



# Autonomous Systems: Challenges and Opportunities

## Topic 9: C2 Architectures and Technologies

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# WAR MADE NEW

「 TECHNOLOGY,  
WARFARE, AND THE  
COURSE OF HISTORY  
「 1500 TO TODAY 」

**MAX BOOT**  
AUTHOR OF *THE SAVAGE WARS OF PEACE*



“My view is that technology sets the parameters of the possible; it creates the potential for a military revolution.”

Max Boot  
*War Made New*



# Outline

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- ▼ UAVs Have Paved the Way
  - ▼ UUVs Are Coming On Strong
  - ▼ The Total Ownership Cost (TOC) Challenge
  - ▼ Lab-based Initiatives
  - ▼ Into the Future
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“The vision of the DoD is that unmanned systems will provide flexible options across operating domains, virtually unlimited. There is no question that the enabling of the warfighter’s execution of assigned Fleet/Force of the future will be heavily dependent upon UVs.” Unmanned systems will be integrated across warfairs, both within and with manned systems, providing the Naval Research Advisory Committee (NRAC) and Joint Force Commander (JFC) with decisive capabilities.”

“The National Defense Authorization Act for FY2007 called for the DoD to establish a policy on relatively new concept. As a result, there is a fear of new and unproven technology.”

*FY 2009-2034 Unmanned Systems Integrated Roadmap*

systems in acquisitions of new systems.

*FY 2009-2034 Unmanned Systems Integrated Roadmap*



# UAVs Have Paved the Way

“By performing tasks such as surveillance; signals intelligence (SIGINT); precision target designation; mine detection; and chemical, biological, radiological, nuclear (CBRN) reconnaissance, unmanned systems have made key contributions to the Global War on Terror (GWOT). As of October 2008, coalition unmanned aircraft systems (UAS) ... have flown almost 500,000 flight hours in support of Operations Enduring Freedom and Iraqi Freedom.”

*FY 2009-2034 Unmanned Systems Integrated Roadmap*

# UAVs Have Paved The Way



▼ UAVs' explosive growth since the Gulf War has created myriad opportunities, for unmanned systems in all domains



▼ These opportunities have been inculcated in official policy ...

▼ ... but UAVs' extensive use has not come without costs.

# UMVs Are Coming On Strong

“Unmanned maritime vehicles (UMVs) present new opportunities to augment our naval forces and maintain maritime superiority around the world.”

*FY 2009-2034 Unmanned  
Systems Integrated Roadmap*

# UMVs Are Coming On Strong



▼ Cultural / organizational challenges persist

▼ Technical challenges force innovation



▼ TOC issues present a challenge – and an opportunity – for UMVs

# The TOC Challenge

“The largest single component of life-cycle cost for a naval ship is acquiring, training, assigning, and supporting manpower for ship operations, maintenance, and support. The primary benefits of optimized crewing are the significant reduction in ownership costs and improved total system performance.”

Patricia Hamburger, Robert  
Bost and Jennifer McKneely  
*Optimized Crewing for Surface Ships*

# The TOC Challenge

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- ▼ The irony of “unmanned” systems
- ▼ TOC issue intensified by increasing manpower costs, rise of optimally manned ships
- ▼ Follow the Firescout model
- ▼ C4 technological innovation a prerequisite for success

# Lab-Based Initiatives

“We will win – or lose – the next series of wars in our nation’s laboratories.”

Admiral James Stavridis  
SOUTHCOM Commander  
“Deconstructing War”  
*U.S. Naval Institute Proceedings*  
December 2005

# Lab-Based Initiatives

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- ▼ Multi-Robot Operator Control Unit (MOCU)
- ▼ Joint Collaborative Technologies Experiment (JCTE)
- ▼ Unmanned Surface Vehicle (USV)
- ▼ UV Sentry

# Representative Lab Efforts

## *Air, Land, & Sea*

Common Operator  
Control Unit (Common OCU)

Robotic Systems  
Pool

In-Theater Combat  
Support Platoon

Networked Remotely  
Operated Weapons



Technology  
Transfer

Automatically Deployed  
Communication Relays

Man-Portable Robots

Unmanned Surface  
Vehicle Technologies



Mobile Robot  
Knowledge Base



Mobile Detection,  
Assessment, & Response

Adaptive  
Mission  
Planning



UGV-UAV-UUV  
Collaboration



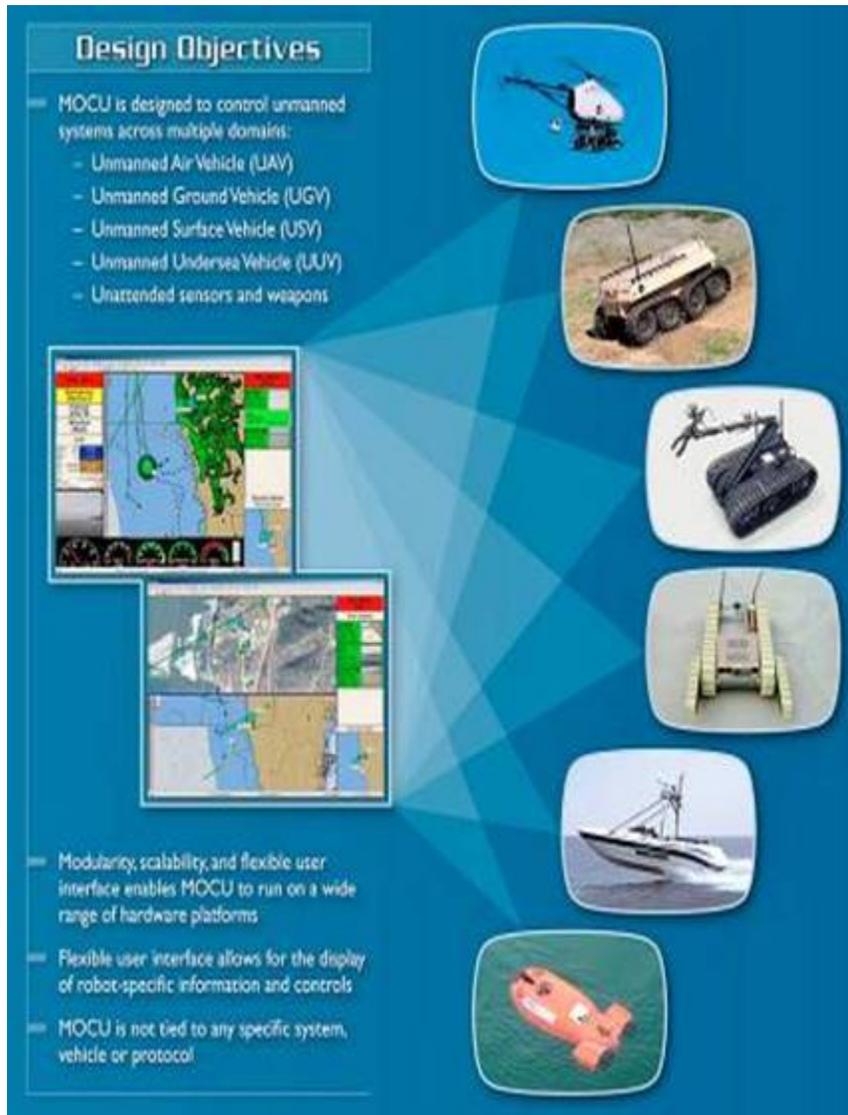
# Multi-Robot Operator Control Unit (MOCU)



MOCU is a flexible software framework capable of monitoring and controlling unmanned systems across multiple domains.

- ▼ Modular, open architecture
- ▼ Government developed and owned
- ▼ Widely adopted

# MOCU ... Multiple UxV Control



- ▼ MOCU was designed from the ground-up to control multiple heterogeneous vehicles
- ▼ MOCU is not tied to any specific vehicle, vehicle type, or protocol
- ▼ Modularity, scalability and flexible display enable control of a wide range of vehicles

# Joint Collaborative Technologies Experiment (JCTE)



- ▼ A two year joint (Navy, Army, Air Force) effort to demonstrate multiple unmanned systems operating in collaboration in multiple domains to accomplish select missions
- ▼ MOCU is the operator interface for all JCTE unmanned systems



# Joint Collaborative Technologies Experiment (JCTE)



# UV Sentry

**An autonomous capability for long-term, persistent and accurate surveillance, detection, identification and engagement of threats that spans large geographical space and media.**

*Ties together existing disparate unmanned systems*



*Reduce system response time*

*Keeps personnel out of hazardous areas*

*Reduce operator workload and bandwidth requirements*

***UV Sentry will address a variety of Naval missions***

# Why UV Sentry?

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- ▼ UV Sentry is a game-changing, disruptive technology:
  - Innovative response to current and emerging threats
  - Minimally manned and highly autonomous
  
- ▼ Cuts across multiple organizations:
  - ONR Departments
  - PEOs
  - Warfare Centers
  
- ▼ Why now?
  - Emerging operational problems compel novel, timely solutions
    - Addresses emerging emphasis on force and infrastructure protection missions
  - Leverage numerous, recent S&T developments

# Into the Future

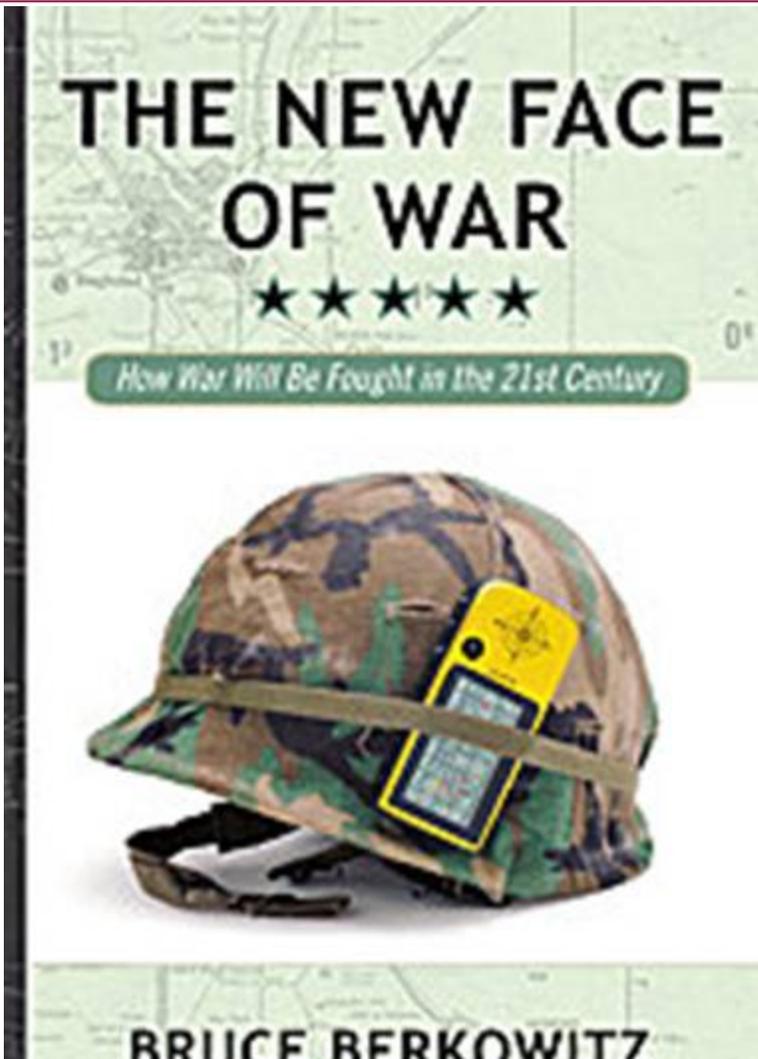
“To change anything in the Navy is like punching a feather bed. You punch it with your right and you punch it with your left until you are finally exhausted, and then you find the damn bed just as it was before you started punching.”

President Franklin Delano Roosevelt

# Into The Future

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- ▼ UxVs' ability to deliver revolutionary change is real ...
- ▼ ... but to be realized, this vision must be supported by commitment at the top levels of naval leadership, and by leadership and stewardship at the programmatic level
- ▼ A way ahead: operationalize the mandate of the Department of Defense *FY2009-2034 Unmanned Systems Integrated Roadmap* to “expedite the transition of unmanned technologies from research and development activities into the hands of the Warfighter.”



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Recent experience suggests that the right technology, used intelligently, makes sheer numbers irrelevant. The tipping point was the Gulf War in 1991. When the war was over, the United States and its coalition partners had lost just 240 people. Iraq suffered about 10,000 battle deaths, although no one will ever really be sure. The difference was that the Americans could see at night, drive through the featureless desert without getting lost, and put a single smart bomb on target with a 90 percent probability.”

Bruce Berkowitz

*The New Face of War*