GOALS

Annotate Vehicle interactions and data

Device
- Thing (Car)
- Capabilities (HVAC)
- Interactions (Action heater)
- Data (data schema)

Context
- Features of Interest (domain-specific metadata)

Interact with the many automotive domains
INTEROPERABILITY IN A FRAGMENTED IOT ECOSYSTEM
REQUIREMENTS [1]

Complexity

Safety

Legacy

WOT ONTOLOGY [2]

- Define a wot:Thing
- Centered on wot:interactionPattern
  - Properties
  - Actions
  - Events
- Use dataSchema
  - Literal value
  - wot:DataType
  - om:Unit_of_measure

[2] https://www.w3.org/2019/wot/td/v1
ABSTRACTING VEHICLES IN THE WEB OF THINGS
VEHICLE SIGNAL SPECIFICATION (VSS) [3]

Car-related concepts
- 451 branches (“engine”, “mirrors”)
- 1103 leaves:
  - 43 attributes (“weight”, “fuelType”)
  - 1060 signals: (700 seat-related), 268 with unit

Examples:
- Gearbox-sensed speed: .Drivetrain.Transmission.Speed
- Engine speed: .Drivetrain.Engine.Speed
- GPS-sensed speed: .Cabin.Infotainment.Speed

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SSN/SOSA PATTERN [4]

- Definition of a signal
- Definition of a sensor
- Well-defined units
- Geolocation

**BUT**

No formal definition of:
- “speed” or other observable properties
- “speedometer” or other car sensors/actuators
- “Car” or vehicle parts

[4] https://www.w3.org/TR/vocab-ssn
http://automotive.eurecom.fr/vsso

Domain Ontology (VSSO)

vsso:Speedometer

vsso:Observablesignal
sosa:Sensor
sosa:ObservableProperty

vsso:Speed
df:type

vsso:Transmission

vsso:Vehicle

vsso:Branch

vsso:Speedometer
df:type

vsso:Speed
df:type

vsso:Transmission
df:type

vsso:Branch
df:type
Main Alignment Pattern (1) [5]

Modeling pattern:

i. Vehicles are Things

ii. Signals are properties
    Read-write depending on the signal type

iii. Actuatable signals can be action

iv. DataSchema use the domain Units

Event modeling pattern:

i. Mapped to the Event Ontology[1]

ii. Wot:Event ≡ event:Event

iii. The FOI (Vehicle) is an Agent

DEMONSTRATION
VEHICLE THING DESCRIPTION

"@context": ["https://www.w3.org/2019/wot/td/v1", 
{"auto": "https://auto.schema.org/" ,
"iot": "https://iotschema.org/" ,
"vsso": "https://automotive.eurecom.fr/vsso#" ,
"qudt": "http://www.qudt.org/1.1/vocab/unit#"}
],
"@type": ["Thing","auto:Car","vsso:Vehicle"],
"id": "http://10.159.160.74:5001/WBY8P61020VD33272/",
"base": "http://10.159.160.74:5001/WBY8P61020VD33272/",
"title": "MyCarThing",
"name": "MyCarThing",
"auto:brand": "BMW",
"auto:model": "i3",
"vsso:vin": "WBY8P61020VD33272",

"properties": {
  "secured": {
    "@type": ["iot:Property","vsso:DoorLock"],
    "description": "Shows the current lock status of the car",
    "type": "string",
    "forms": [{
      "href": "property/secured",
      "contentType": "application/json",
      "op": "readproperty"
    }]
  }
}

"actions": {
  "write-message": {
    "@type": ["Action","iot:ChangePropertyAction"],
    "description": "Send message to the vehicle HMI",
    "safe": false,
    "idempotent": false,
    "input": {
      "type": "object",
      "properties": {
        "subject": {"type": "string"},
        "message": {"type": "string"}
      },
      "required": ["subject","message"]
    },
    "forms": [{
      "href": "action/message",
      "contentType": "application/json",
      "op": "invokeaction"
    }]
  }
}

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When the user is far from the unlocked vehicle, the vehicle lock is activated
LESSONS LEARNED

1. SAFETY – SECURITY – PRIVACY REQUIREMENTS ADAPTED TO THE (VEHICLE) WOT CAPABILITIES
2. DIVIDING COMPLEX THINGS
3. (INFRASTRUCTURE)
Is a vehicle a Thing? A network of things?

**TD: full vehicle**

@context
@type
securityDefinitions

Interactions:
1. property/media-volume
2. action/stop-HVAC
3. event/sow-engine-oil

... 2548. action/write-message

**TD: infotainment**

@context
@type
securityDefinitions

Interactions:
1. property/media-volume
2. ...

**TD: HVAC**

Interactions:
1. action/stop-HVAC
2. ...

**TD: Engine**

Interactions:
1. event/sow-engine-oil
2. ...

**TD: main**

Interactions:
1. property/media-volume
2. ...

**TD: ...**

Interactions
...
Differing Safety, Security and Privacy?

COMPLEX THINGS IN THE WOT (2)

Interactions:
1. property/media-volume
2. action/stop-HVAC
3. event/sow-engine-oil
...
2548. action/write-message

TD: full vehicle
@context
@type
securityDefinitions

TD: main
@context
@type
securityDefinitions

TD: privacy-critical
securityDefinitions

TD: safety-critical
securityDefinitions

TD: HVAC
Interactions:
1. action/stop-HVAC
...

TD: infotainment
Interactions:
1. property/media-volume
...

TD: Engine
Interactions:
1. event/sow-engine-oil
...
QUESTIONS?

THANK YOU FOR YOUR ATTENTION