Traffic Data Acquisition Protocol (TDAP)

Communication protocol for data acquisition with VIPER and RAPTOR systems
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1 Overview

Initially the *Traffic Data Acquisition Protocol* was used to transfer traffic measurement data. This data is normally acquired by inductive loops inlaid in the lanes or by radar and then aggregated locally.

Since revision 2.00 *TDAP* specifies an additional class of frames used to control traffic signals as well as a class of frames used to transfer measurement date from miscellaneous probes.

TDAP uses the Internet protocol to transfer its data to client applications. It was deliberately designed to be simple in use.

2 Target audience

This document is aimed for software developers implementing client applications that will communicate with *TDAD*, *TJDD* or *TMC*.

3 The Internet protocol

The services *TDAP, TJDD* and *TMC* make use of the Internet protocol for data transfer. The services *TDAP* and *TJDD* use the UDP protocol as well as the TCP protocol (client – server applications). The *TMC* service does not support the UDP protocol.

3.1 Firewall configuration

When using the UDP protocol, the client system receives data on a predefined port. There is no such thing as establishing a connection (as is done in client – server mode) prior to transferring data, since UDP is a connection less protocol. The system acquiring the data sends it periodically (when an aggregation interval expires) to the clients without verifying successful reception. If the client systems runs a firewall, the port used to receive the data must be enabled for incoming traffic. If the port is blocked the client application will never receive any data.

In contrast, the TCP protocol implies a client – server setup. The system acquiring the data is the server while the system consuming the data is the client. The connection is established by the client before any data is transferred. If a stateful firewall is used on the client system there is no need to enable specific ports.

3.2 UDP protocol

The data is transferred by the acquiring system to the client system specified by its IP address and port. Data can be sent to multiple clients in parallel. Note that data is never transferred by means of broadcasts since this would prevent it from being routed.

3.3 TCP protocol

The system running the services *TDAD*, *TJDD* or *TMC* is the server and will listen for incoming connection requests. Listening ports on these service are configurable. Multiple connections are allowed but limited according to system resources.

4 Common properties for all services

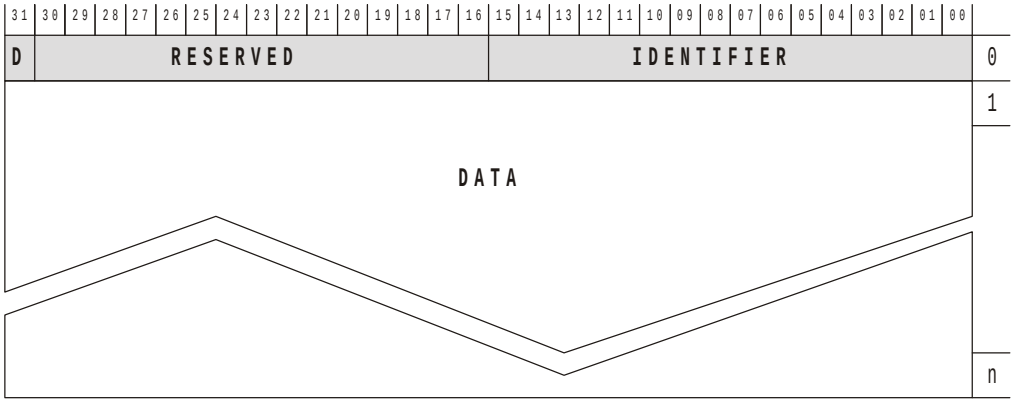
Using the UDP protocol data can be transferred from the acquiring system to the client system exclusively. The TCP protocol allows data to be transferred in both directions.

4.1 Byte ordering

The byte ordering of a 32 bit word corresponds to network byte order. For the Internet protocol this is *big endian*. When developing client applications correct byte ordering must be respected.

4.2 Composition of frames

Basically a frame consists of 32 bit words beginning with a control word containing the following data.



The control word consist of a bit *D* (bit 31) indicating the direction in which data is transferred and a 16 bit *identifier* (bits 0 – 15). The bits 16 – 30 are reserved.

The following table explains the meaning of the direction bit *D* (bit 31).

value of bit D	the frame contains data
0	**from** the client **to** the data acquisition or control system
1	**from** the data acquisition or control system **to** the client

When using the Internet protocol UDP the bit *D* always equals to 1 since data can only be passed from the acquisition system to the client.

The *identifier* (bits 0 -15) specifies the data or payload (found in the *data* section) transferred with the frame.

Frames are always transferred as distinct packets, i.e. in a single UDP or TCP packet. Neither is data fragmented nor packed across a packet boundary. Of course packing multiple data into a single frame is possible.

5 TDAD frame specifications

This section lists all frames used by the *Traffic Data Acquisition Daemon* (TDAD) service. The following table holds a summery of available frames:

identifier	explanation
256	aggregated traffic data C2
257	extended aggregated traffic data C2
258	extended aggregated traffic data Swiss10
512	wrong-way driver
513	individual vehicle

5.1 Aggregated traffic data C2

This frame contains data from a detector capable of distinguishing the two vehicle classes *passenger cars* and *trucks* (see TLS specification for vehicle classification). This data may also be derived from a detector capable of distinguishing more then two vehicle classes. In this case the acquisition system is configured to map multiple vehicle classes to two vehicle classes.

The frame is sent from the data acquisition system to the client with *identifier* 256 and contains the following data:

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															256																0
Status																DID																1
qVhc																																2
vVhc																																3
oVhc																																4
qPcr																																5
vPcr																																6
oPcr																																7
qTrk																																8
vTrk																																9
oTrk																																10

All values (number of vehicles, mean of speed and occupation) refer to the effective aggregation interval.

The items of the frame are specified in the following table:

item	possible value	explanation
Status	0 .. 3	The status of the detector. The value denotes the following: 0: operating and supplying data 1: supplying data but one of two loops is faulty 2: no data is supplied, the detector does not communicate with the processor plug-in module of the acquiring system
DID	0 .. 255	detector ID according to TLS
qVhc	0 .. 2^{16} – 1	number of vehicles (passenger cars and trucks)
vVhc	0 .. 300 km/h	mean vehicle speed (passenger cars and trucks)
oVhc	0 .. 100 %	loop occupation in % (by passenger cars and trucks)
qPcr	0 .. 2^{16} – 1	number of passenger cars
vPcr	0 .. 300 km/h	mean speed of passenger cars
oPcr	0 .. 100 %	loop occupation in % by passenger
qTrk	0 .. 2^{16} – 1	number of trucks
vTrk	0 .. 300 km/h	mean speed of trucks
oTrk	0 .. 100 %	loop occupation in % by trucks

The detector ID is configured at the detector plug-in module and allows an unambiguous identification of each logical detector. All other data refers to the aggregation interval.

Some of the data is deliberately redundant to simplify its processing by the client.

5.2 Extended aggregated traffic data C2

This frame is an extended version of the frame *Aggregated traffic data C2*. It contains data from a detector capable of distinguishing the two vehicle classes *passenger cars* and *trucks* (see TLS specification for vehicle classification). This data may also be derived from a detector capable of distinguishing more then two vehicle classes. In this case the acquisition system is configured to map multiple vehicle classes to two vehicle classes.

The frame is sent from the data acquisition system to the client with *identifier* 257 and contains the following data:

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															257																0
Status																DID																1
qVhc																																2
vVhc																																3
oVhc																																4
qPcr																																5
vPcr																																6
oPcr																																7
qTrk																																8
vTrk																																9
oTrk																																10
lVhc																																11
glVhc																																12
gtVhc																																13
aggInt																																14

All values (number of vehicles, mean of speed, occupation and gap length) refer to the effective aggregation interval. The items of the telegram are specified in the following table:

item	possible value	explanation
Status	0 .. 3	The status of the detector. The value denotes the following: 0: operating and supplying data 1: supplying data but one of two loops is faulty 2: no data is supplied, the detector does not communicate with the processor plug-in module of the acquiring system
DID	0 .. 255	detector ID according to TLS
qVhc	0 .. 2^{16} – 1	number of vehicles (passenger cars and trucks)
vVhc	0 .. 300 km/h	mean vehicle speed (passenger cars and trucks)
oVhc	0 .. 100 %	loop occupation in % (by passenger cars and trucks)

item	possible value	explanation
qPcr	0 .. 2^{16} – 1	number of passenger cars
vPcr	0 .. 300 km/h	mean speed of passenger cars
oPcr	0 .. 100 %	loop occupation in % by passenger cars
qTrk	0 .. 2^{16} – 1	number of trucks
vTrk	0 .. 300 km/h	mean speed of trucks
oTrk	0 .. 100 %	loop occupation in % by trucks
lVhc	0 .. 254 dm	mean length of vehicles (254 equals to 25.4 m)
glVhc	0 .. 2^{24} – 1 m	mean length of gap between vehicles
gtVhc	0 .. 2^{24} – 1 ms	mean time of gap between vehicles
aggInt	0 .. 2^{32} – 1 s	the length of the aggregation interval in use

The detector ID is configured at the detector plug-in module and allows an unambiguous identification of each logical detector. All other data refers to the aggregation interval. Some of the data is deliberately redundant to simplify its processing by the client.

5.3 Extended aggregated traffic data Swiss10

The frame contains data from a detector capable of distinguishing vehicles according to the Swiss 10 specification from the Swiss Federal Roads Office FEDRO (see document FEDRO 13 012).

The frame is sent from the data acquisition system to the client with *identifier* 258 and contains the following data:

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															258																0
Status																DID																1
qVhc																																2
vVhc																																3
oVhc																																4
qPcrCP																																5
vPcrCP																																6
oPcrCP																																7
qTrkCP																																8
vTrkCP																																9
oTrkCP																																10
qPcr																																11
vPcr																																12
oPcr																																13
qPcrTr																																14
vPcrTr																																15
oPcrTr																																16
qTrk																																17
vTrk																																18
oTrk																																19
qTran																																20
vTran																																21
oTran																																22

qTrkTr	23
vTrkTr	24
oTrkTr	25
qArt	26
vArt	27
oArt	28
qBus	29
vBus	30
oBus	31
qBike	32
vBike	33
oBike	34
qTranTr	35
vTranTr	36
oTranTr	37
qArt35	38
vArt35	39
oArt35	40
lVhc	41
glVhc	42
gtVhc	43
aggInt	44

All values (number of vehicles, mean of speed, occupation and gap length) refer to the effective aggregation interval. The items of the frame are specified in the following table:

item	possible value	explanation
Status	0 .. 3	The status of the detector. The value denotes the following: 0: operating and supplying data 1: supplying data but one of two loops is faulty 2: no data is supplied, the detector does not communicate with the processor plug-in module of the acquiring system
DID	0 .. 255	detector ID according to TLS
qVhc	0 .. 2^{16} – 1	number of vehicles (all vehicle classes)
vVhc	0 .. 300 km/h	mean vehicle speed (all vehicle classes)
oVhc	0 .. 100 %	loop occupation in % (all vehicle classes)

item	possible value	explanation
qPcrCP	0 .. 2^{16} – 1	number of passenger cars (compacted*)
vPcrCP	0 .. 300 km/h	mean speed of passenger cars (compacted*)
oPcrCP	0 .. 100 %	loop occupation in % by passenger cars (compacted*)
qTrkCP	0 .. 2^{16} – 1	number of trucks (compacted*)
vTrkCP	0 .. 300 km/h	mean speed of trucks (compacted*)
oTrkCP	0 .. 100 %	loop occupation in % by trucks (compacted*)
qPcr	0 .. 2^{16} – 1	number of passenger cars
vPcr	0 .. 300 km/h	mean speed of passenger cars
oPcr	0 .. 100 %	loop occupation in % by passenger cars
qPcrTr	0 .. 2^{16} – 1	number of passenger cars with trailers
vPcrTr	0 .. 300 km/h	mean speed of passenger cars with trailers
oPcrTr	0 .. 100 %	loop occupation in % by passenger cars with trailers
qTrk	0 .. 2^{16} – 1	number of trucks
vTrk	0 .. 300 km/h	mean speed of trucks
oTrk	0 .. 100 %	loop occupation in % by trucks
qTran	0 .. 2^{16} – 1	number of transporters
vTran	0 .. 300 km/h	mean speed of transporters
oTran	0 .. 100 %	loop occupation in % by transporters
qTrkTr	0 .. 2^{16} – 1	number of trucks with trailers
vTrkTr	0 .. 300 km/h	mean speed of trucks with trailers
oTrkTr	0 .. 100 %	loop occupation in % by trucks with trailers
qArt	0 .. 2^{16} – 1	number of artics
vArt	0 .. 300 km/h	mean speed of artics
oArt	0 .. 100 %	loop occupation in % by artics
qBus	0 .. 2^{16} – 1	number of busses
vBus	0 .. 300 km/h	mean speed of busses
oBus	0 .. 100 %	loop occupation in % by busses
qBike	0 .. 2^{16} – 1	number of bikes
vBike	0 .. 300 km/h	mean speed of bikes
oBike	0 .. 100 %	loop occupation in % by bikes

* The term *compacted* denotes the mapping of the 10 Swiss 10 classes to the two compacted classes *passenger car like* and *truck like*. The Swiss 10 classes *bike*, *passenger car*, *passenger car with trailer*, *transporter*, *transporter with trailer* and *3.5t artic* map to the compacted class *passenger car like*. The Swiss 10 classes *bus*, *truck*, *truck with trailer* and *artic* map to the compacted class *truck like*.

item	possible value	explanation
qTranTr	0 .. 2^{16} – 1	number of transporters with trailers
vTranTr	0 .. 300 km/h	mean speed of transporters with trailers
oTranTr	0 .. 100 %	loop occupation in % by transporters with trailers
qArt35	0 .. 2^{16} – 1	number of 3.5t artics
vArt35	0 .. 300 km/h	mean speed of 3.5t artics
oArt35	0 .. 100 %	loop occupation in % by 3.5t artics
lVhc	0 .. 254 dm	mean length of vehicles (254 equals to 25.4 m)
glVhc	0 .. 2^{24} – 1 m	mean length of gap between vehicles
gtVhc	0 .. 2^{24} – 1 ms	mean time of gap between vehicles
aggInt	0 .. 2^{32} – 1 s	the length of the aggregation interval in use

The detector ID is configured at the detector plug-in module and allows an unambiguous identification of each logical detector. All other data refers to the aggregation interval. Some of the data is deliberately redundant to simplify its processing by the client.

5.4 Aggregated traffic data C51

Yet to be specified.

5.5 Aggregated traffic data C81

Yet to be specified.

5.6 Wrong-way driver

This frame is used to report a wrong-way driver. In contrast to other frames it is not part of the aggregation, hence it is sent immediately when a wrong-way driver is detected. The data passed with the wrong-way driver frame describes the individual vehicle passing the detector in the wrong way. If you opt to receive this kind of data make sure the detector's direction logic is configured accordingly.

The data is sent from the acquisition system to the client with the *identifier* 512 containing the following data:

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															512																0
Status																DID																1
tVhc																																2
vVhc																																3
lVhc																																4

The detector ID is configured at the detector plug-in module and allows an unambiguous identification of each logical detector. All other values refer to the individual vehicle passing the detector in the wrong way.

The items of the frame are specified in the following table:

item	possible value	explanation
Status	0 .. 3	The status of the detector. The value denotes the following: 0: operating and supplying data 1: supplying data but one of two loops is faulty 2: no data is supplied, the detector does not communicate with the processor plug-in module of the acquiring system
DID	0 .. 255	detector ID according to TLS
tVhc	0 .. 8	type of vehicle (vehicle classification), see below
vVhc	0 .. 300 km/h	vehicle speed
lVhc	0 .. 254 dm	length of vehicle (254 equals to 25.4 m)

The *vehicle type* reported heavily depends on the detector's capability to classify vehicles. The following table shows the possible values and the corresponding classes as defined by the TLS specification:

tVhc	TLS class	SWISS 10 class	explanation
0	7	3	passenger car
1	2	4	passenger car with trailer
2	3	8	truck
3	11	5	transporter
4	8	9	truck with trailer
5	9	10	artic truck
6	5	1	bus
7	10	2	bike
8	6	-	vehicle not classifiable
9	-	6	transporter with trailer
10	-	7	artic truck (< 3.5t)

Detectors with lower classification capabilities will map vehicles according to the TLS specification.

5.7 Individual vehicle

This frame is used to report data about an individual vehicle passing across the detector. In contrast to other frames it is not part of the aggregation, hence it is sent immediately on **every** detected vehicle. The data passed with this frame describes the individual vehicle and its relation to the preceding vehicle. Be aware that opting for this frame will massively increase the amount of data transferred to the client.

The data is sent from the acquisition system to the client with the *identifier* 513 containing the following data:

31	30	29	28	27	26	**25**	**24**	23	22	**21**	**20**	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															513																0
Status																DID																1
tVhc																																2
vVhc																																3
lVhc																																4
tOcc																																5
tGap																																6
lGap																																7
tsYear																tsMonth								tsDay								8
tsHour												tsMin																				9

The detector ID is configured at the detector plug-in module and allows an unambiguous identification of each logical detector. All other values refer to the individual vehicle passing the detector. The elements denoted with a leading `ts` indicate the exact time stamp the vehicle was detected.

The items of the frame are specified in the following table:

item	possible value	explanation
Status	0 .. 3	The status of the detector. The value denotes the following: 0: operating and supplying data 1: supplying data but one of two loops is faulty 2: no data is supplied, the detector does not communicate with the processor plug-in module of the acquiring system
DID	0 .. 255	detector ID according to TLS
tVhc	0 .. 8	type of vehicle (vehicle classification), see description of *Wrong-way-driver* frame
vVhc	0 .. 300 km/h	vehicle speed
lVhc	0 .. 254 dm	length of vehicle (254 equals to 25.4 m)
tOcc	0 .. 2^{16} – 1 ms	the occupation time of the detector system by the vehicle
tGap	0 .. 2^{24} – 1 ms	the time elapsed since the detection of the preceding (temporal gap)

item	possible value	explanation
lGap	0 .. 2'540 m	the distance between the preceding vehicle and the current vehicle resolved to 10 meters (spatial gap)
tsYear	1970 .. 2^{16} – 1	Year of vehicle detection time
tsMonth	1 .. 12	Month in year of vehicle detection time
tsDay	1 .. 31	Day of month of vehicle detection time
tsHour	1 .. 24	Hour of vehicle detection time
tsMin	1 .. 59	Minute of vehicle detection time
tsMSec	1 .. 59'999	Millisecond of vehicle detection time

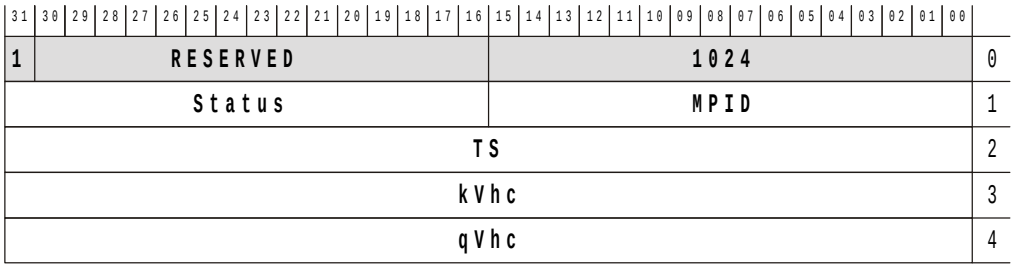
6 TJDD frame specifications

This section lists all frames used by the *Traffic Jam Detection Daemon* (TJDD) service. The following table holds a summery of available frames:

identifier	explanation
1024	aggregated traffic status information

6.1 Aggregated traffic status information

This frame contains information about the traffic status.



All values (such as traffic status, traffic density, etc) are the result of aggregation and extrapolation. The data is sent from the acquisition system to the client with the *identifier* 1024 containing the following data:

item	possible value	explanation
Status	0 .. 3	The status of the metering point. The value denotes the following: 0: operating and supplying genuine data 1: operating and supplying backup data 2: operating and supplying fake / simulated data 3: no data is supplied, metering point out of order
MPID	0 .. 2^{16} – 1	Identification of metering point
TS	0 .. 3	Traffic status. The value denotes the following: 0: normal traffic 1: heavy traffic 2: nose-to-tail traffic 3: jam
kVhc	0 .. 2^{32} – 1 vehicles / km	traffic density
qVhc	0 .. 2^{32} – 1 vehicles / h	traffic flow

The metering point ID (MPID) allows an unambiguous identification of each metering point in the system. If metering points are mapped one to one to logical detectors, the metering point ID equals the logical detector's ID.

7 TMC frame specifications

This section lists all frames used by the TMC system. The following table holds a summery of the frames:

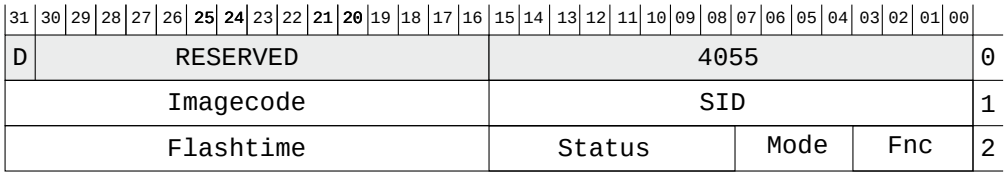
identifier	explanation
3060	environmental probe, visibility values
3061	environmental probe, brightness values
4002	traffic signal, list of unavailable image codes
4049	traffic signal, brightness command
4055	traffic signal, set point and actual value
4128	traffic signal, set point confirmation
4129	system, status
4130	system, update request

7.1 Traffic signals

Frames in this section are specific to a distinctive traffic signal.

7.1.1 Set point and actual value

The frame is used in both directions. When the D bit is cleared the frame carries set point information for the traffic signal. When the D bit is set the frame caries the actual value as well as status information of the traffic signal.



The data is sent in both directions with the *identifier* 4055 containing the following data:

item	possible value	explanation
D	0 / 1	0: frame contains set point data for the control system 1: frame contains actual value from the control system
SID	0 .. 2^{16} – 1	Identification of traffic signal within rack system
Imagecode	1 .. 255	D bit cleared The code of the image the traffic signal should display. Image codes are according to TLS specification (Appendix 7). Image codes that can't be displayed by the traffic signal are rejected. D bit set The image code of the actual value. The image code reported is only valid if the *Status* field of the frame does not indicate any errors.

item	possible value	explanation
Fnc	0 .. 2	Only valid if D bit cleared The *Function* value is only valid for self-luminous traffic signals such as traffic lights or LED signals. None self-luminous traffic signals will ignore this value. 0: turn off 1: turn on 2: flash (if possible, alternatively turn on)
Flash time	200 .. 5'000 ms	Only valid if D bit cleared This value is only valid for self-luminous traffic signals such as traffic lights or LED signals. None self-luminous traffic signals will ignore this value. The value denotes the total flash period length in ms, i.e. the sum of the on **and** the off phase. The duty cycle is controlled by the traffic signal. Values out of range will be adjusted to the nearest limit.
Status	0 .. 3	Only valid if D bit set 0: normal operation 1: communication error 2: one or more images are unavailable 3: no mains (circuit breaker open)
Mode	0 / 1	Only valid if D bit set 0: automatic (traffic signal accepts 4055 frames) 1: manual (traffic signal ignores 4055 frames)

This frame is sent spontaneously by the control system depending on image, status and mode changes.

The SID allows an unambiguous identification of each traffic signal within a rack system.

7.1.2 Set point confirmation

The frame is used to confirm reception of a set point frame 4055. This does **not** necessarily imply the execution of the commands transferred by the set point frame.

31	30	29	28	27	26	**25**	**24**	23	22	**21**	**20**	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															4128																0
Imagecode																SID																1

The frame is sent from the control system to the client with *identifier* 4128 containing the following data:

item	possible value	explanation
SID	0 .. 2^{16} – 1	Identification of traffic signal within rack system

item	possible value	explanation
Imagecode	0 .. 255	The image code to be displayed. If the image code is 0 the image passed by the set point frame 4055 does not exist or can not be displayed.

An image code equal to 0 should be interpreted as negative confirmation to the set point command. Additional information may be available by means of frames 4055 and 4002.

The SID allows an unambiguous identification of each traffic signal within a rack system.

7.1.3 List of unavailable images

The frame contains a list of image codes that can not be displayed by the traffic signal due to errors. If the list is empty all images implemented on the traffic signal are available.

31	30	29	28	27	26	**25**	**24**	23	22	**21**	**20**	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															4002																0
Count																SID																1
1. unavailable image code																																2
2. unavailable image code																																n

The frame is sent from the control system to the client with *identifier* 4002 containing the following data:

item	possible value	explanation
SID	0 .. 2^{16} – 1	Identification of traffic signal within rack system
count	0 .. 255	The number of image codes that can't be displayed by the traffic signal. A count of 0 (i.e. a list having no items) denotes that all images are available. An empty list will always be transmitted as soon as all images that once were unavailable return to the available state.
1. image	1 .. 255	first unavailable image code
2. image	1 .. 255	second unavailable image code
n. image		one entry for every additional image code that is unavailable

This frame is sent spontaneously whenever the list of unavailable images changes. At start-up all images are considered available and **no** empty list is transferred.

The SID allows an unambiguous identification of each traffic signal within a rack system.

7.1.4 Brightness command

The frame contains the brightness to be set on self-luminous traffic signals.

31	30	29	28	27	26	**25**	**24**	23	22	**21**	**20**	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
0	RESERVED															4049																0
Brightness																SID																1

The frame is sent from the client to the control system with *identifier* 4049 containing the following data:

item	possible value	explanation
SID	0 .. 2^{16} – 1	Identification of traffic signal within rack system
Brightness	0 .. 100 %	The brightness in % for self-luminous traffic signals. If supported by the traffic signal the exact value will be applied. If however a traffic signal only supports 2 levels of brightness then 0% .. 49% will trigger the low and 50% .. 100% will trigger the high level. For none self-luminous traffic signals equipped with an electric light 0% denotes turning off the electric light and 100% denotes turning on the electric light.

If this frame is sent to a traffic signal not having the hardware capabilities to change its brightness it will be ignored.

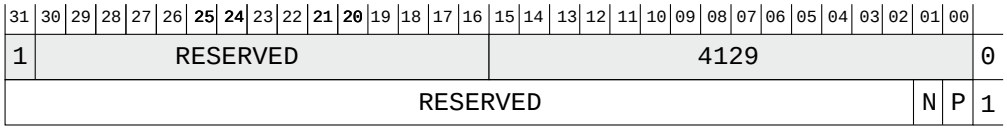
The SID allows an unambiguous identification of each traffic signal within a rack system.

7.2 System

Frames in this section are not specific to one traffic signal, they are specific to a rack system instead. A rack system consists of one or more racks (expansion racks) containing multiple traffic signal plugins but only one PDU (processor) plugin. The processor plugin is the one connecting the entire rack system to the Ethernet.

7.2.1 Status

The frame contains the status bits denoting the operating condition of various software and hardware components.



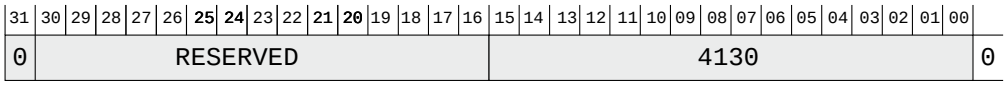
This frame can be adapted depending on specific requirements. It is transferred from the control system to the client with identifier *4129* containing the following data:

item	possible value	explanation
P	0 / 1	The status of the traffic signal plugins in the rack system. 0: all plugins are available and of correct type 1: there is a misconfiguration within the plugins
N	0 / 1	The status of the network (fiber optic node) the control system is connected to. 0: fully operational 1: degraded

This frame is sent spontaneously whenever a status changes.

7.2.2 Update request

The frame is used by a client to initiate the sending of all values stored in the control system. The frame uses *identifier* 4130 and has no data.



On reception of frame 4130 the control system will transfer all actual values of all traffic signals, status information of all traffic signals and systems as well as the last received environmental data.

A client system will typically send this frame (and therefore request the control system to send all data) when it has (re)established the connection with the control system.

7.3 Environment data

The frames of this section carry environmental data acquired by miscellaneous probes.

7.3.1 Brightness

The frame contains the brightness in LUX. Generally the value represents a mean value. If not otherwise constrained by the probe it is a 60 seconds mean value.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															3061																0
Status																PID																1
LUX																																2

The frame is sent automatically and periodically from the acquisition system to the client with *identifier* 3061. It contains the following data:

item	possible value	explanation
Status	0 .. 2	Status of the probe. 0: operating and supplying genuine data 1: operating and supplying fake / simulated data 2: no data is supplied, probe is out of order
PID	0 .. 127	Identification of probe
LUX	0 .. 2^{32} – 1 LUX	The brightness in Lux

The probe ID (PID) allows an unambiguous identification of each probe within a rack system.

7.3.2 Visibility

The frame contains the visibility in meters. Generally the value represents a mean value. If not otherwise constrained by the probe it is a 60 seconds mean value.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	RESERVED															3060																0
Status																PID																1
Vis																																2

The frame is sent automatically and periodically from the acquisition system to the client with *identifier* 3061. It contains the following data:

item	possible value	explanation
Status	0 .. 2	Status of the probe. 0: operating and supplying genuine data 1: operating and supplying fake / simulated data 2: no data is supplied, probe is out of order
PID	0 .. 127	Identification of probe
Vis	0 .. 2^{32} – 1 m	The visibility in meters

The probe ID (PID) allows an unambiguous identification of each probe within a rack system.

8 Revision history

Revision	Date	Comment
1.12	17.08.2005	First revision
1.13	22.02.2007	Added the *extended aggregated traffic data C2* telegram
1.20	28.02.2007	Added the *wrong-way driver* telegram
1.21	01.03.2007	Added the parameter `aggInt` to telegram 257
1.30	08.03.2007	Added *aggregated traffic status information* telegram
1.31	09.03.2007	Range of MPID (telegram 1024) corrected
2.00	30.11.2013	Added TMC frames
2.01	28.02.2014	Added SWISS10 data frame
2.02	28.05.2019	Added frame 513 reporting an individual vehicle