Essential infrastructure tools

- Message passing
  - Modularity
    - Encourages abstraction and decomposition of large problems into well-defined sub-problems
    - Software reuse
    - Fault tolerance
    - Creates viewports into system's internal operation
- Logging, Playback

Example

- MIT DUC
  - 40 CPU cores
  - 22+ distinct modules
  - 60+ module instances

Modularization Example

Laser driver

Red Ball Finder

Obstacle Tracker

Game Pad Drive

laser_t

object_position_t

laser_t

obstacles_t

motor_t

LCM Network

object_position_t

obstacles_t

motion_planner_t

motion_plan_t

motor_t

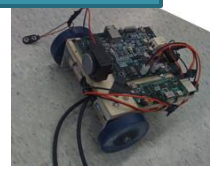
motor_t

pose_t

Motion Planner

Path Follower

Splinter



LCM Type Definition Example

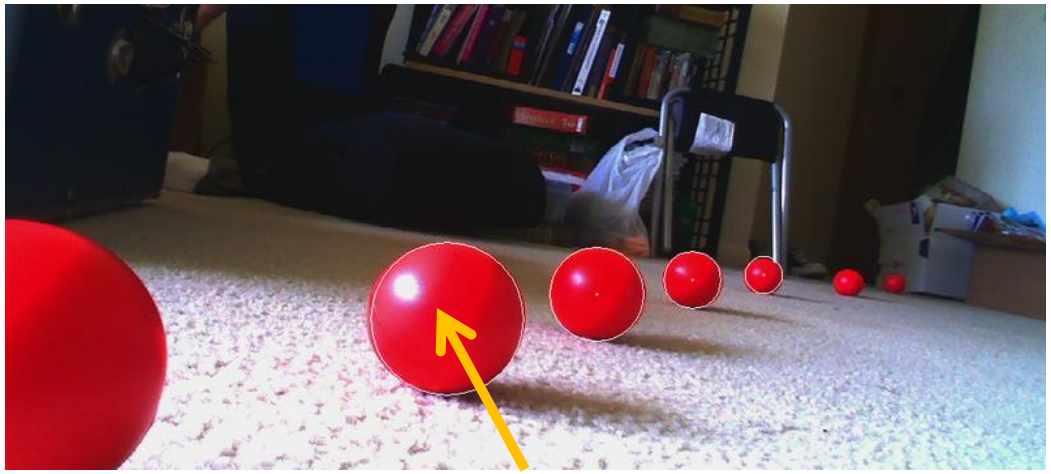
object_position_t.lcm

```
struct object_position_t
{
    int64_t utime;

    double distance;   // distance to object
    double theta;      // direction to object
}
```

lcm-gen

object_position_t.[ch]
object_position_t.java
object_position_t.py



```
objectpos = new object_position_t();

objectpos.utime = System.currentTimeMillis()*1000;
objectpos.distance = 0.3;
objectpos.theta = -0.12;
```

LCM Type Definition Example (2)

laser_t.lcm

```
struct laser_t
{
    int64_t  utime;

    // range data (meters)
    int32_t  nranges;
    float    ranges[nranges];

    // intensity data, in sensor-specific units
    int32_t  nintensities;
    float    intensities[nintensities];

    // the angle (in radians) to the first point in nranges,
    // relative to the laser scanner's own coordinate frame.
    float    rad0;

    // the number of radians between each successive sample
    float    radstep;
}
```

laser_t.[ch]
laser_t.java
laser_t.py