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Subject: How to model speed restrictions for ETCS train categories based on axle load

Posted by [Jörgen Strandberg](#) on Thu, 14 Sep 2017 08:55:41 GMT

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Hi,

Our configuration tool has an internal data model that pretty much models data for ETCS "Packet Number 51: Axle Load Speed Profile" (speed restrictions for trains with axle load higher than or equal to the specified value). For ETCS baseline 2 these axle load values are given in halves of tons.

We are just about to add a railML export feature to our configuration tool. I'm now looking at how to - on the railML v2.2 format - represent these speed restrictions for specific train categories based on axle load.

Looking at the railML v2.2 types it seems that IS:speedChange would be a good way to represent the places where the speed restrictions change. And as a type of train category based on axle load cannot be directly specified in an IS::speedChange, an additional IS:speedProfile with an appropriate maxAxleLoad value could be created and referenced.

But the train category given by a maxAxleLoad value is different from the one given by the same axle load value in Packet Number 51 in ETCS baseline 2.

I feel the need for discussing a best practice of representing this data on the railML v2.2 format.

I have put together the simple example below, followed by a suggested modeling in railML v2.2

- Should speedProfile instances additionally specify maxAxleLoad, and if so what values are relevant in the example?
- How can the end of speed restrictions be modeled, e.g. the one for trains with axle load above 17.5 tons in the example should end at 500 m?

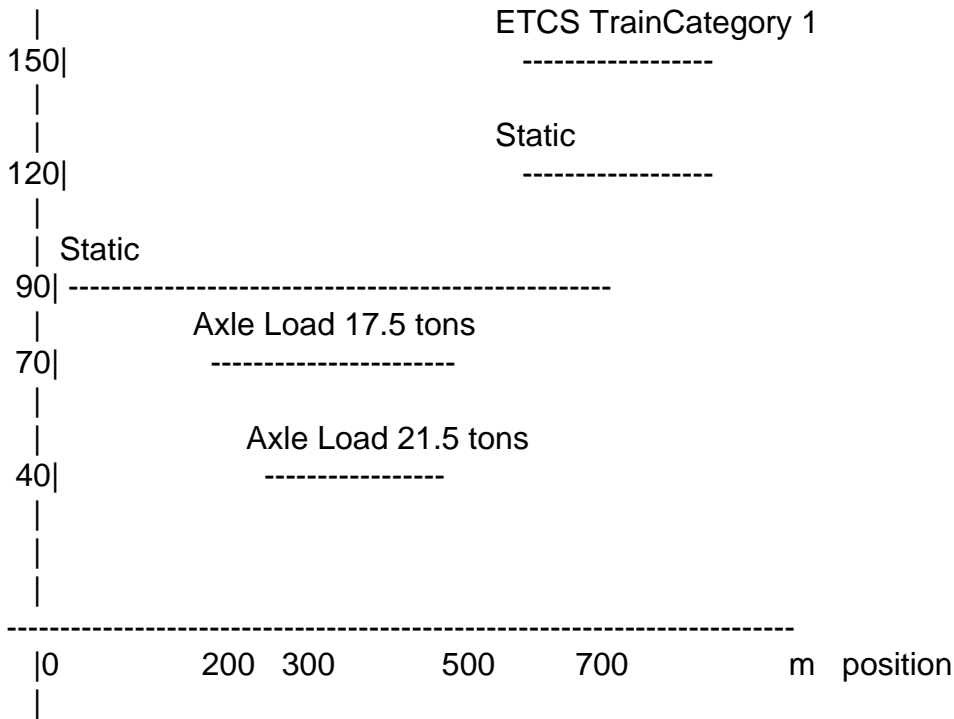
Regards,  
Jörgen Strandberg

#### Example

" Along a railway line, in nominal direction (increasing position values), where the static speed is normally 120 km/h, a length of 700 m is affected by a static speed restriction of 90 km/h. Within this length there is a second speed restriction for trains with an axle load above 17.5 tons and a third speed restriction for trains with an axle load above 21.5 tons. After the 700 m the static speed restriction is lifted and additionally trains of ETCS category 1 are allowed to go at 150 km/h."

Speed restriction

km/h



```
<?xml version="1.0" encoding="UTF-8"?>
<railml xmlns="http://www.railml.org/schemas/2013" version="2.2">
  <infrastructure description="Example track with speed changes."
id="_UkCL4HkXEeeiLuHTeo5DKA" xml:lang="en-us" name="Straight Track">
  <tracks>
    <track id="_tZBxslfMEee4Lbqvey4DcQ" name="BS1_BS2">
      <trackTopology>
        <trackBegin absPos="0" id="_QXGs4lypEeeyKJfSTpocjg" pos="0">
          <bufferStop id="_ivGZ4lfMEee4Lbqvey4DcQ" name="BS1"/>
        </trackBegin>
        <trackEnd absPos="1000" id="_QXP20lypEeeyKJfSTpocjg" pos="1000">
          <bufferStop id="_h12CYlfMEee4Lbqvey4DcQ" name="BS2"/>
        </trackEnd>
      </trackTopology>
      <trackElements>
        <speedChanges>
          <speedChange id="_Ui_qEHkXEeeiLuHTeo5DKA" name="spu_BS1_BS2_0" absPos="0"
pos="0" dir="up" vMax="90"/>
          <speedChange id="_Ui_qEXkXEeeiLuHTeo5DKA" name="spu_BS1_BS2_200_axl17.5"
absPos="200" pos="200" dir="up" profileRef="_Ui_qFXkXEeeiLuHTeo5DKA" vMax="70"/>
          <speedChange id="_Ui_qEnkXEeeiLuHTeo5DKA" name="spu_BS1_BS2_300_axl21.5"
absPos="300" pos="300" dir="up" profileRef="_Uke30nkXEeeiLuHTeo5DKA" vMax="40"/>
          <speedChange id="_Ui_qE3kXEeeiLuHTeo5DKA" name="spu_BS1_BS2_700"
absPos="700" pos="700" dir="up" vMax="120"/>
          <speedChange id="_Ui_qFHkXEeeiLuHTeo5DKA" name="spu_BS1_BS2_700_ETCS1"
absPos="700" pos="700" dir="up" etcsTrainCategory="1" vMax="150"/>
        </speedChanges>
      </trackElements>
    </track>
  </tracks>
</infrastructure>
</railml>
```

```
</trackElements>
</track>
</tracks>
<speedProfiles>
  <speedProfile description="ETCS baseline 2 train category with axle load above 17.5 tons"
id="_Ui_qFXkXEeeiLuHTeo5DKA" name="Trains 17.5tons" influence="decreasing"
verbalConstraint="Trains with axle load > 17.5 tons"/>
  <speedProfile description="ETCS baseline 2 train category with axle load above 21.5 tons"
id="_Uke30nkXEeeiLuHTeo5DKA" name="Trains 21.5tons" influence="decreasing"
verbalConstraint="Trains with axle load > 21.5 tons"/>
</speedProfiles>
</infrastructure>
</railml>
```

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Subject: Re: How to model speed restrictions for ETCS train categories based on axle load

Posted by [Jörgen Strandberg](#) on Tue, 10 Oct 2017 08:14:26 GMT

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Hi,

With aid of Dirk Bräuer I have updated the example, with maxAxleLoad values of speedProfiles, ends of speedRestrictions, and leaner id/profileRef values, as attached below.

But I still don't know how to best map between "ETCS baseline2 train categories based on minimum axle load" and railML speedProfiles based on maxAxleLoad.

The current reasoning goes like this:

In the ETCS representation the static speed profile contains no information about axle load. An axle load dependent speed profile specifies from which lowest axle load value it is valid, and the highest axle load value is implicitly specified once another axle load dependent speed profile (with a higher lowest axle load value) exists.

In the railML representation it seems that a static speedProfile is required to specify maxAxleLoad once there is at least one other speedProfile that is based on axle load, since the latter doesn't specify from which lowest axle load value it is valid, only it's highest axle load value. And if this highest axle load value is not known (e.g. because no other axle load dependent speed profiles exist):

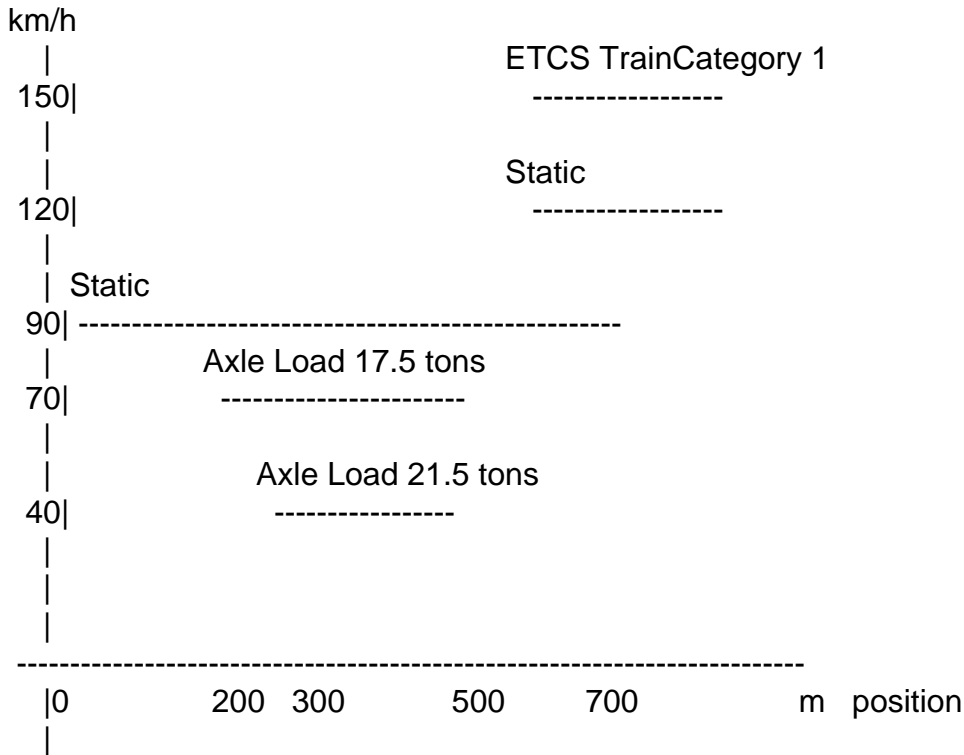
What maxAxleLoad value should distinguish the speedProfile, such as the one with id="spB" in the example below?

Example (rev. A)

" Along a railway line, in nominal direction (increasing position values), where the static speed is normally 120 km/h, a length of 700 m is affected by a static speed restriction of 90 km/h. Within this length there is a second speed restriction for trains with an axle load above 17.5 tons

and a third speed restriction for trains with an axle load above 21.5 tons. After the 700 m the static speed restriction is lifted and additionally trains of ETCS category 1 are allowed to go at 150 km/h."

### Speed restriction



```
<?xml version="1.0" encoding="UTF-8"?>
<railml xmlns="http://www.railml.org/schemas/2013" version="2.2">
  <infrastructure description="Example track with speed changes." id="i1" xml:lang="en-us"
name="Straight Track">
  <tracks>
    <track id="t1" name="BS1_BS2">
      <trackTopology>
        <trackBegin absPos="0" id="t1_b" pos="0">
          <bufferStop id="b1" name="BS1"/>
        </trackBegin>
        <trackEnd absPos="1000" id="t1_e" pos="1000">
          <bufferStop id="b2" name="BS2"/>
        </trackEnd>
      </trackTopology>
      <trackElements>
        <speedChanges>
          <speedChange id="s1" name="spu_1" absPos="0" pos="0" dir="up" profileRef="spS"
vMax="90"/>
          <speedChange id="s2" name="spu_2" absPos="200" pos="200" dir="up" profileRef="spA"
```

```

vMax="70"/>
  <speedChange id="s3" name="spu_3" absPos="500" pos="500" dir="up" profileRef="spA"
vMax="999"/>
  <speedChange id="s4" name="spu_4" absPos="300" pos="300" dir="up" profileRef="spB"
vMax="40"/>
  <speedChange id="s5" name="spu_5" absPos="500" pos="500" dir="up" profileRef="spB"
vMax="999"/>
  <speedChange id="s6" name="spu_6" absPos="700" pos="700" dir="up" profileRef="spS"
vMax="120"/>
  <speedChange id="s7" name="spu_7" absPos="700" pos="700" dir="up"
etcsTrainCategory="1" vMax="150"/>
  </speedChanges>
</trackElements>
</track>
</tracks>
<speedProfiles>
  <speedProfile description="Static speed profile" id="spS" name="Static"
influence="increasing" maxAxleLoad="17.5"/>
  <speedProfile description="ETCS baseline 2 train category with axle load above 17.5 tons"
id="spA" name="Trains 17.5tons" influence="decreasing" maxAxleLoad="21.5"/>
  <speedProfile description="ETCS baseline 2 train category with axle load above 21.5 tons"
id="spB" name="Trains 21.5tons" influence="decreasing" maxAxleLoad="999"/>
</speedProfiles>
</infrastructure>
</railml>

```

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Subject: Re: How to model speed restrictions for ETCS train categories based on axle load

Posted by [Jörgen Strandberg](#) on Fri, 13 Oct 2017 06:30:07 GMT

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Hi,

I guess this inversion of axle load constraints is described also in this comment in the bug report system:

<http://trac.railml.org/ticket/194#comment:3> - which translates to:

Quote:... for vehicles with more than 18t axle load or a meter load of more than 6.4 t/m. With the attributes influence='decreasing' maxAxleLoad='18.00' maxMeterLoad='6.4', one expresses rather the opposite ("max ..." vs "more than ...").

That ticket has been targeted for railML 3.

But how can the inversion be expressed with railML 2.2?

The Example (rev. A) in my last post tries to do it in one way that requires a static speed profile

and a dummy maxAxleLoad, and I must say it seems somewhat awkward.  
Anyone that has another idea?

Regards,  
Jörgen

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Subject: Re: How to model speed restrictions for ETCS train categories based on axle load

Posted by \_\_\_\_\_ on Thu, 23 Nov 2017 12:22:18 GMT

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Dear Jörgen,

the philosophy for speed profiles in railML 2.x is the other way 'round than in your "Example (rev. A)": The base or static speed of a line shall be the speed for the highest axle load and load spreads of the line (for the line's classification such as "D4"). Additionally to this base profile, there may be higher permitted speeds for lower axle loads or load spreads. But as such, no speed restrictions concerning this are designed.

> But how can the inversion be expressed with railML 2.2?

By converting speed restrictions in raised speed profiles with the lowest speed (highest axle load) as base profile.

If this is regarded as too awkward, it may be discussed to introduce additional attributes in a railML 2.x or using extensions (but where I would have concerns regarding compatibility).

> The Example (rev. A) in my last post tries to do it in one  
> way that requires a static speed profile and a dummy  
> maxAxleLoad, and I must say it seems somewhat awkward.

Not a dummy maxAxleLoad but the axle load of the line's classification. It is assumed that each line has a classification such as C3, D4, E5 a.s.o. and from these, the maxAxleLoad can be clearly deduced.

With best regards,  
Dirk.

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