Task

there is VOD server that enables downloading a movie if the following occurs:

1. the user has status active (the saldo on the account is higher than the price for downloading) -- in this case remember about the obligation to change the saldo!
2. some videos have the status ``free of charge'' so anybody with a positive saldo can download, (I assume, that if user has 0$, that he could not but a free movie)
3. in case of retired people the price is reduced by 30%, some movies are free of charge for these customers
4. but age limitations apply: for each movie there is a minimal age of the viewer
5. but licence for a video can be restricted to some country.

Of course, you have to assume that certain data are in external data sets. E.g. you have to determine the age so you have to fetch the birthday of the subject requesting access rights.

Informal description of the solution architecture

Pseudo-looking code of XML:

```
isAccepted():
        if(userAge >= minimumUserAgeOfMovie && userCountryAccount is in
        countriesAllowedForMovie && userAccountBalance > 0.0) then:
                If(movieFree = True) then:
                        return True
                if(userRetired = True) then:
                        if(movieFreeForRetirees = True) then:
                                return True
                        if(userAccountBalance >= PriceOfMovie*0.7) then:
                                userCharge = userCharge - PriceOfMovie*0.7
                                return True
                if(userAccountBalance >= PriceOfMovie) then:
                        userCharge = userCharge - PriceOfMovie
                        return True
                return False
        return False
```

Pseudo-looking code of XML:

```
<PolicySet PolicySet>
    <Policy minimumUserAgeOfMovie>
        <Rule>
            <Condition>
                userAge >= minimumUserAgeOfMovie
            <\Condition>
        </Rule>
    <Policy countriesAllowedForMovie>
        <Rule>
            <Condition>
                userCountryAccount is in countriesAllowedForMovie
            <\Condition>
        </Rule>
    </Policy countriesAllowedForMovie>
    <Policy userAccountBalanceIsPositive>
        <Rule>
            <Condition>
                userAccountBalance > 0.0
            <\Condition>
        </Rule>
    </Policy userAccountBalanceIsPositive>
    <Policy movieFree>
        <Rule>
            movieFree
        </Rule>
    </Policy movieFree>
    <Policy forRetired>
        <Target>
            userRetired
            movieNotFree
        </Target>
        <Rule>
            movieFreeForRetirees
        </Rule>
        <Rule>
            <Condition>
                userAccountBalance >= PriceOfMovie*0.7
            <\Condition>
            <ObligationExpressions>
                    userAccountBalance = userAccountBalance
                                            -PriceOfMovie*0.7
            <\ObligationExpressions>
        </Rule>
    </Policy forRetired>
```

```
<Policy forOthers>
        <Target>
                userNotRetired
                movieNotFree
        </Target>
        <Rule>
                <Condition>
                        userAccountBalance >= PriceOfMovie
                <\Condition>
                <ObligationExpressions>
                                userAccountBalance = userAccountBalance
                                                        -PriceOfMovie
                <\ObligationExpressions>
        </Rule>
    </Policy forRetired>
</PolicySet>
```

XACML policy

```xml
<PolicySet
PolicyCombiningAlgId="urn:oasis:names:tc:xacml:1.0:policy-combining-algorithm:first-applic
able" PolicySetId="PolicySet" xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
Version="1.0">
        <Policy PolicyId="urn:oasis:names:tc:xacml:3.0:vod:minimumUserAgeOfMovie"
RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy
http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-policy-01.xsd"
xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17" Version="1.0">
        <Target/>
        <Rule Effect="Deny"
RuleId="urn:oasis:names:tc:xacml:3.0:vod:minimumUserAgeOfMovie">
                <Condition>
                        <Description>minimumUserAgeOfMovie</Description>
                        <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:date-less-than">
                                <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:date-one-and-only">
                                        <AttributeDesignator MustBePresent="false"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:environment"
AttributeId="urn:oasis:names:tc:xacml:1.0:environment:current-date"
DataType="http://www.w3.org/2001/XMLSchema#date" />
                                </Apply>
                                <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:date-add-yearMonthDuration">
                                        <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:date-one-and-only">
                                                <AttributeSelector MustBePresent="false"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
Path="pathToDB.getUserBirthDate()"
DataType="http://www.w3.org/2001/XMLSchema#date" />
                                        </Apply>
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:movieMinimumAge"
DataType="http://www.w3.org/2001/XMLSchema#yearMonthDuration"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
MustBePresent="true"></AttributeDesignator>
                                </Apply>
                        </Apply>
                </Condition>
        </Rule>
  </Policy>
  <Policy PolicyId="urn:oasis:names:tc:xacml:3.0:vod:countriesAllowedForMovie"
RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy
```

```
http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-policy-01.xsd"
xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17" Version="1.0">
        <Target/>
        <Rule Effect="Deny"
RuleId="urn:oasis:names:tc:xacml:3.0:vod:countriesAllowedForMovie">
                <Description>countriesAllowedForMovie</Description>
                <Condition>
                        <Apply FunctionId="urn:oasis:names:tc:xacml:3.0:function:not">
                                <Apply
FunctionId="urn:oasis:names:tc:xacml:3.0:function:string-at-least-one-member-of">
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:userCountryAccount"
DataType="http://www.w3.org/2001/XMLSchema#string"
Category="urn:oasis:names:tc:xacml:3.0:subject-category:access-subject"
MustBePresent="true"/>
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:countriesAllowedForMovie"
DataType="http://www.w3.org/2001/XMLSchema#string"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
MustBePresent="true"/>
                                </Apply>
                        </Apply>
                </Condition>
        </Rule>
    </Policy>
    <Policy PolicyId="urn:oasis:names:tc:xacml:3.0:vod:userAccountBalanceIsPositive"
RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy
http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-policy-01.xsd"
xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17" Version="1.0">
        <Target/>
        <Rule Effect="Deny"
RuleId="urn:oasis:names:tc:xacml:3.0:vod:userAccountBalanceIsPositive" >
                <Description>userAccountBalanceIsPositive</Description>
                <Condition>
                        <Apply
FunctionId="urn:oasis:names:tc:xacml:3.0:function:double-less-than-or-equal">
                                <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:AccountBalance"
Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                                </Apply>
                                <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#double">0.0</AttributeValue>
                        </Apply>
                </Condition>
        </Rule>
```

```xml
    </Policy>
    <Policy PolicyId="urn:oasis:names:tc:xacml:3.0:vod:movieFree"
RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy
http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-policy-01.xsd"
xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17" Version="1.0">
        <Target/>
        <Rule Effect="Permit" RuleId="urn:oasis:names:tc:xacml:3.0:vod:movieFree">
            <Description>movieFree</Description>
            <Target>
                <AnyOf>
                    <AllOf>
                        <Match
MatchId="urn:oasis:names:tc:xacml:3.0:function:boolean-equal">
                            <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#boolean">True</AttributeValue>
                            <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:movieFree"
DataType="http://www.w3.org/2001/XMLSchema#boolean"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
MustBePresent="true"/>
                        </Match>
                    </AllOf>
                </AnyOf>
            </Target>
        </Rule>
    </Policy>
    <Policy PolicyId="urn:oasis:names:tc:xacml:3.0:vod:forRetired"
RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy
http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-policy-01.xsd"
xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17" Version="1.0">
        <Target>
            <AnyOf>
                <AllOf>
                    <Match
MatchId="urn:oasis:names:tc:xacml:3.0:function:boolean-equal">
                        <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#boolean">True</AttributeValue>
                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:userRetired"
DataType="http://www.w3.org/2001/XMLSchema#boolean"
Category="urn:oasis:names:tc:xacml:3.0:subject-category:access-subject"
MustBePresent="true"/>
                    </Match>
                    <Match
MatchId="urn:oasis:names:tc:xacml:3.0:function:boolean-equal">
                        <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#boolean">False</AttributeValue>
```

```xml
                                            <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:movieFree"
DataType="http://www.w3.org/2001/XMLSchema#boolean"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
MustBePresent="true"/>
                                    </Match>
                            </AllOf>
                    </AnyOf>
            </Target>
            <Rule  Effect="Permit"
RuleId="urn:oasis:names:tc:xacml:3.0:vod:movieFreeForRetirees">
                    <Description>movieFreeForRetirees</Description>
                    <Target>
                            <AnyOf>
                                    <AllOf>
                                            <Match
MatchId="urn:oasis:names:tc:xacml:3.0:function:boolean-equal">
                                                    <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#boolean">True</AttributeValue>
                                                    <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:movieFreeForRetirees"
DataType="http://www.w3.org/2001/XMLSchema#boolean"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
MustBePresent="true"/>
                                            </Match>
                                    </AllOf>
                            </AnyOf>
                    </Target>
            </Rule>
            <Rule  Effect="Permit"
RuleId="urn:oasis:names:tc:xacml:3.0:vod:buyMovieFromRetiresAccoun">
                    <Description>buyMovieFromRetiresAccoun</Description>
                    <Condition>
                            <Apply
FunctionId="urn:oasis:names:tc:xacml:3.0:function:double-greater-than">
                                    <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
                                    <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:AccountBalance"
Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                                    </Apply>
                            </Apply>
                            <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-multiply">
                                    <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
```

```xml
                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:PriceOfMovie"
Category="urn:oasis:names:tc:xacml:1.0:attribute-category:resource"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                    </Apply>
                    <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#double">0.7</AttributeValue>
                </Apply>
            </Condition>
            <ObligationExpressions>
                <ObligationExpression FulfillOn="Permit"
ObligationId="urn:oasis:names:tc:xacml:pay">
                    <AttributeAssignmentExpression
AttributeId="urn:oasis:names:tc:xacml:Balance">
                        <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-multiply">
                            <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
                                <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:PriceOfMovie"
Category="urn:oasis:names:tc:xacml:1.0:attribute-category:resource"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                            </Apply>
                            <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#double">0.7</AttributeValue>
                        </Apply>
                    </AttributeAssignmentExpression>
                </ObligationExpression>
            </ObligationExpressions>
        </Rule>
        <Rule  Effect="Deny"
RuleId="urn:oasis:names:tc:xacml:3.0:vod:notFreeForRetiredDeny"/>
    </Policy>
    <Policy PolicyId="urn:oasis:names:tc:xacml:3.0:vod:forOthers"
RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy
http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-policy-01.xsd"
xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17" Version="1.0">
        <Target>
            <AnyOf>
                <AllOf>
                    <Match
MatchId="urn:oasis:names:tc:xacml:3.0:function:boolean-equal">
                        <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#boolean">False</AttributeValue>
                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:userRetired"
DataType="http://www.w3.org/2001/XMLSchema#boolean"
```

```xml
                    Category="urn:oasis:names:tc:xacml:3.0:subject-category:access-subject"
MustBePresent="true"/>
                            </Match>
                            <Match
MatchId="urn:oasis:names:tc:xacml:3.0:function:boolean-equal">
                                    <AttributeValue
DataType="http://www.w3.org/2001/XMLSchema#boolean">False</AttributeValue>
                                    <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:movieFree"
DataType="http://www.w3.org/2001/XMLSchema#boolean"
Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource"
MustBePresent="true"/>
                            </Match>
                    </AllOf>
                </AnyOf>
        </Target>
        <Rule  Effect="Permit" RuleId="urn:oasis:names:tc:xacml:3.0:vod:buyMovie">
                <Description>buyMovie</Description>
                <Condition>
                        <Apply
FunctionId="urn:oasis:names:tc:xacml:3.0:function:double-greater-than">
                                <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:AccountBalance"
Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                                </Apply>
                        </Apply>
                        <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-multiply">
                                <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:PriceOfMovie"
Category="urn:oasis:names:tc:xacml:1.0:attribute-category:resource"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                                </Apply>
                        </Apply>
                </Condition>
                <ObligationExpressions>
                        <ObligationExpression FulfillOn="Permit"
ObligationId="urn:oasis:names:tc:xacml:pay">
                                <AttributeAssignmentExpression
AttributeId="urn:oasis:names:tc:xacml:Balance">
                                        <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-multiply">
```

```xml
                              <Apply
FunctionId="urn:oasis:names:tc:xacml:1.0:function:double-one-and-only">
                                        <AttributeDesignator
AttributeId="urn:oasis:names:tc:xacml:3.0:PriceOfMovie"
Category="urn:oasis:names:tc:xacml:1.0:attribute-category:resource"
DataType="http://www.w3.org/2001/XMLSchema#double" MustBePresent="true"/>
                              </Apply>
                         </Apply>
                    </AttributeAssignmentExpression>
               </ObligationExpression>
          </ObligationExpressions>
     </Rule>
     <Rule  Effect="Deny" RuleId="urn:oasis:names:tc:xacml:3.0:vod:notFreeDeny"/>
   </Policy>
</PolicySet>
```