

ISO 14229 UDS protocol: Automotive diagnostics

The UDS (Unified Diagnostic Services) protocol is defined in the ISO 14229 series. Automobile OEMs (original equipment manufacturer) follow this standard to provide a common computer system that can be used to diagnose any vehicle.

The automotive industry is drastically evolving, with the main reasons behind this evolution being the increased need for safety and improved driving experience. Cars on the road today contain 40 to 150 individual ECUs (electronic control unit), each performing specific functions such as electronic fuel injection (EFI), engine control, door locks, braking, window operation, and more. Increased complexity requires more efficient ways to test and diagnose vehicle systems when a fault occurs. There have been many diagnostic protocols such as KWP2000, ISO 15765, and K-Line developed over time for vehicle diagnostics. So, to ensure universal compatibility, OEMs and suppliers agreed to rely on a standard protocol which is named as UDS protocol.

UDS is the latest automotive vehicle diagnostic protocol used to diagnose vehicles worldwide. This protocol is defined in the ISO 14229 standard and automobile OEMs follow this standard to provide a common computer system that can be used to diagnose any vehicle.

Architecture of UDS protocol

Nowadays, the utilization of the protocol is increasing due to its flexibility. This protocol is derived from the ISO 14230-3 (KWP2000) and ISO 15765-3 (Diagnostic Communication over CAN (DoCAN)). It is used for the vehicle diagnostic, ECU firmware flashing, and many more such functions.

The UDS protocol uses fifth (session layer) and seventh (application layer) layer of the OSI model while the CAN protocol works on the first (physical layer - ISO 11898-2) and second (data link layer - ISO 11898-2) layer of the OSI model.

Diagnostics in a vehicle

The protocol is defined for two types of devices, namely, server and client. The vehicle will be the server and the diagnostic device will be the client. Recent vehicles are equipped with a diagnostic interface, which makes it possible to connect a computer or diagnostics tool, to the communication system of the vehicle (ECU). UDS requests are sent to the controllers, which provide a positive or negative response. With these responses provided from the controller it is possible to diagnose faults and undesirable behavior inside vehicles such as:

- ◆ Data stored within the system
- ◆ Memory available in the individual control units
- ◆ Live vehicle data such as engine or vehicle speed

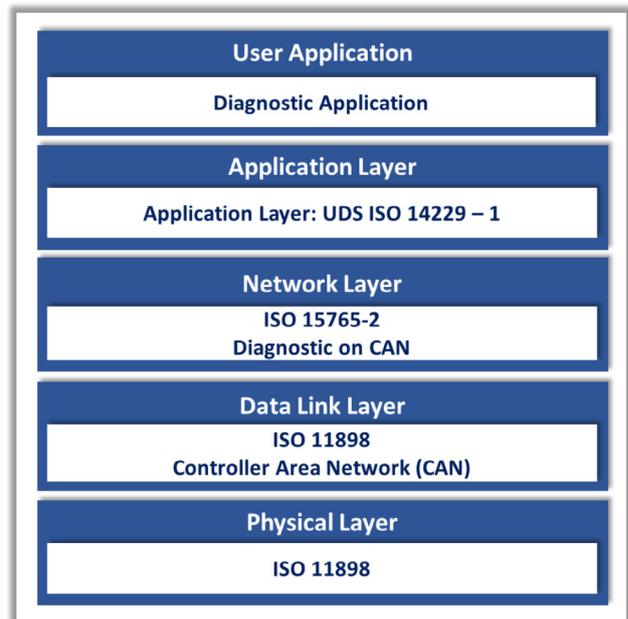


Figure 1: Architecture of UDS protocol (Source: iWave)

- ◆ Firmware updates
- ◆ Interaction with hardware I/O to turn specific output on or off based on the response to identify the fault
- ◆ Run specific functions to understand the environment and operating conditions of an ECU

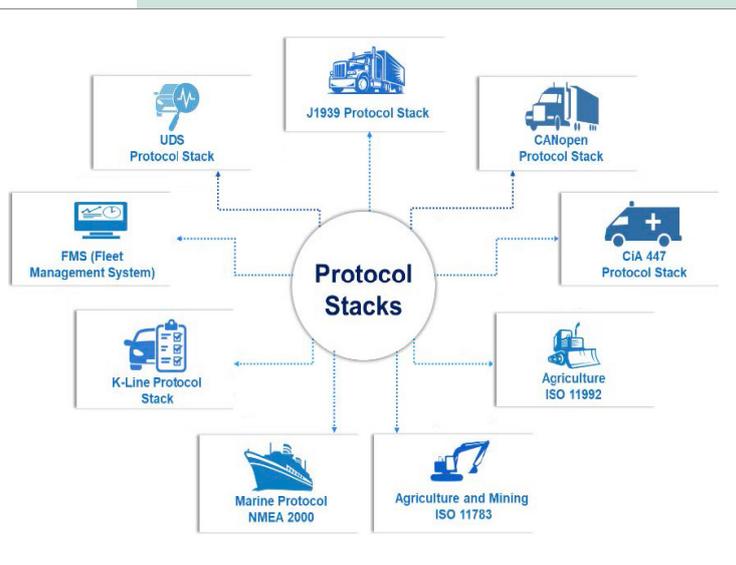
Diagnostic services of UDS protocol stack

iWave offers the UDS protocol stack, which is compliant with the ISO 14229 standard and implements both the application layer (ISO 14229-1) and session layer (ISO 14229-2). The UDS stack enables diagnostics such as UDSonCAN and UDSonIP for both client and server implementations. The UDS protocol offers six different client services for the categories of tasks to be performed on the server such as:

- ◆ Diagnostic and communication management
- ◆ Data transmission
- ◆ Stored data transmission
- ◆ Input/output control
- ◆ Remote activation of routine
- ◆ Upload/download

The company has designed the UDS protocol stack to be fully customizable, allowing users to specify feature sets and fine-tune the stack to meet end application requirements of the client device. Value proposition of ▶

CANopen, J1939, and UDS protocol stacks



The protocol stacks and its application fields (Source: iWave)

CAN network technology finds use in many applications. With the boom in Industry 4.0 and connected mobility applications, there is an increase in the requirement for monitoring and diagnostic tools based on CANopen, J1939, and UDS (which is already explained in the article). CAN protocols will see increased use as there are many vehicle manufacturers entering the market, especially in the electric vehicle segment. iWave Systems has developed protocol stacks for CANopen, J1939, UDS, and other industrial and automotive applications to help new players focus on their product development.

The iWave J1939 protocol stack is compliant with the SAE J1939 standard. It implements the data link layer (J1939-21), vehicle application layer (J1939-71), diagnostics application layer (J1939-73), and network management (J1939-81). Other layers of the standard such as J1939-31 can be provided optionally as an add-on. This protocol stack can be used in heavy-duty environments and is also applicable for light-duty, medium-duty, and heavy-duty vehicles used on-road and off-road. The J1939 protocol also forms the base for a number of other protocols such as ISO 11992 and ISO 11783.

The CANopen stack implements all the services compliant to the CiA 301 specification and the features compliant to the CiA 302 specification. To support the various application profiles, iWave provides add-on modules and services for customizing and porting the stack. The CANopen stack can be used for a multitude of applications such as truck gateways (CiA 413), special-purpose car add-on devices (CiA 447), grid-based photovoltaic systems (CiA 437), battery and charger (CiA 418/419), and municipal vehicles (CiA 422).

UDS protocol stack include: easy-to-use APIs (application programming interface), end-to-end solution offerings for telematics solutions, supported in all available kernel versions as well as development of APIs for integration with customer-specific hardware platform and application. ◀

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