

Topic C

Modeling Variability In Software Product Lines

Requirements For Documenting Variability Across Product Lines

- Document for which product lines, a requirement is valid and whether it is **common, optional or alternative**.
 - Ensure a **product line-specific** recording of **variability constraints**.
 - Facilitate the creation of **views** on the documented variability and constraints.
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The Core Variability Meta Model

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- **Variation point:** defines what can vary in a product line.
- **Variant:** defines a concrete type of variation.



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The Core Variability Meta Model

- **Variability dependency:**
 - ♦ Associates variants and variation Points.
 - ♦ A variant can be related to one or more variation points.
 - ♦ A variation point is at least associated to one variant.
 - ♦ Defines whether a variant is **mandatory** or **optional** to the variation point.
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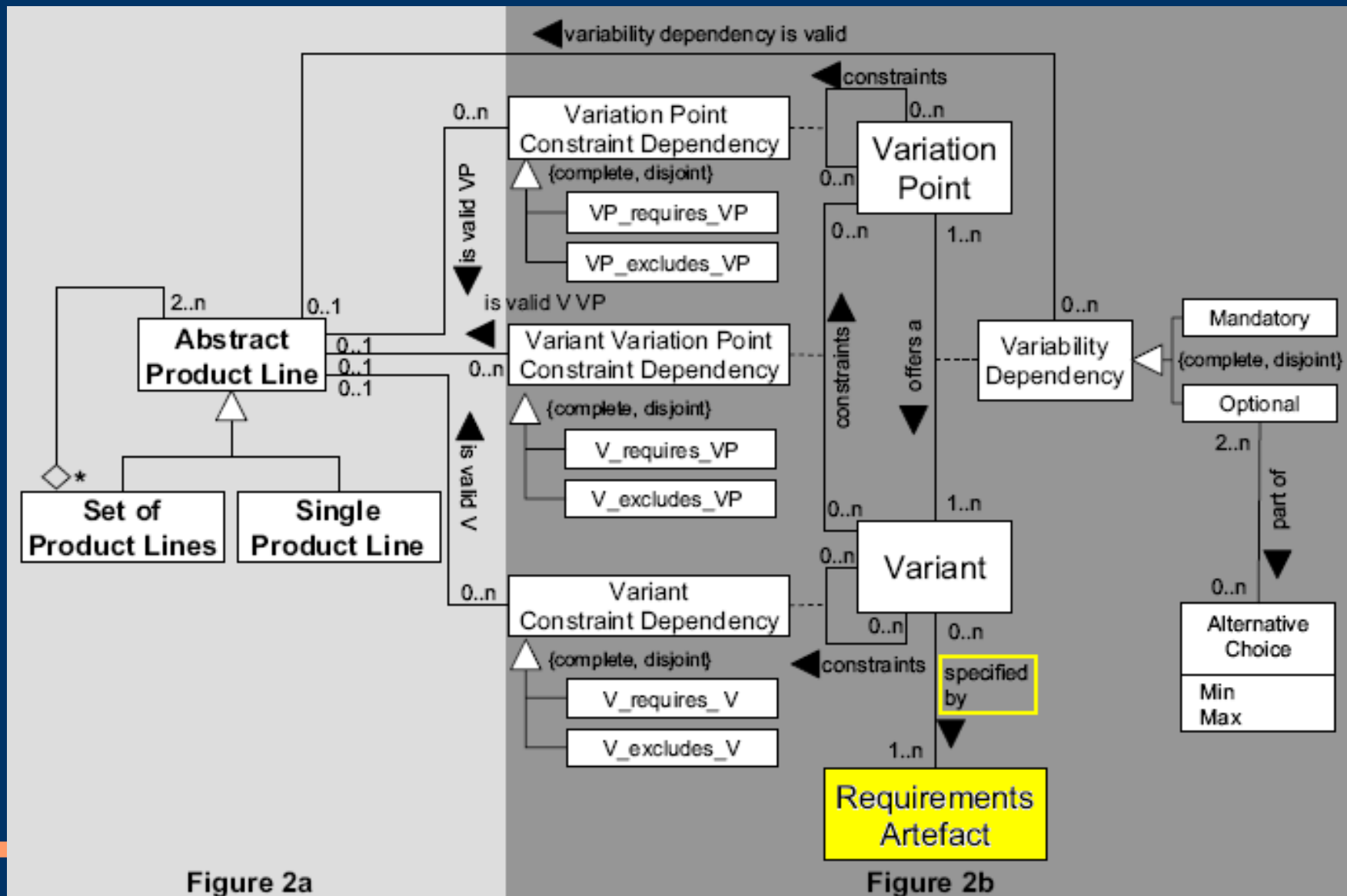
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The Core Variability Meta Model

- **Requirements artefact:** e.g. use case, scenario, textual requirements specification, data model.
 - Requirements artefacts are assigned to a variant using a **specified by** dependency.
This link supports the **requirements traceability**.
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The Core Variability Meta Model



The Core Variability Meta Model

The **variant constraint dependency**: constraints on the level of variants.

- **Variant requires variant dependency**
“record mp3 files” requires “play mp3 files”
 - **Variant excludes variant dependency**
“play DivX video files” excludes “play mpeg4 video files”
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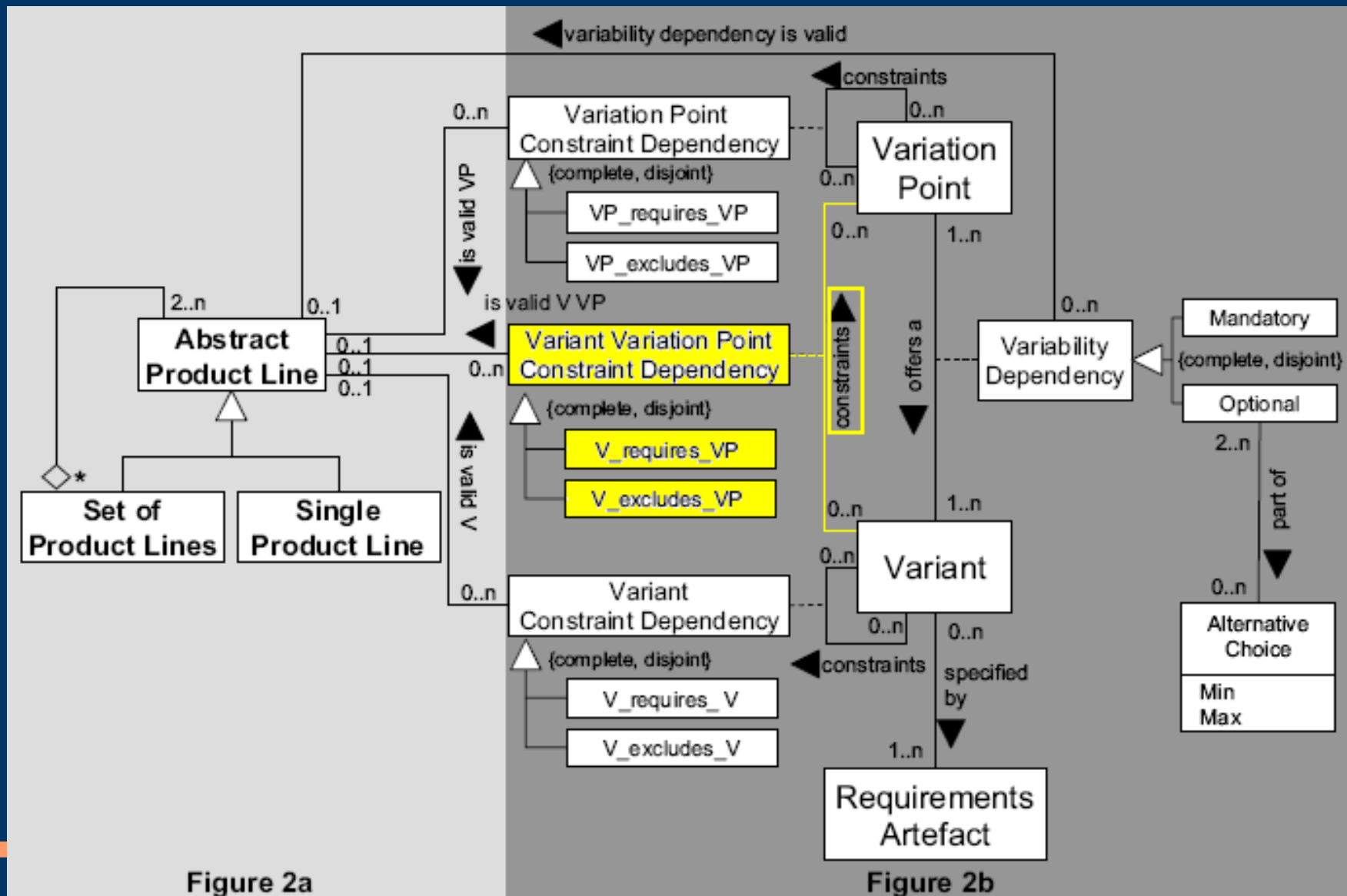
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The Core Variability Meta Model

The **variant variation point constraint dependency**: constraints between variants and variation points.

The Core Variability Meta Model



The Core Variability Meta Model

Variation point constraint dependency:
constraints on the variation point level.

- **Variation point requires variation point dependency**

Defines that all **variants** of a **variation point** require an arbitrary **variant** of the related **variation point**.

- **Variation point excludes variation point dependency**

Defines that all **variants** of a **variation point** exclude all **variants** of another **variation point**.

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Extension Of The Variability Meta Model

By assigning variability to **different product lines (or set of product lines)** it is possible to define for which product line (or set of product lines) a variability information is valid.

Extension Of The Variability Meta Model

- **Class single product line:** represents a single product line.
 - **Class set of product lines:** groups single product lines in to sets.
Allows to indicate, that a variability definition is valid for a set of product lines
 - Generalization class: **abstract product line**
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An Example

Three product lines:

- DVD player
- CD player
- mp3 player

All product lines offer the mandatory variant “digital rights management”.

The “CD and DVD player” (set of) product line(s) offers the mandatory variant “play digital audio” from compact disk.

The “mp3 player” (single) product line offers the mandatory variant “play mp3 files” and the optional variant “play aac files”.

The “DVD player” (single) product line offers the optional variant “play mp3 files”.

◀ variability dependency is valid

Variability Meta Model

Product Line Model

Instance of

←

Instance relations between associations are not shown for reason of readability.

Mandatory

{complete, disjoint}

Optional

Variation Point

1..n

0..n

Variability Dependency

1..n

Variant

2..n 0..1

Abstract Product Line



Set of Product Lines

Single Product Line

all

DVD/CD

CD player

DVD player

mp3 player

v play mp3 files

v play digital audio

v play aac files

v digital rights management

VP

audio

Implementation in DOORS

Formal modules

- Product line structure
abstract product lines, variability dependency
 - Variability view
variant → variation point
 - Requirements artefacts
concrete requirements
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Implementation in DOORS

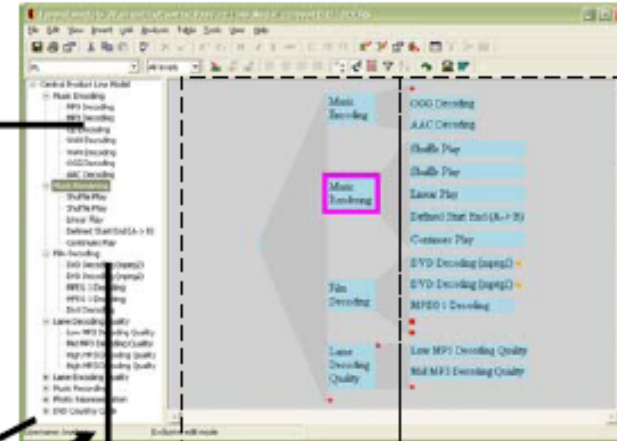
Product Line Structure

ID	Product Line	Variability Dependency	Range Value
1	ALL	optional	0..1
2	ALL	range	1..1
4	ALL	mandatory	1..1
5	CD player	optional	0..1
6	CD player	range	1..1
7	CD player	range	2..2
8	CD player	mandatory	1..1
9	CDD player	optional	0..1
10	CDD player	range	1..1
11	CDD player	range	1..3

Abstract Product Line

Variability Dep. and Range

Variability View



Variation Point

Variant

Variability Dependency is valid for

Attributed Link
- Type: requires
- Valid for PL: CD

Constraint is valid for

Variant is specified by

		From			
To		V1	V2	V7	V9
V1					
V3					
V5					
V6					
V7					

Multiple Constraint

Single Constraint

Constraint Dependencies Exemplary View

Requirements Artefacts