



Semantic Technologies for Describing Measurement Data in Databases

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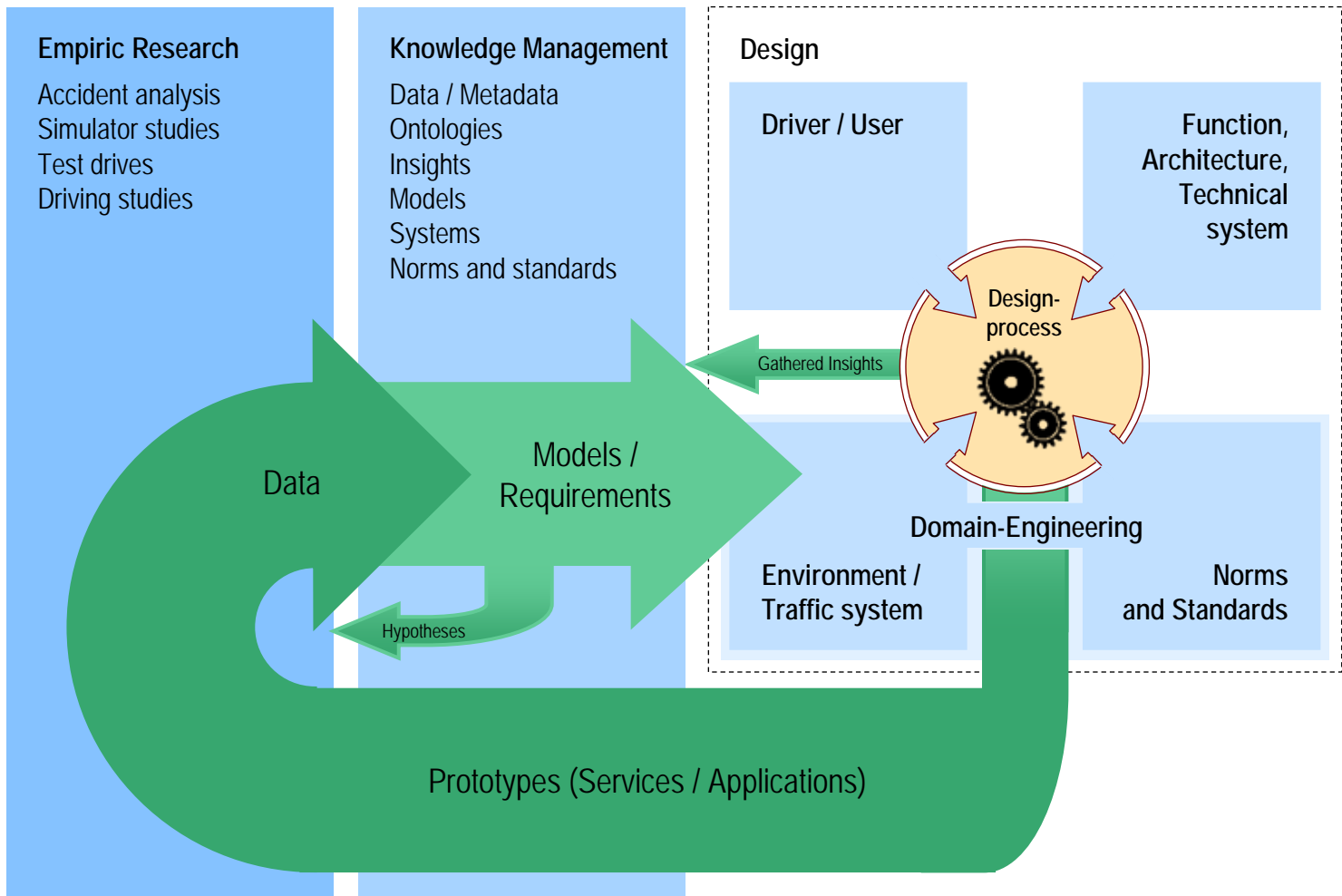


Structure

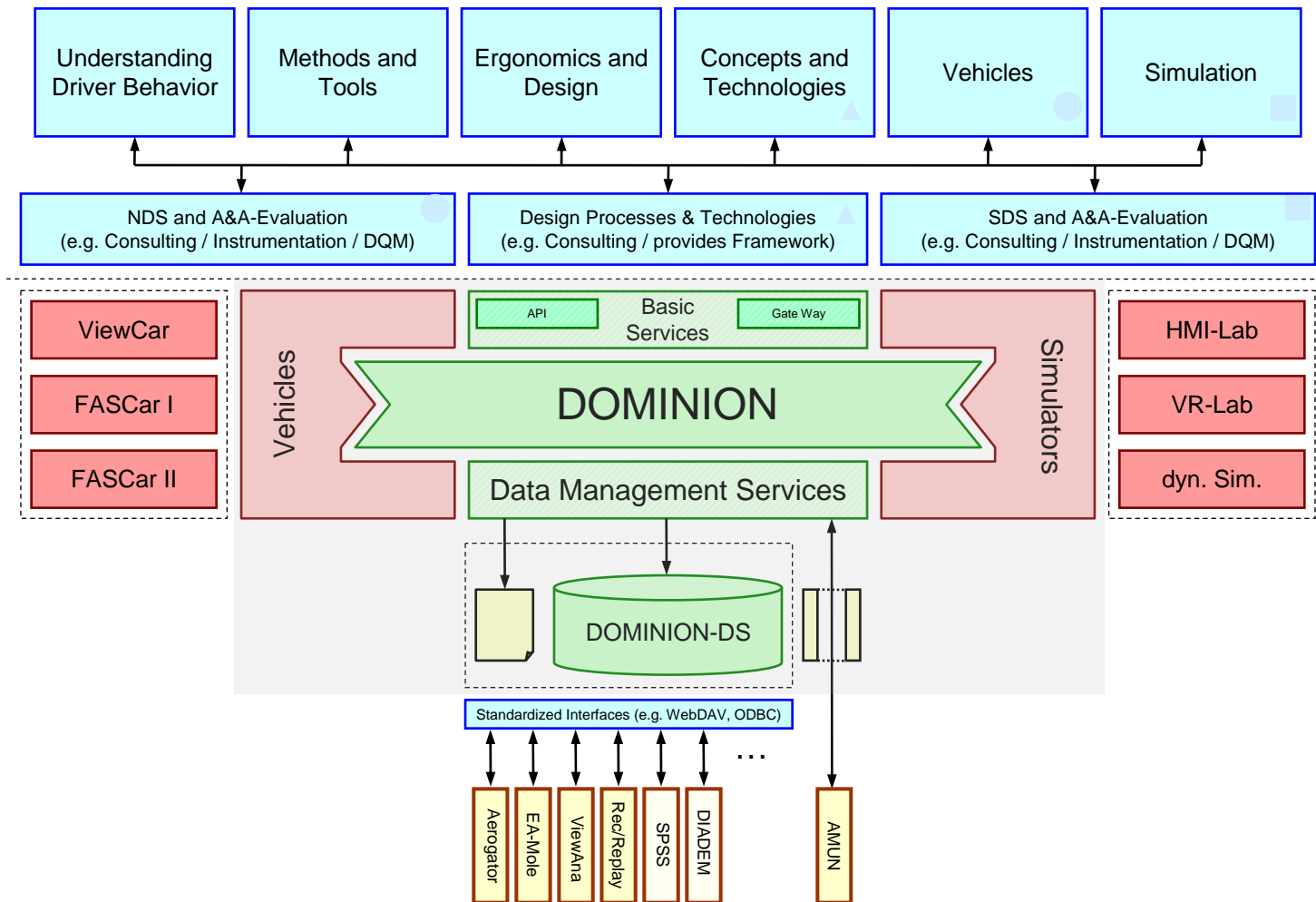
- Background and motivation
- Concept
- Realization
- Application
- Summary



Development Process for Driver Assistance & Automation

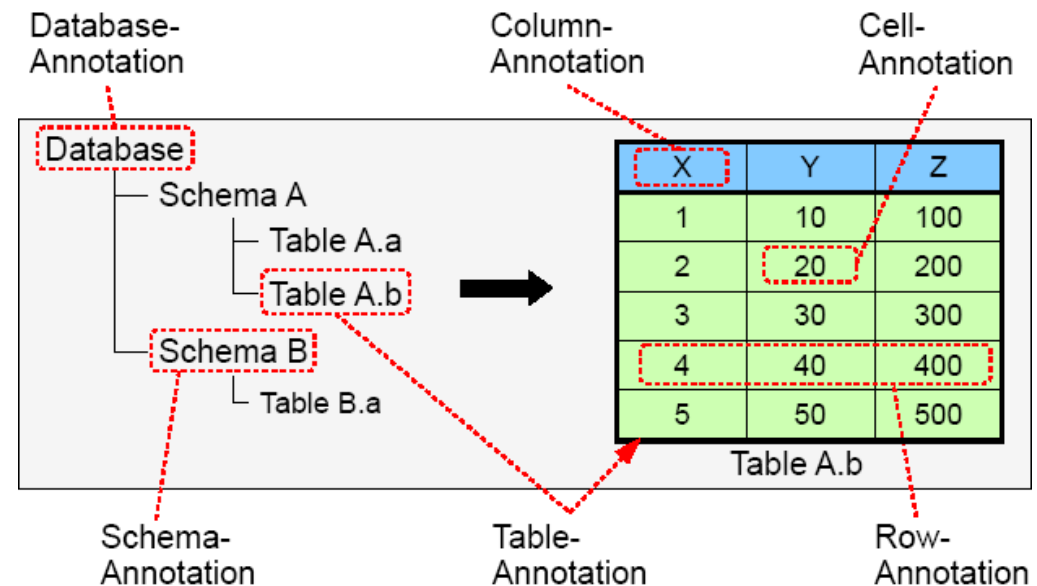


Development Platform Dominion and Data Storage as Target for Semantic Annotations



Tables of a Relational Database with Possible Annotations

- Mapping into URI [BernersLee98]
 - Rows assumed to be identifiable by surrogate keys
 - Example: <http://www.dlr.de/ts/dds/table/b/row/2/column/Y>
 - Only on demand
 - No data
- Semantic Indexing
- Usage like a memo or notepad mechanism
- Schema, i.e.
 - Physical units
 - Experiment info
- Data, i.e.
 - Events
 - DQM results



User Interface for Interactive Working with Annotations

Semantic Database Browser - U_UNOYER."20100716_105523_drvstate"

File Help

Database Layer

Schema: U_UNOYER

- Table: 20100716_105436_drvstate
- Table: 20100716_105523_drvstate
 - Column: STATEID (long)
 - Column: UTC_SEC (long)
 - Column: UTC_USEC (long)
 - Column: SYSTEMTIME (long)
 - Column: UTMNORTHING (double)
 - Column: UTMEASTING (double)
 - Column: LATITUDE (double)
 - Column: LONGITUDE (double)
 - Column: ALTITUDE (double)
 - Column: HEADING (float)
 - Column: VELOCITY (float)
 - Column: TIMEWEEKS (int)

Table Graph Models

WHERE condition:

RowId [STATEID]	STATEID	UTC_SEC	UTC_USEC	UTMNORTHING
46	46	1279270524	272000	-59.0
47	47	1279270524	272000	-59.0
48	48	1279270524	288000	-59.0
49	49	1279270524	303000	-59.0
50	50	1279270524	303000	-59.0
51	51	1279270524	319000	-59.0
52	52	1279270524	319000	-59.0
53	53	1279270524	335000	-59.0
54	54	1279270524	350000	-59.0
55	55	1279270524	350000	-59.0
56	56	1279270524	366000	-59.0
57	57	1279270524	381000	-59.0
58	58	1279270524	381000	-59.0

Properties SPARQL Edit Namespaces Time Line

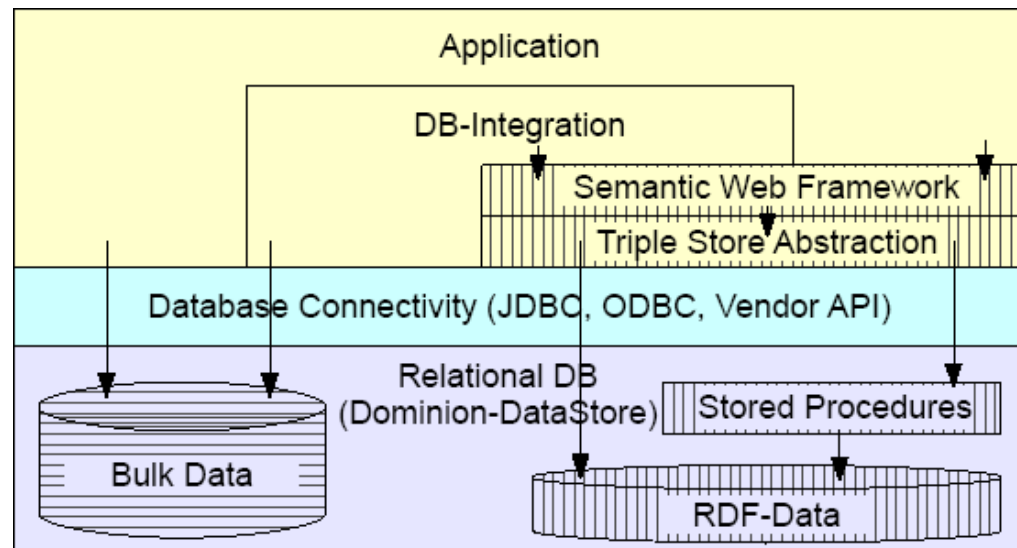
Use namespaces Use labels Describe properties Highlight restrictions Describe not active layers

http://www.dlr.de/ts/dominion-datastore/db/orcl/schema/U_UNOYER/table/20100716_105523_drvstate/column/VELOCITY
<http://data.nasa.gov/qudt/owl/qudt#unit>
<http://data.nasa.gov/qudt/owl/unit#MeterPerSecond>
 annotation-task:columnAnnotatedByTaskExecution
 dmeta:hasMetadata
http://www.dlr.de/ts/dominion-datastore/db/orcl/schema/U_UNOYER/table/20100716_105523_drvstate/column/VELOCITY
 dmeta:hasAccessType
 PUBLIC
 dmeta:hasArrayIndex
 dmeta:hasColumnIndex
 dmeta:hasColumnName
 dmeta:hasDataSize
 dmeta:hasDataType
 dmeta:hasDescription

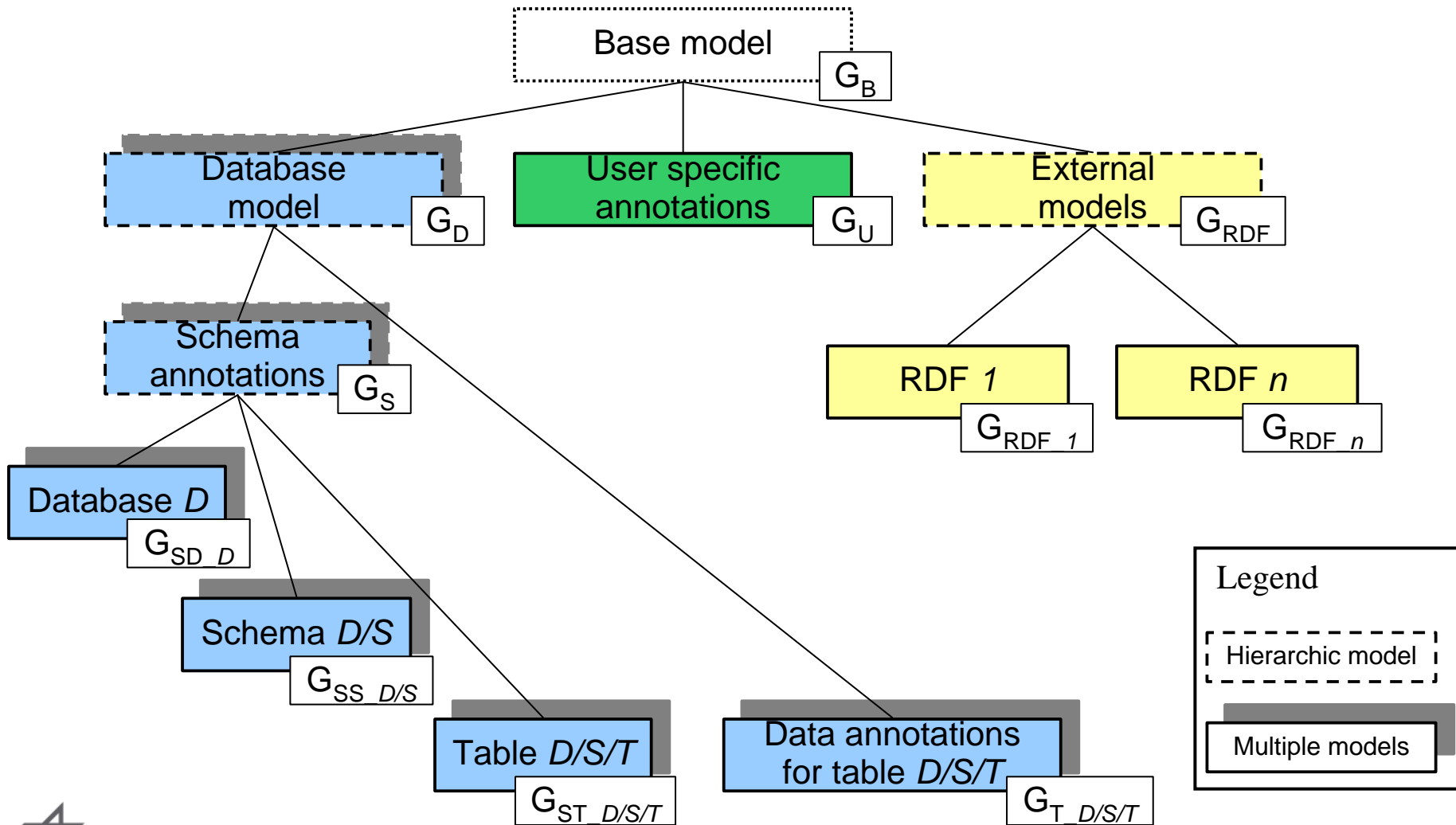
VELOCITY
<http://data.nasa.gov/qudt/owl/qudt#unit>
<http://data.nasa.gov/qudt/owl/unit#MeterPerSecond>
 als Spalte annotiert von Task-Ausführung@de
 besitzt Metadatum@de
http://www.dlr.de/ts/dominion-datastore/db/orcl/schema/U_UNOYER/table/20100716_105523_drvstate/column/VELOCITY
 besitzt Metadaten-Eigenschaft Zugriffs-Typ@de
 PUBLIC
 besitzt Metadaten-Eigenschaft Array-Index@de
 besitzt Metadaten-Eigenschaft Spalten-Index@de

Overview of Architecture Used for Data Access

- For presented user interface and other applications
 - I.e. automatic creation of annotations and processing them
- DB-Integration:
 - Logic database integration
 - Model handling
 - Layers
- Standard RDF-Storage
 - Editable using SQL (stored procedures)
 - Simple access by standard apps (i.e. Matlab)

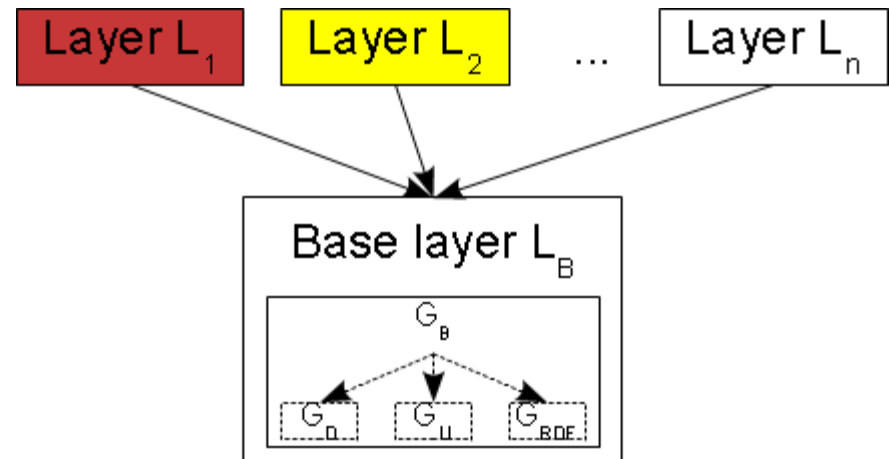


Usage of Several Models for Scalability



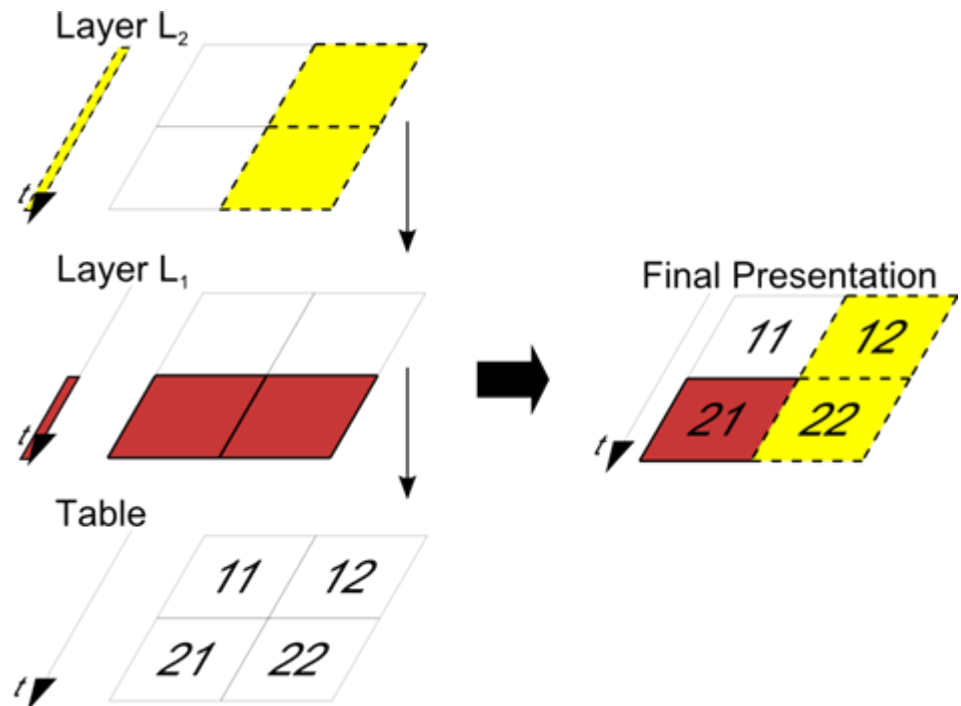
Layers

- Selection and presentation of *relevant* annotations
- Derived view based on *base model* G_B
- Layer as a tuple of
 - RDF Graph model “derived” from base model G_B
 - Colour
 - Index
- Derived using
 - Reasoning
 - SPARQL-Describe
 - SPARQL-Construct
 - SPARQL-Select
 - Reasoning + SPARQL
- *Base layer* uses base model



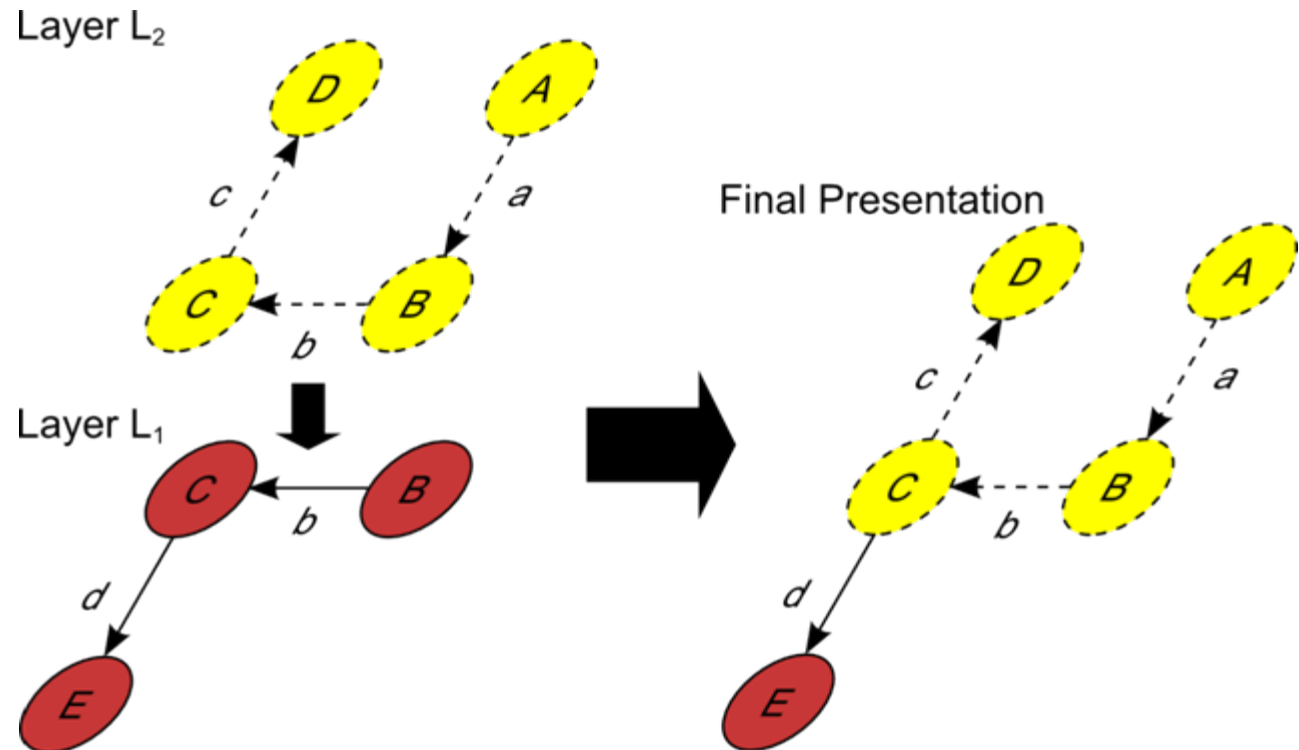
Overlay of Layers for the Presentation of Database Elements

- Layer index used for projection order
- Projection on table
- (and other DB elements)
- Projection on axis
 - Order for sorting
 - Surrogate Key used



Overlay of Layers for Graph Visualisation

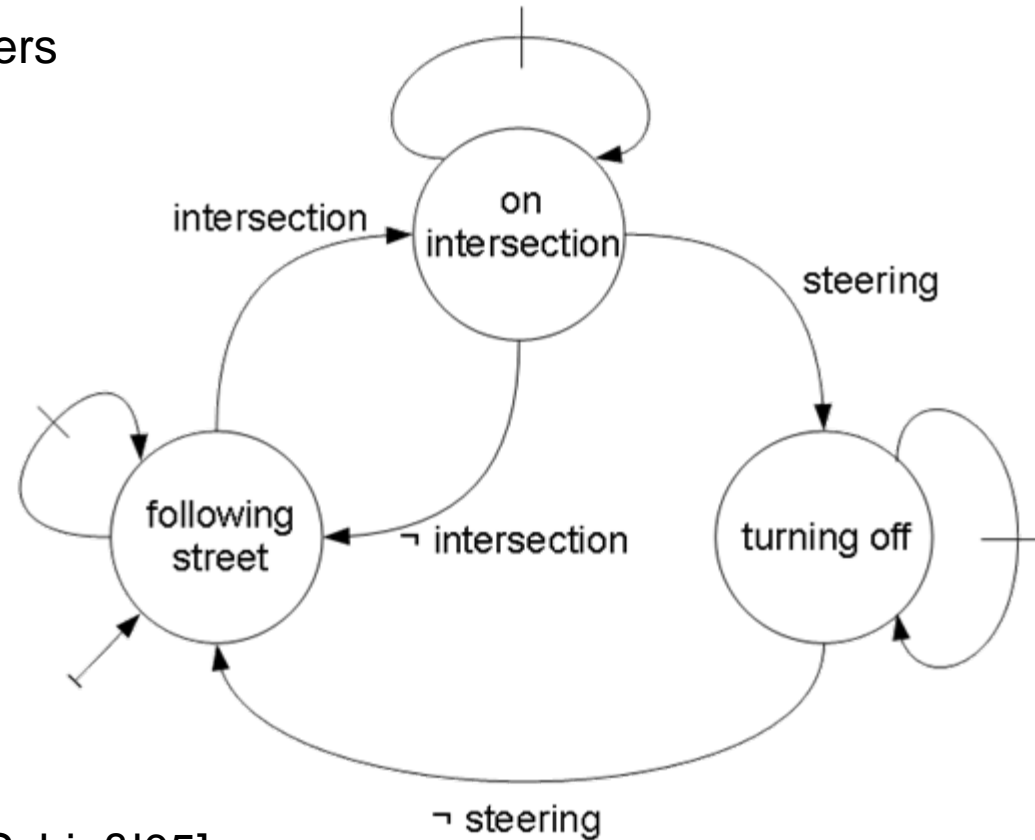
- Graph visualization very common
- Often crowded for many elements



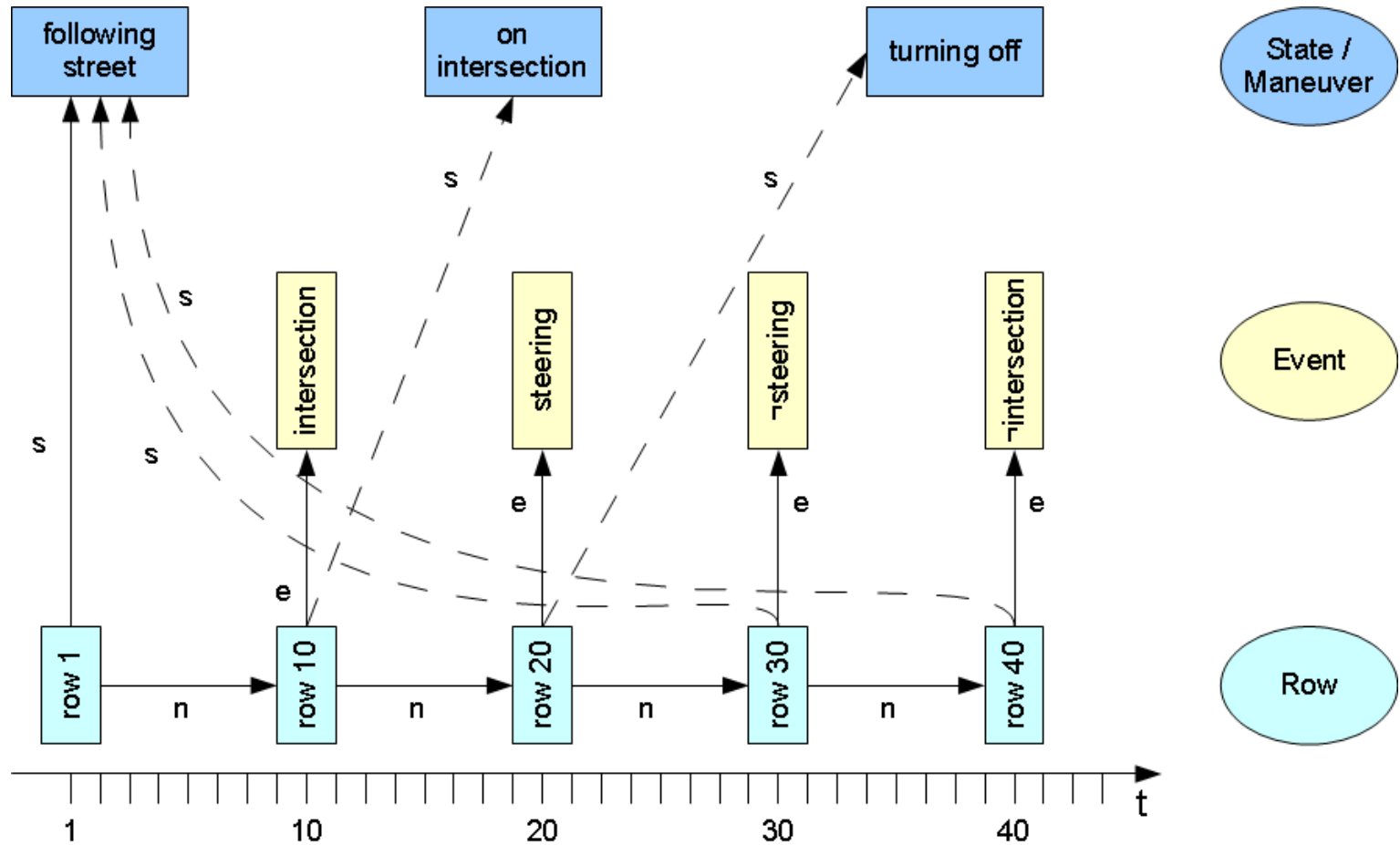
Example State Machine for Turning off on Intersections

- Describes driving maneuvers as states
- Identified events as state transitions
- Events identified using numerical calculations (i.e. Java, Matlab)

- Complete FSM with
 - 15 maneuvers
 - 28 events
 - 155 rules
 - Based on [Vollrath&Schießl05]



Usage of FSM as OWL/SWRL Implementation



Transition rule: $s(?x_1, q) \wedge n(?x_1, ?x_2) \wedge e(?x_2, \sigma) \Rightarrow s(?x_2, q')$



Time Line Representation from User Interface for Base Layer and Two Layers Containing Selected Events

- Projection on axis for different layers
- Layers contain rows with specified events
- Contents can be calculated using reasoning
- Evaluation of interval concept



Integration of (Sem. Wiki) RDF-Data into User Interface

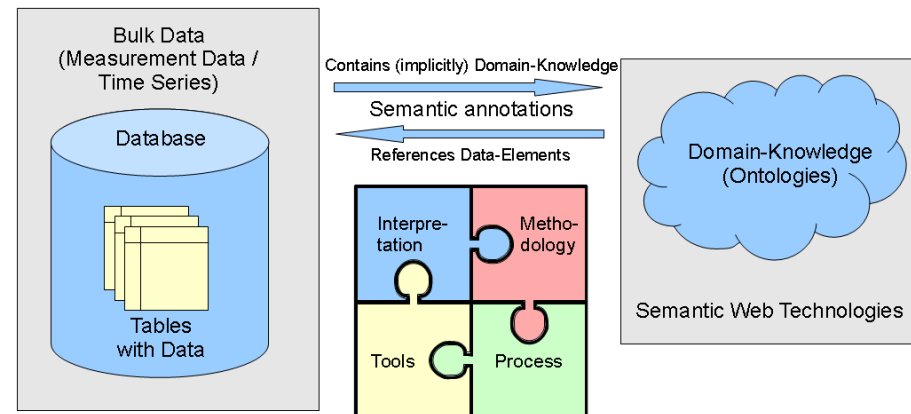
- Describe concepts human understandable in Sem. Wiki
- Facts as additional documentation for data in GUI
- Open URLs / documents by right click
- Units for columns
 - QUDT, references
 - DBpedia, references
 - Wikipedia

The screenshot shows a Semantic Wiki page titled "Anhalten Stand". The page contains a definition: "Anhalten Stand ist das Manöver, in dem das Fahrzeug anhält und/oder steht." It also includes a diagram of a car on a road with labels for "Fahrzeug auf Straße" and "Anhalten Stand". Below the diagram, there is a list of facts under the heading "Fakten zu Anhalten Stand", including "Hat Homepage" and "Hat Kommentar".

The screenshot shows a SPARQL query results interface. The results are displayed as a tree structure of RDF triples. A red arrow points to the triple: `http://www.w3.org/2001/XMLSchema#string`. Another red arrow points to the triple: `http://elib.dlr.de/43697/`.

Summary

- Description of database contents, especially time series
 - On demand usage
 - No data
- Layers for different kinds of visualization and specific data access
- Semantic technologies for
 - Describe information
 - Reasoning (on events with FSMs)
 - Integrate external data
 - Reference external resources
- Domain independent
- Prototype for visualization





Thank you for your attention!

Questions?

