

Automotive Data and Connectivity

Safety **Accessibility**

Efficiency **Environment**

- Increasing interconnection of vehicles and their environment
- Driving assistance and infotainment systems cause huge data volume
- Increasing time for flash programming at production line and after-sales service
- DoIP as a performant and flexible vehicle access

Where is DoIP applied?

Supplementary to legislative CAN

- Vehicle inspection and repair
- Measurement reading
- Routing of data from internal vehicle buses
- Online data streaming
- Flash programming

What is DoIP?

- Short and simple: "DoIP is the packaging of diagnostic messages in Ethernet frames for communication of a diagnostic tester with a vehicle"
- DoIP is a standardized diagnostic transport protocol according to ISO 13400
- DoIP is used in combination with the standardized diagnostic protocol UDS (ISO 14229-5: UDSonIP)
- Services of UDSonIP are identical to UDSonCAN
- DoIP with Ethernet 100 Base-TX instead of CAN enables substantial higher bandwidth
- Vehicle access with DoIP is backwards compatible using discretionary pins of the existing diagnostic connector
- DoIP enables easy integration into various network structures, even with WLAN

Advantages of DoIP

- Performant handling of huge data volumes
- Time-saving at ECU Flash Programming
- Cost-efficient because no VCI is necessary
- Simple integration to IT Infrastructure
- Flexible use because of standardized communication
- Integrated with other standards for vehicle diagnosis
- Future-proof technology enables various use cases

DoIP in Combination with other Standards

OTX (Open Test sequence eXchange)

- ISO 13209
- DoIP extensions in preparation

MCD-3D API

- ISO 22900-3
- ASAM MCD-3D 3.0 required

D-PDU API

- ISO 22900-2
- DoIP specified as amendment

UDS (Unified Diagnostic Services)

- ISO 14229-5 for DoIP

WWH-OBD

- ISO 27145 for DoIP and CAN

DoIP at the OSI Reference Model

OSI Layer	ISO UDS on DoIP	Comparison to ISO UDS on CAN
7: Application	ISO 14229-5 UDS on IP	ISO 14229-3 UDS on CAN
6: Presentation		
5: Session	ISO 14229-2 UDS	ISO 14229-2 UDS
4: Transport	TCP / UDP	ISO 15765-2 Diag on CAN
3: Network	IPv4 / IPv6	ISO 13400-2 DoIP
2: Data Link	IEEE 802.3 Ethernet	ISO 13400-3 DoIP
1: Physical		ISO 11898 CAN

The DoIP Standard: ISO 13400

- Part 1 – General information and use case definition
- Part 2 – Transport protocol and network layer services
 - Assignment of IP address
 - Vehicle search
 - Link connection
 - Status information
 - Data routing to sub buses
 - Message types
 - Error handling
- Part 3 – Wired vehicle interface based on IEEE 802.3
- Part 4 – Ethernet-based high-speed data link connector
- Part 5 – Conformance test specification

DoIP at D-PDU API Standard

Two Use Cases:

- With physical module: Real MVCI which supports DoIP protocol
- With virtual modules: Direct access of tester to vehicle (=MVCI)

Different combination modes / network topologies:

- Single tester and single ECU (DoIP Entity)
- Single tester and single vehicle (DoIP Vehicle and DoIP Group)
- Single tester and multiple vehicles (DoIP Collection and DoIP Group)
- Multiple tester and single / multiple vehicles

Specification of vehicle identification (discovery)
 Definition of DoIP specific Communication Parameter (ComParams)
 Description of DoIP socket and protocol handling

DoIP Communication Principles

Diagnostic tester communicates with vehicle via Gateway ECU

- Ethernet Activation Line enables Ethernet port of the Gateway
- Gateway is routing the message to sub buses CAN / FlexRay / MOST

Link connection

- Configuration of the Gateway with valid IP address (DHCP)
- Tester sends Vehicle Identification Request (UDP)
- Gateway responds with Vehicle Announcement Message (UDP), contains VIN, Gateway address etc.

Diagnostic commands

- Routing Activation Request: Command for routing of subsequent diagnostic messages to ECUs behind the Gateway (TCP)
- Diagnostic communication based on UDS (Unified Diagnostic Services)

DoIP Communication Sequence

Simplified illustration

Message Structure

DoIP Message

DoIP Payload Data (up to 4 GByte)

Ethernet Frame

Ethernet Payload Data (42 – 1500 Byte)

DoIP Vehicle Access

Ethernet pin assignment at OBD connector

Option #1

Option #2

- ISO 15031 signals
- DoIP signals
- OEM specific CAN signals

Cable (for DoIP via Ethernet)

WLAN-Ethernet Bridge (for DoIP via WLAN)

VCI (for DoIP and CAN)