Beyond Classical SERVICE Clause in Federated SPARQL Queries: Leveraging the Full Potential of URI Parameters

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Context

- Semantic Web
  - RDF, SPARQL
- SPARQL Endpoint
  - http://dbpedia.org/sparql
- Federated SPARQL Query
  - select * where {
      service <http://dbpedia.org/sparql> { ?s ?p ?o }
    }

SPARQL Service URL Parameter   2

Problem

- Federated SPARQL Query processing on the World *Wild* Web is not a piece of cake
- Endpoint may not be SPARQL 1.1 compliant
- may not accept too many service binding values
- may not respond
- may not implement correctly GET or POST
- etc.

SPARQL Service URL Parameter   3

Problem

- There is no way to tune service processing in SPARQL, neither on the client nor on the server

SPARQL Service URL Parameter   4

Contribution

1. Tune service processing with URL parameters
2. SPARQL service extension
3. Communication model for SPARQL client-server

SPARQL Service URL Parameter   5

Client Side

SPARQL Client tune HTTP request

- **method**=get | post
- **header**=name:value
- **format**=xml | json
- **timeout**=2718

SPARQL Service URL Parameter   6

Example

```
select * where {
    service <http://corese.inria.fr/sparql?
        method=get&format=json> {
        ?s rdfs:label ?o
    }
}
```

SPARQL Service URL Parameter   7

Client Side

SPARQL Client tune service processing

- **default-graph**=uri&**named-graph**=uri
- **binding**=values|filter
- **slice**=25
- **limit**=100
- **mode**=debug

SPARQL Service URL Parameter   8

Example

```
select * where {
    ?s a foaf:Person
    service <http://corese.inria.fr/sparql?
        slice=20&binding=values> {
        ?s rdfs:label ?o
    }
}
```

SPARQL Service URL Parameter   9

Server Side

- **mode**=log | debug
- **format**=xml | json
- **mode**=link&**transform**=xml

SPARQL Service URL Parameter   10

Federated Endpoint

- Federated query: request several sparql endpoints
- Federated endpoint: associate URL to sparql endpoints URL list
  - http://corese.inria.fr/d2kab/federate ::= URL1 .. URLn
  - SPARQL HTTP request on this URL call federated engine

SPARQL Service URL Parameter   11

Federation Definition

<http://corese.inria.fr/d2kab/federate> a
st:Federation ;
   rdfs:label "d2kab" ;
   st:definition (
<https://ico.iate.inra.fr/fuseki/annotation/query>
<https://ico.iate.inra.fr/fuseki/ontology/query>
<http://taxref-graphdb.i3s.unice.fr/repositories/geco>
).

SPARQL Service URL Parameter   12

SPARQL endpoint fédéré d2kab

<http://corese.inria.fr/d2kab/federate> a st:Federation ;
st:definition (
<http://147.100.179.235:8082/blazegraph/namespace/AnaEE_sites/sparql>
<https://ico.iate.inra.fr/fuseki/annotation/query>
<https://ico.iate.inra.fr/fuseki/ontology/query>
<http://taxref-graphdb.i3s.unice.fr/repositories/geco>
<http://quantum.agroparistech.fr/graphdb/repositories/Composite_making_process>
<http://ontology.irstea.fr/ppdo/sparql>
<https://opendata.inra.fr/openrdf-sesame/repositories/Ahol>
<http://agrold.southgreen.fr/sparql>
<http://ontology.irstea.fr/bsv/sparql>
<http://ontology.irstea.fr/weather/sparql>
<http://ontology.inrae.fr/frenchcropusage/sparql>
<http://sparql.agroportal.lirmm.fr/sparql/>).

Requête fédérée   13

Requête fédérée d2kab

```
select distinct ?crop ?lbl ?scale ?stade where {
service <http://corese.inria.fr/d2kab/federate> {
  ?dummy skos:prefLabel "arboriculture"@fr .
  ?dummy skos:narrower+ ?crop .
  ?crop  skos:prefLabel ?lbl .
  ?topc fcu:relatedCrop   ?crop .
  ?scale skos:hasTopConcept ?topc .
  ?topc  skos:narrower     ?stade .
  filter (regex(?scale), "bbch")) }
}
order by?stade
```

Requête fédérée   14

Source Selection

```
select * where {
values (?serv ) {
  (<http://147.100.179.235:8082/blazegraph/namespace/AnaEE_sites/sparql> )
  (<https://ico.iate.inra.fr/fuseki/annotation/query> )
  (<https://ico.iate.inra.fr/fuseki/ontology/query> )
  (<http://taxref-graphdb.i3s.unice.fr/repositories/geco> )
  (<http://quantum.agroparistech.fr/graphdb/repositories/Composite_making_process>)
  (<http://ontology.irstea.fr/ppdo/sparql> )
  (<https://opendata.inra.fr/openrdf-sesame/repositories/Ahol> )
  (<http://agrold.southgreen.fr/sparql> )
  (<http://ontology.irstea.fr/bsv/sparql> )
  (<http://ontology.irstea.fr/weather/sparql> )
  (<http://ontology.inrae.fr/frenchcropusage/sparql> )
  (<http://sparql.agroportal.lirmm.fr/sparql/> )}}
service ?serv {
  bind (exists {?s skos:prefLabel ?o . } as ?b0)
  bind (exists {?s skos:narrower ?o . } as ?b1)
  bind (exists {?s fcu:relatedCrop ?o . } as ?b2)
  bind (exists {?s skos:hasTopConcept ?o . } as ?b3)
  bind (exists {?dummy skos:prefLabel 'arboriculture'@fr . } as ?b4)
}}
```

Requête fédérée   15

Source Selection Result

http://147.100.179.235:8082/blazegraph/namespace/AnaEE_sites/sparql		true		false	
false	false	false			
http://agrold.southgreen.fr/sparql	1	0	0	0	0
http://ontology.inrae.fr/frenchcropusage/sparql	true	true	false	true	true
http://ontology.irstea.fr/bsv/sparql	true	true	false	true	true
http://ontology.irstea.fr/ppdo/sparql	true	true	true	true	false
http://ontology.irstea.fr/weather/sparql	false	false	false	false	false
http://quantum.agroparistech.fr/graphdb/repositories/Composite_making_process					true
false	false	false	false		
http://taxref-graphdb.i3s.unice.fr/repositories/geco		true	false	false	false
false					
https://ico.iate.inra.fr/fuseki/annotation/query	false	false	false	false	false
https://ico.iate.inra.fr/fuseki/ontology/query	true	false	false	false	false
https://opendata.inra.fr/openrdf-sesame/repositories/Ahol		false	false	false	false
false	false				

Requête fédérée   16

Requête fédérée réécrite

```
select * where {
service <http://ontology.irstea.fr/bsv/sparql> <http://ontology.inrae.fr/frenchcropusage/sparql> {
  ?dummy skos:prefLabel 'arboriculture'@fr . }
service <http://ontology.irstea.fr/ppdo/sparql> <http://ontology.irstea.fr/bsv/sparql>
  <http://ontology.inrae.fr/frenchcropusage/sparql> {
  ?dummy (skos:narrower)+ ?crop   }
service <http://147.100.179.235:8082/blazegraph/namespace/AnaEE_sites/sparql>
  <https://ico.iate.inra.fr/fuseki/ontology/query> <http://taxref-graphdb.i3s.unice.fr/repositories/geco>
  <http://quantum.agroparistech.fr/graphdb/repositories/Composite_making_process>
  <http://ontology.irstea.fr/ppdo/sparql> <http://agrold.southgreen.fr/sparql>
  <http://ontology.irstea.fr/bsv/sparql> <http://ontology.inrae.fr/frenchcropusage/sparql> {
  ?crop skos:prefLabel ?lbl . }
service <http://ontology.irstea.fr/ppdo/sparql> {
  ?topc fcu:relatedCrop ?crop . }
service <http://ontology.irstea.fr/ppdo/sparql>
  <http://ontology.irstea.fr/bsv/sparql> <http://ontology.inrae.fr/frenchcropusage/sparql> {
  ?scale skos:hasTopConcept ?topc .
  filter regex(str(?scale), 'bbch') }
service <http://ontology.irstea.fr/ppdo/sparql> <http://ontology.irstea.fr/bsv/sparql>
  <http://ontology.inrae.fr/frenchcropusage/sparql> {
  ?topc skos:narrower ?stade . }
}
```

Requête fédérée   17

Mode Explication

```
select distinct ?crop ?lbl ?scale ?stade where {
service <http://corese.inria.fr/d2kab/federate?mode=why> {
  ?dummy skos:prefLabel "arboriculture"@fr .
  ?dummy skos:narrower+ ?crop .
  ?crop  skos:prefLabel ?lbl .
  ?topc fcu:relatedCrop   ?crop .
  ?scale skos:hasTopConcept ?topc .
  ?topc  skos:narrower     ?stade .
  filter (regex(?scale), "bbch")) }
}
order by?stade
```

Requête fédérée   18
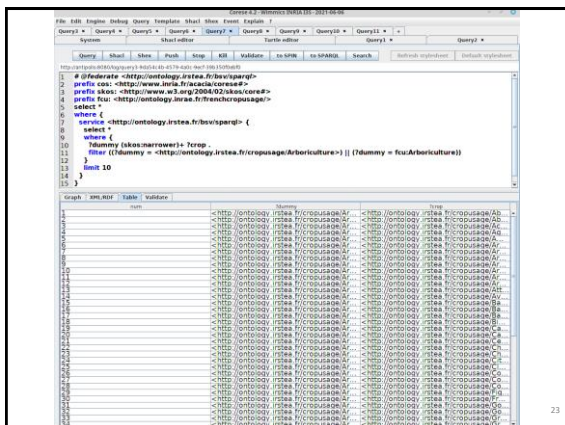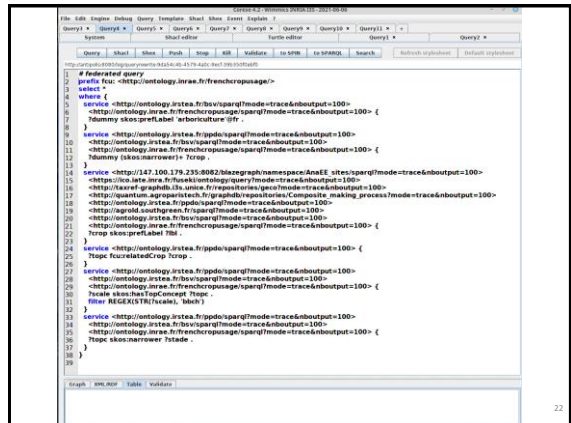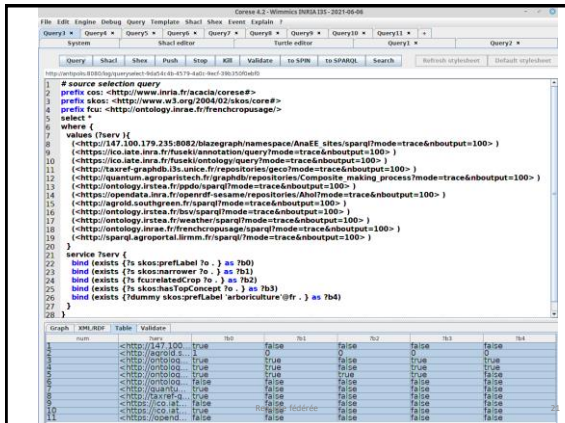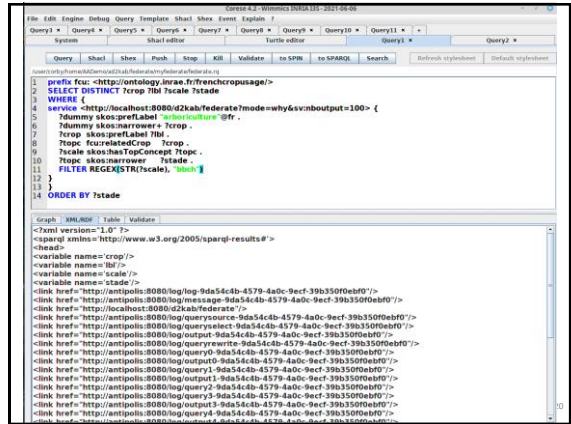
3

Mode Explication

Query Result augmenté avec Linked Result

1. Requête source selection
2. Requête fédérée réécrite
3. Requêtes et résultats intermédiaires

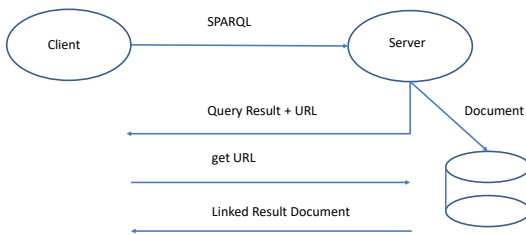GUI montre toutes ces informations

Extended Service

- SPARQL Query + Result post processing
  - Apply **Transformation** to Query Results
- Return Query Results with **Linked Result**
  - Transformation Result saved in a document
  - Query Results provided with link URL to document

SPARQL Service URL Parameter   24

Extended Service

Client — SPARQL → Server

Query Result + URL

get URL

Linked Result Document

Document

SPARQL Service URL Parameter 25

Extended Service Example

Generate a map when query results contain location data

- /sparql?**mode**=link&**transform**=map&**query**=

Generate additionnal json format

- /sparql?**mode**=link&**transform**=json&**query**=

SPARQL Service URL Parameter 26

Map Service

```
prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
select * where {
service
<http://corese.inria.fr/sparql?mode=link&transform=st:map> {
    service <http://fr.dbpedia.org/sparql> {
        ?location geo:lat ?lat ; geo:long ?lon } }
}
 values ?location {
     <http://fr.dbpedia.org/resource/Antibes>
     <http://fr.dbpedia.org/resource/Marseille>
     <http://fr.dbpedia.org/resource/Montpellier>
     <http://fr.dbpedia.org/resource/Paris>
}
```

SPARQL Service URL Parameter 27

Map Service Query Result

```
<?xml version="1.0" ?>
<sparql xmlns='http://www.w3.org/2005/sparql-results#'>
<head>
<variable name='location'/>
<variable name='lat'/>
<variable name='lon'/>
<link href="http://corese.inria.fr/log/mapper-c5ebc09d-91d9-440e-b34c-9e0cca7e0768"/>
</head>
<results>
<result>
<binding name='location'><uri>http://fr.dbpedia.org/resource/Antibes</uri></binding>
<binding name='lat'><literal
datatype='http://www.w3.org/2001/XMLSchema#float'>43.5808</literal></binding>
<binding name='lon'><literal
datatype='http://www.w3.org/2001/XMLSchema#float'>7.12389</literal></binding>
</result>
…
</results>
```
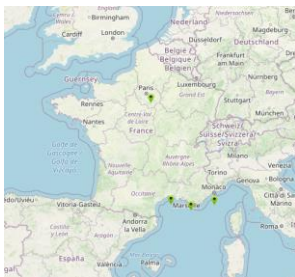
SPARQL Service URL Parameter 28

Map Service Linked Result

http://corese.inria.fr/log/mapper-c5ebc09d...

SPARQL Service URL Parameter 29

Define mode parameters

- mode map ::=
  mode=link&transform=map

SPARQL Service URL Parameter 30

5

Mode map

```
prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
select * where {
service <http://corese.inria.fr/sparql?mode=map> {
    service <http://fr.dbpedia.org/sparql> {
      ?location geo:lat ?lat ; geo:long ?lon } }
}
 values ?location {
    <http://fr.dbpedia.org/resource/Antibes>
    <http://fr.dbpedia.org/resource/Paris>
    <http://fr.dbpedia.org/resource/Marseille>
    <http://fr.dbpedia.org/resource/Montpellier>
}
```

SPARQL Service URL Parameter 31

Client-Server Communication Model

- SPARQL client use service URL parameters

- SPARQL server return Query Results with Linked Result URL referencing message (json or turtle)

SPARQL Service URL Parameter 32

Client-Server Communication Model

- Message content:
  - platform, version, system
  - execution time, date
  - information about dataset: graph size, etc.
  - explanation (failure, etc.)
  - follow up results
  - follow up query
  - application oriented additional data

SPARQL Service URL Parameter 33

Message

```
select * where {
 service
<http://corese.inria.fr/sparql?mode=message> {
   select * where {
    ?x ?p ?y
   }
   limit 10
 }
}
```

SPARQL Service URL Parameter 34

Message Query Result

```
<?xml version="1.0" ?>
<sparql xmlns='http://www.w3.org/2005/sparql-results#'>
<head>
<variable name='x'/>
<variable name='p'/>
<variable name='y'/>
<link href="http://corese.inria.fr/log/message-834a00fb"/>
</head>
```

SPARQL Service URL Parameter 35

Message Linked Result

```
{"mode":["message"],
"remoteHost":"XX.YYY.108.121",
"date":"2021-09-24T10:26:57",
"request":"Request(POST //corese.inria.fr/sparql)@71bba0ad",
"query":"select * \nwhere {\n ?x ?p ?y . \n}\nlimit 10 ",
"header":{"Accept":"application/sparql-
results+xml,application/rdf+xml",
"User-Agent":"Jersey/2.27 (HttpUrlConnection 11)",
"Connection":"keep-alive",
"Host":"corese.inria.fr",
"Content-Length":"80",
"Content-Type":"application/x-www-form-urlencoded"}
```

SPARQL Service URL Parameter 36

Implementation

- Implemented in the Corese platform
  - https://project.inria.fr/corese/
- French ANR D2KAB project
  - https://d2kab.mystrikingly.com/

SPARQL Service URL Parameter 37

Conclusion

- A model for tuning service processing
- Using URL parameters to specify tuning
- SPARQL service extension
  - Query Results Transformation & Linked Result
- Communication model for SPARQL client-server

SPARQL Service URL Parameter 38

Perspective

- Towards model and vocabulary for SPARQL service tuning and extension
- Predefined extended SPARQL services
  - Map, Graphic, etc.

SPARQL Service URL Parameter 39