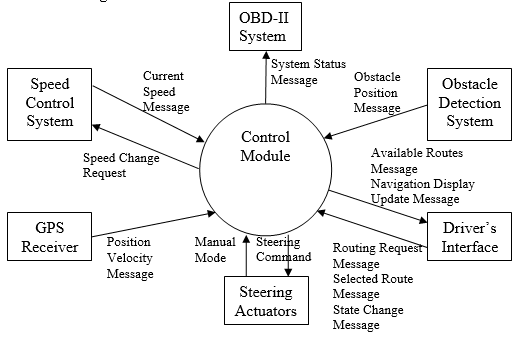
# **Introduction**

This document describes the requirements for the Navigation and Automatic Steering System (NASS) for the Sonny Motors Company’s automobile lines.

## ***System Description***

The Navigation and Automatic Steering system (NASS) will guide Sonny Motors Company automobiles on city streets and highways from their current locations to user supplied destinations. The NASS consists of a computer, and two steering actuators controlled by the computer. The NASS will interact with other systems computerized and mechanical, as part of the overall system that is each automobile. Figure 1.1-1 shows the NASS block diagram.



**Figure ‎1.11 Navigation and Steering System Block Diagram**

## ***Document Scope***

This document describes the Navigation and Automatic Steering system’s requirements. The behaviors of the other systems are described in their respective requirements documents.

# **Applicable Documents**

This section describes the various documents that are referenced in this specification. In the event of conflicts between these documents, the following order of precedence will apply:

1. This document
2. Customer Supplied Documents
3. Government Documents

## ***Customer Supplied Documents***

None.

## ***Government Documents***

Federal Motor Vehicle Safety Standards in effect as of 18 February 2004

On-Board Diagnostic System Requirements, version 2 (OBD-II)

# **Functional Requirements**

This section describes the required behaviors of the Navigation and Automatic Steering System.

## ***Position and Velocity Sensing***

**[SN-001]** The system **shall** update its current position and velocity upon receipt of valid Position Velocity Messages.

**[SN-002]** The system **shall** cease automatic steering if 3 (adaptable) consecutive invalid Position Velocity messages are received within 2 seconds (adaptable).

**[SN-003]** The system **shall** cease automatic steering if 3 (adaptable) consecutive Position Velocity messages indicating GPS signal integrity errors are received within 2 seconds (adaptable).

**[SN-004]** The system **shall** generate a Navigation Display Update message indicating the vehicle’s current position after every 4th (adaptable) valid Position Velocity Message.

## ***Route Selection***

**[SN-005]** Upon receipt of a valid Routing Request Message, the system **shall** determine up to 3 (adaptable number) of routes from the vehicle’s current position to the specified destination.

**[SN-006]** The generated routes **shall** be sent in one or more Available Routes Messages.

**[SN-007]** An Available Routes message indicating that no routes are available **shall** be generated if the system is unable to determine a route to the specified destination.

## ***Steering***

**[SN-008]** Upon receipt of a Selected Route Message, the system **shall** assume responsibility for steering the vehicle along the selected route.

**[SN-009]** The system **shall** take into account the vehicle’s current position and velocity, and the selected route information when determining the timing and magnitude of steering commands.

**[SN-0010]** If a required turn cannot be made safely at the vehicle’s current speed, the system **shall** generate a Speed Change Request indicating the necessary speed reduction.

Note: The safe speed for a 180° turn is 5 mph. The safe speed for a 90° turn is 15 mph. The safe speed for a 45° turn is 35 mph.

**[SN-0011]** The system **shall** generate one or more Speed Change Requests to return the vehicle to its appropriate speed after a turn has been completed.

## ***Obstacle Avoidance***

**[SN-0012]** Upon receipt of an Obstacle Position Message indicating a moving obstacle in the vehicle’s path (e.g., another vehicle that is moving slower than the host vehicle), the system **shall** generate one or more Speed Change Requests to reduce the vehicle’s speed to keep the obstacle at a safe distance.

**[SN-0013]** The system **shall** generate one or more Speed Change Requests to return the vehicle to a safe speed upon receipt of an Obstacle Position Message indicating that the obstacle is no longer a factor.

**[SN-0014]** Upon receipt of an Obstacle Position Message indicating a stationary obstacle, the system **shall** maneuver the vehicle around the obstacle.

**[SN-0015]** If the maneuvers require a speed change to be carried out safely, the system **shall** generate one or more Speed Change Requests to reduce the vehicle’s speed.

**[SN-0016]** The system **shall** generate commands to the steering actuators and one or more Speed Change Requests to return the vehicle to an appropriate direction and a safe speed upon receipt of an Obstacle Position Message indicating that the obstacle is no longer a factor.

When the Obstacle Detection System detects an unavoidable obstacle, the following will be performed:

1. The system **shall [SN-0017]** cease automatic steering within 100 ms (adaptable)
2. The system **shall** **[SN-0036]** generate a Speed Change Request of “0” to apply a brake.
3. The system **shall** [**SN-0037]** notify the driver to take manual control steering the vehicle.

## ***Driver Controls***

**[SN-0018]** The system **shall** suspend automatic steering upon receipt of a State Change message indicating Suspend. In this state, the system will not steer the vehicle and will not generate Speed Change requests. Upon receipt of a State Change message indicating Resume, the following will be performed:

1. If the vehicle is still on the selected route, the system **shall [SN-0019]** resume steering and the generation of Speed Change Requests.
2. Otherwise, the system **shall** **[SN-0033]** generate a System Status Message indicating that the driver must select a new route.

**[SN-0020]** The system **shall** cease automatic steering upon receipt of a State Change Message indicating “Off”.

The driver willbe able to manually steer the vehicle with the NASS active. The system will not “fight” the driver for control of the vehicle. This is similar in concept to the driver being able to override a cruise control without having to disengage it. Upon receipt of a Manual Mode message indicating that the driver is steering the vehicle, the system **shall** **[SN-0030]** suspend steering. Upon receipt of a Manual Mode message indicating that the driver is no longer steering the vehicle, the system shall [**SN-0031**] resume automatic steering.

## ***Emergency Actions***

**[SN-0022]** The system **shall** cease automatic steering if an error is detected within the Navigation and Steering System that prevents it from safely performing its functions.

**[SN-0035]** The system **shall** notify the driver to manually steer the vehicle when it ceases or suspends automatic steering.

## ***Diagnostic Information Generation***

The following will be performed if the system ceases automatic steering other than in response to State Change Messages:

1. One or more System Status Messages shall **[SN-0032]** be generated indicating the reason that automatic steering has ceased.
2. A Navigation Display Update Message indicating that the system has ceased automatic steering and the reason **shall [SN-0023]** be generated.
3. The system **shall [SN-0024]** not accept Routing Request Messages until the vehicle has been shut-off and has been restarted.

# **Non-Functional Requirements**

This section describes attributes the software is required to have that are not directly observable in the product’s behavior.

## ***Reliability***

**[SN-0025]** The system **shall** have a Mean Time Between Failures (MTBF) of no less than twelve (12) months. A failure is defined as any error (except the GPS signal integrity error) within the system that causes it to cease automatic steering, or any error that causes the system to behave in an unsafe manner.

## ***Availability***

**[SN-0026]** The system **shall** be able to generate Navigation Display Update messages indicating the vehicle’s current position 99.9999% (“6 nines”) of the time the vehicle is operating.

**[SN-0027]** The system **shall** be able to generate routes for 95% of the test cases to be supplied by the customer.

**[SN-0039]** When GPS is not available, the system uses the saved offline map to navigate.

## ***Portability***

**[SN-0028]** The software **shall** be designed to maximize portability. This is to ensure the software can be hosted on vehicles in later model years without substantially redesigning it.

## ***Security***

**[SN-0038]** The system **shall** be designed to prevent unauthorized activity and protect system from hacking.