

# Designing SSD Firmware Overlays to Reduce Performance Impact

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# Introduction

- **Memory Constraints**
- **Overlay**
- **Overlay Manager**
- **SSD IO Performance**
- **Overlay Debugging**
- **Conclusion**
- **References**
- **Q & A**

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# Memory Constraints

## Program

- If an executable exceeds available program memory space the solution is overlay.

## Memory

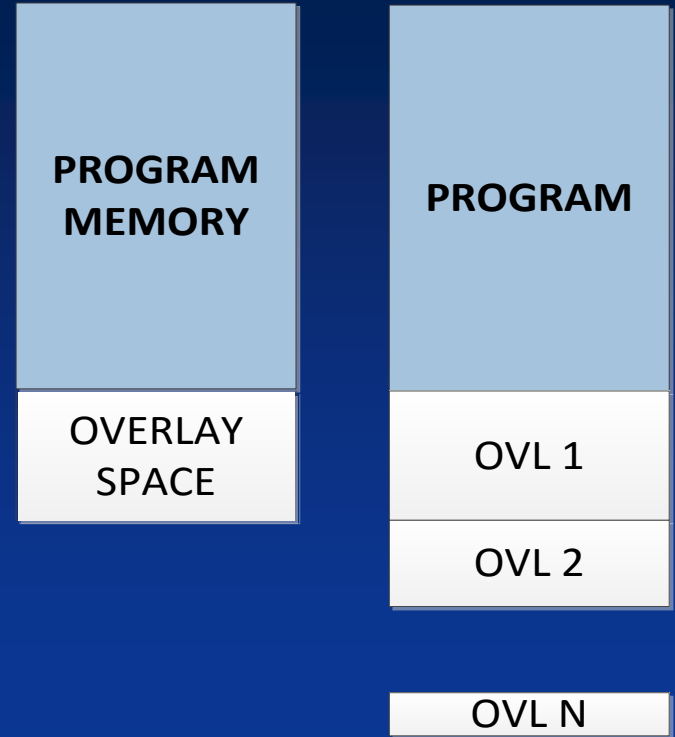
- Overlay space in program memory and number of overlays need to be calculated to minimize IO latency.

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# Overlay Layout

## Overlay

- Program section which is loaded at an address different from where it will run.
- Number and size of overlays depends of the code size and functions.



# Overlay Definition

## Assumptions

- GCC tools are used to build the code.
- Set of  $n$  functions selected to create overlays.

## Overlay definition

- `OVERLAY (f) __attribute__ ((section (".overlay.text"), data_section (".overlay.data"))) f`

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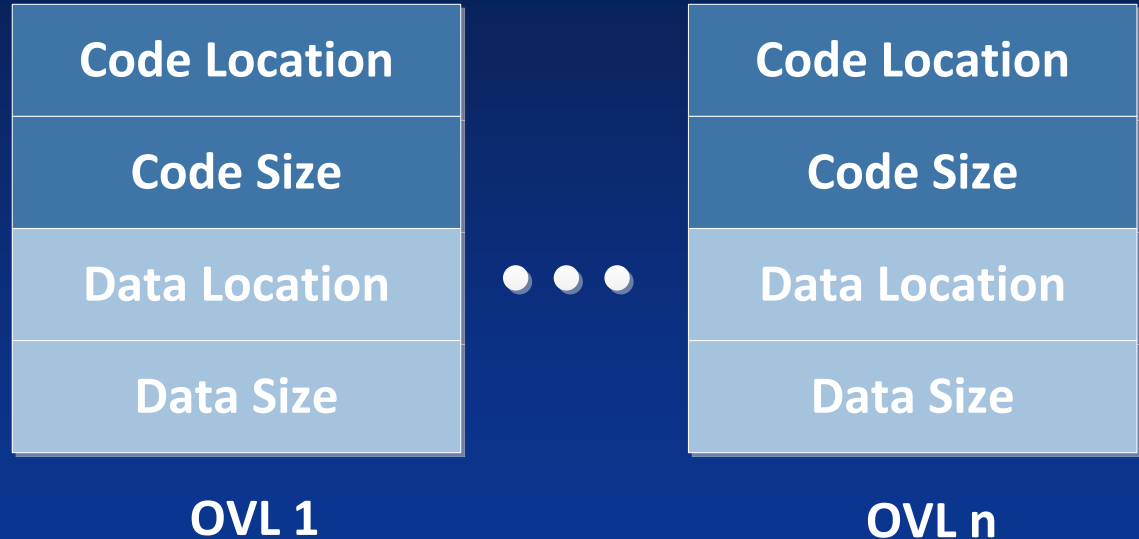
# Manager Overlay Table

## Location

- External memory location where overlay code and data sections are loaded

## Size

- Size of the overlay code and data sections.



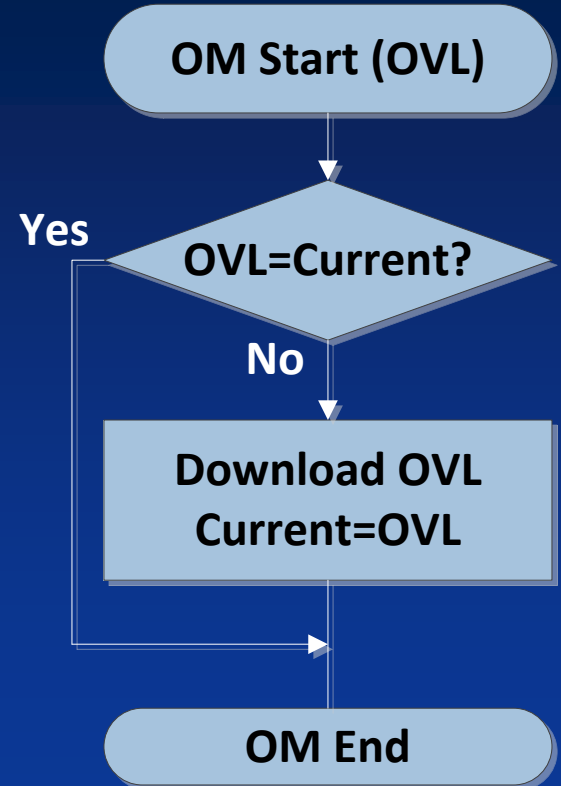
# Overlay Manager Function

## Loading

- Copies overlay code and data sections from external to local memory space.

## Mapping

- Overlay manager keeps the overlay status, it is in external or local memory (unmapped or mapped)



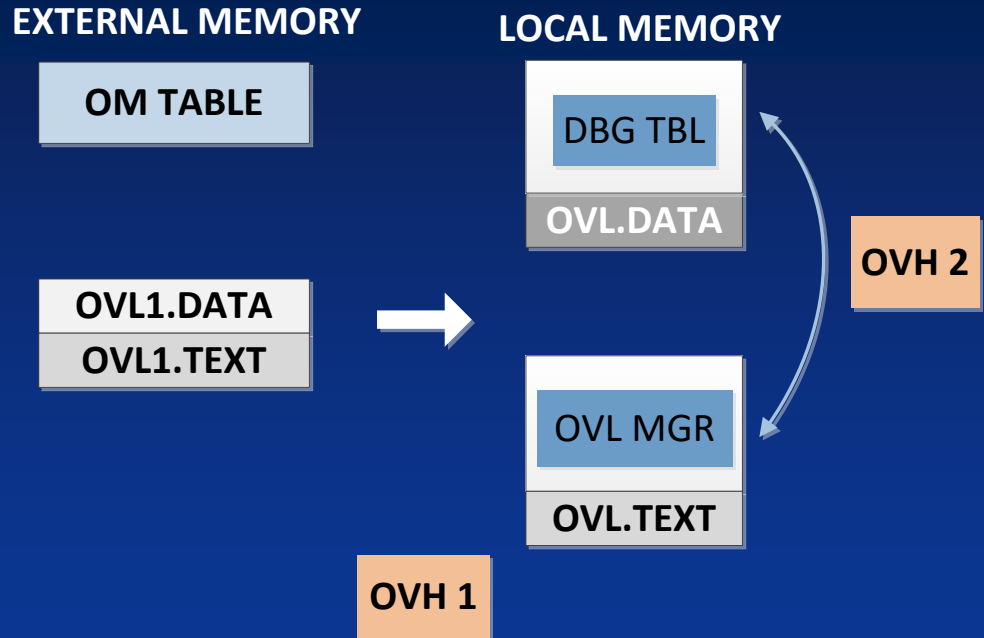
# Handling Overlays

## Overhead 1

- Transactions with external memory OVH1.

## Overhead 2

- Overhead incurred by the overlay manager activities in local transactions OVH2.



# Coding Technique

## Least frequent

- Overlay code is the least frequently run code

## Reentrant

- Designed as a reentrant function to avoid global and static variables.

## Predefined

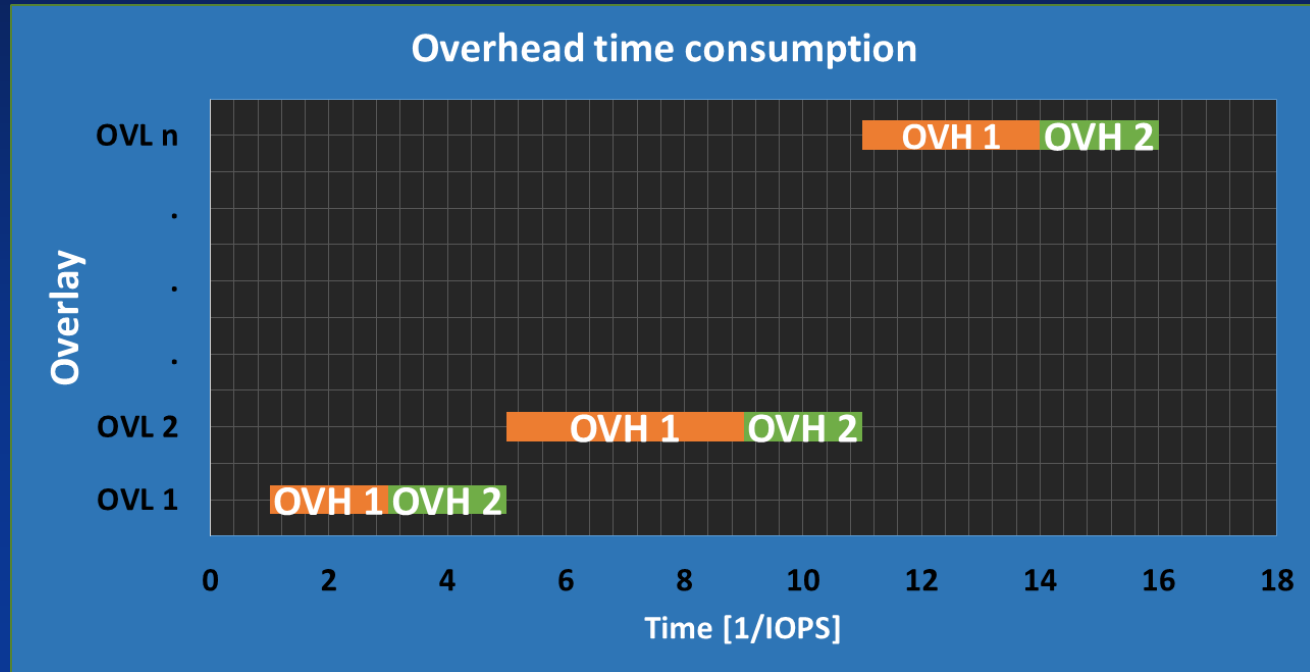
- Text and data sections locations are predefined.

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- Overlay
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- References
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# Overlay Overhead and IO Latency

## Latency

- $L = \text{OVH}(\text{OVL } 1) + \text{OVH}(\text{OVL } 2) + \dots + \text{OVH}(\text{OVL } n)$



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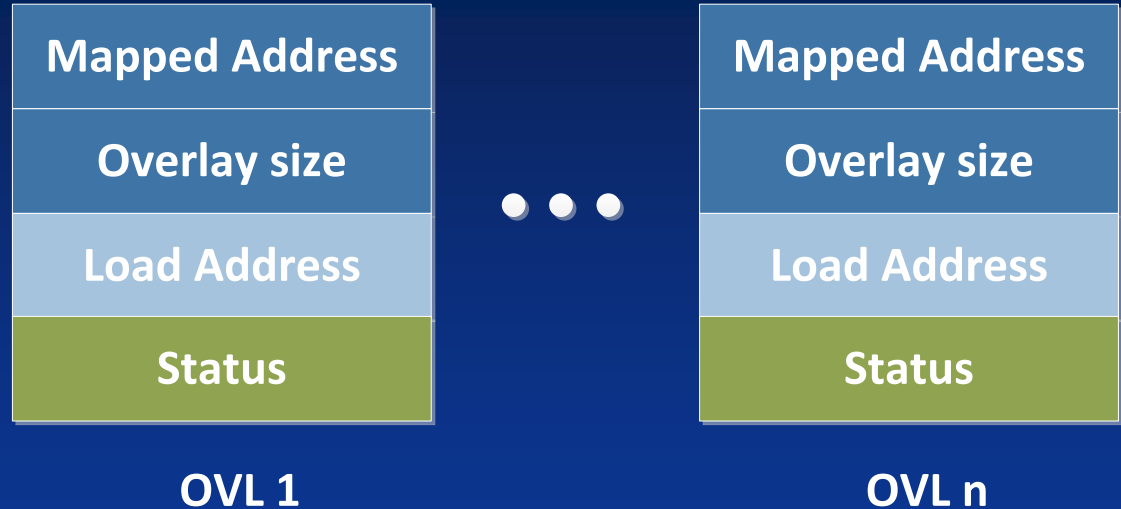
# Debugger Overlay Table

## Overlay table

- Created in local memory to become part of debug inferior.

## Status

- Overlay mapped or unmapped





# Overlay Automatic Debugging

## Debug overlay table

- Debugger gets notification from overlay manager and takes overlay information from debug overlay table.

## Debug event

- Notifies debugger to take proper action.

# Overlay Manual Debugging

## Overlay manual

- Debugger does not rely on the overlay table. Overlays need to be mapped manually for the debugger to identify the mapped overlays.

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- Overlay
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- Q & A

# Decrease Latency

## Coding technique

- To reduce memory transactions from external to the local memory.

## Handling

- To simplify overlay code management by predefinition of the load memory location.

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- **Q & A**

# References

1. Debugging with GDB: the GNU Source-Level Debugger for GDB
2. The GNU C Library Reference Manual
3. NVM Controller Firmware Architectural Specification, PMC

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# Questions ?

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