A Self-Adaptive Consistency Model for Distributed SDN Controllers

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Introduction

Despite all the hype, the adoption of the Software-Defined Networking [1] paradigm raises many challenges including the scalability and reliability issues of centralized designs that can be addressed with the physical decentralization of the SDN control plane [2]. However, such **physically distributed**, but **logically centralized** systems, bring an additional set of challenges regarding the best approach to designing and decentralizing the SDN control plane while maintaining the logically centralized network view.

In particular, maintaining a consistent and up-to-date global network view for SDN applications running on top of distributed SDN controllers while preserving good performance is a challenging task that should be studied carefully. More specifically, ensuring a proper network state distribution in the SDN control plane requires investigating **the required consistency model** [3].

State-of-Art SDN Controller platforms

Current implementations of distributed SDN controllers use **static** mono-level [4] or multi-level [5] consistency models such as the strong, eventual and weak state consistency levels. Such models do not take into account the network constraints and the changing network conditions.

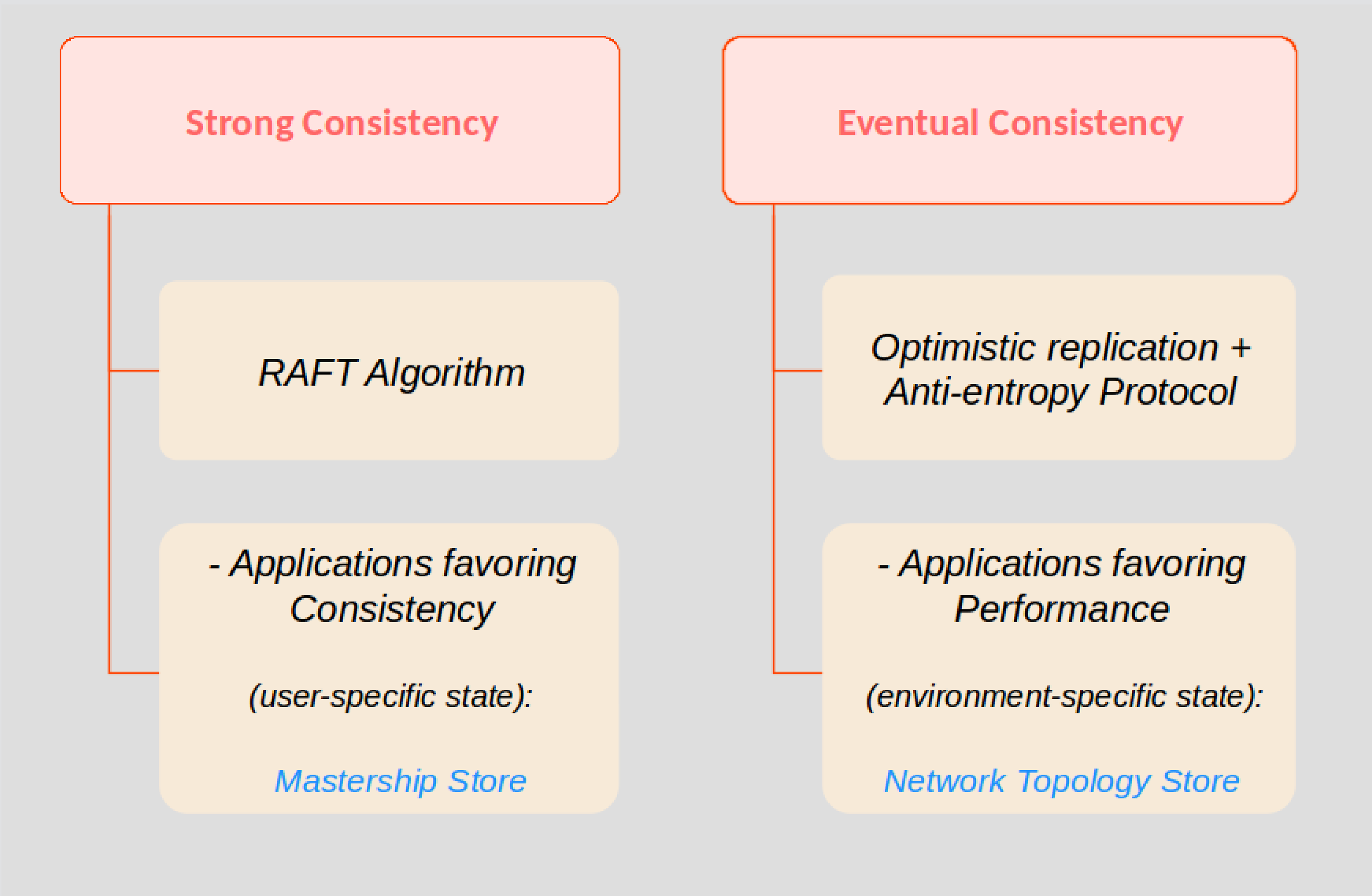


Figure: The Consistency Model of the ONOS Controller Plateform

The Knowledge Sharing Problem

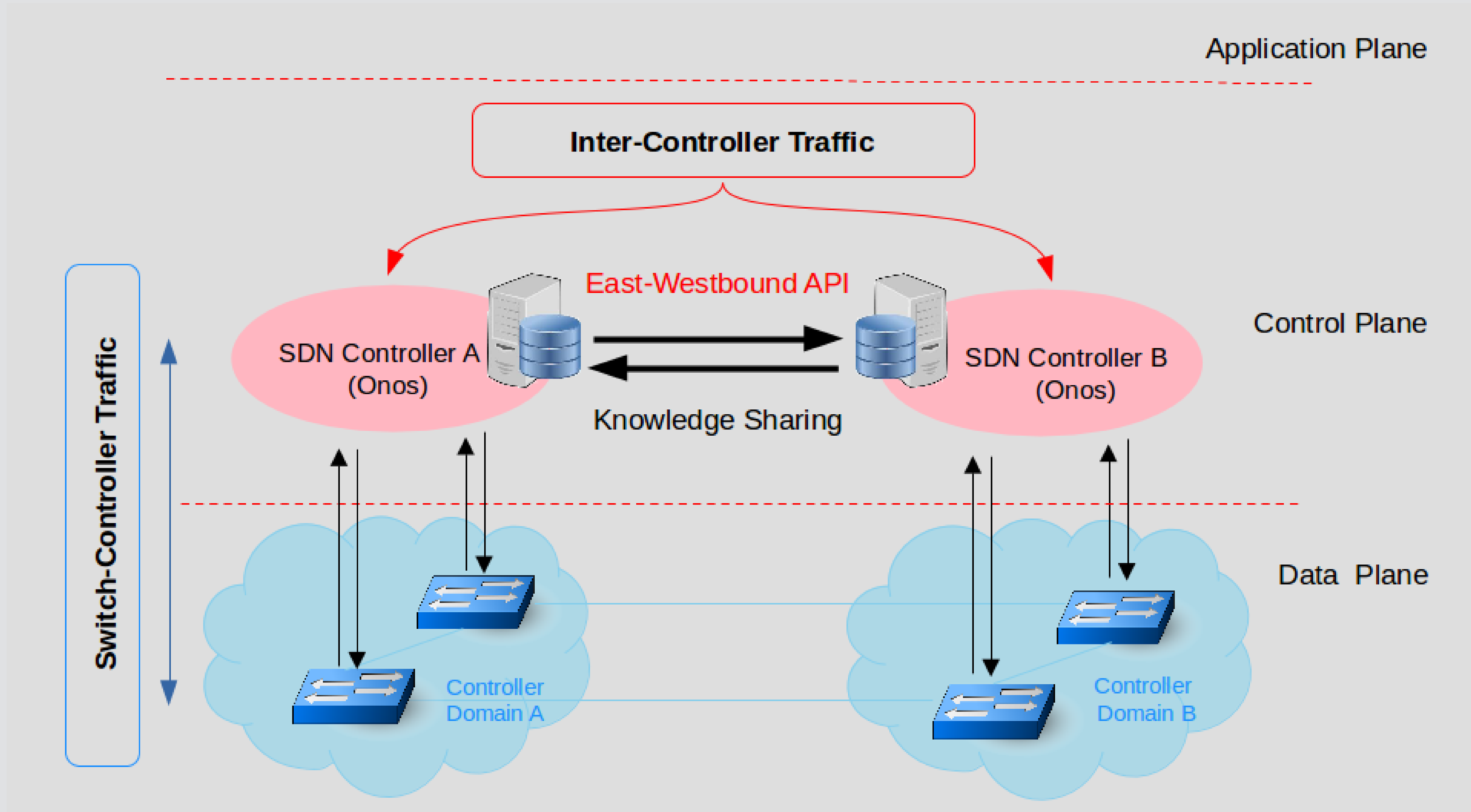
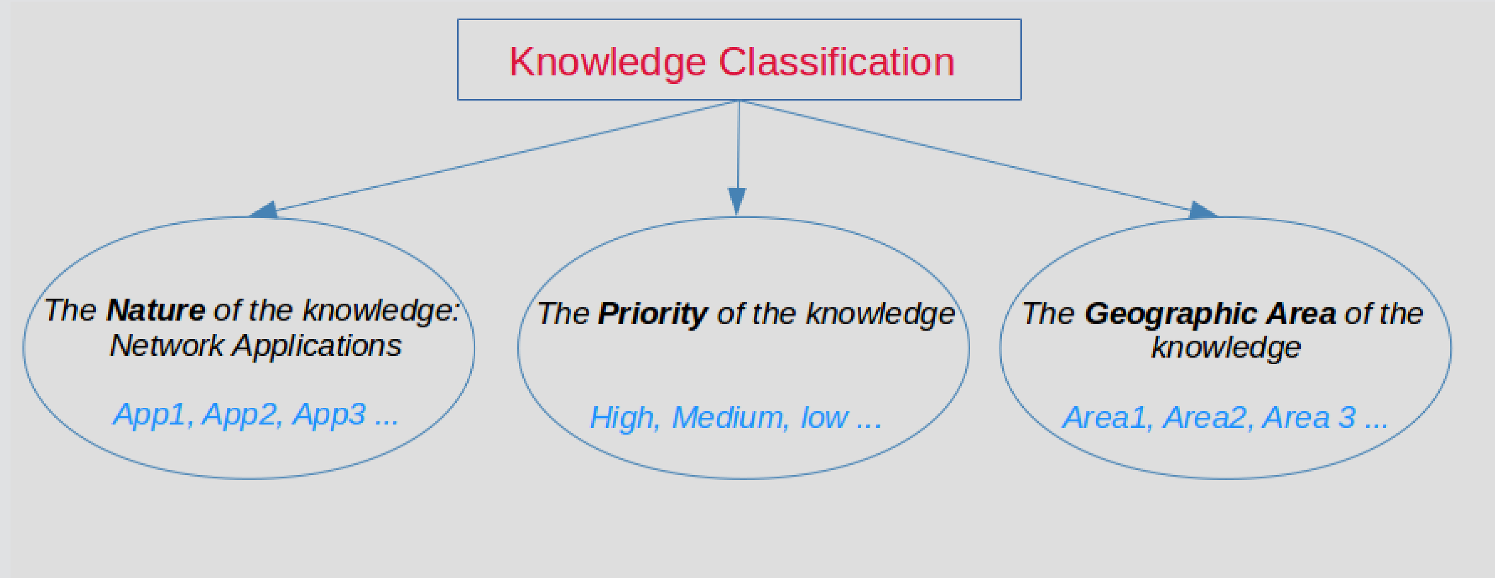


Figure: Distributed SDN control architecture

Potential Solutions

- **Knowledge Granularity** [6]



- **A multi-level Consistency Model**
  (→ Knowledge Sharing Mechanisms)
  - Level 1: Strong Consistency
  - Level 2: Eventual Consistency
  - Level 3: Weak Consistency
  - Level n : ..
- **Adaptive behaviors**
  How does a specific knowledge category adapt dynamically to a certain level of controller consistency ?
  Based on network overhead parameters and performance metrics ?

Conclusion

Designing a distributed SDN control plane where different types of network state are statically assigned to various levels of consistency does not guarantee real-time trade-offs between application correctness and network performance especially in large-scale or dynamic network environments. By contrast, the proposed consistency model adapts to an appropriate level of controller consistency based on data criticality according to changing networking conditions.

The advantages of such a self-adaptive multi-level model include:

- Sparing application developers the tedious task of implementing multiple application-specific consistency models,
- Reducing controller state distribution overhead,
- Ensuring network scalability,
- Enhancing the overall performance of SDN applications.

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