

# Towards customizing multi-tenant Cloud applications using non-intrusive microservices

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# One of Europe's largest independent research organisations



NOK 3.1 billion  
Revenues

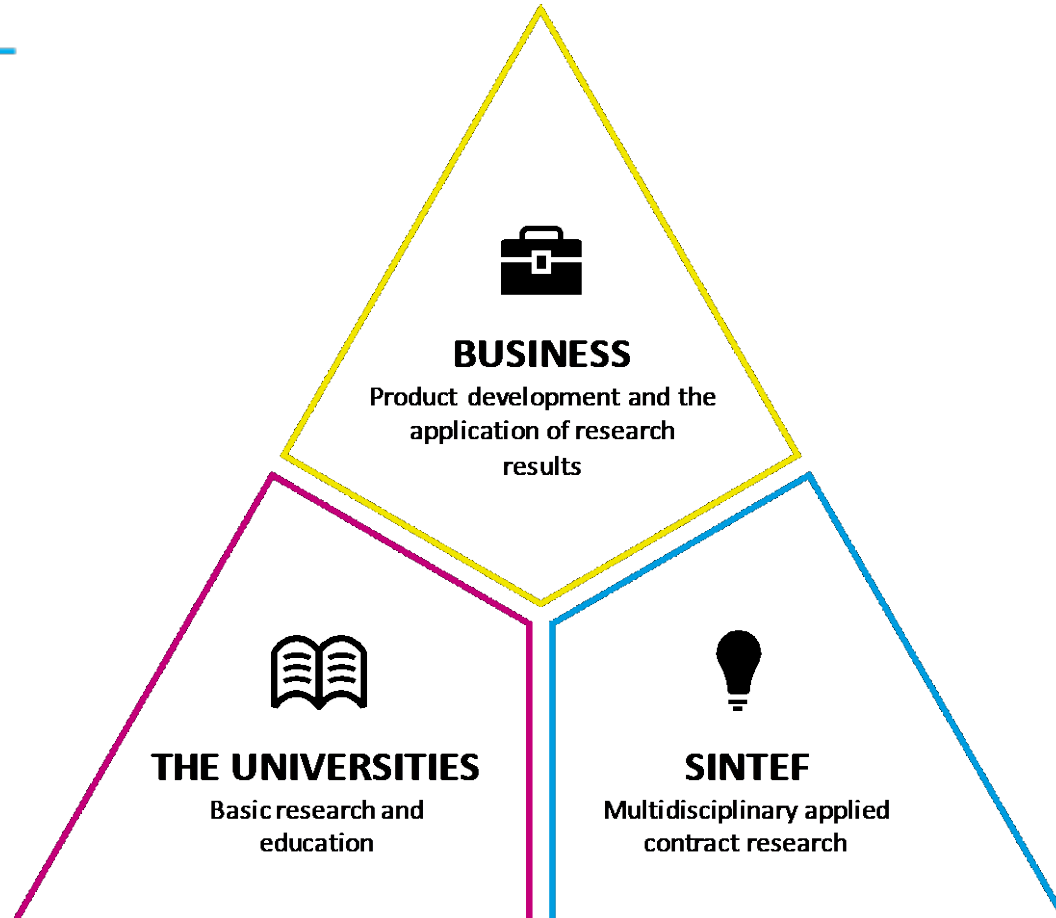
NOK 450 MILL  
International sales



**SINTEF**

# Close working relationship

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## Focus on:

- R&D Results, Patents and IP
- Products and Services
- System Solutions
- Business Concepts
- Spin-off Companies

# Organization

SINTEF Building and Infrastructure

→ SINTEF Digital

SINTEF Materials and Chemistry

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# SINTEF Digital

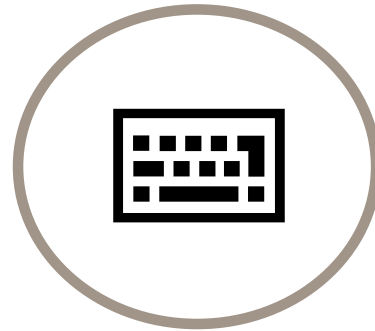
HCI – Human  
Computer  
Interaction

SIS – Secure IoT  
Software

SD – Smart Data



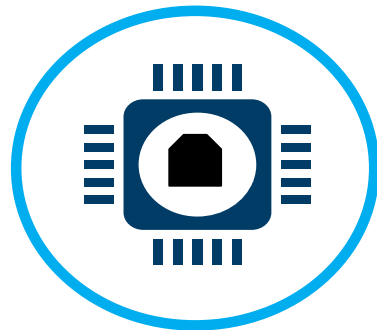
Software and  
Service  
Innovation



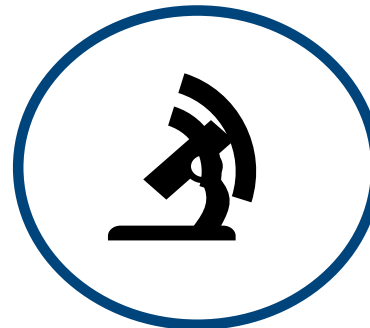
Software engineering,  
Safety and Security



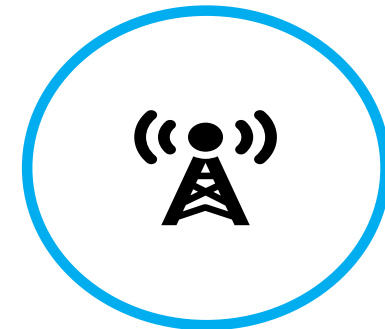
Mathematics and  
Cybernetics



Smart Sensor  
Systems



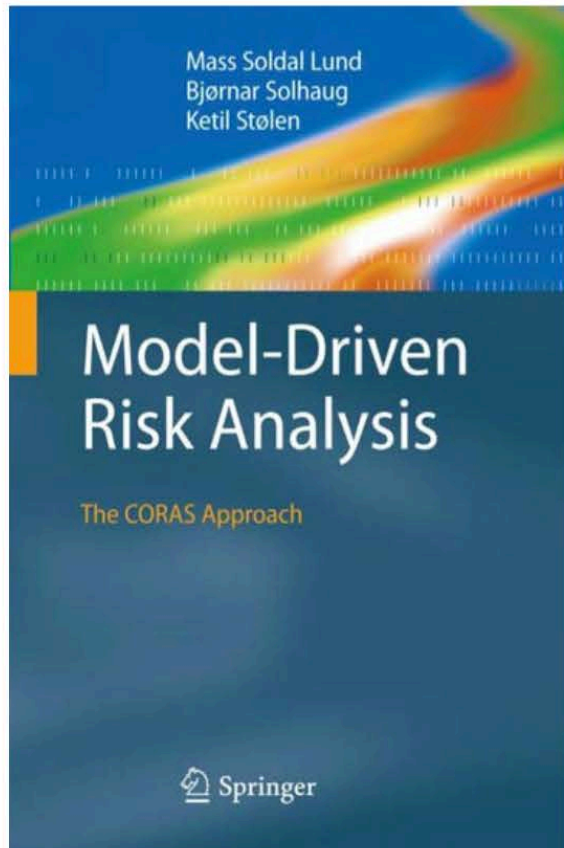
Microsystems and  
Nanotechnology



Acoustics and  
Communication

# Secure IoT Software Research Group

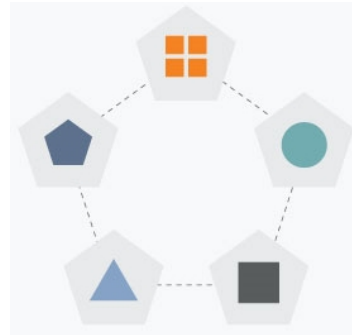
Twitter @secure\_iot\_grp



**This talk shows 1) the problem of customization; 2) our customization approaches; and 3) some lessons learned.**



**The problem of customization for multi-tenant SaaS**



**Customization with intrusive microservices or non-intrusive?**



**Some lessons learned**

# 1) The problem of customization: Why Cirrus?



- More than 60 % of businesses adapt standard systems software to their needs<sup>1</sup>
- Major<sup>2</sup> (potential) customers will never move to the cloud if the service cannot be customised to their specific needs

<sup>1</sup> Maintaining ERP Systems: The Cost of Change. IDC/Michael Fauscette. May 2013.

<sup>2</sup> A major customer is typically a customer with more than hundred employees.



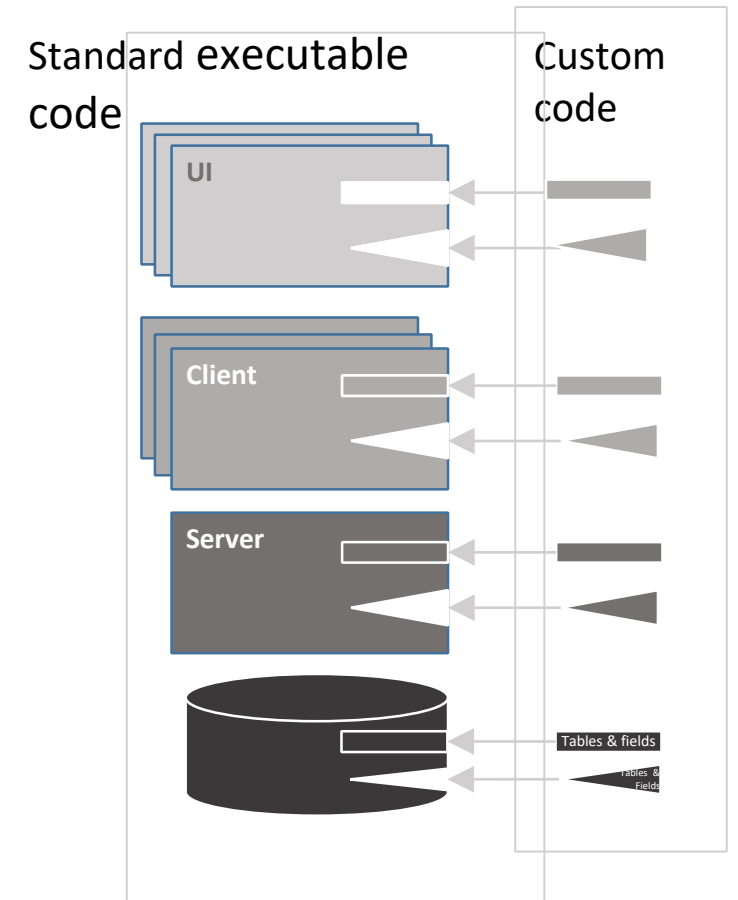
# Enterprise software needs customisation

## Why

- Every company is unique
- Need to integrate with other services
- Everything is changing fast

## How




- UI re-design
- New business logic
- New data types



# Cirrus project: SINTEF in collaboration with Super Office and Visma



Funded by the Research Council of Norway + SuperOffice and Visma.

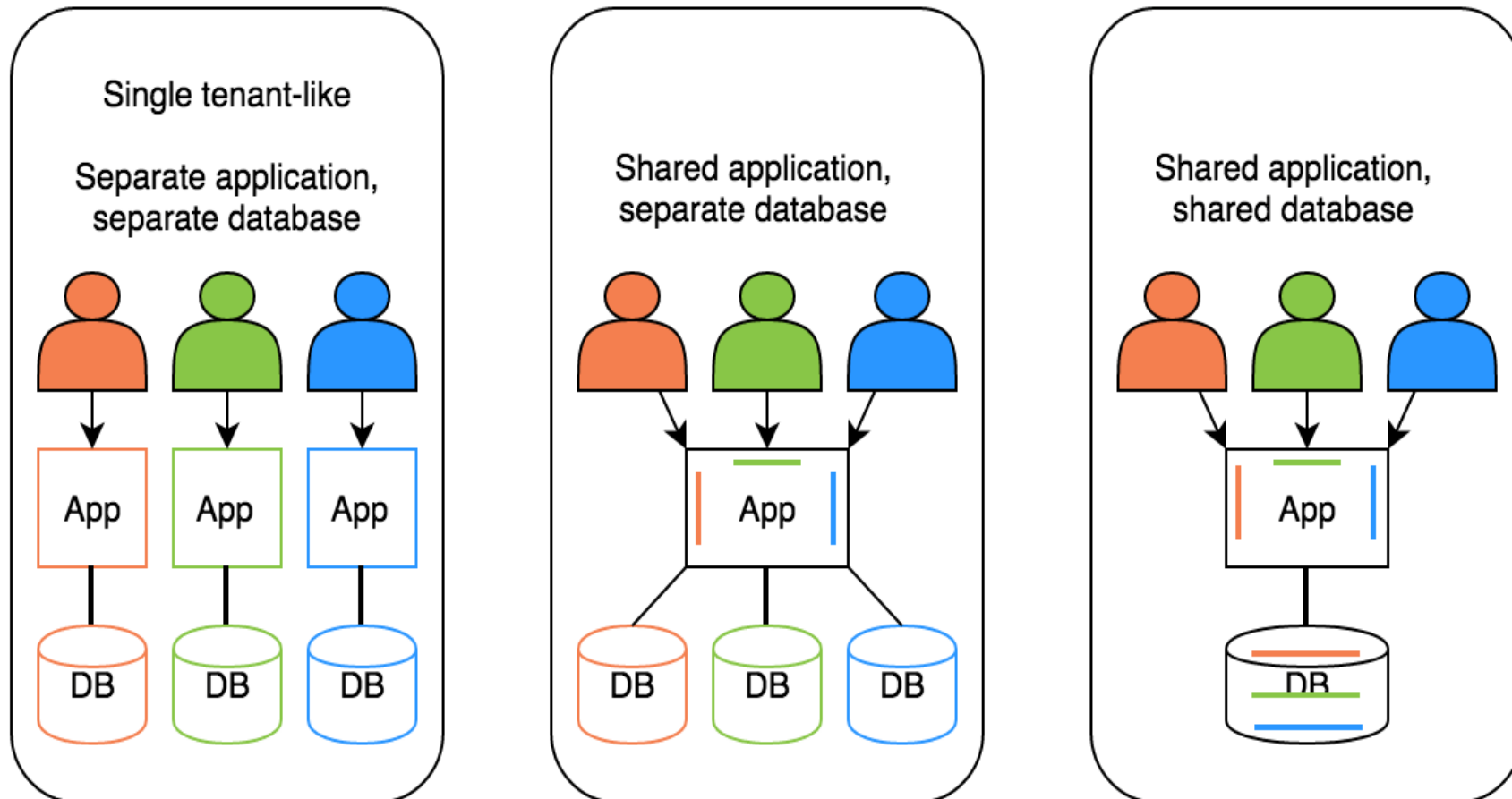
	no. of employees	revenue	no. of customers
 <b>SuperOffice</b>	220	415 MNOK	10 000
 <b>VISMA</b>	8 000	10 BNOK	500 000
 <b>SINTEF</b>	2 082	2 936 MNOK	3 580

SINTEF is the largest independent research organisation in Scandinavia

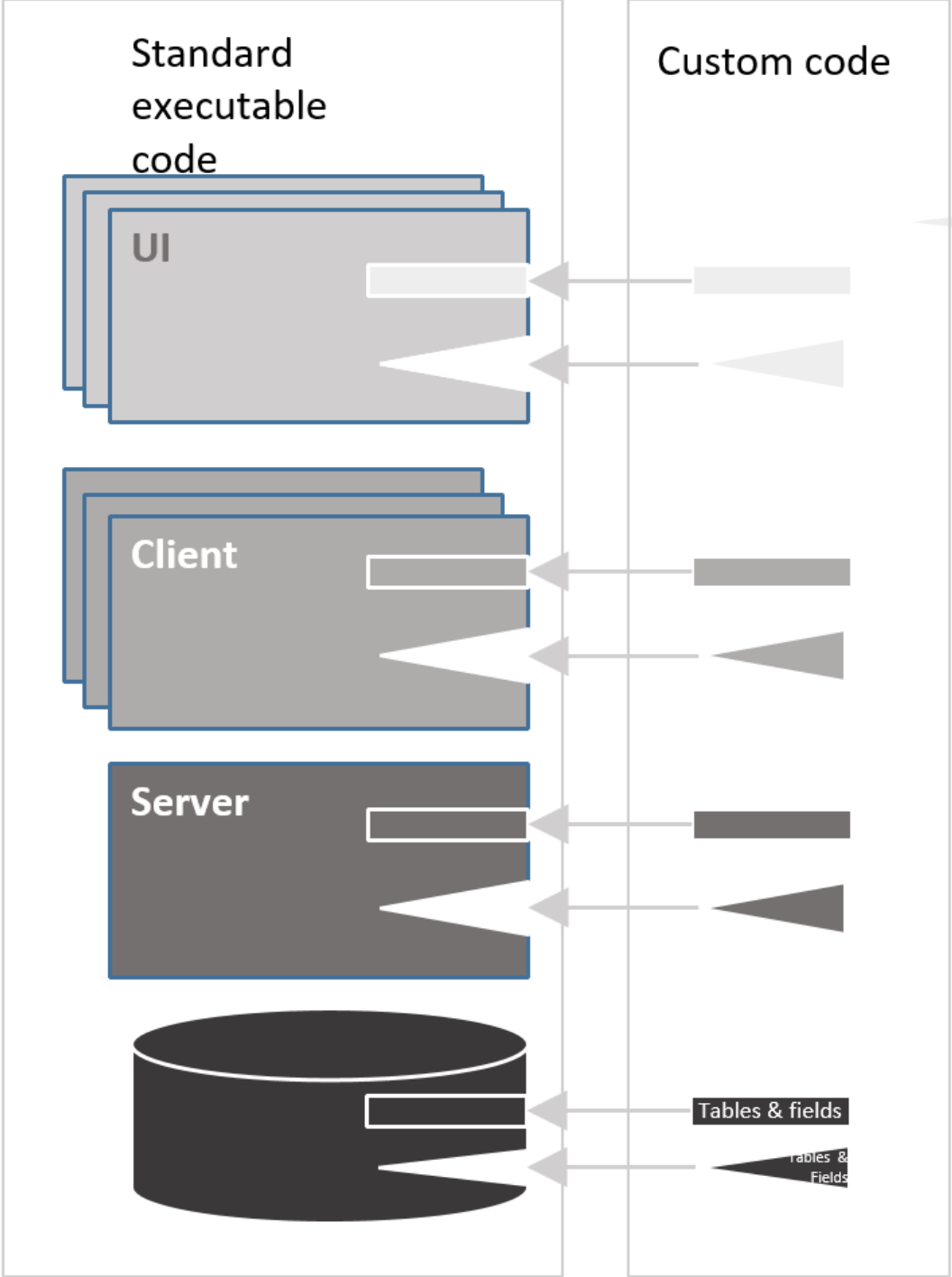
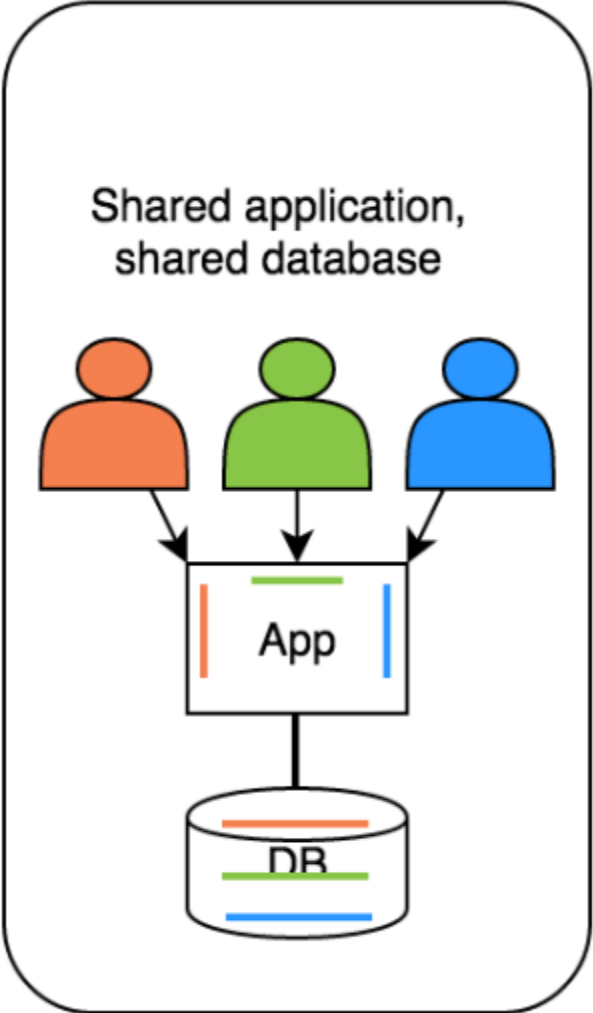


# The Cirrus project aims to

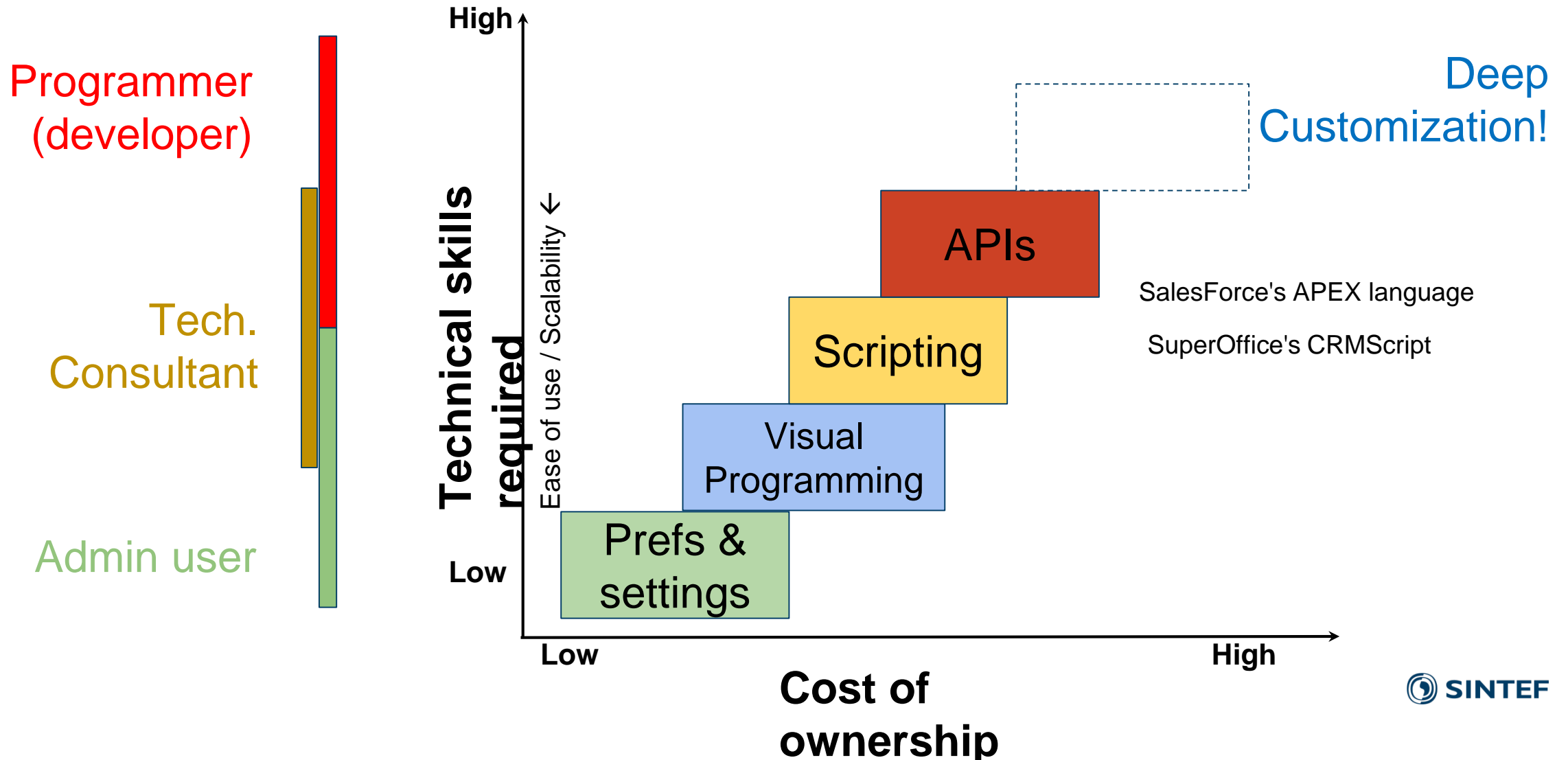
Provide technology, tools and processes to allow customers to modify a multi-tenant cloud-based software-as-a-service with customised code without compromising the benefits of cloud computing.



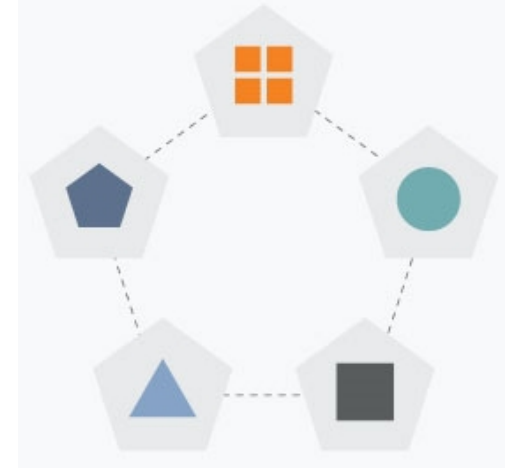
# Customization



# Tool-sets for customization



## 2) Our customization approaches based on Microservices



**What does customization by microservices mean?**

**What does "intrusive microservice" mean?**

**Towards non-intrusive customization?**

# Customization by microservices

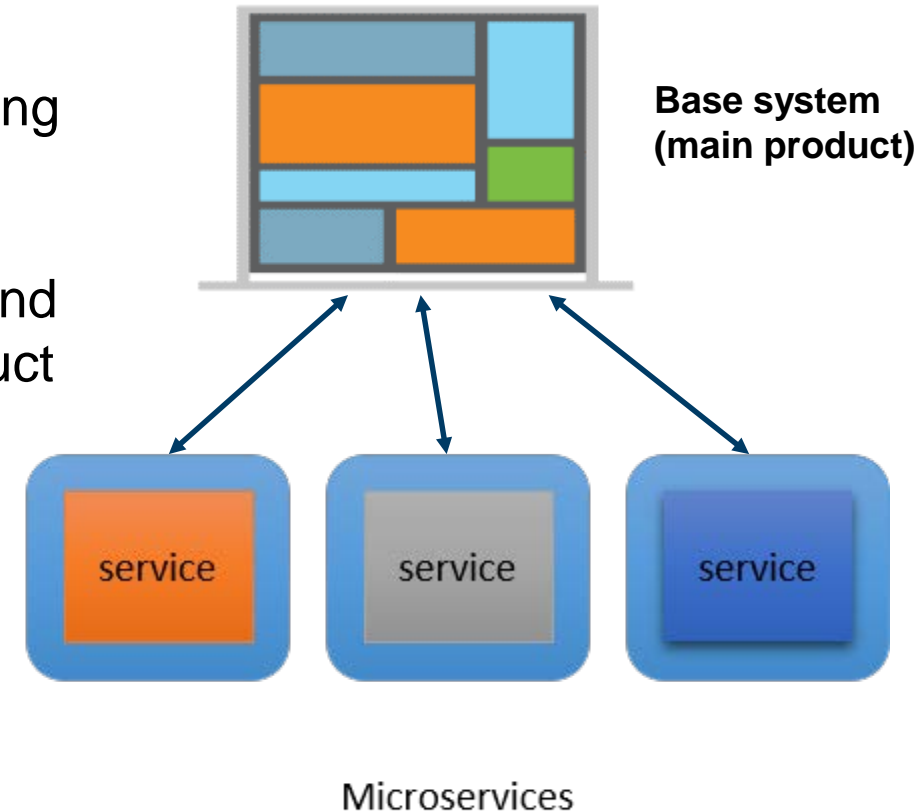


Code for customization is written and packaged as microservices that interact with the base system for customizing user interface (UI), business logic (BL), and database (DB).

Microservices for customisation purposes can be packaged and deployed (e.g., on containers) separately from the main product and each other (of different tenants).

Benefits:

- Isolation, which is important for multi-tenant context.
- Independent development, deployment, and operation.
- Technology stack freedom.

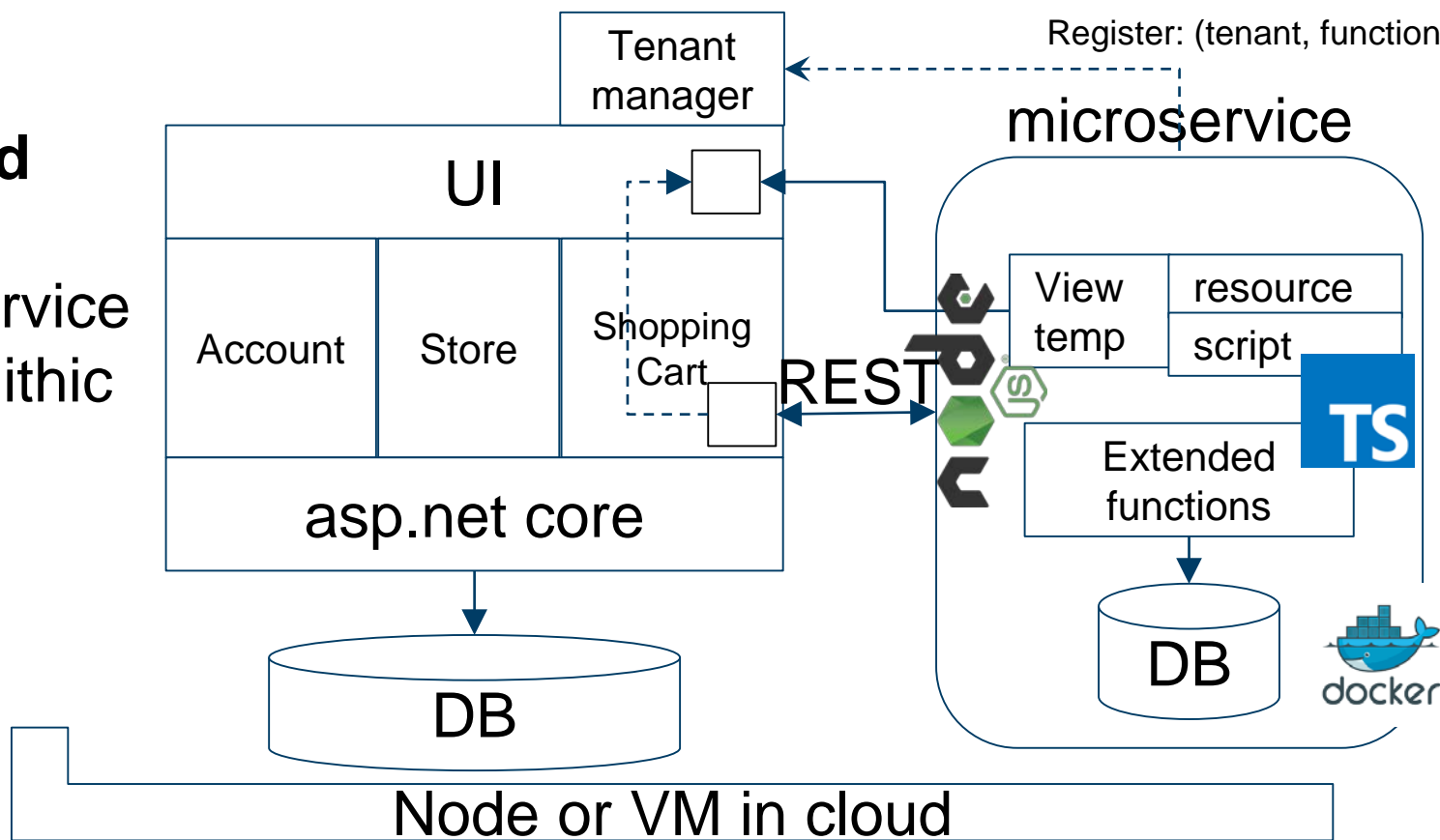




# "Intrusive Microservices"

## Standard product

- Microservice or monolithic
- hotplug



## Custom code as a microservice

- Only the changed function
- Fine-grained replacement
- Not limited by APIs
- No direct access to the product database
- New view template to feed the standard HTML generator (Razor)





# Intrusive custom code



Full context  
(code-level  
customisation)



How much partners can customise?

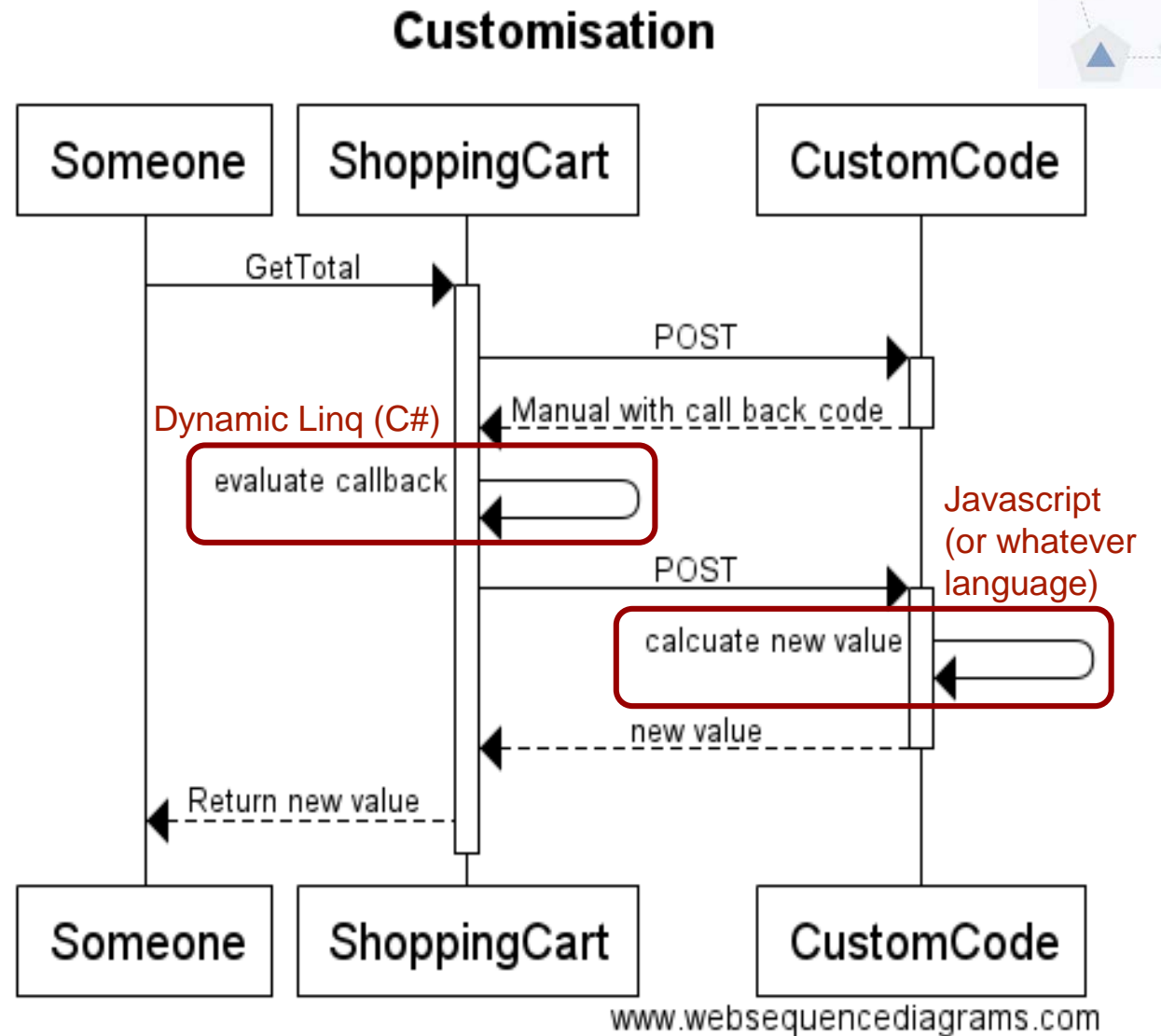
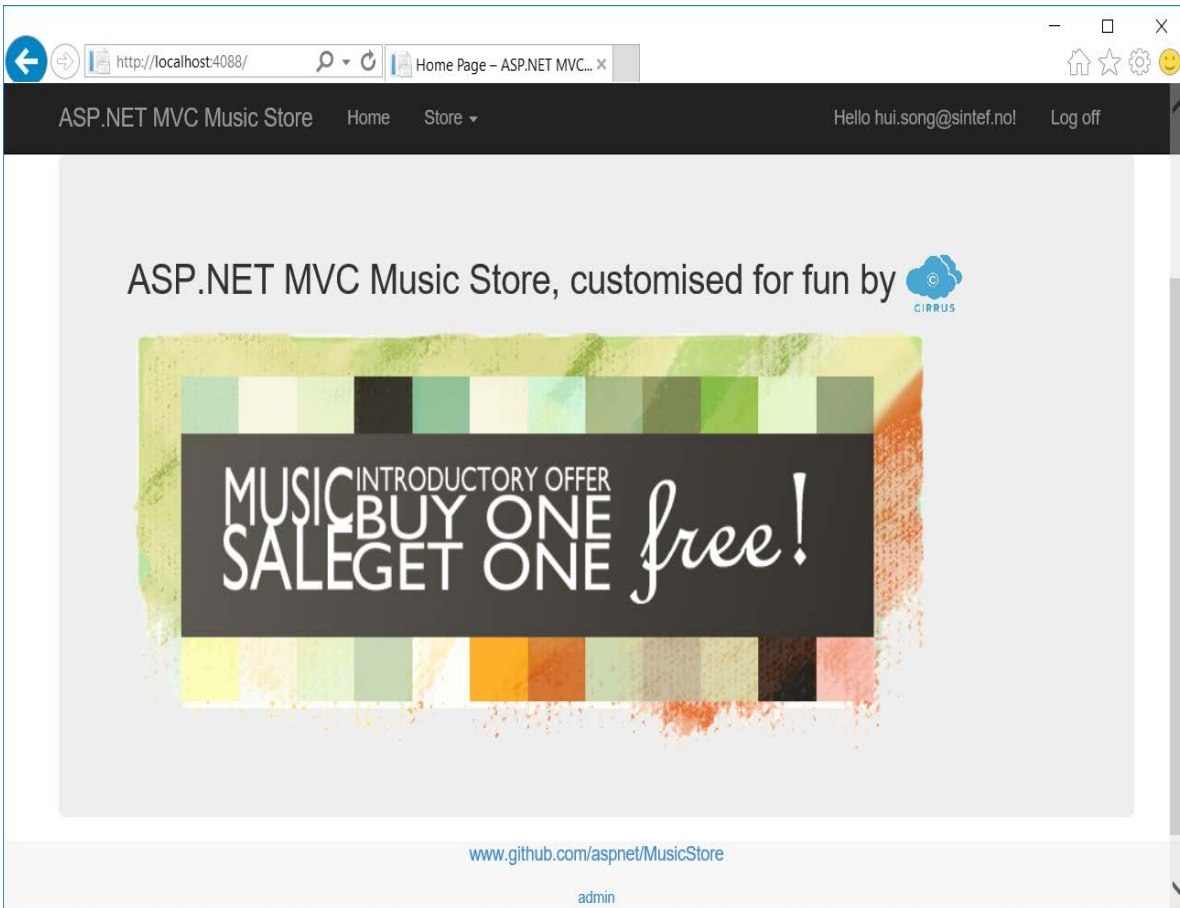
Limited context  
(API and  
services)



(small) code flow

(large) code flow

# Interactions Example



Video demo: <https://www.youtube.com/watch?v=lluCeTHbcxc&t=6s>

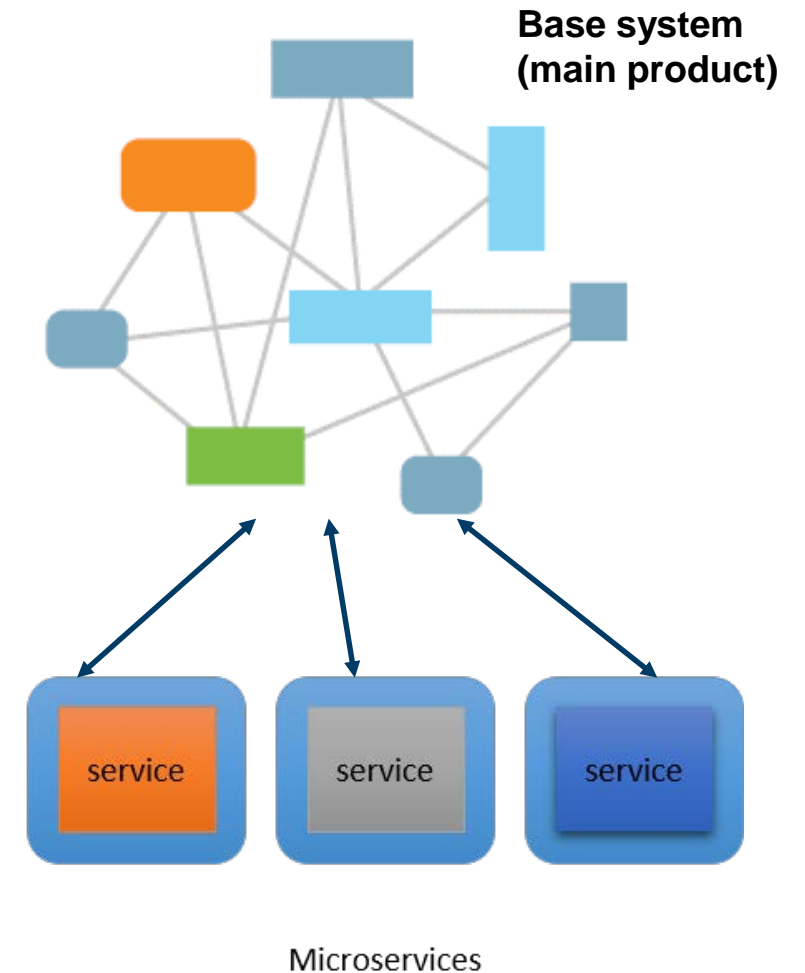


# Intrusive vs. Non-intrusive customization

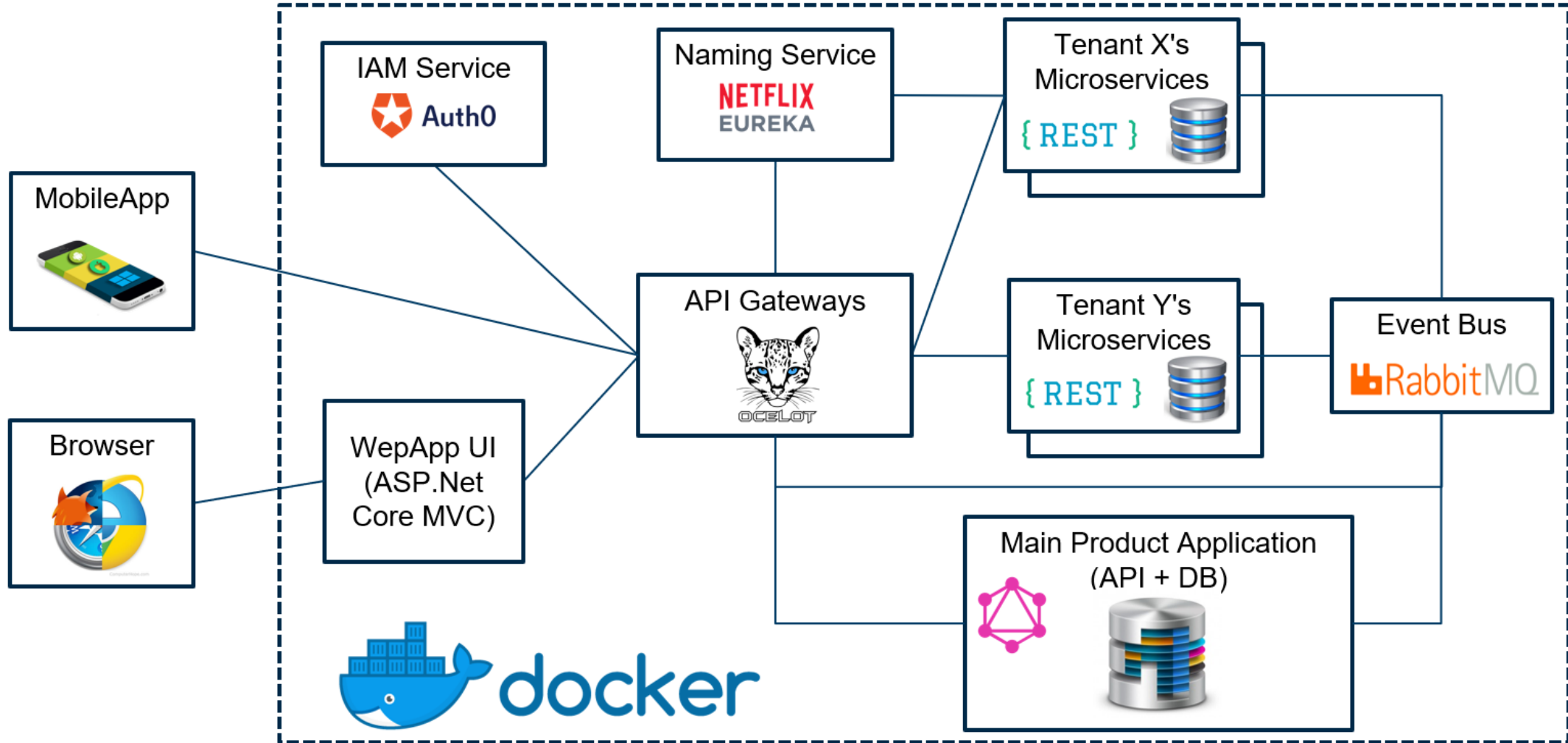
Customization using **intrusive microservices** has a main **drawback**: "intrusive" call-back code!

How to be non-intrusive? It depends a lot on what kind of architecture of the "base" system (main product)!

- Our industrial partner Visma is migrating their ERP system to microservices architecture, which would be much more "customization-friendly".
- We can orchestrate the non-intrusive customization using microservices via API Gateway pattern if the base system has microservices architecture.

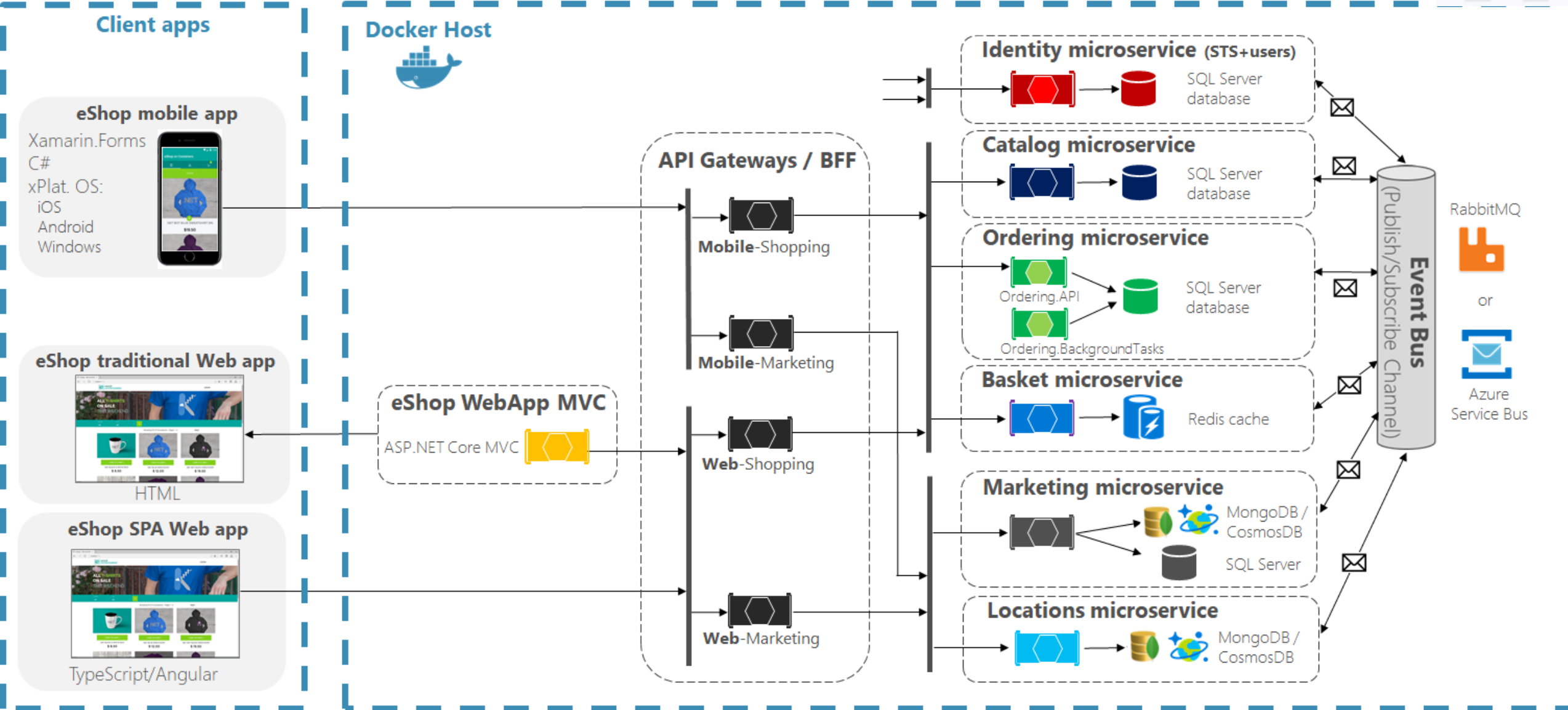


# Non-intrusive customization via API Gateway



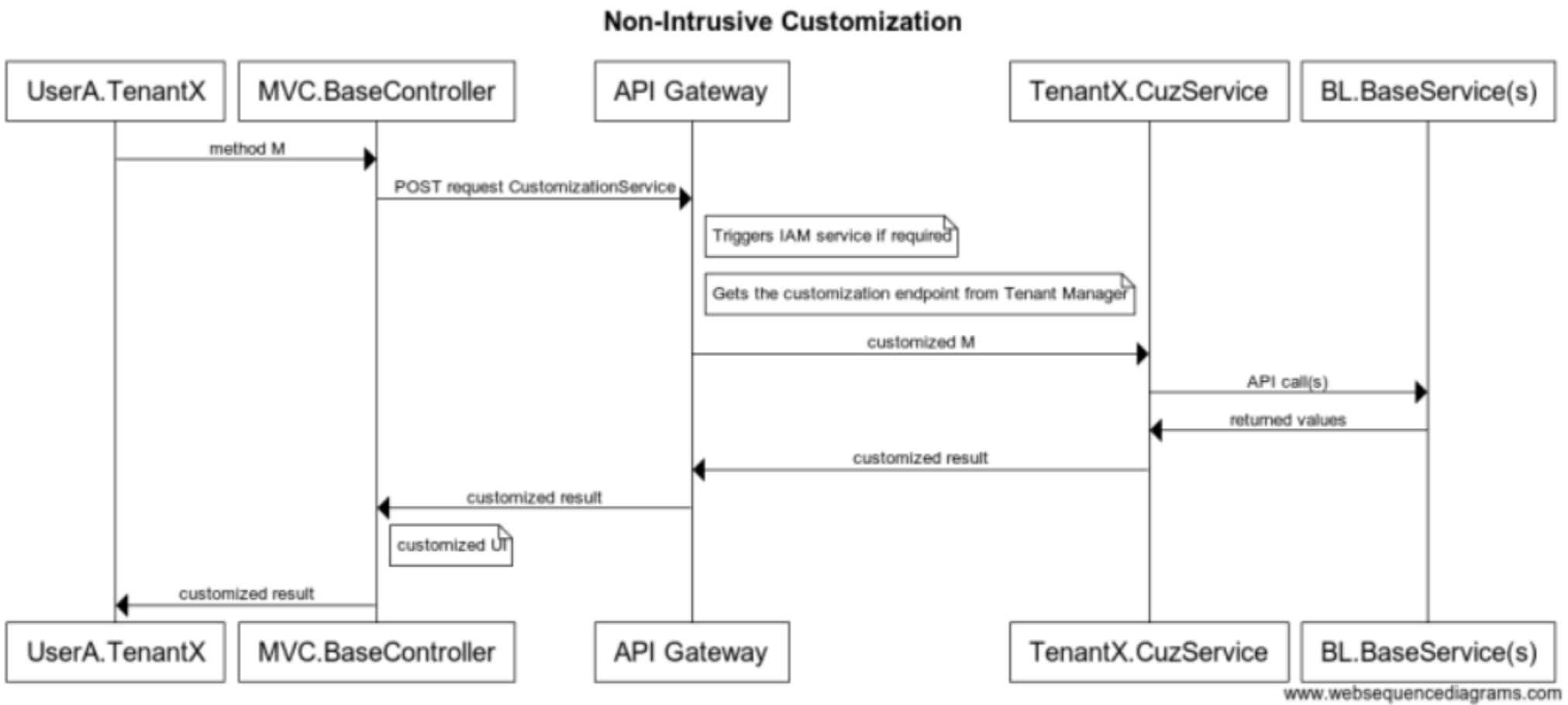
# eShopOnContainers reference application

(Development environment architecture)





# Interactions in non-intrusive customization



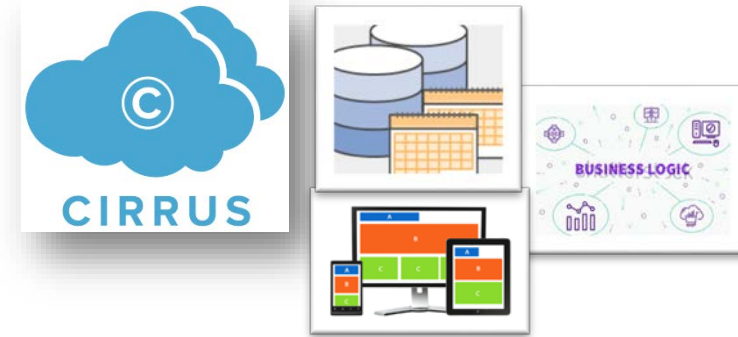
www.websequencediagrams.com

### 3) Some lessons learned.



**Some lessons learned**

# Summary and lessons learned



**Intrusive customization for multi-tenant SaaS using microservices is feasible, even for monolith!**

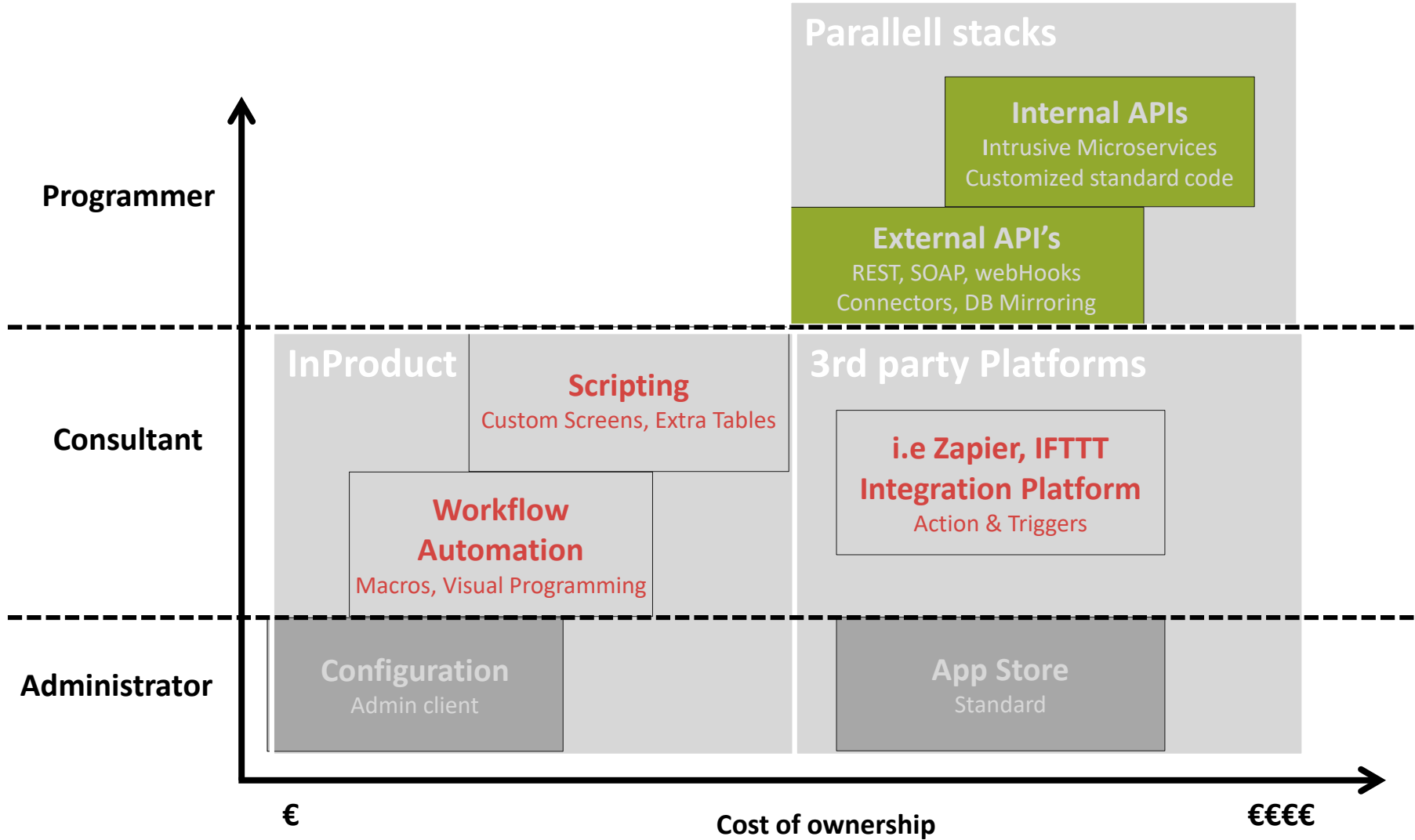
**Microservices architecture would be more customization-friendly for multi-tenant SaaS! Non-intrusive customization using microservices is also feasible then.**

**Microservices-based approach is only one of the main approaches of the Cirrus project. There are other approaches, e.g., based on Scripting language.**

**There is no one silver bullet! We should choose what's best for a specific system, and business model.**

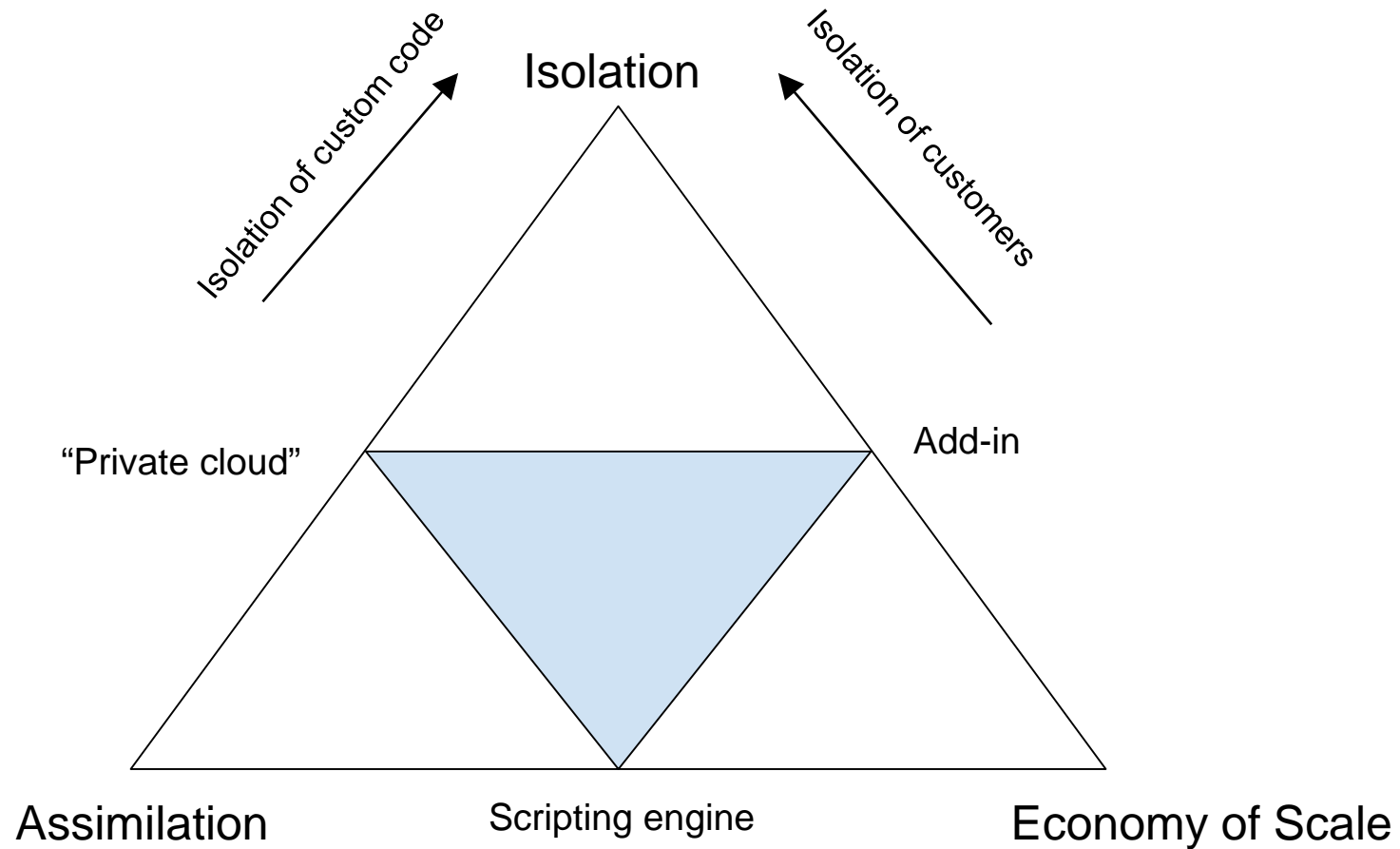


# Customization Tools Right Tool for the Right Job



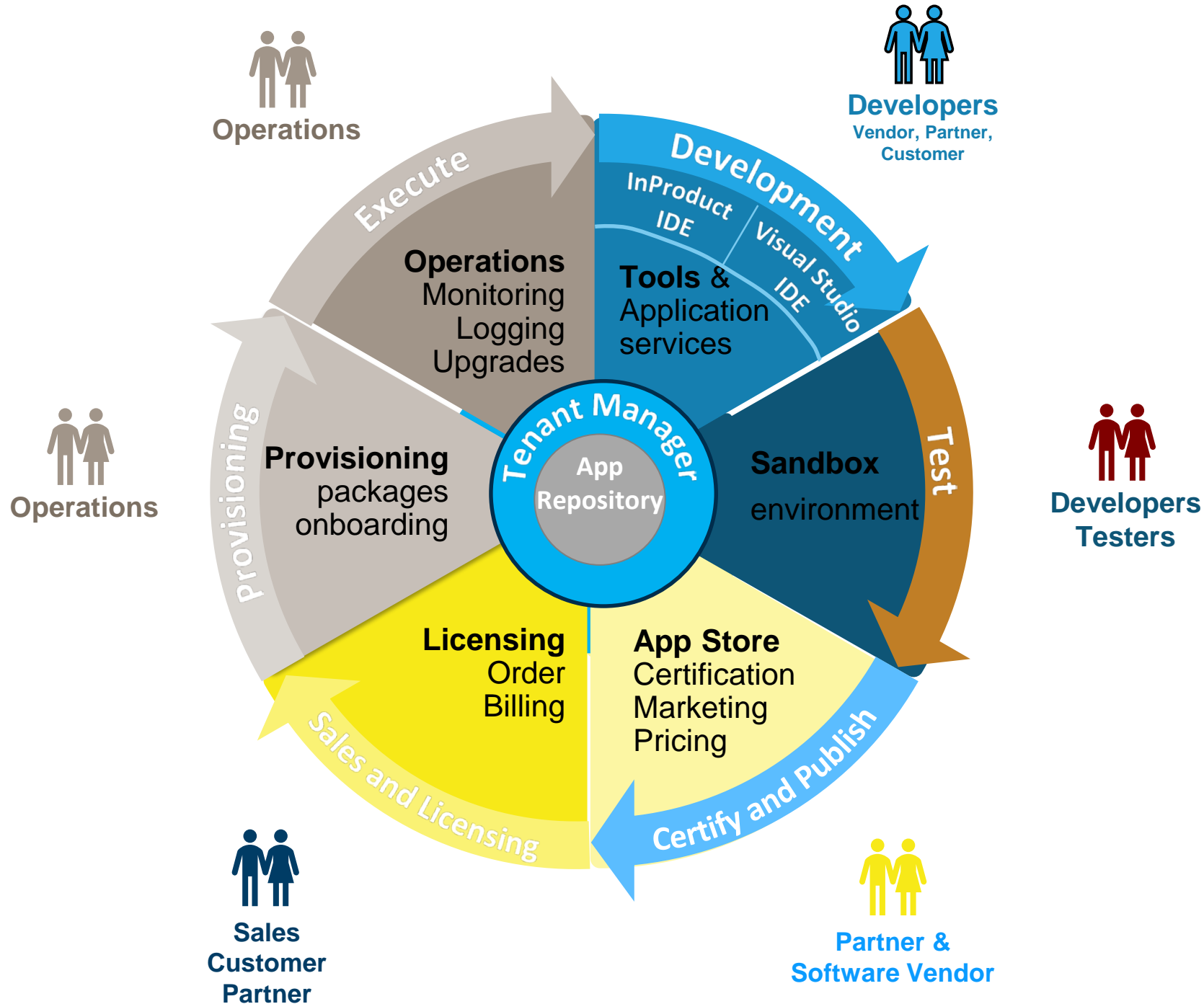


# The Custom Code Challenges with multi-tenancy





# Cirrus ecosystem



For SuperOffice this is part of the CRM Online Platform

Different procedures for: Standard Apps Custom Apps

Support for: New customers Existing customers Migrations

Application Services: Authentication Licensing Billing Education AI Services Logging Monitoring Testing etc.

# Main References & Acknowledgements

- The Cirrus project <https://www.sintef.no/en/digital/software-and-service-innovation/secure-iot-software/cirrus/> This project has received funding from the Research Council of Norway, in collaboration with SuperOffice, and Visma.
- <https://www.expandeworld.com/> More about the Cirrus project at SuperOffice, 2018.
- Song, H., F. Chauvel, and A. Solberg. *Deep customization of multi-tenant SaaS using intrusive microservices*. In Proceedings of the 40th International Conference on Software Engineering: New Ideas and Emerging Results. 2018. ACM.
- Chauvel, Franck, and Arnor Solberg. "Using Intrusive Microservices to Enable Deep Customization of Multi-tenant SaaS." 2018 11th International Conference on the Quality of Information and Communications Technology (QUATIC). IEEE, 2018.



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