Progetto ACINO

Application-Centric IP/Optical Network Orchestration

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Application-centric concept

Overcome inaccurate mapping between applications’ needs and the service they receive by differentiating the service offered to each application at each layer of the transport network, so to adapt the network to the needs of the applications.
Technical Pillars

ACINO Application-Centric Network Orchestration

- Novel Intents and Primitives
- Interaction and Negotiation
- Dynamic Resource Management
- In-Operation Planning
- Network Modelling
- Hierarchical control (devices and controllers)
Listen to apps’ needs

Listen

Intent-based Networking

Think

Application-Centric Optimization

Act

Multi-Layer Network Control

Novel Intents and Primitives

Interaction and Negotiation

Dynamic Resource Management

In-Operation Planning

Network Modelling

Hierarchical control (devices and controllers)
Intent-based Networking

Application

Network

Knows Network Service Needs and requirements (the "What" and "Why")

Determines Network Service Delivery (the "How")

Customer (Requesting System)

Provider (Fulfillment System)

1. Request
   “Get me to the airport, price, time”

2. “Confirmation / agreement
   “ticket reserved, bus (3€)”

Provide a service

Intent Request

“Transport to Airport”

Substance (e.g. Subject, Predicate, Object)

Constraint (Optional)

“Get Me From Here to the Airport”

“Before 17:00” and/or “At most 10€”

Negotiate

Customer (Requesting System)

Provider (Fulfillment System)

1. Request
   “Get me to the airport, price, time”

2. Response/Offer
   “by taxi (30€, 20m) or bus (3€, 50m)”

3. Selection
   “with the bus”

4. Confirmation / agreement
   “ticket reserved”
Intent-based interface: DISMI

Dynamic Intent-driven Service Management Interface

- **Grammar** defines how primitives can be combined to express an intent (verb, nouns, modifiers, etc.)

DISMI validates and compiles complex high-level intents into low-level intents (network layer).

- Create mesh connectivity among 3 abstracted endpoints
- 1 high-level intent *(mesh / regions)* compiled into 3 low-level intents *(p2p / endpoints)*

Ease creation of innovative services

Availability, security, location awareness
Deliver app-centric optimization

Listen
- Intent-based Networking

Think
- Application-Centric Optimization

Act
- Multi-Layer Network Control
- Novel Intents and Primitives
- Interaction and Negotiation
- Dynamic Resource Management
- In-Operation Planning
- Network Modelling
- Hierarchical control (devices and controllers)
App-centric Optimization

ACINO solution is superior
satisfies needs of applications &
does interests of network operators (joint L3/L0 opt)

Same performance, ACINO smaller cost
Same cost, ACINO better performance
Provide multi-layer network control

- **Listen**
  - Intent-based Networking
  - Novel Intents and Primitives
  - Interaction and Negotiation

- **Think**
  - Application-Centric Optimization
  - Dynamic Resource Management
  - In-Operation Planning

- **Act**
  - Multi-Layer Network Control
  - Network Modelling
  - Hierarchical control (devices and controllers)
Network Control: NetStratos

- **Visibility**
  - Service to fiber
- **Dynamicity**
  - Real time operations
- **Completeness**
  - Multi-layer
  - Multi-vendor

Some modules available in Github: [https://github.com/acino-h2020](https://github.com/acino-h2020)
ACINO use-case: In-flight Encryption

- Mission critical infrastructures migrating to the Internet, distributed data centers or even cloud
  - Sensitive applications like government, banking and financial services
- Encryption at the endpoints not always available
- Solution: encrypt traffic during transmission according to applications’ needs
  - Physical Layer (hardware-based)
  - Higher Layer (MACsec, IPsec ...)
- Move configurational complexity away from the client

<table>
<thead>
<tr>
<th>Metric</th>
<th>IPSec</th>
<th>MACSec</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Throughput</td>
<td>Low</td>
<td>Medium</td>
<td>No Overhead</td>
</tr>
<tr>
<td>Payload Size</td>
<td>Restricted (IP Packet)</td>
<td>Restricted (MAC Frame)</td>
<td>Up to 100G</td>
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<tr>
<td>Flexibility</td>
<td>High (L3 Network)</td>
<td>L2 Network only</td>
<td>OTN or SONET/SDH only</td>
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<tr>
<td>HW Availability</td>
<td>High</td>
<td>Carrier Ethernet Capable</td>
<td>Vendor Specific</td>
</tr>
</tbody>
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In-flight Encryption: Experiment

Provisioning of encrypted services over the south-bound interfaces
- IPSec over GRE tunnels using OpenVSwitch
- MACSec on Ethernet with T-API (encryption flag)
- Optical Encryption with T-API (encryption flag)

Max 200 ms from intent request to setup message for encrypted IP or optical tunnel

Summary

• Applications are driving force for network evolution
• ACINO proposes a complete multi-layer orchestration framework to cater to applications’ requirements

• Key contributions
  • Learn: advanced intent-based interface
  • Think: app-centric algos for dynamic allocation of resources
  • Act: multi-layer hierarchical network control

• Demonstrated concept with operator-driven use-cases
• Open-source development
Thank you for your kind attention!

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