The Evolution of Cloud Computing Towards a Vendor Agnostic Market Place Using the SKY CONTROL Framework

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Introduction

Multi-cloud environments offer benefits like vendor diversification and resilience but pose challenges such as increased management complexity, lack of cost transparency, and compliance. This poster introduces **SKY CONTROL**, a vendor-agnostic framework for small and medium-sized enterprises (SMEs). **SKY CONTROL** integrates cost control and risk management into multi-cloud setups, providing static and dynamic resource analyses, a cost calculator, and risk assessment tools. This novel framework is the first implementation of the innovative **Sky Computing** concept for SMEs. It aims to improve cost efficiency, regulatory compliance, and strategic IT planning for SMEs, offering a unified approach to managing hybrid infrastructures.

Opportunities of multi-cloud setups

+ **Reduction of provider dependency**
+ **Cost optimization**
+ **Business continuity through partial redundancy**
+ **Selection of the best service offerings for the respective application**

Challenges of multi-cloud setups

− **Cost management**
− **Cost comparison across different providers**
− **Risk management and resilience**
− **Compliance and governance across all cloud platforms**

Sky Computing

The Sky Computing concept [1] introduces an abstraction layer – the **Intercloud Broker** – between cloud providers and end-user workloads, resolving interoperability issues in multi-cloud setups.

The **Service Catalog** records available instances and services, including locations, pricing, and APIs, while the **Tracker** monitors prices and resource availability across providers. Using this data, the **Optimizer** evaluates workload requirements, checks availability and pricing, and determines optimal service placement. The **Executor** manages application execution by aggregating tasks and deploying workloads based on allocated resources. Additionally, **Compatibility Sets** leverage existing services and APIs from various cloud providers, ensuring seamless, standardized connectivity without requiring reimplementation. The term *"cloud of clouds"* summarizes this concept, because it creates a uniform, interoperable layer above multiple clouds. Sky Computing thus provides a solid foundation for implementing our proposed framework and leveraging the benefits of unified multi-cloud environments for SMEs.
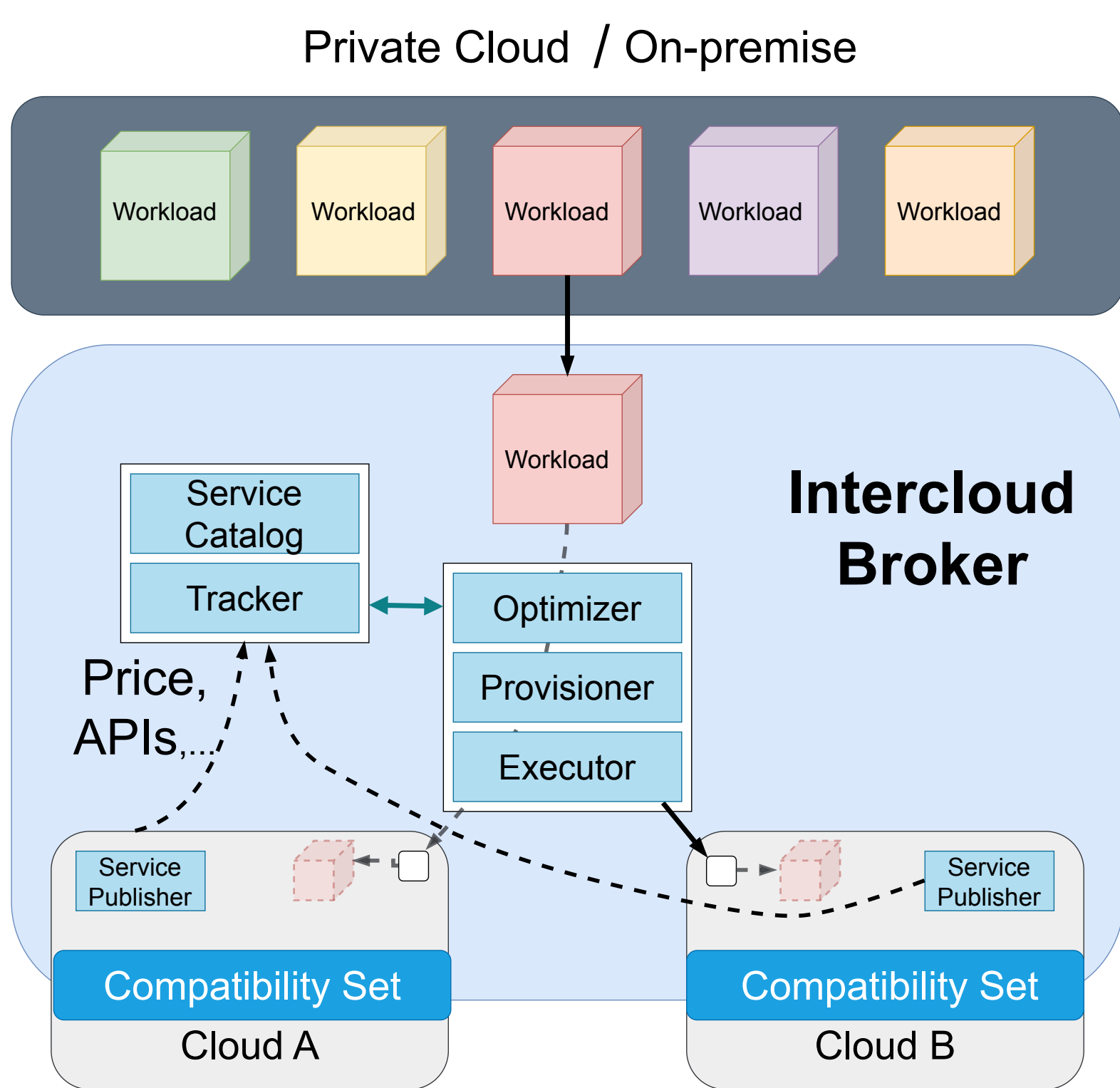
The Intercloud Broker [2]

SKY CONTROL
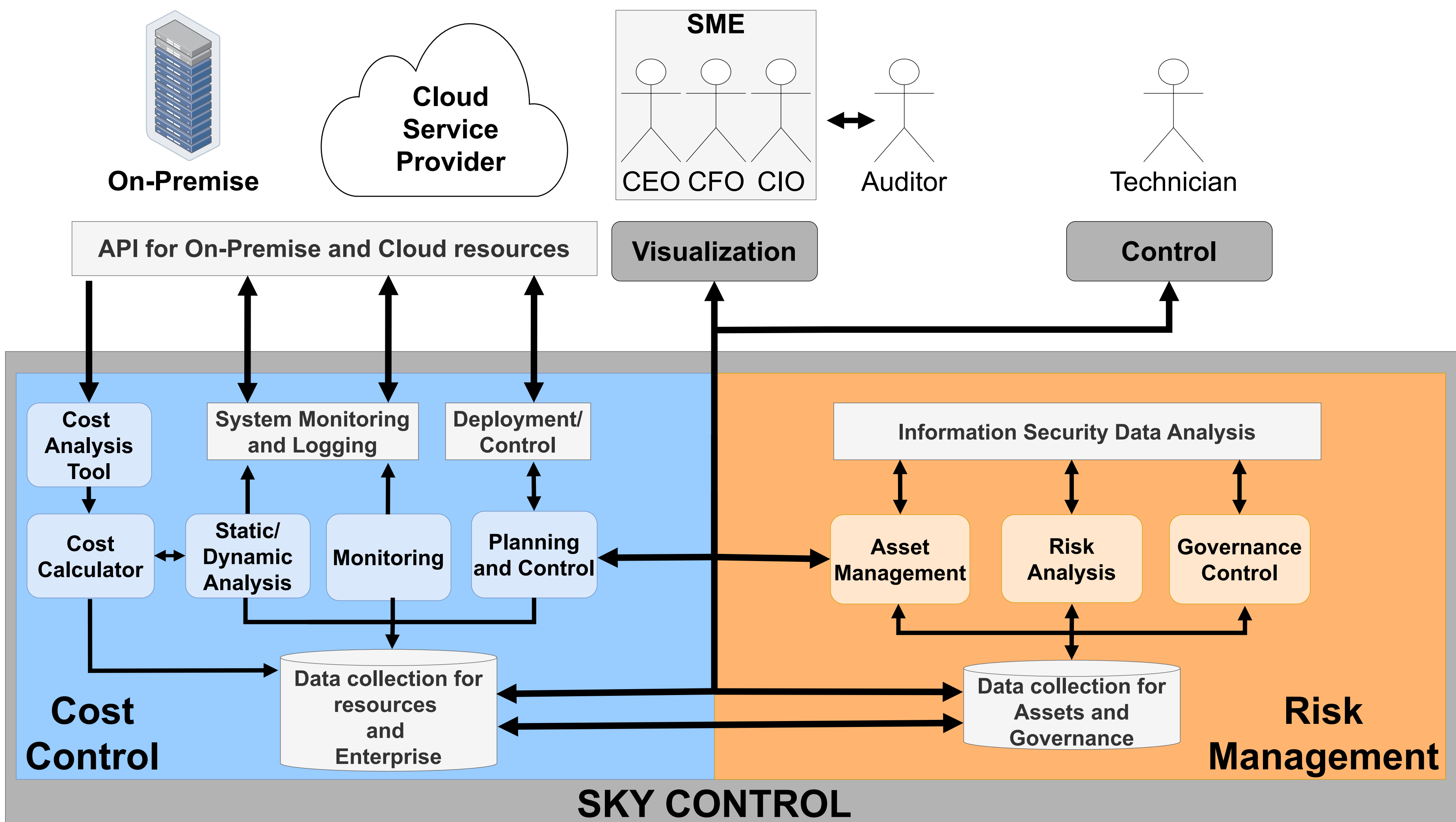
Cost Control

- A control and planning tool provides insights into resource usage across multiple cloud providers.
- Analysis, calculation, and visualization of costs for both on-premise and cloud resources.
- It performs static analysis (e.g., resource IDs, hardware specs) and dynamic analysis (e.g., CPU/memory usage, network bandwidth).
- Deriving pricing trends and predictions from the data, considering the complexity of cloud service integration.

Risk Management

- Manages customer assets, collects detailed insights, and performs risk analysis.
- Evaluates risks based on asset criticality, data sensitivity, and compliance standards (e.g. BSI C5) [3].
- Helps businesses meet governance requirements and enhances compatibility with larger enterprises.
- Provides risk and asset visualization for CIOs, aiding audits and risk mitigation.

Open Questions

⇒ **What are the challenges of multi-cloud environments for SMEs?**
⇒ **How can Sky Computing enhance workload placement efficiency for SMEs compared to multi-cloud setups?**
⇒ **How is it possible to analyze the costs of multi-cloud environments for SMEs?**
⇒ **How can SMEs keep track of the distributed workloads and make sure security risks are analyzed?**

Acknowledgements

References

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[2] Yang, Z., et al. (2023). *SkyPilot: An intercloud broker for sky computing.* In 20th USENIX Symposium on Networked Systems Design and Implementation (NSDI 23), pages 437–455, Boston, MA. USENIX Association.

[3] Di Giulio, et al. (2017). *Cloud standards in comparison: Are new security frameworks improving cloud security?* In 2017 IEEE 10th International Conference on Cloud Computing (CLOUD), pages 50–57.