openCPQ – A React-Based Product-Configuration Toolkit

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MunichJS Meetup, 2015-05-13

Product Configuration

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Variants

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Parameters and Domains

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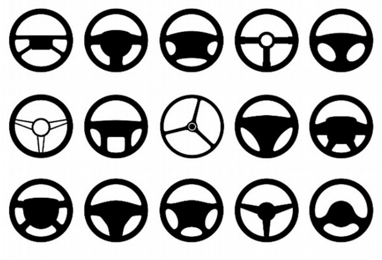

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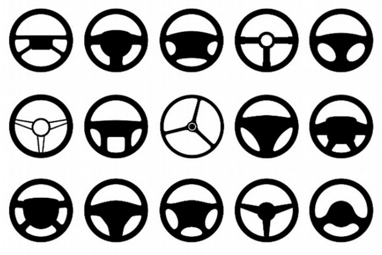

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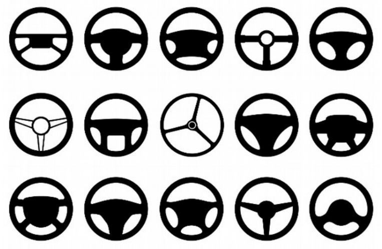

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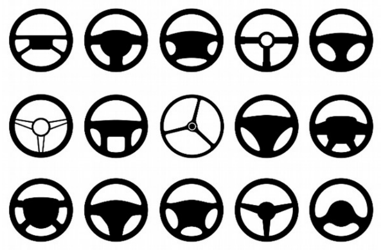

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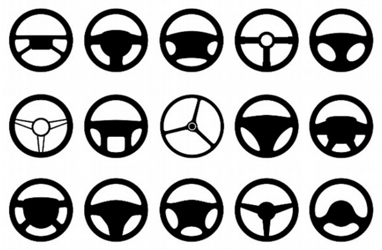

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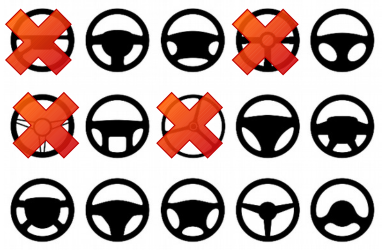

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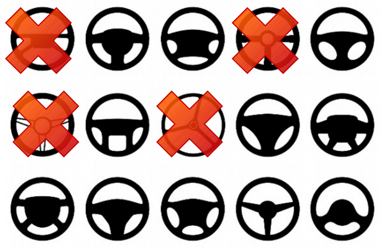

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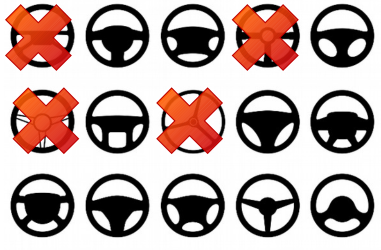
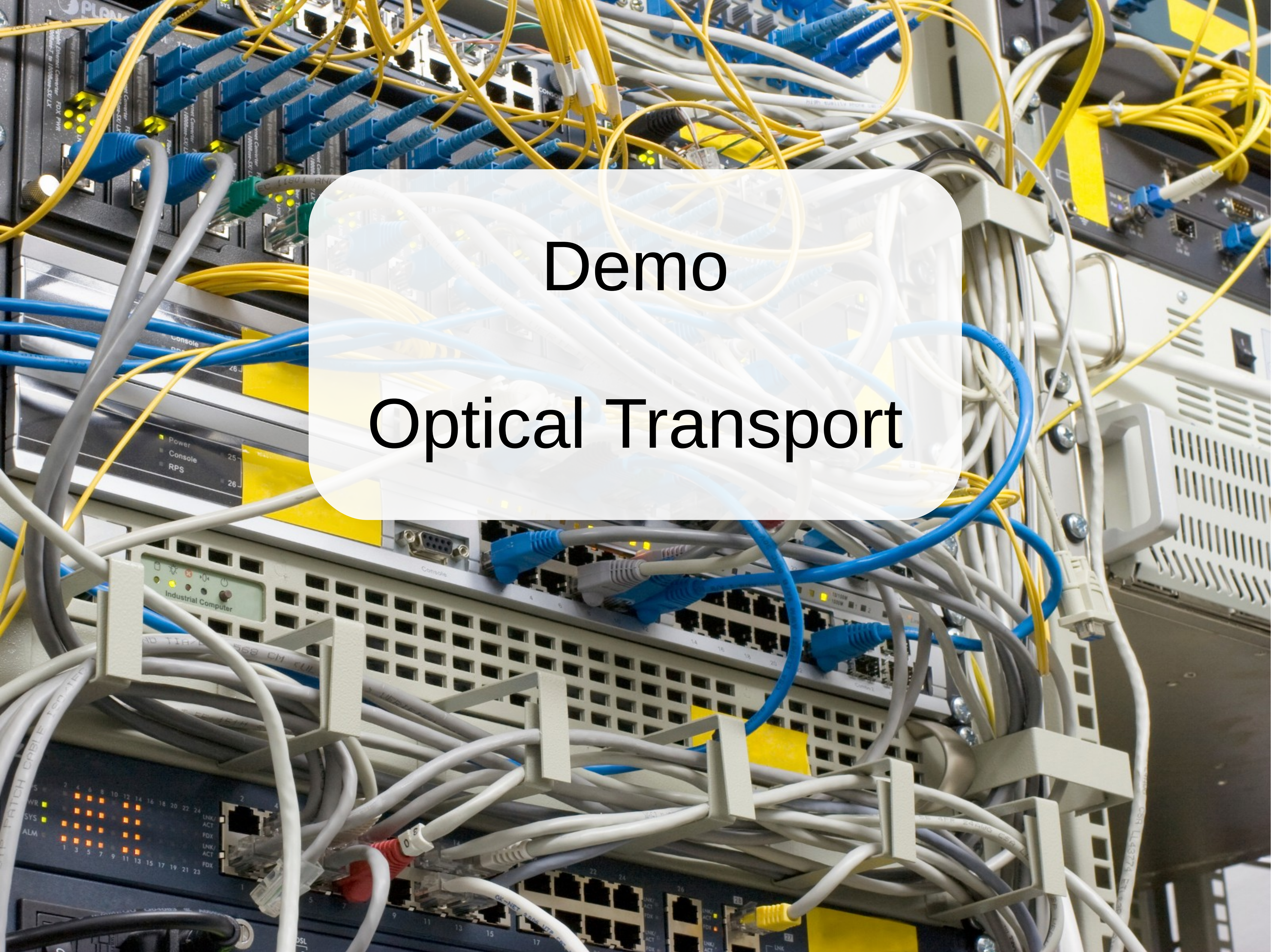


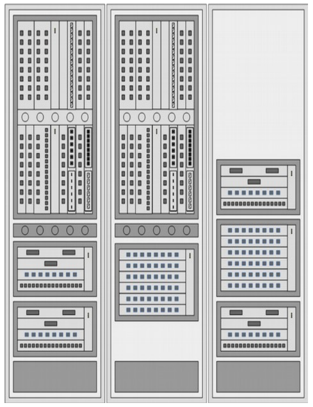
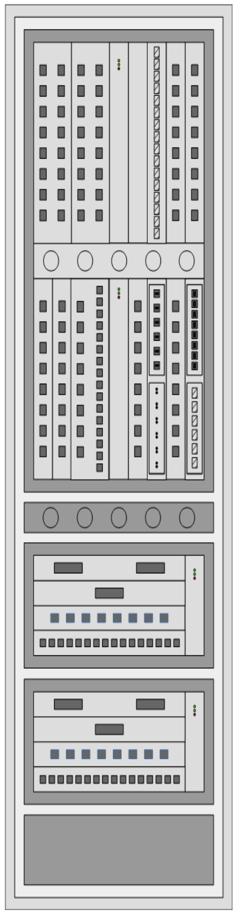
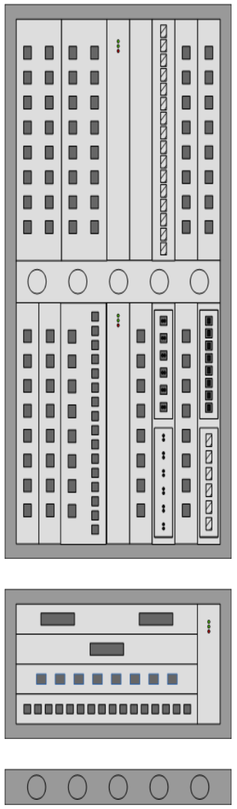
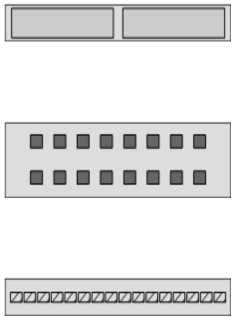
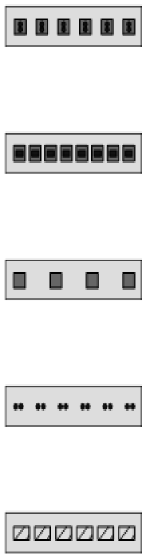


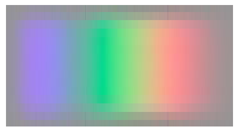
Demo

Optical Transport

Demo Example: Hierarchical Configuration

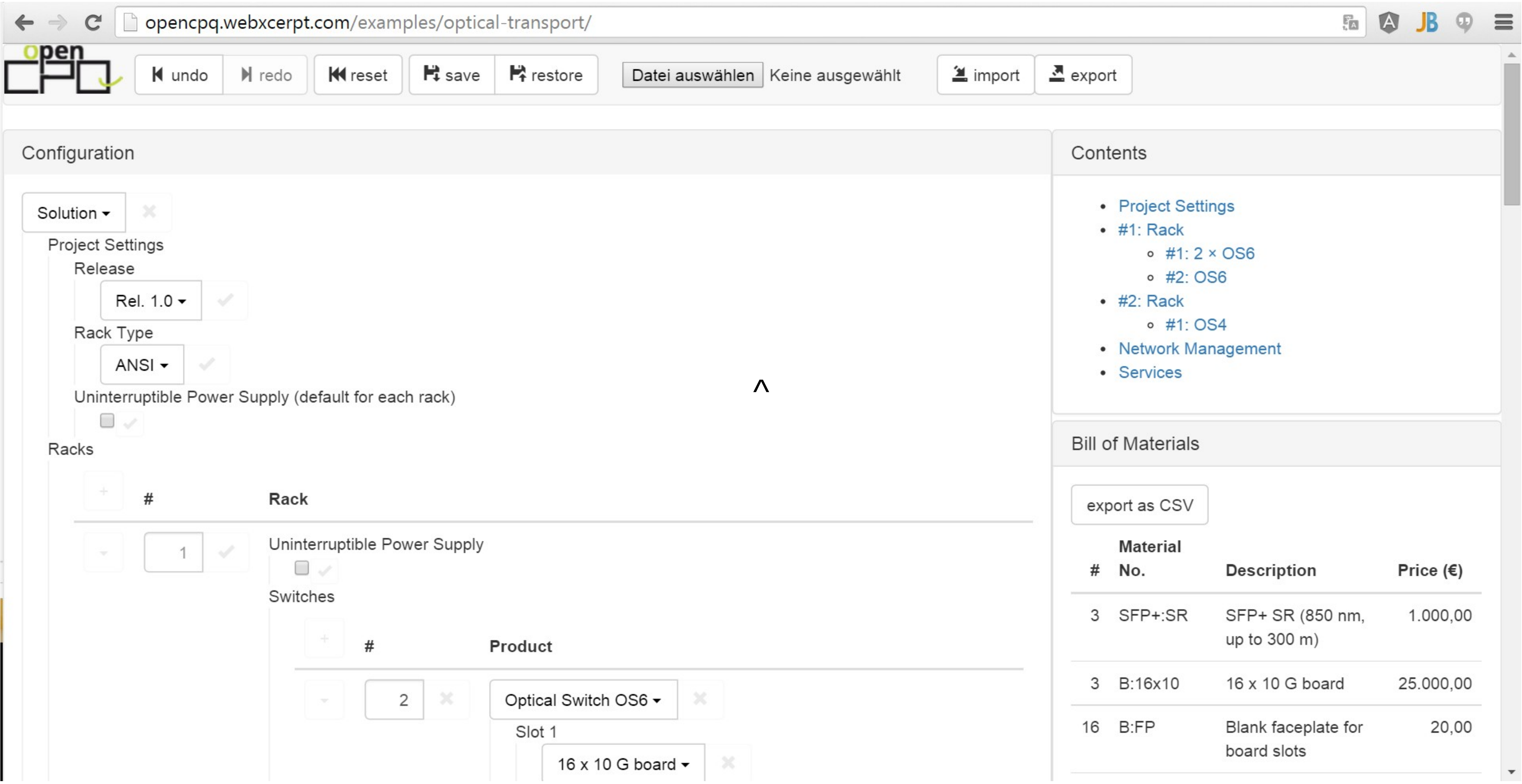
Solution   Rack   Switch   Board   (Module)   Transceiver   (Wavelength)



Demo

http://opencpq.webxcerpt.com/examples/optical-transport/



Configuration

Solution

Project Settings

Release: Rel. 1.0

Rack Type: ANSI

Uninterruptible Power Supply (default for each rack)

Racks

#	Rack
1	Uninterruptible Power Supply Switches

#	Product
2	Optical Switch OS6 Slot 1: 16 x 10 G board

^

Contents

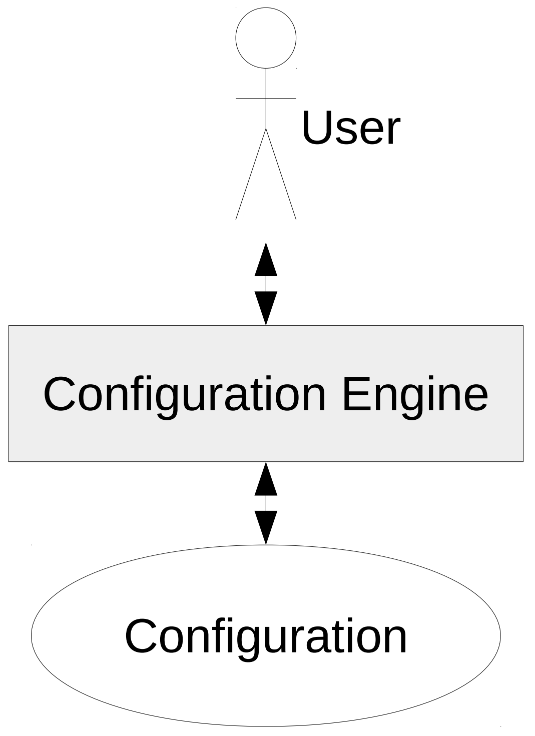
- Project Settings
- #1: Rack
  - #1: 2 × OS6
  - #2: OS6
- #2: Rack
  - #1: OS4
- Network Management
- Services

Bill of Materials

export as CSV

#	Material No.	Description	Price (€)
3	SFP+:SR	SFP+ SR (850 nm, up to 300 m)	1.000,00
3	B:16x10	16 x 10 G board	25.000,00
16	B:FP	Blank faceplate for board slots	20,00

Business Processes



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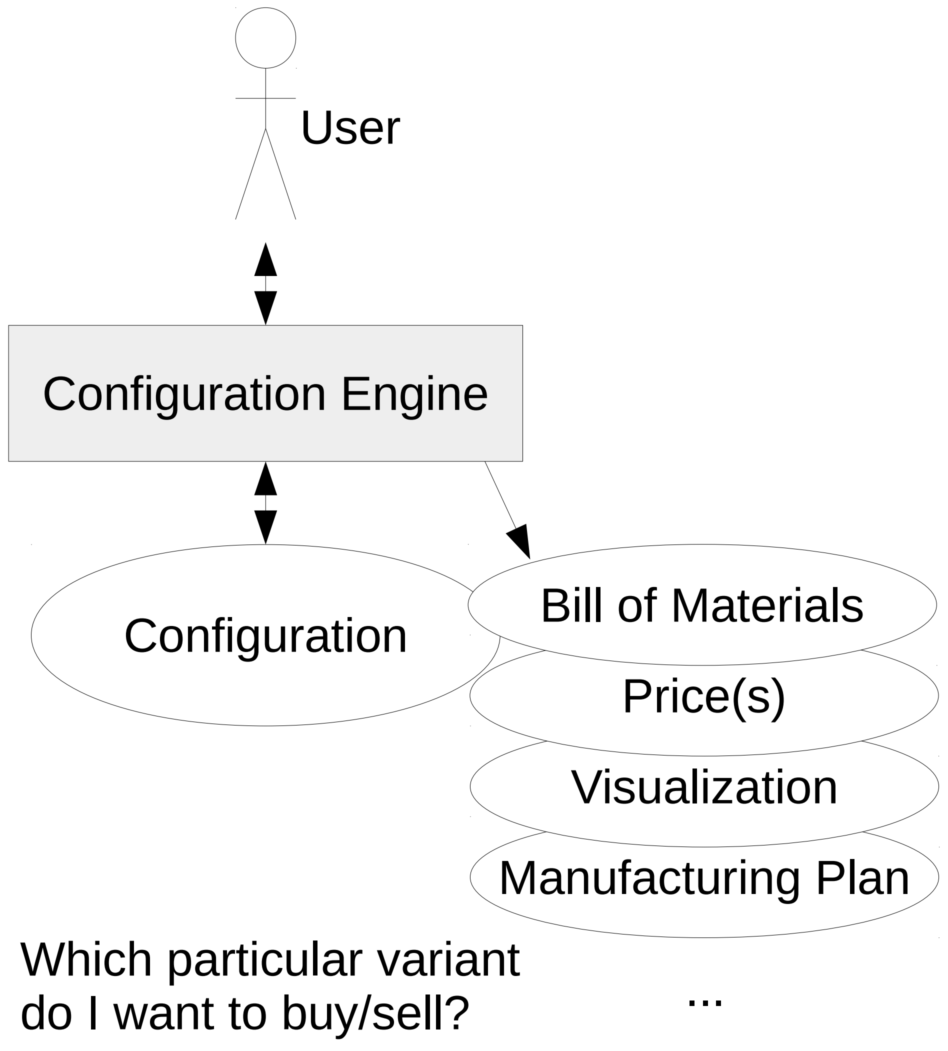

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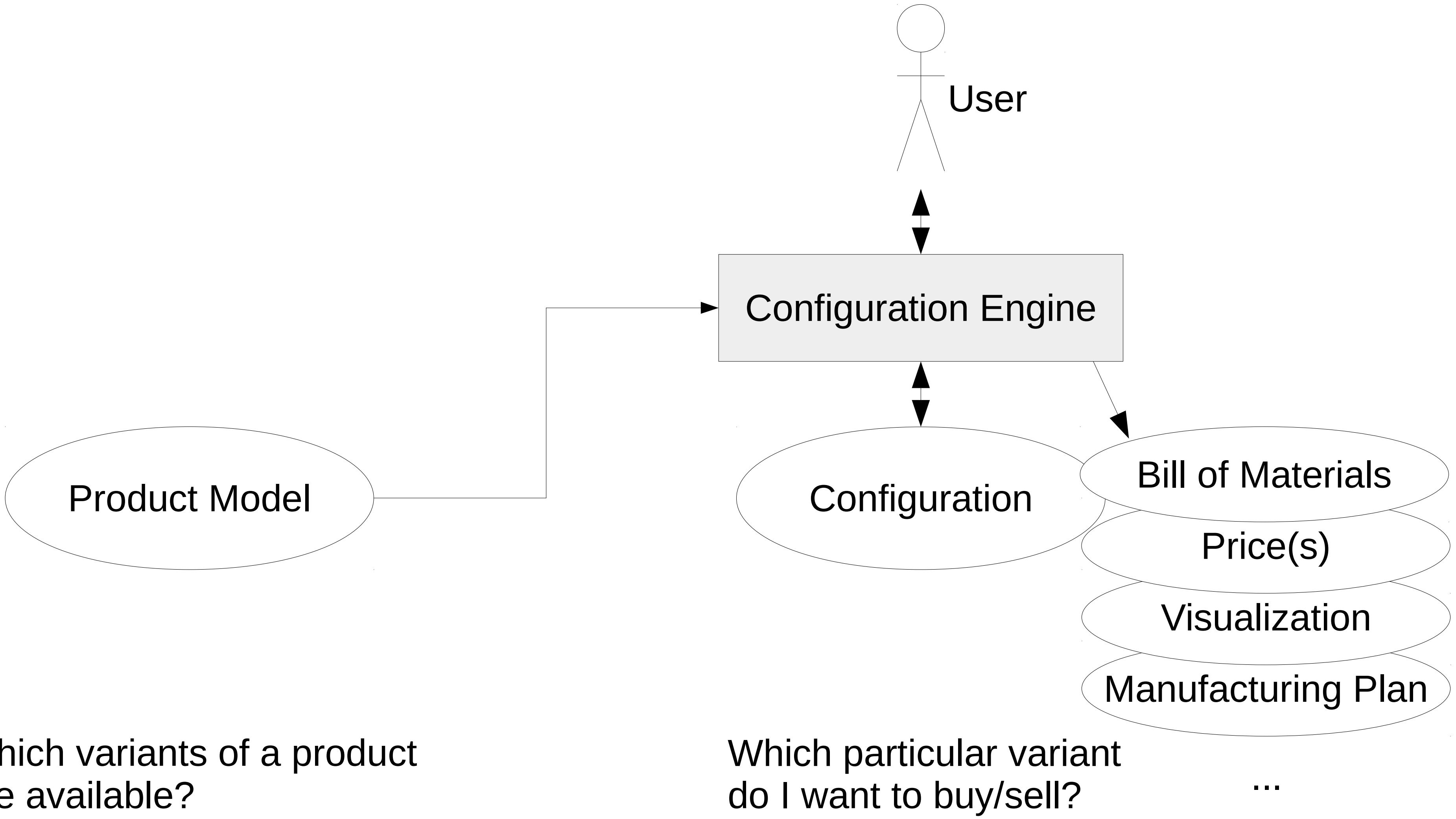

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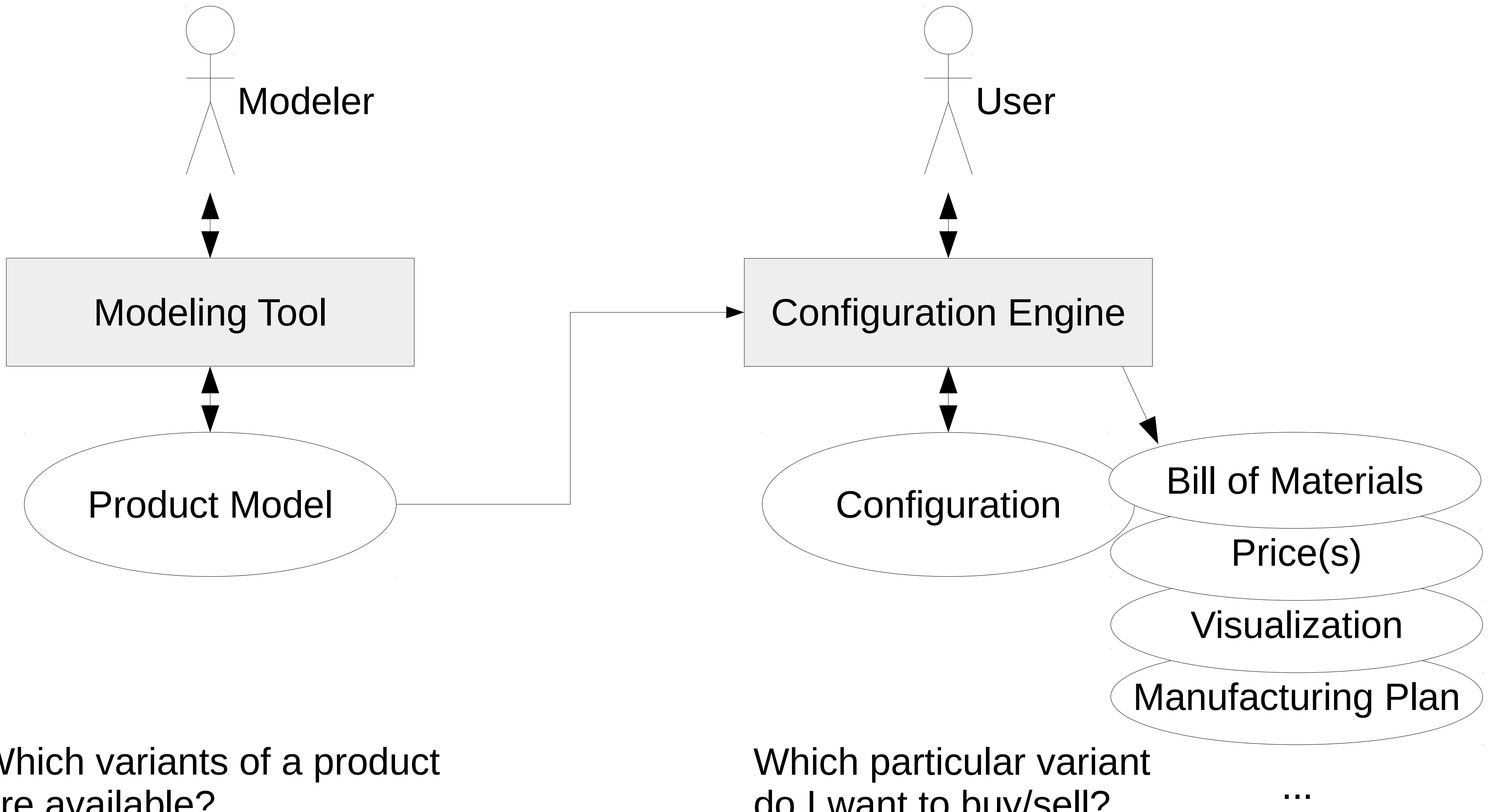

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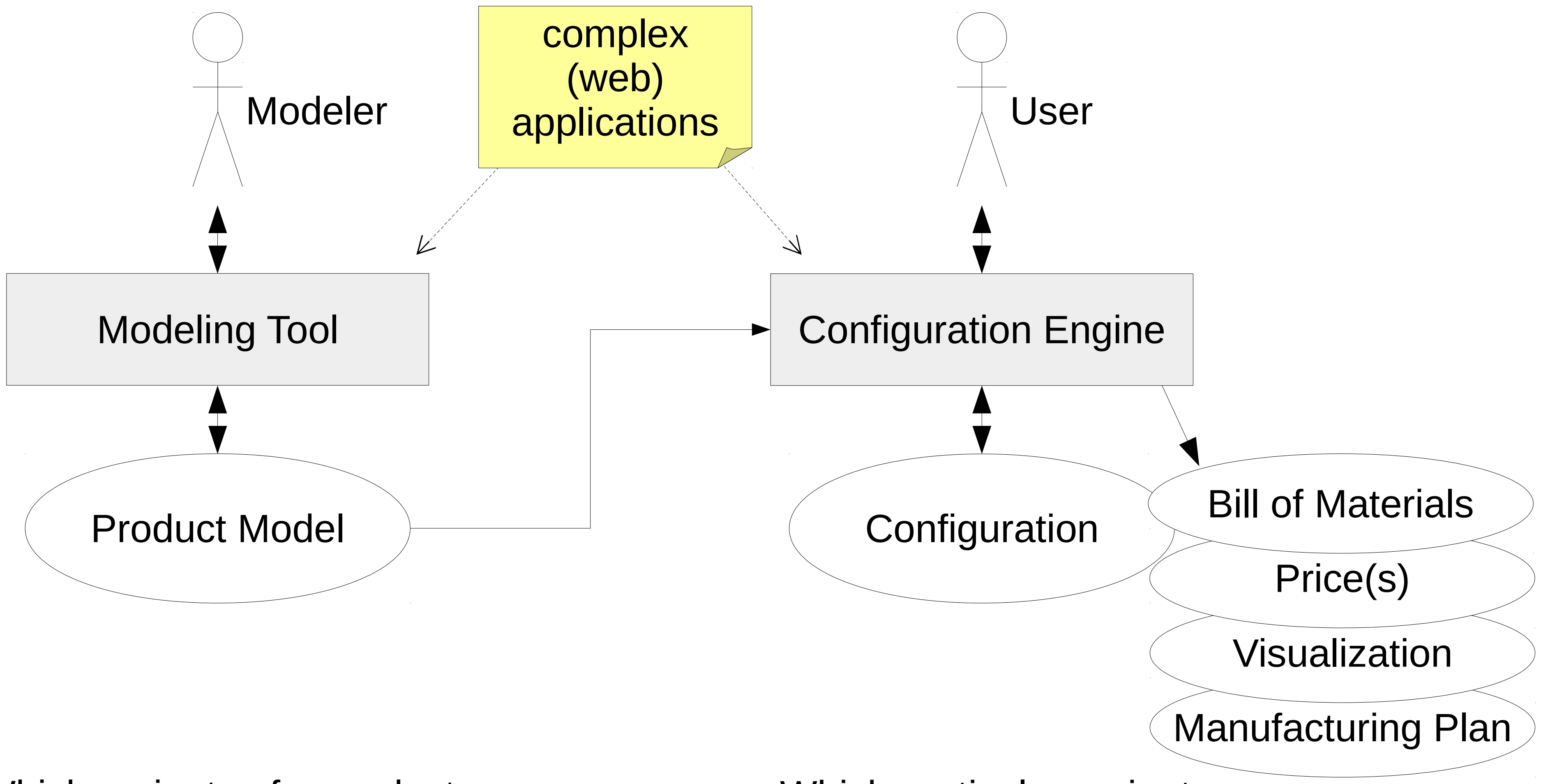

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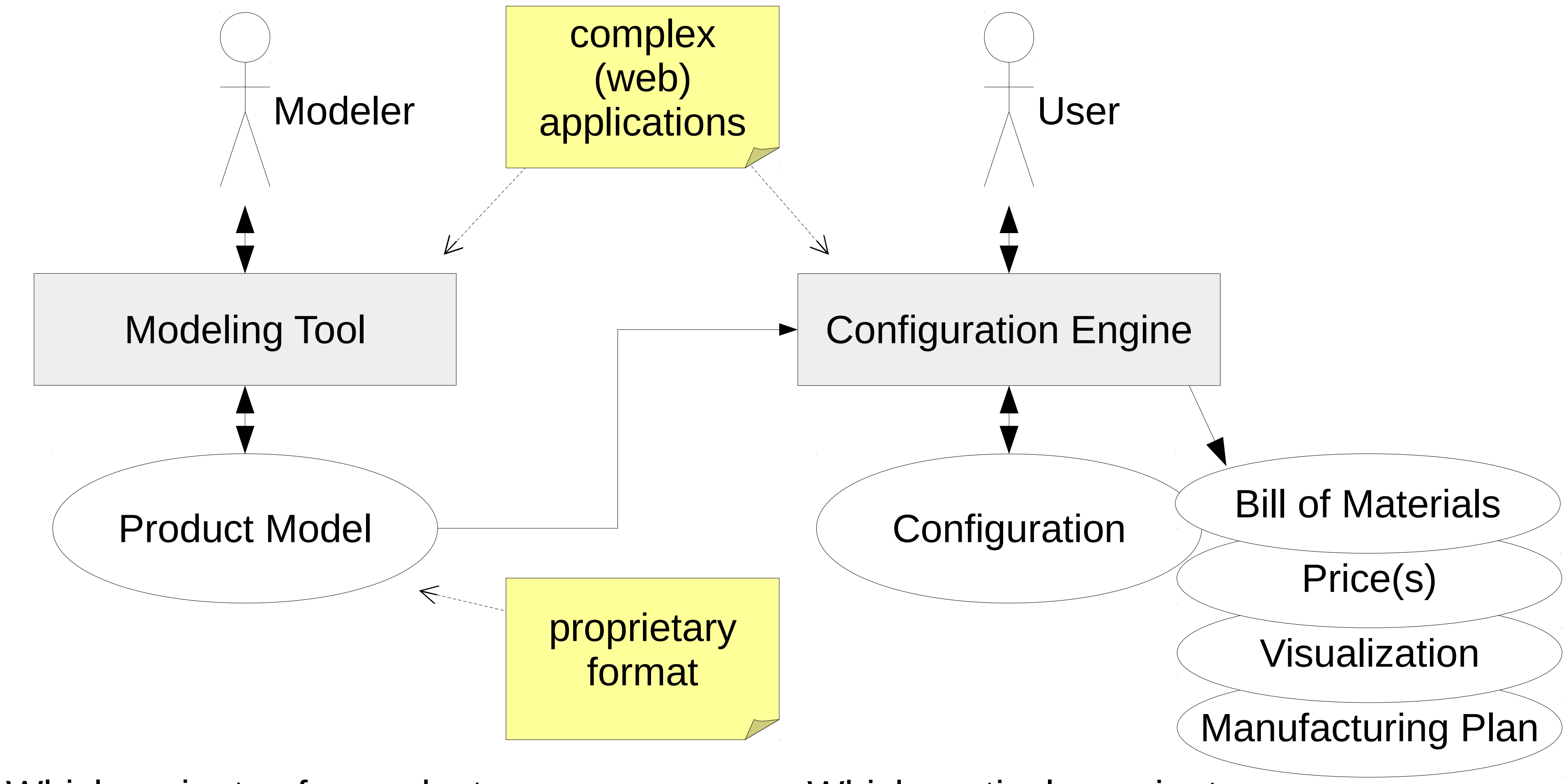

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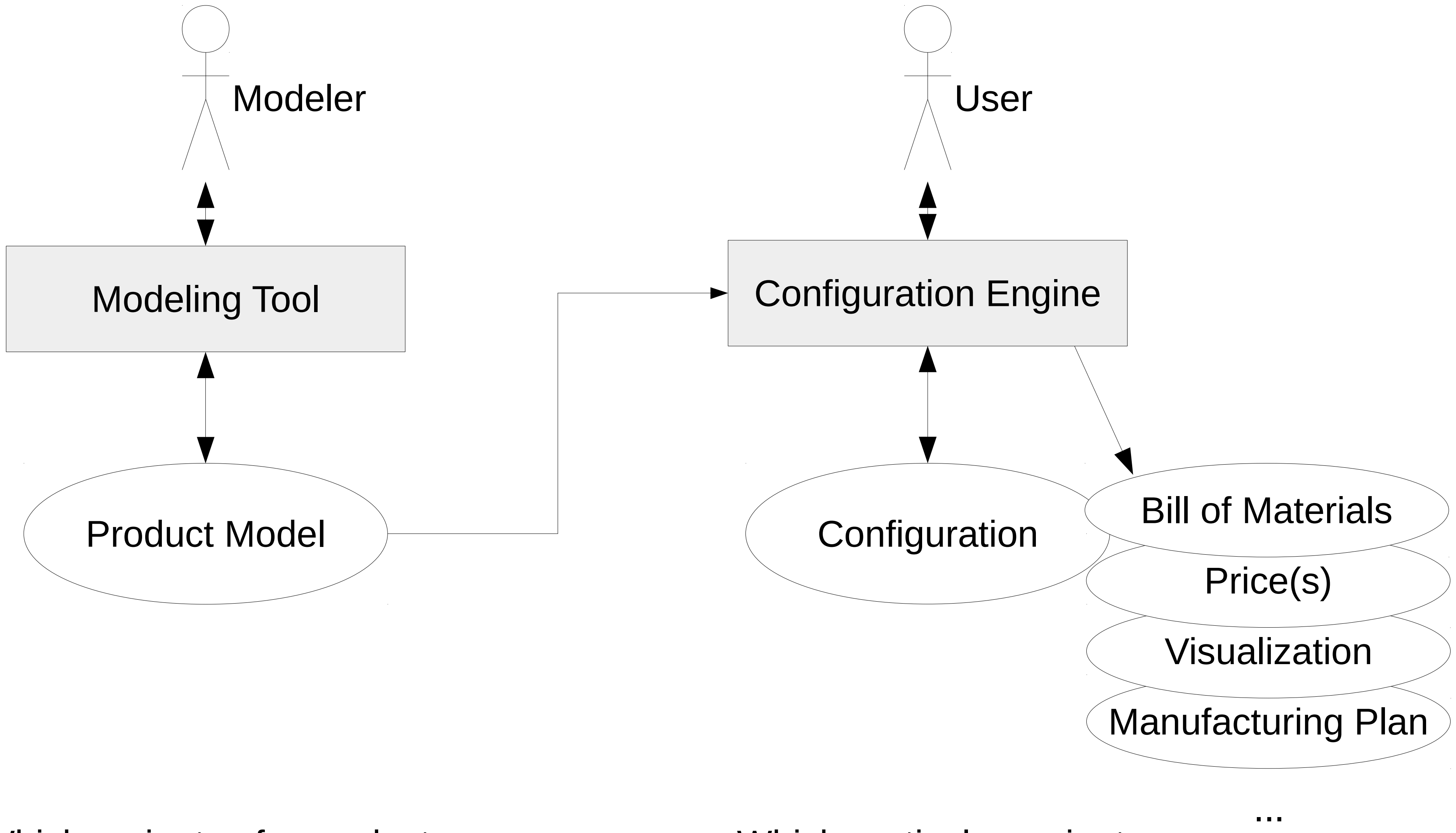
Problem 1

Business Processes



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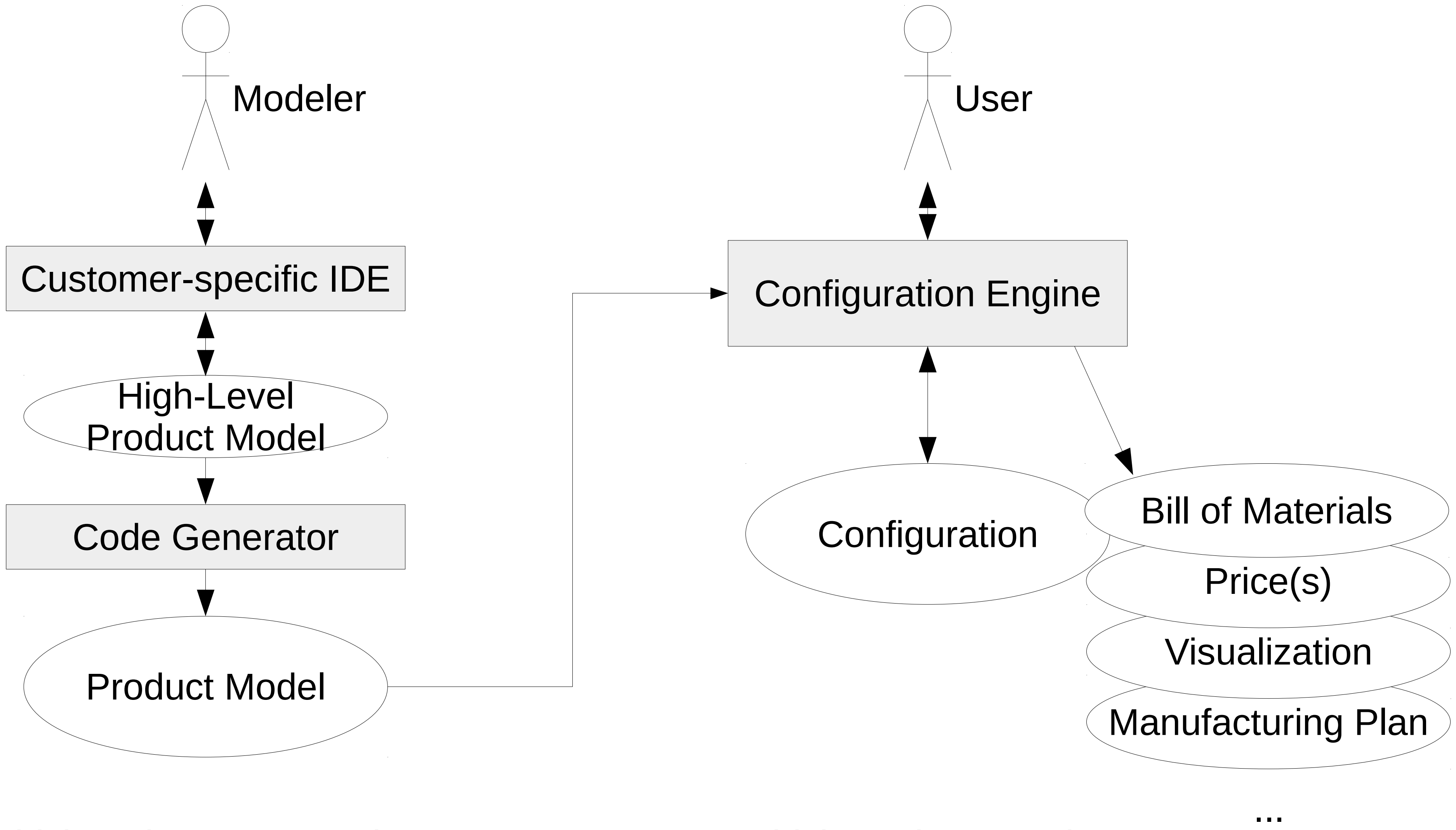

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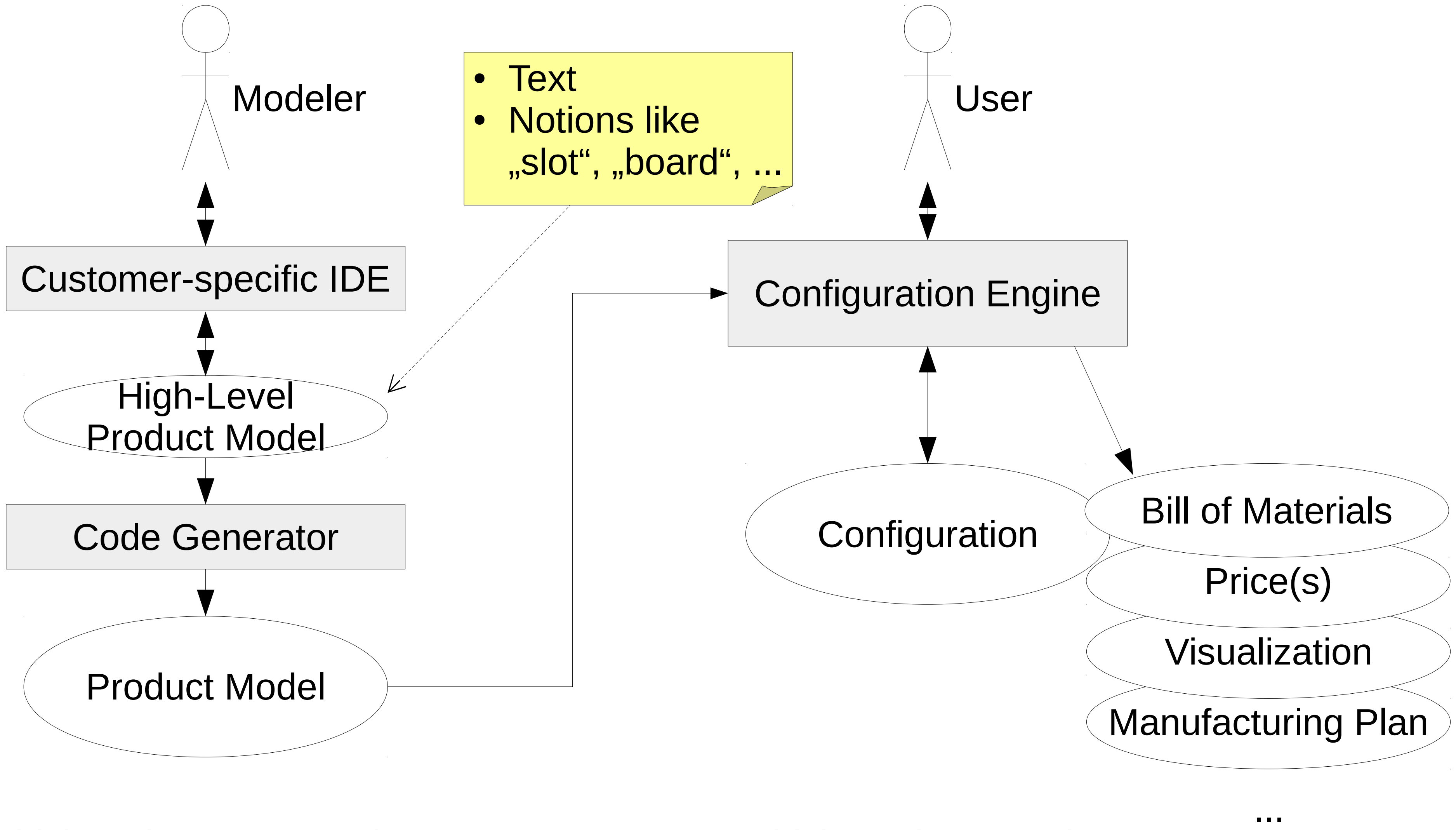

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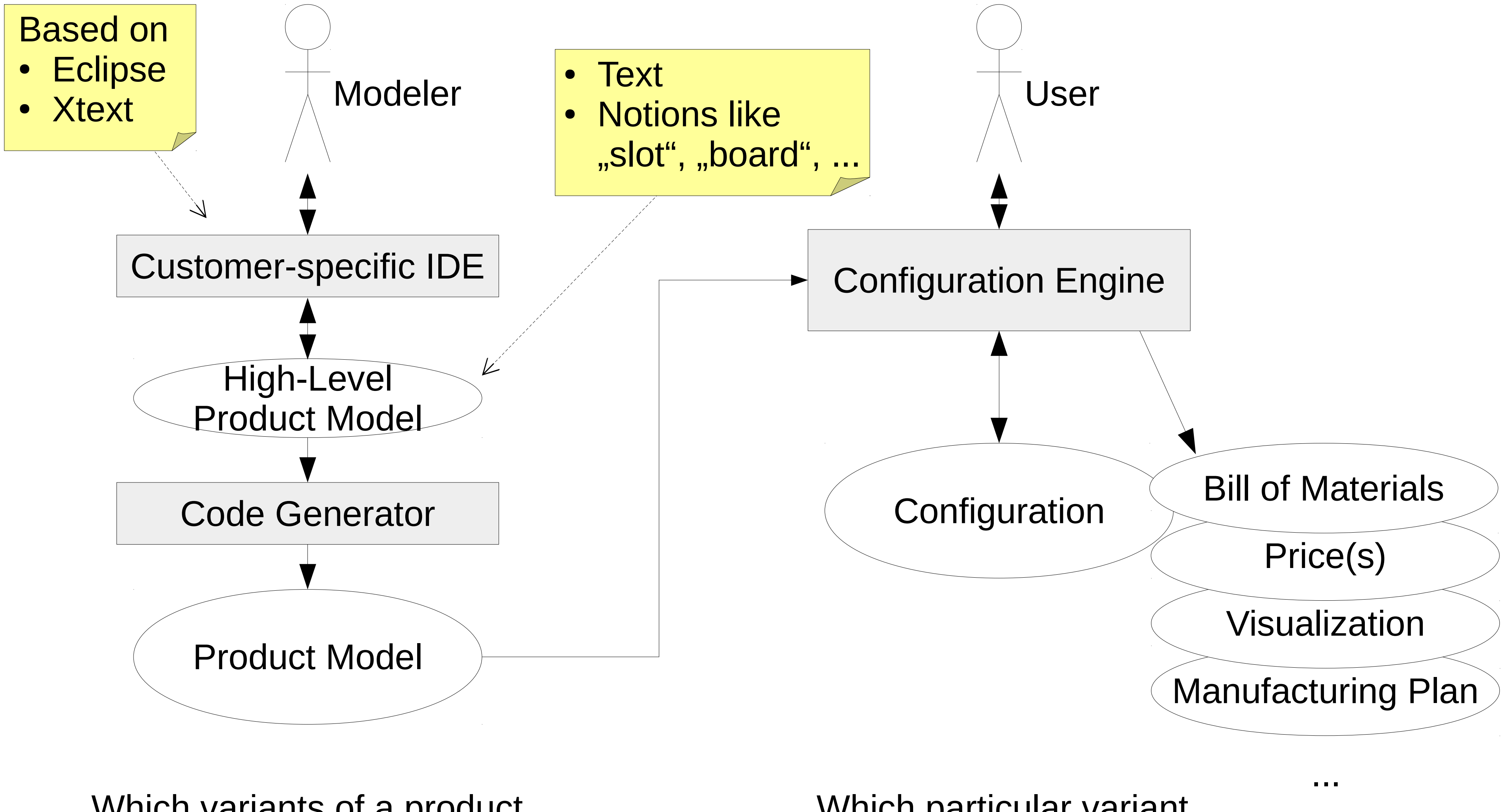

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Models are programs!

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- Programming tools
  - Editors/IDEs
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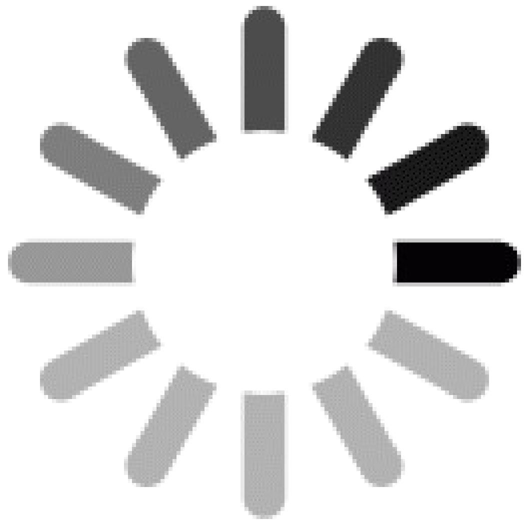
  - Revision control
  - Test and CI frameworks
- General purpose tools and languages
  - Maturity
  - Re-usable knowledge, may already be available
  - Large communities and „ecosystems“

Problem 2



Configuring in the Browser

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Implement configurators in JavaScript.

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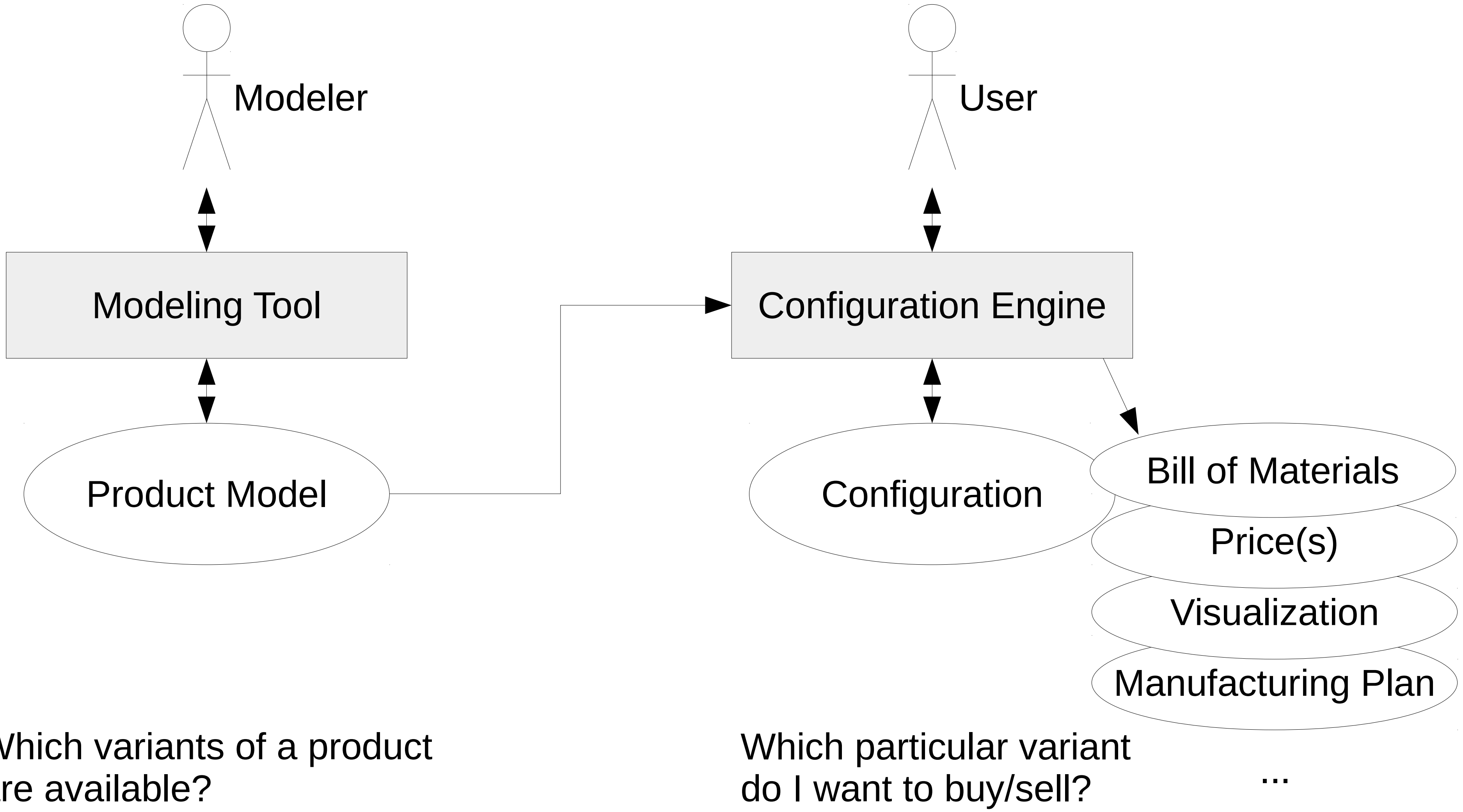
JavaScript is also
a reasonable choice for modeling.

Business Processes



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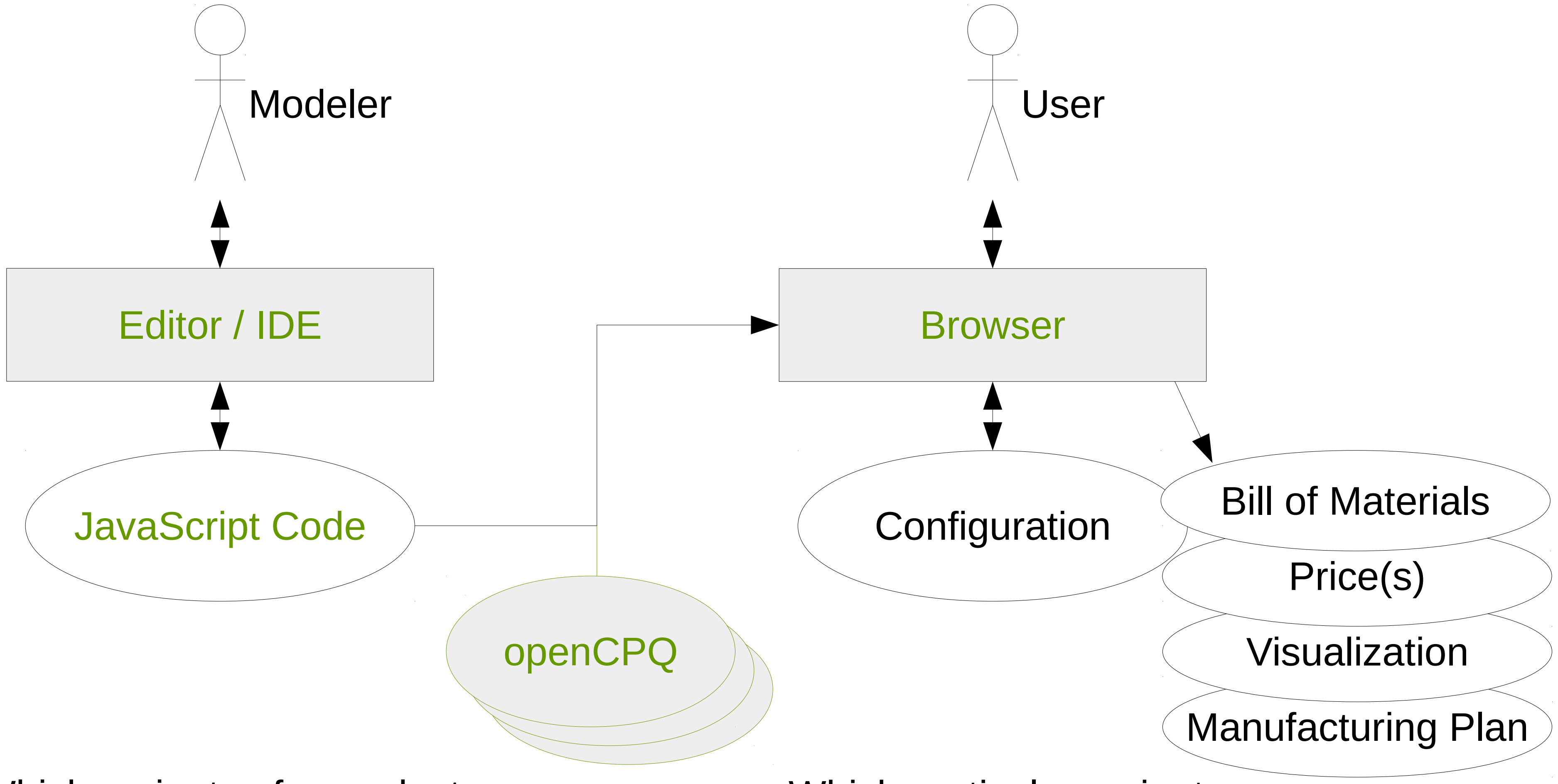

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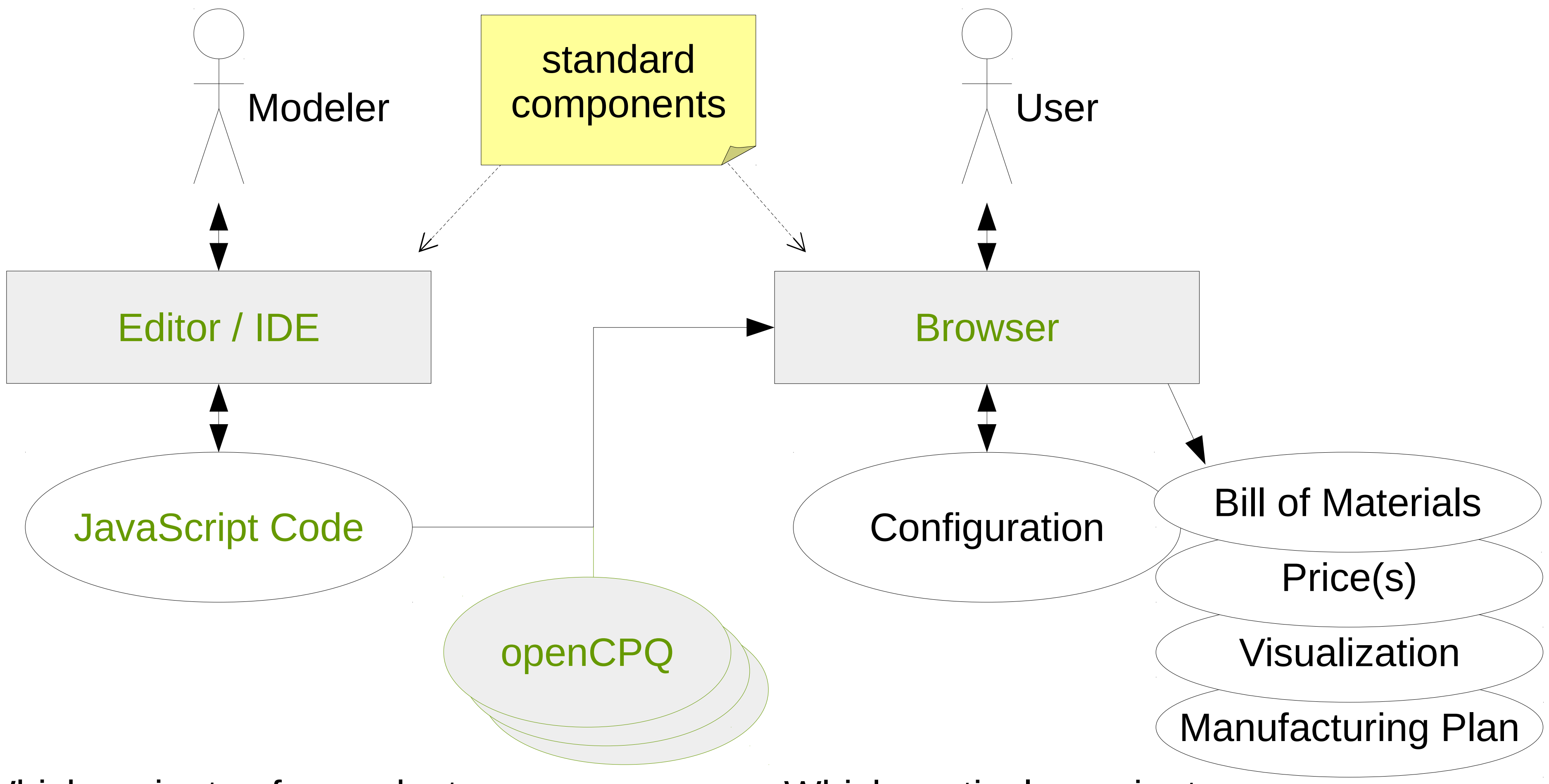

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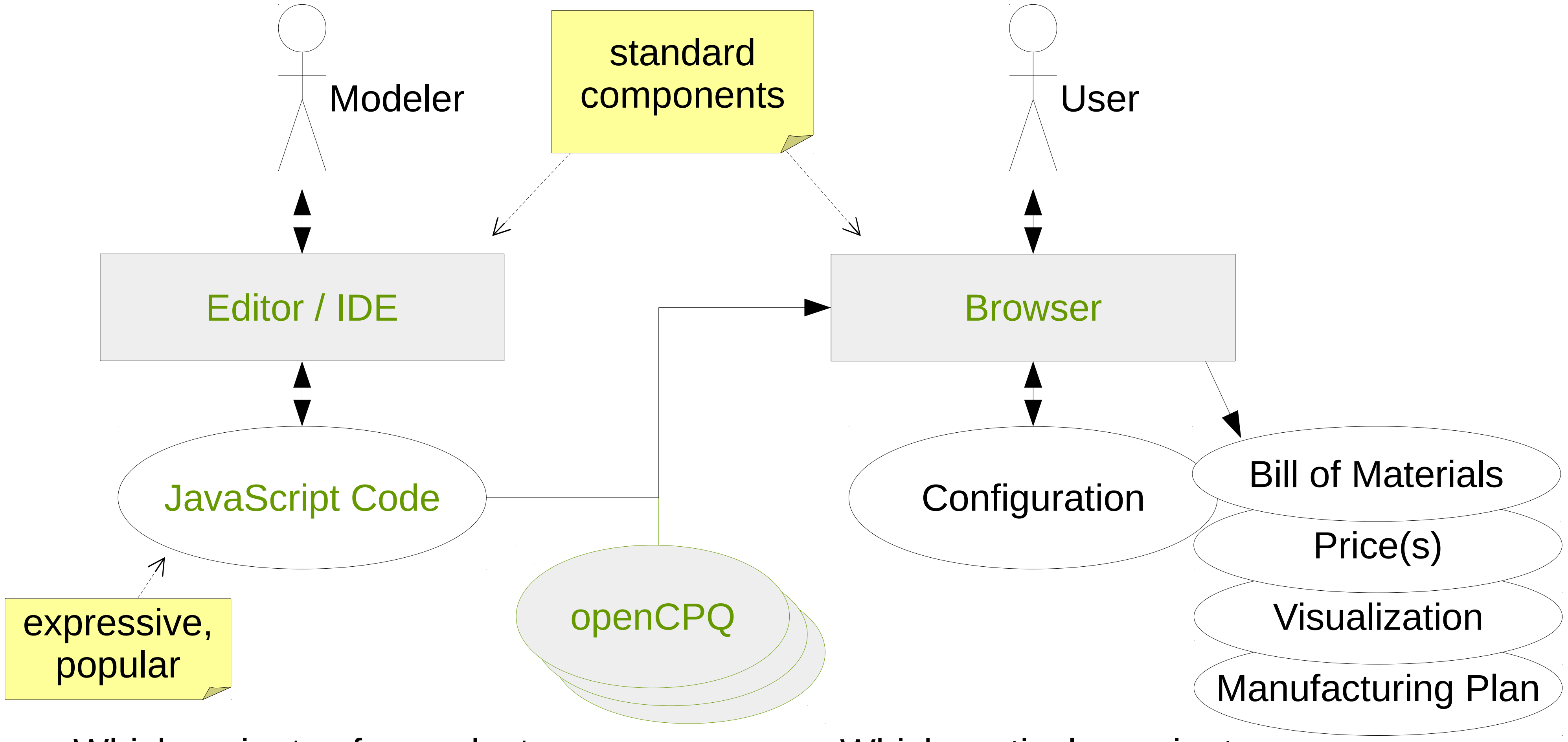

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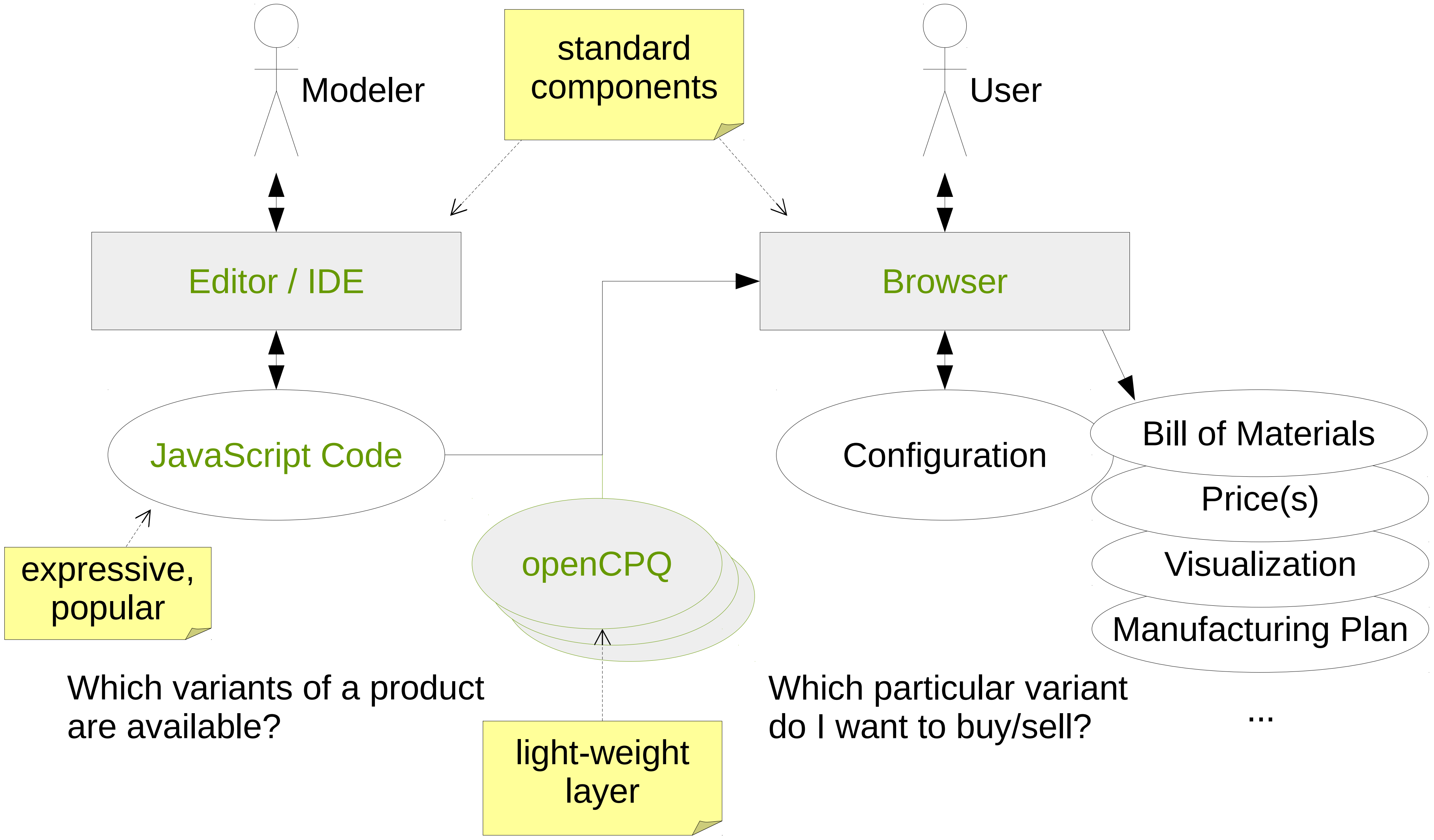

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- Add application-specific building blocks
- A light-weight layer based on React and Bootstrap

openCPQ – an Open-Source Project

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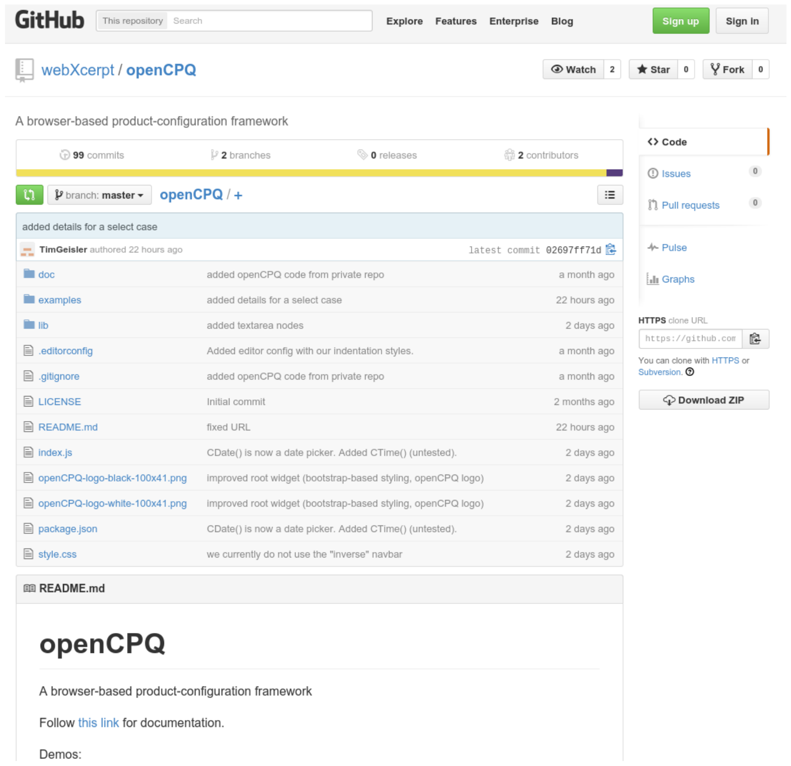
Source code and links to live demos available on Github: https://github.com/webXcerpt/openCPQ



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A browser-based product-configuration framework

99 commits · 2 branches · 0 releases · 2 contributors

branch: master · openCPQ / +

added details for a select case

TimGeisler authored 22 hours ago · latest commit 02697ff71d

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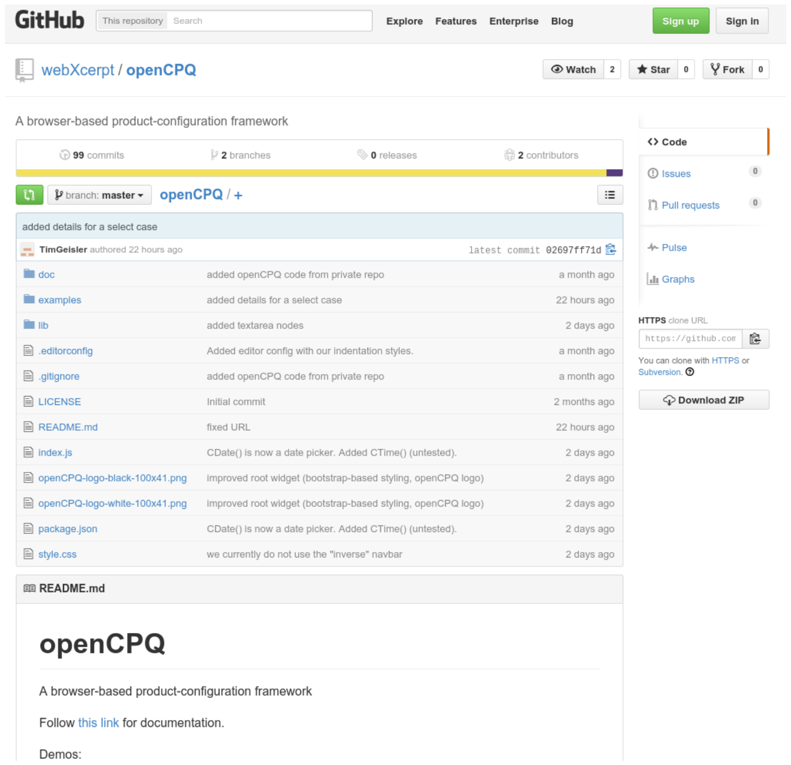

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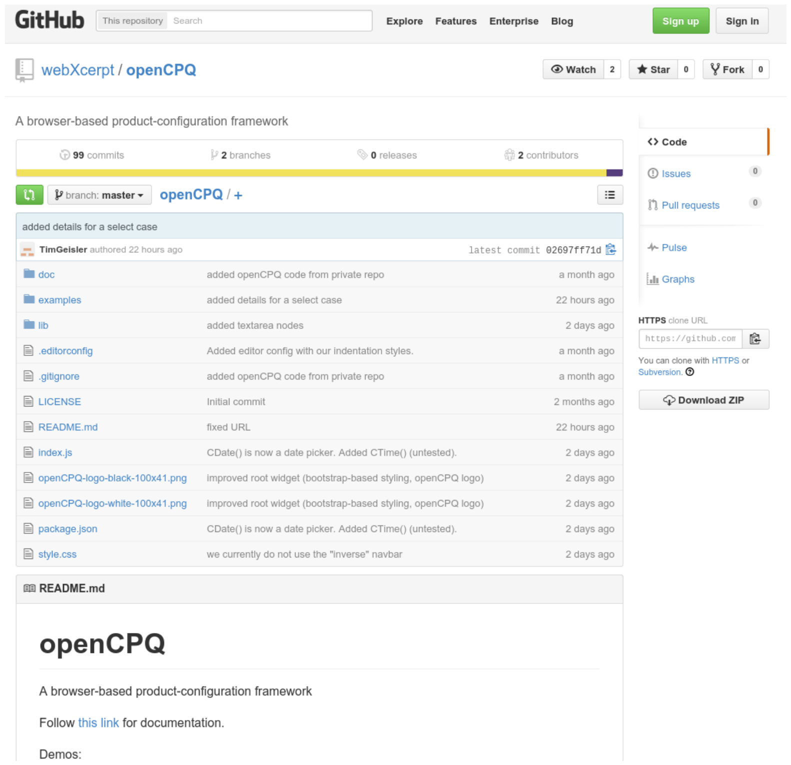

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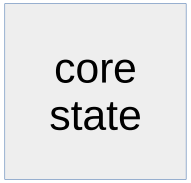
How it Works

Change Propagation: Non-Incremental



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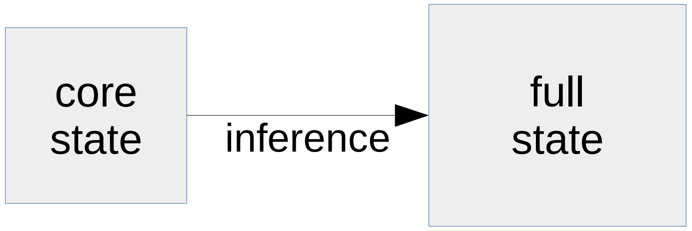

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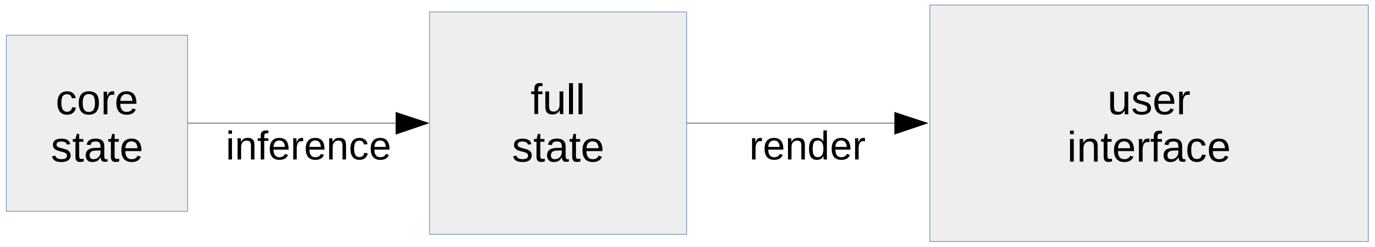

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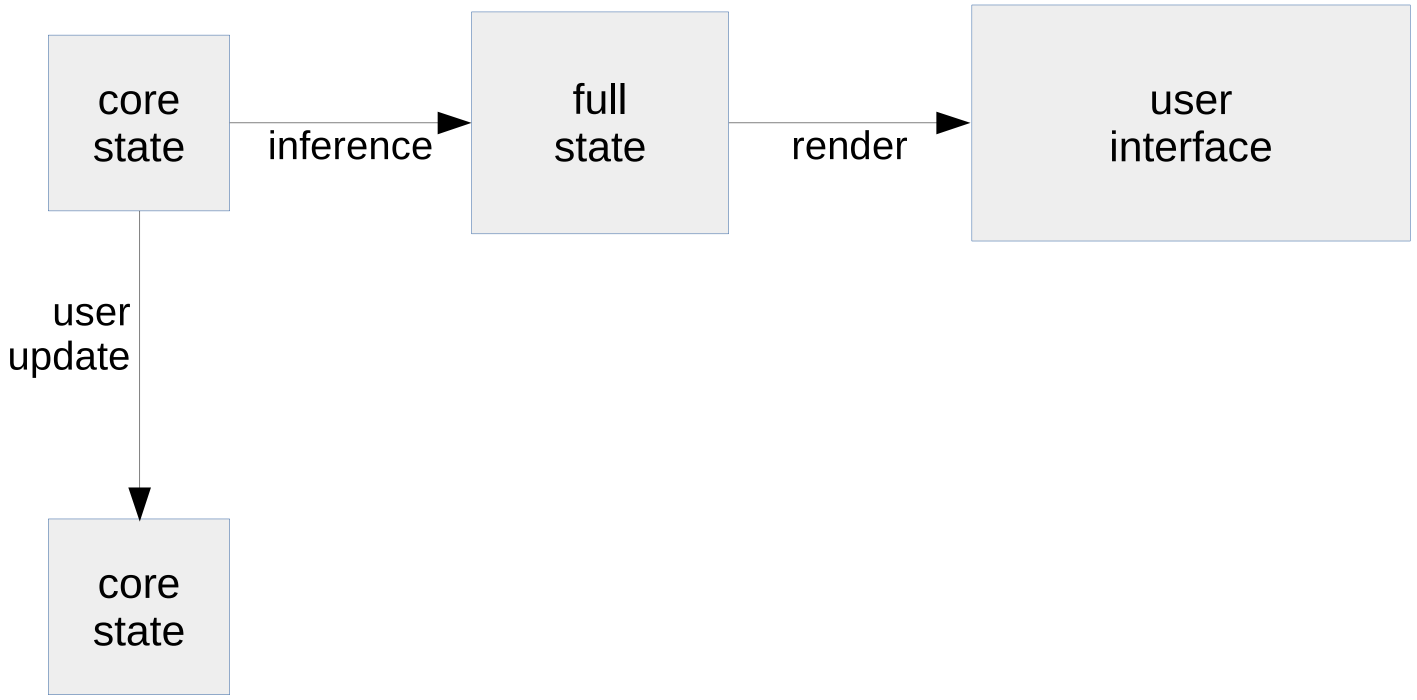

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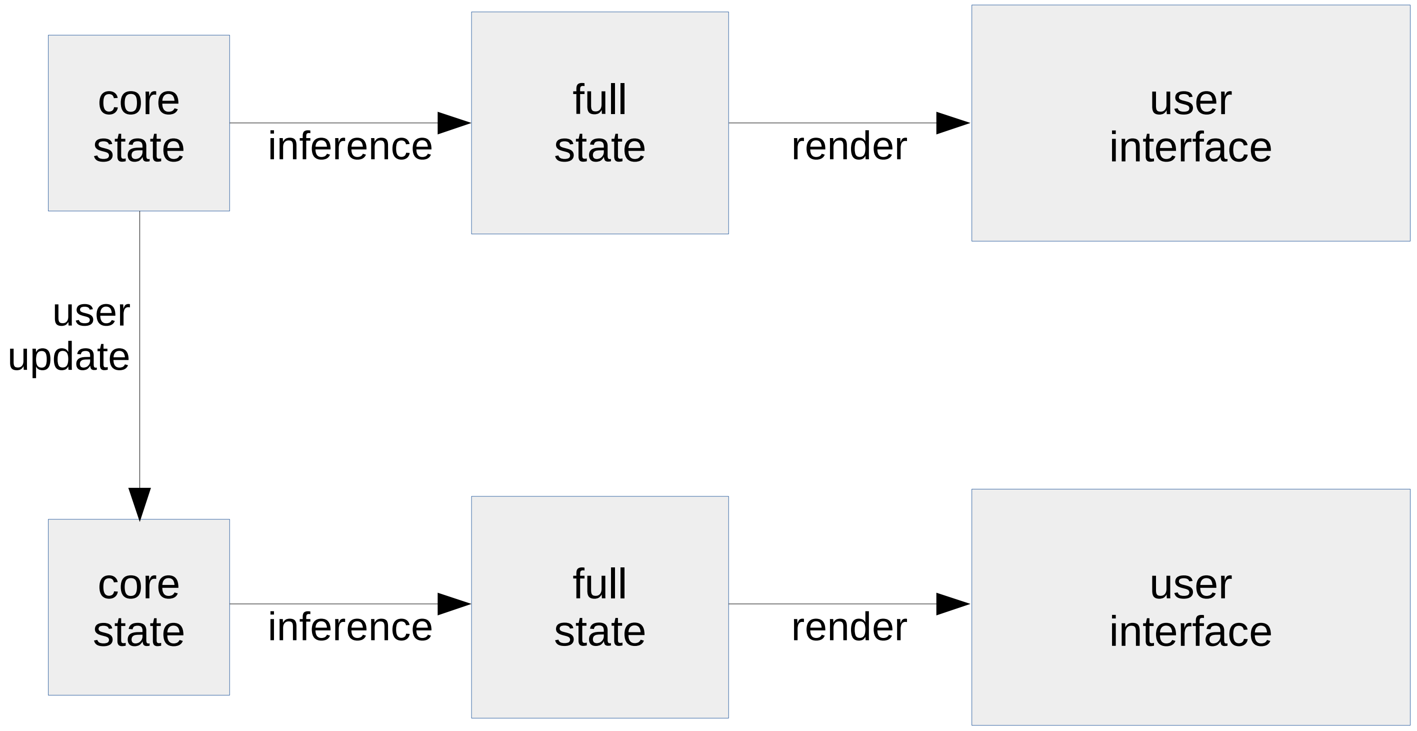

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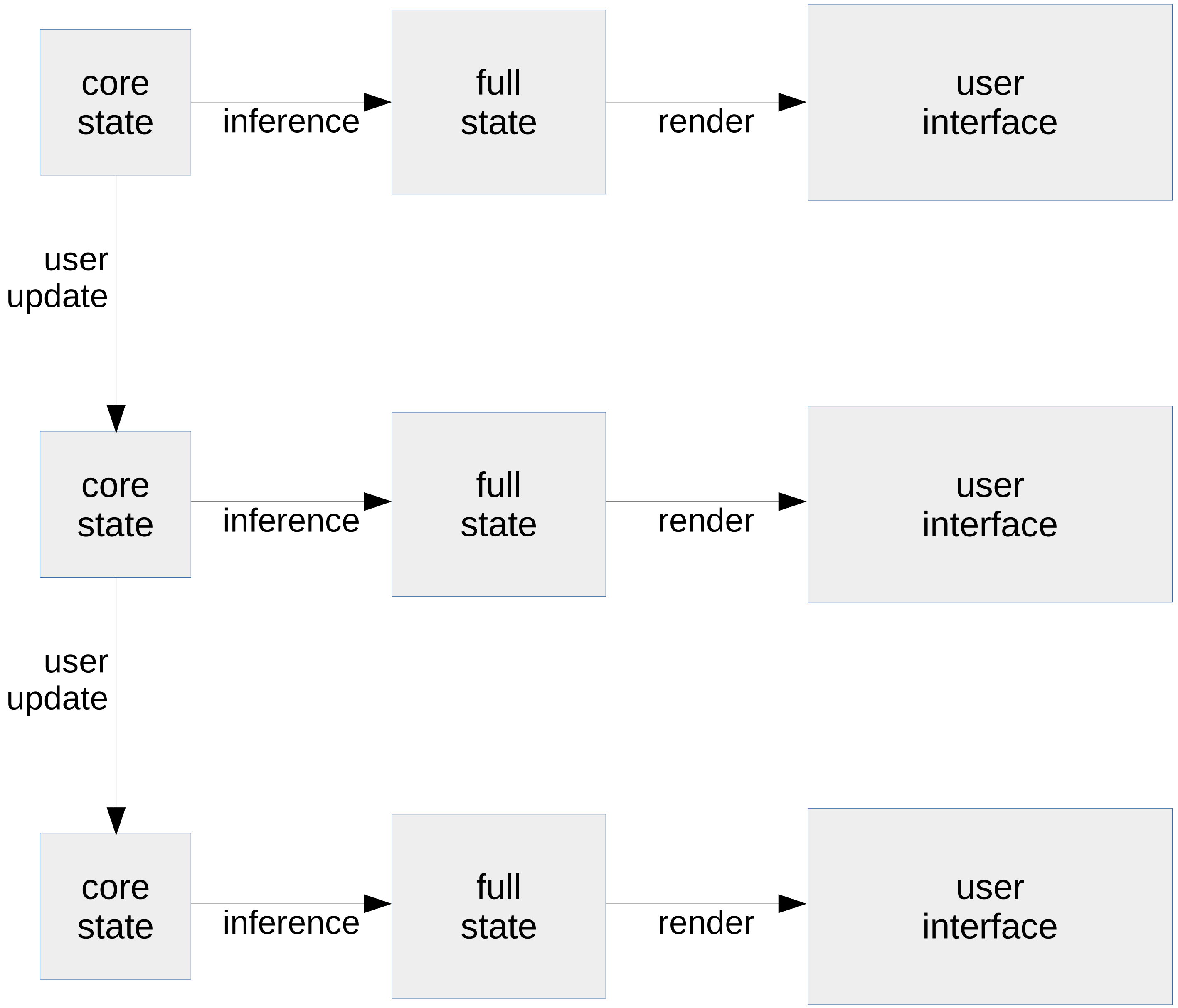

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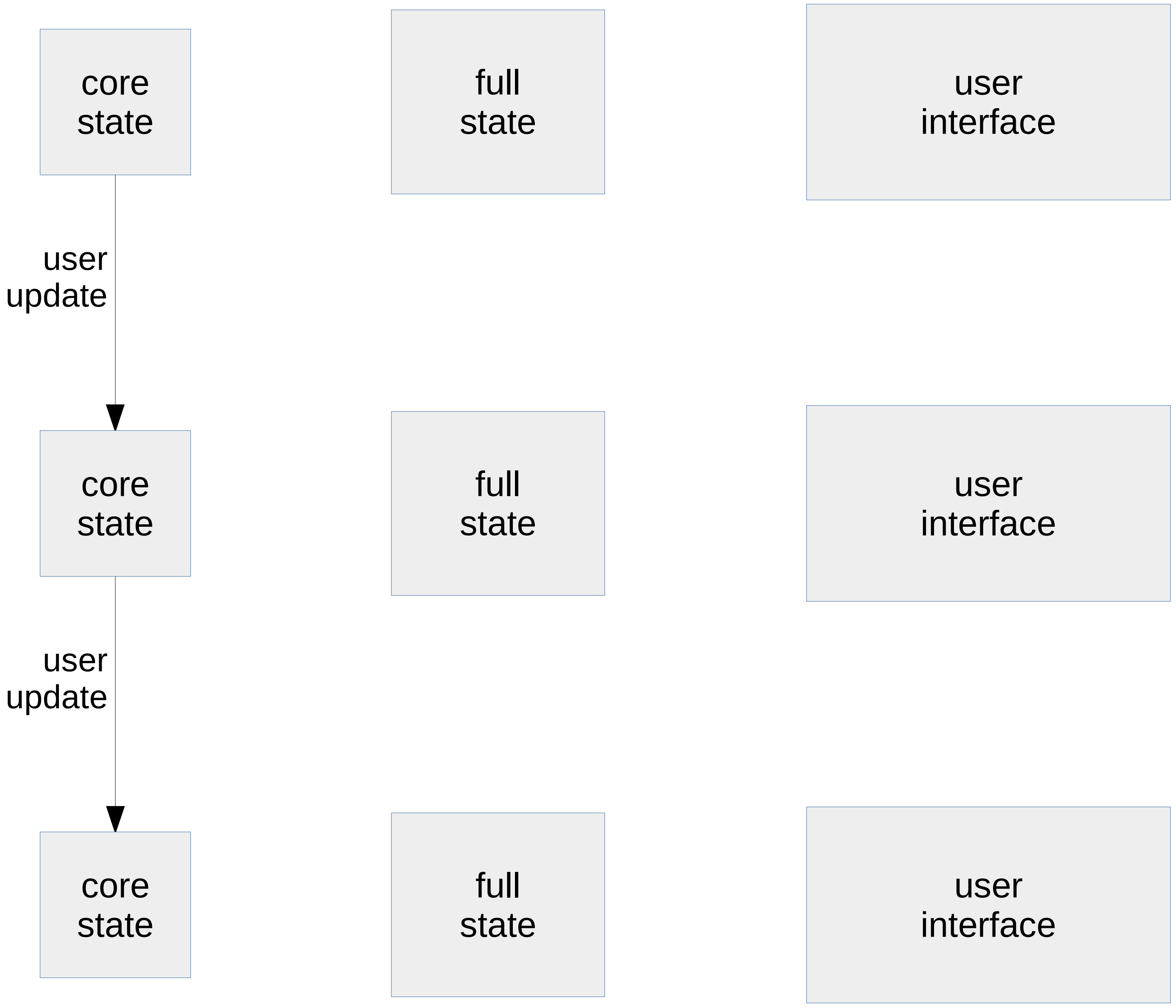

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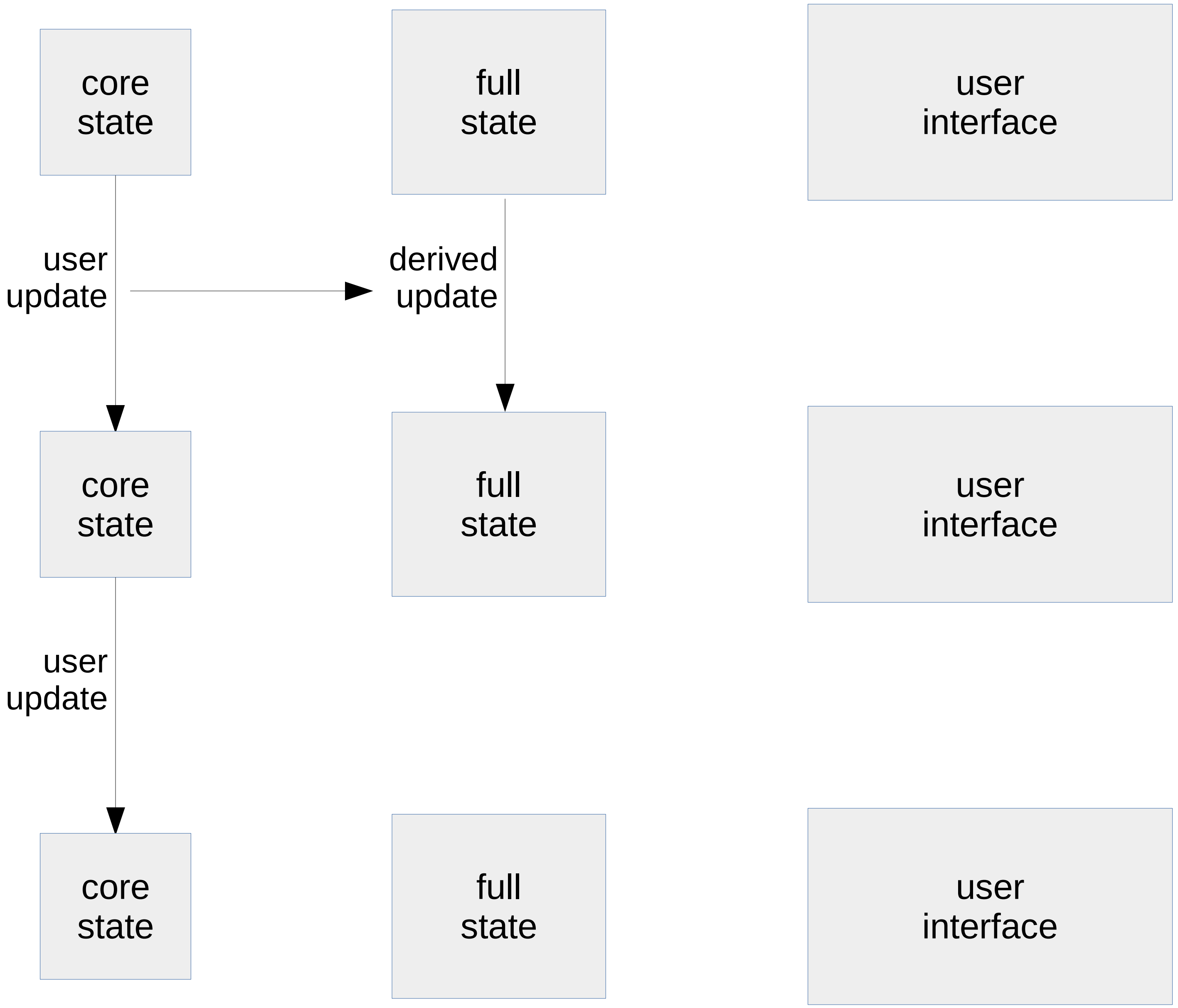

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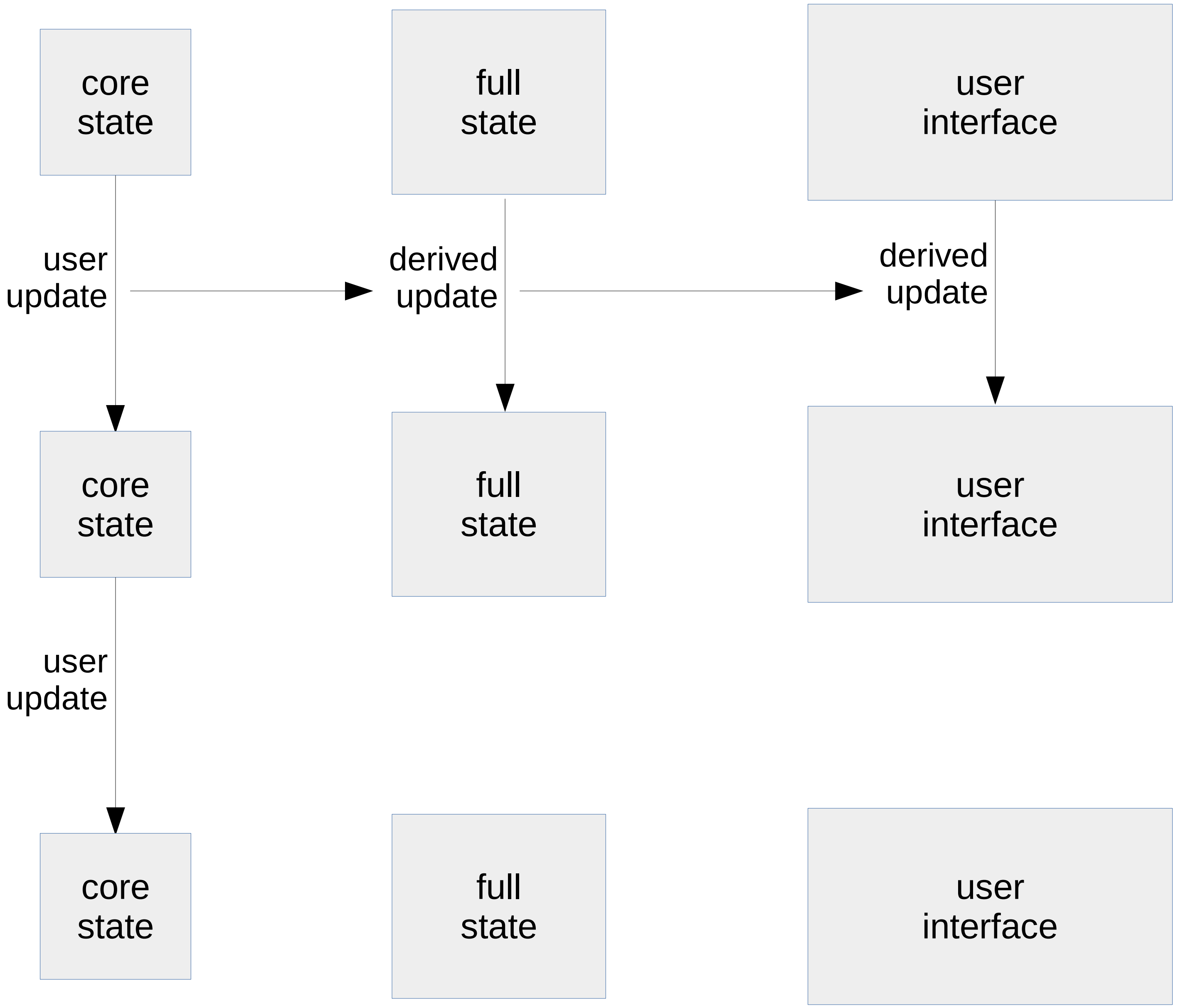

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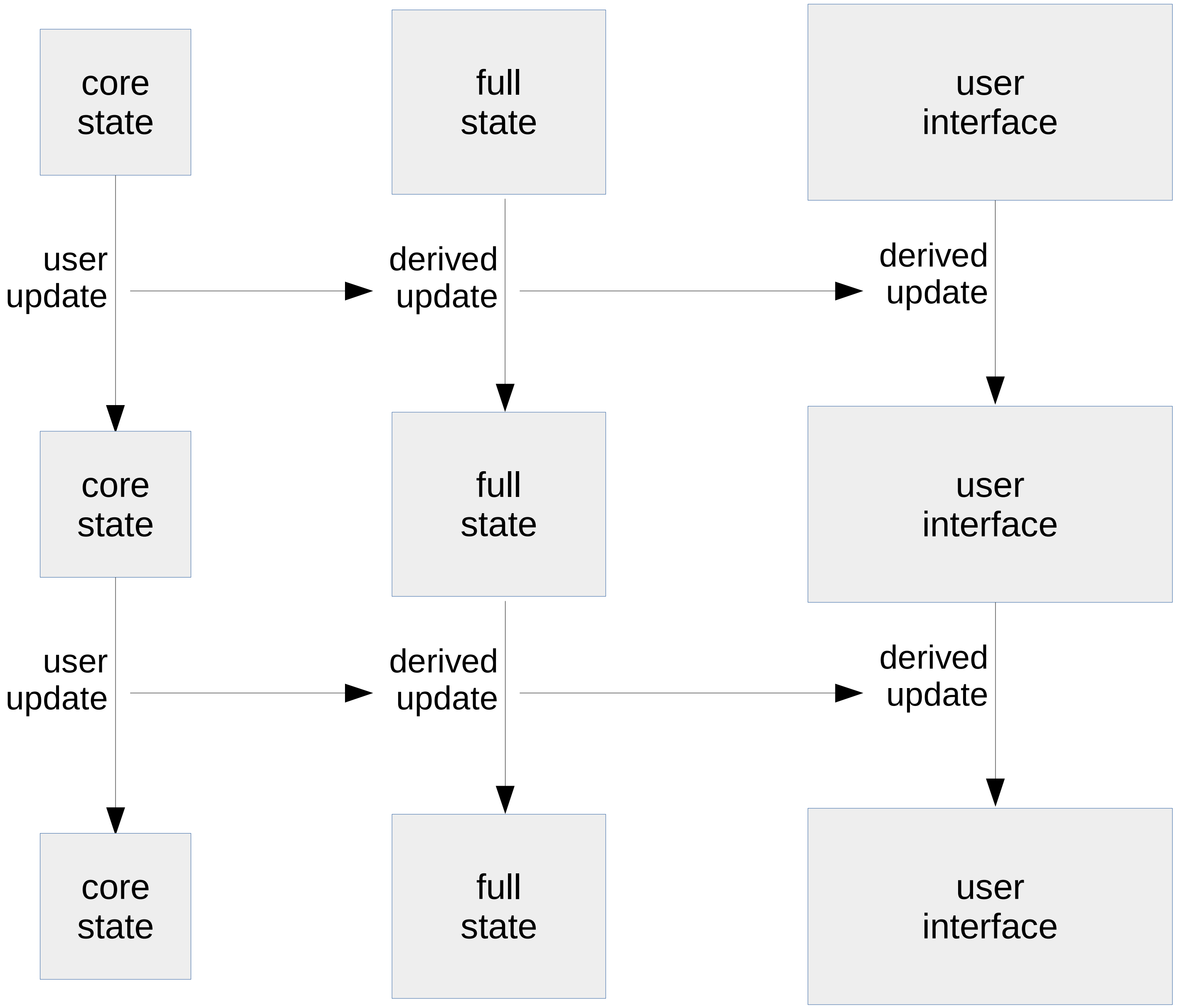
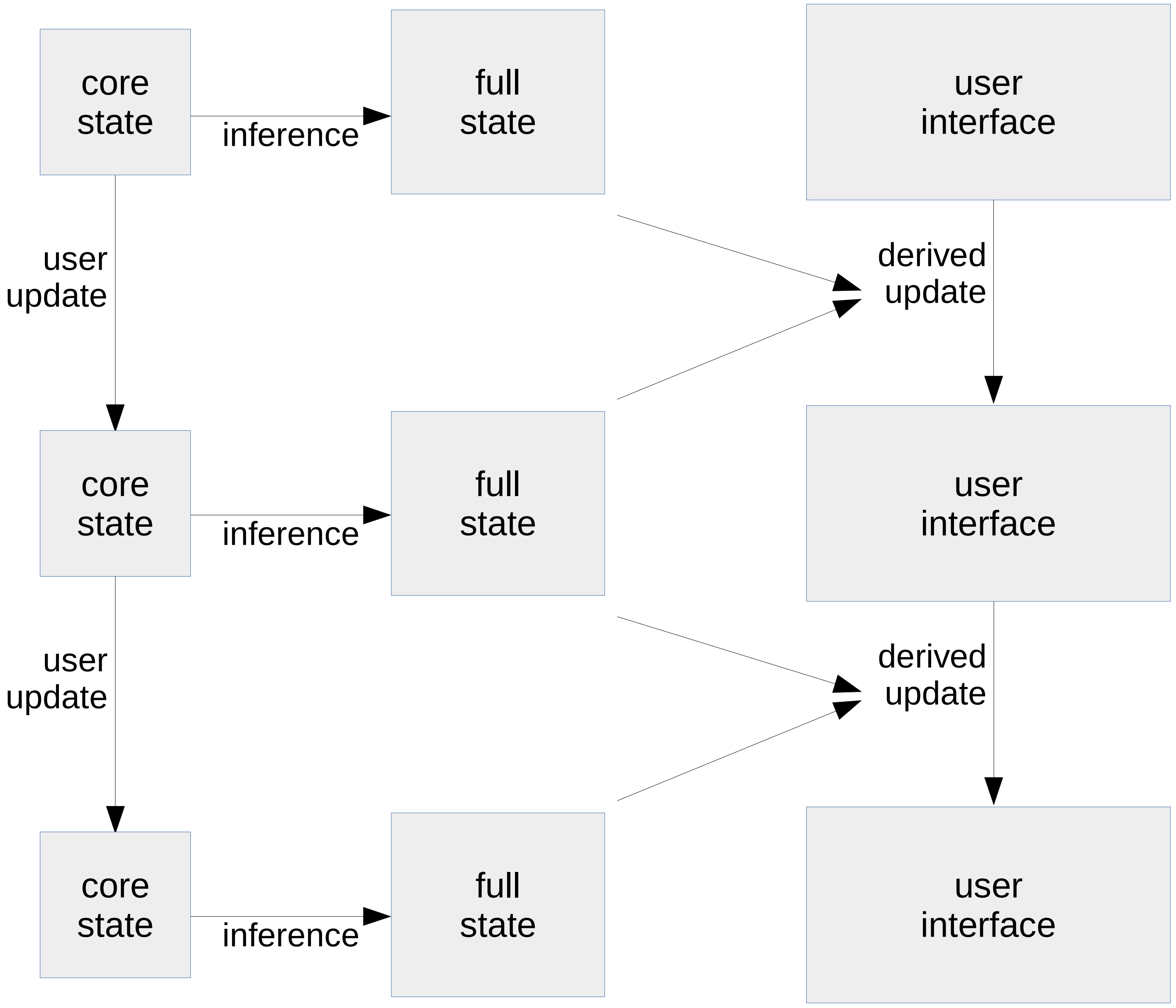


Change Propagation: Mixed



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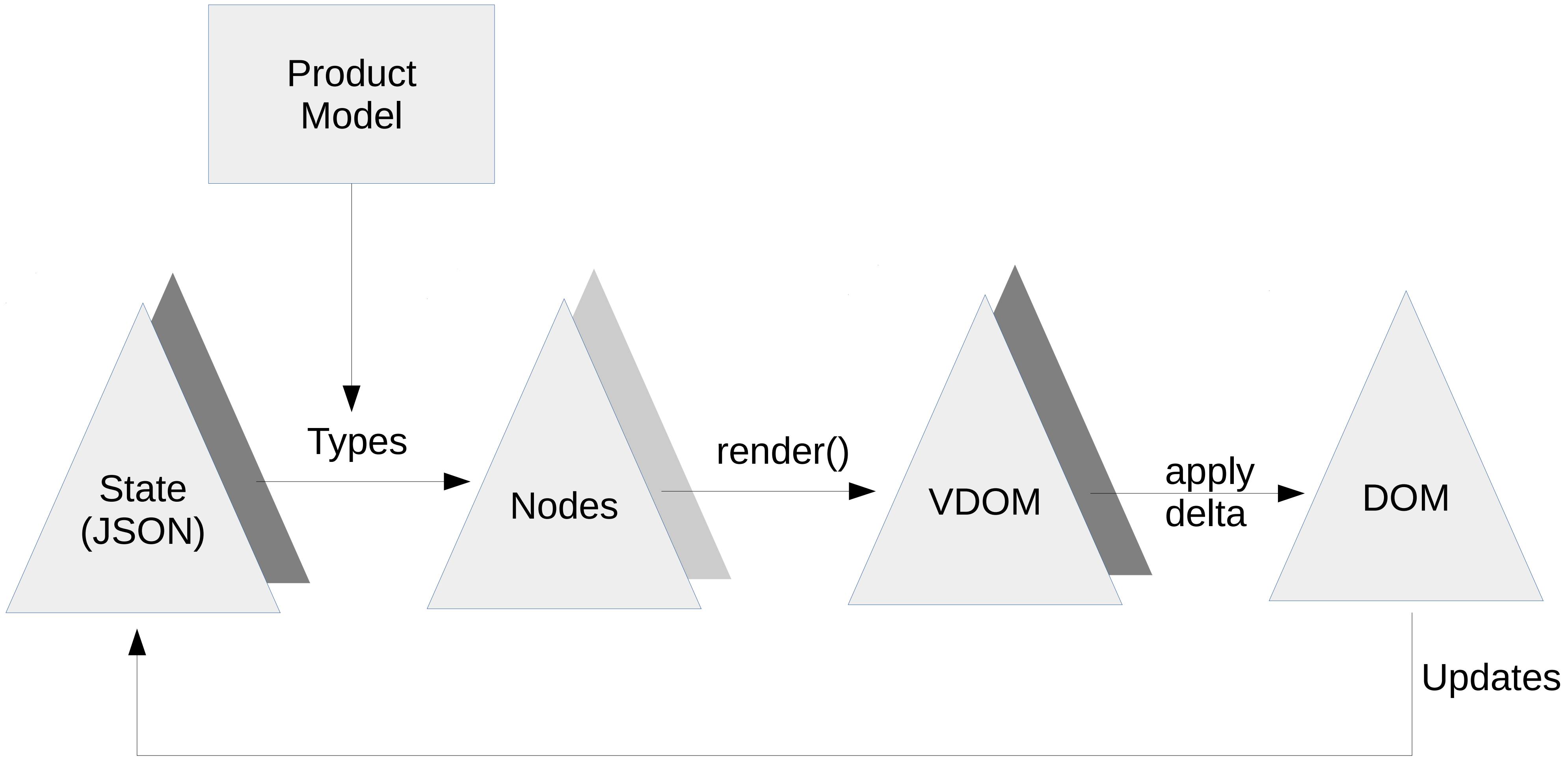
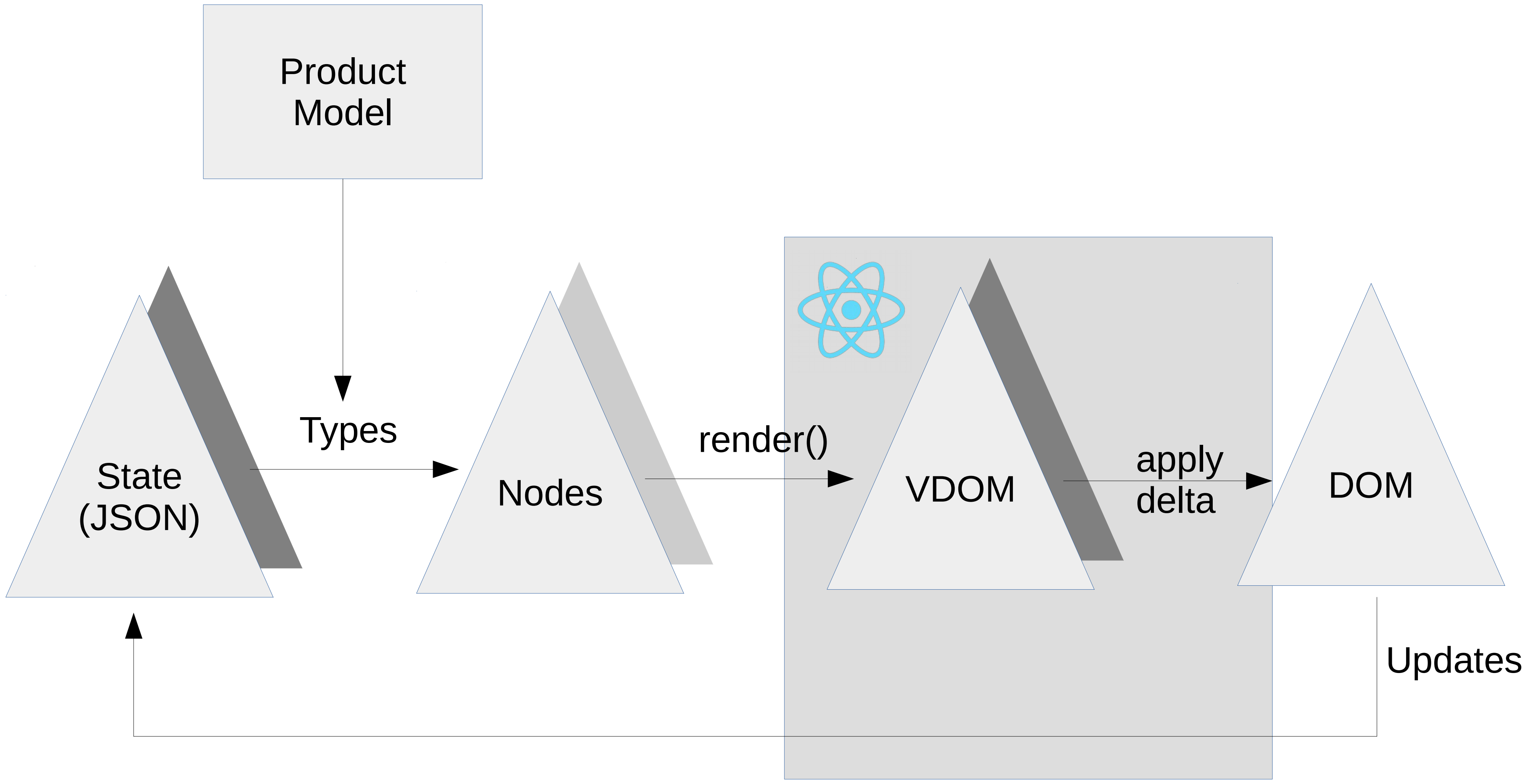
    - generates VDOM from your model
    - possibly using XML templating integrated into JavaScript ("JSX")
  - React
    - diffs the VDOM with the previous VDOM
    - applies only the diff to the actual DOM

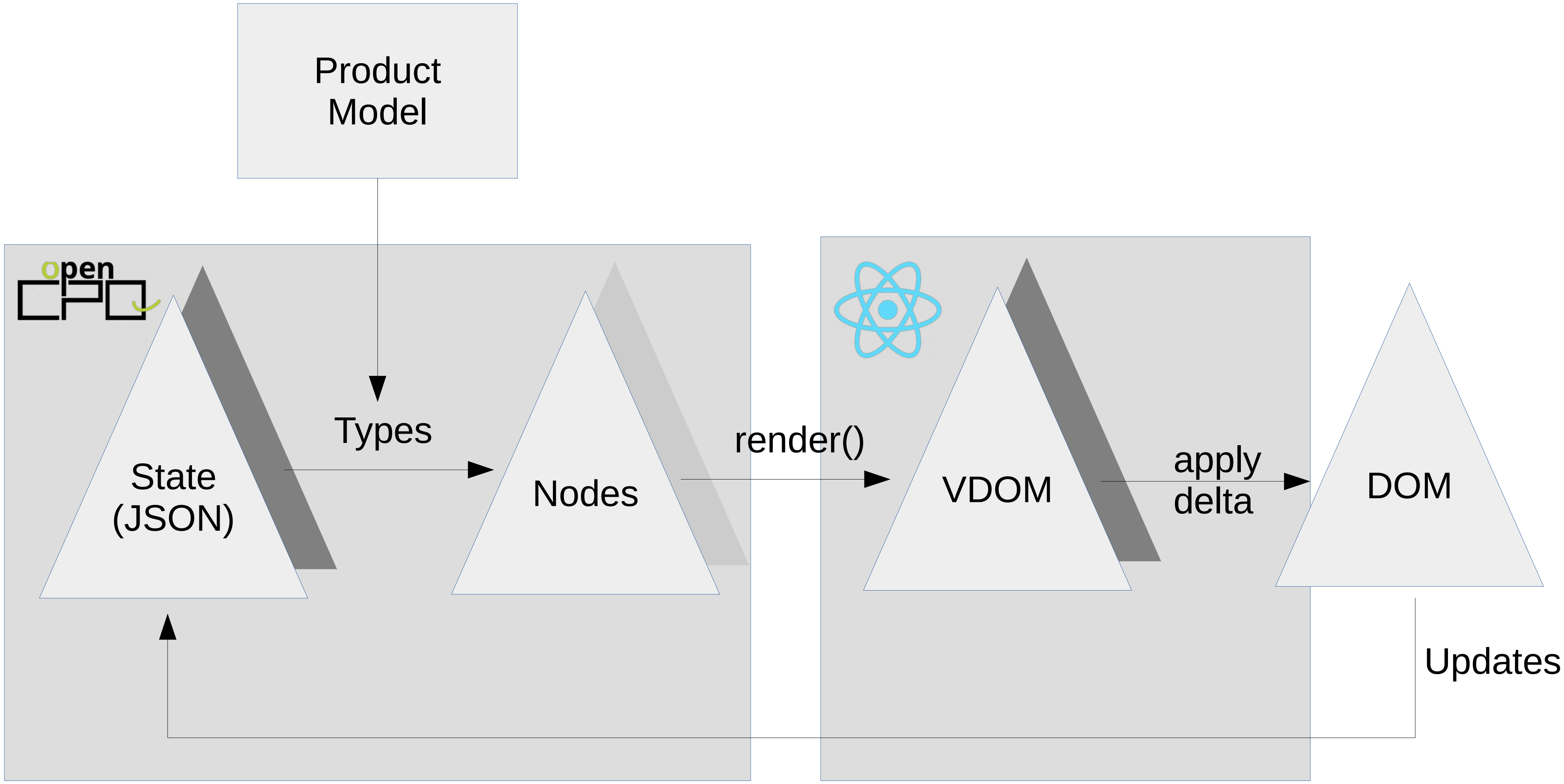
Architecture



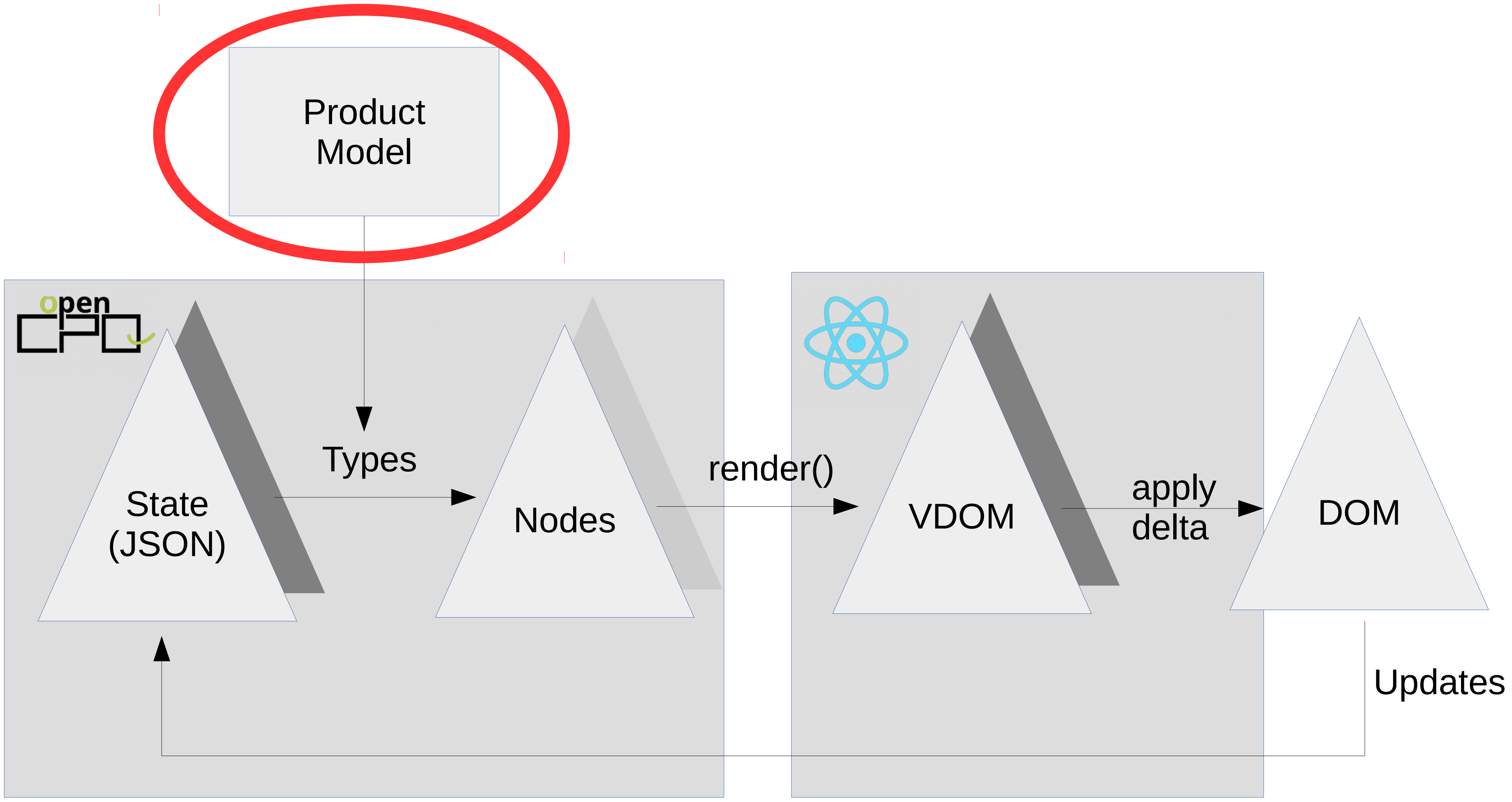
Architecture



Architecture

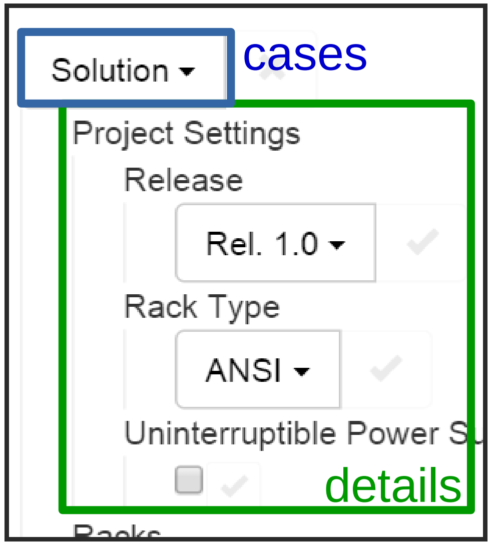


Example Code: Product Model



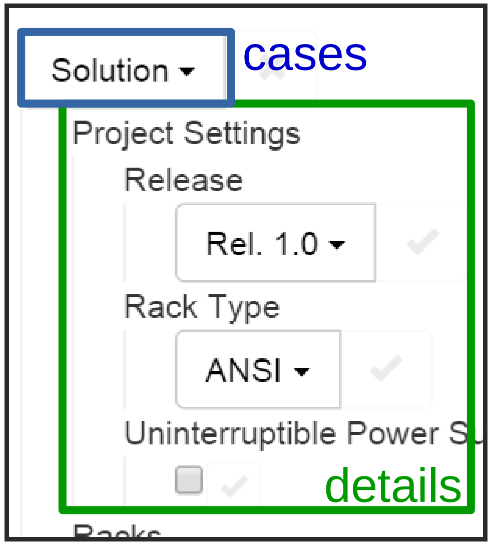
Product Model: Cases with Details

Product Model: Cases with Details



```
var configuration = CSelect([
    unansweredCase("Select Configuration Mode"),
    ccase("Switches", "Optical Switches",
        CQuantifiedList({}, "Optical Switch",
                        opticalSwitches)),
    ccase("Rack",     "Racks",
        CQuantifiedList({}, "Rack",
                        rack)),
    ccase("Solution", "Solution",
          solution),
]);
```

Product Model: Cases with Details



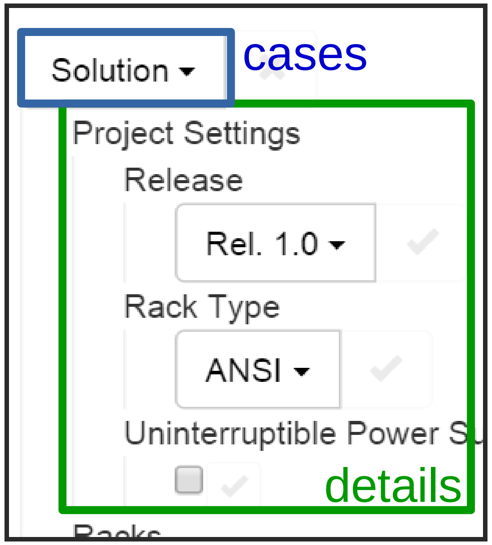
Solution
Project Settings
Release
Rel. 1.0
Rack Type
ANSI
Uninterruptible Power S

```
var configuration = CSelect([
    unansweredCase("Select Configuration Mode"),
    ccase("Switches", "Optical Switches",
        CQuantifiedList({}, "Optical Switch",
                        opticalSwitches)),
    ccase("Rack",     "Racks",
        CQuantifiedList({}, "Rack",
                        rack)),
    ccase("Solution", "Solution",
          solution),
]);
```

Compare to pseudocode:

```
function configuration({caseId, details}) {
    switch (caseId) {
        case "unanswered": /* do nothing */ break;
        case "Switches":
            CQuantifiedList({}, "Optical Switch",
                            opticalSwitches)(details);
            break;
        case "Rack": ...; break;
        case "Solution":
            solution(details);
            break;
    }
}
```

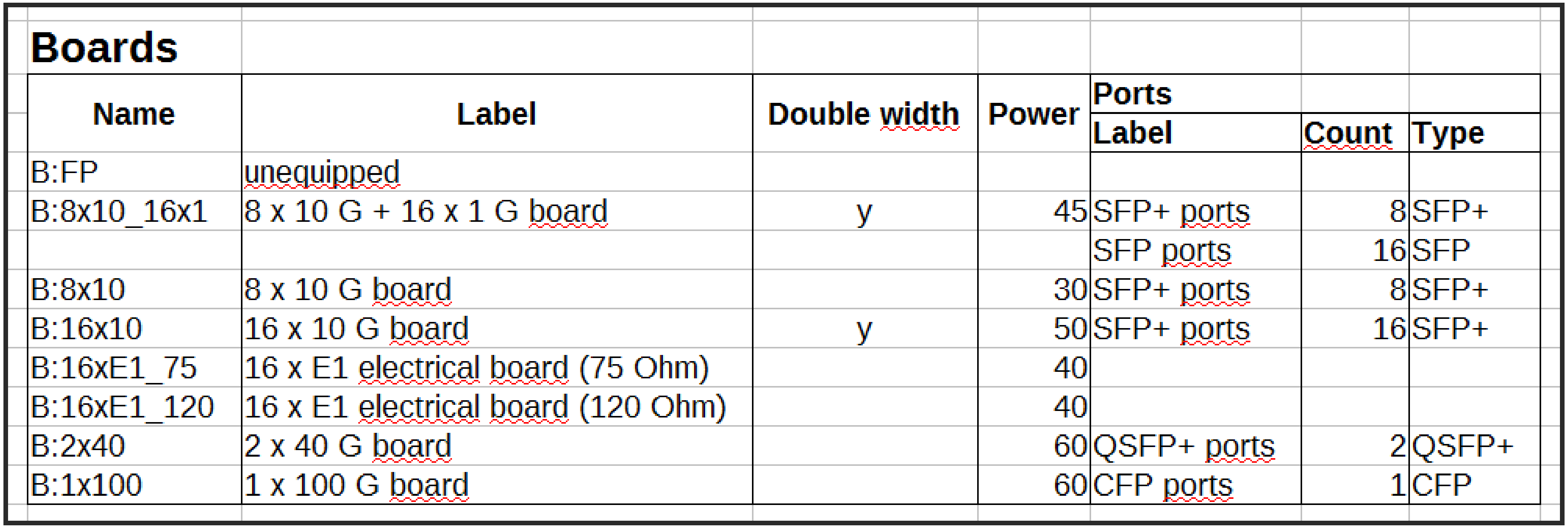
Product Model: Cases with Details



```
var configuration = CSelect([
    unansweredCase("Select Configuration Mode"),
    ccase("Switches", "Optical Switches",
        CQuantifiedList({}, "Optical Switch",
                        opticalSwitches)),
    ccase("Rack",     "Racks",
        CQuantifiedList({}, "Rack",
                        rack)),
    ccase("Solution", "Solution",
          solution),
]);
```

Data-Driven Product Modeling

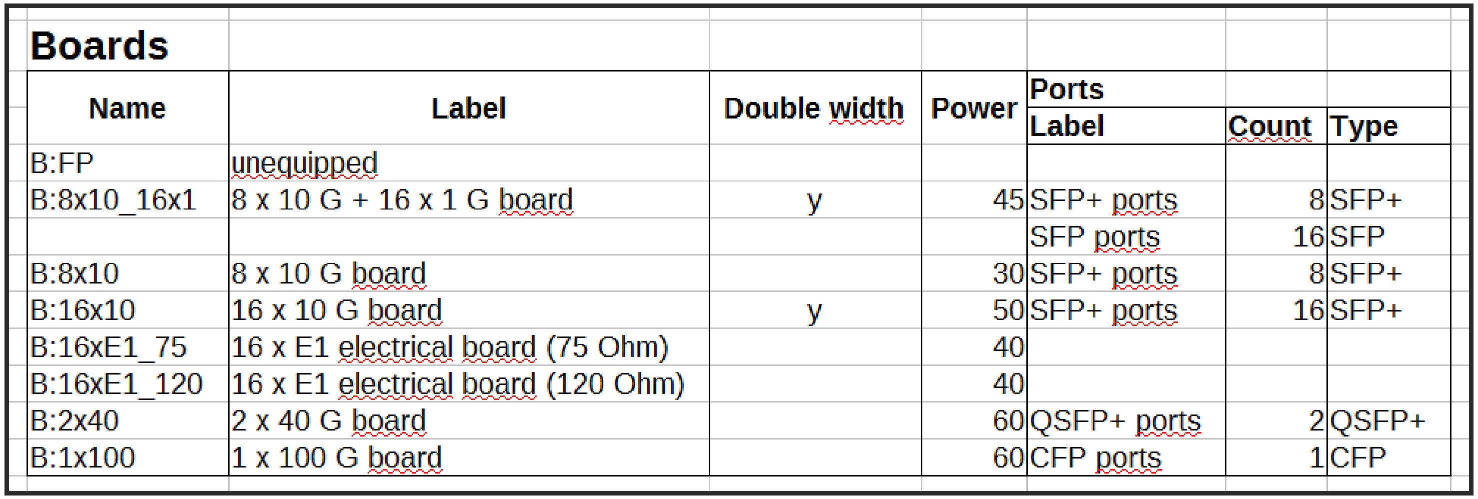
Data-Driven Product Modeling



Boards

Name	Label	Double width	Power	Ports		
				Label	Count	Type
B:FP	unequipped					
B:8x10_16x1	8 x 10 G + 16 x 1 G board	y	45	SFP+ ports	8	SFP+
				SFP ports	16	SFP
B:8x10	8 x 10 G board		30	SFP+ ports	8	SFP+
B:16x10	16 x 10 G board	y	50	SFP+ ports	16	SFP+
B:16xE1_75	16 x E1 electrical board (75 Ohm)		40			
B:16xE1_120	16 x E1 electrical board (120 Ohm)		40			
B:2x40	2 x 40 G board		60	QSFP+ ports	2	QSFP+
B:1x100	1 x 100 G board		60	CFP ports	1	CFP

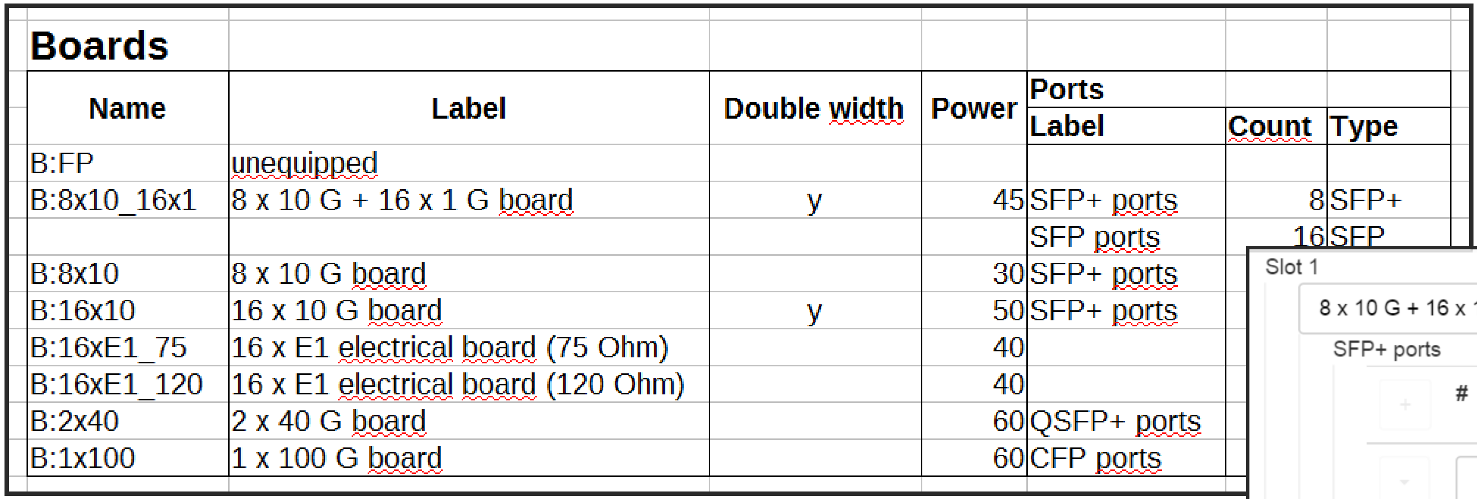
Data-Driven Product Modeling



Boards

Name	Label	Double width	Power	Ports		
				Label	Count	Type
B:FP	unequipped					
B:8x10_16x1	8 x 10 G + 16 x 1 G board	y	45	SFP+ ports	8	SFP+
				SFP ports	16	SFP
B:8x10	8 x 10 G board		30	SFP+ ports	8	SFP+
B:16x10	16 x 10 G board	y	50	SFP+ ports	16	SFP+
B:16xE1_75	16 x E1 electrical board (75 Ohm)		40			
B:16xE1_120	16 x E1 electrical board (120 Ohm)		40			
B:2x40	2 x 40 G board		60	QSFP+ ports	2	QSFP+
B:1x100	1 x 100 G board		60	CFP ports	1	CFP

Data-Driven Product Modeling



Boards

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				Label	Count	Type
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				SFP ports	16	SFP
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B:16x10	16 x 10 G board	y	50	SFP+ ports		
B:16xE1_75	16 x E1 electrical board (75 Ohm)		40			
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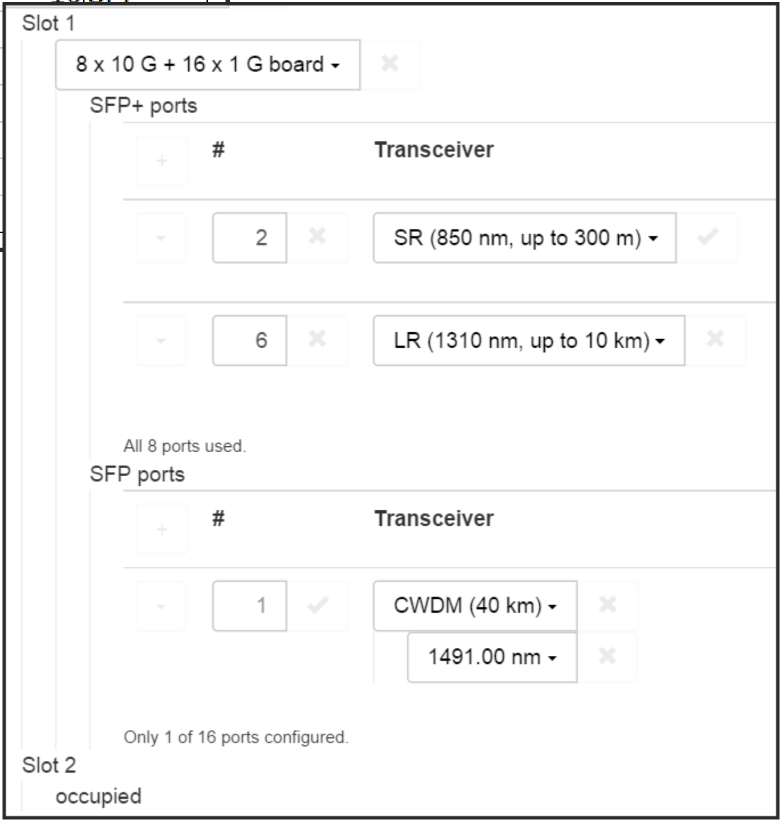
B:2x40	2 x 40 G board		60	QSFP+ ports		
B:1x100	1 x 100 G board		60	CFP ports		



Slot 1

8 x 10 G + 16 x 1 G board

SFP+ ports

#	Transceiver
2	SR (850 nm, up to 300 m)
6	LR (1310 nm, up to 10 km)

All 8 ports used.

SFP ports

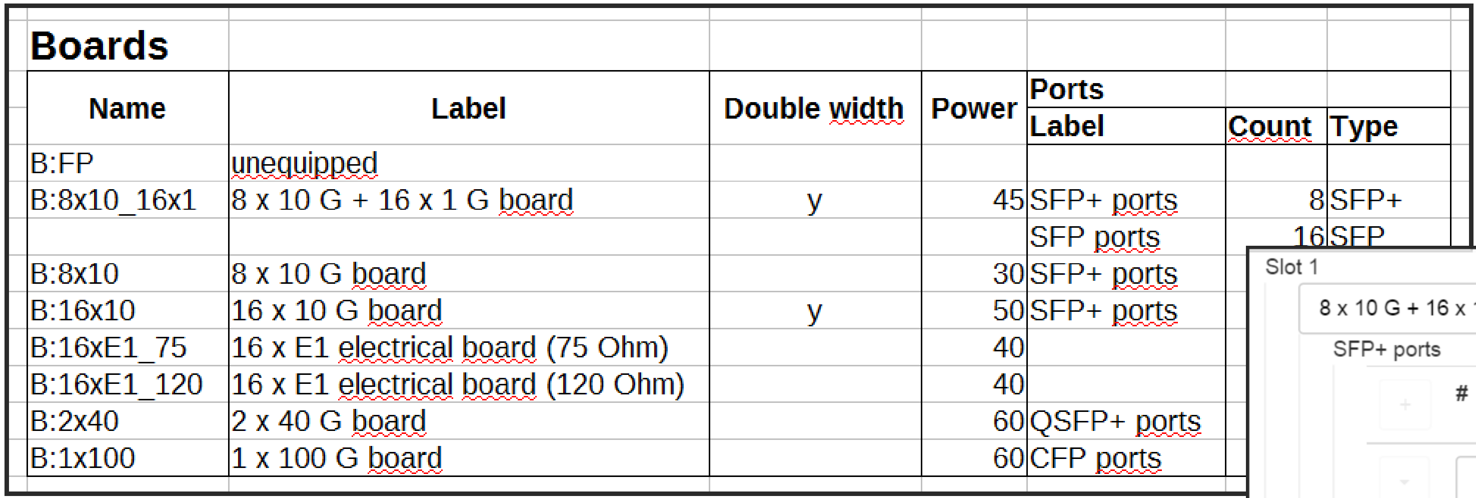
#	Transceiver
1	CWDM (40 km)
	1491.00 nm

Only 1 of 16 ports configured.

Slot 2

occupied

Data-Driven Product Modeling



Boards

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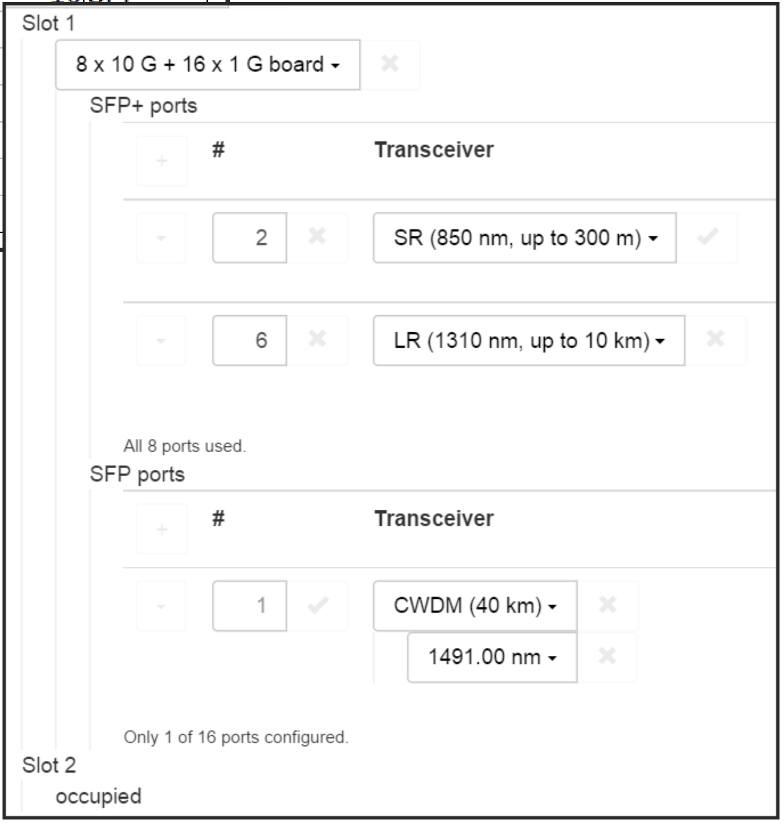
B:2x40	2 x 40 G board		60	QSFP+ ports		
B:1x100	1 x 100 G board		60	CFP ports		

```
function boards(isDoubleWidthSlot) {
    return CSelect([
        for (b of components.boards)
            if (!b.doubleWidth || isDoubleWidthSlot)
                ccaseBOM(b.name, b.label,
                    aggregate("power", b.power,
                        ports(b.ports)))
    ]);
}
```



Slot 1

8 x 10 G + 16 x 1 G board ▾

SFP+ ports

#	Transceiver
2	SR (850 nm, up to 300 m) ▾
6	LR (1310 nm, up to 10 km) ▾

All 8 ports used.

SFP ports

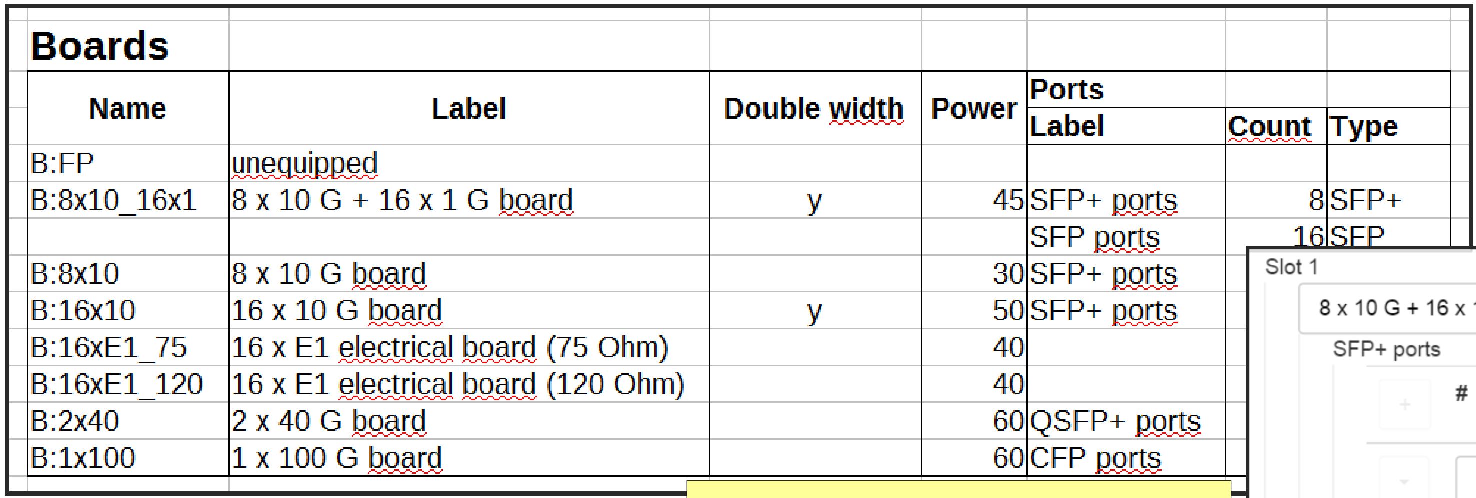
#	Transceiver
1	CWDM (40 km) ▾
	1491.00 nm ▾

Only 1 of 16 ports configured.

Slot 2

occupied

Data-Driven Product Modeling



Boards

Name	Label	Double width	Power	Ports Label	Count	Type
B:FP	unequipped					
B:8x10_16x1	8 x 10 G + 16 x 1 G board	y	45	SFP+ ports	8	SFP+
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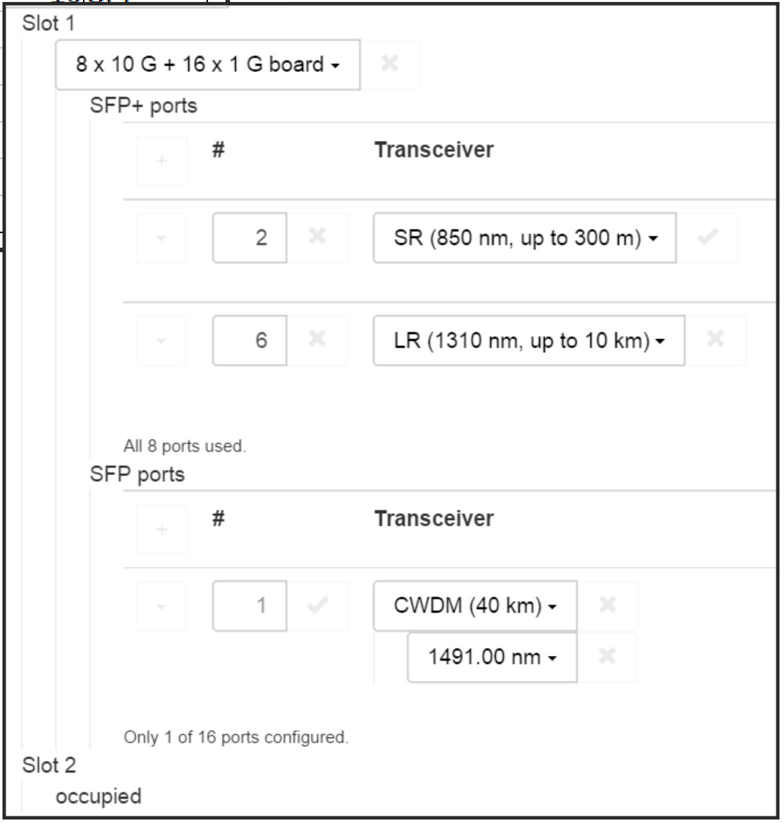
B:2x40	2 x 40 G board		60	QSFP+ ports		
B:1x100	1 x 100 G board		60	CFP ports		

[for (… of …) if (…) …]
array comprehension

```
function boards(isDoubleWidthSlot) {
    return CSelect([
        for (b of components.boards)
            if (!b.doubleWidth || isDoubleWidthSlot)
                ccaseBOM(b.name, b.label,
                    aggregate("power", b.power,
                        ports(b.ports)))
    ]);
}
```



Slot 1
8 x 10 G + 16 x 1 G board
SFP+ ports

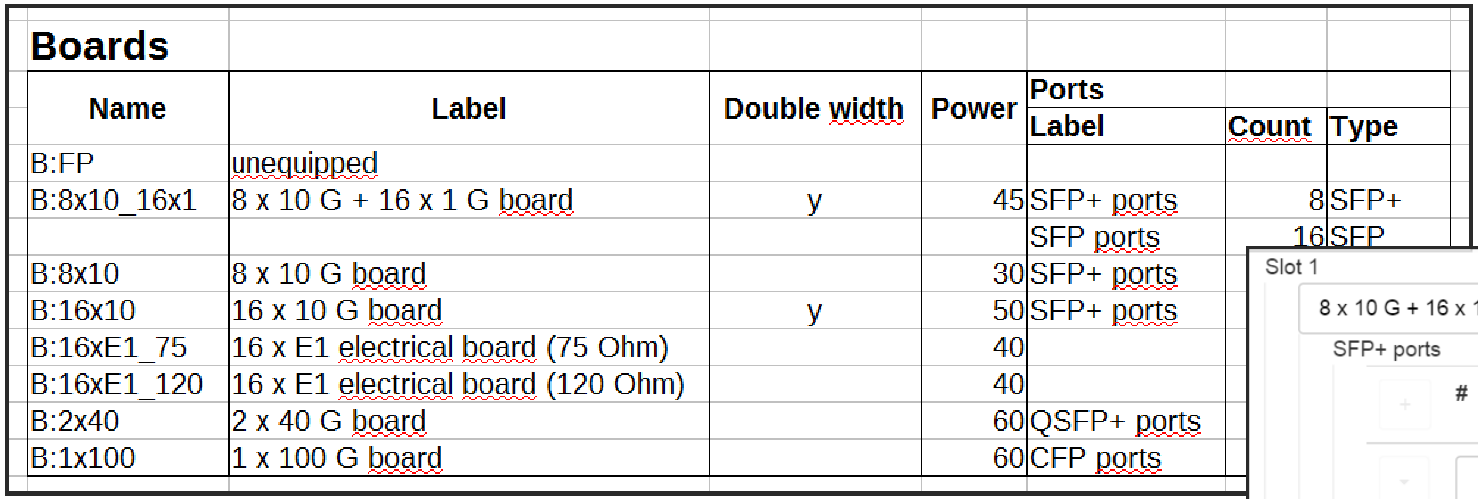
#	Transceiver
2	SR (850 nm, up to 300 m)
6	LR (1310 nm, up to 10 km)

All 8 ports used.
SFP ports

#	Transceiver
1	CWDM (40 km) / 1491.00 nm

Only 1 of 16 ports configured.
Slot 2
occupied

Data-Driven Product Modeling



Boards

Name	Label	Double width	Power	Ports Label	Ports Count	Ports Type
B:FP	unequipped					
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				SFP ports	16	SFP
B:8x10	8 x 10 G board		30	SFP+ ports		
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B:16xE1_75	16 x E1 electrical board (75 Ohm)		40			
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B:1x100	1 x 100 G board		60	CFP ports		

```
function boards(isDoubleWidthSlot) {
    return CSelect([
        for (b of components.boards)
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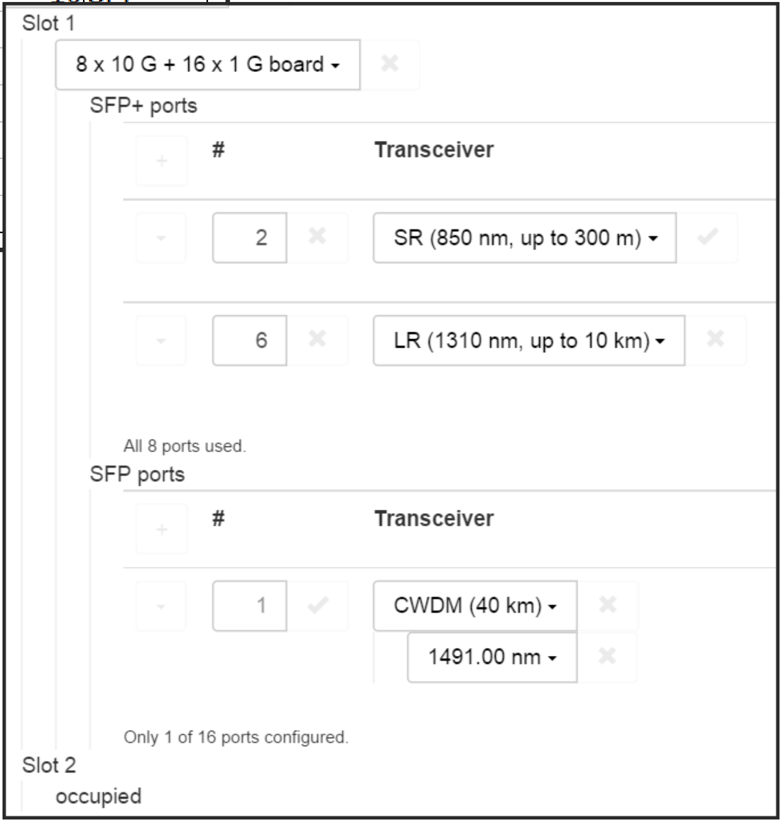
                ccaseBOM(b.name, b.label,
                    aggregate("power", b.power,
                        ports(b.ports)))
    ]);
}
```



Slot 1

8 x 10 G + 16 x 1 G board

SFP+ ports

#	Transceiver
2	SR (850 nm, up to 300 m)
6	LR (1310 nm, up to 10 km)

All 8 ports used.

SFP ports

#	Transceiver
1	CWDM (40 km)
	1491.00 nm

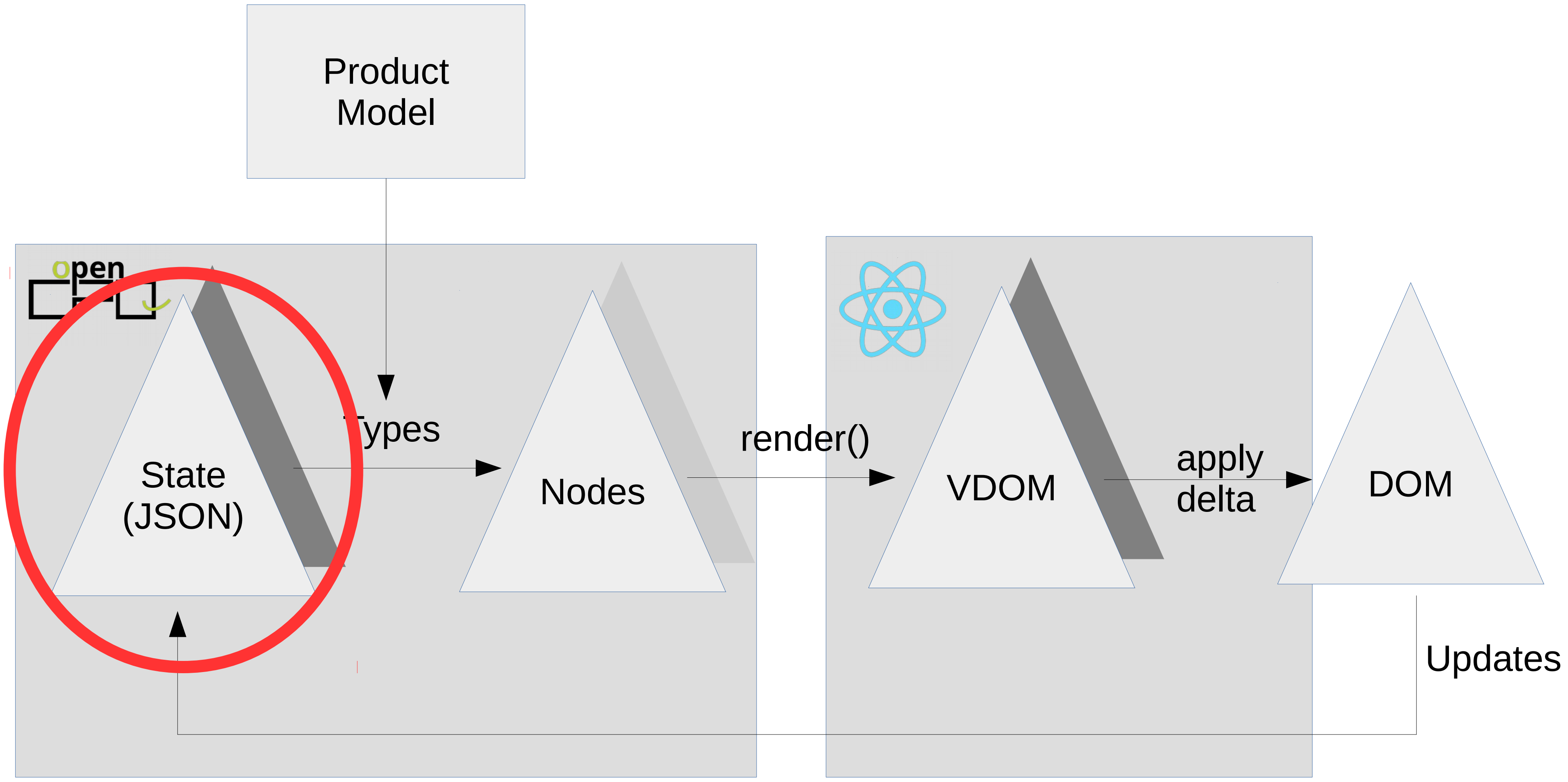
Only 1 of 16 ports configured.

Slot 2

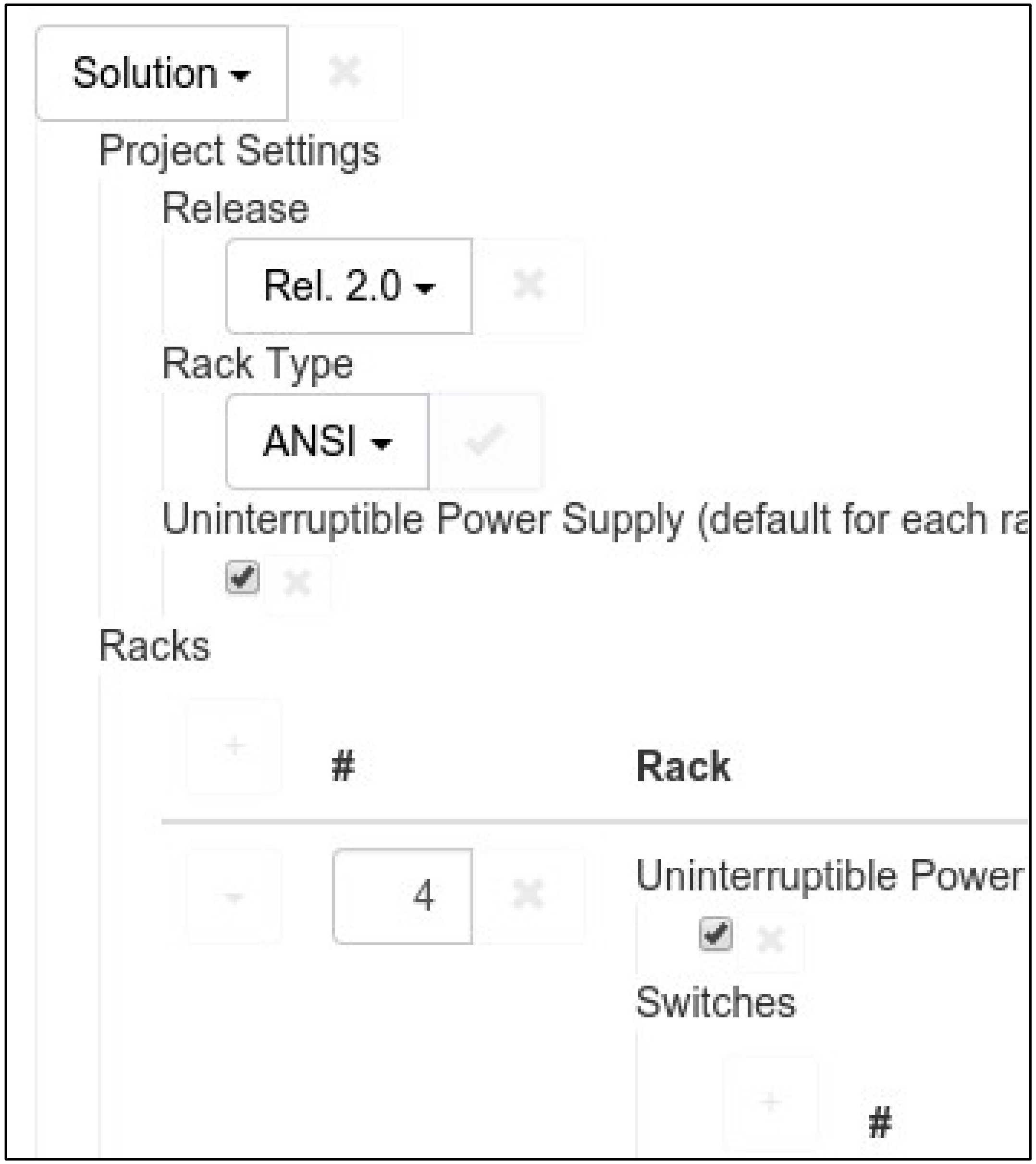
occupied

Concise specification of complex models

Example Data: State



Configuration State



Solution

Project Settings

Release

Rel. 2.0

Rack Type

ANSI

Uninterruptible Power Supply (default for each ra

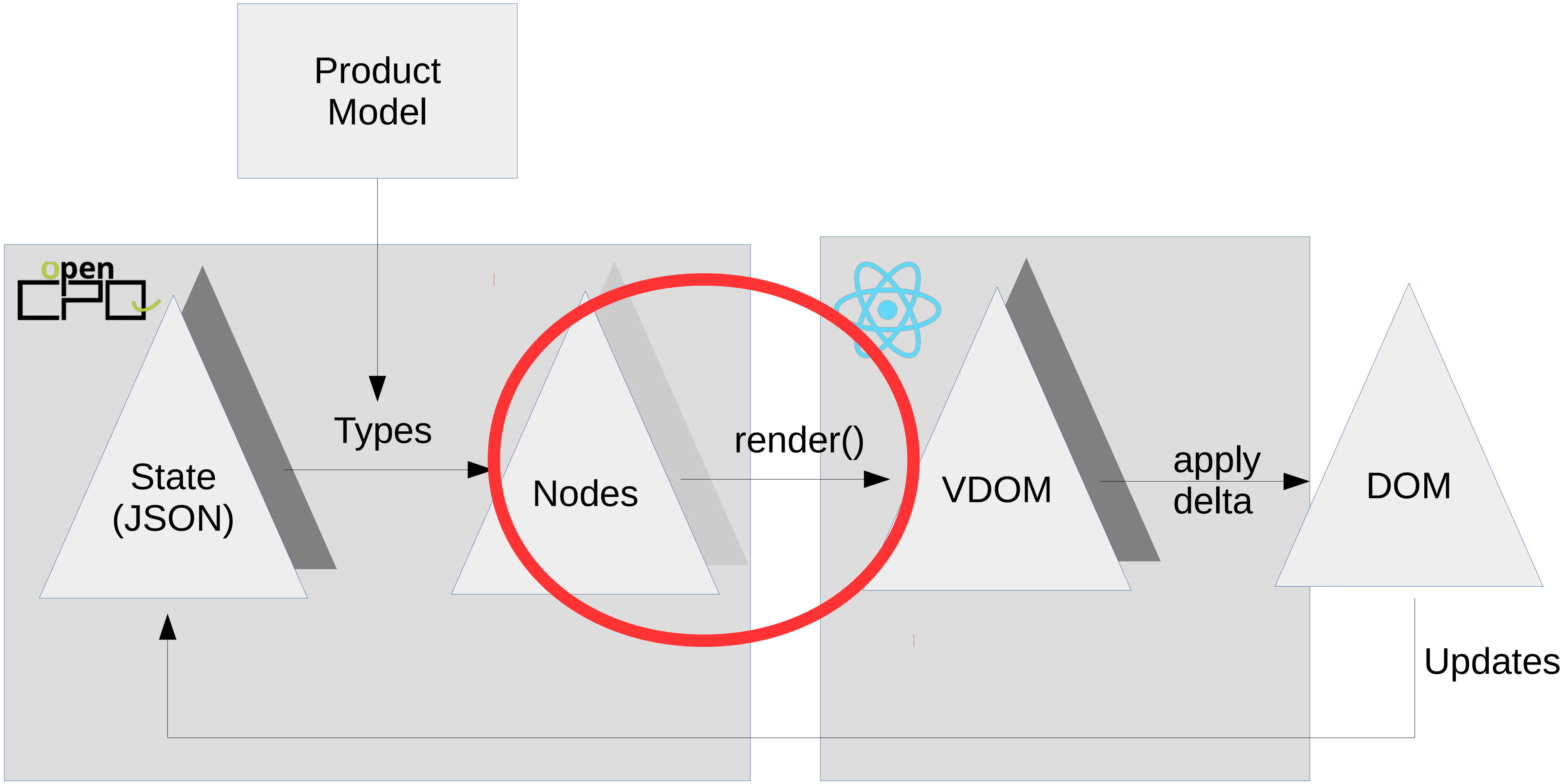
✓

Racks

#	Rack
4	Uninterruptible Power ✓ Switches #

```
{
   "caseId": "Solution",
   "detailValue": {
      "project": {
         "release": {
            "caseId": "R2.0"
         },
         "UPS": true
      },
      "racks": [
         {
            "quantity": "4",
            "value": {
               "UPS": true,
               "switches": [
                  …
               ]
            }
         }
      ]
   }
}
```

Example Code: Node Rendering



Selection Node (simplified)

```
class SelectNode extends Node {

  //constructor(options) { this.__options = options; }

  render() {
    var {cases, currentCase, detailNode, updateTo} = this.__options;
    return (
      <div>
        <DropdownButton title={currentCase.label}>
          {[
            for ({id, label} of cases)
              <MenuItem onSelect={() => updateTo({caseId: id})}>
                {label}
              </MenuItem>
          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

Selection Node (simplified)

Inherited constructor

Unpack constructor parameters.

```
class SelectNode extends Node {

  //constructor(options) { this.__options = options; }

  render() {
    var {cases, currentCase, detailNode, updateTo} = this.__options;
    return (
      <div>
        <DropdownButton title={currentCase.label}>
          {[
            for ({id, label} of cases)
              <MenuItem onSelect={() => updateTo({caseId: id})}>
                {label}
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          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

Selection Node (simplified)

```
class SelectNode extends Node {

  //constructor(options) { this.__options = options; }

  render() { ◄
    var {cases, currentCase, detailNode, updateTo} = this.__options;
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        <DropdownButton title={currentCase.label}>
          {[
            for ({id, label} of cases)
              <MenuItem onSelect={() => updateTo({caseId: id})}>
                {label}
              </MenuItem>
          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

Create a VDOM tree.

Selection Node (simplified)

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        {detailNode.render()}
      </div>
    );
  }
}
```

JSX:
HTML **templates**
in JavaScript

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              </MenuItem>
          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

JSX:
HTML **templates**
in JavaScript

… also with „higher-level“
XML elements
(from react-bootstrap)

Selection Node (simplified)

```
class SelectNode extends Node {

  //constructor(options) { this.__options = options; }

  render() {
    var {cases, currentCase, detailNode, updateTo} = this.__options;
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                {label}
              </MenuItem>
          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

Interpolate JavaScript expressions with {...}

Selection Node (simplified)

```
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  render() {
    var {cases, currentCase, detailNode, updateTo} = this.__options;
    return (
      <div>
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              </MenuItem>
          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

array comprehension

Selection Node (simplified)

```
class SelectNode extends Node {

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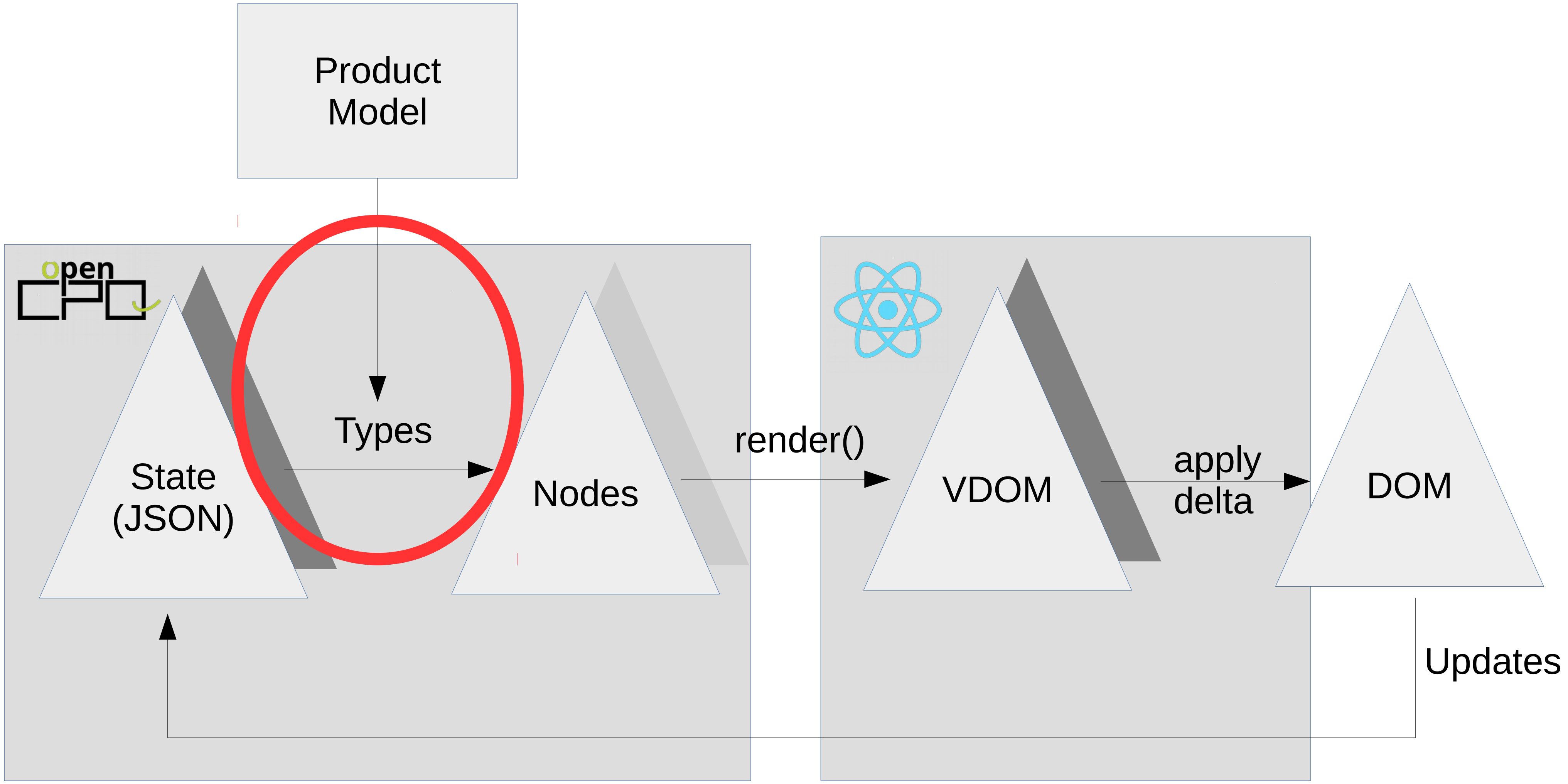
                {label}
              </MenuItem>
          ]}
        </DropdownButton>
        {detailNode.render()}
      </div>
    );
  }
}
```

Example Code: Types



Selection Type (simplified)

```
function ccase(id, label, type = CUnit()) {
  return {id, label, type};
}

function CSelect(cases) {
  return {
    makeNode(ctx) {
      var {state, updateTo} = ctx;
      var {caseId, detailState} = state || {caseId: cases[0].id};
      var currentCase = cases.find(x => x.id === caseId);
      var detailNode = currentCase.type.makeNode({
        ...ctx,
        state: detailState,
        updateTo(newDetail) {
          updateTo({caseId, detailState: newDetail});
        }
      });
      return new SelectNode({cases, currentCase, detailNode, updateTo});
    }
  };
}
```

Selection Type (simplified)

```
function ccase(id, label, type = CUnit()) {
  return {id, label, type};
}

function CSelect(cases) {
  return {
    makeNode(ctx) {
      var {state, updateTo} = ctx;
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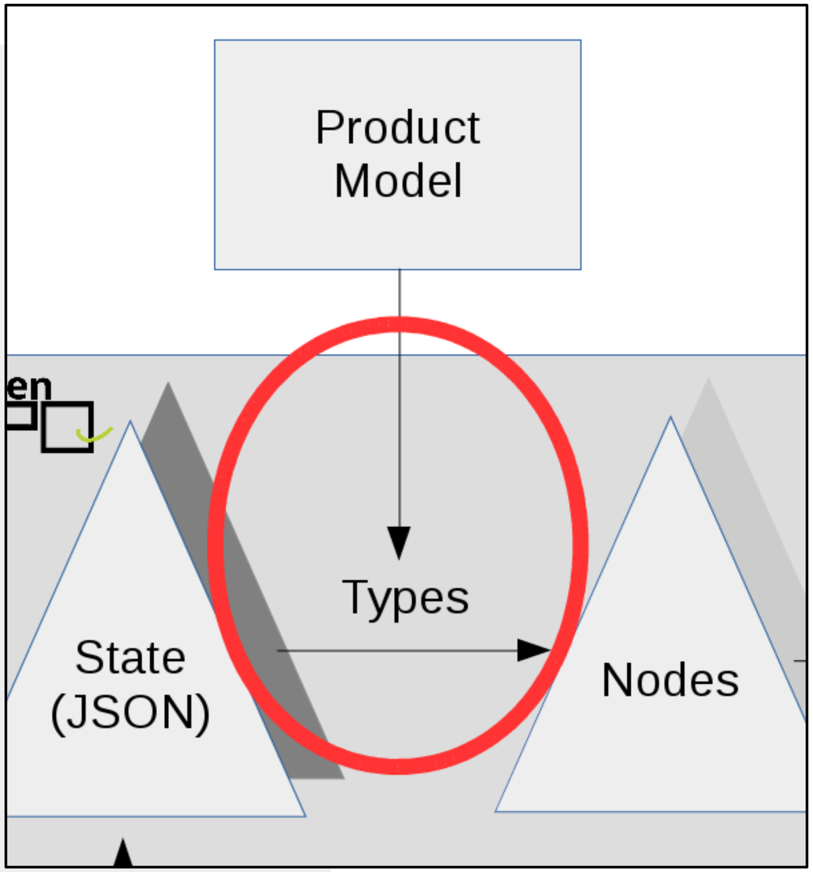
      var currentCase = cases.find(x => x.id === caseId);
      var detailNode = currentCase.type.makeNode({
        ...ctx,
        state: detailState,
        updateTo(newDetail) {
          updateTo({caseId, detailState: newDetail});
        }
      });
      return new SelectNode({cases, currentCase, detailNode, updateTo});
    }
  };
}
```



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}

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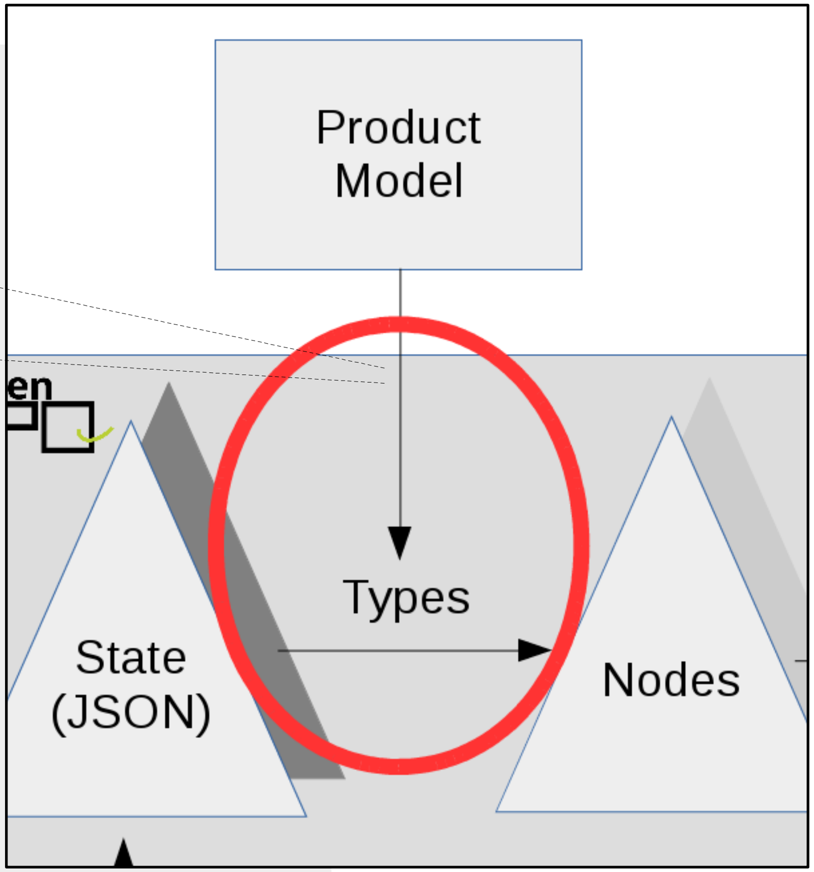
      var {state, updateTo} = ctx;
      var {caseId, detailState} = state || {caseId: cases[0].id};
      var currentCase = cases.find(x => x.id === caseId);
      var detailNode = currentCase.type.makeNode({
        ...ctx,
        state: detailState,
        updateTo(newDetail) {
          updateTo({caseId, detailState: newDetail});
        }
      });
      return new SelectNode({cases, currentCase, detailNode, updateTo});
    }
  };
}
```



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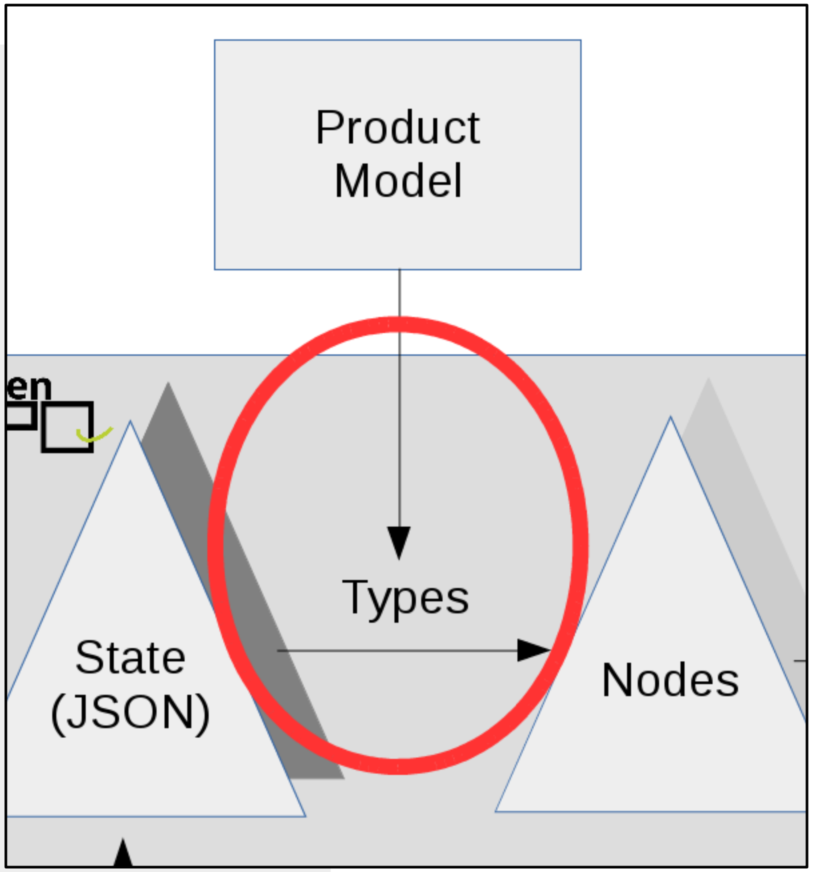
  return {id, label, type};
}

function CSelect(cases) {
  return {
    makeNode(ctx) {
      var {state, updateTo} = ctx;
      var {caseId, detailState} = state || {caseId: cases[0].id};
      var currentCase = cases.find(x => x.id === caseId);
      var detailNode = currentCase.type.makeNode({
        ...ctx,
        state: detailState,
        updateTo(newDetail) {
          updateTo({caseId, detailState: newDetail});
        }
      });
      return new SelectNode({cases, currentCase, detailNode, updateTo});
    }
  };
}
```

Nothing to configure



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  return {
    makeNode(ctx) {
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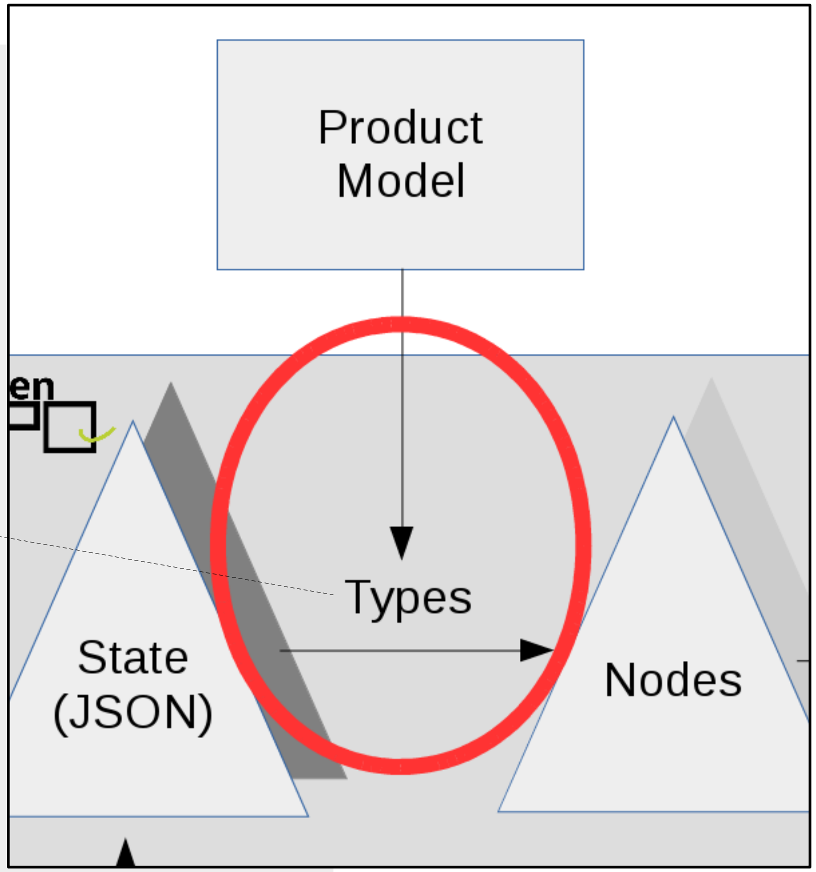
      var {caseId, detailState} = state || {caseId: cases[0].id};
      var currentCase = cases.find(x => x.id === caseId);
      var detailNode = currentCase.type.makeNode({
        ...ctx,
        state: detailState,
        updateTo(newDetail) {
          updateTo({caseId, detailState: newDetail});
        }
      });
      return new SelectNode({cases, currentCase, detailNode, updateTo});
    }
  };
}
```



Selection Type (simplified)

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function ccase(id, label, type = CUnit()) {
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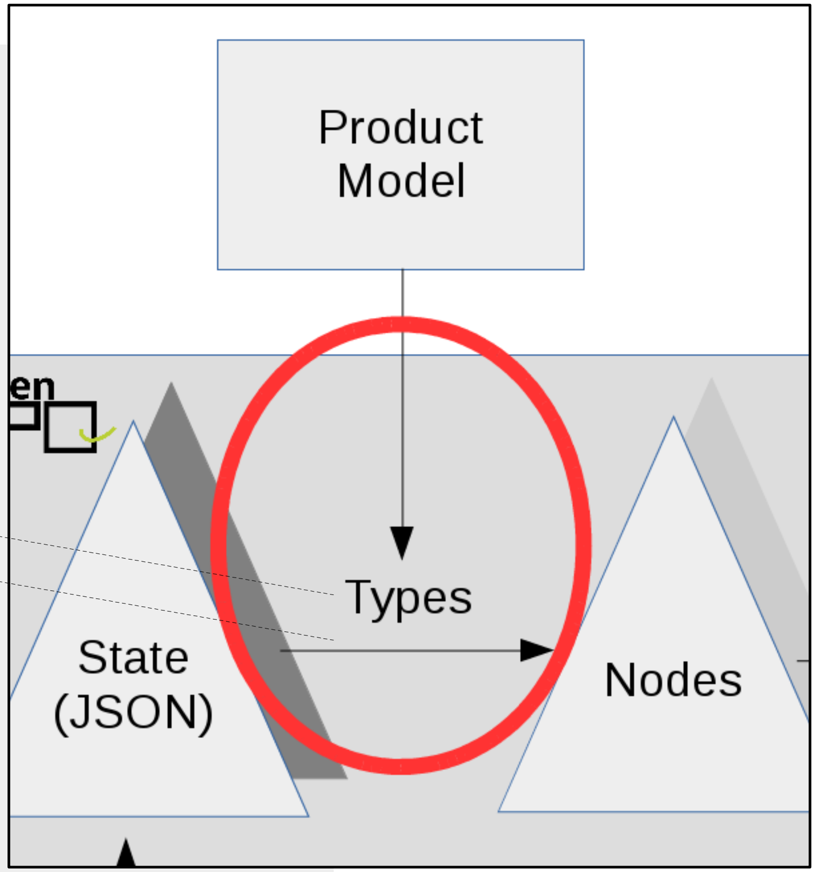

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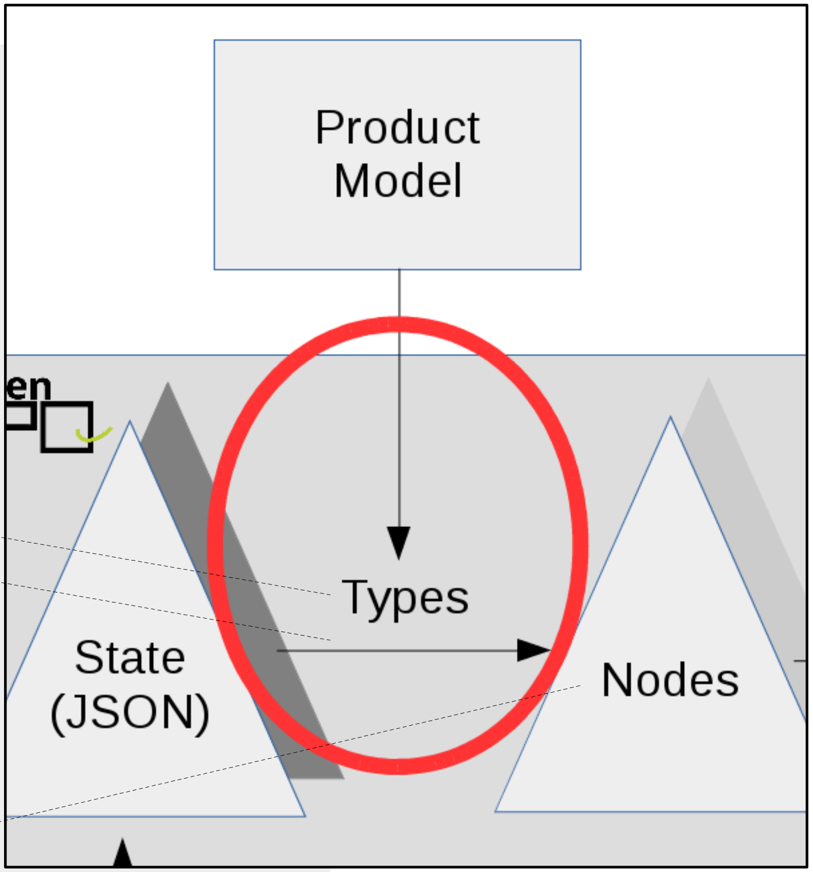

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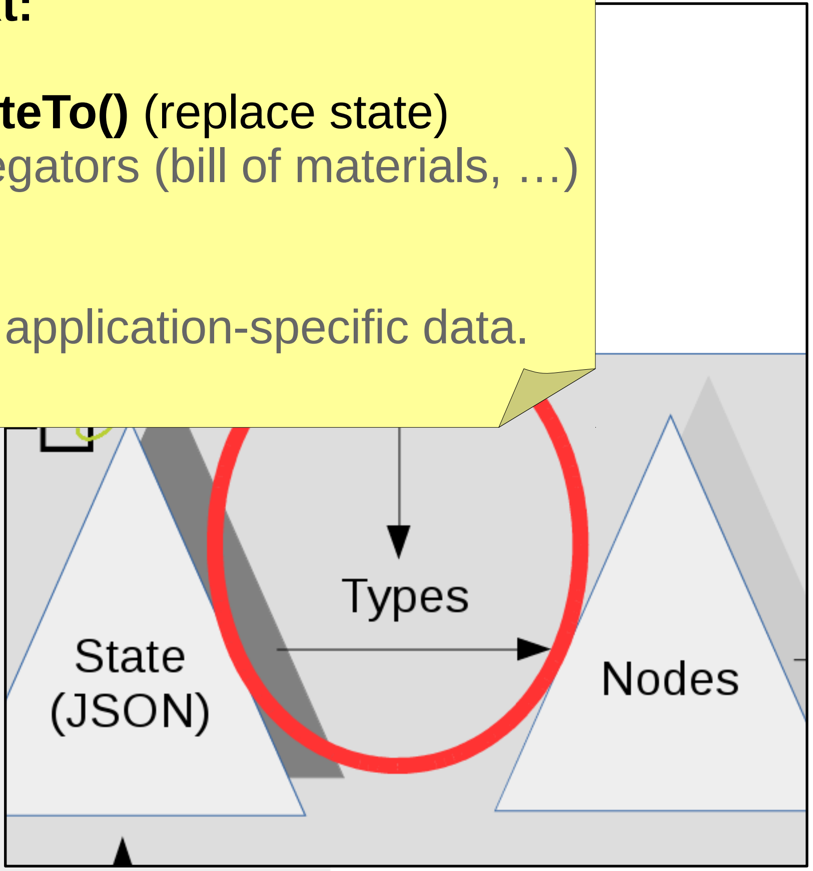
Context:
- **state**
- **updateTo()** (replace state)
- aggregators (bill of materials, …)
- ...

Injects application-specific data.



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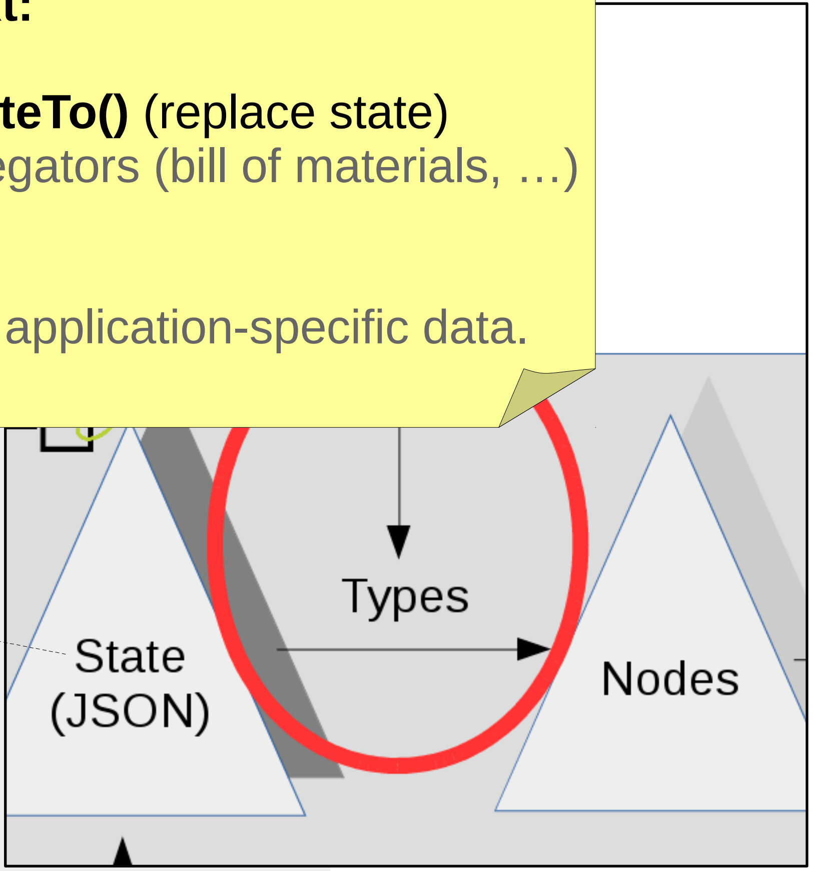

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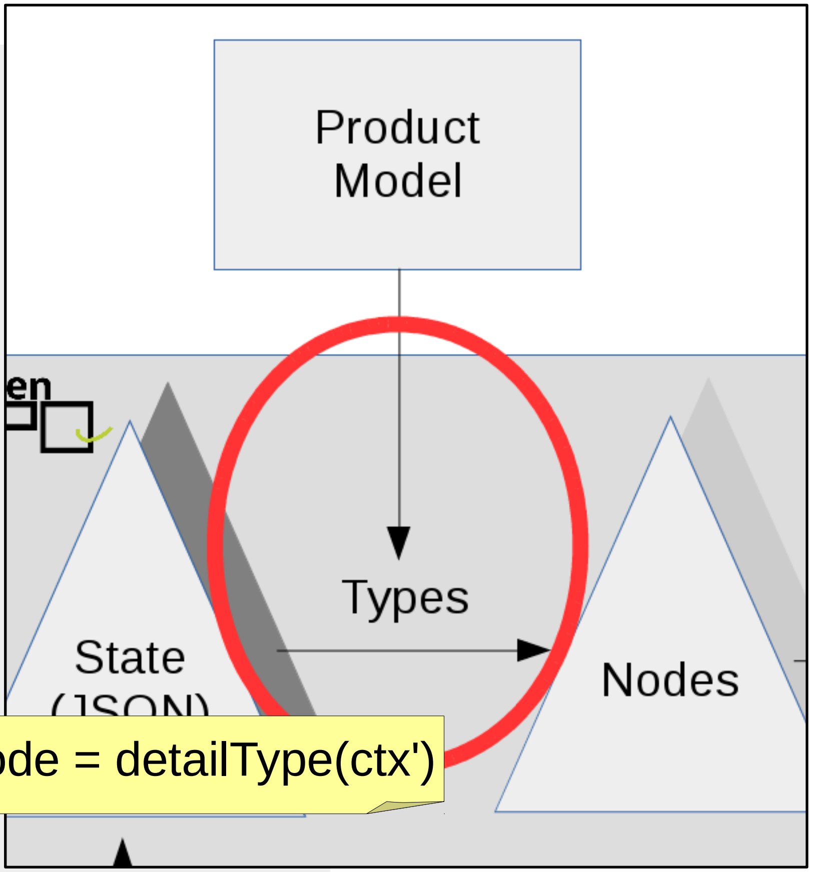

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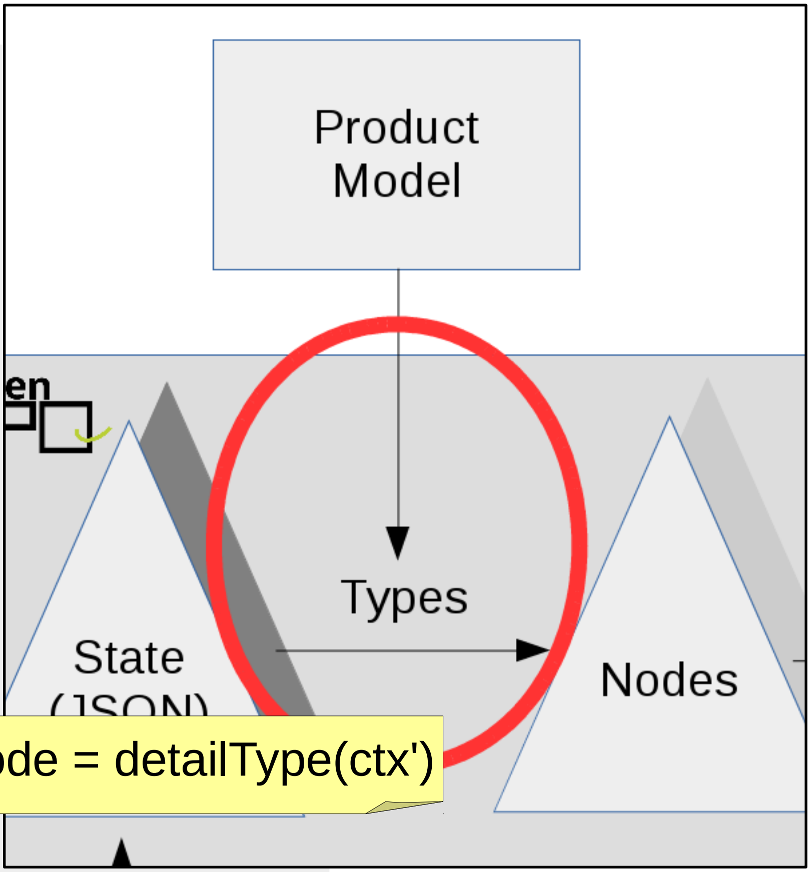

detailNode = detailType(ctx')

updateTo() for detail node:
- **do not modify** surrounding state
- send **new state** to parent's updateTo()

=> easy **undo/redo**

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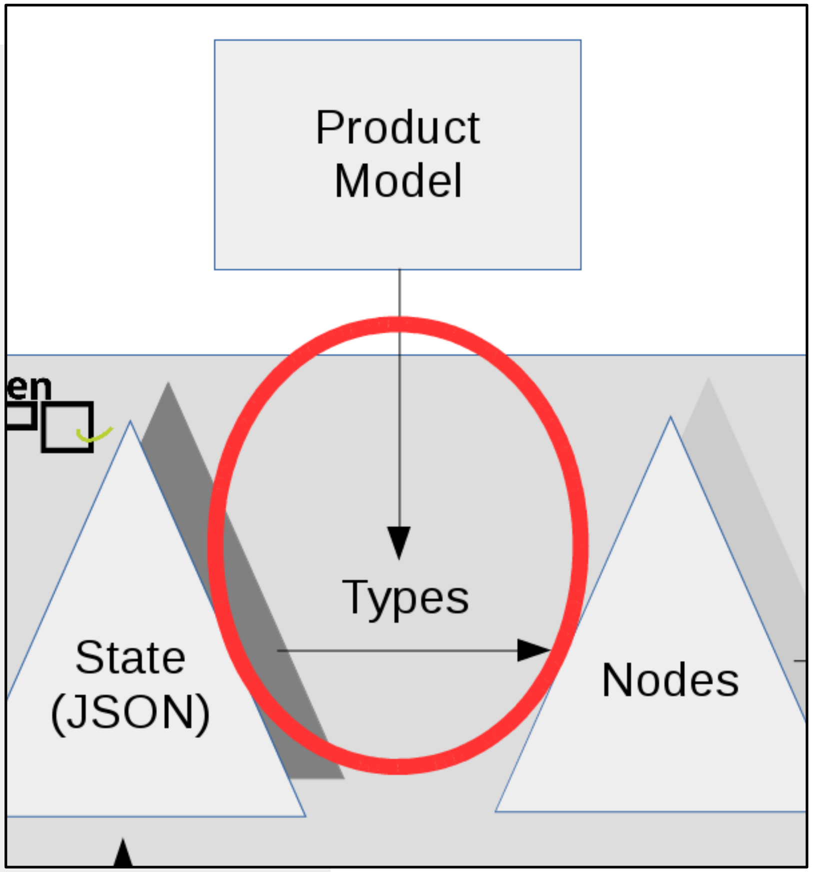

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- webpack (⇦ Gulp/ browserify)
- io (⇦ node JS), npm
- jQuery write less, do more.

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Use, adapt, integrate, contribute!
https://github.com/webXcerpt/openCPQ

Issues to Discuss

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  - …?

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- Cooperation
  - Extensions: Integrations (SAP, Salesforce, ...), Visualization, ...
  - Student projects
  - Application development

webXcerpt manage your information