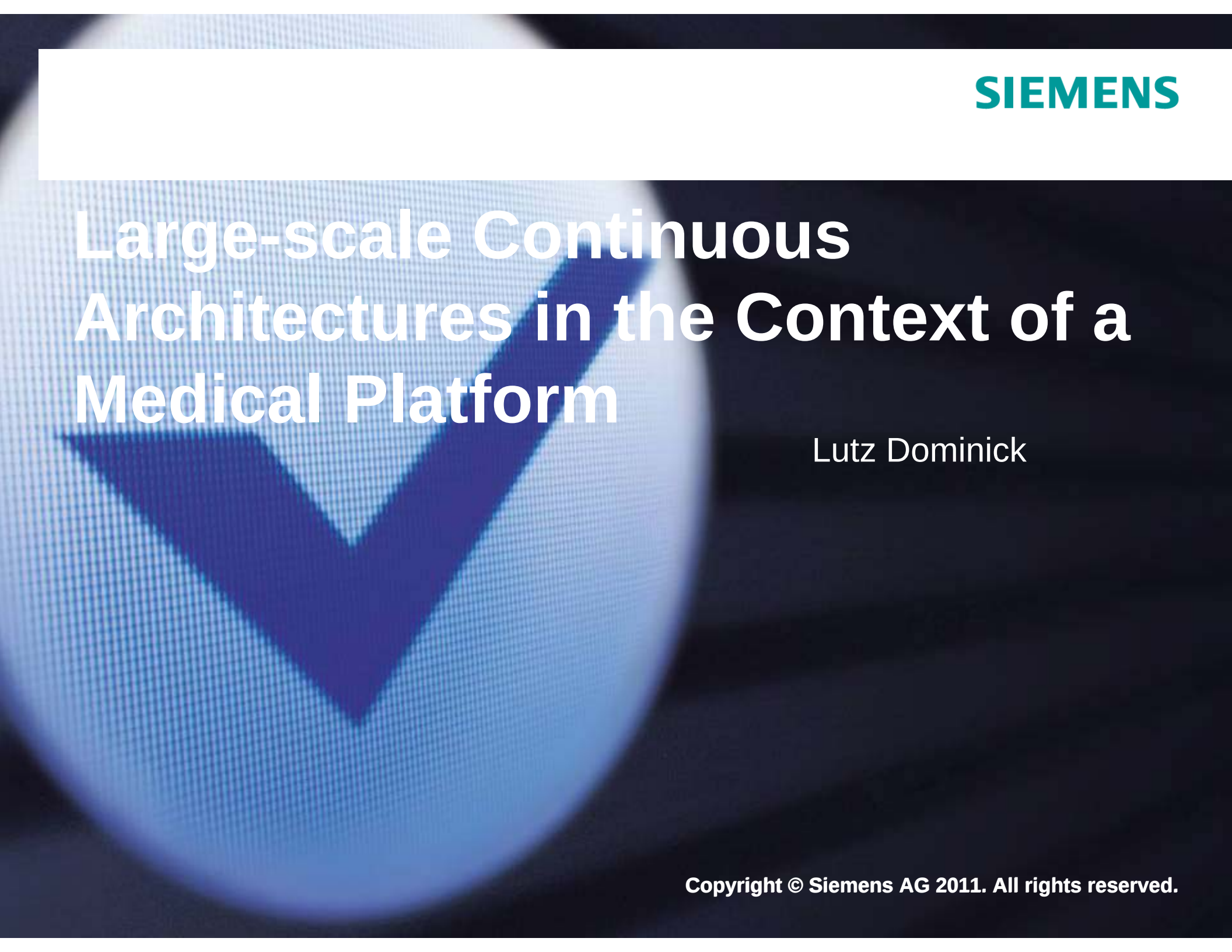

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Large-scale Continuous Architectures in the Context of a Medical Platform

Lutz Dominick

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- SYNGO
- Objectives
- Principles
- Technical Architecture
- Infrastructure Services
- Quality Attributes
- Consequences
- Wrap-Up

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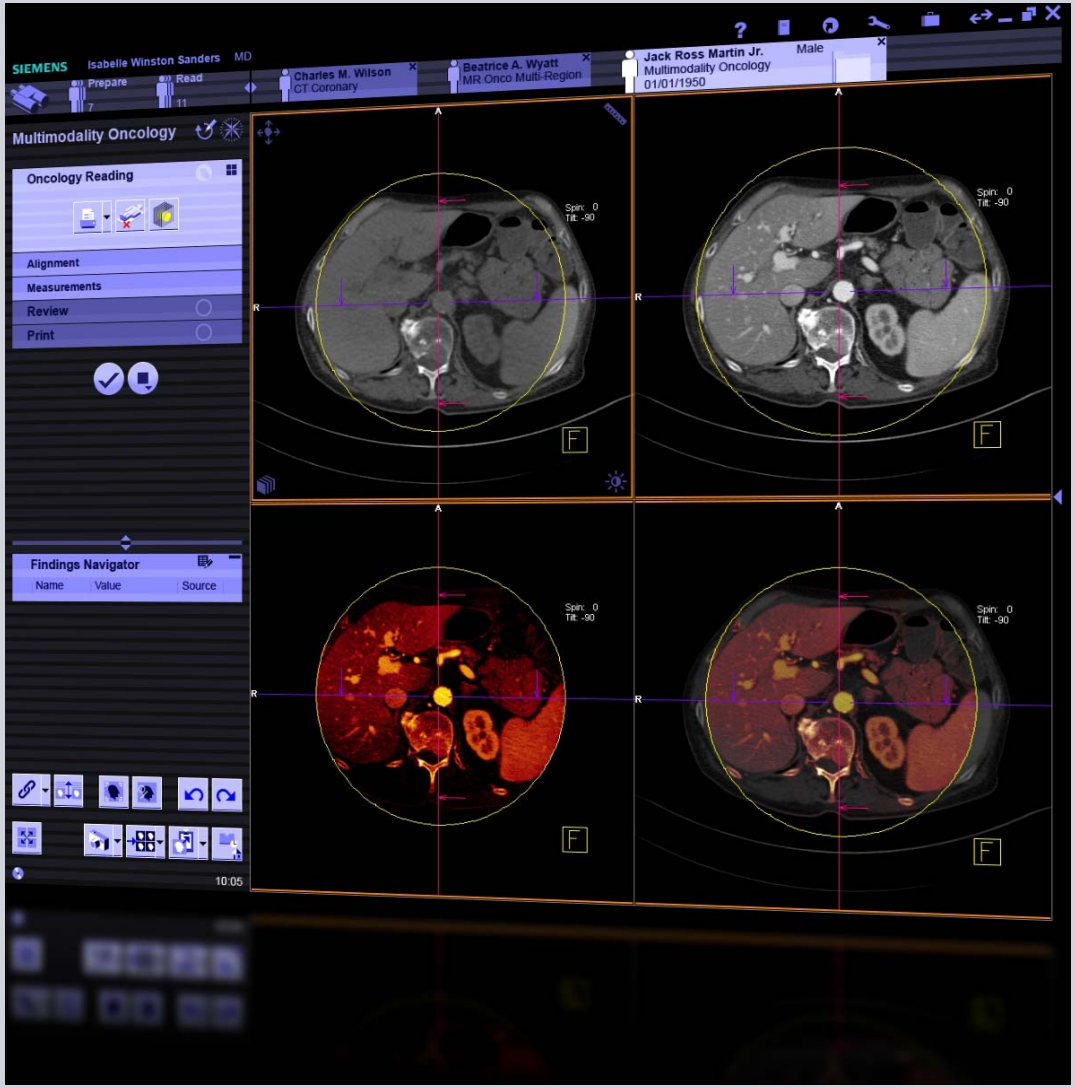
syngo for Medical Imaging

SYNGO Headquarter
in Erlangen, Germany

CT Scanner and *syngo.*via product



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Objectives for *syngo* Medical Platform

- Provide the customer with common User Interface look & feel.
- Support multiple Siemens Healthcare business units and their product lines.
- Serve multiple development sites on several continents.

- Provide a common technical base, infrastructure, and programming model.
- Provide a common domain architecture, frameworks, components, services.
- Implement international and domain standards in a common way.
- Provide extensibility and adaptability mechanisms.

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Objectives for ‘Continuous’ Architecture

- Evolve the platform architecture consistently over time.
- Apply changes to the architecture in a manageable way.
- Match need for change and changeability options at the earliest point in time.
- Evolve the available ‚changeability options‘ of the platform architecture.

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Changeability Option

- Changeability Options alter the structure and the behavior of the architecture in a controlled and manageable way.
- ISO 9126[1)] lists Changeability as subcategory of Maintainability.
- A list with Changeability Options contains architecture or design artefacts and an action on this artefact, often backed up by software design patterns.

Generic examples for Changeability Options:

- Add a new plug-in.
- Replace the component.
- Add a new extension interface for pluggable strategies.
- Create a new component type based on an existing stereotype.
- …

1) ISO/IEC Standard No. 9126-1, Part 1 Quality Model: Software engineering – Product quality; Parts 1–4. Geneva, Switzerland, 2001-2004

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syngo Platform Architecture Principles

- Use cases drive commonality, variability, generalization and genericity.
- Technical frameworks implement the architectural ontology to ensure consistency of architecture, design, and implementation.
- Domain frameworks are the core of the business logic.
- Infrastructure services implement selected cross-cutting concerns.
- Selected quality attributes capture constraints from use cases and architecture.
- 4+1 Views approach and platform guidelines drive the value chain.

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Continuous Architecture Principles

- Continuous Architecture deals with architecture relevant change.
- The architecture defines the contexts for change.

- Use architecture changeability options in defined architecture contexts.
- Prefer options for compatible changes over breaking changes.

- Improve the architecture with new changeability options consistently.
- Avoid work-arounds.

What‘s Context

Umbrella term for all artefacts defined by the architecture (its ‚ontology‘):

- Component stereotypes
- Applications
- Layers …

What‘s Change

Architecture can change because of:

- New components/plug-ins for features
- Performance Optimization
- Refactoring
- Redesign …

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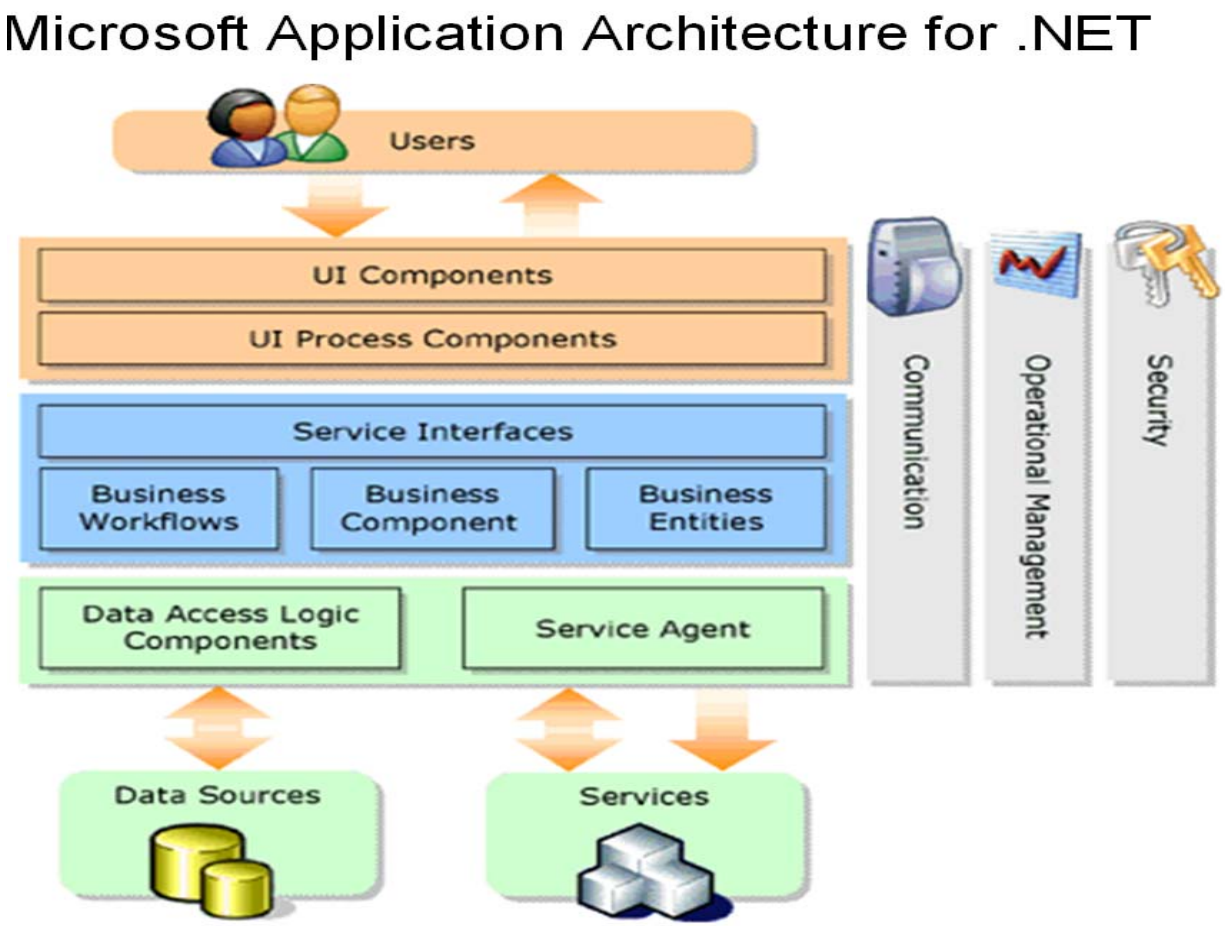
Technology and Architecture Base



Application Architecture for .NET, Designing Applications and Services, Patterns & Practices, Copyright © 2002 Microsoft Corporation. All rights reserved

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Context: Technical Architecture

The Technical Architecture customizes the underlying technology (Microsoft .NET) for the platform, which is the base for the domain architecture.

Capabilities (examples):

- Flexible deployment for the defined architectural layers.
- Platform specific form & component stereotypes (e.g. business component).
- UI controls and UI layouts along the Platform UI Styleguide.
- Communication infrastructure based on Commands & Events.
- Container for run-time execution.
- Generic changeability mechanisms (extensibility, configurability).

Changeability Options (examples):

- New UI controls and Screen layouts.
- New domain specific components and frameworks based on stereotypes.
- New applications, subsystems and systems.

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Context: Architecture Layers

Based on the Layered Architecture design pattern, the platform supports a pre-defined set of layers and deployments. Communication is directed top-down, with remote command calls or web service calls.

Presentation Layer:
→ Application frontend, runs on client machines
Business Layer:
→ Application backend, runs on fat clients or application servers
Services Layer:
→ Enterprise (Web) Services, cross application, on application servers

Capabilities:
- Identical Layers for applications, jobs, services, clients, servers, …

Changeability Options:
- Deploy layers to a specific machine by configuration (e.g. application frontend runs on the client, the backend runs on the server, or both run on the client).

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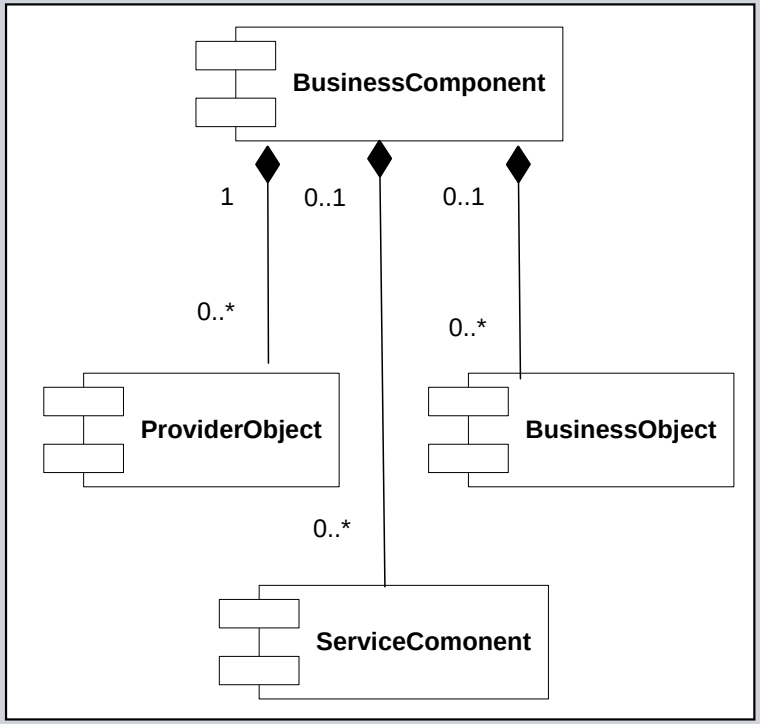
Context: Business Component

A Business Component type is the top most component of one specific domain framework and shields the internals of the framework. It provides the domain interfaces of that framework and extension interfaces for plug-ins.

Capabilities:
- Framework of a (sub-)domain.
- Common business logic.
- Sync/Async business interfaces.
- Extension interfaces.

Changeability Options:
- Flexible deployment by configuration.
- Add new common framework interfaces.
- (Ex)Change providers and business objects.
- (Ex)Change Service Components.
- …



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Context: Infrastructure Services

The Infrastructure Services of the platform implement selected cross-cutting concerns. Service specific guidelines ensure consistent and identical usage for all layers, frameworks and component stereotypes.

Capabilities:

- APIs and Services for: Configuration, Logging, Licensing, Auditing, Tracing, Security, Utilization, Installation, Online Help, Life Cycle Management.
- Factory Facade design pattern connects caller and infrastructure service.
- Data types follow platform standards or international domain standards.
- Consistent and transparent integration into the Technical Architecture.

Changeability Options:

- Introduce new data types (e.g. to Logging).
- Add a new infrastructure service on the platform.
- Replace underlying servers (e.g. Licensing Server) transparently.
- …

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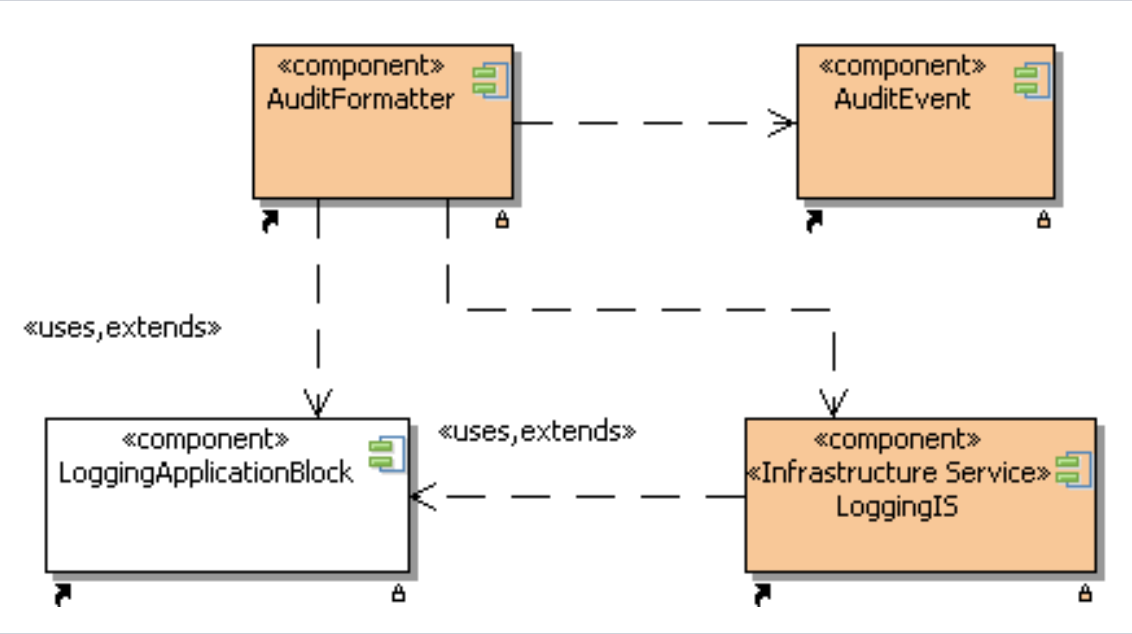
Context: Auditing Infrastructure Service

The Auditing Infrastructure allows to write standardized audit messages to the audit repository from application business logic, along the executed use case.

Capabilities:
- Auditing API functionality.
- Standardized messages.
- Extension interfaces.

Changeability Options:
- New AuditMessages.
- Different formatting.
- Different audit repository.



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Quality Categories – Definitions from ISO 9126[1)]

Category	Description
Usability	Usability is the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions.
Reliability	Reliability is the capability of the software product to maintain a specified level of performance when used under specified conditions.
Functionality	Functionality is the capability of the software product to provide functions which meet stated and implied needs when the software is used under specified conditions.
Efficiency	Efficiency is the capability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions.
Maintainability	Maintainability is the capability of the software product to be modified. Modifications may include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications.
Portability	Portability is the capability of the software product to be transferred from one environment to another.

1) ISO/IEC Standard No. 9126-1, Part 1 Quality Model: Software engineering – Product quality; Parts 1–4. Geneva, Switzerland, 2001-2004

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ISO 9126 Efficiency Subcategory ‘Performance’

Quality	Description	Guidance
Time Behavior (a.k.a. Performance)	The capability of the system to provide appropriate response and processing times and throughput rates when performing its function, under stated conditions.	▪ Describe how start-up / shut-down performance and operational performance are achieved. ▪ List performance measuring points implementation spots. ▪ Provide quantitative data in order to improve architectural decisions. Example: Attribute “Start-Up Time"

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ISO 9126 Portability Subcategory ‘Adaptability’

Quality	Description	Guidance
Adaptability	Adaptability defines the mechanisms of the system to adapt to different environments without applying other actions than those provided by the system as specified. In order to reach adaptability the system has to be able that functionally can by selected and reused, added and replaced in a pre-planned manner and compliant to the architectural principles of the platform without changes to the existing implementation. This requires a component based approach in contrast to monolithic implementation of the system.	**Adaptability** ▪ What extension points are required? ▪ What configuration options are required? ▪ What scalability dimension are required while others are fixed? **Scalability** ▪ Consider different deployments and workload scenarios which will affect the component. ▪ Does the component rely on a scalability infrastructure? ▪ Is the component part of the scalability infrastructure? **Configurability** ▪ Does the component access configuration data? ▪ What needs to be configurable in the scope? ▪ What configuration data is accessed? ▪ What configuration data is manipulated? ▪ Which roles can access which data? **Extensibility** ▪ By which technique extensibility is provided.

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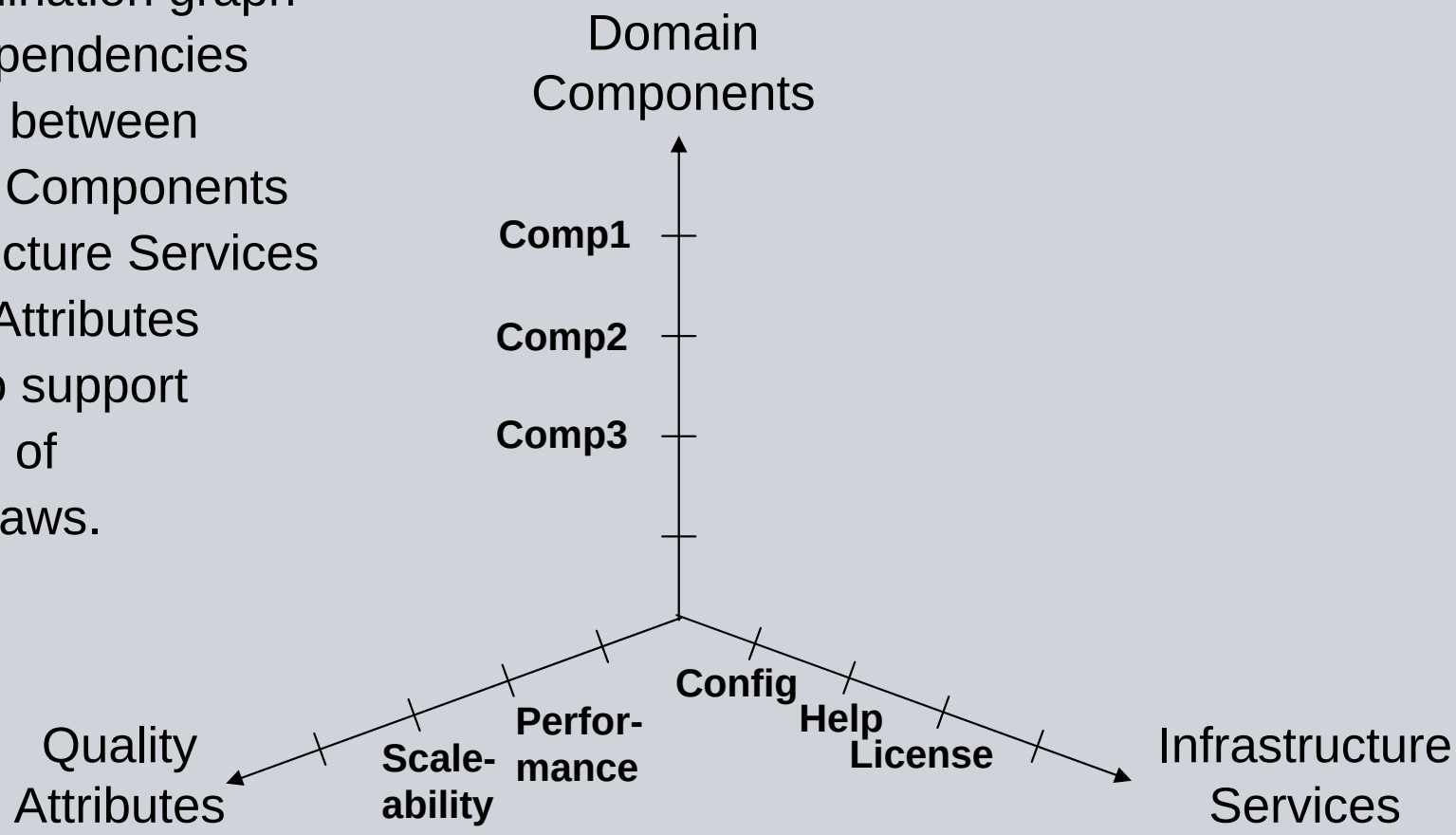
Coordination Graph 1/2

The coordination graph shows dependencies informally between

- Domain Components
- Infrastructure Services
- Quality Attributes

in order to support correction of errors & flaws.



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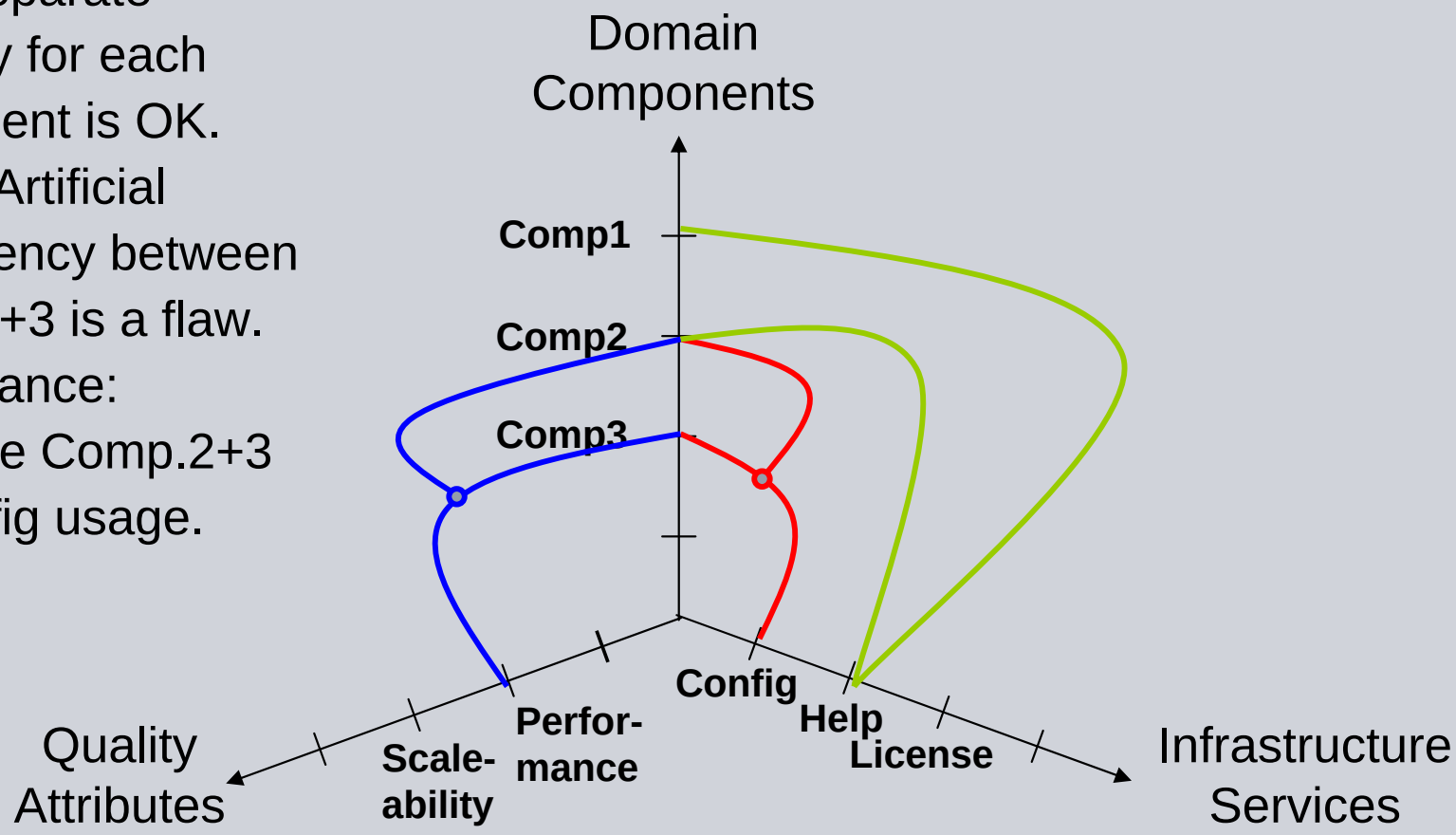
Coordination Graph 2/2

- Help: Separate HelpKey for each component is OK.
- Config: Artificial dependency between Comp.2+3 is a flaw.
- Performance: Seperate Comp.2+3 for Config usage.



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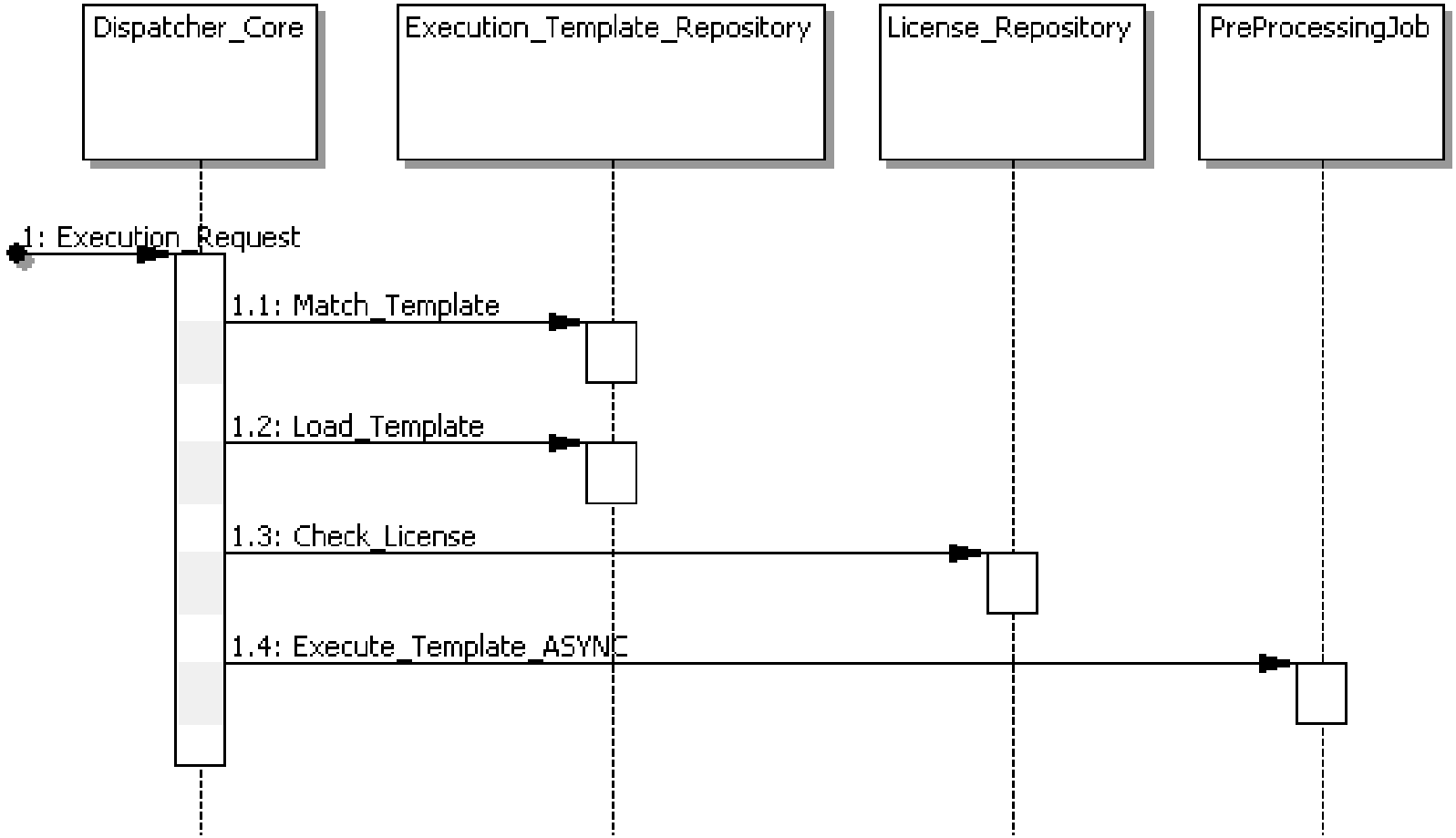
Dispatcher Example with lower Scalability 1/2



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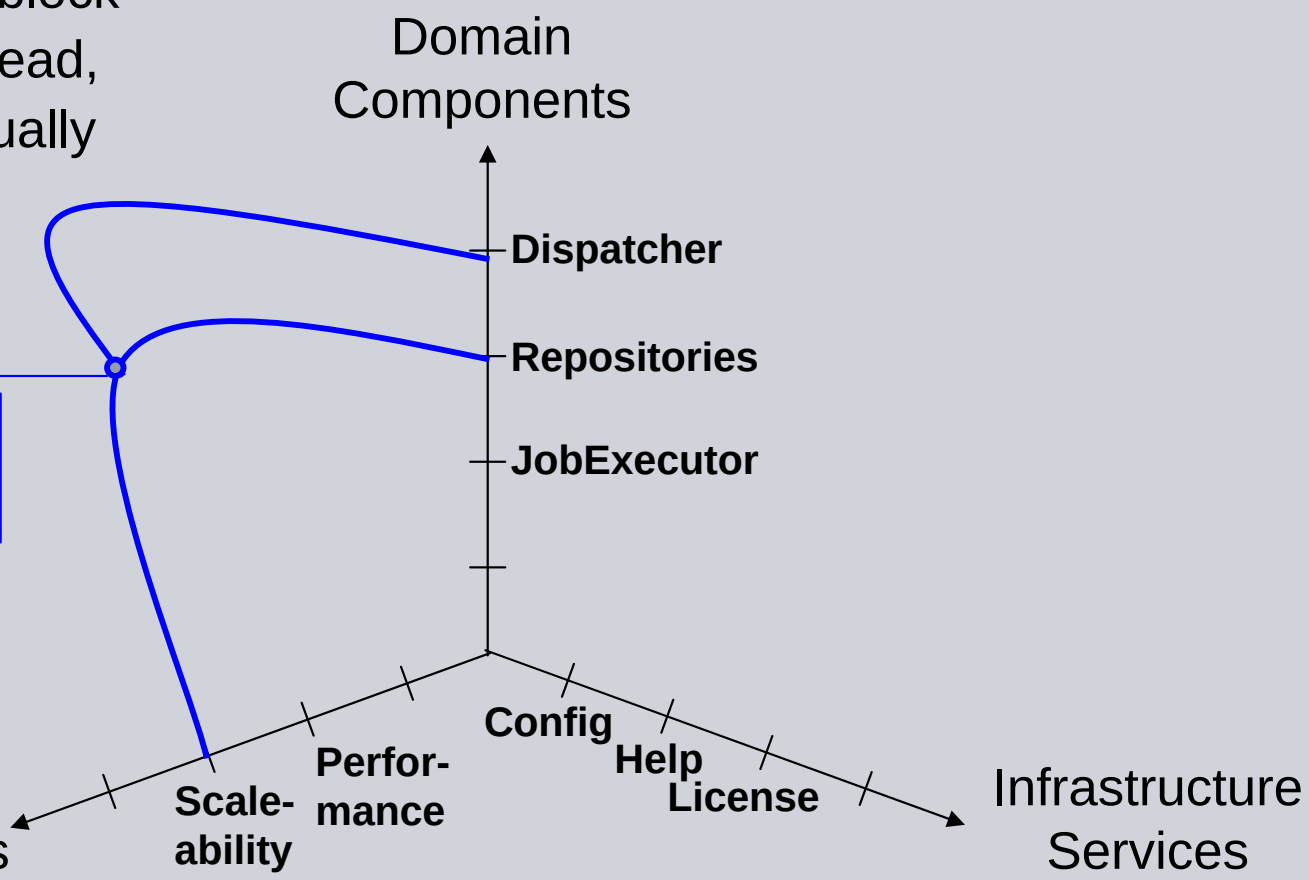
Dispatcher Example with lower Scalability 2/2

Repository queries block the Dispatcher‘s thread, which results in virtually minimal throughput in large scale deployments.

blocked resource:

Dispatcher thread



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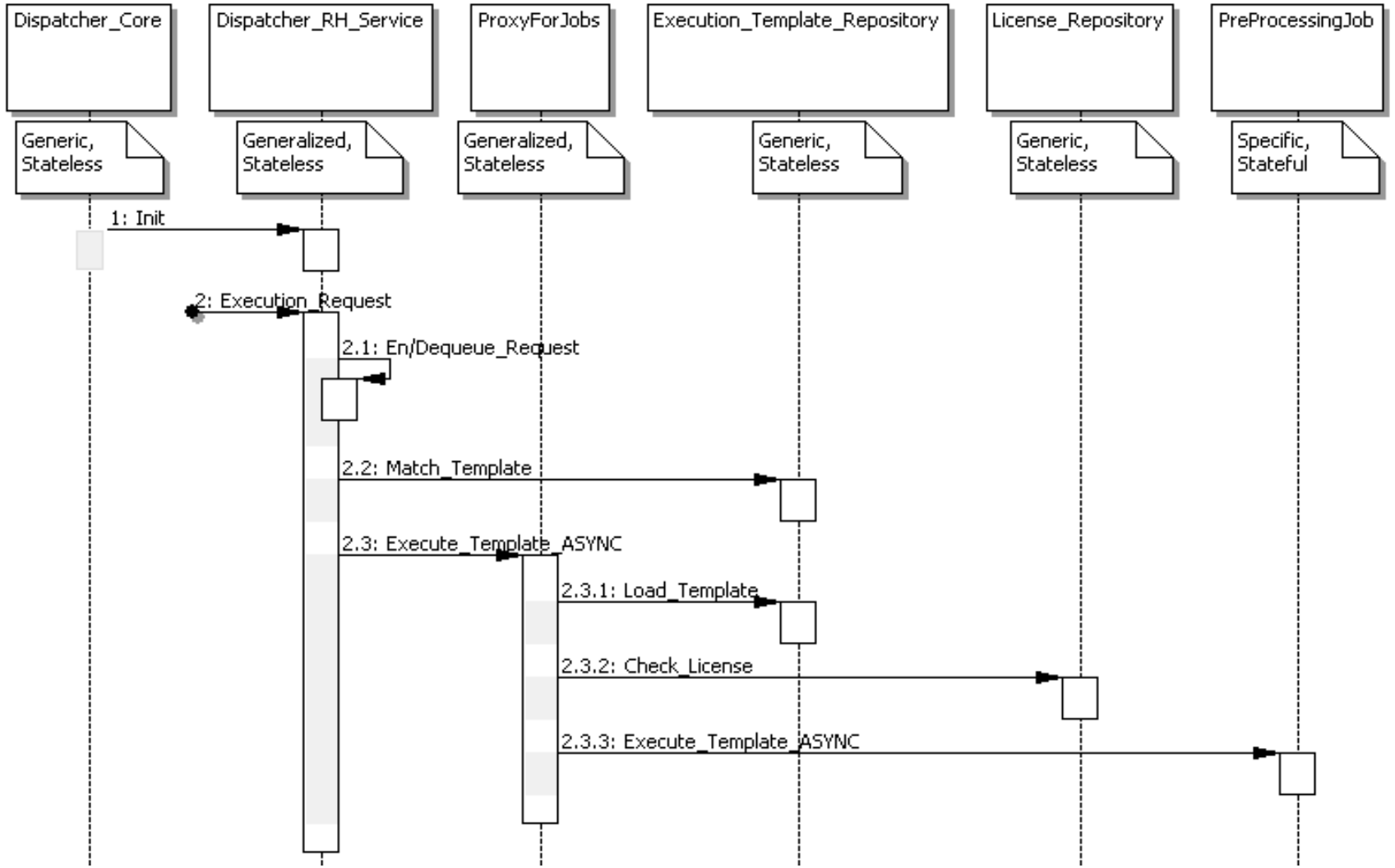
Dispatcher Example with higher Scalability



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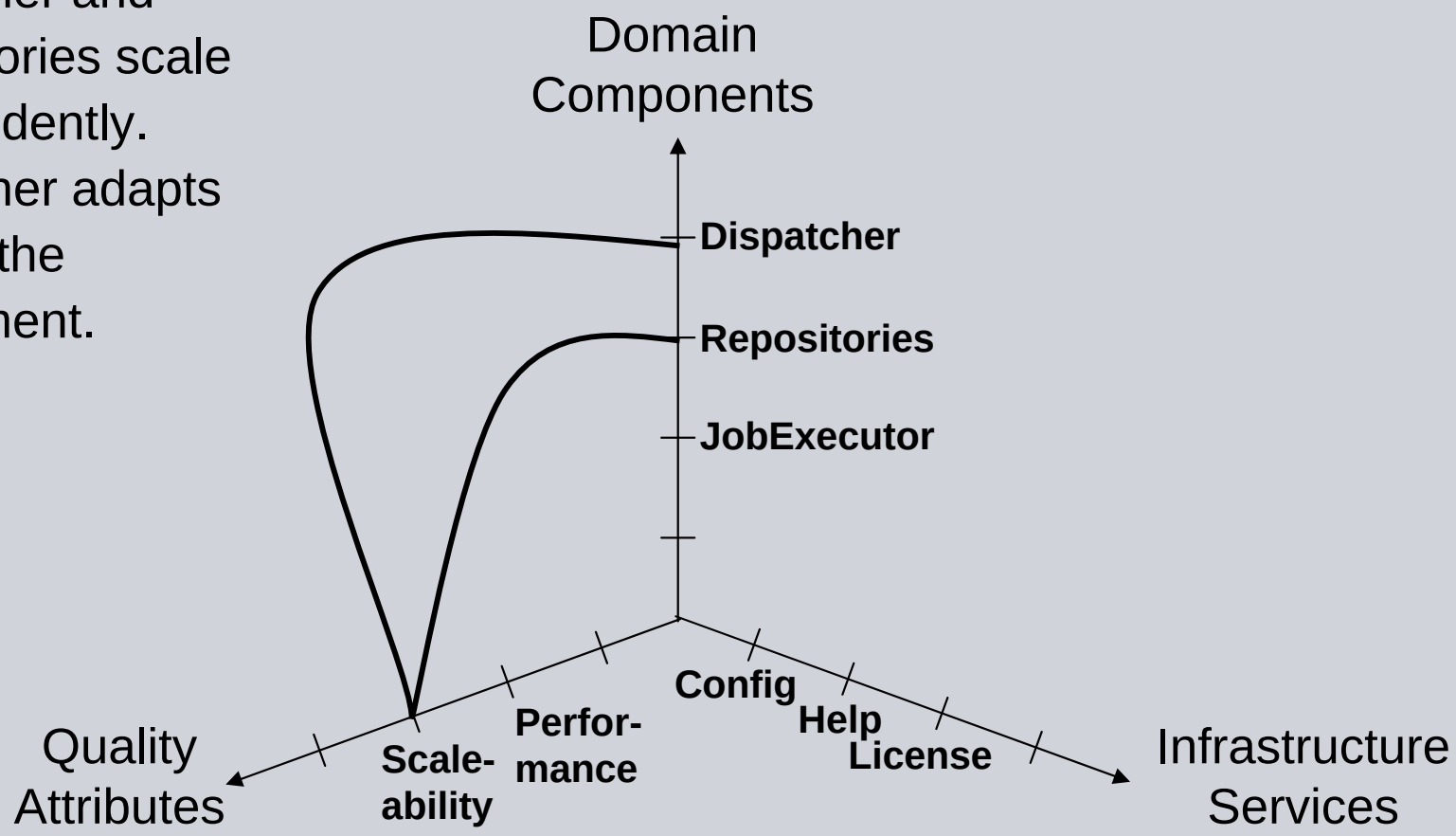
Dispatcher Example with higher Scalability 2/2

- Dispatcher and Repositories scale independently.
- Dispatcher adapts itself to the deployment.



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Context: Scalability of Dispatcher Example

The scalability Quality Attribute of the (artificial) Dispatcher Example allows the Dispatcher to adapt it‘s execution behavior to the current deployment statically and to the current workload dynamically. Therefore, the internal processing is partitioned in steps, which in turn are assigned to dedicated resources.
N.B.: Scalability is treated like a virtual component of the Dispatcher.

Capabilities:
- Match dispatching capability with deployment and workload.
- Optimize throughput based on workload and resources.

Changeability Options:
- Select the execution request message types that are processed.
- Add/remove request handler units at run-time.
- Introduce dedicated request handlers for particular execution request.
- Introduce dedicated execution proxies for particular execution templates.

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Consequences

- On the timeline, architecture change employs explicit changeability options (e.g. new extension points) that can be decided together with the features.
- In discussions on architecture and design: Based on e.g. use cases and features, what of the Capabilities contribute to the changeability options and what the mechanism is. Options can also be altered or removed in a controlled way. The coordination graph helps to discuss the Quality Attributes of a design (e.g. performance of features, performance impact of plug-in loading, …).
- SCRUM teams work on features that cross-cut the architecture, so teams change same contexts at the same time (e.g. components, applications).
  - Concept discusseion, story slicing and teration planning have more support to decide and design the impact of features and the team alignment.
  - The need for discussions among SCRUM teams is detected earlier.
  - Early reviews of the available and new changeability options decreases the probability of ‚technical debt'.
  - Features can stay aligned with architecture and quality attributes.

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Wrap-Up

- The *syngo* platform architecture is partitioned along an architecture ontology and embodies a set of quality attributes.
- Continuous architectures provide and evolve context specific changeability options to handle the impact of change.
- The impact of a feature on architecture, design and on relevant quality attributes can be coordinated at the same time.

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Questions

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Thank you for your attention!

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