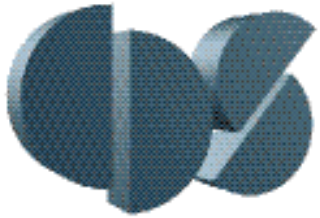
2007 Urban Challenge Summer Kickoff Meeting



Richard M. Murray
Control and Dynamical Systems
California Institute of Technology
13 June 2006

Goals

- Provide a *brief* description of the Urban Challenge and Team Caltech
- Describe goals and plans for the summer and ways to participate
- Break into groups, meet each other, pick a time to meet next week

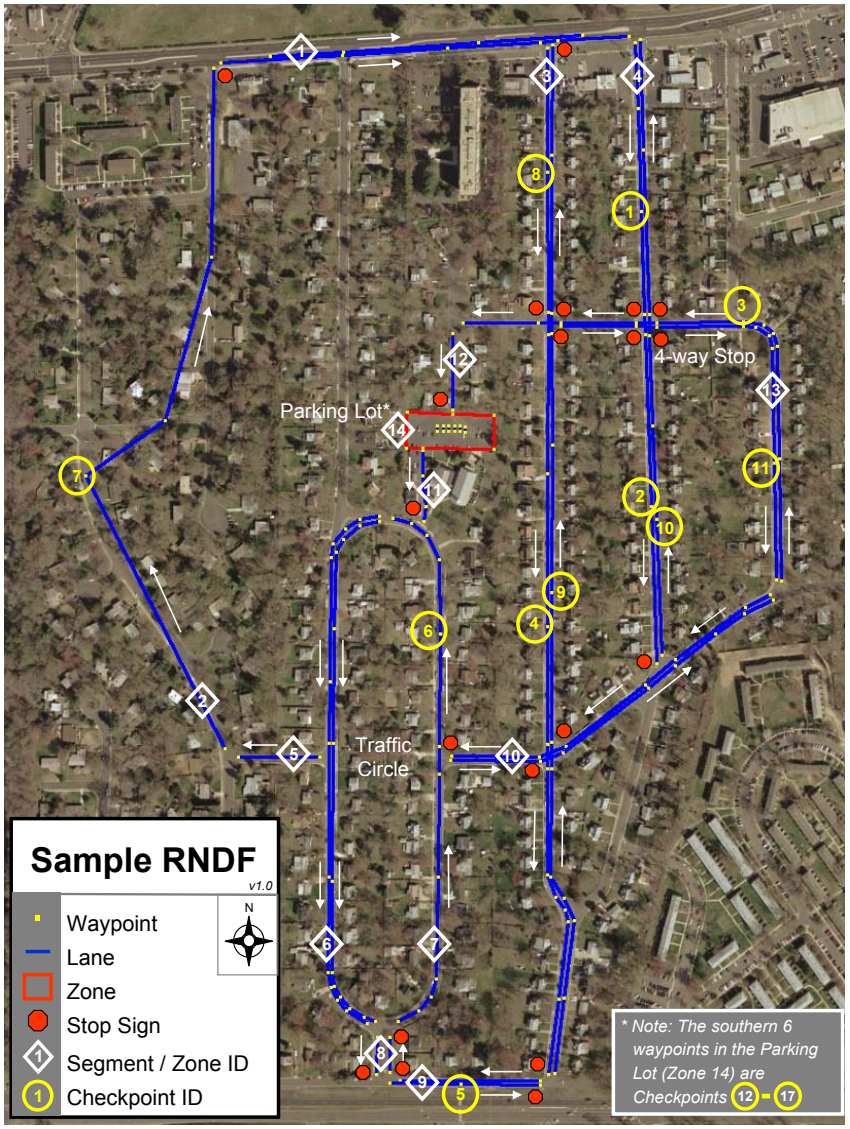
Agenda

4:00	2007 Urban Challenge and Team Caltech
4:10	Team Caltech organizational structure
4:20	Plans for the summer: SURF + conceptual design
4:30	Breakouts by team
5:00	Adjourn

2007 DARPA Grand Challenge (Urban Challenge)

Autonomous Urban Driving

- 60 mile course, less than 6 hours
- City streets, obeying traffic rules
- Follow cars, maintain safe distance
- Pull around stopped, moving vehicles
- Stop and go through intersections
- Navigate in parking lots (w/ other cars)
- U turns, traffic merges, replanning
- Prizes: $2M, $500K, $250K



Baseline Capability: Alice

Team Caltech

- Started in 2003, for DGC04
- Over 100 undergraduates + grad students, faculty and volunteers

Alice

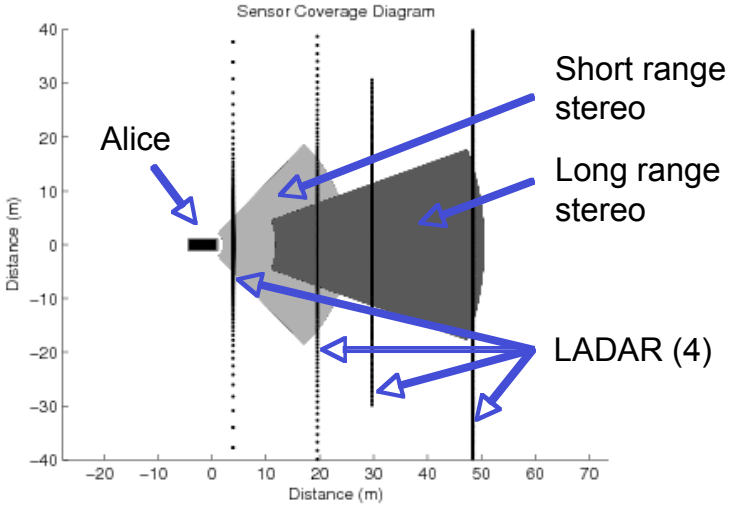
- 2005 Ford E-350 Van
- 5 cameras: 2 stereo pairs, roadfinding
- 5 LADARs: long, med*2, short, bumper
- 2 GPS units + 1 IMU (LN 200)

Computing

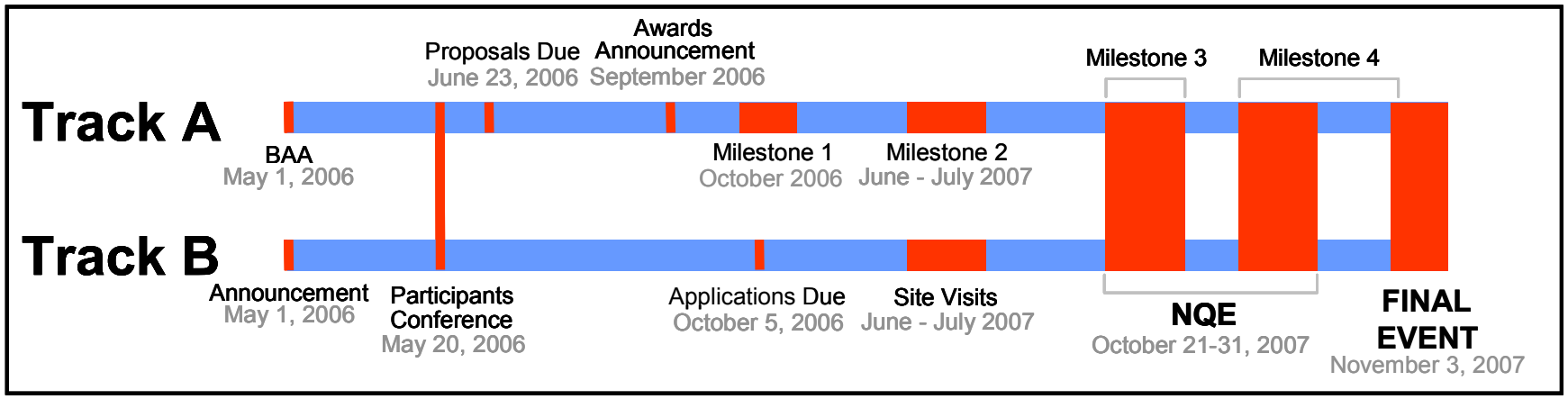
- 6 Dell PowerEdge Servers (P4, 3GHz)
- 1 IBM Quad Core AMD64 (fast!)
- 1 Gb/s switched ethernet

Software

- 15 programs with ~100 exec threads
- 100,000+ lines of executable code



2007 Urban Challenge Participation



Track A: $1M grant from DARPA

- Proposal due 23 June 2006; up to $1M + any additional fundraising
- Award based on technical approach, management and funding plan, strength of team

Track B: no DARPA funding; similar to last year (application, site visit, NQE, GCE)

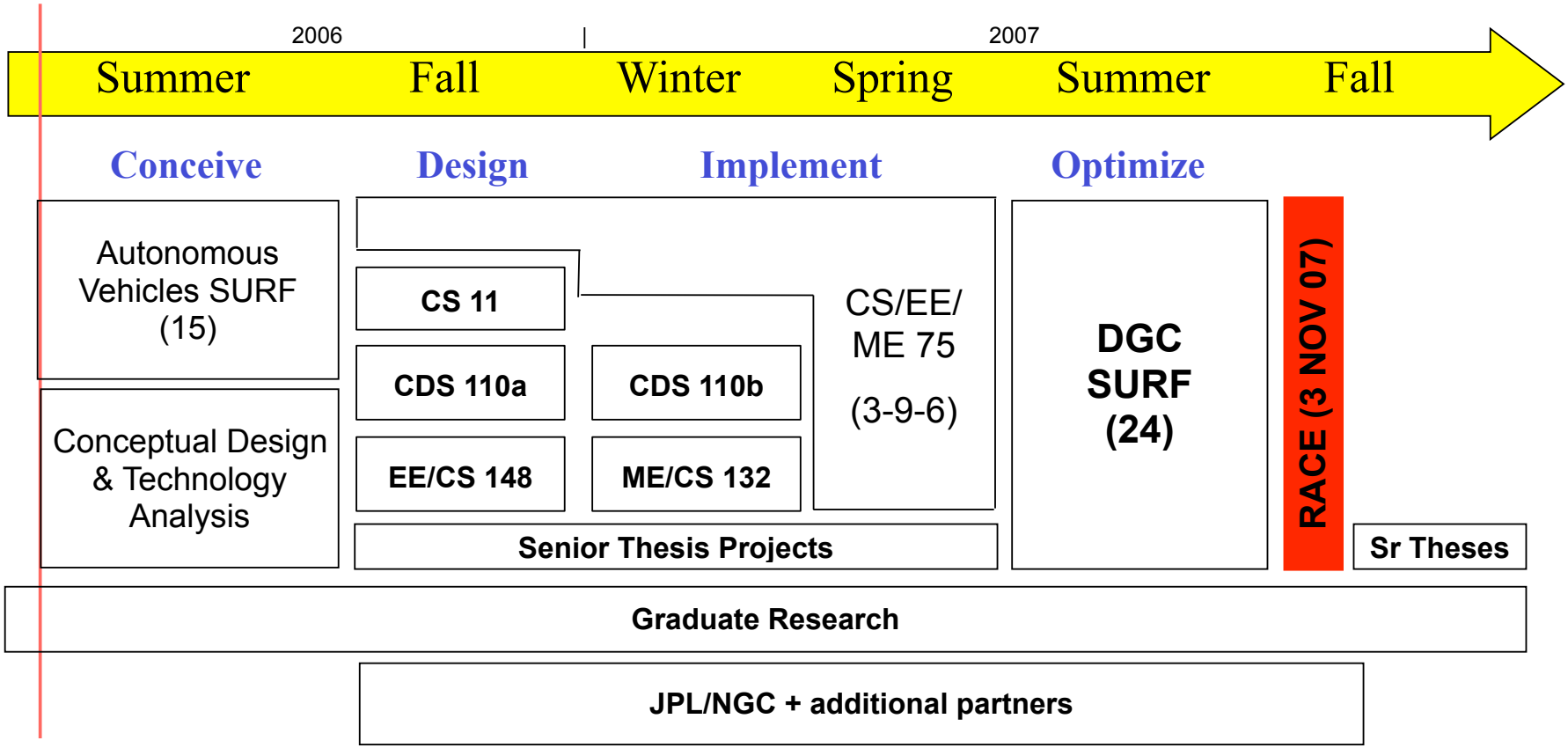
- $50K award for getting to NQE, $100K award for getting to race
- Application due 5 Oct, with video, technical paper due in Feb 07; site visits in Jun 07

Changes from last year

- Use of government resources OK with permission from sponsors

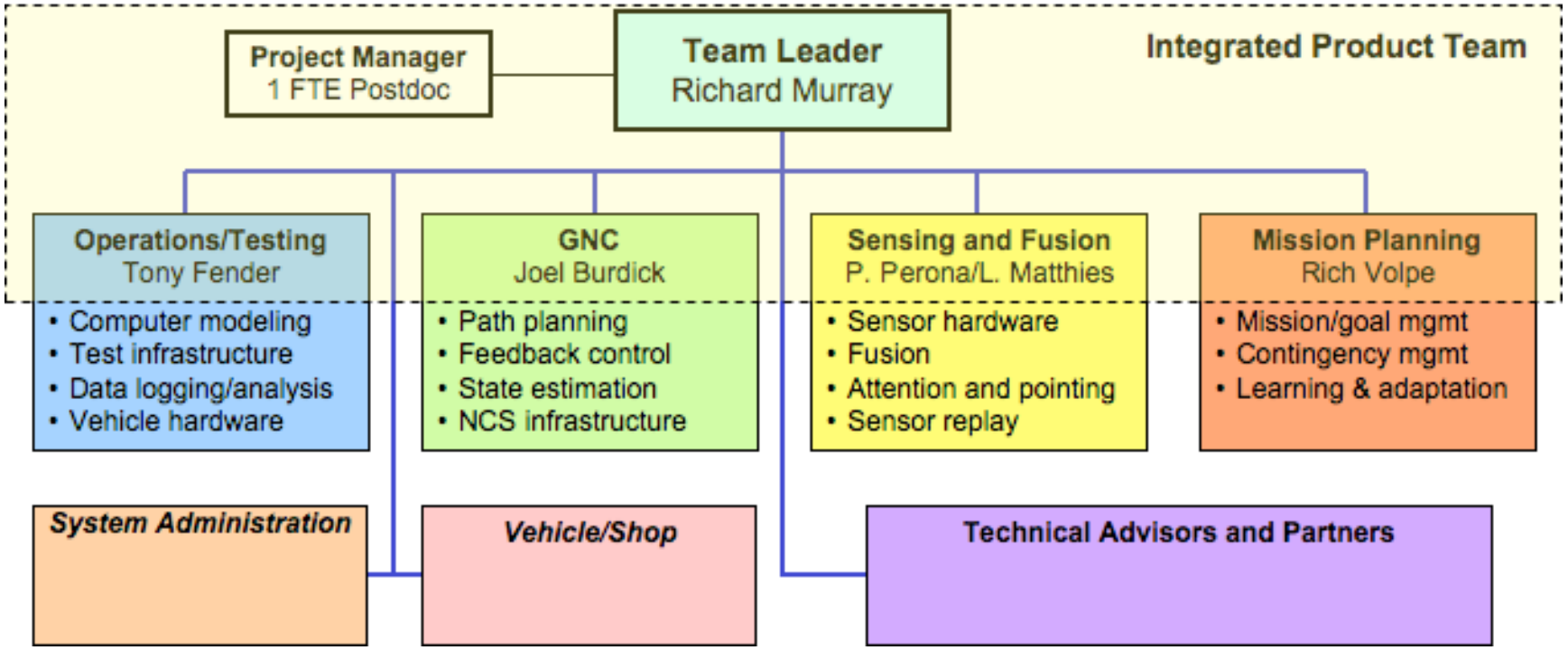
Team Caltech, 2006-07

Goal: design, build and document an autonomous ground vehicle that can win the 2007 Urban Challenge



Organizational Structure

Team Caltech



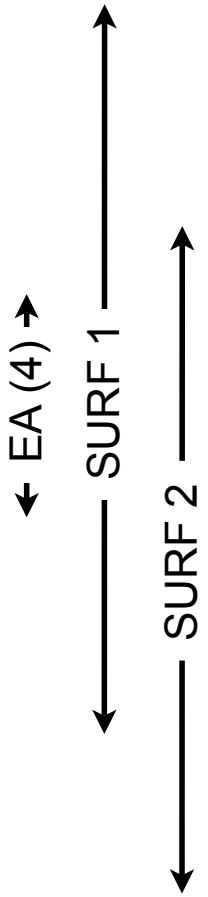
- Integrate undergraduate, graduate, lab, industry participation across team
- 1 FTE grad student on each team, funded by DARPA (coordinator + technical work)
- Additional grad students, postdocs as members of teams (along with undergrads)
- Each team is probably 10-15 people total (6-8 UG, 2-4 grad/PD, 2-3 JPL/industry)

Summer 2006 GOTChA Chart

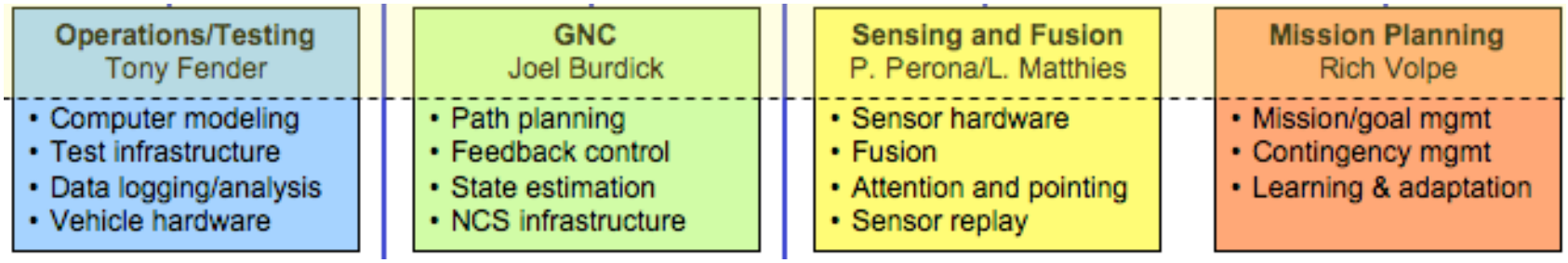
Goals	**Technical Challenges**
1. Figure out how we are going to win the 2007 Urban Grand Challenge 2. Learn what others have done and decide what we can import 3. Decide on the key elements of our system so that we are ready to begin the design phase in the fall	1. Little prior experience in urban driving 2. Decision-making layer is beyond anything we have tried 3. Architecture choices not clear 4. Large, diverse, part-time team 5. Current state estimation is brittle 6. Need to get to testing phase quickly
Objectives	**Approach**
1. Evaluate specific technologies for urban driving and make recommendations on whether to use them 2. Decide on system level architecture to be used for design 3. Decide on system specifications required to complete the race 4. Line up funding ($300K min), equipment, expertise (incl. partners)	1. Use SURF projects to evaluate potential technology solutions 2. Exploit expertise at JPL, NGC 3. Use conceptual design groups to survey approaches, inform team 4. Drive results via field tests, reviews 5. Identify supportors early & request $$

Summer SURF Schedule

Week	Date	Activity
1	12 Jun	Orientation and (re-)planning
2	19 Jun	
3	26 Jun	Field Test #1 / Lab Move
4	3 Jul	Institute Holiday / PDR
5	10 Jul	
6	17 Jul	Field Test #2
7	24 Jul	
8	31 Jul	CDR
9	7 Aug	Field Test #3
10	14 Aug	Posters
11	21 Aug	
12	28 Aug	Field Test #4
13	4 Sep	SURF meeting: Tuesdays @ 4 pm
14	11 Sep	Team meeting: Mondays @ 6 pm (after 7/1)



Conceptual Design - Summer 2007



Break up into groups in selected areas

- Roughly divide by "race teams", with each team having multiple groups of 3-6 people
- Each group is responsible for investigating a single area of focus

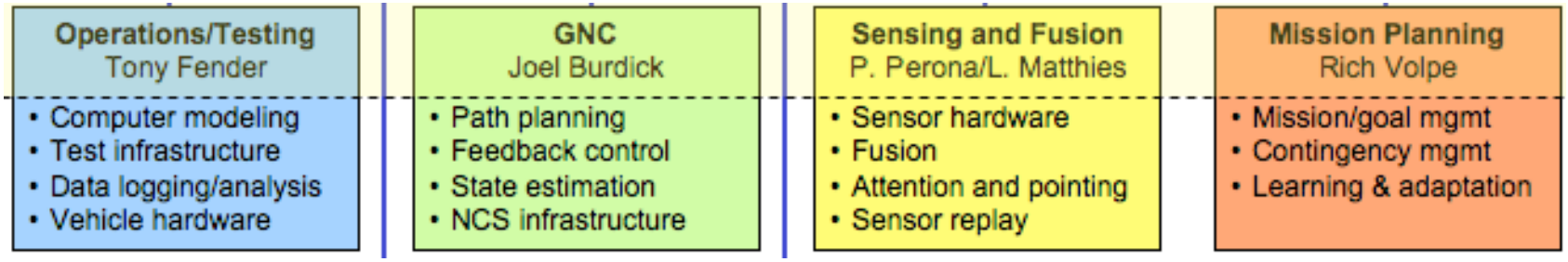
Areas we need to cover (and more)

1. Modeling and simulation
2. Path planning w/ dynamic obstacles
3. Traffic-level planning, tactics
4. State estimation in urban environments
5. Sensor architecture and hardware
6. Detection & tracking of moving objects
7. Software architectures for autonomy
8. Decision-making and planning

Proposed approach

- Each race team will create a list of areas it needs to cover
- Richard, Joel and others will resolve conflicts and overlaps
- Teams will break up into subgroups (w/ overlaps if needed) to cover areas

Conceptual Design - Summer 2007



Richard Murray Ilya Loksha Jing Shen Ken Fisher Albert Wu	Joel Burdick Jessica Gonzalez Morlan Liu Dave Knowles* Martin Larsson Ling Shi Michael Epstein Ziad Fares	Pete Trautman Laura Lindzey Dave Rosen* David Bolin Johnny Zhang Jeremy Ma Arlene Cole-Rhodes Vijay Gupta* Mohamed Aly	Tim Chung/Nok W. Josh Feingold Shawn Surdyk Jose Torres

Next Steps

Breakout sessions

- If your name is listed on the previous chart, please go to that room
- Otherwise, Pick the team that you are most interested in

1. Introduce yourselves (and what you do)
2. Choose a notetaker & get e-mails of participants
3. Discuss some of the questions we need to answer by the end of the summer (take notes)
4. Pick a time when the group can meet next week (ideally, after 3 pm on Tuesday)
5. Decide what everyone should do between now and then (if anything)

Room Assignments
Operations - 110 Steele
GNC - 114 Steele (library)
Sensing - 102 Steele (here)
Reasoning - 125 Steele

Mailing lists

- If you aren't on a mailing list and want to stay informed, please sign up:

http://gc.caltech.edu/mailman/listinfo/team-volunteers