

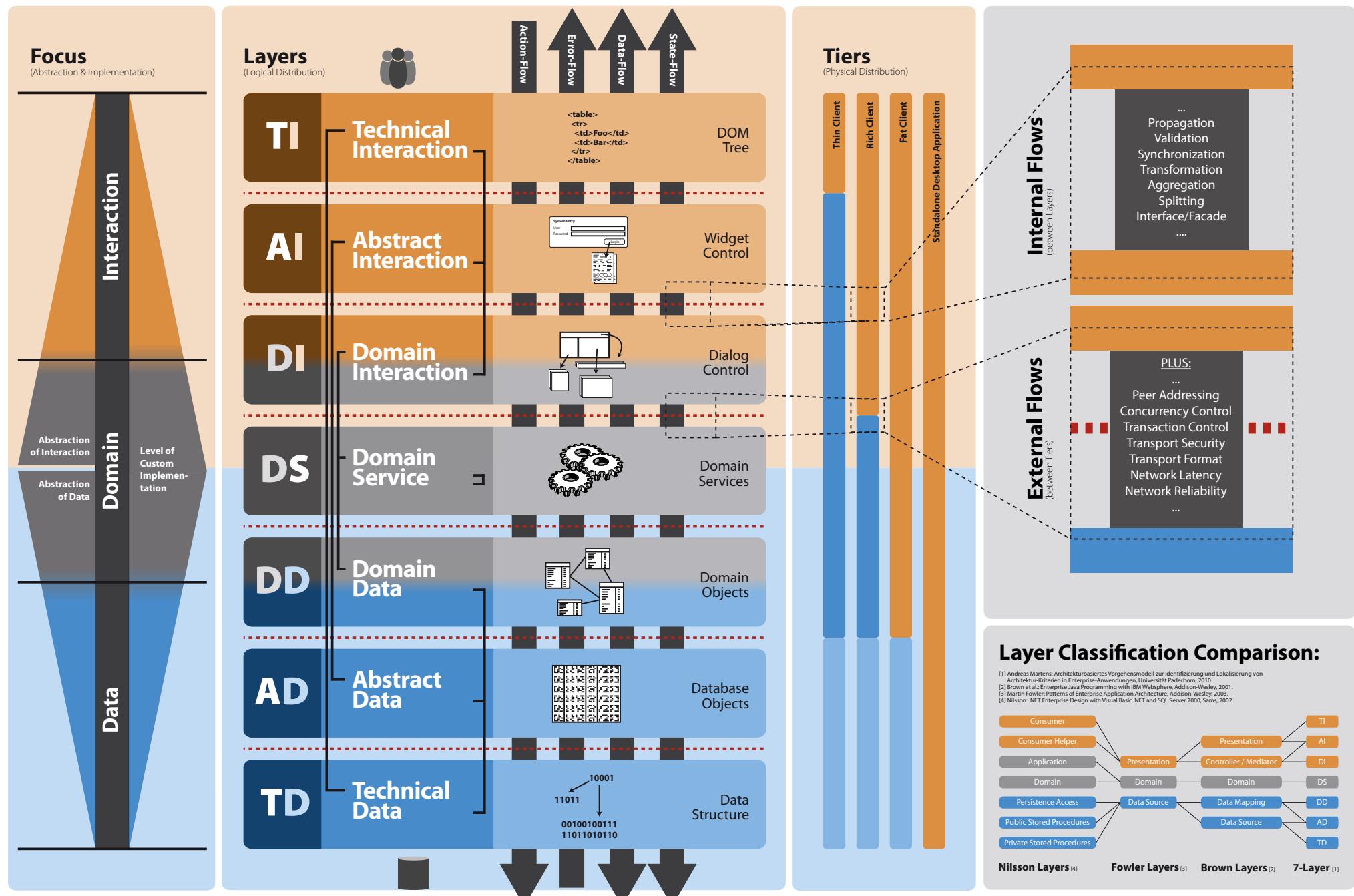


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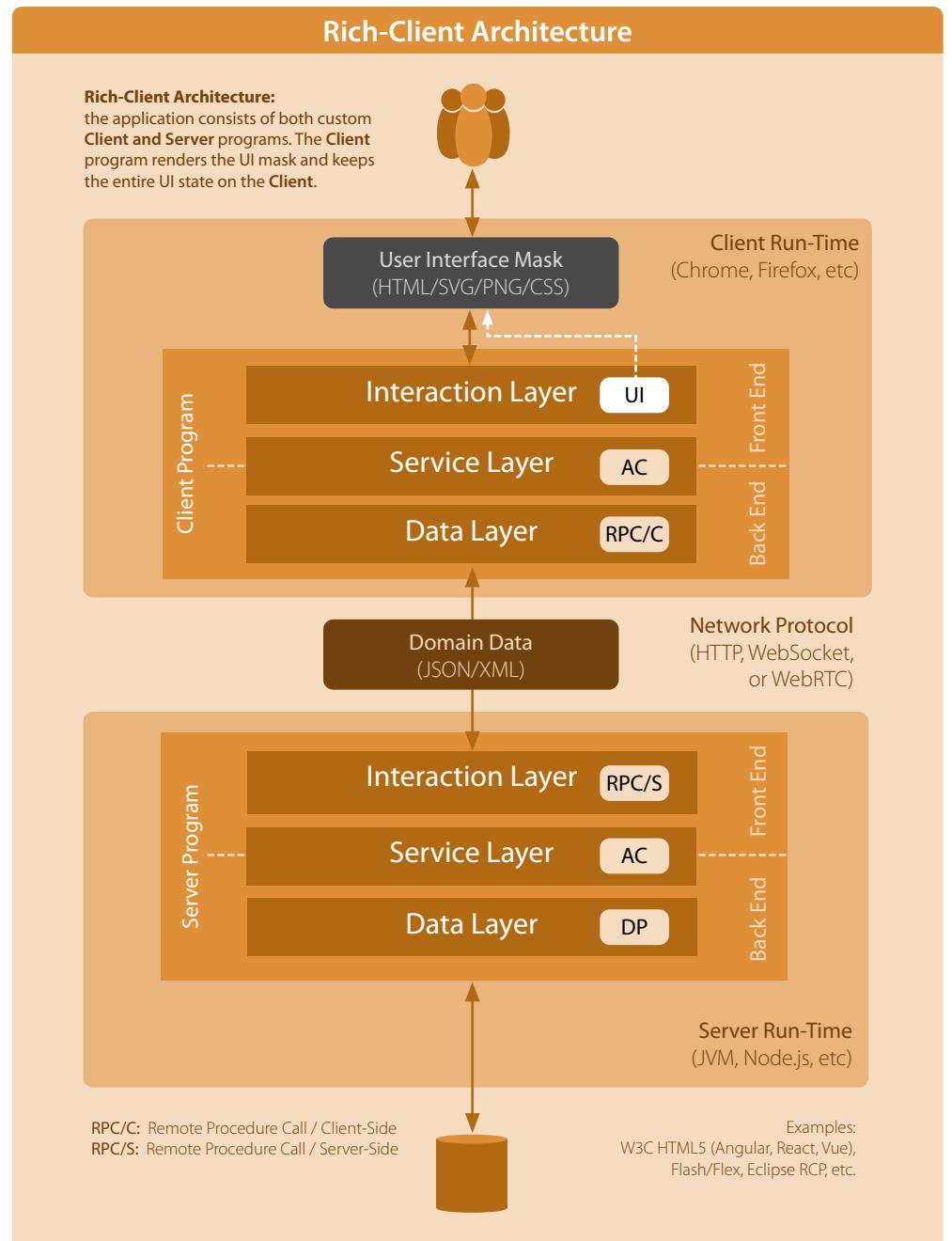
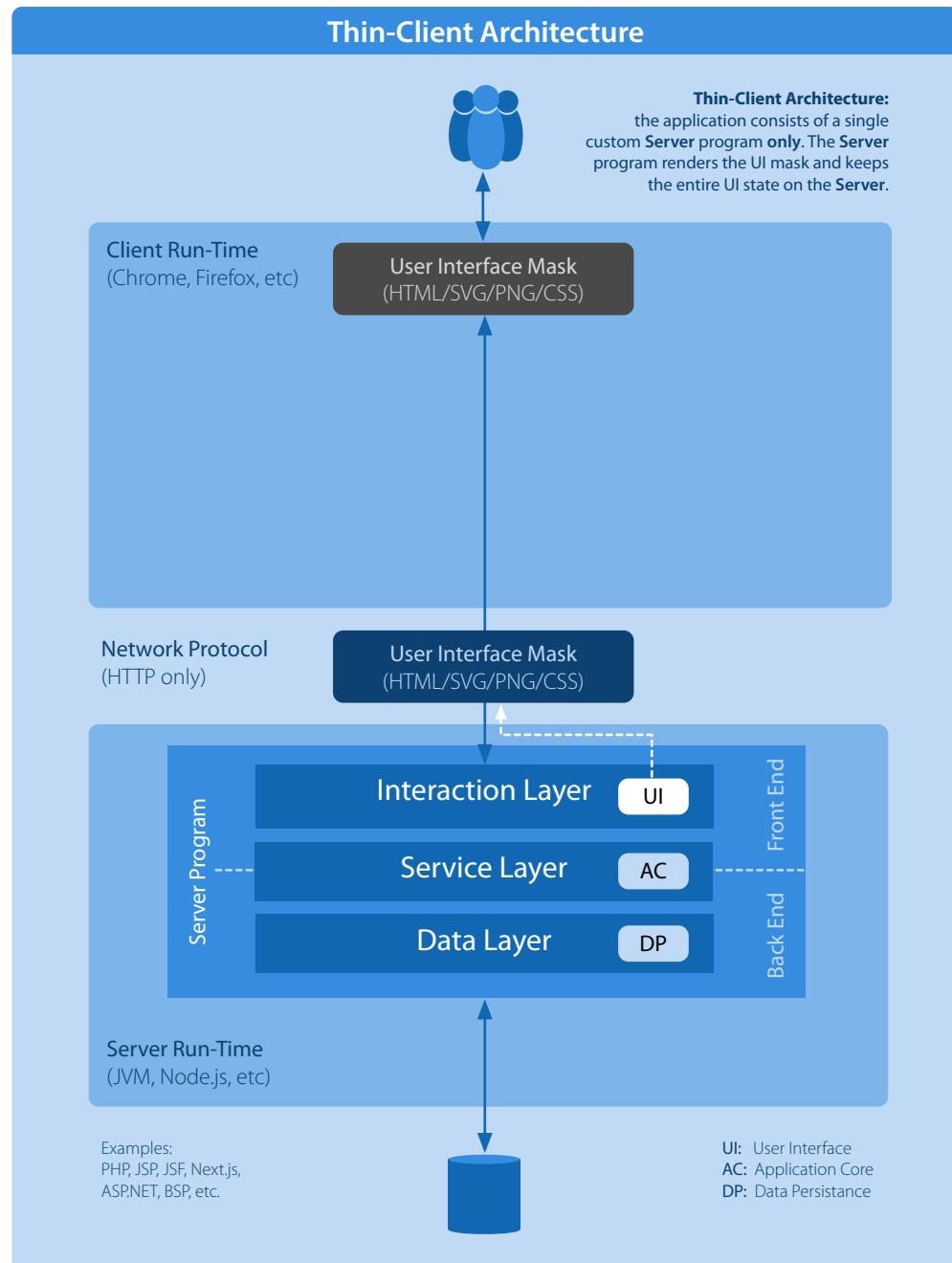
Software Engineering in der industriellen Praxis (SEIP)

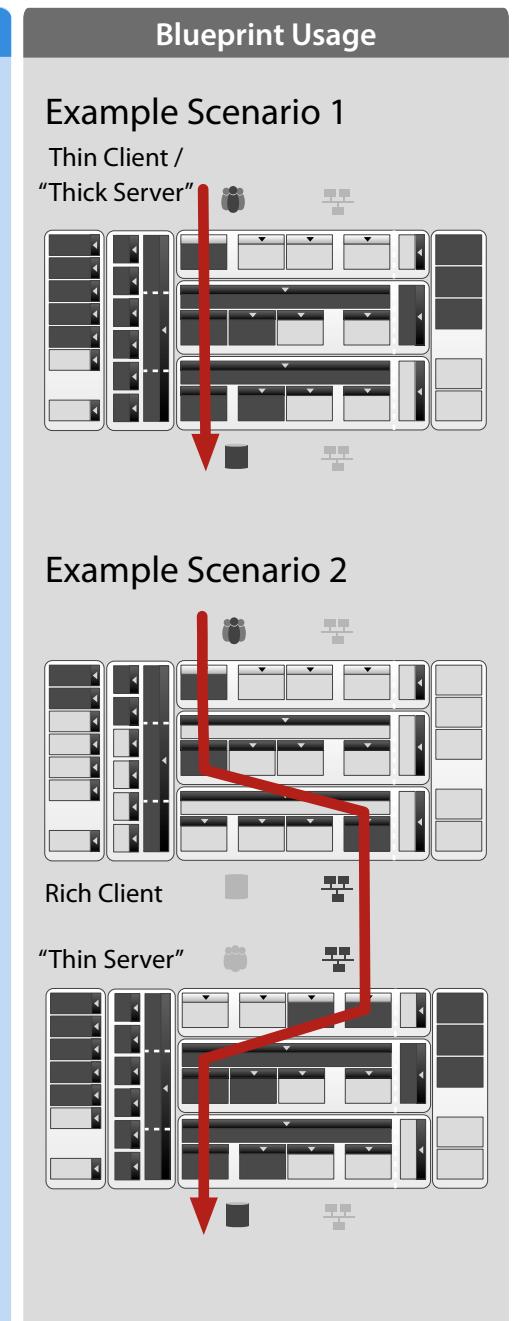
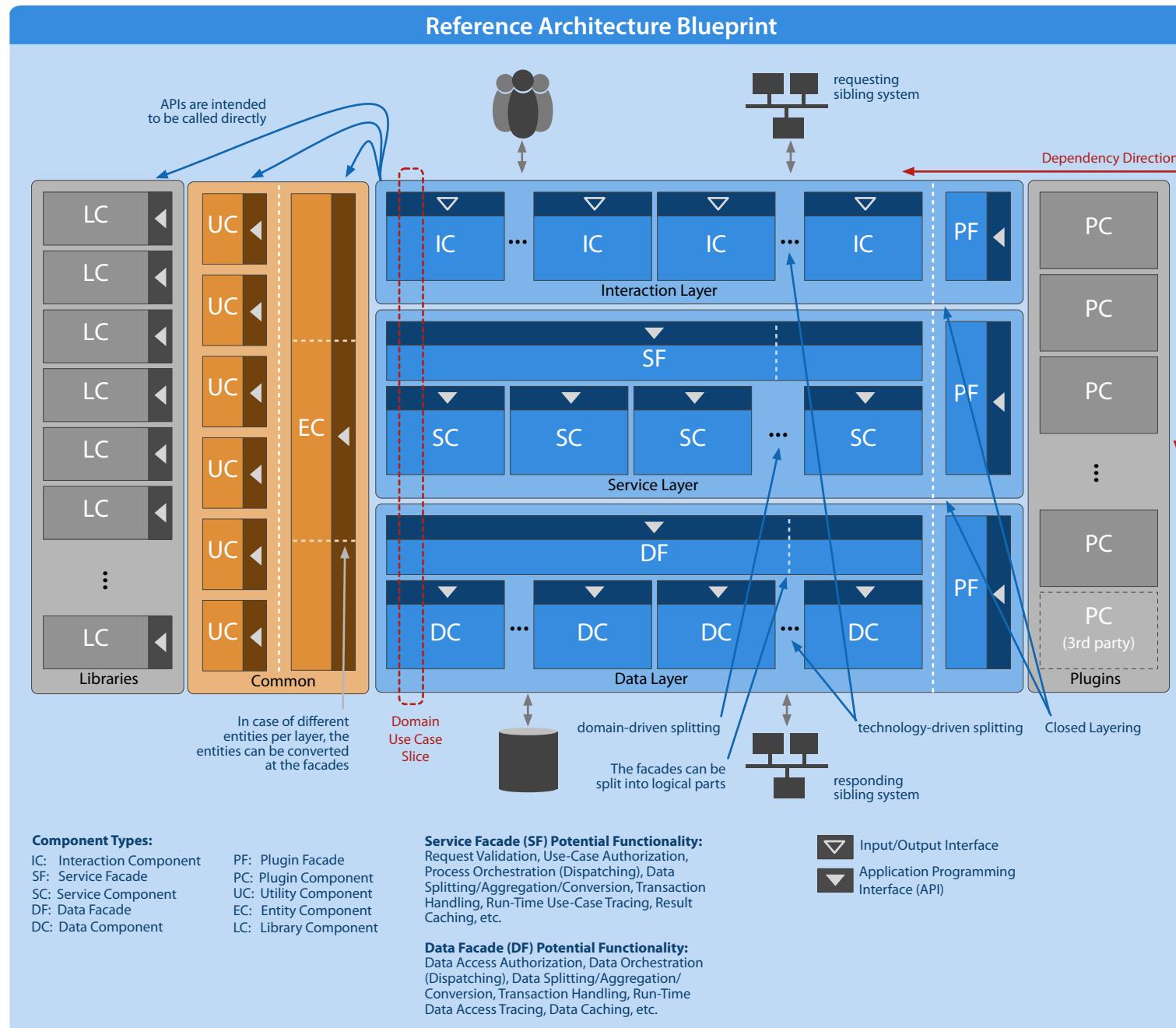
Dr. Ralf S. Engelschall

Application Reference Architecture

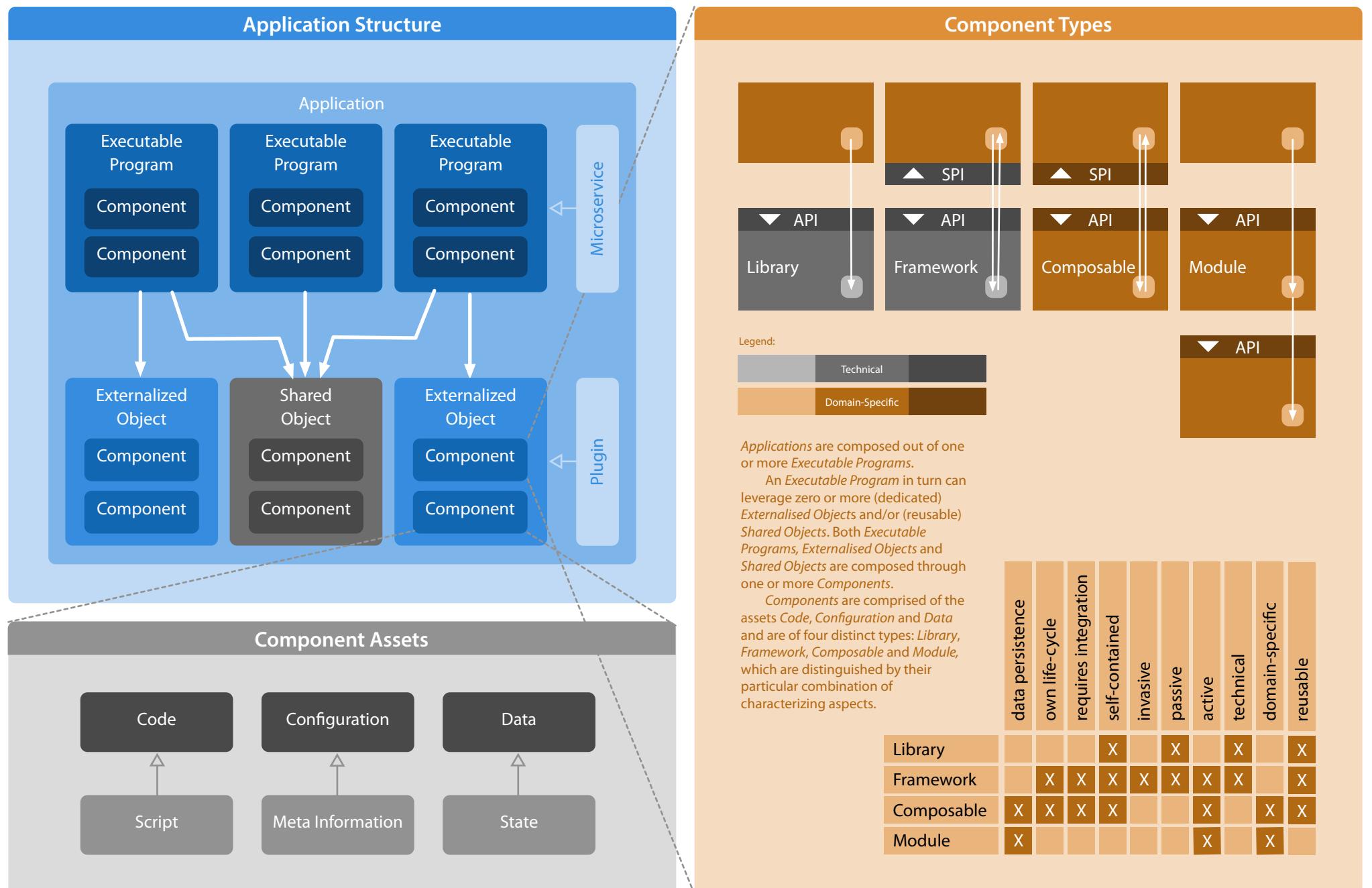


Client-Server Architecture

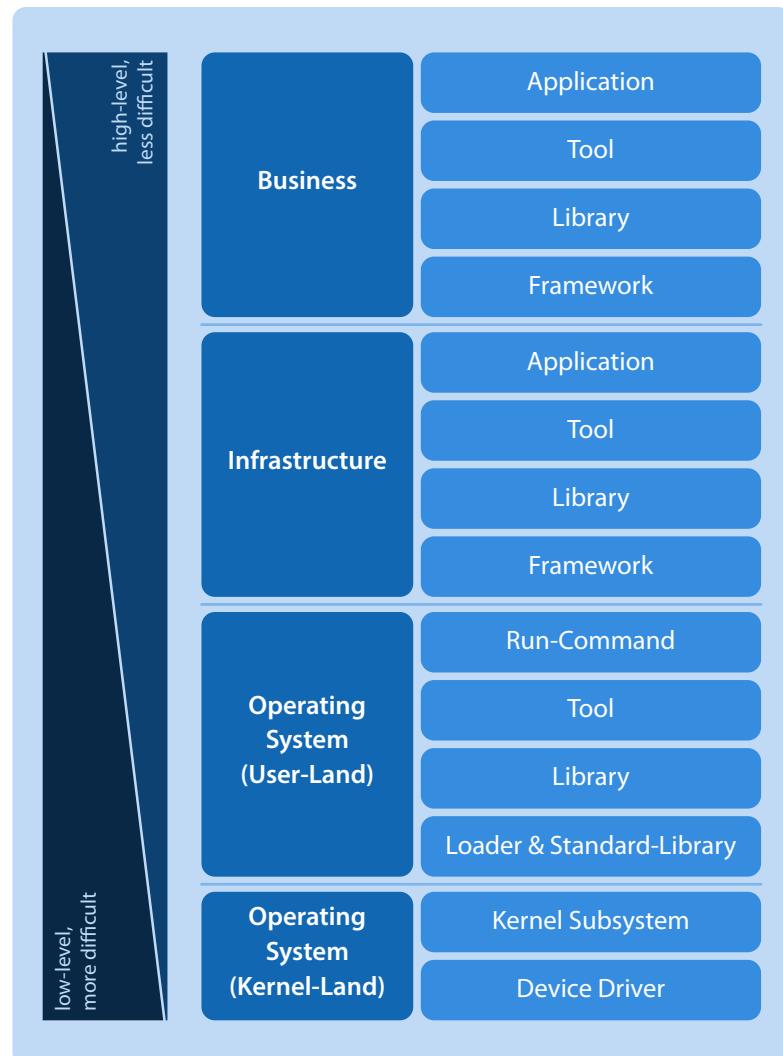




Application Composition



Technology Platforms



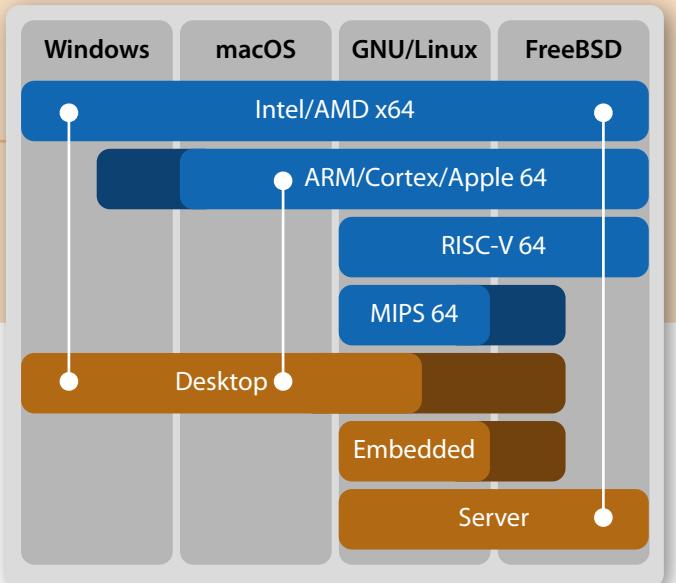
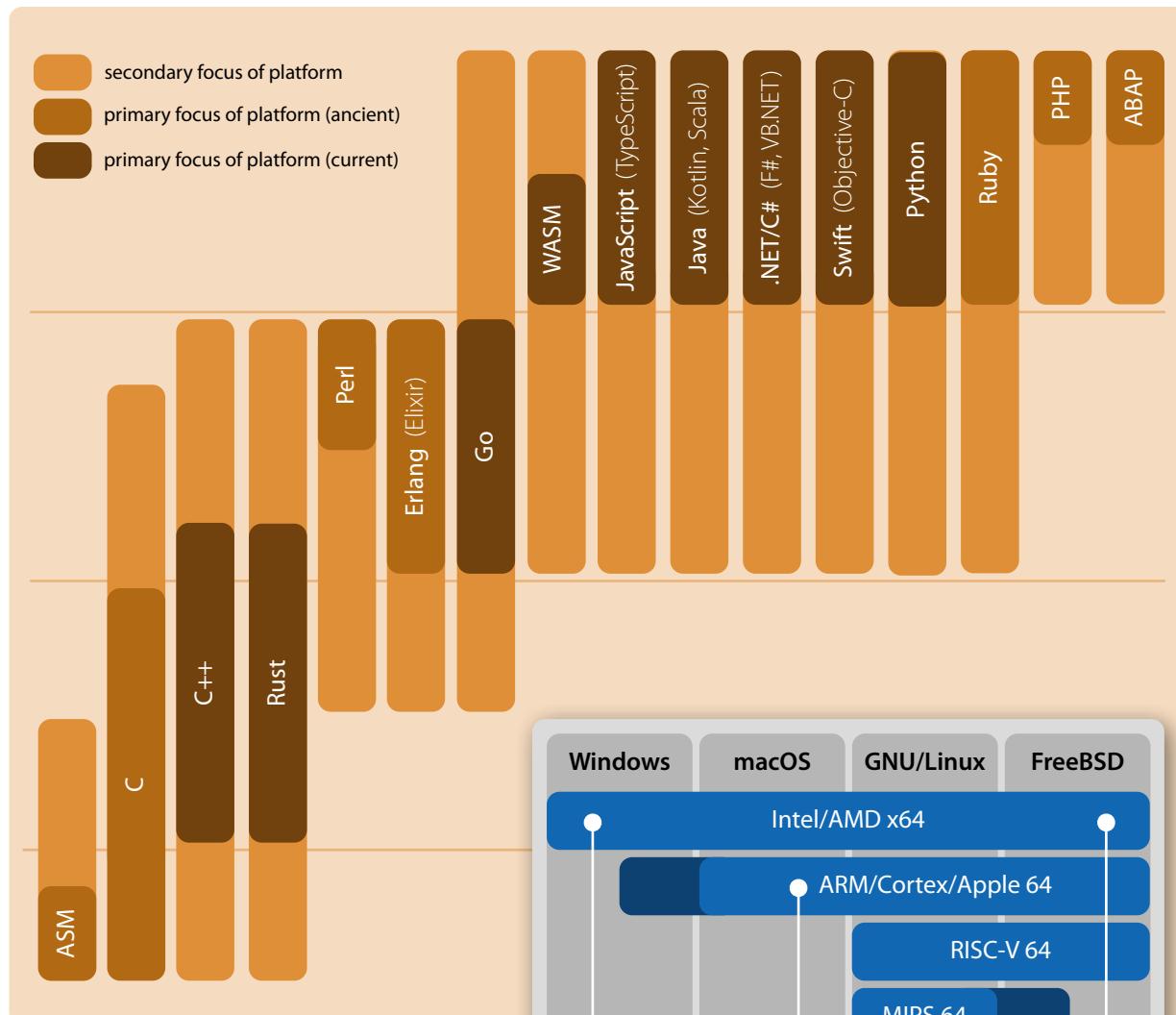
Remember:
A *Technology Platform* is less about choosing a particular programming language and more about choosing a particular ecosystem for targeting a particular level of software!

Opinionated Recommendation (as of 2022):

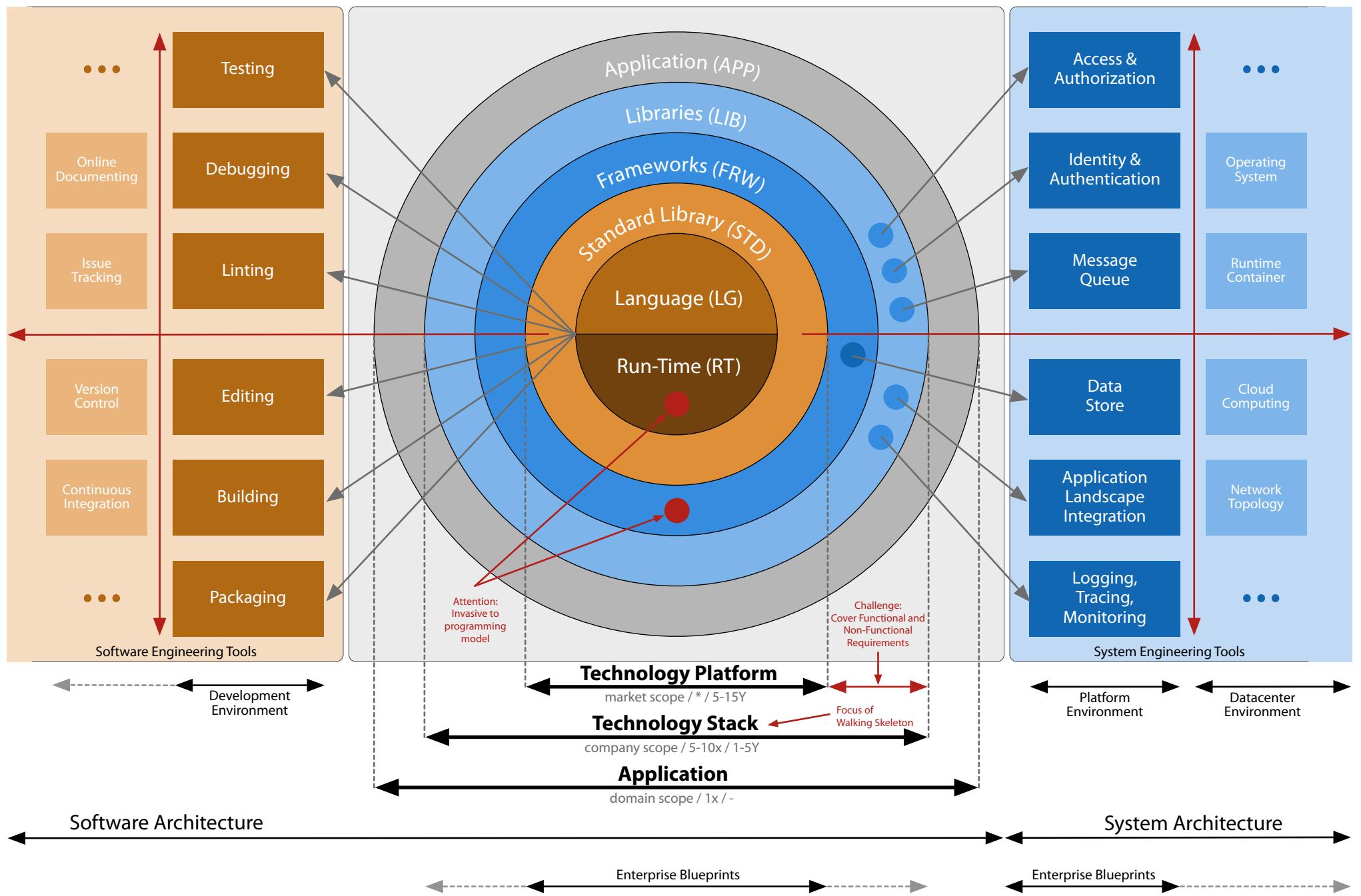
Business:	Scala, Kotlin, TypeScript, AssemblyScript
Infrastructure:	Go, Rust, Scala, Kotlin, TypeScript
Operating System (UL):	Rust, Go
Operating System (KL):	C, C++, Rust

Typical Computing Devices (as of 2022):

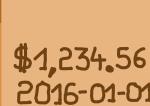
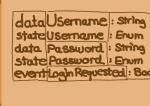
Intel/AMD x64:	Personal Computer (PC)
ARM/Cortex/Apple 64:	Raspberry PI, BeagleBone, ROCKSPro64, iMac
RISC-V 64:	Beagle-V, HiFive Unmatched
MIPS 64:	Compx WPJ344



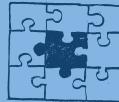
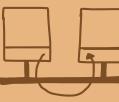
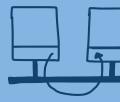
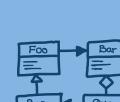
Technology Stack



Rich-Client Aspects

IT Interface Theme			18 Interface Internationalization			DL Dialog Life-Cycle	
Style Reset, Shape, Color, Gradient, Shadow, Font, Icon						Component States, Component State Transitions.	
Bootstrap	TypoPRO, FontAwesome, Normalize					ComponentJS	(none)
IW Interface Widgets			DC Data Conversion			DS Dialog Structure	
Icon, Label, Text Paragraph, Image, Form, Text-Field, Text-Area, Date Picker, Toggle, Radio Button, Checkbox, Select List, Slider, Progress Bar, Hyperlink, Popup Menu, Dropdown Menu, Toolbar, Tooltip, Tab, Pill, Breadcrumb, Pagination, Badge, Alert, Panel, Modal, Table, Scrollbar, Carousel			Value Formatting, Value Parsing, Localization (L10N).			Component, Model/View/Controller Roles, Hierarchical Composition	
Bootstrap	Select2, SlickGrid, ...		VueJS	vue-i18next, I18Next		ComponentJS	ComponentJS-MVC
IL Interface Layouting			DB Data Binding			SP State Persistence	
Responsive Design, Media Query, Frame, Grid, Padding, Border, Margin, Alignment, Force, Magnetism			Reactive, Observer, Unidirectional, Bidirectional, Incremental			Local Storage, Cookies, Caching	
Bootstrap	Swiper, jQuery Page, ...		VueJS	(none)		(none)	Store.js, JS-Cookie
IE Interface Effects			PM Presentation Model			BM Business Model	
Transition, Transformation, Keyframes, Easing Function, Sound Effect, Physics			Parameter Value, Command Value, State Value, Data Value, Event Value, Value Validation, Presentation Logic			Entity, Field, Relationship, Universally Unique Identifiers (UUID)	
VueJS	Animate.css, DynamicJS, Howler, ...		ComponentJS	(none)		(none)	DataModelJS, Pure-UUID
II Interface Interactions			DN Dialog Navigation			UA Use-Case Authorization	
Mouse, Keyboard, Touchscreen, Gesture, Clipboard, Drag & Drop			Deep Linking, Routing, Dialog Flow			User Experience, Dialog Restriction, User, Group, Role, Use-Case, Data, Access.	
VueJS	Hammer, Mousetrap, Dragula, ...		ComponentJS	Director, URL.js		(none)	(none)
IS Interface States			DA Dialog Automation			CN Client Networking	
Rendered, Enabled, Visible, Focused, Warning, Error, Floating			Dialog Macros, Click-Through, Smoke Testing.			Request/Response, Synchronization, Push, Pull, Pulled-Push, REST, GraphQL, Authentication, Session.	
VueJS	(none)		ComponentJS	ComponentJS-Testdrive		(none)	Axios, Apollo Client
IM Interface Mask			DC Dialog Communication			ED Environment Detection	
Markup Loading, Markup Generation, Virtual DOM, Text, Bitmaps, Vectors, 2D/3D Canvas, Accessibility			Service, Event, Model, Socket, Hooks			Runtime Detection, Feature Detection.	
VueJS	jQuery-Markup, D3, Snap.svg, FabricJS, ...		ComponentJS	Latching		(none)	Modernizr, FeatureJS, jQuery-Stage

Thin-Server Aspects

ED Environment Detection Detect the run-time environment, like underlying operating system, execution platform, network topology, feature toggles, etc. Node process, syspath		SN Server Networking Listen to network sockets, accept connections and manage request/response and message communication. HAPI hapi-plugin-websocket, ws		CN Client Networking Provide mechanisms to connect to peers over the network and perform request/response and/or publish/subscribe communication. (none) Axios, MQTT.js, ws	
AP Argument Parsing Parse options and arguments of the Command-Line Interface (CLI) to bootstrap application parameters. (none) yargs		PI Peer Information Determine unique identification and add-on information about the client peer. HAPI hapi-plugin-peer, geoip		TS Task Scheduling Schedule and execute recurring tasks independent of regular I/O operations. (none) node-scheduler	
CP Configuration Parsing Load and parse directives from configuration file to bootstrap application parameters. (none) js-YAML		SH Session Handling Manage secured per-connection sessions to keep state between communication requests and/or client sessions. HAPI YAR		ET Execution Tracing Provide mechanisms for tracing the execution by logging event and measurement information at certain points of interest. Microkernel Winston	
PD Process Daemonizing Detach from the startup terminal and host process in order to run fully independently. (none) daemonize2		UA User Authentication Determine and validate the unique identity of the user communicating over the current network connection. HAPI JWT, Passport		DA Database Access Map in-memory domain entities onto data store dependent persistent data structure. Sequelize GraphQL-Tools-Sequelize	
PM Process Management (Pre-)fork child processes and/or threads of execution and monitor and control them during the life-cycle of the application. (none) cluster, nodemon		RV Request Validation Validate the syntactical and semantical compliance of the requests and sanitize the requests. HAPI Joi, DuckyJS		DC Database Connectivity Locally or remotely connect the database access layer to the underlying data store. Sequelize sqlite3, pg	
CM Component Management Structure the code into components, instantiate them under run-time and manage them in a stateful component life-cycle. Microkernel (none)		RP Request Processing Process the request by dispatching execution according to the provided request and determined context information. HAPI GraphQL.js		DS Database Schema Create, update or downgrade the data schema inside the underlying data store. Sequelize (none)	
CC Component Communication Provide inter-component communication mechanisms like events, hooks, registry, etc. Microkernel Latching		RA Role Authorization Determine whether the role of the current user is allowed to execute the current request. (none) GraphQL-Tools-Sequelize		DB Database Bootstrapping Create, update or downgrade both mandatory bootstrapping and optional domain-specific data inside the underlying data store. Sequelize ini	