

Progetto ACINO

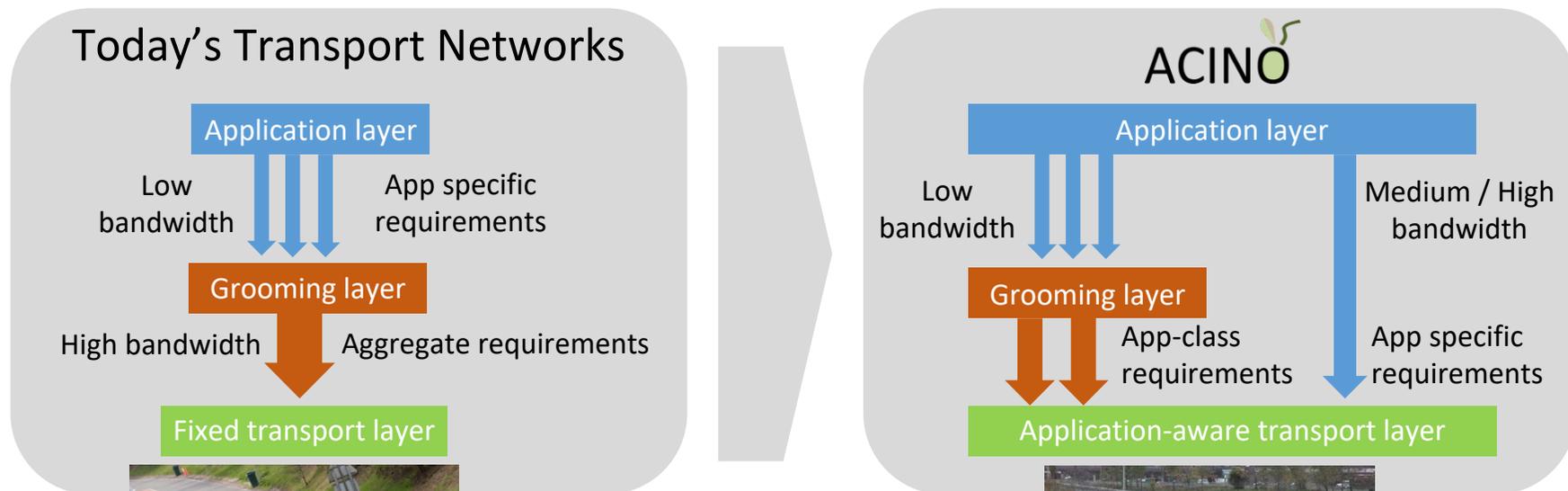
Application-Centric IP/Optical Network Orchestration

Domenico Siracusa – Head of the RiSING research unit
Fondazione Bruno Kessler, CREATE-NET Research Center

Workshop GARR 2018
Rome, May 30th 2018

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***



CREATE-NET
FONDAZIONE BRUNO KESSLER

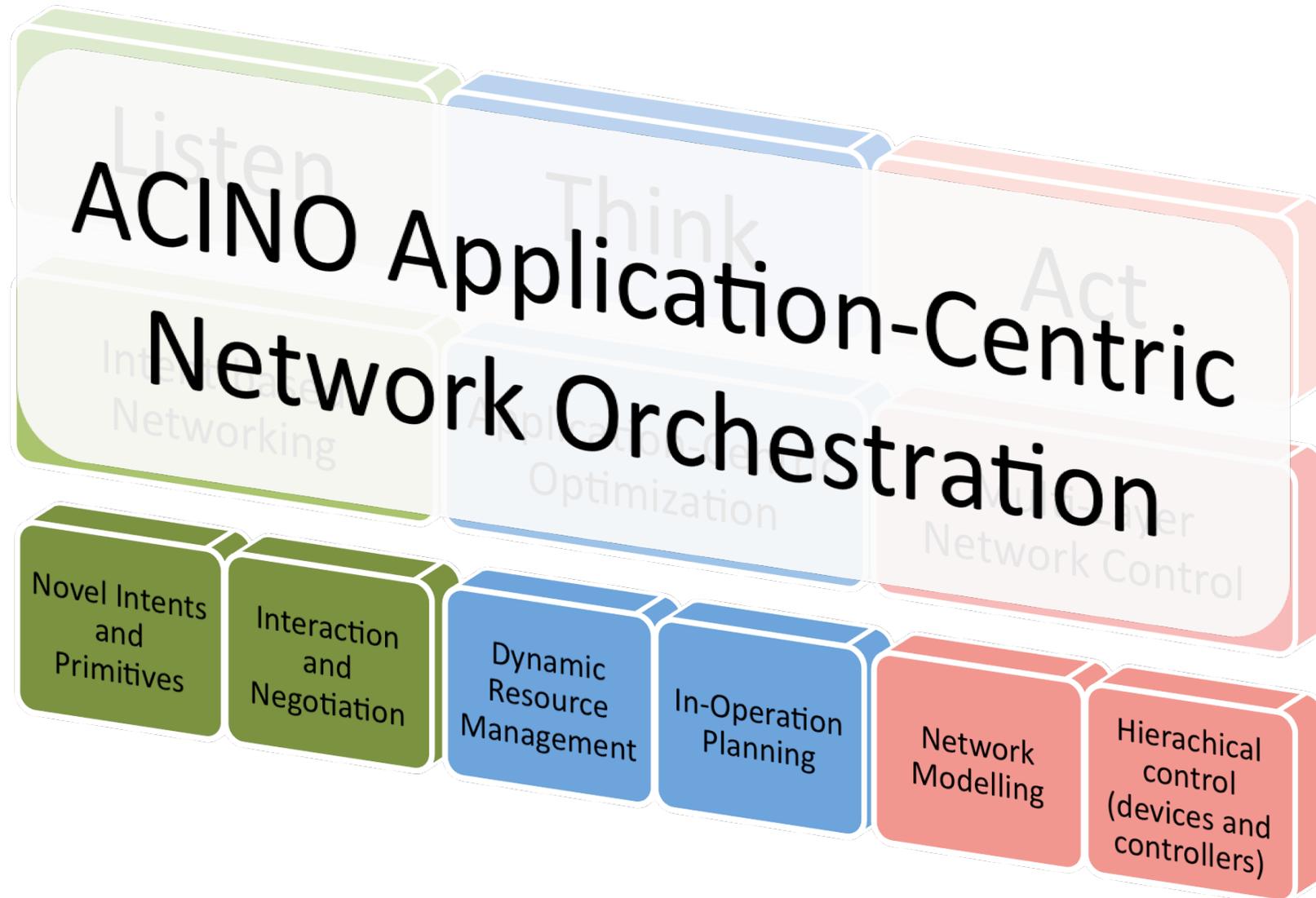
ADVA™
Optical Networking

Telefonica

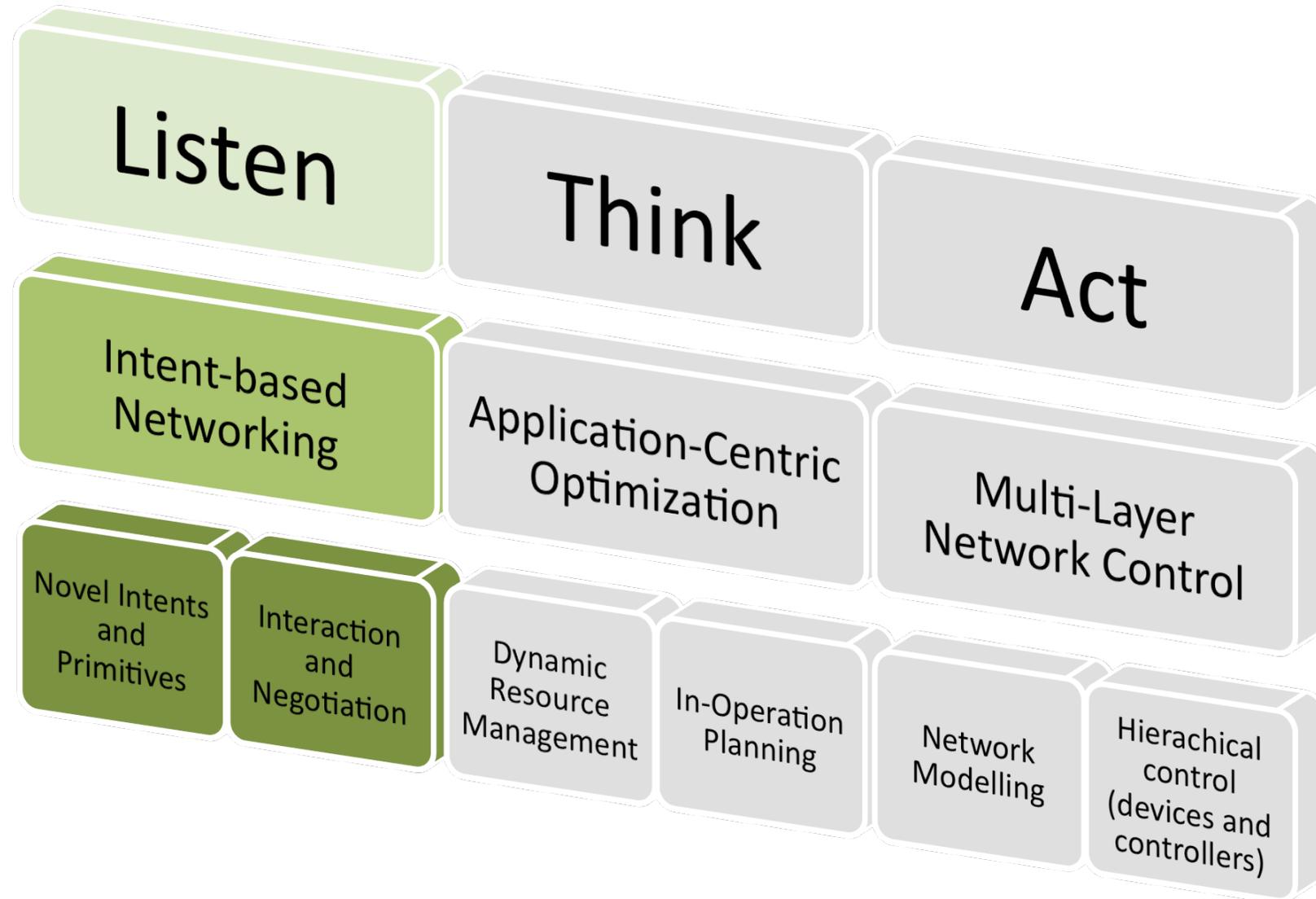
sedona
systems

SWEDISH ICT ACREO

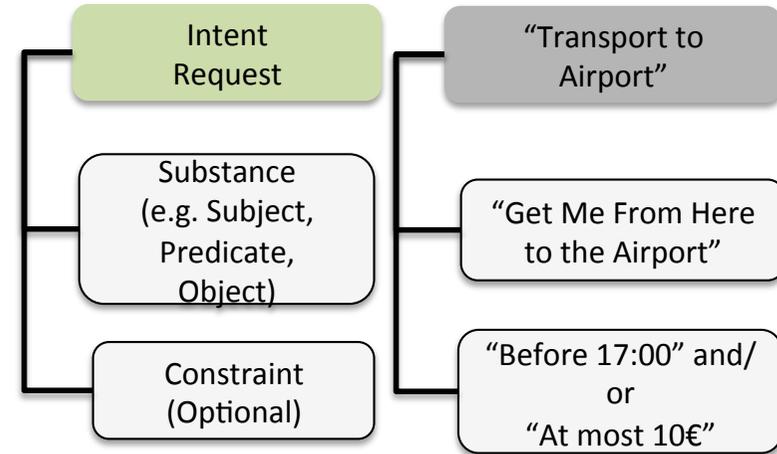
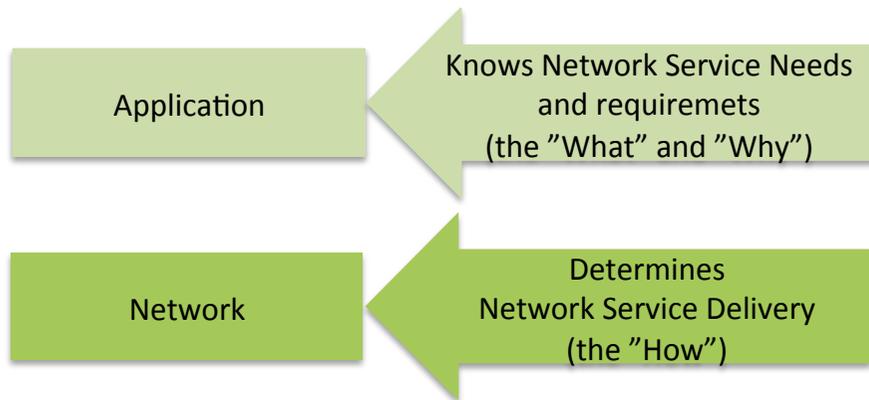
Technical Pillars



Listen to apps' needs

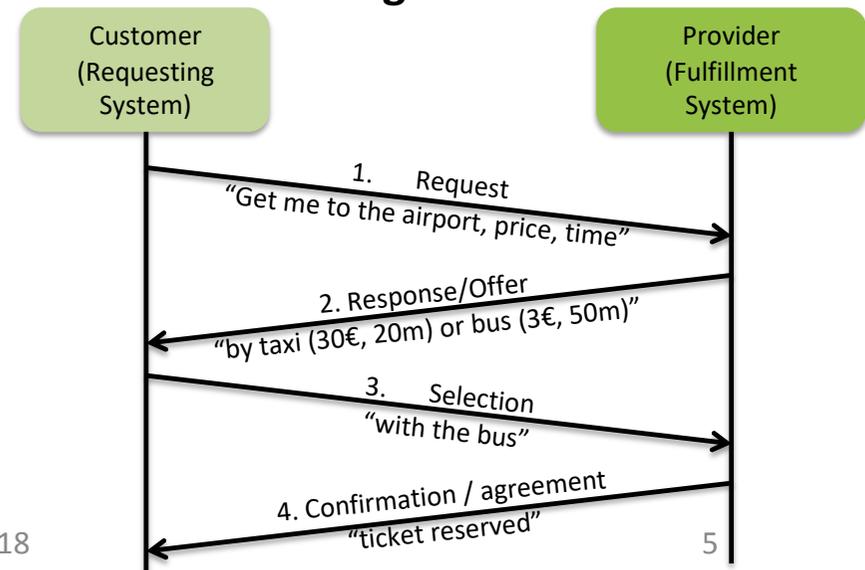
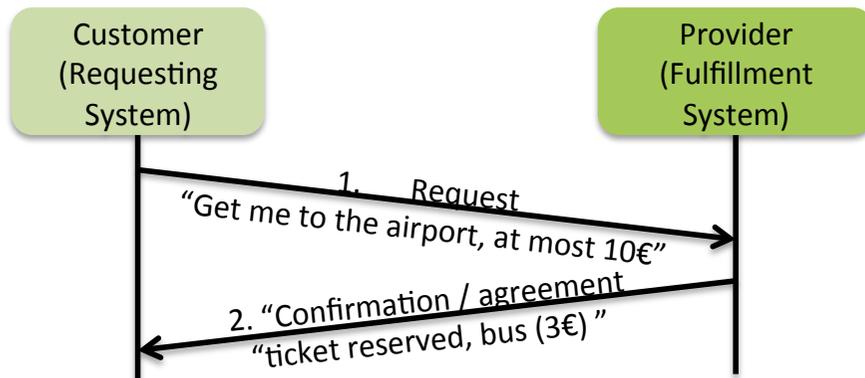


Intent-based Networking



Provide a service

Negotiate

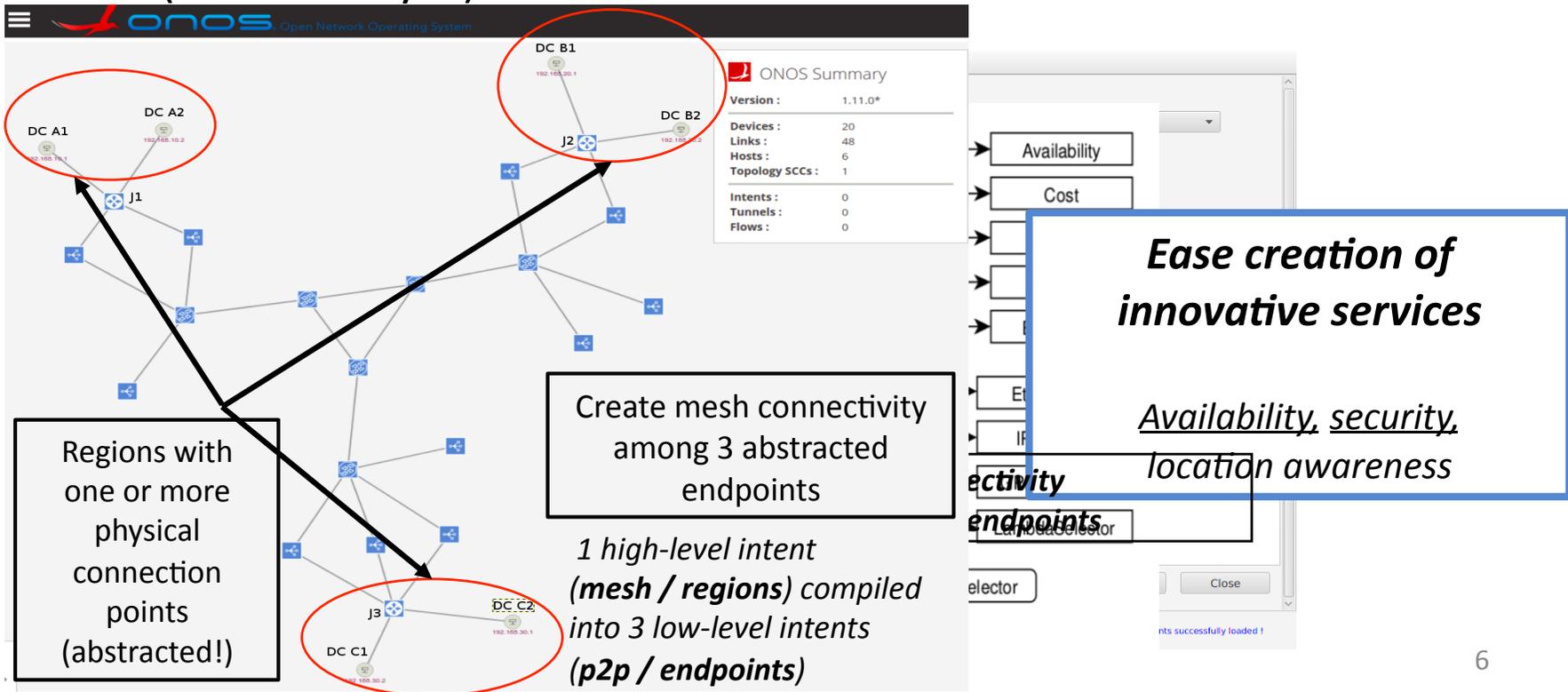


Intent-based interface: DISMI

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)



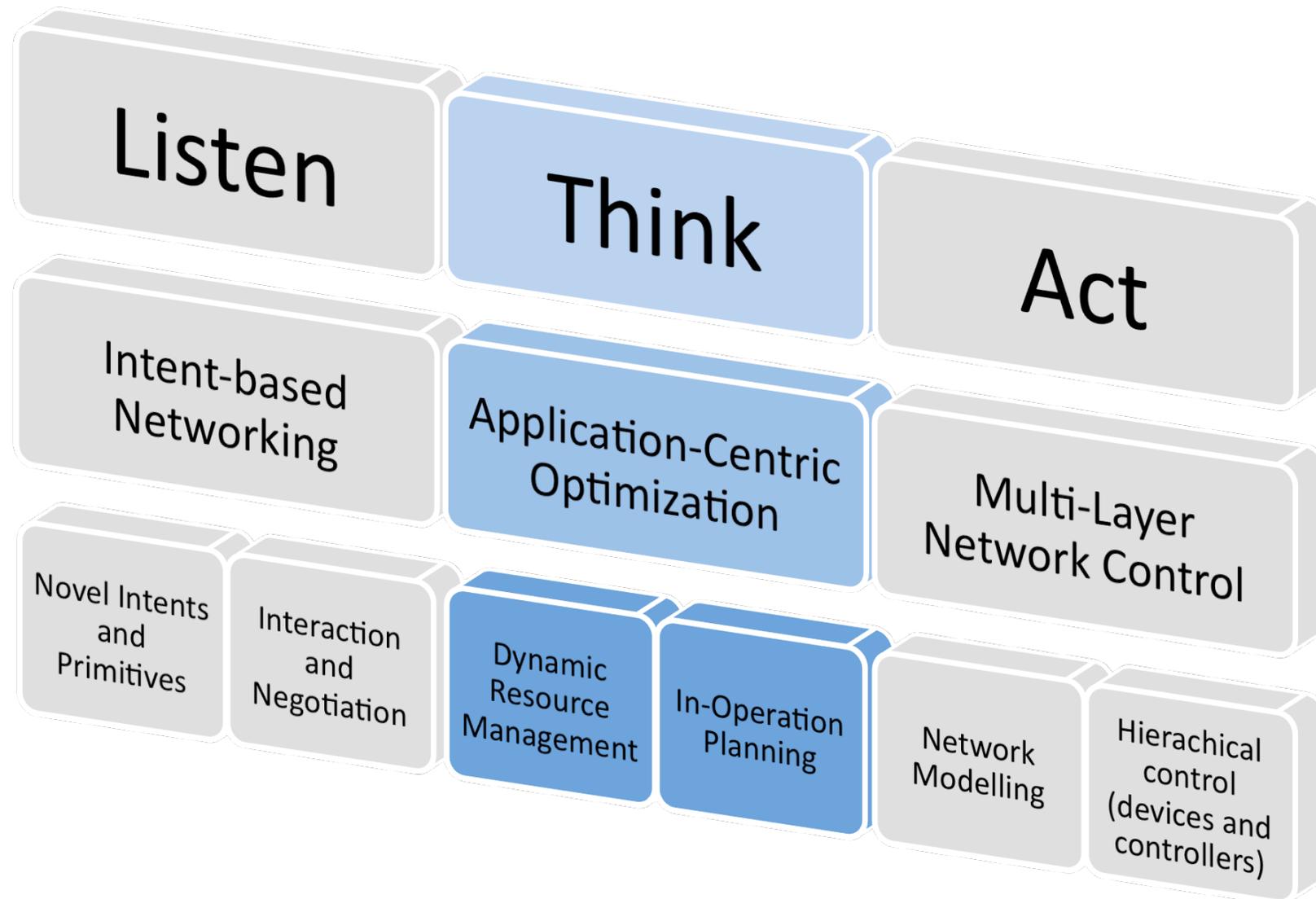
The screenshot shows the ONOS (Open Network Operating System) interface. On the left, a network topology is displayed with nodes labeled DC A1, DC A2, DC B1, DC B2, DC C1, DC C2, J1, J2, and J3. Three regions are circled in red: DC A1 and DC A2, DC B1 and DC B2, and DC C1 and DC C2. A summary panel on the right shows the following data:

ONOS Summary	
Version :	1.11.0*
Devices :	20
Links :	48
Hosts :	6
Topology SCCs :	1
Intents :	0
Tunnels :	0
Flows :	0

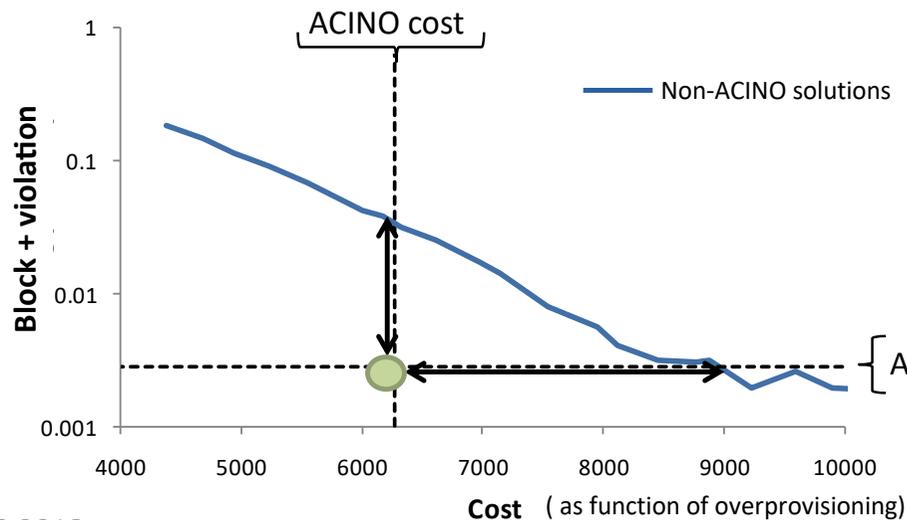
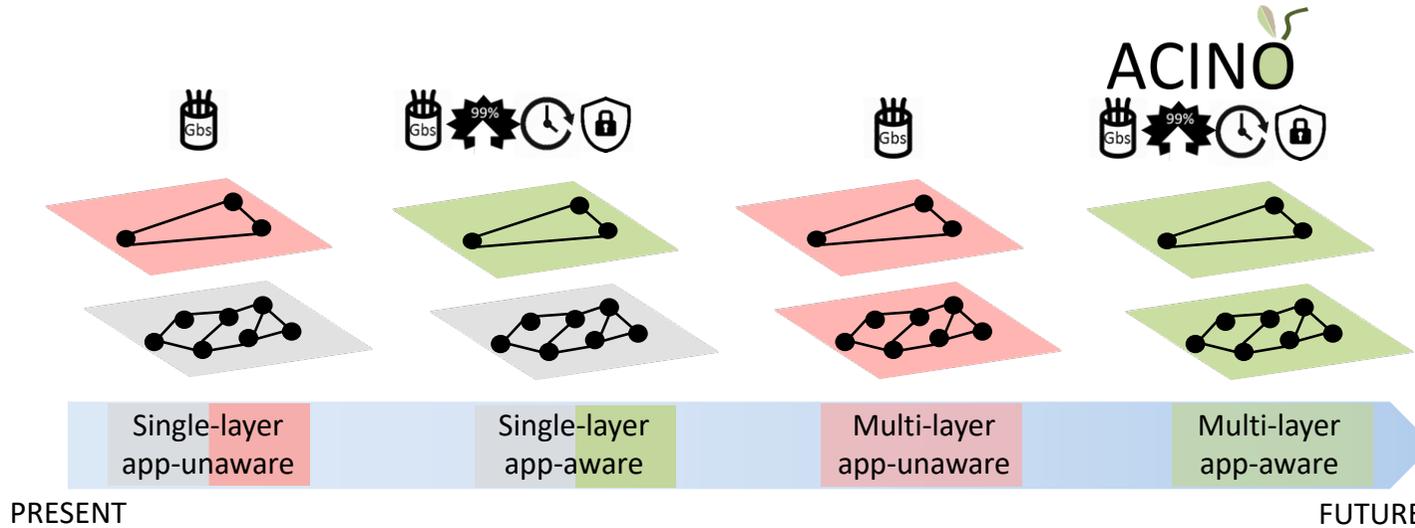
Annotations on the screenshot include:

- A box on the left: "Regions with one or more physical connection points (abstracted!)" with arrows pointing to the circled regions.
- A box in the center: "Create mesh connectivity among 3 abstracted endpoints" with an arrow pointing to the connections between the circled regions.
- A box at the bottom: "1 high-level intent (mesh / regions) compiled into 3 low-level intents (p2p / endpoints)" with arrows pointing to the circled regions.
- A blue box on the right: "Ease creation of innovative services" and "Availability, security, location awareness".
- A box at the bottom right: "activity endpoints" and "selector".

Deliver app-centric optimization



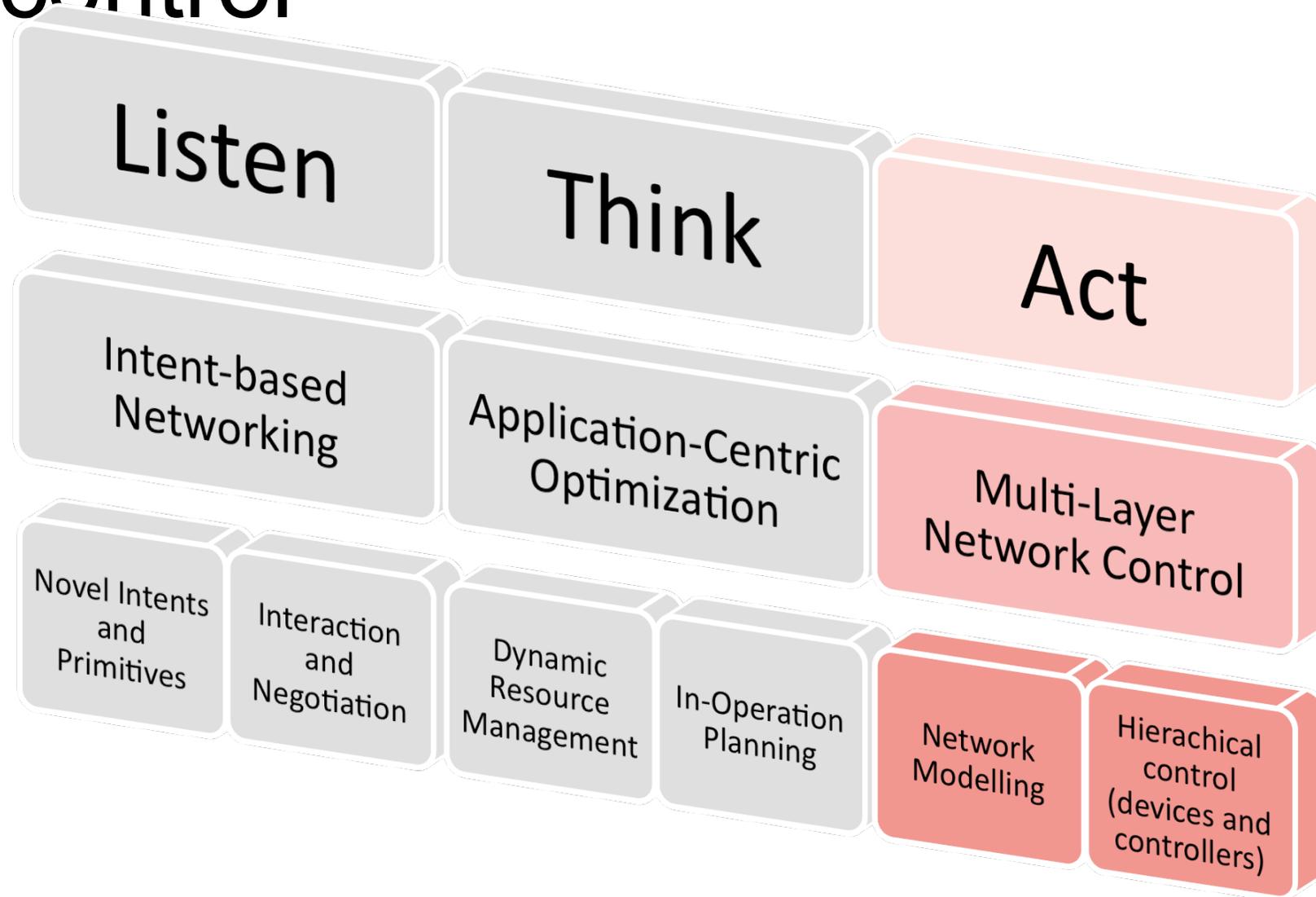
App-centric Optimization



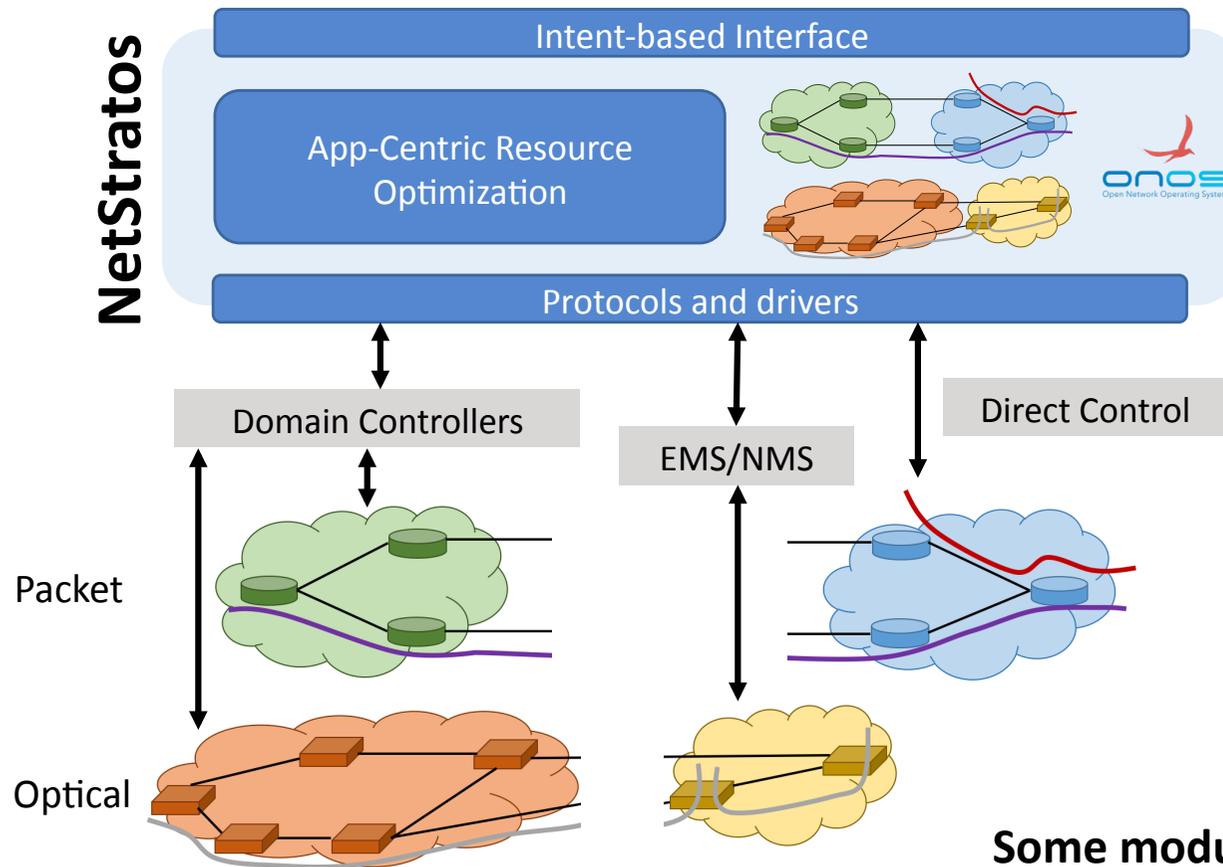
ACINO solution is superior
 satisfies needs of applications &
 does interests of network
 operators (joint L3/L0 opt)

Same performance, ACINO smaller cost	Same cost, ACINO better performance
---	--

Provide multi-layer network control



Network Control: NetStratos



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

Some modules available in



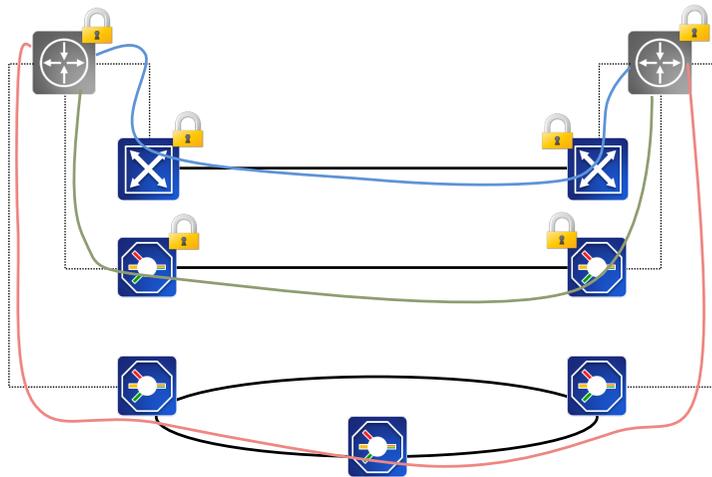
Github: <https://github.com/acino-h2020>

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

Metric	IPSec	MACSec	Physical
Latency	High	Medium	Low
Throughput	Low	Medium	No Overhead
Payload Size	Restricted (IP Packet)	Restricted (MAC Frame)	Up to 100G
Flexibility	High (L3 Network)	L2 Network only	OTN or SONET/SDH only
HW Availability	High	Carrier Ethernet Capable	Vendor Specific

In-flight Encryption: Experiment



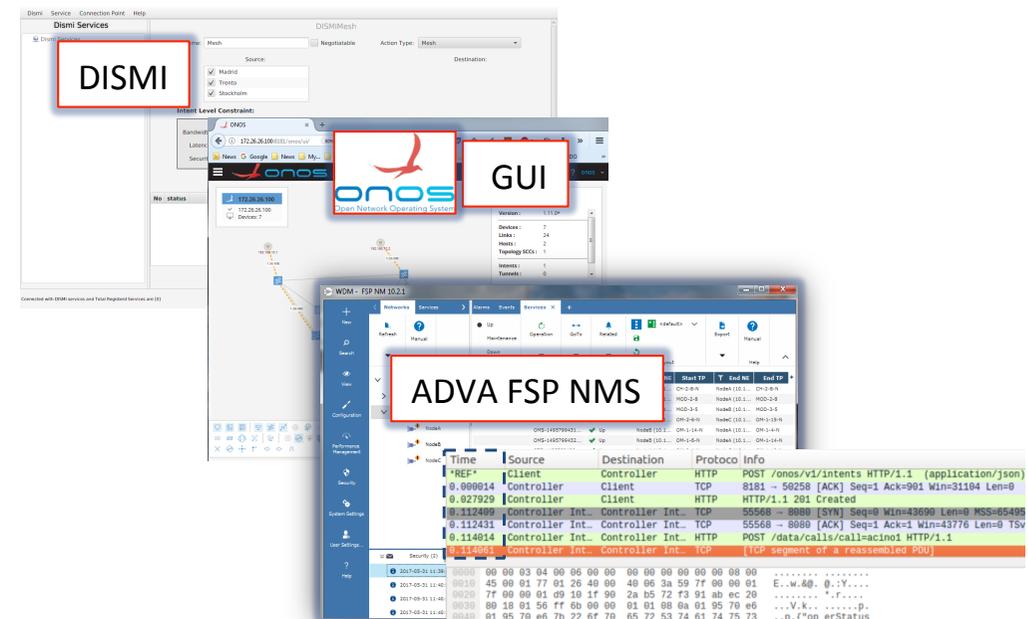
Provisioning of encrypted services over the south-bound interfaces
IPSec over GRE tunnels using OpenVSwitch
MACSec on Ethernet with T-API (encryption flag)
Optical Encryption with T-API (encryption flag)



OFC 2017



T. Szyrkowiec et al. "Automatic Intent-Based Secure Service Creation Through a Multilayer SDN Network Orchestration", JOCN, April 2018.



DISMI

ONOS GUI

ADVA FSP NMS

Time	Source	Destination	Protocol	Info
0.090014	Client	Controller	HTTP	POST /onos/v1/intents HTTP/1.1 (application/json)
0.027929	Controller	Client	TCP	8181 - 56258 [ACK] Seq=1 Ack=901 Win=31104 Len=0
0.112499	Controller Int.	Controller Int.	TCP	55568 - 8080 [SYN] Seq=0 Win=43690 Len=0 MSS=65490
0.112431	Controller Int.	Controller Int.	TCP	55568 - 8080 [ACK] Seq=1 Ack=1 Win=43776 Len=0 TSV
0.114814	Controller Int.	Controller Int.	HTTP	POST /data/calls/call-acino1 HTTP/1.1
0.114863	Controller Int.	Controller Int.	TCP	TCP segment of a reassembled PDU

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

Summary

- Applications are driving force for network evolution
- ACINO^o 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!

dsiracusa@fbk.eu

@custoz