




ERJU SYSTEM PILLAR

TCCS - Data Model_11_ENG



TCCS - Data Model_11_ENG

Author(s)	Olatunji-Felix Ajala -Extern , Kehinde-Emmanuel Enisan -Extern
Abstract	This document extends the SD1 data model with the content required by the ETCS L2/3 use case for engineering and planning aspects.
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2 References

SPT2TS/TCCS SD1 - Data Model/TCCS SD1 - Data Model_12_SS026 : 712671

3 Package "Engineering"

3.1 Package Header

SPT2TS-122300 - Package specification

```
{
  "$schema": "ERJU meta-model.json",
  "isDefinedBy": "http://ERJU/datamodel/1.3/eng",
  "name": "ETCSEngineering",
  "containerStruct": "ETCSEngineering",
  "prefix": "eng",
  "intId": 3,
  "version": "1.3",
  "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

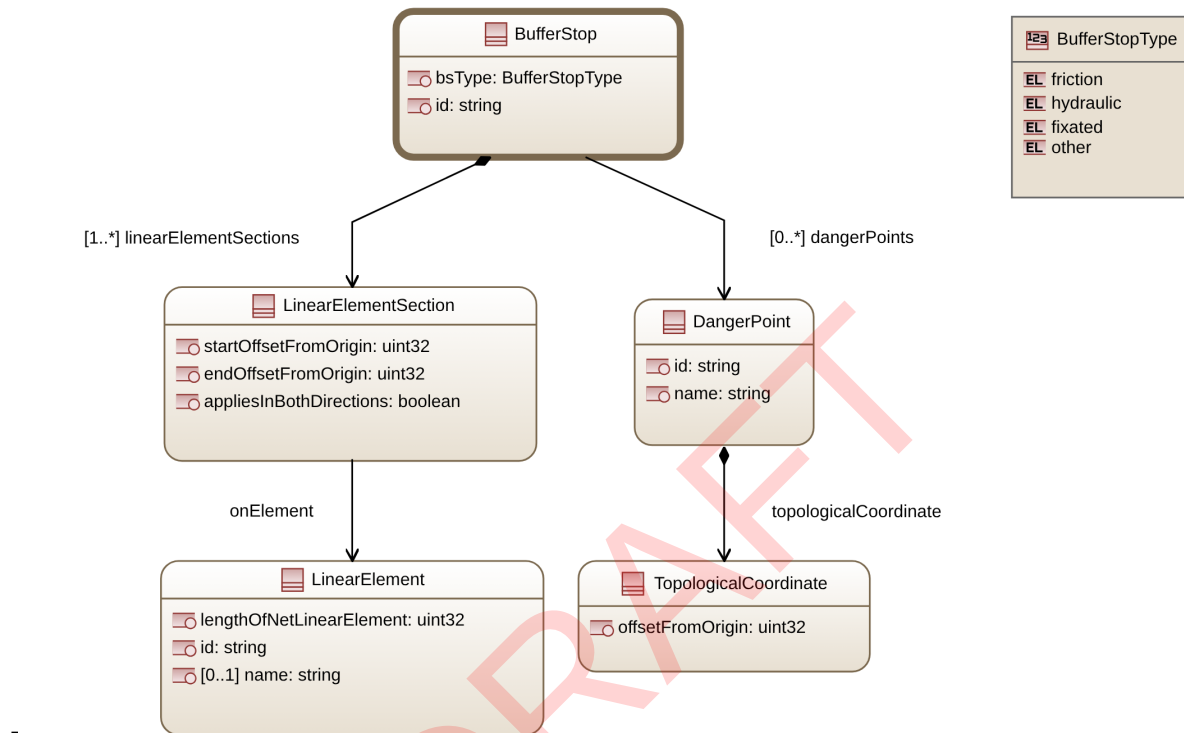
regulations.

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]

SPMS-7525 - BufferStop

object buffer stop on the track



[
Figure 1 Tree View of BufferStop
]

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 hydraulic"},
{ "intId": 2, "name": "fixated", "info": "is of type fixated"},
{ "intId": 3, "name": "other", "info": "is of type other"}
]
}
]
}[]

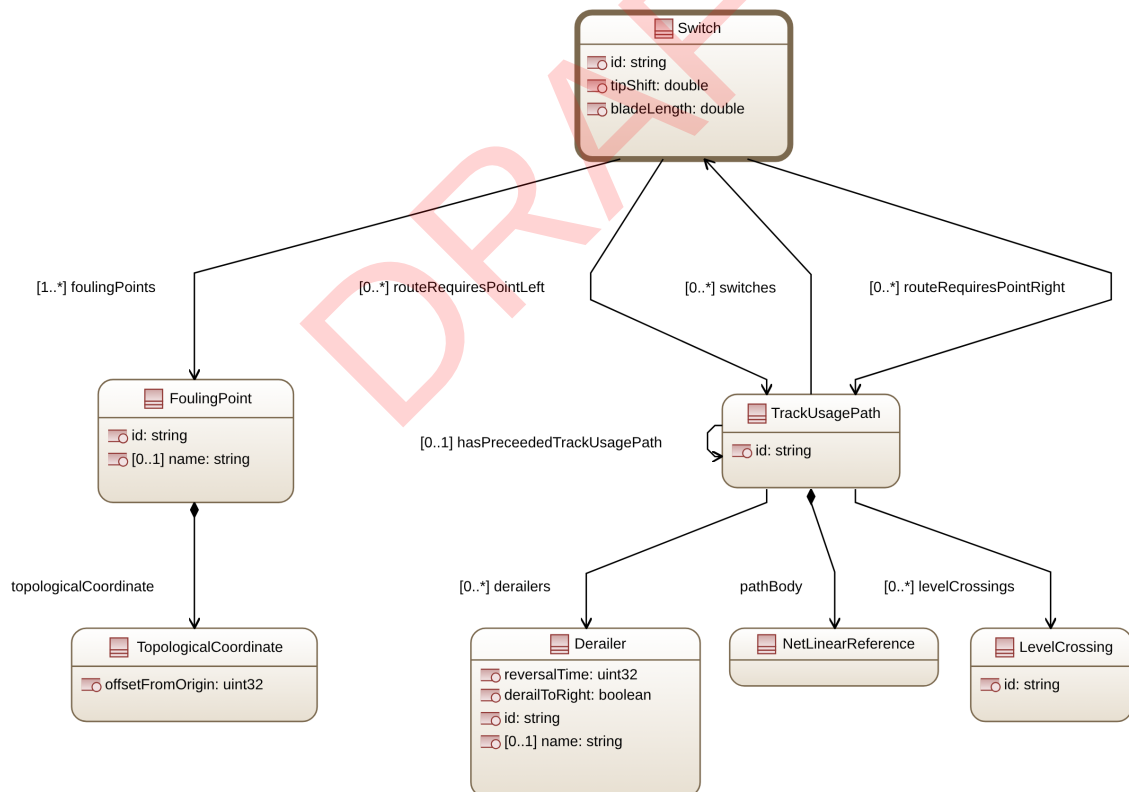
```

3.3 Point and Crossing

SPT2TS-127354 - For base definition of the object see [SPT2TS-49047 - Switch, Crossing, Derailer](#) [🔍]
Content to be approved]

SPMS-7526 - Switch

Defines the physical track asset Switch (Simple Point)



[
Figure 2 Tree View of Switch
]

SPT2TS-122284 - Switch (SimplePoint)

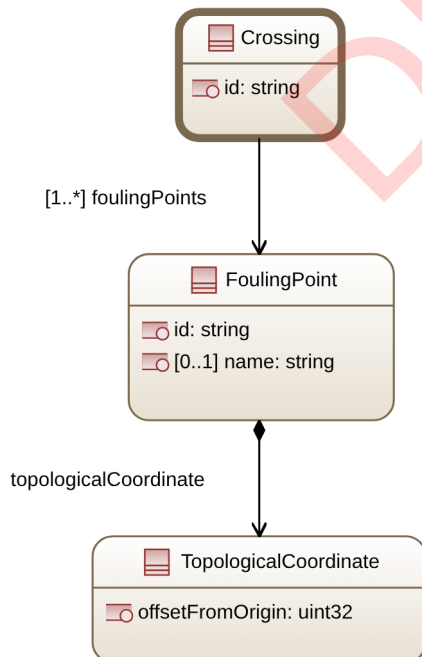
```

{
  "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", "ontology": { "subPropertyOf": "http://data.europa.eu/949/length" }},
        { "intId": 5, "name": "routeRequiresPointRight", "reference": "TrackUsagePath", "multiplicity": "0..*", "info": "list of trackUsagePaths that require this Switch to allow travelling through pointRight."},
        { "intId": 6, "name": "routeRequiresPointLeft", "reference": "TrackUsagePath", "multiplicity": "0..*", "info": "list of trackUsagePaths that require this Switch to allow travelling through pointLeft."}
      ]
    }
  ]
}

```

SPMS-7527 - Crossing

Defines the physical track asset Crossing without possibility to switch between two track edges



[
Figure 3 Tree View of Crossing
]

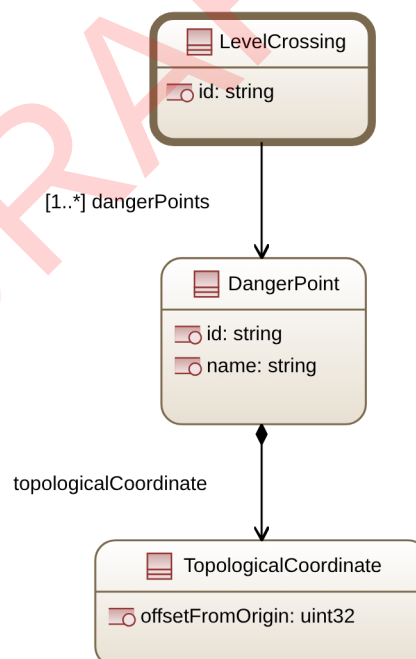
SPT2TS-125472 - Crossing

```
{
  "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]

SPMS-7528 - LevelCrossing



Defines the track asset level crossing [

Figure 4 Tree View of LevelCrossing



]

SPT2TS-122283 - LevelCrossing

```
{
  "structs": [
```

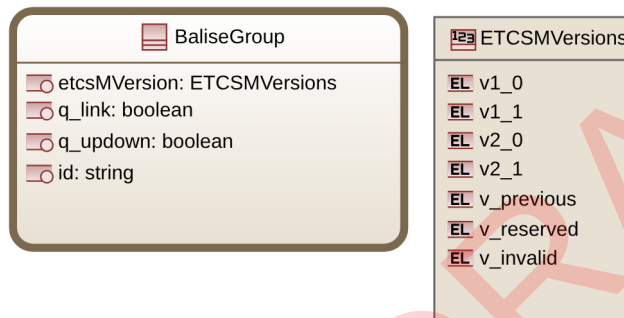
```
{
  "name": "LevelCrossing",
  "info": "Defines the track asset level crossing",
  "attrs": [
    { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.LevelCrossing", "info":
      "Identity of the object; used for referencing"},
    { "intId": 2, "name": "dangerPoints",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

SPMS-7529 - BaliseGroup

Defines a technical device group on the railway trackbed.



[
Figure 5 Tree View of BaliseGroup
]

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": "etcsMVersion", "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)" }
]
}
} []

```

SPMS-7530 - Balise

Defines a technical device on the railway trackbed.

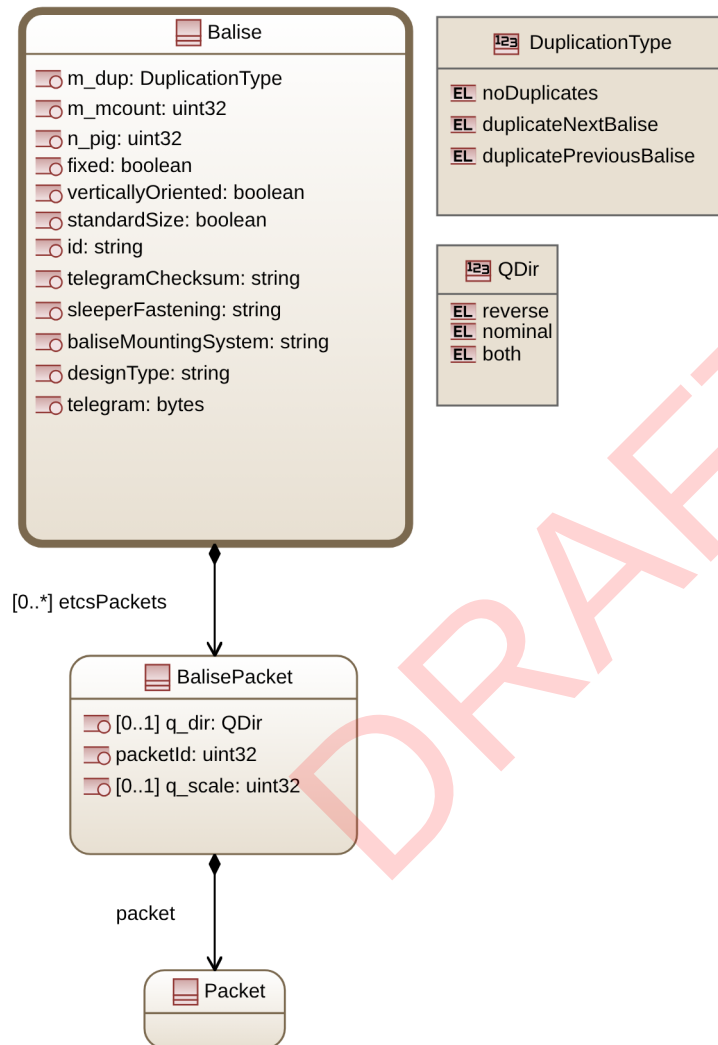


Figure 6 Tree View of Balise

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 if the balise is of standard size.
false when balise is of reduced size" },
{ "intId": 8, "name": "sleepersType", "enumType": "SleepersType", "info": "Defines the sleepersType on
which the Balise was mounted"},
{ "intId": 9, "name": "etcsPackets", "composition": "ss026.BalisePacket", "multiplicity": "0..*", "info":
"Defines the ETCS packets associates to the Balise Group."},
{ "intId": 10, "name": "telegram", "dataType": "bytes", "multiplicity": "0..1", "info": "Defines the telegram
content of the balise"},
{ "intId": 11, "name": "telegramChecksum", "dataType": "string", "multiplicity": "0..1", "info": "Defines the
checksum to verify the integrity of the stored telegram"},
{ "intId": 12, "name": "sleeperFastening", "dataType": "string", "multiplicity": "0..1", "info": "Defines the
fastening system used for the balise on the sleeper"},
{ "intId": 13, "name": "baliseMountingSystem", "dataType": "string", "multiplicity": "0..1", "info": "Defines the
mounting system used for the balise"},
{ "intId": 14, "name": "designType", "dataType": "string", "multiplicity": "0..1", "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 are 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.

[ Open]

SPMS-7531 - Sleepers

Sleepers are components on which the rails are arranged with corresponding gauge.

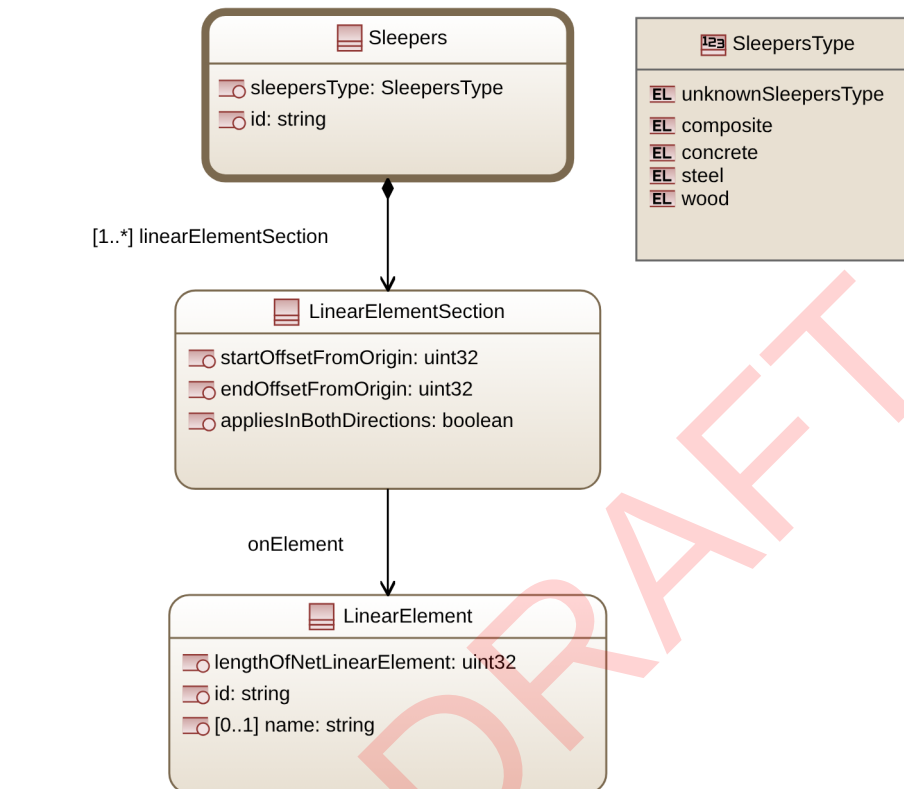


Figure 7 Tree View of Sleepers

SPT2TS-122278 - Sleepers

```

{
  "structs": [
    {
      "name": "Sleepers",
      "info": "Sleepers are components on which the rails are 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"}
]
}]
} []

```

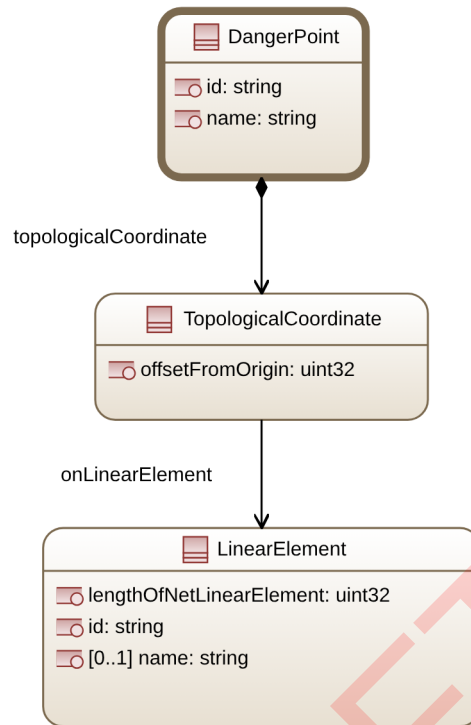
3.7 Danger Point

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.

[ Open]

SPMS-7532 - DangerPoint

a specific location on the railway where a potential conflict or danger may arise between trains or between



trains and other object [

Figure 8 Tree View of DangerPoint

]

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. This 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.

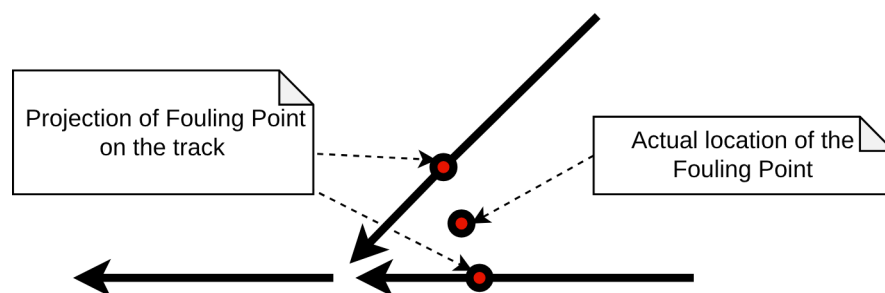
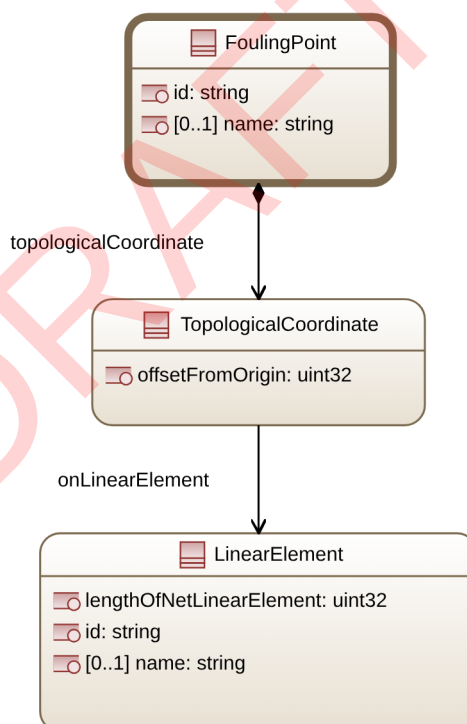


Figure 9 Fouling Point

[ Open]

SPMS-7533 - FoulingPoint

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 [

Figure 10 Tree View of FoulingPoint

]

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" }

]

}}

} []

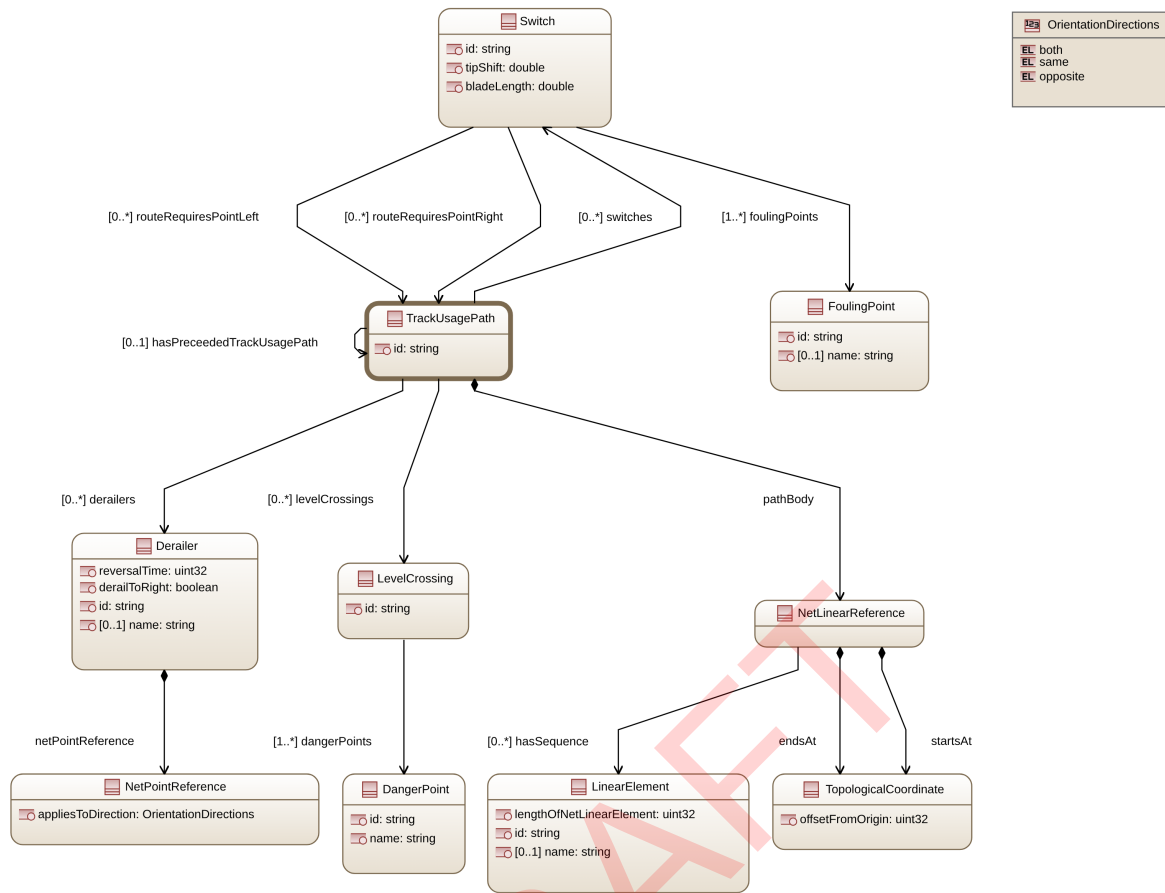
3.9 TrackUsagePath

SPT2TS-131111 - TrackUsagePath represents a defined and usable stretch of track infrastructure that a train is authorized or could intend to follow under specific operational conditions. It encapsulates a sequence of interconnected track elements (such as linear elements, switches, crossings, etc) which, when combined, form a coherent and safe path for train movement within a given railway network. This concept abstracts the traditional notion of a "route" by emphasizing the usage context, such as movement authorization, path planning, or temporary allocation, rather than fixed topology or purely physical layout. The TrackUsagePath may be influenced by ETCS configurations or operational scenarios among others. [ Open]

SPMS-7534 - TrackUsagePath

A defined sequence of track elements and associated infrastructure forming a continuous operational

path.



[
Figure 11 Tree View of TrackUsagePath
]

SPT2TS-131108 - TrackUsagePath

```

{
  "structs": [
    {
      "name": "TrackUsagePath",
      "info": "A defined sequence of track elements and associated infrastructure forming a continuous operational path.",
      "attrs": [
        { "intId": 1, "name": "id", "dataType": "string", "key": "global", "info": "Identity of the object; used for referencing" },
        { "intId": 2, "name": "switches", "reference": "Switch", "multiplicity": "0..*", "info": "Defines the list of switch(es)" },
        { "intId": 3, "name": "derailleurs", "reference": "infra.Derailler", "multiplicity": "0..*", "info": "Defines the list of derailer(s)" },
        { "intId": 4, "name": "levelCrossings", "reference": "LevelCrossing", "multiplicity": "0..*", "info": "Defines the list of level crossings" },
        { "intId": 5, "name": "pathBody", "composition": "infra.NetLinearReference", "info": "List of linear references" }
      ]
    }
  ]
}

```



```
included in the track usage path."},
{ "intId": 6, "name": "hasPreceededTrackUsagePath", "reference": "TrackUsagePath", "multiplicity": "0..1",
  "info": "Defines the preceeded track usage path"
}
}]
} [ ]
```

3.10 Container for Engineering Area

SPMS-7535 - EngArea

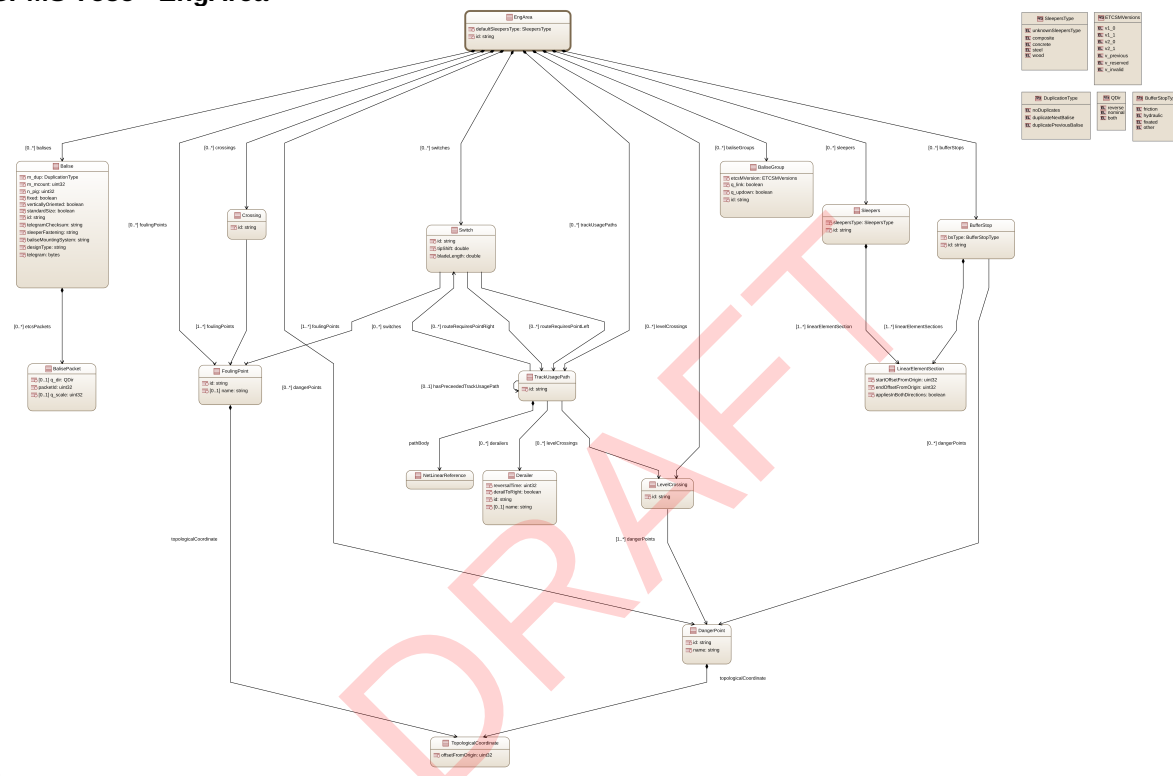


Figure 12 Tree View of EngArea

SPT2TS-122286 - EngineeringArea

```
{
  "structs": [
    {
      "name": "EngArea",
      "attrs": [
        { "intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.TopoArea", "info": "Identity of the object; used for referencing"},
        { "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"}
      ]
    }
  ]
}
```

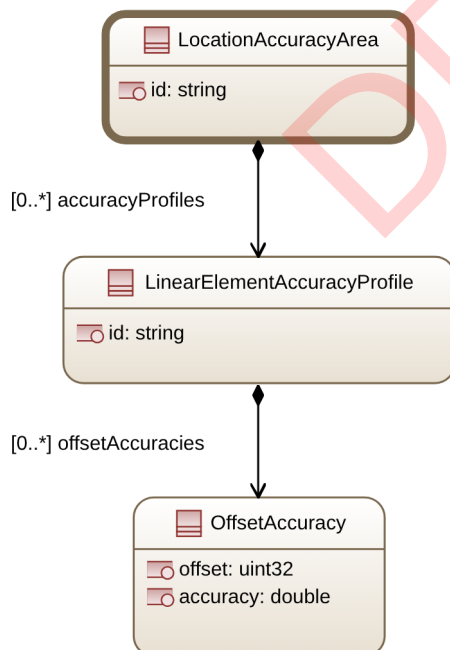
```

{ "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": "baliseGroups", "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": "trackUsagePaths", "composition": "TrackUsagePath", "multiplicity": "0..*", "info":
"Defines the list of track usage paths"},
{ "intId": 10, "name": "dangerPoints", "composition": "DangerPoint", "multiplicity": "0..*", "info": "Defines the
list of danger points"},
{ "intId": 11, "name": "foulingPoints", "composition": "FoulingPoint", "multiplicity": "0..*", "info": "Defines the
list of fouling points"},
{ "intId": 12, "name": "bufferStops", "composition": "BufferStop", "multiplicity": "0..*", "info": "Defines the list
of buffer stops" }
]
}
}
} []

```

3.11 Location accuracy area

SPMS-7536 - LocationAccuracyArea



[
Figure 13 Tree View of LocationAccuracyArea
]

SPT2TS-125478 - LocationAccuracyArea


```
{
  "structs": [
    {
      "name": "LocationAccuracyArea",
      "attrs": [
        {"intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.TopoArea", "info": "Identity of the object; used for referencing"},
        {"intId": 2, "name": "accuracyProfiles", "composition": "LinearElementAccuracyProfile", "multiplicity": "*", "info": "Defines the accuracies for defined linear elements"}
      ]
    }
  ]
}
```

SPT2TS-130380 - LinearElementAccuracyProfile

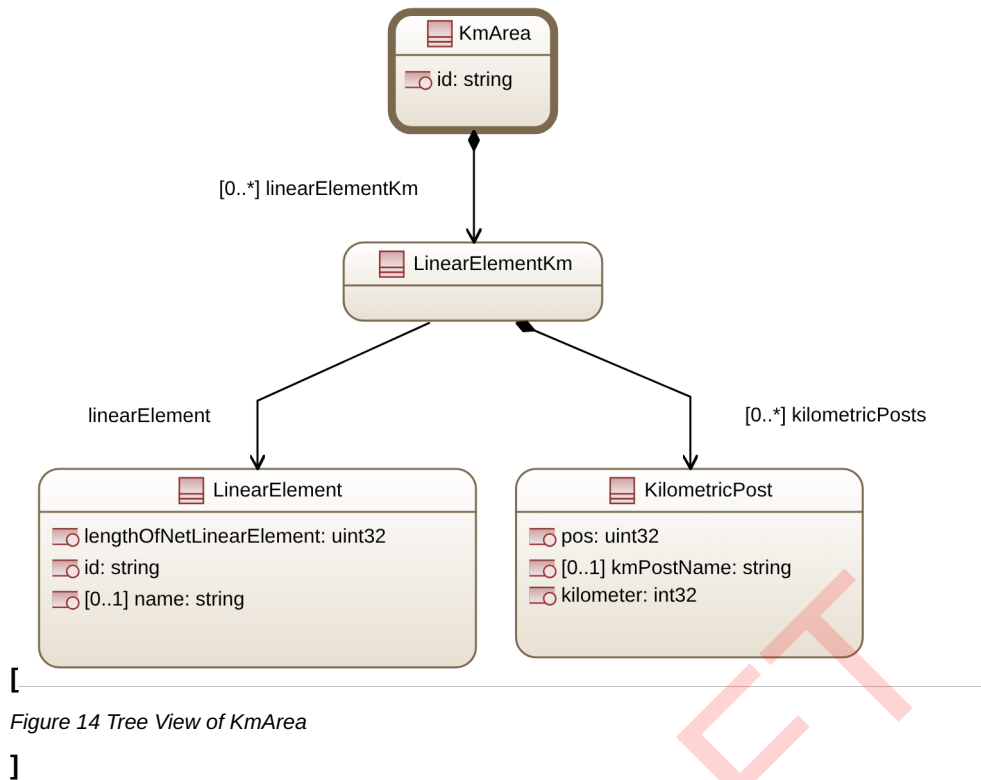
```
{
  "structs": [
    {
      "name": "LinearElementAccuracyProfile",
      "info": "Defines the positional accuracy of a LinearElement along its length, indicating how precisely its geometry is known or measured.",
      "attrs": [
        {"intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.LinearElement", "info": "Identity of the object; used for referencing"},
        {"intId": 2, "name": "offsetAccuracies", "composition": "OffsetAccuracy", "multiplicity": "0..*", "ordered": "byIndex", "info": "must be sorted in accending order according to offset from 0 to LinearElement.length"}
      ]
    },
    {
      "name": "OffsetAccuracy",
      "info": "Positional accuracy specified at a defined offset along a LinearElement.",
      "attrs": [
        {"intId": 1, "name": "offset", "dataType": "uint32", "unit": "m", "exp": -3, "info": "offset on the LinearElement with defined accuracy."},
        {"intId": 2, "name": "accuracy", "dataType": "double", "unit": "m", "info": "defines absolute deviation of the offset as 1sigma"}
      ]
    }
  ]
}
```

3.12 Kilometrage

SPT2TS-127376 - Kilometrage represents the exact KM values of a line along the linear element.

Kilometrage values are not to used of calculation of distance between two Kilometre points. [ Open]

SPMS-7541 - KmArea



SPT2TS-125614 - LinearElementKm(TrackEdgeKm)

```

{
  "structs": [
    {
      "name": "LinearElementKm",
      "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 points on the track. These are sorted by pos from 0 to length"
        }
      ]
    }
  ]
}

```

SPT2TS-125615 - KilometricPost

```

{
  "structs": [
    {
      "name": "KilometricPost",
      "info": "An object that represents 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": "kilometer", "dataType": "int32", "unit": "m", "exp": -3, "info": "Defines exact kilometer value",
        },
        {
          "intId": 3, "name": "kmPostName", "dataType": "string", "multiplicity": "0..1", "info": "Name of the Kilometric Post."
        }
      ]
    }
  ]
}

```

SPT2TS-125616 - KmArea

```
{
  "structs": [
    {
      "name": "KmArea",
      "attrs": [
        {"intId": 1, "name": "id", "dataType": "string", "key": "global", "sameKeyAs": "infra.TopoArea", "info":
          "Identity of the object; used for referencing"},
        {"intId": 2, "name": "linearElementKm", "composition": "LinearElementKm", "multiplicity": "*", "ordered":
          "byKey", "info": "composes of linear element kilometer"}
      ]
    }
  ]
}
```

3.13 Container for ETCS Engineering

SPMS-7542 - ETCSEngineering

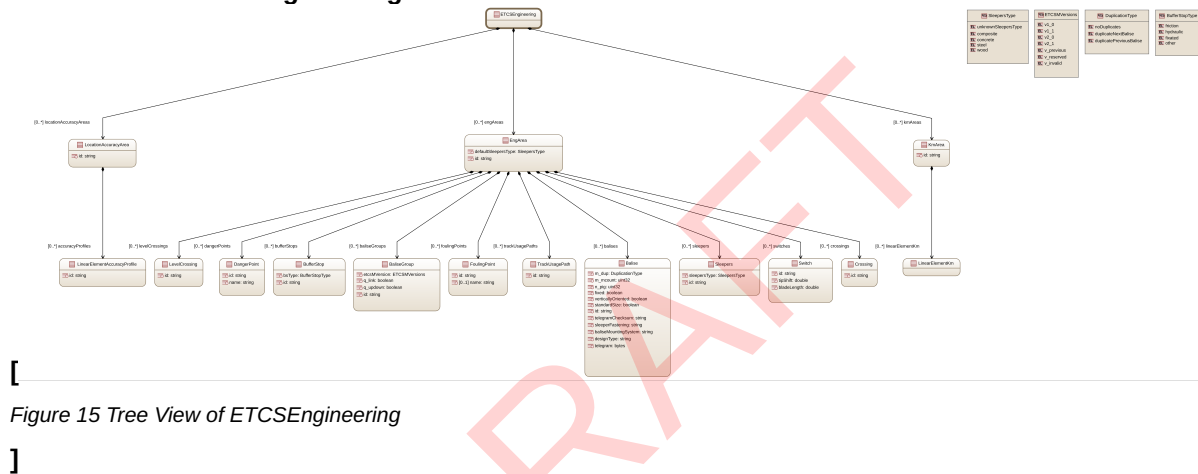


Figure 15 Tree View of ETCSEngineering

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"}
      ]
    }
  ]
}
```