Suggestion for extended Level crossing information in railML
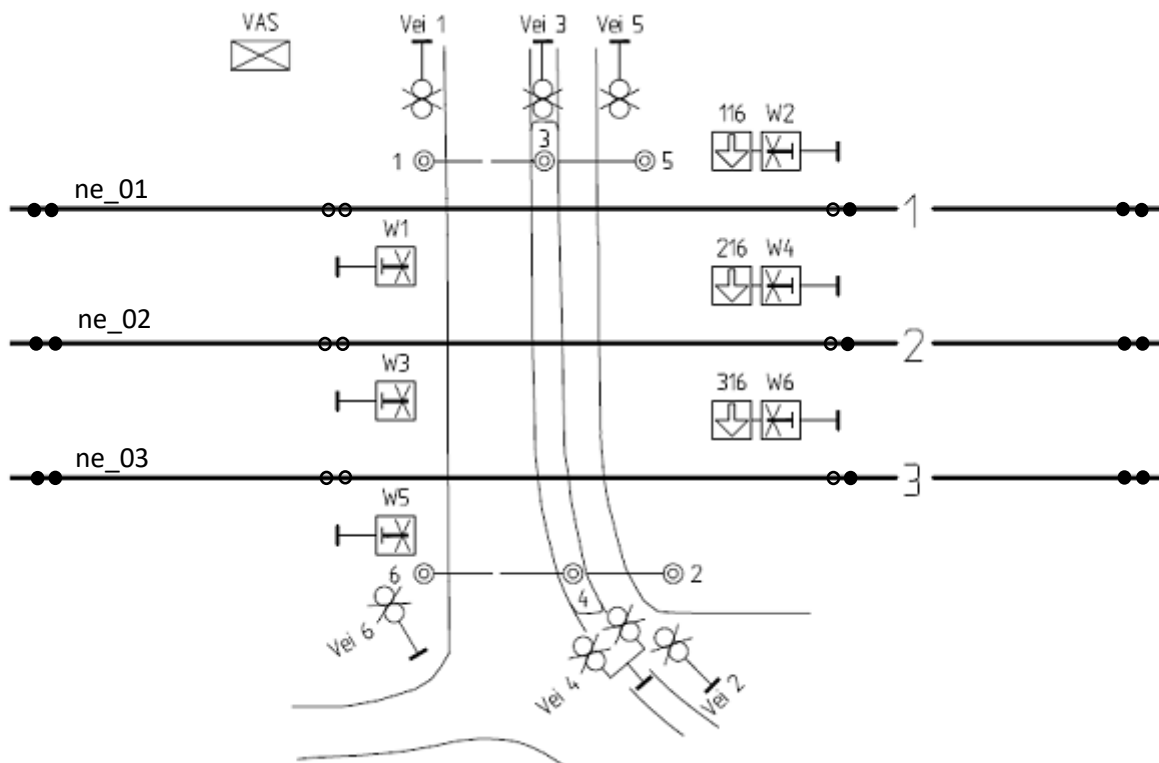
The following parameters are suggested as an extension in the infrastructure schema:

- Support for both a middle position of the Level crossing together with more detailed linear position of each level crossing object (towards the crossing).
- Length of actual crossing (road, walkway, etc)
- Names and position of barriers to protect the crossing
- Names and position of lights towards the crossing (controlled by the Level crossing)
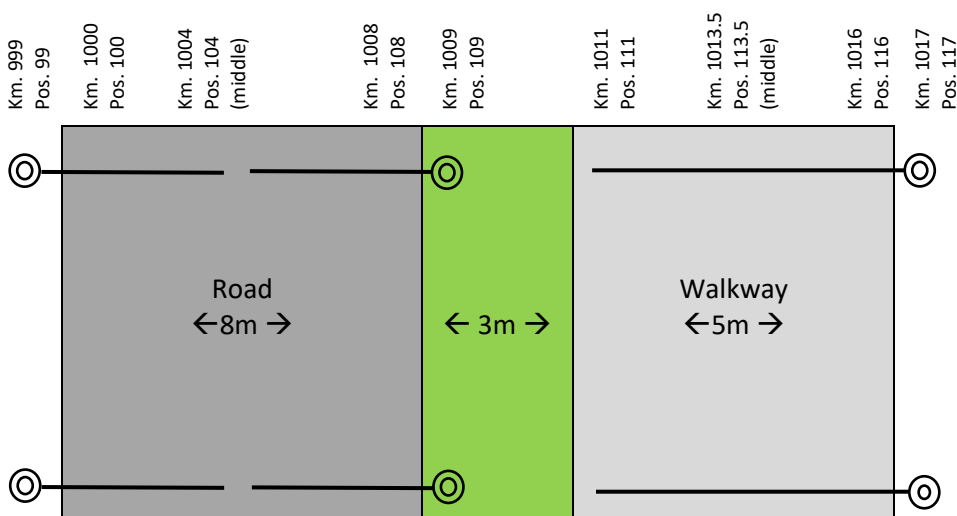
Use case:

Example of Level crossing with extended information about length, barriers and lights.

Below is a schematic plan of a level crossing which consist of both a road and a walkway crossing the railway with 3 tracks.

The road level crossing is selected to be the parent level crossing. The kilometer value in the middle of the road is 1004 and the kilometer value in the middle of the walkway is 1013.5. The width of the road is 8 meters, and the width of the walkway is 5 meters, and it is 3 meters between the road and the walkway.

Support for both a middle position and length of crossing

The middle of each level crossing can be defined by using <spotLocation> and the length of each crossing can be defined using the <linearLocation>.

Is it possible to define both the middle of each level crossing together with the start and end of the road and walkway in the same railML Infrastructure file or must another length attribute be defined as in railML2.4nor?

Can both <spotLocation> and <linearLocation> be used for the same level crossing element? (The middle might of course be calculated if linear location is used, but often the middle "measure" value is given by the Asset Management). The *measure* value is often used as a name of the level crossing even if the actual kilometer value is not correct (historical value) Both *pos* and *measure* values are included in the example.

The level crossing defined by using spotLocation:

```xml
<levelCrossingsIS>
  <levelCrossingIS id="lcr01">
    <name language="NO" name="Bomma plo"/>
    <crossesElement type="road"/>
    <spotLocation applicationDirection="normal" id="lcr01_sloc01" netElementRef="ne_01" pos="104">
      <linearCoordinate measure="1004.0" positioningSystemRef="lps01"/>
    </spotLocation>
    <spotLocation applicationDirection="normal" id="lcr02_sloc01" netElementRef="ne_02" pos="104">
      <linearCoordinate measure="1004.0" positioningSystemRef="lps01"/>
    </spotLocation>
    <spotLocation applicationDirection="normal" id="lcr03_sloc01" netElementRef="ne_03" pos="104">
      <linearCoordinate measure="1004.0" positioningSystemRef="lps01"/>
    </spotLocation>
  </levelCrossingIS>
  <levelCrossingIS id="lcr011" belongsToParent="lcr01" >
    <crossesElement type="footway"/>
    <spotLocation applicationDirection="normal" id="lcr011_sloc01" netElementRef="ne_01" pos="113.5">
      <linearCoordinate measure="1013.5" positioningSystemRef="lps01"/>
    </spotLocation>
    <spotLocation applicationDirection="normal" id="lcr012_sloc01" netElementRef="ne_02" pos="113.5">
      <linearCoordinate measure="1013.5" positioningSystemRef="lps01"/>
    </spotLocation>
    <spotLocation applicationDirection="normal" id="lcr013_sloc01" netElementRef="ne_03" pos="113.5">
      <linearCoordinate measure="1013.5" positioningSystemRef="lps01"/>
    </spotLocation>
  </levelCrossingIS>
</levelCrossingsIS>
```

The level crossing defined by using LinearLocation:

```xml
<levelCrossingsIS>
  <levelCrossingIS id="lcr01">
    <name language="NO" name="Bomma plo"/>
    <crossesElement type="road"/>
    <linearLocation id="lcr01_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_01" posBegin="100" posEnd="108">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1000.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1008.0"/>
      </associatedNetElement>
    </linearLocation>
    <linearLocation id="lcr02_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_02" posBegin="100" posEnd="108">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1000.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1008.0"/>
      </associatedNetElement>
    </linearLocation>
    <linearLocation id="lcr03_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_03" posBegin="100" posEnd="108">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1000.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1008.0"/>
      </associatedNetElement>
    </linearLocation>
  </levelCrossingIS>
  <levelCrossingIS id="lcr011" belongsToParent="lcr01" >
    <crossesElement type="footway"/>
    <linearLocation id="lcr11_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_01" posBegin="111" posEnd="116">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1011.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1016.0"/>
      </associatedNetElement>
    </linearLocation>
    <linearLocation id="lcr12_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_02" posBegin="111" posEnd="116">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1011.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1016.0"/>
      </associatedNetElement>
    </linearLocation>
    <linearLocation id="lcr13_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_03" posBegin="111" posEnd="116">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1011.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1016.0"/>
      </associatedNetElement>
    </linearLocation>
  </levelCrossingIS>
</levelCrossingsIS>
```

The level crossing defined by using both spotLocation and LinearLocation. Only track 1 is shown:

```xml
<levelCrossingsIS>
  <levelCrossingIS id="lcr01">
    <name language="NO" name="Bomma plo"/>
    <crossesElement type="road"/>
    <spotLocation applicationDirection="normal" id="lcr01_sloc01" netElementRef="ne_01" pos="104">
      <linearCoordinate measure="1004.0" positioningSystemRef="lps01"/>
    </spotLocation>
    <linearLocation id="lcr01_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_01" posBegin="100" posEnd="108">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1000.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1008.0"/>
      </associatedNetElement>
    </linearLocation>
  </levelCrossingIS>
  <levelCrossingIS id="lcr011" belongsToParent="lcr01" >
    <crossesElement type="footway"/>
    <spotLocation applicationDirection="normal" id="lcr011_sloc01" netElementRef="ne_01" pos="113.5">
      <linearCoordinate measure="1013.5" positioningSystemRef="lps01"/>
    </spotLocation>
    <linearLocation id="lcr11_1_lloc">
      <associatedNetElement keepsOrientation="true" netElementRef="ne_01" posBegin="111" posEnd="116">
        <linearCoordinateBegin positioningSystemRef="lps01" measure="1011.0"/>
        <linearCoordinateEnd positioningSystemRef="lps01" measure="1016.0"/>
      </associatedNetElement>
    </linearLocation>
  </levelCrossingIS>
</levelCrossingsIS>
```

Barriers

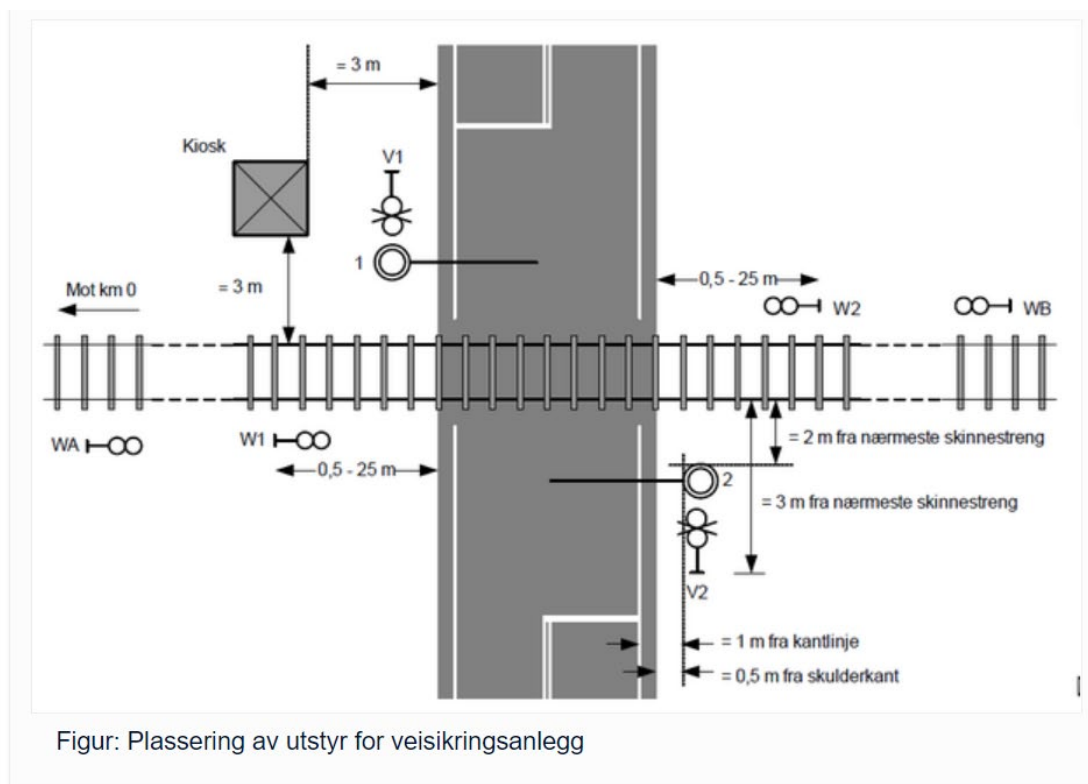The level crossing in the example has a total of 6 barriers with names 1,2,3,4,5 and 6.

The parent level crossing over the road is protected with half barriers on both entry and exit side which will be a total of 4 barriers. The levelCrossing@protection attribute is therefore set to "doubleHalfBarrier".

The child level crossing over the walkway is protected with full barriers on both entry and exit side, which will be a total of 2 barriers. The levelCrossing@protection attribute is therefore set to "singleFullBarrier".

The name and numeration of lights and barriers is defined in Teknisk Regelverk (TRV:05726) as shown below. The location of the barriers must also be defined for correct physical visualization of the level crossing. **A new child element <barriers> of the <levelCrossingIS> element may be introduced to take care of these barrier-parameters.** A new attribute barrier@sideOfCrossing is also introduced. This attribute might not be necessary since the location of the barrier is given by the <spotLocation>.

In the example below is all barriers located 1 meter from the crossing.

Figure from Teknisk Regelverk:

Figur: Plassering av utstyr for veisikringsanlegg

```xml
<levelCrossingsIS>
  <levelCrossingIS id="lcr01">
    <name language="NO" name="Bomma plo"/>
    <crossesElement type="road"/>
    <linearLocation></linearLocation>
    <protection barrier="doubleHalfBarrier" light="flashing">
      <barriers>
        <barrier sideOfCrossing="right">
          <name language="NO" name="1"/>
          <spotLocation id="lcrbar01_sloc01" applicationDirection="both" netElementRef="ne_01" pos="99">
            <linearCoordinate measure="999.0" positioningSystemRef="lps01" lateralSide="left"/>
          </spotLocation>
        </barrier>
        <barrier sideOfCrossing="left">
          <name language="NO" name="3"/>
          <spotLocation id="lcrbar03_sloc01" applicationDirection="both" netElementRef="ne_01" pos="109">
            <linearCoordinate measure="1009.0" positioningSystemRef="lps01" lateralSide="left"/>
          </spotLocation>
        </barrier>
        <barrier sideOfCrossing="left">
          <name language="NO" name="6"/>
          <spotLocation id="lcrbar06_sloc01" applicationDirection="both" netElementRef="ne_03" pos="99">
            <linearCoordinate measure="999.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </barrier>
        <barrier sideOfCrossing="right">
          <name language="NO" name="4"/>
          <spotLocation id="lcrbar04_sloc01" applicationDirection="both" netElementRef="ne_03" pos="109">
            <linearCoordinate measure="1009.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </barrier>
      </barriers>
    </protection>
  </levelCrossingIS>
  <levelCrossingIS id="lcr011" belongsToParent="lcr01" >
    <crossesElement type="footway"/>
    <linearLocation </linearLocation>
    <protection barrier="singleFullBarrier" light="flashing">
      <barriers>
        <barrier sideOfCrossing="left">
          <name language="NO" name="5"/>
          <spotLocation id="lcrbar05_sloc01" applicationDirection="both" netElementRef="ne_01" pos="117">
            <linearCoordinate measure="1017.0" positioningSystemRef="lps01" lateralSide="left"/>
          </spotLocation>
        </barrier>
        <barrier sideOfCrossing="right">
          <name language="NO" name="2"/>
          <spotLocation id="lcrbar02_sloc01" applicationDirection="both" netElementRef="ne_03" pos="117">
            <linearCoordinate measure="1017.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </barrier>
      </barriers>
    </protection>
  </levelCrossingIS>
</levelCrossingsIS>
```

@sideOfCrossing is defined as side of the crossings seen from the crossing towards the railway.

Lights

The level crossing in the example has a total of 7 lights toward the road and walkway. Two of the lights are the same light just duplicated for better visibility. Today's attribute for lights may have 3 different values: continuous, flashing or none. This attribute may be extended with other values. Most controlled level crossings in Norway are using flashing white and red lights.

The name (numeration) and position of lights and barriers are defined in Teknisk Regelverk (TRV:05726). **A new child element <lights> of the <levelCrossingIS> element may be introduced to take care of these lights-parameters.**

The lights are located at the same spot location as the barriers in this example, so the <light> element will look like the <barrier> element.

```xml
<levelCrossingsIS>
  <levelCrossingIS id="lcr01">
    <name language="NO" name="Bomma plo"/>
    <crossesElement type="road"/>
    <linearLocation></linearLocation>
    <protection barrier="doubleHalfBarrier" light="flashing">
      <barriers></barriers>
      <lights>
        <light id="lcrblgt01" sideOfCrossing="right">
          <name language="NO" name="Vei 1"/>
          <spotLocation id="lcrlgt01_sloc01" applicationDirection="both" netElementRef="ne_01" pos="103">
            <linearCoordinate measure="1003.0" positioningSystemRef="lps01" lateralSide="left"/>
          </spotLocation>
        </light>
        <light id="lcrblgt03" sideOfCrossing="left">
          <name language="NO" name="Vei 3"/>
          <spotLocation id="lcrlgt03_sloc01" applicationDirection="both" netElementRef="ne_01" pos="109">
            <linearCoordinate measure="1009.0" positioningSystemRef="lps01" lateralSide="left"/>
          </spotLocation>
        </light>
        <light id="lcrblgt06" sideOfCrossing="left">
          <name language="NO" name="Vei 6"/>
          <spotLocation id="lcrlgt06_sloc01" applicationDirection="both" netElementRef="ne_03" pos="103">
            <linearCoordinate measure="1003.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </light>
        <light id="lcrblgt04" sideOfCrossing="right">
          <name language="NO" name="Vei 4"/>
          <spotLocation id="lcrblgt04a_sloc01" applicationDirection="both" netElementRef="ne_03" pos="109">
            <linearCoordinate measure="1009.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </light>
        <light id="lcrblgt04b" sideOfCrossing="right">
          <name language="NO" name="Vei 4"/>
          <spotLocation id="lcrblgt04b_sloc01" applicationDirection="both" netElementRef="ne_03" pos="109">
            <linearCoordinate measure="1009.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </light>
      </lights>
    </protection>
  </levelCrossingIS>
  <levelCrossingIS id="lcr011" belongsToParent="lcr01" >
    <crossesElement type="footway"/>
    <linearLocation </linearLocation>
    <protection barrier="singleFullBarrier" light="flashing">>
      <lights>
        <light id="lcrlgt05" sideOfCrossing="left">
          <name language="NO" name="Vei 5"/>
          <spotLocation id="lcrlgt05_sloc01" applicationDirection="both" netElementRef="ne_01" pos="117">
            <linearCoordinate measure="1017.0" positioningSystemRef="lps01" lateralSide="left"/>
          </spotLocation>
        </light>
        <light id="lcrlgt02" sideOfCrossing="right">
          <name language="NO" name="Vei 2"/>
          <spotLocation id="lcrlgt02_sloc01" applicationDirection="both" netElementRef="ne_03" pos="117">
            <linearCoordinate measure="1017.0" positioningSystemRef="lps01" lateralSide="right"/>
          </spotLocation>
        </light>
      </lights>
    </protection>
  </levelCrossingIS>
</levelCrossingsIS>
```