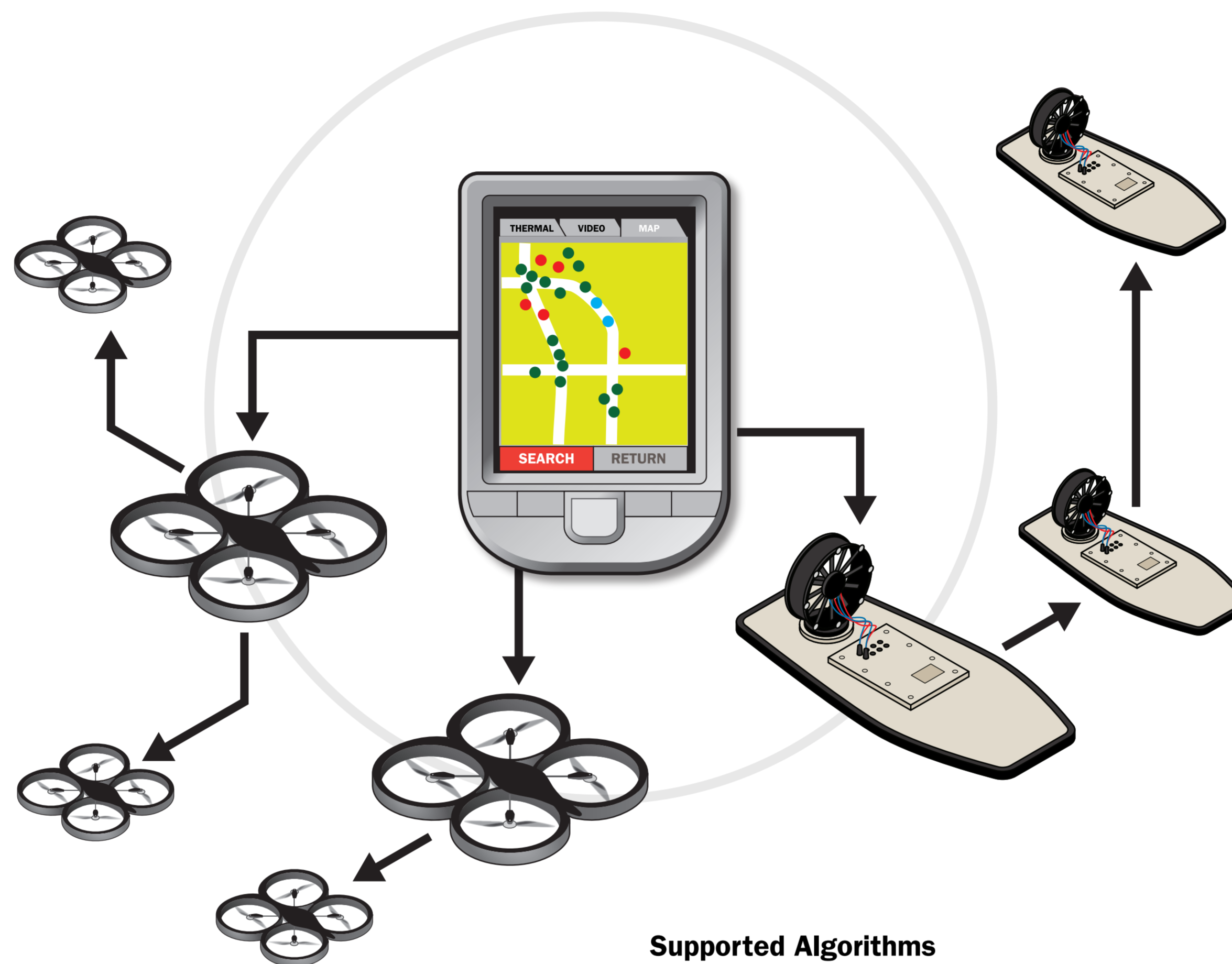


# Effecting Large-scale Adaptive Swarms through Intelligent Collaboration (ELASTIC)

The current control paradigm for unmanned systems is largely centralized and involves multiple pilots and analysts. ELASTIC seeks to invert the paradigm and provide scalable, quality-of-service-enabled distributed control from a central pilot interface. We provide these features through middleware and software tools for extensible distributed algorithms and robotic platforms.

## ELASTIC technologies provide key features for UAS developers and operators

- Knowledge and Reasoning
- Asynchronous Networking
- Extensible Distributed Algorithms
- Platform Abstractions
- Threading, Timing, and Control
- Open Sourced, Well-Documented Code
  - Multi-Agent Distributed Adaptive Resource Allocation (MADARA) for the distributed OS layer: <http://madara.sourceforge.net/>
  - Group Autonomy for Mobile Systems (GAMS) for the algorithms and robotics platforms: <http://jredmondson.github.io/gams/>



## ELASTIC project members made changes to MADARA and GAMS to provide significant enhancements to quality-of-service, timing, control, abstraction and scalability of swarm management

- Controllable threaded algorithm execution
- Auxiliary algorithms
- Containers for knowledge abstraction of algorithm and platform attributes and status
- High Performance Filters for Network Events
- Interoperability bindings between Java and C++ algorithms and platforms
- New formation algorithms
- New platforms for Platypus™ LLC boats, ROS Pioneer 3DX
- Scalable to dozens and hundreds of autonomous agents

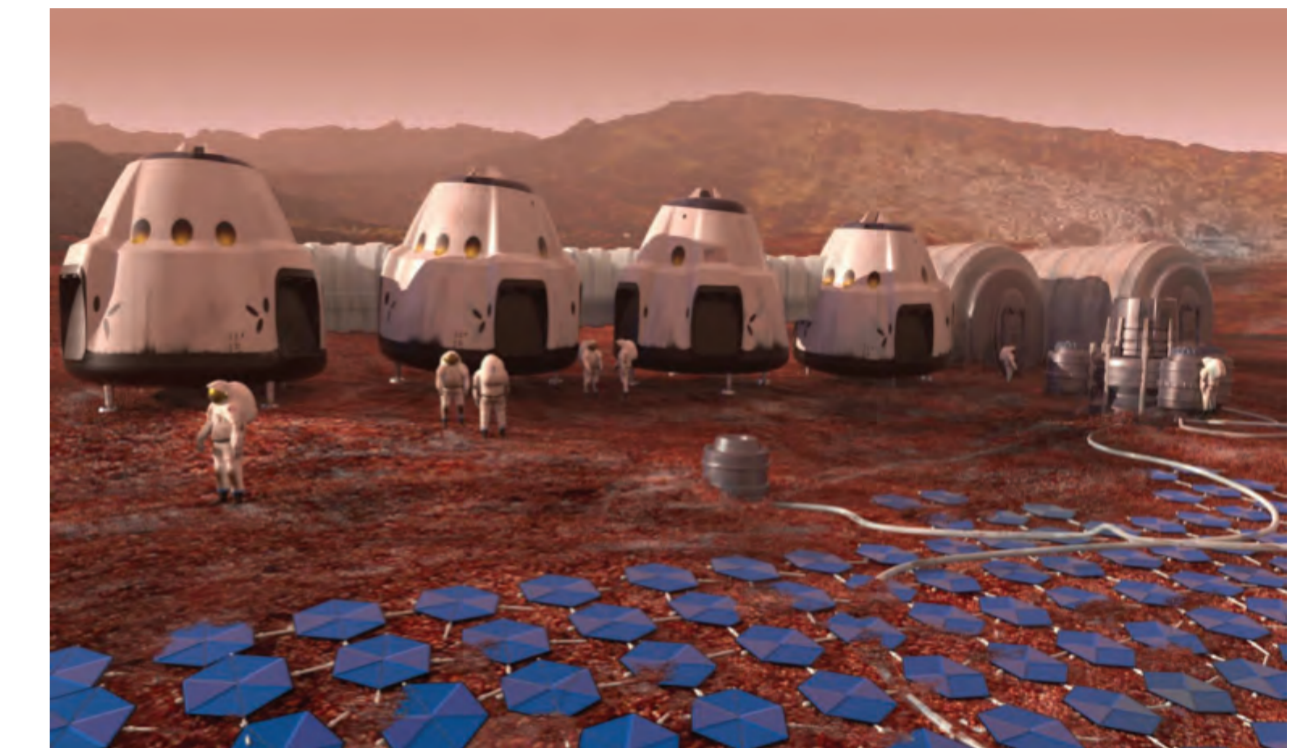
## Supported Algorithms

- Formation Coverage
- Prioritized Region Coverage
- Minimum Time Coverage
- Serpentine Coverage
- Waypoints
- Formation Follow
- Synchronized Formations

## Supported Platforms

- VREP Boat
- VREP Quadcopter
- VREP Ant Robot
- ROS Pioneer 3DX
- Platypus LLC Lutra Boat
- C++, Java, Android, Python
- ARM, Intel

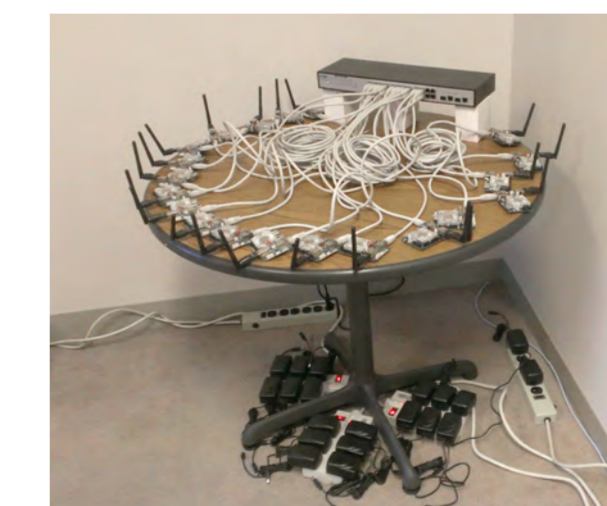
Keck Institute for Space Studies proposal for Multi-Planetary Smart Tiles features ELASTIC middlewares for autonomous robotic tile collaboration.



Chuck Carter/Keck Institute for Space Studies

## ELASTIC results are now used in various projects inside and outside of SEI

- Main code generation target of the DART FY 2015-2016 SEI Line Project
- Autonomy framework proposed for use in the Caltech Keck Institute for Space Studies Multi-Planetary Smart Tile project
- Platypus LLC now uses GAMS and MADARA in their deployed boats for customers in Europe, North America, the Middle East, and South America



20 Node ODR0ID Cluster for GAMS and MADARA testing for use by SEI DART and MADPARTS FY2016 projects



Platypus LLC Boats deployed in Qatar

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