



# Cooperative ITS Corridor

## Joint deployment

### *Platform-independent data model*

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## **Projektkoordination**

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## Version history

Version	Date	Description
0.1	10.06.2015	<b>Initial version of document</b>
0.2	26.08.2015	<ul style="list-style-type: none"> <li>• Replaced element hardShoulderStatus by outsideHardShoulderStatus and insideHardShoulderStatus in class CitsRoadworks</li> <li>• Added element trailerSpeed to class CitsRoadworksSafetyTrailer</li> <li>• Added class CitsActionId to class CitsRoadworksSafetyTrailer</li> <li>• Added values to enumeration type CitsQualityOfMessageEnum</li> </ul>
0.3	29.10.2015	<ul style="list-style-type: none"> <li>• Added section generic classes and enumeration types</li> <li>• Added section use case operations monitoring service (OMS)</li> <li>• Added class IRSOperatingStatus</li> <li>• Added enumeration type CitsErrorStateEnum</li> <li>• Added enumeration type CitsFlasherStateEnum</li> <li>• Added enumeration type CitsPositioningSolutionEnum</li> <li>• Added enumeration value MaintenanceArrowStateEnum.sensorError</li> <li>• Added enumeration value MaintenanceLightStateEnum.sensorError</li> <li>• Added enumeration value MaintenanceTableStateEnum.sensorError</li> </ul>
0.4	25.11.2015	<ul style="list-style-type: none"> <li>• Relation between CitsRoadworks and CitsRoadworksTrailer is now ordered</li> <li>• Added elements detectionTime and referenceTime to class CitsRoadworksTrailer</li> </ul>
0.5	12.02.2016	<ul style="list-style-type: none"> <li>• Added element eventHistory to class CitsRoadworksSafetyTrailer</li> <li>• Added lifecycle table for class CitsRoadworksSafetyTrailer</li> </ul>

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# 1 OUTLINE

This document describes the platform independent data model for the use cases roadworks warning service (RWW) and operations monitoring service (OMS).

## 1.1 Generic classes and enumeration types

This section contains the description of classes and enumeration types used in several use cases. The following diagram shows the location data model in detail:

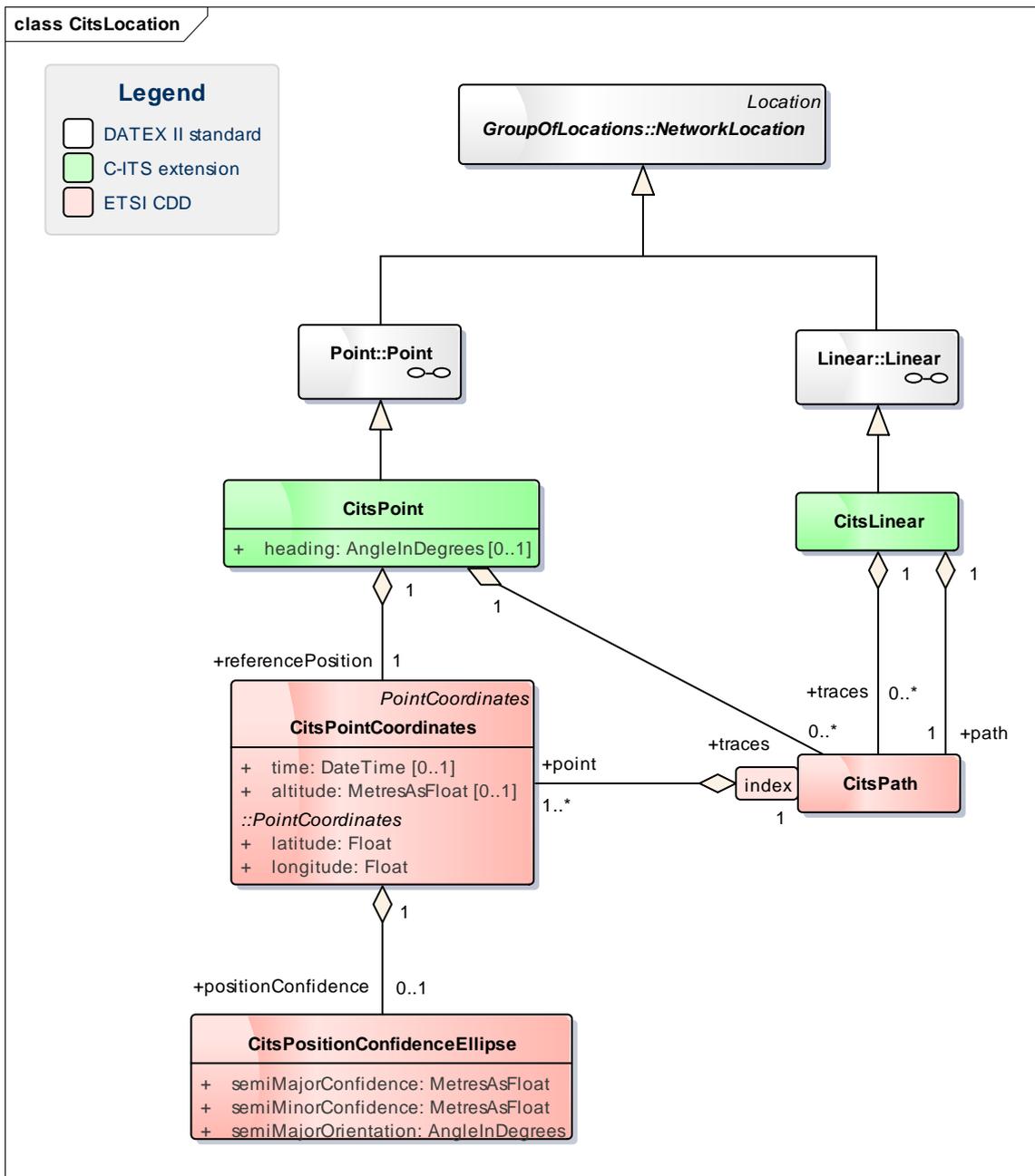


Figure 1: Location data model

This data model contains the classes NetworkLocation, Point, Linear, CitsPoint, CitsLinear, CitsPointCoordinates, CitsPath and CitsPositionConfidenceEllipse. The class NetworkLocation is used as base class for more specific location classes. Its subclasses can be used to describe positions of RWSTs or locations of roadworks within the road network. The class Point is used as base class for point-shaped locations or linear locations with a very short length. The class CitsPoint can be used to model point locations by coordinates and optional traces. The class Linear is used as base class for linear locations. Its subclass CitsLinear can be used to model linear locations by coordinates and optional traces. The class CitsPath is composed of an ordered sequence of point coordinates. It can be used to describe the shape of a linear location or to describe the trace of coordinate points leading to a specific (point or linear) location. A single point-shaped coordinate is described with an object of class CitsPointCoordinates. The class CitsPositionConfidenceEllipse is used to describe the accuracy of the positional information of a single point coordinate.

The following diagram contains the enumeration classes used in this data model:

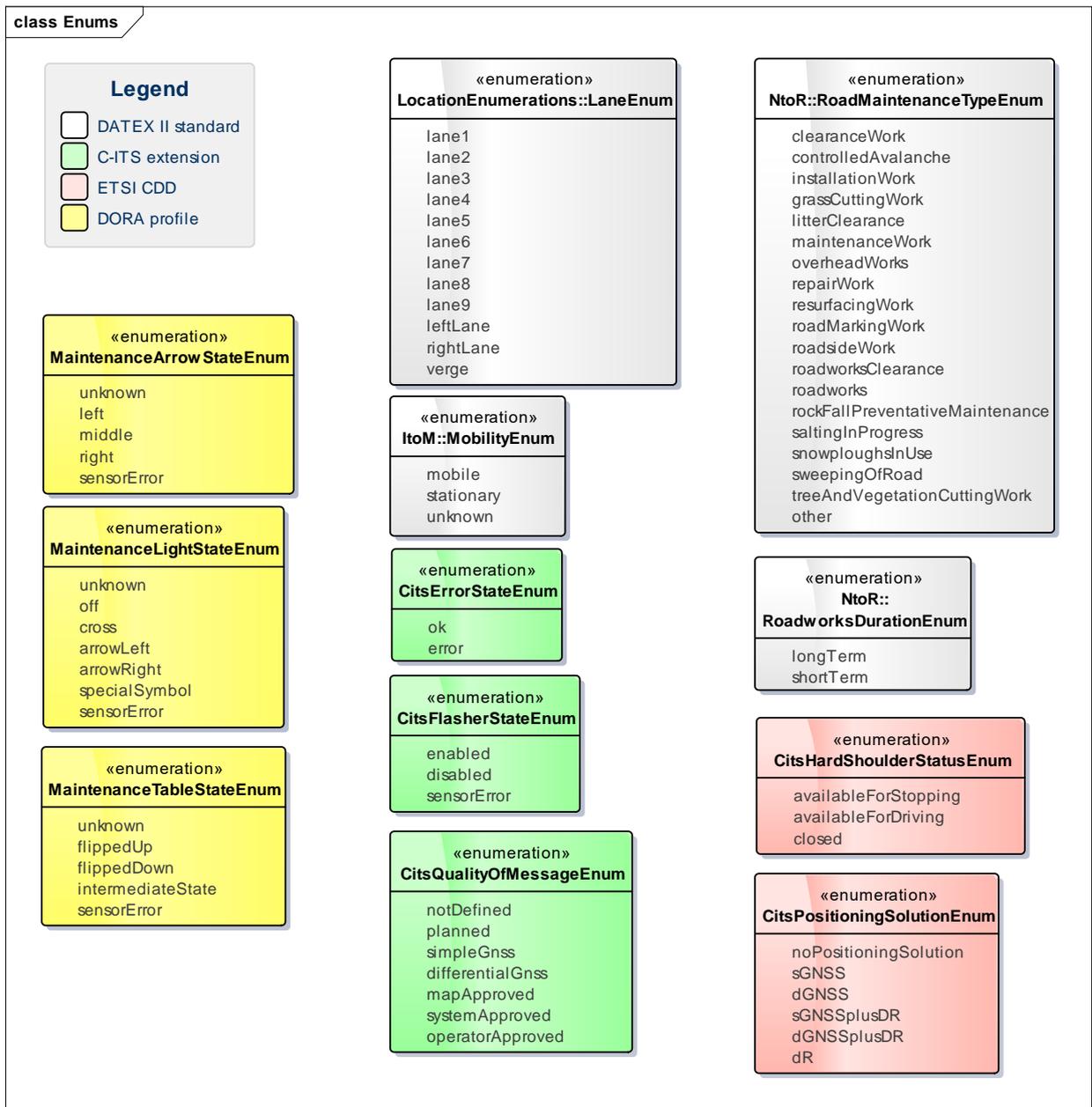


Figure 2: Enumeration classes

This data model contains the enumeration classes MaintenanceArrowStateEnum, MaintenanceLightStateEnum, MaintenanceTableStateEnum, LaneEnum, MobilityEnum, CitsErrorStateEnum, CitsFlasherStateEnum, CitsQualityOfMessageEnum, RoadMaintenanceTypeEnum, RoadworksDurationEnum, CitsHardShoulderStatusEnum and CitsPositioningSolutionEnum. The enumeration classes MaintenanceArrowStateEnum, MaintenanceLightStateEnum and MaintenanceTableStateEnum are used to describe various statuses of a RWST. The enumeration MaintenanceArrowStateEnum is used to describe the direction of the arrow shown on the tin-plate sign. The content of the illuminated arrow sign is described with the enumeration type MaintenanceLightStateEnum. The enumeration MaintenanceTableStateEnum describes the status of a table containing a tin-plate sign showing an arrow and an illuminated arrow sign. The enumeration LaneEnum is used to specify a special driving lane and the enumeration MobilityEnum can be used to

describe the mobility status of a roadworks. An error state is described with the enumeration type CitsErrorStateEnum. The enumeration class CitsFlasherStateEnum describes the status of the flasher light of the RWST. The enumeration class CitsQualityOfMessageEnum describes the service quality of a roadworks dataset. The type of work can be expressed by the enumeration type RoadMaintenanceTypeEnum and the RoadDurationEnum describes the expected duration of a roadworks in general terms. The status of a hard shoulder can be described with the enumeration class CitsHardShoulderStatusEnum. The enumeration class CitsPositioningSolutionEnum describes the type of the positioning solution.

### 1.2 Use case roadworks warning service

The following diagram shows an overview of the data model for roadworks:

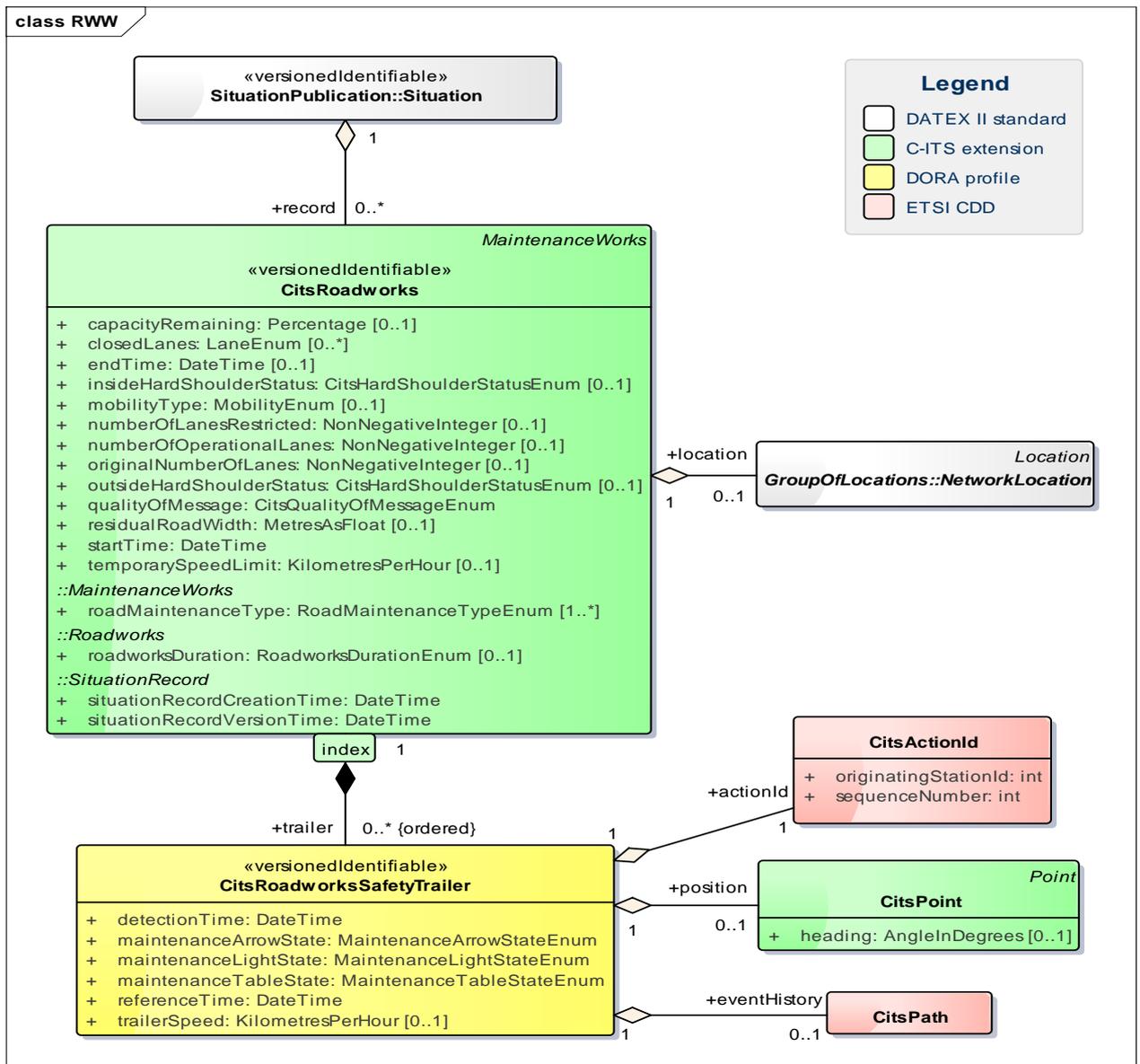


Figure 3: Data model roadworks warning

The data model contains the classes Situation, CitsRoadworks, NetworkLocation, CitsRoadworksSafetyTrailer, CitsActionId, CitsPoint and CitsPath. The class Situation describes a situation containing zero, one or more roadworks. Roadworks are described in the class CitsRoadworks. This class refers to the class NetworkLocation, which contains the location of the roadworks within the road network. A roadworks safety trailer (RWST) is described by an object of class CitsRoadworksSafetyTrailer. Every roadworks object refers to zero one or more CitsRoadworksSafetyTrailer objects. The geographic position of a RWST is described by an object of class CitsPoint. Every RWST refers its actionId by an object of class CitsActionId. The optional event position of a RWST is described by an object of class CitsPath.

### 1.3 Use case operations monitoring service

The following diagram shows an overview of the data model for the operations monitoring service:

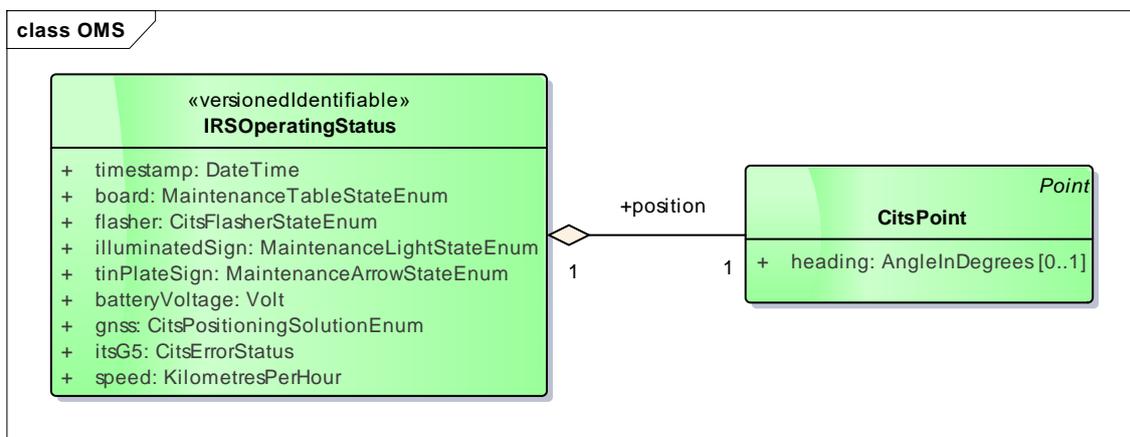


Figure 4: Data model operations monitoring service

The data model contains the classes IRSOperatingStatus and CitsPoint. The class IRSOperatingStatus describes the operating status of an IRS. The geographic position of an IRS is described by an object of class CitsPoint.

## 2 DATA CATALOGUE

The data catalogue describes the classes and enumeration types of the data model.

### 2.1 Classes

#### 2.1.1 CitsActionId

The actionId of a RWST. The class contains the following elements:

Element	Type	Mult. <sup>1</sup>	Description
originatingStationId	int	1	Id of the ITS-S of the RWST
sequenceNumber	int	1	Sequence number

#### 2.1.2 CitsLinear

A linear location defined by a polyline and optional traces leading to the location. The class contains the following elements:

Element	Type	Mult.	Description
path	CitsPath	1	Polyline describing the shape of the location
traces	CitsPath	0..*	Coordinate traces leading to the location

#### 2.1.3 CitsPath

Ordered list of coordinates describing a polyline or a trace. The class contains the following elements:

Element	Type	Mult.	Description
point	CitsPointCoordinates	1..*	Ordered list of coordinates

#### 2.1.4 CitsPoint

Point-shaped location defined by a reference position, optional traces leading to the reference position and an optional heading value. The class contains the following elements:

---

<sup>1</sup> This column contains the multiplicity of an element. Possible values are: 1 (element occurs exactly once), 0..1 (element is optional), 0..\* (element may occur zero, one or more times), 1..\* (element may occur once or more times)

Element	Type	Mult.	Description
heading	AngleInDegrees	0..1	Orientation of a heading with regards to the north
referencePosition	CitsPointCoordinates	1	Reference position of the point location
traces	CitsPath	0..*	Coordinate traces leading to the location

### 2.1.5 CitsPointCoordinates

Coordinates of a single point. The class contains the following elements:

Element	Type	Mult.	Description
latitude	Float	1	Latitude in decimal degrees using the European Terrestrial Reference System 1989 (ETRS89).
longitude	Float	1	Longitude in decimal degrees using the European Terrestrial Reference System 1989 (ETRS89).
altitude	MetresAsFloat	0..1	Height above sea level
time	DateTime	0..1	Time stamp of this geographical position
positionConfidence	CitsPositionConfidenceEllipse	0..1	Accuracy of the positional information

### 2.1.6 CitsPositionConfidenceEllipse

Accuracy of positional information according to the geometric dilution of precision (GDOP). The class contains the following elements:

Element	Type	Mult.	Description
semiMajorConfidence	MetresAsFloat	1	Length of the major semi-axis of the ellipse
semiMinorConfidence	MetresAsFloat	1	Length of the minor semi-axis of the ellipse
semiMajorOrientation	AngleInDegrees	1	Orientation direction of the ellipse major axis

### 2.1.7 CitsRoadworks

Roadworks activities that may potentially affect traffic operations. The class contains the following elements:

Element	Type	Mult.	Description
startTime	DateTime	1	Start time of roadworks activities
endTime	DateTime	0..1	Expected end time of roadworks activities

Element	Type	Mult.	Description
capacityRemaining	Percentage	0..1	The ratio of current capacity to the normal (free flow) road capacity in the defined direction, expressed as a percentage. Capacity is the maximum number of vehicles that can pass a specified point on the road, in unit time given the specified conditions.
numberOfLanesRestricted	NonNegativeInteger	0..1	The number of normally usable lanes on the carriageway which are now restricted either fully or partially (this may include the hard shoulder if it is normally available for operational use, e.g. in hard shoulder running schemes).
numberOfOperationalLanes	NonNegativeInteger	0..1	The number of usable lanes in the specified direction which remain fully operational (this may include the hard shoulder if it is being used as an operational lane).
originalNumberOfLanes	NonNegativeInteger	0..1	The normal number of usable lanes in the specified direction that the carriageway has before reduction due to roadworks or traffic events.
residualRoadWidth	MetresAsFloat	0..1	The total width of the combined operational lanes in the specified direction.
mobilityType	MobilityEnum	0..1	An indication of whether the associated roadworks is mobile or stationary.
outsideHardShoulderStatus	CitsHardShoulderStatusEnum	0..1	Operational status of a hard shoulder, that is located on the outer side of the carriageway (i.e. on the right

Element	Type	Mult.	Description
			side of the carriageway in a country with right-hand traffic). This element must be coded independently from the number of closed lanes.
insideHardShoulderStatus	CitsHardShoulderStatusEnum	0..1	Operational status of a hard shoulder, that is located on the inner side of the carriageway (towards the opposite carriageway, i.e. on the left side of the carriageway in a country with right-hand traffic). This element must be coded independently from the number of closed lanes.
closedLanes	LaneEnum	0..*	Position of closed lanes (contains only closed driving lanes. The operational status of a hard shoulder is coded with the element harShoulderStatus)
temporarySpeedLimit	KilometresPerHour	0..1	Speed limit within the roadworks
qualityOfMessage	CitsQualityOfMessageEnum	1	Service quality of the roadworks object.
roadMaintenanceType	RoadMaintenanceTypeEnum	1..*	Type of activities of the roadworks
roadworksDuration	RoadworksDurationEnum	0..1	Duration of the roadworks in general terms.
situationRecordCreationTime	DateTime	1	The date/time that the roadworks record (the first version of the record) was created by the original supplier.
situationRecordVersionTime	DateTime	1	The date/time that this current version of the roadworks record within the

Element	Type	Mult.	Description
			situation was written into the database of the supplier which is involved in the data exchange. Identity and version of record are defined by the class stereotype implementation.
location	NetworkLocation	0..1	Position of the roadworks object
trailer	CitsRoadworksSafetyTrailer	0..*	Roadworks safety trailers related to this roadworks

The following table describes the lifecycle of the elements of a CitsRoadworks object:

Element	Created or updated by
startTime	Set to current date/time by the RWST after the display panel has been opened.
endTime	Entered by a roadworks management system (RMS) or by an operator.
capacityRemaining	Entered by RMS or operator.
numberOfLanesRestricted	Initially set to 1 by the RWST, if the illuminated arrow sign displays a left or right arrow and no blinking cross. Otherwise the value is not set by the RWST. Is inserted or changed, if several RWSTs are combined or if roadworks information is updated from a RMS or by an operator.
numberOfOperationalLanes	Entered by RMS or operator.
originalNumberOfLanes	Entered by RMS or operator.
resiidualRoadWidth	Entered by RMS or operator.
mobilityType	Entered by RMS or operator.
outsideHardShoulderStatus	Initially set to status closed by the RWST, if the display shows a blinking cross. Otherwise the value is not set by the RWST. May be set by RMS or operator.
insideHardShoulderStatus	Not used within Germany and Austria. Usage rules for The Netherlands may be added in future versions of the document.
closedLanes	Initially set by the RWST, if no blinking cross is displayed and the left arrow is displayed (value set to rightLane) or if the right arrow is displayed (value is set to leftLane). Otherwise the value is not set by

Element	Created or updated by
	the RWST. Is inserted or changed, if several RWSTs are combined or if roadworks information is updated from a RMS or by an operator.
temporarySpeedLimit	Entered by RMS or operator.
qualityOfMessage	Initially set to value <i>unapproved</i> by the RWST. After the location has been matched to a map, the value is set to <i>mapApproved</i> . If the roadworks object has been approved by a RMS the value is set to <i>systemApproved</i> and to <i>operatorApproved</i> , if an operator approved the object. The value may be changed back to <i>unapproved</i> by the RWST, if certain conditions are fulfilled. These conditions are not yet fixed.
roadMaintenanceType	Entered by RMS or operator.
roadworksDuration	Created by RWST and set to value <i>shortTerm</i> .
situationRecordCreationTime	Set to current date/time by the RWST after the display panel has been opened.
situationRecordVersionTime	Initially set by the RWST and updated whenever the roadworks object is updated.
location	Initially set by the RWST with the current location of the RWST. May be changed by RMS or operator. If the location is point-shaped, the RWST updates the location with its current position if it is moved.
Trailer	Initially set by the RWST. The position of the RWST (element trailer.position) is updated by the RWST, if it is moved. If several RWSTs are combined, all trailer objects will be combined.

### 2.1.8 CitsRoadworksSafetyTrailer

Description of a roadworks safety trailer. The class contains the following elements:

Element	Type	Mult.	Description
maintenanceLightState	MaintenanceLightStateEnum	1	Content of the illuminated arrow sign.
maintenanceTableState	MaintenanceTableStateEnum	1	Status of the display panel.
maintenanceArrowState	MaintenanceArrowStateEnum	1	Direction of the arrow displayed on the tin-plate sign.
trailerSpeed	KilometresPerHour	0..1	Current speed of the RWST
detectionTime	DateTime	1	Detection time of roadworks
referenceTime	DateTime	1	Timestamp of corresponding DENM

Element	Type	Mult.	Description
position	CitsPoint	0..1	Geographical position of the RWST.
actionId	CitsActionId	1	ActionId of the RWST
eventHistory	CitsPath	0..1	Event history of the RWST

The following table describes the lifecycle of the elements of a CitsRoadworksSafetyTrailer object:

Element	Created or updated by
maintenanceLightState	Set by the RWST
maintenanceTableState	Set by the RWST
maintenanceArrowState	Set by the RWST
trailerSpeed	Set by the RWST
detectionTime	Set by the RWST
referenceTime	Set by the RWST
position	Set by the RWST
actionId	Set by the RWST
eventHistory	Set by ICS if two or more RWSTs are grouped together to one roadworks object. The event history of one RWST contains the path from its position to the position of the next RWST.

### 2.1.9 IRSOperatingStatus

Description of the operating status of an IRS. The class contains the following elements:

Element	Type	Mult.	Description
timestamp	DateTime	1	Time stamp of the operating status message
board	MaintenanceTableStateEnum	1	Status of the display board
flasher	CitsFlasherStateEnum	1	Status of the flasher light
illuminatedSign	MaintenanceLightStateEnum	1	Status of the illuminated arrow sign
tinPlateSign	MaintenanceArrowStateEnum	1	Status of the tin-plate sign
batteryVoltage	Volt	1	Voltage of the battery
gnss	CitsPositioningSolutionEnum	1	Status of the positioning solution
itsG5	CitsErrorState	1	Error status of the ETSI-G5 modem
speed	KilometresPerHour	1	Speed of the trailer

Element	Type	Mult.	Description
position	CitsPoint	1	Position of the trailer

**2.1.10 Linear**

A linear section along a single road with optional directionality defined between two points on the same road. The class has no elements.

**2.1.11 NetworkLocation**

The specification of a location on a network (as a point or a linear location). The class has no elements.

**2.1.12 Point**

A single geospatial point. The class has no elements.

**2.1.13 Situation**

An identifiable instance of a traffic/travel situation comprising one or more traffic/travel circumstances which are linked by one or more causal relationships. Each traffic/travel circumstance is represented by a CitsRoadworks record. The class contains the following elements:

Element	Type	Mult.	Description
record	CitsRoadworks	0..*	Roadworks objects

**2.2 Enumeration types**

**2.2.1 CitsErrorStateEnum**

Describes a simple generic error state. The type contains the following elements:

Element	Description
ok	No error pending
error	Error pending

**2.2.2 CitsFlasherStateEnum**

Describes the status of the flasher light. The type contains the following elements:

Element	Description
enabled	Flasher light is enabled
disabled	Flasher light is disabled
sensorError	Sensor error

**2.2.3 CitsHardShoulderStatusEnum**

Describes the operational status of a hard shoulder. The type contains the following elements:

Element	Description
availableForStopping	The hard shoulder is available for stopping.
availableForDriving	The hard shoulder is available for driving.
closed	The hard shoulder is closed.

#### 2.2.4 CitsPositioningSolutionEnum

Describes the type of the positioning solution. The type contains the following elements:

Element	Description
noPositioningSolution	No positioning solution
sGNSS	Simple Global Navigation Satellite System
dGNSS	Differential GNSS
sGNSSplusDR	Simple GNSS and dead reckoning
dGNSSplusDR	Differential GNSS and dead reckoning
dR	Dead reckoning

#### 2.2.5 CitsQualityOfMessageEnum

Describes the quality of service for a roadworks object. The type contains the following elements:

Element	Description
notDefined	The quality of the roadworks object is not defined
planned	The roadworks object is planned by the roadworks operator
simpleGnss	Positioning of the roadworks object used simple GNSS
differentialGnss	Positioning of the roadworks object used differential GNSS
mapApproved	The location of the roadworks object has been matched to a map.
systemApproved	The roadworks object has been automatically approved by a roadworks management system.
operatorApproved	The roadworks object has been approved by an operator.

#### 2.2.6 LaneEnum

List of descriptors identifying specific lanes. The position of a lane is static and will not be changed even if hard shoulder running is activated. The type contains the following elements:

Element	Description
lane1	The first lane numbered from nearest the hard shoulder to central median.
lane2	The second lane numbered from nearest the hard shoulder to central median.
lane3	The third lane numbered from nearest the hard shoulder to central median.

Element	Description
lane4	The fourth lane numbered from nearest the hard shoulder to central median.
lane5	The fifth lane numbered from nearest the hard shoulder to central median.
lane6	The sixth lane numbered from nearest the hard shoulder to central median.
lane7	The seventh lane numbered from nearest the hard shoulder to central median.
lane8	The eighth lane numbered from nearest the hard shoulder to central median.
lane9	The ninth lane numbered from nearest the hard shoulder to central median.
leftLane	Any left lane (it is not clear what lane number it is).
rightLane	Any right lane (it is not clear what lane number it is).
verge	On the verge or outside of the carriageway.

### 2.2.7 MaintenanceArrowStateEnum

List of descriptors identifying the content of a tin-plate sign of a RWST. The type contains the following elements:

Element	Description
unknown	Unknown content.
left	Sign displays an arrow to the left.
middle	Sign displays an upwards or downwards arrow.
right	Sign displays an arrow to the right.
sensorError	Sensor error

### 2.2.8 MaintenanceLightStateEnum

List of descriptors identifying the content of an illuminated arrow sign of a RWST. The type contains the following elements:

Element	Description
Unknown	Unknown content.
Off	The illuminated arrow sign is switched off.
Cross	A cross (x) is displayed.
arrowLeft	An arrow to the left is displayed.
arrowRight	An arrow to the right is displayed.
specialSymbol	Another symbol is displayed.
sensorError	Sensor error

### 2.2.9 MaintenanceTableStateEnum

List of descriptors identifying the status of the display panel of a RWST. The type contains the following elements:

Element	Description
unknown	The status is unknown.
flippedUp	The display panel is flipped up
flippedDown	The display panel is flipped down.
intermediateState	The display panel is currently being flipped up or down.
sensorError	Sensor error

### 2.2.10 MobilityEnum

Types of mobility relating to a roadworks object. The type contains the following elements:

Element	Description
mobile	The roadworks object is moving.
stationary	The roadworks object is stationary.
unknown	The mobility of the roadworks object is unknown.

### 2.2.11 RoadMaintenanceTypeEnum

Types of road maintenance. The type contains the following elements:

Element	Description
clearanceWork	Clearance work of an unspecified nature.
controlledAvalanche	Controlled avalanche work.
installationWork	Installation of new equipments or systems on or along-side the roadway.
grassCuttingWork	Grass cutting work.
litterClearance	Work to collect litter from the roadway and/or adjacent verges.
maintenanceWork	Maintenance of road, associated infrastructure or equipments.
overheadWork	Works which are overhead of the carriageway.
repairWork	Repair work to road, associated infrastructure or equipments.
resurfacingWork	Work associated with relaying or renewal of worn-out road surface (pavement).
roadMarkingWork	Striping and repainting of road markings, plus placement or replacement of reflecting studs (cats' eyes).
roadsideWork	Road side work of an unspecified nature.

Element	Description
roadworksClearance	Roadworks are completed and are being cleared.
roadworks	Road maintenance or improvement activity of an unspecified nature which may potentially cause traffic disruption.
rockFallPreventativeMaintenance	Rock fall preventative maintenance.
saltingInProgress	Spreading of salt and / or grit on the road surface to prevent or melt snow or ice
snowploughsInUse	Snowploughs or other similar mechanical devices in use to clear snow from the road.
sweepingOfRoad	Sweeping of the roadway.
treeAndVegetationCuttingWork	Tree and vegetation cutting work adjacent to the roadway.
Other	Other than as defined in this enumeration.

### 2.2.12 RoadworksDurationEnum

Expected durations of roadworks in general terms. The type contains the following elements:

Element	Description
longTerm	Long-term roadworks (24 hours or more)
shortTerm	Short-term roadworks (less than 24 hours)