Autonomy
S&T Priority Steering Council

Team members/Affiliation:

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Autonomy PSC Lead

Division Director

ONR/

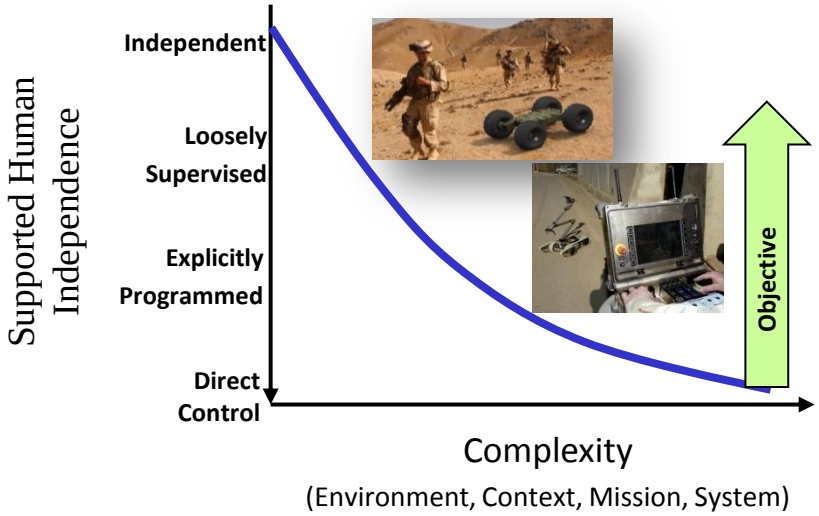
Presentation to S&T EXCOM

14 June 2011

Team Meetings held: and frequency

Two Human-Machine Relationships

Human is *Supported*



Goal
Minimize human control to defining mission

Optimum Level
System understands human intent

Human is *Supporting*

Goal
Minimize supporting humans

Optimum Level
Zero

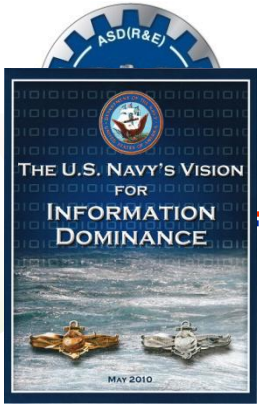
UxV and Autonomy

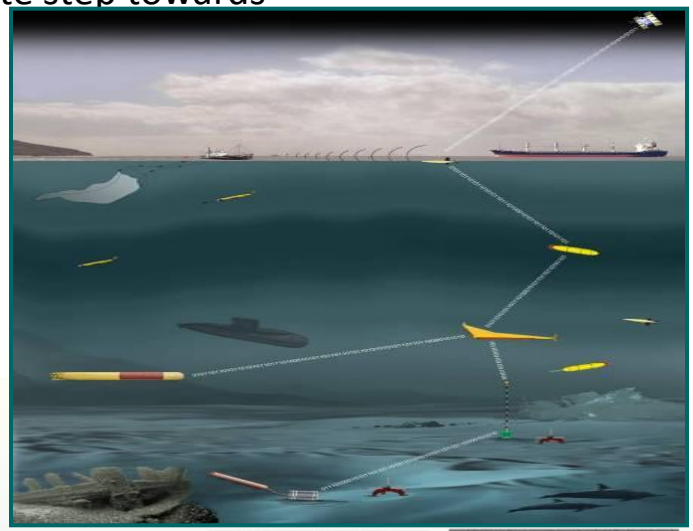
Now:

- Uninhabited UxVs are an intermediate step towards autonomy

We are here

The Future

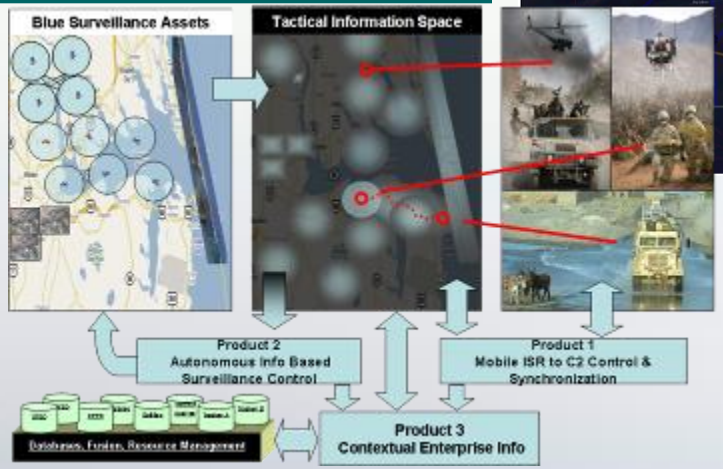




Mid-Term:

- Current UxV systems are rule-based and can support relatively simple missions, but do not operate well in complex, uncertain dynamic environments

Distributed EW



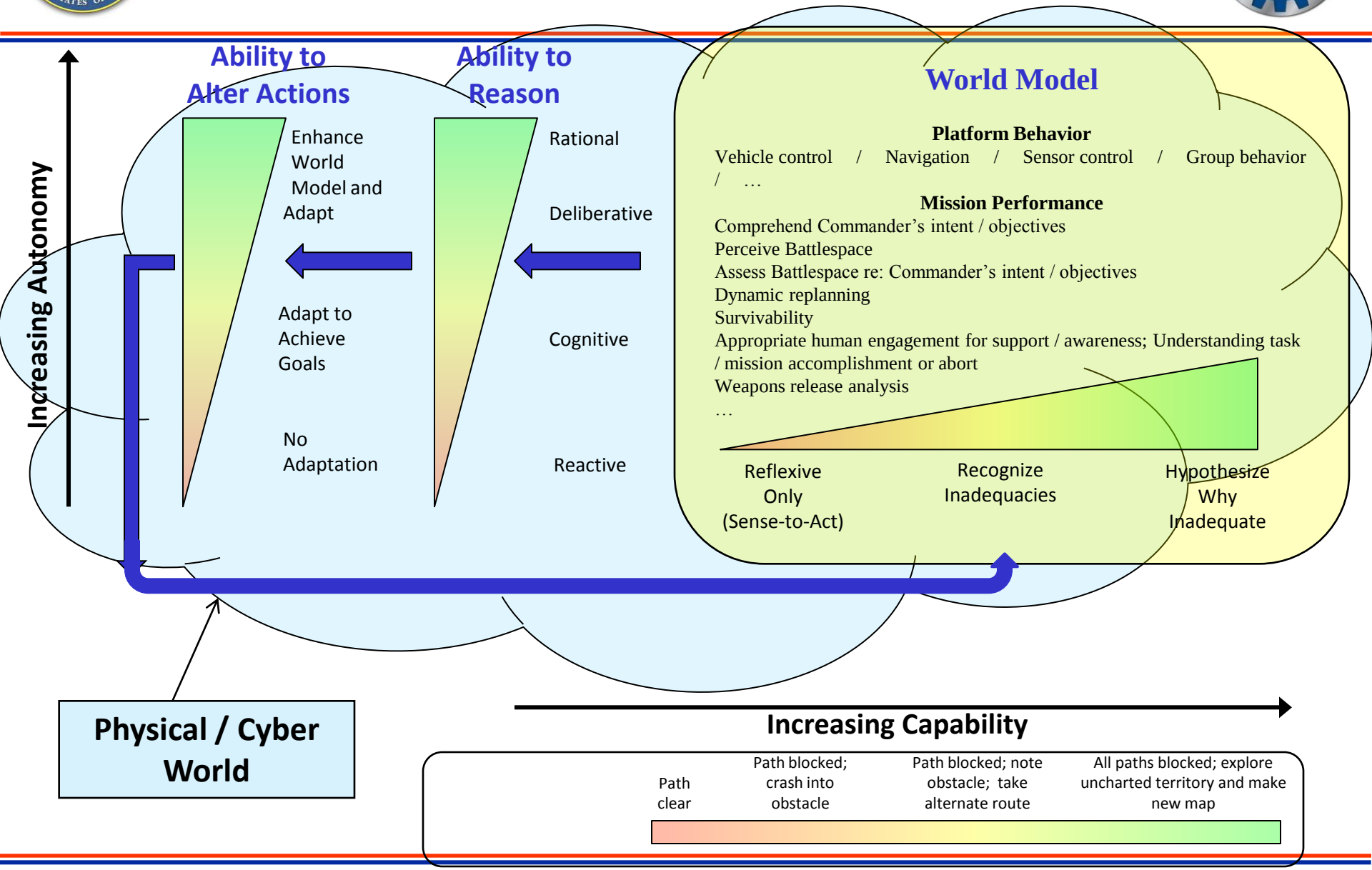
Riverine/Urban Persistent ISR

Persistent Littoral Undersea System

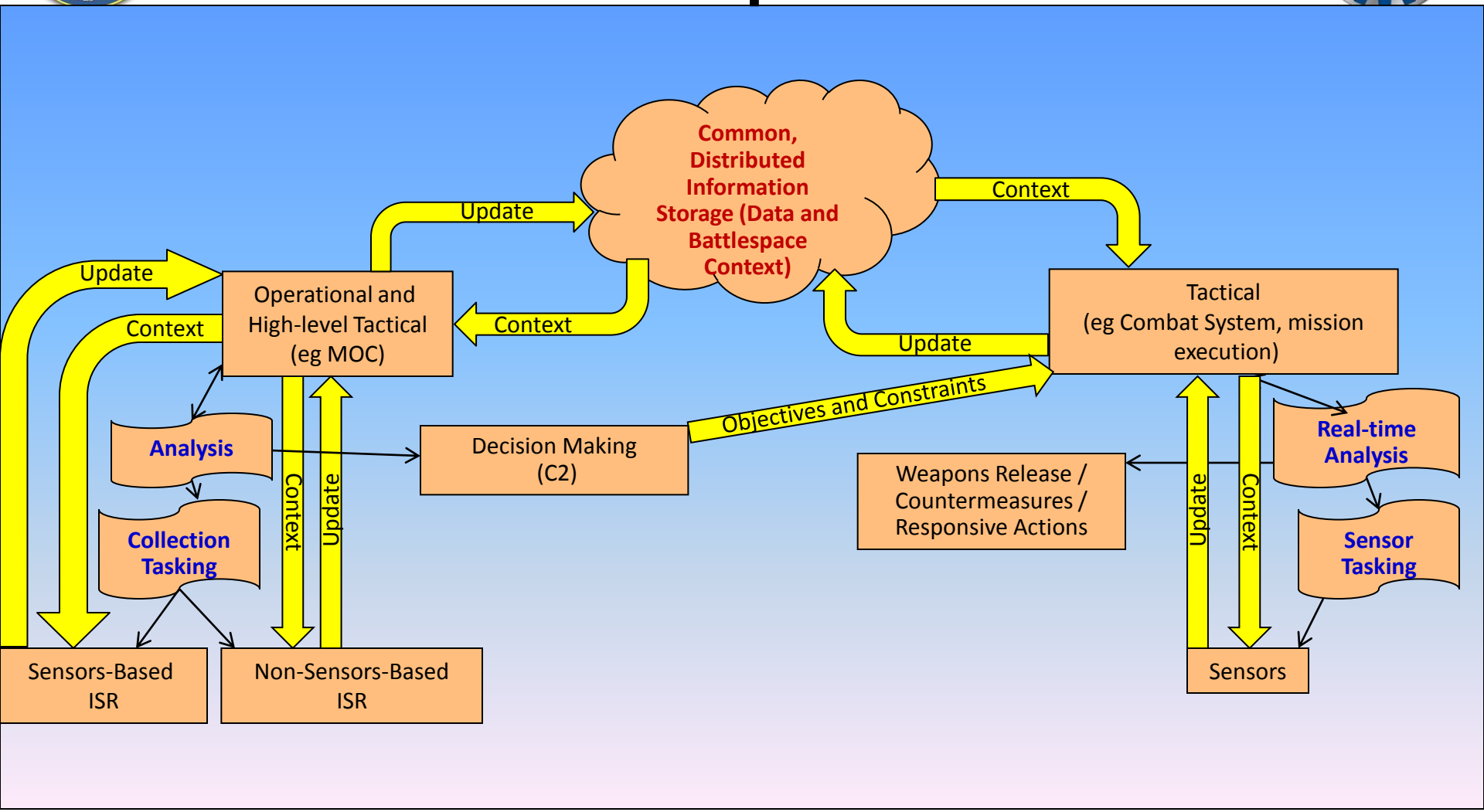
Long-Term:

- Level of reasoning capable of comprehending the battlespace
- Automated, coordinated, distributed, adaptive planning

Levels of Autonomy



Operational and Tactical Pictures Development



Toward Non-Real-Time — Toward Real-Time

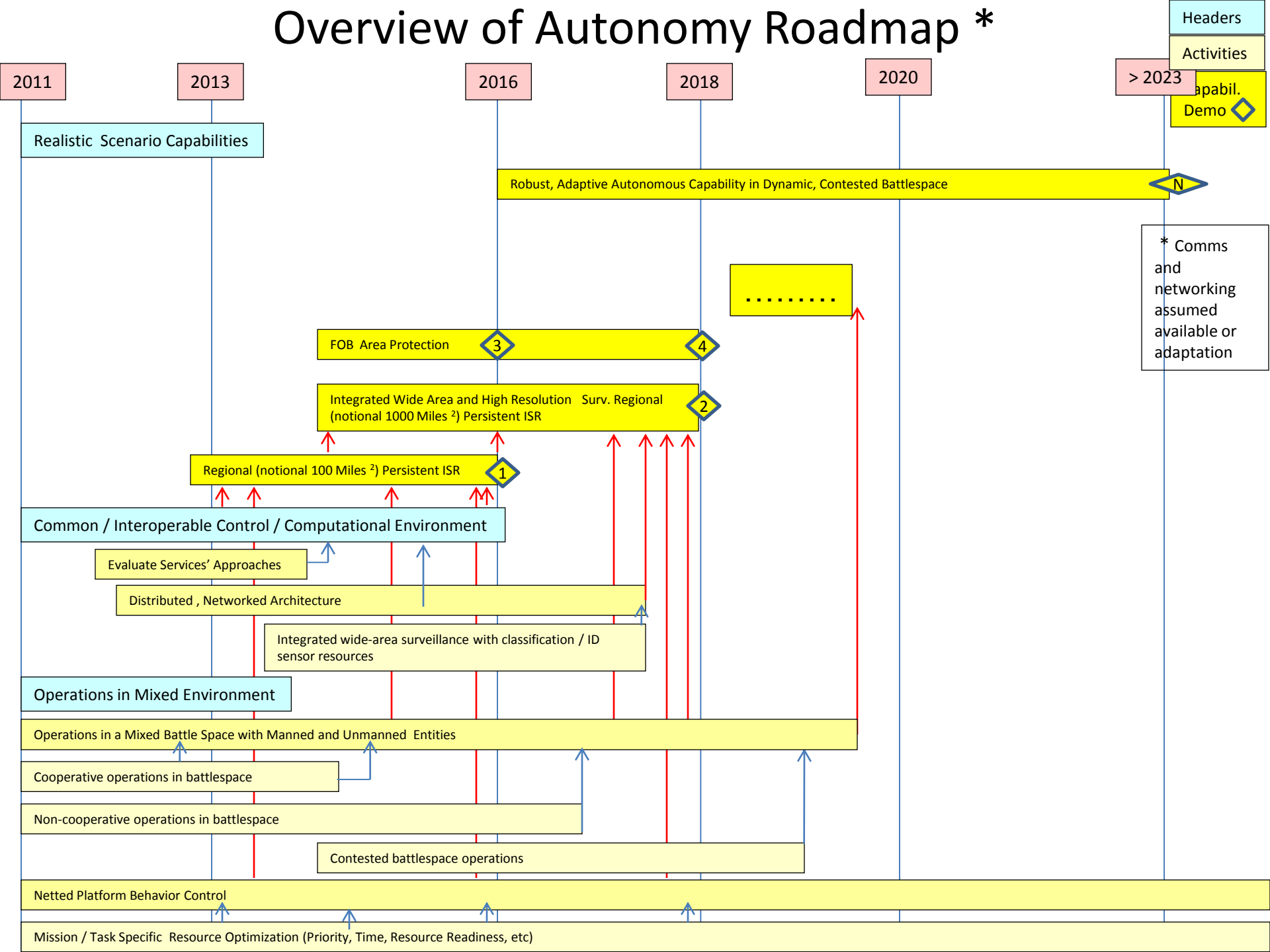
Autonomy Problem Statements

- **Problem: Insufficient manpower to support command and control of persistent, pervasive surveillance assets across relevant battlespace**
  - Desire for, at most, single operator control of unmanned teams
  - Increasing quantity and scope of ISR data pushing analysis “beyond human scale”
  - Expanding domains and time-criticality pushing decision-making “beyond human scale”
- **Problem: Operators/decision-makers don’t have appropriate level of trust in autonomy, ie too low or too high.**
  - Lack technologies for adaptive autonomous control of vehicle systems in the face of extremely harsh, unpredictable and mathematically intractable environments
  - Lack technologies to enable safe manned and unmanned operation in a mixed battlespace (civilian and military AORs)
  - V&V and C&A address only part of trust
    - Ramifications of over-reliance on autonomy in contested, complex battlespaces
- **Problem: Environments so harsh as to not reasonably permit humans to enter and sustain activity**
  - Examples include
    - High radiation, High biological, High chemical environments
  - Mission areas where one may not return

Desired End States

3 year (2016)	5 Year (2018)	7 Year and beyond (2020+)
• Develop highly flexible, interoperable environment for common control and computations • 50% staff reduction for C2 for a notional 100 sq mile area • Autonomously update battlespace context using available sources • Enable timely operational decision making based on commander's intent • Enable mixed manned/unmanned operations within common battlespace • Complete Phase 1 advanced autonomous tech development – Tailored pattern recognition – Decision making – Miniaturization of autonomous control sensors, power supplies, etc – Autonomous Protective system defeat	• No increase in supporting manpower requirements for C2 of 1,000 sq mile area • Integrated wide area – classification / ID sensor resource for autonomous cooperation • Expand mixed manned/unmanned operations to non-cooperative, but not contested battlespace • Enhanced SIGINT input to include signal internals • Continue 2nd generation prototyping • Continue Phase 2 advanced autonomous tech development – Tailored swarming tech-subterranean – Coordinated multi-unit search – Obstacle negotiation, task restructure – Threat recognition & adaptive response	• Continue evolving technologies • Complete Phase 2 advanced autonomous tech development • Initiate Phase 3 advanced autonomous tech development **Beyond** • Fully autonomous operations with periodic need for update • >75% prob of success in contested battlespace • Training/experience (warfighter culture) support inclusion of autonomous capabilities • Complete Phase 3 advanced autonomous tech development • Complete 3rd generation prototype

Overview of Autonomy Roadmap *



Notional Autonomy Roadmap *