Aalto University
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Configurator-as-a-Service: Tool Support for Deriving Software Architectures at Runtime

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Background

- Software variability is often managed with a model-based approach
  - Variability is captured in models that represent, e.g., product features or components
  - Individual variants are then *derived* by binding variability in such models
- Certain situations require *dynamic variability*
  - Examples: mobile device context changes, customization of web services, newly discovered devices in smart spaces...
  - Dynamic variability benefits from model-based approach, since cannot assume human involvement in derivation
  - Tool support with reasonable performance is necessary

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Contribution

- Concepts and implementation of a Configurator-as-a-Service (CaaS), a tool for deriving product variants at runtime
  - Operates on configuration models that describe dynamically varying product architectures from feature and component viewpoint
  - Given a configuration model and requirements for a particular product variant, finds a complete and consistent model of a product variant
  - Implemented as a stateless web service
  - Utilizes efficient *smodels* inference engine for configuration finding, which is a computationally complex task

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Modelling architecture and its variability in CaaS

- Firstly, CaaS separates a *configuration model* and *configuration*
  - Configuration model: a model with variability that describes all possible product variants
  - Configuration: a model of one product variant, derived from the configuration model by binding variability
- Secondly, CaaS uses *Kumbang language* to capture both configuration models and configurations
  - Kumbang synthesizes concepts from many feature modelling methods, Koala and other ADLs, and traditional product configuration
  - Kumbang models products from two viewpoints
    - Features
    - Components (and required / provided interfaces)

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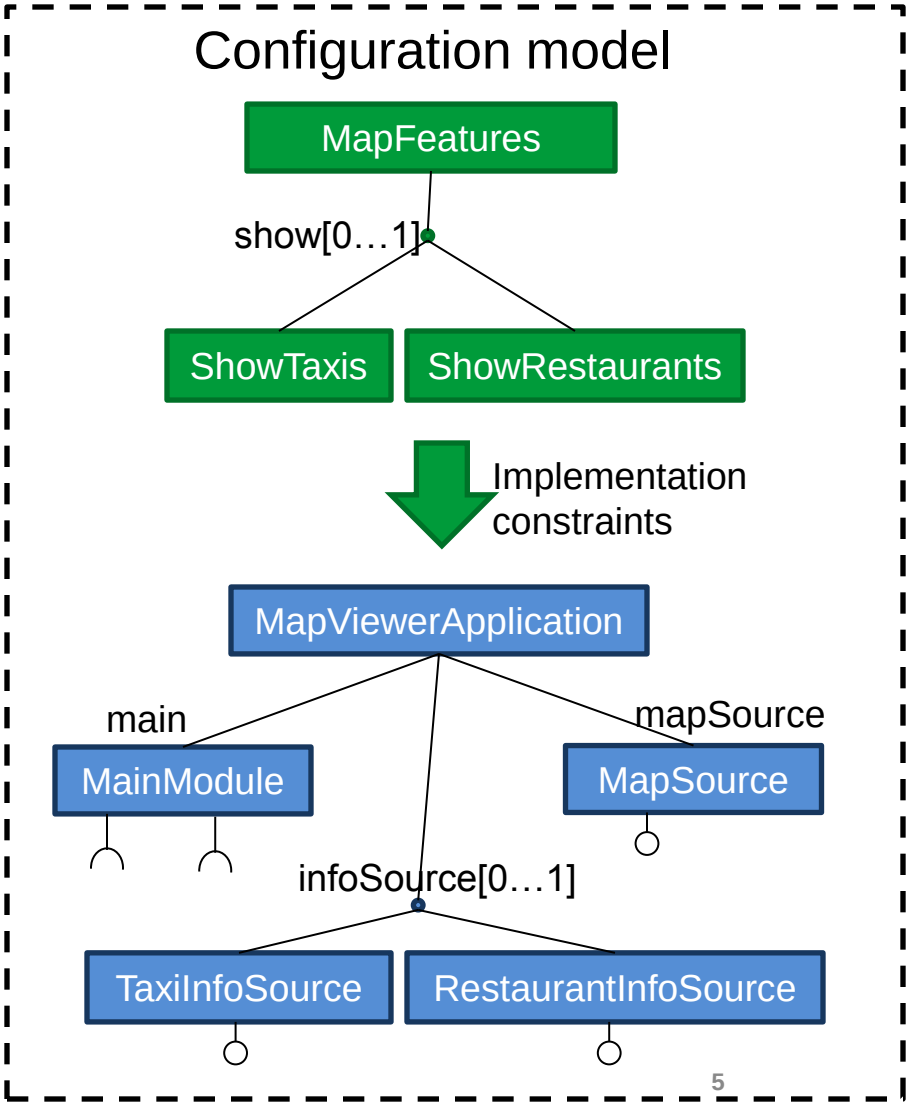
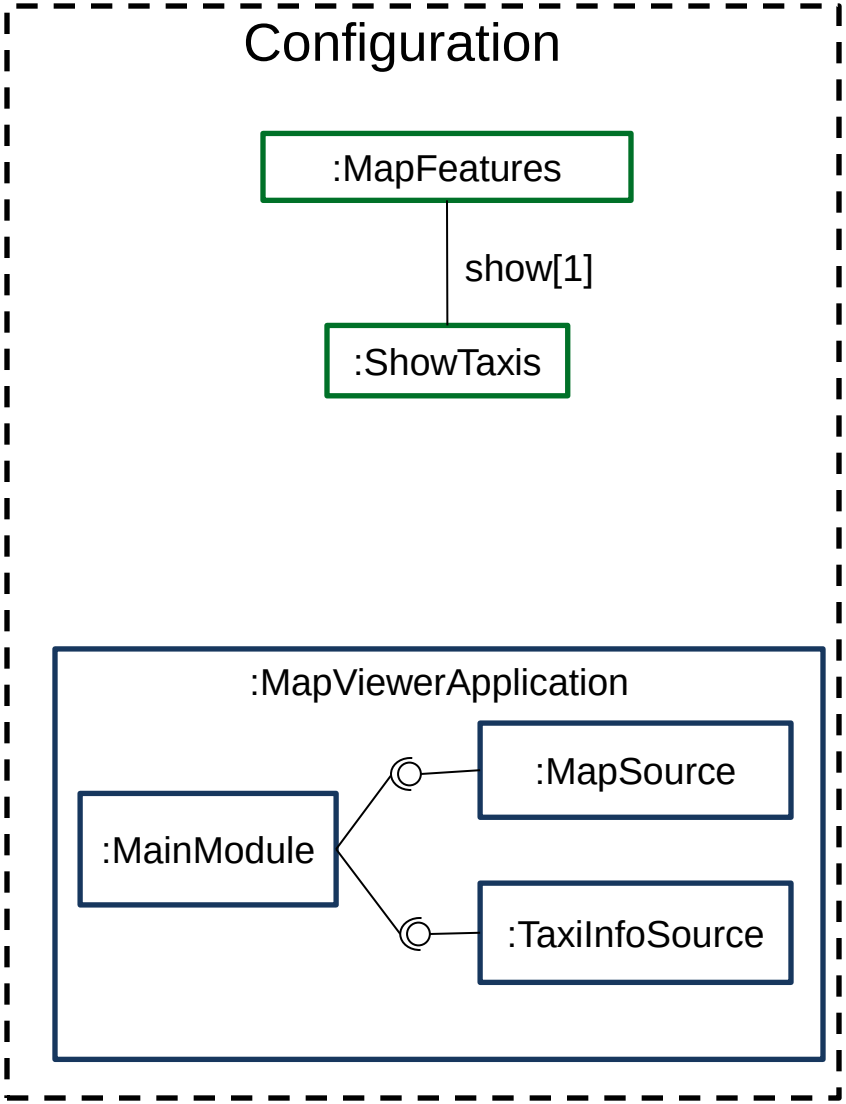
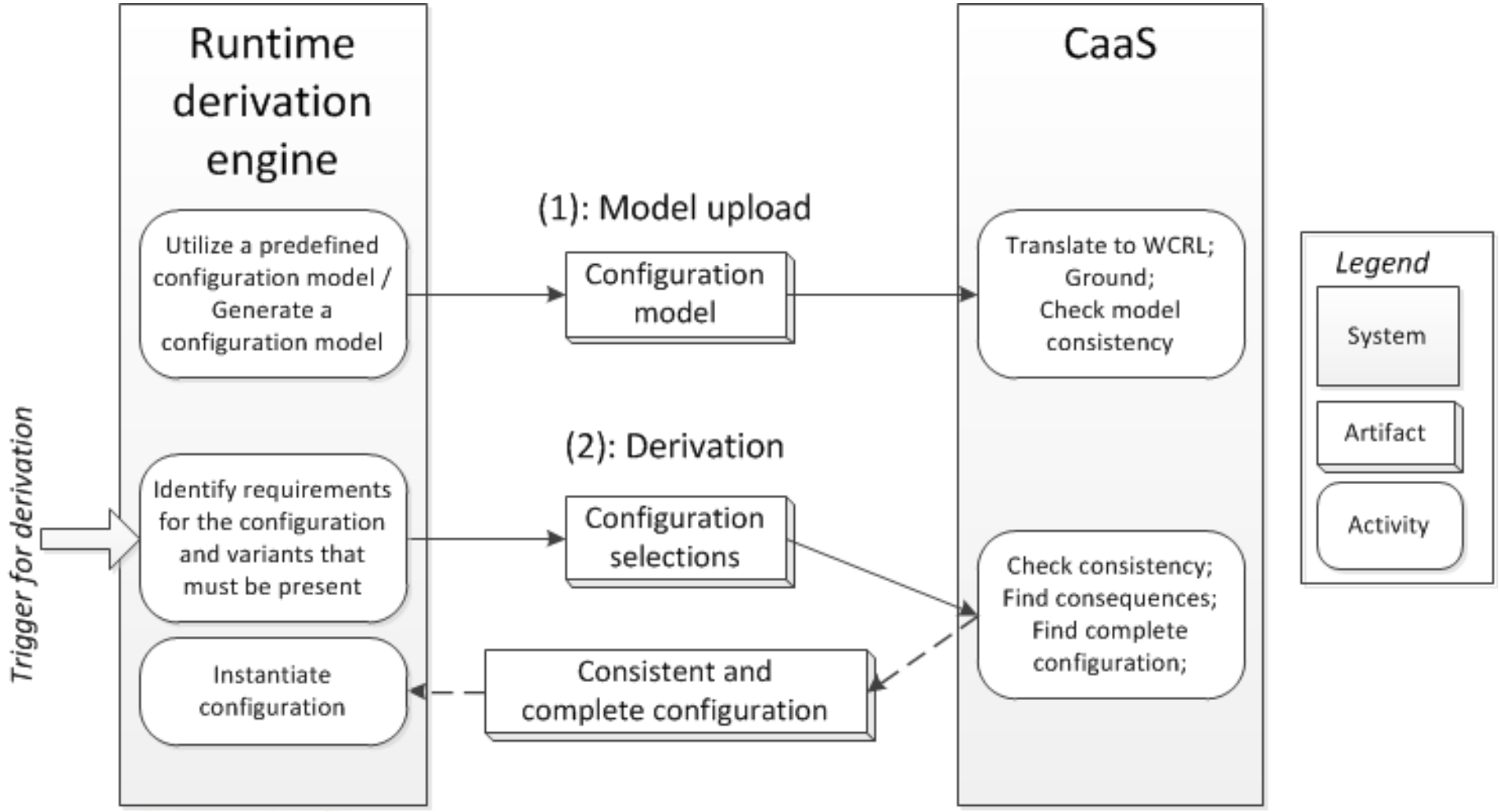
Configuration model & configuration
Features & components

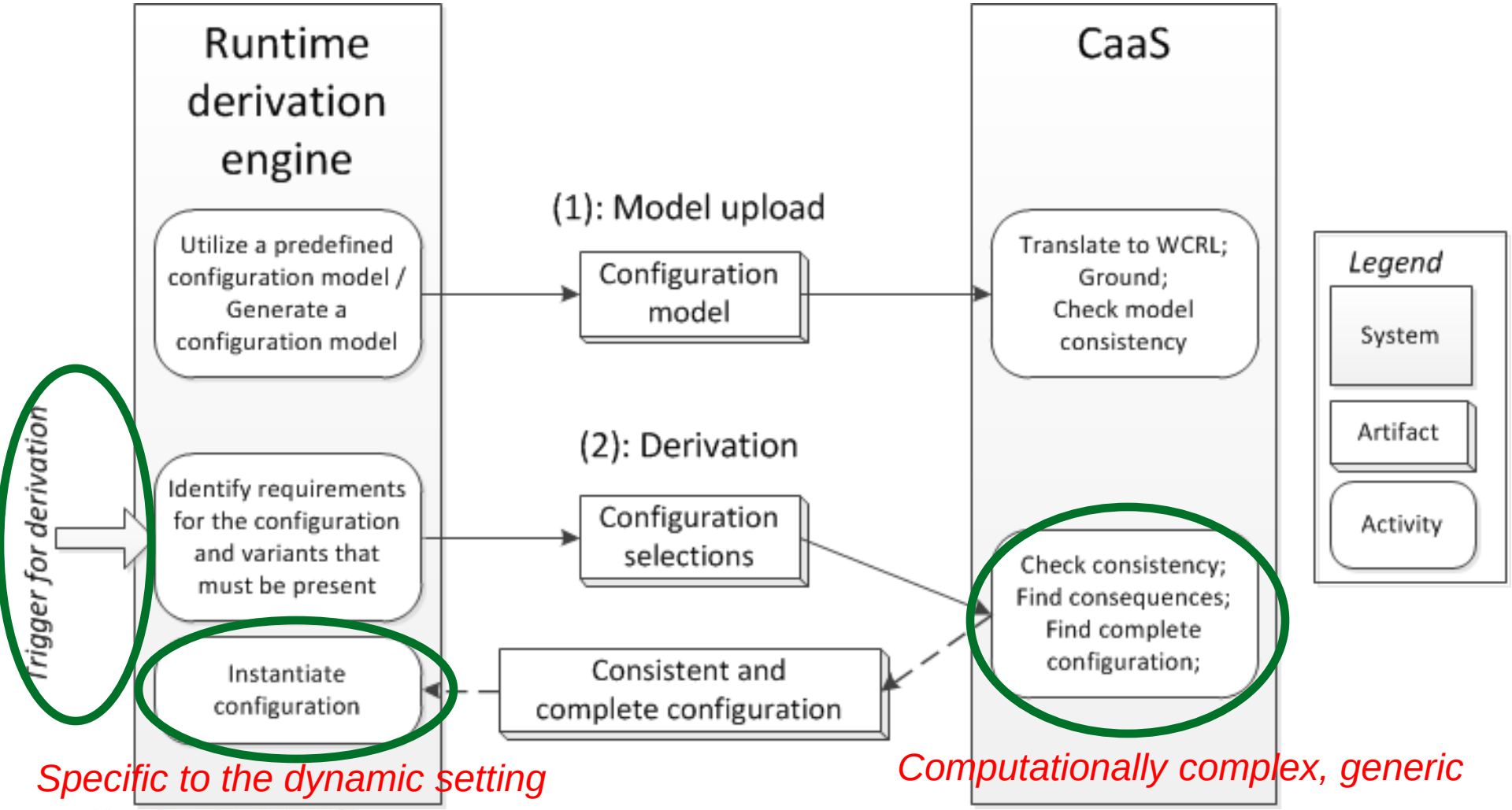




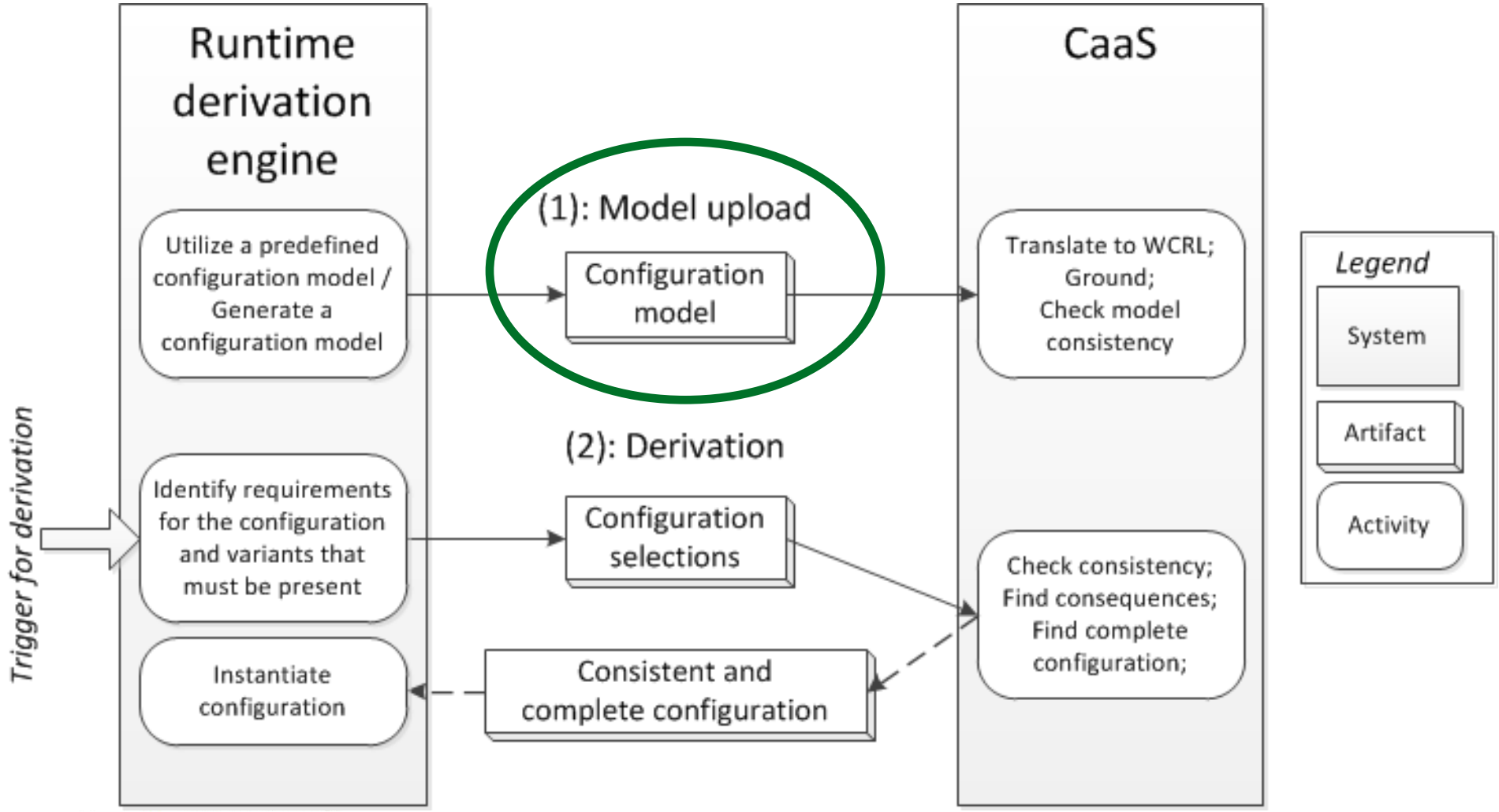
Overall CaaS design



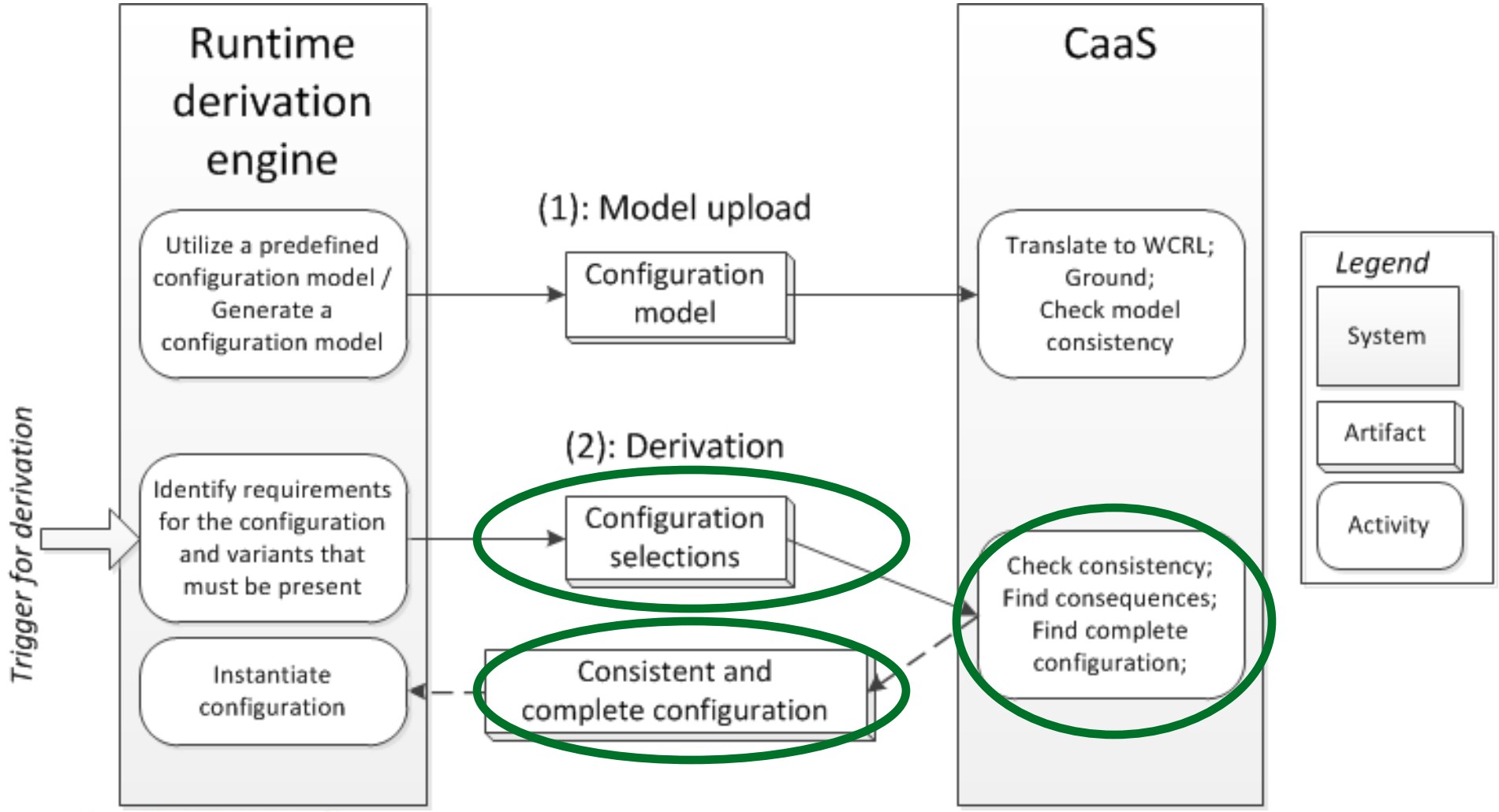
Separation of CaaS and runtime derivation engine



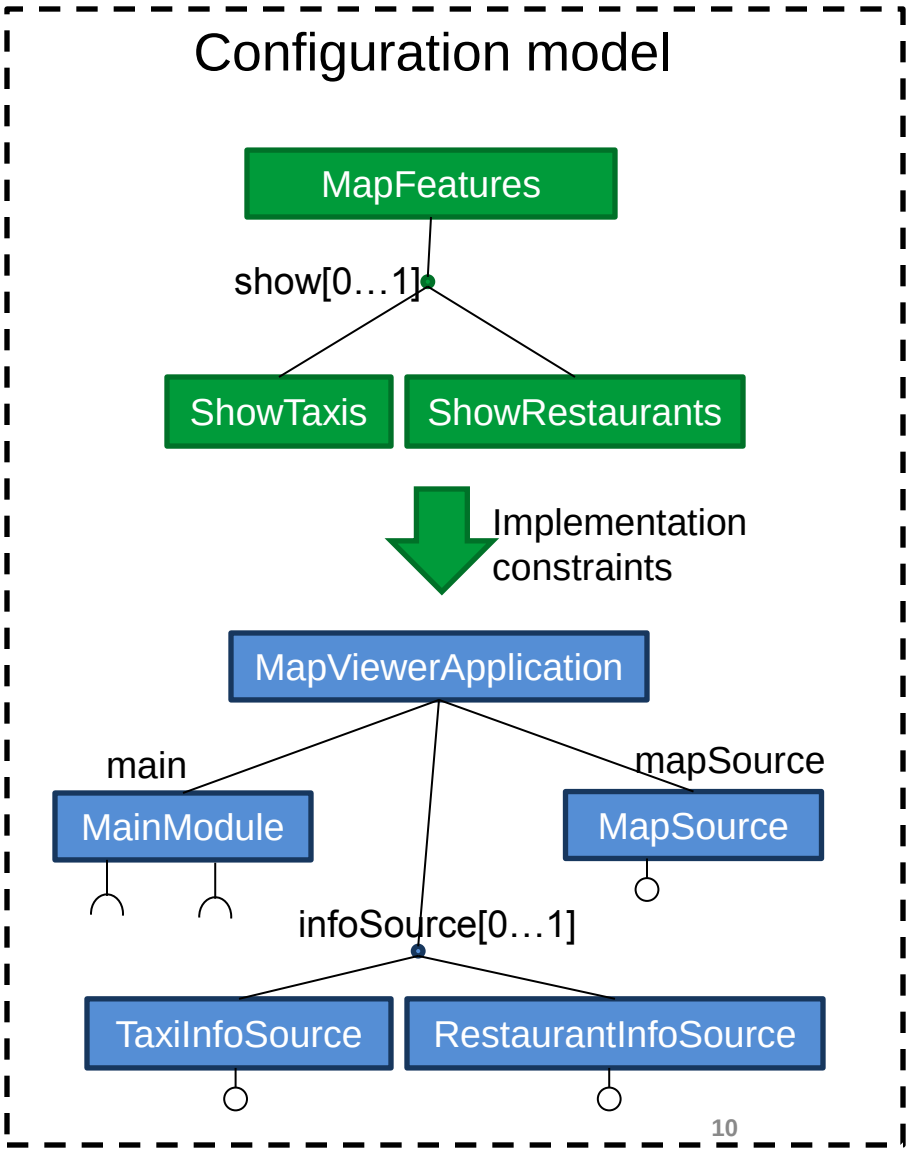
Phase 1: configuration model is created and uploaded

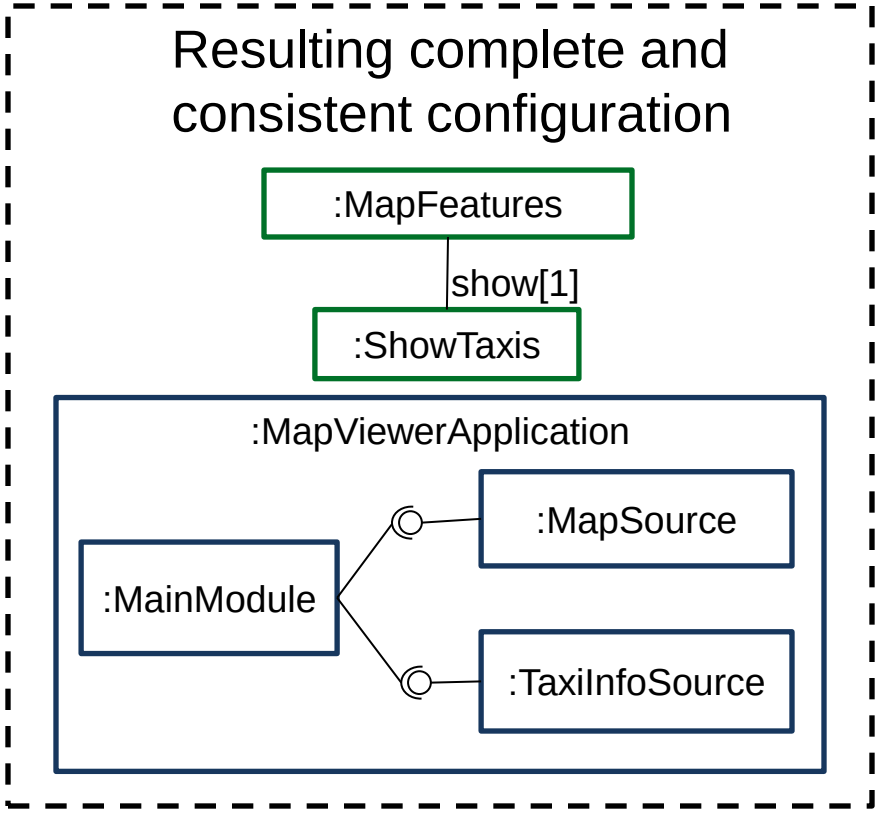


Phase 2: deriving a product variant



Deriving a product variant, example





Finding a complete and consistent configuration

- A consistent configuration ≈ no rules of the configuration model are violated
- A complete configuration ≈ all necessary selections have been made
- In the worst case, this task requires at least an exponential amount of time in relation to the size of the problem
- CaaS utilizes *smodels*, which is a general-purpose inference engine based on stable model semantics of logic programs
  - Configuration models are translated into weight constraints, and consistent and complete configurations are calculated as stable models of such logic programs

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Application of CaaS

- Our Configurator-as-a-Service can be utilized for runtime derivation if
  - The varying product architecture can be modelled with Kumbang, that is, via features and component with interfaces
  - A separate runtime derivation engine exists or can be developed
- We have evaluated the concepts and implementation of CaaS with the case of Social Devices
  - Mobile devices that are able to perform interactive user-visible actions whenever other social devices are near by
  - CaaS is utilized for finding actions and device sets that can perform that action

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Conclusions

- CaaS enables deriving product variats at runtime
  - Models variability and software architectures from feature and component viewpoint
  - Derivation utilizes inference engine *smodels*
- Benefits
  - Separates computationally complex yet generic functionality of runtime derivation from the functionality specific to the particular dynamic setting
  - As a stateless web service, easy to integrate with any runtime derivation framework, and easy to call at runtime
- Current implementation returns only one consistent and complete configuration out of potentially many configurations
  - We are currently working on utilizing recommendation techniques to select the best or good enough configuration among all possible consistent and complete configurations

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