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External Program Testing

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Traditional Burn-In Test Programs

Burn-in programs use a fixed, deterministic structure:

- Sequential test steps with defined power and temperature settings
- Each step runs pre-generated vector patterns on the burn-in board (BIB)
- Pass/fail determined by device output states at specific cycles
- Final disposition follows preassigned criteria defined before the run

Limitation:

This method is static — every device under test (DUT) is evaluated the same way, with no ability to adapt test behavior based on device response.

External Programs: A Dynamic Alternative

External Programs enable flexible, script-driven testing:

- Users can run custom Python scripts instead of fixed vectors
- Scripts communicate with the DUT via JTAG, SPI, I2C, etc.
- Hardware access provided through either a tester API or direct I/O control
- Scripts can be tailored to each board, using libraries or device-specific routines

External Programs Continued

Hybrid operation:

- External programs can run alongside traditional vector steps
- Scripts may condition hardware before deterministic tests
- Enables adaptive, board-aware, device-aware test flows

Benefit:

A more dynamic testing environment that responds to the DUT and supports complex, functional operations.

Figure 1 – Simplified Test Program Flowchart

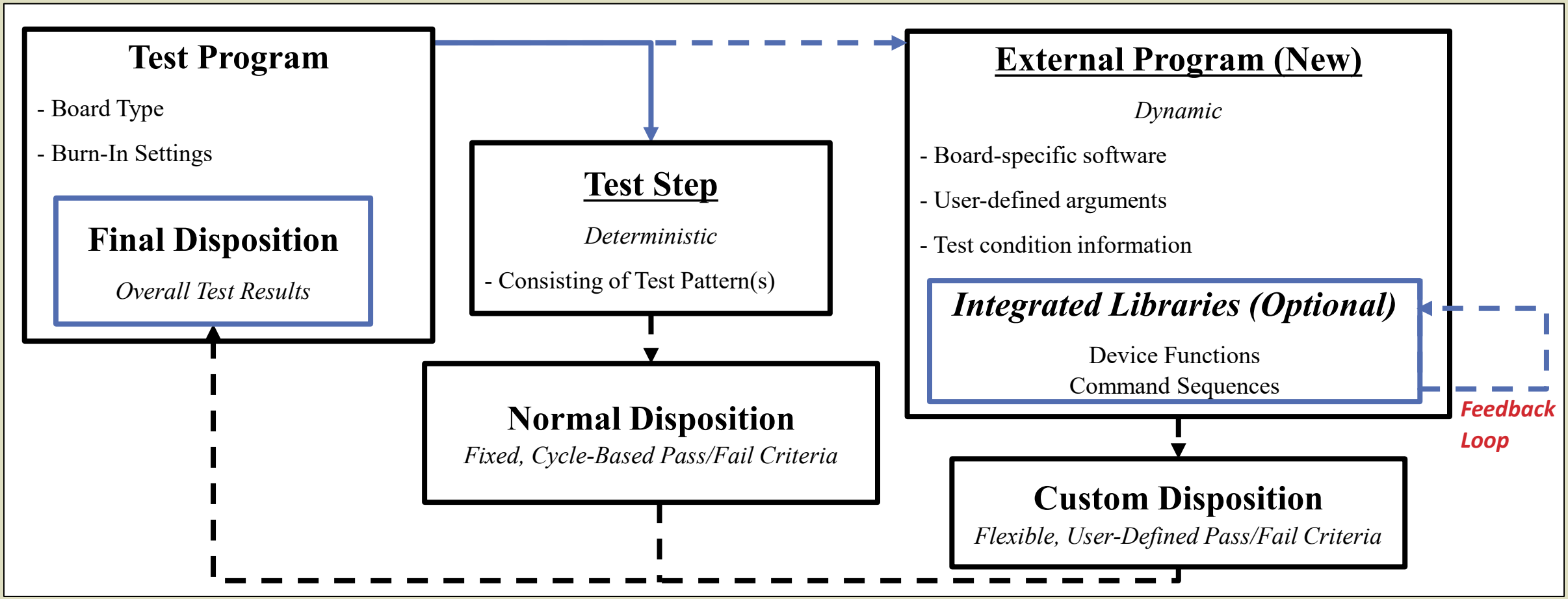


Figure 1 demonstrates the general flow of these two modes of operation, and where the two approaches diverge.

User Arguments & Script Configuration

External programs can be customized through user-defined arguments:

- Select which I/O group, chiplet, or interface to target
- Choose which functions or routines to run on those pins
- Enable debugging levels, logging formats, or verbose printouts
- Specify test modes (e.g., sequential vs. parallel DUT testing)
- Add additional flags to streamline or expand script behavior

Key Point:

Each script decides how many arguments to accept and what functionality they unlock.

System-Provided Context Packet

Alongside user arguments, the system supplies a structured data packet giving the script:

- Current run number and test step name
- The BIB's active DUT positions
- Number of total and populated sockets
- Metadata for logging and correlation with the run
- Output file location or return channel information

System-Provided Context Packet Continued

This allows scripts to:

- Test only populated sockets and tailor behavior per
- Coordinate interactions between DUT positions
- Log results accurately and consistently

Return value:

A similar packet where the script reports pass/fail per DUT, using criteria defined by the script designer.

End-to-End Data Exchange

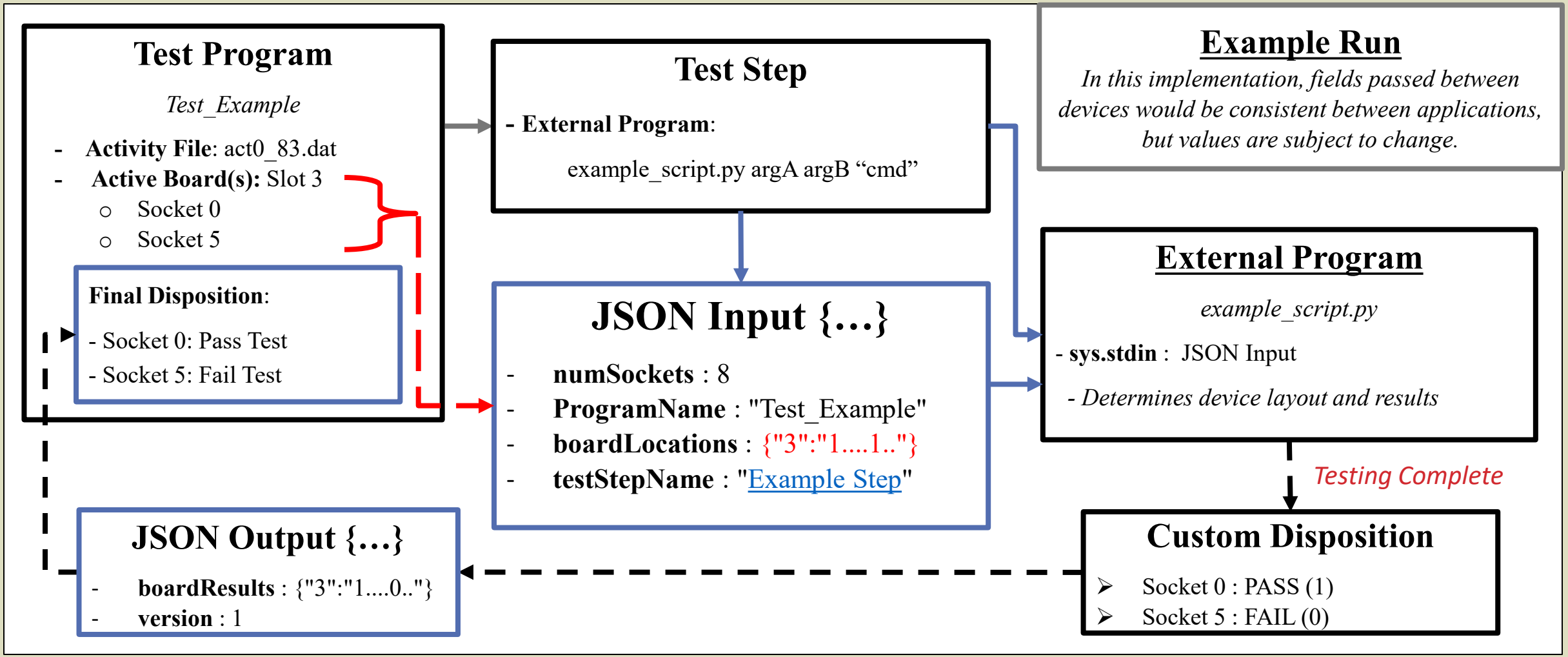
How the exchange works:

1. Burn-in software sends a JSON packet with test conditions
2. Python script receives the packet and parses system + user arguments
3. Script executes its defined test routines
4. Script returns results in a JSON output packet
5. Burn-in software reads the output and applies pass/fail disposition

Key Point:

This flow cleanly separates system context, user options, and script logic, enabling flexible, board-aware testing.

Figure 2 – Program Call Example Exchange



Functional & Dynamic Applications of External Programs

External Programs extend burn-in with SLT-like capabilities:

- Bring functional device testing into the high-stress burn-in environment
- Scripts can use existing device APIs, vendor DLLs, and ATE libraries
- Enable engineers to reuse familiar tools without needing burn-in expertise
- Allow interaction with the DUT's on-board functions, not just digital vectors
- Support flexible, board-specific routines for more meaningful device validation

Benefit:

Burn-in becomes capable of deeper, function-aware testing.

Expanded Interfacing & Debugging Capabilities

Adaptive & Device-Specific Test Flows

- Scripts react to results and automatically choose follow-up sequences
- Can run pattern variations to help diagnose failures
- Provide insight into why a device failed, not just whether it failed
- One script can support multiple device models on the same board
- Patterns can be tailored per DUT, including DUT-to-DUT interactions
- Scripts can adjust board hardware dynamically to optimize test conditions

Benefit:

Test programs become adaptive, individualized, and capable of coordinating across devices.

Example #1 – Adapting Libraries

Goal:

- *Customer A* wants to streamline the process of testing different IPs and protocols on their DUT, without generating patterns for each variation.

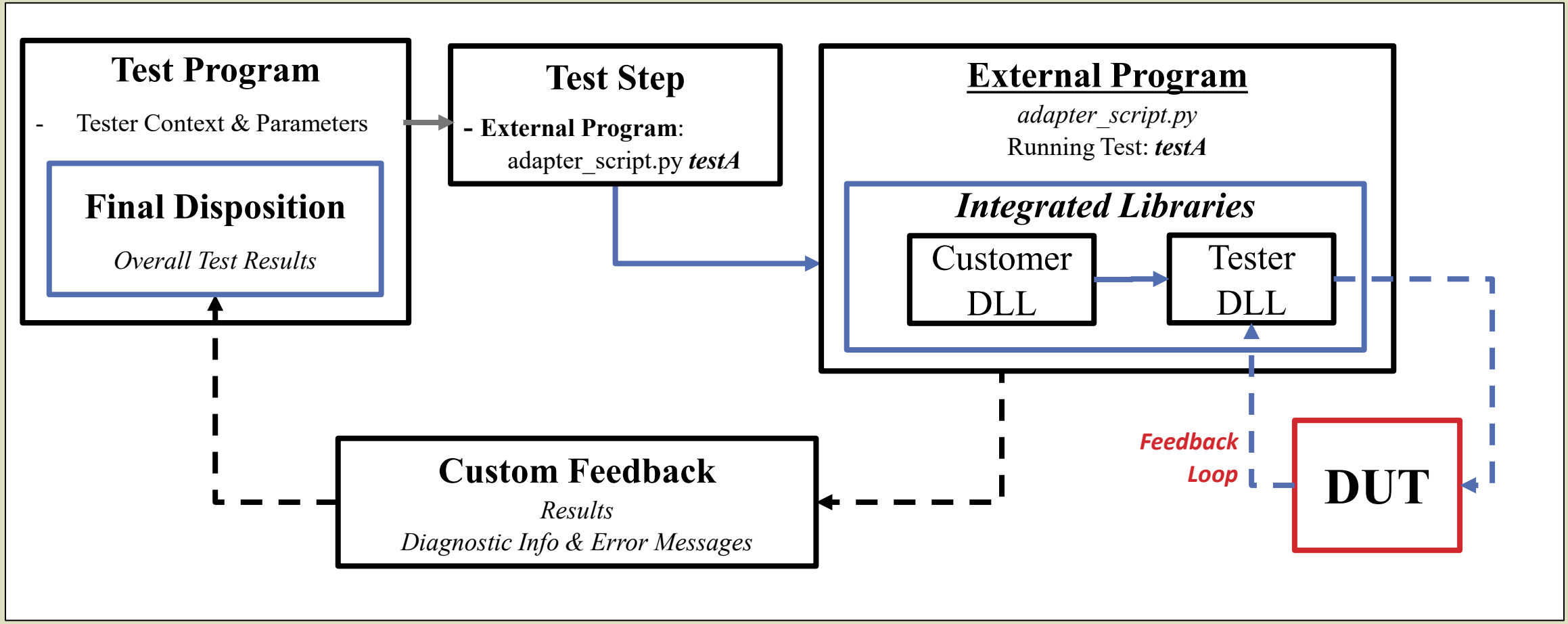
Prerequisites:

- *Customer A* has access to an existing dynamic library of commands from another system type, and wants to repurpose this in burn-in.

Solution:

- Create an additional library adapting customer's command structure to burn-in platform.
- External program script is written to mount both libraries, issue commands based on user arguments, and interface results between DUT and test program.
- Pass/Fail results, error codes, and diagnostic information are printed directly to user.

Figure 3 – Adapting Libraries Example



Interactive Device Access & Remote Debugging

Expanded Troubleshooting Capabilities

- Scripts can access on-chip debug features of the DUT
- Valuable in pre-production for refining test programs
- Useful in pre-production to refine test programs
- Engineers can observe device behavior in real time, not just through fixed patterns
- Provides deeper insight into performance, configuration, and failure causes

Core Idea:

Burn-in can support hands-on, exploratory debugging, not just automated sequences.

Hardware-Level Control & Tool Integration

External Programs can provide direct access to the DUT:

- Commands can be sent interactively using built-in or vendor libraries
- Scripts may expose remote access via SSH, Telnet, or similar protocols
- Users can issue native device commands and view immediate feedback
- Scripts without vendor libraries can still support call-and-response modes
- Real-time results help identify the best test modes, timing, and operating parameters

Benefit:

Interactive testing improves early-stage development and informs the final burn-in configuration.

Hardware-Level Control & External Tools

Hardware-Level Control & External Tools

- External Programs can integrate with external tools (debug pods, analyzers, meters)
- Scripts can monitor and drive buses like JTAG, SPI, I2C. They can directly control board hardware: switches, muxes, routing, clocks
- Example: dynamically rerouting JTAG pins for different device areas
- Supports feedback loops, timing adjustments, and custom board configurations

Benefit:

Enables highly tailored, device-specific test flows and deeper validation.

Example #2 – Dynamic Gating

Goal:

- *Customer B* wants to support a range of DUTs with varying characteristics on a single burn-in board
- Need to determining on mid-test if certain signals or supplies should be connected or disconnected

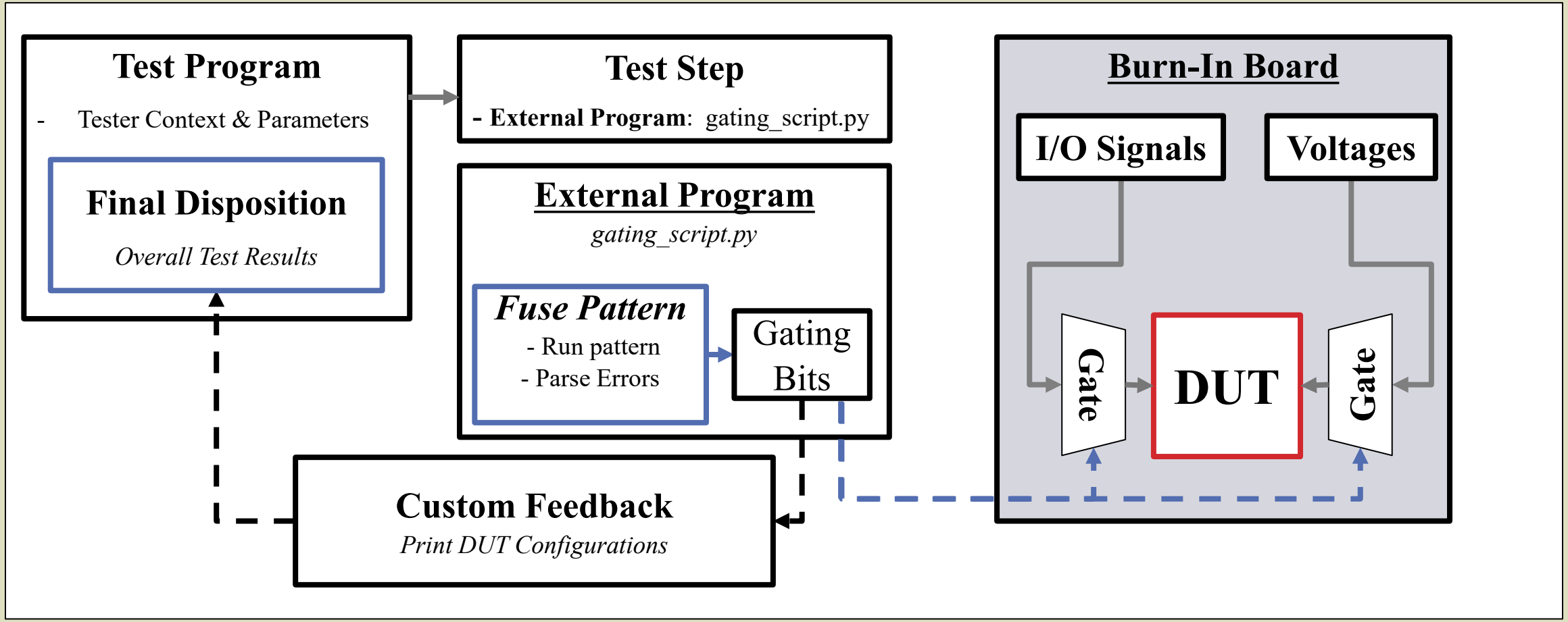
Prerequisites:

- Burn-in board must be designed to allow manual gating on a per-DUT basis
- Need a test pattern exists that can characterize the device, with specific cycles identifying which signals or supplies should be present

Solution:

Create an external program that executes the characterizing pattern, parses out which bits are toggled for which DUTs, and conditions the boards' gating circuits accordingly.

Figure 4 – Dynamic Gating Example



Summary

- External Programs introduce dynamic, script-driven burn-in testing
- Test behavior can adapt to device feedback in real time
- JSON-based context packets enable board-aware, DUT-specific operation
- Scripts can integrate device libraries, external tools, or on-chip debug features
- Supports advanced use-cases, multi-device boards, and hardware-level control

Key Takeaway:

External Programs bring flexibility, intelligence, and deeper visibility to burn-in test flows.

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