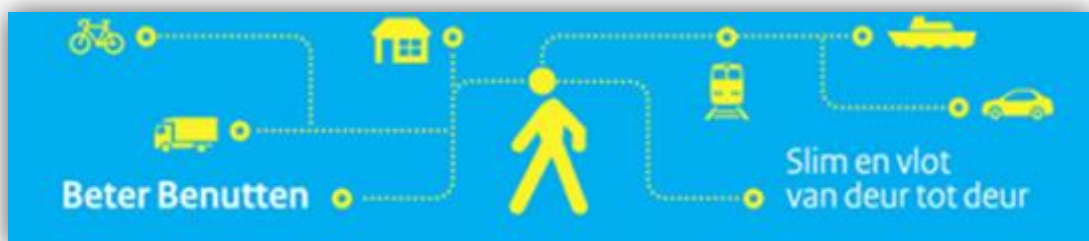
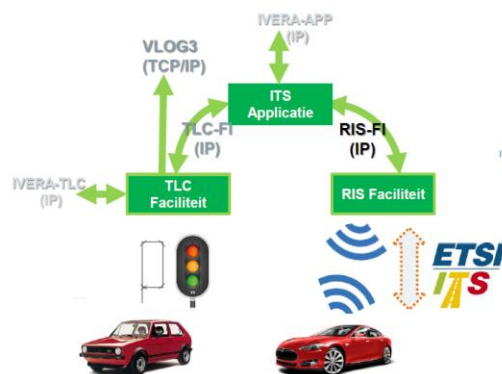


# Intelligente Verkeers Regel Installatie (iVRI) – Fase 1

## Deliverable G4: IRSIDD Interface VLOG

Koppelvlakken beschrijving conform de Interface Requirements Specification (IRS) & Interface Design Description (IDD) methodiek



Datum: 29 januari 2016  
Versie: 1.1

## VOORWOORD

In juni 2015 is opdracht verstrekt door het Ministerie van Infrastructuur en Milieu via het Beter Benutten Vervolg (BBV) programma aan vier VRA leveranciers om te komen tot een gezamenlijke definitie van VRA standaarden ten behoeve van connected en coöperatieve functionaliteit.

Dit document vormt Deliverable G4 van de afgesproken leverdelen in de opdrachtverstrekking, omschreven als “Koppelvlakken beschrijving conform de Interface Requirements Specification (IRS) & Interface Design Description (IDD) methodiek”.

Deze deliverable geeft een overzicht van de V-Log interface uitbreiding, waarmee “connected” use cases kunnen worden voorzien van de benodigde informatie.

Dit document is tot stand gekomen door samenwerking van de vier leveranciers in de werkgroep bestaande uit:

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*NB. De rest van dit document is geschreven in het Engels om internationale uitwisseling te ondersteunen.*

**The rest of this deliverable has been written in English to facilitate international exchange.**

## DOCUMENT CONTROL SHEET

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## CONTENT

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	System overview	5
1.2	Document overview	7
1.2.1	<i>Purpose</i>	7
1.2.2	<i>Document structure</i>	7
1.2.3	<i>Advice for the reader</i>	7
<b>2</b>	<b>References</b>	<b>8</b>
<b>3</b>	<b>Requirements</b>	<b>9</b>
<b>4</b>	<b>Interface design</b>	<b>12</b>
4.1	V-Log format	12
4.1.1	<i>Time reference message</i>	12
4.1.2	<i>Status message</i>	12
4.1.3	<i>Change message</i>	13
4.2	V-Log messages	14
4.2.1	<i>Time to green min/max</i>	14
4.2.2	<i>Time to green likely</i>	15
4.2.3	<i>Remaining green time min/max</i>	16
4.2.4	<i>Remaining green time likely</i>	17
4.2.5	<i>Reason for wait time</i>	18
4.2.6	<i>Environmental factors</i>	18
	<b>Appendix A. ABBREVIATIONS &amp; CONCEPTS</b>	<b>19</b>

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# 1 Introduction

For the project “Beter Benutten Vervolg” concepts are defined to support the road user. The road authorities define use cases for devices connected with current networks such as 3G and 4G (connected use cases) and for future devices requiring local communication through cooperative technology (cooperative use cases). This document handles the connected use cases only and only the part in which the Traffic Light Controller (TLC) can provide the road users with information about the state / status of the traffic situation around the TLC. Road users already have connected devices so a roll out can be done with software deployment only. For most use cases additional data need to be defined. The use cases are analyzed in [UCVLOG] resulting in definition of data for which new messages need to be defined.

## 1.1 System overview

This document specifies the new messages that shall be added to V-log 2.1.0 to create a new version of V-log. V-log 3.0.0 will be compatible with previous versions. With this new version connected use cases can be fed with the needed information.

The data flow of V-log is no part of the message definition, so this document has no intention to change the dataflow. To identify (dis)abilities a brief overview of the data flow is shown below.

In the overview V-log is used in the below picture between the TLC and the Traffic Central System (TCS).

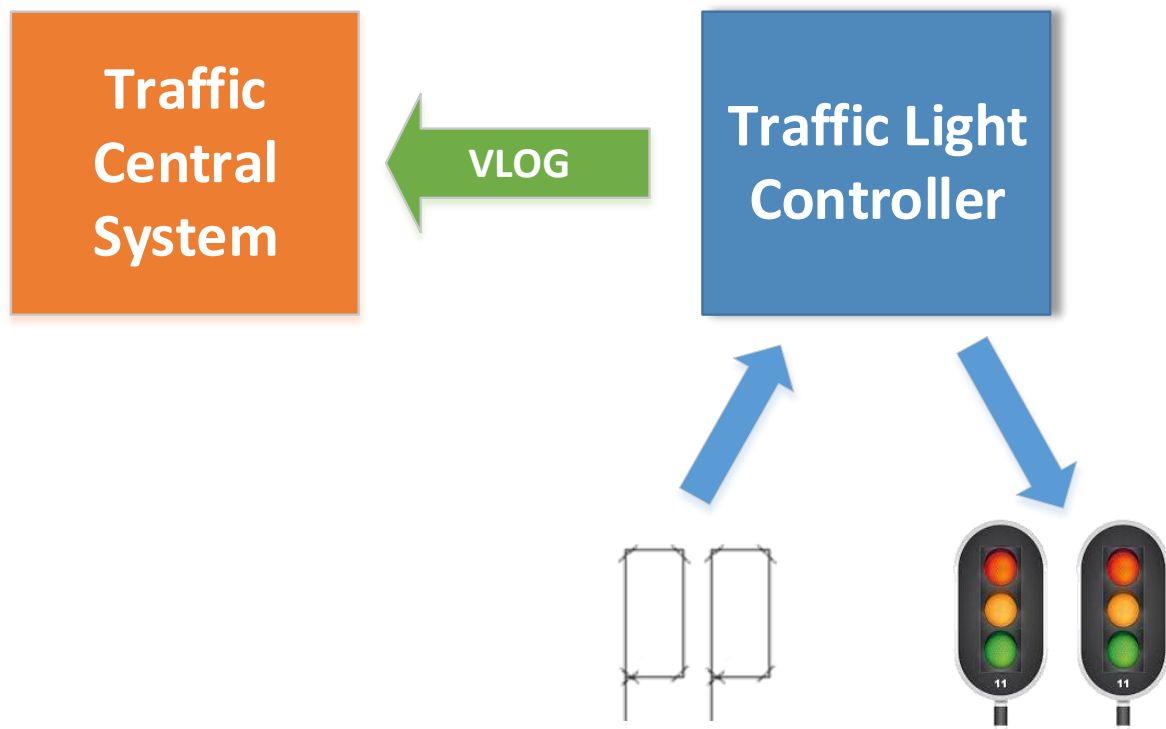
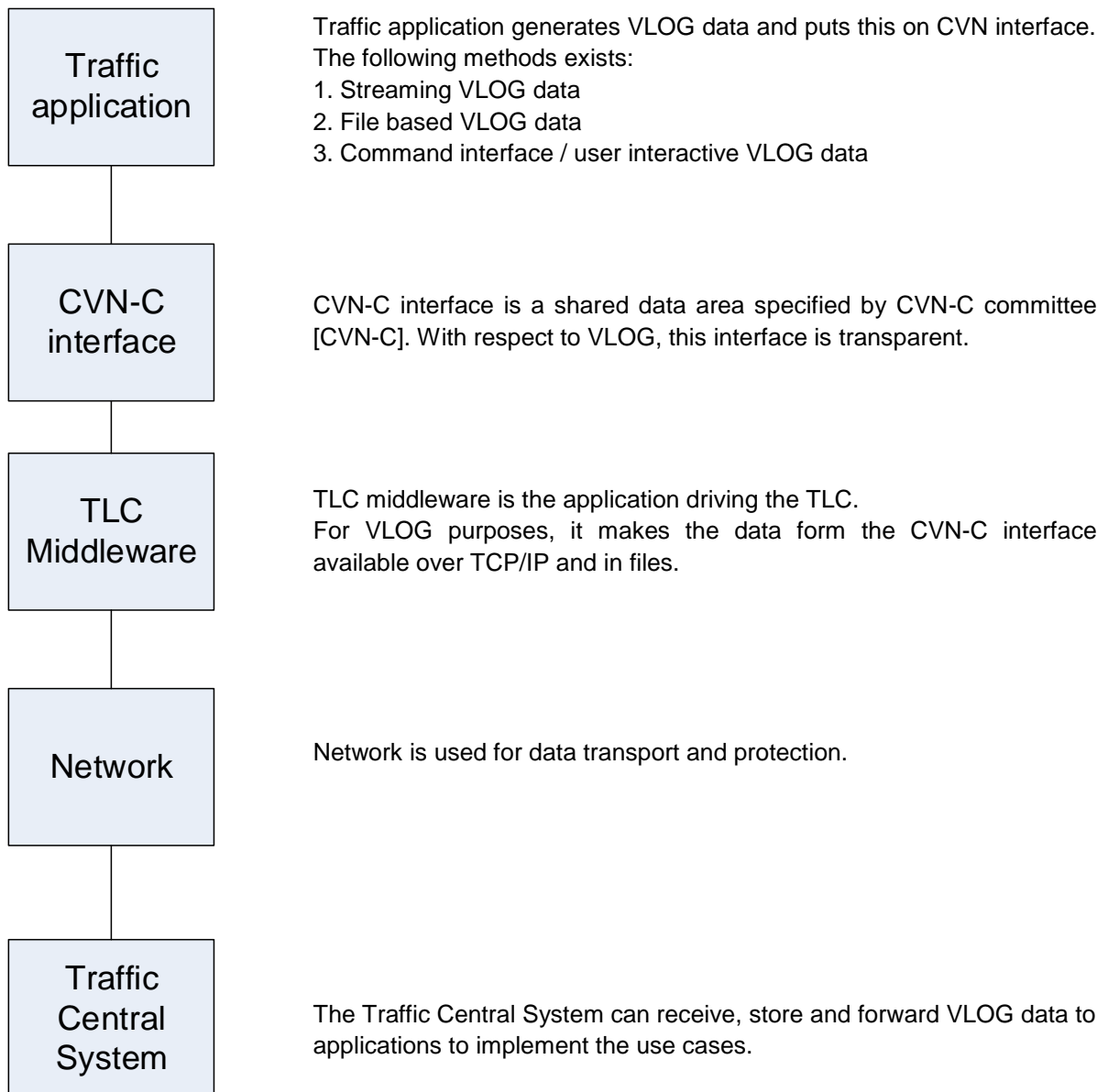


Figure 1 System overview

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If we zoom into the V-log details, we get the following overview:



The V-log data transport scheme will not change. The data is accessible once on a TCP port for a single TCS only. In case more applications need the V-log data the TCS shall multiply the data to make it available to all applications. It also should be noticed that the data flow is unidirectional so with V-log no road user data can be fed to the TLC.

This document describes the new messages and their format. This description shall be provided to the V-log committee to be added to the specification. Note that the V-log specification is written in Dutch and therefore some content of this document may be written in Dutch.

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## 1.2 Document overview

### 1.2.1 Purpose

This document provides specifications of the requirements as well as the proposed changes to the interface.

### 1.2.2 Document structure

Chapter 1 contains system overview and background information.

Chapter 2 contains references to external and internal documents

Chapter 3 contains formal requirements resulting from the use case and functional specification discussions.

Chapter 4 contains the resulting specification of the additions to the V-Log protocol. For clarity, this chapter has been written in the same style as the original V-Log document [PVLOG2].

Appendix A contains acronyms, definition of concepts and Dutch to English translations of central terminology.

### 1.2.3 Advice for the reader

The following format is used to define a requirement:

Req-ID	IRS-xx-yyyy
Title	Protocol compliancy
Description	The V-Log protocol shall be an extension of the current V-Log 2.1 protocol (see [PVLOG2])
Source	VLOG / 5.1
Comment	

- Req-ID: unique identification of the requirement according to the following format: 'IRS-xx-yyyy', where xx is an identifier for the interface, yyyy is a number of the requirement
- Title: a short description of the requirement
- Description: Formal and detailed description of the requirement.
- Source: Reference to a source document used as input for the requirement.
- Comment: Clarification of the requirement.

---

## 2 References

ID	Reference
[BIJ2]	Bijlage 1 Plan van Aanpak.pdf, 18 mei 2015, definitief t.b.v. DO BBV 26/5/2015
[UCVLOG]	VRI Tafel WG1 V-Log Use Case mapping 20150807.pptx
[PVLOG2]	V-Log protocol en definities (V-Log vs 2.1.0 document vs 1.4)
[FSVLOG]	VRI Tafel WG1 V-Log Functionele Specificatie 20150731.pptx
[SAE-J2735]	Dedicated Short Range Communications (DSRC) Message Set Dictionary, SAE International - Proposed draft 2014-09-XX, J2735
[CVN-C]	De CVN C-interface, 4.0 Specification of the CVN-C interface.
[IVERA]	IVERA Functionele specificatie (versie 3.01) IVERA Objectdefinitie Verkeersregelininstallaties (versie 3.01) IVERA Technische specificatie (versie 3.01) Specification of the IVERA protocol.



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### 3 Requirements

This chapter contains requirements identified during analysis of the use-cases of [BIJ2]. For the resulting analysis, refer to [UCVLOG] and [FSVLOG].

Req-ID	IRS-VLOG3-001
Title	Standards compliance
Description	When defining functional additions to the protocol, conformance with international standards shall be sought.
Source	[BIJ2]
Comment	For instance, standards such as specified for cooperative systems in ETSI shall be followed.

Req-ID	IRS-VLOG3-002
Title	Protocol compliancy
Description	The V-Log protocol shall be an extension of the current V-Log 2.1 protocol (see [PVLOG2])
Source	
Comment	

Req-ID	IRS-VLOG3-003
Title	Time-to-green (TTG) information
Description	The V-Log data shall contain information about the expected time remaining until green realization. The following information is required: <ol style="list-style-type: none"><li>1. <i>Minimum</i> time (unit [s], resolution 0.1s).</li><li>2. <i>Maximum</i> time (unit [s], resolution 0.1s)</li><li>3. <i>Likely</i> time (unit [s], resolution 0.1s)<ul style="list-style-type: none"><li>- A specific value shall be used in case any of the above mentioned times are unknown.</li></ul></li><li>4. <i>Confidence</i> (OPTIONAL) value of the <i>likely</i> time following [SAE-J2735]</li></ol>
Source	FSVLOG

Comment	<p>All times identifies an explicit time in the future. This time is a combination of the time-reference message, delta-time field of the status and/or change messages in combination with the expected times.</p> <p>When the <i>minimum</i> time is known, it may not be changed to an earlier point in time with a new message. Similarly, a <i>maximum</i> time may not be changed to a later point in time. However, <i>minimum</i> and <i>maximum</i> times can be changed to “unknown”. When the minimum and maximum times are equal, the actual time is guaranteed. (Not conform SAE) Maximum is always larger than or equal to the minimum time.</p> <p>The <i>likely</i> time provides the most likely remaining time. This time may be based on historical values, detection data or any other means to give accurate predictions. It is always between the <i>minimum</i> and <i>maximum</i> times.</p> <p>The <i>confidence</i> value indicates the level of confidence of the <i>likely</i> time.  <b>Note:</b> The <i>confidence</i> value is defined to be compliant with the [SAE-J2735] Signal Phase and Timing (SPAT) messages.</p>
---------	---

Req-ID	IRS-VLOG3-004
Title	Remaining green time (RGT) information
Description	<p>The V-Log data shall contain information about the expected remaining green time. The following information is required:</p> <ol style="list-style-type: none"> <li>1. <i>Minimum</i> time (unit [s], resolution 0.1s).</li> <li>2. <i>Maximum</i> time (unit [s], resolution 0.1s)</li> <li>3. <i>Likely</i> time (unit [s], resolution 0.1s)</li> <li>- A specific value shall be used in case any of the above mentioned times are unknown.</li> <li>4. <i>Confidence</i> (OPTIONAL) value of the <i>likely</i> time following [SAE-J2735]</li> </ol>
Source	FSVLOG
Comment	<p>All times identifies an explicit time in the future. This time is a combination of the time-reference message, delta-time field of the status and/or change messages in combination with the expected times.</p> <p>When the <i>minimum</i> time is known, it may not be changed to an earlier point in time with a new message. Similarly, a <i>maximum</i> time may not be changed to a later point in time. However, <i>minimum</i> and <i>maximum</i> times can be changed to “unknown”. When the minimum and maximum times are equal, the actual time is guaranteed. (Not conform SAE) Maximum is always larger than or equal to the minimum time.</p> <p>The <i>likely</i> time provides the most likely remaining time. This time may be based on historical values, detection data or any other means to give accurate predictions. It is always between the <i>minimum</i> and <i>maximum</i> times.</p> <p>The <i>confidence</i> value indicates the level of confidence of the <i>likely</i> time.  <b>Note:</b> The <i>confidence</i> value is defined to be compliant with the [SAE-J2735] Signal Phase and Timing (SPAT) messages</p>

Req-ID	IRS-VLOG3-005
Title	TTG and RGT update
Description	A TTG or RGT update shall be sent when the expected times have changed. The number of messages shall be limited by sending one message at most every 1 second. For changes less than one second no update shall be sent. Changes more than 10% of the current value will lead to an update.
Source	
Comment	The intention is to avoid congestion of messages. It is allowed to limit the number of messages even further when the impact on the prediction is low.

Req-ID	IRS-VLOG3-006
Title	Reason for Wait time
Description	It shall be possible to indicate a general reason for extra wait time. Each reason is either active or inactive. Examples of type of reasons: <ul style="list-style-type: none"> <li>- Public transport priority</li> <li>- Emergency vehicle priority</li> <li>- Train crossing active</li> <li>- Bridge intervention</li> <li>- Height warning</li> <li>- Weather intervention</li> <li>- Traffic jam intervention</li> <li>- Tunnel closed</li> <li>- Dosing active</li> </ul> (translations available in Appendix A)
Source	FSVLOG
Comment	

Req-ID	IRS-VLOG3-007
Title	Active environmental factors
Description	It shall be possible to indicate a change in active environmental factors. Each factor can be either active or inactive. Examples <ul style="list-style-type: none"> <li>- Rain</li> <li>- Mist</li> <li>- Risk of slipperiness</li> </ul> (translations available in Appendix A)
Source	FSVLOG
Comment	

---

## 4 Interface design

The interface design stated in this chapter is an extension of the [PVLOG2] document. Only VLOG messages needed to meet the requirements in chapter 3 are described in the next paragraphs.

### 4.1 V-Log format

V-Log messages can be divided into three kind of messages. First, a time reference message. This Message marks the beginning of a V-Log cycle. Second, a status message, this message contains the actual state of a specific item, i.e. phase state or detection state. Third, a change message. These messages are sent on every state change relative to a status message or a previous change message. For data size optimization the status and change messages only contains a delta time relative to the time reference message.

#### 4.1.1 Time reference message

A time reference message only contains the date and time of the started V-Log cycle. For a detailed description see [PVLOG2].

#### 4.1.2 Status message

A status message has the following format:

<type> <delta-time / number> <data-1>..<data-number>

For a detailed description see [PVLOG2 section 2.3].

<type> indication:

Message type	Data element length in bits	Data description
35	34	Time to green min/max per signal group
37	23	Time to green likely per signal group
39	34	Remaining green min/max per signal group
41	23	Remaining green likely per signal group
43	16	Reason for wait time per signal group
45	8	Environmental factors

---

### 4.1.3 Change message

A change message has the following format, depending on if the specific type has an index or not:

<type><delta time / number> <data-1>...<data-number>

Or

<type><delta time / number> <index/data-1>...<index/data-number>

For a detailed description see [PVLOG2 section 2.4].

<type> indication:

Change type	Index length in bits	Data length in bits	Output format and length in bits	Total length in bits	Description
36	8	34	8/2/8/8/8/8	48	Time to green min/max per signal group.
38	8	23	8/7/8/8	32	Time to green likely per signal group
40	8	34	8/2/8/8/8/8	48	Remaining green time min/max per signal group
42	8	23	8/7/8/8	32	Remaining green time likely per signal group
44	8	16	8/8/8	24	Reason for wait time per signal group
46	n.a.(0)	8	8	8	Environmental factors

---

## 4.2 V-Log messages

V-Log 3 messages:

Type	V-Log version	Related requirement
Time to green min/max	3.0.0	IRS-VLOG3-003 IRS-VLOG3-005
Time to green likely	3.0.0	IRS-VLOG3-003 IRS-VLOG3-005
Remaining green time min/max	3.0.0	IRS-VLOG3-004 IRS-VLOG3-005
Remaining green time likely	3.0.0	IRS-VLOG3-004 IRS-VLOG3-005
Reason for wait time	3.0.0	IRS-VLOG3-006
Environmental factors	3.0.0	IRS-VLOG3-007

### 4.2.1 Time to green min/max

This information is available on the CVN-C interface CIF\_FC\_TTGMIN[FC][Realization] and CIF\_FC\_TTGMAX[FC][Realization].

The time to green information is calculated by the application. Update frequency: max one time per sec. Further limitation of updates is allowed when the impact on the prediction is low.

Bit	33-32(MSB)	31-16	15 – 0 (LSB)
Meaning	Realization	Minimum	Maximum

#### **Realization:**

Number that indicates the sequence of realization. Range: 0 – 3 where 0 is the first realization in time.

#### **Minimum:**

Minimum time to green in 0.1 sec. Range: 0 – 65535 where 65535 means unknown.

#### **Maximum:**

Maximum time to green in 0.1 sec. Range: 0 – 65535 where 65535 means unknown.

---

#### 4.2.2 Time to green likely

This information is available on the CVN-C interface CIF\_FC\_TTGVOORSPELD[FC][Realization] and CIF\_FC\_TTGBETROUWBAARHEID[FC][Realization].

The time to green information is calculated by the application. Update frequency: max one time per sec. Further limitation of updates is allowed when the impact on the prediction is low.

Bit	22-21 (MSB)	20 – 16	15 – 0 (LSB)
Meaning	Realization	Confidence	Likely

##### **Realization:**

Number that indicates sequence of realization. Range 0 – 3 where 0 is the first realization in time.

##### **Likely:**

Prediction of the time to green in 0.1 sec. Range: 0 – 65535 where 65535 means unknown.

##### **Confidence:**

The confidence<sup>1</sup> is a number that represents the percentage of probability that the predicted likely time falls within the bandwidth of 5% of the likely time. Range: 0 – 16 where 16 means unknown.

Value	Probability
0	21%
1	36%
2	47%
3	56%
4	62%
5	68%
6	73%
7	77%
8	81%
9	85%
10	88%
11	91%
12	94%
13	96%
14	98%
15	100%
16	Unknown

---

<sup>1</sup> Example 1: The prediction is 100 seconds, which means the prediction is assumed correct if start green is realized between 95 and 105 seconds. The probability indicates this with a value in percent. So if in this case the probability is 11 (91%) in 91 of the 100 cases the start green will be in 95 to 105 seconds.

Example 2: The prediction is 10 seconds, which means the prediction is assumed correct if start green is realized between 9.5 and 10.5 seconds. The probability indicates this with a value in percent. So if in this case the probability is 11 (91%) in 91 of the 100 cases the start green will be in 9.5 to 10.5 seconds.

---

#### 4.2.3 Remaining green time min/max

This information is available on the CVN-C interface CIF\_FC\_RGTMIN[FC][Realization] and CIF\_FC\_RGTMAX[FC][Realization].

The remaining green time information is calculated by the application. Update frequency: max one time per sec. Further limitation of updates is allowed when the impact on the prediction is low.

<b>Bit</b>	<b>33-32(MSB)</b>	<b>31-16</b>	<b>15 – 0 (LSB)</b>
<b>Meaning</b>	Realization	Minimum	Maximum

**Realization:**

Number that indicates the sequence of realization. Range: 0 – 3 where 0 is the first realization in time.

**Minimum:**

Minimum remaining green time in 0.1 sec. Range: 0 – 65535 where 65535 means unknown.

**Maximum:**

Maximum remaining green time in 0.1 sec. Range: 0 – 65535 where 65535 means unknown.



---

#### 4.2.4 Remaining green time likely

This information is available on the CVN-C interface CIF\_FC\_RGTVOORSPELD[FC][Realization] and CIF\_FC\_RGTBETROUWBAARHEID[FC][Realization].

The remaining green time information is calculated by the application. Update frequency: max one time per sec. Further limitation of updates is allowed when the impact on the prediction is low.

<b>Bit</b>	<b>22-21 (MSB)</b>	<b>20 – 16</b>	<b>15 – 0 (LSB)</b>
<b>Meaning</b>	Realization	Confidence	Likely

##### **Realization:**

Number that indicates sequence of realization. Range 0 – 3 where 0 is the first realization in time.

##### **Likely:**

Prediction of the remaining green time in 0.1 sec. Range: 0 – 65535 where 65535 means unknown.

##### **Confidence:**

The confidence is a number that represents the percentage of probability that the predicted likely time falls within the bandwidth of 5% of the likely time. Range: 0 – 16 where 16 means unknown.

<b>Value</b>	<b>Probability</b>
0	21%
1	36%
2	47%
3	56%
4	62%
5	68%
6	73%
7	77%
8	81%
9	85%
10	88%
11	91%
12	94%
13	96%
14	98%
15	100%
16	Unknown

---

#### 4.2.5 Reason for wait time

This information is available on the CVN-C interface CIF\_FC\_RWT[].

The reason for wait time is signal group specific.

<b>Bit</b>	<b>15 – 0</b>
<b>Meaning</b>	Bitmask reason for wait time

##### **Bitmask reason for wait time:**

<b>Bit</b>	<b>Reason</b>
0	Public transport priority
1	Emergency vehicle priority
2	Train crossing active
3	Bridge intervention
4	Height warning
5	Weather intervention
6	Traffic jam intervention
7	Tunnel closed
8	Dosing active
9-15	Reserved

#### 4.2.6 Environmental factors

This information is available on the CVN-C interface CIF\_OMGEVING[].

Environmental factors are intersection specific and only applicable when the traffic controller is prepared with appropriate sensors.

<b>Bit</b>	<b>7 - 0</b>
<b>Meaning</b>	Bitmask for Environmental factors

##### **Bitmask Environmental factor:**

<b>Bit</b>	<b>Environmental factor</b>
0	Rain
1	Mist
2	Risk of slipperiness
3-7	Reserved

---

## APPENDIX A. ABBREVIATIONS & CONCEPTS

### Abbreviations

Abbreviation	Description
IRS	Interface Requirements Specification
IDD	Interface Design Description
V-Log	Traffic data log
TLC	Traffic Light Controller
TCS	Traffic Central System
TTG	Time to green
RGT	Remaining green time

All other abbreviations are assumed as known.

### Concepts

Concept	Description
TLC middleware	The internal software of a TLC delivered by the manufacturer. Amongst others responsible for translating requested signal group states to actual hardware output.
Traffic application	The software inside a TLC that implements the traffic flow regulation. Based on traffic detection information it sends to the TLC middleware the desired signal group states.
Signal group	Traffic signaling for one driving direction.

### Translations

English	Dutch
Bridge intervention	Brug ingreep
Dosing active	Doseren actief
Emergency vehicle priority	Hulpdienst ingreep
Height warning	Hoogtemelding
Mist	Mist
Public transport priority	OV ingreep
Rain	Regen
Risk of slipperiness	Kans op gladheid
TLC Middleware	Procesbesturing
Traffic application	Regelapplicatie
Traffic Central System	Verkeerscentrale
Traffic jam intervention	File ingreep
Traffic Light Controller	Verkeersregelautomaat
Traffic signal installation	Verkeersregelinstallatie
Train crossing active	Trein ingreep
Tunnel closed	Tunnel afsluiting
Weather intervention	Weersingreep