TCCS - Data Model_11_ENG

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TCCS - Data Model_12_SS026

3 Package "Engineering"

3.1 Package Header

SPT2TS-122300 - Package specification

{
"$schema": "ERJU meta-model.json",
"isDefinedBy": "http://ERJU/datamodel/0.4/eng",
"name": "ETCSEngineering",
"containerStruct": "ETCSEngineering",
"prefix": "eng",
"intId": 3,
"version": "1.0",
"info": "Engineering Data for the ETCS Level 2/3 use case",
"enums": [], "structs": []
}

3.2 Buffer Stop

Note: details and need of buffer stop type etc. is under discussion.

SPT2TS-122292 - The modeling of buffer stops as linear objects allows for more precise safety assessments. It enables the evaluation of factors such as the required stopping distance, potential overruns, and the interaction between the buffer stop and the train in various scenarios. This information is crucial for designing appropriate safety measures while planning and ensuring compliance with safety regulations.
From the engineering point of view, buffer stop should be modelled as a linear object, rather than just a point, as it facilitates a more realistic representation of their physical characteristics, collision dynamics, structural integrity, and safety assessments. It enhances the accuracy of engineering analyses and supports the design and evaluation of effective buffer stop systems.
For base definition of the object see SPT2TS-93278 - Buffer Stop **[**Content to be approved **]**

SPT2TS-122285 - BufferStop


```
{
  "structs": [
  {
    "name": "BufferStop",
    "info": "object buffer stop on the track",
    "attrs": [
      { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.BufferStop",
 "info": "Identity of the object; used for referencing"},
      { "intId": 2, "name": "dangerPoints", "reference": "DangerPoint", "multiplicity": "0..*", "info":
"refers to danger points"},
      { "intId": 3, "name": "linearElementSections", "composition": "infra.LinearElementSection",
"multiplicity": "1..*", "info": "composes of track edge sections"},
      { "intId": 4, "name": "bsType", "enumType": "BufferStopType", "info": "Defines buffer stop
type"}
    ]
  }
],
"enums": [
  {
        "name": "BufferStopType",
        "enumLiterals": [
          { "intId": 0, "name": "friction", "info": "is of type friction"},
          { "intId": 1, "name": "hydraulic", "info": "is of type hyraulic"},
          { "intId": 2, "name": "fixated", "info": "is of type fixated"},
          { "intId": 3, "name": "other", "info": "is of type other"}
        ]
    }
]
}
```

3.3 Point and Crossing

SPT2TS-127354 - For base definition of the object see SPT2TS-49047 - Point, Crossing, Derailer **[**Content to be approved **]**

SPT2TS-122284 - Switch (SimplePoint)


```
{
  "structs": [
  {
    "name": "Switch",
    "info": "Defines the physical track asset Switch (Simple Point)",
    "attrs": [
      { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.Switch", "info": "Identity of the object; used for referencing"},
      { "intId": 2, "name": "foulingPoints", "reference": "FoulingPoint", "multiplicity": "1..*", "info": "refers to fouling points"},
      { "intId": 3, "name": "tipShift", "dataType": "double", "unit": "m", "info":"Defines the tip distance from the start of the switch on main and branching tracks"},
      { "intId": 4, "name": "bladeLength", "dataType": "double", "unit": "m", "info":"Defines the length of the  blade of switch along main and branching tracks"}
    ]
  }]
}
```


SPT2TS-125472 - Crossing


```
{
  "structs": [
  {
    "name": "Crossing",
    "info": "Defines the physical track asset Crossing without possibility to switch between two track edges",
    "attrs": [
      { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.Crossing", "info": "Identity of the object; used for referencing"},
      { "intId": 2, "name": "foulingPoints", "reference": "FoulingPoint", "multiplicity": "1..*", "info": "refers to fouling points"}
    ]
  }]
}
```

3.4 Level Crossing

SPT2TS-122290 - For base definition of the object see SPT2TS-64030 - Level Crossing **[**Content to be approved **]**

SPT2TS-122283 - LevelCrossing


```
{
  "structs": [
  {
    "name": "LevelCrossing",
    "info": "Defines the track asset level crossing",
    "attrs": [
      { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs":
"infra.LevelCrossing", "info": "Identity of the object; used for referencing"},
      { "intId": 2, "name": "dangerPoints", "reference": "DangerPoint", "multiplicity": "1..*", "info":
"refers to danger points"}
    ]
}]
}
```


3.5 Balise(Group) and Balise Packet

SPT2TS-127353 - For base definition of the object see SPT2TS-49051 - Balise (Group) **[**Content to be approved **]**

SPT2TS-122282 - BaliseGroup


```
{
  "structs": [
  {
    "name": "BaliseGroup",
    "info": "Defines a technical device group on the railway trackbed.",
    "attrs": [
      { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs":
"infra.BaliseGroup", "info": "Identity of the object; used for referencing"},
      { "intId": 2, "name": "m_version", "enumType": "ss026.ETCSMVersions",  "info": "This gives
the version of the ETCS system. Each part indicates the first and second number of the version
respectively: The first number distinguishes not compatible versions (The three MSBs)_ The
second number indicates compatibility within a version X. (The four LSBs)" },
      { "intId": 3, "name": "q_link", "dataType": "boolean",  "info": "true when the balise group is
linked, otherwise, false (unlinked)"  },
```

{ "intId": 4, "name": "q_updown", "dataType": "boolean", "info": "This defines the direction of information. True when it is Up-link (Track-to-Train) and false when it is Down-link (Train-to-Track)"}
]
}]
}

SPT2TS-125473 - Balise

{
"structs": [
{
"name": "Balise",
"info": "Defines a technical device on the railway trackbed.",
"attrs": [
{ "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.Balise", "info": "Identity of the object; used for referencing"},
{ "intId": 2, "name": "fixed", "dataType": "boolean", "info": "Defines if the balise is fixed or virtual" },
{ "intId": 3, "name": "m_dup", "enumType": "DuplicationType", "info": "Defines whether the information of the balise is a duplicate of the balise before or after"},
{ "intId": 4, "name": "m_mcount", "dataType": "uint32", "range":"0..255", "info": "the purpose of message counter is to make it possible for the ERTMS/ETCS on-board to detect which balise group message the telegram belongs to."},
{ "intId": 5, "name": "n_pig", "dataType": "uint32", "range":"0..7", "info": "position in the group. Defines the position of the balise in the balise group."},
{ "intId": 6, "name": "verticallyOriented", "dataType": "boolean", "info": "Defines the orientation of the balise. false when oriented parallel to the sleepers" },
{ "intId": 7, "name": "standardSize", "dataType": "boolean", "info": "Defines the standard size if balise. false when balise is of reduced size" },
{ "intId": 8, "name": "etcsPackets", "composition": "ss026.BalisePacket", "multiplicity": "0..*", "info": "Defines the ETCS packets associates to the Balise Group."},
{ "intId": 9, "name": "telegram", "dataType": "bytes", "info": "Defines the telegram content of the balise"},
{ "intId": 10, "name": "telegramChecksum", "dataType": "string", "info": "Defines the checksum to verify the integrity of the stored telegram"},
{ "intId": 11, "name": "sleeperFastening", "dataType": "string", "info": "Defines the fastening system used for the balise on the sleeper"},
{ "intId": 12, "name": "baliseMountingSystem", "dataType": "string", "info": "Defines the mounting system used for the balise"},

{ "intId": 13, "name": "designType", "dataType": "string", "info": "Defines the manufacturer type for the balise"}
]
}
],
"enums": [
{
"name": "DuplicationType",
"info": "Flags to indicate whether the information of the balise is a duplicate of the balise before or after.",
"enumLiterals": [
{ "intId": 0, "name": "noDuplicates", "info": " does not duplicate any balise"},
{ "intId": 1, "name": "duplicateNextBalise", "info": " duplicates next balise"},
{ "intId": 2, "name": "duplicatePreviousBalise", "info": "duplicates previous balise"}
]
}
]
}

3.6 Sleeper

SPT2TS-122293 - Sleepers are components on which the rails arranged with corresponding gauge. Depending on the sleeper type, balise holder is chosen to enable precise positioning and to transmit the safety critical data of the balise. Type of sleeper is also relevant for mounting of balises. In general, the area of the engineering structures can be of bad mounting conditions. Therefore, it is necessary to check the balise planning if it is possible to move the balises out of those areas.

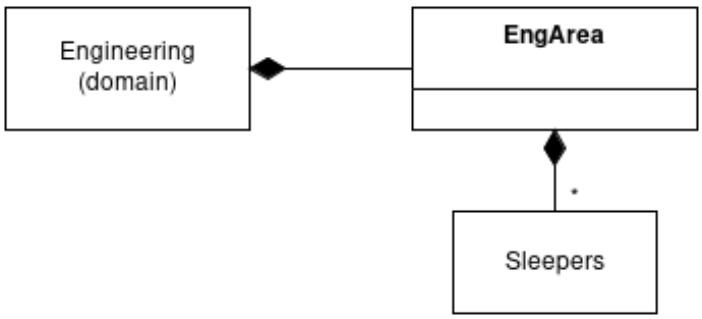

Figure 1 Class Diagram of Sleeper

[Open **]**

SPT2TS-122278 - Sleepers


```
{
  "structs":  [
  {
   "name": "Sleepers",
    "info": "Sleepers are components on which the rails arranged with corresponding gauge.",
   "attrs": [
     {"intId": 1, "name": "id", "dataType": "string", "key": "global", "info": "Identity of the object; used for referencing"},
     {"intId": 2, "name": "linearElementSection", "composition": "infra.LinearElementSection", "multiplicity": "1..*", "info": "composes of track edge sections"},
     {"intId": 3, "name": "sleepersType", "enumType": "SleepersType", "info": "defines sleepers type"}
  ]
}],
"enums": [
{
  "name": "SleepersType",
  "enumLiterals": [
    { "intId": 0, "name": "unknownSleepersType", "info": " sleeper type unknown"},
    { "intId": 1, "name": "composite", "info": " is of type composite"},
    { "intId": 2, "name": "concrete", "info": "is of type concrete"},
    { "intId": 3, "name": "steel", "info": "is of type steel"},
    { "intId": 4, "name": "wood", "info": "is of type wood"}
  ]
}]
}
```


3.7 Danger Point

SPT2TS-122294 - The concept of a "danger point" is crucial for the implementation of the ETCS L2 w.Signal technology. The danger point refers to a specific location on the railway where a potential conflict or danger may arise between trains or between trains and other objects (such as road crossings or platforms). It is identified and managed in the context of ETCS Level 2 planning for the purposes Safety assurance, Balise placement, Movement authority, Signalling and intervention. Overall, in ETCS Level 2 *wosig* planning, the identification and management of danger points are vital for ensuring safe train operations, determining balise placements, calculating movement authorities, and facilitating appropriate signaling and intervention strategies to prevent potential conflicts and enhance railway safety.

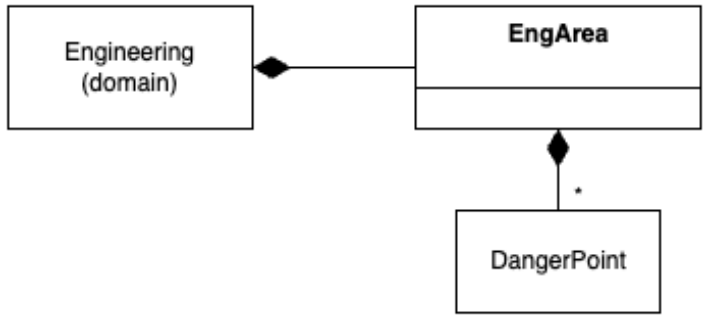

Figure 2 Class Diagram of Danger Point

[Open **]**

SPT2TS-122277 - DangerPoint

{
"structs": [
{
"name": "DangerPoint",
"info": "a specific location on the railway where a potential conflict or danger may arise between trains or between trains and other object",
"attrs": [
{"intId": 1, "name": "id", "dataType": "string", "key": "global", "info": "Identity of the object; used for referencing"},
{"intId": 2, "name": "name", "dataType": "string","info": "User-friendly name, only if different from id"},
{"intId": 3, "name": "topologicalCoordinate", "composition": "infra.TopologicalCoordinate", "info": "Defines the point location on the linear element"}
]
}
]
}

3.8 Fouling Point

SPT2TS-124158 - While danger point is a broad concept related to potential hazard throughout the network, fouling point (see Figure) specifically deals with preventing trains from occupying the same track space as other objects, that is, fouling point refers to the point on a railway track beyond which a train is not allowed to proceed if another train or object is occupying that portion of the track.

Trains are not permitted to “foul” or occupy the beyond the fouling point to prevent collision. Hence, a projection of the fouling point is defined on linear elements of the diverging tracks. This

projection is provided via the topological coordinate. his ensures that if a train is detected beyond the fouling point, it will consistently maintain a safe separation from another train moving on the adjacent track.

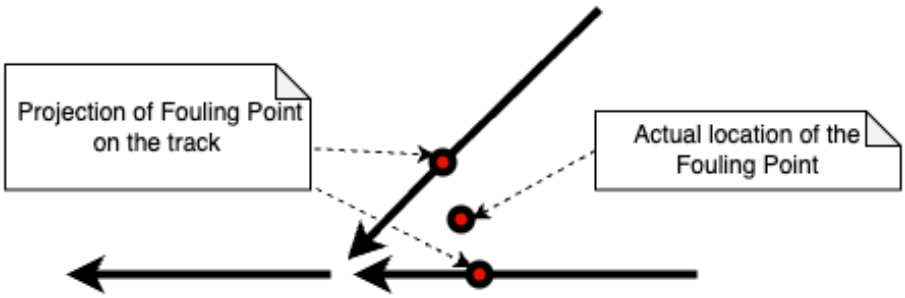

Figure 3 Fouling Point

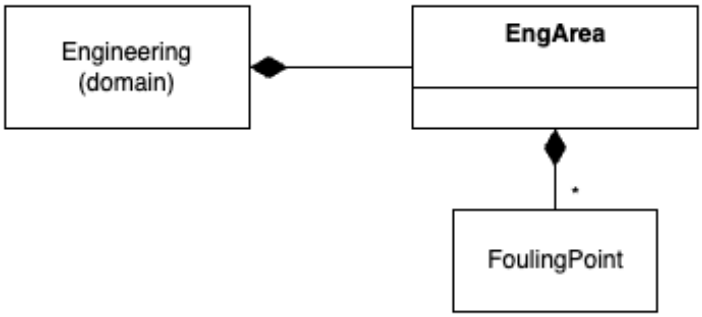

Figure 4 Class digram of Fouling Point

[Open **]**

SPT2TS-124160 - FoulingPoint

{
"structs": [
{
"name": "FoulingPoint",
"info": "the point on a railway track beyond which a train is not allowed to proceed if another train or object is occupying that portion of the track",
"attrs": [
{"intId": 1, "name": "id", "dataType": "string", "key": "global", "info": "Identity of the object; used for referencing"},
{"intId": 2, "name": "name", "dataType": "string", "info": "User-friendly name, only if different from id", "multiplicity": "0..1" },
{"intId": 3, "name": "topologicalCoordinate", "composition": "infra.TopologicalCoordinate", "info": "Defines the point location on the linear element"}

```
    ]
  }]
}
```

3.9 Container for Engineering Area

SPT2TS-122286 - EngineeringArea


```
{
  "structs": [
  {
    "name": "EngArea",
    "attrs": [
      { "intId": 1, "name": "onTopoArea", "reference": "infra.TopoArea", "info": "refrence to the corresponding Topo Area"},
      { "intId": 2, "name": "defaultSleepersType", "enumType": "SleepersType", "info": "Defines the default sleeper type"},
      { "intId": 3, "name": "switches", "composition": "Switch", "multiplicity": "0..*", "info": "Defines the list of switches"},
      { "intId": 4, "name": "crossings", "composition": "Crossing", "multiplicity": "0..*", "info": "Defines the list of crossings" },
      { "intId": 5, "name": "levelCrossings", "composition": "LevelCrossing", "multiplicity": "0..*", "info": "Defines the list of level crossings"},
      { "intId": 6, "name": "baliseGroup", "composition": "BaliseGroup", "multiplicity": "0..*", "info": "Defines the balise groups"},
      { "intId": 7, "name": "balises", "composition": "Balise", "multiplicity": "0..*", "info": "Defines the list of balises"},
      { "intId": 8, "name": "sleepers", "composition": "Sleepers", "multiplicity": "0..*", "info": "Defines the list of sleepers"},
      { "intId": 9, "name": "dangerPoints", "composition": "DangerPoint", "multiplicity": "0..*", "info": "Defines the list of danger points"},
      { "intId": 10, "name": "foulingPoints", "composition": "FoulingPoint", "multiplicity": "0..*", "info": "Defines the list of fouling points"},
      { "intId": 11, "name": "bufferStops", "composition": "BufferStop", "multiplicity": "0..*", "info": "Defines the list of buffer stops" }
    ]
  }]
}
```

3.10 Location accuracy area

SPT2TS-125478 - LocationAccuracyArea


```
{
"structs" : [
{
  "name": "LocationAccuracyArea",
  "attrs": [
    {"intId": 1, "name": "onTopoArea", "reference": "infra.TopoArea", "info": "reference to the corresponding Topo Area"},
    {"intId": 2, "name": "baliseAccuracies", "composition": "BaliseAccuracy", "multiplicity": "*", "info": "Defines the balise accuracies"},
    {"intId": 3, "name": "etcsMarkerAccuracies", "composition": "EtcsMarkerAccuracy", "multiplicity": "*", "info": "Defines the ETCS Marker Accuracies", "ordered": "byKey"},
    {"intId": 4, "name": "stopLocationAccuracies", "composition": "StopLocationAccuracy", "multiplicity": "*", "info": "Defines the Stop Location Accuracies", "ordered": "byKey"},
    {"intId": 5, "name": "nationalBorderAccuracies", "composition": "NationalBorderAccuracy", "multiplicity": "*", "info": "Defines the National Border Accuracies", "ordered": "byKey"},
    {"intId": 6, "name": "bufferStopAccuracies", "composition": "BufferStopAccuracy", "multiplicity": "*", "info": "Defines the BufferStop Accuracies", "ordered": "byKey"}
  ]
}]
}
```


SPT2TS-125479 - BaliseAccuracy


```
{
  "structs": [
  {
     "name": "BaliseAccuracy",
     "attrs": [
       {"intId": 1, "name": "balise", "reference": "infra.Balise", "info": "Defines a reference to a functional balise"},
       {"intId": 2, "name": "accuracy", "dataType": "uint32", "unit": "m", "exp": -3, "info": "defines absolute deviation as 1sigma for balise"}
     ]
```

}]
}

SPT2TS-125480 - EtcsMarkerAccuracy

{
"structs": [
{
"name": "EtcsMarkerAccuracy",
"attrs": [
{"intId": 1, "name": "etcsMarker", "reference": "infra.ETCSMarker", "info": "refers to ETCS Marker"},
{"intId": 2, "name": "accuracy", "dataType": "uint32", "unit": "m", "exp": -3, "info": "defines absolute deviation as 1sigma for etcsMarker"}
]
}]
}

SPT2TS-125481 - StopLocationAccuracy

{
"structs": [
{
"name": "StopLocationAccuracy",
"attrs": [
{"intId": 1, "name": "stopLocation", "reference": "infra.StopLocation", "info": "refers to stop locaton"},
{"intId": 2, "name": "accuracy", "dataType": "uint32", "unit": "m", "exp": -3, "info": "defines absolute deviation as 1sigma for stop location"}
]
}]
}

SPT2TS-125482 - NationalBorderAccuracy

{
"structs": [
{

"name": "NationalBorderAccuracy",
"attrs": [
{"intId": 1, "name": "nationalBorder", "reference": "infra.NationalBorder", "info": "refers to National border"},
{"intId": 2, "name": "accuracy", "dataType": "uint32", "unit": "m", "exp": -3, "info": "defines absolute deviation as 1sigma for stop location"}
]
}]
}

SPT2TS-125483 - BufferStopAccuracy

{
"structs": [
{
"name": "BufferStopAccuracy",
"attrs": [
{"intId": 1, "name": "bufferStop", "reference": "infra.BufferStop", "info": "refers to buffer stop"},
{"intId": 2, "name": "accuracy", "dataType": "uint32", "unit": "m", "exp": -3, "info": "defines absolute deviation as 1sigma for stop location"}
]
}]
}

3.11 Kilometer Signs

SPT2TS-127376 - Kilometer Signs represent the actual signs boards along the track. The data model provides the track edge location as well as the track kilometer written on the sign e.g., 14.00. These are also called as Hectometer signs. This object is not suitable for track planning activities, rather is only used as visual aid or UI purposes for the system users. **[**Content to be approved **]**

SPT2TS-125614 - LinearElementKmSigns (TrackEdgeKmSigns)

{
"structs": [
{
"name": "LinearElementKmSigns",

"attrs": [
{"intId": 1, "name": "linearElement", "reference": "infra.LinearElement", "info": "reference to the corresponding linear element"},
{"intId": 2, "name": "kilometricPosts", "composition": "KilometricPost", "multiplicity": "*", "ordered": "byIndex", "info": "Defines the kilometre posts on the track. These are sorted by pos from 0 to length"}
]
}]}

SPT2TS-125615 - KilometricPost

{
"structs": [
{
"name": "KilometricPost",
"info": "An object that represent a physical sign that would be used to convey Kilometer information at specific location on a LinearElement",
"attrs": [
{"intId": 1, "name": "pos", "dataType": "uint32", "unit": "m", "exp": -3, "info": "position on the associated LinearElement"},
{"intId": 2, "name": "kmPostName", "dataType": "string", "multiplicity": "0..1", "info": "Defines the name of Kilometric Post (optional)"},
{"intId": 3, "name": "kilometerNumber", "dataType": "uint32", "info": "Defines the kilometer number of the kilometric post"}
]
}]}

SPT2TS-125616 - KmArea

{
"structs": [
{
"name": "KmArea",
"attrs": [
{"intId": 1, "name": "onTopoArea", "reference": "infra.TopoArea", "info": "refrence to the corresponding Topo Area"},
{"intId": 2, "name": "linearElementKmSigns", "composition": "LinearElementKmSigns",

"multiplicity": "*", "ordered": "byKey", "info": "composes of linear element kilometer signs"}
]
}
]
}

3.12 Container for ETCS Engineering

SPT2TS-122311 - ETCSEngineering

{
"structs": [
{
"name": "ETCSEngineering",
"attrs": [
{"intId": 1, "name": "engAreas", "composition": "EngArea", "multiplicity": "*", "info": "Defines the list of engineering areas", "ordered": "byKey"},
{"intId": 2, "name": "locationAccuracyAreas", "composition": "LocationAccuracyArea", "multiplicity": "*", "info": "Defines the list of location accuracy areas", "ordered": "byKey"},
{"intId": 3, "name": "kmAreas", "composition": "KmArea", "multiplicity": "*", "info": "Defines the list of km areas", "ordered": "byKey"}
]
}
]
}