Perception

NOTE: Topics in red are still under development and not ready to use

	Topic	Message	Details (Descriptions)
Input	/velodyne_points	Lidar point cloud from the center lidar	- Velodyne Ultra Puck VLP32C - 200m range - 360˚horizontal, 40˚vertical FOV
	/camera/right/image_color	Colour image from right camera	- Resolution: 1920 x 1200 - 41 FPS - 83 deg horizontal FOV - Lens: Fujinon DF6HA-1B - Model: IMX249
	/camera/left/image_color	Colour image from left camera	- Same as right camera

Output	/traffic_light_detection	common_msgs::TrafficLightList	Traffic light state detection given traffic light bounding boxes from obstacle detection node
			- Bounding box coordinates (x, y, h, w) in pixels
			  - x, y is top left corner
			- Gives traffic light state enum for forward, left and right directions
			  - Link -> common_msgs::**TrafficLight.msg**

	/traffic_sign_detection	common_msgs::TrafficSignList	Traffic sign detection from right camera
			- Bounding box coordinates (x, y, h, w) in pixels
			  - x, y is top left corner
			- Sign class given as an enum
			  - 13 sign classes
			  - Link -> common_msgs::**TrafficSign.msg**

	/object_detection	common_msgs::ObstacleList	Obstacle detection from lidar - 3D bounding box coordinates in meters - https://phabricator.watonomous.ca/w/software/perception/3d_object_detection/coordinate_system/ - All boxes are UNKNOWN class

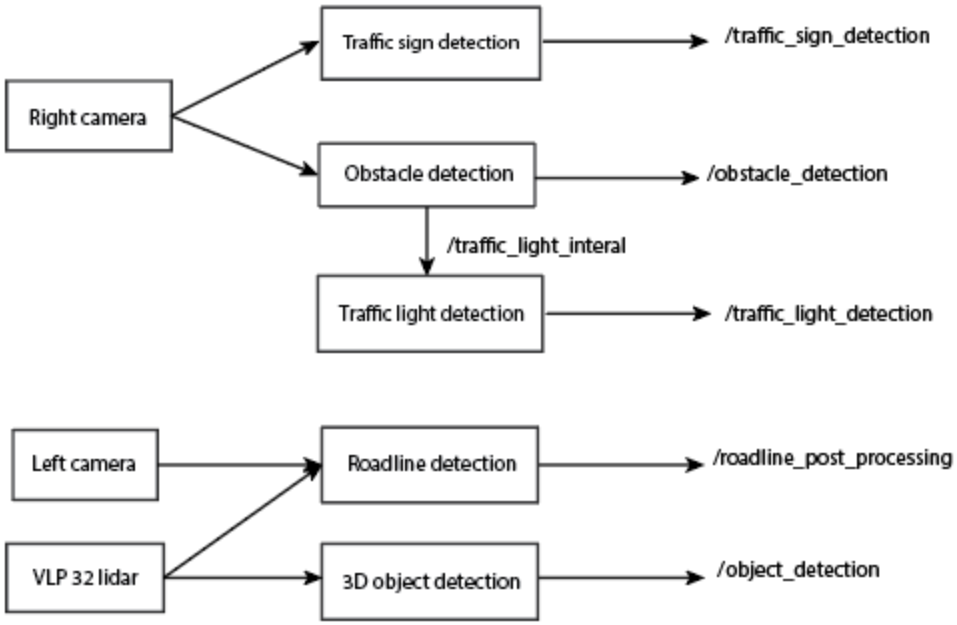
	/obstacle_detection	common_msgs::ObstacleList	Pedestrian, cyclist, and traffic detection from right camera
			- 2D bounding box coordinates (x, y, h, w) in pixels
			  - x, y is top left corner
			- 2 classes given as enums
			  - Link -> common_msgs::**Obstacle.msg**
			- Publishes traffic light bounding boxes for traffic light detection node

	/roadline_post_processing	common_msgs::RoadLinesList	Roadline detection from left camera
			- List of common_msgs::**LaneLine.msg**
			  - List of points
			  - Lane type given as an enum
			  - Parking lines not differentiated from lane lines
			- List of common_msgs::**StopLine.msg**
			  - 2 endpoints

Internal	/traffic_light_detection_visualizer	Image	Traffic light bounding boxes overlayed on camera image
	/traffic_sign_detection_visualizer	Image	Traffic sign bounding boxes overlayed on camera image
	/jsk_bboxes	jsk_recognition_msgs::BoundingBoxArray	Use rviz to visualize 3D object detection that we publish in /object_detection
	/lidar_merged_visualized	sensor_msgs::PointCloud2	Use rviz to visualize post processed lidar point cloud

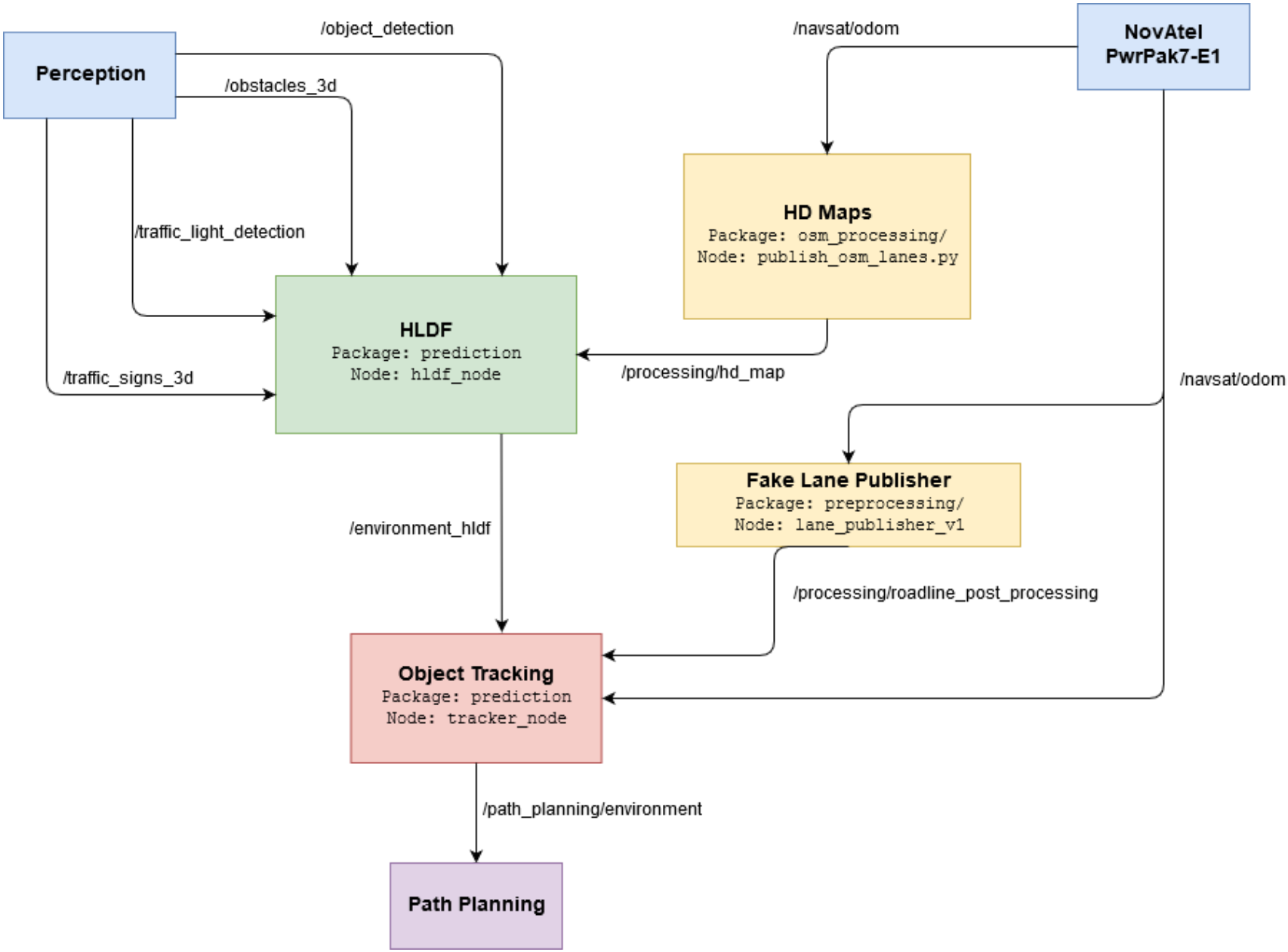
			Post processing involves - Applying transformations - Merging multiple lidars (although we no longer use side lidars) - Filtering out points outside a certain radius (currently 15 m on the side and back, 40 m front) - This will be updated based on path planning requirements
	/obstacle_detection_visualizer	Image	Obstacle bounding boxes overlayed on camera image (contains 80 classes from COCO dataset) - Cyclist boxes are blue - All other boxes are red
	/traffic_light_internal	perception_msgs::TrafficLightBoxes	Traffic light bounding boxes and image from obstacle detection node used by traffic light detection node - Link -> perception_msgs::**TrafficLightBoxes.msg**
	/roadline_detections	perception_msgs::RoadLinesClassMask	List of binary masks from semantic segmentation model separated by class - Link -> perception_msgs::**RoadLinesClassMask.msg**
	/roadline_detection_visualizer	Image	Lanes after post processing visualized
	/raw_mask_roadline_detection_visualizer	Image	Raw output of semantic segmentation model

Perception Pipeline



Processing

	Topic	Message	Details (Descriptions)
Input	/object_detection	common_msgs/ObstacleList	See Perception
	/obstacle_detection	common_msgs/ObstacleList	See Perception
	/traffic_light_detection	common_msgs/TrafficLightList	See Perception
	/traffic_sign_detection	common_msgs/TrafficSignList	See Perception
	/navsat/odom	Novatel Driver	ODOM and IMU data.
	/roadline_post_processing	common_msgs/RoadLinesList	Under development by Perception. Lane detections from Perception
Output	/path_planning/environment	path_planning/environment.msg	- Current vehicle position in global_pose field - Contains all obstacles, traffic lights, traffic signs, and road lines in the surrounding environment.
Internal	/environment_hldf	path_planning/environment.msg	HLDF combines Perception's outputs into an environment message
	/processing/roadline_post_processing	common_msgs/RoadLinesList	Input from lane_publisher_v1 node (the hardcoded lane lines we trace in the parking lot when hd Maps don't work)
	/processing/stopline_detection_output	Not sure	No idea what this is used for.
	/processing/hd_map	path_planning/environment.msg	HD Map publisher turns map into an environment message


Perception
/object_detection
/obstacles_3d
/traffic_light_detection
/traffic_signs_3d
/navsat/odom
NovAtel
PwrPak7-E1
HD Maps
Package: osm_processing/
Node: publish_osm_lanes.py
HLDF
Package: prediction
Node: hldf_node
/processing/hd_map
/navsat/odom
Fake Lane Publisher
Package: preprocessing/
Node: lane_publisher_v1
/environment_hldf
/processing/roadline_post_processing
Object Tracking
Package: prediction
Node: tracker_node
/path_planning/environment
Path Planning

Path Planning

	Topic	Message	Details (Descriptions)
Input	/path_planning/environment	path_planngin/environment.msg NOT: common/environment.msg	From Processing. Contains all obstacles, traffic lights, traffic signs, and road lines in the surrounding environment. - Current vehicle position in global_pose - (Eventually) all data in the environment will be filtered to be within 20m See document for spec
	/navsat/odom	(FROM ROS)	Odometry, used for the feedback controller.
Output	/feedback_desired_output	path_planning/desiredOutput.msg	Feedback controller outputs - torque, wheel angle
Internal	/cost_map_topic	path_planning/RolloutCostmapAndConfig.msg	Costmap + Config for RVIZ visualization
	/path_msg	path_planning/path.msg	Current trajectory we're following (desired path). Followed by Feedback controller
	/path_planning/goal	path_planning/goalLine.msg	Current goal location we're planning to. Only used for rviz

Path Planning Pipeline