Software Platform Ecosystems

INF5750

2017

Unless noted, all tables, citations, and figures are taken from or are facsimiles from: Tiwana, Amrit. *Platform ecosystems: aligning architecture, governance, and strategy*. Newnes, 2013.

From chapters 1, 2 and 5

Contents and learning outcome of the lecture

- What platforms are, and their *core components*
- Difference between *software platforms* and other types of platforms
- *Drivers* towards software platforms
- Some important *concepts*
- Some important *principles*
- Important aspects of platform *architecture*
- Platform *lifecycles*
- How does all this relate to your group assignments and the DHIS2?

Why software platform ecosystems?

- Software platform ecosystem «logics» increasingly plays a more dominant role in competition in a diverse sets of markets
- Competition migrating to rival platforms
  - potent mix of specialized expertise with the disciplining power of platform markets can foster innovation at a pace that can trump even the mightiest product and service business, e.g. Blackberry vs Apple and Google; Camera produces vs mobile phones.

- Why in the open source development course?

Main components of a software platform

Table 1.1 Core Elements of a Platform Ecosystem		
Element	**Definition**	**Example**
Platform	The extensible codebase of a software-based system that provides core functionality shared by apps that interoperate with it, and the interfaces through which they interoperate	iOS, Android Dropbox, Twitter AWS Firefox, Chrome
App	An add-on software subsystem or service that connects to the platform to add functionality to it. Also referred to as a module, extension, plug-in, or add-on	Apps Apps Apps Extensions
Ecosystem	The collection of the platform and the apps specific to it	
Interfaces	Specifications that describe how the platform and apps interact and exchange information	APIs Protocols

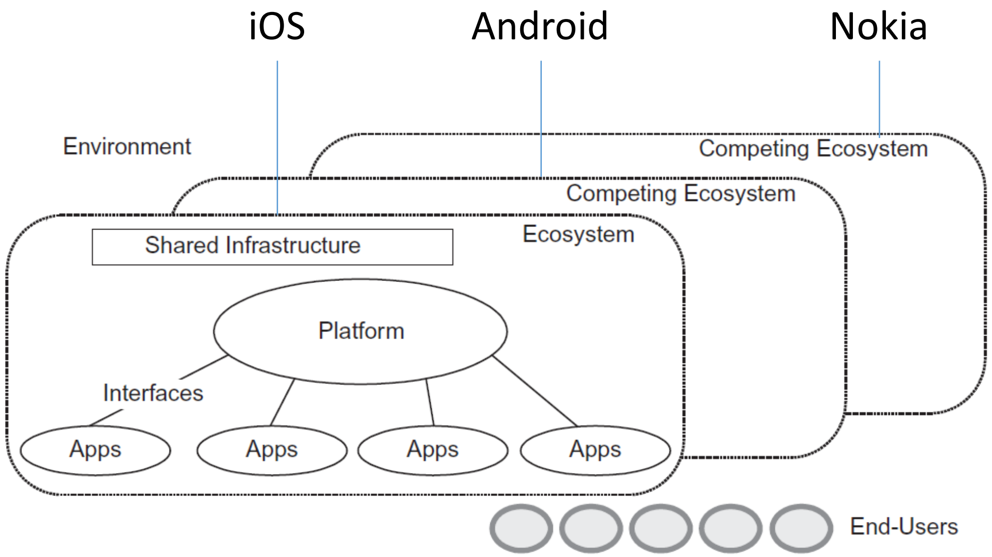


FIGURE 1.1

Elements of a platform ecosystem.

Evolution of platform ecosystems

- Architecture: Structure

A conceptual blueprint that describes how the ecosystem is partitioned into a relatively stable platform and a complementary set of apps that are encouraged to vary, and the design rules binding on both

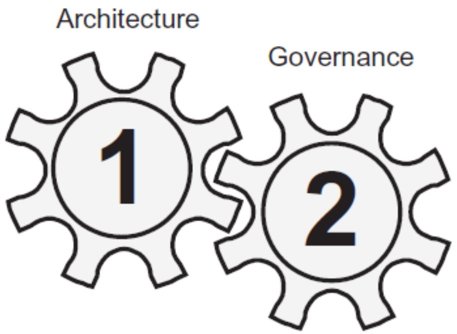


FIGURE 2.19

Architecture and governance are the two gears of evolution of a platform ecosystem.

- Governance: Process and rules

Broadly, *who decides what* in a platform's ecosystem. This encompasses partitioning of decision-making authority between platform owners and app developers, control mechanisms, and pricing and pie-sharing structures

- Evolution: «… *the interplay between its irreversible architecture and how it is governed.*"

Focus in Tiwana (2013): software platforms:

- Platforms where third party complementors add to platform capabilities and functionality
  - Possibilities for hundreds or thousands of actors to add functionality to the same ecosystem

- Upstream value chain the platform itself. Downstream app developers. End users can uniquely mix-and-match downstream complements – making the innovation and adoption in the downstream central for success of failure
- True platforms must be at least two-sided and span at least two distinct groups app developers and end-users that interact through the platform.
- Most successful platforms began as standalone products or services: iOS, Windows, Facebook, Amazon, eBay, Google, Firefox, Salesforce, and Dropbox

- What does that imply and mean?

Drivers towards platformization

Table 1.3 Consequences of the Five Drivers Toward Platform-Centric Business Models

Driver	Description	Consequences
Deepening specialization	Increased need for deep expertise due to growing complexity of products and services	• Simultaneously shrinking and expanding firm boundaries • Red Queen effect from clockspeed compression • Increased interdependence among firms
Packetization	Digitization of "something"—an activity, a process, a product, or a service—that was previously not digitized	• Location-independent distribution ability of work • Deepening specialization
Software embedding	Baking a routine business activity into software	• Products-to-services transformation • Morphing physical–digital boundary • Convergence of adjacent industries
Internet of Things	Everyday objects inexpensively gaining the ability to directly talk using an Internet protocol	• Deluge of data streams from networked objects • Context awareness
Ubiquity	The growing omnipresence of cheap and fast wireless Internet data networks	• Loosely coupled networks rival efficiencies of firms • Alters who can participate from where • Alters where services can be delivered • Scale without ownership

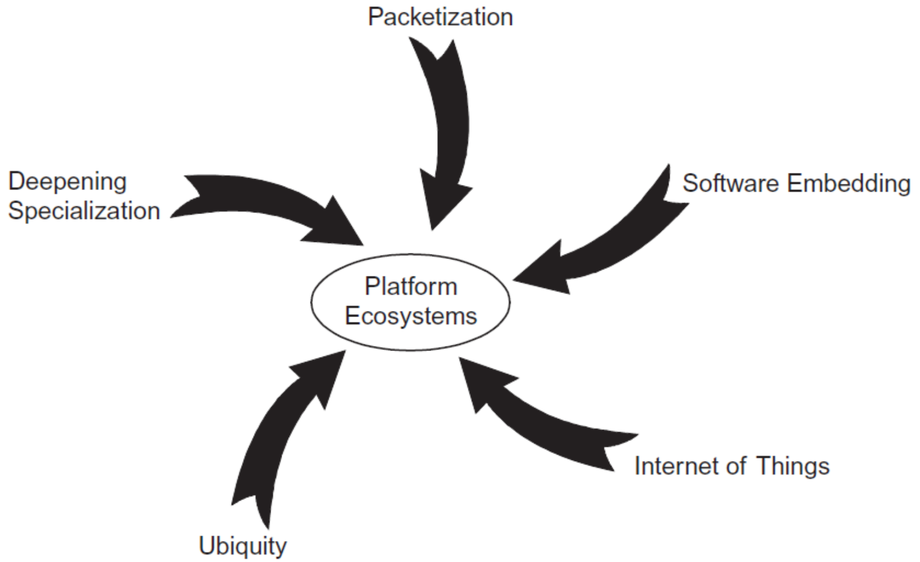


FIGURE 1.3

The five drivers of the migration toward platform-centric business models.

More about drivers

- Deepening specialization:
  - Software code grow larger and become more complex (more functionality) -> more specialization needed for further growth.
  - -> More focus needed for companies
  - -> Need for integration of distributed knowledge from others
  - -> More effort to compete against successful platform owners
- Packetization:
  - Digitalization of an activity, process, product or service
  - -> Enables transportation of information through the Internet – high speed, low cost – Removes location constraints to work -> new possible business models
  - -> Deepening specialization
    - Example: global radiology service in India (e.g. https://www.outsource2india.com/services/radiology.asp)

More about drivers

- Software embedding:
  - Making software of business processes and activities
    - Example: credit card, Vipps, cool photo filters

  - -> from products to services – clients to web-based services, software based maps in cars
  - -> physical – digital boundary -
  - -> convergence across industries – gaming consoles and cameras into phones, Amazon kindle
- Internet of things:
  - Cheap sensors online and networked
    - Example: Sensors to monitor patients at home, door sensors telling if you forget to lock your door

  - -> From stock of data to streams of data
  - -> Communication of contextual data
  - Examples: One Tesla car telling about hump in the road – all other cars get the information and adjust car configuration to take less impact when driving through the same place.
  - Optimalization of resources in a hospital, dynamic prize regulations

More about drivers

- Ubiquity:
  - Precence of Internet «everywhere» – lower prices – faster network

  - -> location independence of tasks and services
  - -> networks of firms
  - -> crowdsourcing
    - Example: Google maps traffic information

- The *combination* of the drivers
  - Pushing innovation ecosystems towards growing number of industries, like:
    - mortgage, finance, drug development, software, automotive, healthcare, banking, food services, and energy

Platform concepts

- Platform lifecycle:

Concept	Relevance			Description
	Platform	App	Ecosystem	
Platform lifecycle	●	●	●	A multifaceted characterization of whether a technology solution—a platform, an app, or the entire ecosystem—is in its pre- or post-dominant design stage; its current stage along the S-curve; and the proportion of the prospective user base that has already adopted it
Dominant design	●	●		A technology solution that implicitly or explicitly becomes the gold standard among competing designs that defines the design attributes that are widely accepted as meeting users' needs
S-curve	●	●	●	A technology's lifecycle that describes its progression from introduction, ascent, maturity, and decline phases
Leapfrogging	●	●	●	Embracing a disruptive technology solution and using it as the foundation for the firm's market offering in lieu of an incumbent solution in the decline phase of its S-curve
Diffusion curve	●	●		A description of whether a technology solution—a platform or an app—is in the stage of having attracted the geeks, early majority, early adopters, late majority, or laggards to its user base

Lifecycle

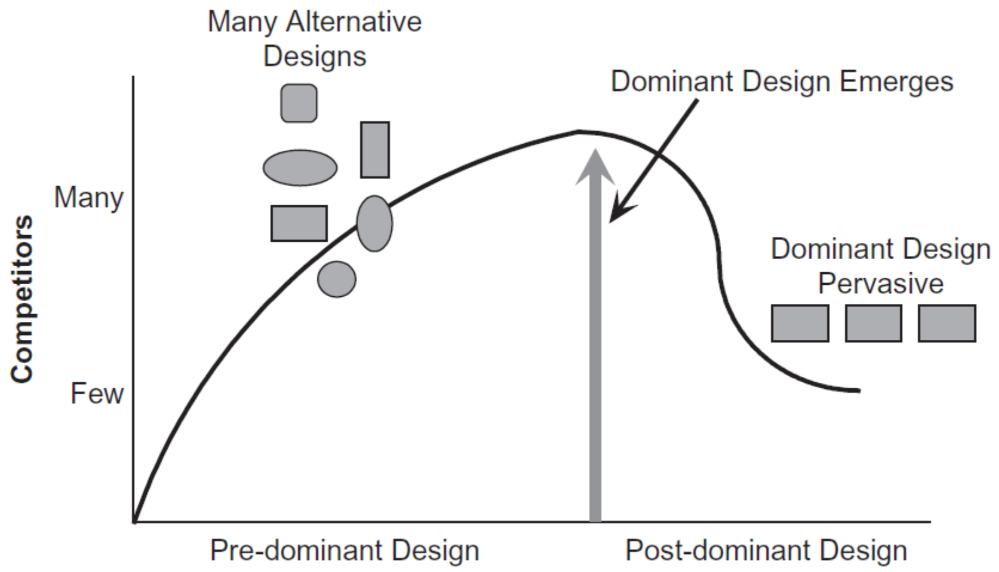


FIGURE 2.2

Pre- and post-dominant design phases in a software platform.

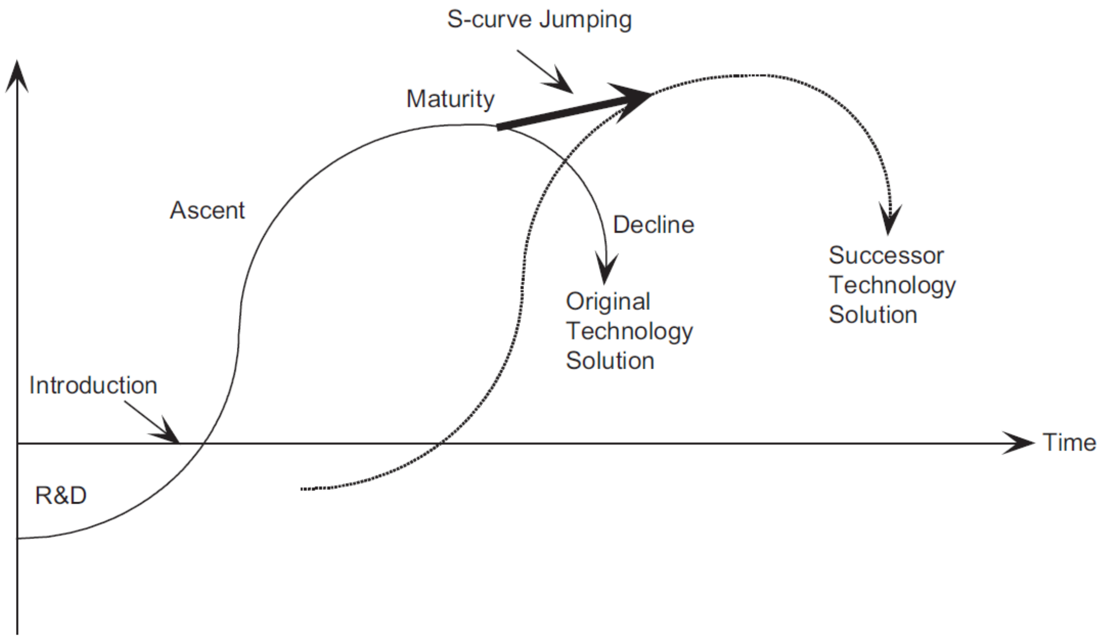


FIGURE 2.3

S-curves in the technology lifecycle.

Platform concepts

- Platform properties:

Concept	Relevance			Description
	Platform	App	Ecosystem	
Multisidedness				The need to attract at least two distinct mutually attracted groups (such as app developers and end-users) who can potentially interact more efficiently through a platform than without it
Network effects	●	●		A property of a technology solution where every additional user makes it more valuable to every other user on the same side (same-side network effects) or the other side (cross-side network effects)
Multihoming	●			When a participant on either side participates in more than one platform ecosystem
Architecture	●	●		A conceptual blueprint that describes components of a technology solution, what they do, and how they interact
Governance			●	Broadly, *who decides what* in a platform's ecosystem. This encompasses partitioning of decision-making authority between platform owners and app developers, control mechanisms, and pricing and pie-sharing structures

Properties

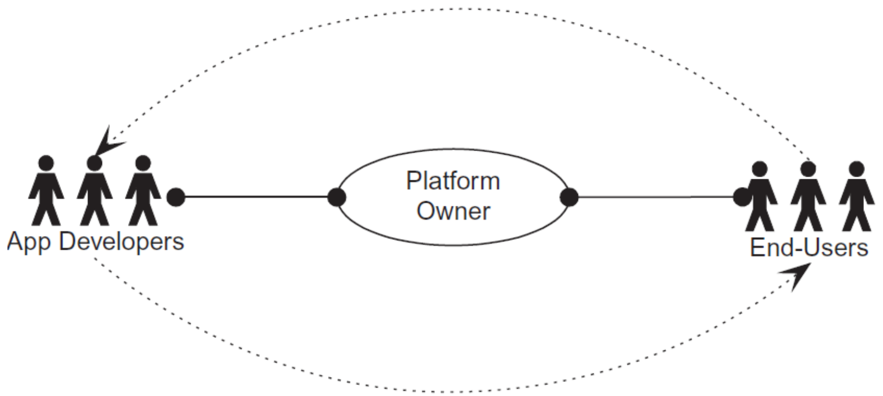


FIGURE 2.8

Two sides in a multisided platform.

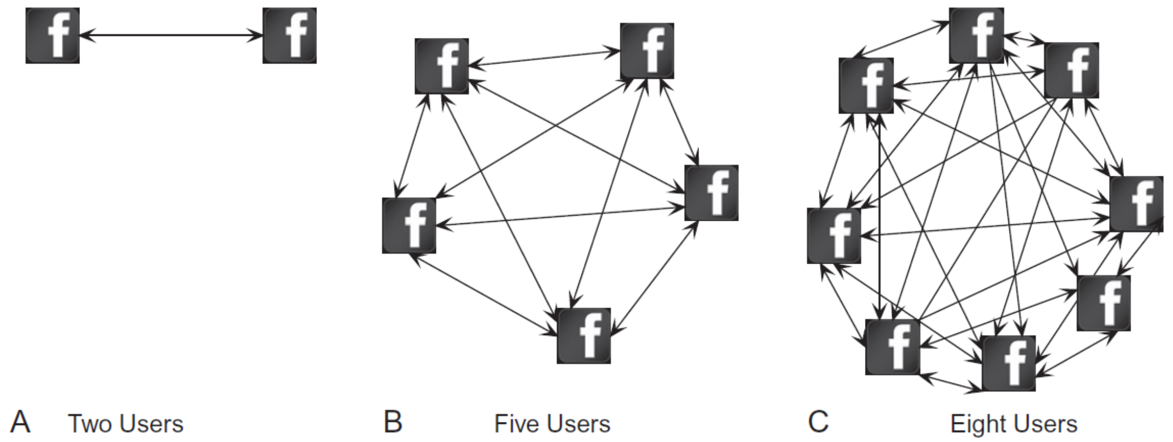


FIGURE 2.9

Networks effects leverage the number of users that any user can communicate with.

	Same Side	Cross-side
Negative	Adding someone **decreases** appeal to all existing users on the **same** side	Adding someone decreases appeal to all existing users on the **other** side
Positive	Adding someone **increases** appeal to all existing users on the **same** side	Adding someone increases appeal to all existing users on the **other** side

Platform concepts

- Platform dynamics:

Concept	Relevance			Description
	Platform	App	Ecosystem	
Tipping	●	●		The point at which a critical mass of adopters makes positive network effects take off
Lock-in	●	●	●	The ways in which a platform can make it more desirable for existing adopters to not jump ship to a rival
Competitive durability	●	●	●	The degree to which the adopters of a technology solution continue to regularly use it long after its initial adoption
Envelopment	●	●		When a platform swallows the market of another platform in an adjacent market by adding its functionality to its existing bundle of functionality

Platform guiding principles

- Platform startup principles:

Chicken-or-egg problem	The dilemma that neither side will find a two-sided technology solution with potential network effects attractive enough to join without a large presence of the other side
The penguin problem	When potential adopters of a platform with potentially strong network effects stall in adopting it because they are unsure whether others will adopt it as well

Platform guiding principles

- Platform design principles:

Seesaw problem	The challenge of managing the delicate balance between app developers' autonomy to freely innovate and ensuring that apps seamlessly interoperate with the platform
Humpty Dumpty problem	When separating an app from the platform makes it difficult to subsequently reintegrate them
Mirroring principle	The organizational structure of a platform's ecosystem must mirror its architecture

Platform guiding principles

- Platform evolution principles

Emergence	Properties of a platform that arise spontaneously as its participants pursue their own interests based on their own expertise but adapt to what other ecosystem participants are doing
Coevolution	Simultaneously adjusting architecture and governance of a platform or an app to maintain alignment between them
Goldilocks rule	Humans gravitate toward the middle over the two extreme choices given any three ordered choices
Red Queen effect	The increased pressure to adapt faster just to survive is driven by an increase in the evolutionary pace of rival technology solutions

Some key points

- The lifecycle of a technology solution has three-dimensions:
  - pre- or post-dominant design stage (from many to one)
  - maturity trajectory (the S-curve)
  - proportion of the total prospective user base adoption
- Multisidedness offers: same-side and cross-side network effects, lock-ins (coercive and value-driven), prospects of swallowing or be swallowed
- Architectures provide blueprint for mass coordination. Conventional coordination and control mechanisms costly and implausible in large ecosystems
- Governance can amplify or diminish the advantages of good architecture. Governance and architecture must be co-designed and coevolved
- Evolutionary pace of a platform is relative to its rivals (the Red Queen effect).
- Emergent innovation can only be facilitated, not planned by a platform owner.
  - Spontaneously arise from the selfish pursuit of self-interest by individual ecosystem participants.
- Chicken-or-egg problem and the penguin problem to get off the ground - unattractive for either side to join unless there is a critical mass on the other side. Uncertainty about whether others will join the platform ecosystem can stall initial adoption, creating the penguin problem
- Balance autonomy with integration (the seesaw problem) separable but re-integratable (Humpty Dumpty). Organized to mirror the architecture and the “microarchitecture” (the mirroring principle).

Platform architectures

- The architecture enable (or not) participation among potential and actual third party innovators
- Third party innovators must be *able* and *motivated* to participate
  - Ability through architecture
  - Motivation through governance

- Main architecture parts (and their interconnectedness)
  - Platform core
  - Platform interfaces
  - «Apps»

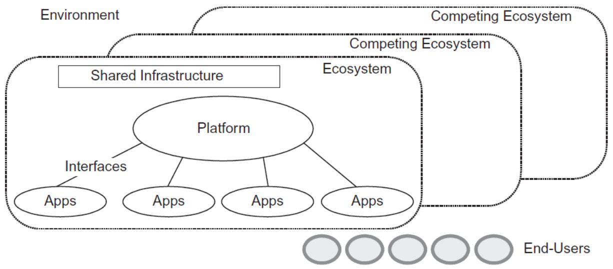


FIGURE 1.1
Elements of a platform ecosystem.

Managing complexity

- What is complexity?
  - A function of the number of parts, types of parts, and number and types of connections between the parts.
    - Structural (difficult to describe)
    - Behaviorally (difficult to control and predict)
  - Too high complexity will lead to at least
    - Incomprehensibility
    - Gridlock

    - -> loss of predictable output from input – ripple effects
    - -> co-innovation risk (80%x80%x80%=51%) – need to reduce dependencies at the right place

Managing complexity

- In a platform ecosystem with numerous actors, complexity must be controlled somehow to reduce risk of gridlocks, unpredictable ripple effects and co-innovation problems

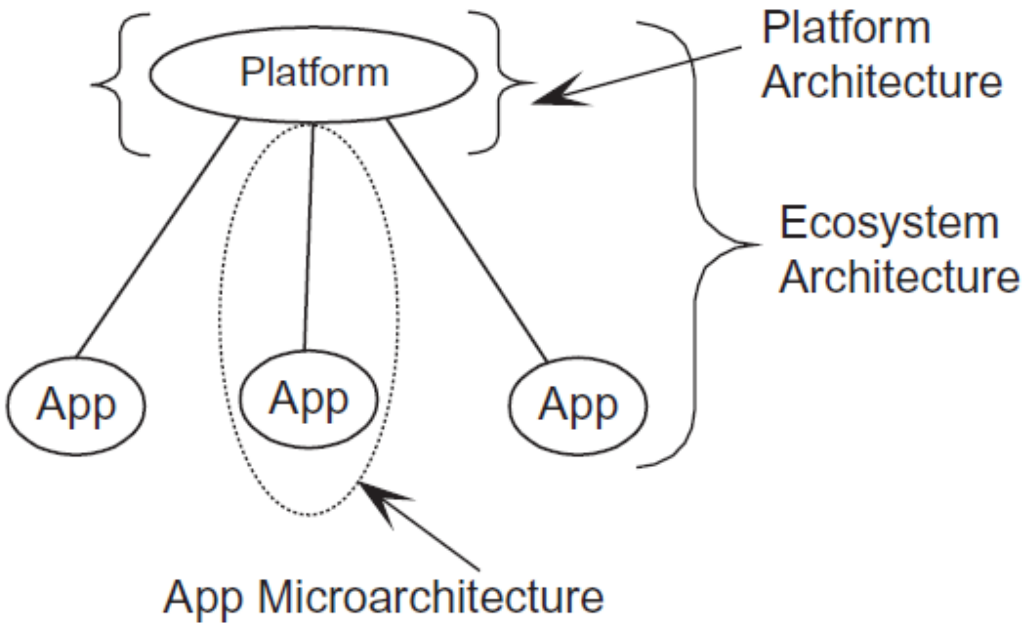
- ->Architecture
  - Balancing between control and autonomy
  - Keeping transaction costs and coordination cost as low as possible

Architecture solutions to orchestrate

- Partitioning (modularization) – core <-> apps - degrees
  - Creating «autonomous» subsystems
    - To cognitively manageable parts
  - Blackboxing
    - Visible information: what they do and how to interact with them
    - Hidden information: how they work
- Systems integration
  - Development activities coordination between platform owner and app developers
    - Managing dependencies
    - Minimizing need for coordination
  - Apps must be integrated to the platform to enable value to end-users
    - Platform – app integration – uneven development, platform changes – ongoing effort
    - App – app integration

Architecture solutions

- Relatively stable core
  - Platform architecture
  - Visible part: Shared sets of assets through defined interfaces
  - Hidden: inner functions of the platform core to make interfaces work and behave as they do
- Dynamics and variability in apps -> innovation
  - Microarchitecture



App architecture (microarchitecture)

1. Presentation Logic
2. Application Logic
3. Data Access Logic
4. Data Storage

Possible partitioning of layers

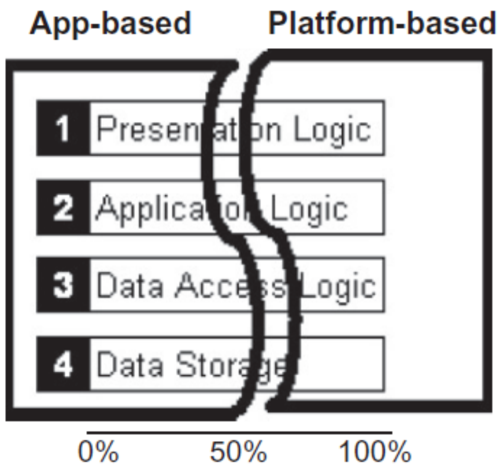


FIGURE 5.10

Each of the four functional elements of an app can be flexibly partitioned between an app and the platform.

Many possibilities for partitioning the app

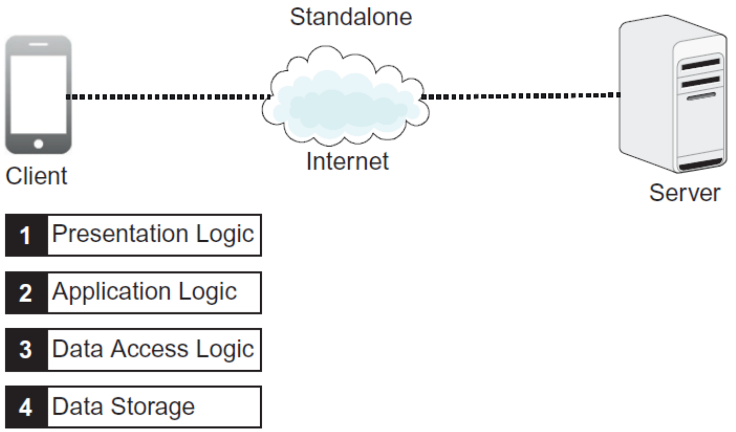


FIGURE 5.11

All four functional elements reside on the client device in the standalone app microarchitecture.

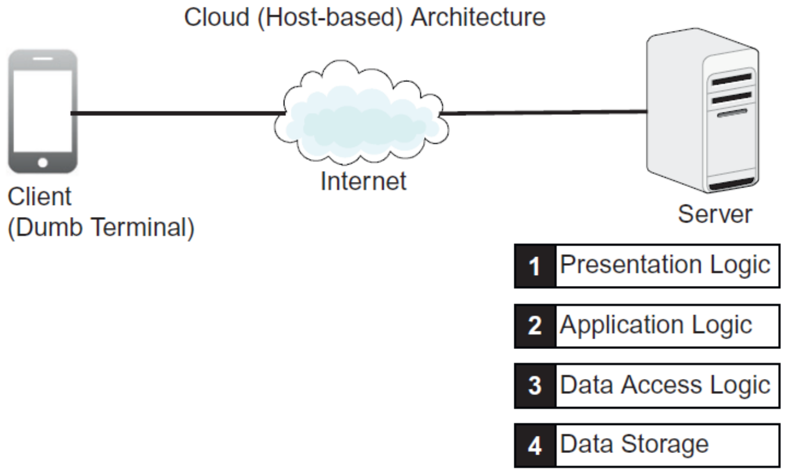


FIGURE 5.12

All four functional elements reside on the client device in the cloud app microarchitecture.

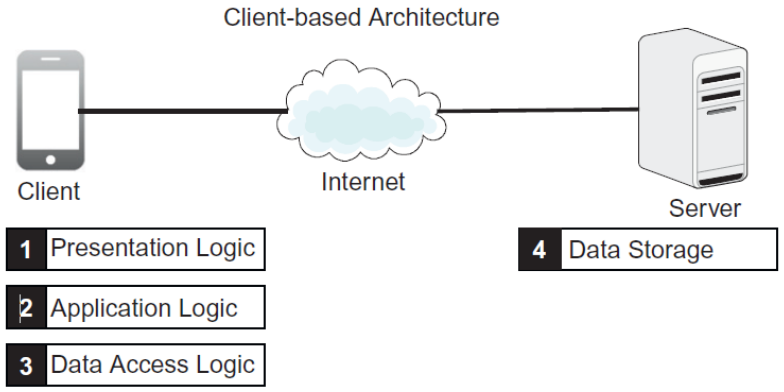


FIGURE 5.13

Only data storage resides on the server side in client-based app microarchitecture.

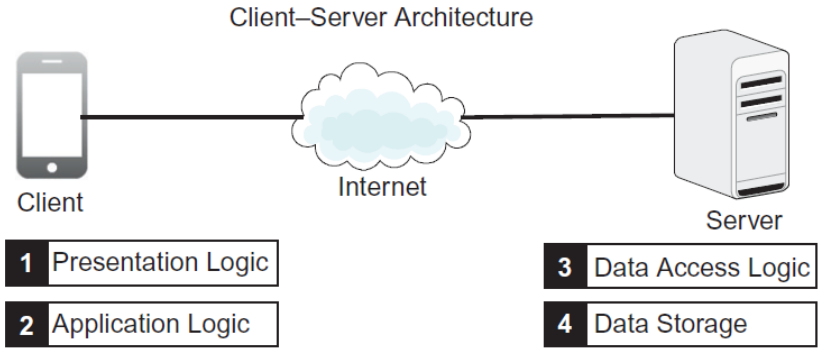


FIGURE 5.14

Client–server app microarchitectures evenly split application functionality among clients and servers.

Many possibilities for partitioning the app

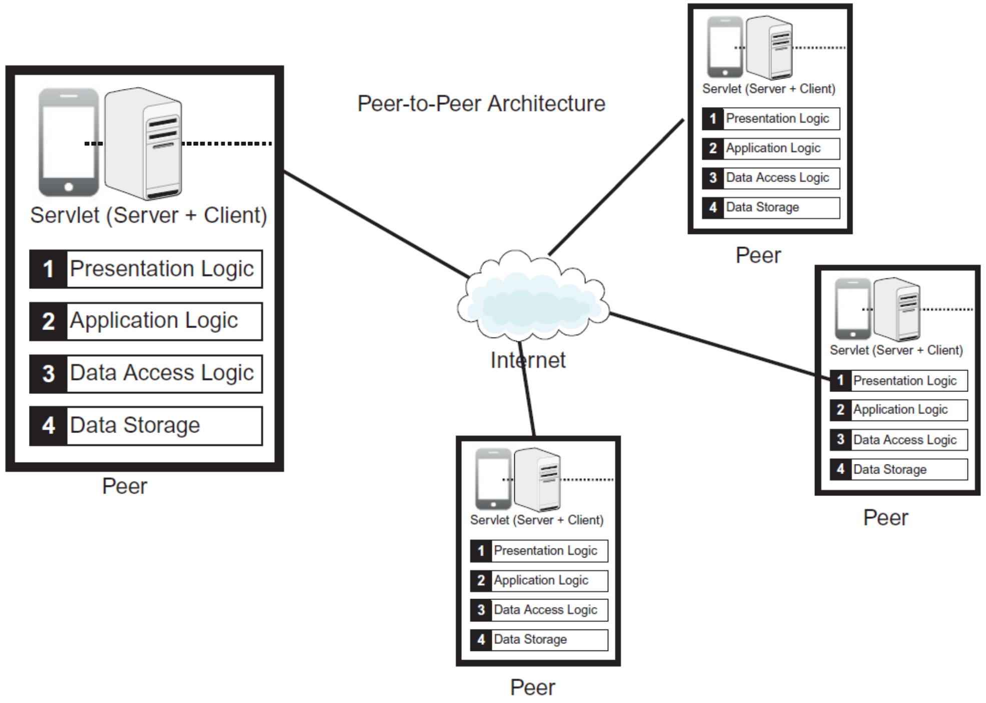


FIGURE 5.15

Peer-to-peer app microarchitecture.

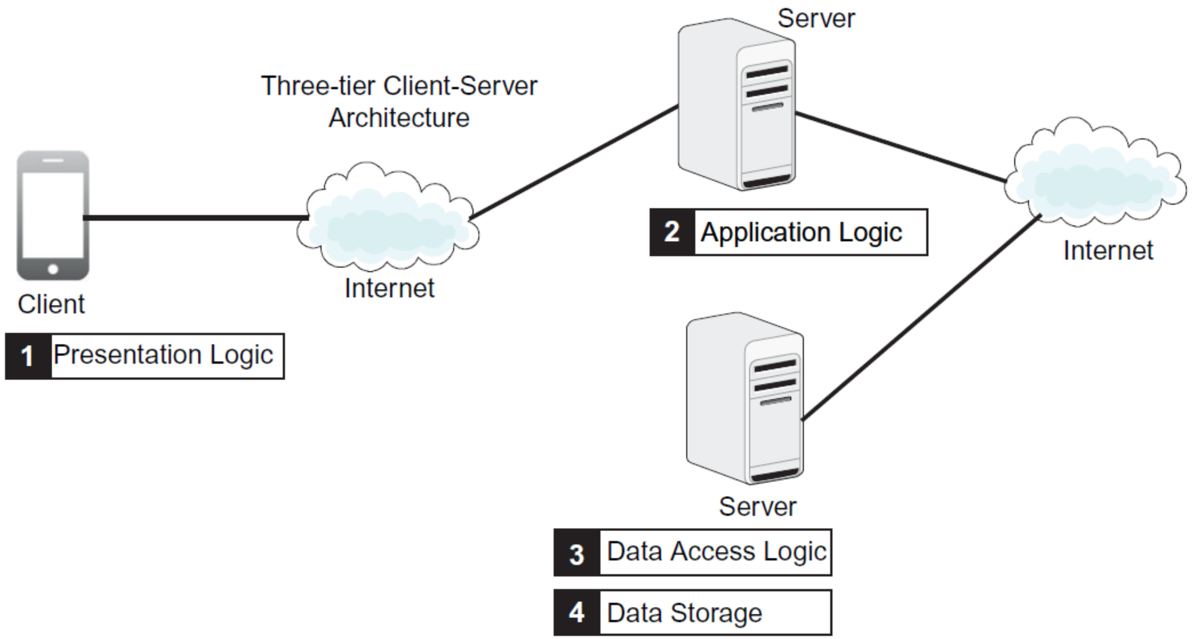


FIGURE 5.16

Tiering.

App architecture choices have consequences

- Hard, or, impossible to maximize all positive consequences; always trade-offs between partitioning inside the platform and across the Internet
- Early architecture choices are hard to change later
  - -> creating path dependencies in architectures
- Some characteristics show up immediately:
  - speed, security, reliability, scalability, testability, and usability
- Some at later stages:
  - maintainability, extensibility, evolvability, and the capacity to mutate and envelop adjacent app market segments
- Developers need knowledge about which types of app architectures gives which types of trade-offs and advantages
  - -> design, not experience too late

Platform architecture

- In practice, irreversible
  - -> have to stick with early choices and their consequences
- Desirable properties
  - Simple; defined interfaces, functionlity etc.
  - Resilient; not breaking the ecosystem upon app failure
  - Maintainable; minimizing consequences of local changes
  - Evolvable; balancing between stability/control of interfaces and autonomy of innovation

  - But also here, trade-offs.

More on modularization and amount of modularity

- Monolithic versus modular
- Not either or – rather a continuum between the two extremes, where most lies in between

- Some important aspects:
  - Division of work among several organizations/actors
    - Emergent properties
  - Dependencies among modules is restricted to defined interfaces
  - Need to be compliant only to interface specifications
  - Possible performance sacrifications

Balancing needs and implications

Table 5.2 Upsides of Modularizing a Platform for Platform Owners and App Developers

Platform Owner	App Developer
Massively distributed innovation	Less reinvention, more specialization
Increased variety of apps	Valuable ignorance
Greater volume of incremental innovation	Greater app evolvability
Control via architecture rather than ownership	Multihoming in rival platforms more feasible

Table 5.3 Downsides of Modularizing a Platform for Platform Owners and App Developers

Platform Owner	App Developer
Modularity is not free	Modularity imposes additional costs
Technical performance takes a hit	App performance takes a hit
Modularization forecloses architectural innovation	Modularity constrains experimentation
Increased risk of imitation by rivals	Leveraging the platform risks getting locked into it

Balancing needs and implications

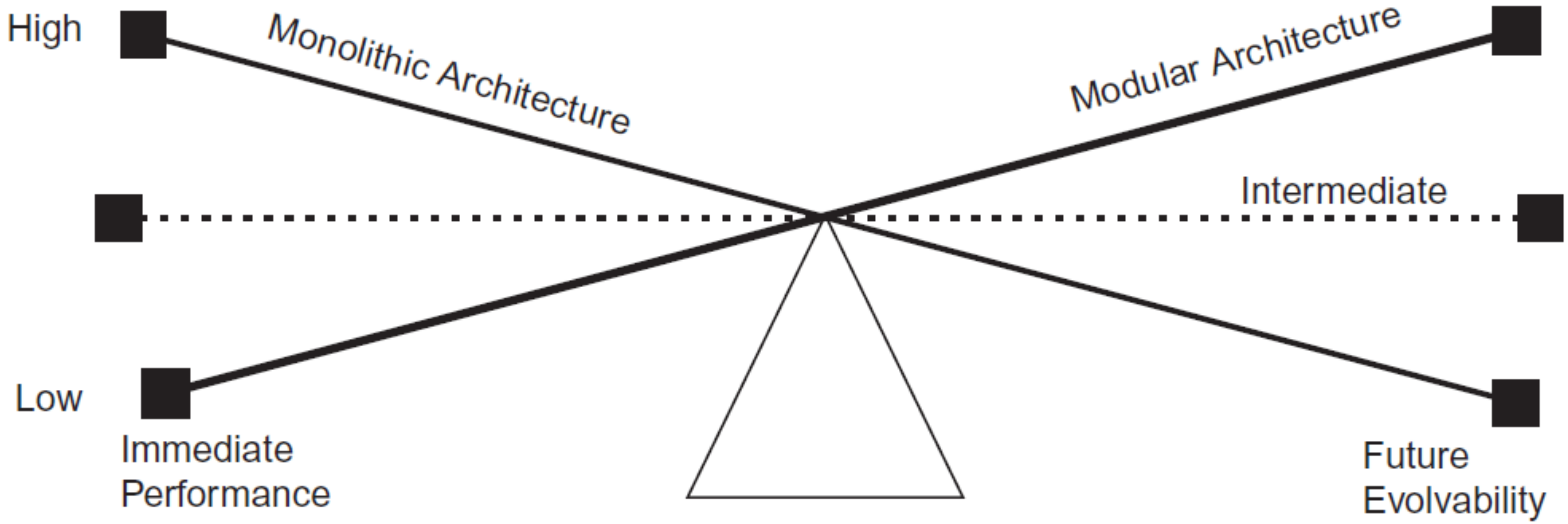


FIGURE 5.18

Tradeoffs between modular and monolithic platform architectures.

What is in, what is out?

- High-reusability functionality
- Generic functionality
- Stable functionality
- Interfaces integral parts of the platform

- High uncertainty functionality – out

- But also in:
  - For attractiveness
  - Expectation from end-users

The interfaces

- Standardization
- Stability
- Versatility
  - flexibility in standards
  - highly dependent functionality stays in the platform
- Openness
  - who can participate

DHIS2 as a platform ecosystem?

- How do *your* developed apps relate to platform architectures as described?
- Do the architectural choices in your app (together with the DHIS2) imply anything for further development and evolvement of your app, and in relation to the DHIS2 core
  - Dependencies – loose coupling
  - Modularization
  - Usage of APIs
  - Placement of functionality and layers

Platform vs application vs Information infrastructure

Table 1 Applications, platforms and information infrastructures

Property/Type of IT system	*Application*	*Platform*	*Information infrastructure*
Emergent properties			
Shared	Yes, locally and through specified functions	Yes, across involved user communities and across a set of IT capabilities	Yes, universally and across multiple IT capabilities (Star and Ruhleder, 1996; Porra, 1999)
Open	No, closed by user group and functionality	Partially, depends on design choices and managerial policies	Yes, universally allowing unlimited connections to user communities and new IT capabilities (Weill and Broadbent, 1998; Kayworth and Sambamurthy, 2000; Freeman, 2007)
Heterogeneous	Yes, partially and mainly by involved social groups	Partially, mainly by social groups but also by technical connections	Yes, increasingly heterogeneous both technically and socially (Kling and Scacchi, 1982; Hughes, 1987; Kling, 1992; Edwards *et al.*, 2007)
Evolving	Yes, but limited by time horizon and user community.	Yes, and limited by architectural choices and functional closure	Yes, unlimited by time or user community (Star and Ruhleder, 1996; Freeman, 2007; Zimmerman, 2007)
	Linear growth	Mostly linear growth	Both linear and nonlinear growth (Hughes, 1987)
	Evolution bounded and context free	Evolution path dependent	Evolution path dependent (Star and Ruhleder, 1996; Porra, 1999; Edwards *et al.*, 2007)
Structural properties			
Organizing principle	Direct composition of IT capabilities within a homogeneous platform	Direct composition of a set of horizontal IT capabilities within a set of homogeneous platforms	Recursive composition of IT capabilities, platforms and infrastructures over time (Star and Ruhleder, 1996; Edwards *et al.*, 2007)
Control	Centralized	Centralized	Distributed and dynamically negotiated (Weill and Broadbent, 1998) Can involve only basisorganizing principles (standards) and rely on installed base inertia (Star and Ruhleder, 1996; Edwards *et al.*, 2007).