Integrating MOOS Into An Existing AUV Using Gumstix

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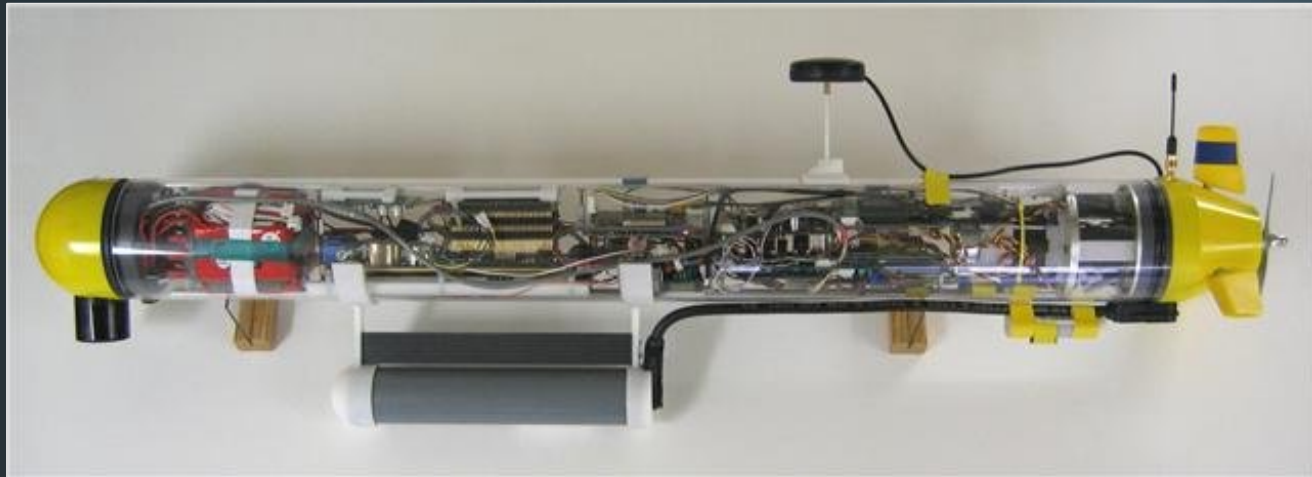
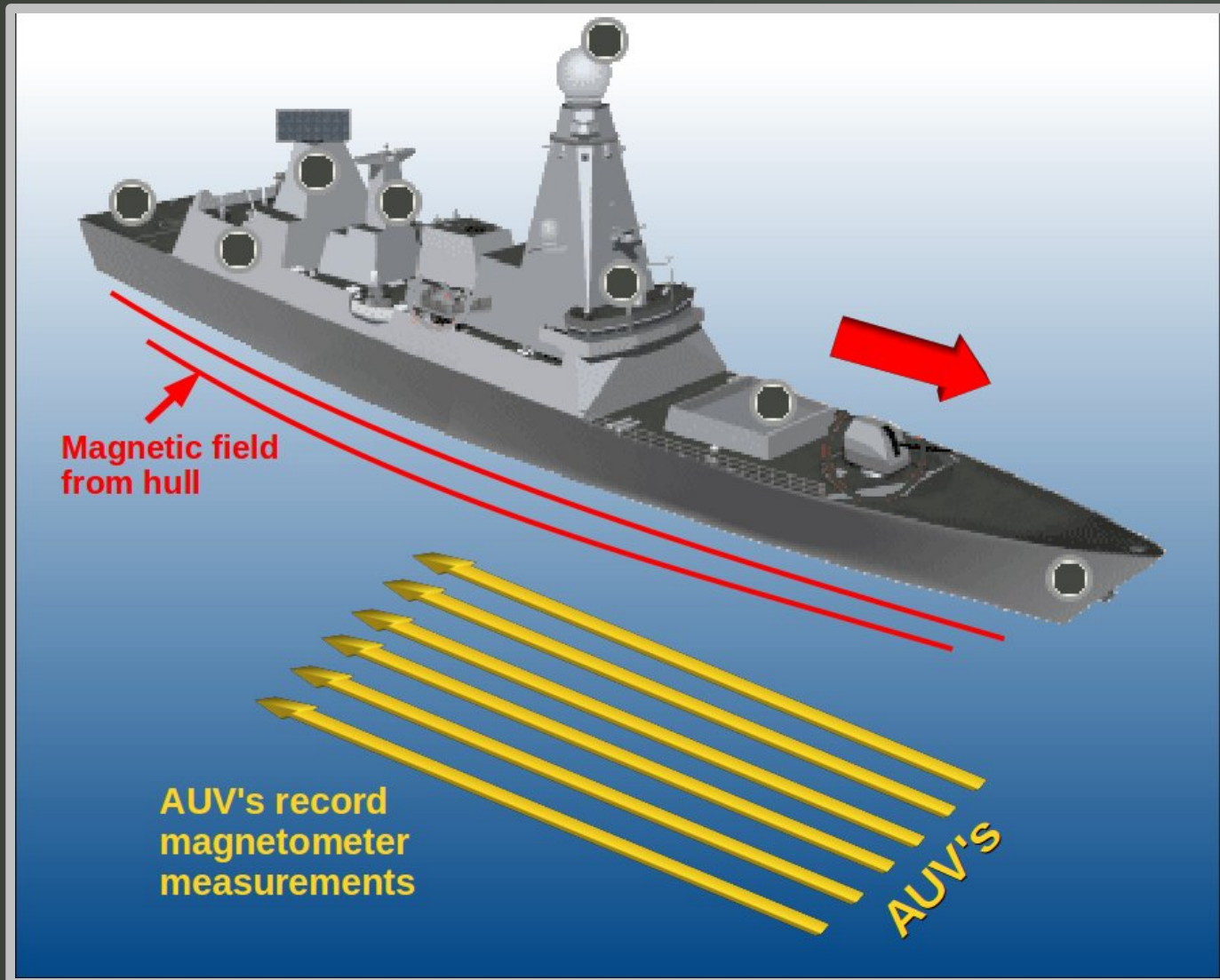**Presented at:** MOOS-DAWG August 24-25, 2010

Team Members

Background

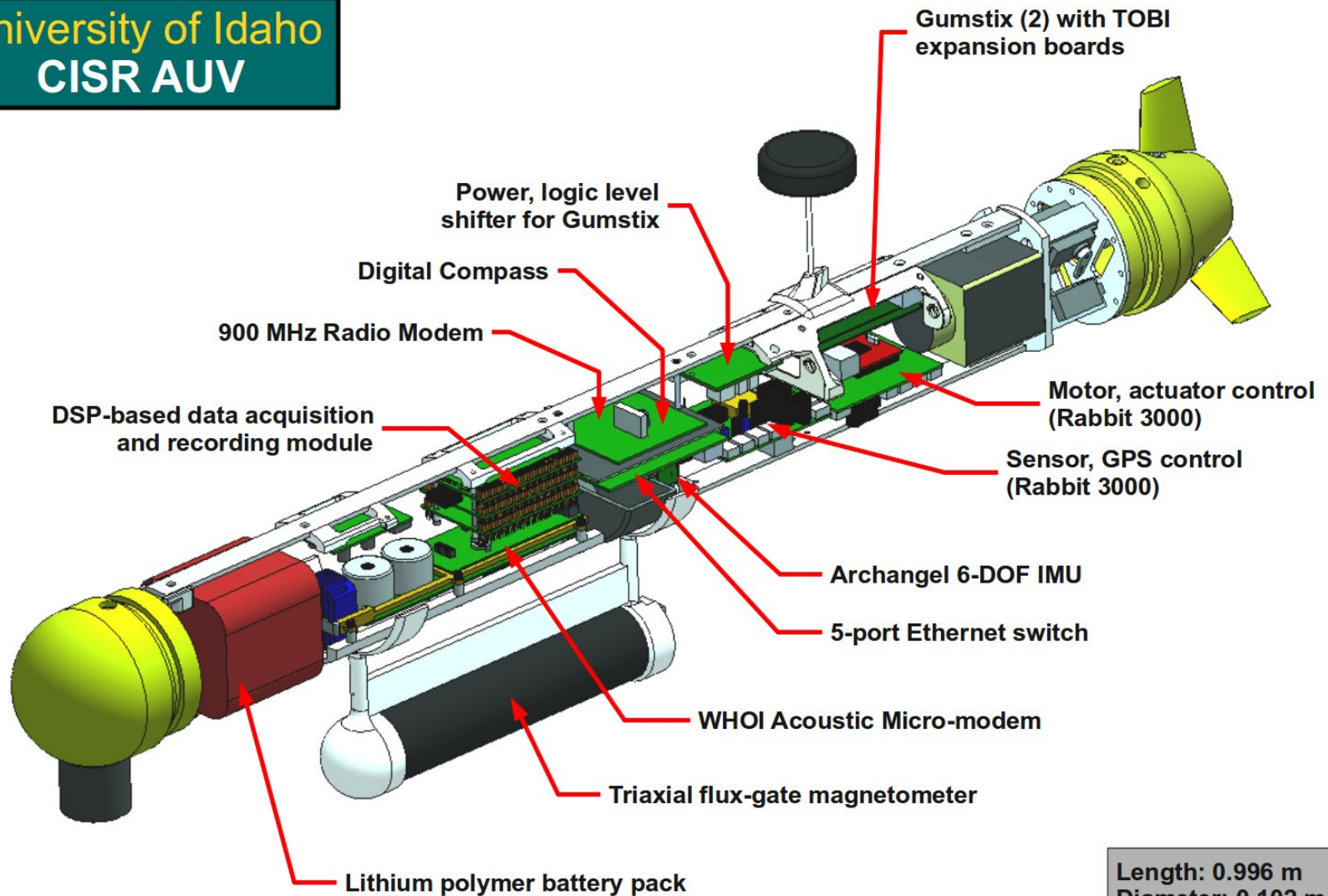University of Idaho CISR AUV

- Total length: ~ 1 meter
- Development platform for forward-area assessment of a ship's magnetic field signature

AUV Deployment

CISR AUV

University of Idaho
CISR AUV

Gumstix (2) with TOBI expansion boards

Power, logic level shifter for Gumstix

Digital Compass

900 MHz Radio Modem

DSP-based data acquisition and recording module

Motor, actuator control (Rabbit 3000)

Sensor, GPS control (Rabbit 3000)

Archangel 6-DOF IMU

5-port Ethernet switch

WHOI Acoustic Micro-modem

Triaxial flux-gate magnetometer

Lithium polymer battery pack

Length: 0.996 m
Diameter: 0.102 m

Motivation

- A need exists for greater computational abilities and portability of software developed for the CISR AUV

- MOOS and the MOOS-IvP suite are a desirable alternative to existing proprietary methods

- Gumstix OVERO processors offer greater processing power and the ability to run MOOS-IvP under a Linux OS.
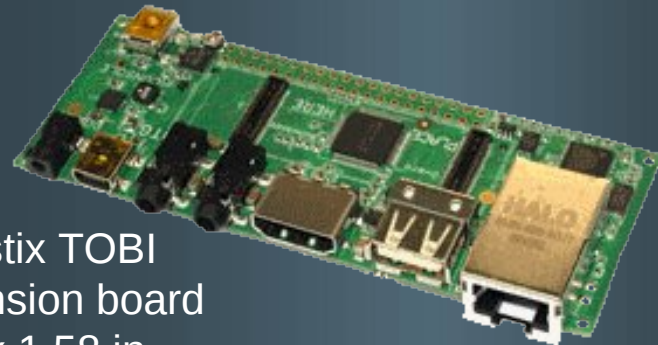
Gumstix OVERO Hardware

- 600 MHz TI OMAP (ARM Cortex-A8) CPU
- NEON floating-point co-processor
- 256 MB SDRAM
- 256 MB NAND flash + uSD media card
- WiFi (OVERO AIR)
- Wired Ethernet via TOBI expansion board
- Connectivity: (3x) Serial ports, USB, I^{2}C, and SPI

Overo AIR
2.28 x 0.67 in

Gumstix TOBI
expansion board
4.13 x 1.58 in

Gumstix Development

OpenEmbedded build system

- Bitbake utility for cross-compilation
- 'Recipe' files specify build configuration
- Build produces installer packages (.ipk)
- Custom recipes can be created for application bundles (MOOS-IvP) or OS with pre-installed applications

Caveats

- Gumstix IO uses 1.8V signaling

- OpenEmbedded only available under Linux

- Bitbake recipe system can be cryptic

- Infrequent problems cross-compiling inlined methods

- Initial Bitbake build takes a **LONG** time

MOOS-Gumstix Strategy

1. Develop software on PC

2. Create Bitbake recipes for MOOS-IvP and AUV apps

3. WiFi access for debug and verification

4. Add start-up scripts to automatically start MOOS

5. Custom Gumstix OS images
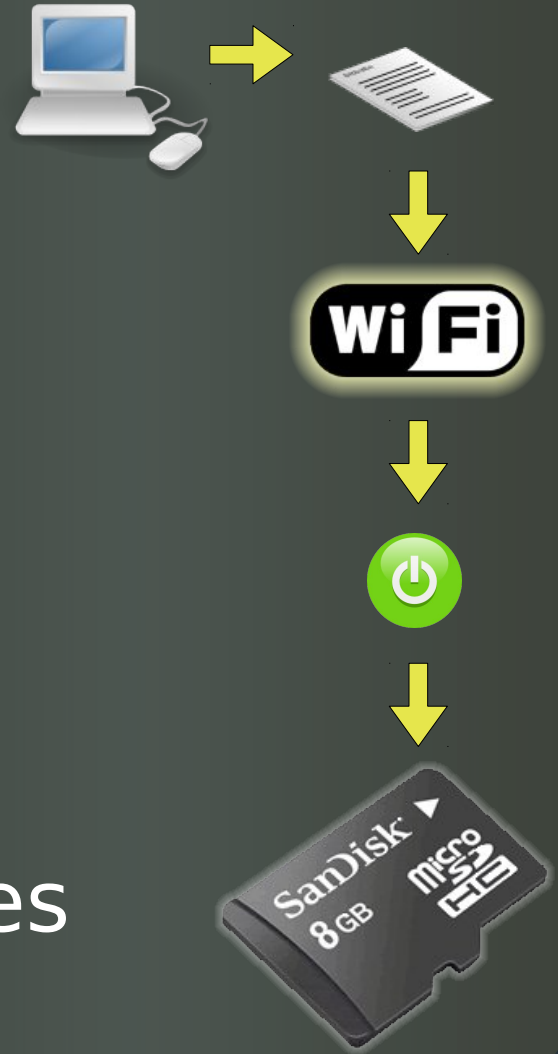
CISR AUV MOOS Community
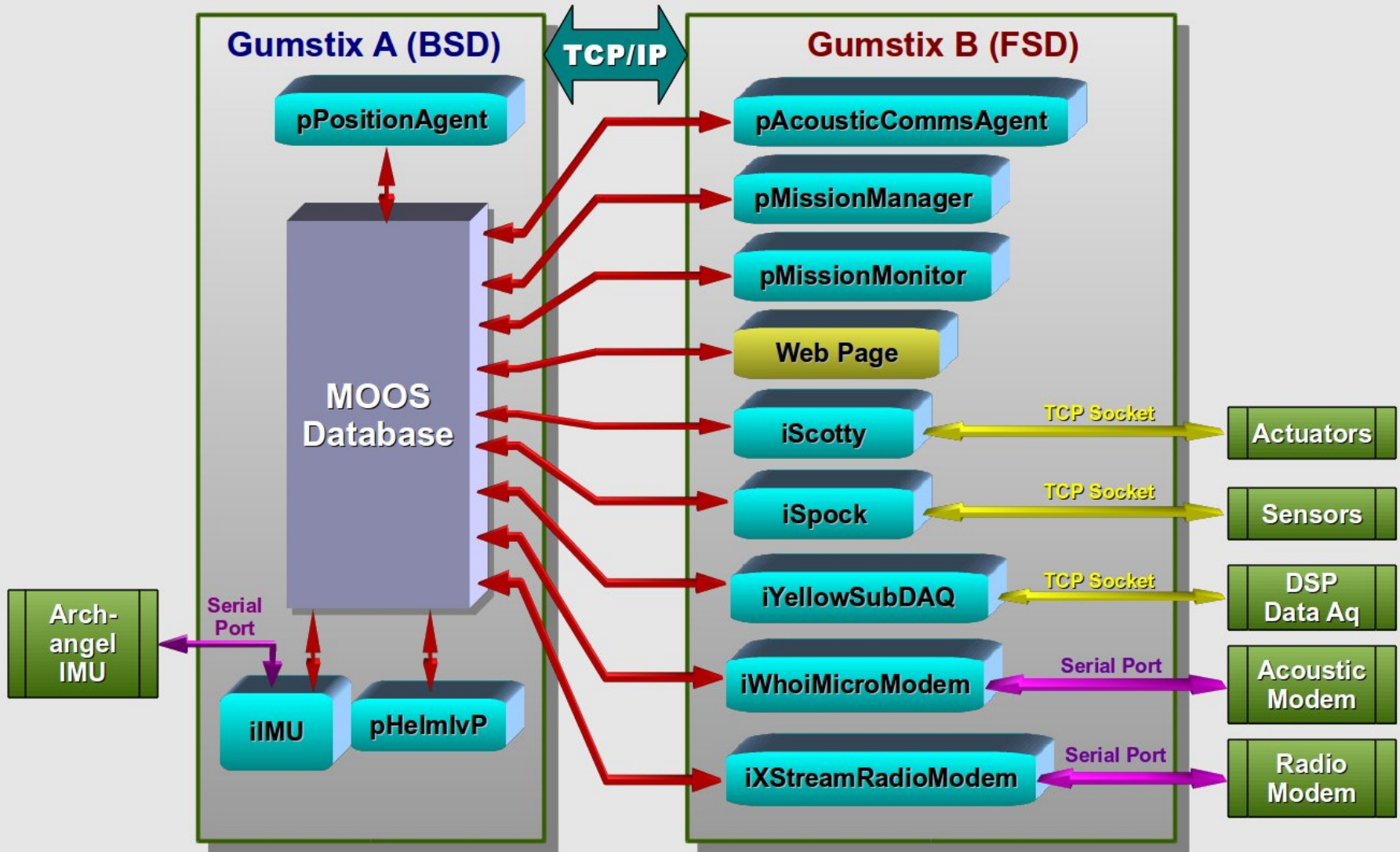
AUV MOOS Instruments

Serial Port Interface
- WHOI Acoustic Micro-modem
- 900 MHz Digi International radio modem
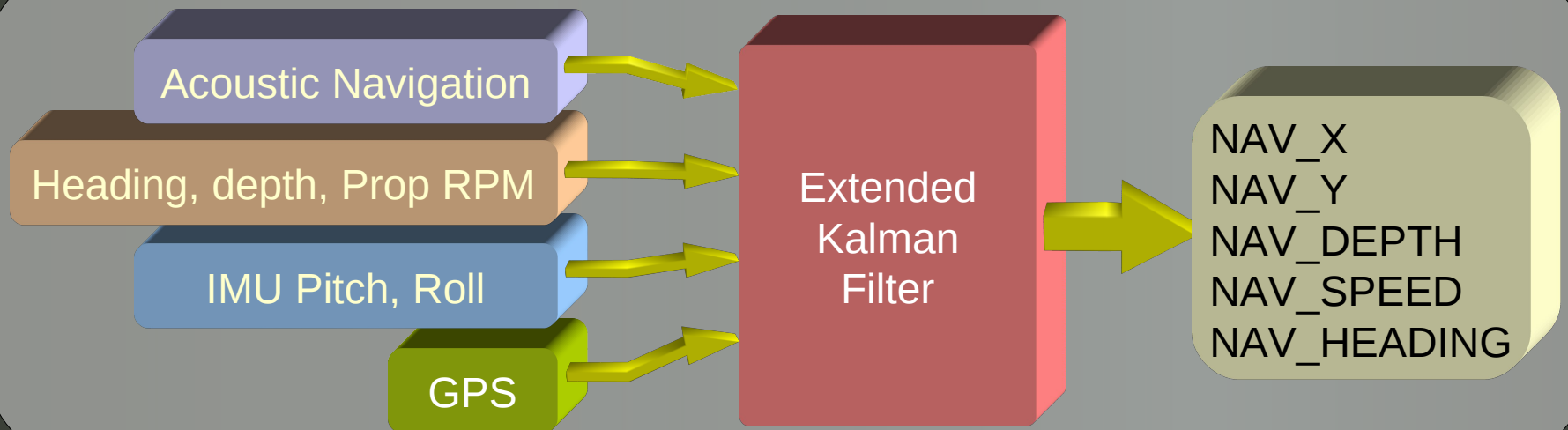- Archangel IM3 IMU

Network Socket Interface (TCP)
- DSP data acquisition system
- Sensor module (Rabbit 3000)
- Motor, actuator control (Rabbit 3000)

AUV Middle-ware

pPositionAgent

- EKF ported from Rabbit 3000 source code
- Combines multiple sensor inputs to produce estimated position of AUV
- Publishes to NAV_ variables

AUV Middle-ware

pMissionManager

- Interpreter for 'mission script' files invoked by commands sent via MOOSDB
- Scripted modification of variables in the MOOSDB at runtime

- Script operations include:
  - Set and test MOOS variable
  - Conditional execution, redirection
  - Wait (seconds)

AUV Middle-ware

pMissionMonitor

- Actively monitors the value of one or more MOOS variables at runtime
- Compares against a constant or range
- On fault condition a pre-defined value is posted to a MOOS variable of choice
- Can be used to engage manual override or invoke a mission script in case of critical systems failure (i.e. water leak, sensor failure, etc.)

MOOS Utilities

MS Visual Studio 2008, 2010 AppWizard

Current Status

Completed:
- Gumstix build system and OS images
- MOOS and AUV instruments on gumstix
- Remote control of AUV actuators

In Progress:
- Middle-ware applications (~67% complete)
- Integration with IvP-Helm
- TDMA for acoustic navigation and comms
- Field testing

MOOS Integration Challenges

MOOS Integration Challenges
- High-resolution timing support
- MOOS source documentation
- Availability of MOOSNavLib documentation and examples
- MOOS serial port and network socket implementations
- Unknown MOOSDB throughput latency

Acknowledgements

Office of Naval Research

Magnetic Signature Assessment System Using Multiple Autonomous Underwater Vehicles (AUVs)

Phase I   (N00014-08-1-0779)
Phase II (N00014-09-1-0711)
Phase III (N00014-10-1-0883)

Questions?