Open Communication Interface for Road Traffic Control Systems

Offene Schnittstellen für die Straßenverkehrstechnik

OCIT Outstations
Introduction to the System

OCIT-O_System_V3.0_D03

OCIT Developer Group (ODG)

OCIT Outstations
Introduction to the System

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Document history

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Specifications

The **OCIT Outstations configuration document OCIT-O KD V3.0** contains an overview of all the specifications are managed by the ODG and arranges versions and revision levels according to:

- associated specifications of the interface "OCIT outstations for traffic signal con-trollers" with reference to the corresponding OCIT-C specifications,
- and gives information on the use of the transmission profiles.

The current issue of the document is published on www.ocit.org.

1 Introduction

This present document describes the creation of OCIT processes and contains rules for the specification and documentation of OCIT outstations interfaces (interfaces at the field level in the traffic signal control system). It describes:

- the standardization organization for OCIT,
- interfaces and how they are arranged in the system model,
- fundamental properties of the OCIT outstations interfaces and
- the structure of the documentation of the OCIT outstations interfaces.

2 Organization

An important part of the investment and future-proofing of road traffic control systems is the ability to network all of its components without any hassles. For this reason, the standardization of interfaces is in the interest of the manufacturer's of such systems or components. With the goal of developing standardized, open interfaces, the signaling manufacturers AVT STOYE GmbH (früher Stoye und AVT), Siemens AG, Stührenberg GmbH and SWARCO TRAFFIC SYSTEMS GmbH (formerly Signalbau Huber und Dambach) founded the ODG workgroup (OCIT Developer Group).

Verkehrs-Systeme AG acts as a partner to the ODG (aka ODG & Partner), working on the standardization of central interfaces (OCIT-C).

To harmonize and bundle the national standardization interests as well as to have a targeted effect on European (possibly international) standardisation, the OCTS harmonisation committee (open communication standards for traffic systems) was established. This committee also serves to determine the requirements for the OCIT interfaces. The founding members of the harmonization committee are:

- German Federal Highway Research Institute (Bundesanstalt für Straßenwesen)
- OCA (Open Traffic Systems City Association e. V.) - develops requirements for municipal operators
- ODG & Partners (OCIT Developer Group and Partners) - the consortium of the signalling manufacturers and its partners in developing OCIT specifications.

The standardized interfaces will be documented under the protected brand designation OCIT®. OCIT stands for:

> **O**pen **C**ommunication **I**nterface for Road **T**raffic Control Systems
> -

The latest information, documentation of the OCIT interfaces of the field levels and groups associated to the OCIT process with links to documents for central level interfaces can be found on the website of the ODG (www.ocit.org).

2.1 Scope of the OCIT standardization

Under the OCIT® trademark, communications interfaces between the components of road traffic control systems are standardized. The goal is to network the components from various manufacturers into such systems. The standardization essentially covers the communication protocols and data of the interfaces. The structure of the components and their internal properties such as databases, user interfaces and middleware are not standardized in OCIT.

The standardization works for OCIT are based on the technical system architecture and regulations for road traffic control systems in the Federal Republic of Germany, Austria, and Switzerland. The scope of use of OCIT interfaces therefore only extends to countries which have similar system landscapes.

2.2 The OCIT trademark®

OCIT (Open Communication Interface for Road Traffic Control Systems) is a protected trademark (**OCIT**®) of the founding companies of the OCIT initiative. The owners promote the standardization of interfaces for road traffic control systems under the OCIT® trademark.

The following rules apply to the use of the OCIT® trademark:

- The designation OCIT as a characterizing designation for groups, activities, systems, interfaces, architecture models or other properties may only be used with the consent of the brand owners.
- In the first citation of the trademark name in publications, OCIT must be written with the symbol ® (OCIT®), supplemented by the footnote "OCIT® is a registered trademark of the companies Siemens AG, SWARCO TRAFFIC SYSTEMS GmbH, AVT-STOYE GmbH and Stührenberg GmbH".
- Owners of rights of use to OCIT interfaces may use the trademark OCIT as part of their product name. Details are governed in the respective contracts.

3 The OCIT interfaces

This chapter provides an overview of the properties of the OCIT interfaces and how they are arranged in the traffic signal control system.

OCIT interfaces form the basis for an open system architecture. They are focused on standardized connections between worldwide centralized and decentralized components such as subsystems, tools and field devices. With the use of internet technology, they make it possible to build up traffic management systems and system-wide networks that are composed of field devices and control centers.

Until now, the following interface areas have been defined in the overall system of traffic control:

- **OCIT Center to Center (OCIT C)** are standardized interfaces between central components and systems and cover practically all the interface areas of traffic management. [1]
- **OCIT-Outstations (OCIT-O)** are standardized interfaces between central devices and field devices.
- **OCIT-O profiles** are definitions to the data transmission technology
- **OCIT-O Car** is a set of standardized interfaces between roadside unit and control center
- **OCIT-LED** is an electrical interface between traffic signal light controller devices and LED signal head modules with 40 V technology.

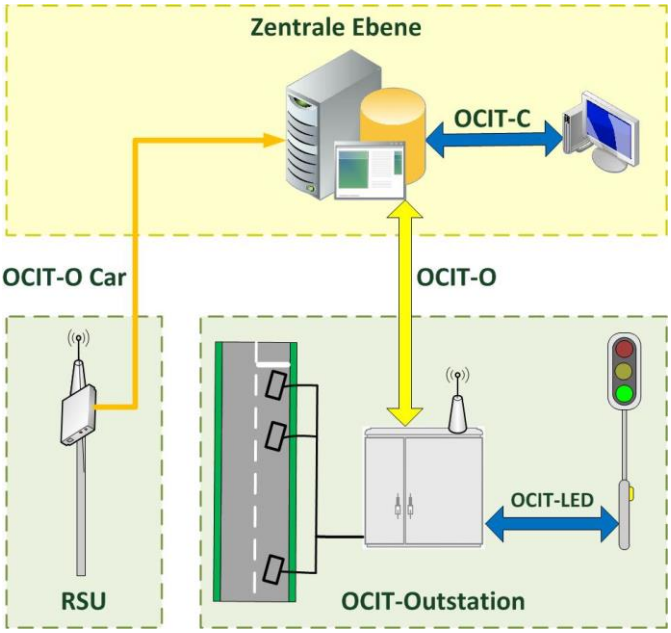

Figure 1 Interface areas of the OCIT system

[1] OCIT-C replaces the former OCIT-I process data and OCIT-I supply data interfaces.

3.1 OCIT-C – communication between central components

OCIT-C stands for "Open Communication Interface for Road Traffic Control Systems - Center to Center". OCIT-C covers the functions for communicating between the central traffic control and traffic guidance systems.

The definition and maintenance of the OCIT-C interface is carried out by the ODG and their partners.

OCIT-C is a standard that supplements OCIT-O perfectly. Using the member numbers, it is possible in OCIT-C to label process data from traffic signal controllers with an OCIT-O interface. All requirements for traffic control up to the overarching traffic management are covered by using OCIT-C and OCIT-O for communication from control centers to field devices.

OCIT-C is therefore geared towards practical requirements. With its low implementation costs, its use is also suitable for solutions with small budgets.

The OCIT-C communication modules are available to all interested users at no cost.

OCIT-C completes the OCIT standard with functionalities for communications between:

- Traffic control centers and traffic management centers (city)
- Traffic engineer work place with traffic control centers
- Traffic control centers (regional, interregional) and traffic management centers
- Parking guidance systems, parking facility systems
- Roadworks management systems
- Local internet users (city information online)
- Application of data from other standards (e.g. TLS, VDV, DATEX II) or proprietary solutions

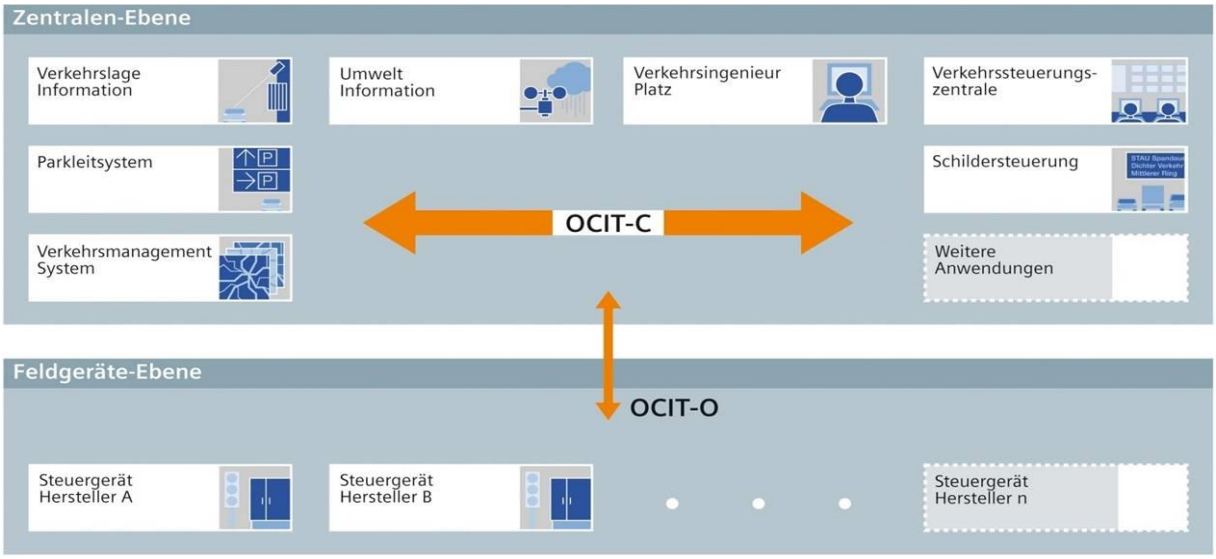

Figure 2: Functional interfaces of OCIT-C

Benefit to operators

- OCIT-C fully covers all currently known fields of municipal traffic technology
- OCIT-C is therefore easy to advertise for bids and is a safe investment
- OCIT-C is an open, freely available standard that can be used licence-free and is standardized in the DKE
- OCIT-C was developed from practical experience and can be used internationally
- OCIT-C is affordable to implement and is even suitable for modest applications such as local websites
- OCIT-C can be used for new and existing systems as well as any traffic-related control processes.

Benefit to operators and implementers

- OCIT-C uses international standard protocols
- OCIT-C data scope can be expanded while maintaining compatibility
- OCIT-C can be expanded for project-specific purposes
- OCIT-C versions are predefined and tested as well as forward and backwards-compatible
- OCIT-C interfaces are easy to read and easy to test in a system environment
- OCIT-C is undergoing controlled further developed by ODG & Partners

3.2 OCIT-O – Communication between the central level and the field device level

OCIT Outstations interfaces use internet technology. They connect traffic signal controllers with central equipment. Their function is to reliably supply, operate and monitor the controller functions remotely. This requires immediate acknowledgement and troubleshooting. That is why the BTPPL transmission protocol developed for OCIT Outstations is so special.

Communication model

The creation of OCIT Outstations gave us a universally usable interface that is not defined for a specific mode of communication. These modes of communication span from cables limited in their bandwidth to wireless connections to LAN/WiFi and the internet. Data transmission is based on standards of telecommunications technology and can use all typical media and telecommunications services that can be connected through the layers 2 and 1. In OCIT-O, so called profiles are defined for these. Transitions between different modes of transmission, telecommunication services and topologies are in essence possible.

Runtime performance

OCIT systems with the OCIT Outstations interface transmit commands and data only when certain events occur. Synchronization of all devices in the system takes place using exact clocks (radio clock or time utility of the control center)

Protocols

The data communication uses the ISO standard "OSI Layers Model"

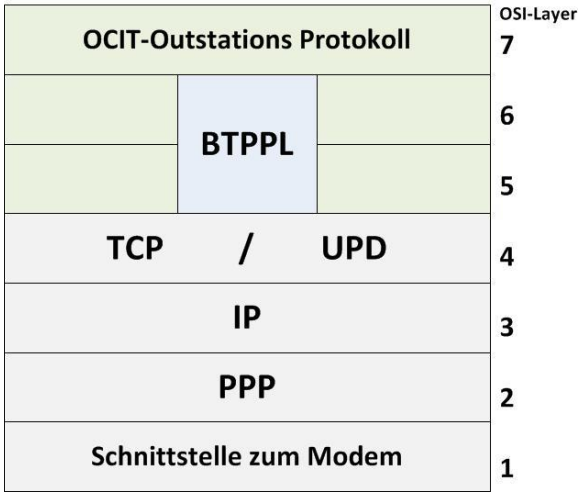

Figure 3: OSI Layer Model (e.g. of profile 1)

The OCIT Outstations protocol is the transmission protocol of the user level. It covers the integration of the OCIT Outstations functions into the equipment software and the BTPPL protocol which was especially developed and bandwidth optimized for OCIT outstations. With the exception of the OCIT outstations protocol BTPPL only standard protocols are used. TCP/UDP/IP are transportation protocols of the middle levels.

Properties of BTPPL

Much less data overhead and therefor significantly shorter transmission times That is why the old cable connections often still in place, with their relatively poor transmission quality, can be used. An integral part of the protocol is the SHA-1 algorithm, which with its 24-byte encoding guarantees high transmission reliability and with password protection ensures that hackers cannot tamper with the field devices.

Functions and objects

All functions that can be carried out via OCIT Outstations must be implemented in the same way by compliant devices in order to ensure standardized system functioning. The exact specification of the OCIT Outstations objects are given in the OCIT documents. The associated data definitions use the XML (Extensible Markup Language) data description language. They are the basis for implementation in the field devices.

OCIT Outstations objects are defined in the documents OCIT-O Basis and OCIT-O TSC, and they represent the standard.

Member numbers

In the OCIT system, it is possible to differentiate between standard OCIT objects and the manufacturer's definitions (manufacturer objects) by using the member numbers.

3.2.1 Rights to the OCIT-O interfaces

The owners grant rights of use worldwide to all interested manufacturers of road traffic control systems. A nominal fee is required for this which is shared equally among the owners. They use the nominal fee for financing the organizational expenses. Meaning:

- The property and the copyrights to the definitions of the OCIT-O interfaces and their documentation are held by the ODG working group. Each member of the work group, through their active collaboration acquires the right to realize and market the jointly developed subsystems in their system (and in systems of connected undertakings).
- Manufacturers who are not members of the ODG work group may purchase rights of use to OCIT-O. The owners grant the rights of use worldwide.
- A nominal fee may be required for the rights of use. The nominal fee is earmarked for a specific purpose and essentially covers the costs of creating the documents and granting the rights of use. It is basically designed in such a moderate way that competition is not hindered.
- The owners of rights of use to OCIT interfaces may use the trademark OCIT® as part of their product name, whereby details are governed contractually.
- For users of systems with OCIT-O interfaces, the use of the interfaces is not connected to the nominal fee. Through the acquisition of a system with OCIT-O interfaces, you receive the non exclusive, non transferable, non sublicenseable, limited right of use to the respective road traffic system from the system manufacturer.
- The latest version of the documentation and the conditions of use can be found at www.ocit.org/download.htm.

3.3 OCIT-O Car – Communication between the control centers and the roadside unit

Especially for cooperative applications, we present the licence-free OCIT-O Car interface. This makes it possible to transmit the Car2X data from a roadside unit (RSU) to a control center. An OCIT-O Car interface can use different transmission profiles.

OCIT-O Car is a subfunction of OCIT-O V3.0.

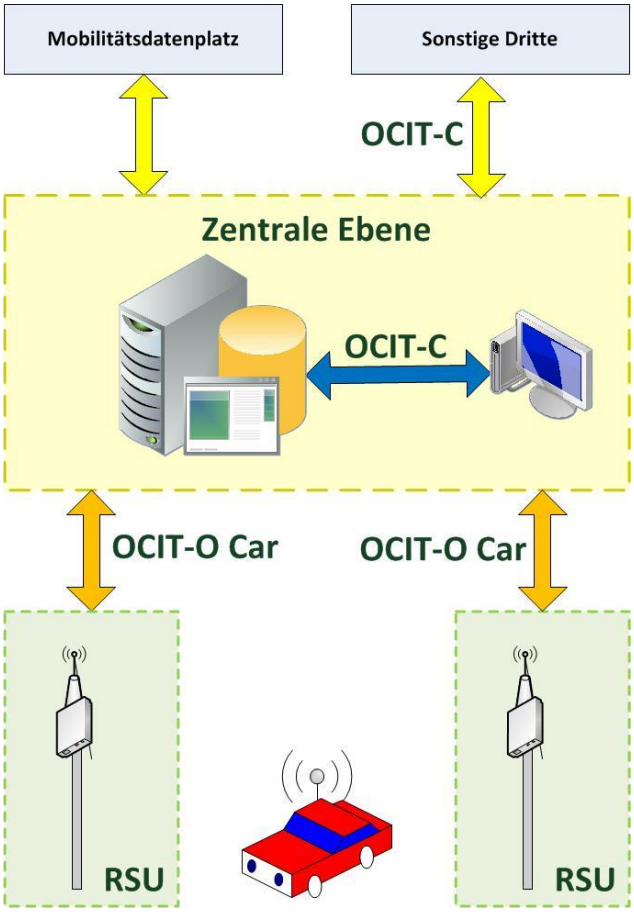

Figure 4: Interface OCIT-O Car

3.4 OCIT-LED

The interface OCIT-LED is an electrical interface between traffic signal controllers and LED signal heads. The key data of the LED signal head modules are: Operating voltage 40 V AC, power consumption < 10 W, reliable operation of the signal monitor as per RiLSA. The interface and the LED signal head modules have been specified by the OCIT-LED working group.

The rights-holders are: The member companies of the ODG (Siemens AG, SWARCO TRAFFIC SYSTEMS GmbH, AVT STOYE GmbH, Stührenberg GmbH) and the following manufacturers of LED inserts.

- Garufo GmbH / Dialight Corporation
- Osram OptoSemiconductors GmbH
- Futurit Ges.m.b.H (Austria)
- IMS AG (Switzerland)
- Gesig Ges. m. b. H (Austria)

The definitions OCIT-LED cover "OCIT-LED signal head modules 40 V AC, Version 1" for LED signal lights as per DIN 67527-1 with:

- 200 mm illuminated area diameter, red, yellow, green:
  Light intensity distribution class B2/2, dispersion pattern W, phantom class 4, protection rating IP 65
- LED signal lights with 300 mm illuminated area diameter, red, yellow, green:
  Light intensity distribution class B3/2, dispersion pattern N, phantom class 4, protection rating IP 65
- LED signal lights with 200 mm illuminated area diameter, white for PT signals:
  color restrictions as per DIN 6163-5, light intensity distribution class B1/2, dispersion pattern not defined, protection rating IP 65
- Small signal head: electric OCIT-LED, no definitions on light technology

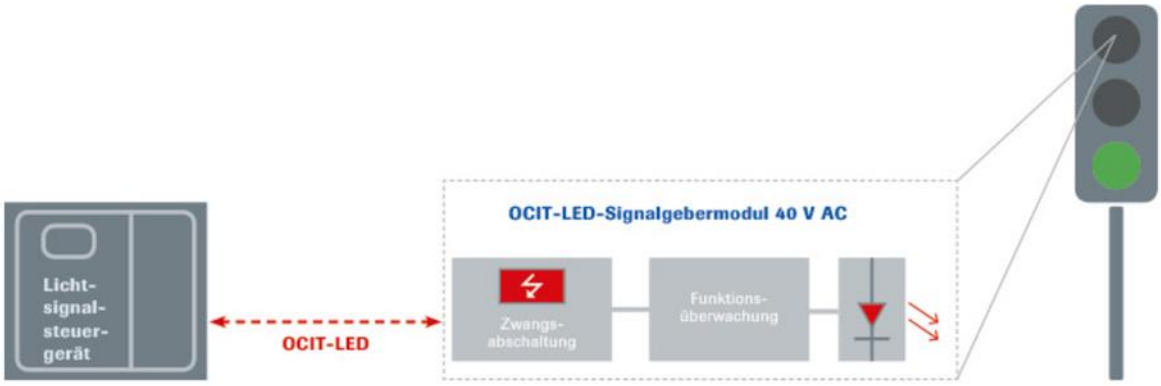

Figure 5: Interface OCIT-LED

4 Structure of the documentation of the OCIT-O interfaces.

Open interfaces require definitions of the

- system
- protocol
- Data model
- data transmission.

The structure of the documentation of the OCIT outstations interfaces corresponds in these areas. The document order of OCIT-O is split up into:

- **Definitions:** Binding specifications of the interfaces which were developed and released as part of the OCIT processes and which are used for communication within the road traffic control systems. They are specified in the **documentation** and are made up of the **documents** (description in text form) and the **data specifications** (specification in XML, extended markup language).
- **Data specification:** Precise specification of the data transferred over the interface. The data specification is composed in XML . It is both readable as a text as well as being machine readable. Details about the XML files can be found in the OCIT-O Protocols document. There are two types of XML files:

  - DTD (Document Type Definition) defines the structure of the XML-TYPE

  - TYPE, are files with the OCIT outstations data specifications

A difference is made between the following areas of the definitions:

- **General definitions** contain definitions of the OCIT outstations interfaces which are independent from a certain device type. This includes system definitions, the OCIT-O protocol and the OCIT-O basic functions which must be implemented in all devices with an OCIT-O interface (e.g. traffic signal controllers, traffic measuring points, and display controls among others).
- **Special definitions** contain the typical functions of certain types of field devices. For traffic signal controllers, these are for example all functions associated with program switchings, and signal monitoring messages among others. These functions are implemented together with the basic functions in the devices.
- **Optimal definitions** contain definitions regarding the data transmission system (transmission profile). They include device functions, properties of the data transfer device and properties of the transmission path. Devices with OCIT-O interfaces can be adjusted to OCIT-O standardized or to project specific transmission profiles.
- **Special definitions** contain definitions for device functions or device parts such as for OCIT-LED signal head modules, and the associated electric interfaces of the traffic signal controllers.

4.1 Designation system for documents

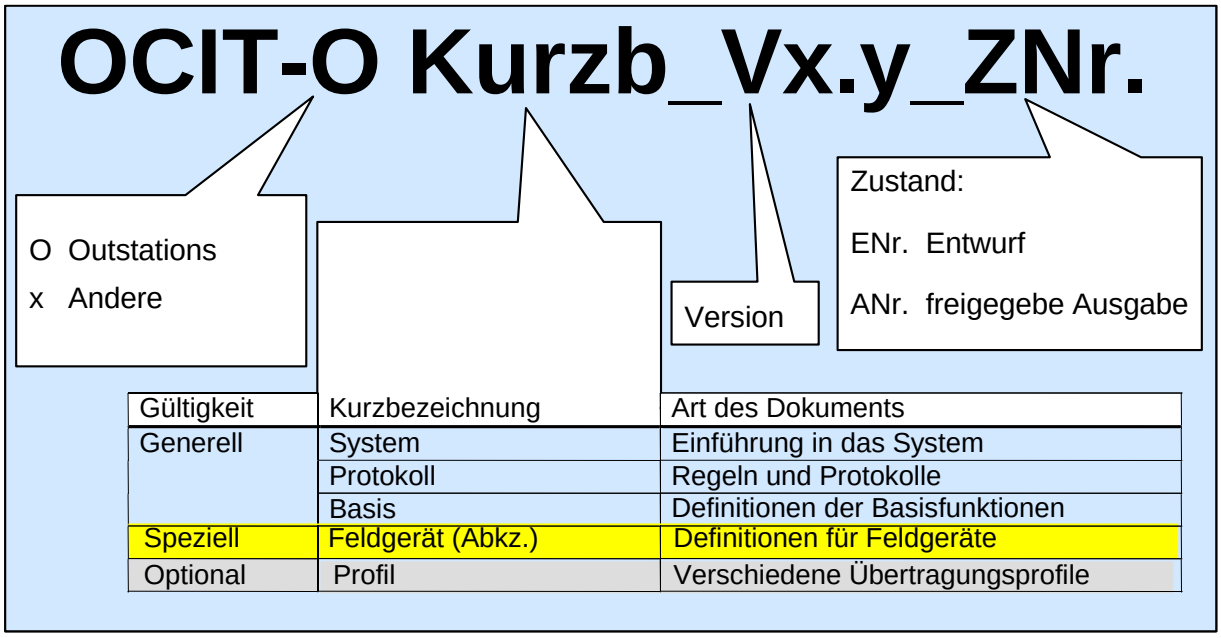

Figure 6: Designation system for documents

The version of a document (V**x.y**) is only changed if through the further development, new functions are added to the interface through the further development. For comprehensive new features, the 1st number is increased, otherwise only the 2nd.

The version (ZNr) changes depending on the state of the editorial processing of a document.

The DTD and XML files contain the version number as text within the file. Source code is zipped and contains the latest version and revision level in the file name.

The latest version of the respective document which is published at www.ocit.org is valid.

4.2 Designation and documentation of OCIT outstation interfaces

An OCIT outstations interface is characterized by its scope of use. Through the selection of a suitable transmission profile, the interface receives a certain characteristic. For this reason, OCIT interfaces are labeled using the name of the field device and the transmission profile. To give an example of this, an OCIT-O interface for traffic signal controllers with transmission profile 3 (Ethernet with DHCP) is named as follows:

OCIT-O Version 3.0 for Traffic Signal Controllers with OCIT-O Profile 3 V1.0

The interface is documented by the

documents and document specifications listed and marked in bold in the following table:

Valid	Documents	Title	Data specifications (XML files)
General	**OCIT-O_System_V3.0**	**Introduction to the System**	
	OCIT-O_Protokoll_V3.0	**Rules and protocols**	**OCIT-O_DTD.dtd**
	OCIT-O_Basis_V3.0	**Basic Definitions for Field Devices**	**OCIT-O_Basis.xml**
Special	**OCIT-O_Lstg_V3.0**	**Traffic signal controllers**	**OCIT-O_Lstg.xml**
Optional	OCIT-O_Profil_1_V1.1	Profile 1 - Transmission profile for point-to-point connections on permanently switched transmission paths	none
Optional	OCIT-O_Profil_2_V1.0	Profile 2 – Transmission profile for dial-up connections in the landline network and GSM mobile telecommunication network	OCIT-O_dial-type.xml
Optional	**OCIT-O_Profil_3_V1.0**	**Profile 3 - Transmission profile for Ethernet with DHCP**	**none**
Optional	OCIT-O_Profil_4_V1.0	Profil 4- VPN interface	none
Optional	OCIT-O Car_Daten_V1.0	Roadside Unit (RSU)	OCIT-O_Car.xml
General	OCIT-C V 2.0	Center to Center	none

5 Member numbers

The member number identifies an owner of user rights. These can be used to differentiate between standard OCIT objects and manufacturer specific OCIT objects in the OCIT system. Member 0 and 1 identify the OCIT outstations objects defined by the ODG and thus the OCIT-O standard. Manufacturer specific OCIT objects are created in accordance with the OCIT rules and labeled using the member numbers of the respective manufacturer.

The current list of member numbers managed by the ODG is published on the homepage www.ocit.org.

OCIT objects are identified in the system by: **Member:Otype**

> **Member:** Number of the manufacturer who defined the object. The manufacturer numbers (member numbers) are issued and managed by the ODG (2 byte)
>
> **OType:** So that the object identifies itself (2 byte). The Otypes are managed by the respective manufacturers.

A difference is made in OCIT outstations between:

- **OCIT Outstations objects**
  represent the standard. All OCIT Outstations compliant devices can execute the functions associated with this.

- **Manufacturer objects**
  are not standardized OCIT outstations objects. They can be defined by owners of rights of use to OCIT outstations. Depending on the situation, the specification takes place without further consultation or together with the manufacturers taking part in the project. The objective of this definition is to create technical possibilities for functions required in OCIT outstations which are not foreseen, still missing, proprietary or project specific.

Members 0 and 1 are the OCIT outstations objects defined by the ODG. They characterize the standard. The manufacturer objects are created by the respective authors in accordance with their own needs.

Authors of OCIT objects can only be owners of rights of use (see chap.3.2.1).

Through the acquisition of a system with OCIT interfaces, the operator receives limited rights of use from the system manufacturer to the respective road traffic control system (see chap.3.2.1). This also applies for project specific objects that a manufacturer realizes for an operator. A use above and beyond this can be specially agreed upon between the partners.

The numbering space <Member> is defined by 2 bytes (0 to 65535) and is sufficient for ODG and Partners member management. For this reason, the numbering space <Member> was redivided as of the end of 2007:

- ODG
- ODG & Partners
- and reserve

The member numbers already issued by ODG and the Partners in the past remain. For this reason, the numbering space of ODG is interrupted from 40 until 16383.

The management of the member numbers is the responsibility of the ODG.

The OType numbers have their own responsibilty for each "member".

No member numbers are required for OCIT-LED. Due to this, the OCIT-LED license numbers are only listed in the list of all OCIT users (which can also be found at www.ocit.org).

6 Proof of functioning

OCIT-O interfaces are an integral part of OCIT-O capable tools. Like for all other device functions, the implementation and design of the OCIT functions is the responsibility of the relevant manufacturer. The manufacturer is obligated to carry out appropriate tests in the OCIT system environment.

To ensure the smooth interaction of the OCIT devices in the mixed-manufacturer system, the following tests are to be performed.

6.1 Interoperability

In the interoperability test for devices capable of communication, devices from various manufacturers are tested in interaction with a central device. The basis for the interoperability test is formed by test specifications with a set of test cases that cover

as fully as possible the functional scope of an OCIT-O version, possibly in the context of a certain connection profile.

For interoperability testing, staff and devices from various providers must be available at a specified time. For this reason, they involve a lot of time, planning and costs. Furthermore, the number of all possible interoperability tests increase exponentially with the number of providers and the number of interfaces. Therefore, it is recommended to carry out project-related integration tests.

6.2 Integration test

In road traffic control systems, integration tests are required as part of projects for the system setup and every major modification. In the integration test, the individual devices are tested in a real system for their interoperability with the central equipment and the functional scope required in the project is to be guaranteed. The functions of the system are tested, which includes the test of the standard interfaces.

7 Field device equipment

OCIT Outstations-compliant devices do not have to support all of the functions defined in the OCIT Outstations specifications, rather only those which are necessary for the respective purpose and configuration in the relevant project. This way, traffic signal controllers which are installed on highways do not necessarily contain the functions which are required for devices with traffic actuated PT prioritization. Central equipment however must support all functions which are required in the customer project (currently and in possible future configurations).

Value ranges for equipment features of the devices are listed in the OCIT outstations documents. These refer to maximum values which can be addressed by the software. Sometimes these values are higher than are needed in practice. For example, in accordance with the definitions, up to 255 partial intersections can be addressed, however the practical limit is closer to 3 or 4. The required number of signal programs, signal groups or detectors depends on the type of application. They are requested individually for each device/system in the tender, so that the manufacturer is able to select and provide suitable device types.

For this reason, it is left up to the manufacturer which basic equipment and which scope of service they provide with the devices and central equipment from their OCIT program. Each manufacturer will endeavor to provide an economically practical selection of OCIT outstations objects and the associated equipment features. The manufacturer documents the equipment of their devices types in separate data sheets.

For OCIT outstations traffic controllers and central equipment, the practical experience up until now has been developed based on the basic configuration from the functions and components specified in OCIT outstations. The basic configuration and its variants are described in a so-called "Function Mirror".

At the central level, generally only a subset of the OCIT-O functions provided by the devices are used. Which OCIT-O functions are used largely depends on the project-specific requirements for regulation and data analysis. The OCIT-O standard therefore only demands specific properties of the control center if these are strictly required for the interoperability of a function.

8 Figures

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9 Glossary

The explanations of the technical terms and abbreviations used in this document can be found in “OCIT – O Glossary V3.0”.

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