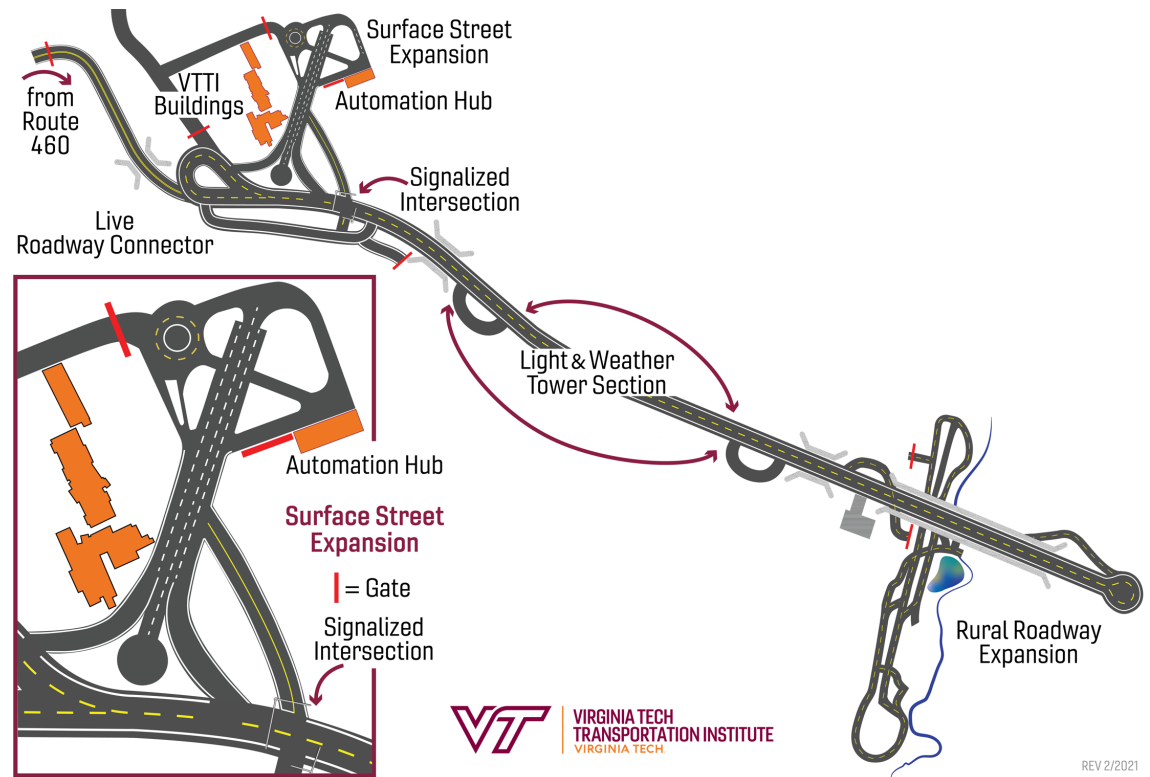


Test Plan Goals

- Initial Phase 2 testing held at VTTI's Smart Road with good results
- Updating original test plan to accommodate new functionality and stakeholder input draft
- Help establish operational expectations
- Testing will be conducted with new non-developer drivers that have been trained in ATMA system operations
- Feedback needed to simulate live road scenario to prepare for final public roadway testing





Testing Protocol

- Daily testing will begin with vehicle and systems inspections
- Test crew will agree upon test scenarios to conduct prior to entering testing facility (support team members may be required)
- All VTTI Smart Road safety protocols will be adhered to per VTTI Safety Committee oversight
- Operational Design Domain for testing
 - Gated facility, no public access
 - No foreign traffic present on test roadway
 - Clear weather
 - Daylight
 - Limited access freeway roadway design
- Data will be collected on onboard Data Acquisition System with time series and video data and retrieved each day
- Any technical failure will result in test stand down to evaluate and resolve issue

Test Plan 1

Test Category: Following Accuracy
Comprehensive

Reported Metrics:

- Lateral Offset
 - Average, Maximum, RMS
- Longitudinal Offset
 - Average, Maximum, RMS
- Number of Errors

Test Subcategory: Comprehensive Loop Details:

Total Tests: 4

- Environment: Entire Highway Section
- Settings: 150ft following distance, 0 lateral offset
- Duration: 1 lap of highway section approx. 4.4 miles at each speed, continuous operation for 13 miles
- Navigation Source: GPS Primary, manual disconnect to rely on vision near gantry
- Variations:
 - Perform 5 mph
 - Perform at 15 mph
 - Perform at 25 mph



Test Plan 2

Test Category: Following Accuracy

Reported Metrics:

- Lateral Offset
 - Average, Maximum, RMS
- Longitudinal Offset
 - Average, Maximum, RMS
- Number of Errors

Test Subcategory: Straight Section

Total Tests: 18

- Environment: Straight section of highway, surface street
- Settings: 150ft following distance, 0 lateral offset
- Duration: ¼ mile per test, some may be combined in one run
- Variations:
 - Perform on level ground
 - Perform on incline
 - Perform on decline
 - Perform all the above at 5, 15, 25 mph
 - Perform all the above with in GPS denied environment



Test Plan 3

Test Category: Following Accuracy

Reported Metrics:

- Lateral Offset
 - Average, Maximum, RMS
- Longitudinal Offset
 - Average, Maximum, RMS
- Number of Errors

Test Subcategory: Curve Section

Total Tests: 8

- Environment: Off ramp loop T1
- Settings: 150ft following distance, 0 lateral offset
- Duration: ¼ mile
- Variations:
 - Varying curvature of T1 and T4
 - Perform at 5 and 15 mph
 - Perform all the above in GPS denied environment



Test Plan 4

Test Category: Offset command

Reported Metrics:

- Time taken to assume new commanded offset
 - Min to max and incremental
- Lateral Offset
 - Average, Maximum, RMS
- Longitudinal Offset
 - Average, Maximum, RMS
- Number of Errors

Test Subcategory: Lateral Offset

Total Tests: 8

- Environment: Straight section of highway
- Settings: 150ft following distance
- Duration: As required
- Variations:
 - 4-8-12 foot offset right and left, stopping in center
 - 12 ft right to 12 ft left offset
 - Perform all the above at 5 and 15 mph
 - Perform all the above in GPS denied environment



Test Plan 5

Test Category: Offset command

Reported Metrics:

- Time taken to assume new commanded offset
 - Min to max and incremental
- Lateral Offset
 - Average, Maximum, RMS
- Longitudinal Offset
 - Average, Maximum, RMS
- Number of Errors

Test Subcategory: Longitudinal Offset

Total Tests: 8

- Environment: Straight section of highway
- Settings: 0ft lateral offset
- Duration: As required
- Variations:
 - 50-400 foot offset
 - 100-200-300 foot offset
 - Perform all the above at 5 and 15mph speed
 - Perform all the above in GPS denied environment
- Note: Max Catch-up Speed Currently 25 mph



Test Plan 6

Test Category: Obstacle Detection

Reported Metrics:

- Deceleration Profile
- Distance to Object
- Number of Errors

Test Subcategory: Static Obstacle

Total Tests: 6

- Environment: Straight section of highway
- Settings: 300ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 5 mph
 - 15 mph
 - 25 mph
 - With 6 ft lateral offset
- Note: Planning to use traffic cone or drum for fixed object



Test Plan 7

Test Category: Obstacle Detection

Reported Metrics:

- Deceleration Profile
- Distance to Object
- Number of Errors



Test Subcategory: Dynamic Obstacle

Total Tests: 3

- Environment: Straight section of highway
- Settings: 400ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 5 mph
 - 15 mph
 - 25 mph
- Note: Using articulated remote controlled human dummy as target

Test Plan 8

Test Category: Obstacle Detection

Reported Metrics:

- Detection of Intruding Vehicle
- Deceleration Profile
- Distance to Object
- Number of Errors

Test Subcategory: Dynamic Vehicle Intrusion

Total Tests: 1

- Environment: Straight section of highway
- Settings: 300ft following distance, 0ft lateral offset, 5 mph
- Duration: 1 mile
- Variations:
 - None



Test Plan 9

Test Category: Commanded Holds and Stops

Reported Metrics:

- Stopping Distance
- Number of Errors

Test Subcategory: Commanded Hold

Total Tests: 2

- Environment: Straight section of highway
- Settings: 150 ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 5 and 15 mph speed



Test Plan 10

Test Category: Commanded Holds and Stops

Reported Metrics:

- Stopping Distance
- Number of Errors

Test Subcategory: Tablet HMI Emergency Stop

Total Tests: 3

- Environment: Straight section of highway
- Settings: 150 ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 5, 15, and 25 mph



Test Plan 11

Test Category: Commanded Holds and Stops

Reported Metrics:

- Stopping Distance
- Number of Errors

Test Subcategory: Wireless Emergency Stop

Total Tests: 3

- Environment: Straight section of highway
- Settings: 150 ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 5, 15, and 25 mph



Test Plan 12

Test Category: Commanded Holds and Stops

Reported Metrics:

- Stopping Distance
- Number of Errors

Test Subcategory: Sensor Error Emergency Stop

Total Tests: 3

- Environment: Straight section of highway
- Settings: 150 ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 5, 15, and 25 mph



Test Plan 13

Test Category: Commanded Holds and Stops

Reported Metrics:

- Stopping Distance
- Number of Errors

Test Subcategory: External Mushroom Button
Emergency Stop

Total Tests: 1

- Environment: Straight section of highway
- Settings: 150 ft following distance, 0ft lateral offset
- Duration: ¼ mile
- Variations:
 - 6 mph only

