# Contract Information


www.spacemicro.com

TOPIC: N06-132 SBIR Phase II
TITLE: Improved approach to non destructive evaluation (NDE) in Aluminum Structures in Marine Environments
Contract: N00024-09-C-4104
NAVSEA Carderock

Contacts:

Carl S. Edwards
858-332-0704
cedwards@spacemicro.com

# Agenda

- One slide intro to Space Micro
- Project Quad Chart
- Project Gantt Chart
- What this is:
- Current development status
- Go Forward Plan
- What does the customer want?
- Who are the customers?

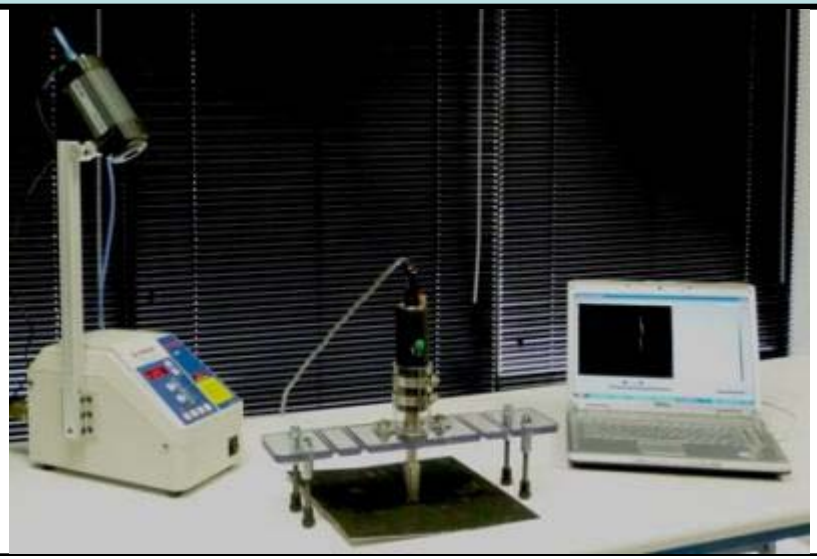
# Space Micro Inc. Corporate Overview

- Founded in 2002
- San Diego based-privately held
- 14,000 sq ft facility (secret)
- 36 employee-owners
- Fast growth - > $6M revenue
- 50% of revenue is from non - SBIR business and products
- Core skill sets for Navy applications
  - Advanced Material Solutions
    - Inspection equipment
    - Coatings
- ISO 9001-2000 Quality program certification

# Improved approach to NDE in Aluminum Structures in Marine Environments

**SBIR Topic Number: N06-132** **Current PoP Ends: 12/23/10**

## CONCEPT



**OBJECTIVE:** Develop a fast, portable and easy-to-use capability for detecting and quantifying defects in marine aluminum structures.

## DESCRIPTION/REQUIREMENT

**Requirement/CAPABILITY GAP:** The current trend to employ aluminum in ship construction requires effective maintenance to mitigate through identifications and repair of corrosion and cracks while in service. Navy ship diagnoses and repair rates will be improved through the rapid location and quantification of defects as they apply to the DDG 1000 and other programs.

**DELIVERABLE:** In the current phase, develop and characterize our technology to show in works on emulation structures. In Option Phases, develop a working prototype for Navy evaluation and ultimate transition into the fleet, to support ship maintenance activity.

**TRANSITION(S):** Following Navy approval, transition this technology into the fleet. In addition to the DDG 1000, Dawnbreaker identified the LCS program, with funding through 2014.

## CONTACTS

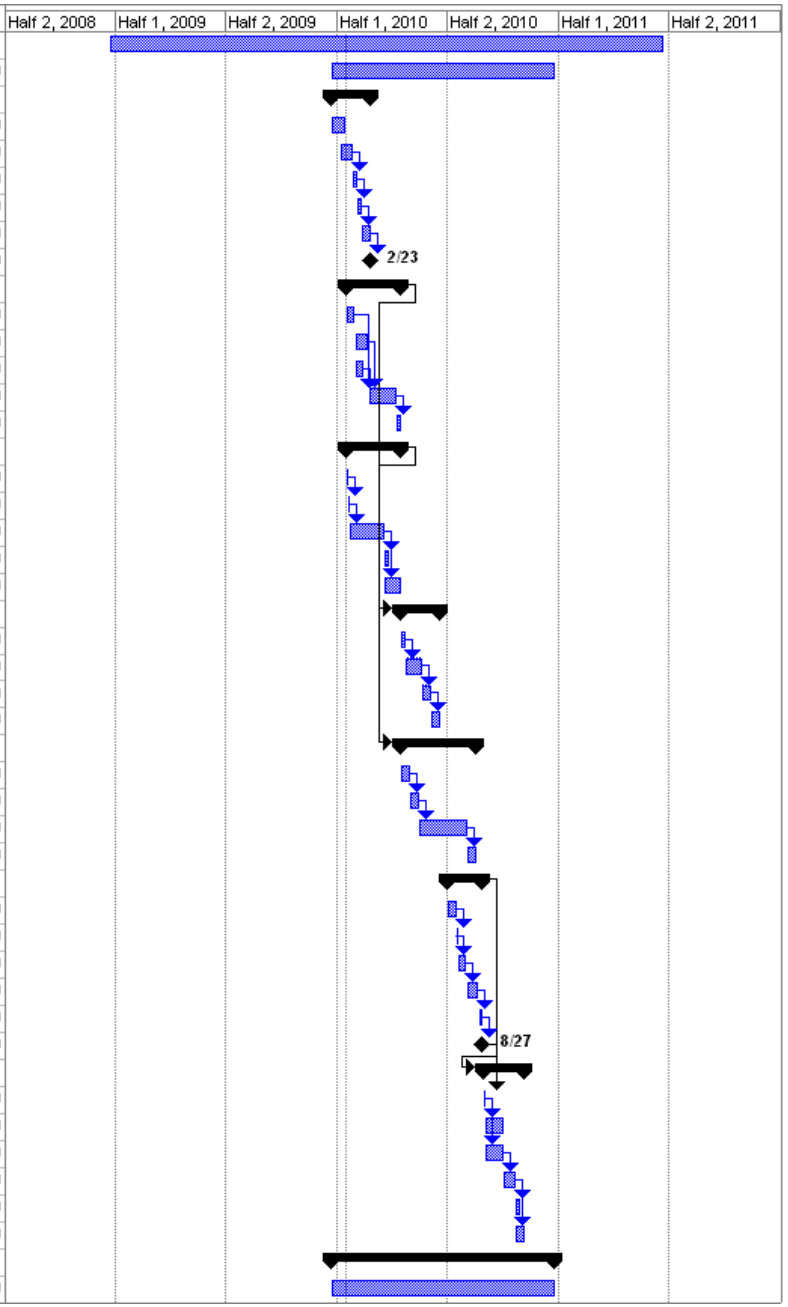
**Tech Sponsor: NAVSEA Carderock**
**POR/Path: DDG 1000/OEM**
**TPOC: Mr. Bruce Bandos**
**TPOC email: bruce.bandos@navy.mil**
**TWH: Dr. Kristen Lipetzky**
**Contractor: Space Micro Inc. Advanced Matls Div.**
**Contractor POC: Carl S. Edwards**
**Contractor email: cedwards@spacemicro.com**

## FUNDING SUMMARY ($K)

| | FY 08 | FY 09 | FY 10 | FY 11 | FY 12 | FY 13 |
|---|---|---|---|---|---|---|
| Phase I / Opt | 100 | | | | | |
| Phase II | | 150 | | | | |
| Phase II Opt 1 | | | 300 | | | |
| Phase II Opt 2 | | | | | | |
| CPP + Funding | | | | | | |
| Phase III | | | | | | |
| TOTAL | 100 | 150 | 300 | | | |

# SMI Phase II Option: Project Gantt Chart

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **NDE_AL_PHASE II PROGRAM** | 650 days | Tue 12/23/08 | Mon 6/20/11 |
| 2 | **Ph II A Prototype Development (Revised)** | 262 days | Wed 12/23/09 | Thu 12/23/10 |
| 3 | **Hardware Proto Development** | **45 days** | **Wed 12/23/09** | **Tue 2/23/10** |
| 4 | Acquire IR Camera | 15 days | Wed 12/23/09 | Tue 1/12/10 |
| 5 | Acquire high power U/S system | 15 days | Tue 1/5/10 | Mon 1/25/10 |
| 6 | DOE evaluation | 6 days | Tue 1/26/10 | Tue 2/2/10 |
| 7 | Est. real time imaging | 5 days | Wed 2/3/10 | Tue 2/9/10 |
| 8 | Schedule early Demo | 10 days | Wed 2/10/10 | Tue 2/23/10 |
| 9 | Early Demo | 0 days | Tue 2/23/10 | Tue 2/23/10 |
| 10 | **Mech. System Development** | **65 days** | **Fri 1/15/10** | **Thu 4/15/10** |
| 11 | Design self level holder | 10 days | Fri 1/15/10 | Thu 1/28/10 |
| 12 | Design camera connection | 15 days | Mon 2/1/10 | Fri 2/19/10 |
| 13 | Est presure required for signal | 10 days | Mon 2/1/10 | Fri 2/12/10 |
| 14 | Devise holding fixture | 34 days | Mon 2/22/10 | Thu 4/8/10 |
| 15 | Publish results | 5 days | Fri 4/9/10 | Thu 4/15/10 |
| 16 | **Image System Development** | **65 days** | **Fri 1/15/10** | **Thu 4/15/10** |
| 17 | Acquire Imaging Software (A003) | 2 days | Fri 1/15/10 | Mon 1/18/10 |
| 18 | Real time signal | 3 days | Tue 1/19/10 | Thu 1/21/10 |
| 19 | Algorithm development | 40 days | Fri 1/22/10 | Thu 3/18/10 |
| 20 | Dev. Baseline ops procedure | 6 days | Fri 3/19/10 | Fri 3/26/10 |
| 21 | Dev. Image library with Hardware | 20 days | Fri 3/19/10 | Thu 4/15/10 |
| 22 | **Proto system Development** | **45 days** | **Fri 4/16/10** | **Thu 6/17/10** |
| 23 | Prelim. Design disclosure | 5 days | Fri 4/16/10 | Thu 4/22/10 |
| 24 | Component Ops and Integration | 20 days | Fri 4/23/10 | Thu 5/20/10 |
| 25 | System theory of operation | 10 days | Fri 5/21/10 | Thu 6/3/10 |
| 26 | Prototype Drawing | 10 days | Fri 6/4/10 | Thu 6/17/10 |
| 27 | **Team with SURVICE Engineering** | **87 days** | **Fri 4/16/10** | **Mon 8/16/10** |
| 28 | Share component data | 10 days | Fri 4/16/10 | Thu 4/29/10 |
| 29 | Identify integration tasks | 10 days | Fri 4/30/10 | Thu 5/13/10 |
| 30 | Implement roadmap for auto/SA | 57 days | Fri 5/14/10 | Mon 8/2/10 |
| 31 | Publish results | 10 days | Tue 8/3/10 | Mon 8/16/10 |
| 32 | **Field Test Prototype/ Ops data base** | **42 days** | **Thu 7/1/10** | **Fri 8/27/10** |
| 33 | In house testing and evaluation | 10 days | Thu 7/1/10 | Wed 7/14/10 |
| 34 | Notice of Test Scheduling (A008) | 2 days | Thu 7/15/10 | Fri 7/16/10 |
| 35 | Dev. R & D Test & Accept plan (A009) | 10 days | Mon 7/19/10 | Fri 7/30/10 |
| 36 | Beta Test | 15 days | Mon 8/2/10 | Fri 8/20/10 |
| 37 | Acceptance Test Reports (A010) | 5 days | Mon 8/23/10 | Fri 8/27/10 |
| 38 | Demo and Brief out | 0 days | Fri 8/27/10 | Fri 8/27/10 |
| 39 | **Manuals and Equipment Lists** | **48 days** | **Mon 8/30/10** | **Wed 11/3/10** |
| 40 | Design Review | 3 days | Mon 8/30/10 | Wed 9/1/10 |
| 41 | Product Drwgs and Lists (A011) | 20 days | Thu 9/2/10 | Wed 9/29/10 |
| 42 | Prepare Operating Documentation | 20 days | Thu 9/2/10 | Wed 9/29/10 |
| 43 | Develop Trouble Shooting Guide | 15 days | Thu 9/30/10 | Wed 10/20/10 |
| 44 | Application Programs Report (A004) | 5 days | Thu 10/21/10 | Wed 10/27/10 |
| 45 | Produce data interpretation log | 10 days | Thu 10/21/10 | Wed 11/3/10 |
| 46 | **Project Management** | **262 days** | **Wed 12/23/09** | **Thu 12/23/10** |
| 47 | Monthly Progress Reports (A006 | 262 days | Wed 12/23/09 | Thu 12/23/10 |



# ANDE™: Schematic

What it is:

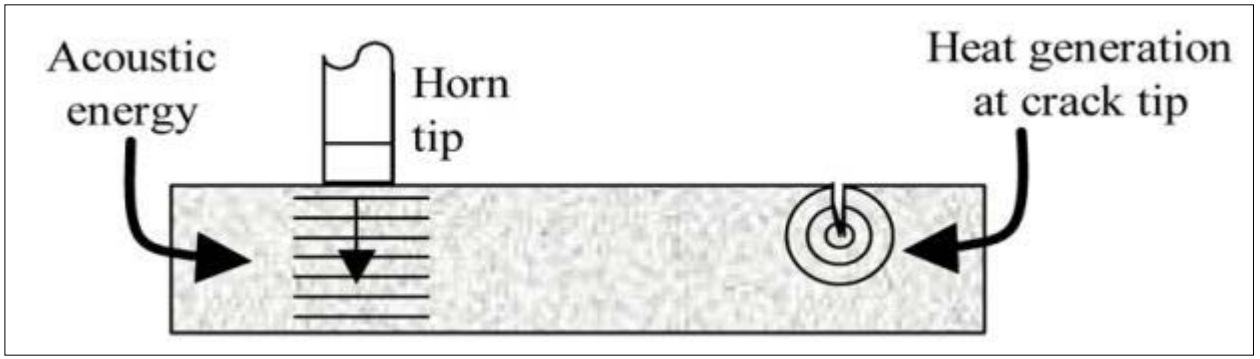



Illustration depicting the basic setup and response of crack-tip vibration. Note: Heat generation at the surface of the crack and is read from the adjacent outer surface using an IR camera.

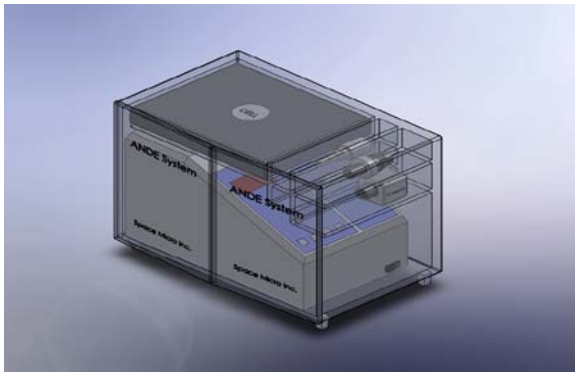
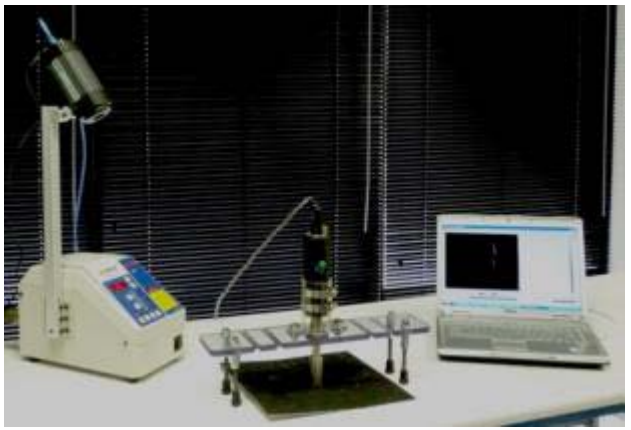
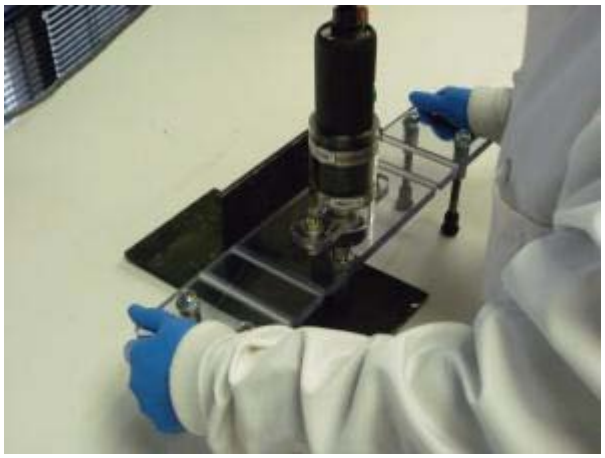
# Current Development Status

| Status | Item |
|---|---|
| C | Acquired FLIR A320 IR camera with 50mk sensitivity |
| C | Look at power and frequency as a function of signal strength; stay with 40KHz for now |
| C | Built and tested rev 1.0 horn holder |
| C | Characterize pressure to generate a signal |
| C | Lock components for Prototype |
| C | Completed and issued the PO to SURVICE Engineering |
| C | Started communication with the new Navy TPOC – Bruce Bandos |
| I | Early demo visit with Navy set for Apr 7/8 at the 2010 Weld Panel, with Lee Kvidahl |
| I | Develop a “one person” system |

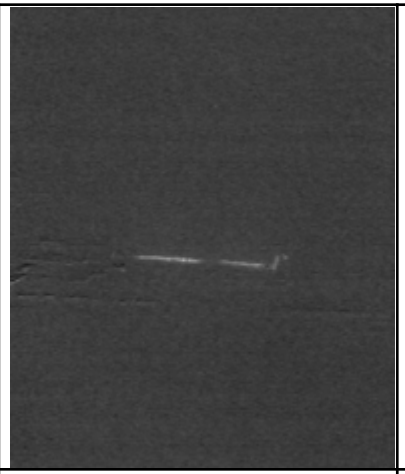
# Current Form Factor

| ANDE Prototype Parameters | | |
|---|---|---|
| | | |
| **Component** | **Weight (lbs)** | **Cost $** |
| US generator | 13.5 | 7000 |
| US Horn | 2 | |
| US Cabling | 2 | |
| Camera | 1.65 | 18000 |
| Camera PS | 0.5 | |
| Camera bar | 1.2 | |
| Horn holder | 2.5 | 150 |
| **Sys Wt./Cost** | **23.35** | **25150** |
| Pelican Case | 14 | 150 |
| Laptop | 3 | 500 |
| Tools/Vises | 3 | 50 |
| Ancillary Eq. | 20 | 700 |
| **Tot. Wt./Cost** | **43.35** | **25850** |

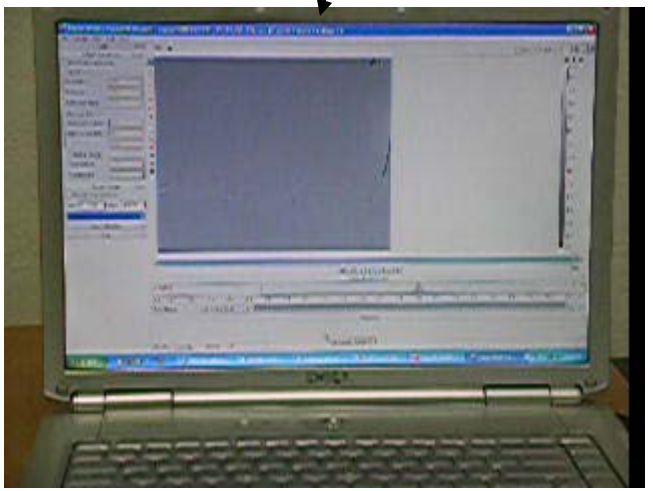
# ANDE™ Operation

| | | |
|---|---|---|
|  |  |  |
| The concept for Option Phase | Test Components – Phase I | Test Components – Phase II |
|  |  |  |
| Push horn to test part | Test the part | ANDE image |

# ANDE defect vs. photo

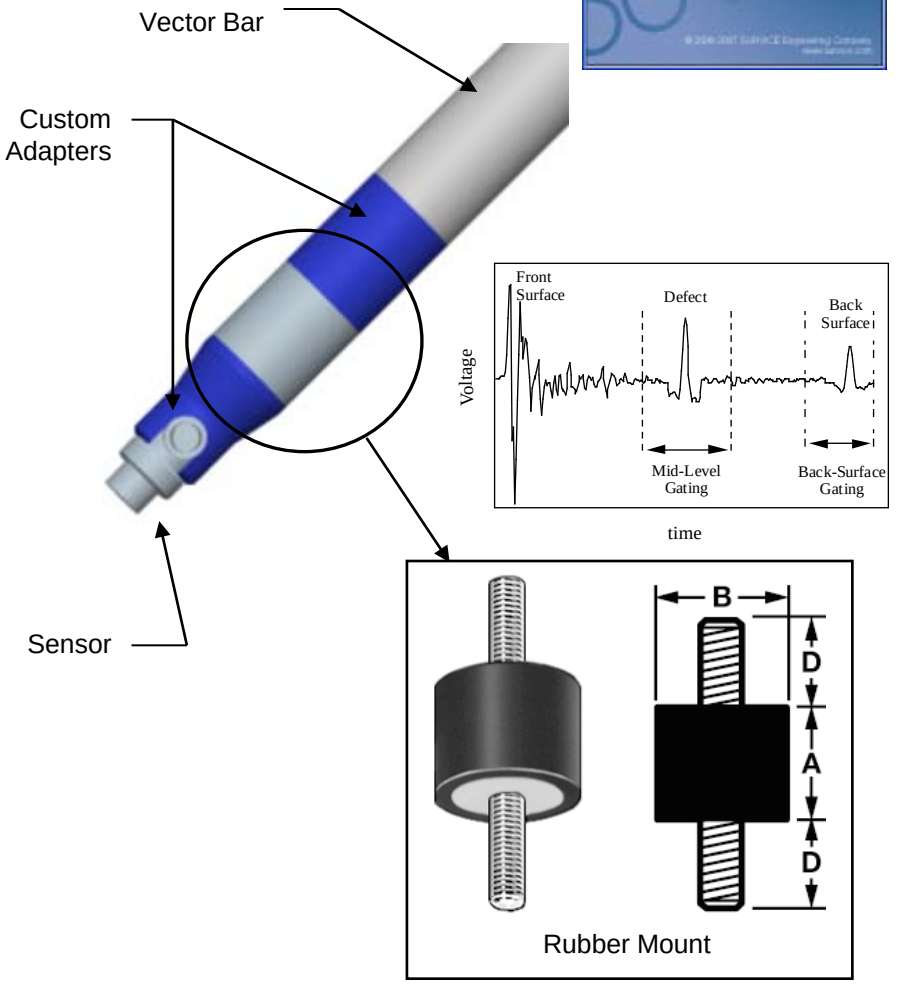
| | | | |
|---|---|---|---|
|  |  |  | |
| 1 Second | 2 Seconds | 3 Seconds | Video |

This shows the speed of the ANDE™ system. Image formation occurs in a second or so after the ultrasonic pulse, as shown in the time lapse images. The video shows the signal generation in real time.

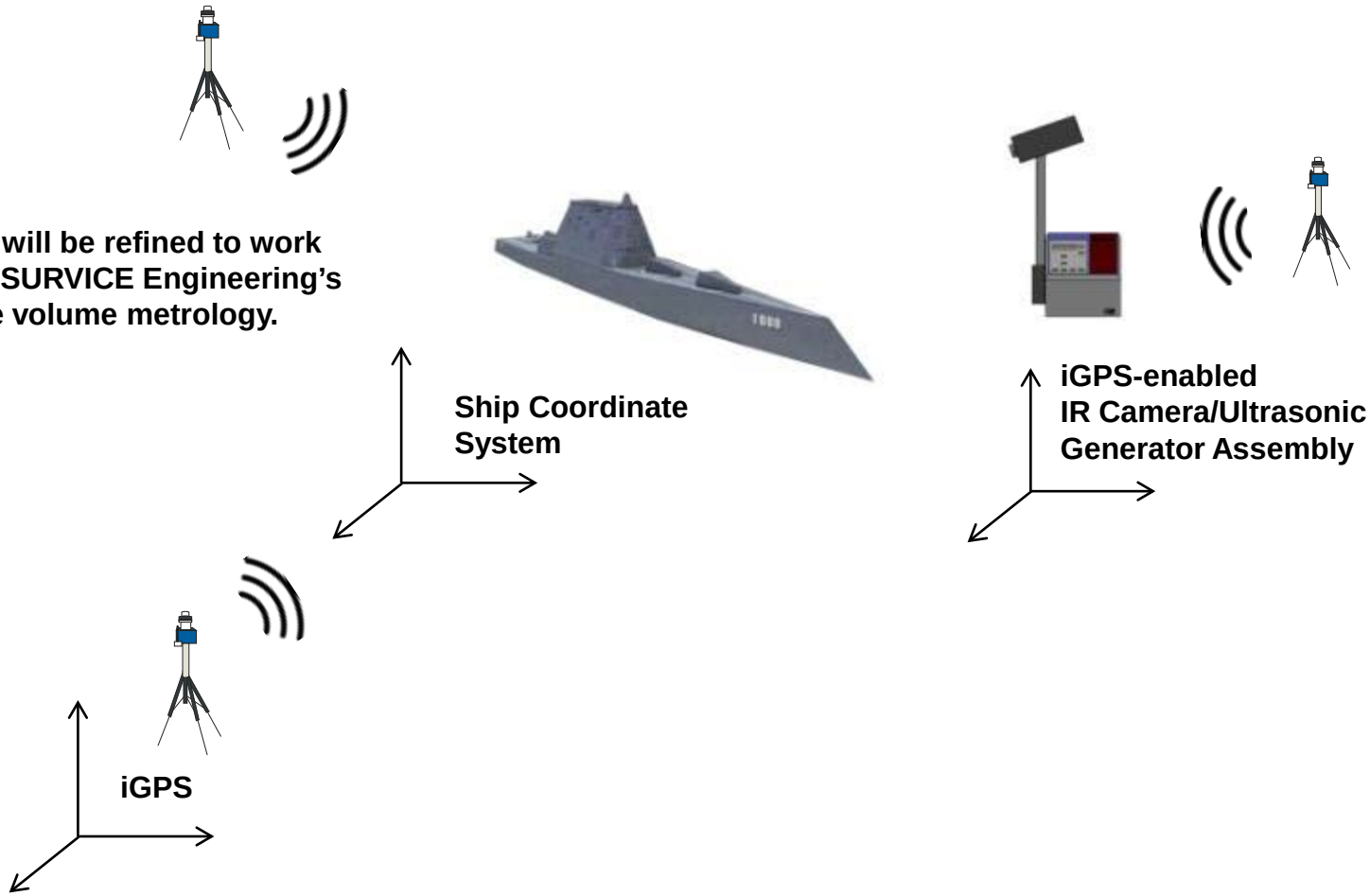


# Spatial Awareness

SURVICE Engineering is our partner on current work with NAVSEA and will enable automation and spatial awareness on this and future work.


# How our system will work on ships

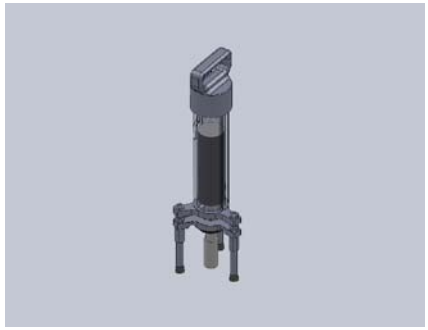


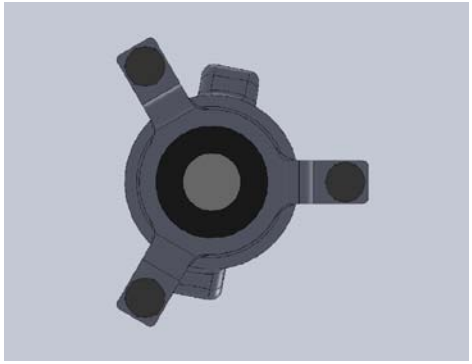
# Go forward plan

- Deliver fully functional prototype at the end of the Option phases
- “One Person” operability
  - Mechanical: Easy connectivity
  - Electronic: One button start
  - Mobility: Easy to position
  - Utilities: 120V source currently;  work around?
- Portable – Pelican case
- Integration
  - Component level – underway
  - Software interconnect to SURVICE System

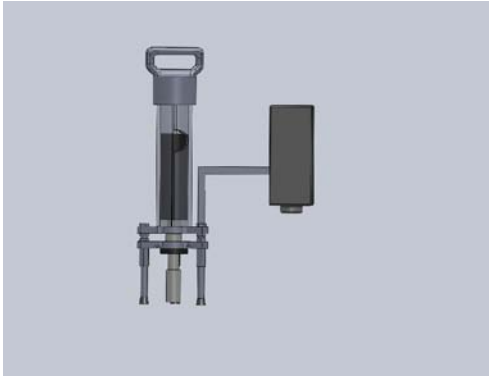
Non-Proprietary or Proprietary

# Next generation designs – notional





**Connect the camera to the horn: Some designs we are considering for the next generation.**



# Phase III Commercialization Strategy

## 1 Marcom, 2 Pursue bridge funding, 3 Sell the box

- Mitigate the “valley of death” for young technologies
- Find the market. Work with Dawnbreaker. Use the Navy Opportunity Forum to publicize externally. Publish an “Innovation Story”.
- Publicize on the Space Micro Inc. website.
- Bridge funding discussed in other slides. Find additional funding.
- SMI will “sell the box”, rather than license this technology out. Either providing  it as a subsystem in SURVICE’s automated system or as a stand alone for smaller applications.

Non-Proprietary or Proprietary

# Wrap Up

- Who are our customers (in this room)?
- What do the customers want?