Modularity in Complex Systems: Understanding System Architecture in Unmanned Aircraft Systems

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Motivation

➤ Because of Warfighter demand, the DoD's *investment is increasing tenfold* in unmanned aircraft systems (UASs) this decade. However, cross-platform *coordination is lacking*, and *cost & schedule growth* are concerns.

➤ Industry uses modular product architectures to manage product families to increase *market share*, increase *economic order quantities* and shorten *time to market*. Models are developed for these purposes.

➤ The DoD focuses on *delivering a capability for the best value*. Models for using modularity in this purpose have not been developed. These models could improve cost, schedule and performance of acquisition programs.

➤ This research will characterize the *benefits of a modular architecture strategy to acquire UASs*.

Research Questions

How much value can be gained by adopting a modular strategy to acquire UASs?

➤ What functional mission capabilities are found in military UASs and are common to multiple systems?

➤ How are functional capabilities embodied in UASs?

➤ What functional capabilities should be common to UASs?

➤ Where does commonality and modularity exist and where do opportunities exist to increase modularity and commonality?

Research Approach

➤ Develop functional and physical models of UASs to a module level

➤ Identify modules that perform a mission capability

➤ Construct models to show how systems map to mission capability

➤ Identify best opportunities for commonality in UAS architectures

Expected Contributions

Expand theory: Develop platform concepts for government organizations and products (Government products deliver a capability vice seeking profit)

Methods: Develop, modify, and apply modularity concepts – concepts usually developed for profit ventures – to government applications

Global Hawk   (www.af.mil/photos)

Global Hawk Ground Station www.directionsmag.com

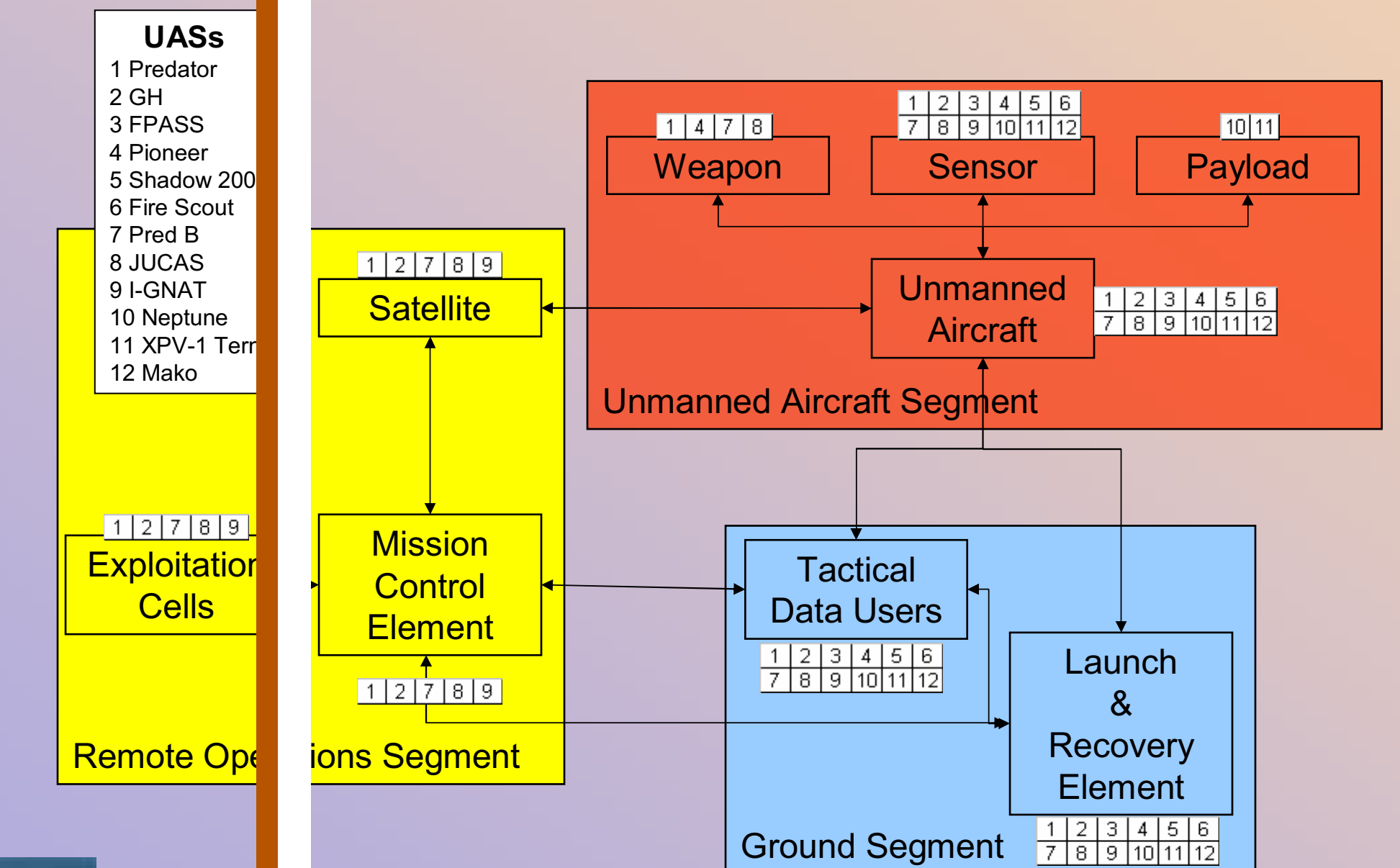Predator Ground Station (www.spyflight.co.uk)

Predator A   (www.af.mil/photos)

Data Analysis

Generalized UAS Architecture for 12 Military Systems

UASs
1 Predator
2 GH
3 FPASS
4 Pioneer
5 Shadow 200
6 Fire Scout
7 Pred B
8 JUCAS
9 I-GNAT
10 Neptune
11 XPV-1 Tern
12 Mako

UAS Common Capabilities

UAS Capability Module Matrix

	GH	Predator	Reaper	Fire Scout
Air Vehicle	X	X	X	X
Communications				
ARC-210	X	X	X	X
TCDL	X			X
Sensor				
AAS-52		X	X	X
MTS		X	X	X
Weapons				
Hellfire		X	X	X
SDB			X	
GCS				
AFMSS		X	X	
Intel WS		X	X	X