

Describing Customizable Products on the Web of Data

Linked Data On the Web Workshop - Rio de Janeiro - May 14th, 2013

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01

Publishing descriptions of customizable products
A challenging issue

02

Configuration as Linked Data
The Configuration Ontology

03

Designing sharable vocabularies
Requirements

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

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More

Show only

- ☐ In stock nearby
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Any category

- Books
- Science Books
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- 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

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The Pleasure of Finding Things Out

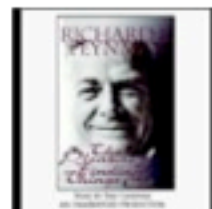
The Pleasure of Finding Things Out is a magnificent treasury of the best short works of Richard P. Feynman, including interviews, speeches ...

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The Pleasure of Finding Things Out

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

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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](#)

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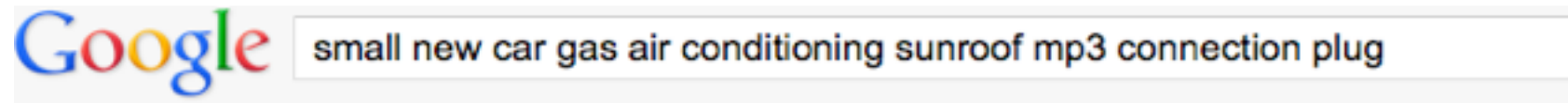
The pleasure of finding things out: the best short works of ...

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

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☐ Free shipping

☐ New items

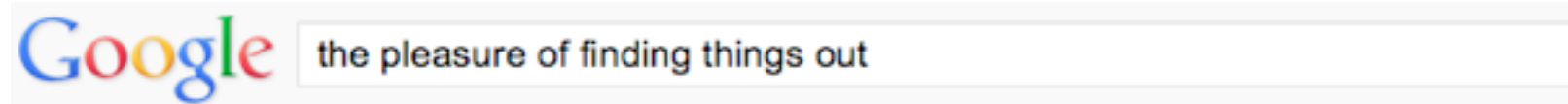
Any store

autoshipper.com

MotorZoo

	2010 Buick Enclave CXL W/2XL SUV 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 ... Add to Shopping List	\$33,399.00 used autoshipper.com
	2012 Volkswagen Golf TDI 4-Door w/ Sunroof & N Color: Black, Interior: Titan Black, Restraint: 6 Air Bags, Body Style: 4 Dr Hatchback, Number of Doors: 4, Fuel Type: Diesel, Transmission Type ... Add to Shopping List	\$28,500.00 MotorZoo
	2012 Volkswagen GTI W/Convenience & Sunroof Color: Black, Interior: Interlagos, Body Style: 4 Dr Hatchback, Number of Doors: 4, Fuel Type: Gasoline, Transmission Type: Automatic, Front side ... Add to Shopping List	\$28,650.00 MotorZoo
	2011 Nissan Murano AWD 2DR CONVERTIBLE 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 ... Add to Shopping List	\$48,020.00 MotorZoo

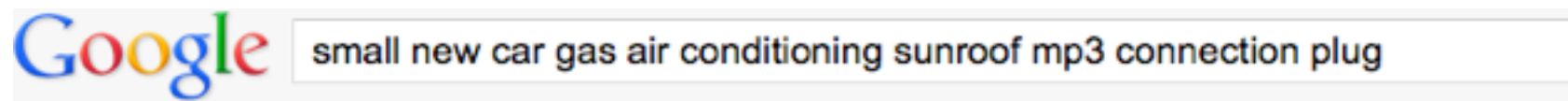
Books



- 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



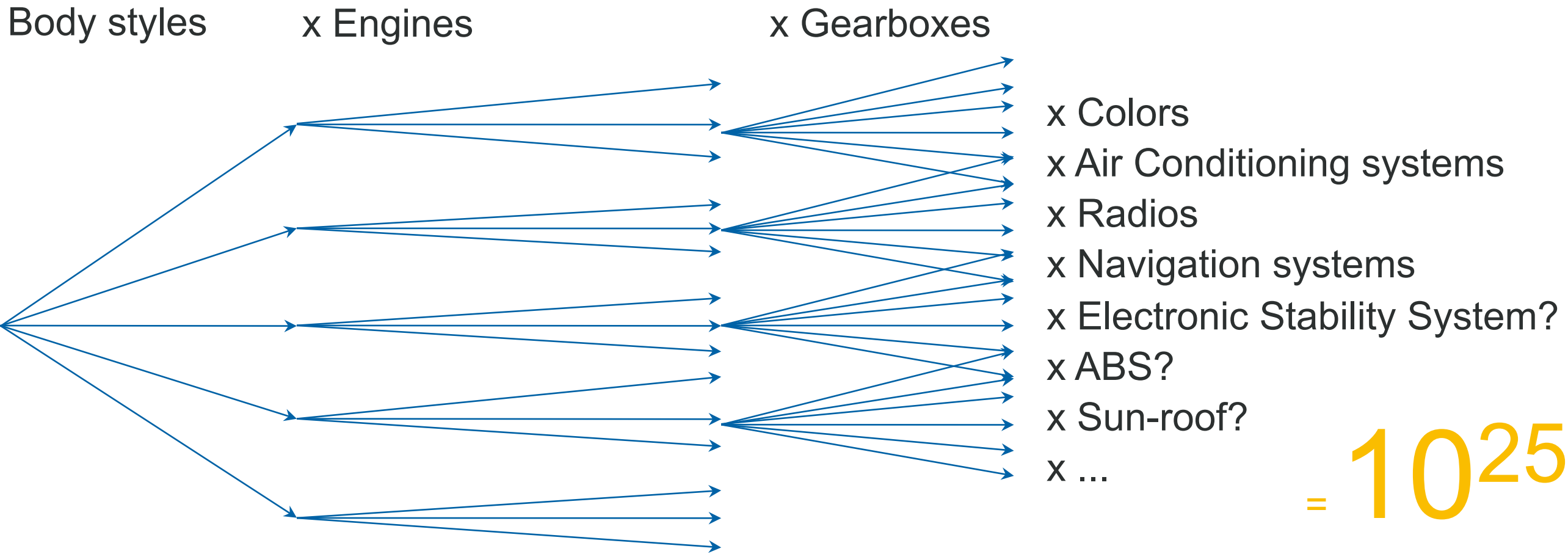
- Partially Defined Products
- Many criteria
- Comparisons on many criteria
- No id
- and... a huge diversity

Product ranges in the automotive industry are huge

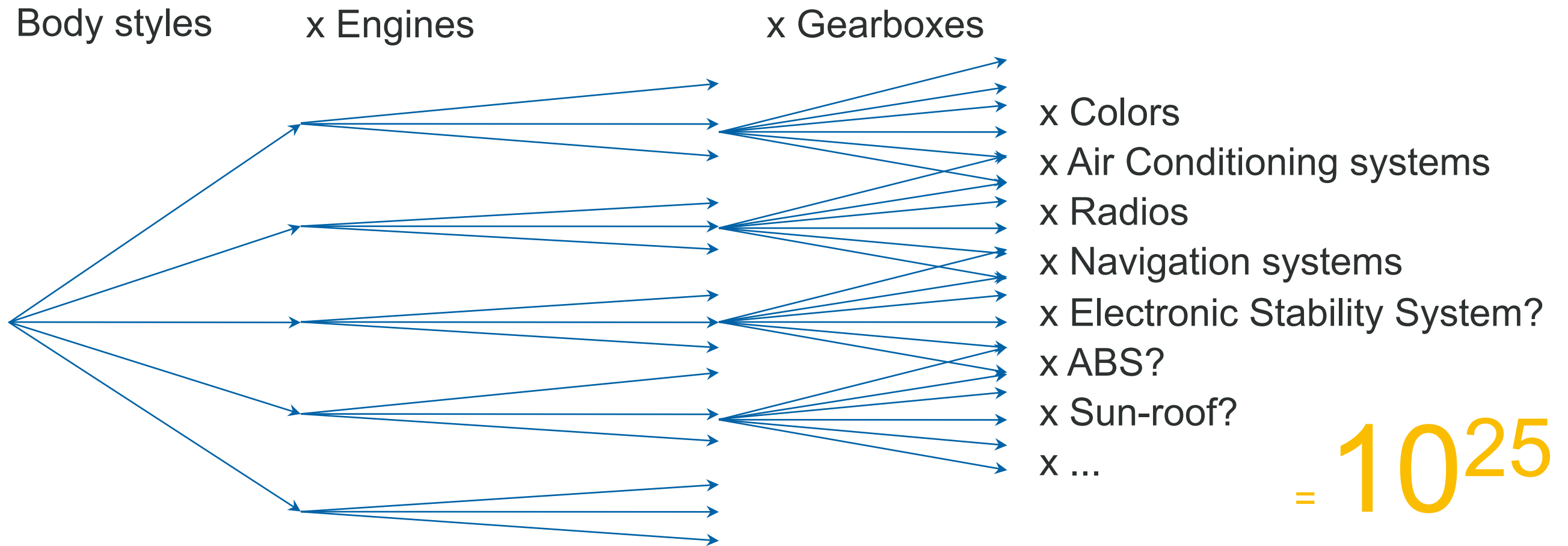
10²⁰

different cars for sale at Renault

Product ranges in the automotive industry are huge



Huge, and complex



= 10^{25}

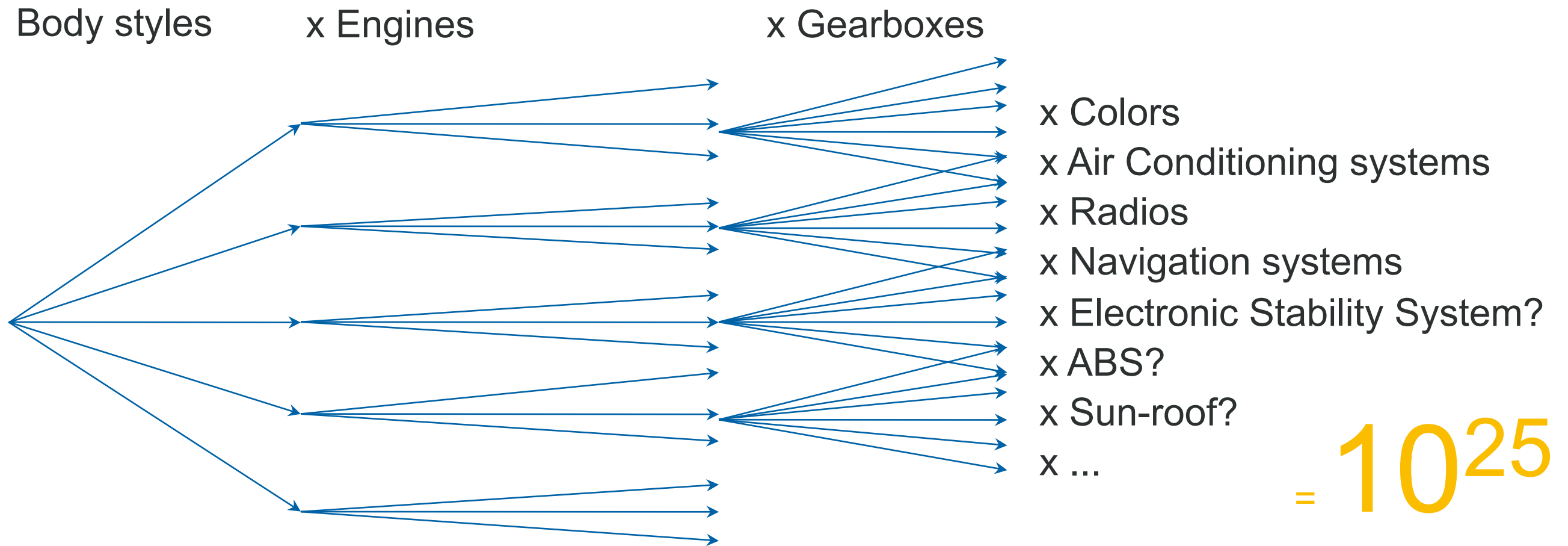


= 10^{20}

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



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

↓
= 10^{20}









Description of an automotive range

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

How to publish such descriptions?

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

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**



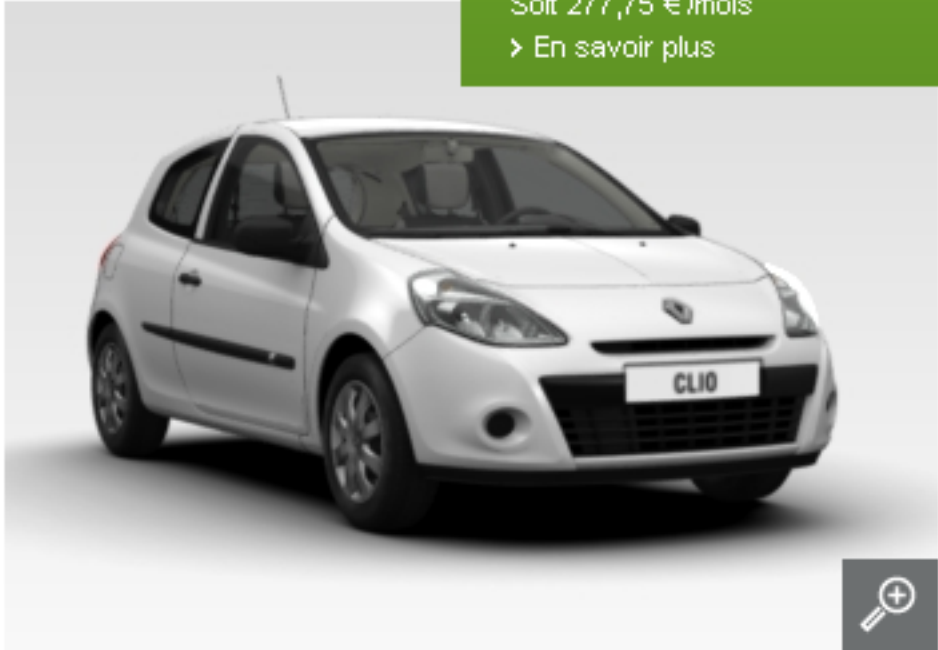
☐ -

☐ 

A partir de
13 950,00 € TTC

Soit 277,75 € /mois

> En savoir plus



The configuration process


- at each step: list of 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 €

A configurator as a REST service

- `ConfigurationService?spec=spec1&spec=spec2&...` (*)
└─ Previous selections ─┘
 - returns: Possible choices
 - = specifications compatible with the previous selections
 - to choose specX: append "&spec=specX" to (*)
- (*) identifies a state of the configuration process
 - = a "Configuration"
 - = a Partially Defined Car
 - = a subset of the range
- (*) : URI of configuration

Configuration as Linked Data

- **ConfigurationService?spec=spec1&spec=spec2&... (*)**
 - returns the list of (compatible specification, URI of the refined configuration)
 - eg. (specX, ConfigurationService?spec=spec1&spec=spec2&...&spec=specX)
- **Configuration Process = Traversal of a graph of linked Configurations**
 - = Linked Data!
- **Reasoning handled by the server, complexity hidden to the client**
 - a GUI just has to display the links

Entry point: the list of models

```
<http://uk.co.rplug.renault.com/docs#this>
  a co:Configuration ;
  co:possible
    [ a co:ConfigurationLink ;
      rdfs:label "Laguna Hatchback 2011"@en ;
      co:linkedConf <http://uk.co.rplug.renault.com/c/BAv/AAl#this> ;
      co:specToBeAdded <http://uk.co.rplug.renault.com/spec/BAv/LA3#this>
    ] ;
  co:possible
    [ a co:ConfigurationLink ;
      rdfs:label "Mégane Sport Tourer"@en ;
      co:linkedConf <http://uk.co.rplug.renault.com/c/BACp/AAl#this> ;
      co:specToBeAdded <http://uk.co.rplug.renault.com/spec/BACp/M3K#this>
    ] ;
  ...
```

Renault range (UK)

Possible choices:
the list of models

I want a Laguna Hatchback...

The "Laguna Hatchback" configuration

<http://uk.co.rplug.renault.com/c/BAv/AAl#this>

a co:Configuration ;

co:chosenSpec <http://uk.co.rplug.renault.com/spec/BAv/LA3#this> ;

co:possible

[a co:ConfigurationLink ;

co:linkedConf <http://uk.co.rplug.renault.com/c/BAv/AAMDg#this>

co:specToBeAdded <http://uk.co.rplug.renault.com/spec/BAv/PT1633_automatic_gearbox#this>

];

co:possible

[a co:ConfigurationLink ;

...

<http://uk.co.rplug.renault.com/spec/BAv/PT1633_automatic_gearbox#this>

a co:Specification ;

rdfs:label "Automatic Gearbox"@en .

Previous selections
(encoded in the URI,
in clear in the data)

Possible choices

I want an automatic gearbox...

The "Laguna Hatchback, automatic gearbox" configuration

<http://uk.co.rplug.renault.com/c/BAv/AAMDg#this>

a co:Configuration ;

co:chosenSpec

<http://uk.co.rplug.renault.com/spec/BAv/LA3#this> ,

<http://uk.co.rplug.renault.com/spec/BAv/PT1633_automatic_gearbox#this>

co:possible

[a co:ConfigurationLink ;

co:linkedConf <http://uk.co.rplug.renault.com/c/BAv/AAMDg#this> ;

co:specToBeAdded <http://uk.co.rplug.renault.com/spec/BAv/PT1628_diesel#this>

];

co:possible

[a co:ConfigurationLink ;

...

gr:hasPriceSpecification [gr:hasCurrencyValue "21795"^^<http://www.w3.org/2001/XMLSchema#float>...];

co:impliedSpec <http://uk.co.rplug.renault.com/spec/BAv/PT1627_direct_common_rail_with_turbo#this>,...

co:impossible

[a co:ConfigurationLink ;...

Previous selections
(encoded in the URI,
in clear in the data)

Possible choices

More info

Configuration ontology

- <http://purl.org/configurationontology>
- **The configuration process as the traversal of a graph of Configurations**
 - **3 main classes: Specification, Configuration and ConfigurationLink**
 - **properties: chosenSpec, impliedSpec, possible, impossible, defaultSpec, etc**
 - the different kinds of relations between a Configuration and a Specification
- **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 could use it

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**
 - **Accurate description of the range, that can be explored by crawlers**
 - just a matter of following links.
- **Configuration URI: a global identifier for Partially Defined Products**

Configuration URI: a global identifier for Partially Defined Products

- **A Configuration**

- = a "Partially Defined Product"

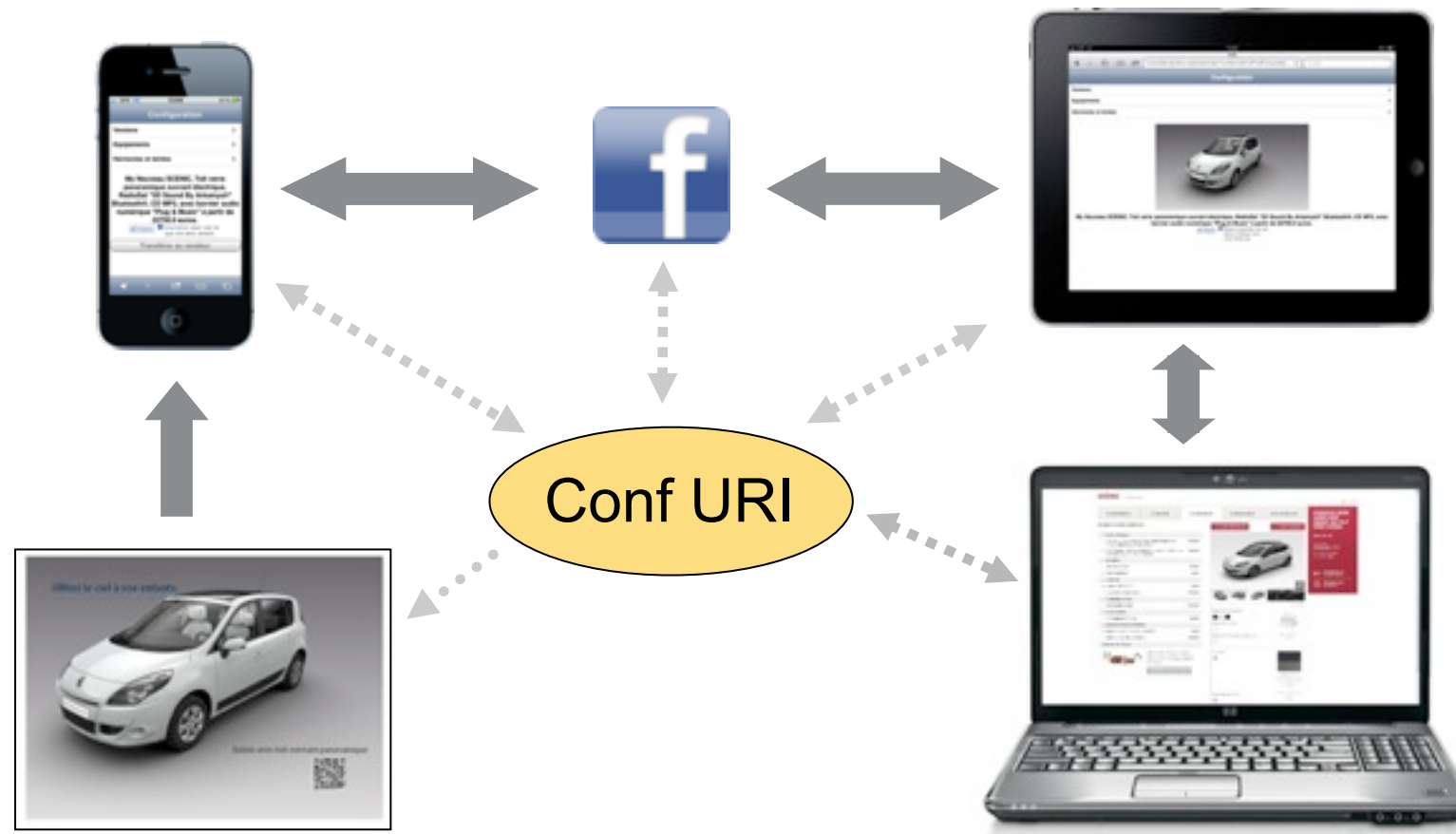
- a commercial offer

- has a "from price"

- can be described using GoodRelations

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

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



Aggregation of data from different publishers

- **Range comparators, market places, etc.**
- **Companies will publish data using their own terms (URIs of specifications)**
 - **many specifications are unique to a company**
 - and needs to be described, and therefore identified
 - **the ultimate goal of the configuration process is an order, defined in the manufacturing company's terms**
 - **no additional cost**
 - **precision is lost when mapping to other vocabularies**
 - my:GorgeousPanoramicSunroof is more than a dbpedia:Sunroof
- **Mapping required**
 - **Use dbpedia URIs? Hmm...**
- **Reference thesaurus of specifications**
 - **some shared way to say "diesel" or "CO2 emission level"**

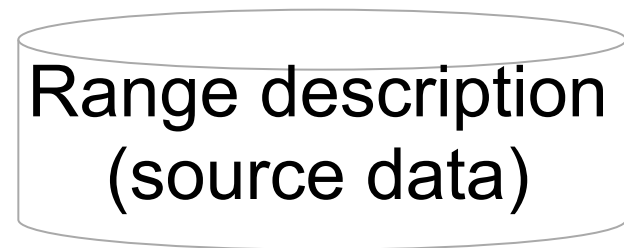
Reference thesaurus of Specifications

- **There's none**
- **Some vocabularies attempt to describe cars**
 - **but do not support Partially Defined Products (PDP)**
 - A PDP is not a completely defined one with some properties left undocumented!
- **VSO ("Vehicle Sales Ontology")**
 - **provides some terms, but uses a pattern that doesn't work for PDP:**
 - `vso:fuelType rdfs:range vso:FuelTypeValue.`
 - `foo:ACar vso:fuelType dbpedia:Diesel.`
 - No room left for the kind of the relation between the configuration and the specification (possible, implied, etc)
 - Should be enough to state once for all that: `dbpedia:Diesel a vso:FuelTypeValue.`
- **Shift from vocabularies describing products to vocabularies defining classes of Specifications**
 - **hierarchies of terms, etc.**

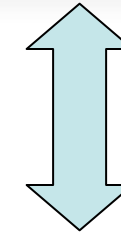
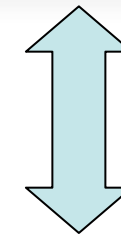
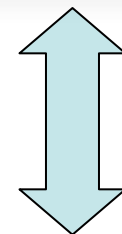
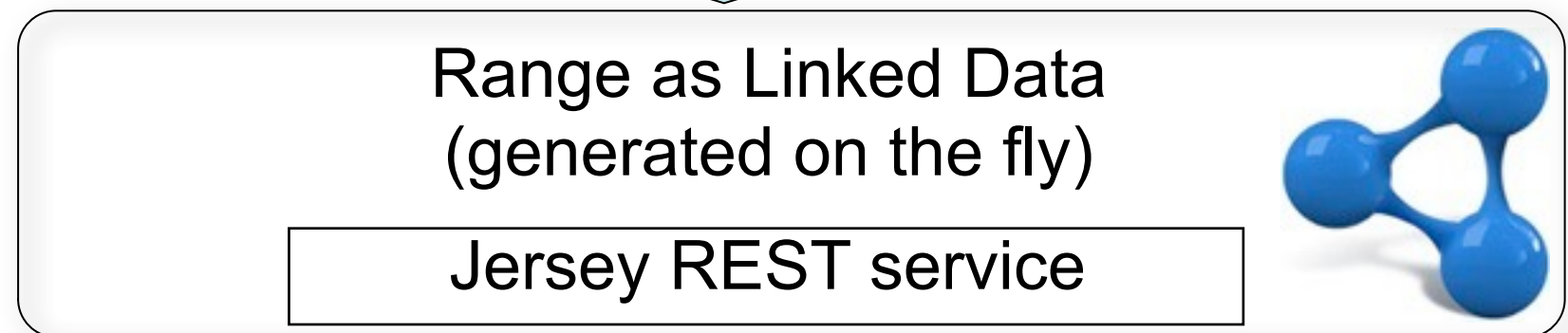
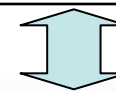
Conclusion

- **Ranges of customizable products can be described as Linked Data**
- **URLs for Partially Defined Products**
- **A generic ontology**
- **Renault publishes data about its range**
 - **10²⁰ cars (and more configurations) fully described in RDF**
 - **<http://{uk,br,fr,de,es,it}.co.rplug.renault.com/docs#this>**
(set ACCEPT HTTP Header to application/rdf+xml or to text/turtle)
 - **quick start guide (and a javascript configurator based on this data):**
<http://purl.org/configurationontology/quickstart>
- **Agents can crawl and use these data**
 - **a challenge for Search Engines (10²⁰ is huge!)**
- **A reference thesaurus of classes of specifications would be helpful for Range comparators**





Compilation
→
(offline)



HTTP

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?