Refining Network Intents for Self-Driving Networks

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Self-Driving Networks

High-level Architecture

Operator ➔ Intent ➔ Process ➔ Adapt ➔ Learn ➔ Monitor

Network

IETF 105, NMRG 54th Meeting
Self-Driving Networks

Focus of our work!
Nowadays...
Nowadays...
Nowadays...

Higher-level

PGA

JANUS

COCOON

NetKat

IETF 105, NMRG 54th Meeting
How to deploy intents expressed in natural language?
Network Intent Refinement using Nile
Network Intent Refinement using *Nile*

1. Receive intents expressed in natural language
Network Intent Refinement using *Nile*

1. Receive intents expressed in natural language
2. Use *Nile* to ask for operator feedback
Intent Refinement By Example

Experimental Service Chaining scenario, using SONATA-NFV and Mininet

Original scenario
Intent Refinement By Example

“Please add a firewall and an IDS from Iperf client to server”

Original Intent
Intent Refinement By Example

“Please add a firewall and an IDS from Iperf client to server”

Original Intent
Intent Refinement By Example

“Please add a firewall and an IDS from Iperf client to server”

Original Intent

NER using Bi-LSTM (Dialogflow.com)
“Please add a **firewall** and an **IDS** from **Iperf client** to **server**”

Extracted entities
“Please add a **firewall** and an **IDS** from *Iperf client* to *server***

*Extracted entities*
"Please add a **firewall** and an **IDS** from Iperf client to server"
Intent Refinement By Example

define intent testIntent:
    from endpoint('iperf client')
    to endpoint('iperf server')
    add middlebox('firewall'),
    middlebox('ids')

Nile intent
Intent Refinement By Example

Is this what you want?

<table>
<thead>
<tr>
<th>define intent testIntent:</th>
</tr>
</thead>
<tbody>
<tr>
<td>from endpoint('iperf client')</td>
</tr>
<tr>
<td>to endpoint('iperf server')</td>
</tr>
<tr>
<td>add middlebox('firewall'),</td>
</tr>
<tr>
<td>middlebox('ids')</td>
</tr>
</tbody>
</table>

Nile intent

YES  NO
define intent testIntent:
  from endpoint('iperf client')
  to endpoint('iperf server')
  add middlebox('firewall'),
  middlebox('ids')

Nile intent

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Nile intent
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    to endpoint('iperf server')
    add middlebox('firewall'),
    middlebox('ids')

Nile intent

Nile compiler to SONATA-NFV commands
Intent Refinement By Example

# deploy vnfs
vim-emu compute start -n fw <params>
vim-emu compute start -n ids <params>

# chain vnfs
vim-emu network add -b -src iperf-c:c-eth0 -dst fw:in
vim-emu network add -b -src fw:out -dst ids:in
vim-emu network add -b -src ids:out -dst iperf-s:s-eth0

Compiled SONATA-NFV commands
Intent Refinement By Example

# deploy vnfs
vim-emu compute start -n fw <params>
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Compiled SONATA-NFV commands
Intent Refinement By Example

“Please add a **firewall** and an **IDS** from **Iperf client to server**”
Evaluation

(i) The accuracy we can achieve with different sizes of training datasets, aiming to find the optimal ratio between dataset size and prediction accuracy.

(ii) The impact of the operator feedback on the accuracy of predictions over time to determine if it improves accuracy.

- 5 dataset sizes:
  - 100, 500, 1000, 2000, 5000 entries.
  - 20% validation split.

- We generated the datasets automatically with random sets of entities and Nile intent pairs, combining a different number of middleboxes, endpoints, traffic matching rules, time, and QoS requirements in each intent.
Results

(i) The accuracy we can achieve with different sizes of training datasets, aiming to find the optimal ratio between dataset size and prediction accuracy.
Results

(ii) The impact of the operator feedback on the accuracy of predictions over time to determine if it improves accuracy.
Results

(ii) The impact of the operator feedback on the accuracy of predictions over time to determine if it improves accuracy.
Summary

“How to deploy network intents expressed as natural language?”

Using our refinement process + *Nile*

Low-level of technical knowledge required

Feedback from user allows to learn over time

“What’s next?”

Fully implement *Nile* compilation into OpenFlow and P4 backends.

Further evaluate the end-to-end proposed solution.
Thank you!

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