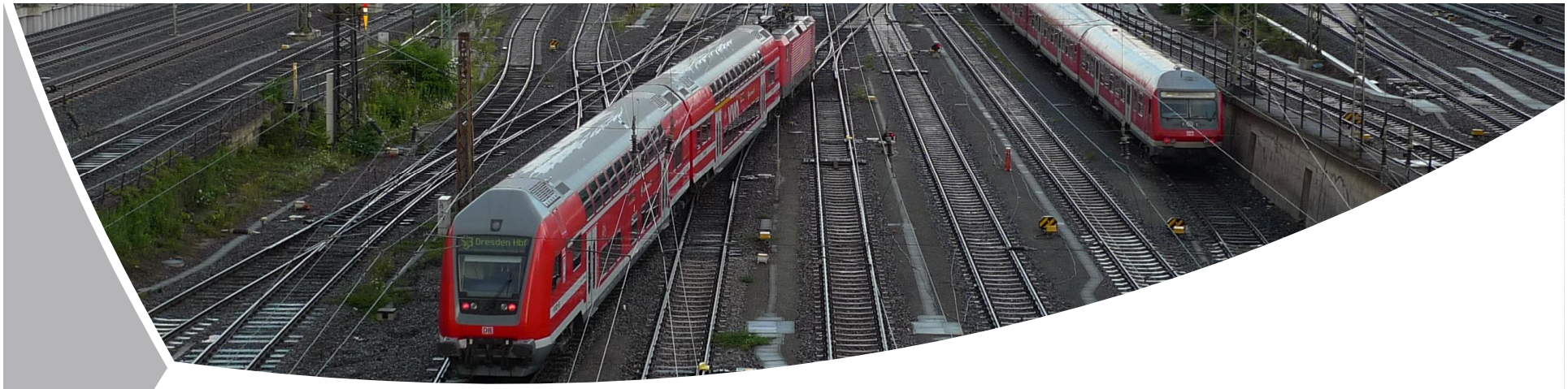

railML®: The use of interlocking data for engineering and for simulation

Dr. Bob Janssen; railML.org-IL-coordinator, Den Haag

26th railML conference · Paris, October 8th, 2014

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Use Cases

Simulation

- Design timetables
- Test timetables
- Test scenarios

Engineering

- Unified data exchange
- Automated data input
- Humanless tool chain

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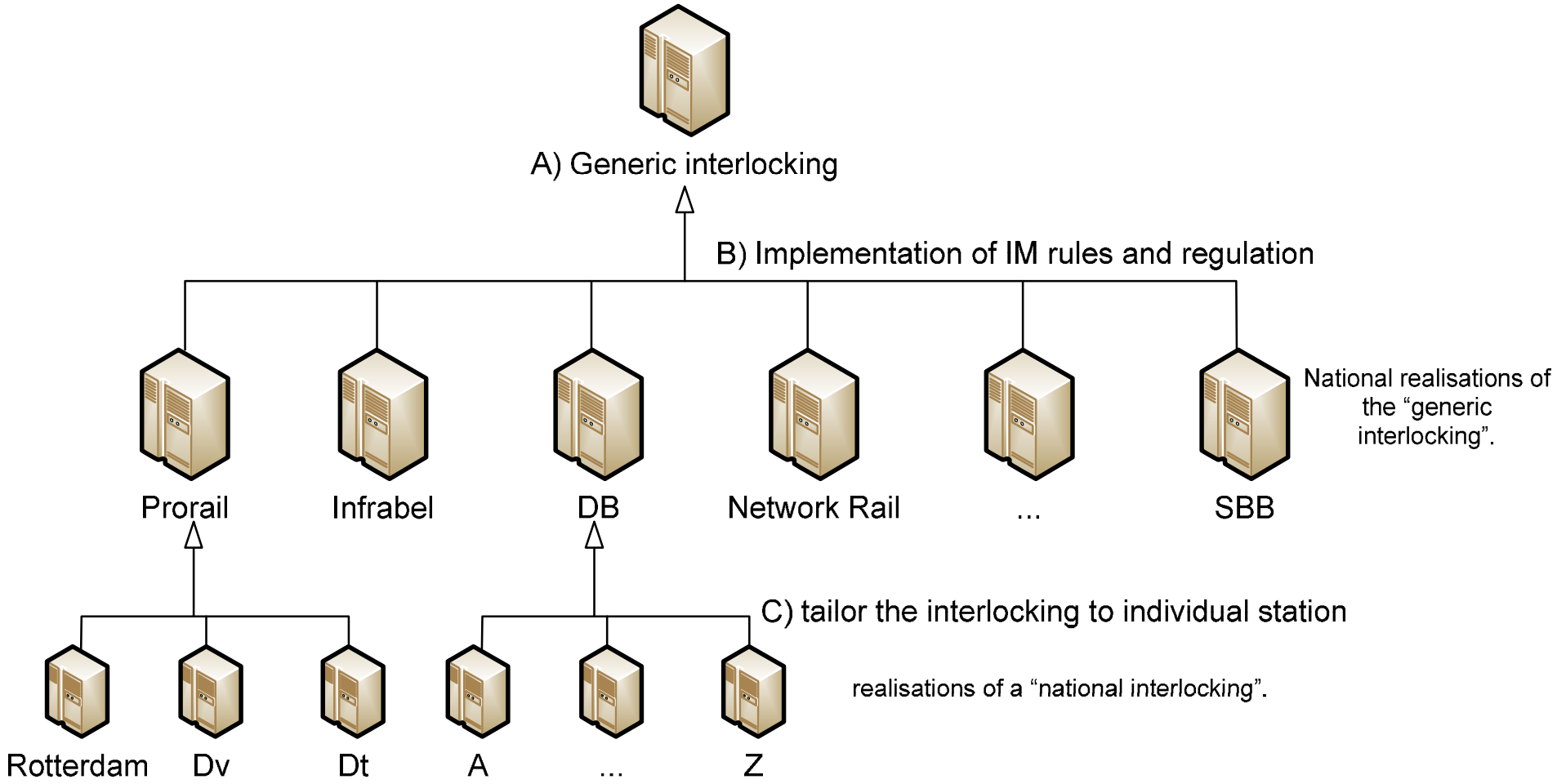
The making of an interlocking



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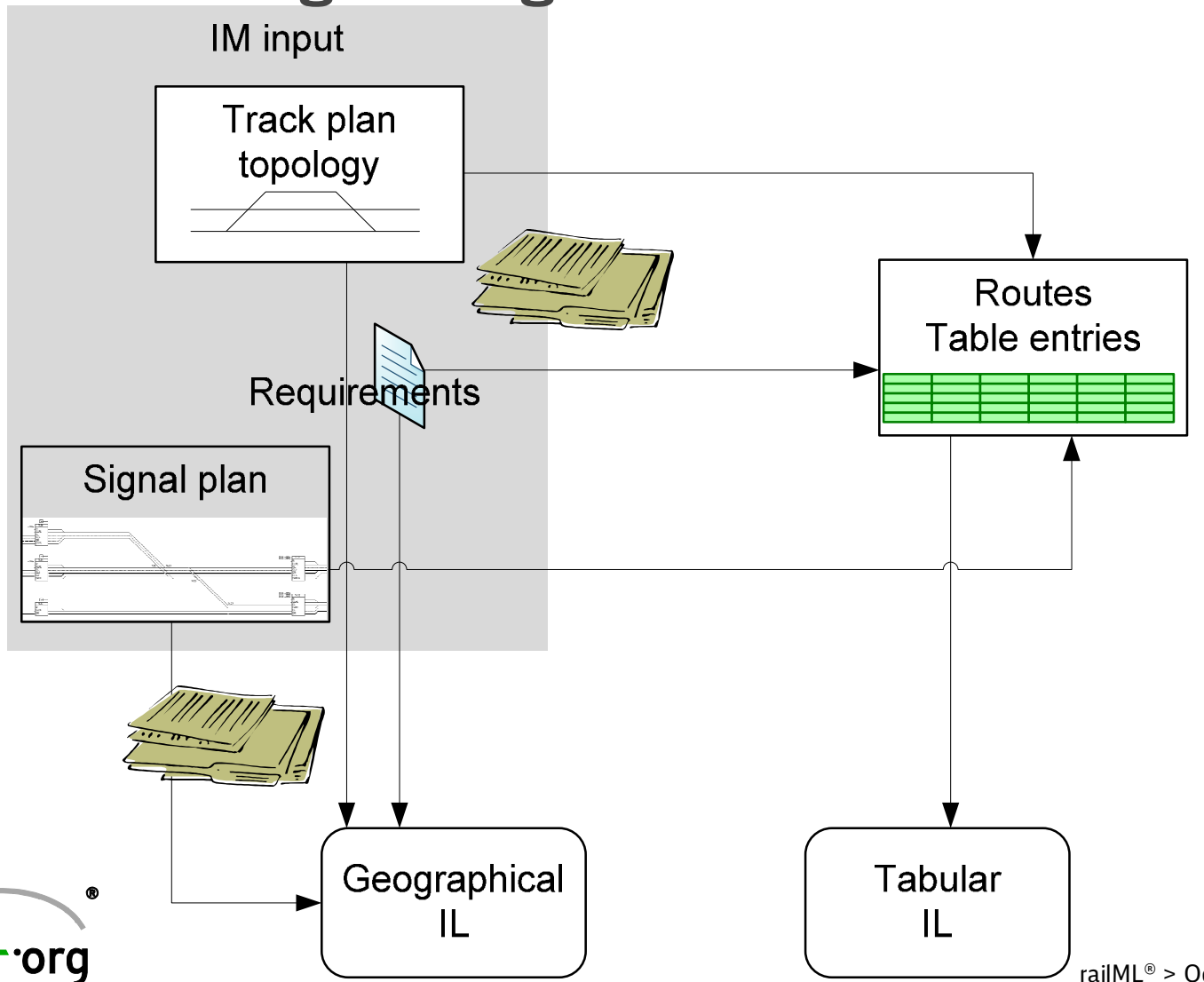
Present engineering workflow



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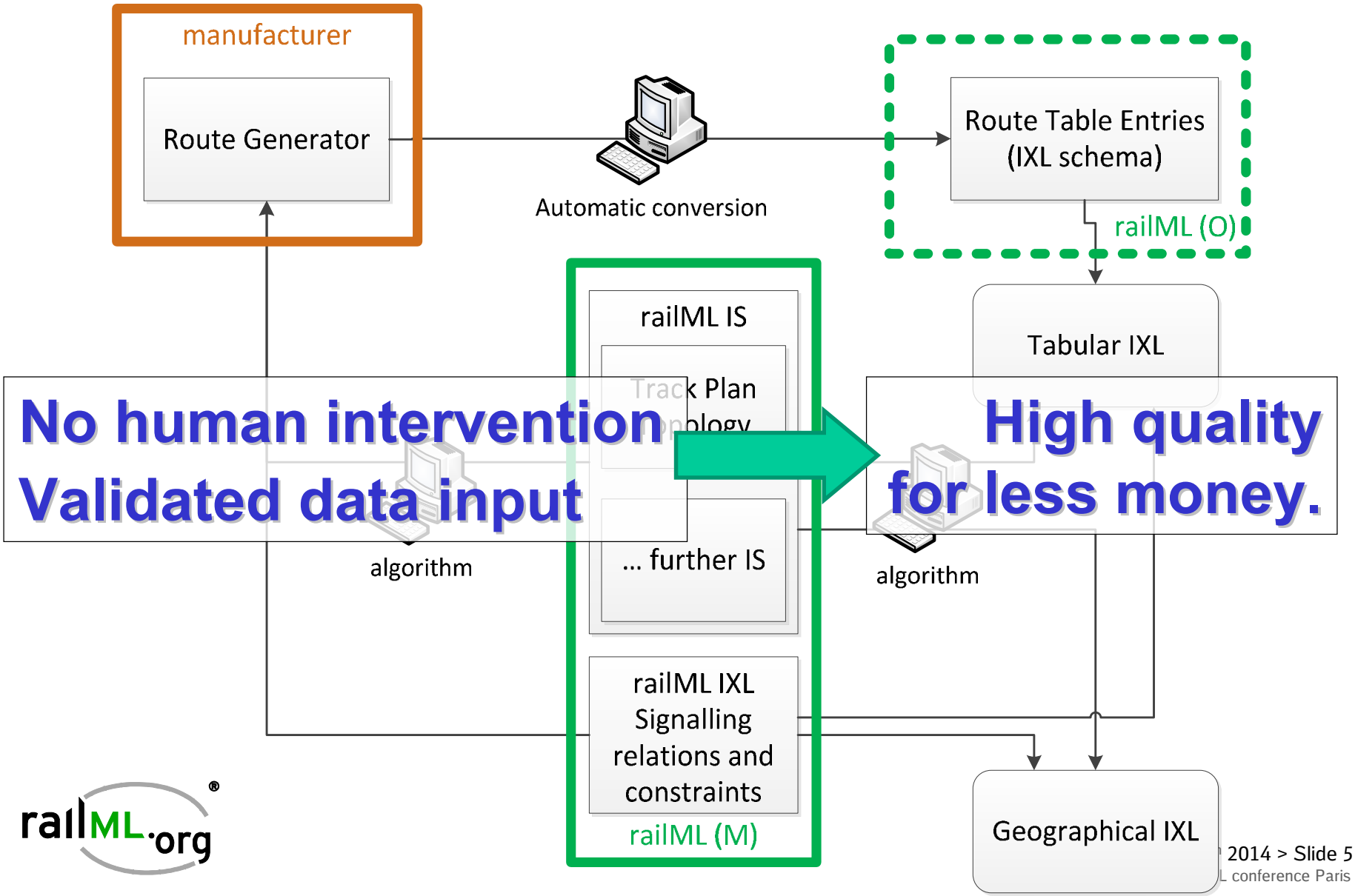
Future engineering workflow



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Interlocking families

Route tables

- Route is sequence of track elements
- Track elements are in a given state

Geographical

- Route is path through a network of track elements

Common to both families and defined in IS

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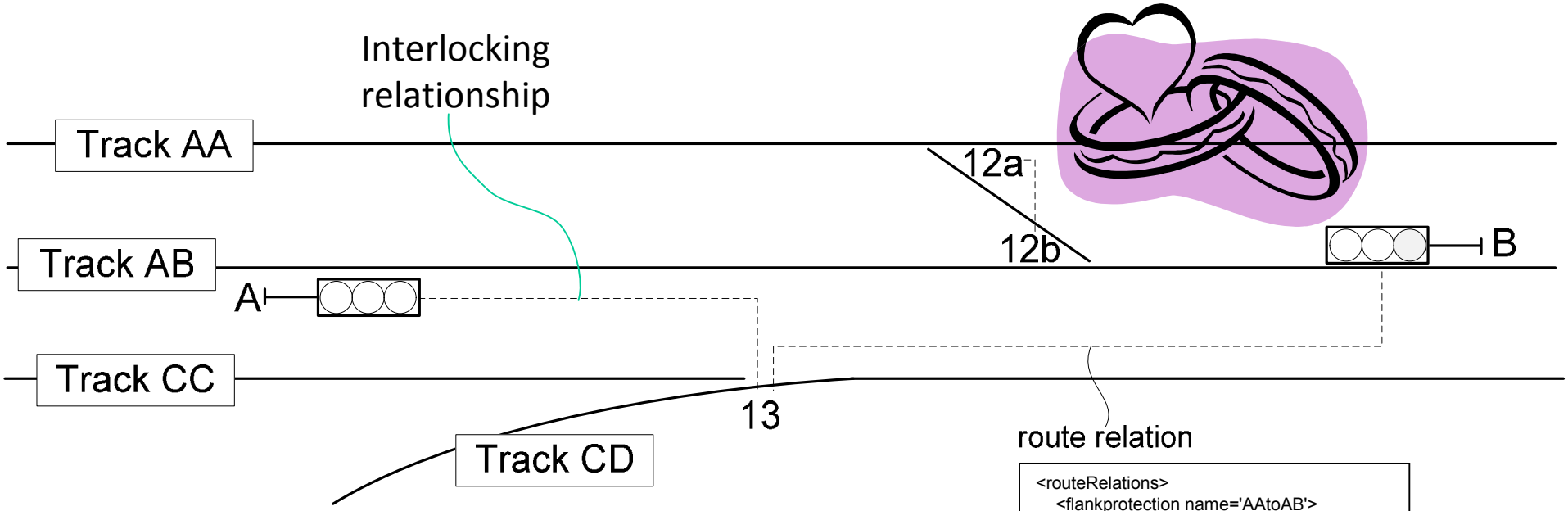
Interlocking is all about relations




```
<routeRelations>
   <flankprotection name='AAtoAB'>
      <point refId='12a'/>
      <point refId='12b'>
   </flankprotection >

   <flankprotection name='overSpeedCD1'>
       <signal refId='A'/>
       <point refId='13' status='Right'>
   </flankprotection >

   <flankprotection name='overSpeedCD2'>
      <signal refId='B'/>
      <point refId='13' status='Right'>
   </flankprotection>
</routeRelations>
```

Two tastes of flank protection

- Trivial : signals A, B and points 12a, 12b interlock
- Non-trivial: signals A, B and point 13 interlock

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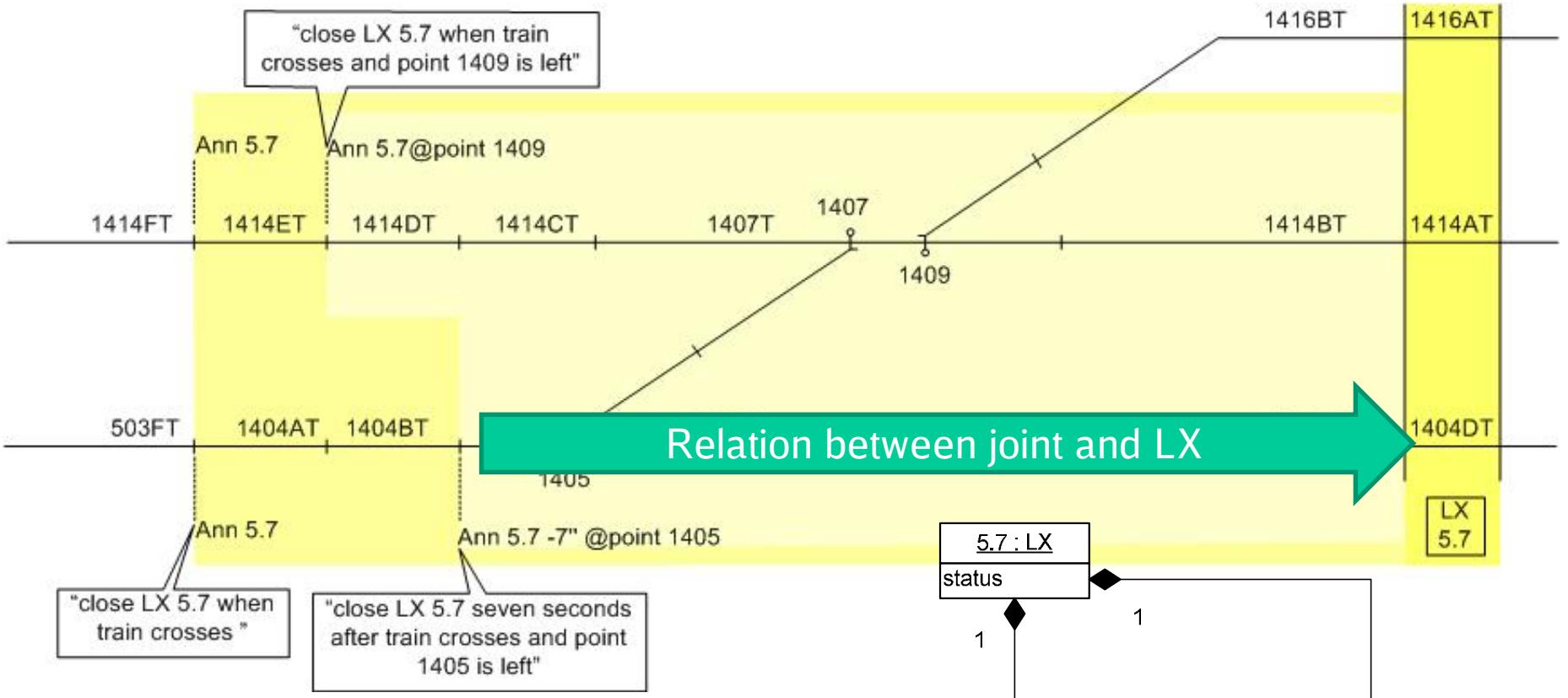
Level Crossing relations



LX is a set of relations between a barrier, signals and train detection

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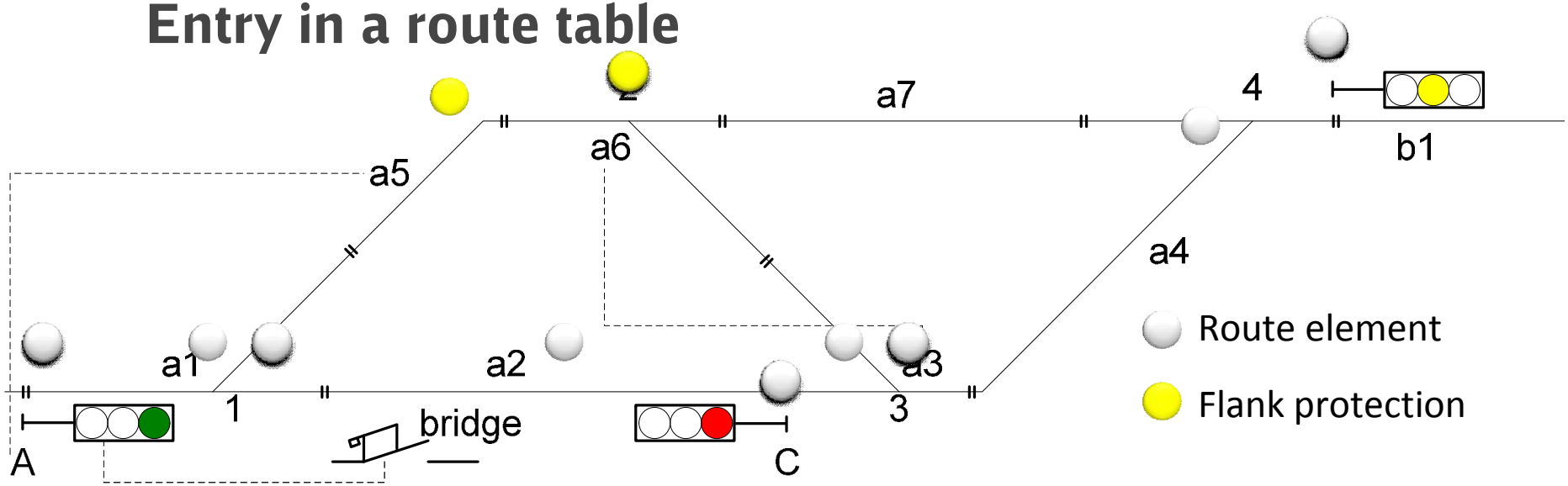
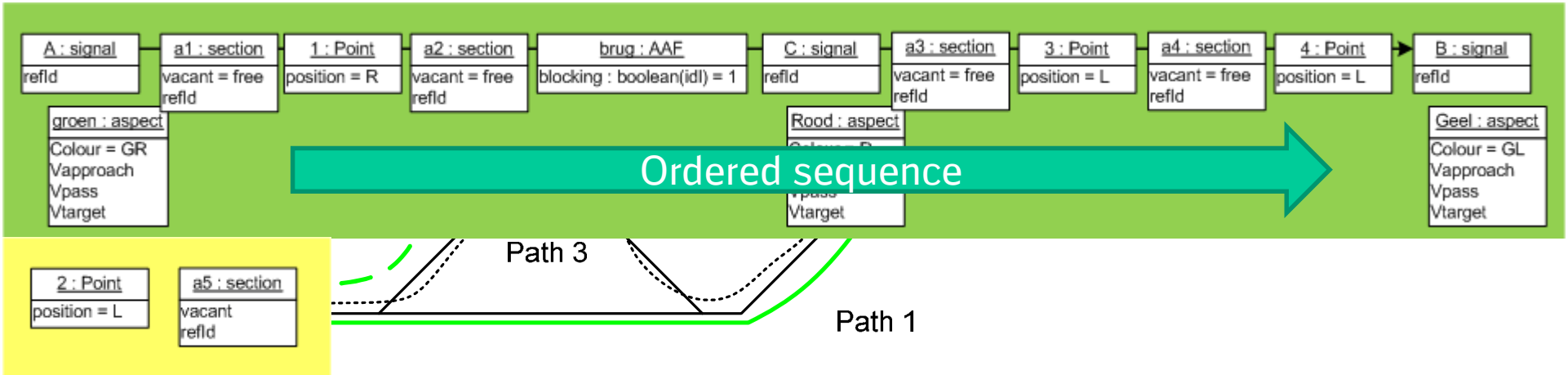
Entry in a route table





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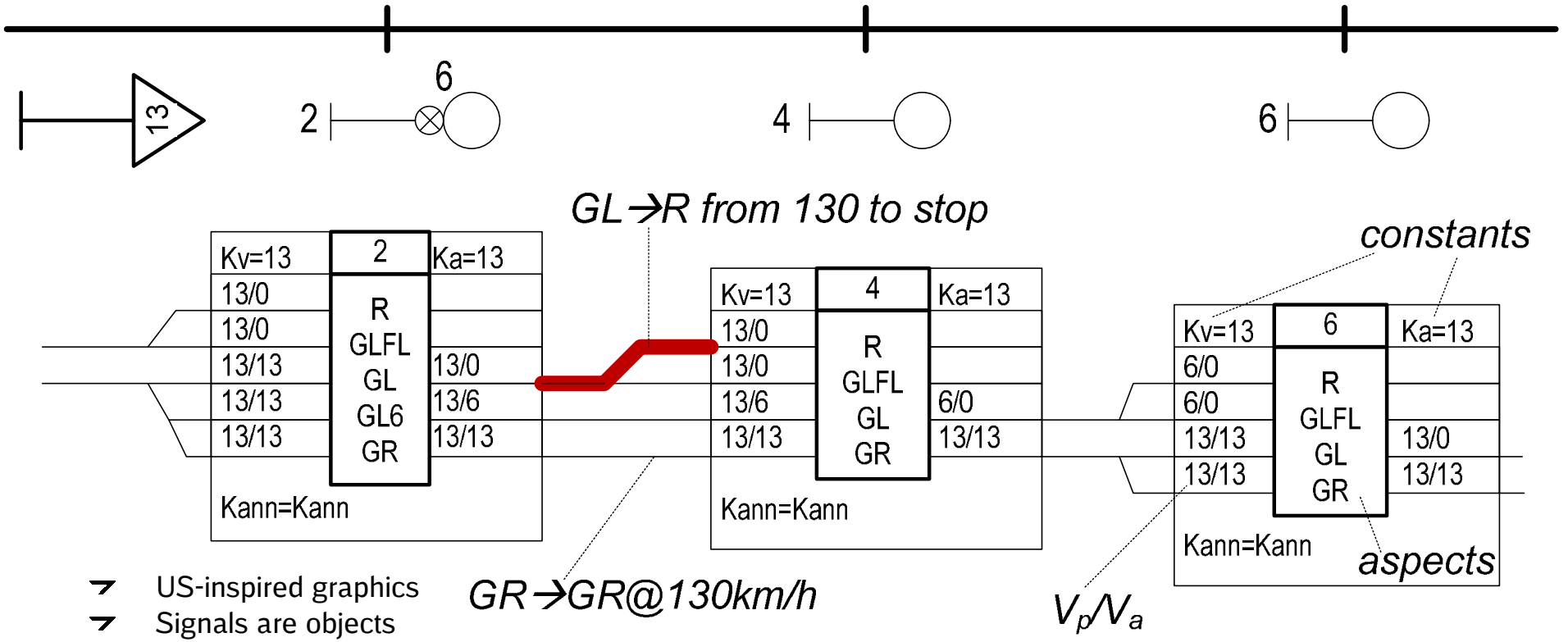
How to model a signal plan



- US-inspired graphics
- Signals are objects
- Attributes are signal aspects, speeds and *links to next signal*
- Model the signal plan as a linked list

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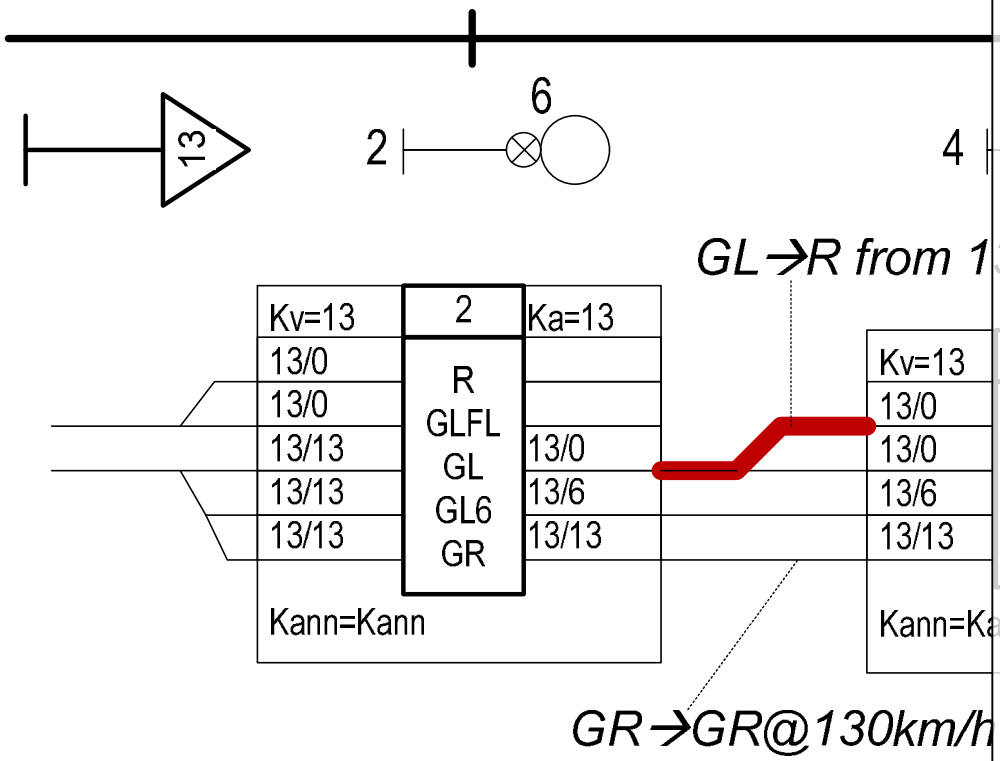
RailML model of a signal plan



railML® shall represent the relations between signals, aspects, speed profile and links between signals

```
<signalRelations>
 <signal refId='2' Kv='13' Ka='13'>
                <aspect code='R' Vp='0'/>
                <aspect code='GLFL' Vp='0'/>
                <aspect code='GL' Vp='13' Vz='0'>
                  <target refId='4'/>
                </aspect>
                <aspect code='GL6' Vp='13' Vz='6'>
                   <target refId='4'/>
                </aspect>
                <aspect code='GR' Vp='13' Vz='13'>
                   <target refId='4'/>
                </aspect>
 </signal>
 <signal refId='4' Kv='13' Ka='13'>
                <aspect code='R' Vp='0'/>
                <aspect code='GLFL' Vp='0'/>
                <aspect code='GL' Vp='6' Vz='0'/>
                   <target refId='6'/>
                </aspect>
                <aspect code='GR' Vp='13' Vz='13'/>
                   <target refId='6'/>
                <aspect/>
 </signal>
 <signal refId='6' Kv='13' Ka='13'>
                <aspect code='R' Vp='0'/>
                <aspect code='GLFL' Vp='0'/>
                <aspect code='GL' Vp='13' Vz='0'>
                   <target refId='8'/>
                </aspect>
                <aspect code='GR' Vp='13' Vz='13'>
                   <target refId='8'/>
   </signal>
</signalRelations>
```

constants

aspects

V_p V_a

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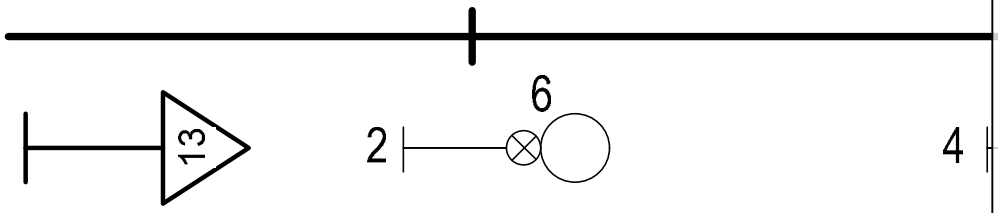
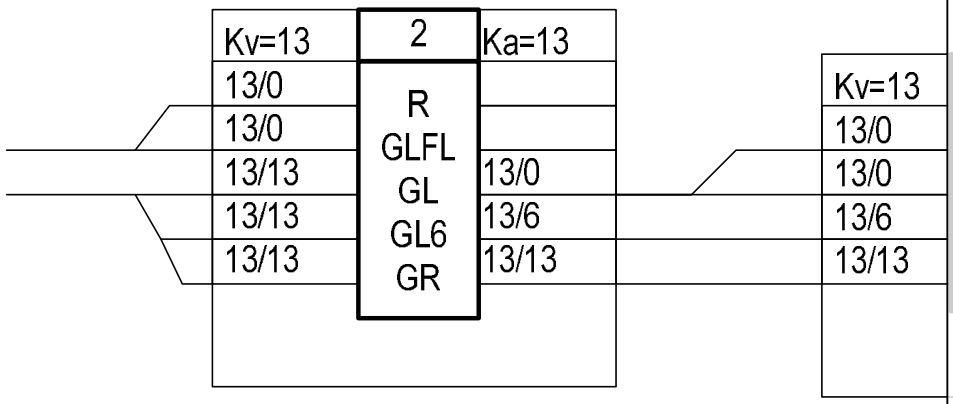
Power to XPath





Query: where can we go
when signal 2 shows yellow?

Xpath=//signal[@refId='**2**']/aspect[@code=='**GL**']
Result=
<signal refId='2'>
<aspect code='**GL**', Vp='13', Vz='**0**'>
<target refId='**4**'>
</signal>

```
<signalRelations>
 <signal refId='2' Kv='13' Ka='13'>
        <aspect code='R' Vp='0'/>
        <aspect code='GLFL' Vp='0'/>
        <aspect code='GL' Vp='13' Vz='0'>
          <target refId='4'/>
        </aspect>
        <aspect code='GL6' Vp='13' Vz='6'>
          <target refId='4'/>
        </aspect>
        <aspect code='GR' Vp='13' Vz='13'>
          <target refId='4'/>
        </aspect>
 </signal>
 <signal refId='4' Kv='13' Ka='13'>
        <aspect code='R' Vp='0'/>
        <aspect code='GLFL' Vp='0'/>
        <aspect code='GL' Vp='6' Vz='0'/>
          <target refId='6'/>
        </aspect>
        <aspect code='GR' Vp='13' Vz='13'/>
          <target refId='6'/>
        <aspect/>
 </signal>
 <signal refId='6' Kv='13' Ka='13'>
        <aspect code='R' Vp='0'/>
        <aspect code='GLFL' Vp='0'/>
        <aspect code='GL' Vp='13' Vz='0'>
          <target refId='8'/>
        </aspect>
        <aspect code='GR' Vp='13' Vz='13'>
          <target refId='8'/>
   </signal>
</signalRelations>
```

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Conclusions

- IS models topological relationships
- IL models interlocking relationships
- Route tables are best modelled as ordered sequences with required states.
- Interlocking relationships are modelled as associations between elements.
- Searching routes through railML® is trivial.
- Visual representation of railML® IL is needed.

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