

Intersection Topology Format (ITF)

Profile version 2.1



Over deze publicatie

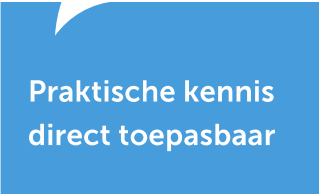
De internationale ontwikkeling van Smart Mobility zorgt voor flinke vernieuwingen in verkeer, vervoer en mobiliteit. Dit raakt direct ook de verkeersregelinstallaties in de Nederlandse steden en provincies en op rijkswegen. Als verkeersregelinstallaties kunnen communiceren met voertuigen en weggebruikers kunnen weggebruikers worden geïnformeerd over actuele fasewisselingen van verkeersregelinstallaties en hierop hun rijgedrag vroegtijdig aanpassen, kunnen doelgroepen als openbaar vervoer, nood- en hulpdiensten en vrachtwagens conform beleidswensen van overheden worden geprioriteerd en kan data van voertuigen zelf worden gebruikt voor betere netwerkregelingen. Dit bevordert doorstroming, bereikbaarheid, verkeersveiligheid en duurzaamheid, legt de basis voor connected en automated driving en speelt in op een digitale samenleving waarin data en connectiviteit bijdragen aan economisch aantrekkelijke en duurzame steden.

Voor het effectief, veilig en leveranciers- en overheidsonafhankelijk communiceren van intelligente verkeersregelinstallaties (iVRI's) met voertuigen en weggebruikers hebben bedrijven en overheden in het Innovatiepartnership Talking Traffic binnen internationale standaarden gezamenlijk specificaties en koppelvlakken voor iVRI's vastgelegd. Eenduidig gebruik door alle overheden en betrokken bedrijven van deze uniforme afspraken binnen internationale standaarden is noodzakelijk voor interoperabiliteit en een goede en betrouwbare werking. Deze standaarden zijn daarom vastgesteld door de landelijke publiek-private Strategic Committee 'Borgen en beheren iVRI standaarden en producten'. Na vaststelling gelden deze standaarden voor alle bedrijven en overheden die in Nederland (willen gaan) werken aan iVRI's t.b.v. intelligente mobiliteit. Vanuit de rol van onafhankelijk en landelijk kennisinstituut verzamelt CROW deze landelijk vastgestelde standaarden en stelt deze transparant ter beschikking aan overheden, adviesbureaus en leveranciers.

About this publication

The international developments in Smart Mobility technology are boosting innovations for traffic, transportation and mobility. This has a direct effect on traffic control systems in Dutch cities and provinces, as well as national highways. When traffic controllers are able to communicate with vehicles and road users, the latter can be informed about real-time phase changes in traffic lights, enabling them to anticipate and adjust driving behaviour accordingly. Also, special interest groups, such as emergency services, public transport and freight carriers, can be prioritized in line with public policy guidelines. The data provided by vehicles themselves can be utilised to improve network-based traffic control programmes. This has a positive effect on flow, accessibility, traffic safety and sustainability, laying out the fundamentals for connected and automated driving and preparing for a digital society in which data and connectivity contribute to economically viable and sustainable cities.

In order to let intelligent traffic controllers (iVRI) communicate with vehicles and road users in an effective, safe and platform independent way, businesses and governments have created and recorded common specifications and interfaces for iVRI technology. These are compliant to international standards and developed within the framework of the Talking Traffic Innovation partnership. The unambiguous use of these uniform agreements, within international standards, by all governmental bodies and businesses is necessary for interoperability and a good and reliable operation. These standards are adopted by the national public-private Strategic Committee 'Ensuring and maintaining iVRI standards and products'. After adoption, these standards apply to all businesses and governmental bodies in the Netherlands that work, or plan to work, on iVRI technology for intelligent mobility purposes. Being an independent national knowledge institute, CROW collects these national standards and provides them to governments, consultants and suppliers in a transparent way.



Praktische kennis
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Intersection Topology Format (ITF)

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1 Introduction

1.1 Purpose of this Document

This document provides the Dutch Profile for the Intersection Topology Format (ITF). It offers an interpretation of data elements and describes the use of them as extension to the standards.

1.2 Intersection Topology Format (ITF)

C-ITS applications which make use of signal phase and timing information of traffic lights require topology information of the intersection. Such topology information allows these applications to, for example, match signal phase and timing information to driving lanes. Additionally, it offers information like possible and allowed manoeuvres at an intersection. Other applications, for example those that convert traffic light data to signal phase and timing information and those in charge of the actual traffic light control (either priority handling or optimization), also require information on sensors, signal group relations and the traffic light controller inputs and outputs.

This document offers a guideline to the Intersection Topology Format as requested by the Ministry of Infrastructure and the Environment, in support of the Program Beter Benutten ITS and the Call for Innovation Partnerships Talking Traffic. The Intersection Topology Format provides an open standard for capturing all necessary topology information in a uniform and consistent way.

The Intersection Topology Format is largely based on the internationally standardised topology message MAP (SAE J2735, ISO TS 19091) completed with elements derived from SPOC and V-Log practices. This has resulted in an Intersection Topology Format that supports at least two uses:

1. Analysis of the V-Log stream using an Intersection Topology file;
2. Provision of (content of) the MAP intersection topology in accordance to SAE J2735.

1.3 Document structure

The structure of this document is as follows. Chapter 2 and 3, respectively, give descriptions of the Data Frames and Data Elements of the Intersection Topology Format. The format is also described in an Excel document and in a XML schema definition (XSD) file. Both are enclosed separately as annex A and annex B respectively. Chapter 4 provides examples and graphics to illustrate application of the Intersection Topology Format. In Chapter 5 an introduction to an example Intersection Topology File is given. The (XML) file itself is enclosed as a separate annex C to this document.

It is important to note that the version of all files and documents currently is v2.0. It is planned that the Intersection Topology Format will further evolve when applied to a variety of intersections. The format and its documentation will be adapted accordingly. Also the developments of international standardization on the subject of intersection topology should be monitored and processed if needed.

1.4 Assumptions

The following standards have been used to prepare this profile.

- SAE J2735, Dedicated Short Range Communications (DSRC) Message Set Dictionary, March 2016
- ISO TS19091, Intelligent transport systems – Cooperative ITS – Using V2I and I2V communications for applications related to signalized intersections, 2016(E)
- ETSI 103 301, Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Facilities layer protocols and communication requirements for infrastructure services, V1.1.1 (2016-11)
- ETSI TS102 894-2, Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary, V1.2.1 (2014-09)

1.5 Legend

Chapter 2 contains the actual profile describing how the data frames (DFs) and data elements (DEs) shall be used for the implementation of the Intersection Topology Format.

The description of the DFs and DEs can be found in aforementioned standards. The description of the DEs and DFs in this document build upon the descriptions in these standards.

The font style of the name of DEs and DFs indicates the status as defined in the standards:

- **Bold**: required by the standard;
- *Italic*: these are optional in the standard;
- Underlined: one of these can be chosen (OR);

The status in the profile is indicated in a separate column by means of one of the following labels:

- **Mandatory**. This DF or DE is mandatory in the standard and is thus always provided.
- **Profiled**. This DF or DE is mandatory in the profile although optional in the standard. It is therefore assumed that this DF or DE will always be provided.
- **Conditional**. This DF or DE is mandatory in specific conditions and not used in other conditions. The conditions are provided in the profile.
- **Optional**. This DF or DE is optional in the standard as well as in the profile.
- **Used**. This DF or DE is a choice in the standard and used in the profile. It is therefore assumed that this DF or DE can be provided.
- **Not used**. This DF or DE is optional or a choice in the standard but not used in the profile. A response to the use of this DF or DE is therefore not guaranteed, but as the message is compliant with the ASN.1 specification, the message is valid
- **Future use**. This DF or DE is not relevant for use cases currently in scope and therefore not profiled in the current version of the profile.
- **Bold**. Applies to attributes in an enumeration or bitstring and indicates the attribute shall be assigned if applicable. All non-bold attributes are optional.

1.6 Document history

Version	Date	Changes
0.9	30-06-2016	Profile document part of v0.9
0.95	16-01-2017	Profile document part of v0.95
0.97	18-05-2017	Profile document part of v0.97
1.2	29-06-2017	Profile document part of v1.2
1.8	02-11-2017	Profile document part of v1.8
2.0	16-11-2017	Approved by WG Techniek on 16 th of November 2017
2.1	22-03-2018	Added: corrections, clarifications and interpretation.

2 Topology

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
0.1	formatVersion [FormatVersion]	Topology format version	Mandatory	-	Set by application
0.2	version [Version]	Version information of the topology file	Mandatory	-	See level 1
0.3	defaultVariant [VariantID]	Default variant. If no variant is activated by indicator or activeperiod, this variant is active. If variants are described, this element has to be defined.	Mandatory	-	Set by application
0.4	mapData [MapData]	Topology data similar to J2735.	Mandatory	-	See chapter 3
0.5	controlData [ControlData]	Topology data specific for traffic light control.	Mandatory	-	See chapter 4

Level 1: Version					
1.0	versionID [VersionID]	Version number of topology. Increases every time a new revision is released.	Mandatory	revision [MsgCount] is used to indicate a revision of MapData only, versionID [VersionID] is used to indicate a revision in the MapData or ControlData.	Set by application
1.1	timestamp [TimeStamp]	Date/time of issue	Mandatory	-	Set by application
1.2	startDate [StartDate]	Starting date/time on which this topology is valid	Mandatory	-	Set by application
1.3	<i>endDate</i> [EndDate]	Ending date/time on which this topology loses validity	Optional	-	Set by application
1.4	<i>Comment</i> [Comment]	Comment to this topology	Optional	-	Set by application

3 ITF: MapData

This part of the Intersection Topology Format is predominantly based on the SAE J2735 and ISO TS 19091 standards. Therefore this part of the ITF profile is largely consistent with the MAP profile v1.2. 'Standard' in the table below refers to these standards.

Standard			Profile			
Level	Field	Meaning	Status	Content	Value	
Level 0: MapData						
0.1	msgIssueRevision [MsgCount]	The msgIssueRevision data element is used to provide a revision related to the issued standard, to be able to identify the compatibility.	Mandatory	Other than the IntersectionGeometry, this element is used to indicate the revision number of the defining standard. 0 = ISO/TS 19091:2016(E)	0	
0.2	<i>intersections</i> <i>[Intersection-GeometryList]</i> <i>(1..32)</i>	The IntersectionGeometry-List data frame consists of a list of Intersection-Geometry entries.	Conditional	<p>Mandatory in profile in case of intersection. The MapData message is always used to transfer the intersection topology. Therefore the geometry is mandatory.</p> <p>One IntersectionGeometry for each independent conflict area. That is:</p> <ul style="list-style-type: none"> • If controlled: having own stop lines and signal heads for all conflicting directions. • Lanes between conflict areas are not connecting-lanes (volgrichting) of another intersection. 	See level 1	
0.3	<i>dataParameters</i> <i>[DataParameters]</i>	The DataParameters data frame is used to provide basic (static) information on how a map fragment was processed or determined.		Mandatory	-	-
			<i>processAgency</i> <i>[ProcessAgency]</i>	Mandatory	Used to indicate the last editor of the MapData.	Set by application
			<i>lastCheckedDate</i> <i>[LastCheckedDate]</i>	Mandatory	Used to indicate the date the source data was last checked. Conform ISO 8601	Set by application
0.4	<i>restrictionList</i> <i>[RestrictionClassList]</i> <i>(1..254)</i>	The RestrictionClassList data frame is used to enumerate a list of user classes which belong to a given assigned index.	Conditional	When restrictions are used within the intersection topology their restriction classes must be defined here.	See level 2	
				<i>restrictionClassAssignment</i> <i>[RestrictionClass-Assignment]</i>		
				The RestrictionClass-Assignment data frame is used to assign (or bind) a single RestrictionClassID data element to a list of all user classes to which it applies. A collection of these bindings is conveyed in the RestrictionClassList data		

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
0.5	<i>regional</i> [REGION.Reg-MapData]		Not used	Used to provide "SignalHeadLocation" which defines the XYZ position of a signal head within an intersection and the related signal group identifier.	

Level 1: IntersectionGeometryList → IntersectionGeometry						
1.1	<i>name</i> [Descriptive-Name]	The DescriptiveName data element is used to provide a human readable and recognizable name for the IntersectionGeometry data frame.		Profiled	Mandatory in Dutch profile as opposed to standard. Human readable and recognizable for road authority. Maximum 63 characters. Shorter is better. Name of the intersection as known by road authority, e.g. "xp31.a" and identical to the name provide under controlledIntersection > name. Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, June 28, 2017, the Netherlands'.	Set by application
1.2	id [Intersection-ReferenceID]	The IntersectionReference-ID is a globally unique value set, consisting of an optional RoadRegulatorID and a required IntersectionID assignment, providing an unique mapping to the intersection MAP.	<i>region</i> [RoadRegulatorID]	Profiled	Mandatory in Dutch profile as opposed to standard. For each road operator a RoadRegulatorID is provided in the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie 20170728'.	Set by application
			id [IntersectionID]	Mandatory	The identifier shall be defined by the road operator.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
					that country or region.
1.3	revision [MsgCount]	The MsgCount data element is used to provide a sequence number within a stream of messages with the same DSRCmsgID and from the same sender. Depending on the application the sequence number may change with every message or may remain fixed during a stream of messages when the content within each message has not changed from the prior message sent.	Mandatory	The revision number must be increased by 1 each time the MapData of this intersection changes. The revision numbers of SPAT and MAP must be the same as an indication that the right MAP revision is used. revision [MsgCount] is used to indicate a revision of MapData only, versionID [VersionID] is used to indicate a revision in the MapData or ControlData.	Set by application
1.4	refPoint [Position3D]	The Position3D data frame provides a precise location in the WGS-84 coordinate system, from which short offsets may be used to create additional data using a flat earth projection centred on this location.	Mandatory	Serves to decode the offsets, the centre of an intersection (conflict area) is used.	See level 10
1.5	<i>laneWidth</i> [LaneWidth]	The LaneWidth data element conveys the width of a lane in units of 1 cm.	Mandatory	Mandatory in profile as opposed to standard. The default lane width is 3 meters.	300
1.6	<i>speedLimits</i> [SpeedLimitList] (1..9)	The SpeedLimitList data frame consists of a list of SpeedLimit entries.	Profiled	Mandatory in profile as opposed to standard. The global speed limit used within this intersection. Can be overridden on GenericLane level. If one limit applies to all vehicles, only one value is used, with SpeedLimitType set to vehicleMaxSpeed. An additional value may be used for other types.	See level 3
1.7	[laneSet] LaneList (1..255)	The LaneList data frame consists of a list of GenericLane entries.	Mandatory	All lanes relevant for traffic shall be described, also lanes without a SignalGroup. The 'multipleLanesTreatedAsOneLane' as part of LaneSharing shall not be used. Only lanes fully independent from the intersection (e.g. parallel road) may be excluded.	See level 4

Level 2: RestrictionClassList → RestrictionClassAssignment					
2.1	id [RestrictionClassID]	The RestrictionClass data element defines an intersection-unique value to convey data about classes of users. The mapping used varies with each intersection and is defined in the MAP message if needed. The defined mappings found there	Mandatory	A number is defined for each restriction class required for the intersection.	Set by application Starts at 0

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		are used to determine when a given class is meant. The typical use of this element is to map additional movement restrictions or rights (in both the MAP and SPAT messages) to special classes of users (trucks, high sided vehicles, special vehicles etc.). There is the general presumption that in the absence of this data, any allowed movement extends to all users.			
2.2	users [Restriction-UserTypeList] (1..16)	The RestrictionUserTypeList data frame consists of a list of RestrictionUserType entries.	Conditional	Lists all users where this RestrictionClass applies to. For example busses and taxis.	See level 9

Level 3: SpeedLimitList → RegulatorySpeedLimit					
3.1	type [SpeedLimitType]	The SpeedLimitType data element relates the type of speed limit to which a given speed refers.	Mandatory	<p>Types:</p> <ul style="list-style-type: none"> • Unknown (0), • maxSpeedInSchoolZone (1), • maxSpeedInSchoolZoneWhenChildrenArePresent (2), • maxSpeedInConstructionZone (3), • vehicleMinSpeed (4), • vehicleMaxSpeed (5), • vehicleNightMaxSpeed (6), • truckMinSpeed (7), • truckMaxSpeed (8), • truckNightMaxSpeed (9), • vehiclesWithTrailersMinSpeed (10), • vehiclesWithTrailersMaxSpeed (11), • vehiclesWithTrailersNightMaxSpeed (12) • nominalSpeed (13) -- actual average velocity driven by vehicles. <p>Only vehicleMaxSpeed is mandatory, all other types are optional.</p>	Set by application
3.2	speed [Velocity]	This data element represents the velocity of an object, typically a vehicle speed or the recommended speed of travel along a roadway, expressed in unsigned units of 0.02 meters per second. When used with motor vehicles it may be combined with the transmission state to form a data frame for use.	Mandatory	The maximum speed in m/s in units of 0.02 m/s.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
Level 4: LaneList → GenericLane					
4.1	laneID [LaneID]	The LaneID data element conveys an assigned index that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of special lanes.	Mandatory	Each lane gets a unique number within the intersection. It is tempting to use the Dutch lane numbering scheme here, but the value is limited to 255. Therefore LaneIDs typically are numbered continuously starting at 1, but other methods are permitted (incl. skipping one number) as long as no additional meaning is put on the number which cannot be guaranteed. It is assumed that receivers of the MAP message always derive the Lane ID's from the latest received MAP message.	Set by application Start at 1
4.2	<i>name</i> [DescriptiveName]	The DescriptiveName data element is used to provide a human readable and recognizable name for the GenericLane data frame.	Profiled	Mandatory in profile as opposed to standard. It is suggested to use the number of the signal head or otherwise (incl. egress lanes) a random name/number. The shorter, the better. In case multiple signal heads serve one lane, the signal head for regular (motorised) traffic is used.	Set by application
4.3	<i>ingressApproach</i> [ApproachID]	The ApproachID data element is used to relate the index of an approach, either ingress or egress within the subject lane.	Conditional	Mandatory in profile for ingress lanes as opposed to standard. Number used to group all ingress lanes of an arm into one group. This value is used to find all other lanes of an arm when driving on one of them, for example before the road fans out. Pedestrians lanes have the same ApproachID as the approach they cross (therefore should be excluded to find all vehicle driving lanes). Pedestrian lanes which relate to both an ingress and egress approach (e.g. crossing without safe island), have both the ingressApproachID and egressApproachID assigned (again the same ApproachID's as the approaches they cross). All bicycle lanes (separated from vehicle lanes) in one quadrant of an intersection have the same ingressApproachID which is unique within the intersection. Bicycle lanes at safe islands have the ApproachID set in the same manner as pedestrian lanes, i.e. the ingress or egress ApproachID of the approach they cross.	Start at 1.

Standard			Profile			
Level	Field	Meaning	Status	Content	Value	
4.4	<i>egressApproach</i> [ApproachID]	The ApproachID data element is used to relate the index of an approach, either ingress or egress within the subject lane.	Conditional	Mandatory in profile for ingress lanes as opposed to standard. Number used to group all egress lanes of an arm into one group. This value is used to find all other lanes of an arm when driving on one of them, for example before the road fans out. Pedestrians lanes have the same ApproachID as the approach they cross (therefore should be excluded to find all vehicle driving lanes). Pedestrian lanes which relate to both an ingress and egress approach (e.g. crossing without safe island), have both the ingressApproachID and egressApproachID assigned (again the same ApproachID's as the approaches they cross). All bicycle lanes (separated from vehicle lanes) in one quadrant of an intersection have the same ingressApproachID which is unique within the intersection. Bicycle lanes at safe islands have the ApproachID set in the same manner as pedestrian lanes, i.e. the ingress or egress ApproachID of the approach they cross.	Start at 1.	
4.5	laneAttributes [LaneAttributes]	The LaneAttributes data frame holds all of the constant attribute information of any lane object (as well as denoting the basic lane type itself) within a single structure. Constant attribute information are those values which do not change over the path of the lane, such as the direction of allowed travel. Other lane attribute information can change at or between each node.	directionalUse [LaneDirection]	Mandatory	Set according to the layout of the intersection. Typically used for pedestrian-lanes or bidirectional bicycle paths. Bitstring (size = 2), with bits as defined: Ingresspath (0) Egresspath (1)	Set by application
			sharedWith [LaneSharing]	Mandatory	The LaneSharing data element is used to denote To be filled according to the allowed traffic. With bits as defined:	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		<p>the presence of other user types (travel modes) who have an equal right to access and use the lane. The typical use is to alert the user of the MAP data that additional traffic of another mode may be present in the same spatial lane.</p>		<p>overlappingLaneDescriptionProvided (0) multipleLanesTreatedAsOneLane (1) -- not permitted in profile as all lanes shall be described. otherNonMotorizedTrafficTypes (2) individualMotorizedVehicleTraffic (3) -- includes all motorized traffic including busses and taxis, i.e. normal operation. Shall not be used in combination with bits 4 and 5. busVehicleTraffic (4) taxiVehicleTraffic (5) pedestriansTraffic (6) cyclistVehicleTraffic (7) trackedVehicleTraffic (8) pedestrianTraffic (9)-use 6 instead (error)</p>	
		<p>laneType [LaneTypeAttributes]</p> <p>The LaneTypeAttributes data frame is used to hold attribute information specific to a given lane type. It is typically used in the LaneAttributes data frame as part of an overall description of a lane object.</p>	Mandatory	To be filled according to the allowed traffic.	See level 5
4.6	nodes [NodeSetXY] (2..63)	<p>The NodeSetXY data frame consists of a list of Node entries.</p> <p>A lane made up of two or more XY node points and any attributes defined in those nodes.</p>	Mandatory	<p>Each lane is described by a list of nodes, starting at the stop line (or closest to the intersection for egress lanes). The length of each lane is subject to the following rules:</p> <ul style="list-style-type: none"> Lanes may not run over the conflict zone of a controlled intersection (use a ConnectionTrajectory instead). Ingress lanes must be at least 300 m and at best 1000 m long, except when violating the rules above or when the lane ends. 	See level 6

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
				<ul style="list-style-type: none"> Egress lanes must be at least 100 m long, except when violating the rules above or when the lane ends. Note: an ingress lane may be connected to an ingress lane of another intersection. In that case, the ingress lane of the other intersection must continue to the conflict area of the current intersection. Only pedestrian lanes must be several meters long, equal to the width of the sidewalk or island. When lanes fan out, the lane before the fan out must be the through traffic lane (i.e. the main road) (in most cases the straight direction). <p>Simple lanes can be adequately described with only two node points, while lanes with curvature may require more points. The center line obtained when connecting the nodes must never differ more than 1/4th of the lane width from the actual center line of the lane. However, the 2nd node must be perpendicular to the stop line to allow for correct map-matching.</p>	
4.7	<i>connectsTo</i> [ConnectsToList] (1..16)	The ConnectsToList data structure is used in the generic lane descriptions to provide a sequence of other defined lanes to which each lane connects beyond its stop point.	connection [Connection] The Connection data structure is used in the ConnectsToList data frame to provide data about how the stop line at the end of a single lane connects to another lane beyond its stop point.	Profiled Mandatory in profile as opposed to standard, for ingress lanes with a signal group. <ul style="list-style-type: none"> Each ingress lane of an intersection must be connected to an egress lane of the current intersection or an ingress lane of the (another) intersection. All egress lanes of the intersection should be described, either as egress lane of the current intersection OR as ingress lane of another intersection if this intersection is described within the same MAP. It is not allowed to connect to ingress lanes of another intersection which is not described in this MAP. Pedestrian lanes are defined as bi-directional ingress lanes, the Connection connects to the ingress lane at the other side of the road. 	See level 7

Standard				Profile		
Level	Field	Meaning		Status	Content	Value
					In case the Connection connects one ingress lane to another ingress lane (e.g. of another intersection), it is notable that the first node of the 1st ingress lane and the last node of the 2nd ingress lane must be connected (as opposed to only first nodes in case of ingress-egress connections).	
4.8	<i>regional</i> [REGION.Reg-GenericLane] (1..4)	The element REGION.Reg-GenericLane is used for additional "regional information", as defined in ISO/PDTS 19091.		Conditional	Mandatory in case mandatory objects or attributes are located on a connectionTrajectory.	-
			addGrpC [ConnectionTrajectory-addGrpC] 'ConnectionTrajectory-addGrpC' can be used to describe the path across the conflict area of the intersection.	Mandatory	As regional is limited to 4, a maximum of 4 connectionTrajectories can be provided for each lane. Therefore, connectionTrajectory shall be reserved for connections for motorised traffic, complex turning manoeuvres and connections of which the NodeAttributes are essential. In case an ingress lane connects to more than 4 egress lanes, the most right egress lanes must be defined first.	See level 11

Level 5: LaneTypeAttributes						
5.1	<u>vehicle</u> [Lane-Attributes-Vehicle]	The LaneAttributes-Vehicle data element relates specific properties found in a vehicle lane type. This data element provides a means to denote that the use of a lane is restricted to certain vehicle types.		Used	Containing attributes of vehicle lane type. <ul style="list-style-type: none"> • isVehicleRevocableLane (0) • isVehicleFlyOverLane (1) • hovLaneUseOnly (2) • restrictedToBusUse (3) • restrictedToTaxiUse (4) • restrictedFromPublicUse (5) -- e.g. driveway of emergency vehicle station • hasIRbeaconCoverage (6) • permissionOnRequest (7) 	Set by application
5.2	<u>crosswalk</u> [Lane-Attributes-Crosswalk]	The LaneAttributes-Crosswalk data element relates specific properties found in a crosswalk lane type.		Used	Containing attributes of crosswalk lane type. <ul style="list-style-type: none"> • crosswalkRevocableLane (0) • bicycleUseAllowed (1) 	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
				<ul style="list-style-type: none"> isXwalkFlyOverLane (2) – dan beschrijven we die niet fixedCycleTime (3) biDirectionalCycleTimes (4) hasPushToWalkButton (5) audioSupport (6) -- 'rateltikker' rfSignalRequestPresent (7) -- 'radio device to request extended green' unsignalizedSegmentsPresent (8) 	
5.3	bikeLane [Lane-Attributes-Bike]	The LaneAttributes-Bike data element relates specific properties found in a bicycle lane type.	Used	Containing attributes of bike lane type. <ul style="list-style-type: none"> bikeRevocableLane (0) pedestrianUseAllowed (1) isBikeFlyOverLane (2) fixedCycleTime (3) biDirectionalCycleTimes (4) isolatedByBarrier (5) unsignalizedSegmentsPresent (6) 	Set by application
5.4	trackedVehicle [Lane-Attributes-TrackedVehicle]	The LaneAttributes-TrackedVehicle data element relates specific properties found in a tracked vehicle lane types (trolley and train lanes). The term "rail vehicle" can be considered synonymous. In this case, the term does not relate to vehicle types with tracks or treads.	Used	Containing attributes of tracked vehicle lane type. <ul style="list-style-type: none"> spec-RevocableLane (0) spec-commuterRailRoadTrack (1) spec-lightRailRoadTrack (2) -- i.e. tram spec-heavyRailRoadTrack (3) -- i.e. train spec-otherRailType (4) -- i.e. trolleybus 	Set by application

Level 6: NodeSetXY → NodeXY						
6.1	node-LatLon [Node-LLmD-64b]	A 64-bit node type with lat-long values expressed in standard SAE one tenth of a micro degree. May only be used if the offset is more than 327.67 m from the previous point.		Mandatory	-	Set by application
			lat [Latitude] The geographic latitude of an object, expressed in 1/10th	Mandatory	-	Set by application

Standard			Profile			
Level	Field	Meaning	Status	Content	Value	
6.2	<i>attributes</i> <i>[NodeAttributeSetXY]</i>	The NodeAttributeSetXY is a data frame used to convey one or more changes in the attribute set which occur at the node point at which it is used.	<i>localNode</i> <i>[NodeAttributeXYList]</i> <i>(1..8)</i>	Conditional	Mandatory in profile as opposed to standard, if available and when applicable. Up to 8 node attributes can be described: (0) reserved (1) stopline (2) roundedCapStyleA (3) roundedCapStyleB (4) mergePoint (5) divergePoint (6) downstreamStopLine (7) downstreamStartNode (8) closedToTraffic -- nice to have (9) safeland (10) curbPresentAtStepOff (11) hydrantPresent (12) yield -- nice to have, used to indicate presence of yield marking on the pavement, relevant when the intersection controller is off or in case of amber flashing.	Set by application
			<i>disabled</i> <i>[SegmentAttributeXYList]</i>	Conditional	Mandatory in profile as opposed to standard, if available and when applicable. Attributes are	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		<p>(1..8)</p> <p>The disabled data frame consists of a list of SegmentAttributeXY entries which are disabled at this node point.</p>		<p>enabled/disabled as seen from the order of the nodes. i.e. inside out from the intersection. The functional logic, however, should be provided as seen from the direction of driving (e.g. mergingLaneLeft indicates the presence of another lane on the left side of the current lane, as seen from the driving direction). For bidirectional lanes, the order of the nodes defines the direction which must be considered the 'driving direction' for defining SegmentAttributes.</p> <p>Up to 8 segment attributes can be described out of the following types:</p> <p>(0) reserved</p> <p>(1) doNotBlock</p> <p>(2) whiteLine</p> <p>-- nice to have for segments longer than 15 meters. If set, the whiteLine is present at the left hand side of the lane.</p> <p>(3) mergingLaneLeft</p> <p>-- used to indicate that a lane change to the left lane is possible and allowed.</p> <p>(4) mergingLaneRight</p> <p>-- used to indicate that a lane change to the right lane is possible and allowed.</p> <p>(5) curbOnLeft</p> <p>(6) curbOnRight</p> <p>(7) loadingzoneOnLeft</p> <p>(8) loadingzoneOnRight</p> <p>(9) turnOutPointOnLeft</p> <p>(10) turnOutPointOnRight</p> <p>-- 9/10: in case a lane overlaps with a conflict area caused by a small side road</p> <p>(11) adjacentParkingOnLeft</p> <p>(12) adjacentParkingOnRight</p> <p>(13) adjacentBikeLaneOnLeft</p> <p>(14) adjacentBikeLaneOnRight</p> <p>-- 13/14: in case of shared lane but with marked</p>	

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
				bicycle part. (15) sharedBikeLane -- bicycle street (16) bikeBoxInFront -- 16: typical use OFOS (17) transitStopOnLeft (18) transitStopOnRight -- nice to have (19) transitStopInLane -- nice to have (20) sharedWithTrackedVehicle (21) safeland (22) lowCurbsPresent (23) rumbleStripPresent (24) audibleSignalingPresent (25) adaptiveTimingPresent (26) rfSignalRequestPresent (27) partialCurbIntrusion (28) taperToLeft (29) taperToRight (30) taperToCenterLine -- 28-30 shall only be used with merging point (not diverging points). (31) parallelParking (32) headInParking (33) freeParking (34) timeRestrictionsOnParking (35) costToPark (36) midBlockCurbPresent (37) unEvenPavementPresent	
		<i>enabled</i> <i>[SegmentAttributeXYList]</i> <i>(1..8)</i> The enabled data frame consists of a list of SegmentAttribute-XY entries which are enabled at this node point and which remain	Conditional	Mandatory in profile as opposed to standard, if applicable. Up to 8 segment attributes can be described. See previous.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		enabled until disabled or the lane ends.			
		<p><i>data</i> [LaneDataAttributeList] (1..8)</p> <p>The LaneDataAttributeList data frame consists of a list of LaneDataAttribute entries. Attributes which require an additional data values some of these are local to the node point, while others persist with the provided values until changed and this is indicated in each entry.</p>	Conditional	Mandatory in profile as opposed to standard, if applicable. Only used to indicate speedLimits, if they are different than the global speed limit of the Intersection. The new speedLimit provided persists with the provided values for all segments unless changed again. Note that changes must be provided based on the order of the nodes, i.e. inside out from the intersection.	See level 8
		<p><i>dWidth</i> [Offset-B10]</p> <p>A value added to the current lane width at this node and from this node onwards.</p>	Conditional	Only used for motorised traffic lanes. Mandatory in case the smallest width of the lane is < 2,75m. The current lane width is defined on the top level (default 3 meters). Widths smaller than 2,75m shall be measured accurately and the dWidth is provided at the first node of the lane only.	Set by application
		<p><i>dElevation</i> [Offset-B10]</p> <p>A value added to the current Elevation (i.e. the elevation at the previous node) which applies at this node and from this node onwards.</p>	Optional	The current elevation is defined on the top level as part of the reference position. Recommended if the road gradient, compared to the previous node, is more than 2%, which is considered the minimum gradient which affects the road capacity. Note that changes must be provided based on the order of the nodes, i.e. inside out from the intersection.	Set by application

Level 7: ConnectsToList → Connection						
7.1	connectingLane [ConnectingLane]	The ConnectingLane data frame ties a single lane to a single maneuver needed to reach it from another lane. It is typically used to connect the allowed maneuver from the end of a	<p>lane [LaneID]</p> <p>The LaneID data element conveys an assigned index that is unique within an intersection.</p>	Mandatory	LaneID expresses the lane the current lane connects to. If IntersectionReferenceID is filled, the lane belongs to another intersection.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		lane to the outbound lane so that these can be mapped to the SPAT message to which both lanes apply.			
		It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of special lanes.			
		<i>maneuver</i> <i>[AllowedManeuvers]</i>	Profiled	Mandatory in profile as opposed to standard. Used to describe the allowed movements related to the signal head. SignalGroupID and Restrictions apply to this movement only.	Set by application
		The AllowedManeuvers data element relates the allowed (possible) maneuvers from a lane, typically a motorized vehicle lane.		<ul style="list-style-type: none"> • maneuverStraightAllowed (0) • maneuverLeftAllowed (1) • maneuverRightAllowed (2) • maneuverUTurnAllowed (3) • maneuverLeftTurnOnRedAllowed (4) • maneuverRightTurnOnRedAllowed (5) • maneuverLaneChangeAllowed (6) • maneuverNoStoppingAllowed (7) • yieldAllwaysRequired (8) • goWithHalt (9) • caution (10) • reserved1 (11) 	
7.2	<i>remoteIntersection</i> <i>[Intersection-ReferenceID]</i>	The IntersectionReference-ID is a globally unique value set, consisting of an optional RoadRegulatorID and a required IntersectionID assignment, providing a unique mapping to the intersection MAP.			
		<i>region</i> <i>[RoadRegulatorID]</i>	Profiled	IntersectionReferenceID is mandatory if the ConnectingLane is part another intersection.	Set by application
		The RoadRegulatorID data element is a globally unique identifier assigned to a regional authority.		RoadRegulatorID is mandatory in profile as opposed to standard.	
		id [IntersectionID]	Mandatory	If the lane connects to another intersection the IntersectionID is mandatory.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		The IntersectionID is used within a region to uniquely define an intersection within that country or region.			
7.3	<i>signalGroup</i> [SignalGroupID]	The SignalGroupID data element is an index used to map between the internal state of one or more signal controllers and a common numbering system that can represent all possible combinations of active states (movements and phases). All possible movement variations are assigned a unique value within the intersection. The SignalGroupID data element is used to match the signal group send by the SPAT message for this lane/maneuver.	Conditional	Mandatory if the lane is controlled by a signal. Please note that the range for the SignalGroupID is such that the common Dutch number scheme could contain too high numbers. Therefore SignalGroupIDs must be numbered continuously starting at 1 (see SPAT profile). 0 = unknown.	Set by application
7.4	<i>userClass</i> [RestrictionClassID]	The RestrictionClass data element defines an intersection-unique value to convey data about classes of users. The typical use of this element is to map additional movement restrictions or rights (in both the MAP and SPAT messages) to special classes of users (trucks, high sided vehicles, special vehicles etc.).	Conditional	Mandatory if Connection or AdvisorySpeed (SPaT) is valid for a specific class only, for example public transport.	Set by application
7.5	<i>connectionID</i> [LaneConnectionID]	The LaneConnectionID data entry is used to state a connection index for a lane to lane connection. It is used to relate this connection and any dynamic clearance data sent in the SPAT.	Mandatory	Mandatory in profile as opposed to standard. Can be used to uniquely identify one connection, for example to support a priority request. To each Connection a unique (within intersection) LaneConnectionID must be added. LaneConnectionIDs typically are numbered continuously starting at 0, but other methods are permitted (incl. skipping one number) as long as no additional meaning is put on the number which cannot be guaranteed. It is assumed that users of the connectionID (e.g. when creating a SRM) always derive the connectionID from the latest received MAP message (as opposed to static configuration).	Set by application

Level 8: LaneDataAttributeList → LaneDataAttribute						
8.1	<i>speedLimits</i> [SpeedLimitList] (1..9)	The SpeedLimitList data frame consists of a list of SpeedLimit entries.	regulatorySpeedLimit [RegulatorySpeedLimit]	Profiled	Mandatory if speed limit differs from the general speed limit defined at top level (e.g. for side road as opposed to main road). For bicycle and pedestrian lanes, no speedLimits will be provided (or corrected), therefore should be ignored here.	See level 3

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
				The implication is that speedLimit for these lanes (i.e. the base value defined several levels up) is false for these lane types.	
8.2	<u>regional</u> <u>[REGION.Reg-</u> <u>LaneDataAttribute]</u>	The element is used for additional "regional information", as defined in ISO/PDTS 19091.	Conditional	Reserved for regional extensions. Can be used to indicate Height and Weight restrictions, mandatory if these apply.	-
		<u>addGrpC</u> <u>[LaneDataAttribute-addGrpC]</u>	Conditional	Mandatory when height and weight restrictions apply.	See level 12

Level 9: RestrictionUserTypeList → RestrictionUserType					
9.1	<u>basicType</u> <u>[RestrictionAppliesTo]</u>	The RestrictionAppliesTo data element provides a short list of common vehicle types which may have one or more special movements at an intersection, i.e. the movement is restricted to the indicated types only. In general, these movements are not visible to other traffic with signal heads, but the SPAT data reflects the state of the movement. Various restricted movements at an intersection can be expressed using this element to indicate where the movement applies.	Used	Out of a set of most commonly used types: (0) none (1) equippedTransit (2) equippedTaxis (3) equippedOther (4) emissionCompliant (5) equippedBicycle (6) weightCompliant (7) heightCompliant (8) pedestrians (9) slowMovingPersons (10) wheelchairUsers (11) visualDisabilities (12) audioDisabilities (13) otherUnknownDisabilities	Set by application
9.2	<u>regional</u> <u>[REGION.Reg-</u> <u>RestrictionUserType]</u>	The element is used for additional "regional information", as defined in ISO/PDTS 19091.	Used		-
		<u>addGrpC</u> <u>[RestrictionUserType-addGrpC]</u> 'RestrictionUserType-addGrpC' can be used to set EmissionType as a user restriction, i.e. the restricted users are allowed to use a movement or lane. Emission types are euro1...euro6.	Conditional	Mandatory when emission and fuel restrictions apply.	See level 13

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
Level 10: Position3D					
10.1	lat [Latitude]	The geographic latitude of an object, expressed in 1/10th integer micro degrees, as a 31 bit value, and with reference to the horizontal datum then in use. The value 900000001 shall be used when unavailable.	Mandatory	-	Set by application
10.2	long [Longitude]	The geographic longitude of an object, expressed in 1/10th integer micro degrees, as a 32-bit value, and with reference to the horizontal datum then in use. The value 1800000001 shall be used when unavailable.	Mandatory	-	Set by application
10.3	<i>altitude</i> [Altitude]	The Altitude data element is used to provide a three-dimensional geographic position of an object. It provides the elevation expressed in units of 10 centimetres below or above sea level.	Conditional	Mandatory in profile as opposed to standard if the road gradient within the scope of the intersection is more than 2%.	Set by application
Level 11: REGION.Reg-GenericLane → ConnectionTrajectory-addGrpC					
11.1	nodes [NodeSetXY] (2..63)	The NodeSetXY data frame consists of a list of Node entries. A ConnectionTrajectory is made up of two or more XY node points and any attributes defined in those nodes.	Mandatory	Each ConnectionTrajectory is described by a list of nodes, with the first and last node overlapping one node of the connecting lanes. Simple ConnectionTrajectories can be adequately described with only two node points, while ConnectionTrajectories with curvature may require more points. The center line obtained when connecting the nodes must never differ more than 1/4 th of the lanewidth from the actual center line of the lane.	See level 6
11.2	<i>connectionID</i> [LaneConnectionID]	The LaneConnectionID data entry is used to state a connection index for a lane to lane connection. It is used to relate this connection and any dynamic clearance data sent in the SPAT.	Mandatory	Used to relate the node-path of the ConnectionTrajectory to the ConnectsTo [Connection].	Set by application
Level 12: REGION.Reg-LaneDataAttribute → LaneDataAttribute-addGrpC					
12.1	<i>maxVehicleHeight</i> [VehicleHeight]	Provides the maximum allowed height of vehicles on the road.	Conditional	Mandatory if applicable.	Set by application
12.2	<i>maxVehicleWeight</i> [VehicleMass]	Provides the maximum allowed weight of vehicles on the road.	Conditional	Mandatory if applicable.	Set by application
Level 13: REGION.Reg-RestrictionUserType → RestrictionUserType-addGrpC					
13.1	<i>emission</i> [EmissionType]	Toxis emission type euro1 to euro6.	Conditional	Mandatory if applicable.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
13.2	<i>fuelType</i> [FuelType]	Provides the type of fuel used by a vehicle.	Conditional	Mandatory if applicable.	Set by application

4 ITF: ControlData

This part of the Intersection Topology Format is defined for Dutch purposes and not related to international standards. Therefore, 'standard' in the table below refers to the definition as agreed by relevant stakeholders.

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
Level 0: ControlData					
0.1	<i>controller</i> [TLC] (0..1)	The TLC data frame is used to provide a complete description of the TLC.	Optional	-	See level 1
Level 1: ControlData → TLC					
1.1	name [DescriptiveName]	Name of the TLC as known by road authority.	Mandatory	e.g. "xp31" Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
1.2	descriptiveName [DescriptiveName]	The DescriptiveName data element is used to provide a human readable and recognizable name for the location of the TLC.	Mandatory	e.g. "Kerkstraat-Schoolstraat" Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
1.3	uniqueID [UniqueID]	The UniqueID data element provides a globally unique identifier (GUID) for the TLC.	Mandatory	The UniqueID is a generated number. Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
1.4	<i>alias</i> [Alias]	A comma separated name as used by other systems.	Optional	e.g. 'KWC=xp131, TM=vri131' Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
1.5	tlcIdentifier [TlcIdentifier]	Hexadecimal representation of the composition of RoadRegulatorID and IntersectionID.	Mandatory	e.g. "0C4104DC" Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
1.6	<i>brand</i> [Brand]	The Brand data element is used to describe the brand of the TLC.	Optional	-	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
1.7	<i>tlcType</i> [TlcType]	The TlcType data element is used to provide a descriptive and readable type indication for the traffic light controller.	Optional	-	Set by application
1.8	<i>serialNumber</i> [SerialNumber]	The SerialNumber data element is used to indicate the serial number of the traffic light controller.	Optional	-	Set by application
1.9	<i>tlcPosition</i> [Position3D]	The Position3D data frame is used to describe the position of the TLC cabinet in a position on the surface of the earth, expressed by a longitude, latitude and elevation.	Optional	-	See level 4
2.0	controlUnits [ControlUnits]	List of control units within the TLC.	Mandatory	-	-
		controlUnit [ControlUnit] Single control unit.	Mandatory	-	See level 2

Level 2: ControlData → ControlUnits → ControlUnit					
2.1	Name [Name]	Name of the control unit known by the road authority.	Mandatory	-	Set by application
2.2	<i>vlogID</i> [VlogID]	The VlogID data element is used to provide the ID which corresponds to V-Log data.	Optional	-	Set by application
2.3	<i>inputs</i> [InputList] (0..1024)	The InputList data frame consist of a list of Input entries.	Optional	Inputs are limited to control relevant signals like flashing lights, bridges, railway crossings, dynamic lanes, coordination tunnels, etc. TLC internal signal are explicitly excluded.	-
		input [Input] The Input data element is used to describe an input signal of a ControlUnit.	Mandatory	-	See level 5
2.4	<i>outputs</i> [OutputList] (0..1024)	The OutputList data frame consist of a list of Output entries.	Optional	Outputs are limited to control relevant signals like flashing lights, bridges, railway crossings, dynamic lanes, coordination, tunnels, etc. TLC internal signal are explicitly excluded.	-
		output [Output] The Output data element is used to describe an output signal of a ControlUnit.	Mandatory	-	See level 6

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
2.5	intersections [Intersection-GeometryAddList] (1..32)	The IntersectionGeometry-AddList data frame consist of a list of Intersection entries.	Mandatory	A topology file may include multiple intersections. If it concerns signalised intersections the topology file includes those intersections controlled by one traffic light controller.	See level 3
		intersection [IntersectionGeometry-Add]	Mandatory		

Level 3: ControlUnit → IntersectionGeometryAddList → IntersectionGeometryAdd					
3.1	intersectionID [Intersection-ReferenceID]	The IntersectionReferenceID data frame is used to provide globally unique identification for one intersection	Mandatory	-	See level 7
3.2	name [Name]	Name of the intersection as known by road authority.	Mandatory	e.g. "xp31.a" and identical to the name provide under intersectionGeometry > name. Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
3.3	descriptiveName [DescriptiveName]	The DescriptiveName data element is used to provide a human readable and recognizable name for the intersection.	Mandatory	e.g. "Kerkstraat-Schoolstraat Oost" Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
3.4	<i>alias</i> [Alias]	A comma separated name as used by other systems.	Optional	e.g. 'KWC=xp131,TM=vri131' Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application
3.5	<i>intersectionType</i> [IntersectionType]	The IntersectionType data element is used to indicate if the topology file covers an intersection or a roundabout.	Optional	One out of the following types: (0) Intersection (1) Roundabout	Set by application
3.6	approaches [ApproachList] (1..32)	The ApproachList data framen consists of a list of Arm entries.	Mandatory	Intersection approaches are related to ingress and egress approaches. A bi-directional approach consists of an ingress approach and an egress approach.	-

Standard			Profile			
Level	Field	Meaning	Status	Content	Value	
			approach [Approach]	Mandatory	-	See level 8
			The Approach data frame is used to describe one arm of the intersection.			
3.7	<i>variants</i> [VariantList] (1..16)	The VariantList data frame consist of a list of Variant entries.		Optional	By default, all lanes are active, but typically a subset of all lanes is valid if a variant is active. For example, lanes with a peak hour purpose (e.g. left turn lane) and an off-peak hour purpose (e.g. right turn lane) are typically duplicated. Both situations can be configured using two variants.	-
			variant [Variant]	Mandatory	-	See level 9
			The Variant data frame describes a single topology variant. For example, to disable or enable a specific driving lane, including its connections. The active variant can be determined by checking the VLogIndicator or the ActivePeriodList. If a VLogIndicator is used, this prevails over ActivePeriodList. Only one variant can be active at the same time.			
3.8	<i>sensors</i> [SensorList] (1..256)	The SensorList data frame consist of a list of Sensor entries.		Optional	The Sensor data frame may also be used to capture the output of cameras. Each detection area configured for the camera's field of view should be treated as a single sensor entry.	-

Standard			Profile			
Level	Field	Meaning		Status	Content	Value
			sensor [Sensor] The Sensor data frame is used to describe a single detection area as seen by the ControlUnit software. For example, a loop detector or a push button.	Mandatory	-	See level 10
3.9	<i>signalGroups</i> <i>[SignalGroupList]</i> <i>(1..256)</i>	The SignalGroupList data frame consists of a list of SignalGroup entries.	sg [SignalGroup] The SignalGroup data frame contains identifiers of a single signal group.	Mandatory	-	See level 11
				Conditional	-	-
3.10	<i>signalGroupRelations</i> <i>[SignalGroupRelation-List]</i> <i>(1..65535)</i>	The SignalGroupRelation-List data frame consist of a list of SignalGroupRelation entries.	signalGroupRelation [SignalGroupRelation] The SignalGroupRelation data frame is used to describe the relation between two signal groups in case they cannot be allowed to let traffic flow simultaneously and therefore let traffic flow consecutively.	Mandatory	-	See level 12
				Conditional	Typically, in the case that two signal groups cannot be green or yellow at the same time, the ClearanceTimeType data element is used. In the case that two signal groups are allowed to be green and yellow at the same time, the ClearanceTimeType data element and ClearanceTime data element are not specified.	-

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
Level 4: ControlData → TLC → Position3D					
4.1	lat [Latitude]	The Latitude data element is used to provide the geographic latitude of an object.	Mandatory	-	Set by application
4.2	long [Longitude]	The Longitude data element is used to provide the geographical longitude of an object.	Mandatory	-	Set by application
4.3	<i>altitude</i> [Altitude]	The Altitude data element is used to provide a three-dimensional geographic position of an object. It provides the elevation expressed in units of 10 centimetres below or above sea level.	Optional	-	Set by application

Level 5: ControlData → TLC → InputList → Input					
5.1	ioName [IOName]	The IOName data element is used to describe the name of an input or output which is unique within the inputList and outputList respectively.	Mandatory	Typically, this value is equal to the name used in the TLC software in the field.	Set by application
5.2	<i>alias</i> [Alias]	The Alias data element is used for compatibility with existing practice and unique within the list they are used.	Optional	-	Set by application
5.3	<i>ioType</i> [IOType]	The IOType data element is used to indicate the type of IO signal.	Mandatory	One out of the following types: (0) Boolean (1) 16bit	Set by application
5.4	vlogIdx [VlogIdx]	The VlogIdx data element is used to provide the index in the V-Log stream of the TLC.	Mandatory	VlogIdx typically is numbered continuously starting at 0, but other methods are permitted (incl. skipping one number). VlogIdx shall be unique within the list it is part of. If available, VlogIdx is based on the existing field configuration.	Set by application
5.5	<i>comment</i> [Comment]	The Comment data element is used to provide a free space for human readable comments.	Optional	-	Set by application

Level 6: ControlData → TLC → OutputList → Output					
6.1	ioName [IOName]	The IOName data element is used to describe the name of an input or output which is unique within the inputList and outputList respectively.	Mandatory	Typically, this value is equal to the name used in the TLC software in the field.	Set by application
6.2	<i>alias</i> [Alias]	The Alias data element is used for compatibility with existing practice and unique within the list they are used.	Optional	-	Set by application
6.3	<i>ioType</i> [IOType]	The IOType data element is used to indicate the type of IO signal.	Mandatory	One out of the following types: (0) Boolean (1) 16bit	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
6.4	vlogIdx [VlogIdx]	The VlogIdx data element is used to provide the index in the V-Log stream of the TLC.	Mandatory	VlogIdx typically is numbered continuously starting at 0, but other methods are permitted (incl. skipping one number). VlogIdx shall be unique within the list it is part of. If available, VlogIdx is based on the existing field configuration.	Set by application
6.5	<i>comment</i> [Comment]	The Comment data element is used to provide a free space for human readable comments.	Optional	-	Set by application

Level 7: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → IntersectionReferenceID					
7.1	region [RoadRegulatorID]	The RoadRegulatorID data element is used to provide a globally unique region ID, typically issued by an authorised authority.	Mandatory	e.g. "31001" Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'. For each road operator a RoadRegulatorID is provided in this document.	Set by application
7.2	id [IntersectionID]	The IntersectionID data element is used to provide a region unique intersection identification, typically issued by a regional road authority.	Mandatory	e.g. "1" Refer to the document 'Addendum VRA en geregeld Kruisingsvlak Identificatie, Partnership Talking Traffic, July 28, 2017, the Netherlands'.	Set by application

Level 8: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → ApproachList → Approach					
8.1	approachID [ApproachID]	The ApproachID data element is used to provide an ID of the approach which is unique within the intersection.	Mandatory	-	Set by application
8.2	<i>alias</i> [Alias]	The Alias data element is used for compatibility with existing practice and unique within the list they are used.	Optional	-	Set by application
8.3	name [Name]	The Name data element is used to provide a human readable and recognizable name for the Approach data frame. Typically, a street name.	Mandatory	-	Set by application
8.4	<i>approachLanes</i> [LaneReferenceList] (1..254)	The LaneReferenceList data frame consists of a list of Lane entries. It is used to indicate	Optional	-	See level 13

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
		which lanes are part of an Arm.	approachLane [ApproachLane]	Mandatory	
					The ApproachLane data frame describes the lane which is part of the approach.

Level 9: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → VariantList → Variant					
9.1	variantID [VariantID]	The VariantID data element is used to provide an ID of the variant an object which is unique within the intersection. It is used for arms, variants and sensorsControlData.	Mandatory	-	Set by application
9.2	name [DescriptiveName]	The DescriptiveName data element is used to provide a human readable and recognizable name for the Variant data frame.	Mandatory	-	Set by application
9.3	variantCategory [VariantCategory]	The VariantCategory data element is used to denote the cause of the variant.	Mandatory	One out of the following types: (0) normalOperation (1) congestion (2) incident (3) emergency (4) event (5) Environmental (6) temporarilyClosed (7) closed (8) roadwork (9) extremeWeatherCondition	Set by application
9.4	enabledLanes [EnabledLaneList] (1..254)	The EnabledLaneList data frame consist of a list of LaneID entries. It describes which lanes (with 'revocableLane' bit set) are enabled in a particular variant.		Mandatory	By default, all lanes are active, but typically a subset of all lanes is valid if a variant is active. For example, lanes with a peak hour purpose (e.g. left turn lane) and an off-peak hour purpose (e.g. right turn lane) are typically duplicated. The EnabledLaneList data frame indicates which of the two LaneID's is valid.
			laneID [LaneID]	Mandatory	

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
9.5	<i>vlogIndicator</i> [VlogIndicator]	The VlogIndicator data frame is used to provide a combination of V-Log properties that allow determining which variant is currently active. The indicator is valid if the V-Log signal of category VlogCat at index VlogIdx is equal to MatchValue.	Optional	-	See level 14
9.4	<i>activePeriods</i> [ActivePeriodList] (1..16)	The ActivePeriodList data frame consist of a list of ActivePeriod entries. This list can be used to define periods for which a variant is active.	Optional	-	See level 15
			activePeriod [ActivePeriod]		
		The ActivePeriod data frame is used to provide a single period for which a variant is active.			
9.7	<i>comment</i> [Comment]	The Comment data element is used to provide a free space for human readable comments.	Optional	-	Set by application

Level 10: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → SensorList → Sensor					
10.1	sensorID [SensorID]	The SensorID data element is used to provide an ID of the sensor which is unique within the ControlData data frame.	Mandatory	-	Set by application
10.2	name [DescriptiveName]	The DescriptiveName data element is used to provide a human readable and recognizable name for the sensor. Typically, this value is equal to the name used in the TLC software.	Mandatory	-	Set by application
10.3	<i>alias</i> [Alias]	The Alias data element is used for compatibility with existing practice and unique within the list they are used.	Optional	-	Set by application

Standard			Profile			
Level	Field	Meaning	Status	Content	Value	
10.4	sensorDeviceType [SensorDeviceType]	The SensorType data element is used to indicate the type of a sensor.	Mandatory	One out of the following types: (0) unknown -- to indicate dummy sensors as known by the TLC. However, it is strongly recommended not to use dummies to prevent pollution. (1) inductionLoop (2) communicationLoop (3) pushButton (4) camera (5) radar (6) motionDetector (7) pressureSensor (8) infrared (9) radio	Set by application	
10.5	sensorOutput [SensorOutput]	The SensorOutput data element is used to indicate the functional output(s) of the sensor.	Mandatory	-	Set by application	
10.6	<i>vlogIdx</i> [VlogIdx]	The VlogIdx data element is used to provide the index in the V-Log stream of the TLC.	Optional	VlogIdx typically is numbered continuously starting at 0, but other methods are permitted (incl. skipping one number). VlogIdx shall be unique within the list it is part of.	Set by application	
10.7	sensorPosition [Position]	The sensorPosition data frame is used to describe the geographical location of the sensor..	Mandatory	-	-	
			lat [Latitude]	Mandatory	-	Set by application
			The Latitude data element is used to provide the geographic latitude of an object.			
	long [Longitude]	Mandatory	-	Set by application		
	The Longitude data element is used to provide the geographical longitude of an object.					

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
10.8	<i>length</i> [Length]	The Length data element is used to indicate either the length of a lane or the length of a detection area of a sensor, in centimetres. The length of a lane is calculated upstream from the stopline (65534 = out of geographical scope) to the first point at which the width becomes less than 2 meters. The length of a detection area of a sensor is calculated longitudinally.	Optional	-	Set by application
10.9	<i>width</i> [Width]	The Width data element is used to indicate the width of a detection area of a sensor, in centimetres.	Optional	-	Set by application
10.10	<i>geoShape</i> [GeoShape] (3..63)	The GeoShape data frame consist of a list of IndexedPosition entries. It is used to describe the detection area of a sensor.	Optional	The shape is a closed shape: the last position connects to the first position.	-
		indexPoint [IndexedPosition]	Mandatory	-	See level 16
10.11	<i>sensorAllocations</i> [SensorAllocationList] (1..255)	The SensorAllocationList data frame consists of a list of SensorAllocation entries.	Optional	If a detection area, e.g. a loop detector, is placed over two lanes, two sensor allocations must be created.	-
		sensorAllocation [SensorAllocation]	Mandatory	-	See level 17
		The SensorAllocation data frame is used to describe on what lanes a detection area is located.			

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
10.12	<i>sensorRelations</i> [SensorRelationList] (1..255)	The SensorRelationList data frame consists of a list of SensorRelation entries.	Optional	The primary use of sensorRelations is for detection areas located on ingress lanes which detect traffic <i>going to</i> one or more lanes (i.e. the inflow of traffic). These lanes must be indicated as sensor relations. The start of a fan-out marks the logical boundary that allows to unambiguously define which lanes are related to a sensor. From this point downstream to the conflict area, sensors are typically related to a single lane only. An alternative use of sensorRelations is for detection areas located on egress lanes which may detect traffic <i>coming from</i> multiple lanes (i.e. the outflow of traffic).	-
		sensorRelation [SensorRelation] The SensorRelation data frame is used to describe to which lanes a detection area is related.	Mandatory	-	See level 18

Level 11: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → SignalGroupList → SignalGroup					
11.1	name [DescriptiveName]	The DescriptiveName data element is set to human readable and recognizable SignalGroupID. For example, fc02, fc21, SG31, SG41, etc.	Mandatory	The descriptiveName must be identical to the movementName in the SPAT message.	Set by application
11.2	signalGroup [SignalGroupID]	The SignalGroupID data element is used to provide the ID of the signal group which is unique within the intersection.	Mandatory	Dummy signal groups are defined only by means of a SignalGroupID, they are not used in the connection list. However, it is strongly recommended not to define dummies to prevent pollution.	Set by application
11.3	<i>alias</i> [Alias]	The Alias data element is used for compatibility with existing practice and unique within the list they are used.	Optional	-	Set by application
11.4	vlogIdx [VlogIdx]	The VlogIdx data element is used to provide the index in the V-Log stream of the TLC.	Mandatory	VlogIdx typically is numbered continuously starting at 0, but other methods are permitted (incl. skipping one number). VlogIdx shall be unique within the list it is part of.	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
11.5	<i>minRedTime</i> [MinRedTime]	Minimum duration this signalGroup needs to stay red once it turns red (Guaranteed red time)	Optional	Mandatory if available.	Set by application
11.6	<i>minGreenTime</i> [MinGreenTime]	Minimum duration this signalGroup needs to stay green once it turns green (Guaranteed green time)	Optional	Mandatory if available.	Set by application
11.7	<i>minYellowTime</i> [MinYellowTime]	Minimum duration this signalGroup needs to stay yellow once it turns yellow (Guaranteed yellow time)	Optional	Mandatory if available.	Set by application

Level 12: ControlData → IntersectionGeometryList → IntersectionGeometryAdd → SignalGroupRelationList → SignalGroupRelation					
12.1	fromSignalGroup [SignalGroupID]	The SignalGroupID data element is used to indicate the primary signal group in a signal group relation.	Mandatory	-	Set by application
12.2	toSignalGroup [SignalGroupID]	The SignalGroupID data element is used to indicate the secondary signal group in a signal group relation.	Mandatory	-	Set by application
12.3	<i>alias</i> [Alias]	The Alias data element is used for compatibility with existing practice and unique within the list they are used.	Optional	-	Set by application
12.4	<i>clearanceTimeType</i> [ClearanceTimeType]	The ClearanceTimeType data element is used to indicate the method applied for the calculation of clearance times.	Conditional	Mandatory if clearanceTime is provided. (0) protectedByClearance (1) protectedByIntergreen Which method is applicable shall be defined by the road authority.	Set by application
12.5	<i>clearanceTime</i> [ClearanceTime]	The ClearanceTime data element is used to indicate the time to clear the conflict area of two conflicting movements. The values provided are minimum (legal) clearance times, which are also supervised by the controller hardware. In units of 0.1 seconds, 9999 = dynamic.	Optional	Mandatory if available.	Set by application

Level 13: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → ApproachList → Approach → LaneReferenceList → ApproachLane					
13.1	<i>lanePosition</i> [LanePosition]	Index that gives the position of the lane on the ingressApproach from right (1) to left (n).	Optional	-	Set by application
13.2	laneID [LaneID]	The LaneID data element is used to provide an ID of the GenericLane which is unique within an intersection.	Mandatory	-	Set by application
13.3	<i>capacity</i> [Capacity]	The Capacity data element indicates the theoretical maximum capacity of a ingress lane at green with unlimited supply of vehicles (pae/hour). The data element is used for traffic engineering assessments.	Optional	-	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
13.4	<i>length</i> [LaneLength]	The Length data element is used to indicate either the length of a lane or the length of a detection area of a sensor, in decimetres. The length of a lane is calculated upstream from the stopline (65534 = out of geographical scope) to the first point at which the width becomes less than 2 meters. The length of a detection area of a sensor is calculated longitudinally.	Optional	-	Set by application

Level 14: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → VariantList → Variant → VlogIndicator					
14.1	vlogCat [VlogCat]	The VlogCat data element is used to provide the V-Log category.	Mandatory	One out of the following types: (0) DP (1) IS (2) FC (3) US (4) DS	Set by application
14.2	vlogIdx [VlogIdx]	The VlogIdx data element is used to provide the index in the V-Log stream of the TLC.	Mandatory	VlogIdx typically is numbered continuously starting at 0, but other methods are permitted (incl. skipping one number). VlogIdx shall be unique within the list it is part of.	Set by application
14.3	matchValue [MatchValue]	The MatchValue data element indicates the V-Log value corresponding to the variant. If the V-Log variant signal matches this value, the variant is active.	Mandatory	-	Set by application

Level 15: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → VariantList → Variant → ActivePeriodList → ActivePeriod					
15.1	days [Days]	The Days data element is used to indicate the days of the week to which a variant applies.	Mandatory	-	Set by application
15.2	beginTime [BeginTime]	The BeginTime data element is used to indicate the start of the validity period of a variant, this moment included.	Mandatory	The notation is a ISO 8601 time expression including time zone (and without the date expression and T delimiter).	Set by application
15.3	endTime [EndTime]	The EndDate data element is used to provide the latest date the topology file is valid.	Mandatory	The notation is a ISO 8601 time expression including time zone (and without the date expression and T delimiter).	Set by application

Level 16: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → SensorList → Sensor → GeoShape → IndexedPosition					
16.1	index [Index]	The Index data element defines the order of nodes in a nodelist or points in a geoshape.	Mandatory	-	Set by application
16.2	lat [Latitude]	The Latitude data element is used to provide the geographic latitude of an object.	Mandatory	-	Set by application

Standard			Profile		
Level	Field	Meaning	Status	Content	Value
16.3	long [Longitude]	The Longitude data element is used to provide the geographical longitude of an object.	Mandatory	-	Set by application
Level 17: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → SensorList → Sensor → SensorAllocationList → SensorAllocation					
17.1	laneID [LaneID]	The LaneID data element is used to provide an ID of the GenericLane which is unique within an intersection.	Mandatory	-	Set by application
17.2	<i>distance</i> [LaneDistance]	The LaneDistance data element provides the distance from the stopline of the lane to the first interface with the detection area of the sensor. This value is used for traffic engineering assessments.	Optional	In case of ingress lanes the distance must be calculated upstream from the stop line. In case of downstream lanes the distance must be calculated downstream from the first node of the lane.	Set by application
Level 18: ControlData → IntersectionGeometryAddList → IntersectionGeometryAdd → SensorList → Sensor → SensorRelationList → SensorRelation					
18.1	laneID [LaneID]	The LaneID data element is used to provide an ID of the GenericLane which is unique within an intersection.	Mandatory	-	Set by application
18.2	<i>purpose</i> [Purpose]	The Purpose data element is used to provide the purpose from the perspective of the TLC application.	Optional	One out of the following types: (0) unknown (1) measure -- Mostly the first loop from a lane or the loop right after the stop line to detect red-light runners (2) verification -- Detection loop which has the function to set a green request (3) gapMeasure -- First loop of a lane (GapTime 0+) (4) gapVerification -- Long loop (GapTime often 0) (5) safety -- First loop after long loop (6) Congestion -- Detectionloops to detect congestion (7) platoon	Set by application

Annex A: Planned V3.0 revisions

Planned changes are marked in red.

0.5	<i>regional</i> [REGION.Reg-MapData]		Used	Used to provide "SignalHeadLocation" which defines the XYZ position of a signal head within an intersection and indicates the related signal group identifier.	-
12.5	<i>clearanceTime</i> [ClearanceTime]	The ClearanceTime data element is used to indicate the time to clear the conflict area of two conflicting movements. The values provided are minimum (legal) clearance times, which are also supervised by the controller hardware (including permissive conflicts). In units of 0.1 seconds, 9999 = dynamic.	Optional	Mandatory if available.	Set by application
6.2	<i>attributes</i> [NodeAttributeSetXY]	<i>disabled</i> [SegmentAttributeXYList] (1..8) The disabled data frame consists of a list of SegmentAttributeXY entries which are disabled at this node point.	Conditional	[...] Desired extension (not part of the profile): (38) isolatedByBarrier	Set by application
Tbd	<i>maxOccupancyTime</i>	Tbd	Tbd	Tbd	Tbd
Tbd	<i>maxGapTime</i>	Tbd	Tbd	Tbd	Tbd

Annex B: Bit string example

A bit string is an arbitrarily long array of bits. Specific bits can be identified by parenthesized integers and assigned names. As an example, the bit string for the data element LaneSharing is shown in **Fout!**
Verwijzingsbron niet gevonden..

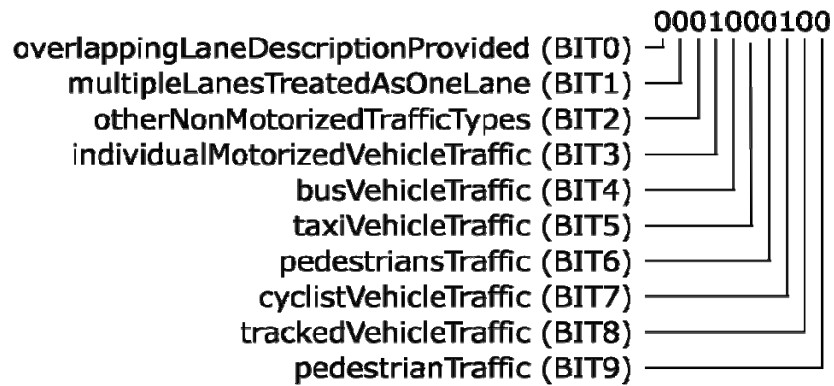


Figure 1 Bit string example

The example shows the 10 bit sting '0001000100', where BIT3and BIT7 are set from left to right. This indicates that user types individualMotorizedVehicleTraffic and cyclistVehicleTraffic can access and use the respective lane.

Annex C: Members subWG NL profile

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Colophon

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