

Exploring Schema Matching to Compare Geospatial Standards: Application to Underground Utility Networks



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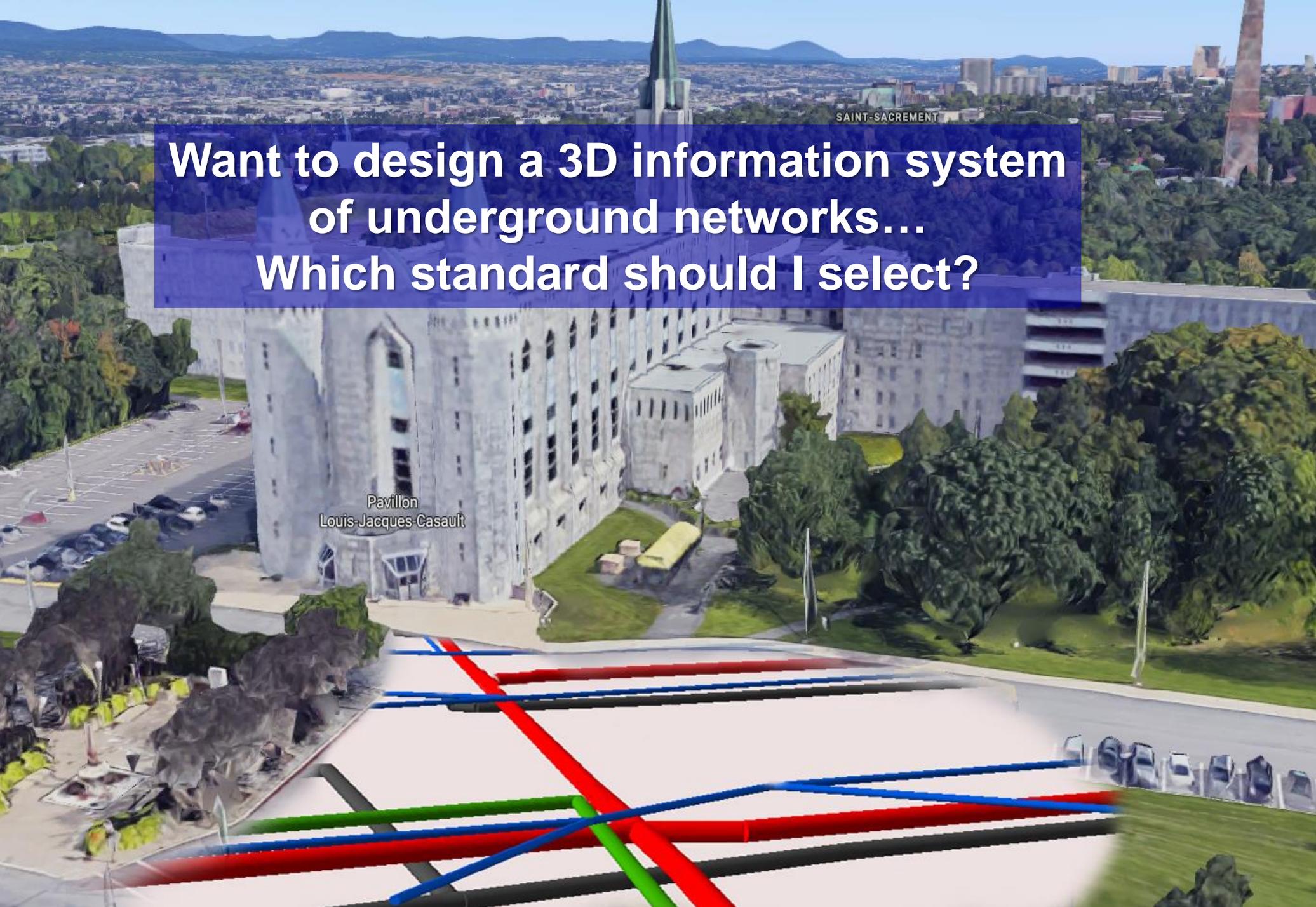


Claire Ellul, University College London

Want to design a 3D information system
of underground networks...
Which standard should I select?

Pavillon
Louis-Jacques-Casault

SAINT-SACREMENT



OGC meetings (April 2017 and July 2018)

Underground Infrastructure Concept Development Study

Kutzner and Kolbe, CityGML Utility Network ADE - Scope, Concepts, and Applications. Technical University of Munich


 Technical University of Munich


 Chair of Geoinformatics

Existence of characteristics relevant to network modelling in various data models

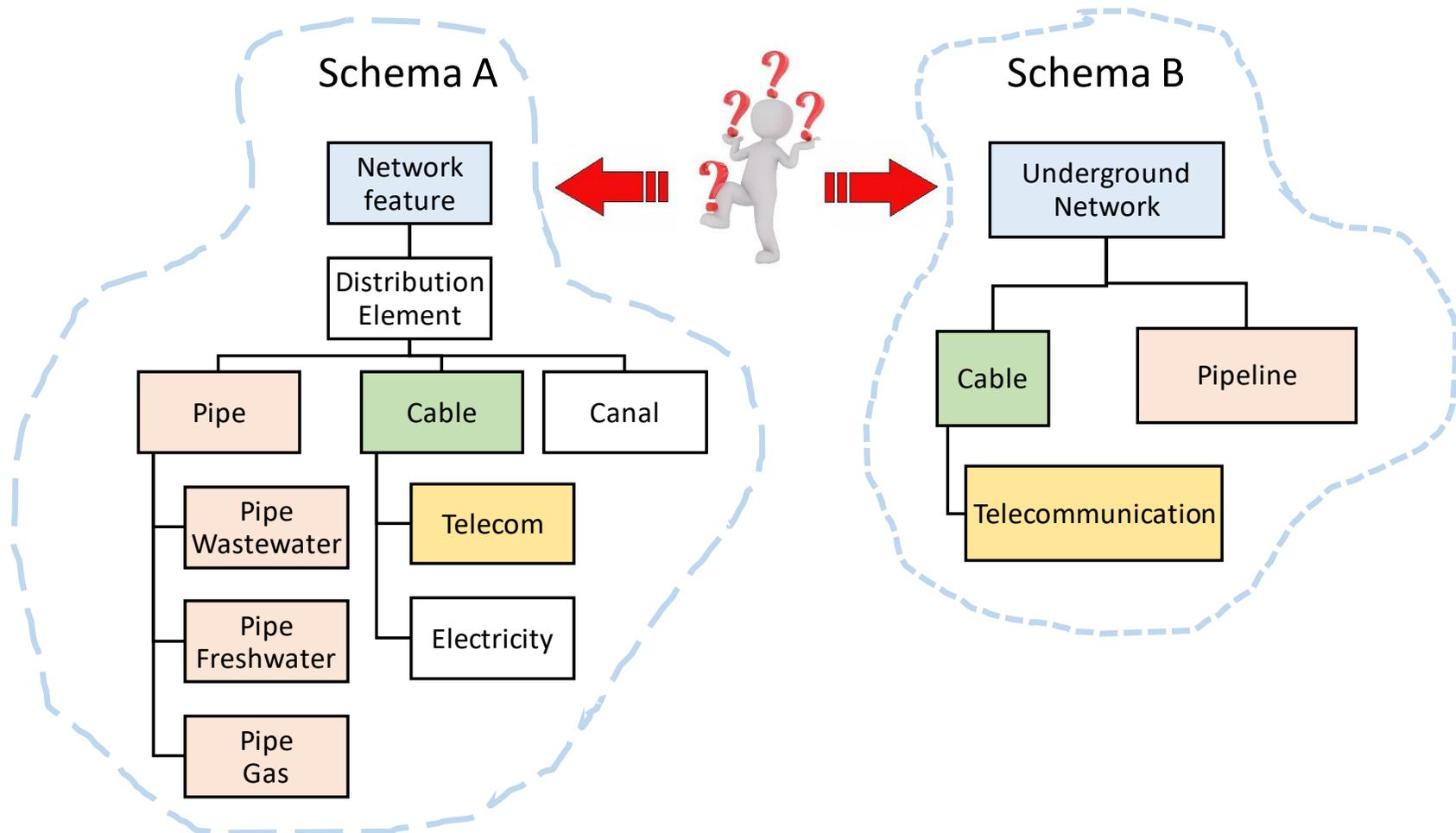
	INSPIRE Utility Networks	IFC	ArcGIS Utility Networks	SEDRIS	Pipeline ML	CityGML Utility Network ADE
Representation of heterogeneous networks	+	•	•	+	•	++
Dual representation	+	++	+	++	-	++
Topographic/graphic aspects	++	++	++	++	++	++
3D geometries	-	++	-	+	-	+
Functional aspects	-	-	-	-	-	•
Hierarchical modelling						
• networks/ subnetworks	++	-	-	++	-	++
• components/ subcomponents	++	++	•	-	•	++
Interdependencies between						
• network features and city objects	-	•	-	•	-	++
• network features of different network types	-	++	-	-	-	++

- = no support, • = basic support, + = sophisticated support, ++ = comprehensive support

Source: Kutzner, T. & Kolbe, T. H., 2016: Extending Semantic 3D City Models by Supply and Disposal Networks for Analysing the Urban Supply Situation, http://www.dgpf.de/src/tagung/jt2016/proceedings/papers/36_DLT2016_Kutzner_Kolbe.pdf

7.12.2017
T. Kutzner, T. H. Kolbe - Scope and design principles of the CityGML Utility Network ADE
10

Schema matching principles



WordNet Search - 3.1

- [WordNet home page](#) - [Glossary](#) - [Help](#)

Word to search for:

Display Options:

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations

Display options for sense: (frequency) {offset} <lexical filename > [lexical file number]
(gloss) "an example sentence"

Display options for word: word#sense number (sense key)

Noun

- (23){08451269} <noun.group>[14] [S:](#) (n) **network#1 (network%1:14:00::)**, [web#4 \(web%1:14:00::\)](#) (an interconnected system of things or people) "he owned a network of shops"; "retirement meant dropping out of a whole network of people who had been part of my life"; "tangled in a web of cloth"
- (4){03826014} <noun.artifact>[06] [S:](#) (n) **network#2 (network%1:06:01::)** ((broadcasting) a communication system consisting of a group of broadcasting stations that all transmit the same programs) "the networks compete to broadcast important sports events"
 - [domain category](#)
 - [direct hypernym](#) / [inherited hypernym](#) / [sister term](#)
 - {03081962} <noun.artifact>[06] [S:](#) (n) **communication system#2 (communication system%1:06:00::)**, [communication equipment#1 \(communication equipment%1:06:00::\)](#) (facility consisting of the physical plants and equipment for disseminating information)
- (1){03825135} <noun.artifact>[06] [S:](#) (n) **net#6 (net%1:06:00::)**, **network#3 (network%1:06:00::)**, [mesh#4 \(mesh%1:06:00::\)](#), [meshing#2 \(meshing%1:06:01::\)](#), [meshwork#1 \(meshwork%1:06:00::\)](#) (an open fabric of string or rope or wire woven together at regular intervals)

OpenII

Matching score
Interval [0,1]

The screenshot displays the OpenII software interface, which is used for schema matching. The interface is divided into several sections:

- Top Menu:** Project, Edit, Search, Matchers, View, Help.
- Left Panel (Schemas):** A tree view showing the 'GUS (Root)' schema. The 'DELIVERY_PIPE' node is highlighted in yellow. Other nodes include DAMAGE, DEPTH_METRE, DIAMETER_MM, EQUIPMENT, GEOMETRIE, ID_NUMBER, INSTALLATION_DATE, LENGTH_METRE, OID, OWNER, PUMPING_STATION_ID, REPAIR_DATE, SERIAL_NUMBER, SLOPE, STATUS, TYPE, PIPE_REFOUL_STATION_FK, FLOOR_LAMP, GAS_PIPE, HYDRO_NETWORK, MANHOLE_SEWER, SEWAGE_SUMP, STANDPIPE, and TELECOMMUNICATION_CABLE.
- Right Panel (Schemas):** A tree view showing the 'NetworkComponents (Root)' schema. The 'Abstract_Pipe' node is highlighted in yellow. Other nodes include _DistributionElement, _Protection Shell, Abstract_Device, Abstract_DistributionElement, Abstract_NetworkFeature, class, elevationQuality, exteriorDiameter, exteriorHeight, exteriorWidth, function, functionOfLine, hasMaterial, isGravity, locationQuality, occupiedHollowSpace, representedBy, status, transportedMedium, yearOfConstruction, AnyDevice, Bedding, Cable, and Canal.
- Central Area:** A complex network diagram showing the relationships and matches between the two schemas. A yellow highlight is visible across the top part of this diagram.
- Bottom Left:** A progress bar for the first schema, showing 'Depth 1' to 'Depth 5', a search input field, and 'Finished: 0/169'.
- Bottom Right:** A progress bar for the second schema, showing 'Depth 1' to 'Depth 3', a search input field, and 'Finished: 0/71'.
- Far Right:** An 'Evidence' scale ranging from 0.0 (yellow) to 1.0 (green), with a red box around it. Below the scale are 'Filters' for User, System, Hierarchy, and Best.



Overall comparison

Matching scores

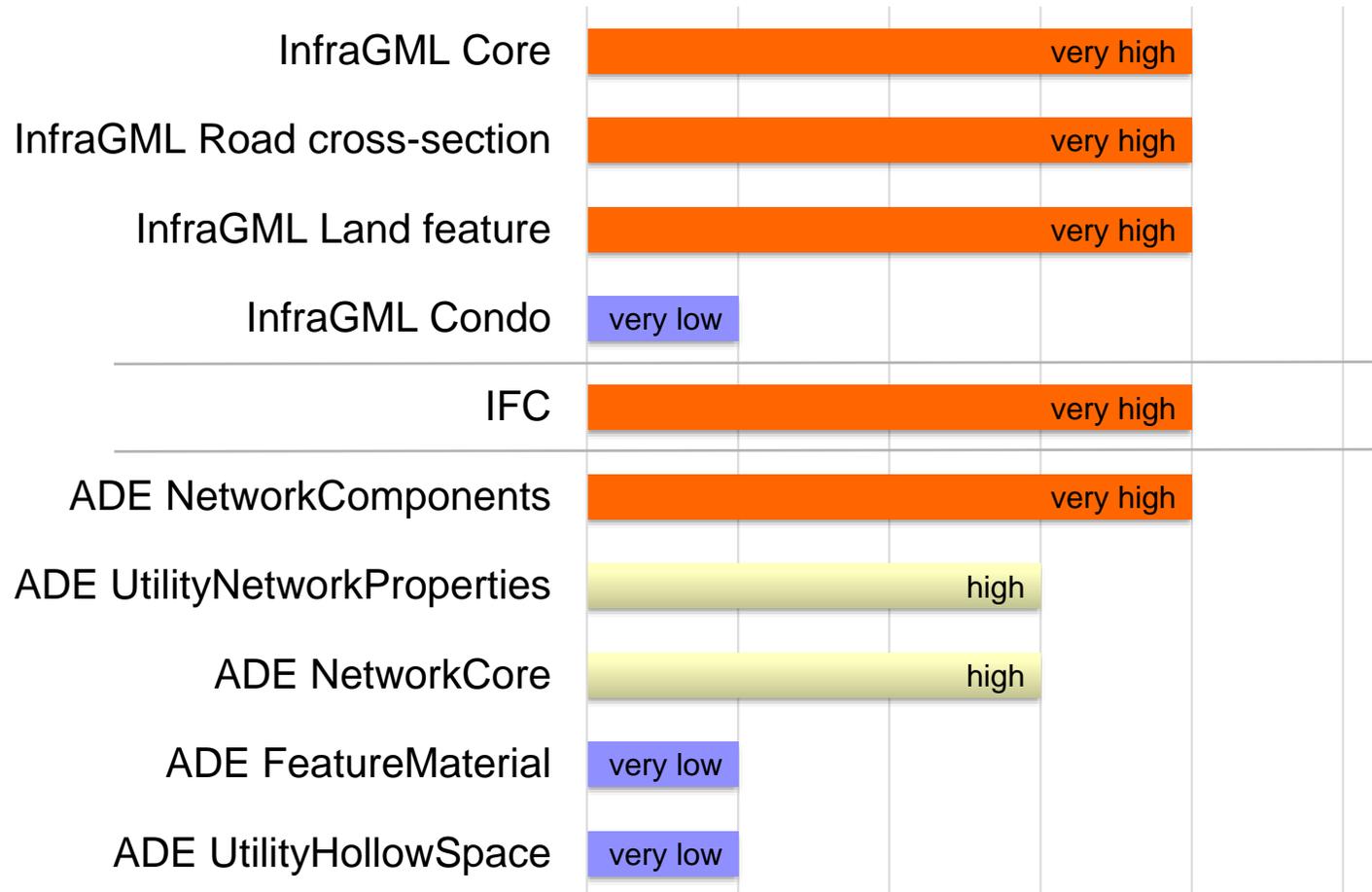
Very low < 0.2

Low 0.2 to 0.3

High 0.3 to 0.4

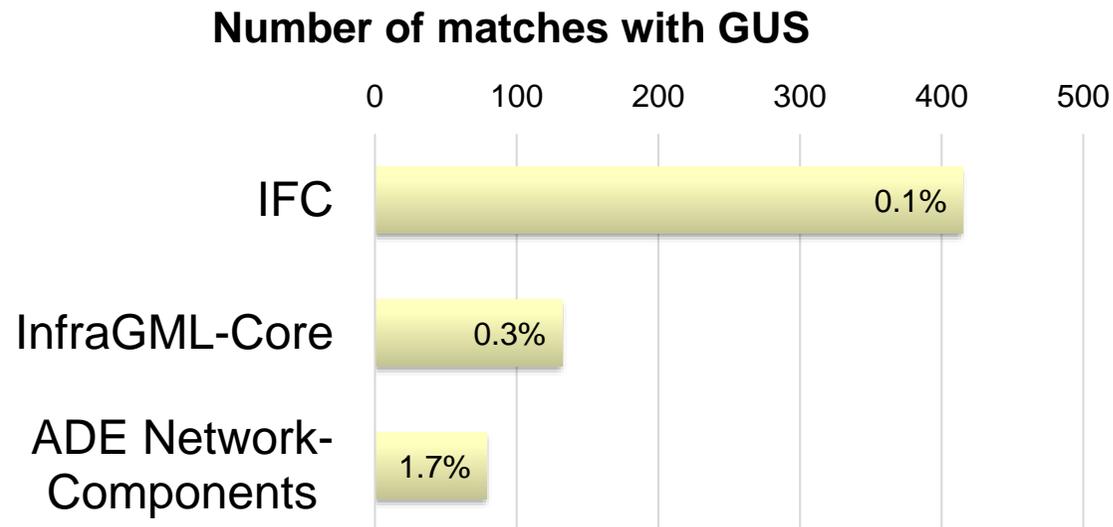
Very high > 0.4

Matching Scores with GUS



Syntactic comparison

Class name comparisons (String matching based on Edit distance)



Syntactic comparison (all name)

Class name comparison (**String matching** based on Edit distance)

GUS	InfraGML
Damage (infrastructure_ type)	AbstractCurve Type
Damage (infrastructure_ type)	AbstractSurface Type
Delivery_pipe (type)	ReferentType (type)
Floor_lamp (type)	ReferentType (type)

Syntactic comparison (only class name)

Class name comparison (**String matching** based on Edit distance)

GUS	ADE Network Component
Gas_pipe	Abstract_Pipe
Hydro_network	Abstract_NetworkFeature
Sewer_junction	SimpleFunctionalElement
Standpipe	Abstract_Pipe
Sanitary_pipe	Abstract_Pipe

Syntactic comparison (only class name)

Class name comparison (**String matching** based on Edit distance)

GUS	ADE Network Component
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Standpipe	Abstract_Pipe
Sanitary_pipe	Abstract_Pipe

Semantic comparison

Class name comparison with Wordnet semantic

GUS	ADE Network Component
Floor_lamp	ControllerDevice
Damage	RoundShell
Floor_lamp	AnyDevice
Standpipe	Abstract_Pipe
Water_valve	Canal

Is schema matching a useful approach for selecting a standard?

- ❖ Rapid comparison of standards with GUS 
- ❖ Large schemas 
- ❖ Automation (result interpretation) 

3 levels

- Structural matching 
 - String matching 
 - Semantic matching 
- ❖ Applicable, tools available 

Next steps and recommendations

- ❖ **Further develop best practice when using this approach**
 - Iterative process
 - Grouping elements
 - Interpretation of the results (no match is still a result...)
 - Quality assessment
- ❖ **Make better use of **definitions** in the schema (semantic aspects)**
 - Annotation, documentation, thesaurus,

Acknowledgements

