Extrinsically adaptable systems

R. Poss
Universiteit van Amsterdam

Motivation

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

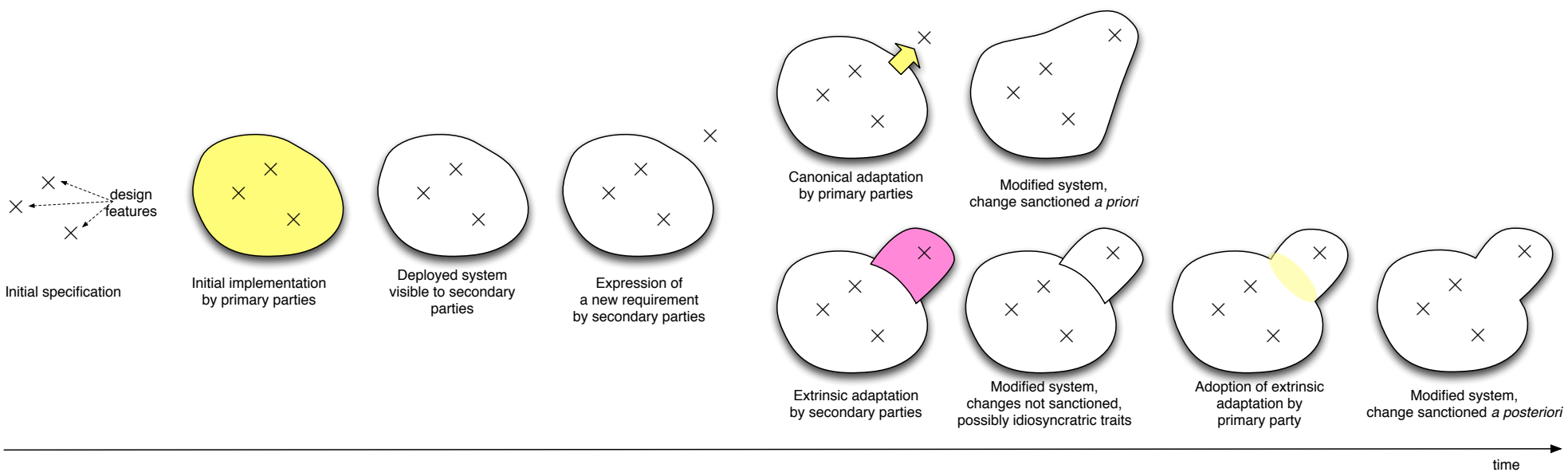
Extrinsic adaptations

- Considering a system S designed
  at time t0 by party p0
- A new party p1 != p0 comes with a new requirement
  at time t1 > t0
- p1 changes S "from the outside" without asking p0
  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

- So far: extrinsic = modify a "composite from the outside", don't change the individual parts
  - Assumption: the concepts "parts" and "composite" exist
- Do they?
  - Yes: "extrinsic" has a meaning
  - 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

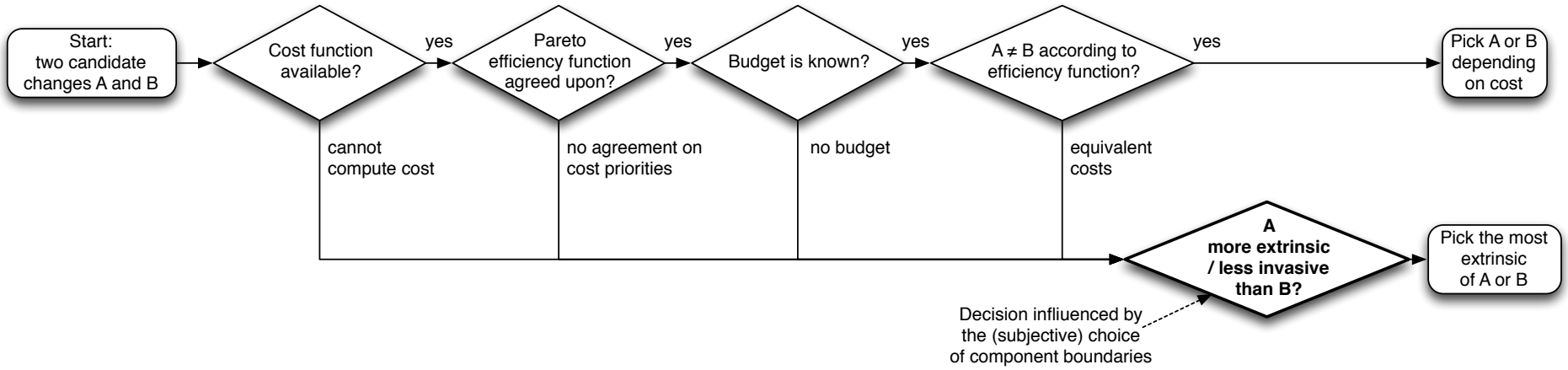
Extrinsic vs invasive adaptations

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

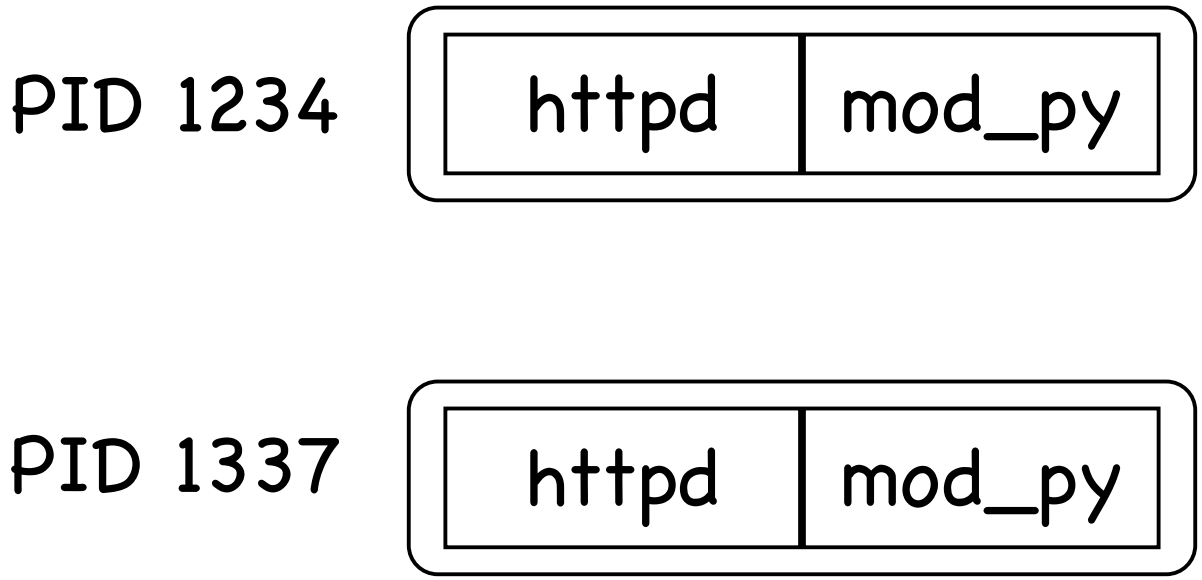


What we have so far

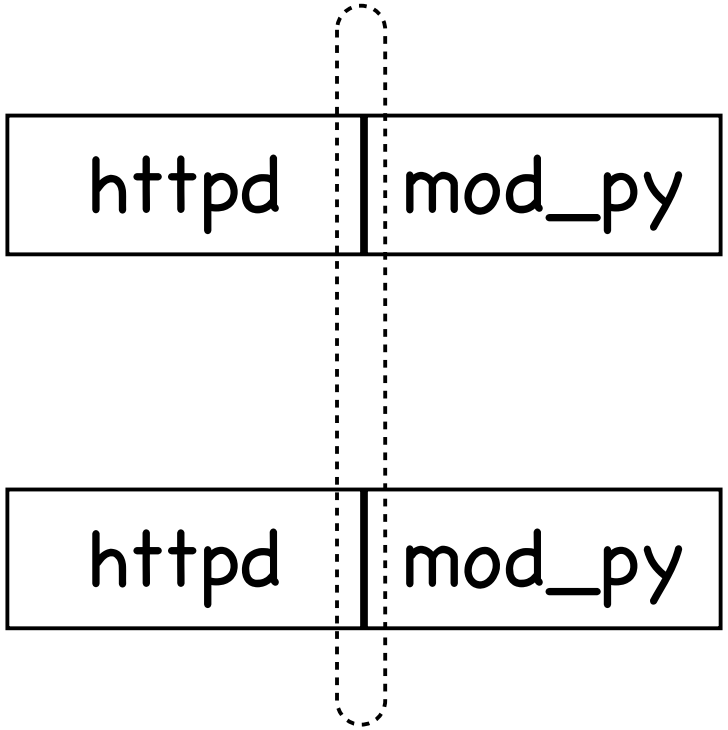
- Adaptations happen
  - people want them, innovation process
- Extrinsic or invasive? Matters for acceptability
  - Cost function available? All good, but unusual
  - Otherwise, depends on the definition of what is a "part" and what is a "composite"
- Ultimately evaluation requires a

choice of component boundaries

Component boundaries

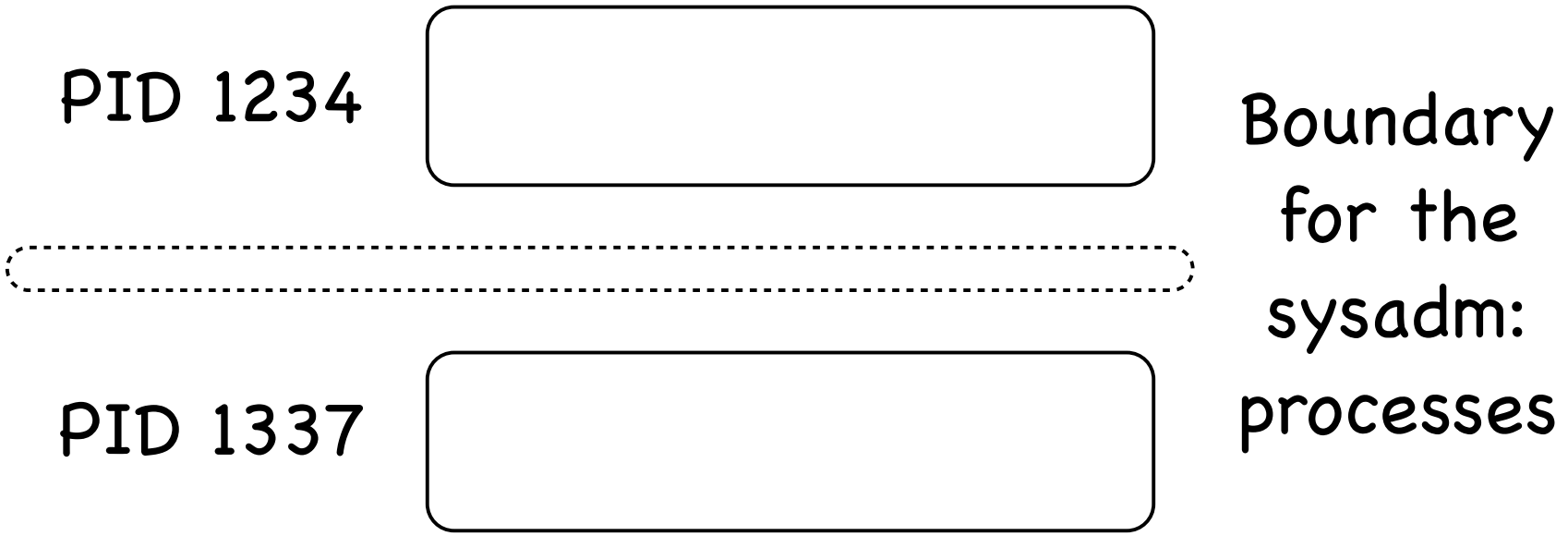


Component boundaries

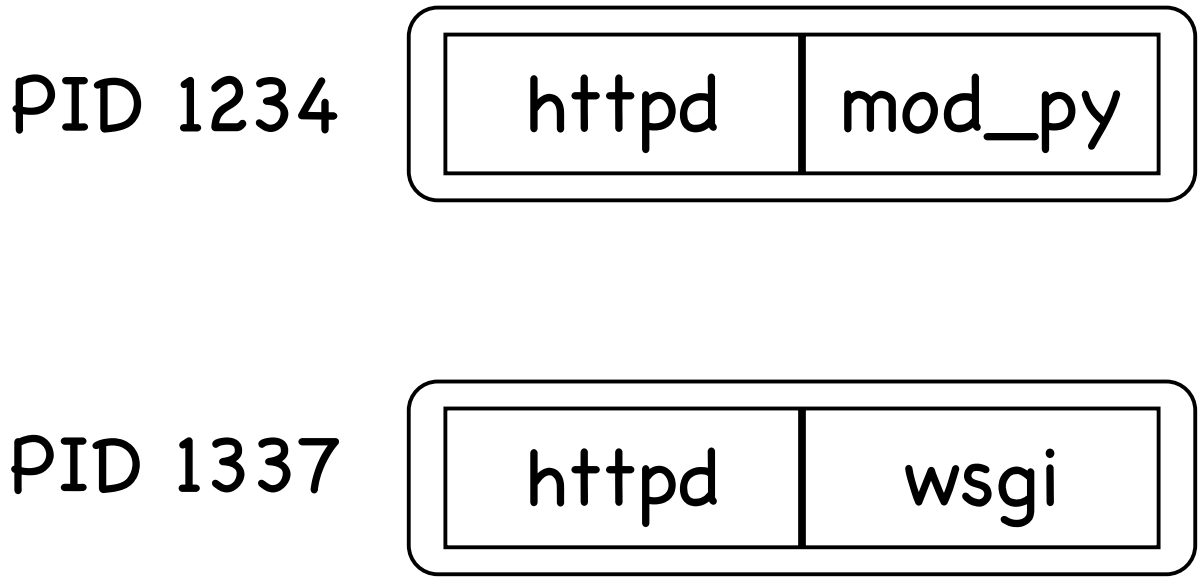


Boundary for the programmer: code bases

Component boundaries

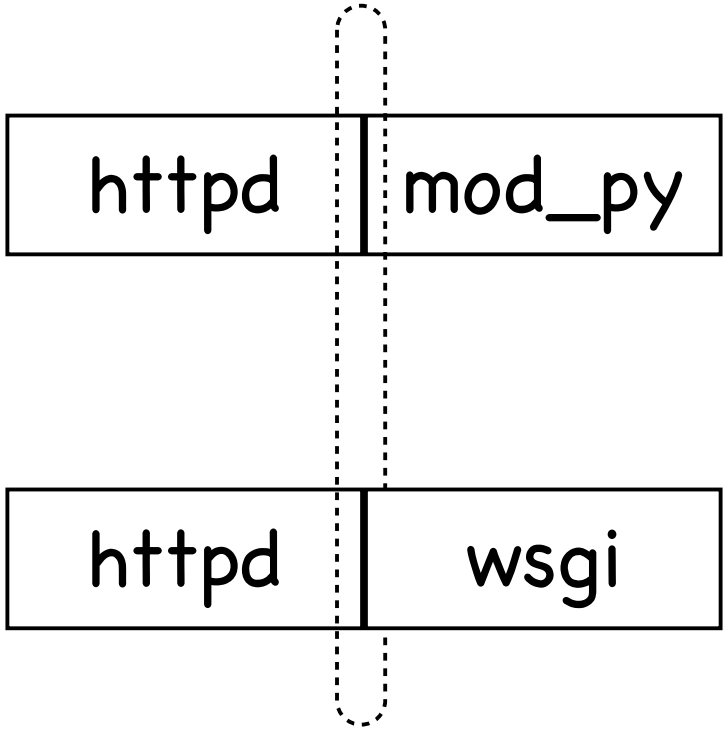


Component boundaries



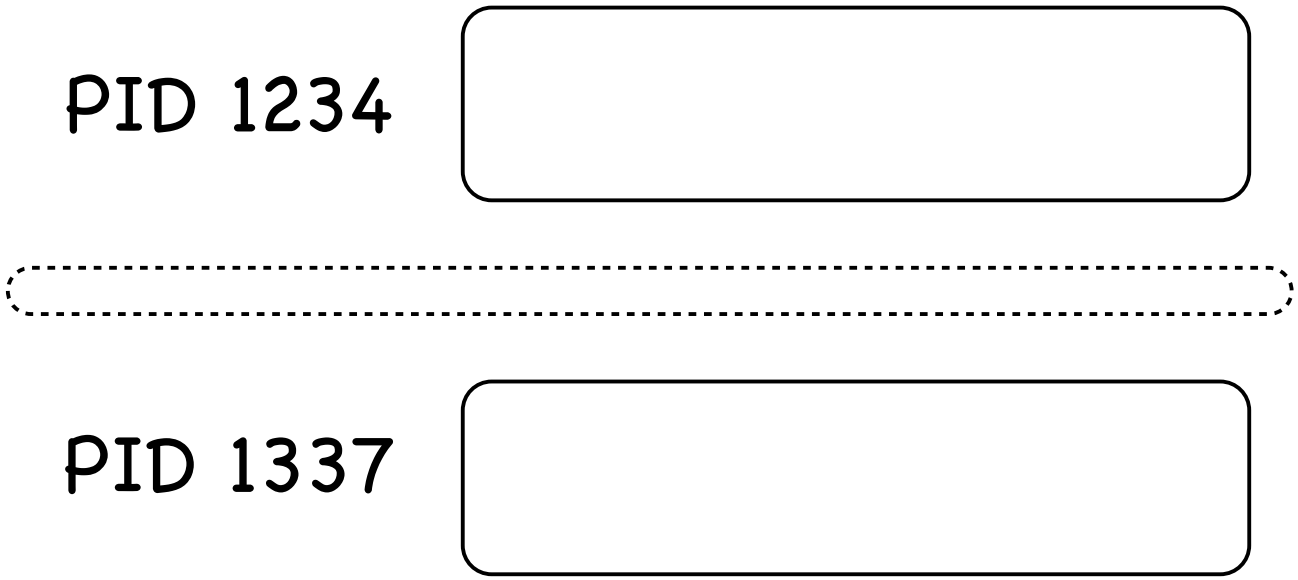
Component boundaries

Programmer view



change of interface at boundary:
inconsistency, disruptive

Component boundaries



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

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

Weight for scoring

- Hindrance factor = Ftrans + N * Ftech
  - Ftrans = friction against transparency
    Ftech = technical friction
    N = envisioned number of changes over the lifetime of the system
- Extr. Adaptability = 1 - Ftrans - N * Ftech
- 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

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

Thank you