The Vertically Integrated Projects (VIP) Program and Consortium:

Engaging the World via Large-Scale, Long-Term, Multi-D Projects that Support Innovation

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Goal: Involve Everyone on Campus in Innovation

What is Innovation?

"The development of novel products, services, and processes for the benefit of society"
(Too Narrow!)

_____

"Inspiration plus Execution"
(Works in all Disciplines!)

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Vertically Integrated Projects Program VIP
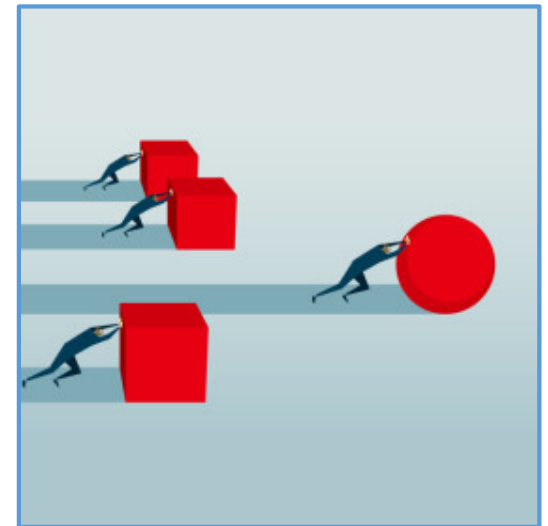
Barriers: The 3 Forms of Fragmentation

Fragmentation By Mission

Innovation/Research: Discovery, Design, Creativity, ….

Education: Pass on Knowledge, Skills

Service: Create Partnerships, Enable Economic Development

Fragmentation By Time

Semesters

Academic Years

Fragmentation By Discipline

Scholarship, "Thinking"

Budget Lines, Culture

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The VIP Approach: Integrate Research & Education

Foster Innovation by Involving Students in Challenging Projects Embedded in Faculty Research

Ensure Success by Providing:
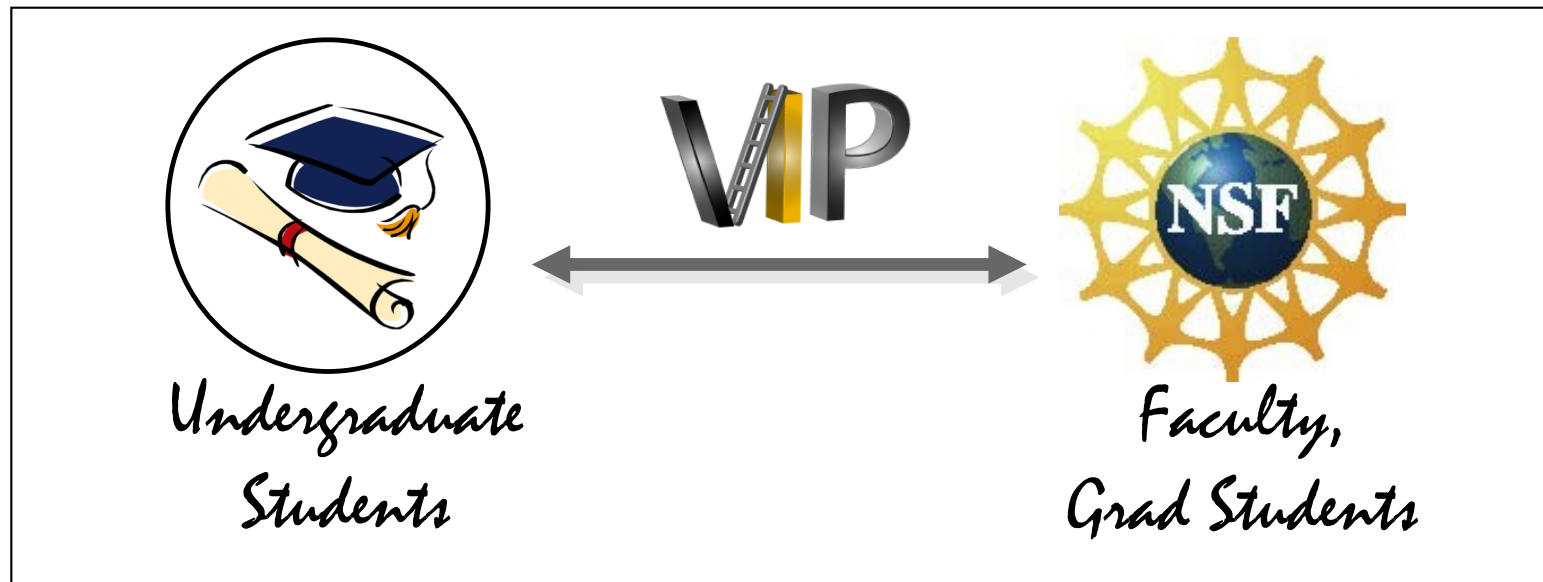
Time   Context   Mentoring

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VIP: Bringing People Together

Undergraduate Students

Faculty, Grad Students

Students need Real Projects in which they Experience the Innovation Process

Faculty can Benefit from Help at all Levels of the Innovation Process

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VIP Program Architecture: The Basics

Enable Long-Term, Large-Scale, Multidisciplinary Teams

- Projects led by faculty; embedded in their research
- Large teams: 10-20+ undergraduates; 1-4 grad students
- 2nd year through 4th year students on every team
- Long-term participation – up to 3 years per student
- New students replace those who graduate
- Students drawn from *all* disciplines needed by the project
- Teams continue for years, *decades*
- Academic credit each semester

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Example: The 17 year old Stadium-IoPT Team

The Stadium-IoPT Team's Testbed: Bobby Dodd Stadium

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People and Information: In-Stadium Web Apps in 2001

Internet

Video and Data Capture

Web and Video Servers
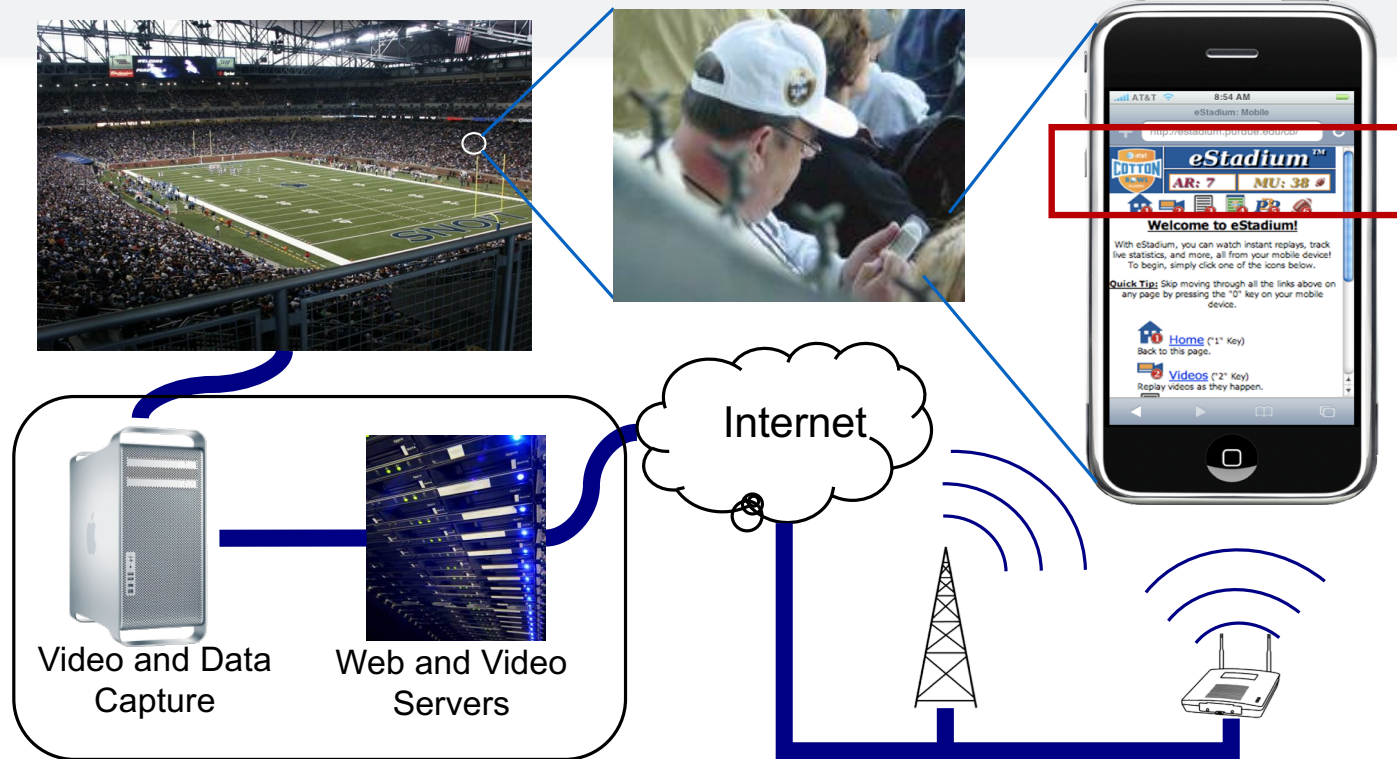
Video clips, stats, tracker on your phone during a game:
http://estadium.gatech.edu

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Stadium-IoPT: Sensor Net Subproject
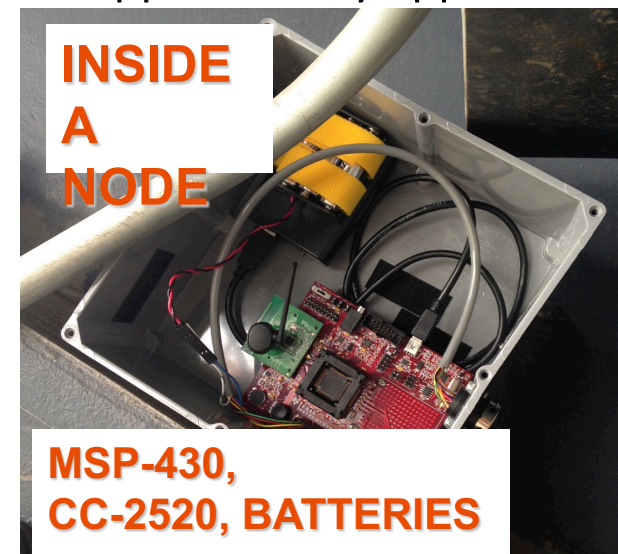

SENSOR

WSN NODE
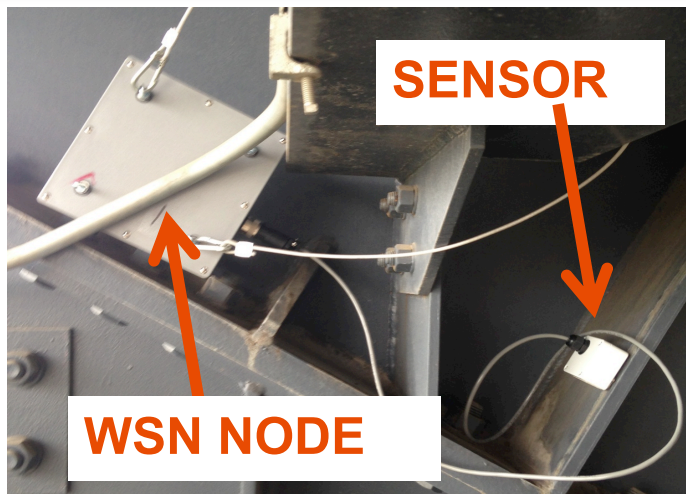
Sensing Tasks:
- Vibration, Audio, Spectrum
- Sensors vary node-to-node
- Processing tasks differ
- Energy varies node-to-node

Sensor Net Sub-Project:
- Many sensor motes
- 6-month football season
- Supports many applications

INSIDE A NODE

MSP-430, CC-2520, BATTERIES
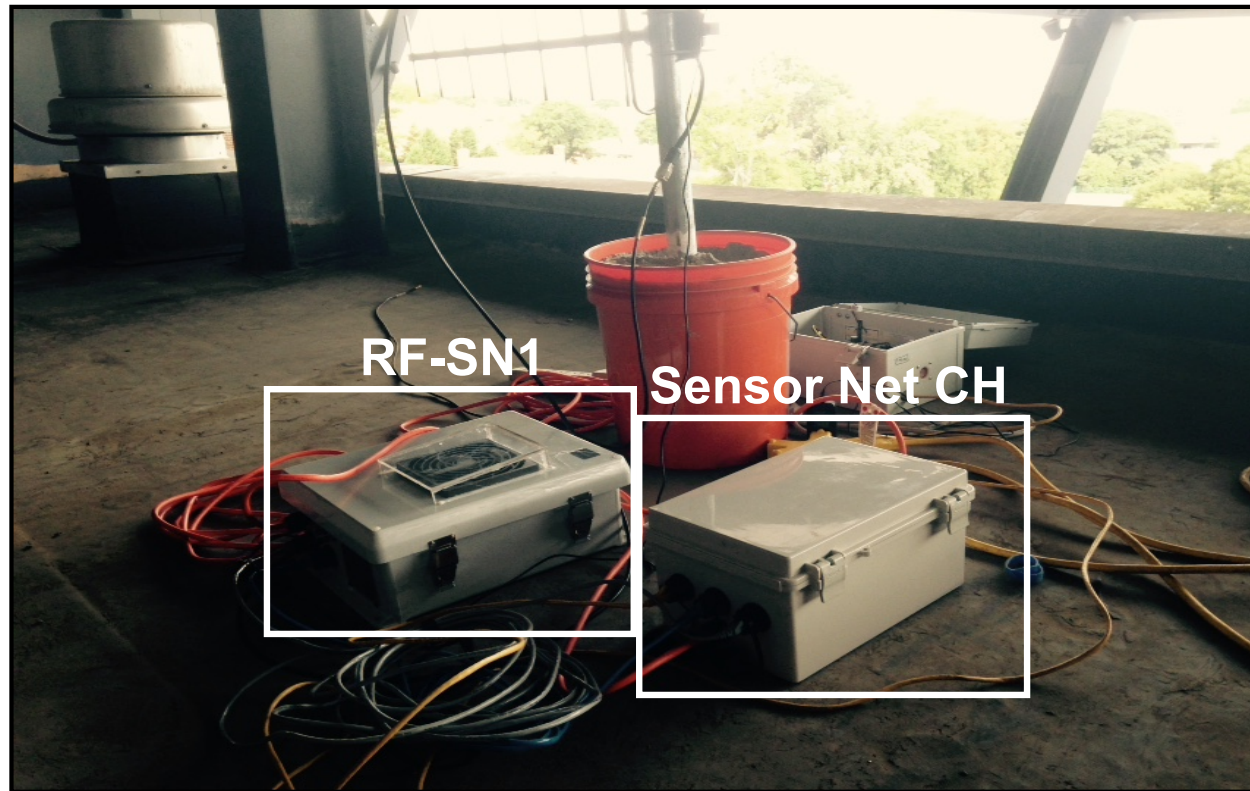
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Stadium-IoPT: Sensor Net Subproject

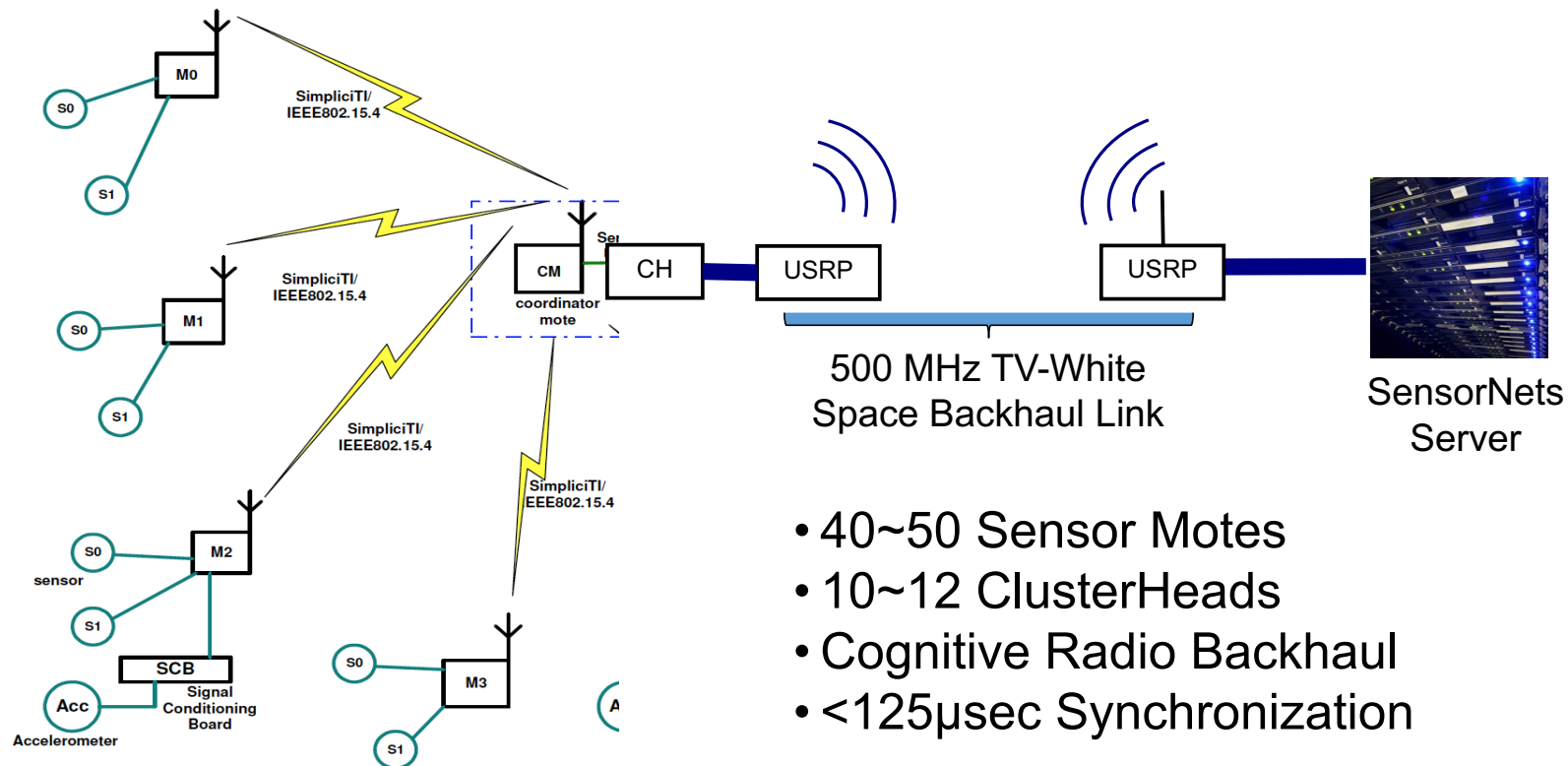# Stadium-IoPT: Sensor Net Subproject

Stadium-IoPT: Sensor Net Subproject

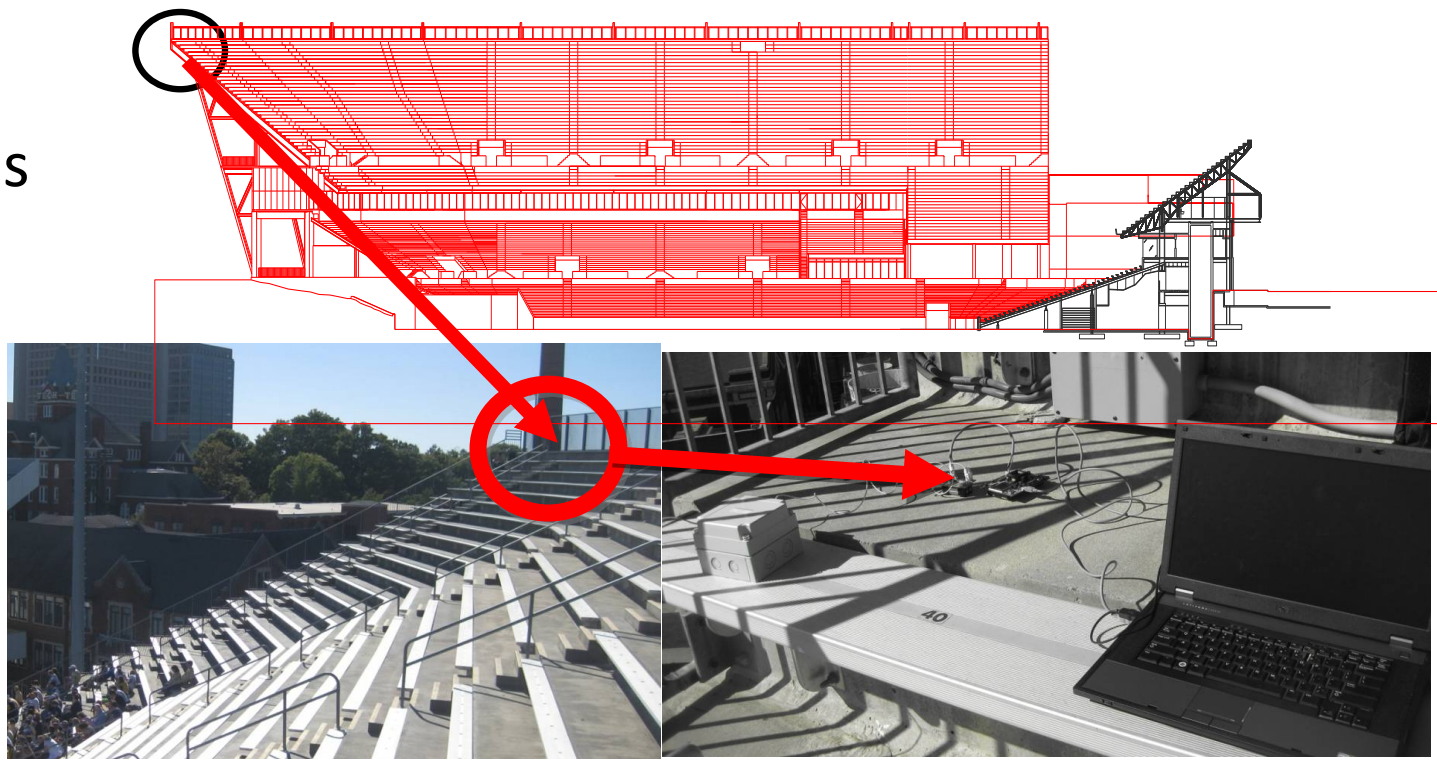# Stadium-IoPT: Sensor Net Subproject

- 40~50 Sensor Motes
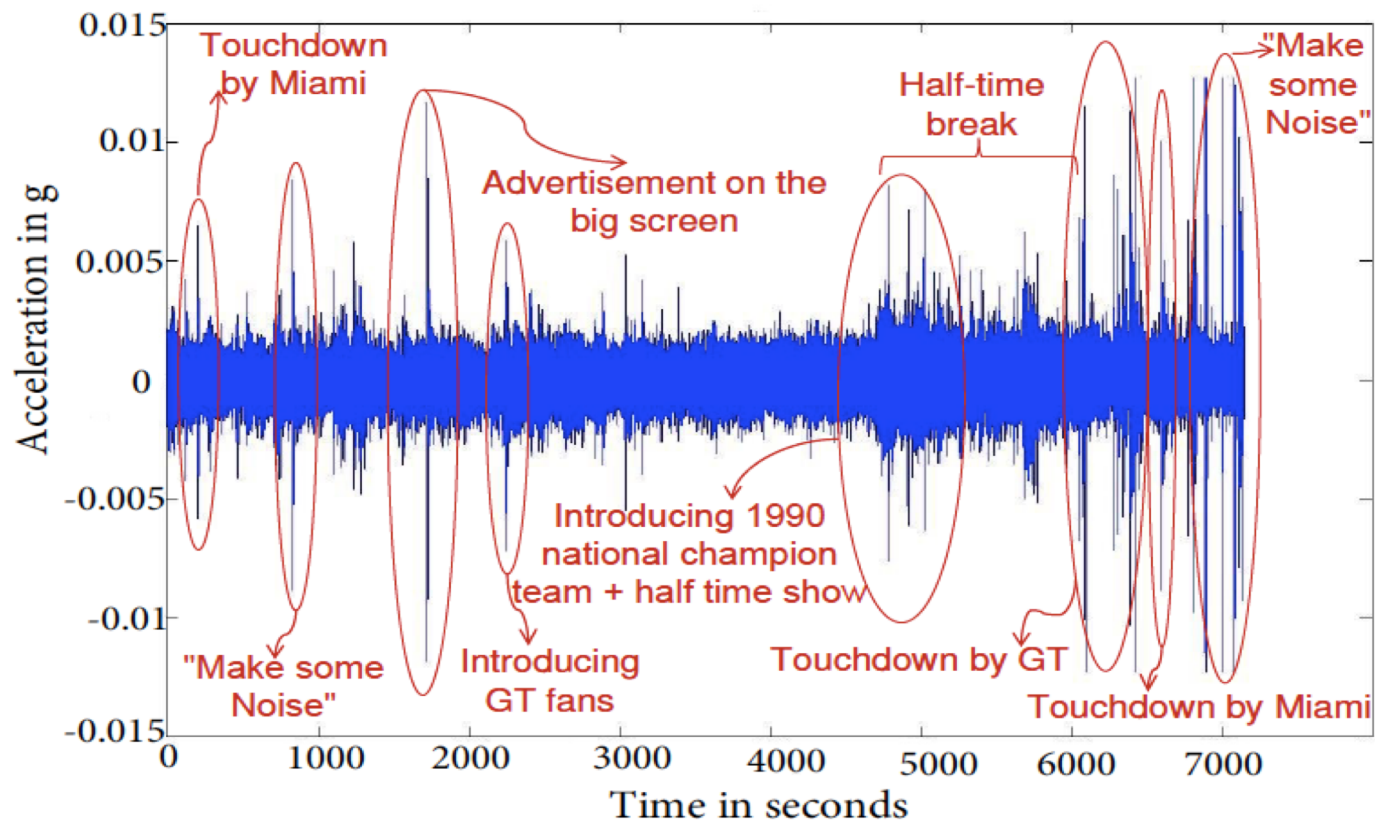- 10~12 ClusterHeads
- Cognitive Radio Backhaul
- <125µsec Synchronization

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Stadium-IoPT: Sensor Net Subproject

Sensing
Vibrations

Stadium-IoPT: Game Vibrations

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Georgia Tech VIP Teams: Fall 2017

- 58 Teams in Spring 2018; 900 Undergraduates Enrolled

- Students and Faculty from Every GT College: Architecture, Business, Computing, Engineering, Liberal Arts, and Science

- List of GT VIP teams. Click on any team's icon to see a one-page description of that team and the list disciplines from which that team is seeking students:

  http://www.vip.gatech.edu/teams

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VIP@GT Enrollment: 2009-2018
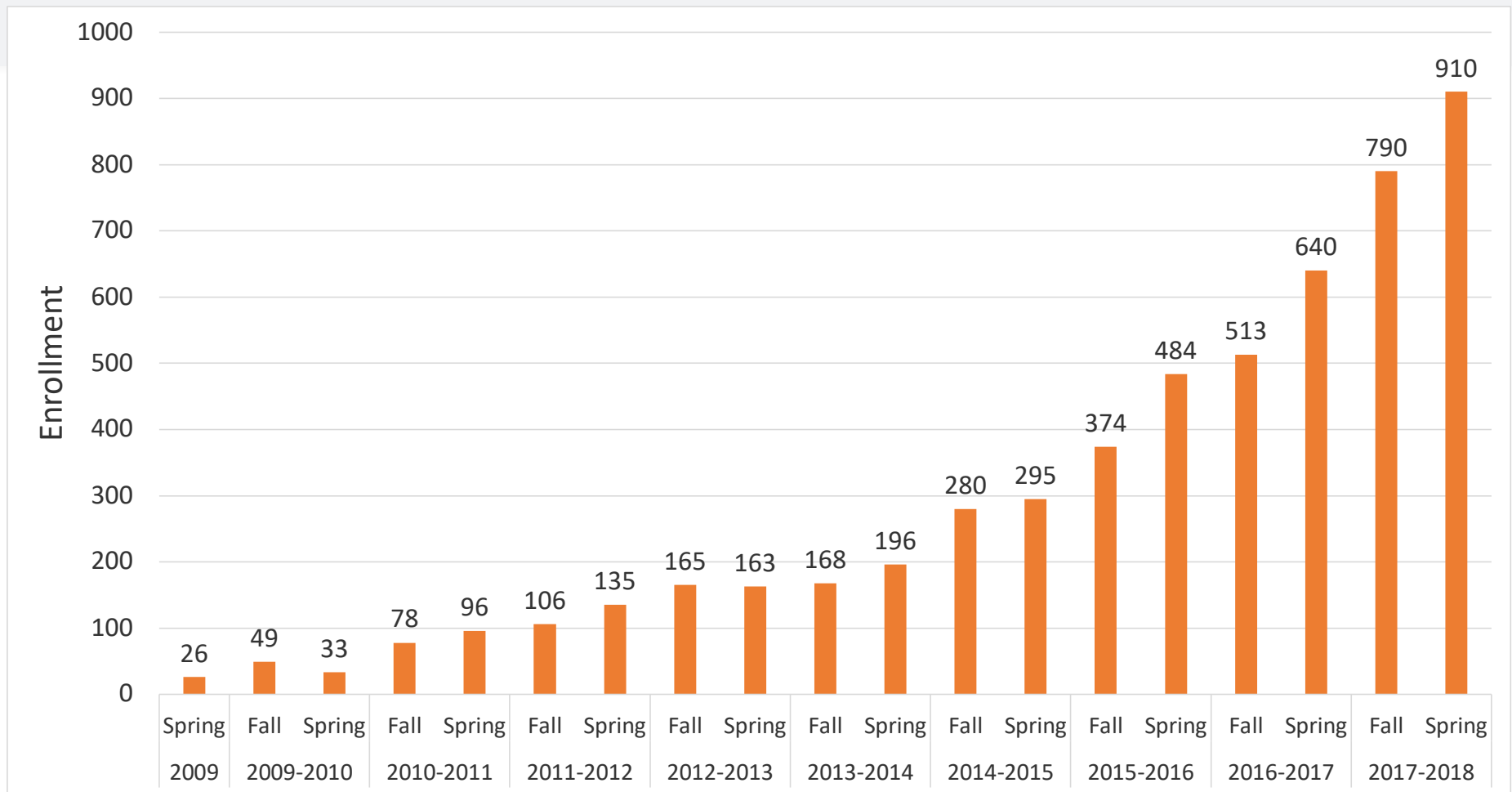
VIP@GT Enrollment Spr '18: By Team and Major
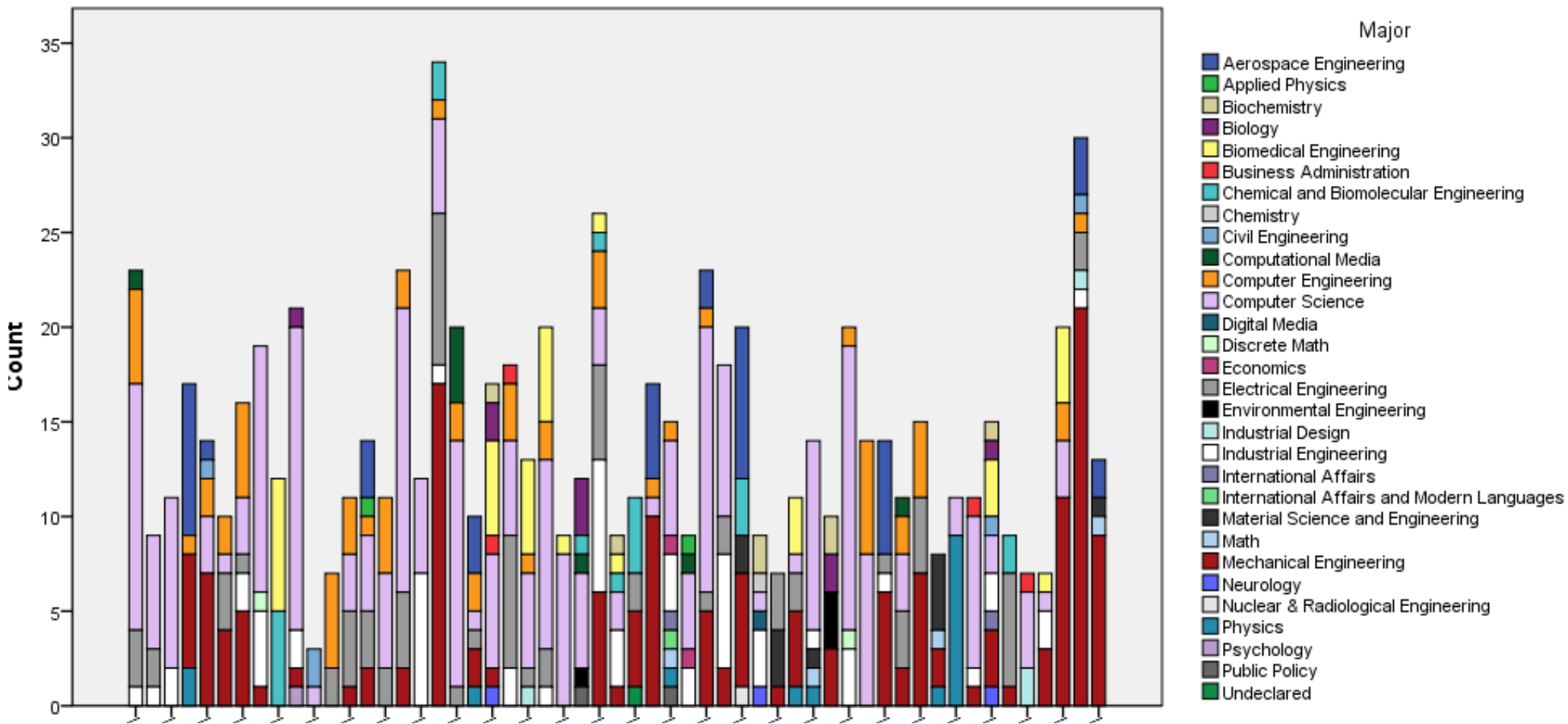
Cross-Campus Collaboration, GT

1/3 of VIP teams draw instructors from more than one GT Unit.

VIP Team

Academic Resilience
Agile Communication Architectures
AquaBots
Augmented Reality Experiences
Bee-Snap
ChemFlow
Chip Scale Power & Energy
Civic Data and Design
Data-Driven Education
EcoCAR
Engineering for Social Innovation
Engineering Smart Cities
Hands-on Learning
Humor Genome
Intelligent Transportation Systems
IP Crowd
Smart City Infrastructure
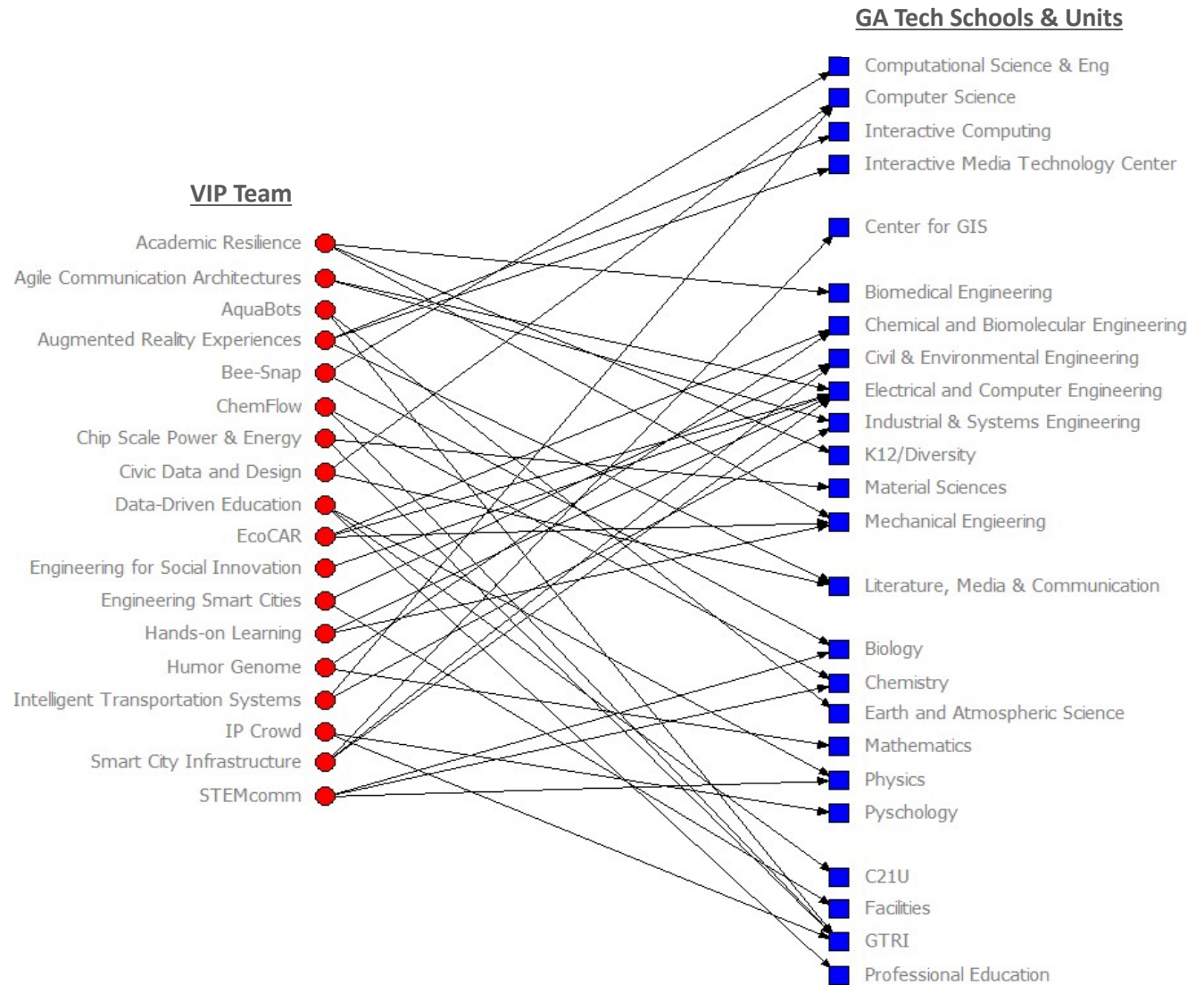STEMcomm

GA Tech Schools & Units

Computational Science & Eng
Computer Science
Interactive Computing
Interactive Media Technology Center
Center for GIS
Biomedical Engineering
Chemical and Biomolecular Engineering
Civil & Environmental Engineering
Electrical and Computer Engineering
Industrial & Systems Engineering
K12/Diversity
Material Sciences
Mechanical Engieering
Literature, Media & Communication
Biology
Chemistry
Earth and Atmospheric Science
Mathematics
Physics
Pyschology
C21U
Facilities
GTRI
Professional Education

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VIP@GT Team Composition: By Academic Rank

UG Enrollment by
Academic Rank,
Spring 2018
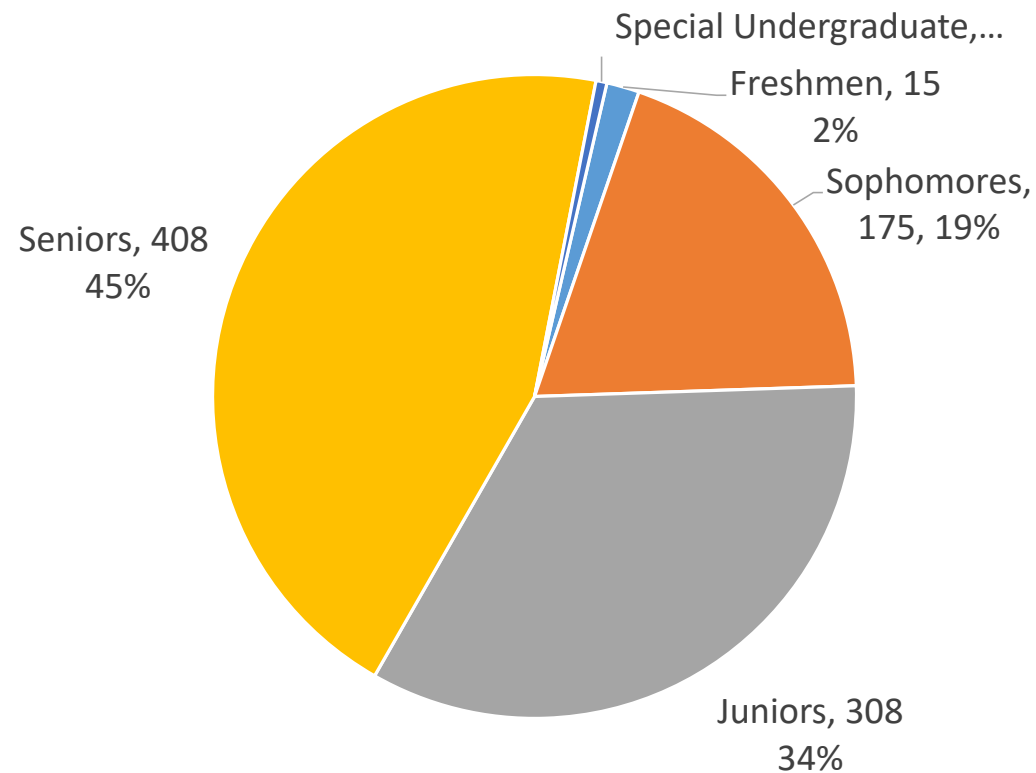
VIP Teams: Disciplines of Advisers/Co-Advisers

VIP@GT Enrollment: By Major, Spring 2018
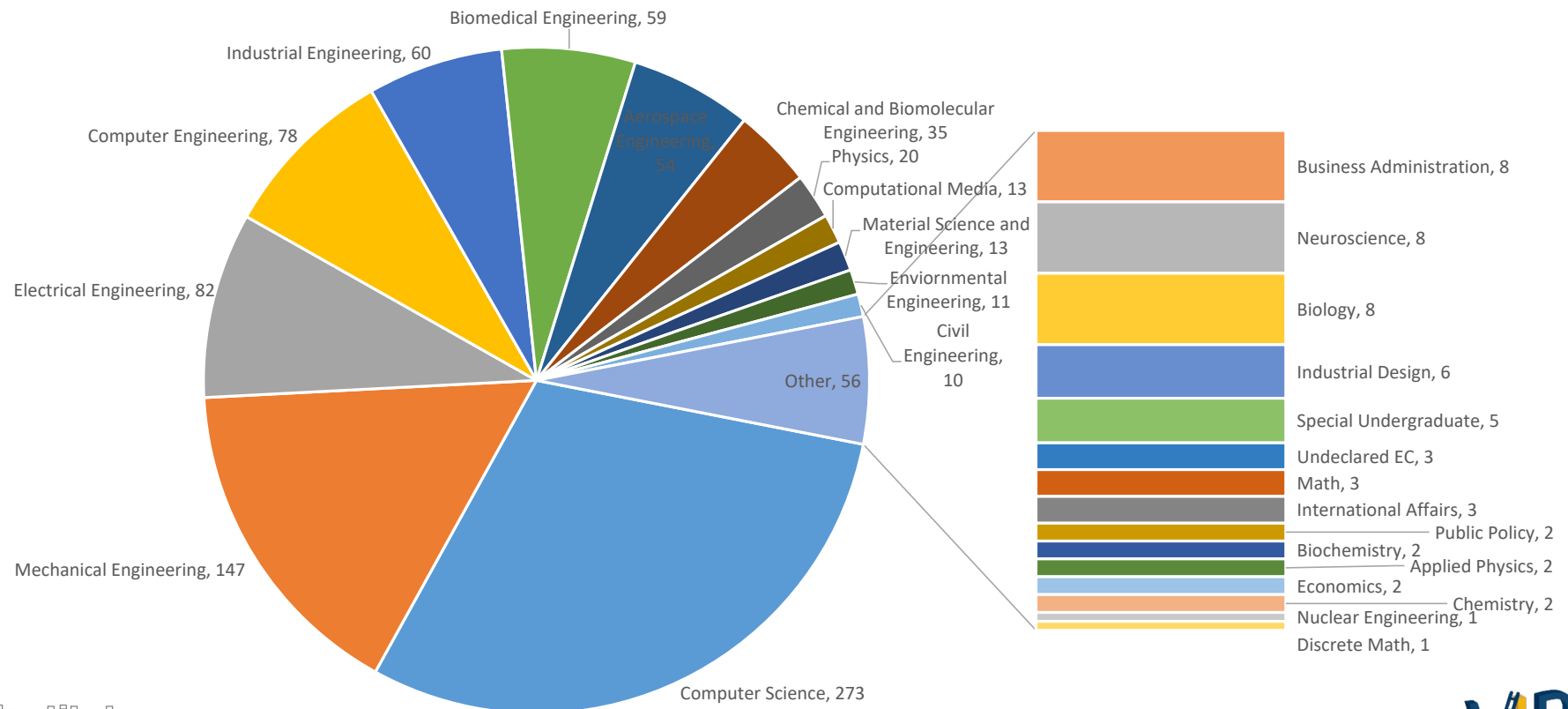
VIP@GT Course Structure: Campus-wide Courses

	1 credit	2 credits	3 credits	For pay (0 credits)
Sophomore	VIP 2601			
Junior	VIP 3601	VIP 3602	VIP 3603 by dept. request	VIP 3600
Senior	VIP 4601	VIP 4602	VIP 4603 by dept. request VIP 4813 capstone	VIP 4600
Graduate			VIP 6603	VIP 6600

- Each course can be taken multiple times
- Each *team* is one section of *every* course
- No Auditors, Volunteers, or P/F Students
- Available to all Disciplines

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How VIP@GT Credits Count: ECE/BME Example

Provide Incentive to Participate Multiple Years

- Take 5 or fewer credits:
  - All are Approved-Elective (Free-Elective) Credits
- Take 6+ credits:
  - 3 to 6 Become Technical Elective Credits
  - Rest are Approved-Elective (Free-Elective) Credits
- VIP + VIP Senior Capstone: 8+ Credits
  - 3+ Credits as a Junior
  - 2 Credits (4811) 1st-Semester Senior Year
  - 3 Credits of VIP Senior Design (4813)

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Faculty Credit Options (Current Curriculum):

No Course Release for Adviser(s)
- Works in Depts with Low Teaching "Loads"
- Faculty will do VIP because it helps their research

One Course/Year *every year* for Primary VIP Adviser
- ½ Course/Semester matches actual time commitment
- 24+ distinct students/year for each year team operates
- Works if VIP counts as dept elective(s)/capstone

One Course/Year for *first 2 Years* for Primary VIP Adviser
- Gives credit when educating team falls on adviser
- Team is providing research benefits by year 2
- Allows dept to launch a specified # of new teams each year

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Access and Diversity for VIP@GT

- <u>Credit bearing + counts toward degrees</u>:
  Enables *all* students to participate

- <u>Joining teams</u>:
  No interviews, GPA requirements, or Prerequisites

- <u>Unique among High-Impact programs</u>:
  %URMs in VIP = % in overall student population.

- <u>High Participation amongst Transfer Students</u>

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Assessment: Many Aspects

Ongoing Study of Learning Outcomes and Impacts on Faculty, Depts, and Institutions

- Eval. Teams at Boise State, Georgia Tech, Univ. of Michigan

Exit Surveys: 233 VIP Students; 1781 non-VIP Students:

- Ability to work in a multidisciplinary team ($t(1982) = 4.437$, $p < 0.001$, $d = 0.313$);
- Ability to work with individuals from diverse backgrounds ($t(1987) = 3.271$, $p = 0.001$, $d = 0.231$);
- Understanding of technology applications relevant to your field of study ($t(2002) = 3.19$, $p = 0.001$, $d = 0.224$);

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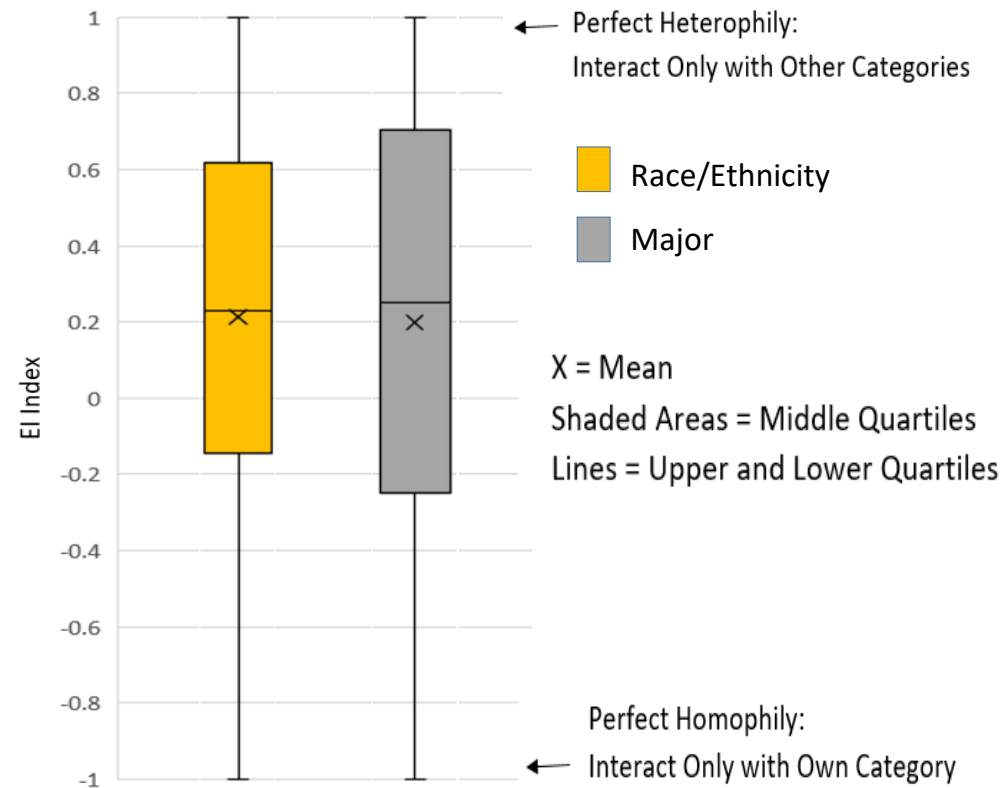Vertically Integrated Projects Program

VIP

Assessment: Peer-Eval. Based Social Network Study

On average, students
interacted more often with:
- Other races/ethnicities
- Other majors

At team level:
- Greatest clumping by major (6 of 24 teams)
- Clumping by race/ethnicity on one team
  - New faculty workshops

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Assessment: Continued

Social Network Analysis of VIP Teams:

- Peer Evaluation Tool Used for Grading Twice a Semester
- Students Indicate Who/How-Often They work with Each Peer
- Linked with VIP Database of Students + Registrar's Database
- Enables Monitoring of Teams Health
- Helps Identify Best Practices in Team Management for Advisers
- EI Index Computed for Populations of Interest

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VIP: Benefits for Students

- Realistic Team Experience
- Opportunity to Learn/Master different Roles/Skills
- In-Depth Experience in their Field
- Long-term Multi-Disciplinary Experience
- Knowledge Exchange across many Boundaries
- Provide a Compelling Reason to be on Campus
- Preparation for Work / Grad School
- Understanding of the Innovation Process

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VIP: Benefits for Faculty

- Better Organized, More Effective UG Research
- Continuity of Knowledge and Experience on Team
- Enthusiastic Minds and Hands
- Beneficial Education & Broader Impact for Grants
- Recruiting for Graduate School
- Adds New Dimension to Research Capability
- Peer Leadership and Management Reduces Workload

VIP: Benefits for Universities

- Enhances Student Learning
- Enhances Faculty Research
- Enables New Partnerships
- Creates Multidisciplinary Opportunities
- Compelling Reason to have a Campus
- Everyone Participates in Innovation
- Deepens/Broadens the University Community

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The VIP Consortium: 28 Members So Far.....

Domestic
- Arizona State University
- Boise State University
- Colorado State University
- Drexel University
- Florida International University [URM]
- **Georgia Tech**[AAU,1]
- Howard University [URM]
- **Morehouse College**[URM]
- New York University[AAU]
- Purdue University[1]
- Rice University[AAU]
- Texas A&M University [URM, 1]
- UC Davis[URM, AAU]
- University of Delaware

- **University of Georgia**
- University of Hawaii[URM]
- University of Michigan[AAU, 1]
- University of Washington[AAU]
- VA Commonwealth University
- Virginia Tech

International
- Natn'l Dong Hwa University
- Natn'l Ilan University
- Universidad del Norte
- Riga Technical University
- Inha Univ.
- Malmö University
- University of Pretoria
- University of Strathclyde [1]

Pending
- **Georgia State University**
- Iowa State[AAU]
- NCA&T[URM]
- Notre Dame
- Reykjavik University
- Tuskegee University [URM]
- UC Riverside

AAU: Member Institution

URM: Underrepresented Minority Institution

1: Program in place prior to Consortium establishment

Bold: Georgia Institutions

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The VIP Consortium: Annual Meeting

The VIP Program: Essential Characteristics

- VIP Program Led by Faculty
- Projects embedded in Professors' Research Efforts
- Large-Scale Projects Lasting Years/Decades
- Multidisciplinary Teams Possible/Encouraged
- Program is Curricular; <u>All</u> Students Graded
- Incentives for Students to Participate for 2+ Years
- Classroom and Meeting Space Supporting Teams
- Learning Outcomes Include Disciplinary *and* Professional Skills

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The VIP Consortium: Essential Characteristics

- All Institutions Have a Professor-Led VIP Program
- Program Must Have Essential Elements of VIP but Adapt as needed to Local Conditions
- Share Resources/Tools/Processes/etc.
- Everyone Contributes What They Can
- Participation in Evaluation and Dissemination
- Publish Papers and Write Proposals Together

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What could you do if you had a VIP team?

http://www.vip.gatech.edu

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6/7/18

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