Software-Defined Networking (SDN): A distributed SDN control plane for large-scale networks

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What exactly is SDN and Why is it important? [1]

- Separation between the Data and Control Planes (abstractions),
- Centralization of the Control logic in Software-based controllers,
  → Network Programmability, Openness, Innovation, increased Visibility,
  → better Flexibility, better Network Management, Network Automation..

The Logically-Centralized SDN control architecture

Physically-Centralized vs Physically-Distributed SDN Control

Major Distributed SDN Control Challenges

A- The Controller Placement Optimization Problem

- Finding the appropriate number and locations of the SDN controllers,
  → to achieve the best trade-off between performance and reliability criteria,
- Multi-criteria placement algorithms, Gradual context-based strategies [2].

B- The Knowledge Sharing Problem

Inter-controller communication is needed → correct application behaviors
→ too much Overhead (performance ↓) especially in large-scale SDNs.
⇒ Need for an adaptive multi-level consistency for large-scale SDNs?

We propose adaptive and time-varying control consistency models [3] [4].
They adapt to changing network and application conditions
→ to satisfy application SLAs & minimize inter-controller overheads at scale.
In [5], the proposed Quorum-based consistency strategy uses RL (Q-learning).
It is implemented on ONOS for our CDN-like application.

Ongoing Work and Future Perspectives

Towards a standardized distributed SDN control plane:
- An interoperable, automated, scalable and reliable SDN control plane,
- Securing the SDN control plane (the inter-controller communications).
- Innovative use-cases for the intelligent next-generation networks:
- Application of AI and distributed SDN to the sliced 5G core network.

Main Contributions

References

In CNSM conference, Halifax, NS, Canada, October 21-25, 2019.