Advanced UDS (ISO 14229) Interview Q&A; for HiL Validation Engineers

Q: What is UDS (Unified Diagnostic Services)?

UDS (ISO 14229) is a standardized diagnostic communication protocol used between a diagnostic tester and vehicle ECUs for fault diagnosis, flashing, and data access.

Q: What transport protocols does UDS use?

UDS typically uses CAN (ISO 15765-3), but it can also operate over Ethernet (DoIP - ISO 13400) or LIN (ISO 17987).

Q: What is Service 0x10 in UDS?

DiagnosticSessionControl – it is used to switch ECU between different diagnostic sessions like default, extended, programming, etc.

Q: List different Diagnostic Sessions used in UDS?

0x01: Default Session, 0x02: Programming Session, 0x03: Extended Session, and optionally OEM-specific sessions like EOL or Safety Session.

Q: What is the purpose of Service 0x11?

ECUReset – it requests the ECU to perform a reset (hard, soft, or key-off equivalent).

Q: What is UDS Service 0x14 used for?

ClearDiagnosticInformation – used to clear stored DTCs in ECU memory.

Q: Explain Service 0x19 (ReadDTCInformation).

It retrieves Diagnostic Trouble Codes (DTCs) and their associated status bytes, snapshot data, or extended data records.

Q: Explain sub-function 0x01 of Service 0x19.

ReportNumberOfDTCByStatusMask – returns the count of DTCs that match a specific status mask.

Q: Explain sub-function 0x02 of Service 0x19.

ReportDTCByStatusMask – returns all DTCs and their status bytes that match a provided status mask.

Q: What is a DTC Status Byte?

An 8-bit field representing the fault's condition (e.g., test failed, confirmed, pending, MIL requested).

Q: What is Service 0x22 used for?

ReadDataByIdentifier – retrieves specific ECU parameters or live data identified by a Data Identifier (DID).

Q: What is Service 0x23?

ReadMemoryByAddress – reads memory content from specified address and size.

Q: Explain Service 0x27 (SecurityAccess).

Used to unlock security-protected functions of an ECU by exchanging seed-key pairs between tester and ECU.

Q: What are common security levels?

Level 1: Routine access (e.g., reading), Level 2: Flashing access, Level 3: Calibration access (OEM-dependent).

Q: What is Service 0x28 used for?

CommunicationControl – enables or disables certain communication types (Tx/Rx) on a CAN channel.

Q: Explain Service 0x2E.

WriteDataByIdentifier – used to modify ECU data stored in RAM, EEPROM, or Flash using a DID.

Q: What is Service 0x31 used for?

RoutineControl – used to start, stop, or query the result of a specific ECU routine such as checksum verification or actuator test.

Q: What are common RoutineControl examples?

Start Routine (0x01), Stop Routine (0x02), Request Routine Results (0x03).

Q: What is Service 0x34 used for?

RequestDownload – initiates the ECU programming sequence by defining memory regions for flashing.

Q: What is Service 0x36 used for?

TransferData – transfers actual data blocks during ECU flashing after 0x34.

Q: What is Service 0x37 used for?

RequestTransferExit – signals the end of data transfer during ECU reprogramming.

Q: What is Service 0x3E used for?

TesterPresent – prevents ECU session timeout during long diagnostic operations.

Q: What is Service 0x85?

ControlDTCSetting – enables or disables DTC recording in the ECU.

Q: What is Service 0x2F used for?

InputOutputControlByIdentifier – controls or simulates ECU inputs/outputs temporarily.

Q: What are Negative Response Codes (NRC)?

NRCs indicate why a diagnostic request failed. Examples include 0x11 (ServiceNotSupported), 0x22 (ConditionsNotCorrect), 0x33 (SecurityAccessDenied).

Q: What is the general format of a UDS request?

[Service ID] + [Optional Sub-function] + [Data Parameters].

Q: What is the general format of a UDS positive response?

[Service ID + 0x40] + [Response Data].

Q: What is a Functional vs Physical request?

Physical: Directed to one ECU (target address). Functional: Broadcast to all ECUs capable of responding.

Q: What is the difference between extended and default sessions?

Default session is for normal operation with limited access. Extended session allows access to more diagnostic services and tests.

Q: What are preconditions before flashing an ECU?

Switch to Programming Session, unlock SecurityAccess, disable communication control, and clear DTCs.

Q: What is the role of CANoe in UDS testing?

CANoe is used to simulate ECUs, send UDS requests, analyze responses, and automate test execution via CAPL or vTESTstudio.

Q: What are CAPL functions commonly used for UDS testing?

Functions like diagRequest(), diagResponse(), testWaitForResponse(), and on diagResponse() event handlers.

Q: How is UDS testing automated in CANoe?

Using CAPL scripts and vTESTstudio test cases linked to Diagnostic Descriptions (CDD) files.

Q: What is a CDD file?

CANoe Diagnostic Description file that defines services, DIDs, DTCs, and routines for test automation.

Q: How can you simulate DTCs in CANoe?

By using Diagnostic Simulation setup or manually triggering conditions via CAPL for specific DTC status changes.

Q: What is the difference between pending and confirmed DTC?

Pending DTC indicates a fault detected but not confirmed; confirmed DTC means the fault is validated after multiple cycles.

Q: What happens when DTCs are cleared via 0x14?

All stored and pending DTCs are removed from ECU memory, and related status bytes reset.

Q: Explain the DTC memory structure in ECU.

Includes Primary (active), Mirror (backup), and Non-Volatile memory (persistent after power cycle).

Q: What is the MIL and when is it activated?

Malfunction Indicator Lamp – activated when a confirmed DTC requests a warning to driver.

Q: What is OBD-related diagnostic information?

OBD DTCs (e.g., P0xxx) are mandatory for emission-related faults; accessed via standard DIDs and 0x19 service.

Q: Explain the Seed-Key algorithm concept.

ECU sends a seed (random number), tester computes key using an OEM-specific algorithm to gain access.

Q: What happens if the wrong key is sent during SecurityAccess?

ECU responds with NRC 0x35 (InvalidKey) and may impose a delay or lockout.

Q: What is a session timeout and how is it prevented?

ECU returns to default session if no activity within timeout period. TesterPresent (0x3E) keeps session active.

Q: What are the benefits of UDS over KWP2000?

More services, better session control, extended data handling, and improved security mechanisms.

Q: What is the difference between hard and soft reset in ECUReset (0x11)?

Hard reset reinitializes hardware and software. Soft reset reboots only the software layer without power cycling.

Q: How are UDS test cases structured in HiL testing?

Each test includes request message, expected response, pass/fail criteria, and post-condition checks.

Q: What is Regression Testing in UDS validation?

Re-running previously executed UDS tests after ECU software updates to ensure no new issues introduced.

Q: What are the common UDS logging formats in CANoe?

.asc (ASCII), .blf (Binary Logging Format) for capturing diagnostic communication and timing analysis.