# Joint Development of a Non-Magnetic Azimuth Sensor for Dismounted Targeting Operations in All Environments

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# Overview

- Problem with Current Azimuth Sensors for the Dismounted User
- Key Performance Parameters
- Joint Approach to Obtaining a Solution
- Azimuth & Vertical Angle Measurement (AVAM) Joint Working Group (JWG)
- Path to AVAM JWG Success
- Schedule of Joint Development Efforts
- Pros & Cons of Current Solutions

# The Task

- What Are We Trying to Do?
  - We are attempting to develop a High Accuracy, Non-Magnetic Azimuth & Vertical Angle Module
    - Joint, Long Term Goal: To Support Joint Effects Targeting System (JETS) with production in 2014
- Why?
  - **Magnetic anomalies, especially ON the User, are common** and result in potentially significant Target Location Error (TLE). Majority of cases, the **User is unaware of the interference**.
    - Current gear in the field causes azimuth errors of up to 150 mils!
  - GPS guided munitions require more accuracy than is available in current dismounted targeting sensors
    - Require <20m (T), <10m (O) according to Naval Surface Fire Support requirement

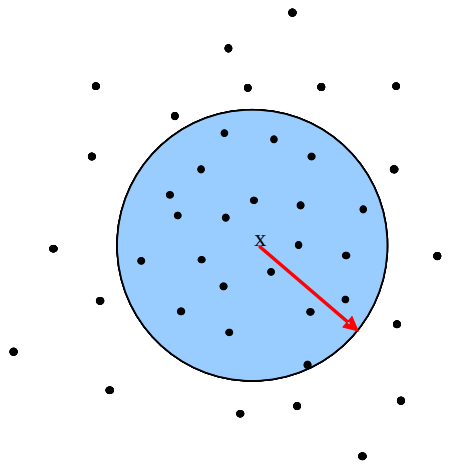
JDAM

Excalibur

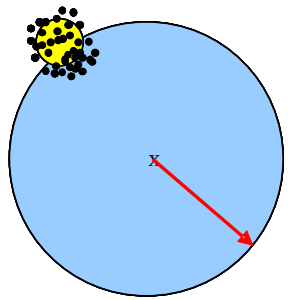
- **Users are unaware of magnetic anomalies caused by their gear which affect azimuth error by up to 150 mils**
- **Munitions have already been fielded requiring a solution within as short a timeframe as possible**

# Target Location Error Definition

***Target Location Error 50 (TLE50):*** *TLE50 is a measure of deviation from the actual location of a target and defined as the radius of a circle which is centered at the actual target coordinate in which 50% of the observations are contained.*



Old Targeting System
Old Weapon System



Old Targeting System
New Weapon System

Current technologies allow the User to very precisely miss targets.

# Key Performance Parameters

| Key Parameter | Near-Term<br>External / Tripod Mount<br>Threshold (T) | Long-Term<br>Internal / Fully Integrated<br>Objective (O) |
|---|---|---|
| *Azimuth Accuracy* | *±4 mils Probable Error (PE)* | *±1 mil PE* |
| *Vertical Angle Accuracy* | *±4 mils PE* | *±1 mil PE* |
| Orientation Range | Pitch: ±500 mils (~30°)<br>Bank: ±270 mils (~15°) | Pitch: ±1511 mils (~85°)<br>Bank: ±500 mils (~30°) |
| Slew Rate | 30° per second | 1000° per second |
| *Set up Time* | *< 180 seconds* | *< 1* second |
| Operational Temperature | -40°C - +70°C | -40°C - +70°C |
| Shock | 40g / 11 ms | 2000 g / 1.5 ms (weapon fire) |
| Vibration | MILSTD 810/ min integrity | MILSTD 810/ min integrity |
| *Volume* | *≤50 cu in* | *≤0.25 cu in* |
| *Weight* | *≤4.0 lbs (≤2.0 lbs preferred)* | *≤0.2 lbs* |
| *Power* | *≤10.0 W (≤2.0 W preferred)* | *≤250 mW* |
| *Average Unit Production Cost (FY07 dollars)* | *$20K* | *TBD* |

# AVAM JWG Participants

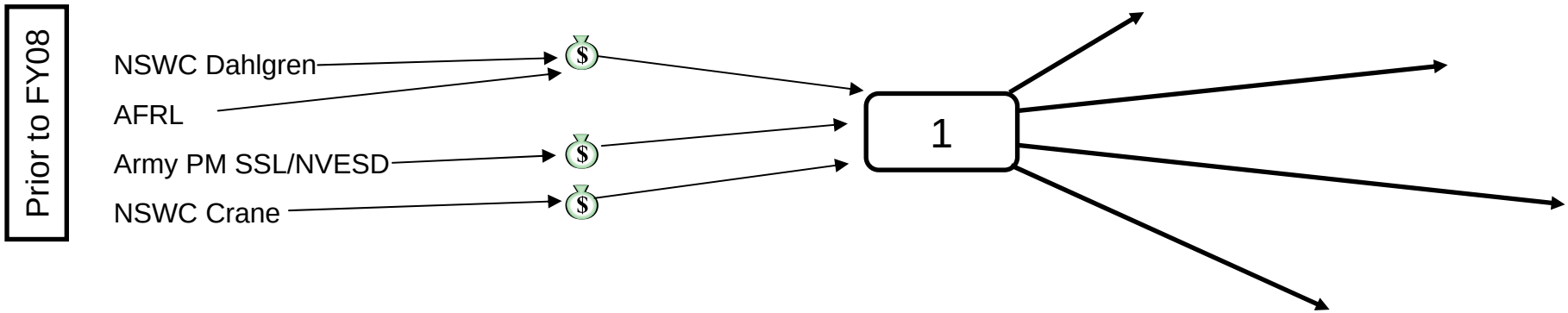
- Naval Surface Warfare Center (NSWC), Dahlgren Division (Chair)
- Army Product Manager (PM) Soldier Sensors & Lasers (SSL)
- Office of Naval Research (ONR)
- Marine Corps Systems Command (MCSC) Program Manager (PM) Fire Support Systems (FSS)
- Night Vision & Electronic Sensors Directorate (NVESD)
- Johns Hopkins University (JHU) / Applied Physics Lab (APL)
- NSWC, Crane Division
- Air Force Research Lab (AFRL)
- Defense Advanced Research Projects Agency (DARPA)
- Marine Corps Warfighting Lab (MCWL)

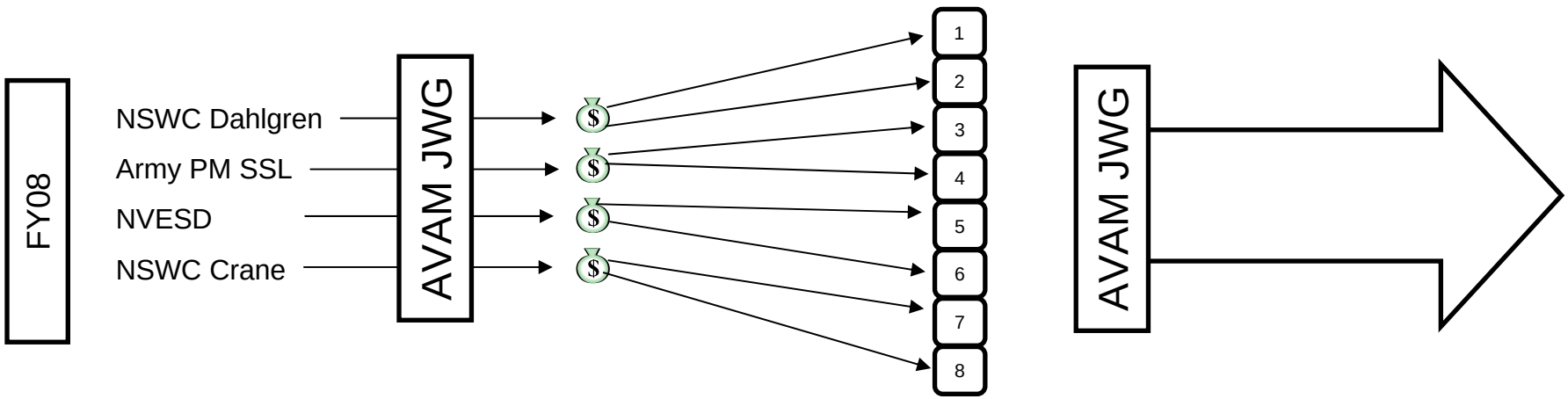
# AVAM JWG History

- Government funded efforts laid a foundation for current collaboration
  - Limited coordination across DoD resulted in duplication of efforts
  - Spurred initiation of quarterly JWG meetings
- The 2007 Joint Precision Azimuth Sensing Conference (JPASC)
  - Opportunity for ALL government stakeholders to listen to industry representation
  - Determine what progress was being made in the field of azimuth sensing
  - Present unified front to industry and demonstrate the need & market for azimuth sensing
- Close collaboration between Naval Surface Warfare Center (NSWC), Marine Corps Systems Command (MCSC) Program Manager Fire Support Systems (PM FSS), Office of Naval Research (ONR) 30 (Fires), Army Product Manager Soldier Sensors & Lasers (PM SSL), Night Vision & Electronic Sensors Directorate (NVESD), Special Operations Command (SOCOM), Johns Hopkins University / Applied Physics Lab (JHU/APL), and others (2007-present)
  - Several development efforts underway to meet a joint requirement for a non-magnetic azimuth sensor
  - Collaboration during proposal evaluation prevented duplication of efforts
  - Joint attendance encouraged at status meetings with contractors

# AVAM JWG Evolution

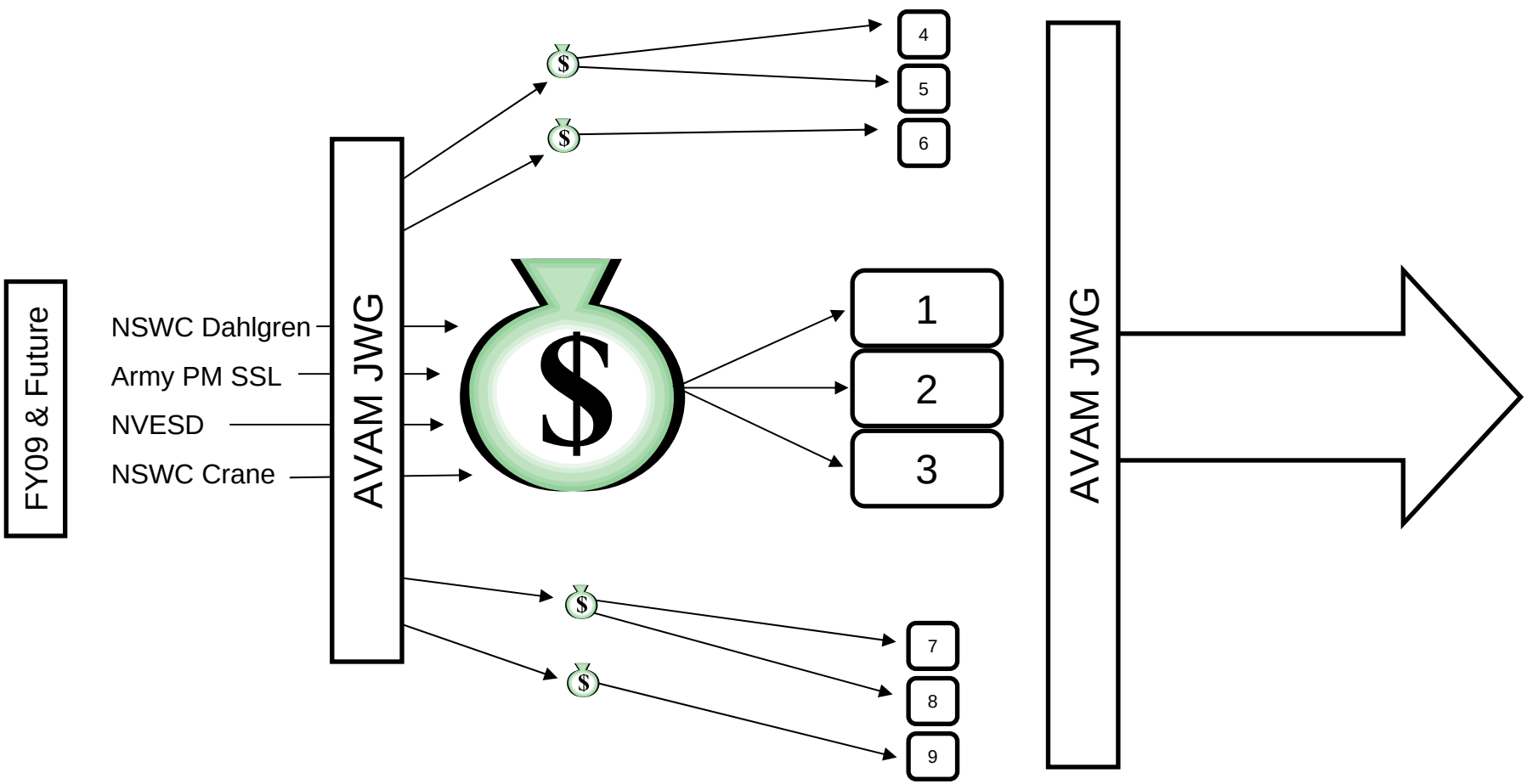
| Organization | Contract Vehicle | Contractor | Direction Provided |
|---|---|---|---|




CONCEPTUAL PURPOSES ONLY

# AVAM JWG Evolution (cont.)




CONCEPTUAL PURPOSES ONLY

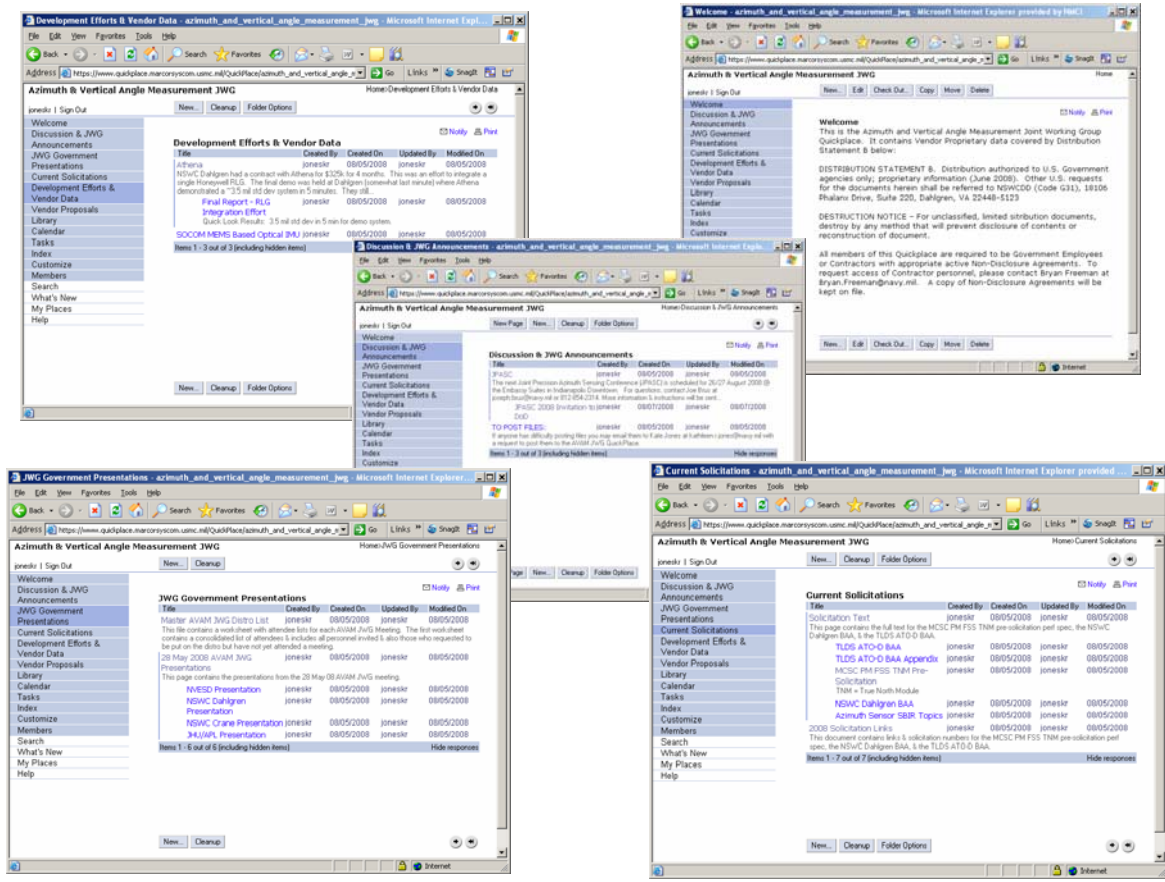
# Path to JWG Success

- Significant effort & vigilance by all involved is required to establish & maintain joint forum
  - Frequent & open communication
  - Quarterly JWG meetings
  - Joint proposal evaluations
  - Joint attendance at contractor status meetings
  - Report distribution
  - Joint demonstrations / tests
  - JPASC / industry days
  - Tools for sharing information
- Set aside differences early
  - Goal is to find a solution, regardless of funding source
  - Define common requirements
  - Acknowledge differences in implementation
  - No feelings of ownership towards specific technologies

**Deliberate collaboration is required to achieve a successful Joint Working Group**

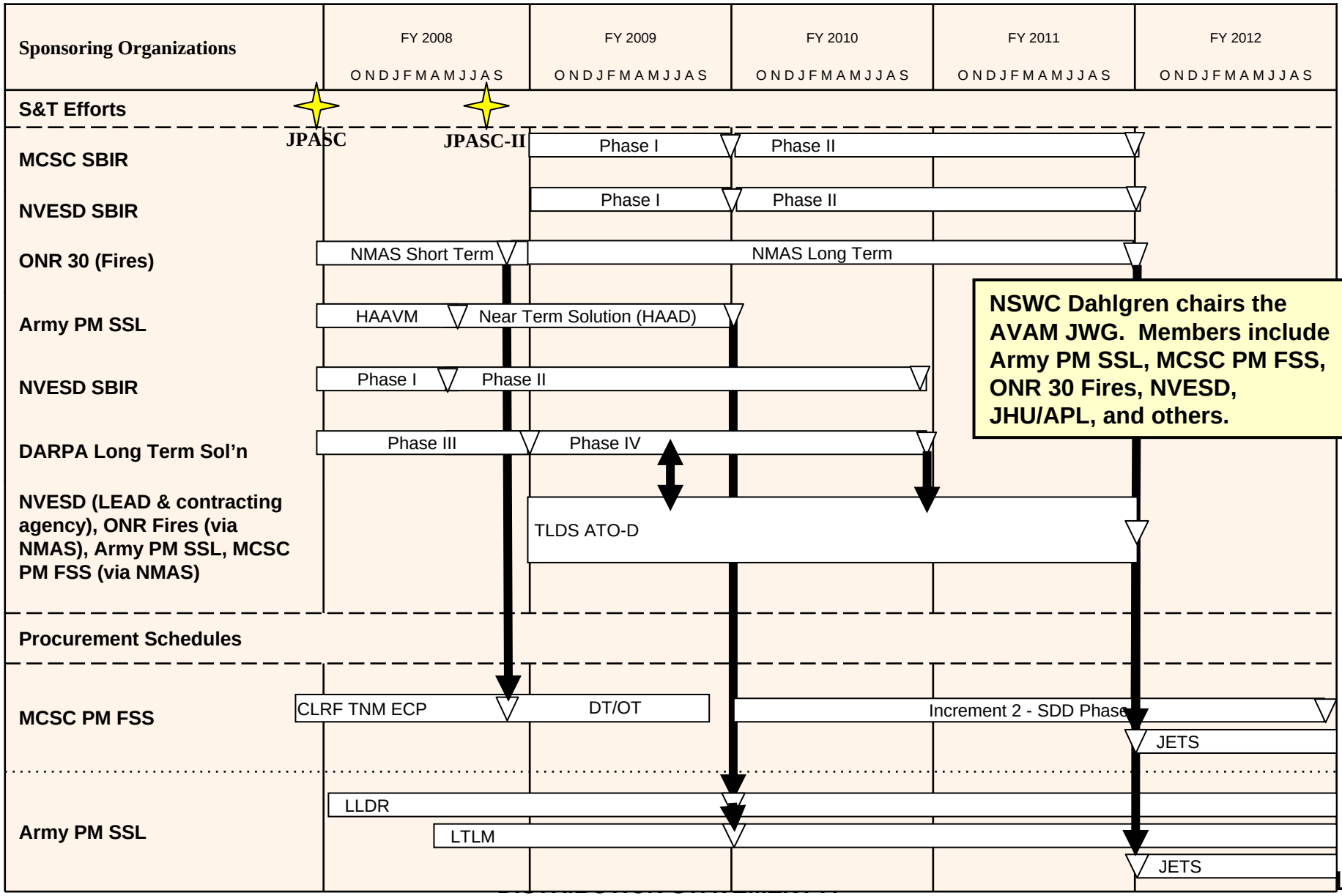
# Tools

- Online tools are used to share data within the AVAM JWG
- All government support contractors must have appropriate, active Non-Disclosure Agreements on file




AVAM JWG meetings are scheduled using the Discussion & JWG Announcements page. Notification can be sent to all members when items are posted, simplifying the scheduling process.

# Joint Development Efforts for AVAM



# FY09 Alternatives Analysis

| Approach | Perf. < 4 mil (T) | Size < 50 $in^3$ | Weight < 2 lb | Power < 5 W | Cost < 20 K | Maturity FY09 |
|---|---|---|---|---|---|---|
| GPS | | | | | | |
| Ring Laser Gyro | | | | | | |
| Fiber Optic Gyro | | | | | | |
| Hemispherical Resonator Gyro | | | | | | |
| Fluid Based Gyro | | | | | | |
| MEMS | | | | | | |
| Celestial | requires unobstructed view of the sky | | | | | |

Low Risk | Medium Risk | High Risk

# Summary

- All services currently have the capability to very precisely miss targets
- All services require small, lightweight, precise azimuth sensor unaffected by the environment
- Joint development efforts are capitalizing on DoD investment to develop suitable azimuth sensors