

Product Derivation with Requirements Models

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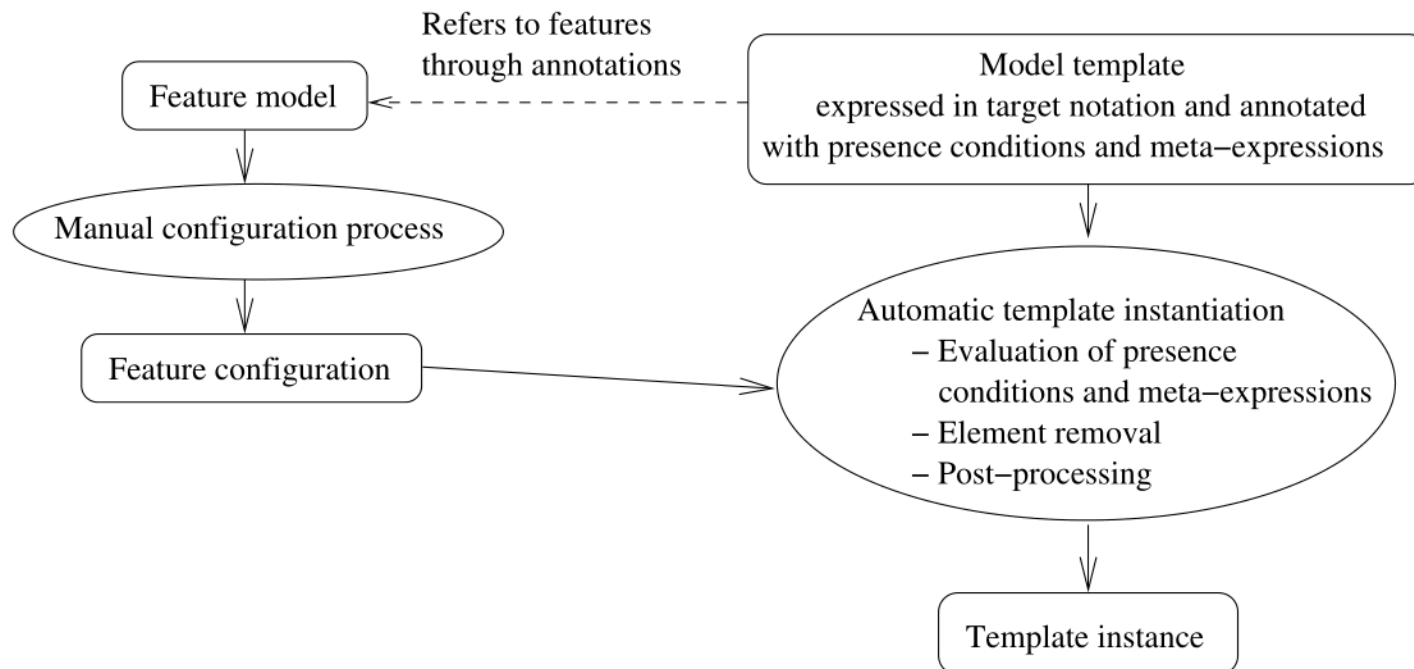


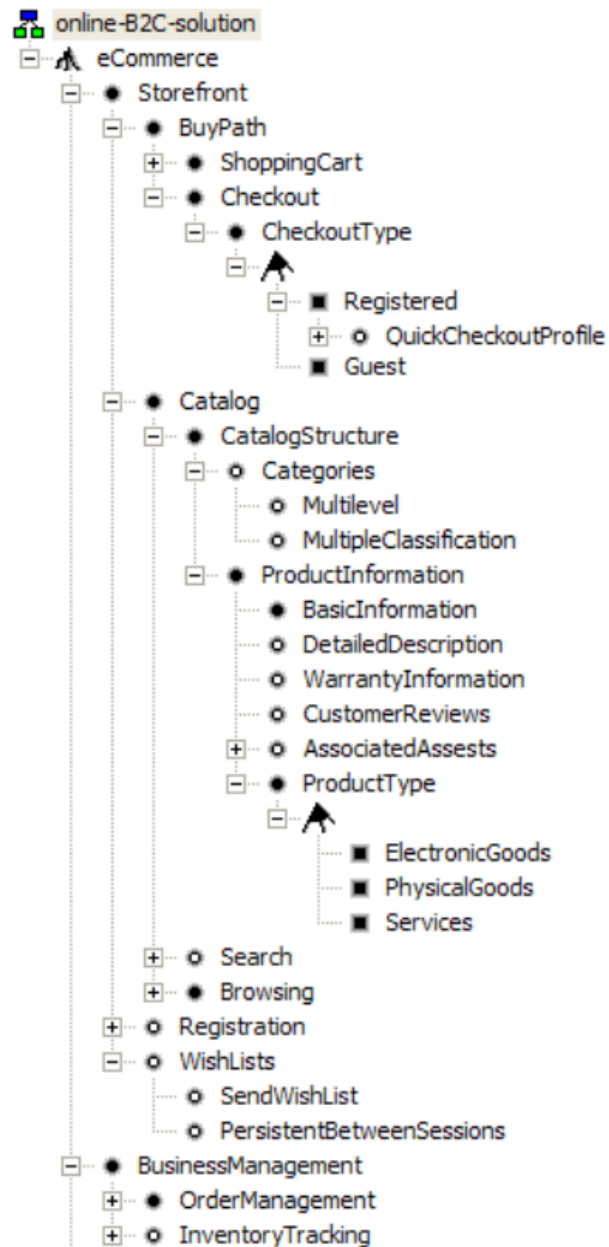
Starting Point

- Software Product Line
 - We want to configure the product by selecting or deselecting certain features.
 - Based on the set of selected features, how do we derive requirements and design artifacts for a concrete product?
- Problem: How do we map abstract features to concrete design artifacts?

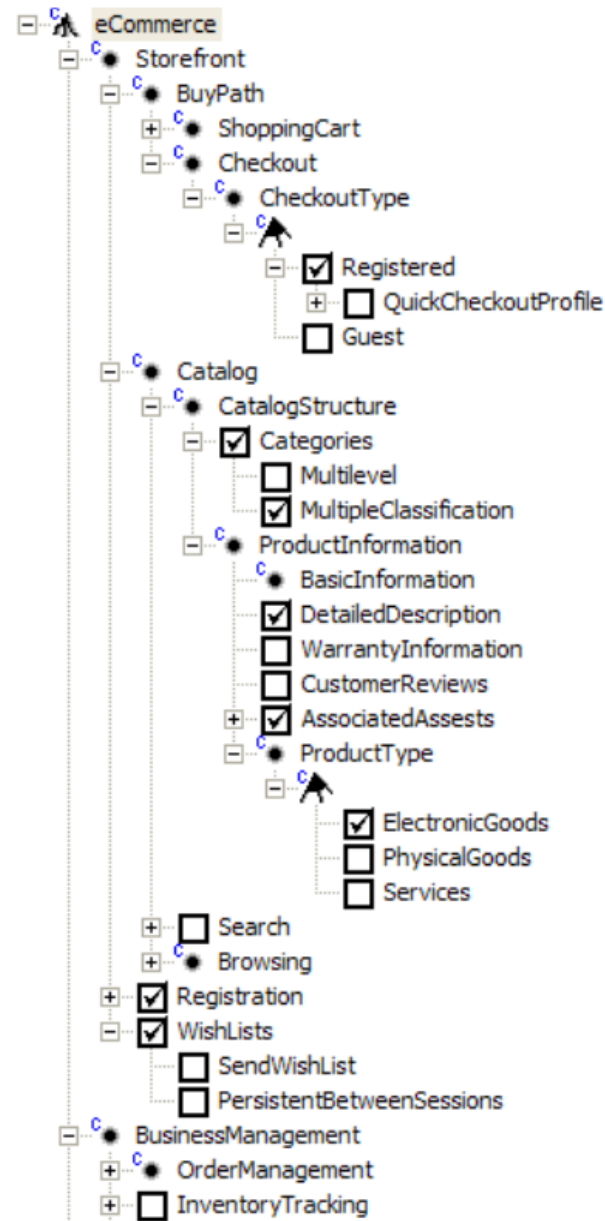
Separated Approach

- Configuration of features and generation of artifacts are two separate steps:

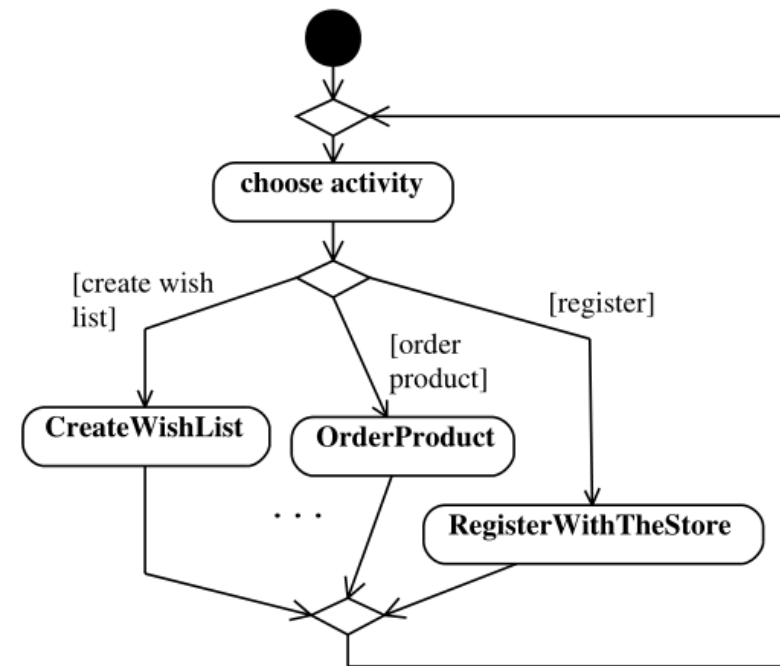
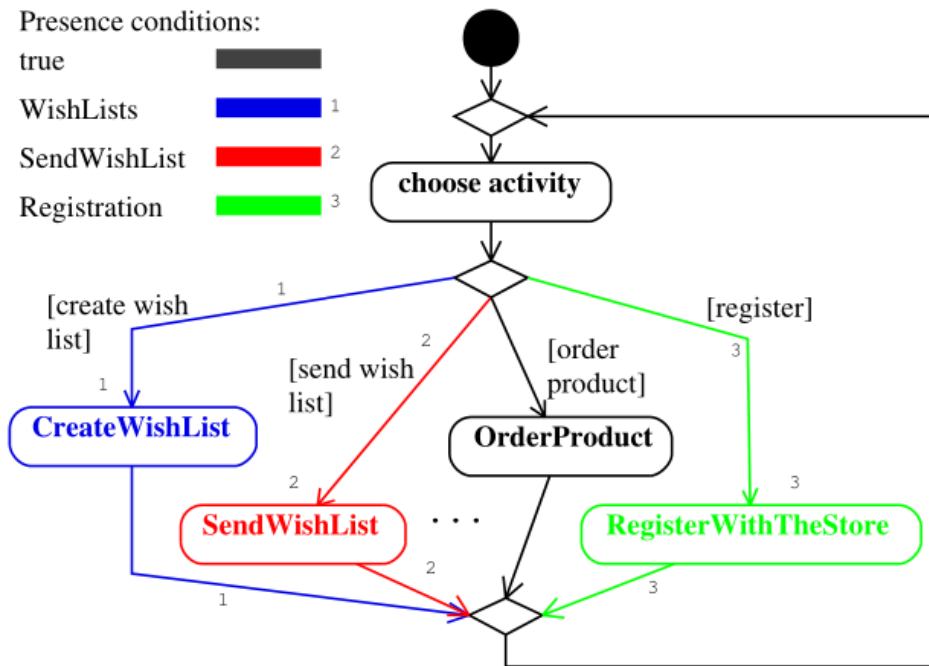


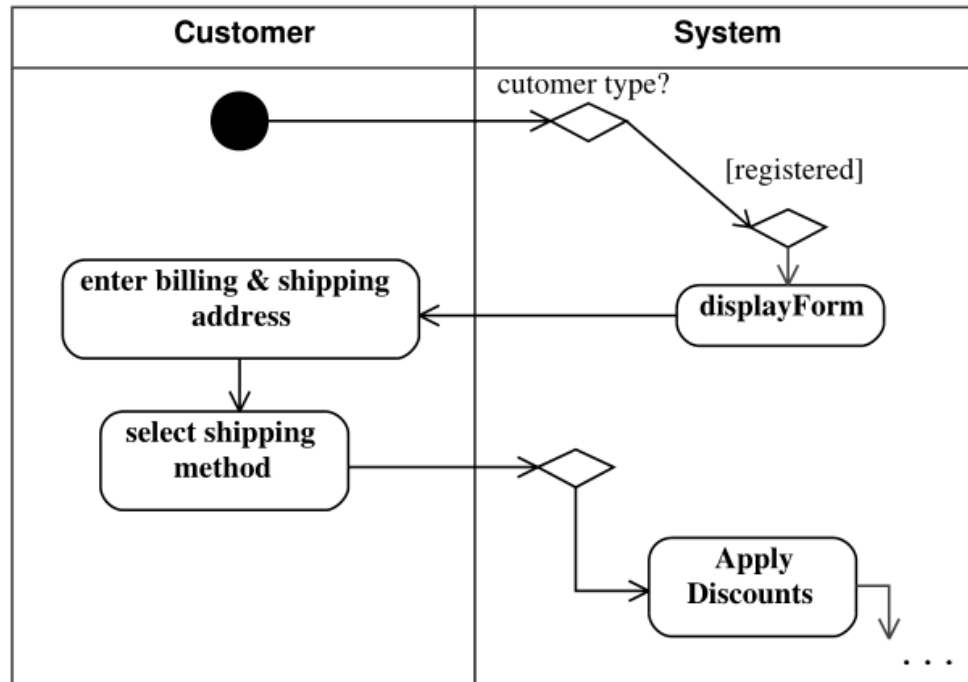


(a) Online B2C Feature Model

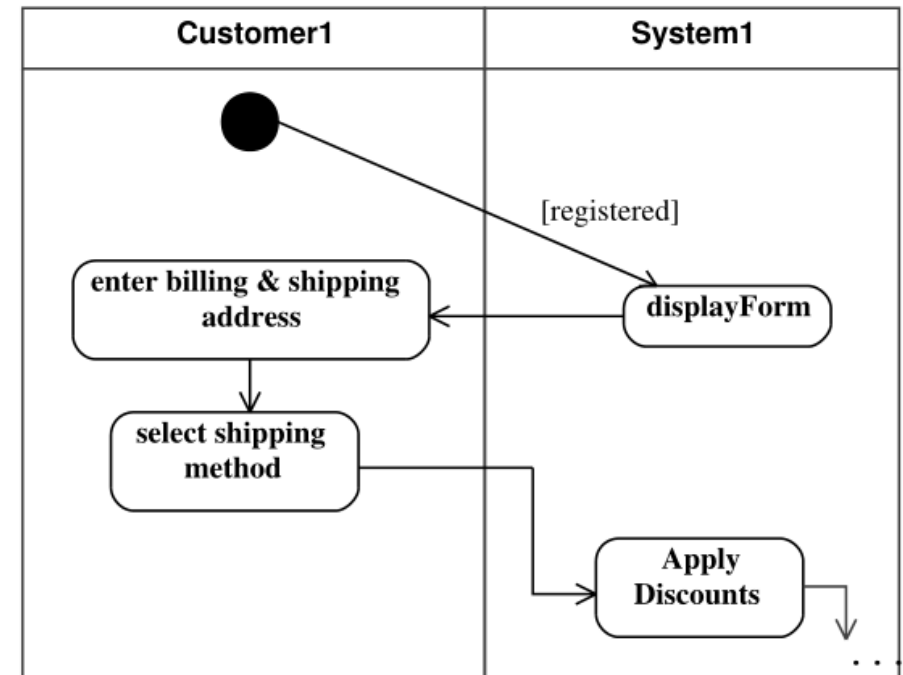


(b) Feature configuration





(a) Checkout instance after region removal



(b) Checkout instance after simplification



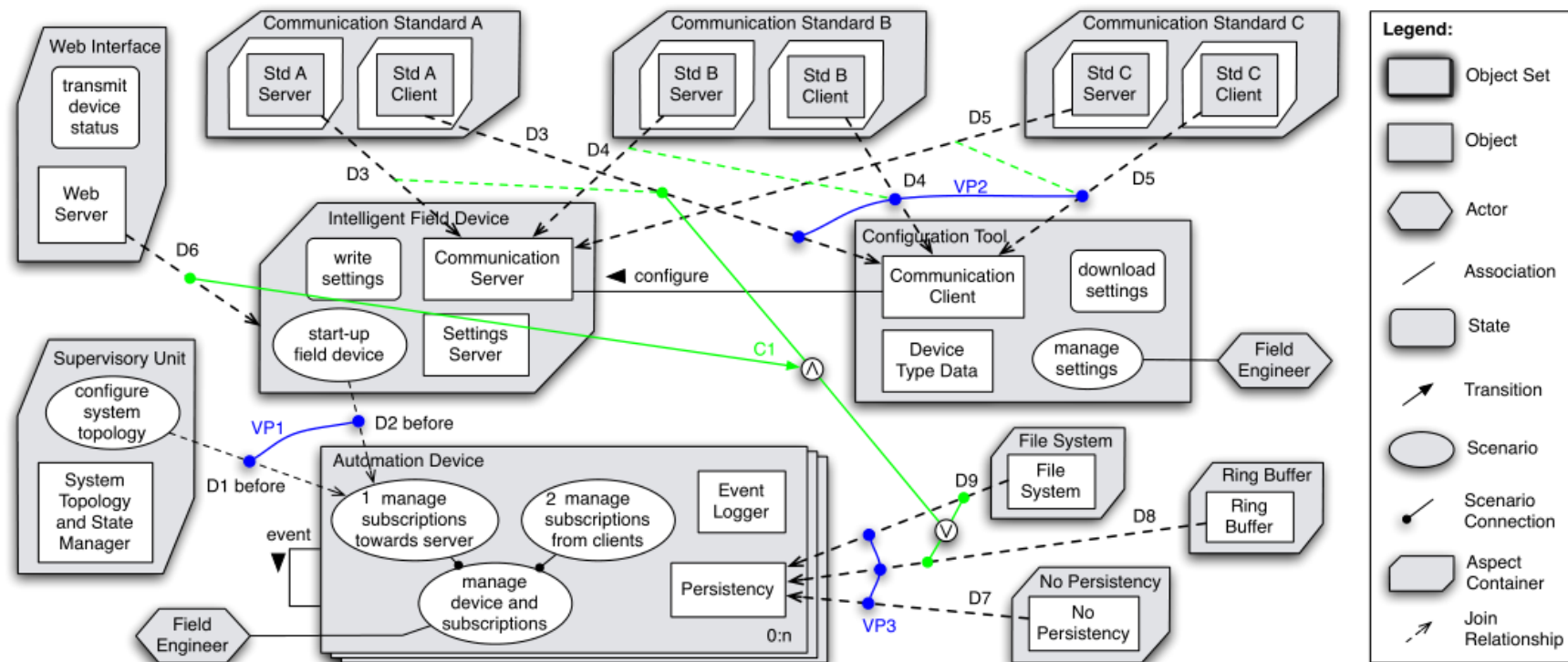
Problems with Separated Approach

- Feature model and requirement model are expressed in different languages
 - User needs to perform context switches
- Implementation details of each feature are scattered among many individual diagrams
 - E.g. one feature may influence many separate class and activity diagrams



Better: Integrated Approach

- Builds on ADORA
 - Product configuration and product generation in one integrated model
- Stepwise and incremental product derivation
 - Product derivation sequentially
 - After each decision, the view and model are updated



Decision Table

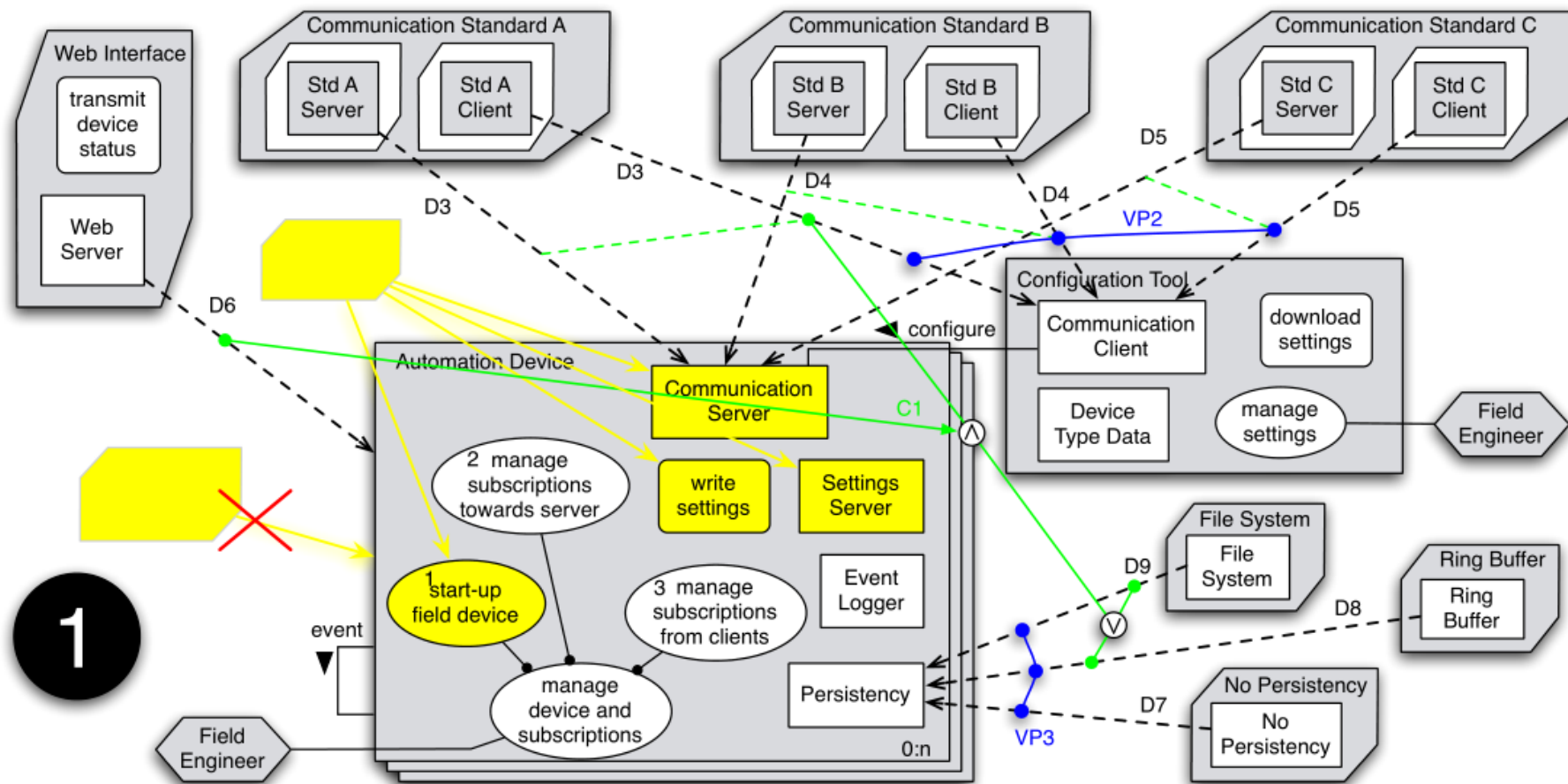
ID	Description / Derivation Question	Design Rationale	Constraints	ifTrue	ifFalse	Decision
D1	Should the automation device be a supervisory unit?	The automation device platform is used for cost and quality reasons.	VP1	¬D2	D2	undecided
D2	Should the automation device be an intelligent field device?	The automation device platform is used for cost and quality reasons.	VP1	¬D1	D1 ¬D6	undecided
D3	Should the intelligent field device support communic. std. A?	Standard A is the newest and most performant one.	VP2, C1		¬D6	undecided
D4	Should the intelligent field device support communic. std. B?	Is a must in some countries.	VP2			undecided
D5	Should the intelligent field device support communic. std. C?	C is still required by many legacy systems.	VP2			undecided
D6	Should the intelligent field device a web interface?	The web interface allows access over the world wide web.	C1	D3 ¬D7		undecided
D7	Is there no memory in the automation device?	Might be interesting for non-critical systems.	VP3	¬D6 ¬D8 ¬D9		undecided
D8	Is there a ring buffer in the automation device?	Ring buffers are cheap to implement and fast.	VP3, C1	¬D7 ¬D9		undecided
D9	Is there a file system in the automation device?	File system offer huge amounts of storage space.	VP3, C1	¬D7 ¬D8		undecided

Variation Points Table

ID	Description / Rationale	minCard	maxCard	Decisions Involved
VP1	An automation device always can be either a supervisory unit or an intelligend field device.	1	1	D1, D2
VP2	There are three different communication standards to configure a field device: standard A, B, and C. At least one must be chosen.	1	3	D3, D4, D5
VP3	There exist three different persistency types: no persistency, a ring buffer, or a file system. One of these must be selected.	1	1	D7, D8, D9

Constraints Table

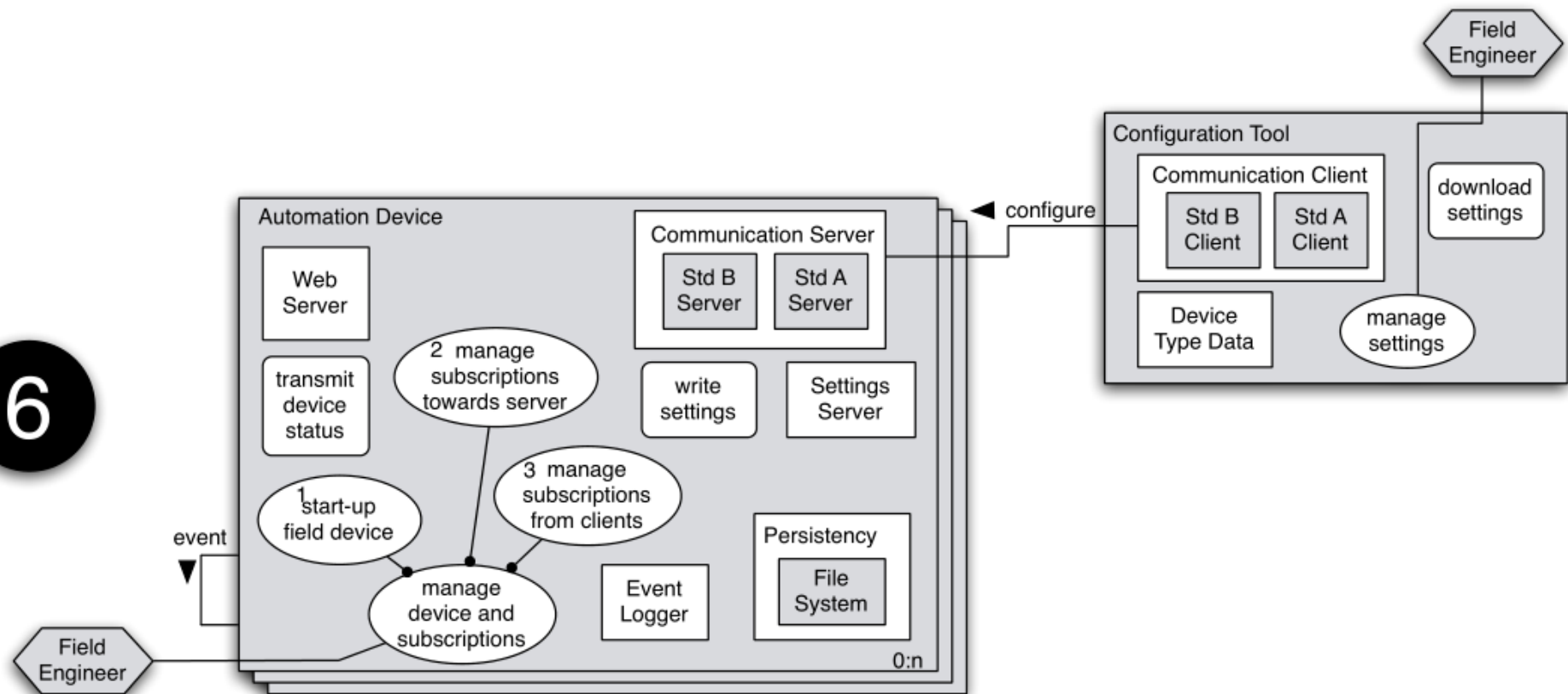
ID	Description / Rationale	Antecedent	Operator	Consequent
C1	A web interface always requires the communication standard A and a local persistency installed (either ring buffer or FS).	D6	=>	D3 and (D8 or D9)



Decision Table

ID	...	Constraints	ifTrue	ifFalse	Decision
D1		VP1	-	-	false
D2		VP1	-	-	true
D3		VP2, C1		¬D6	undecided
D4		VP2			undecided
D5		VP2			undecided
D6		C1	D3 ¬D7		undecided
D7		VP3	¬D6 ¬D8 ¬D9		undecided
D8		VP3, C1	¬D7 ¬D9		undecided
D9		VP3, C1	¬D7 ¬D8		undecided

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Decision Table

ID	...	Constraints	ifTrue	ifFalse	Decision
D1		VP1	-	-	<i>false</i>
D2		VP1	-	-	<i>true</i>
D3		VP2, C1	-	-	<i>true</i>
D4		VP2	-	-	<i>true</i>
D5		VP2	-	-	<i>false</i>
D6		C1	-	-	<i>true</i>
D7		VP3	-	-	<i>false</i>
D8		VP3, C1	-	-	<i>false</i>
D9		VP3, C1	-	-	<i>true</i>



Conclusion

- Integrated approach helps to understand the design implications of a specific feature
- Product configuration and product generation in one integrated model
- Integrated approach scalable?