Multi-Label Deep Neural Network</th>
<th>Input</th>
<th>From Orchestrator Feature value of network service (&quot;MTTR&quot;, &quot;Subscriber number&quot;, &quot;How many VNFs&quot;, &quot;network band size&quot;, etc.)</th>
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<tbody>
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<td>From Alarm Mgmt System Type of Root Cause “linkdown”, “virtual machine down”, “application error” etc.</td>
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<tr>
<td></td>
<td>From Information System Configuration Information (What type of VM, hypervisor, etc) and Maintenance Information (Planned or Un-Planned, partial or whole maintenance) etc.</td>
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<tr>
<th>Output</th>
<th>Assessment API No. which is best 3 score of output accuracy from past learning result.</th>
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**Other**

- Deep learning framework = Chainer (http://chainer.org/)

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<tr>
<th>AI Orchestrator Declarative</th>
<th>Input</th>
<th>From Support AI Desired topology (which is represented as <strong>extended TOSCA template</strong>)</th>
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<td>From DMN Engine Constraint (workflow is generated within the requirement)</td>
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| Output | Workflow which consists of APIs of operation systems (e.g. Openstack, Ansible). |
System architecture (Support AI)

AI (Deep Learning)

DNN Multi-Label determines correspond APIs from each the API No 1 - n.