GLOBAL
BIODIVERSITY
INFORMATION
FACILITY

Biodiversity
Information
Standards
TDWG

Key Enabling Technologies - Transfer Protocols

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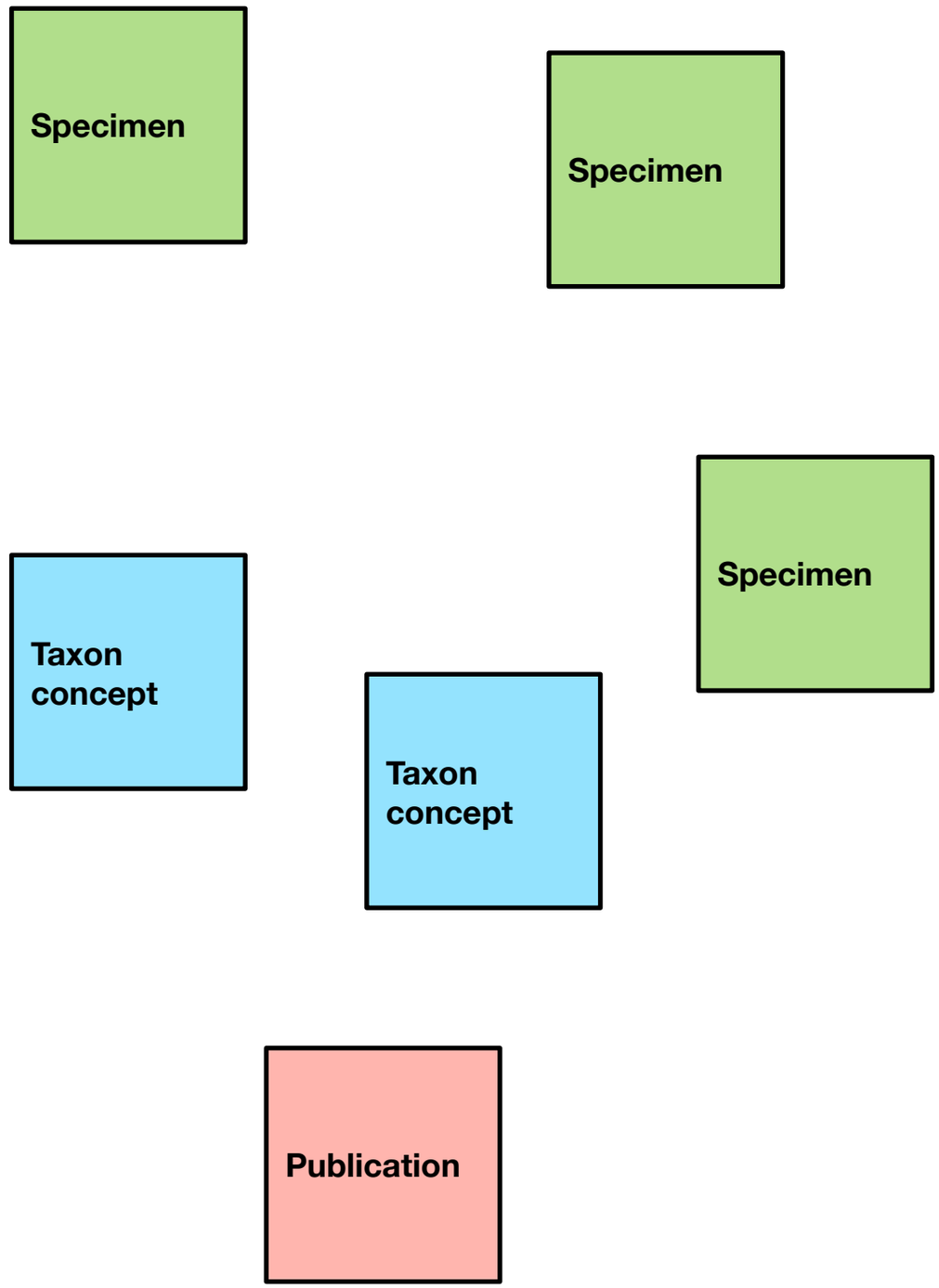
TDWG architecture - three core abilities

1. Construct data objects to model objects and concepts in biodiversity informatics
    - This is the role of the TDWG data standards
    - Standards being recast as reusable (LSID) vocabularies to simplify reuse



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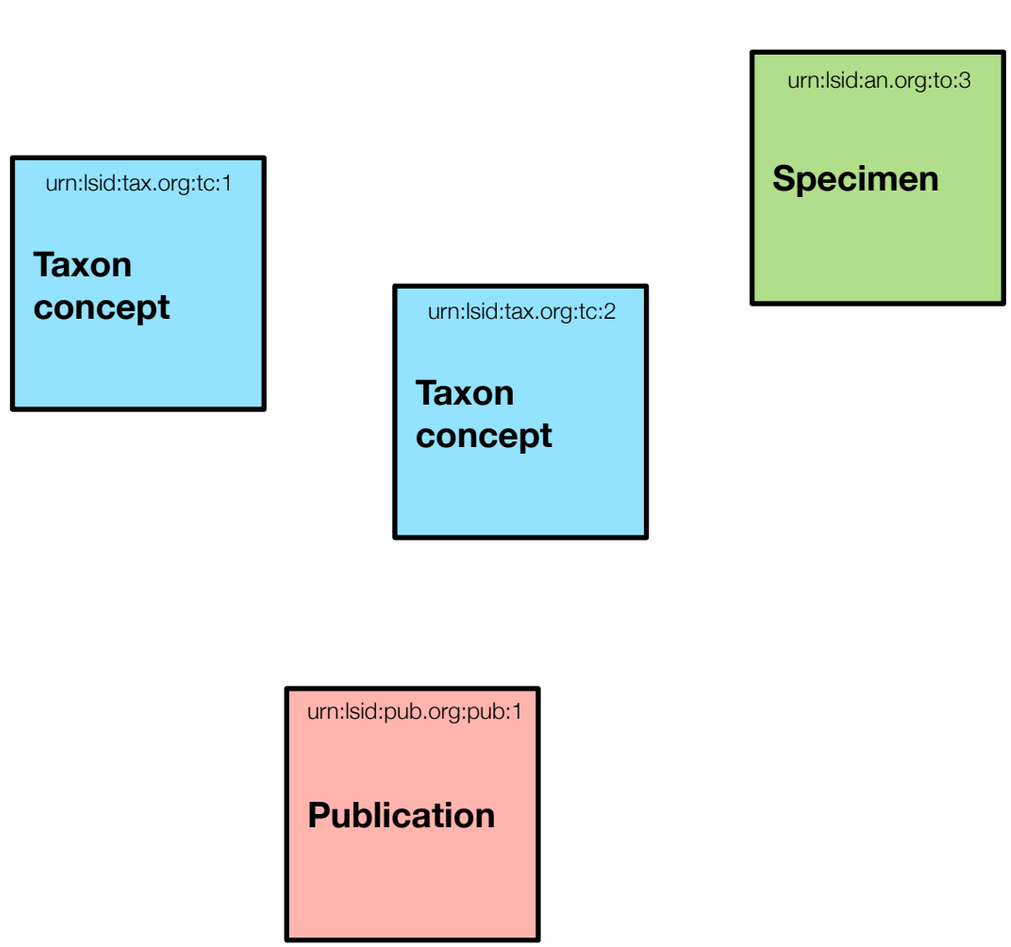
   - This is the role of globally unique identifiers (GUIDs)
   - TDWG has adopted Life Science Identifiers (LSIDs) - compatible with the TDWG vocabularies



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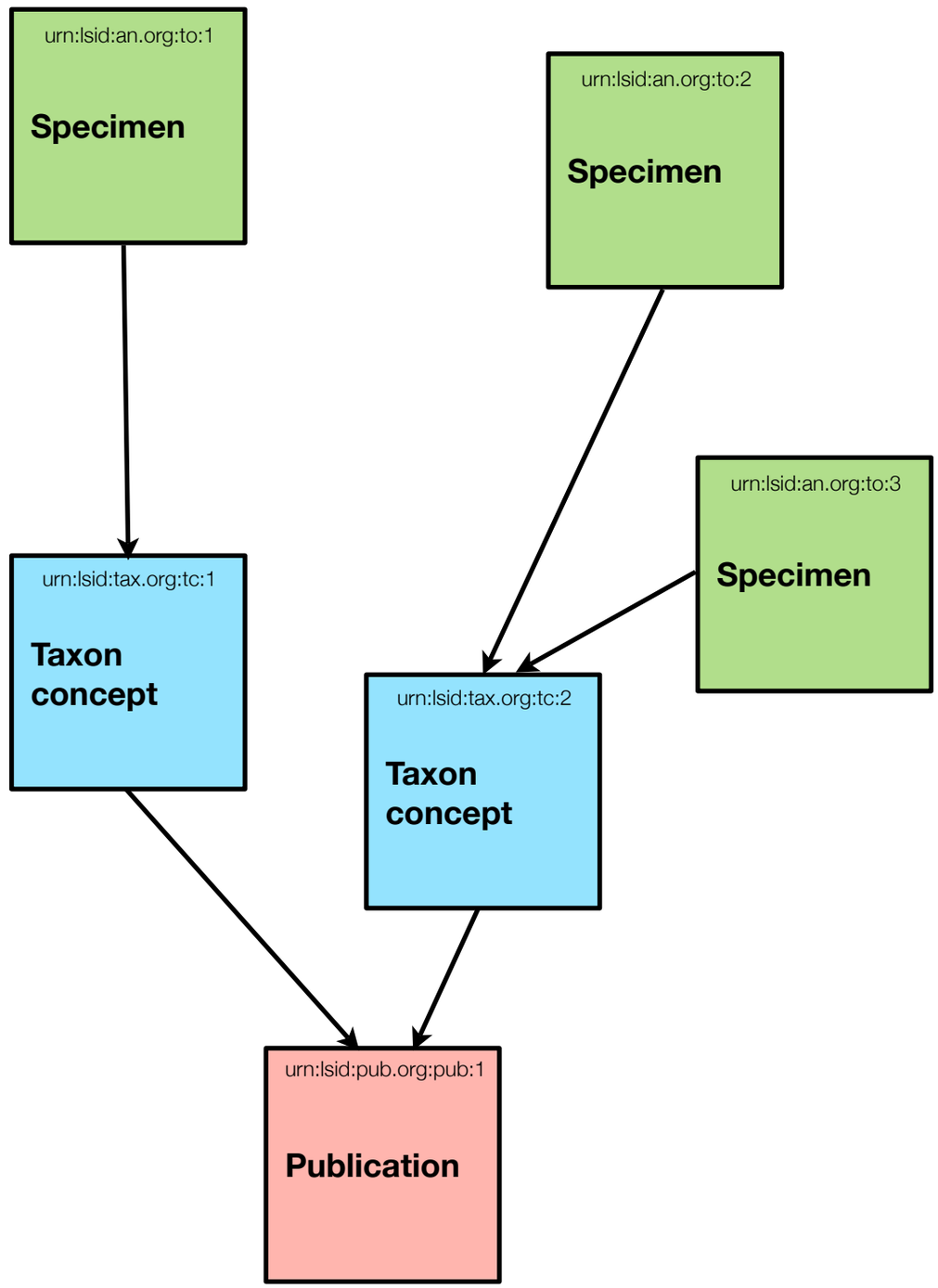

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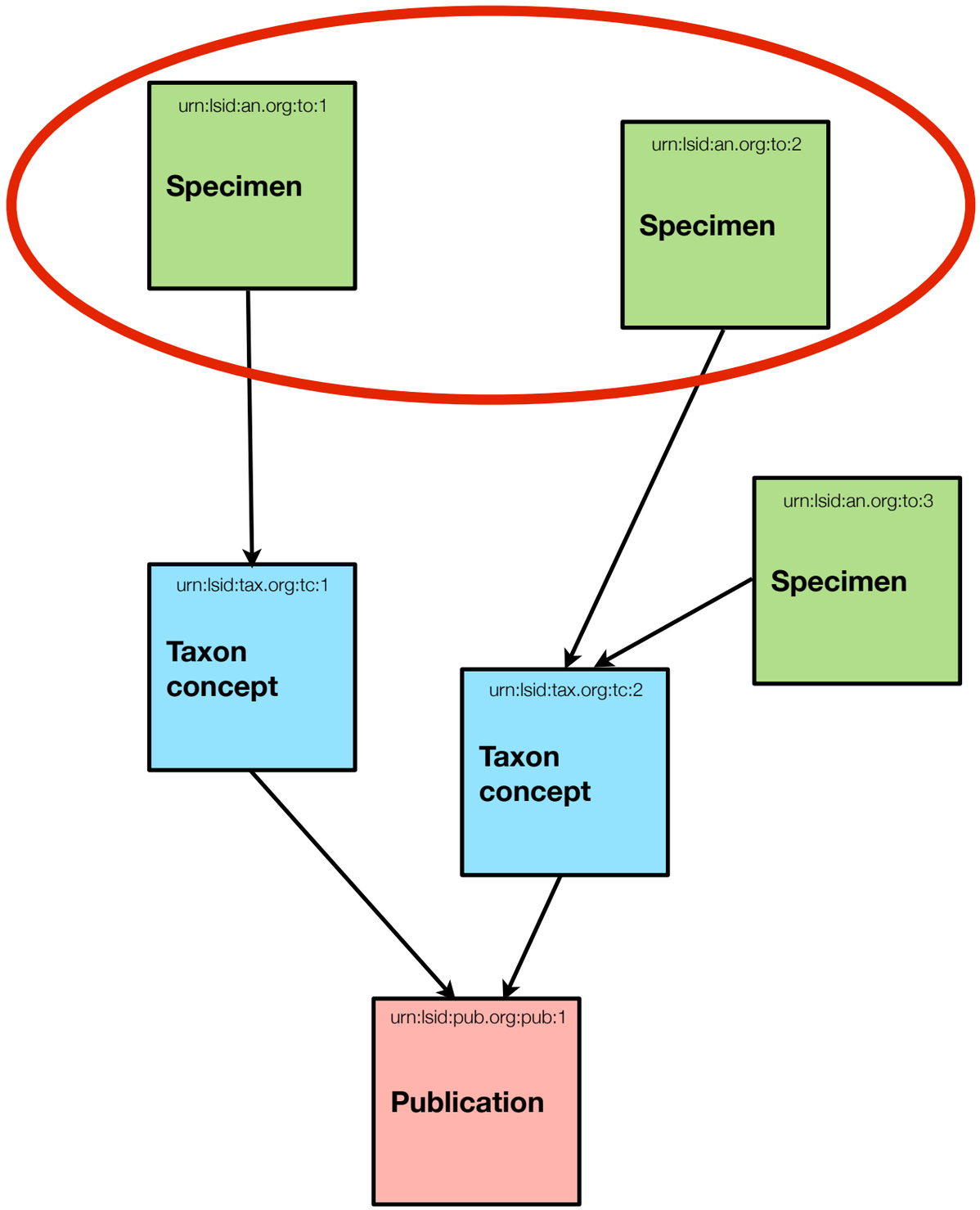
3. Discover and access data objects
   - This is the role of the access protocols
   - TDWG has developed DiGIR and BioCASe as access protocols and now developed TAPIR as their successor



TDWG data access protocols

- DiGIR
  - Most widely used TDWG protocol (including MaNIS, ORNIS, HerpNET, OBIS, GBIF)
  - Usually returning Darwin Core data (occurrence records with simple structure)
  - Implementations in PHP and Python (and some special adaptors for particular systems)
  - Metadata, inventory and search operations
- BioCASe
  - Large number of providers in Europe - the BioCASE project - and accessed by GBIF
  - Usually returning ABCD data (occurrence records with complex structure)
  - Implementation in Python
  - Capabilities, scan (== inventory) and search operations
- TAPIR
  - Early providers already connected to GBIF - protocol adopted for use by several networks
  - Returning Darwin Core or ABCD data (can support a range of structures)
  - Exploring use with new TDWG vocabularies
  - Implementations in Python, PHP and .NET
  - Metadata, capabilities, ping, inventory and search operations

TAPIR inventory

Example request

```
<?xml version="1.0" encoding="UTF-8"?>
<request xmlns="http://rs.tdwg.org/tapir/1.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://rs.tdwg.org/tapir/1.0
                             http://rs.tdwg.org/tapir/1.0/schema/tapir.xsd">
  <header>
    <source sendtime="2005-11-11T12:23:56.023+01:00">
    </source>
  </header>
  <inventory count="true" limit="100" start="0">
    <concepts>
      <concept id="http://example.net/schema1/Country" tagName="country"/>
      <concept id="http://example.net/schema1/Genus" tagName="genus"/>
    </concepts>
    <filter>
      <like>
        <concept id="http://example.net/schema1/Genus"/>
        <literal value="Luzu*"/>
      </like>
    </filter>
  </inventory>
</request>
```

TAPIR inventory

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<?xml version="1.0" encoding="UTF-8"?>
<request xmlns="http://rs.tdwg.org/tapir/1.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://rs.tdwg.org/tapir/1.0
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    </concepts>
    <filter>
      <like>
        <concept id="http://example.net/schema1/Genus"/>
        <literal value="Luzu*"/>
      </like>
    </filter>
  </inventory>
</request>
```

Example URL-encoded request

```
http://example.net/tapir.cgi?op=inventory&count=false&start=0&limit=100& concept=Country@schema1&concept=Genus@schema1
```

TAPIR inventory

Example request

```
<?xml version="1.0" encoding="UTF-8"?>
<request xmlns="http://rs.tdwg.org/tapir/1.0"
         xmlns:xsi="http://www.w3.org/2001/XM
         xsi:schemaLocation="http://rs.tdwg.o
                            http://rs.tdwg.o
  <header>
    <source sendtime="2005-11-11T12:23:56.023
    </source>
  </header>
  <inventory count="true" limit="100" start="
    <concepts>
      <concept id="http://example.net/schema1
      <concept id="http://example.net/schema1
    </concepts>
    <filter>
      <like>
        <concept id="http://example.net/schem
        <literal value="Luzu*"/>
      </like>
    </filter>
  </inventory>
</request>
```

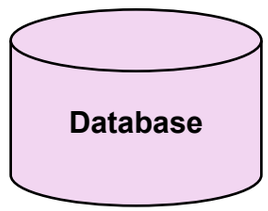
Example response

```
<?xml version="1.0" encoding="UTF-8"?>
<response xmlns="http://rs.tdwg.org/tapir/1.0"
          xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xsi:schemaLocation="http://rs.tdwg.org/tapir/1.0
                              http://rs.tdwg.org/tapir/1.0/schema/
tapir.xsd">
  <header>
    <source accesspoint="http://example.net/tapir.cgi"
            sendtime="2005-11-11T12:23:56.023+01:00">
      <software name="TapirService" version="1.0"/>
    </source>
  </header>
  <inventory>
    <concepts>
      <concept id="http://example.net/schema1/Country"/>
      <concept id="http://example.net/schema1/Genus"/>
    </concepts>
    <record>
      <value>AUSTRALIA</value>
      <value>Calicium</value>
    </record>
    <record>
      <value>AUSTRALIA</value>
      <value>Fellhanera</value>
    </record>
    <summary start="0" next="2" totalReturned="2" totalMatched="35"/>
  </inventory>
</response>
```

Example URL-encoded request

http://example.net/tapir.cgi?op=inventory&count=false&start=0&limit=100& concept=Country@schema1&concept=Genus@schema1

TAPIR - a flexible interface to data



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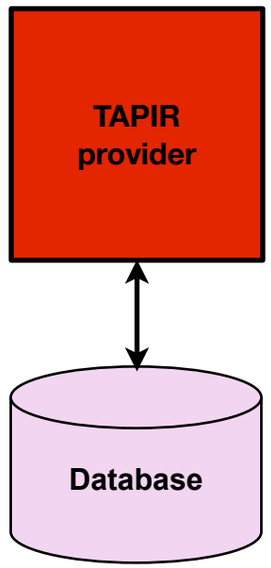

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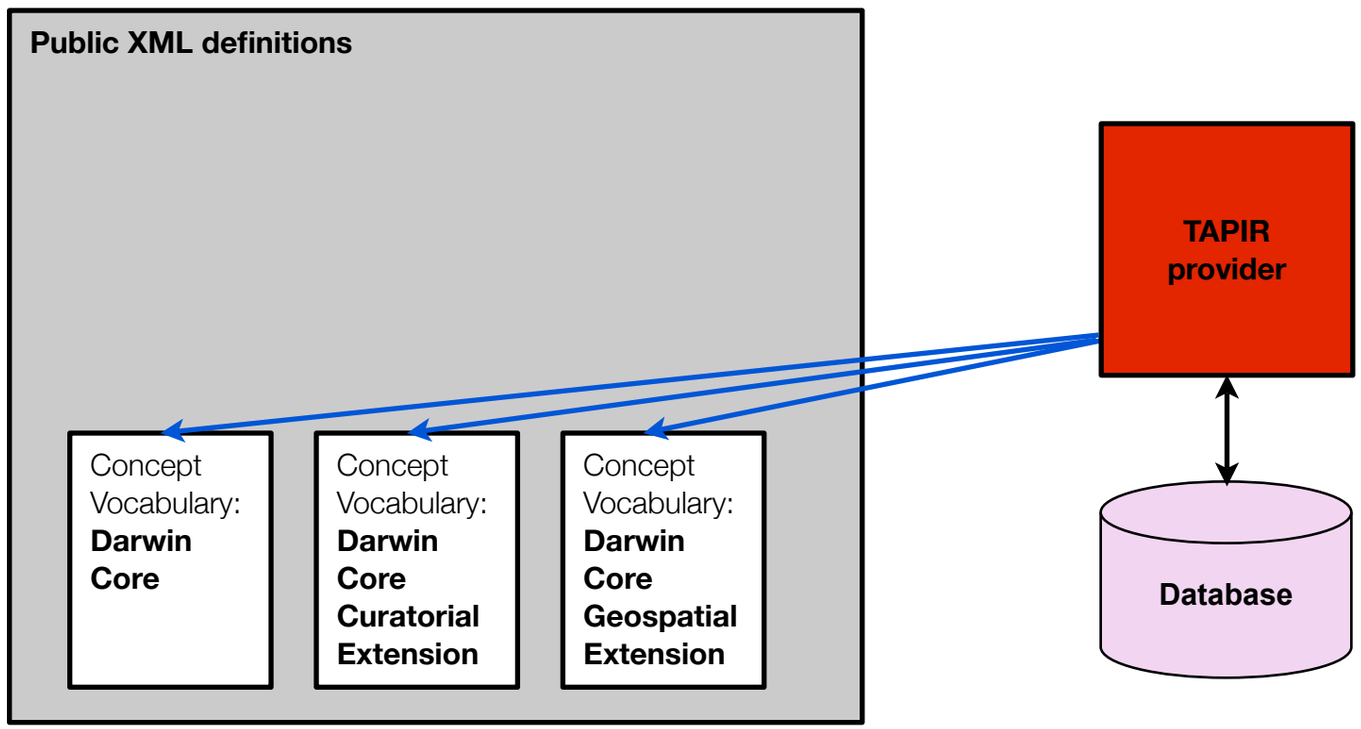

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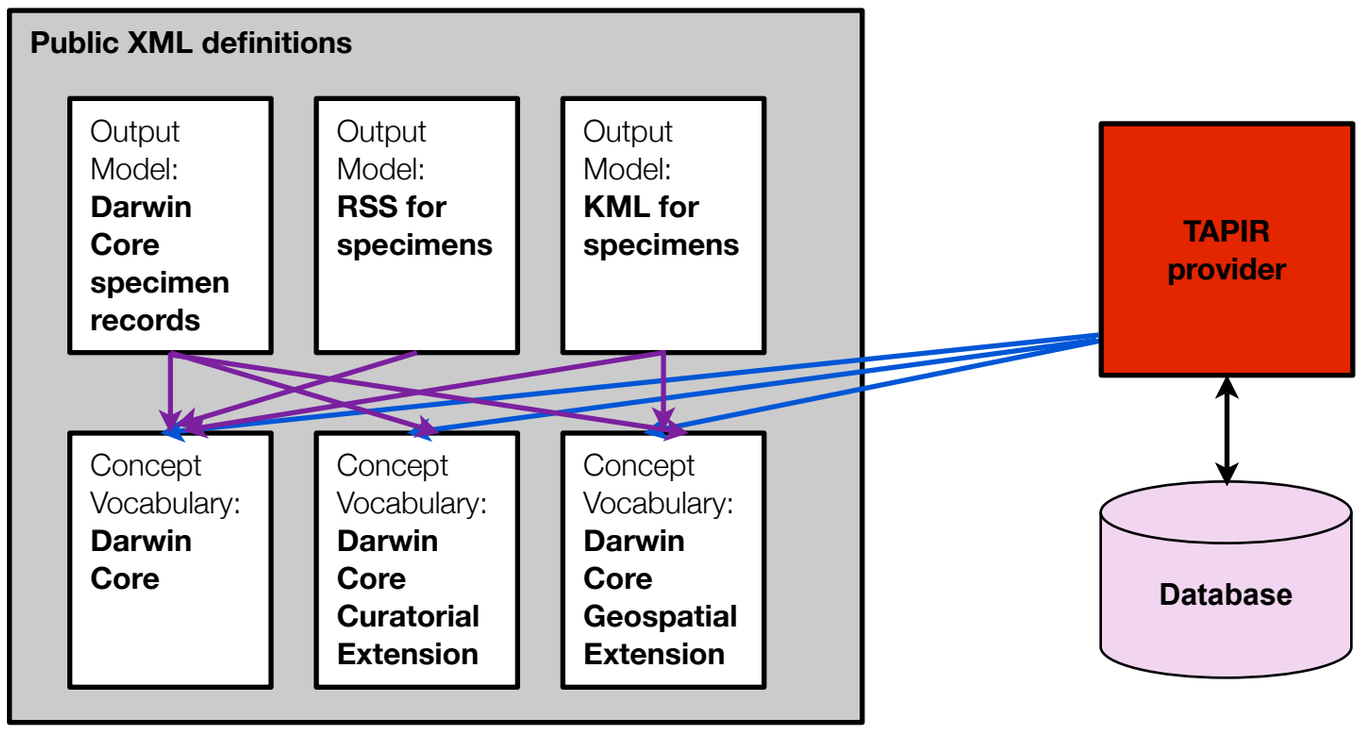

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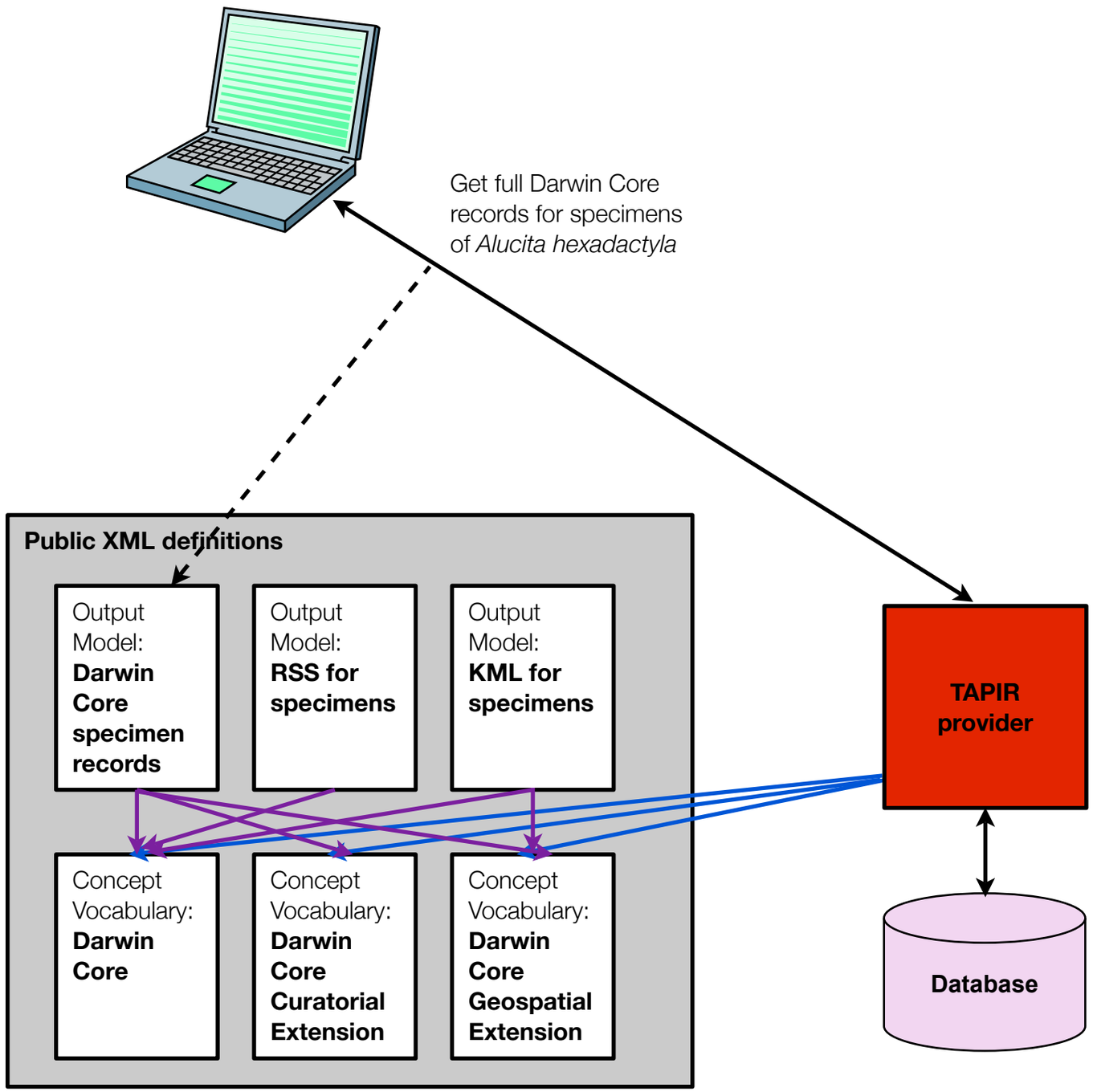

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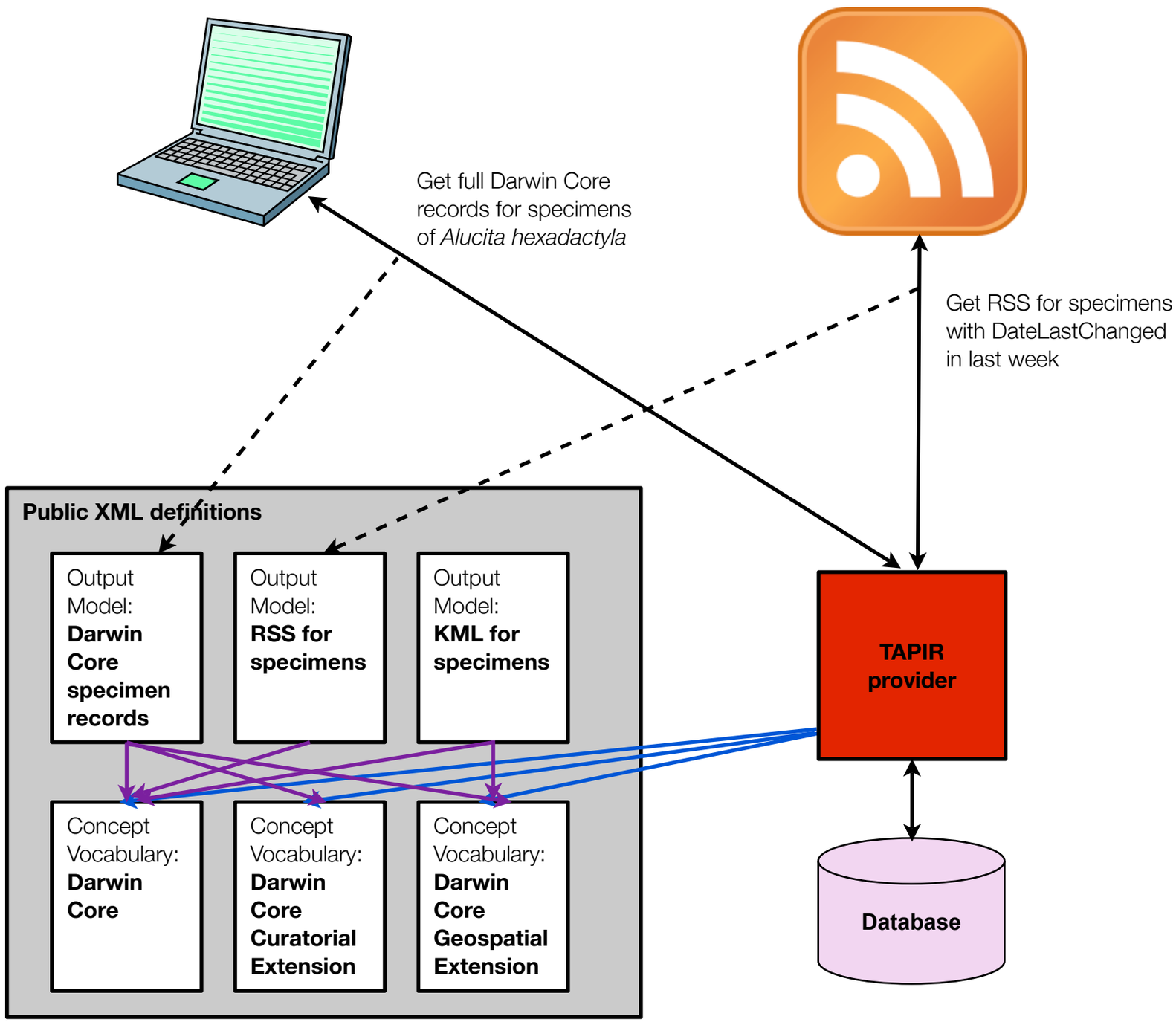

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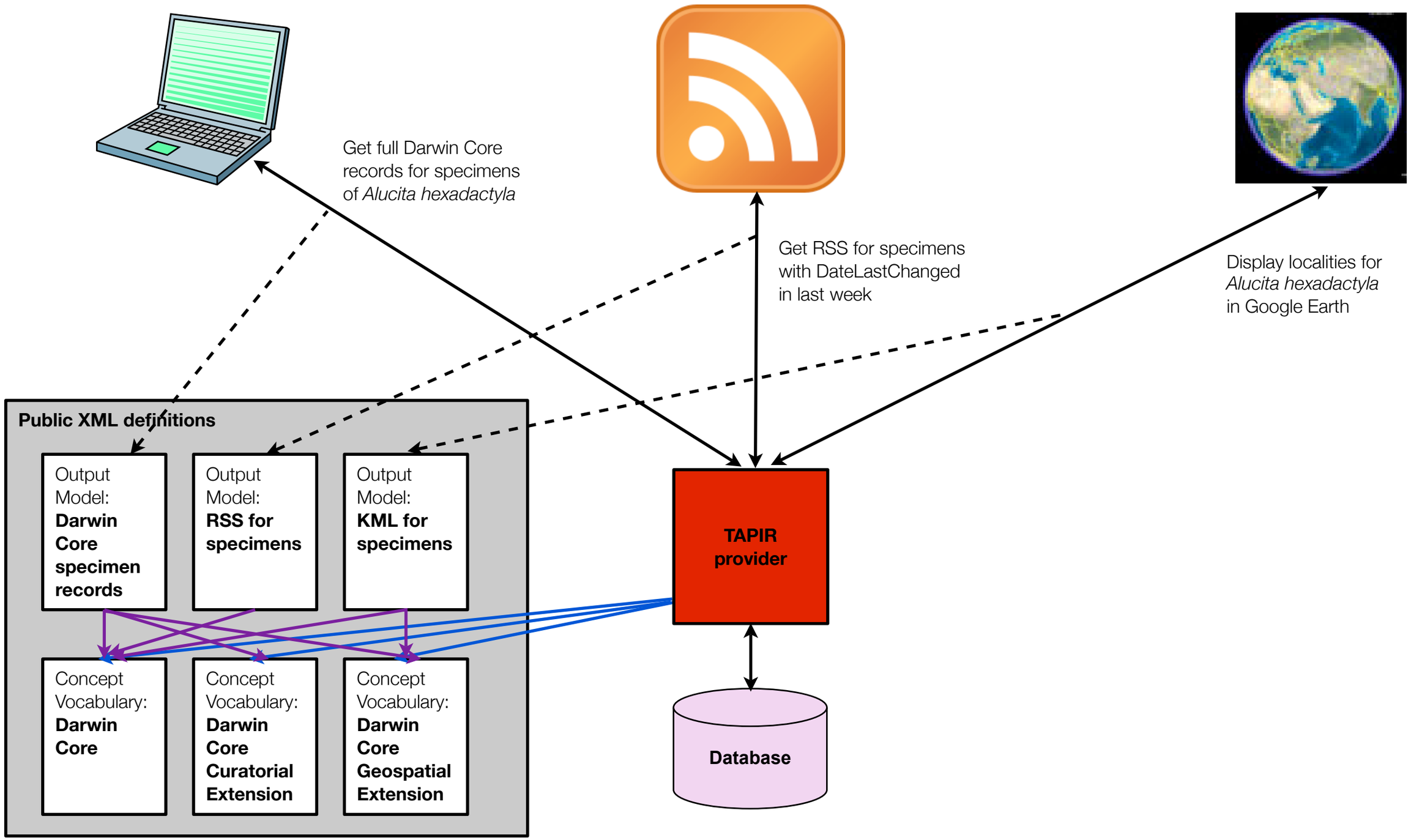

Other protocols: OAI-PMH

- Simple protocol for harvesting metadata from a data provider
- A data provider serves a **repository** of **record**s each with an **identifier** and makes the records available in various **metadata formats**
- Six request types
  - **Identify** - Get information describing a repository
  - **ListMetadataFormats** - List supported metadata formats
  - **ListIdentifiers** - List identifiers of available records (e.g. records changed since a given date)
  - **ListRecords** - List full records (e.g. records changed since a given date)
  - **GetRecord** - Get the record with a given identifier (in a given metadata format)
  - **ListSets** - List supported sets (categories of record - these can be used to limit results with ListIdentifiers and ListRecords)

OAI-PMH - a protocol for harvesting metadata

Identify

Repository

```
<?xml version="1.0" encoding="UTF-8"?>
<OAI-PMH xmlns="http://www.openarchives.org/OAI/2.0/"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/
        http://www.openarchives.org/OAI/2.0/OAI-PMH.xsd">
  <responseDate>2002-02-08T12:00:01Z</responseDate>
  <request verb="Identify">http://memory.loc.gov/cgi-bin/oai</request>
  <Identify>
    <repositoryName>Library of Congress Open Archive Initiative
                Repository 1</repositoryName>
    <baseURL>http://memory.loc.gov/cgi-bin/oai</baseURL>
    <adminEmail>anybody@loc.gov</adminEmail>
    <earliestDatestamp>1990-02-01T12:00:00Z</earliestDatestamp>
    ...
```

Identifier	Metadata	Date	Sets
urn:lsid:my.org:item:12646	<oai_dc:dc ...	14/09/07	
urn:lsid:my.org:item:12645	<oai_dc:dc ...	14/09/07	
urn:lsid:my.org:item:12644	<oai_dc:dc ...	14/09/07	
urn:lsid:my.org:item:12643	<oai_dc:dc ...	11/09/07	
urn:lsid:my.org:item:12642	<oai_dc:dc ...	11/09/07	
urn:lsid:my.org:item:12641	<oai_dc:dc ...	03/09/07	
urn:lsid:my.org:item:12640	<oai_dc:dc ...	02/09/07	
urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	
urn:lsid:my.org:item:12638	<oai_dc:dc ...	25/08/07	
urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	

OAI-PMH - a protocol for harvesting metadata

ListIdentifiers
from 7 Sep 2007

Repository

```
<?xml version="1.0" encoding="UTF-8"?>
<OAI-PMH xmlns="http://www.openarchives.org/OAI/2.0/"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/
        http://www.openarchives.org/OAI/2.0/OAI-PMH.xsd">
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urn:lsid:my.org:item:12643	<oai_dc:dc ...	11/09/07	
urn:lsid:my.org:item:12642	<oai_dc:dc ...	11/09/07	
urn:lsid:my.org:item:12641	<oai_dc:dc ...	03/09/07	
urn:lsid:my.org:item:12640	<oai_dc:dc ...	02/09/07	
urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	
urn:lsid:my.org:item:12638	<oai_dc:dc ...	25/08/07	
urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	

OAI-PMH - a protocol for harvesting metadata

GetRecord

urn:lsid:my.org.item:12644

Repository

```
<?xml version="1.0" encoding="UTF-8"?>
<OAI-PMH xmlns="http://www.openarchives.org/OAI/2.0/"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/
        http://www.openarchives.org/OAI/2.0/OAI-PMH.xsd">
 <responseDate>2002-02-08T12:00:01Z</responseDate>
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 <Identify>
  <repositoryName>Library of Congress Open Archive Initiative
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urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	

OAI-PMH - a protocol for harvesting metadata

ListRecords
set=**GREEN**

Repository

```
<?xml version="1.0" encoding="UTF-8"?>
<OAI-PMH xmlns="http://www.openarchives.org/OAI/2.0/"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/
        http://www.openarchives.org/OAI/2.0/OAI-PMH.xsd">
  <responseDate>2002-02-08T12:00:01Z</responseDate>
  <request verb="Identify">http://memory.loc.gov/cgi-bin/oai</request>
  <Identify>
    <repositoryName>Library of Congress Open Archive Initiative
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    <baseURL>http://memory.loc.gov/cgi-bin/oai</baseURL>
    <adminEmail>anybody@loc.gov</adminEmail>
    <earliestDatestamp>1990-02-01T12:00:00Z</earliestDatestamp>
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urn:lsid:my.org:item:12643	<oai_dc:dc ...	11/09/07	
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urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	
urn:lsid:my.org:item:12638	<oai_dc:dc ...	25/08/07	
urn:lsid:my.org:item:12639	<oai_dc:dc ...	25/08/07	

Other protocols: WFS and SPARQL

- Open Geospatial Consortium (OGC) Web Feature Service (WFS)
  - One of several OGC web service models
  - WFS implementations return geographical **features**
  - A **feature** is a data object which can be represented or manipulated by GIS tools
  - TDWG occurrence data can be represented as **features** using e.g. Darwin Core terms
  - A feature service implementation can support filtered queries like TAPIR
- SPARQL (SPARQL Protocol and RDF Query Language)
  - Supports queries (potentially across multiple distributed databases) based on RDF triple patterns
  - Potential example: *Find* ***TaxonOccurrence*** *objects* ***recordedAt ?locality*** *where* ***?locality isA ProtectedArea***
  - Very powerful but not suited for general use with our data at this stage

Why use different protocols?

- TAPIR
  - Powerful general search capability (complex filters)
  - Flexible representation of output data
  - Easy to handle new classes of data object
- OAI-PMH
  - Highly efficient for maintaining caches of data
  - Scope for supporting broad classes of user via set mechanism
- WFS
  - Essential for exposing data objects to GIS tools in a standards-compliant form
- SPARQL
  - Valuable for exploring repositories of RDF data and reasoning over their contents

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Thank you

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