Department of the Navy

The Importance of Integrated Air and Missile Defense to the Department of the Navy (and the Joint Force)

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Under Secretary of The Navy

3d Annual Symposium on the State of Integrated Air and Missile Defense
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BLUF: IAMD is the key enabler for joint power projection operations in the guided munitions era

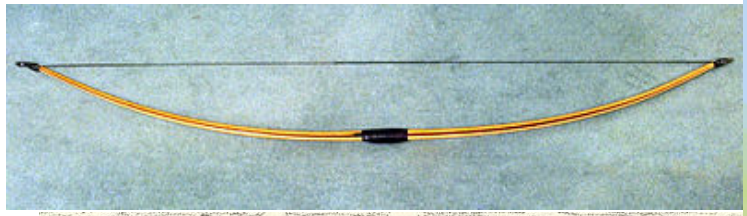
"…the information age is nothing new to the navies of the world. The role of information (scouting) reached fruition in the 1930s with the fusion of air-search and radio communications. Information warfare and operations are indeed evolving with technology, but in most respects they are an extension of [the World War II sensory revolution]. **What we have seen in naval tactics is a new weapon—the well-aimed long-range missile—to take advantage of sensing and communications technology, and vice versa."**

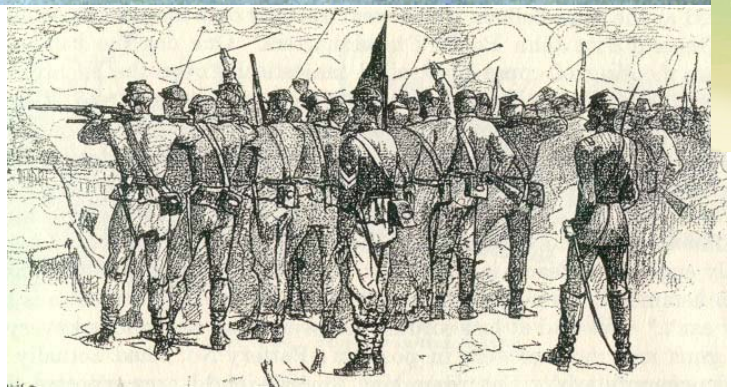
Captain Wayne P. Hughes, Jr.
Fleet Tactics and Coastal Combat, p.4

IAMD is the foundation of any modern fleet

Unguided munitions warfare

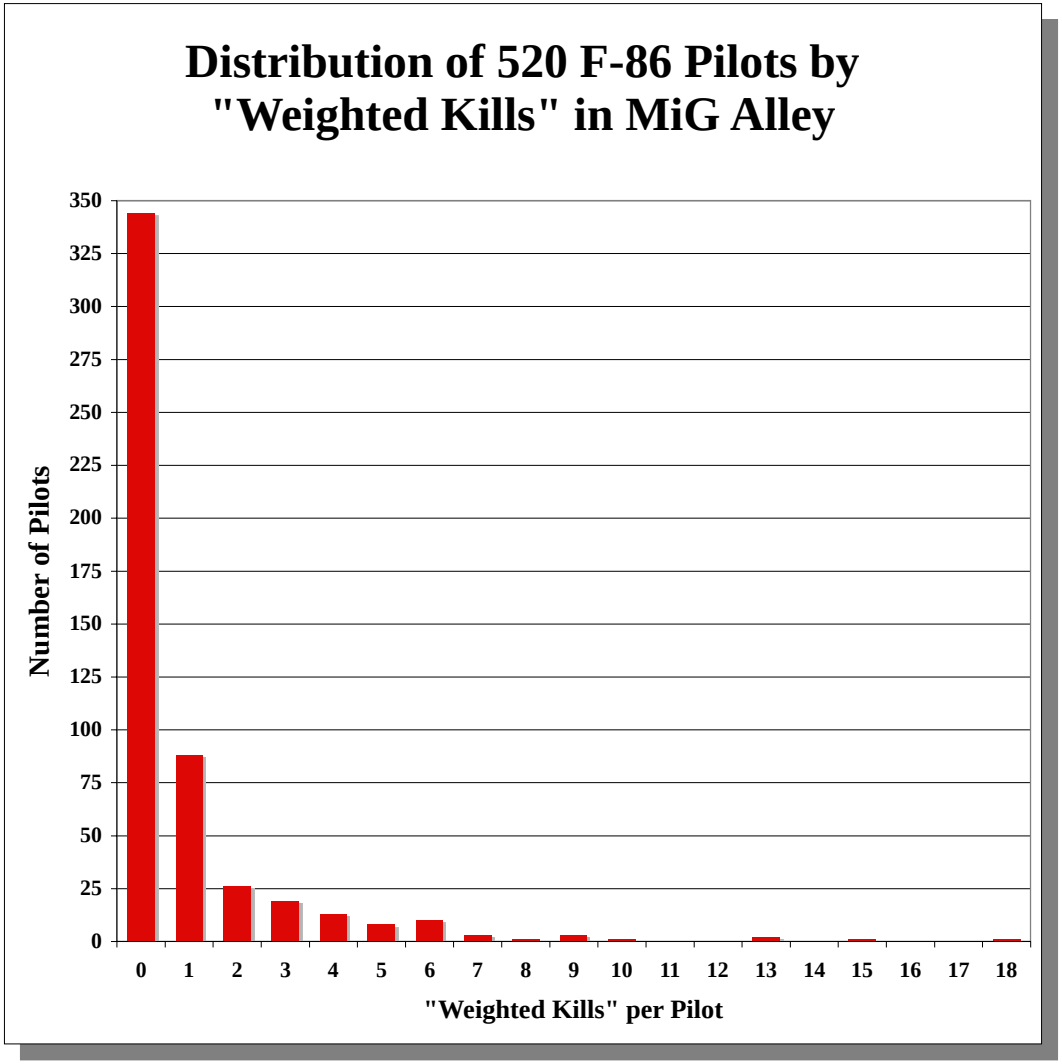
- Combat with unguided munitions had one central characteristic: ***most munitions that were thrown, propelled, fired, launched, or dropped ultimately missed their targets—with miss distances increasing over range***





- Unguided munitions warfare was marked by a statistical measure known as **circular error probable (CEP)**

Even in close-in, line-of-sight combat, only a few gifted individuals flourished in this regime



"You can count on about three, if you are lucky, of your pilots in the squadron to possess those things necessary to be exceptional leaders and produce more than an occasional kill or two."

— Major "Boots" Blesse, 1954
No Guts, No Glory

Unguided munitions warfare thus had an inherent bias towards mass

- **Unguided munitions warfare:**
  - Most projectiles that are thrown, shot, fired, or dropped ***miss their targets*** **(increasingly so as range increases)**
  - **Rate-of-fire** far more important than munitions range
  - **Munitions range is dependent on cost**; lack of accuracy means the cost premium for long range munitions was rarely worth it
  - **Collateral damage an accepted fact of life**

WWII saw the first significant move away from unguided weapons warfare

• **First step: battle networks—** three vertically-linked grids which operate together as a single cooperative and adaptive fighting network:

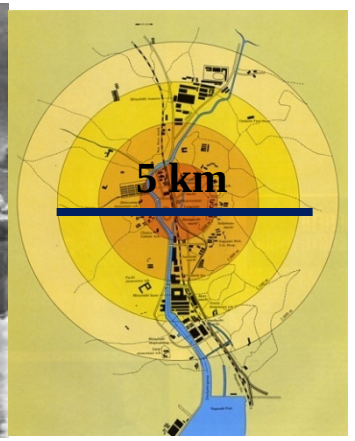
- Sensor grid (*common battle network picture)*
- C3I grid
- Effects grid

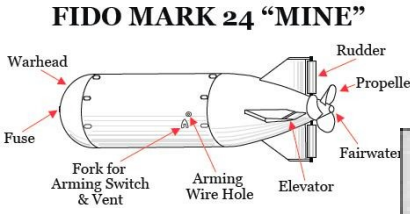
• Battle networks helped take surprise out of enemy attacks; however, with unguided weapons, mass v mass engagements were still the norm

Second step: technical alternatives to unguided weapons

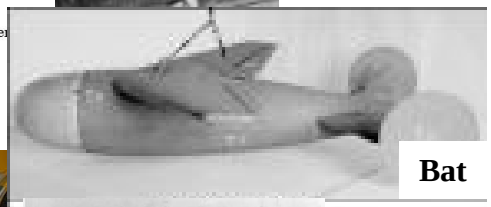
- ***Atomic munitions*** solved the problem of large CEPs by delivering one enormous pulse of destructive firepower

- ***Guided munitions*** solved the problem of large CEPs by actively correcting for individual-aiming or subsequent errors while homing on their targets or aim-points
  - This reduced CEPs to the point that individual munitions (as opposed to dense salvos) could achieve effects on target

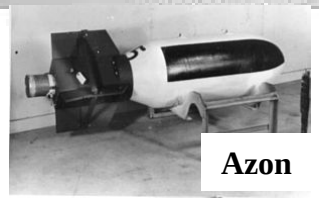





Wren


Bat


Fritz-X


Azon

Both battle networks and guided munitions played big roles in AirSea Battle (I): The Battle for Okinawa

- Unfortunately, our opponent had the guided weapons

"Approximately 2,800 *Kamikaze* attackers sunk 34 Navy ships, damaged 368 others, killed 4,900 sailors, and wounded over 4,800. Despite radar detection and cuing, airborne interception and attrition, and massive anti-aircraft barrages, a distressing **14 percent of *Kamikazes* survived to score a hit on a ship;** nearly 8.5 percent of all ships hit by *Kamikazes* sank."

Dr. Richard P. Hallion,
"Precision Weapons, Power-Projection, and the Revolution in Military Affairs"

AirSea Battle (I) spurred the first move toward modern fleet battle networks, emphasizing IAMD

- Lacking guided weapons of their own, Navy forced to engage kamikazes at greater ranges away for the task force

- In 1944 and 1945, 24 Gearing class DDs were converted into DDRs, equipped with:
  - Aircraft homing beacons (YE and YG)
  - Air search radar for range and bearing (SC-2 or SR)
  - Height finder radar (SP)
  - Fighter control circuits (VHF radios) and a fighter director officer

- As Norman Freidman explains, this marked an important first step toward modern fleet design:
  - "**This might be the first step in the integration of the task force, individual ships no longer carrying their own weapons, but rather achieving their effects in cooperation with the entire force. Radars and radios, then, could no longer be considered mere auxiliaries to the weapons of a single ship, but rather contributions to the total information gathering capacity of the task force, which capacity would in turn contribute to the total combat capacity of the task force, *directed in unison*.**"

First step toward modern integrated fleet "battle networks"

More broadly, AirSea Battle (I) helped to illuminate the key characteristics of guided weapons warfare

- **Unguided munitions warfare:**
  - Most projectiles that are thrown, shot, fired, or dropped ***miss their targets*** **(increasingly so as range increases)**
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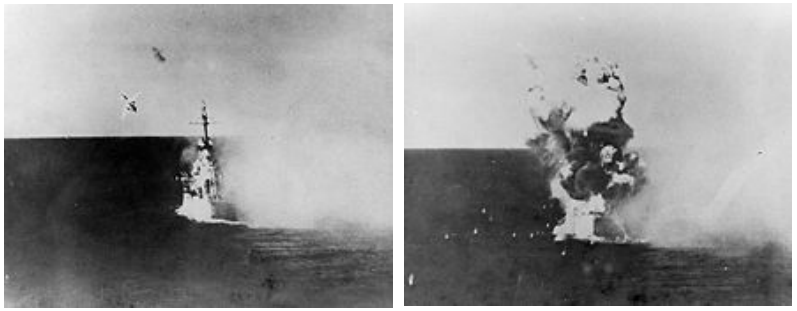
  - **Collateral damage an accepted fact of life**

- **Guided munitions warfare**:
  - Munitions have a good chance of hitting their targets; ***accuracy is independent of range***
  - **Maximum effective range and weapon Pk** are more important than rate-of-fire or density of barrage
  - **Range is still dependent on cost** (and costs for guided munitions are uniformly higher than for unguided weapons), but operational ROI much higher
  - **Operator skill no longer so important**; weapon does much of the work
  - **[Over time, collateral damage far less acceptable]**

The implications of AirSea Battle (I) were clear to naval planners

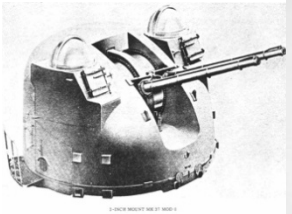
- In the unguided weapons regime, massive salvos were required to achieve a single target hit. **In the guided weapons regime, a salvo only had to be dense enough to saturate an opponent's defenses**



- Naval warfare would see collisions between opposing guided weapon battle networks; combat outcomes would depend on the winner of guided weapon salvo competitions
  - Regime was offensive dominant
    - "Attack effectively first"
  - Burden on fleet defenses would be very high (especially in atomic warfare)
    - **IAMD needed to defeat saturation and ride out salvos**

Navy's first gen fleet design (1945-1958) reflected the transition from unguided to guided weapons warfare

- Key operational problem:
  - Getting carriers close enough to the Soviet Union to conduct nuclear strikes
    - **Integrated air defense against jet bombers armed with tactical nuclear weapons**



3"/70

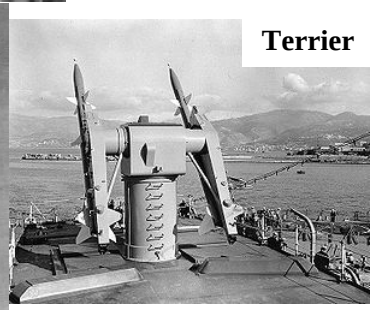
5"/54

- First steps:
  - Develop improved gun systems 3"/50 and 70, 5"/54
  - New air search, height finding radars
  - Upgrade radar pickets to control fleet jet interceptors

Talos

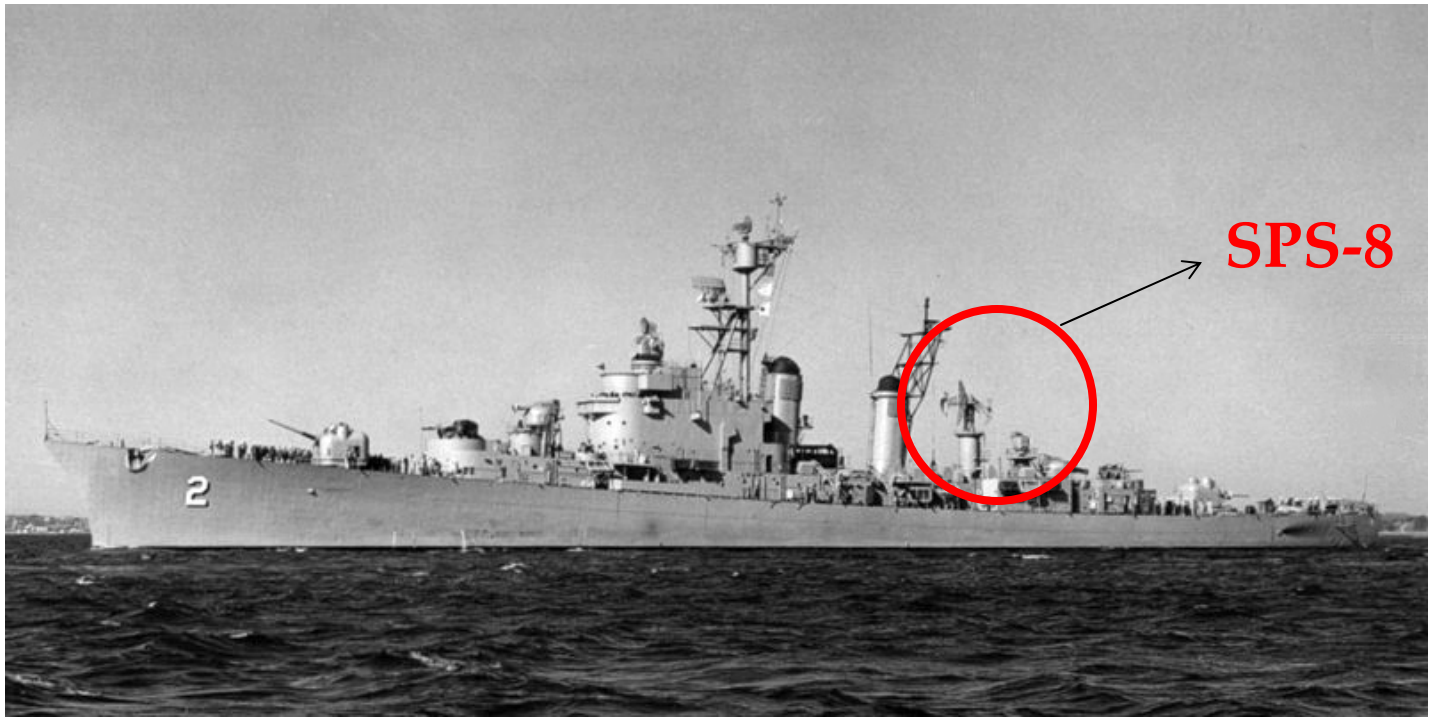
- Second steps:
  - Develop new surface-to-air missiles ("3 Ts")
  - Develop tools to prevent task saturation in CIC
    - CDS to EDS
  - Network fleet CICs together
    - Data links
    - High capacity, long-range communications

Tartar



Terrier

First gen IAMD ships (1945-1958) focused on air control of carrier CAPs



Mitscher-class DL

Second gen fleet design (1956-1976) marked a concerted shift to guided munitions warfare (and IAMD)

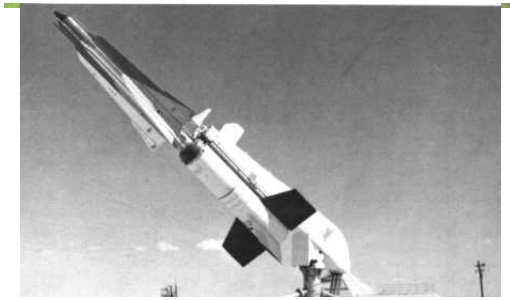
- Shift accelerated by appearance of first Soviet air launched anti-ship cruise missiles

- Second gen bet: advanced Typhon combat system
  - Track via missile guidance (SPG-59) + Typhon missiles
  - Attempt failed; led to development of Aegis + standard missile family (SM-1 introduced 1970)

- Danger of saturation spurred development of terminal anti-missile systems
  - RIM-7 Sea Sparrow

- Major advance in fleet battle networking came with NTDS
  - "…the first shipboard tactical data system in the world to use stored-program, solid state computers. Also the first to use multiple computers in a distributed tactical data processing system…[and] **The first shipboard system in the world to use automatic computer-to-computer data exchange between ships and aircraft."**

AS/KS-1 Komet (Kennel)



RIM-50 Typhon

RIM-7 Sea Sparrow

Gen 2 saw a mix of converted and new construction IAMD combatants

CAG

CLG

CG

CLGN

DDGs

DLGN
S

DLGs

Third gen fleet design (1975-1989) was all about high intensity guided weapons warfare against the Soviet Navy

- All combat systems and weapon guidance systems shift to digital electronics
- Harpoon ASCM, Tomahawk anti-ship missile (TASM) and land attack missile (TLAM) reintroduce offensive punch to surface battle line
- **But fleet never loses focus on importance of IAMD**
  - Key new systems slotted into NTDS battle networks
    - Aegis AAW combat system with SPY-1 radar
    - New Threat Upgrade (NTU) for Gen 2 combatants
- New Vertical Launch System (VLS) converts BFC combatants into modular missile batteries
- New effectors:
  - SM-2: longer range, digital autopilot, improved ECCM
  - RIM-7M Sea Sparrow + Phalanx CIWS
  - SLQ-32 + Mk 36 decoy launcher (e.g., SRBOC)


TASM/TLAM


Harpoon


SPY-1


Aegis Combat System


NTU


VLS


SM-2 VL


CIWS

Gen 3 fleet design included a mix of upgraded Gen 2 and new Gen 3 multi-mission combatants

Kidd DDGs

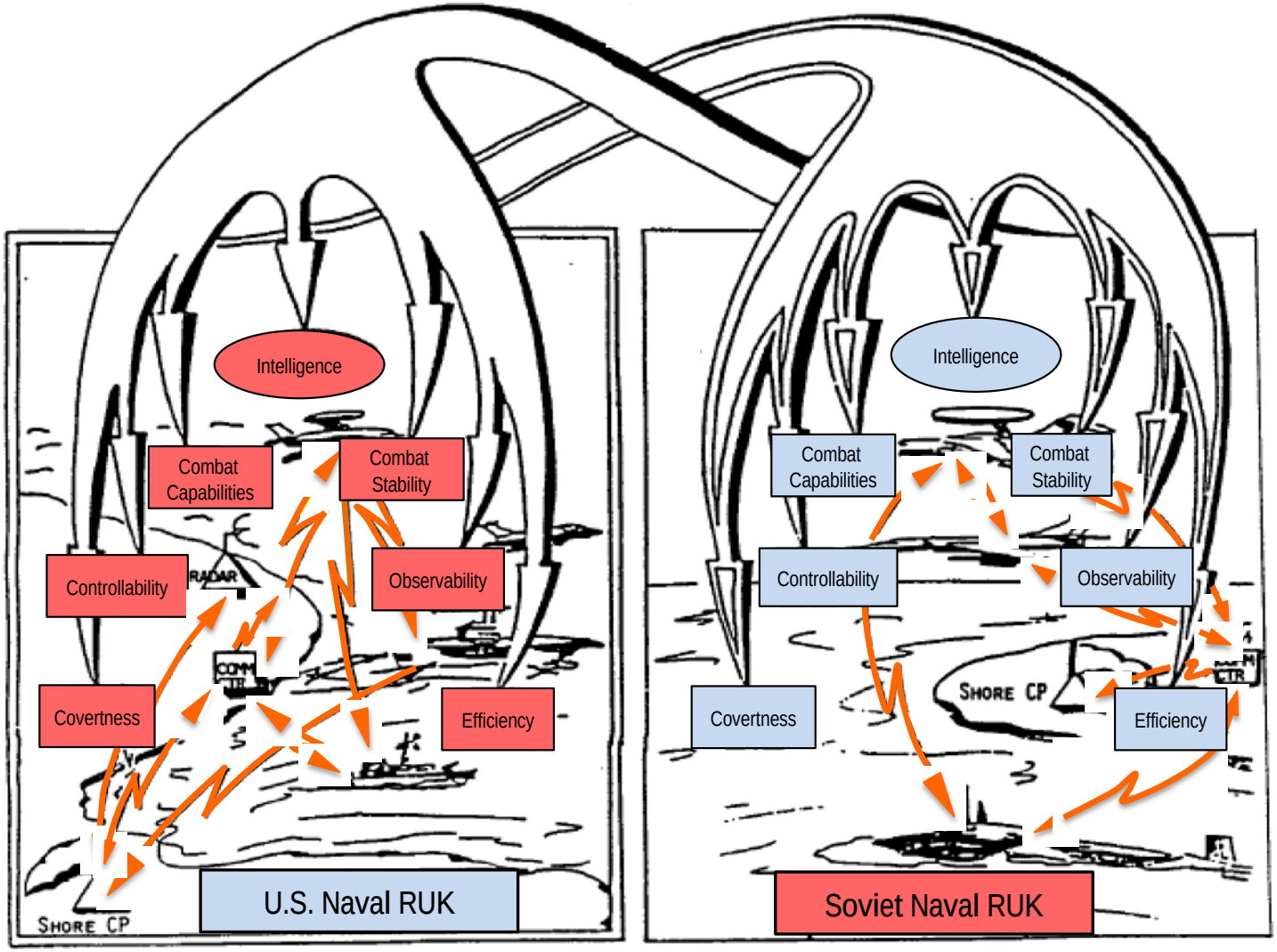
VLS Ticonderoga CGs

NTU CGs

Ticonderoga CGs

AirSea Battle (II), late Cold War

- Collision of two guided munitions battle networks (or recon-strike complexes, RUKs)



Source: Captain 1st Rank E. G. Shevelev, "Fundamentals and Applications of Military Systemology (Study Aid)," Foreign Broadcast Information Service, *JPRS Report: Central Eurasia*, JPRS-UMA-93-002-L, May 23, 1993

Fourth generation fleet design (1988-2001) focused on littoral combat and battle network communications and data exchange

- Key operational problems:
  - Rapid halt of armored invasions
    - High premium on strike, which meant high premium on VLS (for TLAM)
    - New GPS/INS weapons (e.g., TLAM Blk III)
  - Connecting the fleet to the joint battle network
    - Copernicus; C4I to the warfighter
    - CCC, TCC; GLOBIXS, TADIXS, BCIXS, TADILS

- **IAMD in littoral clutter**
  - Improved sensor grid
    - SPY-1D radar introduced on Burke DDGs
  - Improved C3I grid
    - Network Centric Warfare
    - Cooperative engagement capability (CEC)
  - Improved effectors
    - **Ballistic missile defense interceptors**
    - Rolling Airframe Missile (RAM)
    - Nulka decoy

- First steps toward fleet-wide OACE: ARCI

VLS TLAM

SPY-1D

RAM

Nulka

TLAM Blk III

Gen 4 fleet design was also all about battle force standardization

- First move: divest all 2nd and 3d Gen BFC combatants without Aegis and/or VLS
- Second move: divest all FFs, and move toward an all Perry-class FFG fleet (long version)
  - Lack of capable AAW system a killer
- Third move: complete Gen 3 production runs
  - Build out all 27 Ticonderoga-class CGs
  - Build 57 Arleigh Burke DDG program
- Fourth move: complete conversion of 24 Spruance DDs into "TLAM barges"
- Planned move: gradually replace DDs and FFGs with 32 DD-21 land attack destroyers with "submarine like" survivability


27 Tico CGs (22 VLS)

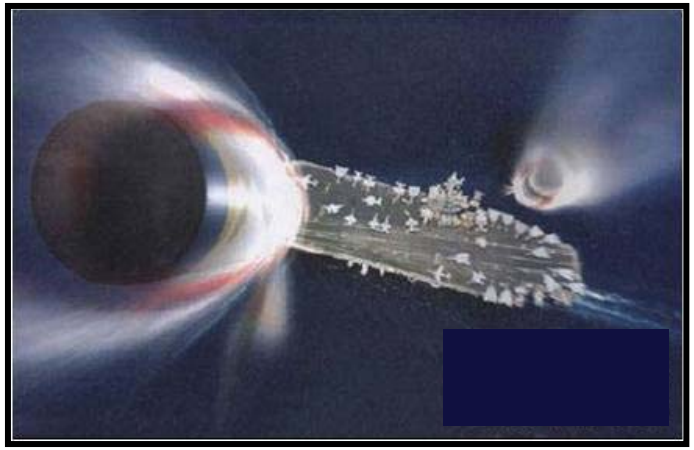

57 Burke DDGs (all VLS)

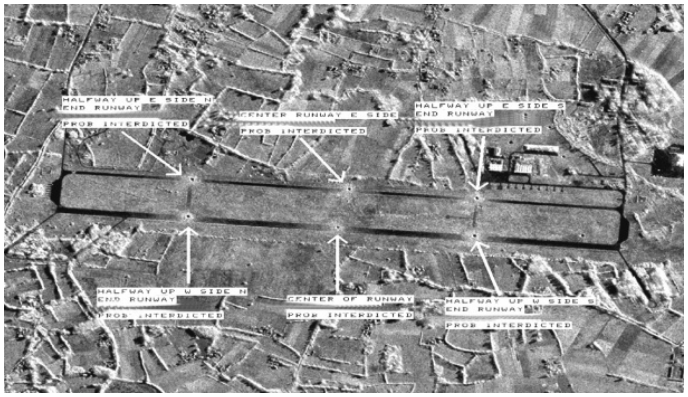

24 Spruance VLS DDs


30 Perry FFGs


32 DD-21 (all VLS)

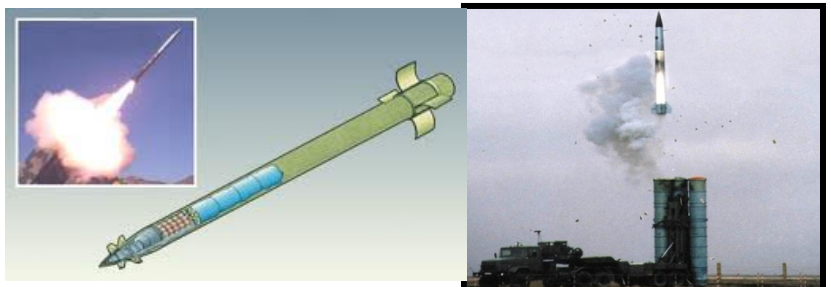
Fifth gen fleet design is all about adapting to the mature guided munitions regime (proliferated)





Anti-access ("A2"): prevent operational freedom of action

Most problematically for the US, guided weapons complicate getting joint forces into theater, and constrain their operations once there

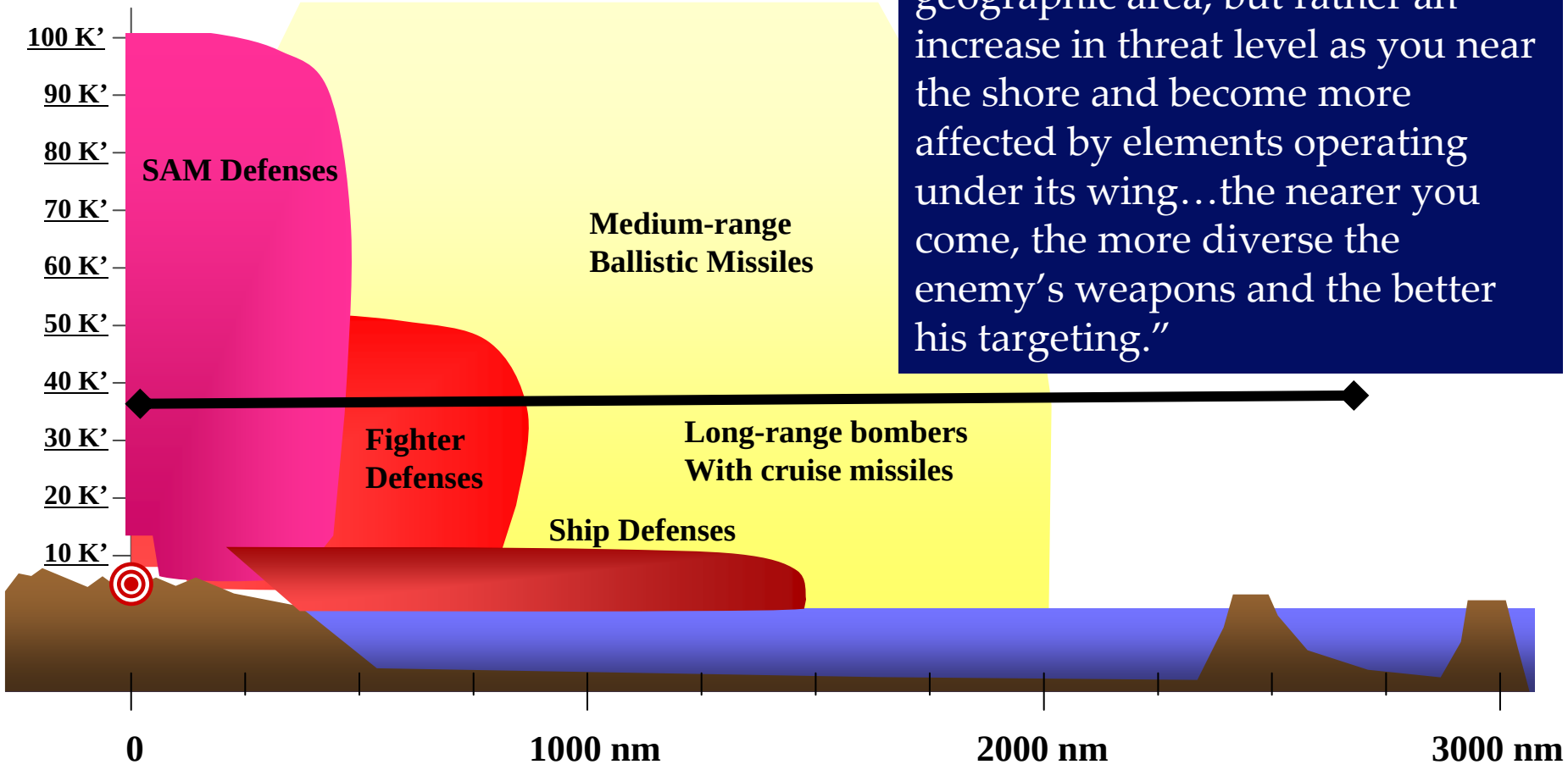


Area-denial ("AD"): prevent tactical freedom of action

Open Source Materials

Modern "A2-AD" networks greatly expand the contested zone that US joint forces will have to cross

"The littoral is not a fixed geographic area, but rather an increase in threat level as you near the shore and become more affected by elements operating under its wing…the nearer you come, the more diverse the enemy's weapons and the better his targeting."



The expanding contested "littoral" battle space

As it has been since 1945, fifth gen fleet design (2001-?) aims to win future guided weapon salvo competitions

- Key aim: to disrupt and destroy enemy A2-AD networks and their defensive and offensive guided weapon systems in order to enable US freedom of action to conduct concurrent and follow-on operations
  - Win a two-sided force and counter-force battle against an opponent with rough battle network and guided weapons parity

- FORCE: Disrupting/destroying the enemy's A2/AD network by…
  - "Scouting" the enemy's battle network
  - "Attacking effectively first" using both kinetic and non-kinetic means (e.g., network attack)
  - Coordinating operations and attacks using widely dispersed forces
  - Sustaining effective salvos and network attacks

COUNTERFORCE: reducing the effect of enemy guided weapon and network attacks

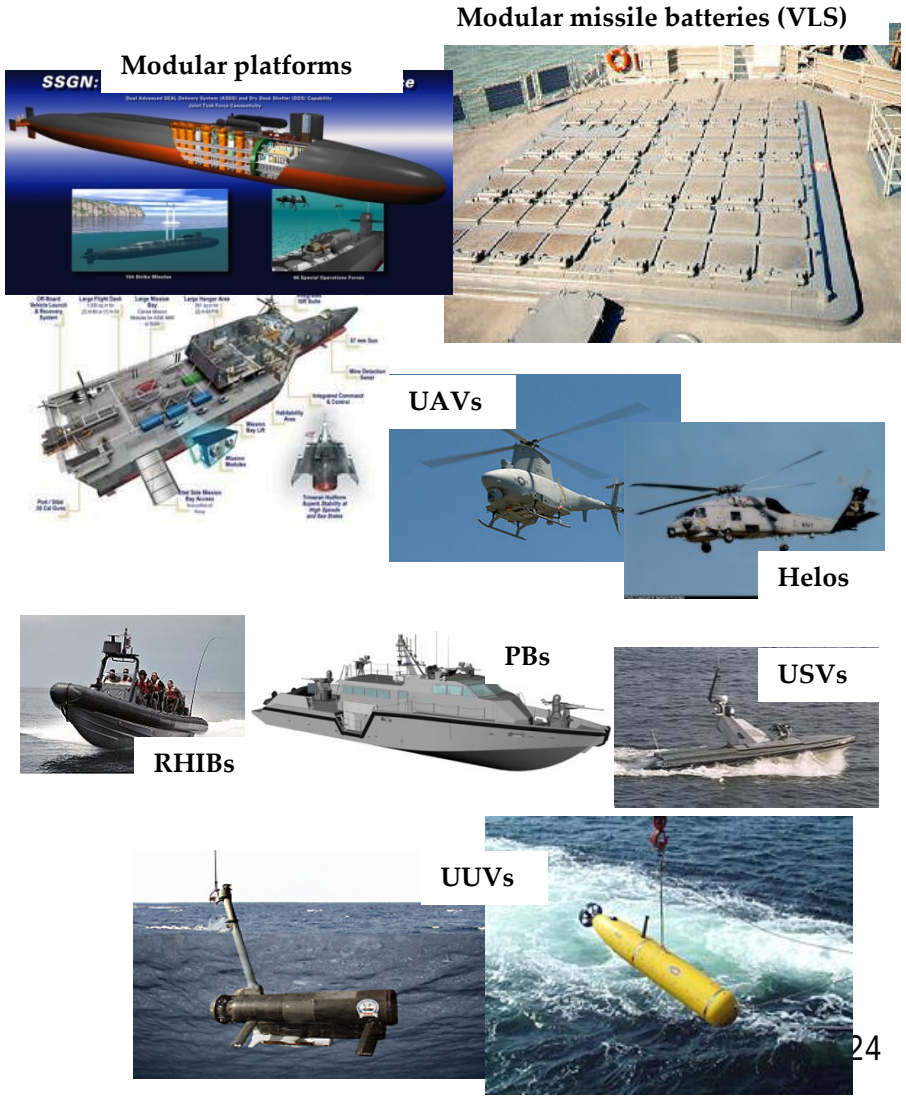
- *Reducing the total number of **effective** enemy guided weapon salvos and network attacks*
  - "Anti-scouting" activities to prevent targeting
    - Blinding, disrupting, dismantling the opposing battle network (cyber and kinetic attack)

- *Reducing the potential density of enemy guided weapon salvos*
  - "Killing the archers"

- ***Riding out actual enemy salvos and network attacks***
  - Passive defenses (spoofing, deception, etc)
  - Active defenses
    - Cyber
    - IAMD
  - Enhanced readiness posture; launch on warning
  - Dispersal and hardening

In response to this evolving threat, Fifth generation fleet design (2001- ?) is all about building a "Total Force Battle Network"

- Key design principles:
  - Optimize the network, not the platform
    - "All platforms sensors; all sensors netted; all relevant information available to the warfighter"
  - Build energy-efficient platforms with:
    - Smaller crews (automation)
    - Open architecture combat systems for rapid capability upgrades
    - Reconfigurable, modular payloads and payload bays for mission flexibility
    - Air and surface interfaces
  - Field multiple manned and unmanned "second-stage" (off-board) systems
    - Helos + UAVs
    - USVs + RHIBs + Boats
    - UUVs



The Gen 5 surface force reflects the shift to a Total Force Battle Network

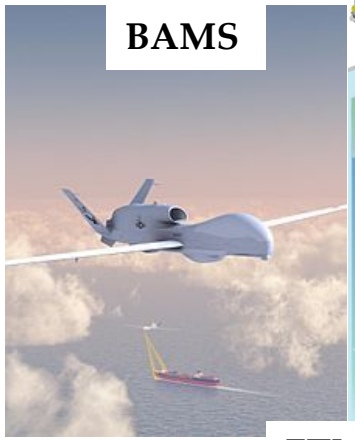
- Key operational problems:
  - Maintain cost-effective global forward presence
  - Defeat multi-dimensional A2/AD networks
  - Ballistic missile defense
- Gen 5 reintroduces a hi-lo mix:
  - Large ***multi-mission*** battle network combatants with high capacity missile batteries for high-end combat missions
    - Modular missile batteries
  - Small ***multi-role*** battle network combatants for low-end missions
    - Modular mission packages

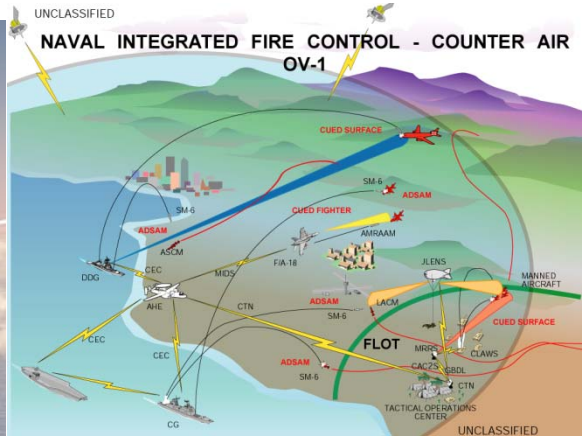
~ 90 Large Battle Network Combatants

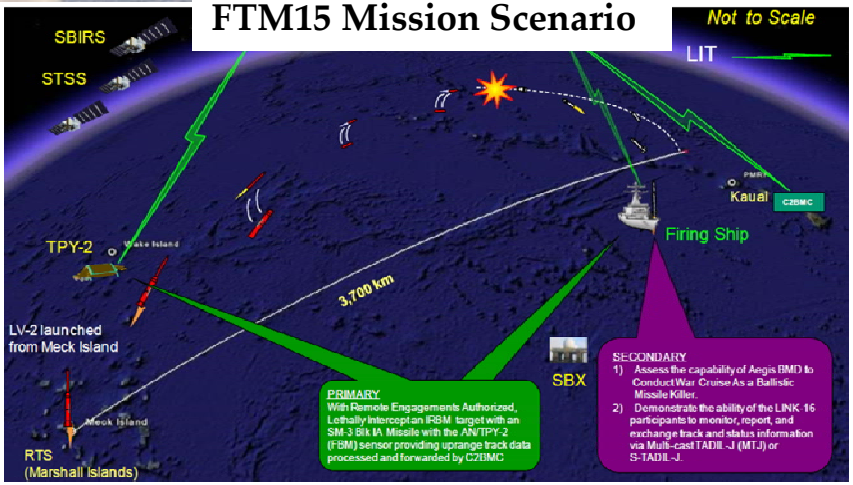
~ 55 Small Battle Network Combatants

Power of the Total Force Battle Network is/will be far greater than the sum of its parts

- Redundant, multi-phenomenology, inter-netted **sensor grids**
  - Maritime Patrol and Reconnaissance Force
    - BAMS + P8
  - National and Joint sensors
  - New battle network sensors
    - SPY-1D(V) to AMDR
    - E-2D
- Adaptive, collaborative **C5I grids**
  - Interactive tactical chat rooms
  - Common Operating Picture (COP)
  - Single Integrated Air Picture (SIAP)
- Multi-dimensional, cross-domain **effects grids**
  - Network-enabled weapons
  - Launch on remote; engage on remote
- **A focus on the network allows fleet designers to forego unaffordable, do-it-all IAMD platforms**
  - E.g., CG(X)

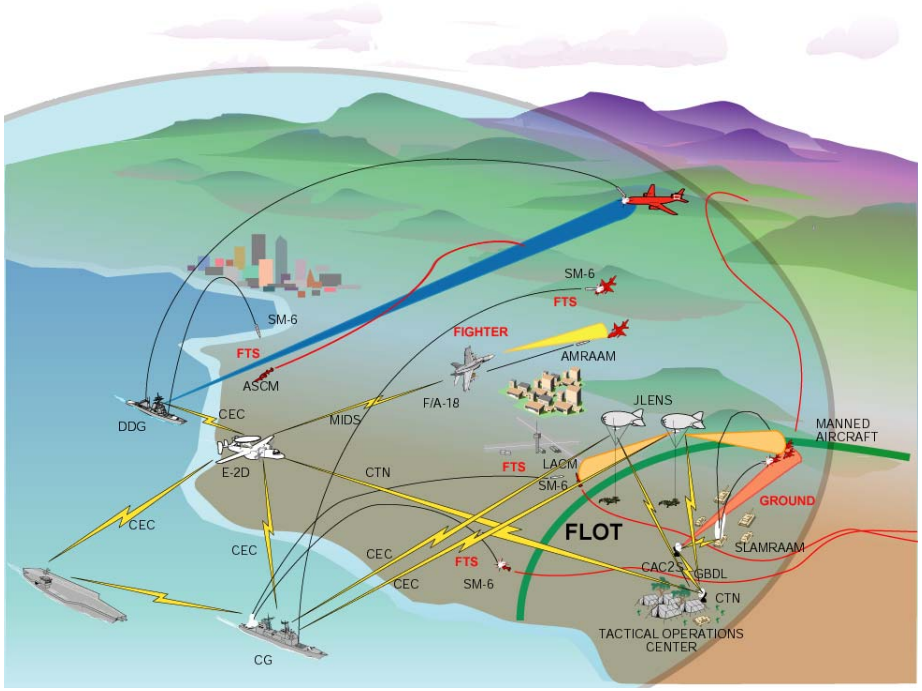






IAMD is the foundation for joint power projection operations in the mature guided munitions regime

- Not optional
- AirSea Battle…
  - …to Joint Forcible Entry…
    - …to AirLand Battle (updated to account for G-RAMM)
- Seamless joint solutions are the key
  - Air Force – Navy integration on ASB
  - Army ADA
- Can't afford to lose sight how DEW and EM weapons can change the equation



Questions?