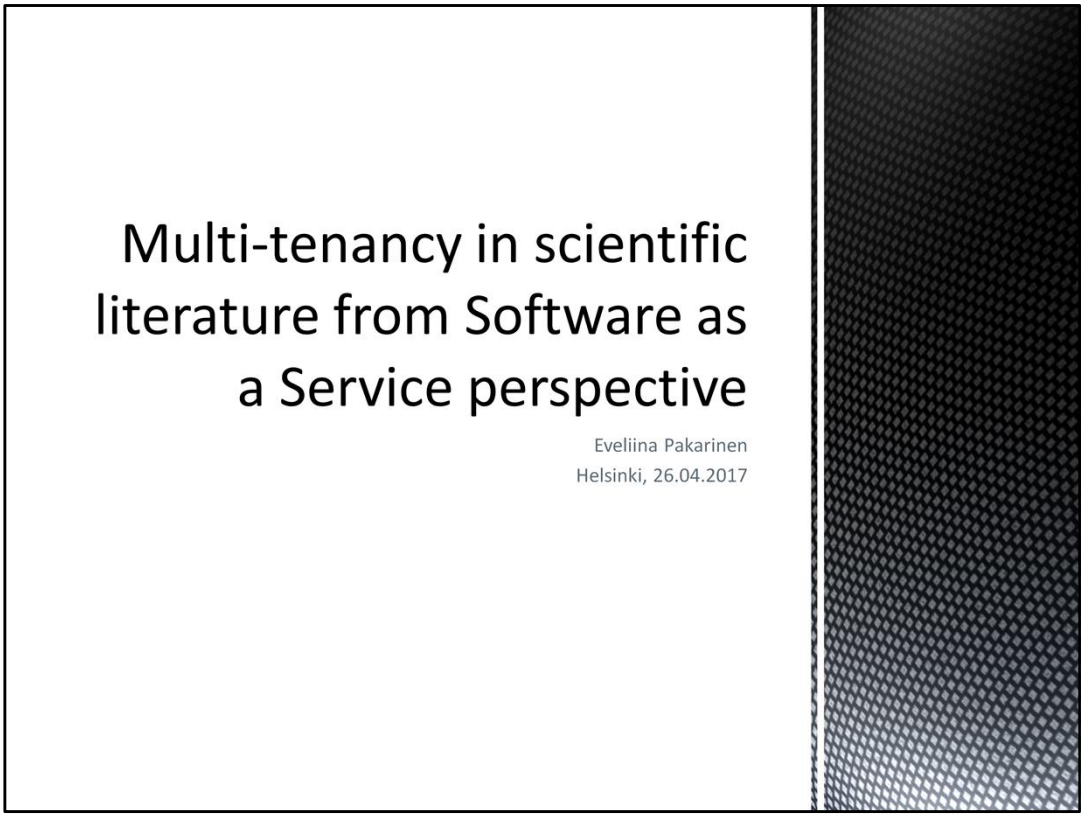


Tell about yourself and introduce the topic of this seminar paper

Contents

Research questions and data collection

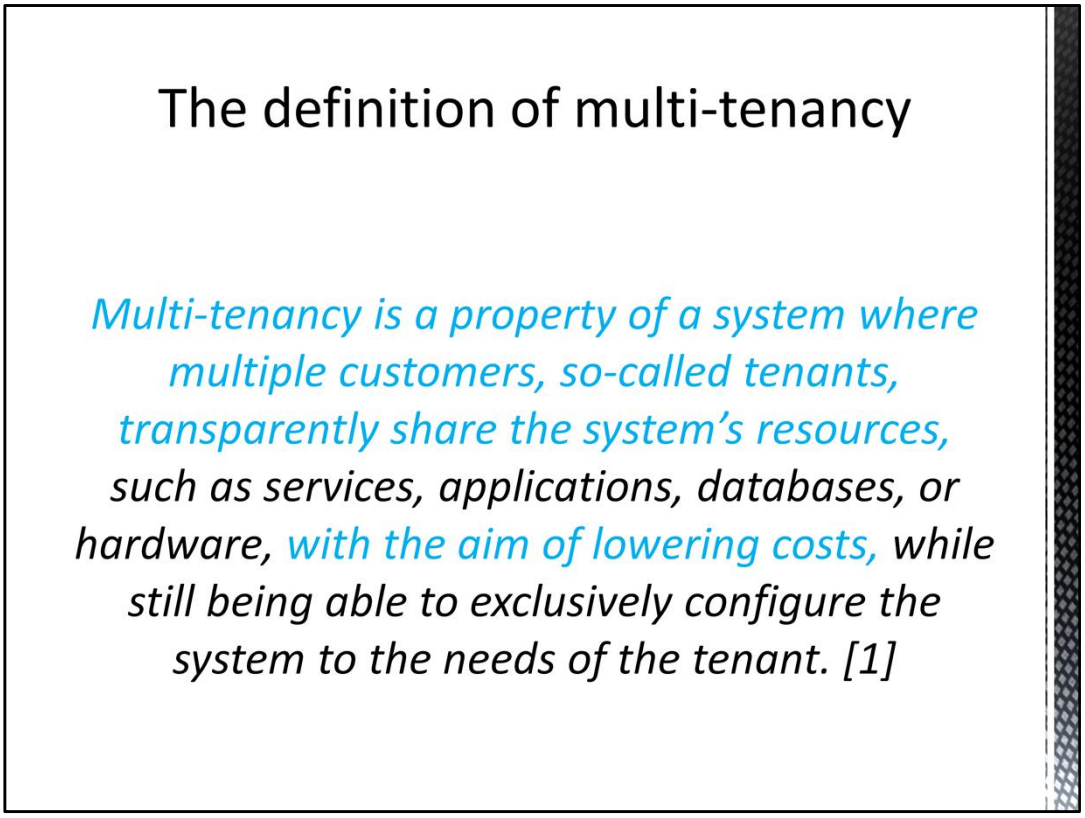
1. *How is multi-tenancy defined in scientific literature?*
2. *What is the connection between multi-tenancy and SaaS business model?*
3. *What challenges the characteristics of multi-tenancy can cause?*

- Search for academic papers → filter out papers → select relevant papers

My research questions are the following questions.

Seminar paper is based on academic papers
First I did search for academic papers in Digital libraries
Found papers based on references on the papers
After finding papers filtered out papers that had no potential to be used as a reference
After that papers that were left were studied further and relevant papers were chosen as reference

References found also during writing process.



Mt is high level architectural pattern
Multi-tenancy is a relatively new topic in scientific literature, first time was mentioned in year 2006

There have been many definitions for multi-tenancy and differences in the interpretation of multi-tenancy among academics.
The definition which I used in my seminar paper is based on a research about structural search in academic literature and I selected this definition because it is comprehensive and clear

Definition states that mt...

The characteristics of multi-tenancy

Multi-tenancy is a property of a system where multiple customers, so-called tenants, transparently share the system's resources, such as services, applications, databases, or hardware, with the aim of lowering costs, while still being able to exclusively configure the system to the needs of the tenant. [1]

The definition contains also the three most often mentioned characteristics of multi-tenancy

The first characteristic is that the tenants share applications and databases transparently
This means that for example when sharing db all of the data is stored in the same database

All of the characteristics bring also challenges with them
A security breach can therefore cause the exposure of one tenant's data to another tenant so security must be taken seriously when developing multi-tenant applications

The characteristics of multi-tenancy

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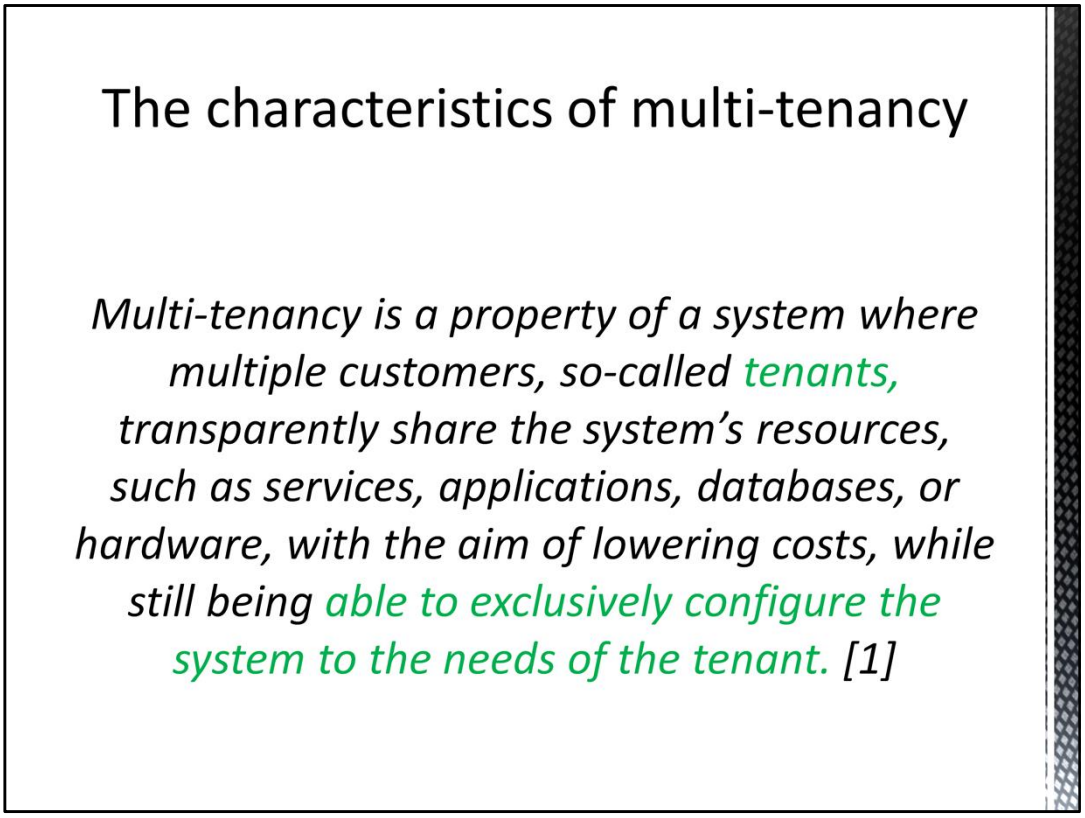
The second characteristic is that tenants can share the same hardware

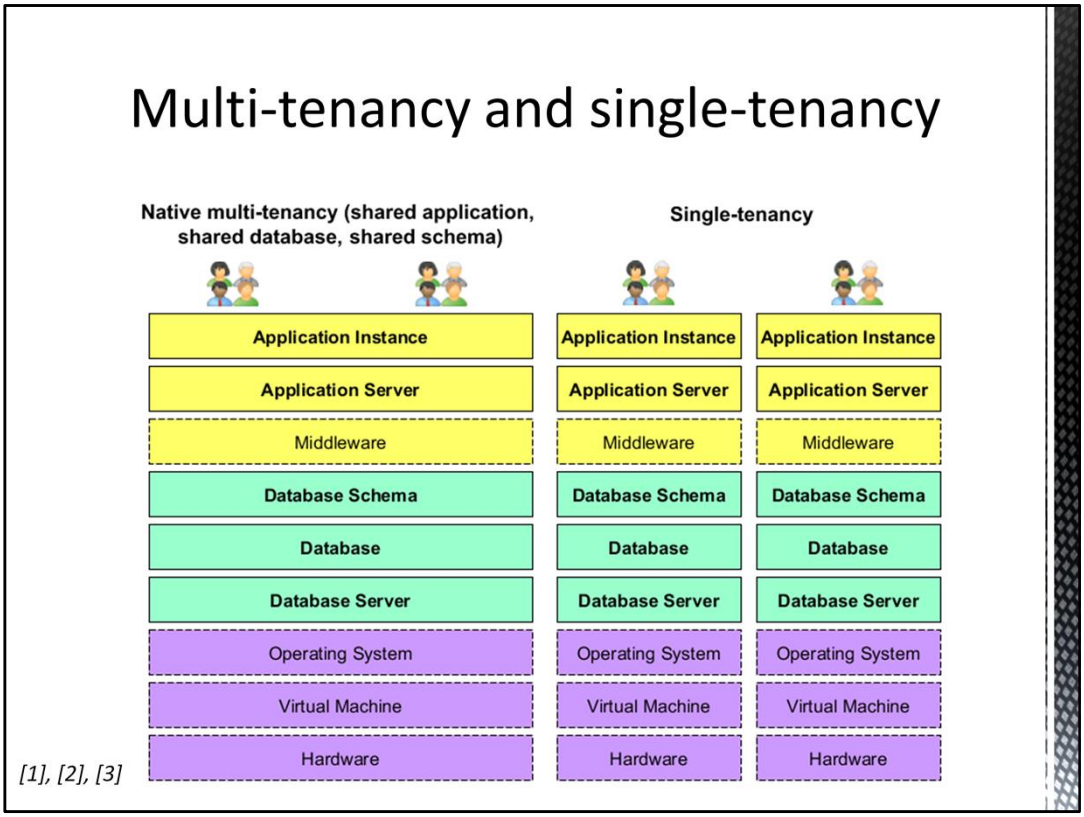
When sharing the same hardware service provider does not need to have so much hardware to serve multiple tenants.
So service provider can improve the profit margin when the server utilization increases

The overall service delivery costs decrease and service provider can offer the application at lower service subscription costs to the customers



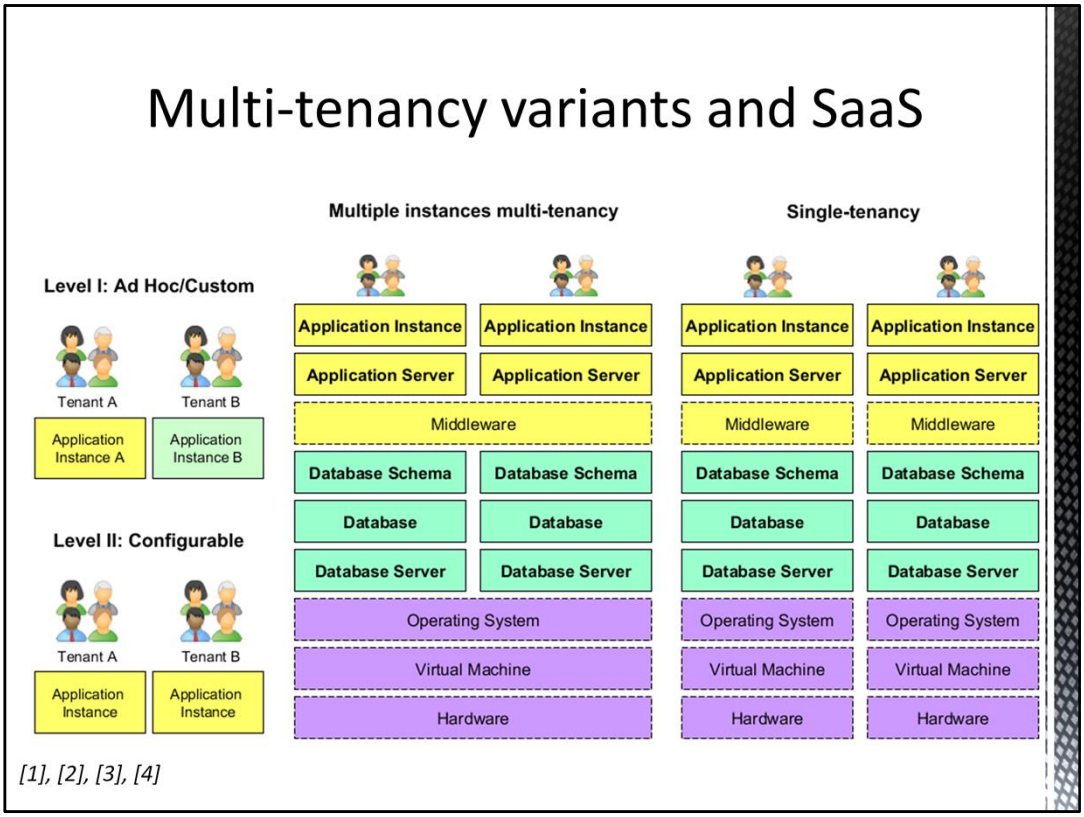
The third characteristic of multi-tenancy is that the tenants can configure the application instance heavily on runtime

The disadvantage of this approach is
Adding configurability to the application can result to complexities in the application code(base)
Code complexity can make application maintenance harder



Here you can see visual representation how the different system levels are organized in pure (native) multi-tenancy and as a comparison point in single tenancy.

In pure multi-tenancy tenants share all of the system levels while in single-tenancy each tenant gets an own application instance



Multi-tenancy comes in many different variants which represent the perspective from which mt can be seen. So there are many variants of multi-tenancy between single-tenancy and pure multi-tenancy which were presented in the previous slide

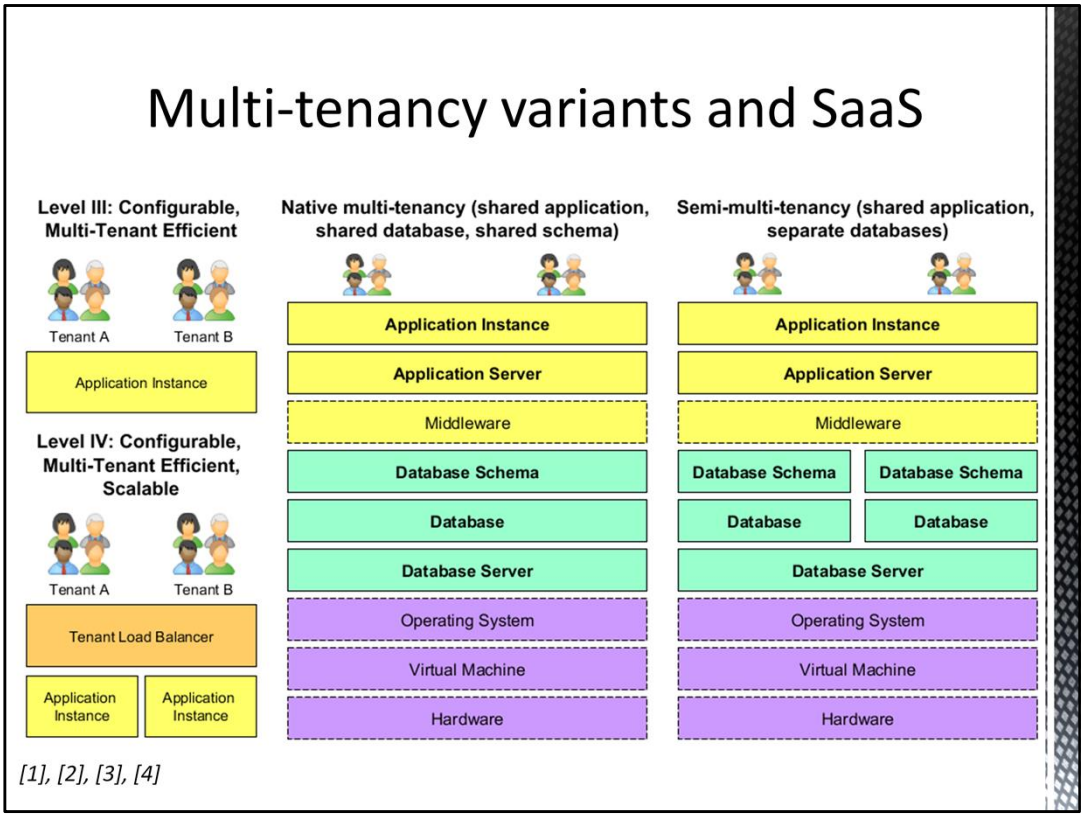
The second research question was what is the connection between mt and SaaS

SaaS (Software as a Service) is a business model where software is offered as an on demand service to the customers

In academic research of multi-tenancy SaaS is an important research topic and multi-tenancy is also part of the Software as a Service maturity model.
This model is used to express the maturity of a SaaS application. The maturity model has four distinct levels and at each level one attribute of a mature SaaS application is added to the model

Here you can see the first two levels of the maturity model.
At the first level applications are custom applications and each tenant has an own individual application. At the second level configurability is added to the application although each tenant has still an own instance.

The applications at these levels of the maturity model can be offered to the customers in a multi-tenant way by hosting the applications on the same hardware. This corresponds to multiple-instances multi-tenancy variant which you can see here. This reduces the amount of hardware which is needed to host the applications



At the third level of SaaS maturity model multi-tenancy is added to the model.
At this level tenants use the same application instance transparently without knowing about the sharing of application instance with other tenants

This level of maturity model corresponds to the semi-multi-tenancy variant where tenants also share the same application instance without necessarily sharing the same database instance or schema.
Or this level can also be the native multi-tenancy.
In semi-multi-tenancy loading the database to memory for each tenant can cause performance problems so more tenants can be hosted on the same server in native multi-tenancy than in semi-mt

The fourth level of SaaS maturity model adds also scalability to the model
At this level applications can be scaled up using tenant load balancer and adding application instances according to the current demand

Conclusion

1. *Many definitions – three main characteristics*
2. *Variants of multi-tenancy – attribute of a mature well-defined SaaS application*
3. *Challenges in performance, maintenance and security areas*

Performance – hardware sharing – problem by one tenant can affect the performance of others
Maintenance – runtime configuration – complexity in code
Security – application/database sharing – security breach exposure of other tenant's data

Variants of multi tenancy:
- Different benefits: for example higher hardware utilization and lower service delivery costs

In addition to the advantages of mt there are also challenges which affect the use of multi-tenancy

References

[1] J. Kabbedijk, C.-P. Bezemer, S. Jansen, and A. Zaidman, "Defining multi-tenancy: A systematic mapping study on the academic and the industrial perspective," Journal of Systems and Software, vol. 100, pp. 139 – 148, 2015. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S0164121214002313

[2] C. J. Guo, W. Sun, Y. Huang, Z. H. Wang, and B. Gao, "A framework for native multi-tenancy application development and management," in The 9th IEEE International Conference on E-Commerce Technology and The 4th IEEE International Conference on Enterprise Computing, Ecommerce and E-Services (CEC-EEE 2007), July 2007, pp. 551–558.

[3] F. Chong, G. Carraro, and R. Wolter, "Multi-tenant data architecture," 2006, accessed: 23.03.2017. [Online]. Available: https://msdn.microsoft.com/en-us/library/aa479086.aspx

[4] F. Chong and G. Carraro, "Architecture strategies for catching the long tail," 2006, accessed: 23.03.2017. [Online]. Available: https://msdn.microsoft.com/en-us/library/aa479069.aspx