

Extrinsically adaptable systems

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Motivation

- ⦿ Observation 1: as “consumer” systems get form, they lose customizability
- ⦿ Observation 2: at least in computer architecture, we lack innovators
- ⦿ Is there a cause-effect relationship?
 - ⦿ Can we improve the situation?

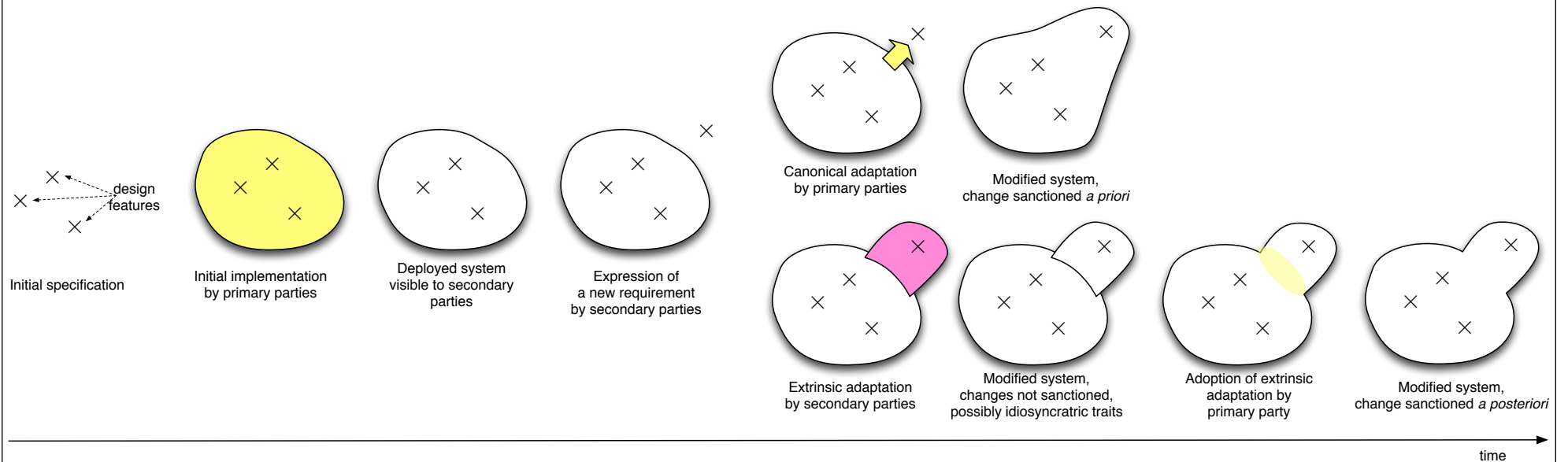
Extrinsic adaptations

- ⊗ Considering a system S designed at time t_0 by party p_0
- ⊗ A new party $p_1 \neq p_0$ comes with a new requirement at time $t_1 > t_0$
- ⊗ p_1 changes S “from the outside” without asking p_0 first = an **extrinsic adaptation**
 - ⊗ this scenario is one of the main instruments of innovation
- ⊗ But when is this possible? What is needed?

Examples

- ⊗ Angry birds vs. advertisements
- ⊗ Text encoding in video player
- ⊗ Code generation for a new architecture
- ⊗ In general: 2ndary party comes up with new requirement, then implements change outside of the “preferred” process of primary party

General process



Extrinsic vs invasive adaptations

- ④ So far: extrinsic = modify a “composite from the outside”, don’t change the individual parts
 - ④ Assumption: the concepts “parts” and “composite” exist
- ④ Do they?
 - ④ Yes: “extrinsic” has a meaning
 - ④ No: changes become **invasive**

Extrinsic vs invasive adaptations

- Example: a smartphone is modified by installing a custom ROM
 - User 1 considers the system phone+ROM as a whole; customization violates the apparent system integrity and perceived as disruptive, unwelcome
 - User 2 knows about the difference between hardware and software; knows that the original ROM can be restored easily; may be curious about the customization

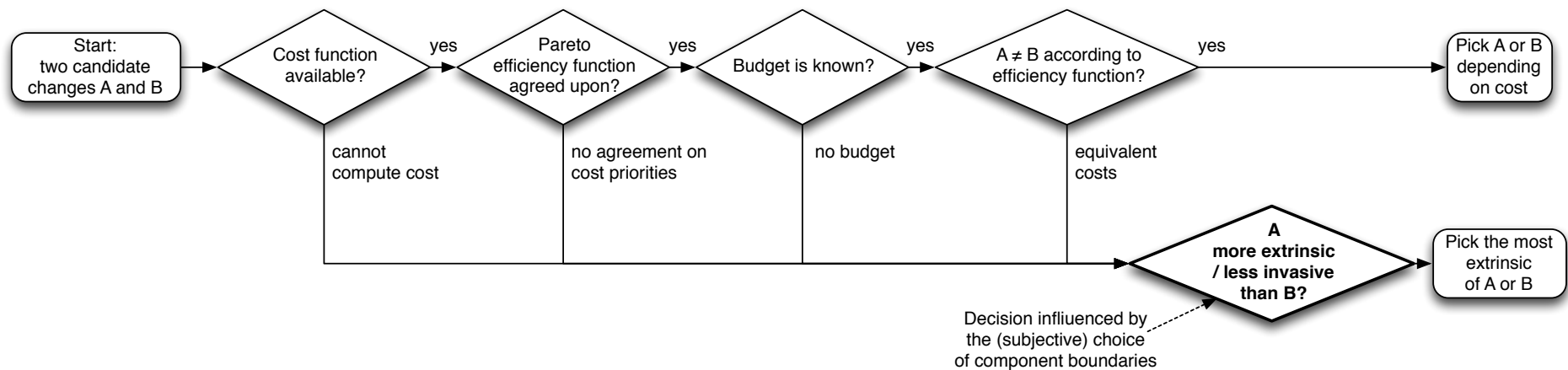
Extrinsic vs invasive adaptations

- ④ Why this matters: **SUBJECTIVENESS**
 - ④ INVASIVE = BAD
 - ④ EXTRINSIC = GOOD, or at least acceptable
- ④ Given an objective adaptation (eg it already happened):
 - ④ If an audience is told there were no boundaries, the change is perceived as invasive, "bad"
 - ④ If the audience knows about internal boundaries and the change seems outside of them, it is perceived as extrinsic and acceptable

Objectiveness of perception

- ☉ Surely we can evaluate whether changes are acceptable using objective criteria?
 - ☉ Cost functions
 - ☉ Against budgets
 - ☉ Comparisons
- ☉ Two problems: consensus on cost function, consensus on pareto factors

Objectiveness of perception

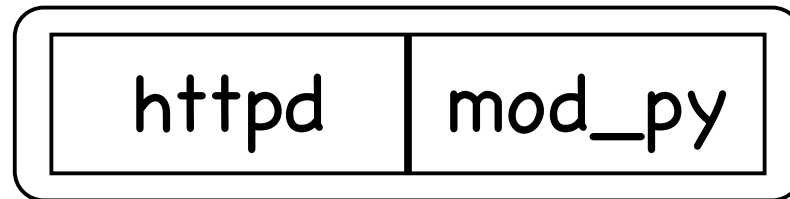


What we have so far

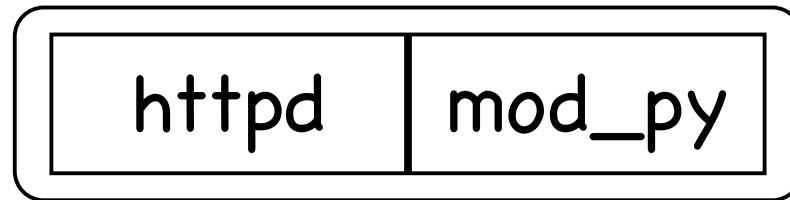
- ⊗ Adaptations happen
 - ⊗ people want them, innovation process
- ⊗ Extrinsic or invasive? Matters for acceptability
 - ⊗ Cost function available? All good, but unusual
 - ⊗ Otherwise, depends on the definition of what is a "part" and what is a "composite"
- ⊗ Ultimately evaluation requires a **choice of component boundaries**

Component boundaries

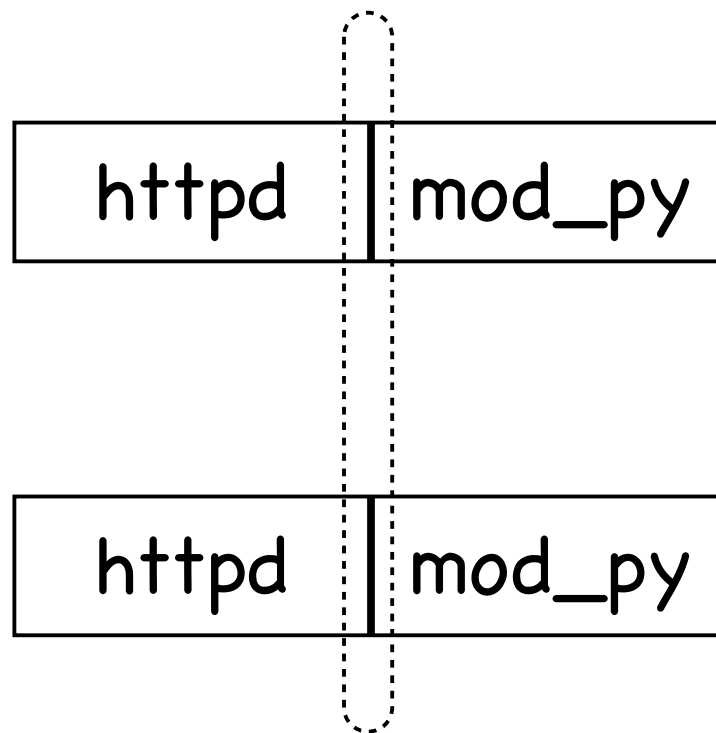
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Component boundaries



Boundary for the
programmer: code bases

Component boundaries

PID 1234



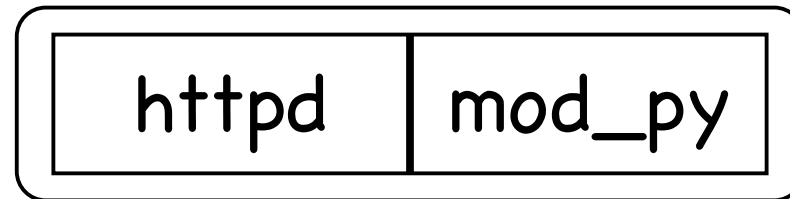
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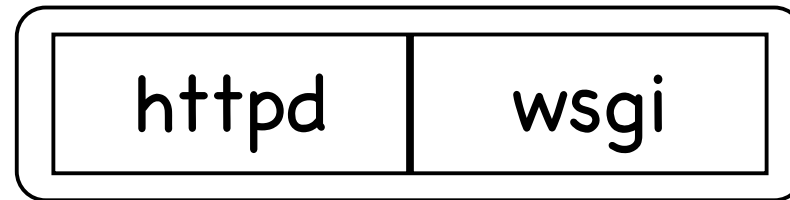
Boundary
for the
sysadm:
processes

Component boundaries

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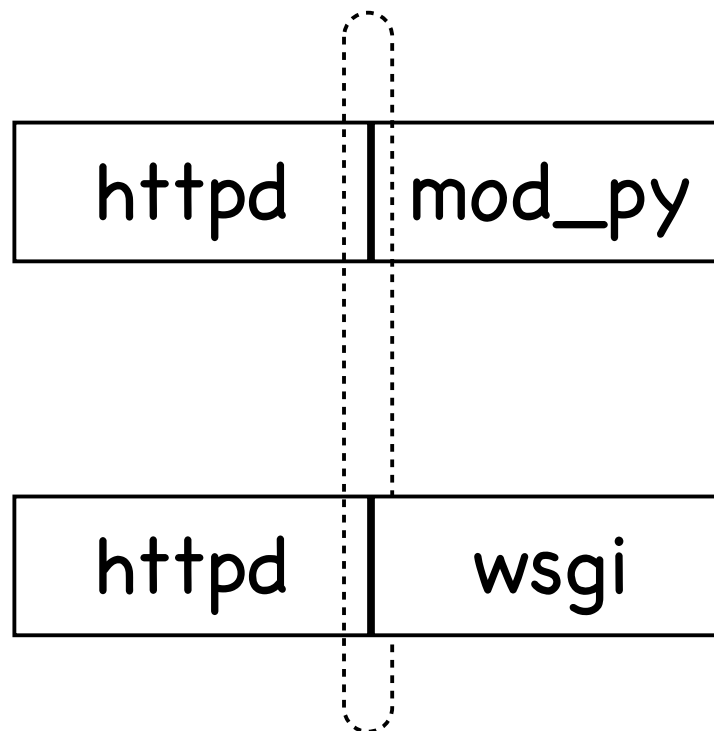


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Component boundaries

Programmer view



change of interface at boundary:
inconsistency, disruptive

Component boundaries

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No impact on component identity
with this chosen boundary: change acceptable

Acceptability & Component boundaries

- ⊗ In general the **choice of boundaries** determines whether a change is invasive or extrinsic, thus “bad” or “acceptable”
- ⊗ Multiple choices possible, usually **not congruent**
- ⊗ Example used process vs code base, but also:
 - ⊗ License vs processes
 - ⊗ Physical packaging vs software sources
 - ⊗ Vendor vs software sources
- ⊗ In general problematic: **law vs technical view**

Acceptability & Component boundaries

- ⊗ Example: consumer multimedia box
 - ⊗ DRM, DMCA = legal boundary
 - ⊗ But these boundaries do not exist from the logical, pure software perspective
- ⊗ So the pure software programmer is a-OK with software customization, Vendor usually not OK
- ⊗ All this only matters in the eyes of 3rd party non-technical observers, either bystanders or (worst case) a court of justice
- ⊗ This is a social / economical struggle, not technical

What we have so far (2)

- ⊙ Adaptations happen
 - ⊙ people want them, innovation process
- ⊙ Extrinsic or invasive? Matters for acceptability
 - ⊙ Cost function available? All good, but unusual
 - ⊙ Otherwise, depends on the definition of what is a “part” and what is a “composite”
- ⊙ Choice of component boundaries differs between interested parties: social, economical, sometimes political struggles
- ⊙ Can we recognize this when it happens?
 - ⊙ Can we quantify the struggle somehow?

Proposal: quantify extrinsic adaptability

- ⊗ Difficult to do directly: “possible to modify” and “acceptable to modify” are too abstract
- ⊗ BUT: we can quantify the opposing forces, which prevent adaptability, namely:
 - ⊗ **technical friction** and
 - ⊗ **friction against transparency**
- ⊗ Extrinsic adaptability = 1 - “hindrance factor”

Technical friction

- “Makes changes difficult to implement”
- I found the following 3 fundamental forms:
 - against alternate integration
 - against extension
 - against change resilience over time
- NB: Substitution = extension + alternate integration
- Can you think of more?

Technical friction

- Example mechanisms that oppose friction:
 - Tight integration
(acts against alternate integration)
 - Warranty seals
(all 3 forms)
 - Validation of component signatures
(acts against extension)
- Can you think of others?

Friction against transparency

- ④ “Hiding the internal boundaries”
 - ④ pushes changes towards invasiveness, or increases the costs
- ④ I found the following 5 fundamental mechanisms: secrecy, physical barriers, obfuscation, encryption, alienation
- ④ Can you think of others?

Weight for scoring

- ④ Hindrance factor = $F_{trans} + N * F_{tech}$
 - ④ F_{trans} = friction against transparency
 - F_{tech} = technical friction
 - N = envisioned number of changes over the lifetime of the system
- ④ Extr. Adaptability = $1 - F_{trans} - N * F_{tech}$
- ④ NB: only in the context of a specific selection of component boundaries!

Relevance today

- ⦿ Computing systems:
 - ⦿ Software systems = OK, largely adaptable
 - ⦿ Software+hardware systems = hm....
 - ⦿ Modularity and adaptability used to be welcome, desired; currently not due to insane competition in stagnant market and technology walls
- ⦿ But it needn't be so hard!
 - ⦿ Adaptable systems: no vendor lock in, higher reusability, less waste, lower evolution costs.
 - ⦿ This is about ETHICS!
 - ⦿ (and maybe government regulation...)

How we can move forward

- ④ Recognize “invasive” vs “extrinsic” subjective evaluations of changes
- ④ Be conscious of discourse that shifts the perception of component boundaries
- ④ Talk about factors that ease adaptability, or reduce friction to changes
- ④ Quantitatively grade/review products and technology based on their hindrance factor

Thank you