

# Mixed-Tenancy Systems

## A hybrid Approach between Single and Multi-Tenancy

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Multi-Tenancy is an architectural paradigm that is supposed to allow operators to exploit economies of scale. This is due to the fact that a single instance of Multi-Tenancy application serves multiple customers at the same time. Thus, operators may utilize resources and facilitate application operations more efficiently. On the other hand, however, a major drawback of Multi-Tenancy is the customers' hesitation of sharing infrastructure, application code, or data with other tenants. According to recent studies, this is due to the fact that one of the major threats of Multi-Tenancy is information disclosure due to a system malfunction, system error, or aggressive actions by individual users. So far, the only approach in research to counteract on this hesitation has been to develop new techniques to enforce the isolation between tenants using the same instance.

This work tackles this challenge by proposing a novel approach that is referred to as Mixed-Tenancy. It allows customers to express their deployment constraints about if or even with whom they want to share the application. To be more precise, the approach enables the customer to make that choice not just for the entire application but specifically for individual application components and their underlying infrastructure stack. Based on these constraints a deployment is computed that uses infrastructure as efficiently as possible by being in compliance with all constraints. Such a deployment is referred to as valid and optimal. Thus, Mixed-Tenancy is an approach that allows operators to exploit economies of scale by still keeping customers' hesitations concerning the privacy threats of Multi-Tenancy in mind.

This work contributes to the creation of Mixed-Tenancy systems by introducing a generic model that allows capturing customers' deployment constraints. Thereby, the model allows customers to express complex constraints (e.g. "sharing shall only be permitted with companies from Europe but not with competitors") while still allowing the operator to keep its customer base secret. In addition the problem of computing a valid and optimal deployment is formally defined and analyzed. Furthermore, it is proven to be NP-hard and two intuitive heuristics are introduced and compared.

Finally, this work evaluates the applicability of Mixed-tenancy by investigating a case study in the area of cloud computing. This is done by introducing Mixed-Tenancy to an existing cloud application, called OpenERP, currently used in industry. It thereby demonstrates that the Mixed-Tenancy approach may indeed be successfully applied to real-world systems.