



# Autonomy S&T Priority Steering Council

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**Autonomy PSC Lead**

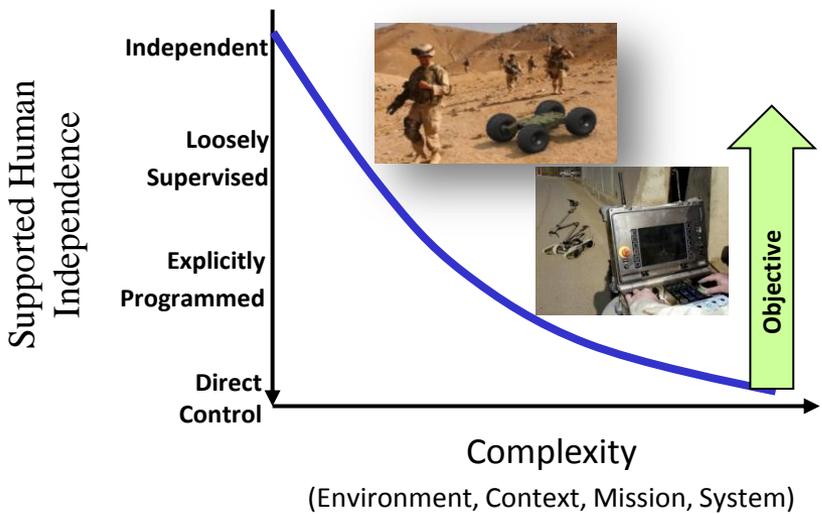
**Division Director**

**ONR/**

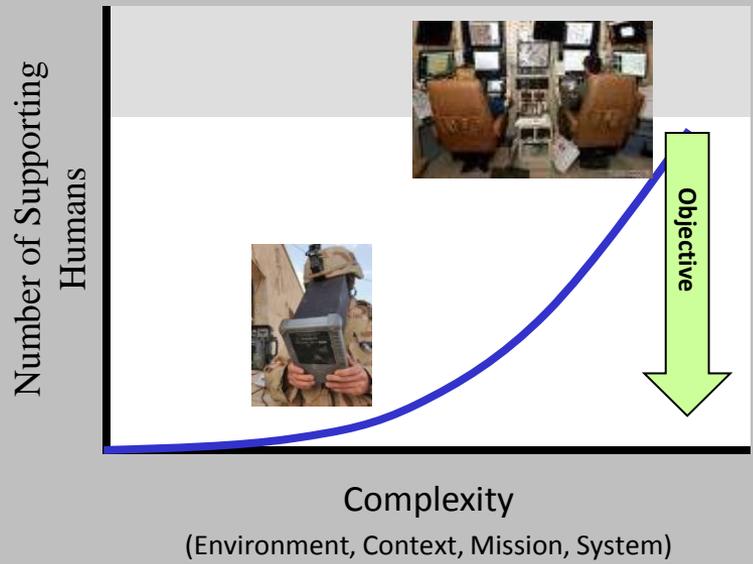


# Two Human-Machine Relationships

## Human is Supported



## Human is Supporting



### Goal

Minimize human control to defining mission

### Optimum Level

System understands human intent

### Goal

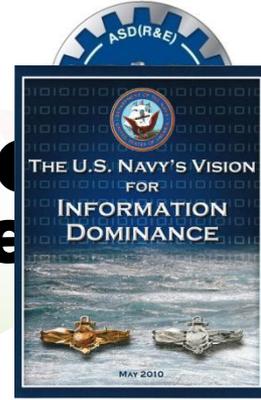
Minimize supporting humans

### Optimum Level

Zero

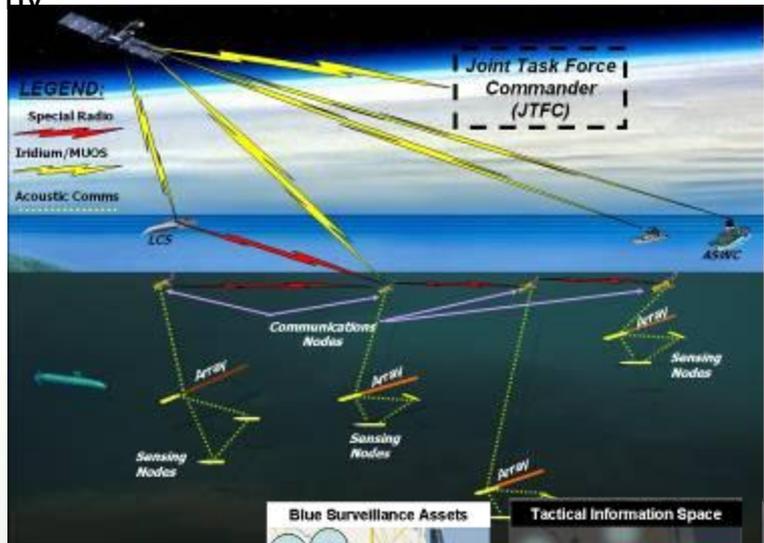


# UxV and Autonomy



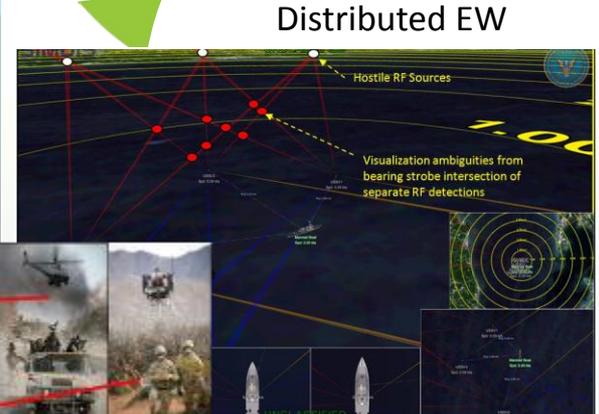
Now:

- Uninhabited UxVs are an intermediate step towards autonomy



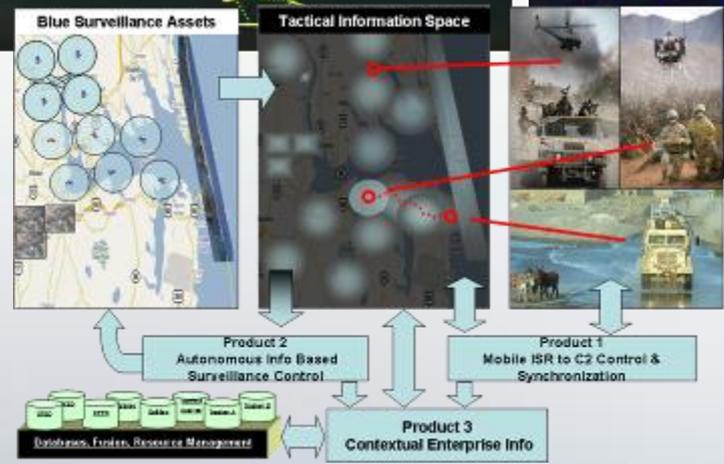
Mid-Term:

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



Long-Term:

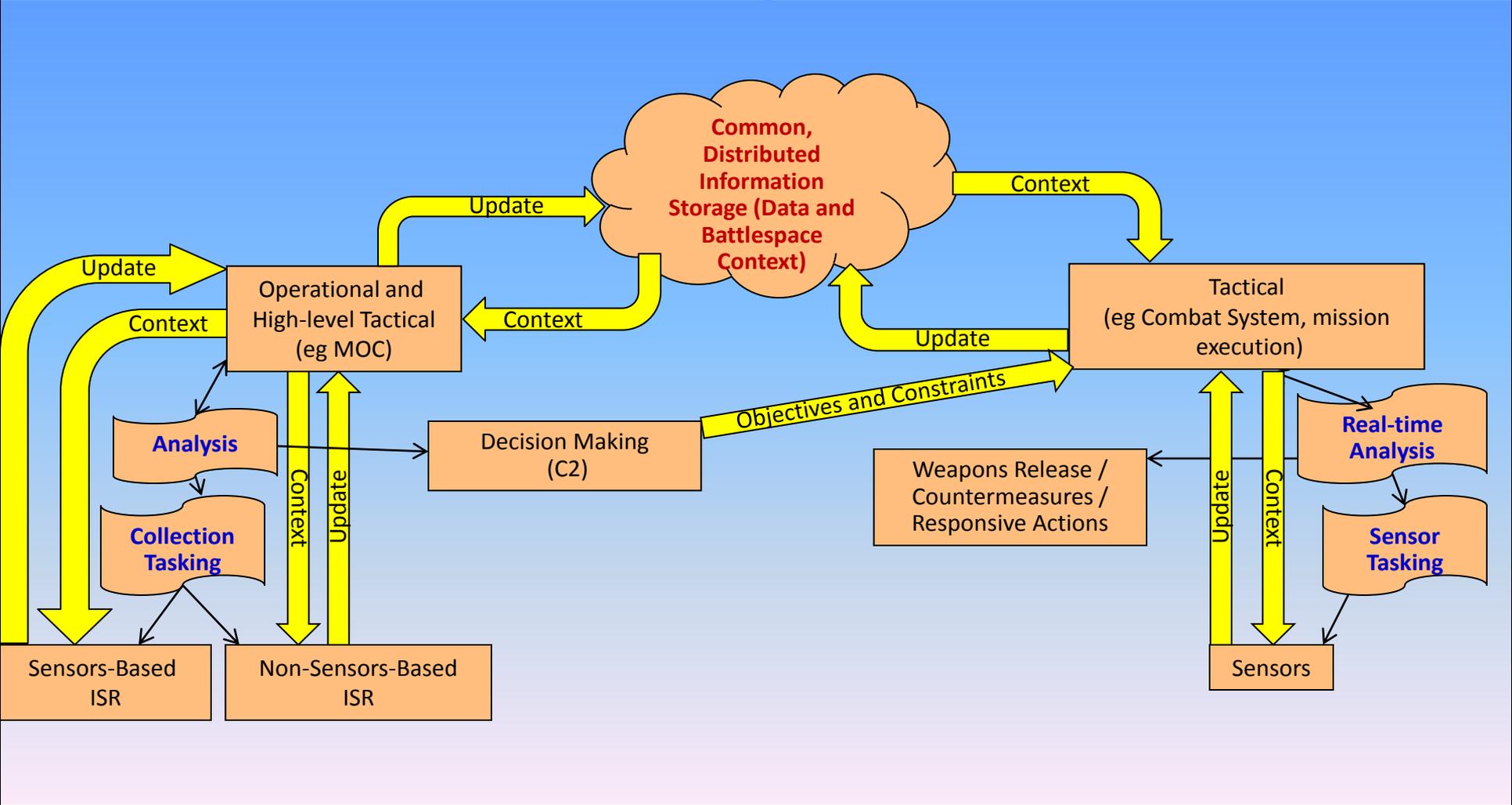
- Level of reasoning capable of comprehending the battlespace
- Automated, coordinated, distributed, adaptive planning



Persistent Littoral Undersea System

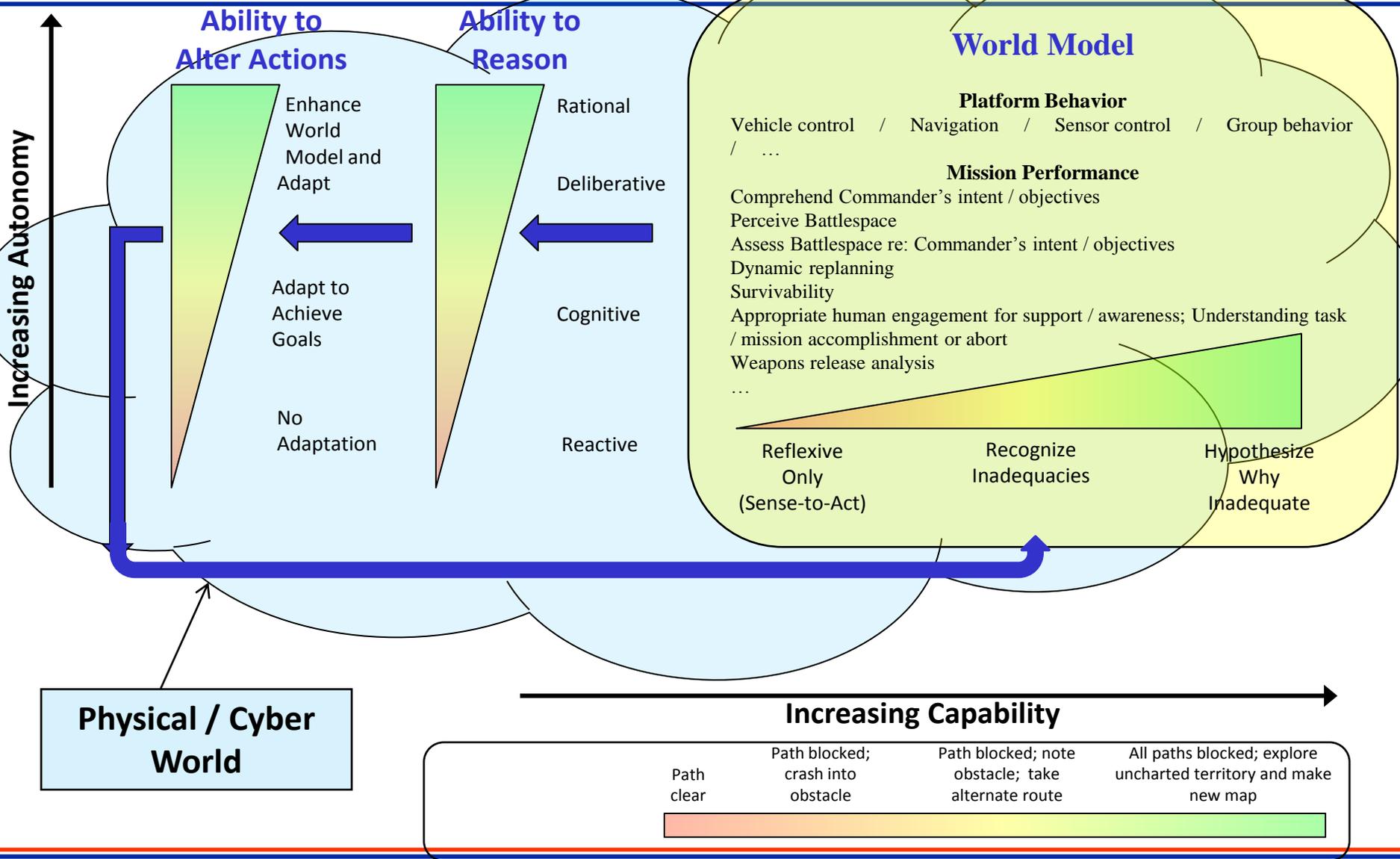


# Operational and Tactical Pictures Development





# Levels of Autonomy





# Autonomy Problem Statements



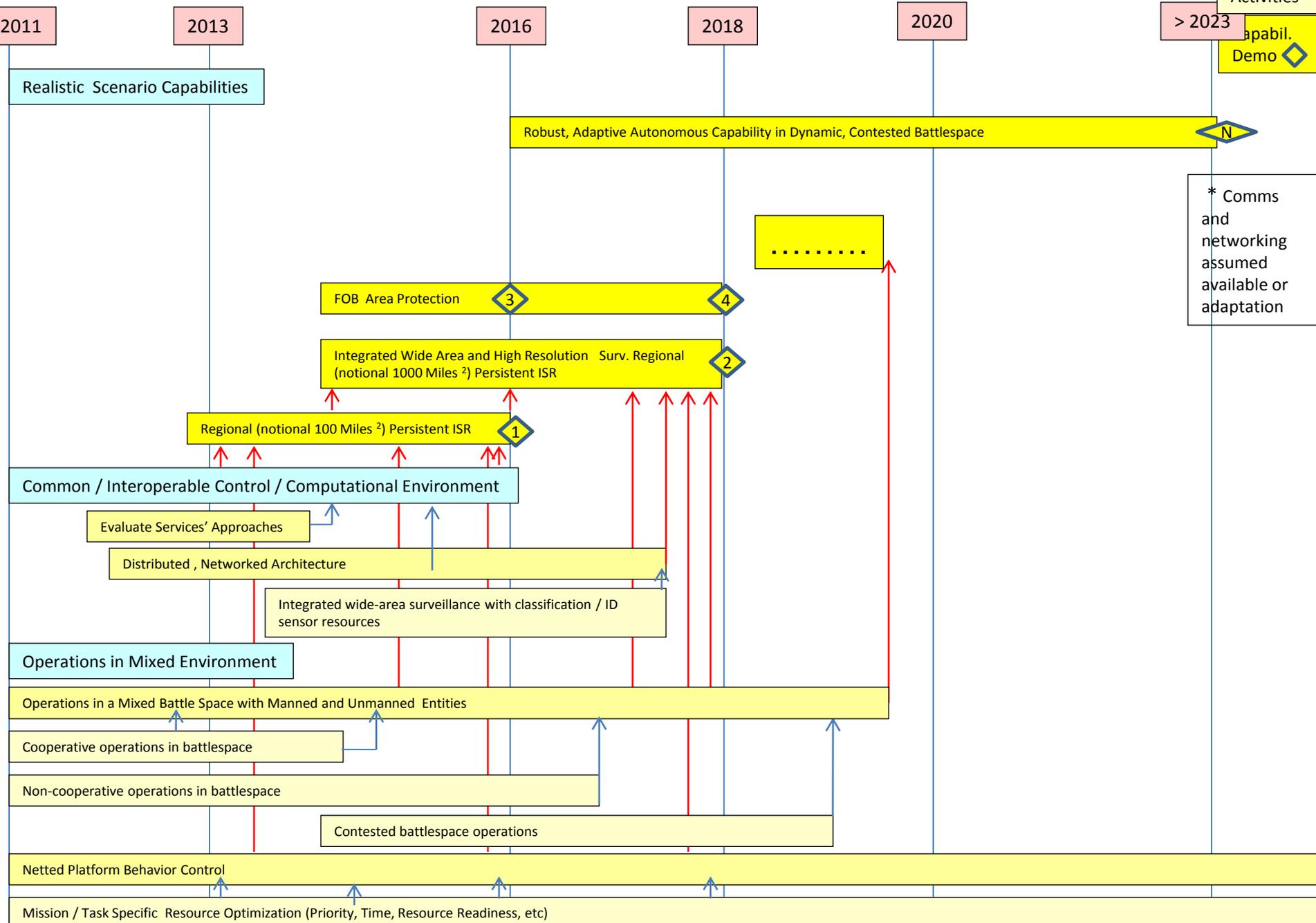
- **Problem: Insufficient manpower to support command and control of persistent, pervasive surveillance assets across relevant battlespace**
  - Desire for, at most, single operator control of unmanned teams
  - Increasing quantity and scope of ISR data pushing analysis “beyond human scale”
  - Expanding 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

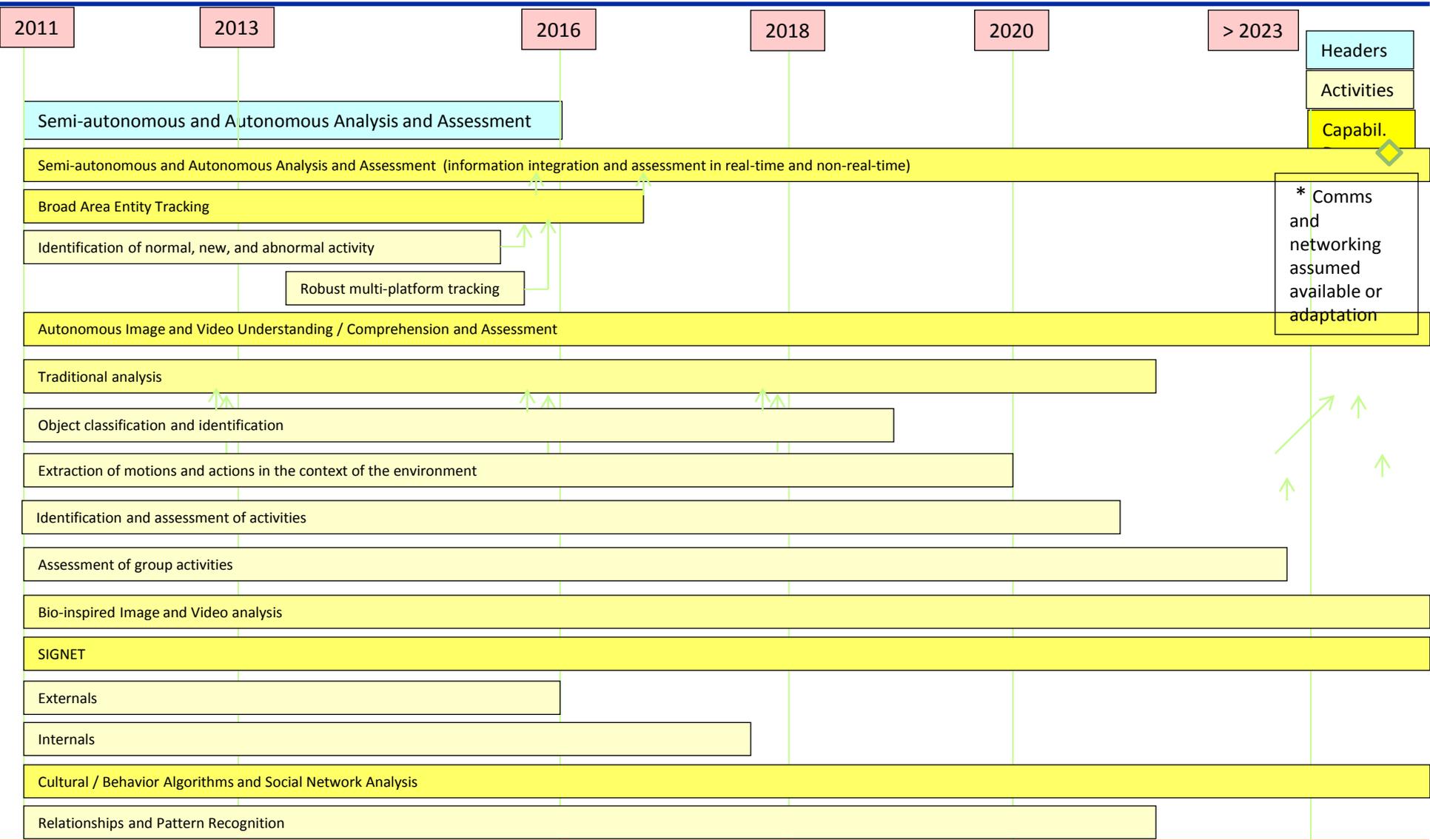
3 year (2016)	5 Year (2018)	7 Year and beyond (2020+)
<ul style="list-style-type: none"> <li>• Develop highly flexible, interoperable environment for common control and computations</li> <li>• 50% staff reduction for C2 for a notional 100 sq mile area</li> <li>• Autonomously update battlespace context using available sources</li> <li>• Enable timely operational decision making based on commander's intent</li> <li>• Enable mixed manned/unmanned operations within common battlespace</li> <li>• Complete Phase 1 advanced autonomous tech development               <ul style="list-style-type: none"> <li>– Tailored pattern recognition</li> <li>– Decision making</li> <li>– Miniaturization of autonomous control sensors, power supplies, etc</li> <li>– Autonomous Protective system defeat</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• No increase in supporting manpower requirements for C2 of 1,000 sq mile area</li> <li>• Integrated wide area – classification / ID sensor resource for autonomous cooperation</li> <li>• Expand mixed manned/unmanned operations to non-cooperative, but not contested battlespace</li> <li>• Enhanced SIGINT input to include signal internals</li> <li>• Continue 2<sup>nd</sup> generation prototyping</li> <li>• Continue Phase 2 advanced autonomous tech development               <ul style="list-style-type: none"> <li>– Tailored swarming tech-subterranean</li> <li>– Coordinated multi-unit search</li> <li>– Obstacle negotiation, task restructure</li> <li>– Threat recognition &amp; adaptive response</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Continue evolving technologies</li> <li>• Complete Phase 2 advanced autonomous tech development</li> <li>• Initiate Phase 3 advanced autonomous tech development</li> </ul> <p style="text-align: center;"><u>Beyond</u></p> <ul style="list-style-type: none"> <li>• Fully autonomous operations with periodic need for update</li> <li>• &gt;75% prob of success in contested battlespace</li> <li>• Training/experience (warfighter culture) support inclusion of autonomous capabilities</li> <li>• Complete Phase 3 advanced autonomous tech development</li> <li>• Complete 3<sup>rd</sup> generation prototype</li> </ul>

# Overview of Autonomy Roadmap \*





# Notional Autonomy Roadmap \*



\* Comms and networking assumed available or adaptation