

Design considerations for ODD languages

Robert Myers

Background: the MUSICC project

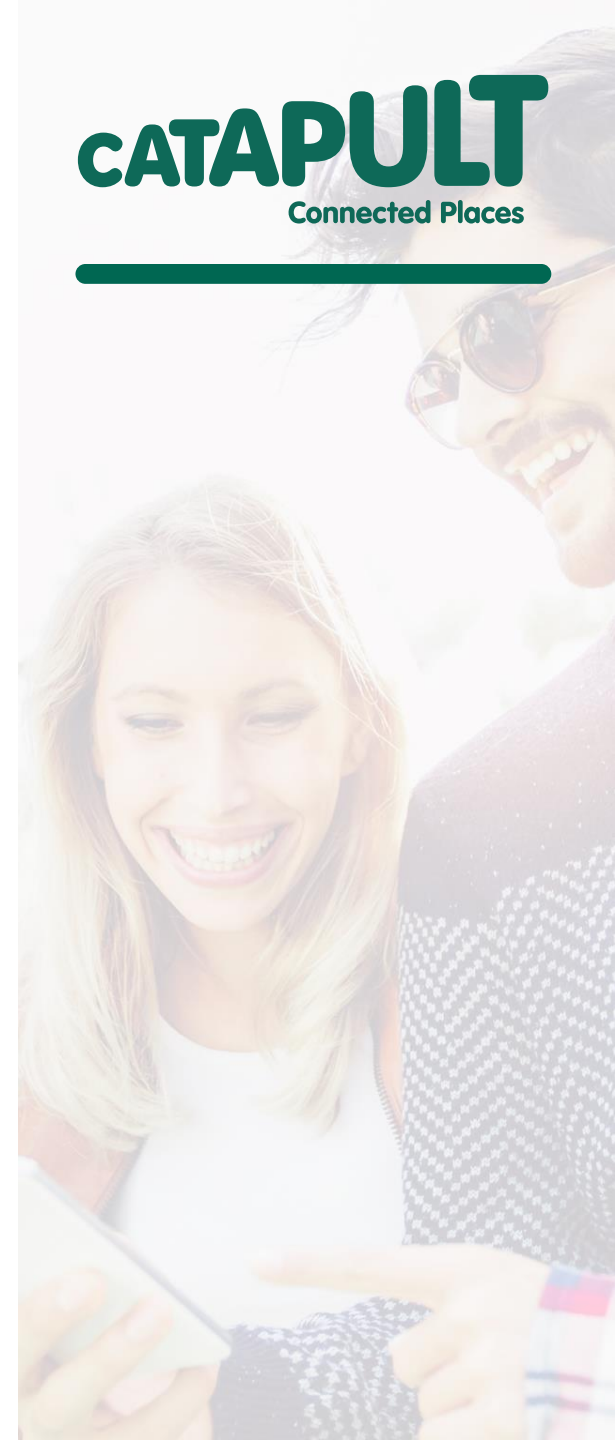
Much more at <https://cp.catapult.org.uk/case-studies/musicc/>

Future of type approval

- V&V increasingly use simulation
- Type approval methods will need to change to keep up!
- **Test scenarios** will become very important, with some likely to be prescribed by regulation

Key output of the project

A proof-of-concept system to store and share a *library of scenarios* for regulatory use



Background: the MUSICC project

Much more at <https://cp.catapult.org.uk/case-studies/musicc/>



Notifications
Hi Robert
profile
logout

Revision: 0.1.3

label
 OR AND

version
 OR AND

updateDateTime
dd/mm/yyyy --: OR AND

updateUsername
 OR AND

MUSICC_ID
 OR AND

OpenScenario_ID
 OR AND

OpenDrive_ID
 OR AND

Description
 OR AND

CountryCode

Query: Search Download

- NOT
- label
- version
- updateDateTime
- updateUsername
- MUSICC_ID
- OpenScenario_ID
- OpenDrive_ID
- Description
- CountryCode
- DriveOnRightOrLeft
- UseCase
- ScenarioType
- Exposure
- SituationDemand

MUSICC_ID	info
M119	?
M122	?
M125	?
M127	?
M120	?
M121	?
★ UK CPC-Demo highway_test_aggressive_overtake	8 2020-01-28T13:26:09 M123 ?
★ UK TSC-Demo oncoming_vehicle	9 2020-01-28T13:26:10 M124 ?
★ UK TSC-Demo unexpected_emergency_stop	6 2020-01-28T13:26:11 M126 ?

Showing 1 to 9 of 9 entries Show 25 entries First Previous 1 Next Last



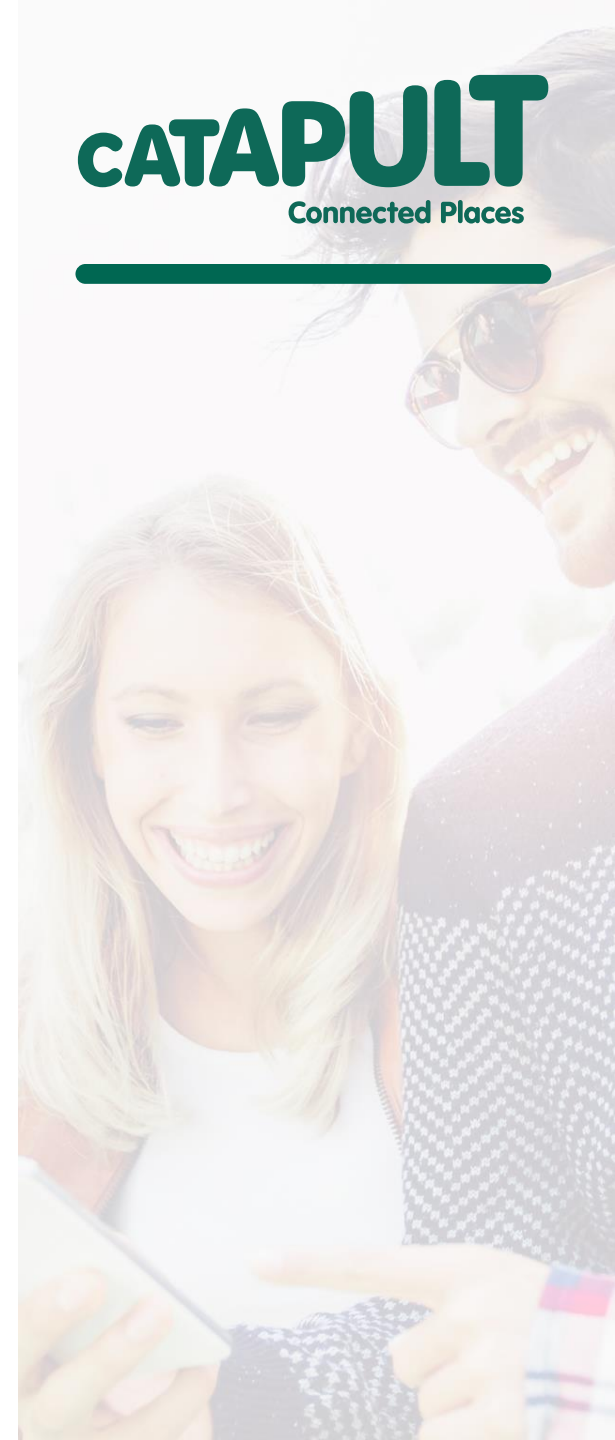
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Themes

- Need to **find the right scenarios** – but only the right scenarios!
 - Highly dependent on machine readable ODD
- Open standards

CATAPULT
Connected Places



Topics in this document

Aim: share what we've learned about ODD ontology requirements



Connected Places Catapult

Design considerations for ODD ontology

March 2020

Key topics

- Purpose and use cases
- Content
- Semantics

Purpose and use cases

A few example applications

Test case selection
for regulatory
approval
(MUSICC)

Can the vehicle do
what it claims to?

Route planning /
vehicle selection

Is the mission
expected to stay inside
ODD?

ODD monitoring
(onboard, part of
ADS)

Has the vehicle left the
ODD unexpectedly?

- Need for an ODD description which is **identical**, **unambiguous** and **machine readable**
- Slightly different requirements for each use case

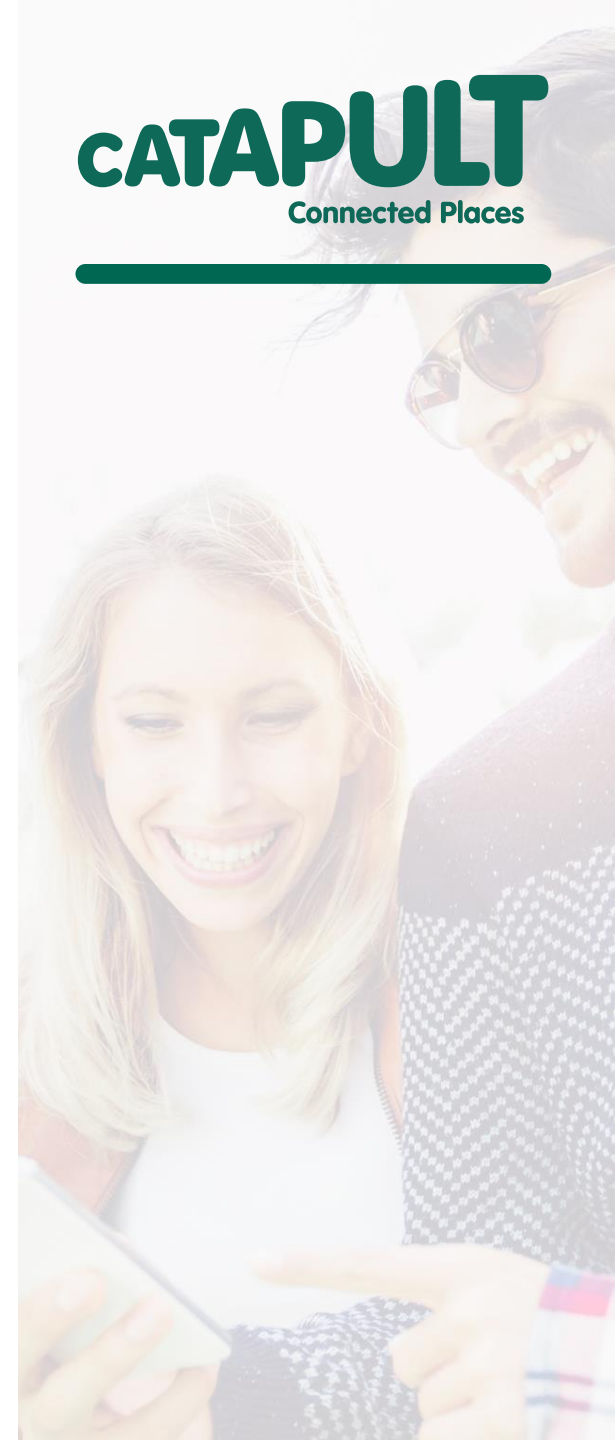
Content

Geofences

- Well defined and understandable!
- Road networks change over time – specify what the ADS can handle

Categoric lists

- Good combination of precision and readability – e.g. “bright sunlight” defined by a luminance range
- Potentially much more expressive power



Content

Sometimes use cases conflict

Physical properties

Precipitation type: snow
Mean droplet size: 1mm
Intensity: 30 g/dm²/hr

Ideal input for
sensor model

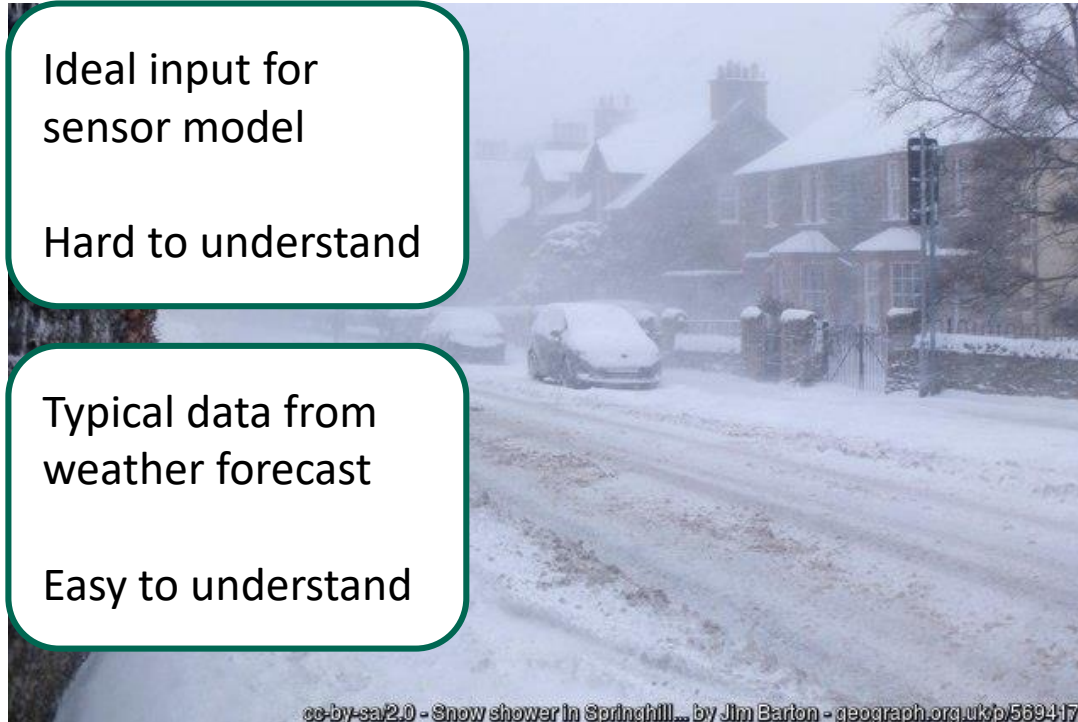
Hard to understand

Effect

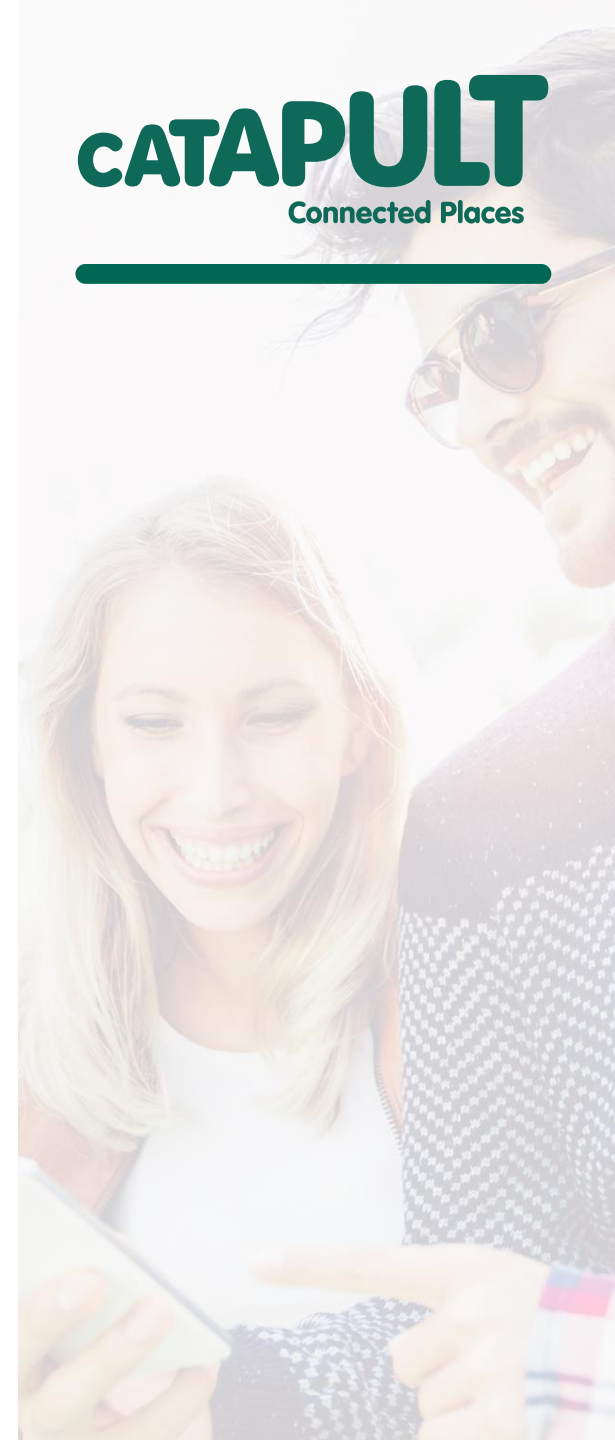
Precipitation type: snow
Visibility distance: 100m

Typical data from
weather forecast

Easy to understand



Similar problem in specifying other road user behavior
“Cycling prohibited” vs “no cyclists”



Semantics

Hierarchy or not?

ODD: main roads only

Description using non-hierarchical ontology

Road types:

Urban motorway

Urban non-motorway dual
arterial

Urban single arterial

High street (significant
through traffic)

Rural motorway

Rural non-motorway dual trunk
road

Description using hierarchical ontology

Road types: Arterial (all)



What if I want to say “all urban roads”?

Hierarchy works well where there is only one way to categorise

Possible solution: overlapping lists (but harder to understand and maintain)

Semantics

Safe versioning

Test case selection
for regulatory
approval
(MUSICC)

Dangerous error: something is **omitted** from the ODD

ODD monitoring
(onboard, part of
ADS)

Dangerous error: something extra is **included** in the ODD

Suggestions:

- ODD description tied to a single ontology version
- Validity checks
- Migration tool

Semantics

Complex criteria

- Cannot make right turns at roundabouts
- Cannot overtake unless high quality mapping data is available
- Can only operate if at least 1 lane >3m wide

Need to be able to search OpenLABEL (or similar)