Feature Modeling and Configuration Management

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Agenda

- What is a Product Family?
- What is Feature Modelling?
- What is the XFeature Tool?
- XFeature Tool Demonstration
- Pointers to More Informations

Overview of Product Families

Product Families

Product Families Examples

- VW Corrado

Product Families Examples

Product Families Examples

- Computer Hardware Configuration

Wählen Sie Ihr MacBook Pro.

15" : 2,2GHz

2,2 GHz Intel Core 2 Duo
Auflösung von 1440 x 900 Pixeln
2 GB Arbeitsspeicher
120 GB Festplatte[1]
8x SuperDrive Laufwerk (Double Layer)
NVIDIA GeForce 8600M GT Grafikprozessor mit 128 MB SDRAM

Versandfertig in: 3 Tage
Kostenfreie Lieferung

CHF 2.507,08 *
(CHF 2.330,00 exkl. MwSt.)

Auswählen

15" : 2,4GHz

2,4 GHz Intel Core 2 Duo
Auflösung von 1440 x 900 Pixeln
2 GB Arbeitsspeicher
160 GB Festplatte[1]
8x SuperDrive Laufwerk (Double Layer)
NVIDIA GeForce 8600M GT Grafikprozessor mit 256 MB SDRAM

Versandfertig in: 3 Tage
Kostenfreie Lieferung

CHF 3.123,63 *
(CHF 2.903,00 exkl. MwSt.)

Auswählen

17" : 2,4GHz

2,4 GHz Intel Core 2 Duo
Auflösung von 1680 x 1050 Pixeln
2 GB Arbeitsspeicher
160 GB Festplatte[1]
8x double-layer SuperDrive
NVIDIA GeForce 8600M GT Grafikprozessor mit 256 MB SDRAM

Versandfertig in: 7 - 10 Tage
Kostenfreie Lieferung

CHF 3.475,48 *
(CHF 3.230,00 exkl. MwSt.)

Auswählen

15" | 17"

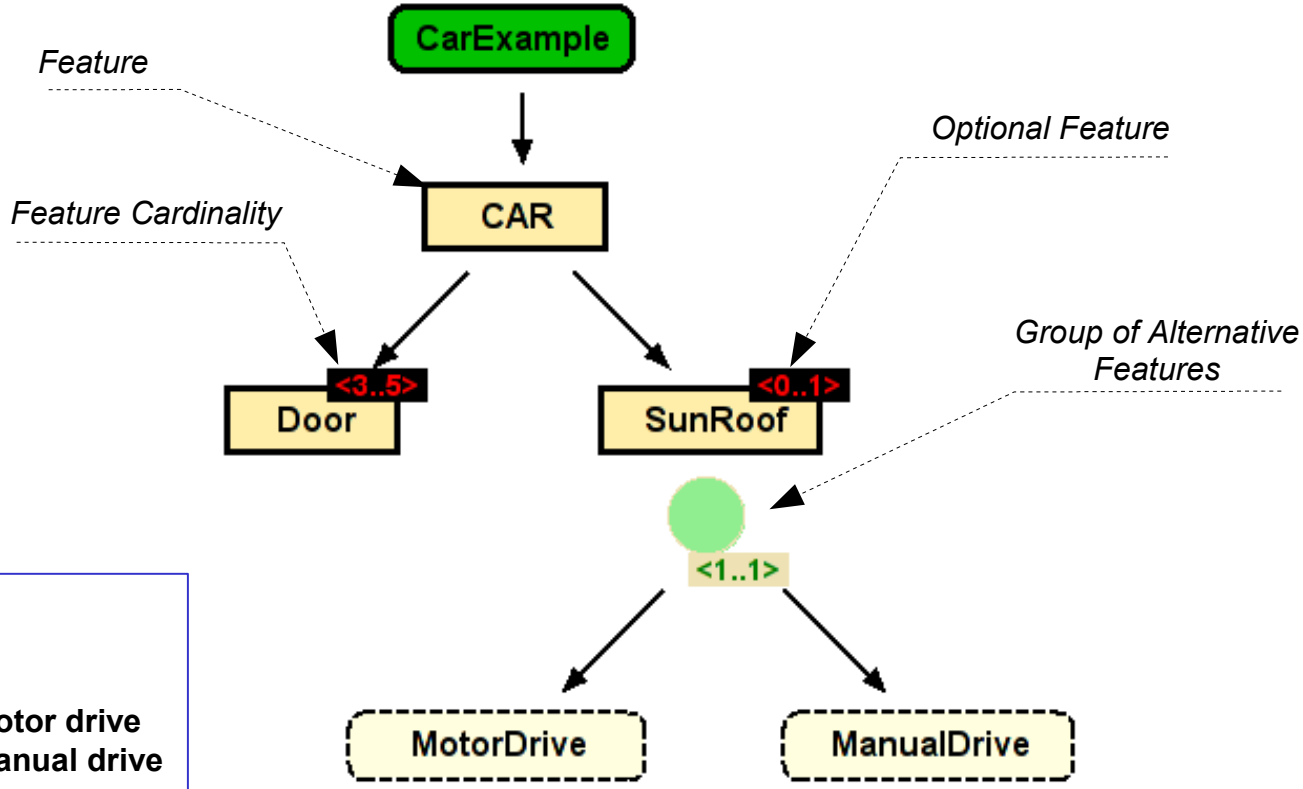
Product Families Examples

SQL Server 2005 Features Comparison

Published: November 7, 2005 | Updated: May 22, 2006

Scalability and Performance					
Feature	**Express**	**Workgroup**	**Standard**	**Enterprise**	**Comments**
Number of CPUs	1	2	4	No Limit	Includes support for multicore processors.
RAM	1 gigabyte (GB)	3 GB	Operating system maximum	Operating system maximum	Memory limited to maximum supported by operating system.
64-bit Support	Windows on Windows (WOW)	WOW	✓	✓	
Database Size	4 GB	No Limit	No Limit	No Limit	
Partitioning				✓	Support for large-scale databases

A Family of Car Types

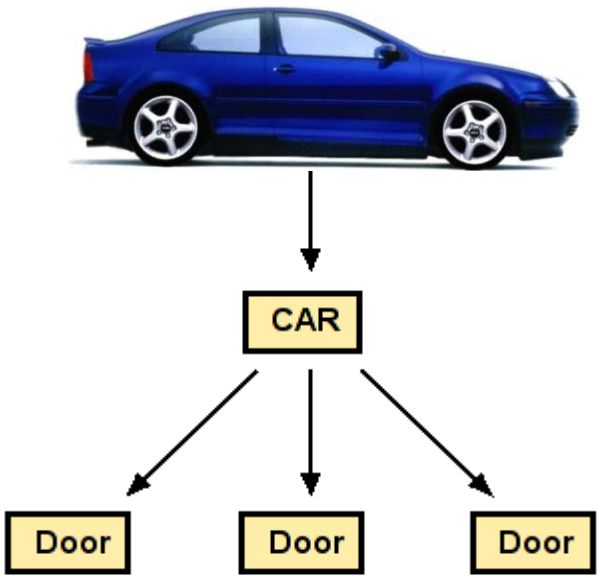


Instances of this family include:

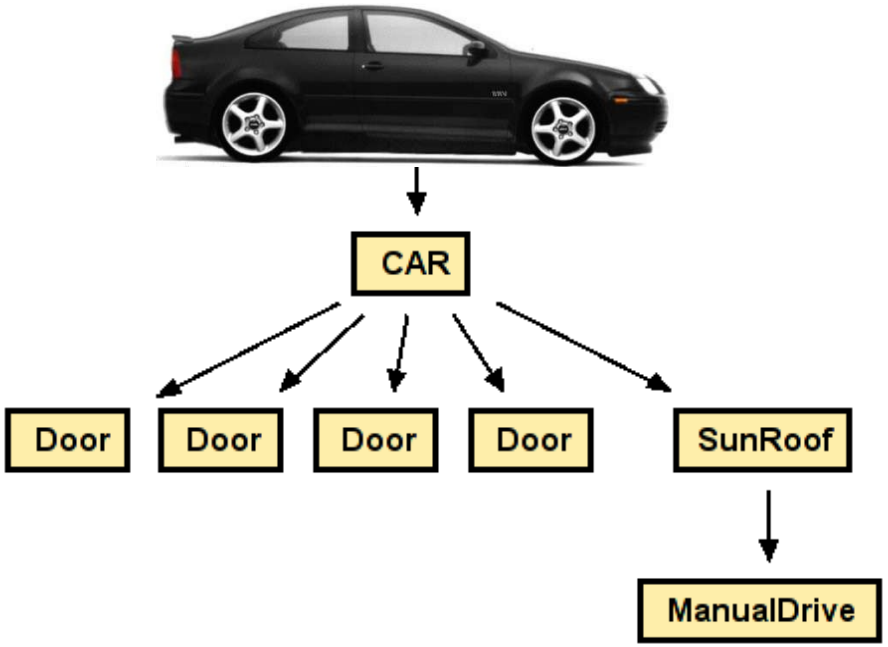
- **A car with 3 doors and no sunroof**
- **A car with 5 doors and a sunroof with motor drive**
- **A car with 4 doors and a sunroof with manual drive**
- **. . .**

Different authors have proposed different graphical notations for representing feature diagrams.

Family Instances



A family instance characterized by three doors and no sun-roof



A family instance characterized by four doors, and sun-roof with manual drive.

Instantiation Process

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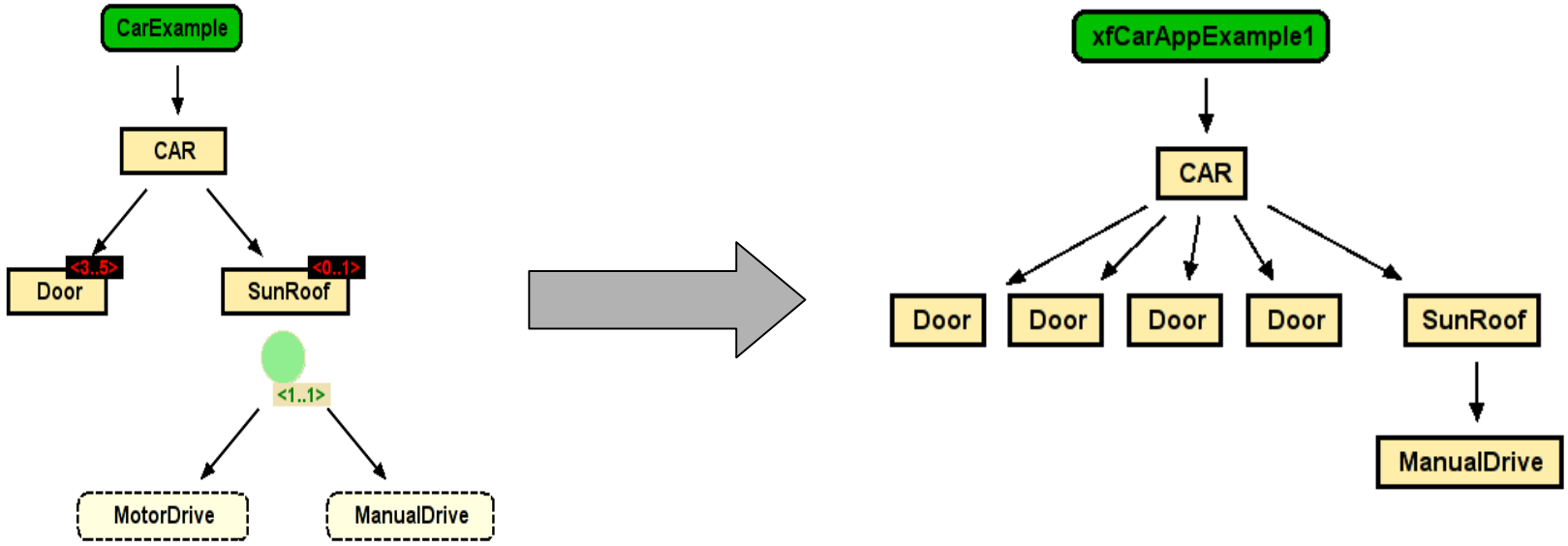


Family specification through a feature model (family domain analysis)

Product specification as an instance of the family feature model (application requirement definition phase)

A good family modelling tool should:
(1) support the definition of family models
(2) support the definition of combination constraints on the features
(3) support the instantiation of the family models to create instance/application models
(4) provide tips to help the user select the instance/application features

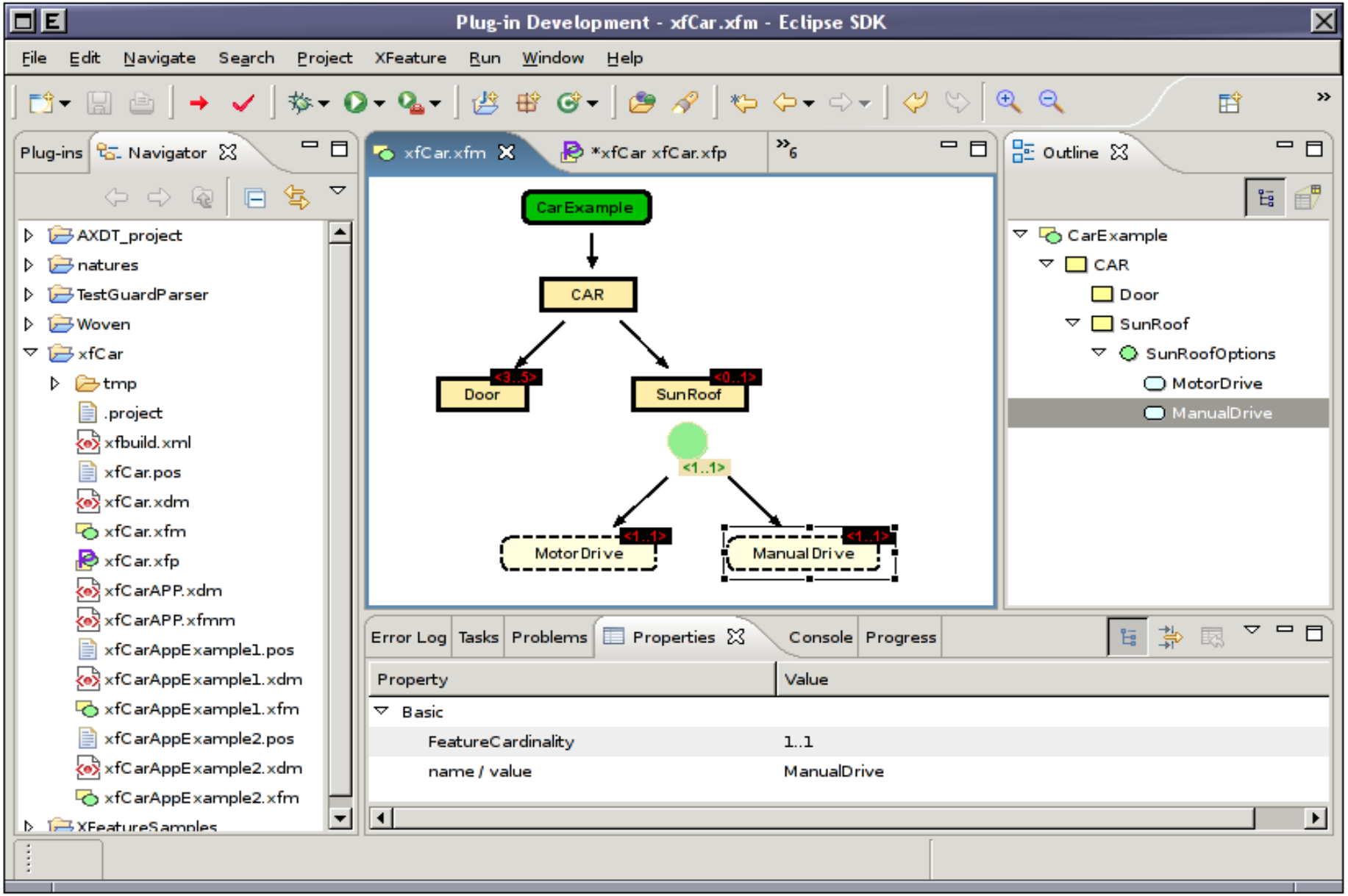
Feature Modelling

- **Feature**: a characteristic of a system that is of relevance to its end-user
- **Feature Model**: a model of all the features of product that can be potentially instantiated from a family together with the constraints on their combinations
  - There may be compatibility constraints between features (i.e. feature A is incompatible with feature B)
- Feature models are expressed using tree-like structures
  - Each node in the tree represents a feature
  - A feature may be broken up into subfeatures represented as children nodes
  - Various conventions are used to describe constraints on the feature combinations
- Feature modelling is used whenever there is a need to model variability within a set of related products

The XFeature Tool

http://www.pnp-software.com/XFeature/

XFeature Screenshot



XFeature Principles

- **Feature Model Approach**
  - Both family and product (e.g. an application) models are expressed as feature models
- **Model-Driven Approach**
  - Tool is built on a feature meta-meta-model
  - Users can define their own feature meta-model
- **XML-Based approach**
  - Express a feature meta-model as an XML Schema
  - Express a feature model as an XML document that must comply with the XML Schema
- **Eclipse-Based Approach**
  - Tool is built as a plug-in for the Eclipse platform
- **Open Software Approach**
  - Tool available as free and open software under EPL

XFeature Configuration

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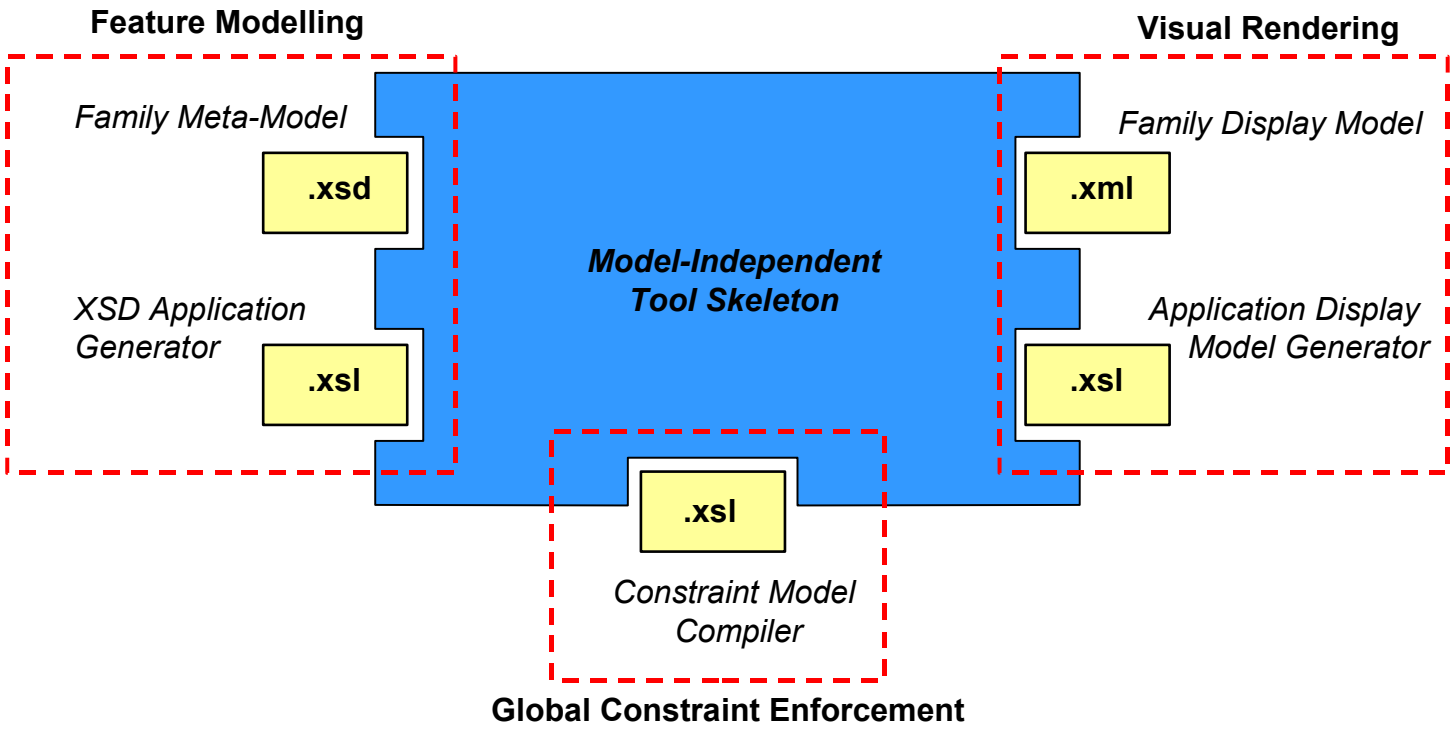

- Users define both the meta-model used by the tool and the tool "look & feel"
- Constraint modelling has been recently implemented

The XFeature Tool
Live Demonstration

Use of XFeature as Automatic Configuration Tool

Automatic Configuration of an Application from Family BBs

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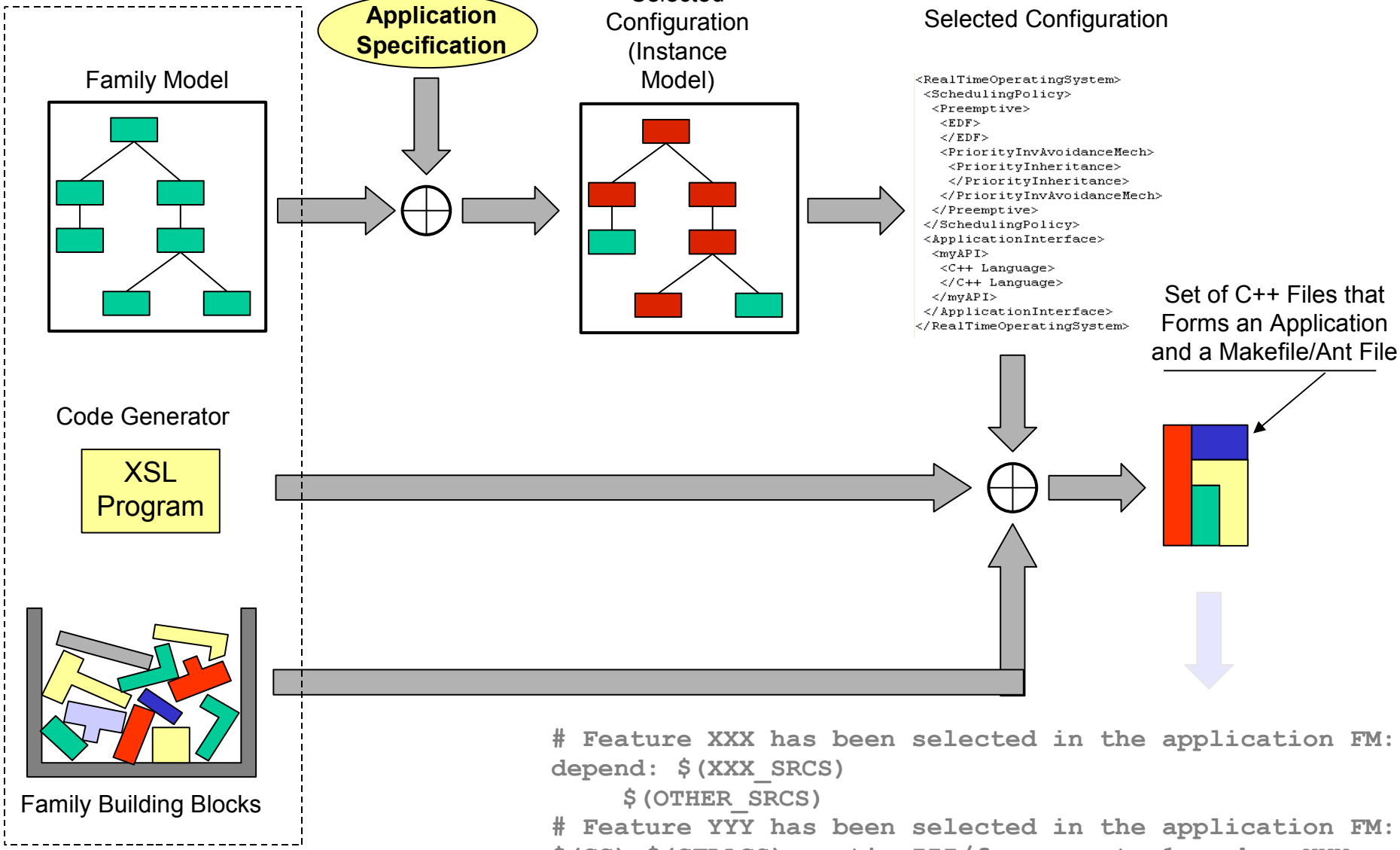
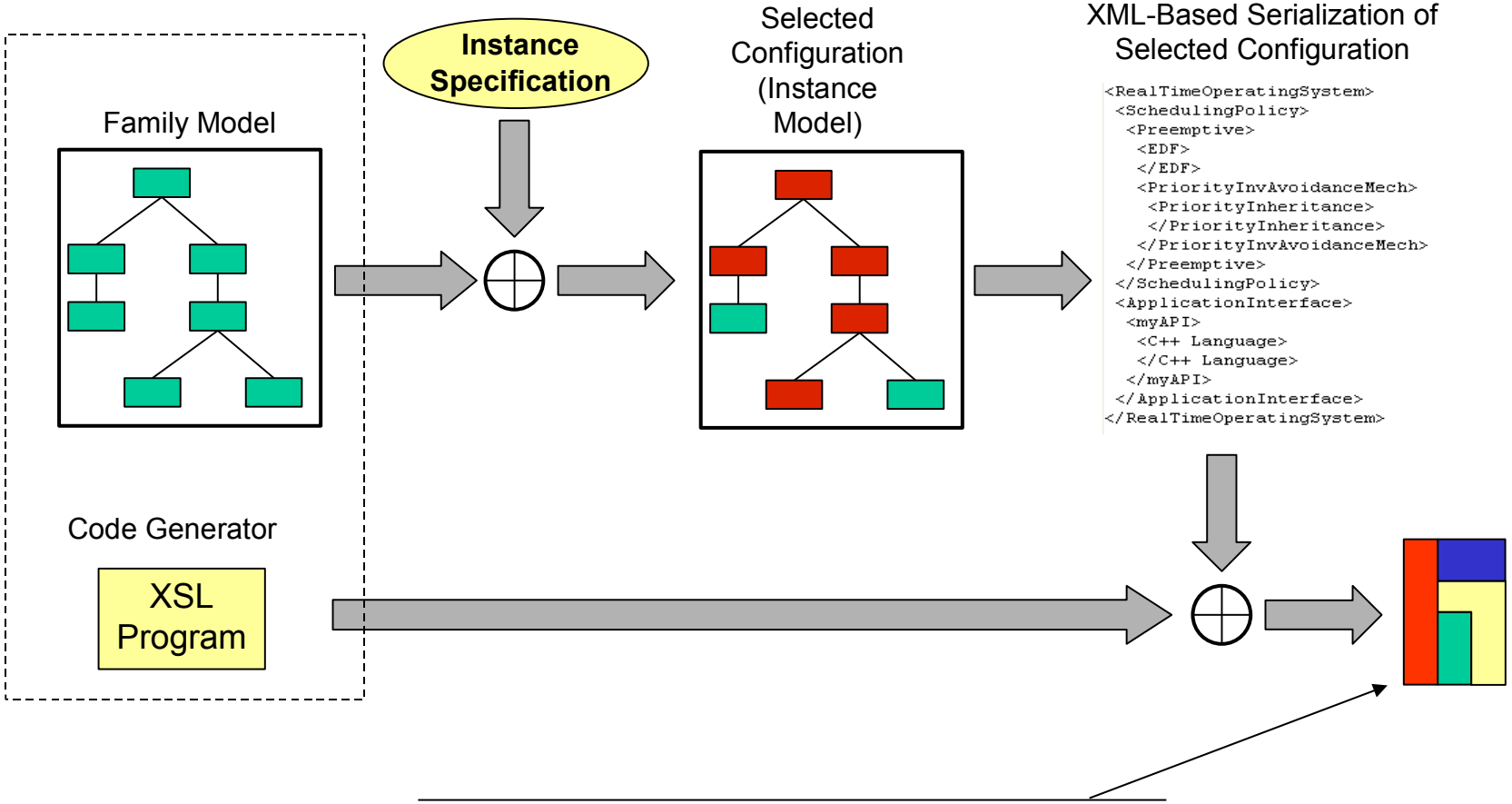


Configuration Tool



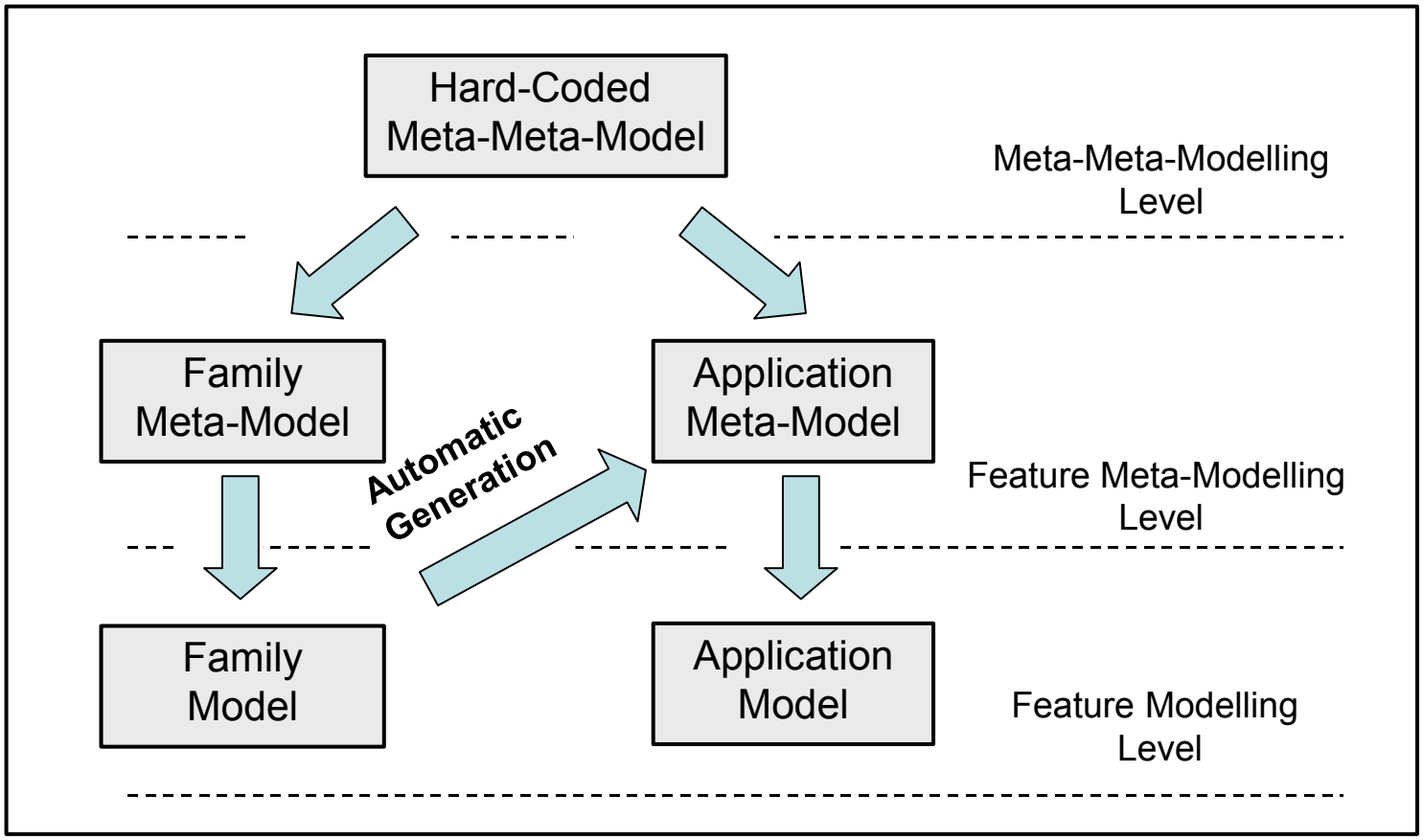
What can be generated from serialized model?

- **Invoice**
- **User Manual**
- **System Specification:** `RAM size in the product 16kB / 64kB`
  `GUI language EN / DE / FR / IT`
  `Version of certain component 1.1 or 1.2`
  `HAV / HBV / HCV`

References

- More Info:
  - XFeature website
    - http://www.pnp-software.com/XFeature
  - Chapter 4 of “Generative Programming”
    - by Krzysztof Czarnecki and Ulrich W. Eisenecker (Addison-Wesley)
  - pure::variants tool
    - Non-graphical Eclipse-based tool
    - http://www.pure-systems.com/3.0.html
  - University of Waterloo
    - Research oriented tool
    - http://gp.uwaterloo.ca/fmp/

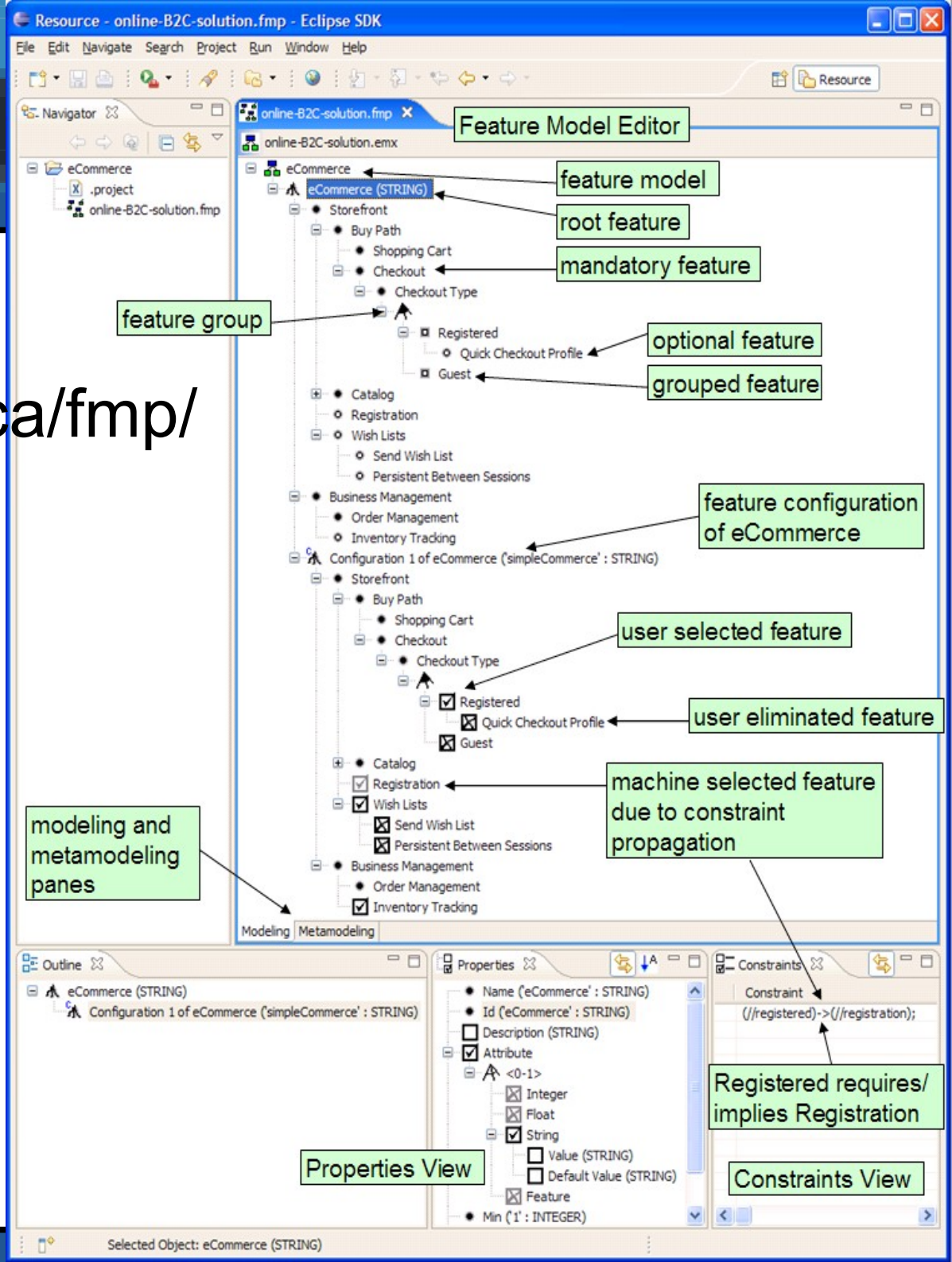
XFeature Architecture



- XFeature users typically operate the tool at Feature modelling Level

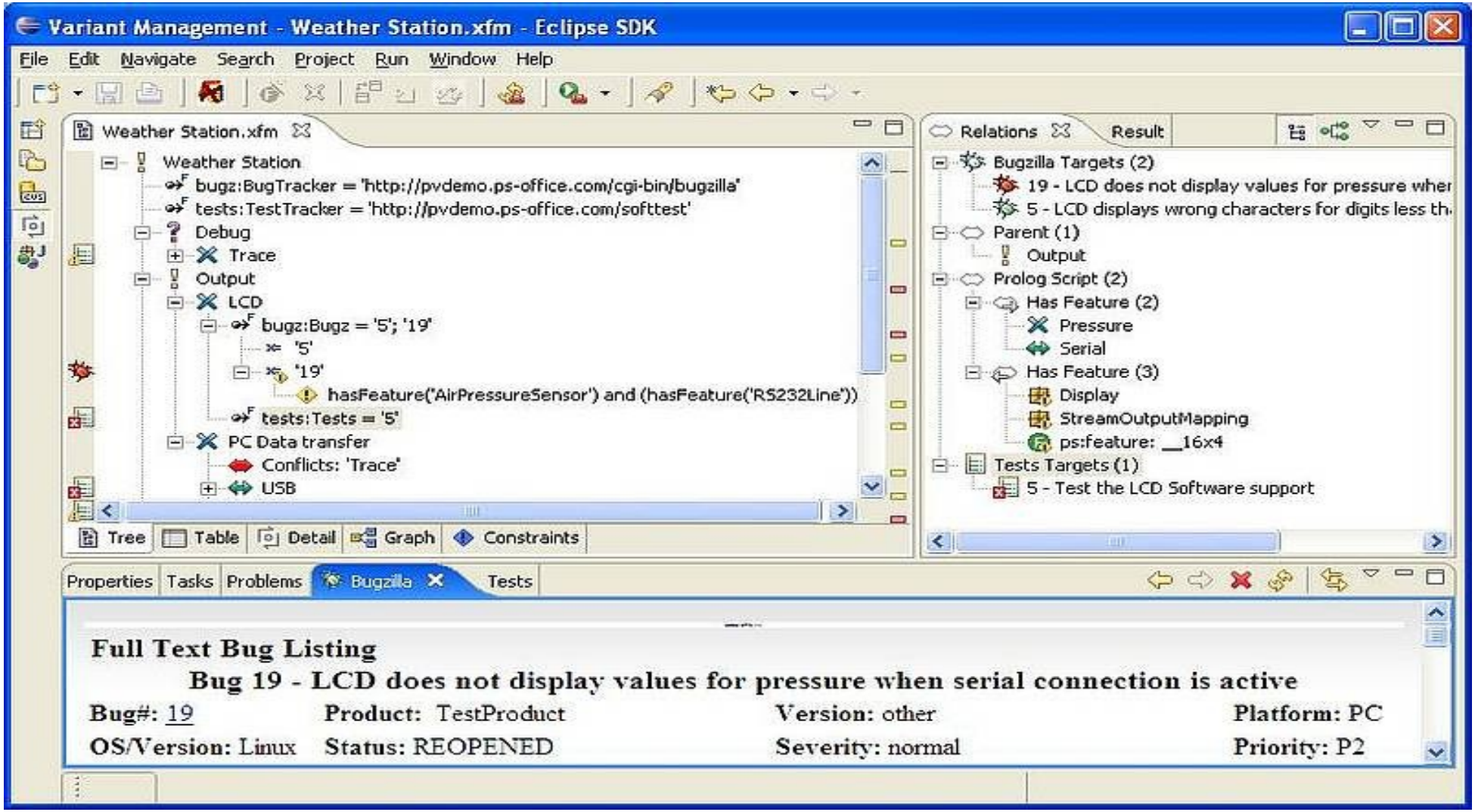
Feature Modelling Plug-in (FMP)

- http://gp.uwaterloo.ca/fmp/



pure::variants

- http://www.pure-systems.com/



Feature Modelling in Software Development

Reuse Driven SW Development

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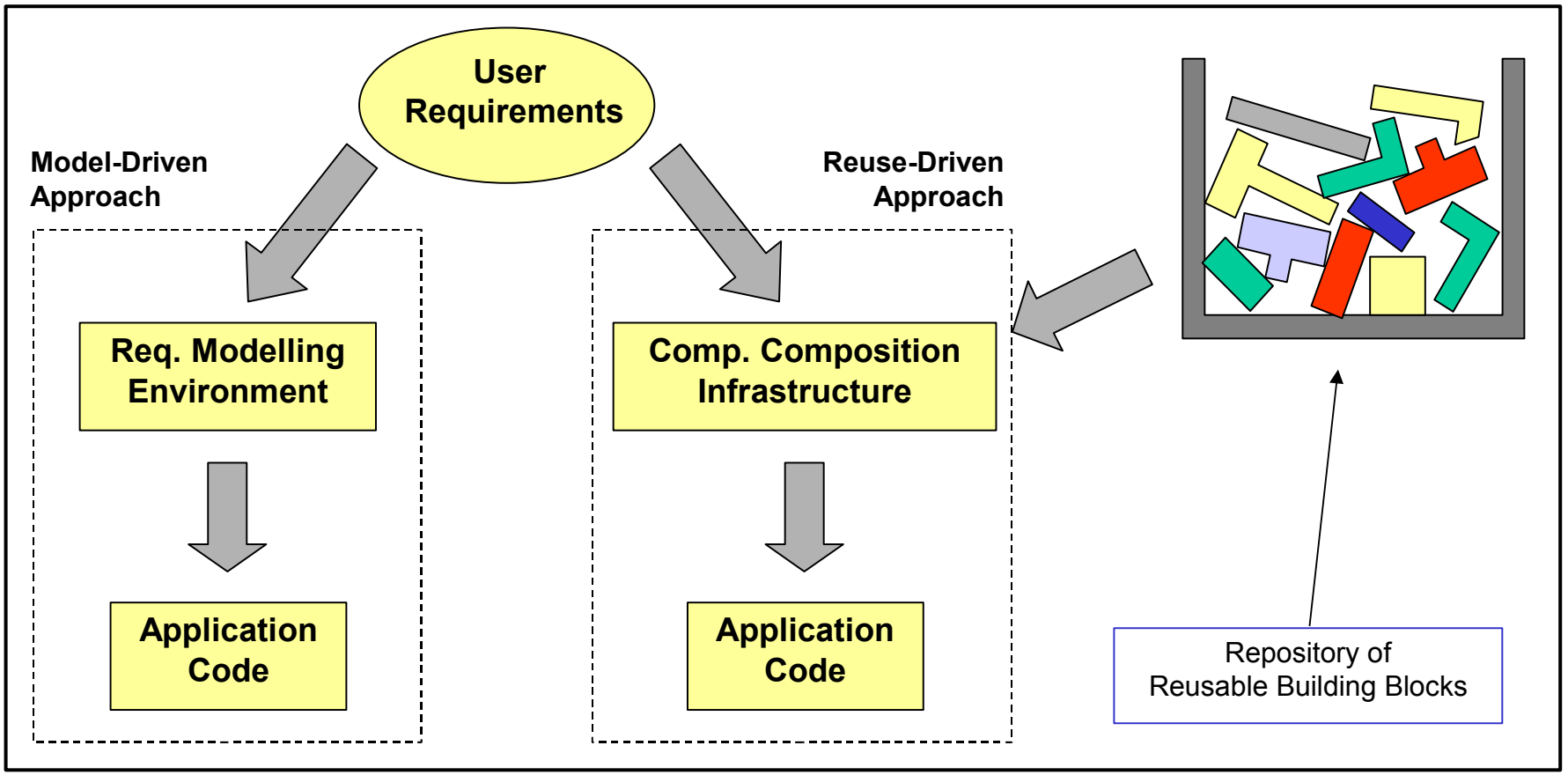
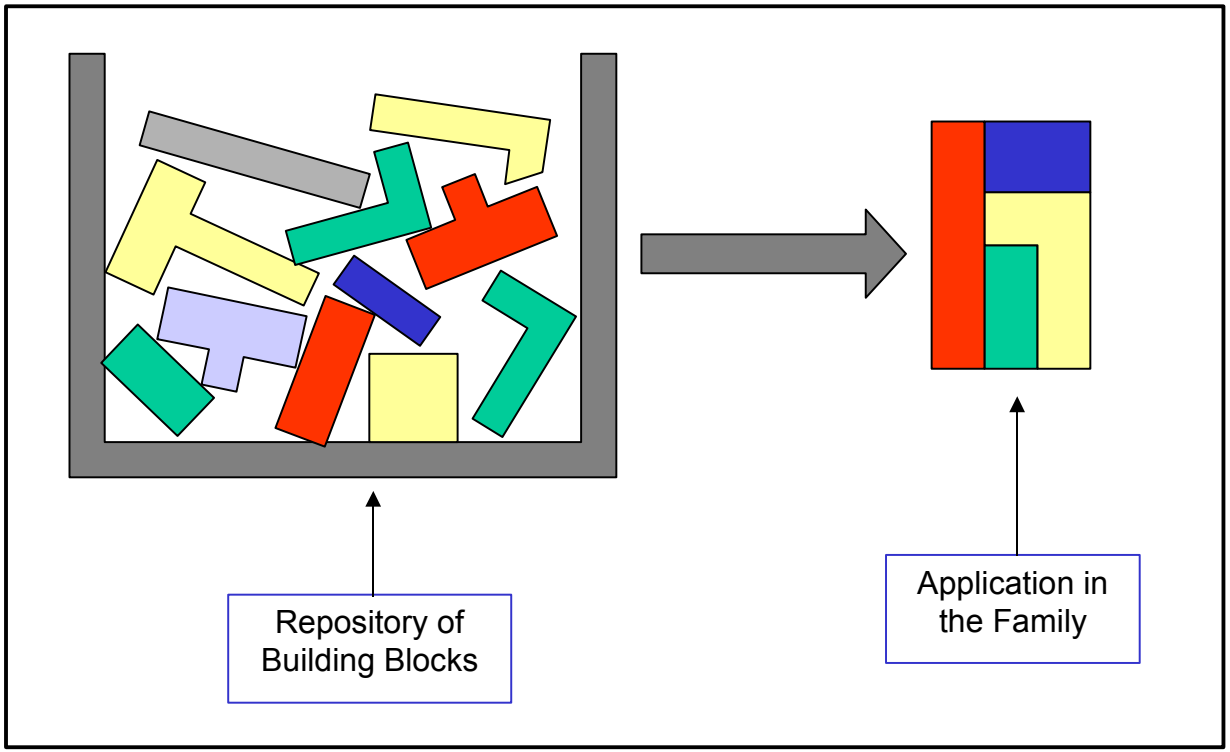


Software Product Family

- Software Product Family
  - A set of applications that can be built from a set of shared software assets (the “building blocks”)



Family-Based Process - 1

- Two main stages:

FAMILY CREATION: process whereby the software family and its reusable software **building blocks are created** together with the **language and tools** required to instantiate applications from the family

FAMILY INSTANTIATION: process whereby the assets provided by the software family are tailored to match the needs of a specific application

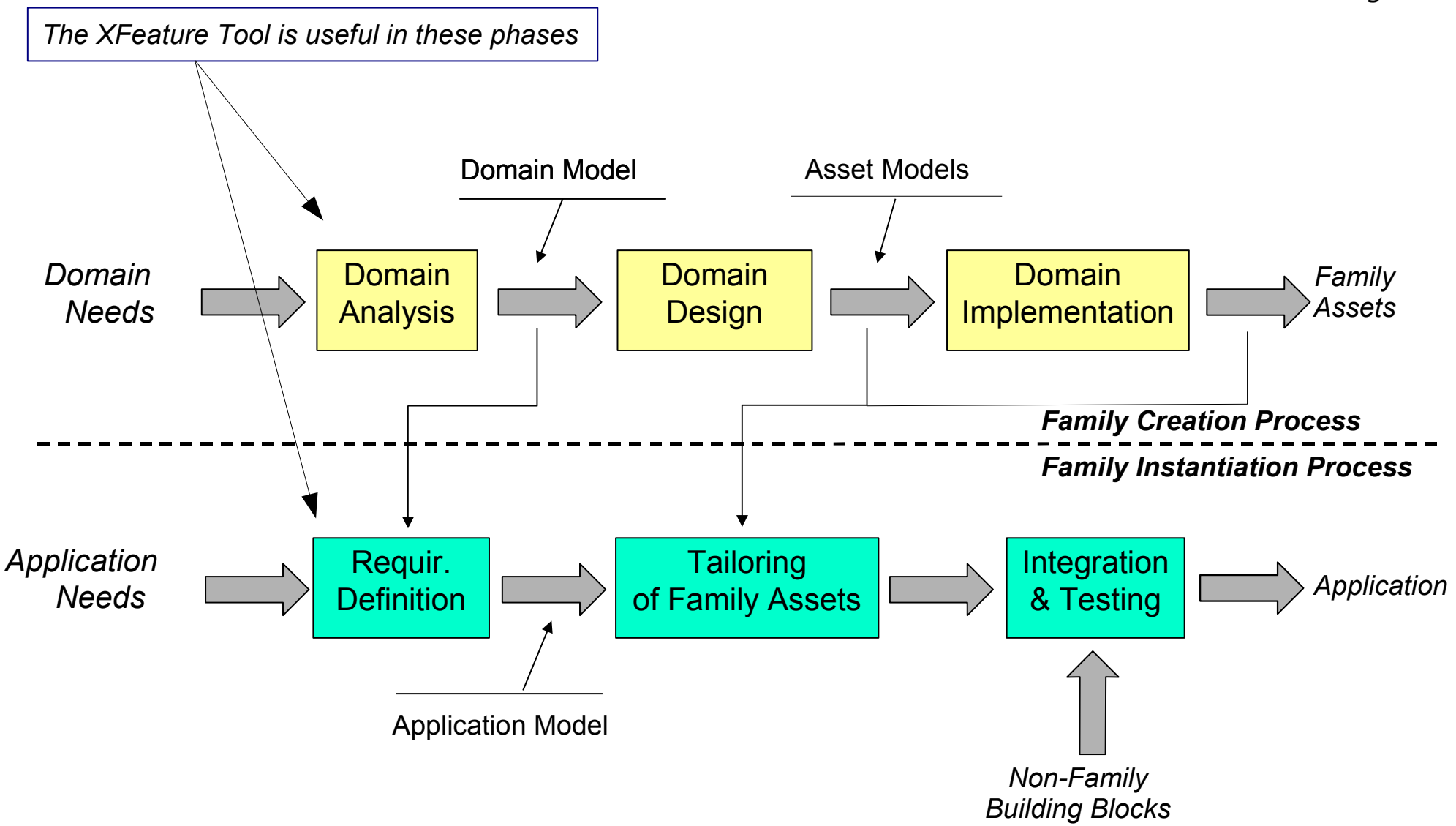
- The family creation process has three main stages:

DOMAIN ANALYSIS: create a model of the family domain

DOMAIN DESIGN: design the shared software assets for the family

DOMAIN IMPLEMENTATION: implement the shared software assets for the family

Family-Based Process - 2



Domain Analysis

- Domain analysis results in the construction of a **domain model**
- The domain model captures the user's point of view on the software framework
  - Similar to user requirements in single application development
- Domain model consists of:
  - Description of the features that the framework supports
  - Definition of constraints on their legal combinations
- Standard Technology to construct Domain Models:
  - **Feature modelling, of course**