Building interoperable read-write Linked Data applications with the W3C Linked Data Platform and the LDP4j framework

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HANDS-ON

Recipe for using LDP4j

1. Prepare dependencies

2. Create a Maven web-app project

3. Implement your business logic

4. Build the project

5. Deploy onto an servlet container

6. Enjoy!!!

Developing an application (I)

- **Prepare dependencies:**
  - From the sources

```
> git clone https://github.com/ldp4j/ldp4j
> cd ldp4j
> mvn clean install
```

  - Use Sonatype's OSS snapshot repository

```xml
<?xml version="1.0" encoding="UTF-8"?>
<settings
  xmlns="http://maven.apache.org/SETTINGS/1.0.0"  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation=
    "http://maven.apache.org/SETTINGS/1.0.0 http://maven.apache.org/xsd/settings-1.0.0.xsd">
  <!-- Other configuration here -->
  <profiles>
    <profile>
      <id>ldp4j</id>
      <activation><!-- Activation configuration here --></activation>
      <repositories>
        <repository>
          <id>sonatype-oss-public-snapshots</id>
          <url>https://oss.sonatype.org/content/groups/public/</url>
          <snapshots><enabled>true</enabled></snapshots>
          <releases><enabled>false</enabled></releases>
        </repository>
      </repositories>
    </profile>
  </profiles>
</settings>
```

Developing an application (II)

- ## Create a Maven web-app project:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project
    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd"
    xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <!-- Module coordinates here -->
    <packaging>war</packaging>
    <properties>
        <ldp4j.version>1.0.0-SNAPSHOT</ldp4j.version>
        <!-- Other properties here -->
    </properties>
    <dependencies>
        <dependency>
            <groupId>org.ldp4j.framework</groupId>
            <artifactId>ldp4j-application-api</artifactId>
            <version>${ldp4j.version}</version>
        </dependency>
        <dependency>
            <groupId>org.ldp4j.framework</groupId>
            <artifactId>ldp4j-server-core</artifactId>
            <scope>runtime</scope>
            <version>${ldp4j.version}</version>
        </dependency>
        <!-- Other dependencies here -->
    </dependencies>
    <!-- Other build settings here -->
</project>
```

Developing an application (III)

- **Implement your resource handlers…**

```java
package org.example;

import org.ldp4j.application.data.DataSet;
import org.ldp4j.application.ext.Deletable;
import org.ldp4j.application.ext.ResourceHandler;
import org.ldp4j.application.session.ResourceSnapshot;
import org.ldp4j.application.session.WriteSession;

public class MyDeletableResourceHandler implements ResourceHandler, Deletable {

    @Override
    public DataSet get(ResourceSnapshot resource)
                                        throws UnknownResourceException, ApplicationRuntimeException {
        // TODO Implement your data retrieval logic
        return null;
    }

    @Override
    public void delete(ResourceSnapshot resource, WriteSession session)
                                        throws UnknownResourceException, ApplicationRuntimeException {
        // TODO Implement your deletion logic
    }

}
```

Developing an application (IV)

- … and container handlers:

```java
package org.example;

import org.ldp4j.application.data.DataSet;
import org.ldp4j.application.ext.ContainerHandler;
import org.ldp4j.application.ext.ContentProcessingException;
import org.ldp4j.application.ext.Modifiable;
import org.ldp4j.application.session.ContainerSnapshot;
import org.ldp4j.application.session.ResourceSnapshot;
import org.ldp4j.application.session.WriteSession;

public class MyModifiableContainerHandler implements ContainerHandler, Modifiable {

    @Override
    public DataSet get(ResourceSnapshot resource) throws UnknownResourceException, ApplicationRuntimeException {
        // TODO Implement your data retrieval logic
        return null;
    }

    @Override
    public ResourceSnapshot create(ContainerSnapshot container, DataSet representation, WriteSession session)
                              throws UnknownResourceException, UnsupportedContentException, ApplicationRuntimeException {
        // TODO Implement your creation logic here
        return null;
    }

    @Override
    public void update(ResourceSnapshot resource, DataSet content, WriteSession session)
                                    throws UnknownResourceException, UnsupportedContentException,
                                        InconsistentContentException, ApplicationRuntimeException {

        // TODO Implement your modification logic here
    }

}
```

Developing an application (V)

- **Annotate the handlers:**

```java
package org.example;

...

import org.ldp4j.application.ext.annotations.Resource;

@Resource(
    id="resourceTemplateId"
)
public class MyDeletableResourceHandler implements ResourceHandler, Deletable {

...

}
```

```java
package org.example;

...

import org.ldp4j.application.ext.annotations.BasicContainer;

@BasicContainer(
    id = "containerTemplateId"
    memberHandler = MyDeletableResourceHandler.class
)
public class MyModifiableContainerHandler implements ContainerHandler, Modifiable {

...

}
```

Developing an application (VI)

- ## Implement your application class:

```java
package org.example;

import org.ldp4j.application.data.Name;
import org.ldp4j.application.data.NamingScheme;
import org.ldp4j.application.ext.Application;
import org.ldp4j.application.ext.Configuration;
import org.ldp4j.application.session.WriteSession;
import org.ldp4j.application.setup.Bootstrap;
import org.ldp4j.application.setup.Environment;

public class MyApplication extends Application<Configuration> {
    @Override
    public void setup(Environment environment, Bootstrap<Configuration> bootstrap) throws ApplicationSetupException {
        MyModifiableContainerHandler containerHandler=new MyModifiableContainerHandler();
        MyDeletableResourceHandler resourceHandler=new MyDeletableResourceHandler();
        // TODO Your handler configuration logic here
        bootstrap.addHandler(resourceHandler);
        bootstrap.addHandler(containerHandler);

        Name<?> rootContainerName=NamingScheme.getDefault().name("containerName") ;

        environment.publishResource(rootContainerName, MyModifiableContainerHandler.class, "containerRootPath");
    }
    @Override
    public void initialize(WriteSession session) throws ApplicationInitializationException {
        // TODO Your handler initialization logic here
        // Remember, the session has to be updated to reflect the state of the data managed by the handlers
    }
    @Override
    public void shutdown() throws ApplicationShutdownException {
        // TODO Your shutdown logic here
    }
}
```

Developing an application (and VII)

- **Update the web application descriptor:**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app
    metadata-complete="false"
    version="3.0"
    xmlns="http://java.sun.com/xml/ns/javaee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="
        http://java.sun.com/xml/ns/javaee
        http://java.sun.com/xml/ns/javaee/web-app_3_0.xsd">

    <display-name>My LDP4j Application</display-name>

    <context-param>
        <param-name>ldp4jTargetApplication</param-name>
        <param-value>org.example.MyApplication</param-value>
    </context-param>

    <!-- Other configuration here -->

</web-app>
```
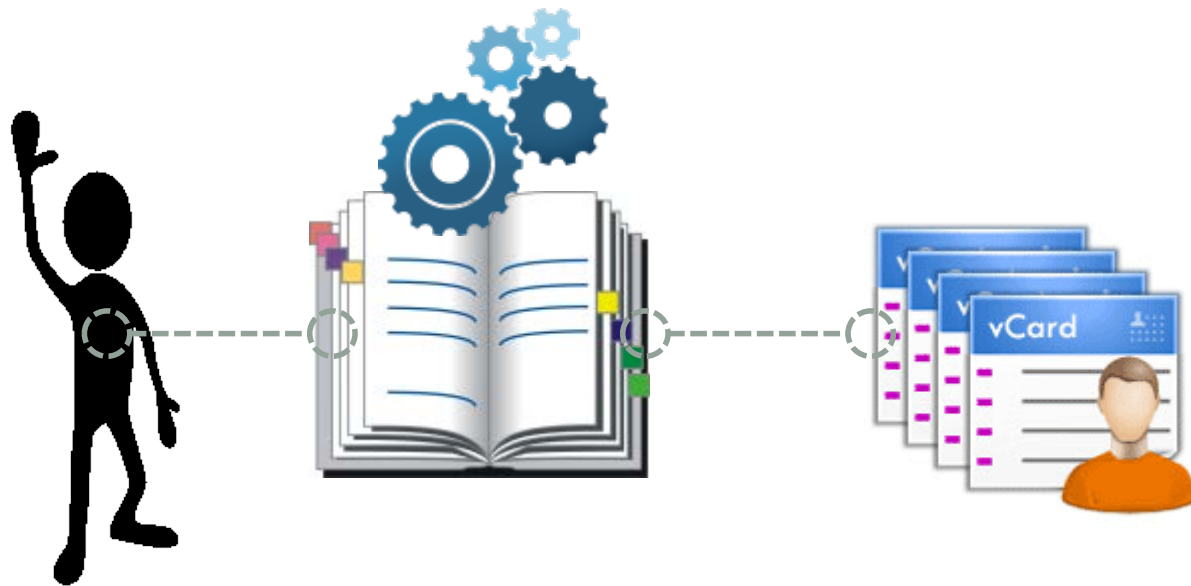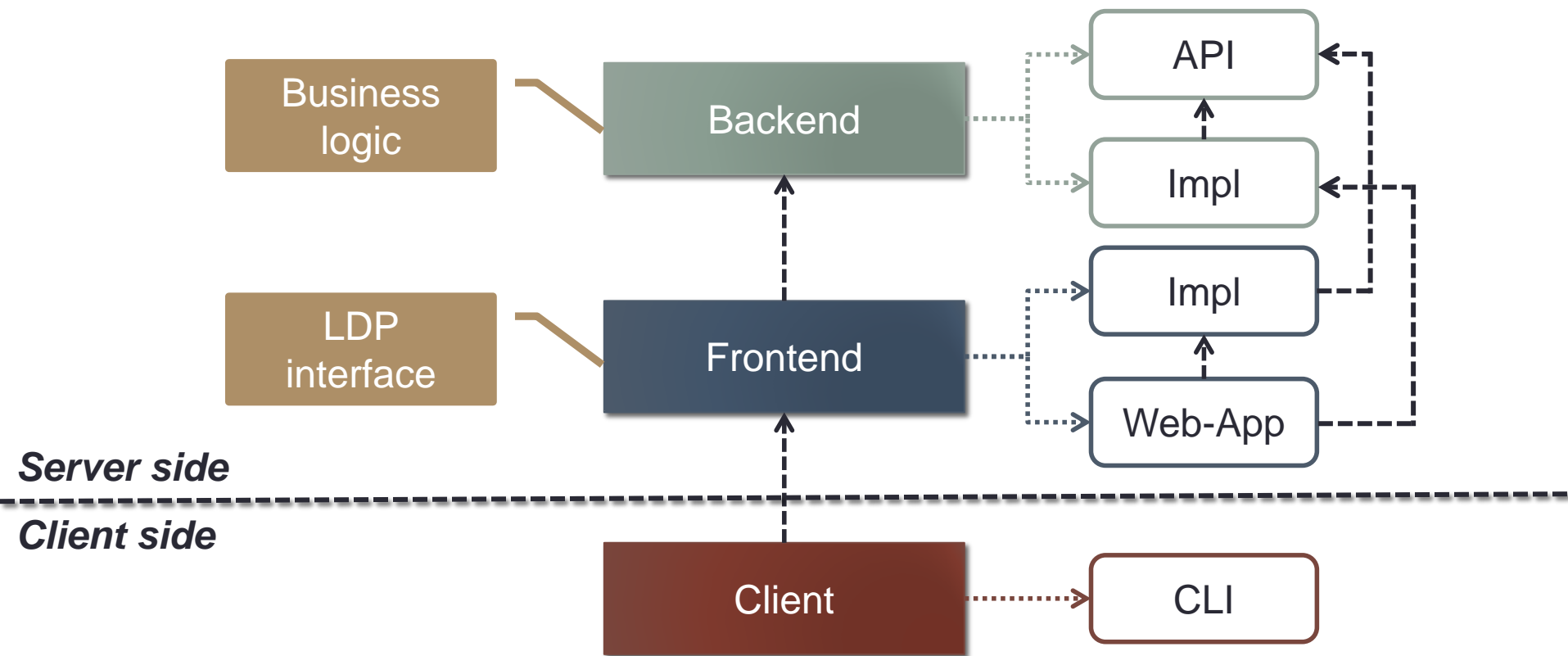
An example read-write Linked Data application with LDP4j

- **Contacts Application:** a multi-tenant address book application
  - Persons shall be able to register for a personal address book
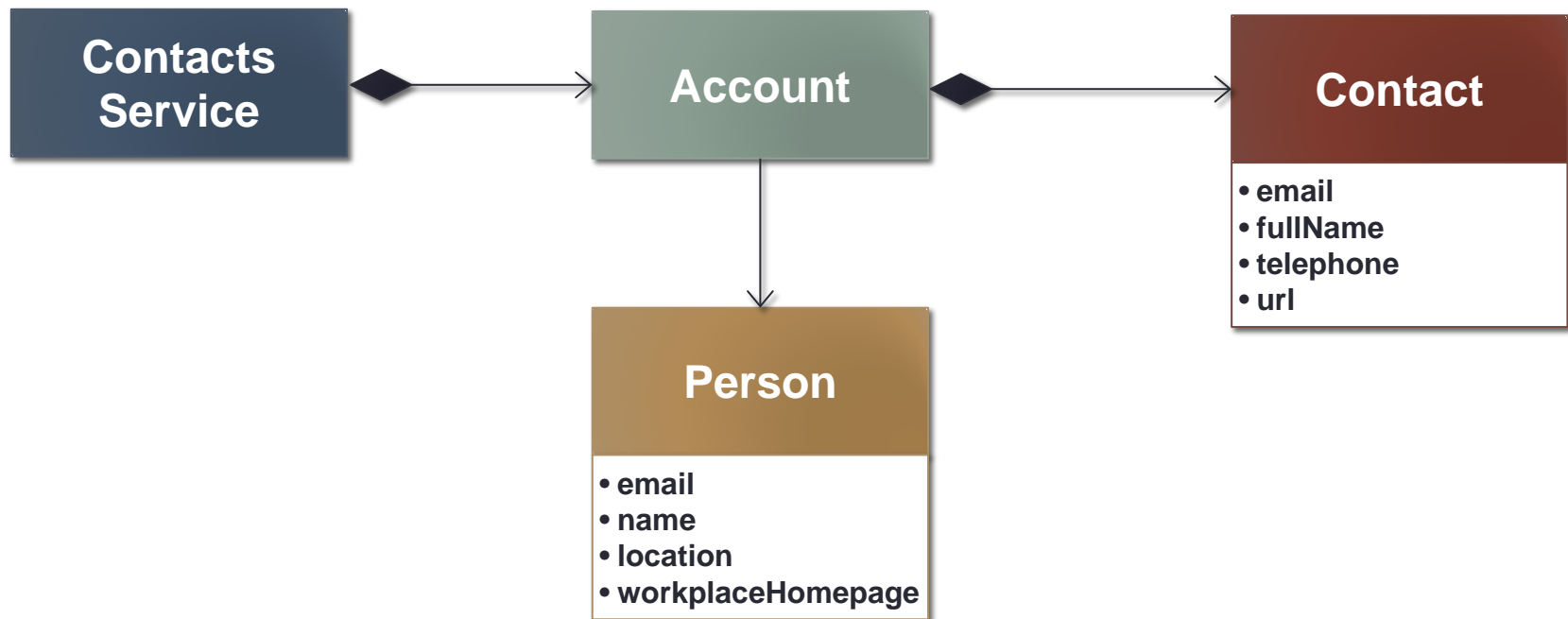 - Each address book will host the contacts that belong to the owner

Architecture of the solution

Application component design
Domain model

```
┌─────────────────┐          ┌─────────────────┐          ┌─────────────────────┐
│    Contacts     │◆────────▶│     Account     │◆────────▶│      Contact        │
│    Service      │          │                 │          ├─────────────────────┤
└─────────────────┘          └────────┬────────┘          │ • email             │
                                      │                    │ • fullName          │
                                      │                    │ • telephone         │
                                      ▼                    │ • url               │
                             ┌─────────────────┐           └─────────────────────┘
                             │     Person      │
                             ├─────────────────┤
                             │ • email         │
                             │ • name          │
                             │ • location      │
                             │ • workplaceHomepage │
                             └─────────────────┘
```
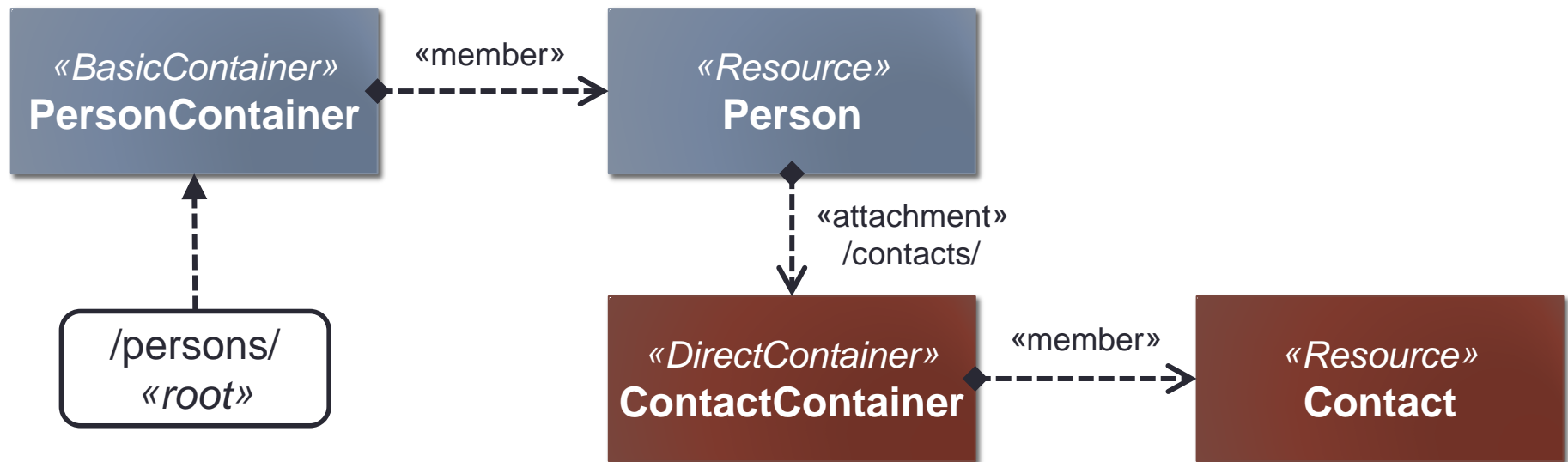
Application component design
Service API

- **ContactsService**
  - **getInstance**
  - **createPerson**
  - **getPerson**
  - **deletePerson**
  - **listPersons**
  - **addContactToPerson**
  - **getPersonContact**
  - **deletePersonContact**
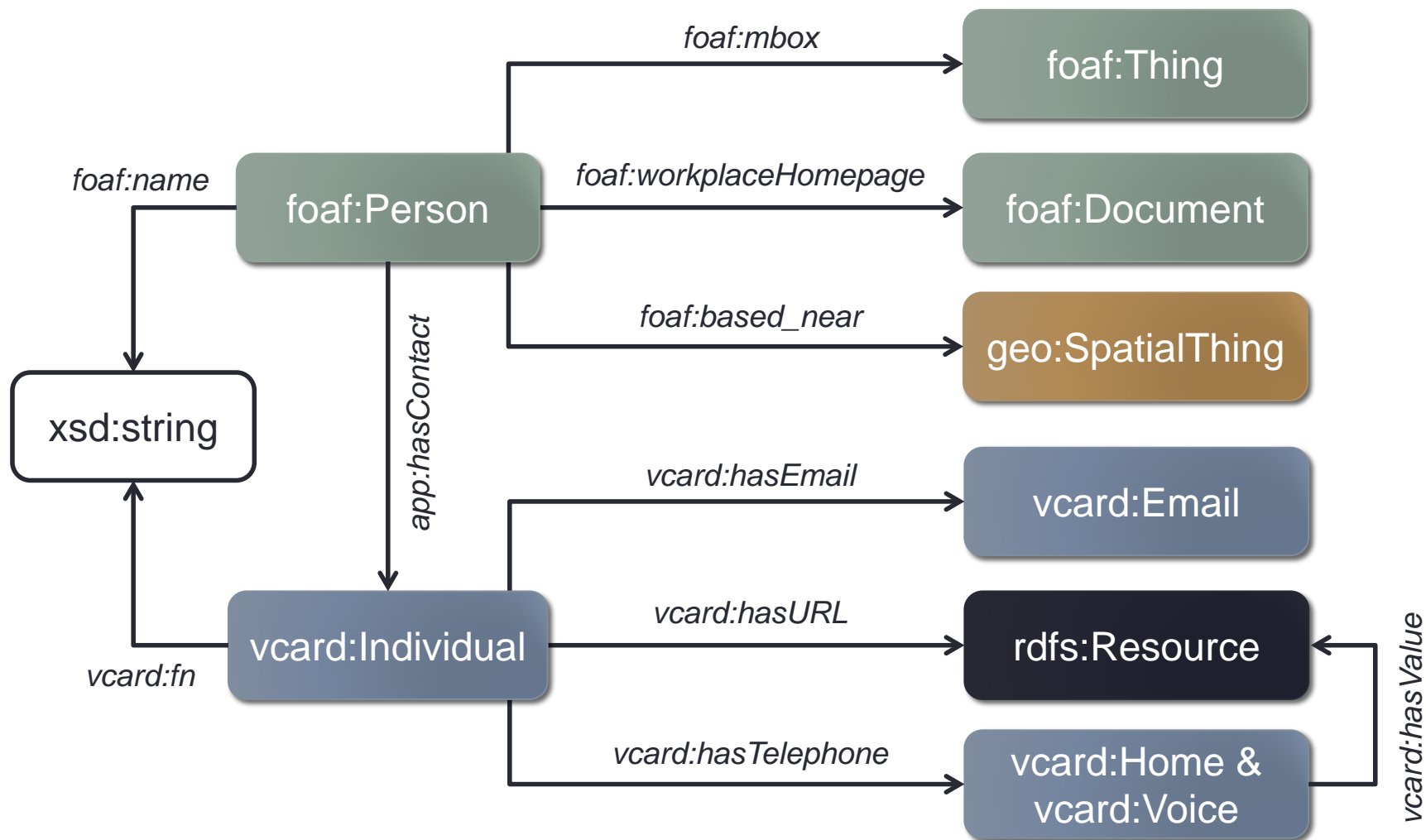 - **listPersonContacts**

Frontend component design
LDP Organization

Frontend component design
Vocabulary

Frontend component design
Exposed API

- **Manage persons:**
  - **POST** {base}/persons/ **[foaf:Person]**
  - **GET** {base}/persons/**{pid}**/ **[foaf:Person]**
  - **PUT** {base}/persons/**{pid}**/ **[foaf:Person]**
  - **DELETE** {base}/persons/**{pid}**/
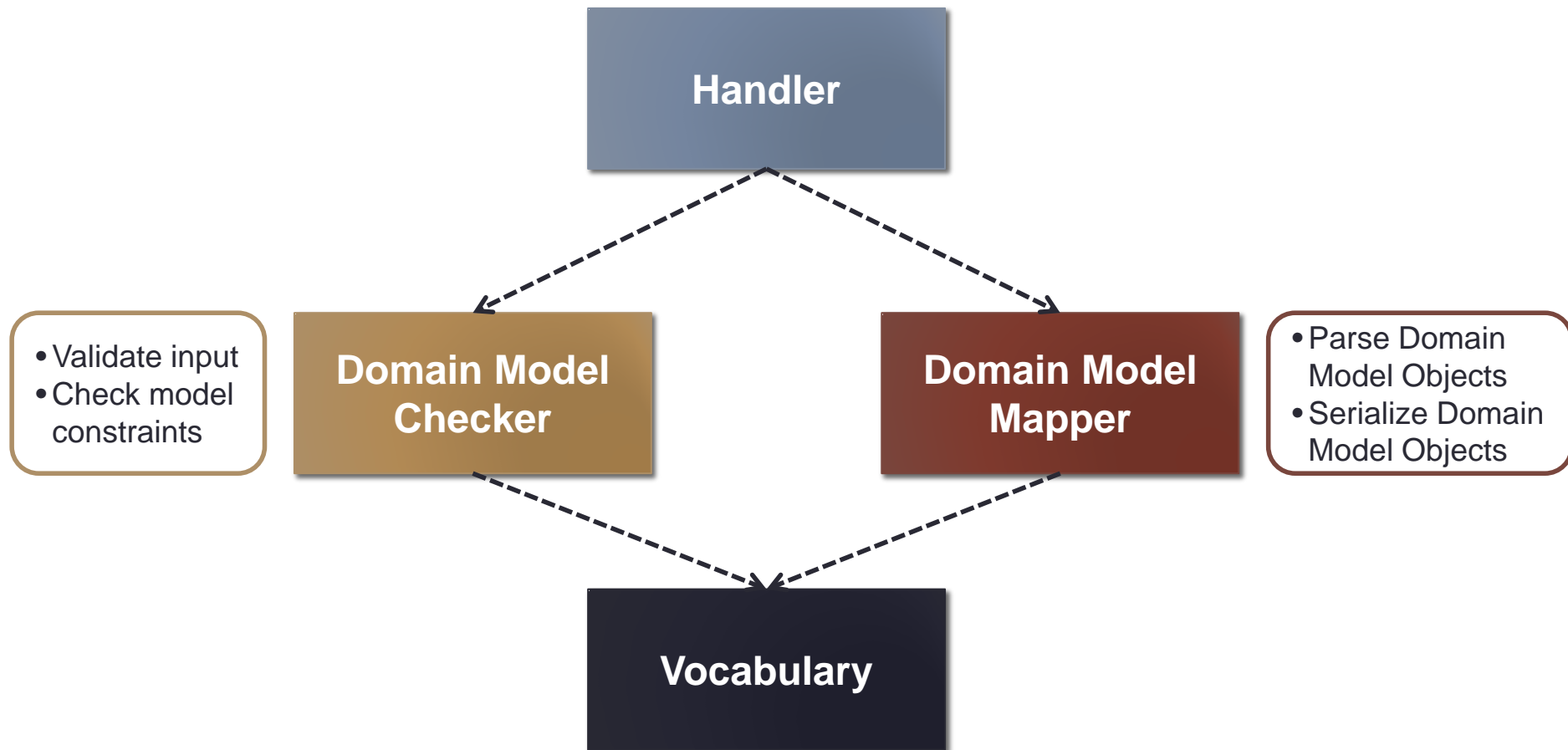
- **Manage contacts:**
  - **POST** {base}/persons/**{pid}**/contacts/ **[vcard:Individual]**
  - **GET** {base}/persons/**{pid}**/contacts/**{cid}**/**[vcard:Individual]**
  - **PUT** {base}/persons/**{pid}**/contacts/**{cid}**/**[vcard:Individual]**
  - **DELETE** {base}/persons/**{pid}**/contacts/**{cid}**/

- **Other introspection operations:**
  - **GET** {base}/persons/ **[ldp:BasicContainer]**
  - **GET** {base}/persons/**{pid}**/contacts/ **[ldp:DirectContainer]**

Frontend component design
Separation of concerns

Client component design

- **CLI**

- **Shell for manipulating LDP resources**
  - *LDP commands*
    - retrieve-resource
    - modify-resource
    - create-resource
    - delete-resource

- **Local resource metadata and representation caching**
  - *Cache introspection commands:*
    - list-cached-representations
    - show-cached-representation

Person management (I)
PersonContainerHandler

- Annotated as **BasicContainer**, having as memberHandler **PersonHandler.**

- Implements **ContainerHandler**, thus supports retrieval and creation, **but nothing else**.

- **Get operation:**
  - As only one container is to exist ever, we don't need to track its state.

- **Creation operation:**
  - Parse person from input representation
  - If the parsed person is not valid,
    - Throw an **UnsupportedContentException**
  - Else
    - Request the creation of the person to the backend
    - Add a new member to the container related to the created person
    - Attach to the created member a resource for the ContactsHandler to be used for creating the contacts for the created person

Person management (II)
PersonHandler (I)

- Annotated as **Resource** and has attached a **ContactContainerHandler.**
- Implements **ResourceHandler**, **Modifiable** and **Deletable**.
- **Get operation:**
  - Find out the identity of the person associated to the target resource
  - If no person exists for the specified identity
    - Throw an **UnknownResourceException**
  - Else
    - Retrieve the person from the backend
    - Serialize the retrieved person
- **Update operation:**
  - Find out the identity of the person associated to the target resource
  - If no person exists for the specified identity
    - Throw an **UnknownResourceException**
  - Parse person from input representation
  - If the parsed person is not valid,
    - Throw an **UnsupportedContentException**
  - Else
    - If the parsed person does not satisfy the model constraints
      - Throw a **InconsistentContentException**
    - Else
      - Request the update of the person to the backend
      - Modify the resource associated to the person

Person management (III)
PersonHandler (II)

- Delete operation:
  - Find out the identity of the person associated to the target resource
  - If no person exists for the specified identity
    - Throw an **UnknownResourceException**
  - Else
    - Request the deletion of the person to the backend
    - Delete the resource associated to the person

Contact management (I)
ContactContainerHandler

- Annotated as **DirectContainer**, having as memberHandler **PersonHandler.**
- Implements **ContainerHandler**, thus supports retrieval and creation, **but nothing else**.
- **Get operation:**
  - As the only information relevant for the container are the members, and that's covered by LDP4j, we don't need to track its state.
- **Creation operation:**
  - Find out the identity of the person associated to the target resource
  - If no person exists for the specified identity
    - Throw an **UnknownResourceException**
  - Parse contact from input representation
  - If the parsed contact is not valid,
    - Throw an **UnsupportedContentException**
  - Else
    - Request the creation of the contact for the identified person to the backend
    - Add a new member to the container related to the person's contact container

Contact management (II)
ContactHandler (I)

- Annotated as **Resource.**
- Implements **ResourceHandler**, **Modifiable** and **Deletable**.
- **Get operation:**
  - Find out the identity of the contact associated to the target resource
  - If no contact exists for the specified identity
    - Throw an **UnknownResourceException**
  - Else
    - Retrieve the contact from the backend
    - Serialize the retrieved contact
- **Update operation:**
  - Find out the identity of the contact associated to the target resource
  - If no contact exists for the specified identity
    - Throw an **UnknownResourceException**
  - Parse contact from input representation
  - If the parsed contact is not valid,
    - Throw an **UnsupportedContentException**
  - Else
    - If the parsed contact does not satisfy the model constraints
      - Throw a **InconsistentContentException**
    - Else
      - Request the update of the contact to the backend
      - Modify the resource associated to the contact

Contact management (III)
ContactHandler (II)

- Delete operation:
  - Find out the identity of the contact associated to the target resource
  - If no contact exists for the specified identity
    - Throw an **UnknownResourceException**
  - Else
    - Request the deletion of the contact to the backend
    - Delete the resource associated to the contact

Putting it all together
ContactsApplication

- Extend the **Application** class

- During the application setup:
  - Setup the backend service
  - Instantiate and configure the handlers
  - Register the handlers
  - Publish a PersonContainerHandler root resource

- Initialization and shutdown
  - As no state is tracked there is no need to do any thing else

Mapping concerns

- **Identity:**
  - *Persons:* identified by their emails
    - Contacts container: person email
  - *Contacts:* identified by the email of the owner and the email of the contact
- **Transformation:**
  - *Person:* Managed individual
    - email: External individual
    - name: Literal
    - workplaceHomepage: External individual
    - location: External individual
  - *Contact:* Managed individual
    - email: External individual
    - fullName: Literal
    - url: External individual
    - telephone: Local individual
      - number: Literal

Validation & constraints concerns

- Typing is required for principal entities
  - Persons
  - Contacts
  - Telephones
- All properties are mandatory
- Emails are write-once, read-many
  - Set when the resource is created (POST)
  - Cannot be modified when the resource is updated (PUT)

Playing with the Contacts Application

- Get the and build the sources:

```
> git clone https://github.com/ldp4j/eswc2015-tutorial/
[...]
> cd eswc2015-tutorial
> mvn clean install
[...]
```

- Execute the Frontend of the application[1]:

```
> cd frontend/dist/
> cd eswc2015-tutorial
> mvn tomcat7:run-war-only
[...]
```

- Open your browser's REST client add-on and point it to
  - http://localhost/contacts/ldp4j/api/persons/
- Or use the application Client:

```
> cd client/
> target/client/bin/ContactsClient.sh
[...]
```

[1] By default the container starts on port **80**. However it can be changed to any other by starting the container using **-Dfrontend.http.port=***«desired-port»*

Checking the application status

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "persons/"
- Last Modified : Sat, 30 May 2015 18:27:47 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#BasicResource
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/> .

<>
        rdf:type ldp:Container, ldp:RDFSource, ldp:Resource .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_.dat
```

Creating a person... (I)

- Craft a person description
  (e.g., src/main/resources/persons/mesteban.ttl)

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .

<> a foaf:Person;
  foaf:name "Miguel Esteban Gutierrez";
  foaf:mbox <mailto:mesteban@fi.upm.es>;
  foaf:based_near <http://es.dbpedia.org/resource/Getafe>;
  foaf:workplaceHomepage <http://www.centeropenmiddleware.com/> .
```

Creating a person... (II)
Request the creation...

```
contacts> create-resource -e src/main/resources/persons/mesteban.ttl \
                           http://localhost/contacts/ldp4j/api/persons/
```

```
Creating resource...
- Content-Type: text/turtle
- Content:
[...]
@prefix foaf: <http://xmlns.com/foaf/0.1/> .

<> a foaf:Person;
   foaf:name "Miguel Esteban Gutierrez";
   foaf:mbox <mailto:mesteban@fi.upm.es>;
   foaf:based_near <http://es.dbpedia.org/resource/Getafe>;
   foaf:workplaceHomepage <http://www.centeropenmiddleware.com/> .
Resource created:
- New resource available at http://localhost/contacts/ldp4j/api/persons/1/
Target resource status:
- Entity Tag    : "cb04ca0c-004b-47fd-906a-fcda43fa7fc1"
- Last Modified : Sat, 30 May 2015 18:37:01 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#BasicContainer
  + type : http://www.w3.org/ns/ldp#Resource
```

Creating a person... (III)
... check the created person resource...

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "e244be45-9c74-49a7-b2ae-57da222f086d"
- Last Modified : Sat, 30 May 2015 18:29:33 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
        rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
        <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
        <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Getafe> ;
        <http://xmlns.com/foaf/0.1/mbox> <mailto:mesteban@fi.upm.es> ;
        <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
        <http://xmlns.com/foaf/0.1/workplaceHomepage>
<http://www.centeropenmiddleware.com/> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_.dat
```

Creating a person... (III)
... check the created contacts resource...

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "44419594-68d9-4858-99c3-40a33509da4f"
- Last Modified : Sat, 30 May 2015 18:29:33 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#DirectResource
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/contacts/> .

<>

        rdf:type ldp:Container, ldp:DirectContainer, ldp:RDFSource, ldp:Resource ;
        ldp:hasMemberRelation <http://www.ldp4j.org/ns/application#hasContact> ;
        ldp:insertedContentRelation ldp:MemberSubject ;
        ldp:membershipResource <..> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_contacts_.dat
```

Creating a person… (IV)
… and the application status.

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "f8a759fb-c78f-476f-9e27-f5a88e000473"
- Last Modified : Sat, 30 May 2015 18:29:33 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#BasicResource
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/> .


<>
        rdf:type ldp:Container, ldp:RDFSource, ldp:Resource ;
        ldp:contains <1/> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_.dat
```

… adding a contact… (I)

- Craft a contact description
  (e.g., src/main/resources/contacts/corky.ttl)

```
@prefix vcard: <http://www.w3.org/2006/vcard/ns#> .

<> a vcard:Individual ;
  vcard:hasURL <http://example.com> ;
  vcard:hasEmail <mailto:corky@example.com> ;
  vcard:fn "Corky Crystal" ;
  vcard:hasTelephone [
    a vcard:Home, vcard:Voice;
    vcard:hasValue <tel:+61755555555>
  ] .
```

… adding a contact… (II)
Requesting the creation…

```
contacts> create-resource –e src/main/resources/contacts/corky.ttl \
                          http://localhost/contacts/ldp4j/api/persons/1/contacts/
```

```
Creating resource...
- Content-Type: text/turtle
- Content:
[...]
<> a vcard:Individual ;
  vcard:hasURL <http://example.com> ;
  vcard:hasEmail <mailto:corky@example.com> ;
  vcard:fn "Corky Crystal" ;
  vcard:hasTelephone [
    a vcard:Home, vcard:Voice;
    vcard:hasValue <tel:+61755555555>
  ] .Resource created:
- New resource available at http://localhost/contacts/ldp4j/api/persons/1/contacts/1/
Target resource status:
- Entity Tag    : "523ab17b-c631-45e7-84b0-b6e58c5918d9"
- Last Modified : Sat, 30 May 2015 18:39:05 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#DirectContainer
  + type : http://www.w3.org/ns/ldp#Resource
```

Center for
Open
Middleware

… adding a contact… (III)
… *check the created contact resource…*

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/1/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "e244be45-9c74-49a7-b2ae-57da222f086d"
- Last Modified : Sat, 30 May 2015 18:39:05 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/contacts/1/> .

<>
    rdf:type <http://www.w3.org/2006/vcard/ns#Individual>, ldp:RDFSource, ldp:Resource ;
    <http://www.w3.org/2006/vcard/ns#fn> "Corky Crystal" ;
    <http://www.w3.org/2006/vcard/ns#hasEmail> <mailto:corky@example.com> ;
    <http://www.w3.org/2006/vcard/ns#hasTelephone> [
        # FOLDED: _:mailto:corky@example.com.telephone
        rdf:type <http://www.w3.org/2006/vcard/ns#Home>,
                 <http://www.w3.org/2006/vcard/ns#Voice> ;
        <http://www.w3.org/2006/vcard/ns#hasValue> <tel:+61755555555>
    ] ;
    <http://www.w3.org/2006/vcard/ns#hasURL> <http://example.com> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_contacts_1.dat
```

… adding a contact… (IV)
… the person's contacts container resource…

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "8e8a86ab-171e-435a-a7ae-1909333537ae"
- Last Modified : Sat, 30 May 2015 18:39:05 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#DirectResource
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/contacts/> .


<..>
        <http://www.ldp4j.org/ns/application#hasContact> <1/> .


<>
        rdf:type ldp:Container, ldp:DirectContainer, ldp:RDFSource, ldp:Resource ;
        ldp:contains <1/> ;
        ldp:hasMemberRelation <http://www.ldp4j.org/ns/application#hasContact> ;
        ldp:insertedContentRelation ldp:MemberSubject ;
        ldp:membershipResource <..> .


Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_contacts_.dat
```

… adding a contact… (V)
… and the person resource.

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "adaffbba-eb36-4118-8f63-8da178c0e12d"
- Last Modified : Sat, 30 May 2015 18:39:05 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
        rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
        <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
        <http://www.ldp4j.org/ns/application#hasContact> <contacts/1/> ;
        <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Getafe> ;
        <http://xmlns.com/foaf/0.1/mbox> <mailto:mesteban@fi.upm.es> ;
        <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
        <http://xmlns.com/foaf/0.1/workplaceHomepage>
<http://www.centeropenmiddleware.com/> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_.dat
```

Updating the person… (I)

- Craft the new person description starting from the representation retrieved from the server:

```
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
        rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
        <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
        <http://www.ldp4j.org/ns/application#hasContact> <contacts/1/> ;
        <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Alcorcón> ;
        <http://xmlns.com/foaf/0.1/mbox> <mailto:mesteban@fi.upm.es> ;
        <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
        <http://xmlns.com/foaf/0.1/workplaceHomepage> <http://www.centeropenmiddleware.com/>
        .
```

Updating the person… (II)
Request the modification

```
contacts> modify-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Modifying resource...
- If-Match    : "e244be45-9c74-49a7-b2ae-57da222f086d"
- Content-Type: text/turtle
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
   rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
   <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
   <http://www.ldp4j.org/ns/application#hasContact> <contacts/1/> ;
   <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Alcorcón> ;
   <http://xmlns.com/foaf/0.1/mbox> <mailto:mesteban@fi.upm.es> ;
   <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
   <http://xmlns.com/foaf/0.1/workplaceHomepage> <http://www.centeropenmiddleware.com/> .

Resource modified:
- Entity Tag    : "adaffbba-eb36-4118-8f63-8da178c0e12d"
- Last Modified : Sat, 30 May 2015 18:43:12 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#Resource
```

… and updating the contact… (I)

- Craft the new contact description starting from the representation retrieved from the server:

```
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/contacts/1/> .

<>
    rdf:type <http://www.w3.org/2006/vcard/ns#Individual>, ldp:RDFSource, ldp:Resource ;
    <http://www.w3.org/2006/vcard/ns#fn> "Corky Crystal" ;
    <http://www.w3.org/2006/vcard/ns#hasEmail> <mailto:corky@example.com> ;
    <http://www.w3.org/2006/vcard/ns#hasTelephone> [
        # FOLDED: _:mailto:corky@example.com.telephone
        rdf:type <http://www.w3.org/2006/vcard/ns#Home>,
                 <http://www.w3.org/2006/vcard/ns#Voice> ;
        <http://www.w3.org/2006/vcard/ns#hasValue> <tel:+61755555555>
    ] ;
    <http://www.w3.org/2006/vcard/ns#hasURL> <http://www.example.com> .
```

… and updating the contact… (II)
Request the modification

```
contacts> modify-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/1/
```

```
Modifying resource...
- If-Match     : "e244be45-9c74-49a7-b2ae-57da222f086d"
- Content-Type: text/turtle
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/contacts/1/> .

<>
    rdf:type <http://www.w3.org/2006/vcard/ns#Individual>, ldp:RDFSource, ldp:Resource ;
    <http://www.w3.org/2006/vcard/ns#fn> "Corky Crystal" ;
    <http://www.w3.org/2006/vcard/ns#hasEmail> <mailto:corky@example.com> ;
    <http://www.w3.org/2006/vcard/ns#hasTelephone> [
        # FOLDED: _:mailto:corky@example.com.telephone
        rdf:type <http://www.w3.org/2006/vcard/ns#Home>,
                 <http://www.w3.org/2006/vcard/ns#Voice> ;
        <http://www.w3.org/2006/vcard/ns#hasValue> <tel:+61755555555>
    ] ;
    <http://www.w3.org/2006/vcard/ns#hasURL> <http://www.example.com> .

Resource modified:
- Entity Tag    : "5c27e1c2-248b-44d6-b0e6-10a232c23231"
- Last Modified : Sat, 30 May 2015 18:46:28 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#Resource
```

Breaking the rules… (I)

- Modify the person's email…

```
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
        rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
        <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
        <http://www.ldp4j.org/ns/application#hasContact> <contacts/1/> ;
        <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Alcorcón> ;
        <http://xmlns.com/foaf/0.1/mbox> <mailto:miguel.esteban@centeropenmiddleware.com> ;
        <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
        <http://xmlns.com/foaf/0.1/workplaceHomepage> <http://www.centeropenmiddleware.com/>
        .
```

Breaking the rules… (II)
Request the modification and…

```
contacts> modify-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Modifying resource...
- If-Match    : "adaffbba-eb36-4118-8f63-8da178c0e12d"
- Content-Type: text/turtle
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
   rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
   <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
   <http://www.ldp4j.org/ns/application#hasContact> <contacts/1/> ;
   <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Alcorcón> ;
   <http://xmlns.com/foaf/0.1/mbox> <mailto:miguel.esteban@centeropenmiddleware.com> ;
   <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
   <http://xmlns.com/foaf/0.1/workplaceHomepage> <http://www.centeropenmiddleware.com/> .

Could not modify resource
- Server response: Specified values for application-managed properties are not consistent
with the actual resource state Person email cannot be modified
- Constraint report [http://localhost/contacts/ldp4j/api/persons/1/?ldp:constrainedBy=a69
cafd2-0259-45a7-9f65-8885ac779beb]:
[...]
```

Breaking the rules… (III)
… see the failure

```
@prefix sh: <http://www.w3.org/ns/shacl#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
        ldp4j:entityTag "\"adaffbba-eb36-4118-8f63-8da178c0e12d\"" ;
        ldp4j:lastModified "2015-05-30T18:43:12.819+02:00"^^xsd:dateTime ;
        ldp:constrainedBy <?ldp:constrainedBy=a69cafd2-0259-45a7-9f65-8885ac779beb> ;
        sh:nodeShape _:s0 .

<?ldp:constrainedBy=a69cafd2-0259-45a7-9f65-8885ac779beb>
        rdf:type ldp4j:ConstraintReport ;
        ldp4j:failureDate "2015-05-30T18:49:01.822+02:00"^^xsd:dateTime ;
        ldp4j:failureId "a69cafd2-0259-45a7-9f65-8885ac779beb" ;
        ldp4j:failureRequest [
[...]
        ] ;
        ldp4j:hasShape _:s0 .
```

Breaking the rules… (IV)
… see the failure

```
[...]
_:s0   # Referenced 2 times by resources: <>,
       # <?ldp:constrainedBy=a69cafd2-0259-45a7-9f65-8885ac779beb>
         rdf:type sh:Shape ;
         rdfs:comment "Person resource shape" ;
         rdfs:label "PersonShape" ;
         sh:property [ # FOLDED: _:s0_pc0
                  rdf:type sh:PropertyConstraint ;
                  sh:hasValue <mailto:mesteban@fi.upm.es> ;
                  sh:predicate <http://xmlns.com/foaf/0.1/mbox> ;
                  sh:valueType <http://xmlns.com/foaf/0.1/Thing>
         ] , [ # FOLDED: _:s0_pc1
                  rdf:type sh:PropertyConstraint ;
                  sh:datatype xsd:string ;
                  sh:maxCount "1"^^xsd:integer ;
                  sh:minCount "1"^^xsd:integer ;
                  sh:predicate <http://xmlns.com/foaf/0.1/name>
         ] , [ # FOLDED: _:s0_pc2
                  rdf:type sh:PropertyConstraint ;
                  sh:maxCount "1"^^xsd:integer ;
                  sh:minCount "1"^^xsd:integer ;
                  sh:predicate <http://xmlns.com/foaf/0.1/based_near> ;
                  sh:valueType <http://www.w3.org/2003/01/geo/wgs84_pos#SpatialThing>
         ] , [ # FOLDED: _:s0_pc3
                  rdf:type sh:PropertyConstraint ;
                  sh:maxCount "1"^^xsd:integer ;
                  sh:minCount "1"^^xsd:integer ;
                  sh:predicate <http://xmlns.com/foaf/0.1/workplaceHomepage> ;
                  sh:valueType <http://xmlns.com/foaf/0.1/Document>
         ] .
```

Deleting the contact… (I)
Request the deletion and check the resource…

```
contacts> delete-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/1/
```

```
Deleting resource...
- If-Match: "5c27e1c2-248b-44d6-b0e6-10a232c23231"
Resource deleted
```

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/1/
```

```
Retrieving resource...
Cannot retrieve resource
- Server response: Endpoint at http://localhost/contacts/ldp4j/api/persons/1/contacts/1/ is
gone. Last activity on Sat, 30 May 2015 18:46:28 GMT
– Resource has been already deleted
```

Deleting the contact… (II)
… the person's contacts container resource…

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "a65d3ed5-19bc-4e4a-90e7-af9ffab40df5"
- Last Modified : Sat, 30 May 2015 18:51:01 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#DirectResource
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/contacts/> .


<>
        rdf:type ldp:Container, ldp:DirectContainer, ldp:RDFSource, ldp:Resource ;
        ldp:hasMemberRelation <http://www.ldp4j.org/ns/application#hasContact> ;
        ldp:insertedContentRelation ldp:MemberSubject ;
        ldp:membershipResource <..> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_contacts_.dat
```

Deleting the contact… (III)
… and the person resource.

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "7d56b23c-9cb4-4742-9ae0-8d5e980e279a"
- Last Modified : Sat, 30 May 2015 18:51:01 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/1/> .

<>
        rdf:type ldp:RDFSource, ldp:Resource, <http://xmlns.com/foaf/0.1/Person> ;
        <http://www.ldp4j.org/ns/application#hasAttachment> <contacts/> ;
        <http://xmlns.com/foaf/0.1/based_near> <http://es.dbpedia.org/resource/Getafe> ;
        <http://xmlns.com/foaf/0.1/mbox> <mailto:mesteban@fi.upm.es> ;
        <http://xmlns.com/foaf/0.1/name> "Miguel Esteban Gutierrez" ;
        <http://xmlns.com/foaf/0.1/workplaceHomepage>
<http://www.centeropenmiddleware.com/> .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_1_.dat
```

Deleting the person… (I)
Request the deletion and check the resource…

```
contacts> delete-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Deleting resource...
- If-Match: "7d56b23c-9cb4-4742-9ae0-8d5e980e279a"
Resource deleted
```

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/
```

```
Retrieving resource...
Cannot retrieve resource
- Server response: Endpoint at http://localhost/contacts/ldp4j/api/persons/1/ is gone. Last
activity on Sat, 30 May 2015 18:51:01 GMT
- Resource has been already deleted
```

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/1/contacts/
```

```
Retrieving resource...
Cannot retrieve resource
- Server response: Endpoint at http://localhost/contacts/ldp4j/api/persons/1/contacts/ is
gone. Last activity on Sat, 30 May 2015 18:51:01 GMT
- Resource has been already deleted
```

Deleting the person… (II)
… and the application status.

```
contacts> retrieve-resource http://localhost/contacts/ldp4j/api/persons/
```

```
Retrieving resource...
Resource retrieved:
- Content-Type  : text/turtle
- Entity Tag    : "7d56b23c-9cb4-4742-9ae0-8d5e980e279a"
- Last Modified : Sat, 30 May 2015 18:56:44 GMT
- Links:
  + type : http://www.w3.org/ns/ldp#BasicResource
  + type : http://www.w3.org/ns/ldp#Resource
- Content:
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

@base <http://localhost/contacts/ldp4j/api/persons/> .

<>
        rdf:type ldp:Container, ldp:RDFSource, ldp:Resource .

Representation persisted to d:\iStack\workspaces\eclipse\luna\default\eswc2015-
tutorial\client\.cache\http_localhost_contacts_ldp4j_api_persons_.dat
```
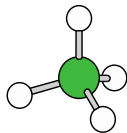
Questions?

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