XALGORITHMS Foundation

RuleML Community • Monthly Webinar • 2019-06-28

AN INTERNET OF RULES

SYSTEM OVERVIEW

Joseph Potvin
Executive Director, Xalgorithms Foundation

The Last Page First

Some Questions on My Mind

General Framework:

- What conceptual map can illustrate RuleML vis-à-vis IoR functions?
- How might complementarity between IoR and RuleML be described?

Synergies:

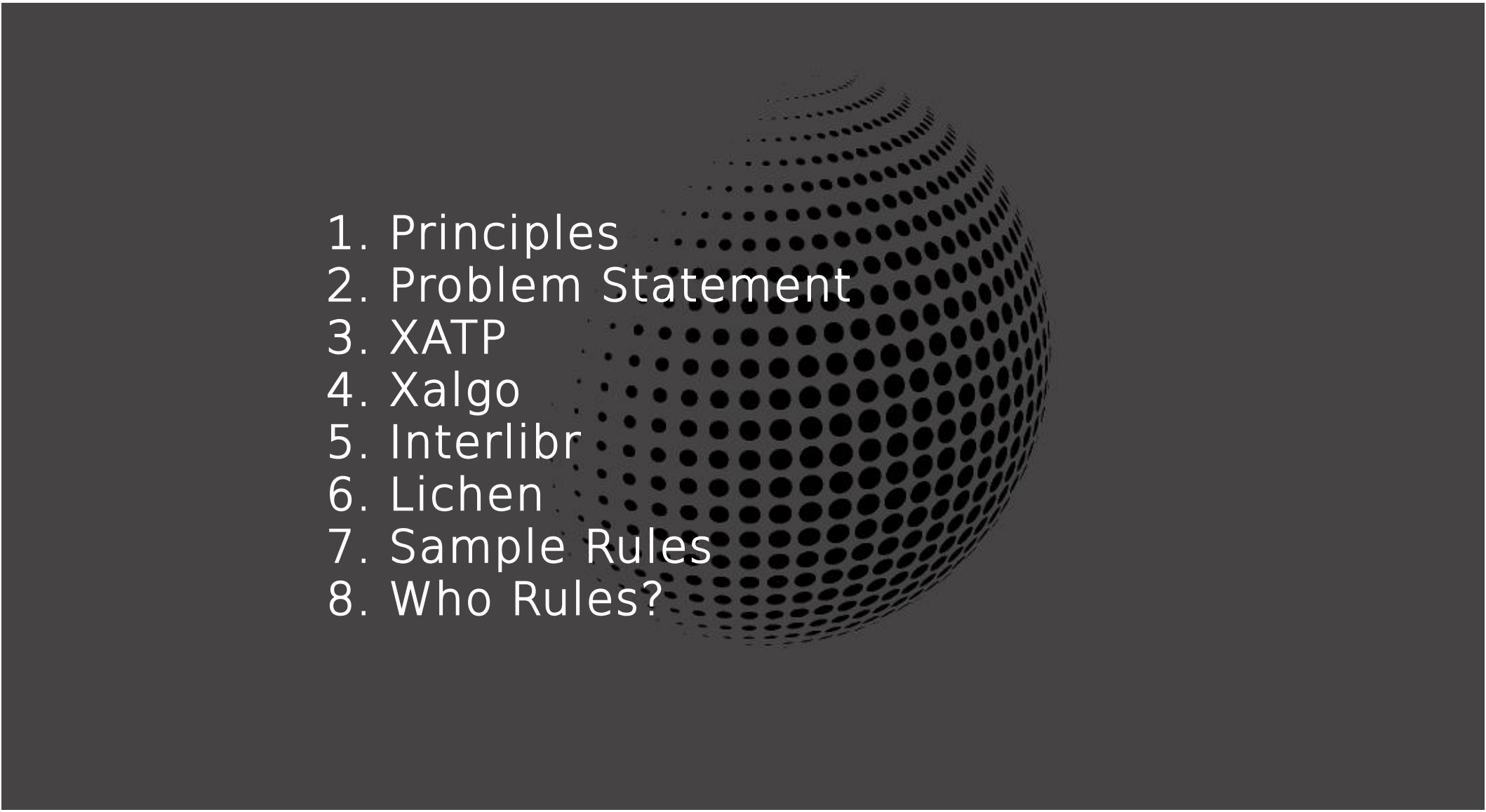
- Can an IoR expedite the achievement of RuleML community goals?
- What challenges does RuleML face that an IoR may help to overcome?

Issues/Incongruities:

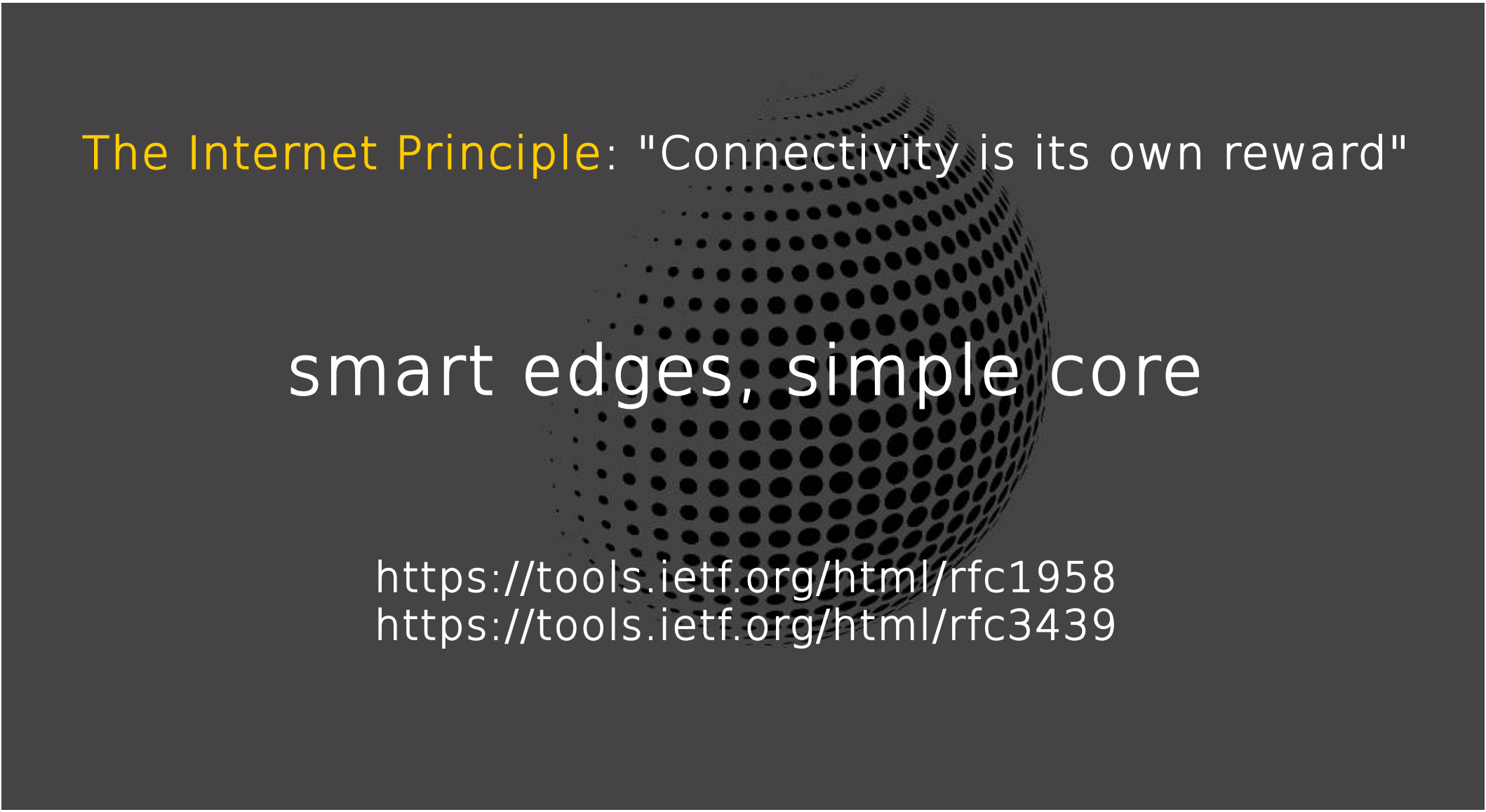
- Does any aspect of this overview seem incongruous with RuleML?
- Are there any apparent conceptual/technical/practical errors-omissions?

Experimentation:

- What exploratory projects might be useful over the next year?
- What challenges would the RuleML community put to IoR designers?


1. Principles
2. Problem Statement
3. XATP
4. Xalgo
5. Interlibr
6. Lichen
7. Sample Rules
8. Who Rules?

Internet Principles (IETF)



The Internet Principle: "Connectivity is its own reward"

smart edges, simple core

https://tools.ietf.org/html/rfc1958
https://tools.ietf.org/html/rfc3439

Internet Principles (IETF)

The Simplicity Principle: "Complexity is the primary mechanism which impedes efficient scaling"

seek the simplest possible solution

Occam's razor

"Plurality should not be posited without necessity."

https://tools.ietf.org/html/rfc3439

Web Principles (W3C)

The Least Power Principle: "The less powerful the language, the more you can do with the data stored in that language."

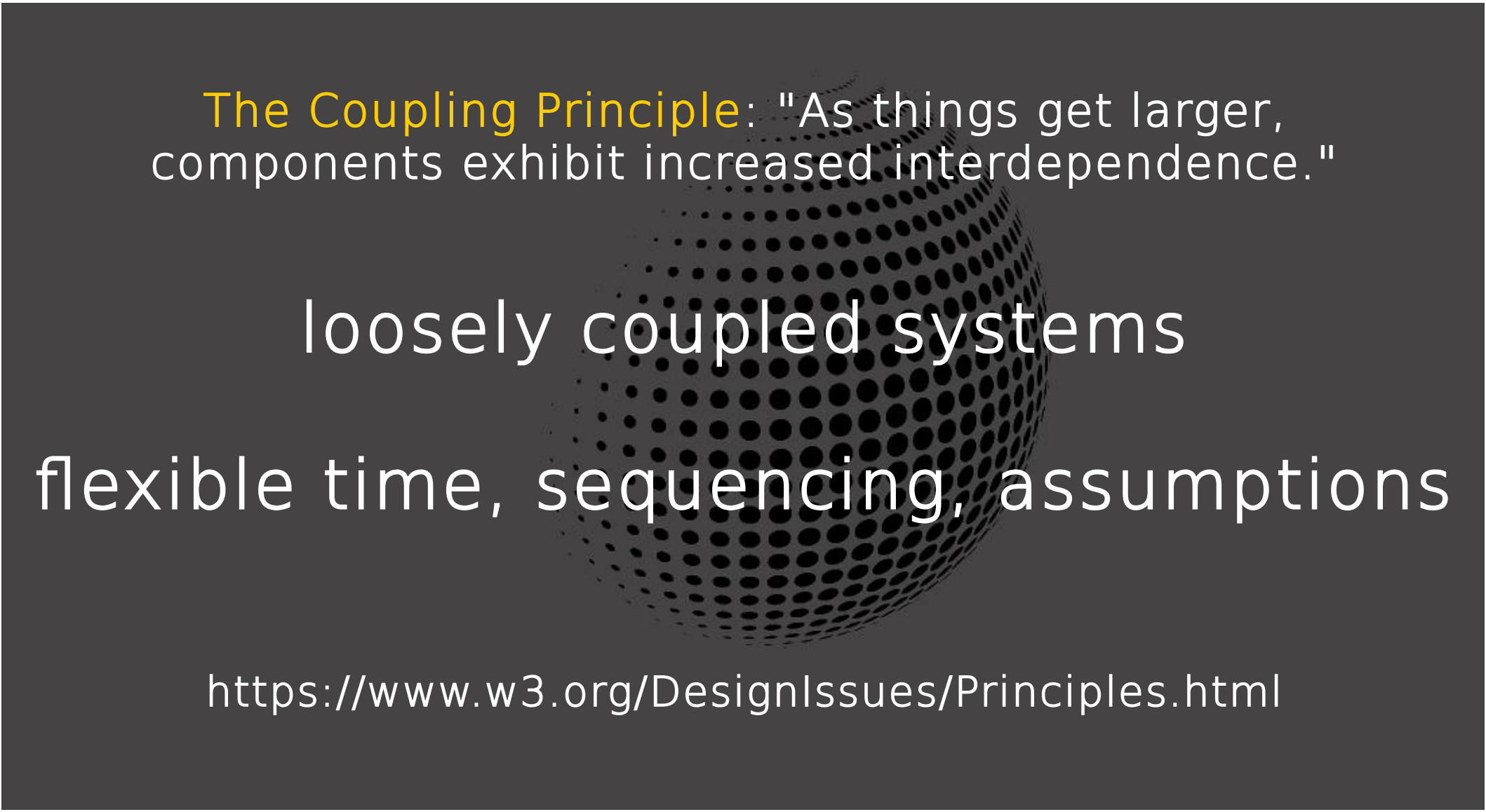
use concise declarative expressions so

anyone can write programs for them

https://www.w3.org/2001/tag/doc/leastPower.html
https://www.w3.org/DesignIssues/Principles.html

Web Principles (W3C)

The Coupling Principle: "As things get larger, components exhibit increased interdependence."

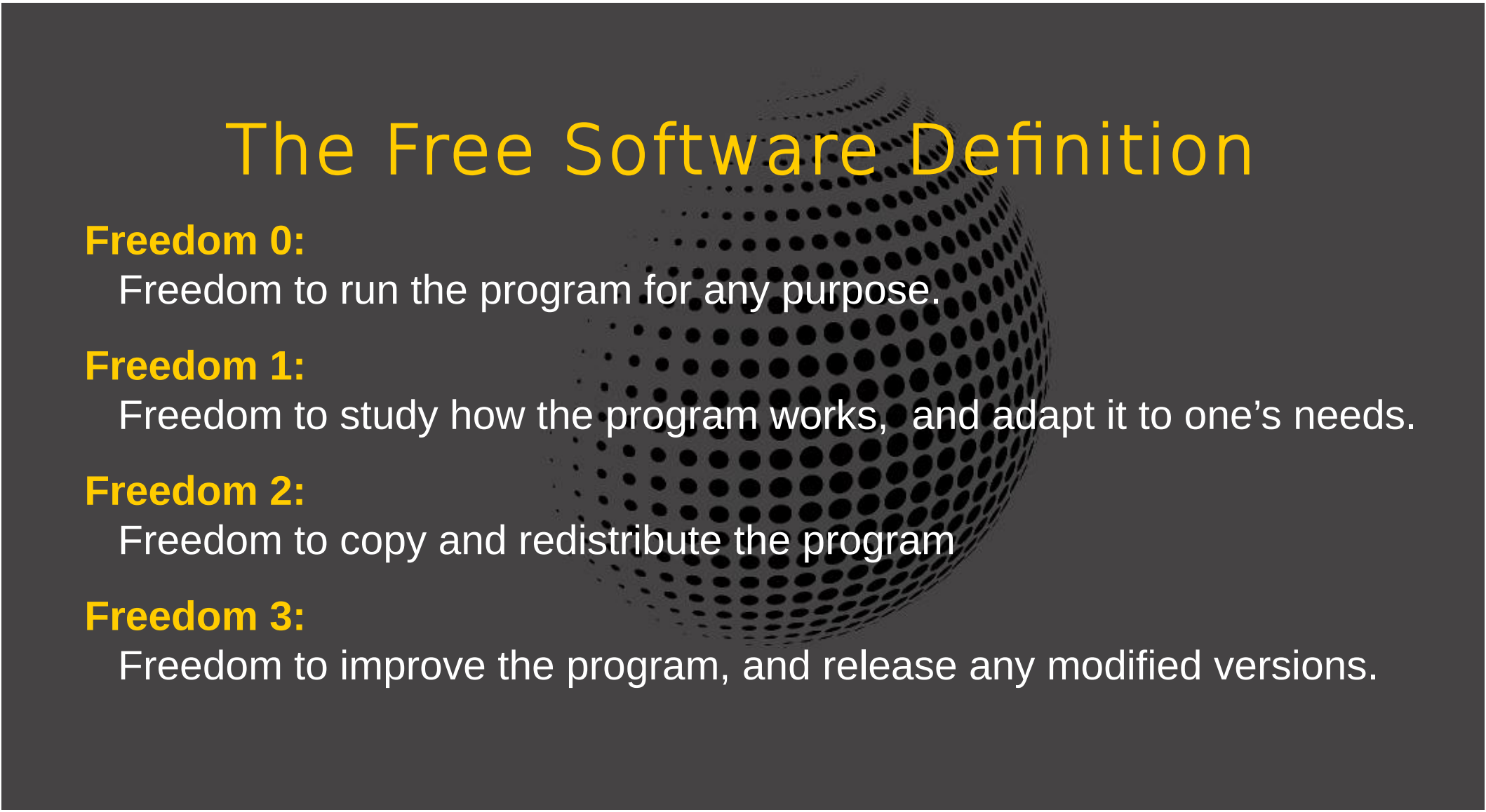


loosely coupled systems

flexible time, sequencing, assumptions

https://www.w3.org/DesignIssues/Principles.html

Free/Libre Software Principles (FSF)



The Free Software Definition

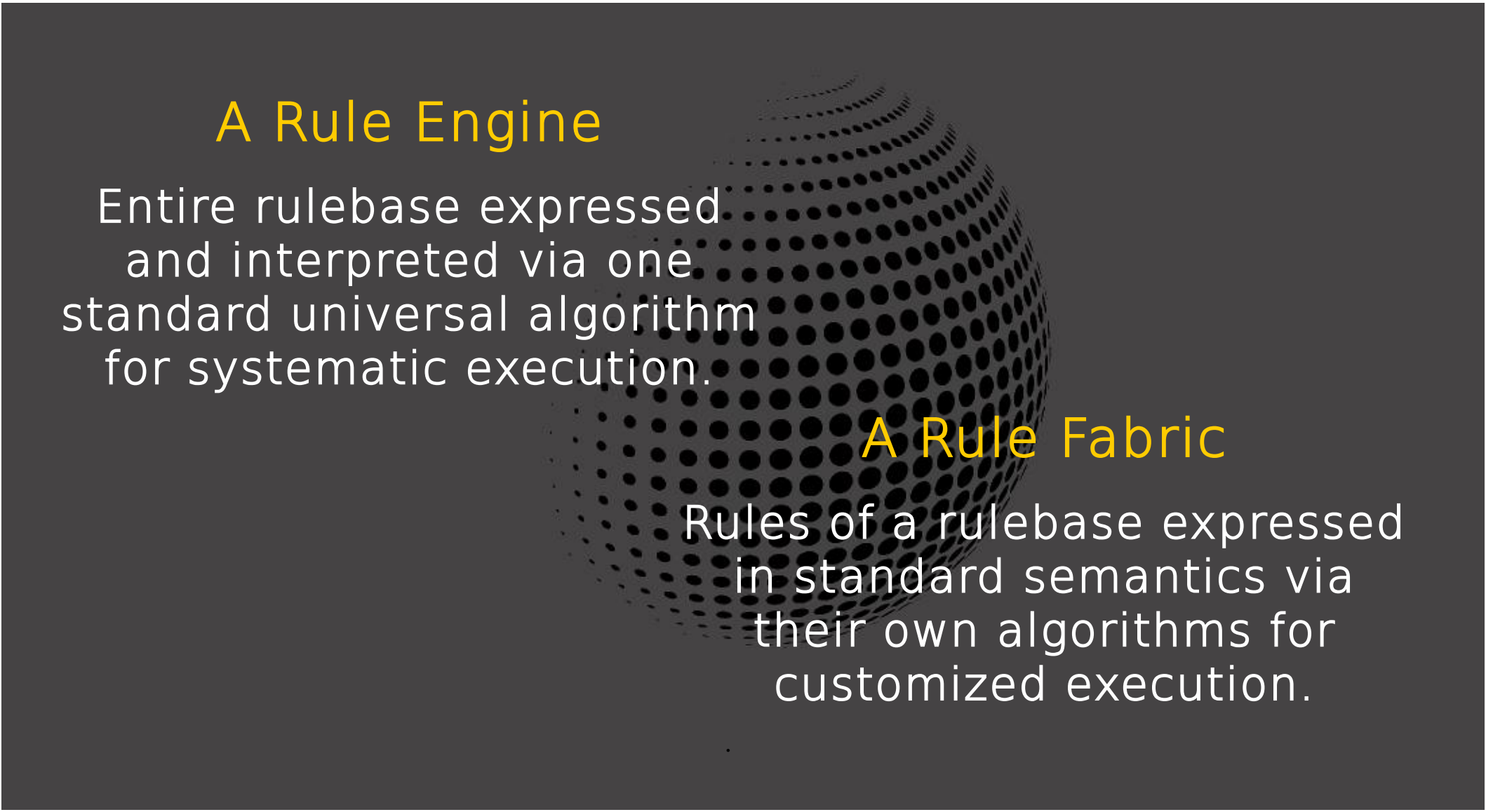
Freedom 0:
Freedom to run the program for any purpose.

Freedom 1:
Freedom to study how the program works, and adapt it to one's needs.

Freedom 2:
Freedom to copy and redistribute the program

Freedom 3:
Freedom to improve the program, and release any modified versions.

System Design Implications



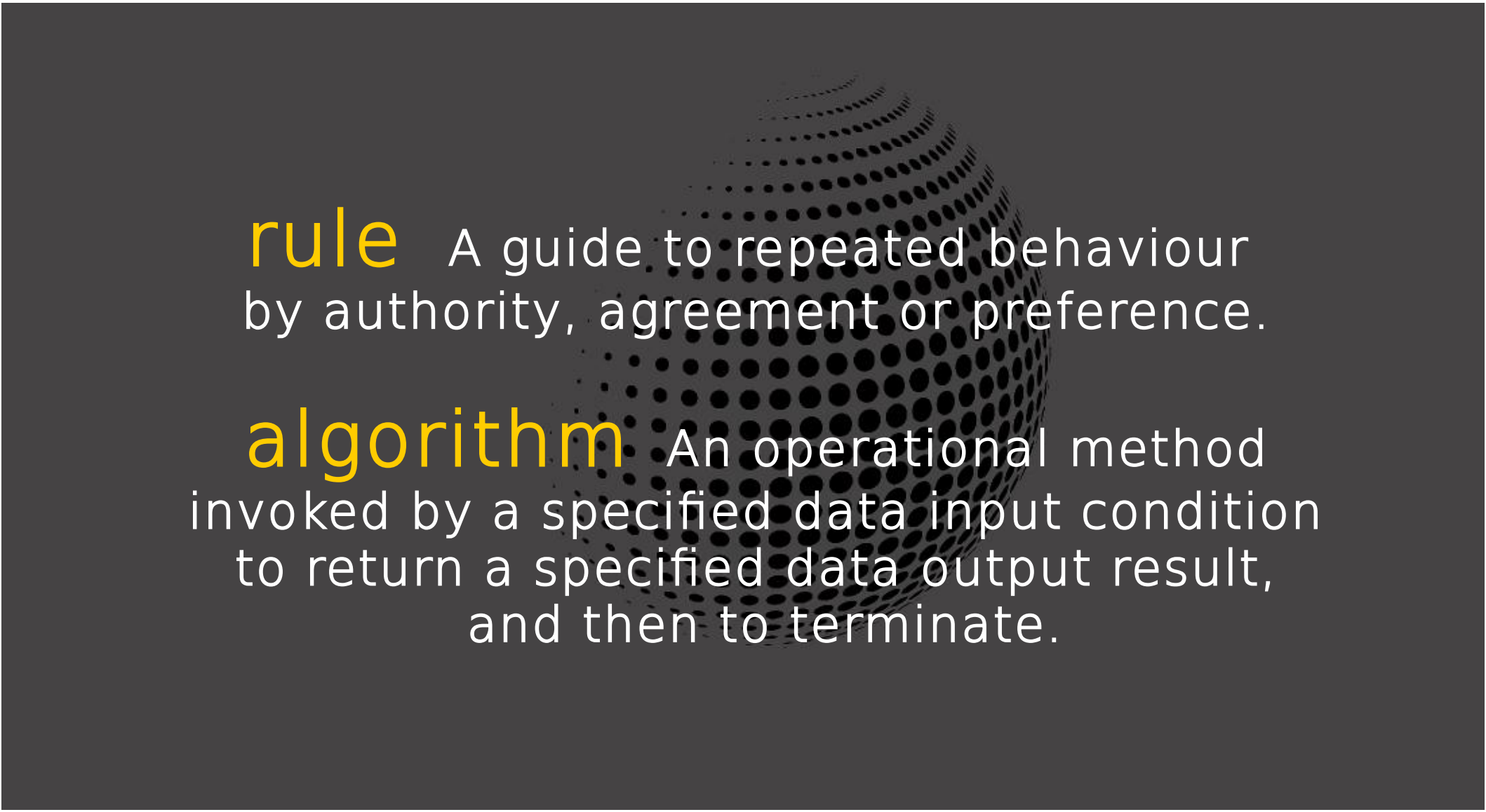
A Rule Engine

Entire rulebase expressed and interpreted via one standard universal algorithm for systematic execution.

A Rule Fabric

Rules of a rulebase expressed in standard semantics via their own algorithms for customized execution.

‘Algorithms’ Implement ‘Rules’



rule A guide to repeated behaviour by authority, agreement or preference.

algorithm An operational method invoked by a specified data input condition to return a specified data output result, and then to terminate.

‘Algorithms’ Implement ‘Rules’

RULE: A normative precept by which repeated behaviour is guided through authority, agreement or preference.

[early: 1..n] [late: 2..n]
Wittgenstein, L. (1991). Philosophical Investigations: The German Text, with a Revised English Translation 50th Anniversary Edition (3 edition). Malden, MA: Wiley-Blackwell. (early: “repeating” vs. late: “social & repeating”)

ALGORITHM: A posited reusable operational method invoked by a specified data input condition to generate a specified data output result, and then to terminate.

[abstract state machine]
Gurevich, Y. (2014). What is an Algorithm? (Revised). In A. Olszewski (Ed.), Church’s Thesis: Logic, Mind and Nature (p. 15). Copernicus Center Press. ("abstract state machine")

[recursor]
Moschovakis, Y. N. (2001). What is an Algorithm? In B. Engquist & W. Schmid (Eds.), Mathematics Unlimited: 2001 and Beyond (pp. 919–936). Springer. ("recursor")

‘IF..THEN’ Conditional vs. ‘WHEN’ Relational

ALGORITHM: A posited reusable operational method invoked by a specified data input condition to generate a specified data output result, and then to terminate.

IF x, THEN y

WHEN x | y

0th Conditional
Present Uncertain Fact
Present Certain Fact

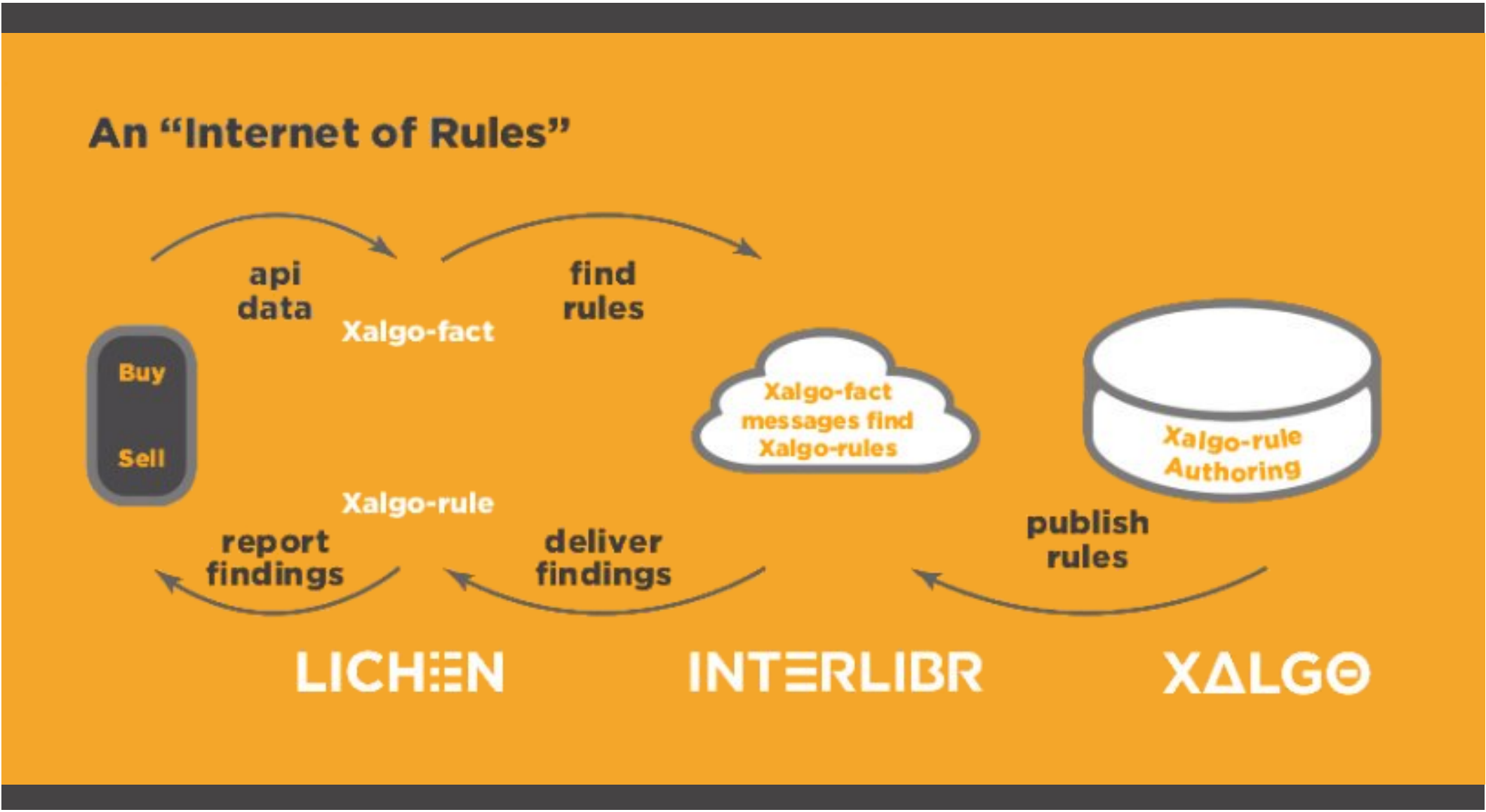
Certain Fact
Certain Fact

1st Conditional
Present Uncertain Situation
Future Certain Action

2nd Conditional
Present or Future Uncertain Situation
Present or Future Certain Action

A Problem Statement

AN INTERNET OF RULES



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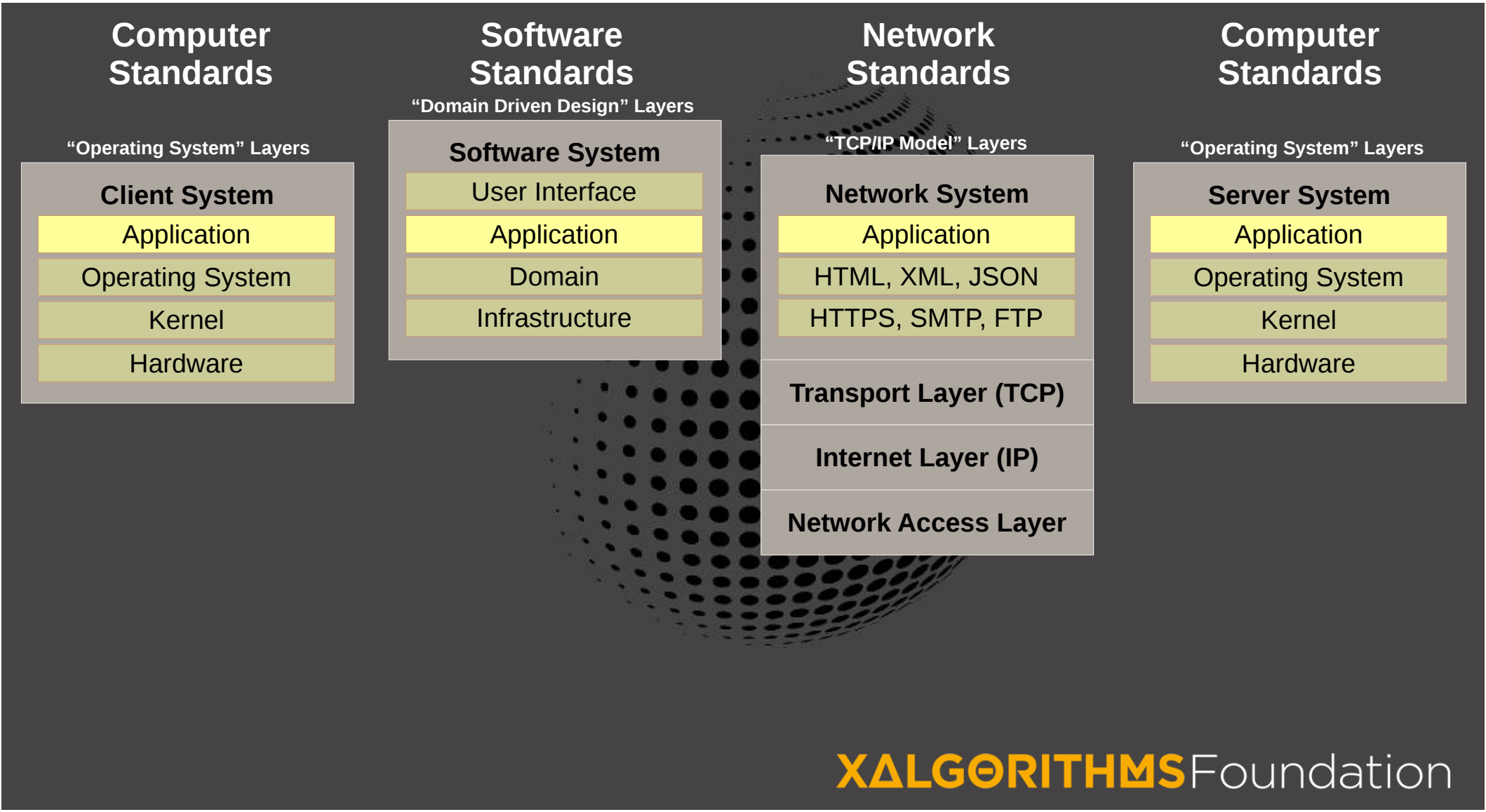
Computing Interoperability Standards

Enabling Cross-Platform Networked Applications



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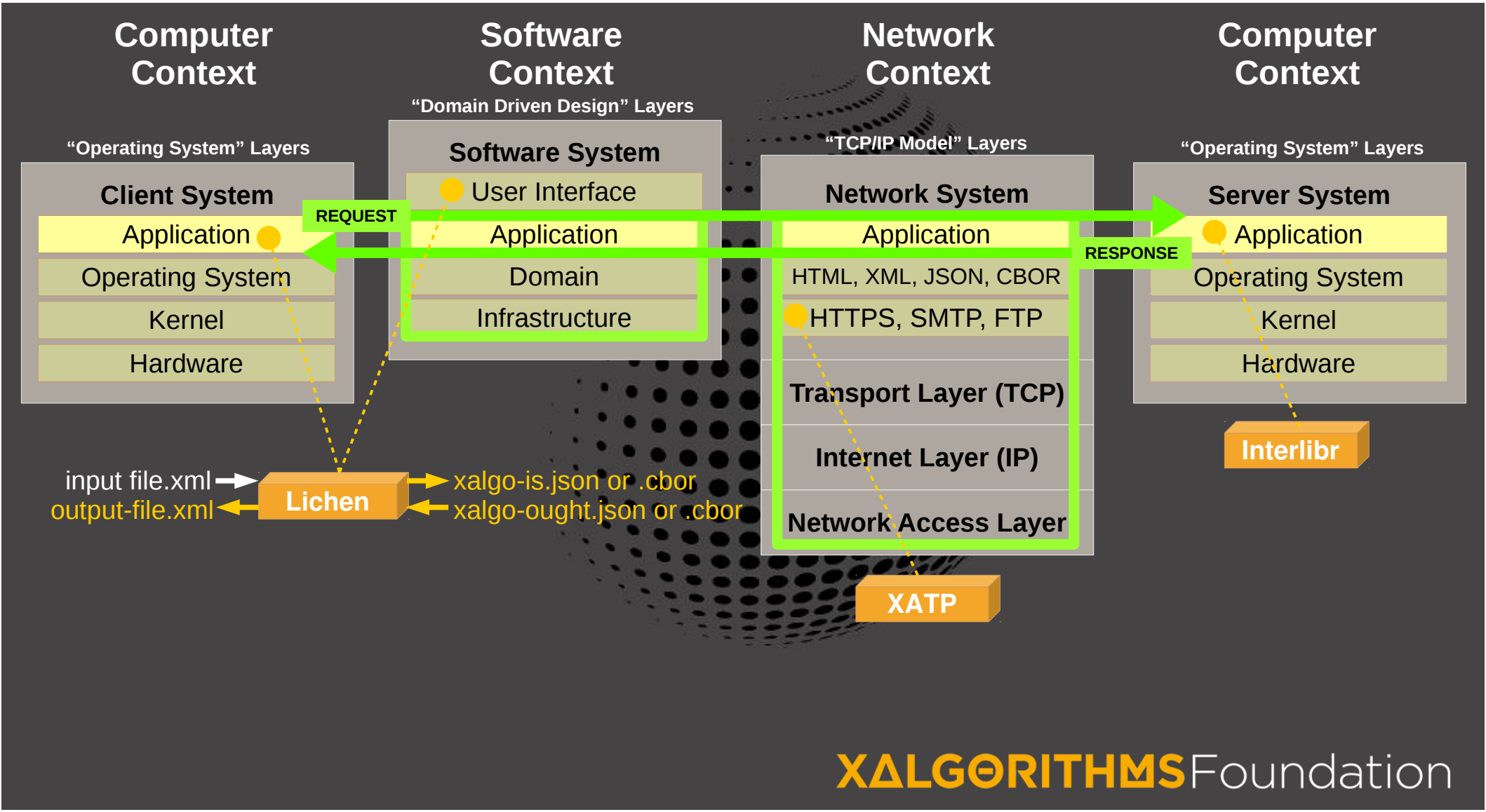
An Internet of Rules Via 3 Auxiliary Components

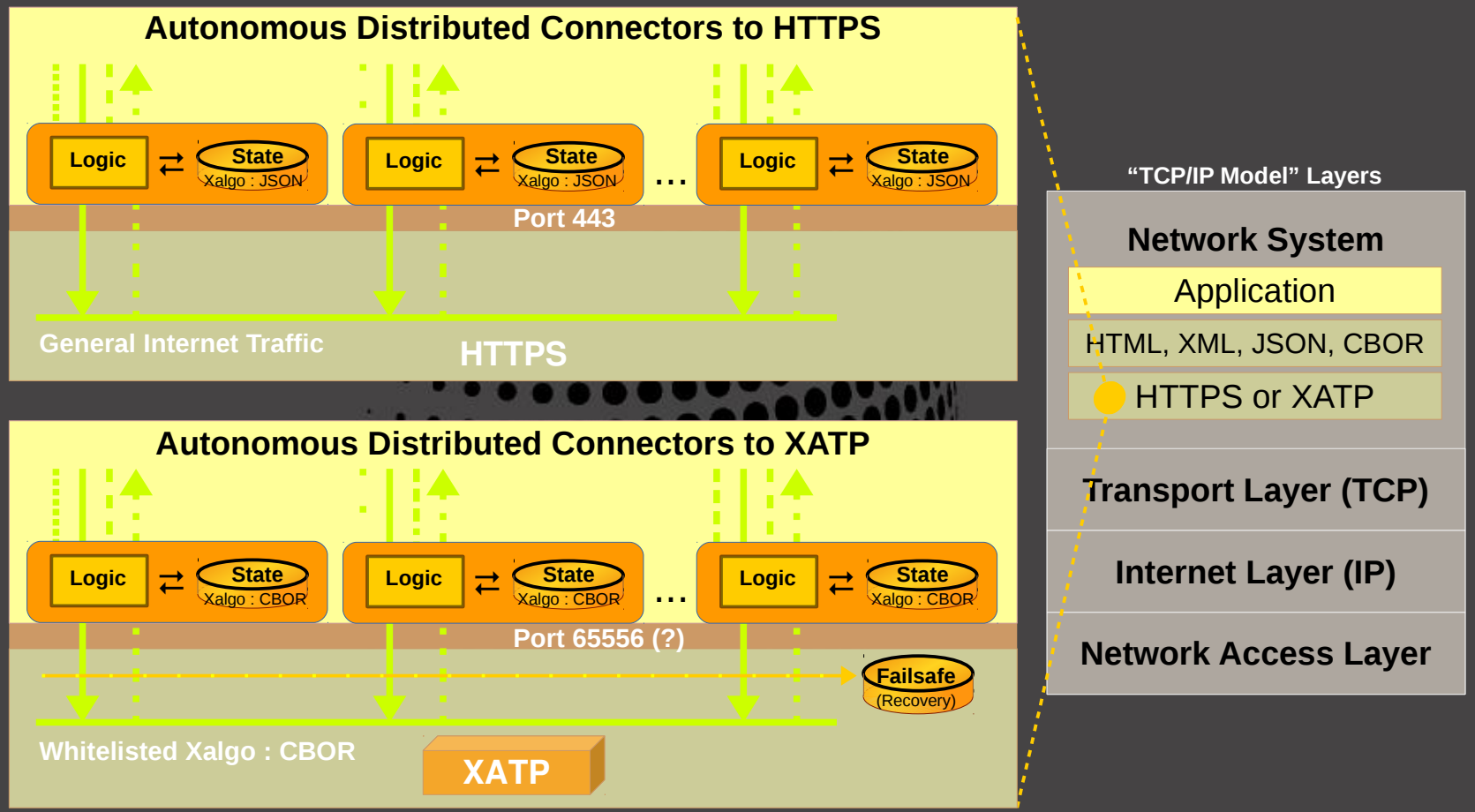
Creating a Seamless Request-Response Service for Finding Algorithms that Implement "In-Effect" & "Applicable" Rules



Optional: External Algorithms Transfer Protocol

Internet of Rules via Two Performance Modes (RE: Speed & Security)

[JSON over HTTPS] or [CBOR over XATP]

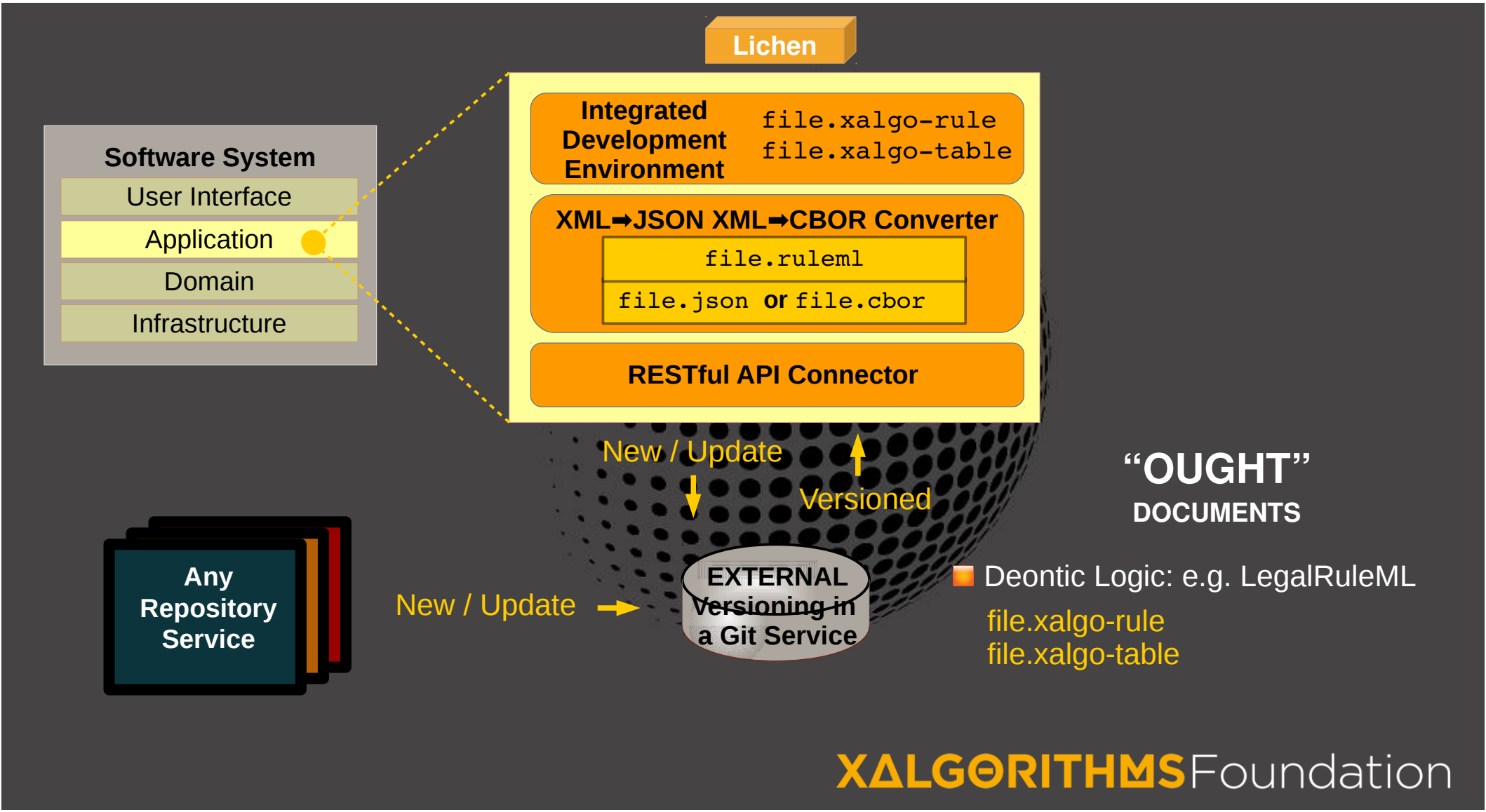


XALGORITHMS Foundation

Bray, T. (2014). RFC 7159. The JavaScript Object Notation (JSON) Data Interchange Format. Retrieved from https://tools.ietf.org/html/rfc7159

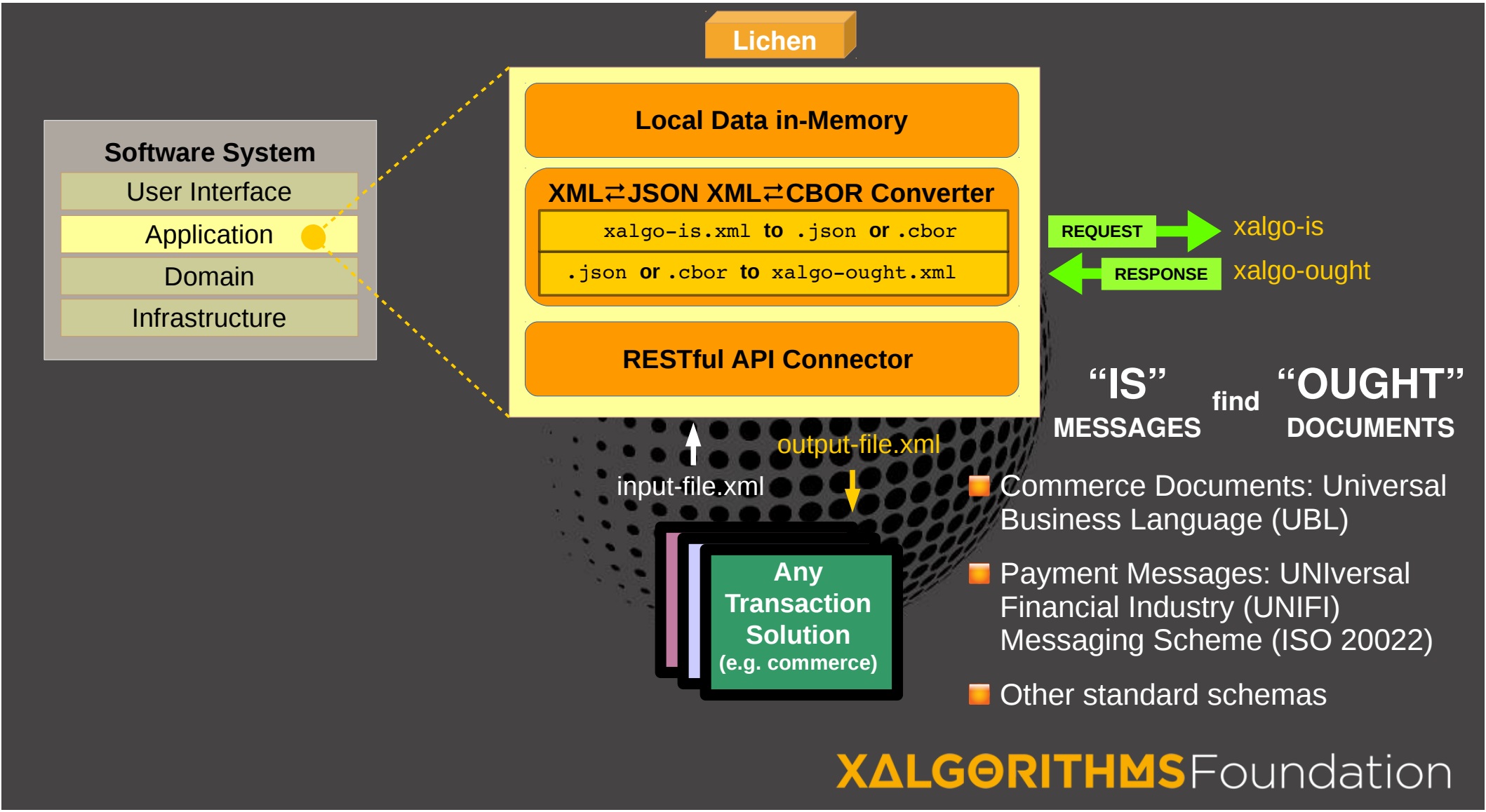
Bormann, C., & Hoffman, P. (2013). RFC 7049. Concise Binary Object Representation (CBOR). Retrieved from https://tools.ietf.org/html/rfc7049

Lichen (Xalgo Author)
Integrated Development Environment (IDE)



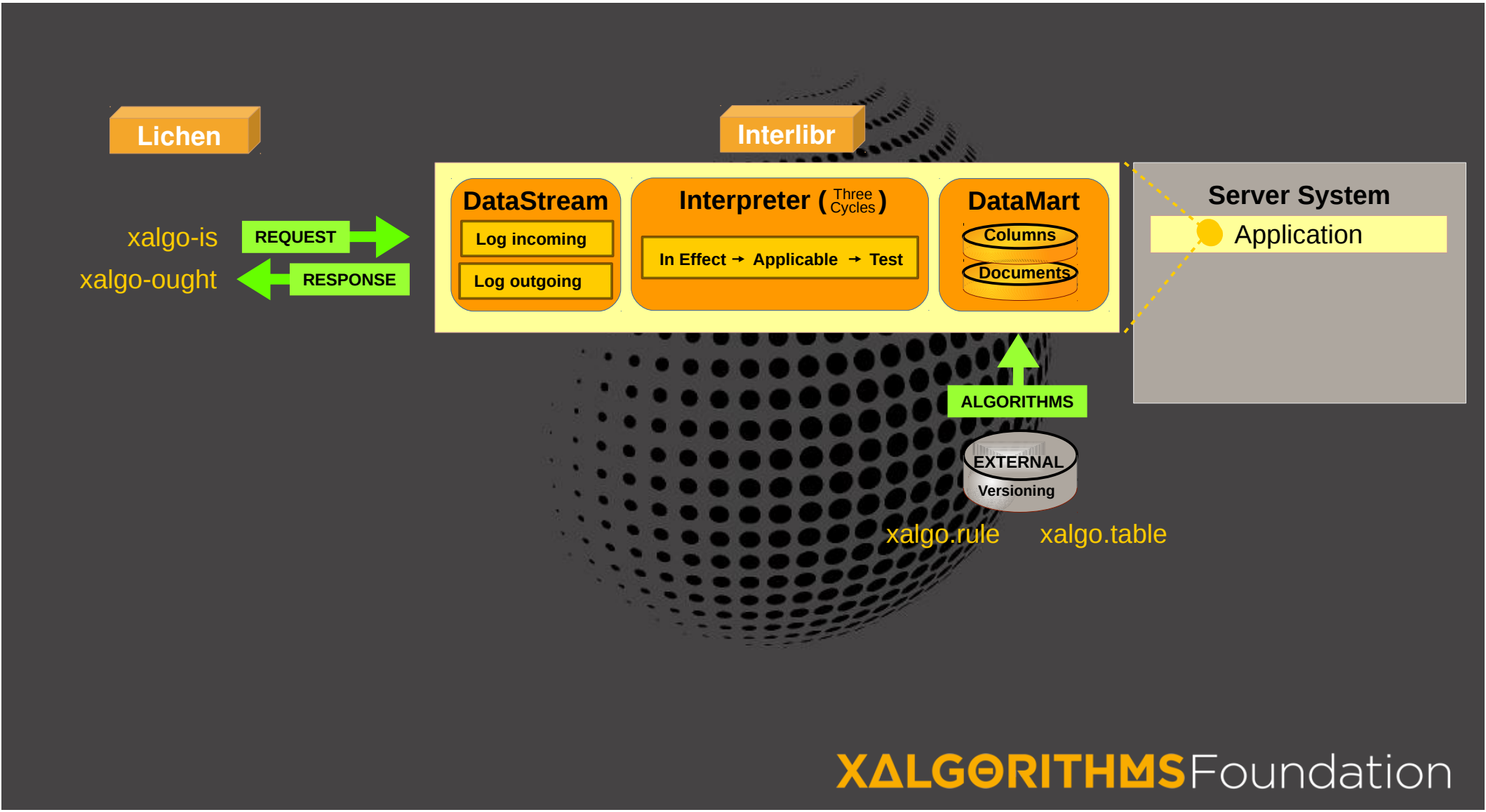
Lichen (Xalgo Messenger)

Optimize Pre-Event Data for High-Performance Request-Response



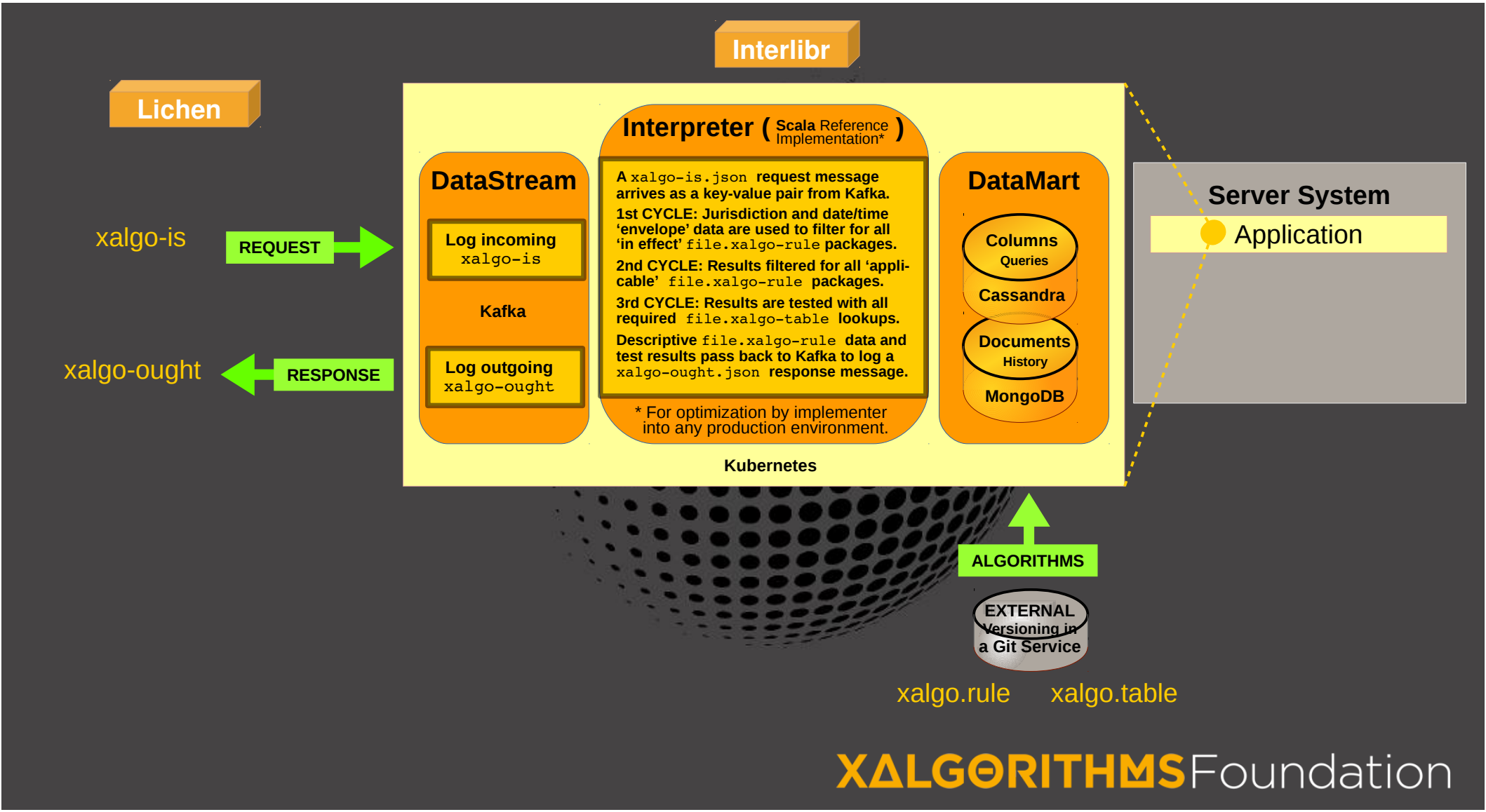
Interlibr

Request-Response Service is a sort of “Algorithms Search Engine”



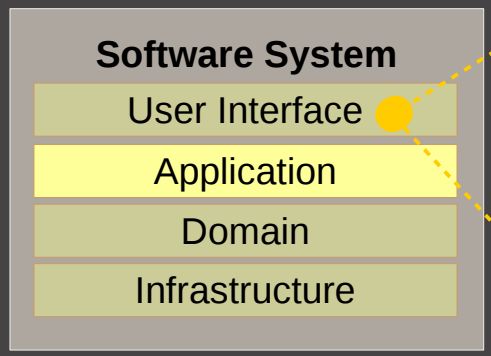
Interlibr

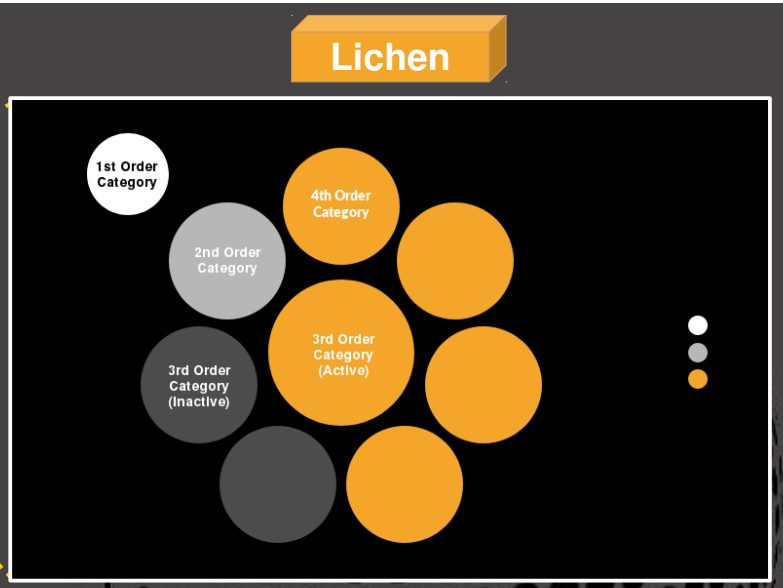
Request-Response Service is a sort of “Algorithms Search Engine”



Lichen (Results Interface)

Design Problem: How to Present Many Equally-Significant Categories?





Lichen's dynamic categories-oriented results interface compels simplicity through a 4±1 design constraint.

Maximums

4±1 new categories

4±1 clicks deep

4±1 hierarchical levels

Several Display Integration Options

2 × 4 × 2 × 5 = 80 categories

5 × 2 × 5 × 2 = 100 categories

3 × 4 × 3 × 4 = 144 categories

3 × 5 × 3 × 5 = 225 categories

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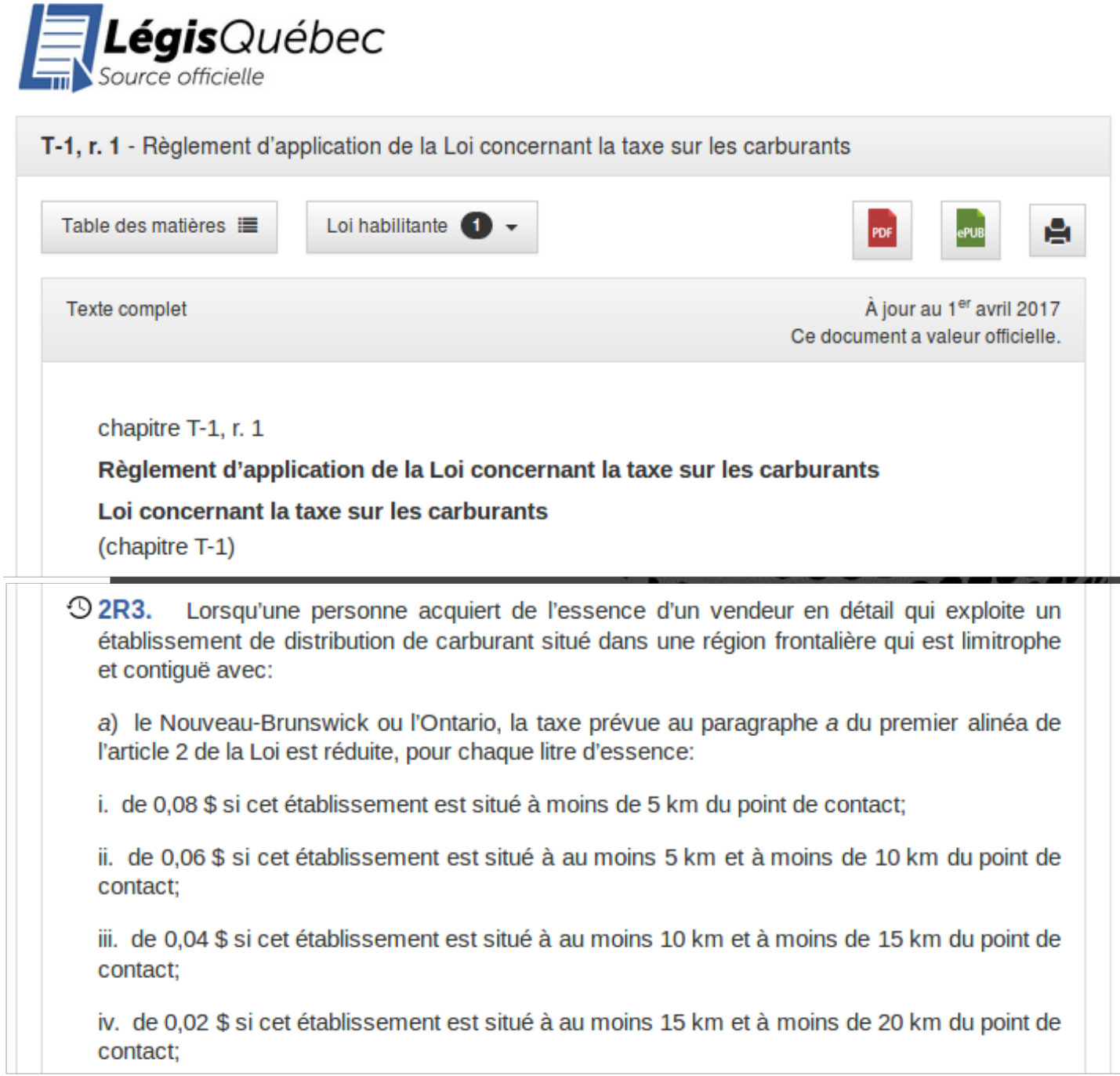
Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. Behavioral and Brain Sciences, 24(1), 87–114. https://doi.org/10.1017/S0140525X01003922

Mathy, F., & Feldman, J. (2012). What's magic about magic numbers? Chunking and data compression in short-term memory. Cognition, 122(3), 346–362. https://doi.org/10.1016/j.cognition.2011.11.003

A Sample Rule



LégisQuébec
Source officielle

T-1, r. 1 - Règlement d'application de la Loi concernant la taxe sur les carburants

Table des matières | Loi habilitante 1 | PDF | ePUB

Texte complet

À jour au 1er avril 2017
Ce document a valeur officielle.

chapitre T-1, r. 1

Règlement d'application de la Loi concernant la taxe sur les carburants

Loi concernant la taxe sur les carburants
(chapitre T-1)

2R3. Lorsqu'une personne acquiert de l'essence d'un vendeur en détail qui exploite un établissement de distribution de carburant situé dans une région frontalière qui est limitrophe et contiguë avec:

a) le Nouveau-Brunswick ou l'Ontario, la taxe prévue au paragraphe a du premier alinéa de l'article 2 de la Loi est réduite, pour chaque litre d'essence:

i. de 0,08 $ si cet établissement est situé à moins de 5 km du point de contact;

ii. de 0,06 $ si cet établissement est situé à au moins 5 km et à moins de 10 km du point de contact;

iii. de 0,04 $ si cet établissement est situé à au moins 10 km et à moins de 15 km du point de contact;

iv. de 0,02 $ si cet établissement est situé à au moins 15 km et à moins de 20 km du point de contact;

'Gas Tax' Reduction Based on Location

Québec. Section 2R3(a) de la Règlement d'application de la Loi concernant la taxe sur les carburants (chapter T-1, r. 1). Ministère de justice, Québec (MJQ). Recueil des lois et des règlements du Québec (RLRQ). "LégisQuébec".

http://legisquebec.gouv.qc.ca/fr/ShowDoc/cr/T-1,%20r.%201

A Sample Rule

A Multi-Year Collective Agreement

CANADA. Agreement between the Treasury Board and Professional Institute of the Public Service of Canada. Group: Computer Systems (Code: 303), Annex A. https://www.tbs-sct.gc.ca/agreements-conventions/view-visualiser-eng.aspx?id=1

**Appendix "A"

CS: Computer Systems Group annual rates of pay (in dollars)

Top of page

Table Legend

$) Effective December 22, 2013
A) Effective December 22, 2014
B) Effective December 22, 2015
X) Restructure effective April 1, 2016 (CS-01 to CS-04)
C) Effective December 22, 2016
D) Effective December 22, 2017

CS-01: annual rates of pay (in dollars)

Effective Date	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
$) December 22, 2013	53611	55593	57573	59541	61508	63474	65439	69088
A) December 22, 2014	54281	56288	58293	60285	62277	64267	66257	69952
B) December 22, 2015	54960	56992	59022	61039	63055	65070	67085	70826
X) Restructure effective April 1, 2016	55510	57562	59612	61649	63686	65721	67756	71534
C) December 22, 2016	56204	58282	60357	62420	64482	66543	68603	72428
D) December 22, 2017	56907	59011	61111	63200	65288	67375	69461	73333

A Sample Rule

Rates and Computation

ABSD Rates on the higher of the purchase price or market value

Profile of Buyer	ABSD Rates from 8 Dec 2011 to 11 Jan 2013	ABSD Rates from 12 Jan 2013
Singapore Citizens (SC)[1] buying first residential property	Not applicable	Not applicable
SC[1] buying second residential property	Not applicable	7%
SC[1] buying third and subsequent residential property	3%	10%
Singapore Permanent Residents (SPR)[1] buying first residential property	Not applicable	5%
SPR[1] buying second and subsequent residential property	3%	10%
Foreigners (FR) and entities[2] buying any residential property	10%	15%

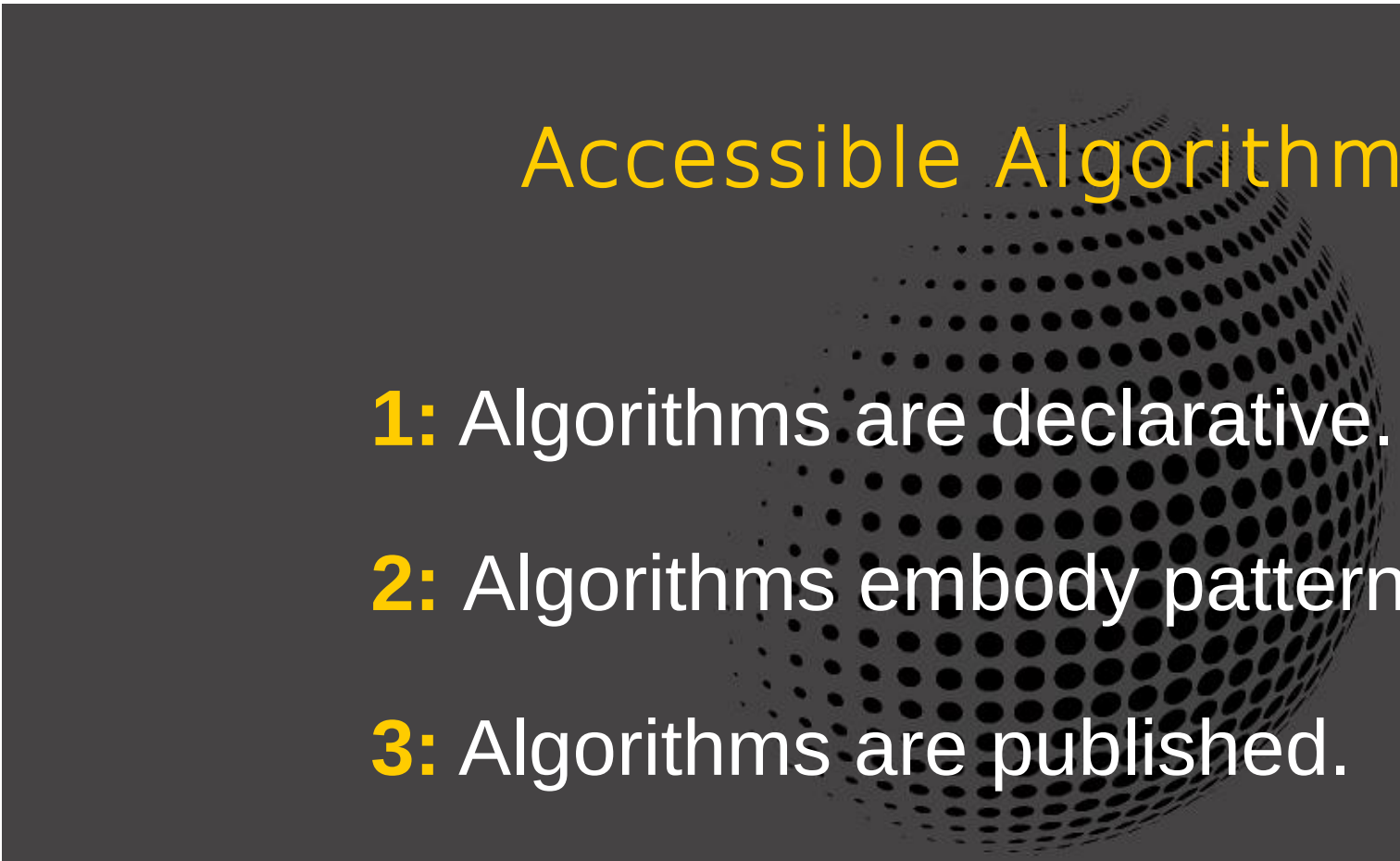
INLAND REVENUE AUTHORITY OF SINGAPORE

A Stamp Duty on Real Property Purchases, based on Identity and Asset Ownership

Additional Buyer's Stamp Duty (ABSD) on Real Property Purchases, Inland Revenue Authority of Singapore. https://www.iras.gov.sg/irashome/Other-Taxes/Stamp-Duty-for-Property/Working-out-your-Stamp-Duty/Buying-or-Acquiring-Property/What-is-the-Duty-that-I-Need-to-Pay-as-a-Buyer-or-Transferee-of-Residential-Property/Additional-Buyer-s-Stamp-Duty--ABSD-1

Xalgo Target Design Principles

Accessible Algorithms



1: Algorithms are declarative.

2: Algorithms embody patterns.

3: Algorithms are published.

4: Algorithms are simple.

Xalgo Functions

WHEN: Specify the facts that invoke the given rule's algorithm with certainty.

REQUIRE: Preload a specific table before executing this rule.

ASSEMBLE: Construct a dynamic in-memory table from preloaded, computed or provided document data.

REFINE: Combined FILTER, MAP and REDUCE process as follows:

FILTER: Remove rows from the computation before applying MAP assignments.

MAP: Update or add column keys on a per-row basis.

TAKE: Prune rows from the table after modifications have occurred.

KEEP: Retain the virtual table until the next modifying statement.

REVISE: Specify a particular permanent change to the indicated data.

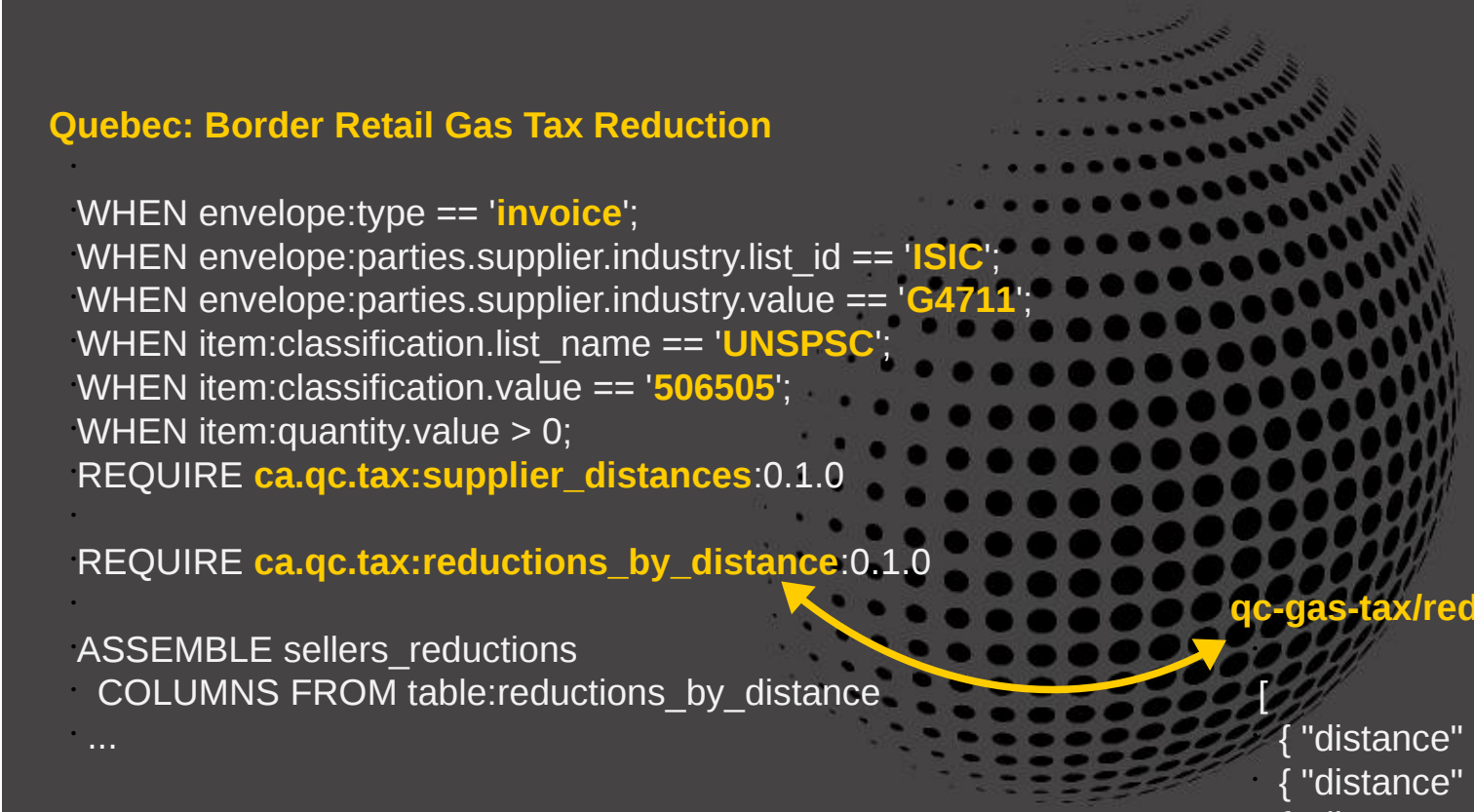
Declarative. Published. Patterned. Simple.

Quebec: Border Retail Gas Tax Reduction

```
WHEN envelope:type == 'invoice';
WHEN envelope:parties.supplier.industry.list_id == 'ISIC';
WHEN envelope:parties.supplier.industry.value == 'G4711';
WHEN item:classification.list_name == 'UNSPSC';
WHEN item:classification.value == '506505';
WHEN item:quantity.value > 0;
REQUIRE ca.qc.tax:supplier_distances:0.1.0

REQUIRE ca.qc.tax:reductions_by_distance:0.1.0

ASSEMBLE sellers_reductions
  COLUMNS FROM table:reductions_by_distance
  ...
```



qc-gas-tax/reductions_by_distance.json

```
[
  { "distance" : 20, "reduction" : 0.00 },
  { "distance" : 15, "reduction" : 0.02 },
  { "distance" : 10, "reduction" : 0.04 },
  { "distance" : 5, "reduction" : 0.06 }
  { "distance" : 0, "reduction" : 0.08 }
]
```

Quebec: Border Retail Gas Tax Reduction

```
WHEN envelope:type == 'invoice';
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WHEN envelope:parties.supplier.industry.value == 'G4711';
WHEN item:classification.list_name == 'UNSPSC';
WHEN item:classification.value == '506505';
WHEN item:quantity.value > 0;
REQUIRE ca.qc.tax:supplier_distances:0.1.0

REQUIRE ca.qc.tax:reductions_by_distance:0.1.0

ASSEMBLE sellers_reductions
  COLUMNS FROM table:reductions_by_distance
...
```

Canada: CS Group 303 Annual Rates of Pay

```
WHEN envelope:type == 'payment_authorization';
WHEN envelope:parties.supplier.industry.list_id == 'ISIC';
WHEN envelope:parties.supplier.industry.value == 'S9420';
WHEN item:classification.list_name == 'UNSPSC';
WHEN item:classification.value == '81111***';
WHEN item:quantity.value > 0;
REQUIRE ca..payroll:cs-group303_base-
  pay_by_contract:0.1.0
REQUIRE ca..payroll:cs-group303_base-pay_by_years-
  service:0.1.0
ASSEMBLE employees_base-pay
  COLUMNS FROM table:cs-group303_base-pay_by_contract
...
```

Quebec: Border Retail Gas Tax Reduction

```
WHEN envelope:type == 'invoice';
WHEN envelope:parties.supplier.industry.list_id == 'ISIC';
WHEN envelope:parties.supplier.industry.value == 'G4711';
WHEN item:classification.list_name == 'UNSPSC';
WHEN item:classification.value == '506505';
WHEN item:quantity.value > 0;
REQUIRE ca.qc.tax:supplier_distances:0.1.0

REQUIRE ca.qc.tax:reductions_by_distance:0.1.0

ASSEMBLE sellers_reductions
  COLUMNS FROM table:reductions_by_distance
...
```

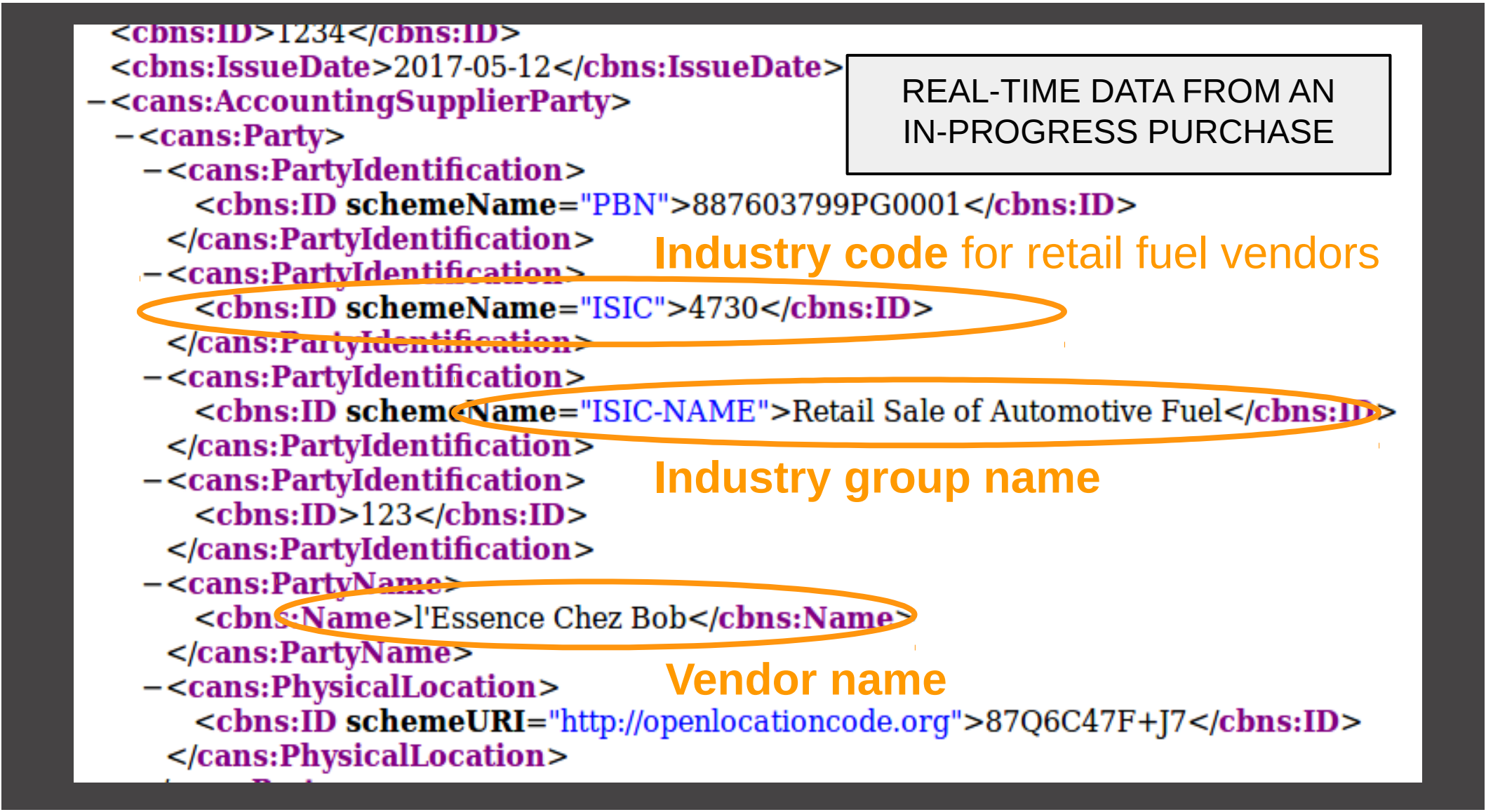
Singapore: Additional Buyers' Stamp Duty

```
WHEN envelope:type == 'option-to-purchase';
WHEN envelope:parties.buyer.industry.list_id == 'ISIC';
WHEN envelope:parties.buyer.industry.value == 'L6810';
WHEN item:classification.list_name == 'UNSPSC';
WHEN item:classification.value == '80131600';
WHEN item:quantity.value > 0;
REQUIRE sg..tax:buyer_profiles:0.1.1;

REQUIRE sg..tax:rates_by_profile:0.1.1;

ASSEMBLE buyers_rates
  COLUMNS FROM table:rates_by_profile
...
```

Event Data Source: UBL Invoice, Any Platform



Round-Trip: Completed UBL Invoice, Any Platform

```
<cbns:BaseUnitMeasure unitCode="LTR">1</cbns:BaseUnitMeasure>
<cbns:PerUnitAmount currencyID="CAD">-0.04</cbns:PerUnitAmount>
-<cans:TaxCategory>
 -<cans:TaxScheme>
   <cbns:ID>QUEBEC_BORDER_GAS_TAX_REDUCTION</cbns:ID>
   <cbns:Name>Québec Border Gas Tax Reduction</cbns:Name>
  </cans:TaxScheme>
 </cans:TaxCategory>
</cans:TaxSubtotal>
</cans:TaxTotal>
-<cans:Item>
 <cbns:Description>Regular Gas</cbns:Description>
 -<cans:CommodityClassification>
   <cbns:ItemClassificationCode listName="UNSPSC">506505</cbns:ItemClassificationCode>
 </cans:CommodityClassification>
 -<cans:AdditionalItemProperty>
   <cbns:ID>UNSPSC-NAME</cbns:ID>
   <cbns:Name languageID="EN">Gasoline and Petrol</cbns:Name>
 </cans:AdditionalItemProperty>
</cans:Item>
-<cans:Price>
 <cbns:PriceAmount currencyID="CAD">1.00</cbns:PriceAmount>
 <cbns:BaseQuantity unitCode="LTR">1</cbns:BaseQuantity>
</cans:Price>
```

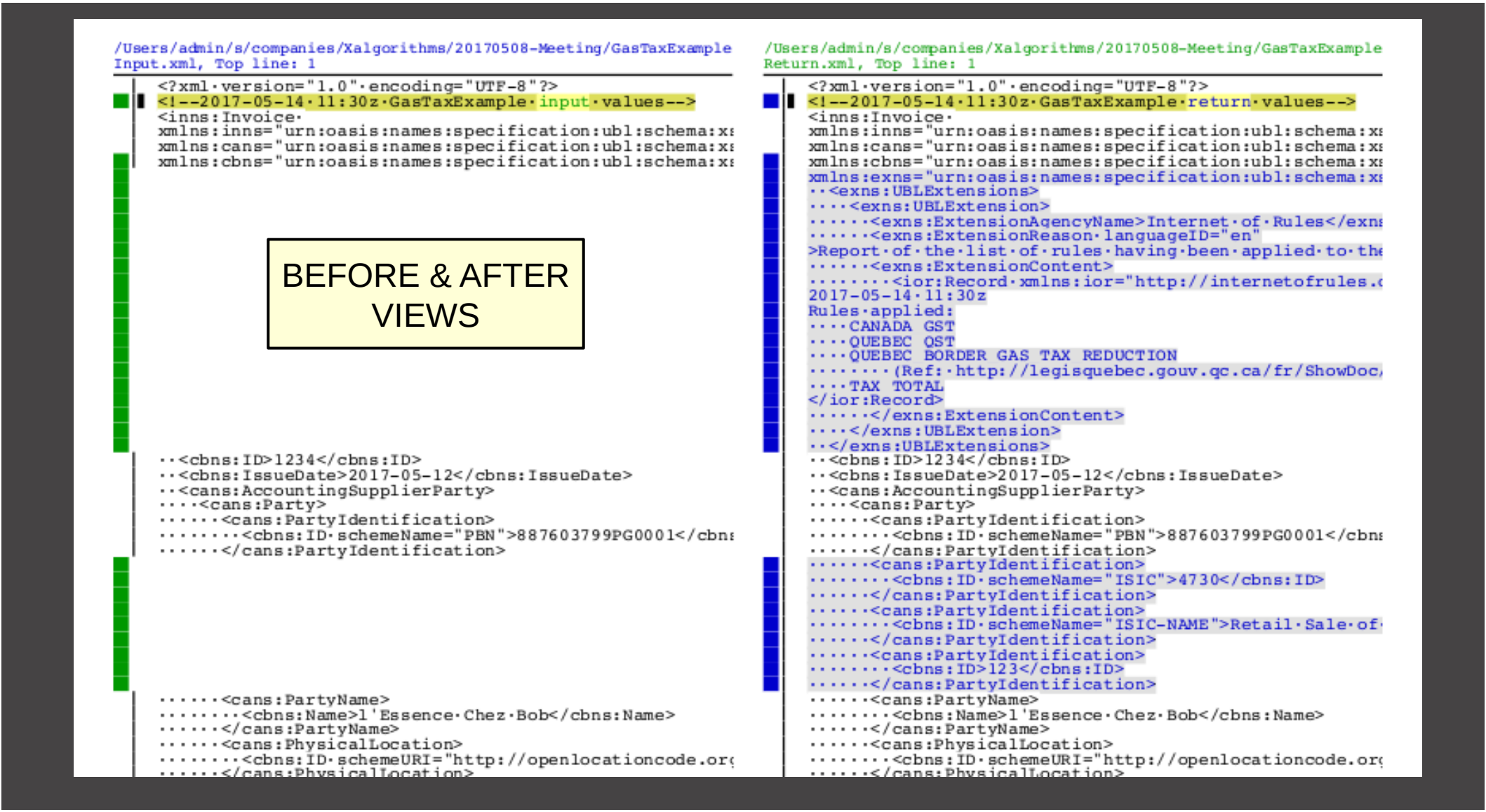
Tax Reduction

Rule name

DATA RETURNED
IN XML (UBL SCHEMA)

Product group name

If the Parties Choose to Use the Results



Ultimately, Who Rules?
The Algorithm Manager or the Operations Manager?

TOWARDS A FRAMEWORK OF WEIGHTED OPTIONS

Who can/should/shall override whom?
Under what circumstances?
Based on what criteria?
How can this be ensured?

Rule source (de jure authority and/or de facto origins)

Rule subjectivity (degree of commitment)

Rule strength (gravity of non-compliance)

Ultimately, Who Rules?
The Algorithm Manager or the Operations Manager?

Prioritize
Operations Manager Agency

EMPOWERING STATEMENT

To the extent the algorithm is not fulfilling a given requirement, the operations manager:

can
should
shall

...override the algorithm manager and take control.

Prioritize
Algorithm Manager Agency

EMPOWERING STATEMENT

To the extent the operations manager is not fulfilling a given requirement, the algorithm manager:

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Ultimately, Who Rules?
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Prioritize
Operations Manager Agency

CONSTRAINING STATEMENT

To the extent the operations manager is fulfilling a given requirement, the algorithm manager:
cannot
should not
shall not
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Prioritize
Algorithm Manager Agency

CONSTRAINING STATEMENT

To the extent the algorithm manager is fulfilling a given requirement, the operations manager:
cannot
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...override the algorithm manager and take control.

Ultimately, Who Rules?
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Prioritize
Operations Manager Agency

DELEGATING STATEMENT

The operations manager may voluntarily delegate control to the algorithm manager:
pro-actively
upon request.

Prioritize
Algorithm Manager Agency

DELEGATING STATEMENT

The algorithm manager may voluntarily delegate control to the operations manager:
pro-actively
upon request.

Ultimately, Who Rules?
The Algorithm Manager or the Operations Manager?

POTENTIAL CRITERIA FOR INTERVENTION OR DELEGATION

Better attainment

Effectiveness

Efficiency

Sequence (in order to proceed)

Information (in order to proceed)

Priority of rules (defeasible logic)

Mandate (modal logic)

Alpha Testing Now

https://github.com/Xalgorithms

Video demo... https://tinyurl.com/yym4pgwd

Wrap-Up

Questions

General Framework:

- What conceptual map can illustrate RuleML vis-à-vis IoR functions?
- How might complementarity between IoR and RuleML be described?

Synergies:

- Can an IoR expedite the achievement of RuleML community goals?
- What challenges does RuleML face that an IoR may help to overcome?

Issues/Incongruities:

- Does any aspect of this overview seem incongruous with RuleML?
- Are there any apparent conceptual/technical/practical errors-omissions?

Experimentation:

- What exploratory projects might be useful over the next year?
- What challenges would the RuleML community put to IoR designers?