

Product Customization as Linked Data

Extended Semantic Web Conference - Ηράκλειο - May 30th, 2012

François-Paul Servant (francois-paul.servant@renault.com)

Edouard Chevalier (edouard.chevalier@renault.com)

01

Publishing descriptions of customizable products
A challenging issue

02

Configuration as Linked Data
The Configuration Ontology

03

Use cases, applications
and benefits

Publishing product descriptions on the web of data

- **has recently gained momentum**
 - **schema.org**
 - **GoodRelations**
- **Use rich data for Web marketing**
- **in order to increase the visibility of commercial offers**
 - **talking to all kinds of devices and agents**
 - **search engines, price comparators, recommendation applications**
 - **SEO ("search engine optimization")**



the pleasure of finding things out



Search

About 7,020 results (0.21 seconds)

Everything

Images

Maps

Videos

News

Shopping

Books

More

Show only

- ☐ In stock nearby
- ☐ Google Checkout
- ☐ Free shipping
- ☐ New items

Any category

- Books
- Science Books
- DVDs & Videos
- Music
- Pool & Spa Accessories
- More

Any price

- Up to \$15
- \$15 – \$20
- \$20 – \$30

Set your location

Sort by: Relevance



The pleasure of finding things out: the best short works of ...

by Richard Phillips Feynman, Jeffrey Robbins - Basic Books (2005.04.06) - paperback - 288
The Pleasure of Finding Things Out is a magnificent treasury of the best short works of Richard P. Feynman—from interviews and speeches to ...

★★★★☆ 73 reviews - [Add to Shopping List](#)

\$6

from 32 stores

[Compare prices](#)



The Pleasure of Finding Things Out

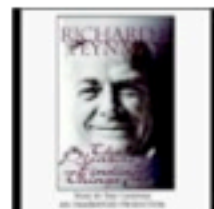
The Pleasure of Finding Things Out is a magnificent treasury of the best short works of Richard P. Feynman, including interviews, speeches ...

[Add to Shopping List](#)

\$7.00 used

[Barnes & Noble](#)

★★★★☆ 628 reviews



The Pleasure of Finding Things Out

The Pleasure of Finding Things Out digital audio book download.

[Add to Shopping List](#)

\$7.49

[Audible.com](#)

★★★★☆ 103 reviews



The pleasure of finding things out: the best short works of ...

by Richard Phillips Feynman, Jeffrey Robbins - Perseus Books (1999) - paperback - 270
The Pleasure of Finding Things Out is a magnificent treasury of the best short works of Richard Feynman—from interviews and speeches to lectures ...

★★★★☆ 73 reviews - [Add to Shopping List](#)

\$5

from 20 stores

[Compare prices](#)



Pleasure Of Finding Things Out, The [Book]

by Richard P. Feynman - Penguin (2007.10.19) - paperback - 288 pages

This collection of the best short works of rule-breaking genius Richard Feynman shows his passion for knowledge and sense of fun at their most ...

★★★★☆ 73 reviews - [Add to Shopping List](#)

\$5

from 9 stores

[Compare prices](#)



The pleasure of finding things out: the best short works of ...

by Richard Phillips Feynman, Jeffrey Robbins - Perseus Books (1999.09.16) - hardback - 270

\$8

from 15 stores

What's about cars?

For cars, especially for new cars, results are a bit disappointing...

Google

Search 4 results (0.14 seconds)

Everything Sort by: Relevance

Images

Maps

Videos

News

Shopping

More

Show only

☐ In stock nearby

☐ Google Checkout





☐ Free shipping

☐ New items

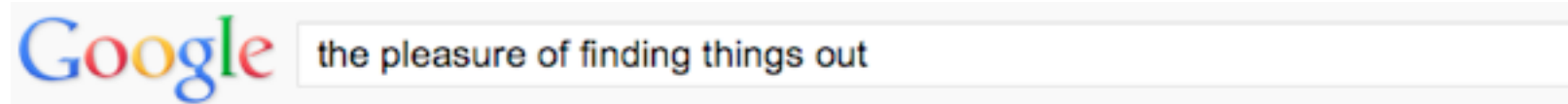
Any store

autoshipper.com

MotorZoo

| | | |
|---|--|---|
|  | <p>2010 Buick Enclave CXL W/2XL SUV</p> <p>Used 2010 Buick Enclave CXL W/2XL SUV for sale in Cary, North Carolina, 27511 CARFAX 1-Owner BRAND NEW TIRES Extra Clean. JUST REPRICED FROM \$36 ...</p> <p>Add to Shopping List</p> | <p>\$33,399.00 used</p> <p>autoshipper.com</p> |
|  | <p>2012 Volkswagen Golf TDI 4-Door w/ Sunroof & N</p> <p>Color: Black, Interior: Titan Black, Restraint: 6 Air Bags, Body Style: 4 Dr Hatchback, Number of Doors: 4, Fuel Type: Diesel, Transmission Type ...</p> <p>Add to Shopping List</p> | <p>\$28,500.00</p> <p>MotorZoo</p> |
|  | <p>2012 Volkswagen GTI W/Convenience & Sunroof</p> <p>Color: Black, Interior: Interlagos, Body Style: 4 Dr Hatchback, Number of Doors: 4, Fuel Type: Gasoline, Transmission Type: Automatic, Front side ...</p> <p>Add to Shopping List</p> | <p>\$28,650.00</p> <p>MotorZoo</p> |
|  | <p>2011 Nissan Murano AWD 2DR CONVERTIBLE</p> <p>Color: Cap Beige, Body Style: 2 Dr SUV, Number of Doors: 2, Fuel Type: Gasoline, Engine: 6, Displacement: 3.5, Transmission Type: CVT, All-wheel ...</p> <p>Add to Shopping List</p> | <p>\$48,020.00</p> <p>MotorZoo</p> |

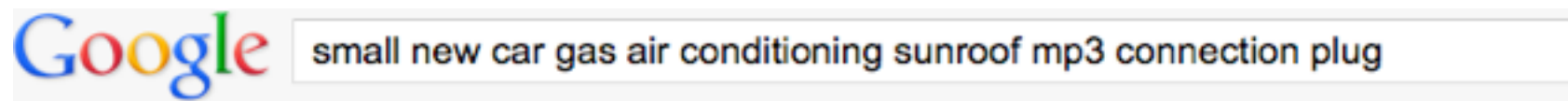
Books



- Completely Defined Products
- Few search criteria
- Comparisons of the offers on a small number of criteria
- ISBN
- <130.000.000 different books*

* <http://booksearch.blogspot.com/2010/08/books-of-world-stand-up-and-be-counted.html>

Cars



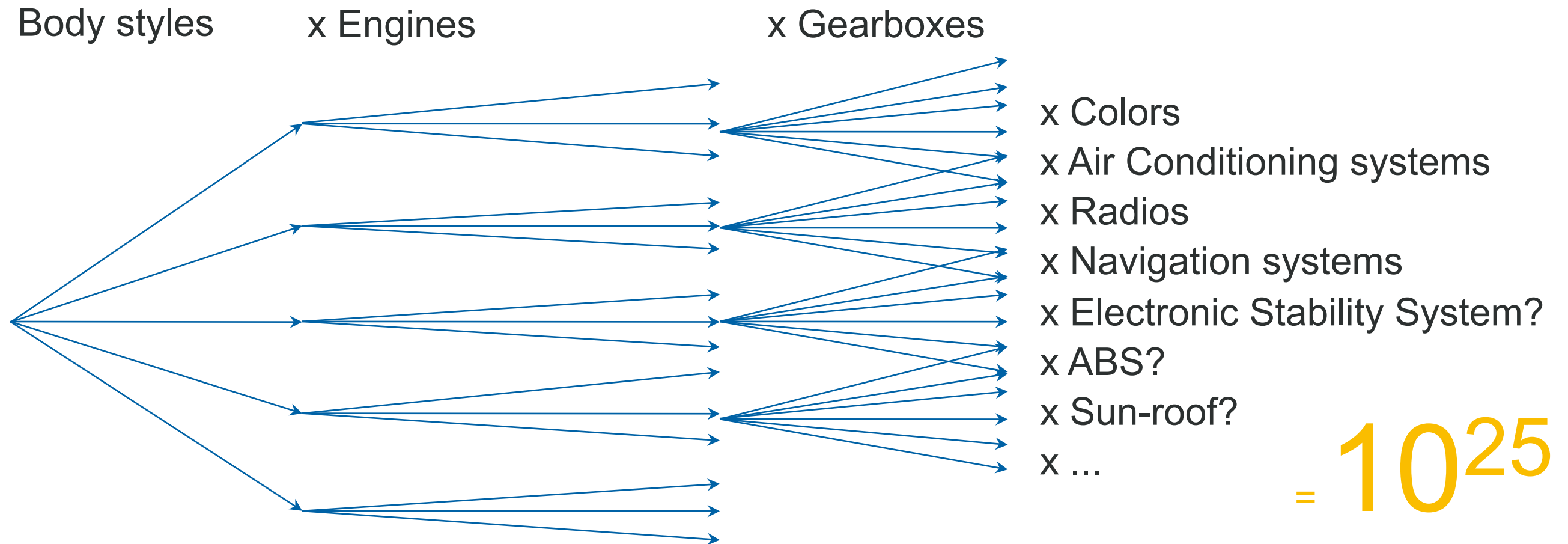
- Partially Defined Products
- Many criteria
- Comparisons on many criteria (CO2 emission level?...)
- No id
- and... a huge diversity

Product ranges in the automotive industry are huge

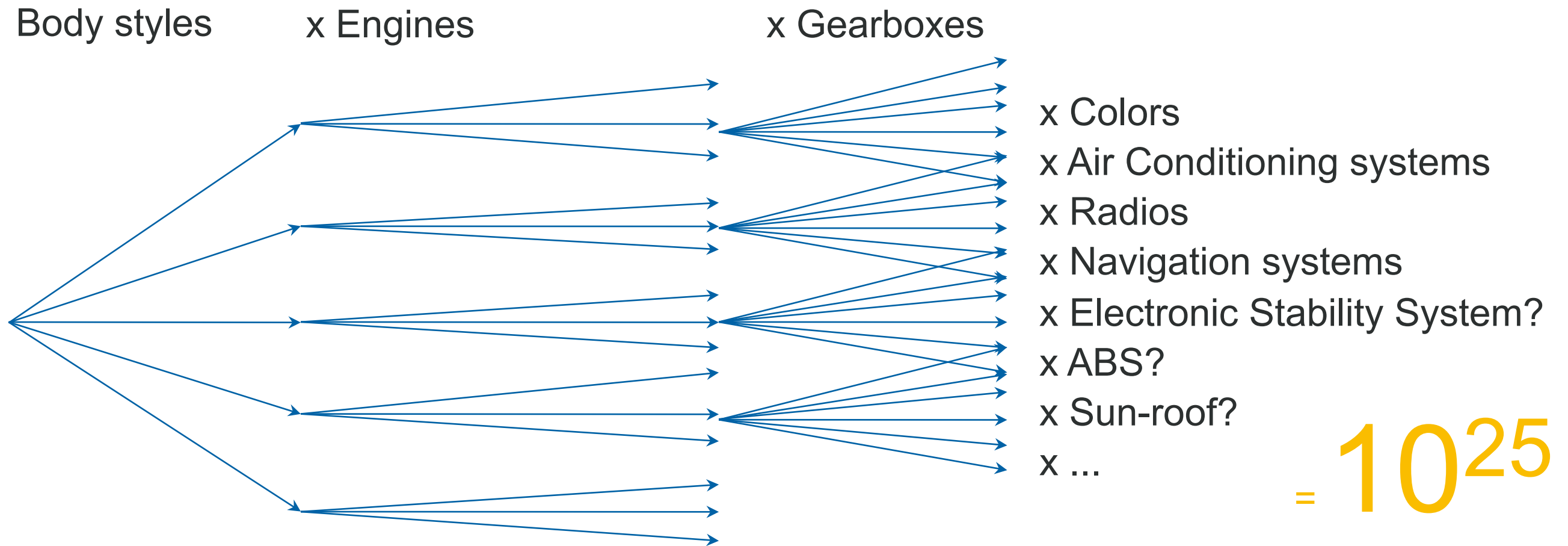
10²⁰

different cars for sale at Renault

Product ranges in the automotive industry are huge



Huge, and complex



= 10^{25}

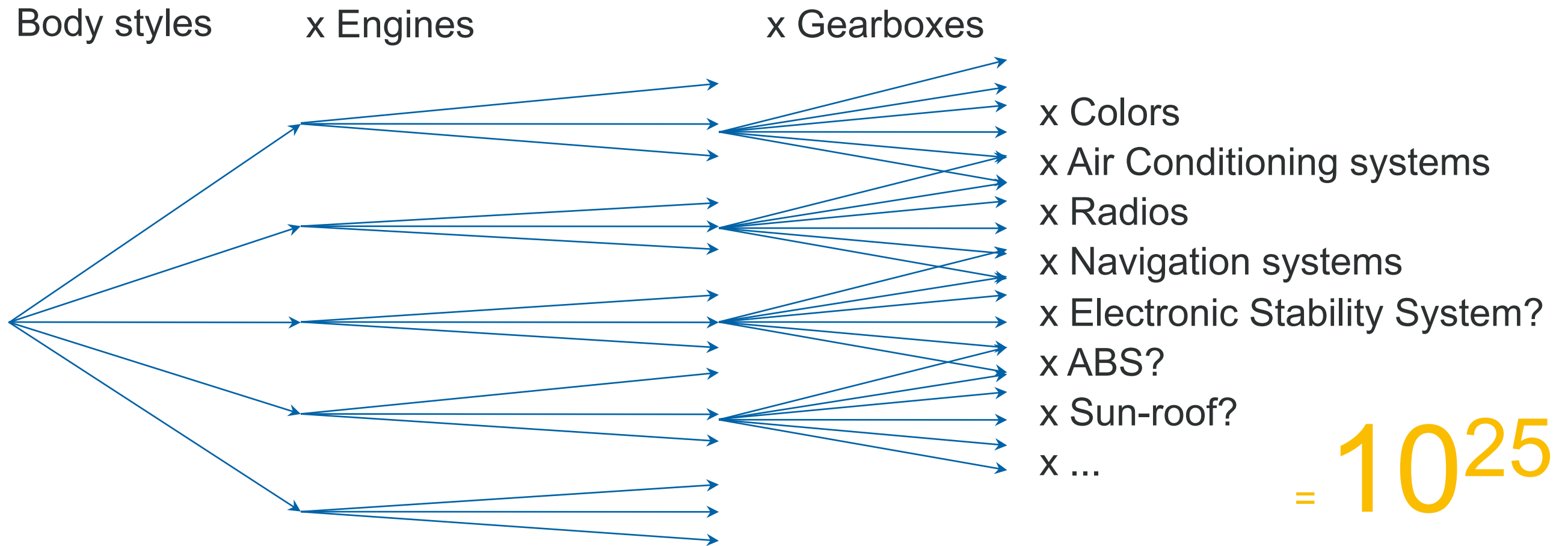


= 10^{20}

Every combination of features is not possible :
technical, industrial and legal constraints, marketing policy

- "Unglazed rear doors exclude rear wipers"
- "Rear electric windows imply front electric windows"- ...

Huge, and complex



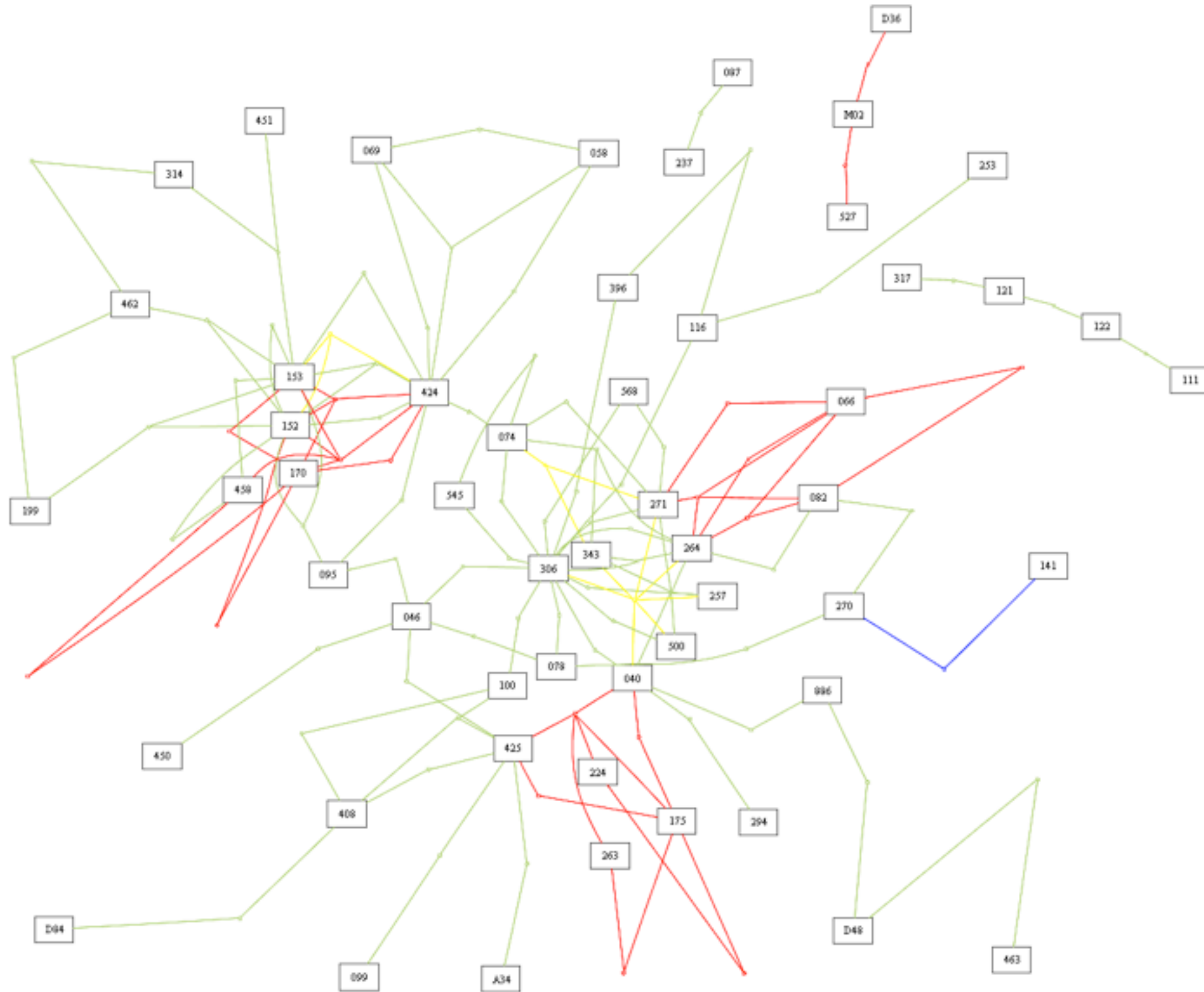
= 10^{25}



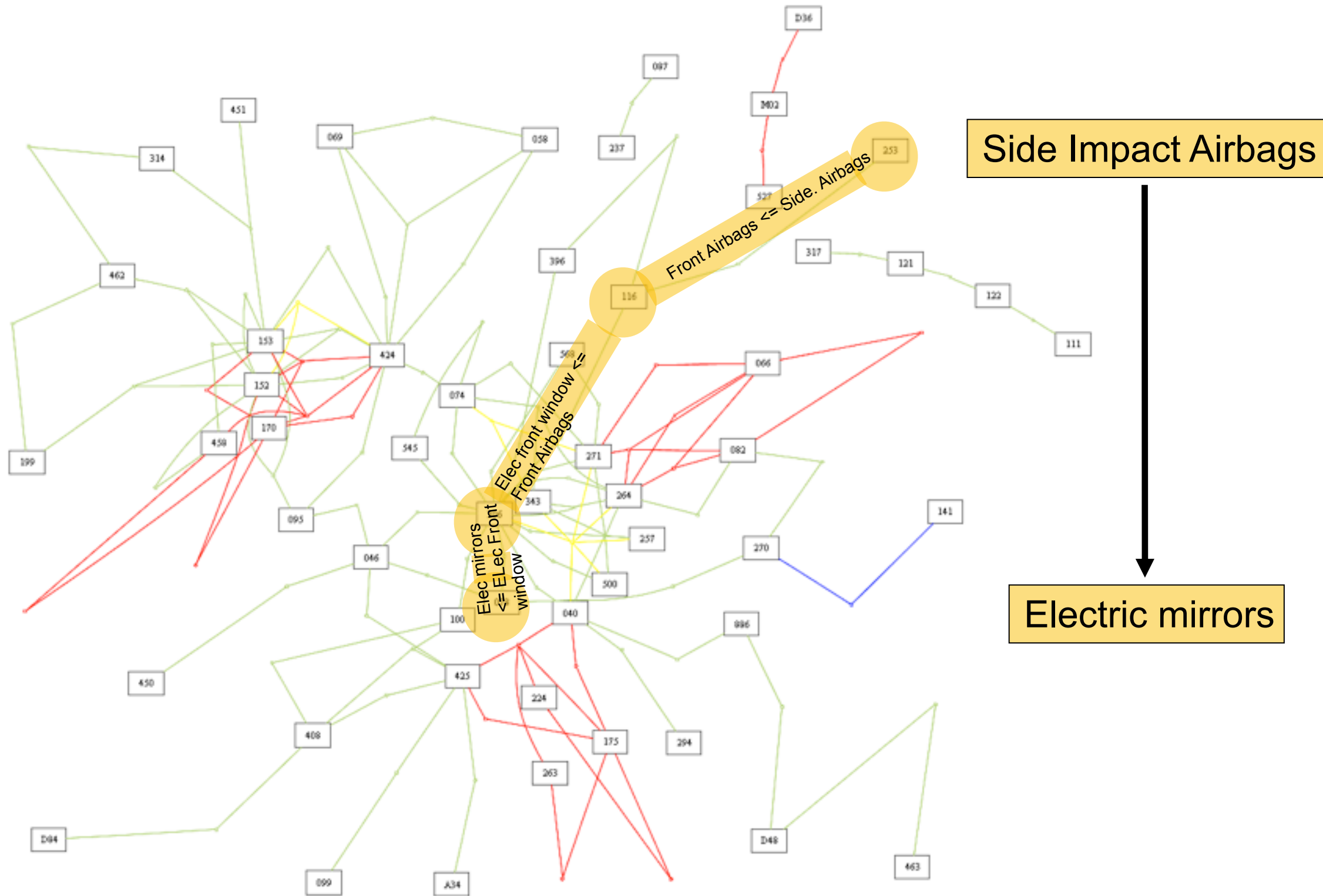
= 10^{20}

1 chance upon 100,000 to get an
existing car,
if you choose its features
without taking the constraints into account.

Propagation of constraints



Propagation of constraints



Description of an automotive range

- The range cannot be enumerated: defined "in intention"
- A set of Variables and Constraints:
 - a "Constraint Satisfaction Problem" (CSP)
 - Computationally hard!
- Automatic reasoning software required









How to publish such descriptions?

- The CSP can be represented using Semantic Web languages
- But publishing such data on the web is too demanding of the clients
 - Reasoning better hosted on the server
- So?

03

Configuration as Linked Data

Configurators: an effective way of presenting a range to human users

| LA GAMME RENAULT | | | |
|------------------------|--|--|--|
| Véhicules Particuliers | | | |
| TWINGO |  NOUVELLE TWINGO | | |
| WIND |  RENAULT WIND | | |
| CLIO |  CLIO CAMPUS BYEBYE |  CLIO |  CLIO ESTATE |
| MODUS |  MODUS |  GRAND MODUS | |
| KANGOO |  KANGOO | | |

Configurators: interactive definition of a car, one choice after the other

| 01 PREFERENCES | 02 VERSIONS | 03 ÉQUIPEMENTS | 04 SERVICES | 05 FINANCEMENT | 06 RÉCAPITULATIF |
|----------------|-------------|----------------|-------------|----------------|------------------|
|----------------|-------------|----------------|-------------|----------------|------------------|

SÉLECTIONNEZ VOS PRÉFÉRENCES

▼ **Nombre de portes**

☐ 3

☐ 5


▼ **Motorisation**

☐ Diesel

☐ Essence

▼ **EC02**



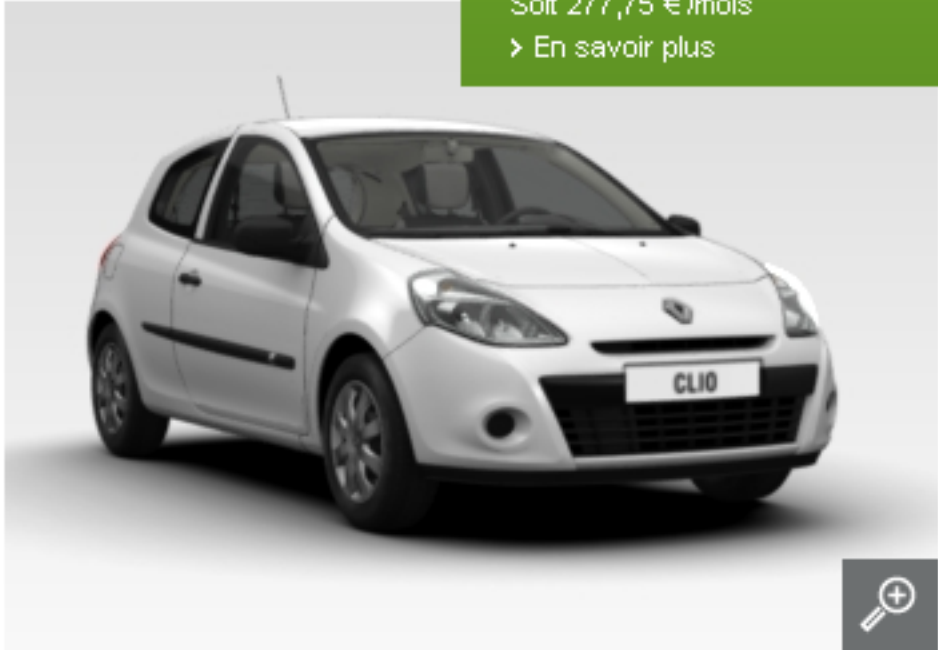
☐ -

☐ 

A partir de
13 950,00 € TTC

Soit 277,75 € /mois

> En savoir plus



The configuration process


- at each step: list of the possible choices, given the choices made so far

Previous selections


MA CONFIGURATION

Ma version
Authentique 5P dCi 75 **16 250,00 €**

Mes préférences :
Motorisation : Diesel
Nombre de portes : 5




RENAULT eco²



Ouvrir ►

Modifiez votre couleur de peinture et votre ambiance intérieure



Possible choices

▼ SECURITE

- ☐ Roue de secours normale 110,00 €
- ☒ Kit de gonflage et de réparation 0,00 €

▼ CONFORT

- ☐ Climatisation manuelle 1 000,00 €

▼ CONDUITE

- ☐ Régulateur-limiteur de vitesse 250,00 €

▼ RADIO

- ☐ Radiosat 80w CD MP3 avec prise RCA 400,00 €

▼ ACCESSOIRES

- ☐ Attelage RDSO 7BR (Posé) 590,00 €
- ☐ Attelage col de cygne 7BR* (Posé) 430,00 €
- ☐ Barres de toit aluminium 145,00 €
- ☐ Accoudoir central (posé)(sauf sur GT/ XV de France / Initiale et Night&Day) 150,00 €
- ☐ Boite de 4 écrous antivol 39,00 €
- ☐ Parrot MKI 9200 (posé) 315,00 €
- ☐ GPS Garmin 1340LMT 249,90 €
- ☐ Avertisseur de radar Mini Coyote 199,90 €

Configuration service

- `ConfigurationService?spec=spec1&spec=spec2&...` (*)

Previous selections

- returns: Possible choices
 - = the specifications compatible with previous selections
 - to choose spec3: append "&spec=spec3" to (*)
- (*) identifies a state of the configuration process
 - = a "Configuration"
 - = a Partially Defined Car
- (*) : URI of configuration

Configuration as Linked Data

- **ConfigurationService?spec=spec1&spec=spec2&... (*)**
- **returns the list of**

[compatible specification, URI of the linked (modified) configuration]
 - **eg. [spec3, ConfigurationService?spec=spec1&spec=spec2&spec=spec3]**
- **Configuration Process = Traversal of a graph of linked Configurations**
- **= Linked Data!**
- **Reasoning handled by the server, complexity hidden to the client**

Example

I want a Clio 3...

<http://conf.renault.com/CL3> : "I want a Clio 3"

```
{
  model: http://conf.renault.com/doc/CL3,
  - choices: {
    specChoice: [ ]
  },
  minPrice: 13950,
  - impact: [
    - {
      - possibles: [
        - {
          specCode: "DIESEL",
          next: http://conf.renault.com/CL3/DIESEL
        },
        - {
          specCode: "GASOLINE",
          next: http://conf.renault.com/CL3/GASOLINE
        }
      ],
      impossibles: [ ]
    },
    - {
      - possibles: [
        - {
          specCode: "AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/AIR\_CONDITIONING
        },
        - {
          specCode: "NO_AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/NO\_AIR\_CONDITIONING
        },
        - {
          specCode: "CLIMATE_CONTROL",
          next: http://conf.renault.com/CL3/CLIMATE\_CONTROL
        }
      ],
      impossibles: [ ]
    },
    + { ... }
  ]
}
```


<http://conf.renault.com/CL3> : "I want a Clio 3..."

```
{
  model: http://conf.renault.com/doc/CL3,
  - choices: {
    specChoice: [ ]
  },
  minPrice: 13950,
  - impact: [
    - {
      - possibles: [
        - {
          specCode: "DIESEL",
          next: http://conf.renault.com/CL3/DIESEL
        },
        - {
          specCode: "GASOLINE",
          next: http://conf.renault.com/CL3/GASOLINE
        }
      ],
      impossibles: [ ]
    },
    - {
      - possibles: [
        - {
          specCode: "AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/AIR\_CONDITIONING
        },
        - {
          specCode: "NO_AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/NO\_AIR\_CONDITIONING
        },
        - {
          specCode: "CLIMATE_CONTROL",
          next: http://conf.renault.com/CL3/CLIMATE\_CONTROL
        }
      ],
      impossibles: [ ]
    },
    + { ... }
  ]
}
```

...diesel

<http://conf.renault.com/CL3/DIESEL> : "I want a Clio 3, diesel..."

```
{
  model: http://conf.renault.com/doc/CL3,
  - choices: {
    - specChoice: [
      - {
        - specCodes: [
          "DIESEL"
        ]
      }
    ]
  },
  minPrice: 16250,
  - impact: [
    - {
      - possibles: [
        - {
          specCode: "AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/DIESEL-AIR\_CONDITIONING
        },
        - {
          specCode: "NO_AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/DIESEL-NO\_AIR\_CONDITIONING
        }
      ],
      - impossibles: [
        - {
          specCode: "CLIMATE_CONTROL"
        }
      ]
    },
    + { ... },
    + { ... }
  ]
}
```

<http://conf.renault.com/CL3/DIESEL> : "I want a Clio 3, diesel..."

```
{
  model: http://conf.renault.com/doc/CL3,
  - choices: {
    - specChoice: [
      - {
        - specCodes: [
          "DIESEL"
        ]
      }
    ]
  },
  minPrice: 16250,
  - impact: [
    - {
      - possibles: [
        - {
          specCode: "AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/DIESEL-AIR\_CONDITIONING
        },
        - {
          specCode: "NO_AIR_CONDITIONING",
          next: http://conf.renault.com/CL3/DIESEL-NO\_AIR\_CONDITIONING
        }
      ],
      - impossibles: [
        - {
          specCode: "CLIMATE_CONTROL"
        }
      ]
    },
    + { ... },
    + { ... }
  ]
}
```

...with air conditioning

<http://conf.renault.com/CL3/DIESEL-CLIM> : a Clio 3, diesel, with air conditioning

Made selections

```
{
  model: http://conf.renault.com/doc/CL3,
  - choices: {
    - specChoice: [
      - {
        - specCodes: [
          "DIESEL"
        ]
      },
      - {
        - specCodes: [
          "AIR_CONDITIONING"
        ]
      }
    ]
  },
  minPrice: 17250,
  - impact: [
    - {
      - possibles: [
        - {
          specCode: "SUN_ROOF",
          next: http://conf.renault.com/CL3/DIESEL-AIR\_CONDITIONING-SUN\_ROOF
        },
        - {
          specCode: "NORMAL_ROOF",
          next: http://conf.renault.com/CL3/DIESEL-AIR\_CONDITIONING-NORMAL\_ROOF
        }
      ],
      impossibles: [ ]
    },
    + { ... }
  ]
}
```

Possible choices

Configuration ontology

- <http://purl.org/configurationontology>
- **The configuration process as the traversal of a graph of Configurations**
 - **2 main classes: Specification and Configuration**
 - **properties: chosenSpec, impliedSpec, possible, impossible, defaultSpec, etc**

ex:Conf1 a co:Configuration ;

co: chosenSpec :CL3 , cl3:Diesel ;

co: possible [:possibleSpec cl3:AirConditioning ; :linkedConf ex:Conf1PlusAirConditioning.]

[:possibleSpec cl3:SunRoof ; :linkedConf ex:Conf1PlusSunRoof.],

- **A generic, domain independent ontology**
 - **not limited to the automotive industry**
 - **doesn't depend on the vocabulary used for the specifications**
 - **most online configurator applications can use it**

Integration with GoodRelations

- **A Configuration :**

- **a "Partially Defined Product"**

- can be completed to a product that can be ordered - without changing any of the current selections
 - has a "starting price" = min(corresponding completely defined products)

- **a commercial offer**

- **the expression of a customer's wish list (constrained by the definition of the range)**

- BTW: an important thing, in a marketing point of view!

- **Can seamlessly be described using GoodRelations**

- **as a Product or as a Commercial offer**

ex:Conf1 a co:Configuration ;

co: chosenSpec :CL3 , cl3:Diesel ;

gr:hasPriceSpecification [a gr:UnitPriceSpecification ; gr:hasCurrency "EUR". gr:hasCurrencyValue

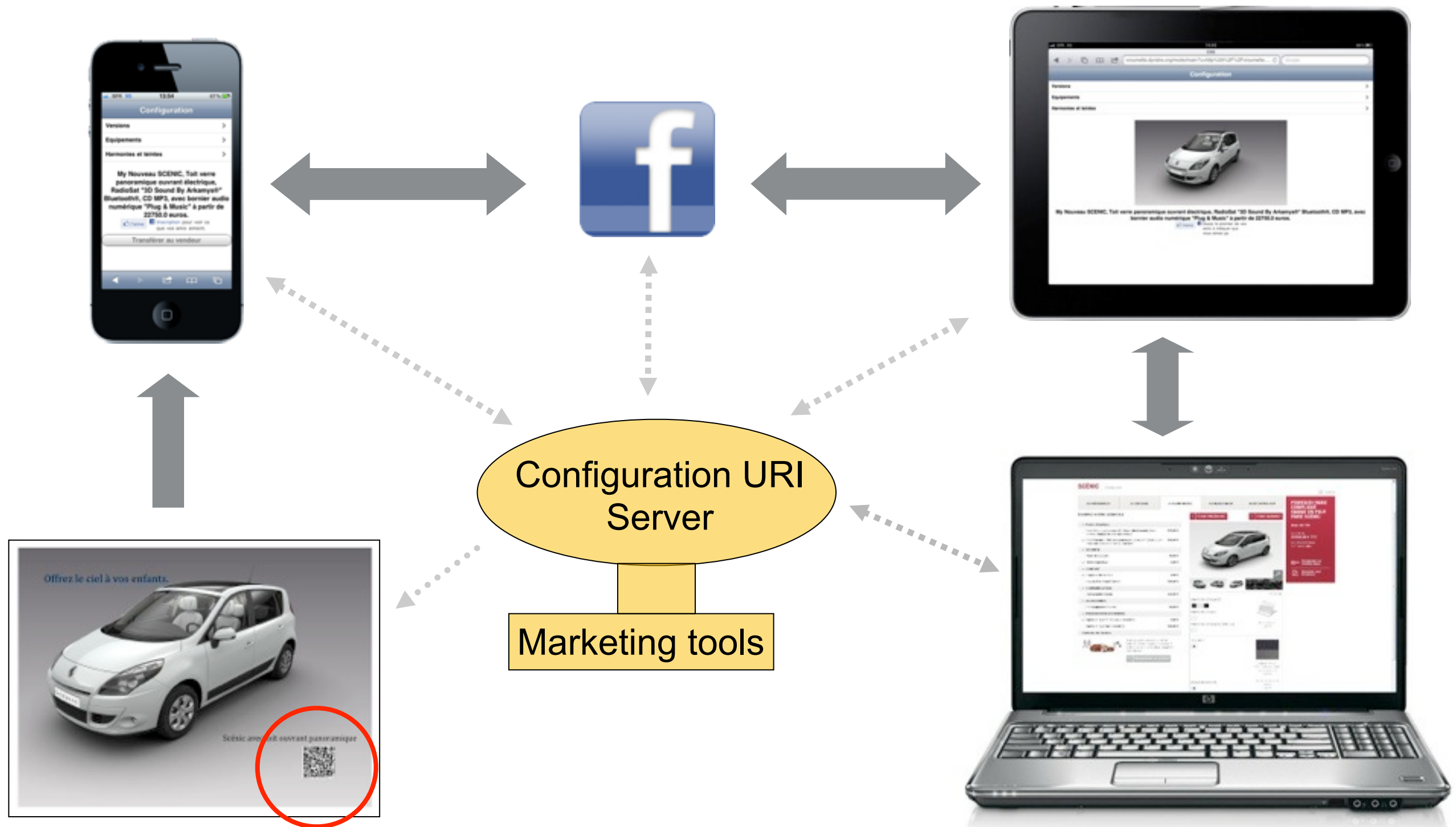
03

Benefits & applications

Benefits

- **Improved Architecture of the configuration server**
 - **Web architecture**
- **Decreased development costs of web applications**
 - **No need to understand the concepts underlying configuration**
 - **No need to learn an API**
 - **Just "display the data and follow the links"**
- **Data published on the web of data for e-business**
 - **ready to be used by agents (eg. range comparators)**
- **Configuration URI: a global identifier for Partially Defined Products**
 - **Tagging web content**
 - **Advertising**
 - **Easy sharing of configurations between applications, devices, media**
 - link between web site and corporate applications (eg. ordering system...)
 - Facebook

Sharing configurations between applications, devices, media



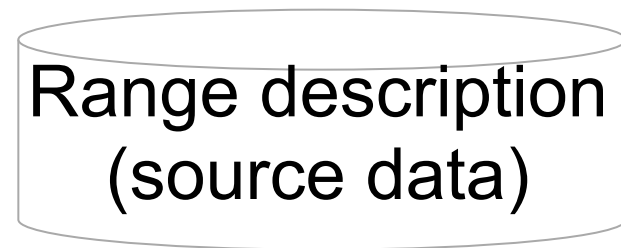
Indexing configurations

- **Accurate description of the range, that can be explored by crawlers**
 - just a matter of following links.
- **But 10^{20} is huge!**
 - Partial indexing
 - Based on the specifications
 - **Beware to the semantics of the properties!**
 - spec1 and spec2 can both be compatible with a given configuration, but not (spec1 and spec2) -
 - only way to know: query the configuration service
 - **Choose the indexing strategy**
 - some specifications have more value than others
- **Sitemap**
 - **which configurations should be included to get the most of it from a marketing point of view?**

Conclusion

- **Ranges of customizable products can be described as Linked Data**
- **URIs for Partially Defined Products**
- **A generic ontology**
- **Renault has begun to publish such data about its range**
 - **`http://{fr,de,it,es}.co.rplug.renault.com/docs`**
 - **JSON in Germany and Italy for the moment, more to come soon**
 - **RDF really soon now**
 - **RDFa in the web sites coming a little bit later**
- **Todo (?): linking our specifications to vocabularies such as VSO or dbPedia?**
- **Agents can crawl and use these data**
 - **eg. range comparators**

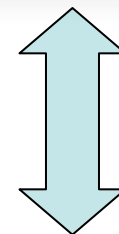
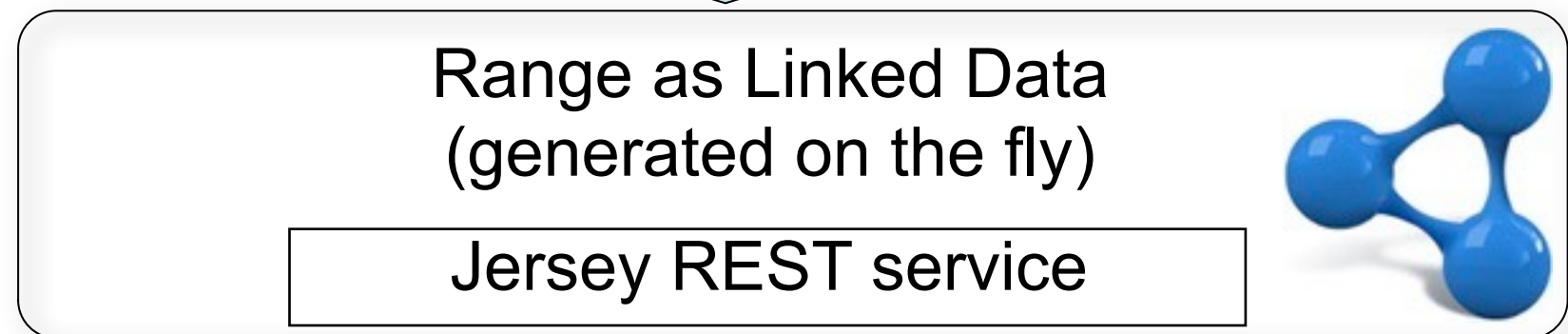
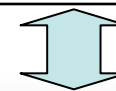




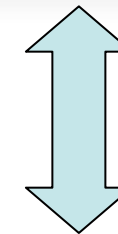
Compilation
→
(offline)



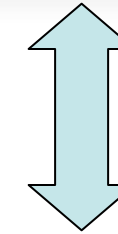
Configuration
Engine



Configurator
web app



Crawler



Agent

HTTP

Configuration as Linked Data



— dc:subject —→

<http://.../CL3/DIESEL>



<http://.../CL3/DIESEL>

"Clio 3 diesel"

16.250 €

Possible choices

<http://.../CL3/DIESEL-CLIM>

"Clio 3, diesel, with air conditioning"

<http://.../CL3/DIESEL-SUNROOF>

<http://.../CL3/DIESEL-CLIM-SUNROOF>

Renault and Semantic Web

- **Linking Enterprise Data**

- **"Semantic Web Technologies in Automotive Repair and Diagnostic"**

- OWLED 2007, <http://www.w3.org/2001/sw/sweo/public/UseCases/Renault/>

- **"Linking Enterprise Data"**

- LDOW 2008 (Linked Data On the Web, WWW 2008 Workshop)

- <http://events.linkeddata.org/ldow2008/papers/21-servant-linking-enterprise-data.pdf>

- **"Euro 5", first application in production based on Linked Data (2010)**

- After-sales technical documentation

- **"A Semantic Web Representation of a Product Range Specification based on Constraint Satisfaction Problem in the Automotive Industry"**

- OSEMA 2011 <http://ceur-ws.org/Vol-748/paper4.pdf>

- A vocabulary to represent Constraint Satisfaction Problems

- <http://vocab.deri.ie/csp>

- **Product customization as Linked Data**

