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xBRL-CSV Technology Stack

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Agenda

- Solution concept
  - Short- and long-term objectives
- Technology stack
  - Components overview
- Demo
  - Demo of existing components
- Proof of concept
  - EBA 2.9.1.1
- Roadmap
  - Development roadmap

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Solution Concept

Handling Large Reports – Solution Concept

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- **Short-term objective**
  - **Support for xBRL-CSV specification**
  - **Validation engine capable to validate large CSV files**
  - **High performance & low resource consumption**
  - **Additional tools necessary to implement full CSV scenario**
- Final objective
  - OIM as a common data model
  - Mapping layer and conversion engines to handle other (non-xBRL data formats)
  - High performance & low resource validation engine

xBRL-CSV tools

OIM RegData Store

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xBRL-CSV Platform Concept

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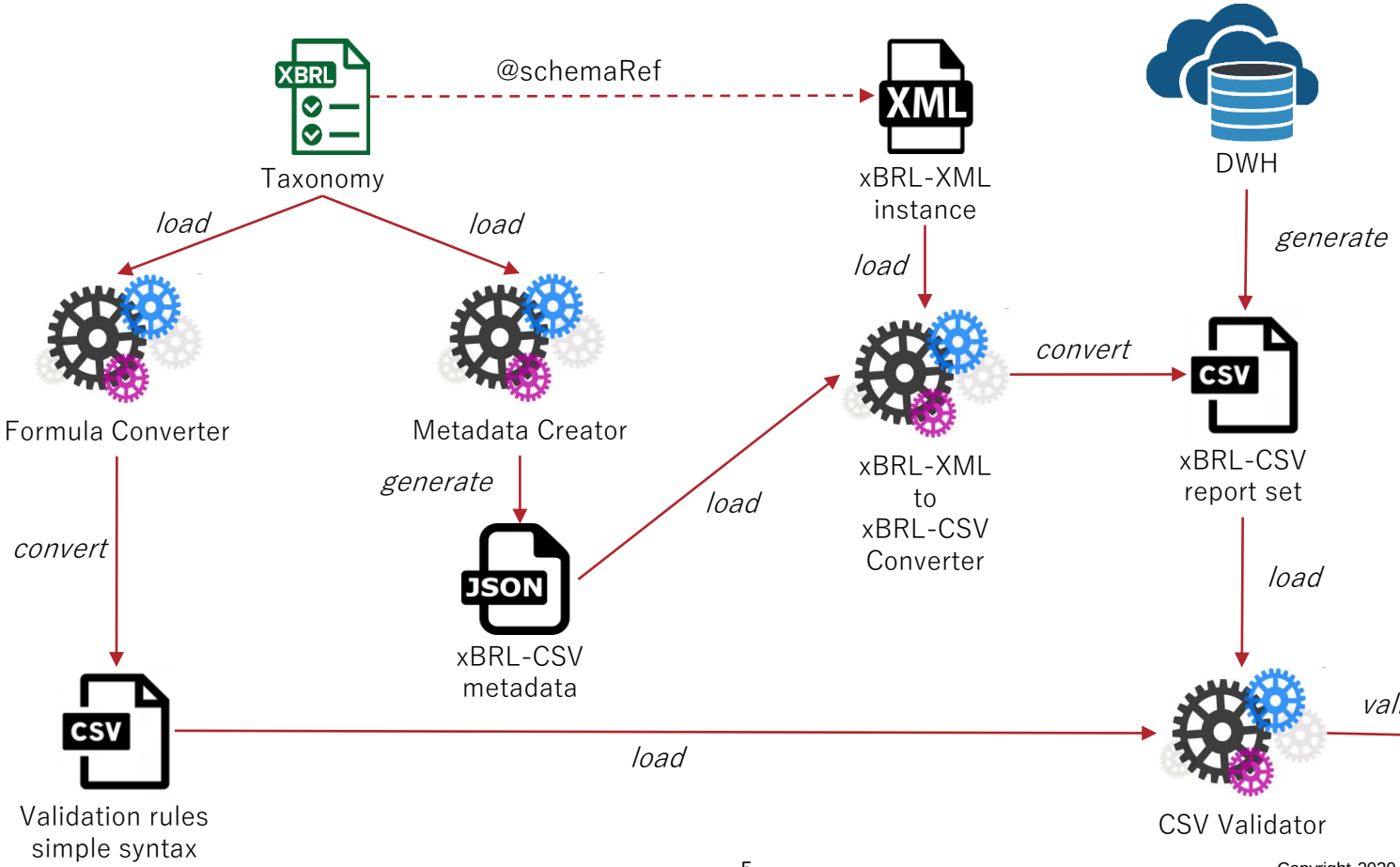

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xBRL-CSV Platform - Concept

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- Features
  - High performance evaluation of xBRL-CSV documents
  - Low memory and CPU consumption
  - Generic approach – taxonomy agnostic implementation
  - Utilize existing Formula definition layer*
- Architecture
  - Component architecture – easy to integrate building blocks
  - CLI and API interfaces

(*) Limitation may apply – not all rules might be finally applicable to CSV syntax

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Technology Stack

Components

Metadata Creator

- Generate metadata JSON for xBRL-CSV reporting

Formula Converter

- Process Formula Linkbase to rules which can be applied to xBRL-CSV

xBRL-XML to xBRL-CSV Converter

- Convert xBRL-XML instances to xBRL-CSV syntax

CSV Validator

- Validate xBRL-CSV document

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Metadata Creator

- Tool for generating JSON metadata for xBRL-CSV reports
- Table definitions as defined in Table Linkbase
- Configurability
  - Closed / Open tables distribution between CSV files
- Input
  - XBRL taxonomy with Table Linkbase
- Output
  - Set of JSON files


```
"tableTemplates": {
  "C 07.00.d (CR SA)": {
    "columns": {
      "76336": {
        "dimensions": {
          "eba_dim:EXC": "eba_EC:x12",
          "concept": "eba_met:mi180",
          "eba_dim:BAS": "eba_BA:x9",
          "eba_dim:APR": "eba_AP:x42",
          "eba_dim:TRI": "eba_TR:x4",
          "eba_dim:IMS": "eba_IM:x3",
          "eba_dim:PRP": "eba_PL:x10",
          "eba_dim:RWS": "eba_PC:x14",
          "eba_dim:MCY": "eba_MC:x195"
        }
      },
      "88510": {
        "dimensions": {
          "eba_dim:EXC": "eba_EC:x12",
          "eba_dim:CPS": "eba_CT:x2",
          "concept": "eba_met:mi180",
          "eba_dim:BAS": "eba_BA:x9",
          "eba_dim:ECB": "eba_EC:x16",
          "eba_dim:APR": "eba_AP:x42",
          "eba_dim:TRI": "eba_TR:x4",
          "eba_dim:IMS": "eba_IM:x3",
```

Metadata Creator

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Formula Converter

- Process Formula Linkbase definitions
- Convert assertions to syntax easily applicable for xBRL-CSV data
- Taxonomy-agnostic solution
- Configurability
- Input
  - XBRL taxonomy with Formula Linkbase
- Output
  - Intermediate files containing processed Formula expressions
- Current Limitations
  - XPath Expressions

```
eba_v4890_m, ${C 26.00, 010, 010} > 0
eba_v4890_m, ${C 26.00, 010, 020} > 0
eba_v0654_m, iaf:numeric-greater-equal-than(${C 28.00, 330}, ${C 28.00, 340})
eba_v4012_a, ${C 28.00, 020} = (xs:QName('eba_ZZ:x1'), xs:QName('eba_ZZ:x2'))
eba_v6535_a, ${C 00.01, 010, 020} = (xs:QName('eba_SC:x6'), xs:QName('eba_SC:x7'))
eba_v6304_m, not(empty(${C 27.00, 020}) or xff:has-fallback-value(QName('', 'a')))
eba_v4013_a, ${C 27.00, 070} = (xs:QName('eba_ZZ:x27'), xs:QName('eba_ZZ:x28'))
```

Formula Converter

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xBRL-XML to xBRL-CSV Converter

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- Converting xBRL-XML instances to xBRL-CSV
- Integrate DPM DB (e.g. to support DPM DB ID-based rules)
- Applicability for specific usage scenarios
  - Testing xBRL-CSV workflows
  - Converting xBRL-XML instances created with established reporting processes to CSV format requested by Regulator
- Input
  - Metadata JSON for xBRL-CSV reporting
  - Input xBRL-XML instances
- Output
  - Set of CSV files

xBRL-XML to xBRL-CSV Converter

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xBRL-XML to xBRL-CSV Converter

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view of open table with 2 typed dimensions in XWand Reporter

					eba_dim:BAS: eba_BA:x9								
		eba_met:bi238	eba_met:ei205	eba_met:mi180, eba_dim:MCY: eba_MC:x59	eba_met:mi180, eba_dim:IMS: eba_IM:x3	eba_met:mi180, eba_dim:MCY: eba_MC:x223	eba_met:mi180, eba_dim:MCY: eba_MC:x130	eba_met:mi180, eba_dim:MCY: eba_MC:x99	eba_met:mi180, eba_dim:MCY: eba_MC:x221	eba_met:mi180, eba_dim:MCY: eba_MC:x154	eba_met:mi180, eba_dim:MCY: eba_MC:x52	eba_met:mi180, eba_dim:MCY: eba_MC:x223	
m:INC	eba_dim:GCC	030	040	050	060	070	080	090	100	110	120	130	
	0	true	eba_ZZ:x14	290002.0	290003.0	290004.0	290005.0	290006.0	290007.0	290008.0	290009.0	2900010.0	
1	1	true	eba_ZZ:x14	290012.0	290013.0	290014.0	290015.0	290016.0	290017.0	290018.0	290019.0	2900110.0	
2	2	true	eba_ZZ:x14	290022.0	290023.0	290024.0	290025.0	290026.0	290027.0	290028.0	290029.0	2900210.0	
3	3	true	eba_ZZ:x15	290032.0	290033.0	290034.0	290035.0	290036.0	290037.0	290038.0	290039.0	2900310.0	
4	4	true	eba_ZZ:x15	290042.0	290043.0	290044.0	290045.0	290046.0	290047.0	290048.0	290049.0	2900410.0	
5	5	true	eba_ZZ:x15	290052.0	290053.0	290054.0	290055.0	290056.0	290057.0	290058.0	290059.0	2900510.0	
6	6	true	eba_ZZ:x15	290062.0	290063.0	290064.0	290065.0	290066.0	290067.0	290068.0	290069.0	2900610.0	
7	7	true	eba_ZZ:x15	290072.0	290073.0	290074.0	290075.0	290076.0	290077.0	290078.0	290079.0	2900710.0	

When tabular data's structure is modelled based on Table Linkbase table, then a csv file corresponds practically 1-to-1 with the table view (for open Y-axis tables)

```
1 id,GCC,INC,C_030,C_040,C_050,C_060,C_070,C_080,C_090,C_100,C_110,C_120,C_130,C_140,C_150,C_160,C_1
2 1,0,0,true,eba_ZZ:x14,290002.0,290003.0,290004.0,290005.0,290006.0,290007.0,290008.0,290009.0,2900
3 2,1,1,true,eba_ZZ:x14,290012.0,290013.0,290014.0,290015.0,290016.0,290017.0,290018.0,290019.0,2900
4 3,2,2,true,eba_ZZ:x14,290022.0,290023.0,290024.0,290025.0,290026.0,290027.0,290028.0,2900
5 4,3,3,true,eba_ZZ:x15,290032.0,290033.0,290034.0,290035.0,290036.0,290037.0,290038.0,2900
6 5,4,4,true,eba_ZZ:x15,290042.0,290043.0,290044.0,290045.0,290046.0,290047.0,290048.0,2900
7 6,5,5,true,eba_ZZ:x15,290052.0,290053.0,290054.0,290055.0,290056.0,290057.0,290058.0,290059.0,2900
```

xBRL-CSV file with values from the table

xBRL-XML to xBRL-CSV Converter

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xBRL-CSV Validator

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- Dedicated validation engine for xBRL-CSV reports
- No XML data model in memory
- Capabilities
  - Rules for any kind of closed and open tables
  - Open table: rules operating per row as well as totals calculated for all rows
  - Cross-table rules
- Input
  - Validation rules definition file
  - xBRL-CSV files – reported instance
- Output
  - Validation results log

CSV Validator

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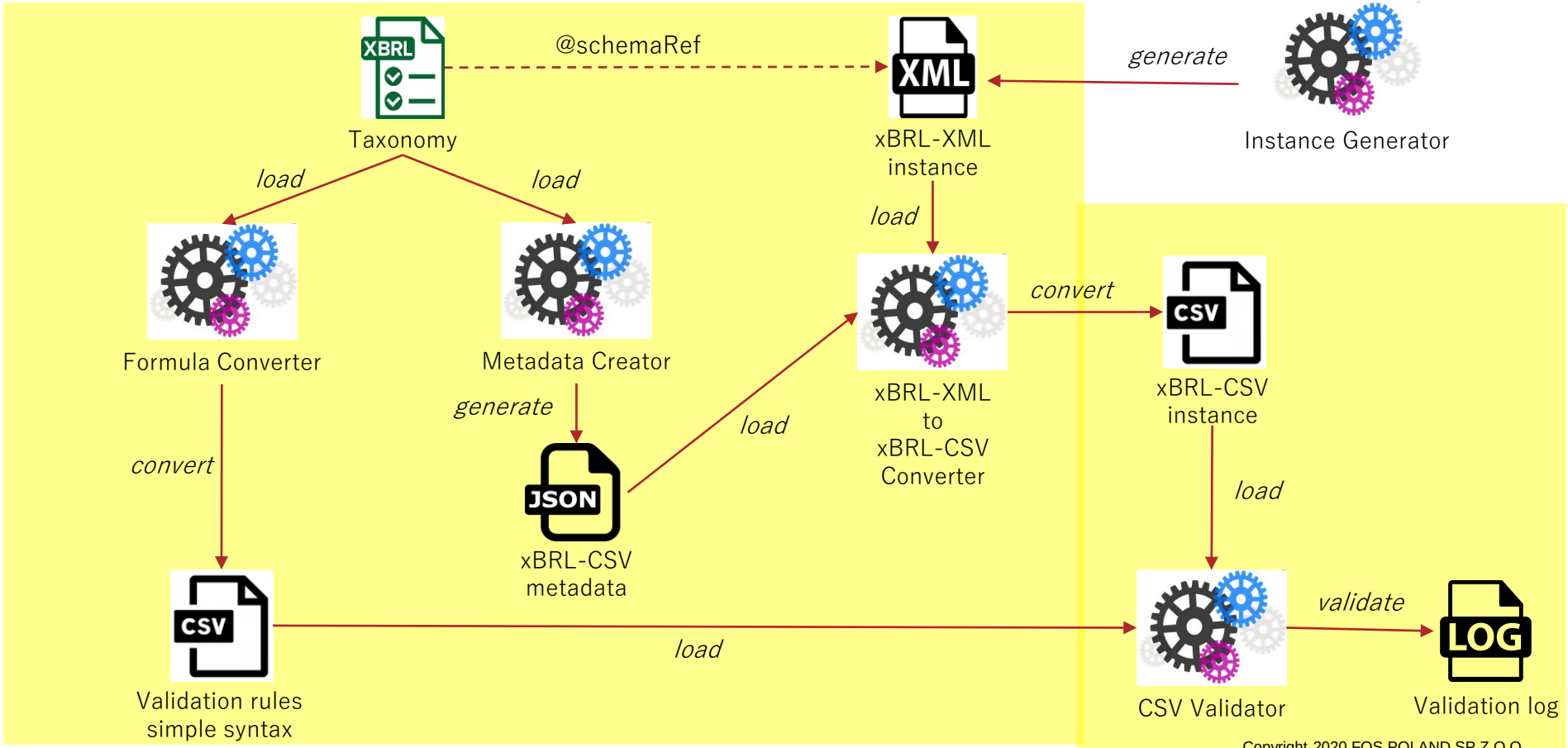
Demo

Demo scenario



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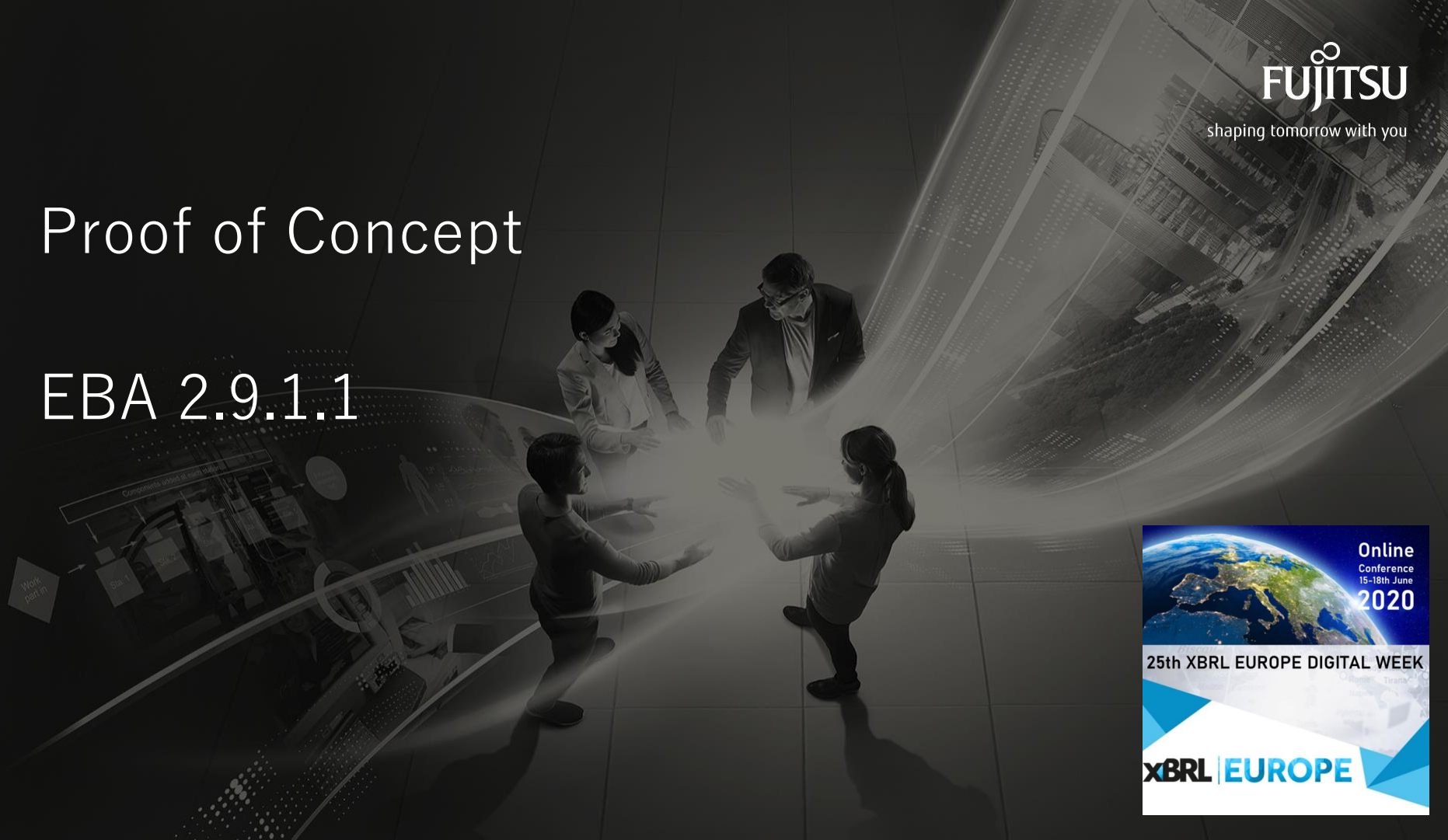
Proof of Concept

EBA 2.9.1.1



POC Definition

- COREP_OF_CON module (EBA 2.9.1.1)
- Selected tables used for tests
  - Open table containing large volume of granular data: C17.02
  - Corresponding closed table: C17.01a
- Validation rules
  - All rules applicable for above mentioned tables
- Goal
  - Feasibility study of the full process of xBRL-CSV validation
  - Detailed comparison of resource consumption between xBRL-XML/CSV validations
  - Define expected conversion rates for CSV file size and validation time (& memory)

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POC Steps

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- Generate sample xBRL-XML instances
  - Random but “close to real” data
  - Few instances of different sizes (10MB, 100MB, 1GB, 2GB)
- Trace details of xBRL-XML validation
  - Identify top 5 rules responsible for >90% of validation time
- Generate corresponding metadata JSON for xBRL-CSV reporting
- Process Formula Linkbase to expressions applicable to CSV
- Convert xBRL-XML test instances to xBRL-CSV format
- Execute and trace xBRL-CSV Validator
- Collect benchmark results

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xBRL-XML Formula Validation - resources

Instance size [MB]	Rows	Facts	Formula		
			Validation time [sec]	Memory consumption [GB]*	Top 5 Rule Ids
10	1000	19000	2,7	1,6	**eba_v5842_h = 1.5s** **eba_v5838_m = 0.2s** eba_v5839_m = 0.1s eba_v5017_a = 0.1s **eba_v5833_s = 0.1s**
102	10000	190000	14	1,7	**eba_v5842_h = 11s** **eba_v5838_m = 0.8s** **eba_v5833_s = 0.4s** eba_v5017_a = 0.2s eba_v4025_a = 0.1s
1000	100000	1900000	168	6,6	**eba_v5842_h = 123s** **eba_v5838_m = 10.3s** **eba_v5833_s = 5.2s** **eba_v4861_m = 1.4s** eba_v4025_a = 1.3s
1980	200000	3800000	222	13	**eba_v5842_h = 160s** **eba_v5838_m = 18.7s** **eba_v5833_s = 9.1s** **eba_v4861_m = 2.9s** eba_v0568_m = 2.3s

- **eba_v5842_h**
- **eba_v5838_m**
- **eba_v5833_s**
- **eba_v4861_m**

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Formulas in scope

Rule ID	Table(s)	Expression	Rows	Cols
eba_v5842_h	C 17.02	{c0060} = +{c0140} + {c0150} + {c0110} + {c0080} + {c0160} + {c0130} + {c0120} + {c0100} + {c0090}	All	
eba_v5838_m	C 17.01.a	{c0080} >= +{c0010} + {c0020} + {c0030} + {c0040} + {c0050} + {c0060} + {c0070}	(0010;0020;0030;0070;0080;0110;0120;0130;0170;0180;0210;0220;0230;0270;0280;0310;0320;0330;0370;0380;0410;0420;0430;0470;0480;0510;0520;0530;0570;0580;0610;0620;0630;0670;0680;0710;0720;0730;0770;0780;0810;0820;0830;0870;0880)	
eba_v5833_s	C 17.01.a	{C 17.01.a} >= 0	(0010;0020;0030;0050;0060;0110;0120;0130;0150;0160;0210;0220;0230;0250;0260;0310;0320;0330;0350;0360;0410;0420;0430;0450;0460;0510;0520;0530;0550;0560;0610;0620;0630;0650;0660;0710;0720;0730;0750;0760;0810;0820;0830;0850;0860;0910;0911;0912;0913;0914;0920;0921;0922;0923;0924;0930;0935;0936;0945;0950;0960)	(0010;0020;0030;0040;0050;0060;0070;0080)
eba_v4861_m	C 17.01.a	if ({c0010} + {c0020} + {c0030} + {c0040} + {c0050} + {c0060} + {c0070}) > 0 then {c0080} >= {c0010} + {c0020} + {c0030} + {c0040} + {c0050} + {c0060} + {c0070}	(0910;0920)	

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Validation Benchmark

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			xBRL-XML			xBRL-CSV			CSV vs. XML		
#	Rows	Facts	Instance size [MB]	Validate time [sec]	Memory usage [GB]*	File size [MB]	Validate time [sec]**	Memory usage [GB]	File size decrease	Validate speed increase	Memory usage decrease
1	1 000	19 000	10	2,7	1,6	0,24	0,2	0,35	42	14	5
2	10 000	190 000	102	14	1,7	2,5	0,4	0,6	41	35	3
3	100 000	1 900 000	1000	168	6,6	29	2,5	0,8	34	67	8
4	200 000	3 800 000	1980	222	13,0	39	4,2	0,8	51	53	16

Taxonomy: EBA 2.9.1.1, Module: COREP_OF_CON
CPU: Intel i7-8650U, RAM: 24GB

* Memory consumption shows overall memory needed to load and process both taxonomy and instance
** Validation time of xBRL-CSV files includes file loading time - file content is read line-by-line during validation

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xBRL-CSV – Promise

1. File size: 40-50x smaller
2. Validation time: 50-60x faster
3. Memory consumption: constant, 2GB

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xBRL-CSV – Under development

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- Current development is driven by known EBAs expectations/requirements
- Final goal: Native CSV validator – not using XML data model
- Additional validation layers to be applied on xBRL-CSV files
  - XBRL, Dimensions
- Open questions
  - **Formulas applicable – limitations to be defined – e.g. no Xpath Expressions**
  - Metadata (JSON) file structure – single file vs file per table
  - CSV content for closed tables – e.g. transposed or not
  - CSV file structure for closed tables – single file vs file per table
  - Format of some additional properties to be provided – e.g. filing indicators

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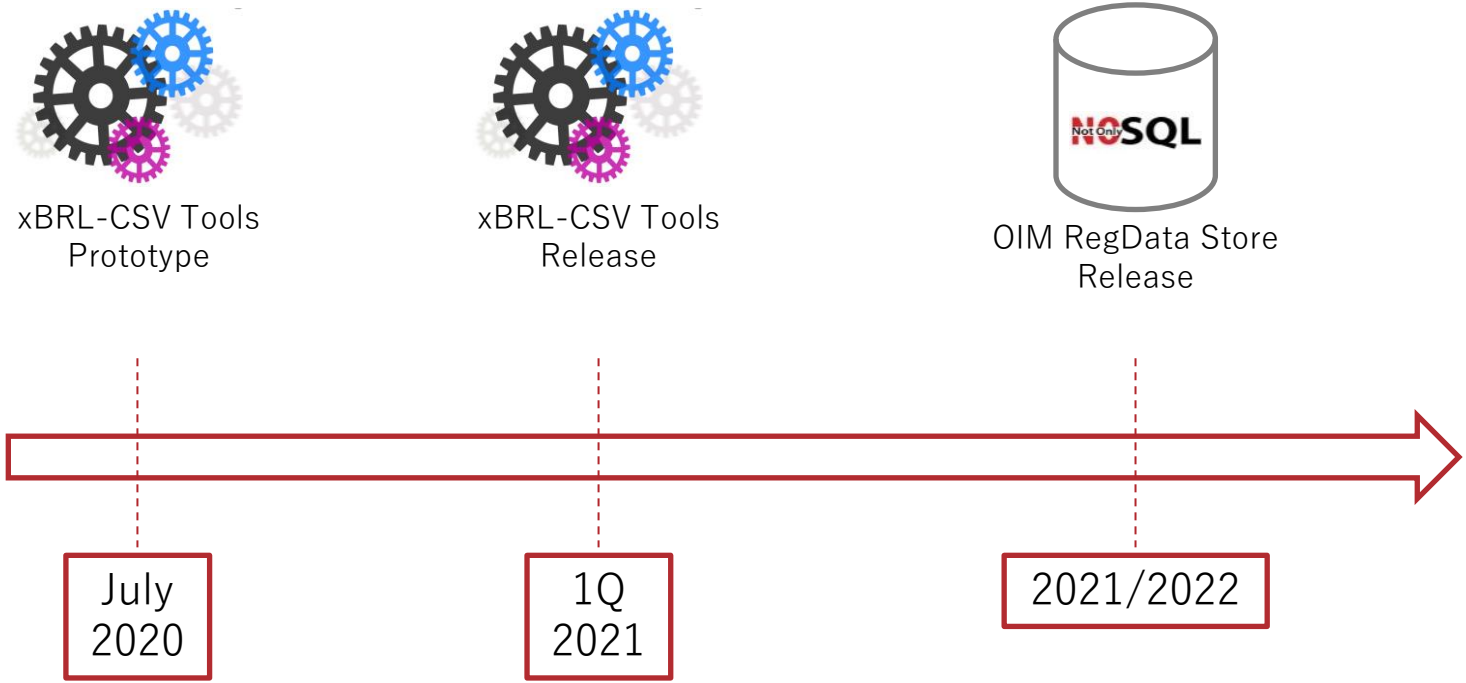
Roadmap

Roadmap



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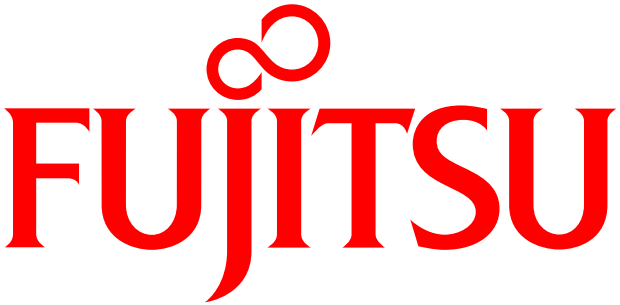

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