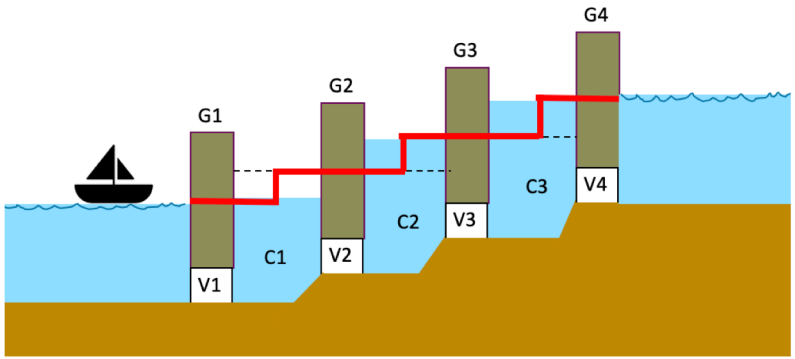
# WETS Testing Considerations

September 30, 2025

Michael M Lee

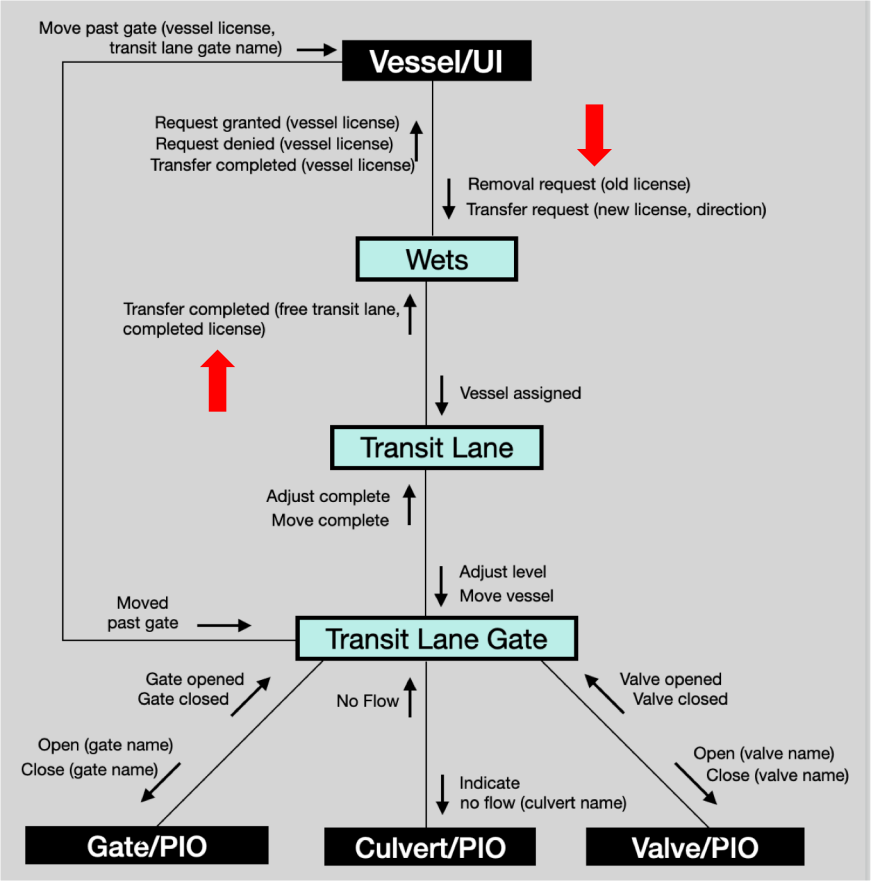


# Testing Approach

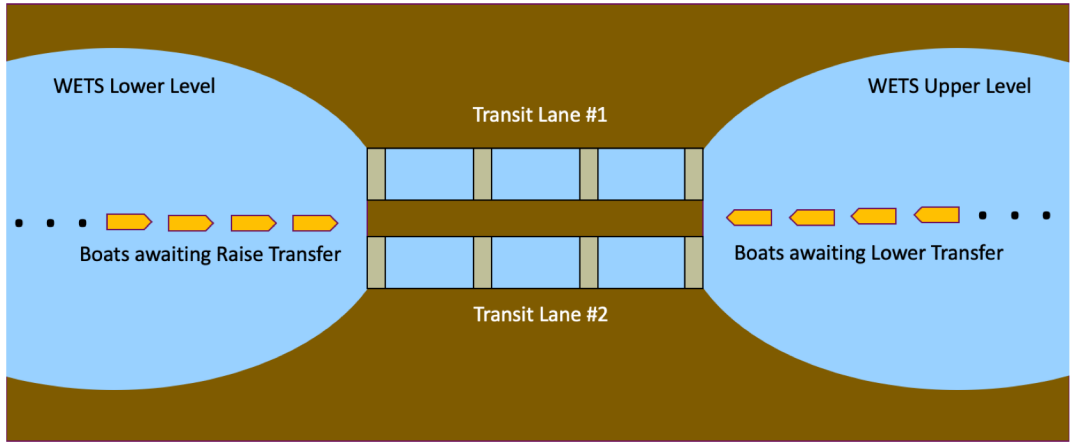
- "White Box" testing
  - Internal structure, design, and implementation known
- 1st Consideration: Cover all Model Execution Paths
  - Consider activating events ➔ Cause reactive system to do something
  - Consider conditional logic in Activities ➔ Multiple tests for coverage
- 2nd Consideration: Cover "Some Number" of Physical Configurations
  - Each with coverage for all "configuration dependent" model execution paths

# Execution Paths Considerations

- Purpose
  - Transport water vessels up and down a canal
- Behavior
  - Event-Driven (Reactive)
  - Idle without activating events
- Activating Events
  - Transfer request (external)
  - Remove request (external)
  - Transfer completed (internal)



# Physical Configuration Considerations




- Possible Configuration Variations
  - 1 to many Transit Lanes
  - 2 to many Transit Lane Gates per Transit Lane

# Execution Paths for Activating Events (1 of 2)

- Transfer Request (new vessel, transit lane available)
  - Branching Condition1: Requesting vessel direction ➔ Up/Down
  - Branching Condition2: Water Level adjustments necessary ➔ Yes/No
    - 4 Execution Paths (dependent on configuration)

- Transfer Request (new vessel, no transit lane available)
  - 1 Execution Path (independent of configuration)

- Transfer Request (existing vessel)
  - 1 Execution Path (independent of configuration)

# Execution Paths for Activating Events (2 of 2)

- Transfer Completed
  - Branching Condition1: Waiting vessel exists ➔ Yes/No
  - Branching Condition2: Requested vessel direction ➔ Up/Down
    - 3 Execution Paths (independent of configuration*)

- Remove Request
  - Branching Condition1: Requesting Vessel already exists ➔ Yes/No
    - 2 Execution Paths (independent of configuration)

# Coverage Test Cases (1/2)

## Transfer Request Tests (6)

| Test# | Transit Lane Available | Request Direction | Available Direction | New Vessel | System processing |
|---|---|---|---|---|---|
| 1 | No | NA | NA | Yes | Create Waiting Vessel |
| 2* | Yes | Up | Up | Yes | Assign Up Transit Lane, Do Up Transfer |
| 3* | Yes | Up | Down | Yes | Assign Down Transit Lane, Adjust Water Levels, Do Up Transfer |
| 4* | Yes | Down | Up | Yes | Assign Up Transit Lane, Adjust Water Levels, Do Down Transfer |
| 5* | Yes | Down | Down | Yes | Assign Down Transit Lane, Do Down Transfer |
| 6 | NA | NA | NA | No | Reject request |

* = Configuration dependent

# Coverage Test Cases (2/2)

## Remove Request Tests (2)

| Test# | This Vessel Waiting | System Processing |
|---|---|---|
| 7 | No | Reject Request |
| 8 | Yes | Remove waiting vessel |

## Transfer Completed Tests (3)

* = Configuration dependent BUT covered by Tests 2,3,4, 5.

| Test# | Any Vessel Waiting | Vessel Direction | System Processing |
|---|---|---|---|
| 9* | Yes | Up | Assign Transit Lane, Adjust Water Levels if Necessary, Do Up Transfer |
| 10* | Yes | Down | Assign Transit Lane, Adjust Water Levels if Necessary, Do Down Transfer |
| 11 | No | NA | No processing required at this point |

# Possible Configurations

- Minimum Configuration
  - 1 Transit Lane, 2 Transit Lane Gates per Transit lane
- Maximum Configuration
  - Unbound ➔ Possibilities
    - Chose range of configurations for “certification” ✓
    - Do “1, 2, many” inductive proof ?
- Certification
  - 1-to-3 Transit lanes (3)
  - 2-to-4 Transit Lane Gates (3)
  - Configuration Tests = 9

# Tests for Execution Paths X Configuration

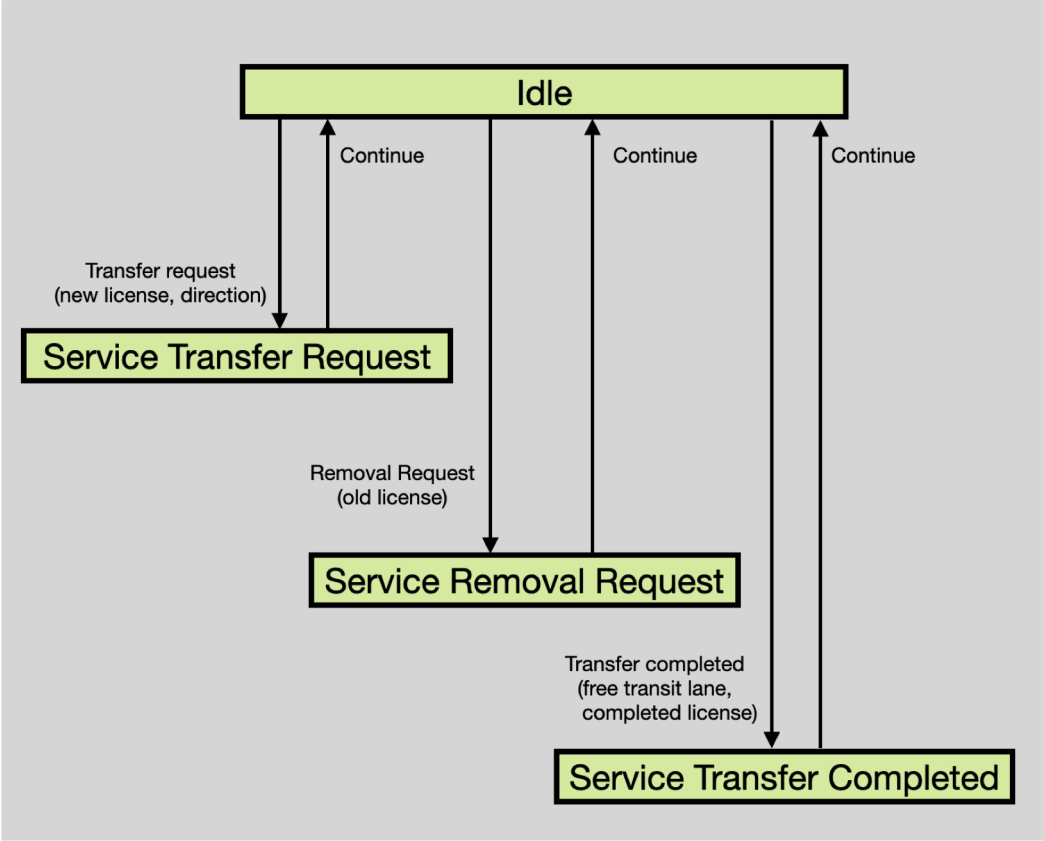
- Total Number of Test Cases
  - Configuration possibilities (9) multiplied by the sum of the execution paths that are configuration dependent (4) plus the sum of the execution paths that are independent of the configuration (7)
  - Total Test Cases = 9*4 + (2+2+3) = 43

# Next Steps

- Run all tests (11) successfully for 1 configuration

- Coverage = 100% ➔ Run configuration dependent tests for remaining configurations
  - Passing == 100% ➔ ✓
  - Passing <> 100% ➔ Determine Why, Fix
  - Re-Test

- Coverage <> 100% ➔ Determine Why, Fix
  - Re-Test

# Questions? Comments?? Suggestions???

# Activating Event Activities