dependences & dependability

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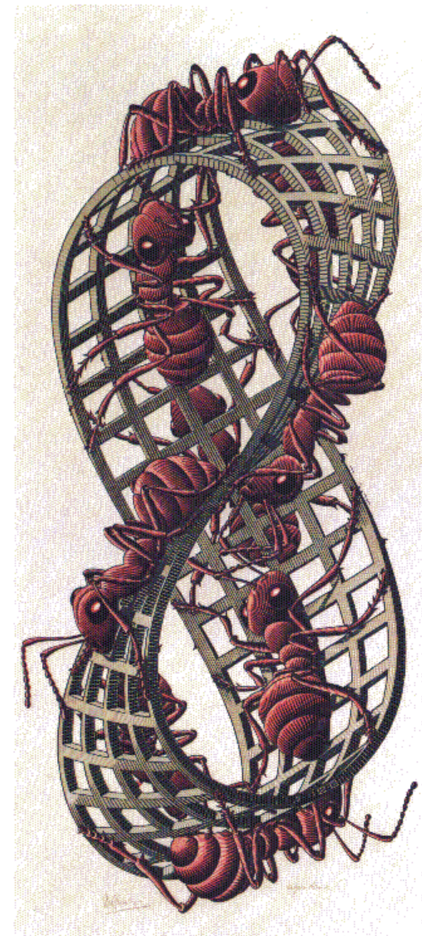
HDCP Review
Ames, June 18, 2003

dependability

dependable software
- › ‘the software works’
- › will it ever be a reality?

no, because for most systems
- › requirements are complex
- › codebase is large
- › bugs are inevitable

so, change viewpoint
- › dependable properties, not systems
- › ‘with high probability, no catastrophes’
- › example: ‘emergency stop button works’



guaranteeing properties

an approach
- identify properties & concerns
- design to encapsulate properties
- determine scope from code
- check conformance statically

SDG research areas
problem frames
dependency model
assumption trees
Alloy analysis

other elements
- conformance monitors
- ‘software interlocks’

in this talk, focus on
- dependency model and assumption trees
- because funding primarily from HDCP

dependencies and decoupling

decoupling
- a key aim in software design
- reduce inter-module dependences
- limit scope of modification & reasoning

standard models are binary
- dependency exists or not
- quantity, not quality

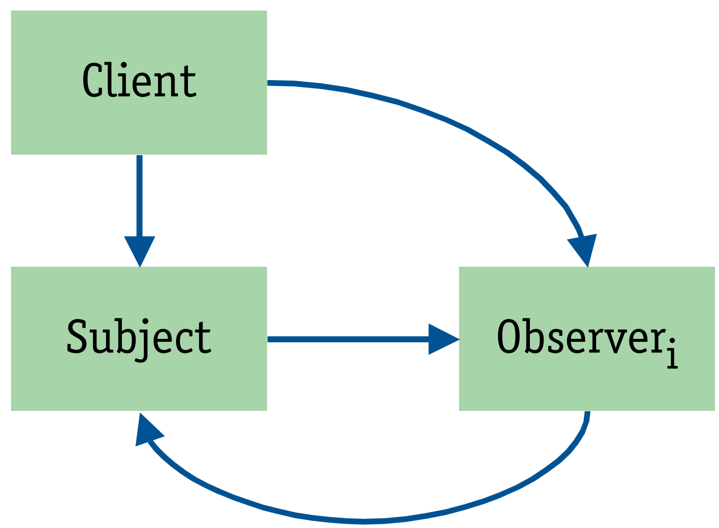
in practice
- more flexible design has more dependences
- want to trace particular properties
- so need a richer model

standard model

module A 'uses' module B when

› correct working of A depends on correct working of B

example: Observer



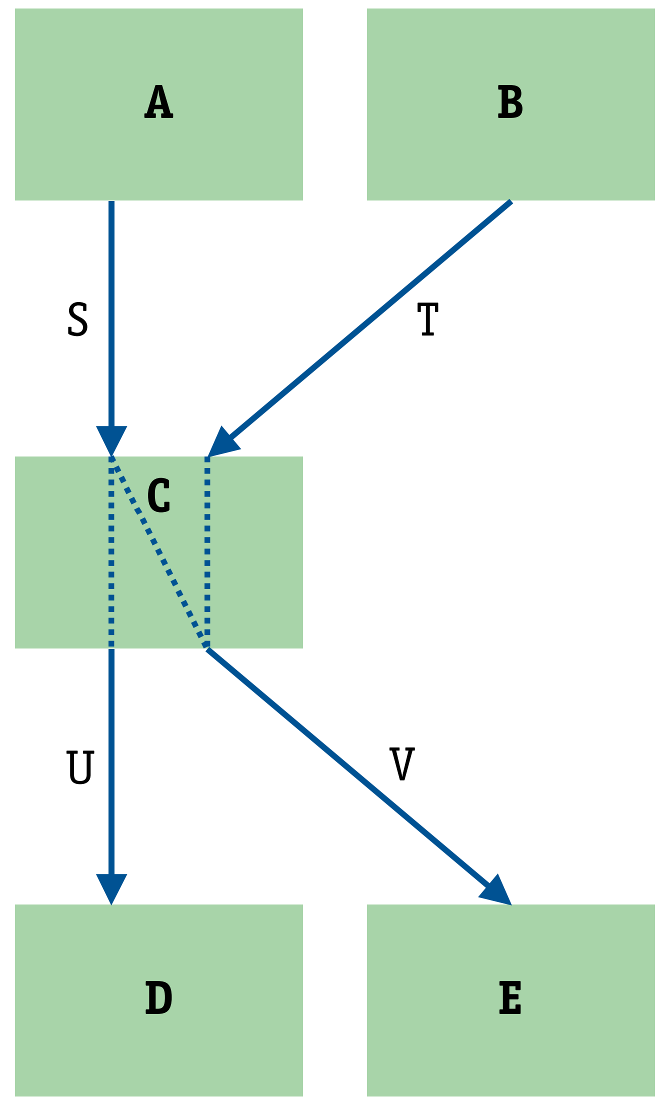
David Parnas. Designing software for ease of extension and contraction.
IEEE Transactions on Sofware Engineering, 5(2), 1979.

a new model

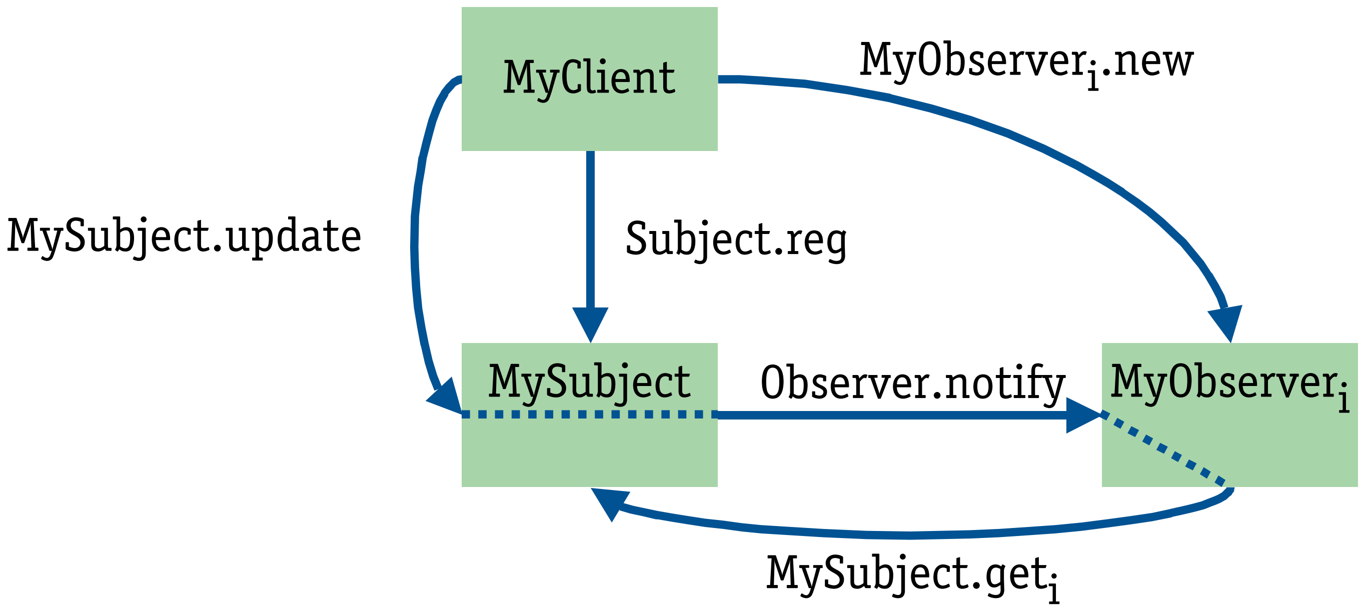
dependences mediated by specs
- module A has S-use of module C
- means A relies on C satisfying S

module as specification transducer
- for a given exported spec
- module relies on imported specs

example: module C
- exports S and T
- imports U and V
- transduces
    S -> U, V
    T -> V



example: observer pattern



really 2 distinct patterns: **Register** and **Notify**

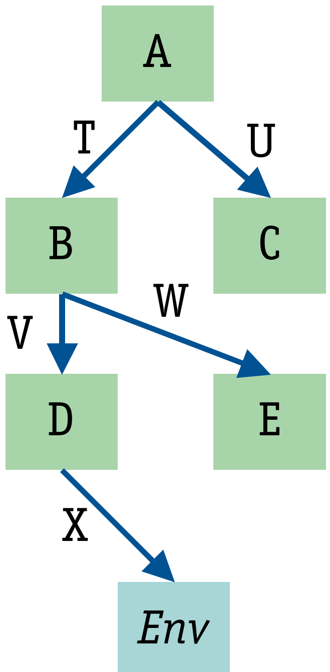
assumption trees

suppose we care about property P
- which modules must be checked?

approach
- identify set of partial module specs for P
- trace dependences from these, forming a tree
- verify each node in the tree

joint work with Drew Rae

example



transducers

A: R->T ; S->T,U

B: T->V,W

D: V->X

suppose P is established by spec R

assumption tree is:

A: R
  B: T
    D: V
      Env: X
    E: W

checks

A: satisfies R given T

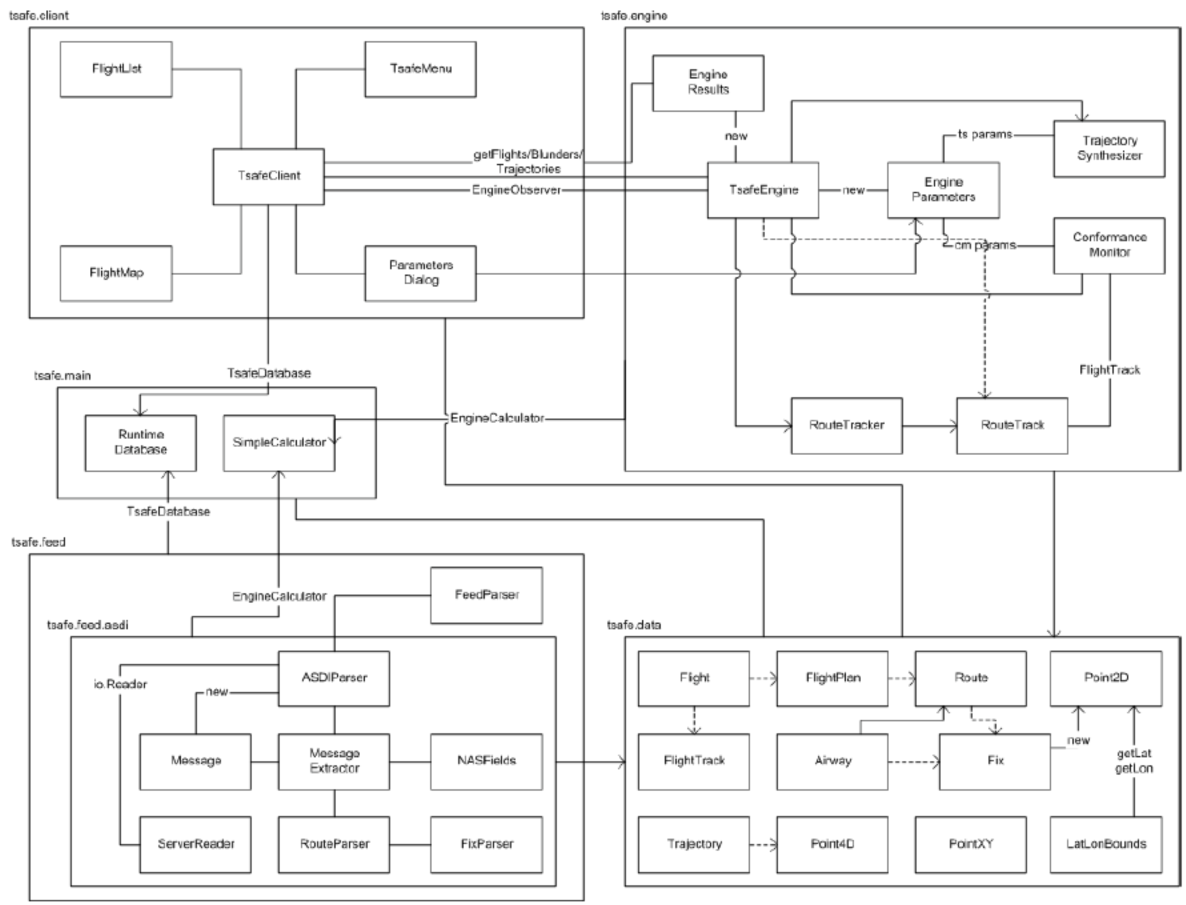
B: satisfies T given V, W

D: satisfies V given X

Env: satisfies X

application: TSAFE

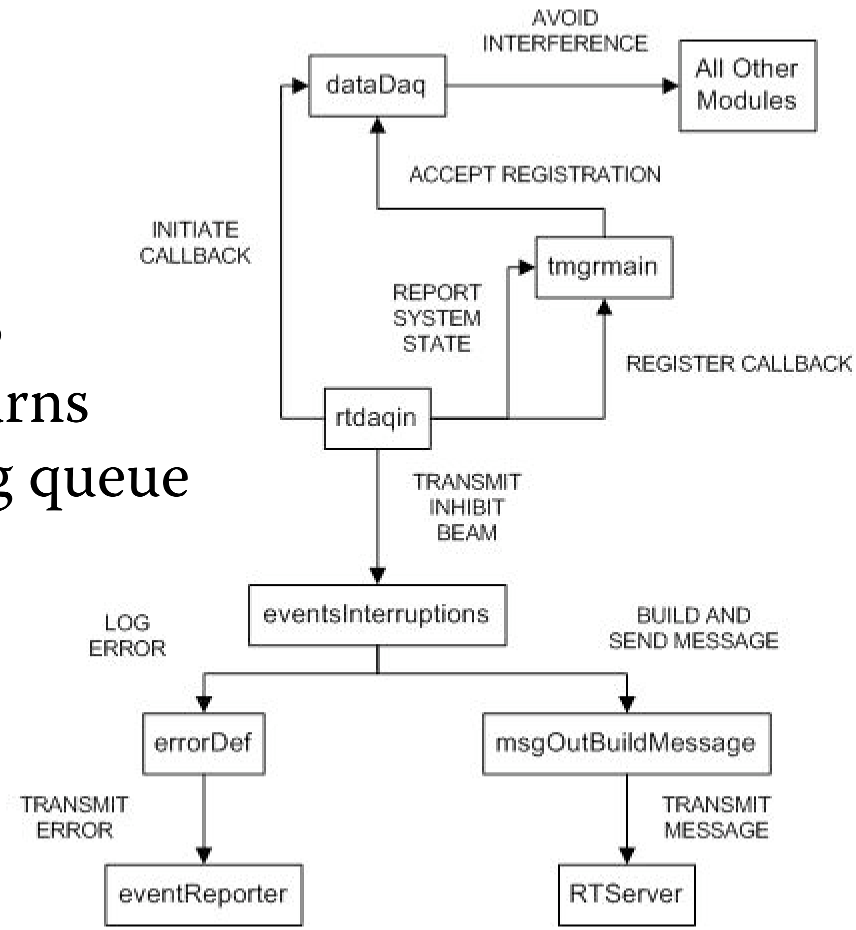
- design of prototype expressed in model
- undesirable couplings led to changes



Greg Dennis's masters thesis

application: NPTC

› northeast proton therapy center
› property: emergency stop works
› assumptions discovered
  treatment room is not room 3
  disk is not full, so logging returns
  other processes don't hog msg queue



analysis by Drew Rae

future work

automating dependency analysis

- dependency extractor for Java: prototype complete
- now working on specification discovery

automating conformance checking

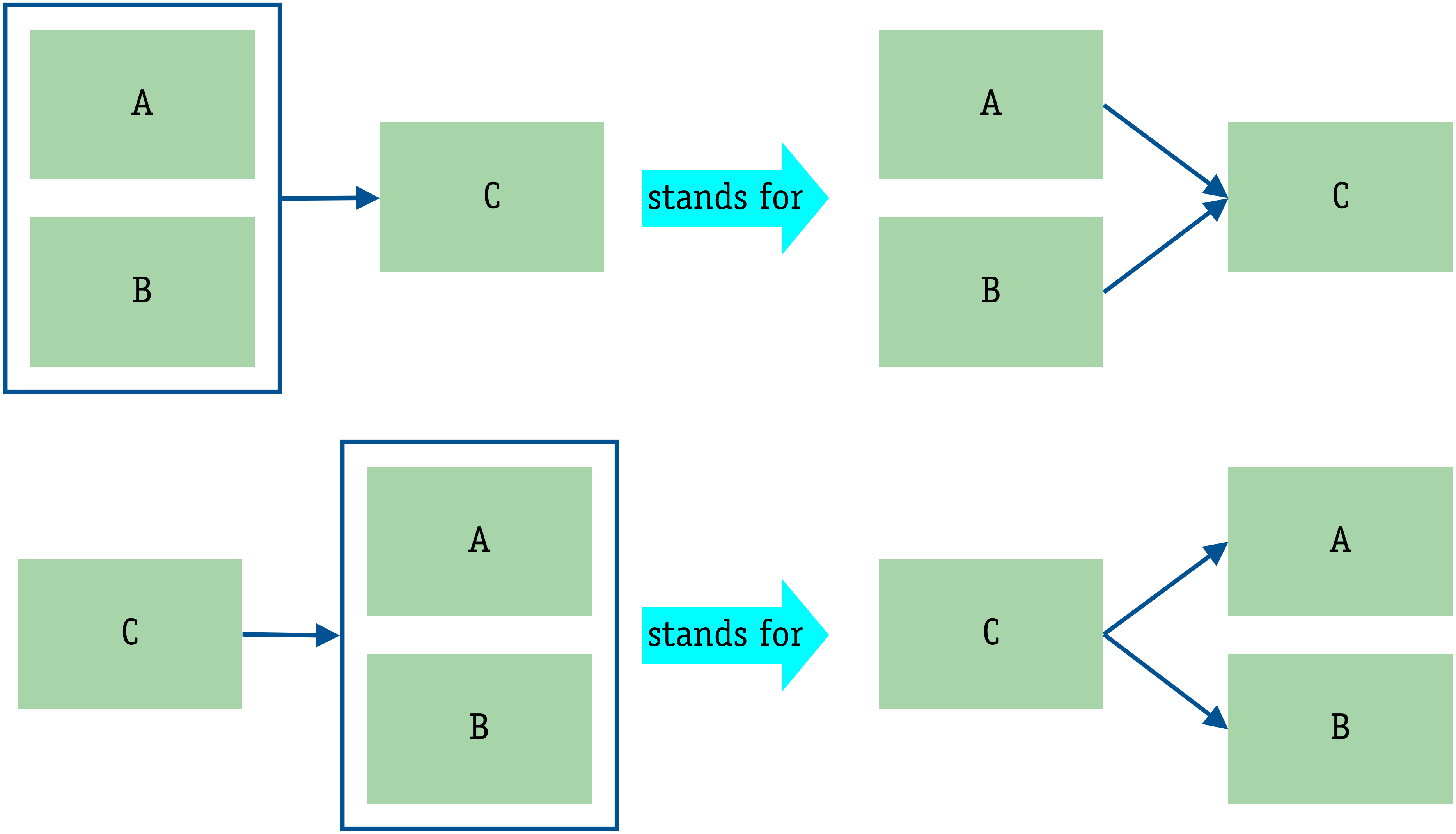
- find relevant code within module?
- extract transducers?

application to CTAS (with Notkin, Kotov)

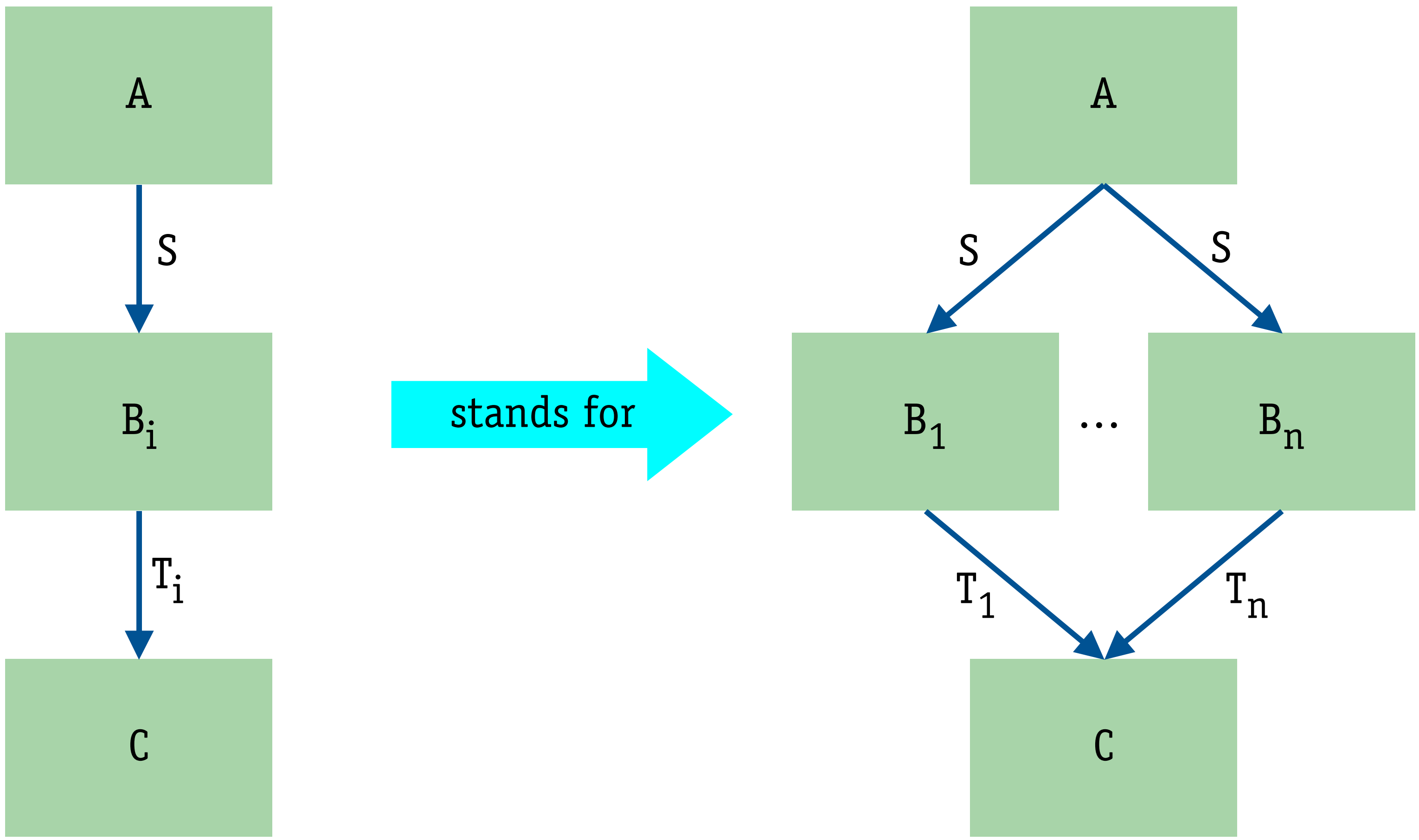
- property: generated advisories don't lead to conflicts
- establish with checker and gatekeeper

extra slides

grouping



templates



related work

dependence models in other fields
- Eppinger's Design Structure Matrix
- Suh's Axiomatic Design

configuration models
- Units model, Felleisen et al

code dependences
- similar to my modular slicing (FSE 1994)

construction dependences
- make, etc

architectural dependences
- Richardson et al