

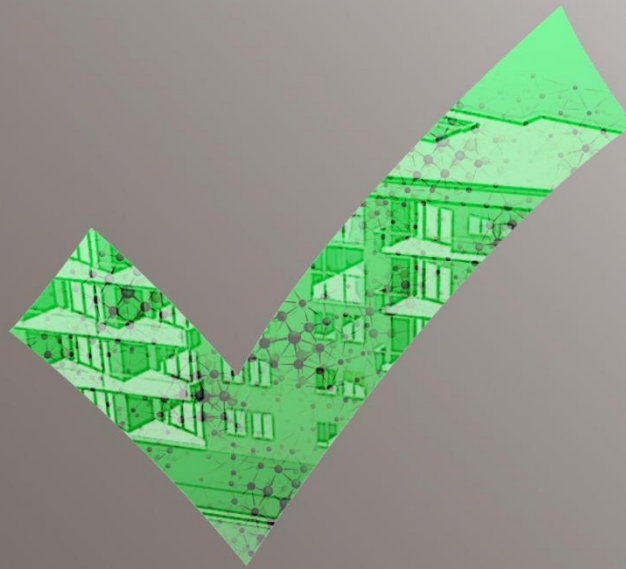


Reasoning on Geometry

for compliance checking

LDAC 2018 – Industry Track

CSTB/TI - Nicolas BUS; Guillaume PICINBONO



« Digitizing French Building Regulation »

*Build an **extensible** and «**white box**» compliance checker*

Sponsor : French Ministry for Housing

18 Month => July 2018

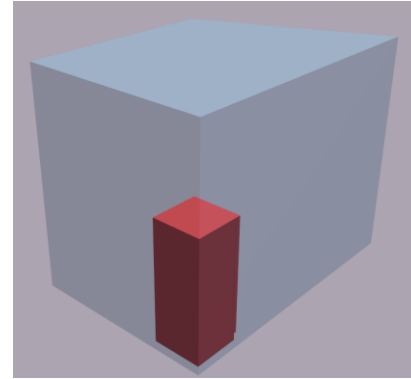
Involving regulation experts and knowledge engineers

Lead by CSTB

Checking compliance means
inferring on both
semantic (property + fonctionnal relations)
AND geometry (positions + dimensions + topological relations)

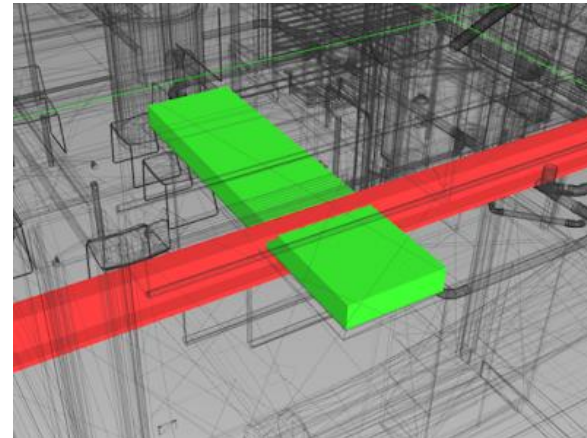
Containments :

relation between a wall and a door|window in it



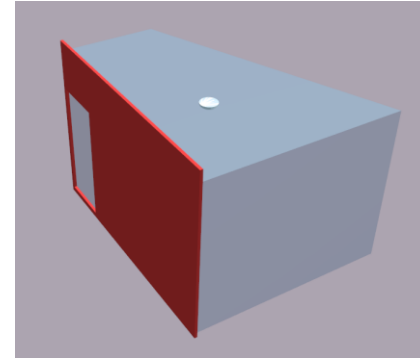
Intersection :

two BuildingElement with intersecting volumes



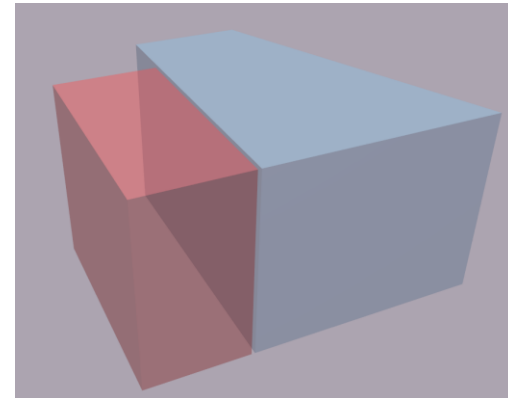
Boundaries :

Building elements that limits a Space



Adjacency :

two spaces/zones sharing a common interface

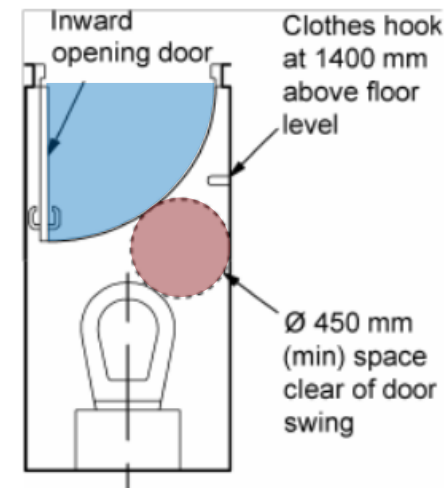
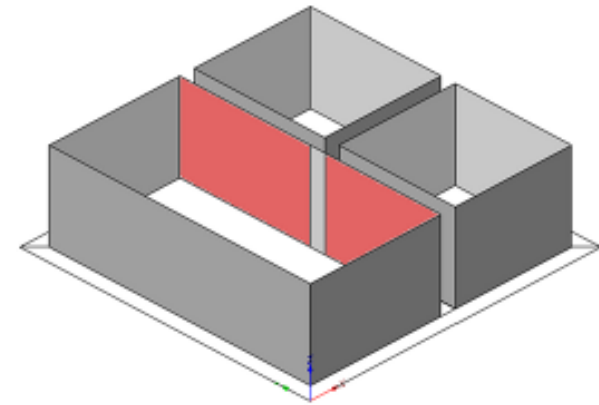


Overlapping :

two surfaces that overlaps (by projection) with tolerance on distance.

Virtual geometry :

surfaces and volumes that materialize requirements (interfaces, manoeuvring spaces, clean area...).
Non necessarily part of the IFC model.



// Inferring relation from geometry

[Zone 1 geometry]

[Zone 2 geometry]

=>

<zone1> bot:adjacentZone <zone2>

// Inferring topological relations, dimensions and virtual geometry

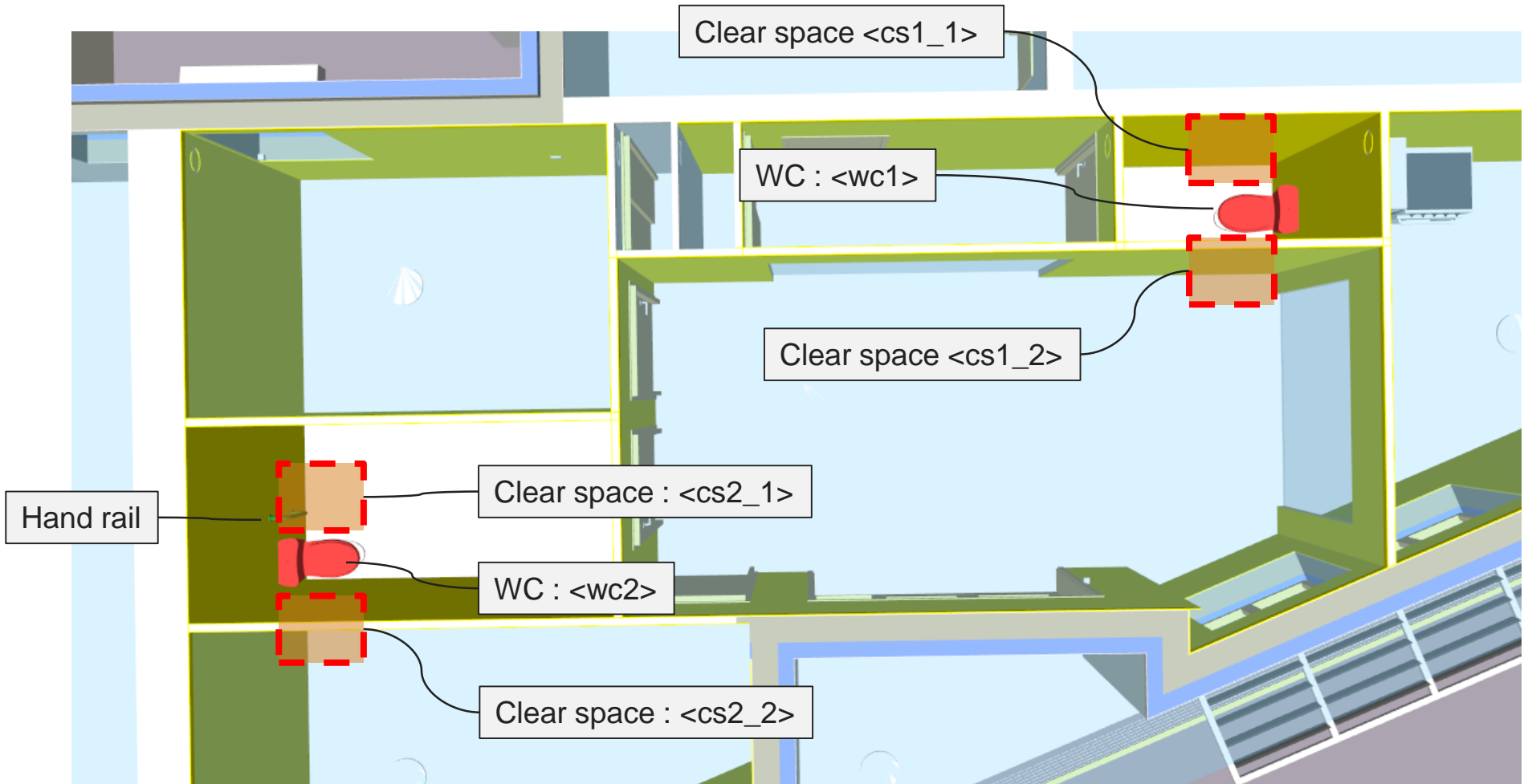
[Zone 1 geometry]

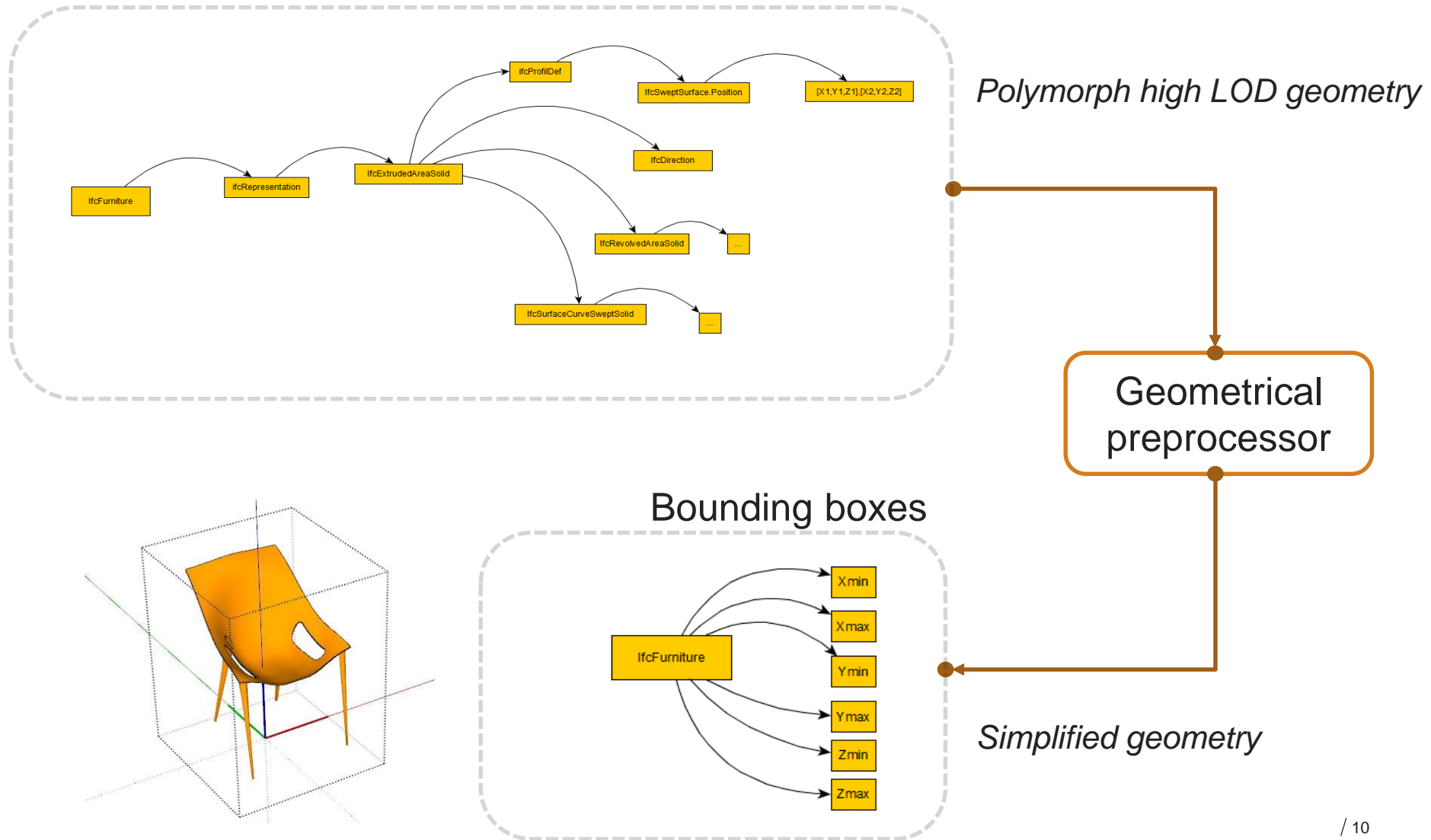
[Zone 2 geometry]

=>

```

<zone1>      bot:adjacentZone      <zone2> .
<interface1> bot:interfaceOf        <zone1> ;
              bot:interfaceOf        <zone2> .
<interface1> :hasGeometry           <geometry> ;
              :surface               <*.**^xsd:double> ;
    
```



SEMI-FORMAL CONSTRAINT

IF no **clear_space** of **width 0.8m**, **depth 1m** beside a **WC_seat**
THEN NON-COMPLIANT

RULE + ONTOLOGY

?wc a :WCSeat

=>

?wc :NeedClearSpace ?cs1 ; :NeedClearSpace ?cs2 .

?cs1 :Width 0.8 ; :Depth 1 .

...

?cs1 :X (?WC_X + ?dX) .

?cs1 :Y (?WC_Y) .

FORMAL CONSTRAINT

SELECT ?wc

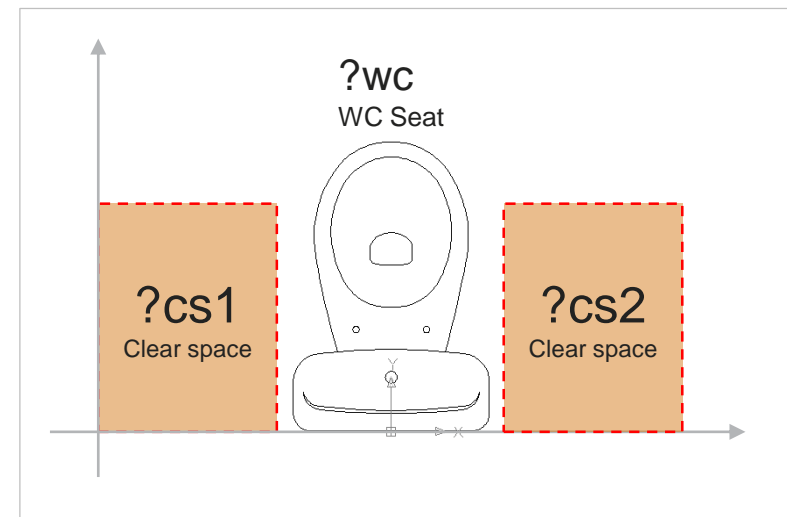
...

?wc a :WC ; ?wc :NeedClearSpace ?cs

?e :Intersects ?cs

...

HAVING COUNT(DISTINCT ?cs)=2



**Extending geoSPARQL and WKT ?
What about 3D ?**

**Using reasoner implementing geoSPARQL ?
Using CAD software as preprocessor ?**



Toward French Semantic Regulation checking based on semantic rules

LDAC 2018 – Paper

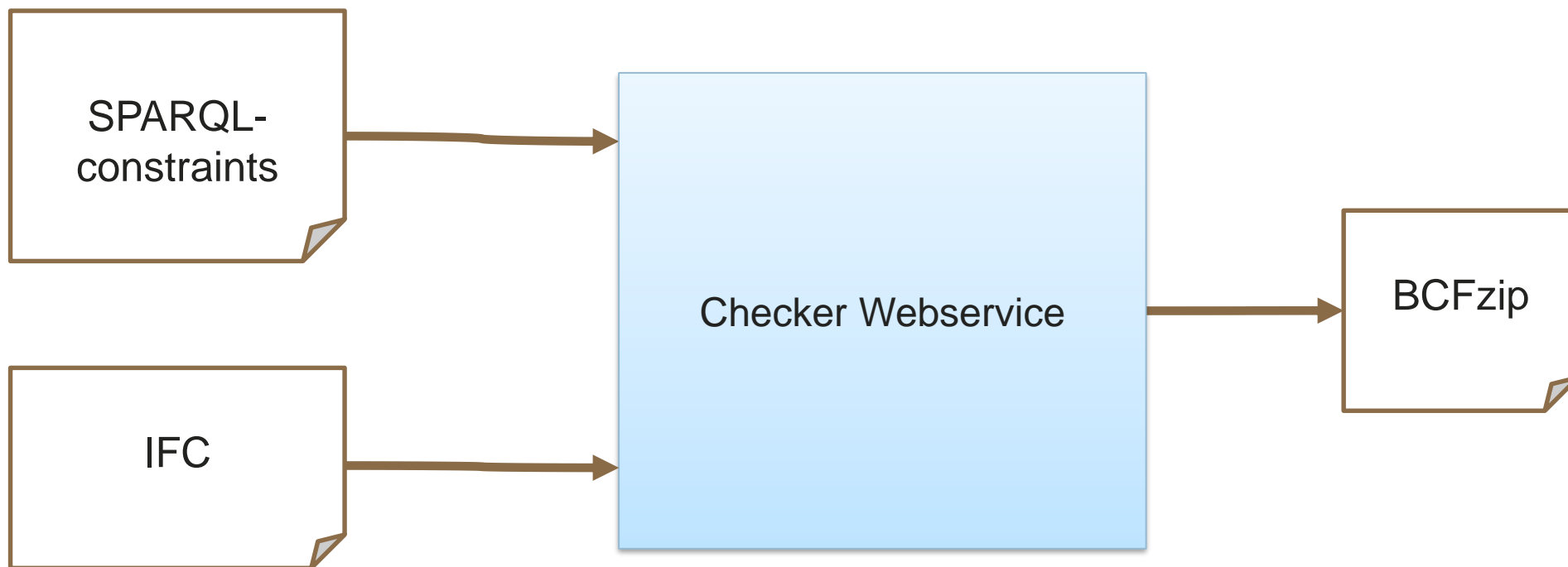
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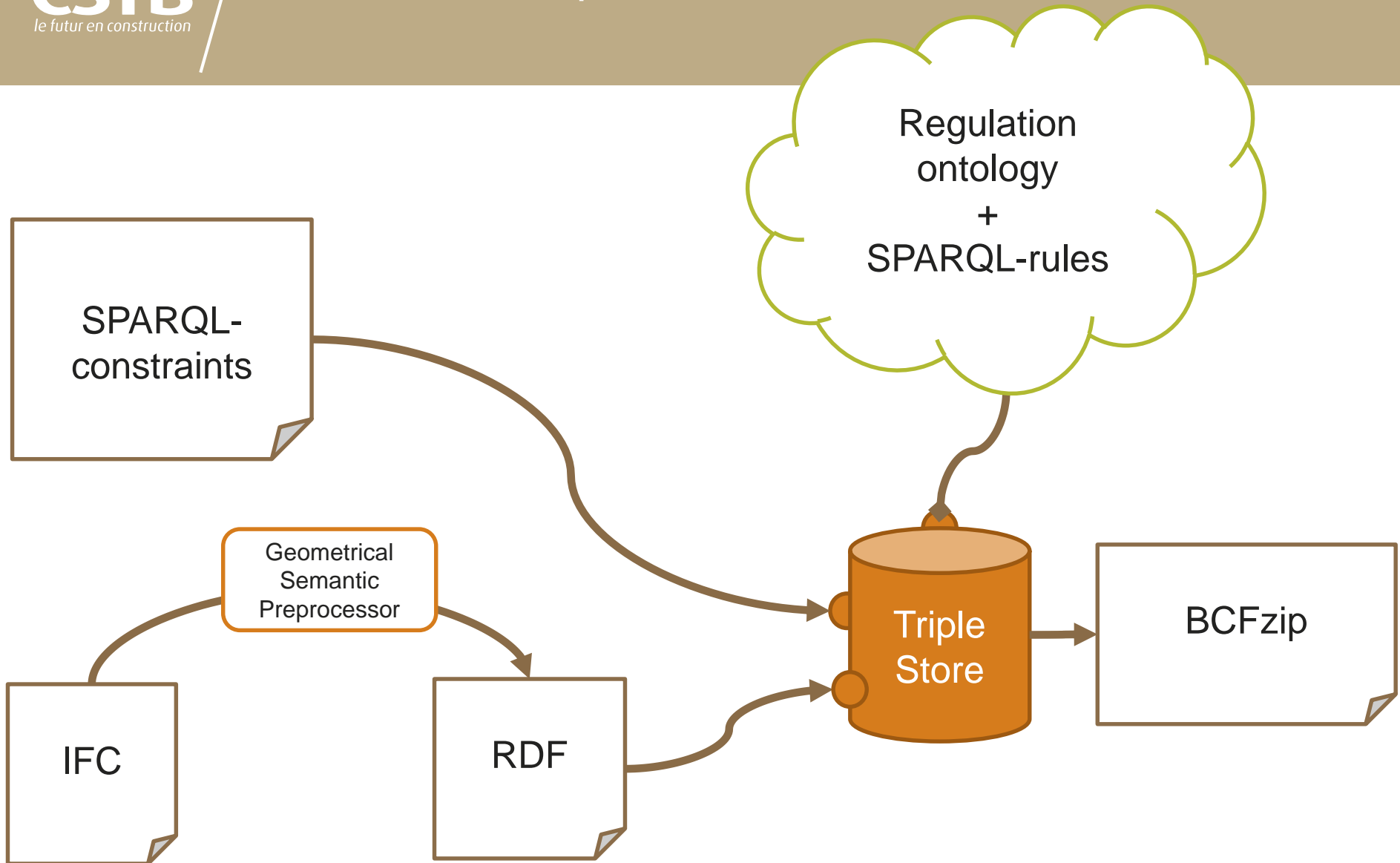
nicolas.bus@cstb.fr

Thanks your attention...

CSTB
le futur en construction

Appendices





The screenshot displays the 'Plateforme Numérique Bâtiment' interface. A yellow callout box with the text 'Executing checker service' has an arrow pointing to the 'Vérifier la maquette' option in a context menu. The interface includes a sidebar with navigation icons, a top header with the platform name and a 'beta' badge, and a main area with a file list and a table of file details.

File Name	Format	Status	Date	Size
cer	PDF		13/04/2018 11:27	736.25 ko
test.edf	EDF		22/03/2018 11:16	21.54 ko
AIX_ESQ_ARC_ENV.master.bcfzip	BCF		03/11/2017 10:51	40.8 ko
AIX_ESQ_ARC_ENV.ifc	IFC	invalide	03/11/2017 10:51	30.19 Mo
AC9R1-Haus-G-H-Ver2-2x3.master.bcfzip	BCF		03/11/2017 10:49	10.28 ko
AC9R1-Haus-G-H-Ver2-2x3.ifc	IFC	invalide	03/11/2017 10:49	4.35 Mo
test8.master.bcfzip	BCF		23/10/2017 14:40	12.1 ko

The screenshot displays the 'Assistant de contrôle IFC' (IFC Control Assistant) dialog box. The dialog lists several constraint sets, with 'Règles sur les Réseaux, fluides' (Rules on Networks, fluids) highlighted. A yellow callout box with the text 'Selecting a Constraints set to apply' points to this selection. The background shows a file explorer interface with a list of files and folders.

Protocole test	Fichier pour tester l'usage de la plateforme DHUP pour une vidéo
wimi_pfptnbdev_io_9445	
wimi_pfptnbdev_io_9449	
Règles sur les Matériaux	
Règles sur les Réseaux, fluides	
Règles sur les Espaces	
PFPTNB - Vérifications Essentielles 2.0	Vérification de présence des informations essentielles : Unités, Phase, Géoréférencement, Arborescence spatiale, Quantités de bases
PFPTNB - Vérifications Essentielles 2.1	Vérification de présence des informations essentielles : Unités, Phase, Géoréférencement, Arborescence spatiale, Quantités de bases
Règles sur les Equipements	
Règles sur les Revêtements	
Règles sur les Menuiseries	

Reading the report

Aut RefLongitude de IfcSite doit être renseigné		Alerte
A4.1 - IfcBuilding dans IfcSite	La structure spatiale de rattachement du ou des bâtiments (IfcBuilding) est le site (IfcSite)	RAS
A4.2 - IfcBuildingStorey dans IfcBuilding	La structure spatiale de rattachement des étages (IfcBuildingStorey) est le bâtiment (IfcBuilding)	RAS
A4.3 - IfcSpace dans IfcBuildingStorey	La structure spatiale de rattachement des espaces (IfcSpace) est l'étage (IfcBuildingStorey)	RAS
B1.1 - Murs - Longueur	La longueur des murs (IfcWall / IfcWalStandardCase) est attendue dans la quantité de base (BaseQuantities) NominalLength.	Alerte
B1.2 - Murs - Hauteur	La hauteur des murs (IfcWall / IfcWalStandardCase) est attendue dans la quantité de base (BaseQuantities) NominalHeight.	Alerte
B1.3 - Murs - Epaisseur	L'épaisseur des murs (IfcWall / IfcWalStandardCase) est attendue dans la quantité de base (BaseQuantities) NominalWidth.	Alerte
B1.4 - Murs - Volume	Le volume des murs (IfcWall / IfcWalStandardCase) est attendu dans la quantité de base (BaseQuantities) NetVolume.	Alerte
B2.1 - Dalles - Surface	La surface des dalles (IfcSlab) est attendue dans la quantité de base (BaseQuantities) NetArea.	Alerte
B2.2 - Dalles - Epaisseur	L'épaisseur des dalles (IfcSlab) est attendue dans la quantité de base (BaseQuantities) NominalWidth.	Alerte
B2.3 - Dalles - Volume	Le volume des dalles (IfcSlab) est attendu dans la quantité de base (BaseQuantities) NetVolume.	Alerte
B3.1 - Poteaux - Longueur	La longueur des poteaux (IfcColumn) est attendue dans la quantité de base (BaseQuantities) NominalLength.	Alerte

Watching report as
BCF annotations

