

Naval Transformation and the Littoral Combat Ship

Center for Strategic and Budgetary
Assessments

February 25, 2004

CSBA and the Littoral Combat Ship

- ***Strategy for a Long Peace*, January 2001**
 - Urged that the *Streetfighter* concept then being debated within the Navy be more fully explored
- ***The Challenge of Maritime Transformation: Is Bigger Better?*, April 2002**
 - Questioned the Navy's decision to stop producing frigates; endorsed "inshore warfare squadrons"
 - Dismissive of emphasis placed on expendability in the *Streetfighter* debates
- ***Meeting the Anti-Access and Area Denial Challenge*, May 2003**
 - Skeptical of using small crewed combatants in a high end A2/AD environment (did not address suitability for other scenarios)
 - Recommended two different operational squadrons be assembled and tested in an operational setting

Report Outline

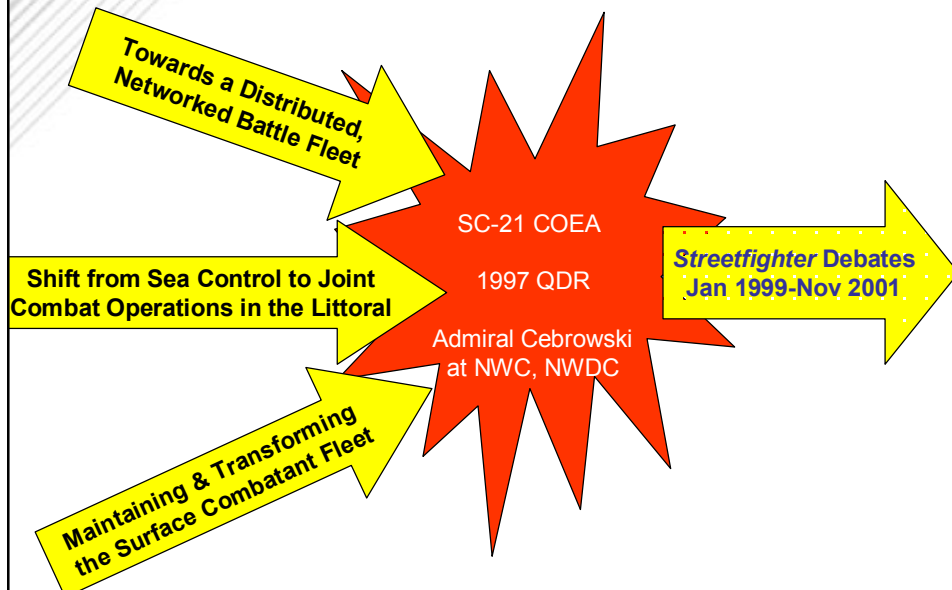
- **Part I: The LCS as Part of Broader Naval Transformation**
 - Forces Impelling Transformation
 - *Streetfighter* Debates
 - LCS as a Part of Navy Transformation Plans

- **Part II: Small Network Combatants in the 21st Century Assured Access Navy**
 - Requirements for an “Assured Access” Navy
 - Traditional Role of Small Combatants
 - LCS as a Battle Network Component System

- **Part III: Unresolved Issues**

- **Part IV: Recommendations**

1998: The “Big Bang”



1999-2001: A Contentious Debate

- The *Streetfighter* debate served as a surrogate debate over the implications of the possible shift to a new Networked Battle Fleet Era
 - The Navy argued that the conceptual, cultural, and organizational precepts of the Carrier Era remained valid
 - Admiral Cebrowski and *Streetfighter* advocates argued that the Navy was moving to a new era with new design precepts
- Throughout, the corporate Navy argued vociferously against small combatants
 - 2001 QDR: Navy denigrates small combatants
- Both sides made key mistakes in the debate
 - Streetfighter advocates allowed the debate to turn too much on risk aversion and “expendability”
 - The 30-Year Shipbuilding Plan published in 2000 neither acknowledged the internal debate over small combatants nor hedged the Navy’s bets over the debate’s outcome

2001/2002: The *Initial* Phase of the Debate Ends

- New cultural mindset: Navy’s job is to guarantee delivery of joint goods and services ashore
 - “Assured access” is job 1
- New *Departmental* focus: Sea basing is forging intra-Departmental ties that have atrophied since WWII/Korea
- New way to conceive of the battle fleet:
 - Distributed fleet battle networks
 - Total Ship Battle Force to “Total Force Battle Network” (TFBN)
 - TFBN design goals: “Get connected, get modular, get off-board, get unmanned”

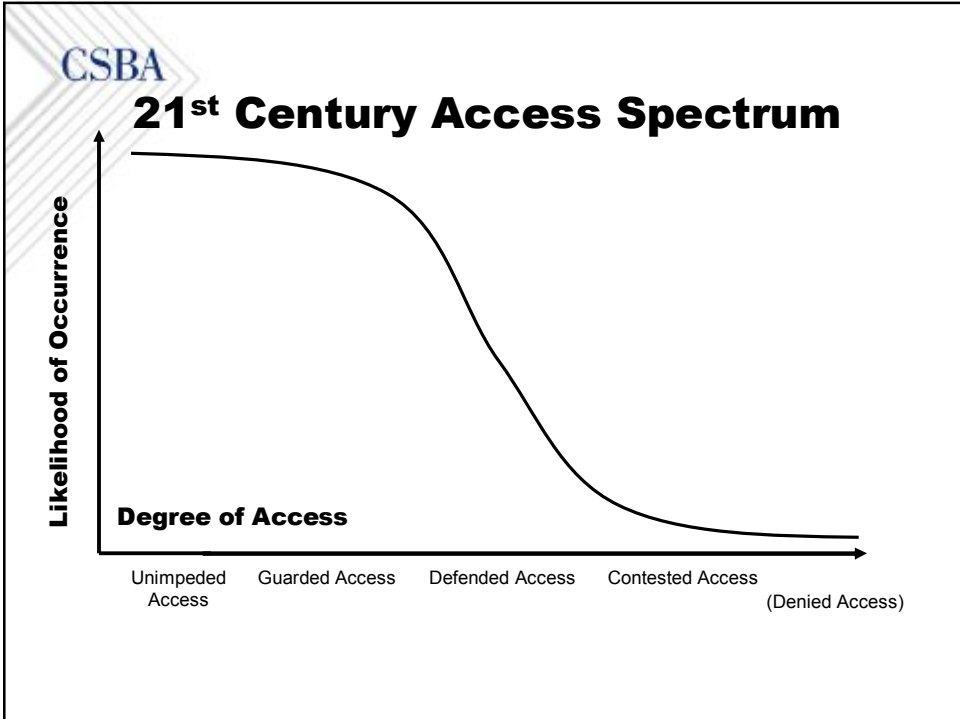
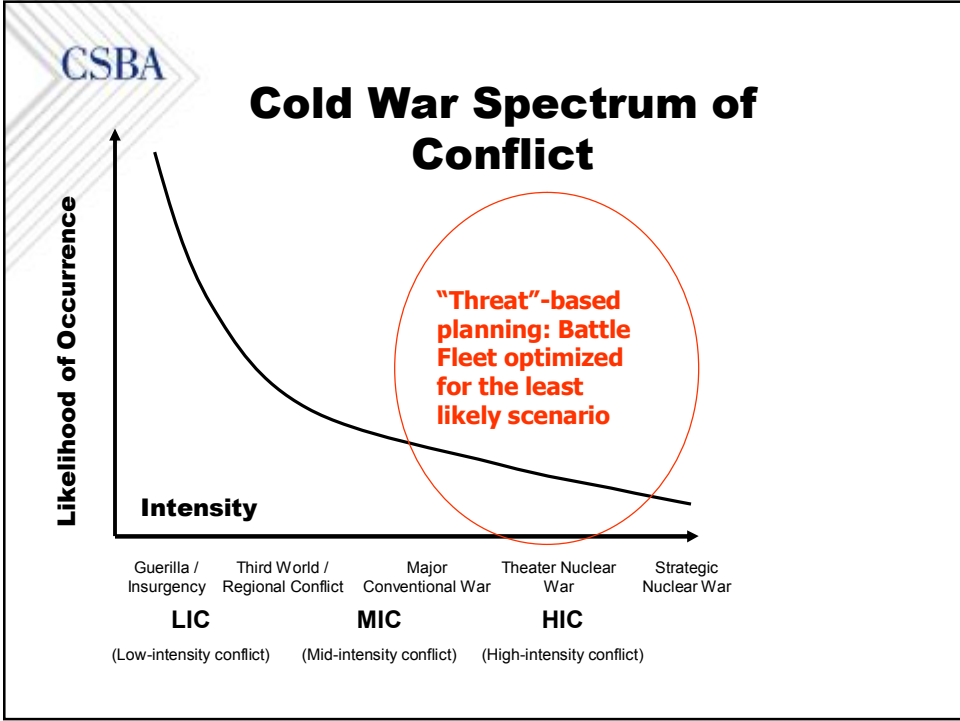
The *Initial* Phase of the Debate Ends (2)

- **“New” surface combatant fleet structure:**
 - Large combatants: DD(X) and CG(X) form the littoral “battle line”
 - Intermediate combatants: legacy AEGIS combatants augment battle line and form independent SAGs
 - Small combatants: The LCS screens the “big boys”
- **New operational architecture: Global ConOps Navy**
 - 37 smaller independent strike groups
- **New fleet deployment pattern: Fleet Response Plan/Flexible Deployment Concept**
 - Fleet (network) surge

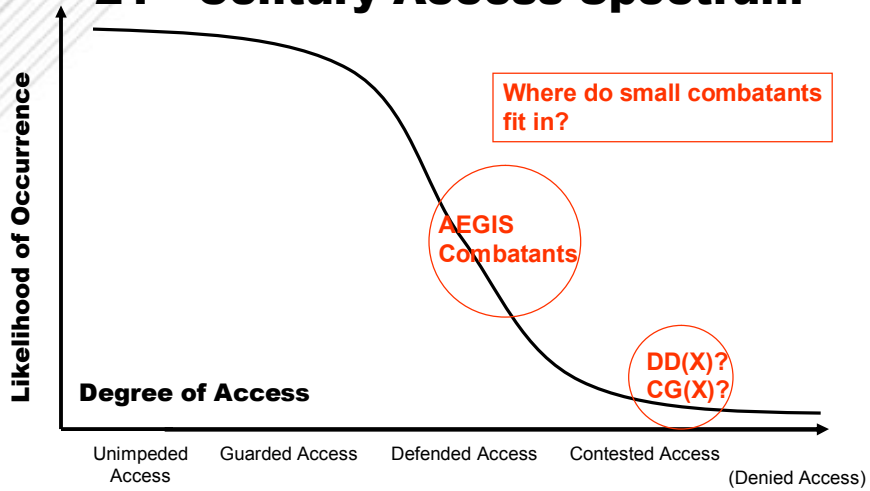
**All indicators: the Navy is shifting to a new battle fleet era:
Distributed, Networked Battle Fleet**

Small Combatants in the 21st Century “Assured Access Navy”

- **The guiding questions should be:**
 - What is the proper battle fleet (battle network) design architecture for the 21st century “Assured Access Navy?”
 - What is the proper (initial) mix of sensors, surface combatants, submarines, aircraft, unmanned systems for the 21st century TFBN?
- **The answer is not immediately evident: high degree of uncertainty; exact character of future threats unknown; no metrics to adequately direct the evolution of the evolving TFBN**
- **Must rely on “capabilities-based” planning, judgment, analysis, testing**



21st Century Access Spectrum



Traditional Small Combatant Missions

- Battle Force Screening
 - Mine Warfare
- Protection of Shipping
- ASuW/Offensive Maritime Interdiction
 - Battle Force Scouting
- Sea base/Amphibious Support
 - Close-in Fire Support
 - Riverine Warfare
- Support to Naval Special Operations
- Maritime Domain Awareness and Maritime Security/Patrol
 - Battle Network Sensor Emplacement

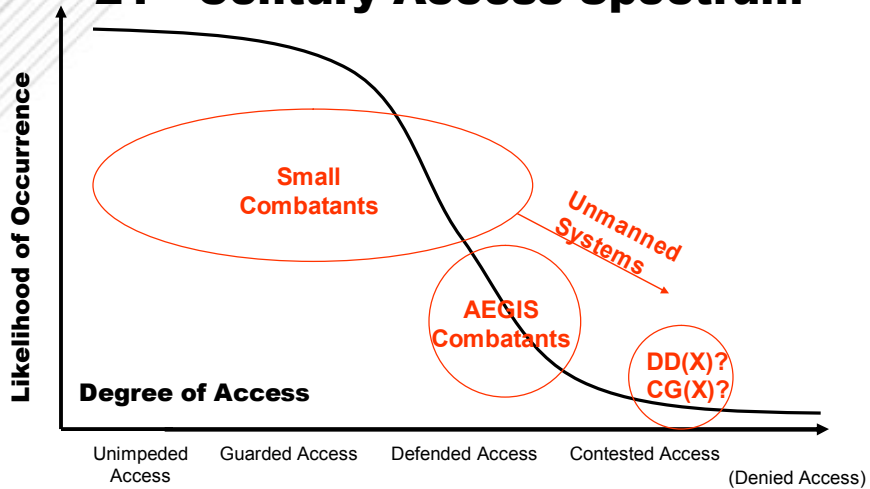
Whenever the Fleet Has Operated Close to Shore, Small Combatants Have Dominated Past Fleet Numbers

- Ratio of large: intermediate: small combatants in past battle forces is instructive:
 - World War II: 1:9:90
 - Vietnam: 1:20:150
 - Late Cold War (allied naval coalition): 1:30:126
- Two good reasons to consider small combatants in the TFBN mix:
 - Like Vietnam, if US takes unilateral action, will need to provide own small combatants
 - Allied navies adopting intermediate size ships

Small Combatants in the 21st Century Assured Access Navy

- Key Question: Any reason to believe small combatant missions less important in the future than in the past, or that intermediate/large combatants will better perform them?
- Answer appears to be no, for three reasons:
 - Precedence. As fleet operates close to shore, small combatants tend to dominate in defended access scenarios
 - Utility. Cost-effective performance of small combatants in unimpeded, guarded access in high demand; allows battle network coverage to expand
 - Flexibility. Small combatants free up more capable intermediate and large combatants for more stressful duties

21st Century Access Spectrum



LCS Introduces a New Level of Design Modularity

- Construction modularity
- Configuration modularity (MEKO®-class ships)
- Mission modularity (StanFlex combatants)
- “Battle (network) modularity”
 - Allows rapid configuration of fleet battle network to account for access condition, enemy capabilities
 - Allows battle network to reconfigure itself during the course of single campaign
 - Unprecedented design/operational goal
 - Modularity factor makes 56 multi-role, single mission ships equivalent to a force of 77-88 single mission ships (or higher)

The LCS as Part of a Distributed Fleet Battle Network

- **LCS should be viewed less as a traditional warship, and more as a “battle network component system”**
 - “Sea Frame” (basic hull and systems)
 - Core crew (mans the sea frame)
 - Mission modules (onboard weapons stations; off-board systems)
 - Pack-up Kits (supplies, consumables for off-board systems)
 - Mission packages (combination of mission modules + PUKs)
 - Mission crew (operates the mission package)
 - Reconfiguration support structure (LCS “Pit crew”)

LCS Attempts to Address Many of the Limitations Associated With Small Combatants

- **Sustained battle speed allows small combatant operations with high speed battle forces**
- **Modularity may allow one or two hull forms to perform 10 of 11 small combatant missions (riverine warfare the exception)**
- **Controlling weight gain in the mission package makes it more likely that the ship will maintain its design characteristics over the life of the ship**
- **Emphasis on modular off-board systems increases likelihood ship will be effective over 20-30 year service life**
 - “Invulnerable to obsolescence”

Next Steps

- **LCS appears to be on solid ground. However, it is:**
 - The first small “battle force capable” combatant to be designed and built by US Navy/shipbuilding industry in 60 years
 - A battle network component system with no US or foreign naval precedent
- **There remain a host of operational issues to explore**
 - What are the true operational and tactical benefits of battle (network) modularity?
 - What are the overhead costs associated with battle modularity?
 - How should the LCS force be best organized and employed?
- **Still not clear how the TFBN will ultimately evolve; LCS will evolve along with it**

Caution: Inter-Era Shifts are Characterized By High Degrees of Uncertainty

- **Frigate to Battleship Era. In 20-year span:**
 - 74 *pre-Dreadnought* and 6 *Dreadnought* battleship classes were built
- **Battleship to Carrier Era. In 20-year span:**
 - Extensive war gaming, analysis, fleet problems conducted
 - 8 carrier prototypes built
 - During World War II, every combatant in the battle fleet performed a different role than the one for which it was designed (except mine sweepers)
- **Analysis only goes so far; need new metrics to measure the power of future fleet battle networks, and to guide the early development of the TFBN**

Squadron Operational Testing: The Way Ahead?

- Down select to at least two operational prototypes
- Build two prototype *squadrons*
 - Award one competitor R&D ship in FY05, follow-on SCN ship in FY06
 - Award second competitor R&D ship in FY06, follow-on SCN ship in FY07
 - Provides for minimum testing force: two, 2-ship squadrons in FY08 (also need mission modules and support unit)
 - Option: create larger prototype squadrons by dividing FY08/FY09 ships among competitors (could assign 2,3, or 4 in current production profile)
- When appropriate, Navy enters production pause to conduct meaningful operational tests

Questions?



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The Problem

“We do not know the true face of our next adversary or the exact method of engagement. The threat may come from terrorists, but it could come in the form of cyber-war, a traditional state-on-state conflict, or some entirely new form of attack.”

The Joint Operations Concepts, November 2003



Littoral Asymmetric Threats

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- ◆ Proliferation of asymmetric weapons can impede littoral access

- Mines
- Diesel Submarines
- Small, fast, coordinated boat attacks



- ◆ Threats can hamper the fleet's ability to project power ashore and to flow forces via maritime routes to the Joint Commander

- ◆ Mine threat highlighted during support of Operation Iraqi Freedom

- Impact caused by a relatively benign enemy
- What would be impact from a more capable foe?



Identifying Capability Gaps

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- ◆ Navy's 21st century missions include littoral operations in support of:

- Assured access
- Forcible entry
- Littoral supremacy

- ◆ IWAR 2000 validated requirement for assured access:

- Ability to identify & discriminate a complex mix of hostile, neutral & friendly forces
- Capability to immediately respond & defeat littoral threats in a cluttered, dynamic and congested oceanographic environment

- ◆ Global Wargame 2000/2001 showed utility of small fast warship:

- Capable in ASW
- Effective against Small Boat Threat
- Versatile and persistent platform for MIW off board systems

- ◆ Legacy force not optimized to operate in the littorals, therefore:

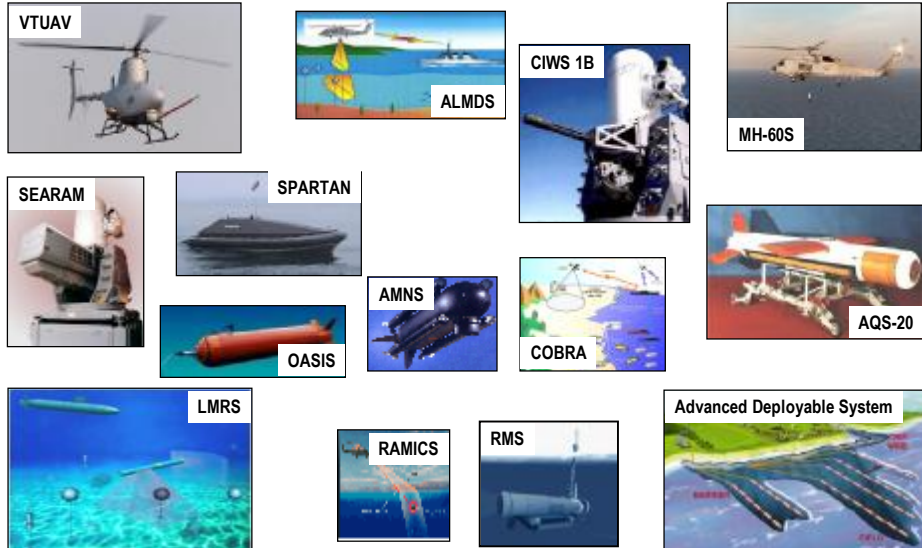
- Gaps surfaced in MIW, Littoral SUW and Littoral ASW





Candidate Mission Systems that can Fill the Gap

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Challenge is to introduce these into the Littoral



Littoral Combat Ship

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- ◆ A small, fast delivery vehicle is needed to employ combat systems.
Vehicle must have following performance attributes:
 - Persistence
 - Large Payload
 - Connected
 - Reduced Crew / Reduced Lifecycle Cost
 - Employment / Control of multiple Off board Systems



LCS Modularity

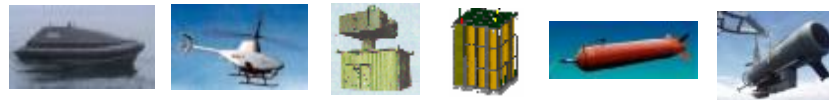
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- ◆ LCS hull, or “seaframe,” will be fitted with a “mission package” that will be key to providing the Joint Force Commander with a versatile range of capabilities.
- ◆ Attributes will include:
 - Focused Capability and Tactical Flexibility
 - Open Architecture Environment to permit “plug and play”
 - Non-invasive Technological Refresh Opportunities
 - Ability to Expand Role of Unmanned Systems



LCS Seaframe and Mission Modules

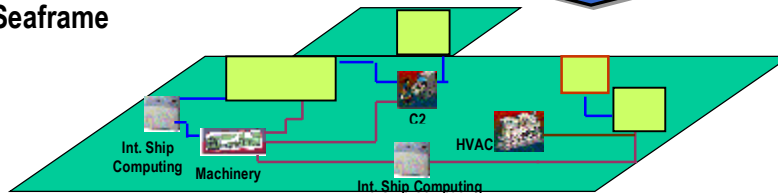
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Mission Modules



Seaframe



Space, common open architecture, C4I, common control system, and seamless integration to ship services



LCS Missions

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- ◆ **Focused Missions:**
 - Mine Warfare (MIW)
 - Littoral Surface Warfare (SUW)
 - Against small, fast, surface craft
 - Littoral Anti-Submarine Warfare (ASW)
 - Against quiet diesel submarines
- ◆ **Inherent Capabilities to Conduct:**
 - Joint Littoral Mobility
 - Movement of troops and equipment
 - Intelligence, Surveillance, and Reconnaissance (ISR)
 - Special Operations Forces (SOF) Support
 - Maritime Interdiction/Interception Operations (MIO)
 - Anti-Terrorism/Force Protection (AT/FP)



LCS Key Performance Parameters

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Key Performance Parameter	Threshold	Objective
Sprint Speed	40 knots	50 knots
Navigational Draft	20 feet	10 feet
Endurance at Transit Speed (includes payload)	3,500 nmi at 18 knots	4,300 nmi at 20 knots
Mission Package Payload (Weight)	180 MT (105 MT mission package / 75 MT mission package fuel)	210 MT (130 MT mission package / 80 MT mission package fuel)



LCS Key Performance Parameters (cont'd)

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Key Performance Parameter	Threshold	Objective
Time for Mission Package Change-out to full operational capability including system OPTEST	4 days	1 day
Interoperability	Achieve 100% of top level Information Exchange Requirements (IER) designated as critical	Achieve 100% of top level IERs designated as critical
Simultaneous Off-board Vehicle Control	2 indigenous vehicles	All off-board vehicles
Ability to successfully conduct a Detect-to-Engage (DTE) scenario	Conduct a DTE utilizing indigenous weapons and sensor systems in littoral MIW, SUW, and ASW mission areas	Conduct a DTE utilizing indigenous weapons and sensor systems in littoral MIW, SUW, and ASW mission areas



Way Ahead

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6 Industry Concepts
(06 Feb 03)

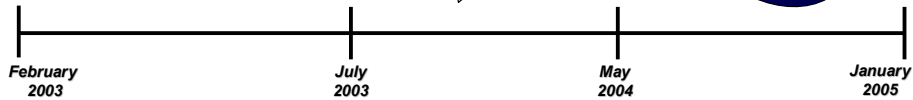


3 Preliminary Designs
(Contract Award 17 July 2003)



Flight 0 Construction Start
(Contract Award Jan 2005)

1 or 2 Final Design(s)
(Contract Award May 2004)

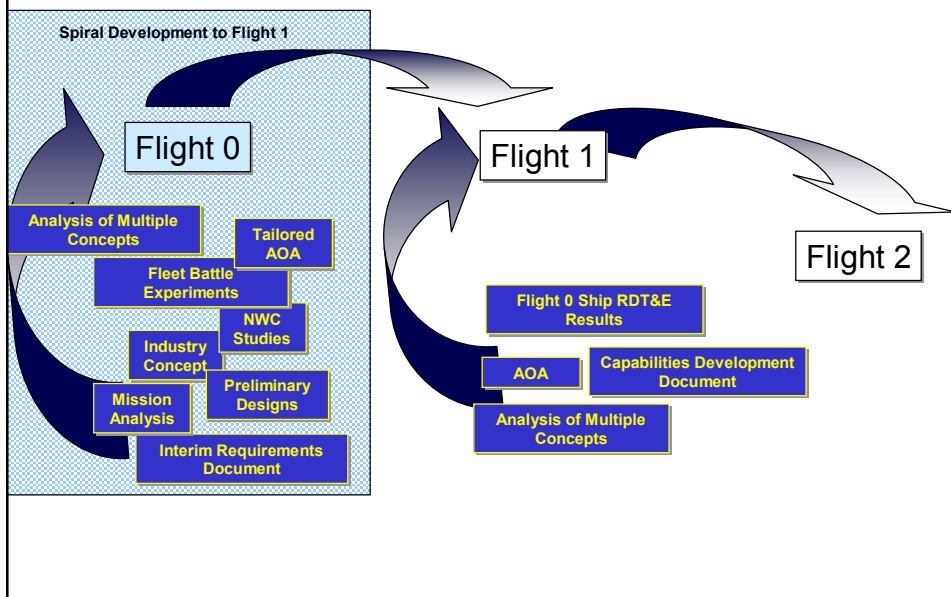


First Ship in the Water in 2007



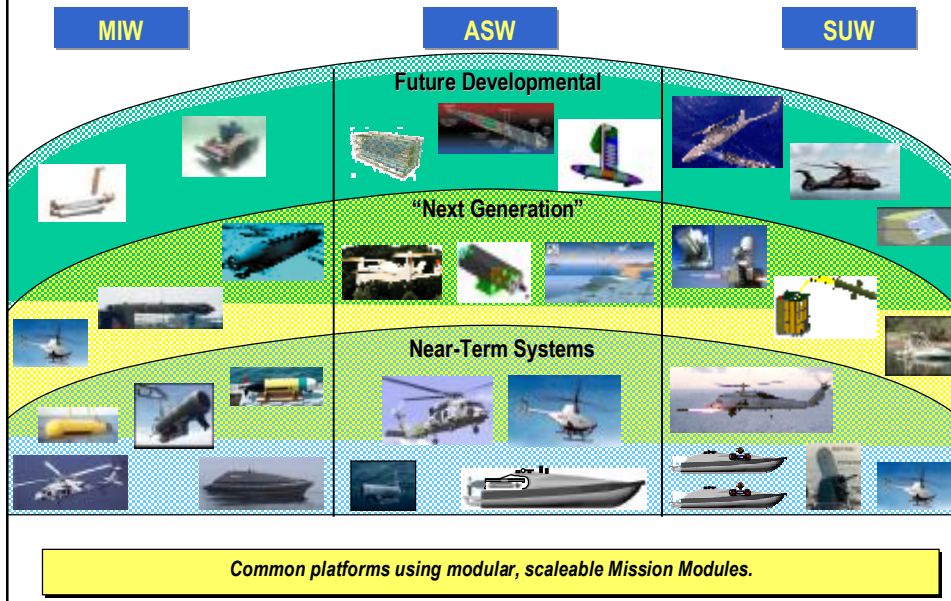
LCS Spiral Development

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Flexible Combat Power in the Littorals Future Growth Capability

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Experiment, Test & Validate

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- ◆ Fleet Battle Experiments, Limited Objective Experiments, and at sea testing:
 - Using Sea Slice, Skjold, HSV, X-Craft and Triton as surrogate LCS:
 - Conducted USV & UUV operations in support of MIW & ASW
 - Exercised exploratory mine hunting & establishment of Q-routes
 - Demonstrated the tactical advantage of high sprint speeds
 - Highlighted the value of signature management & shallow draft
 - Provided mission support for SOF (insertion/extraction)



At-sea testing, exploiting current technologies, validated LCS fast track acquisition



Summary

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- ◆ LCS closes the MIW, SUW, and ASW capability gaps in the littorals
- ◆ Modularity of mission packages enables spiral development of warfighting capability – quickly
- ◆ Unmanned vehicles extend the battlespace and take the Sailor out of harms way
- ◆ Ongoing learning process through experimentation and Sea Trial



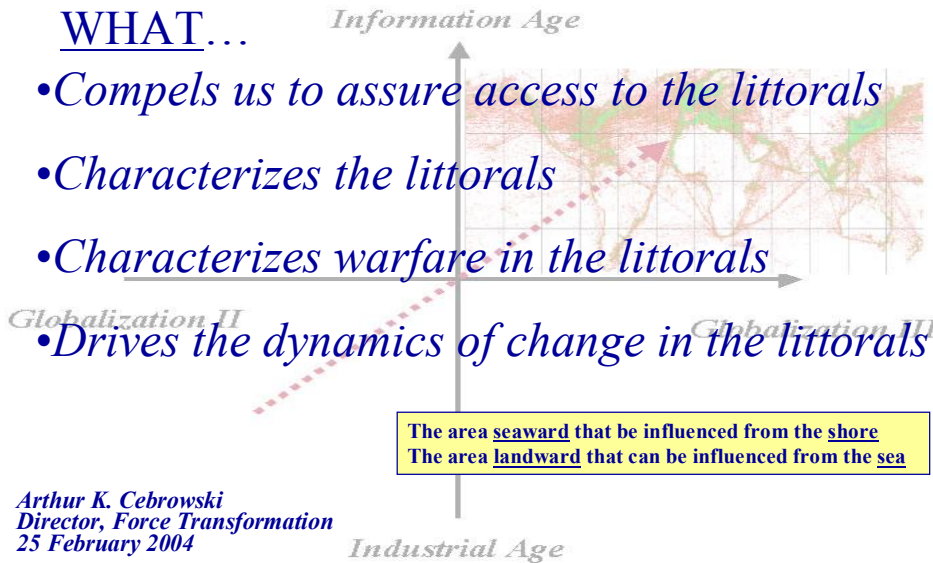
The Littorals



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WHAT...

- *Compels us to assure access to the littorals*
- *Characterizes the littorals*
- *Characterizes warfare in the littorals*
- *Drives the dynamics of change in the littorals*



The area seaward that be influenced from the shore
 The area landward that can be influenced from the sea

Arthur K. Cebrowski
 Director, Force Transformation
 25 February 2004



Transforming Defense

... Working definition



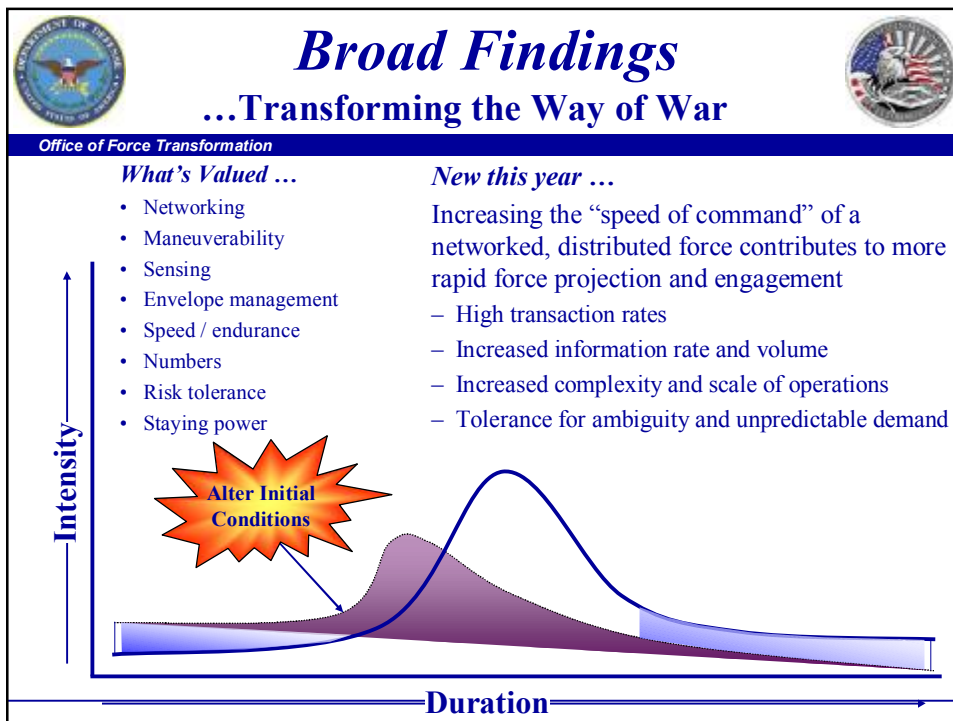
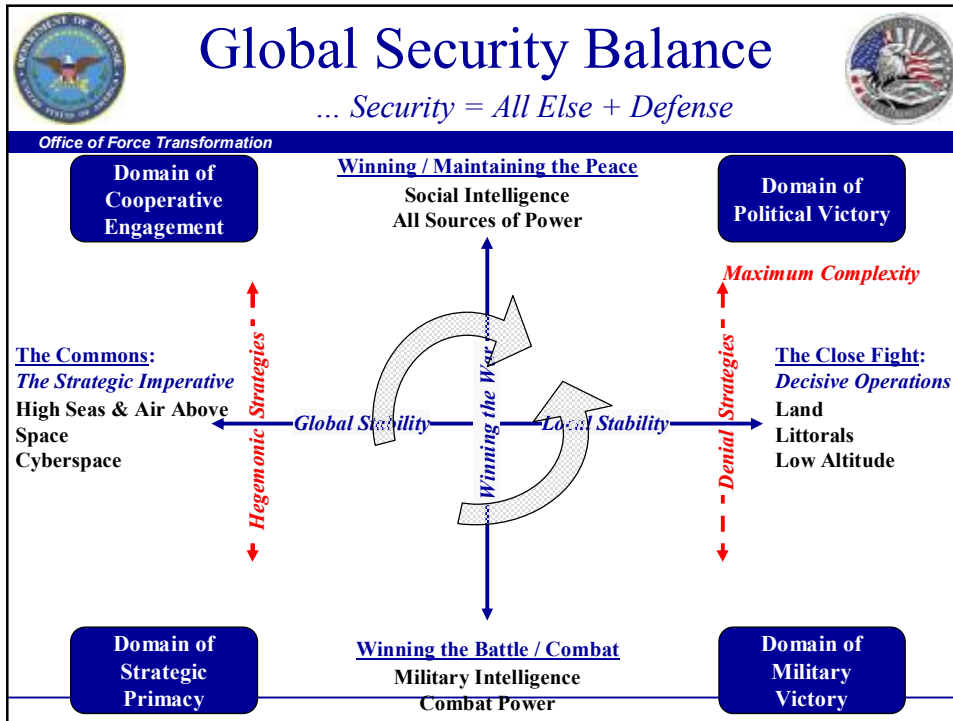
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Elements of Transformation

- Continuing process
- Creating/anticipating the future
- Co-evolution of concepts, processes, organizations, and technology
- New competitive areas/competencies; revalued attributes
- Fundamental shifts in underlying principles
- New sources of power
- Broadened capabilities base

- *New Strategic Context*
- *Broadened Threat Context*
- *Technological Threats Facilitated by Falling Barriers to Competition*

Vision: *Broad and sustained competitive advantage*



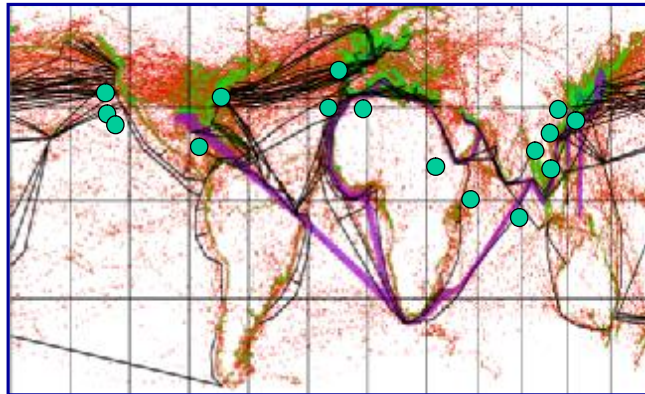


Global Trends



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Globalization II → Globalization III



Industrial Age → Information Age



Characteristics of the Littoral



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- The intersection of power and wealth creation and distribution
 - High transaction rates
 - High learning rates
- Environmental and threat complexity
 - High degree of ambiguity
 - High saturation risk
- Value is created by “actual” presence
 - Local knowledge



Information age competition ...Characteristics of the Littorals



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- Fog and fiction will always be present...
 - *Competition continuously increases complexity...in order to survive and win*
- Solving for complexity will require...
 - *Getting a solution quickly rather than...*
 - identifying a perfect solution over time then executing as fast as possible
- Increased importance of collaboration and cooperation
 - *Networking and creating options have greater value than individual performance*
 - *Reach dominates Richness*
- Different set of tools, rules and legislation needed:
 - *Higher rates of learning...*
 - High numbers of operational experiments with imperfect surrogate articles
 - *Continuous feedback...*
 - Co-evolve force so that it can adapt to a competitive complex environment



Fighting in the Littoral



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- Outsider is disadvantaged
 - “A ship’s a fool that fights a fort”
 - Depth of magazine
- Attacker has the initiative
 - Time and mode
 - Broad option base required
- Sanctuaries are fleeting
 - Envelope management required
 - Target denial required

Sensing
Networking
Dispersion
Speed
Access

War ≠ Shooting



“Attack Effectively First”



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- *How much is speed worth...is there value in being slow?*
 - *In business... 'first mover advantage'*
 - *In sports... 'first to the finish'*
 - *In combat... 'speed is life'*
- *Speed is a function of the domains of military competition*
 - *Necessary to create options and...*
 - *Required to increase complexity through...*
 - *High transaction rates*



Dynamics of Change ...in the Littorals



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- *Expanding in both directions*
- *Increasing population density*
- *Increased complexity*
- *Increased premium on...*
 - *Increased Transaction Rates*
 - *Learning rates*
 - *Option generation rates*
 - *All require an increase in variety and numbers*



Additional Design Rules



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- *Create Options*
 - Preserve design teams – create a stable commercial market
 - Loosen requirements – incentives for innovation
 - Increase variety and numbers
- *Higher rates of learning*
 - High numbers of operational experiments with imperfect articles
- *Increased Transaction Rates*
 - For experimentation – Requirements write themselves
 - High numbers of evolutionary cycles solve complex problems



New Rules for Dynamic Fitness



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- *Achieve Over Matching complexity* – *increase variety at the right scale*
 - Match Scale but over match complexity
- *Value Adaptability*
 - Reconfigurability through modular design & high change out rates
 - Payload fractions matter
- *Achieve a Total system approach*
 - Determine dynamic relationships among all elements of the force
 - sensors, network infrastructure, weapons, platform, C2 and warrior preparation
- *Increase Information fusion rates & tacit understanding*
 - Relocate complexity to mitigate inherent capability limits



Survivability in the Missile Age



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Naval battle for Okinawa

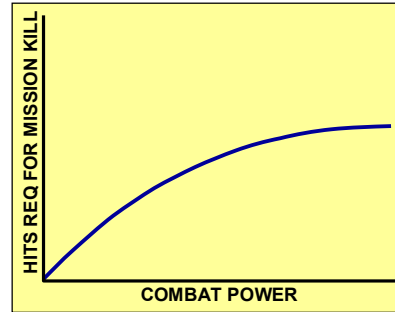
Kamikaze as first cruise missile
26 ships sunk, 368 ships damaged
(some beyond repair)
About 9,000 sailors killed / wounded

Tanker wars 1981-1988

Iraq fired 257-261 missiles, >205 hits
Best survivability: big tankers

Missiles vs. Warships - 155 fired

Results variable but hits are devastating
USS Stark
Royal Navy losses in Falklands (6 ships)
1973 Arab-Israeli war - 101 missiles fired
Zero STYX hits
Gabriel's devastating



ROBUSTNESS IS KEY TO NAVAL FORCES PREVAILING IN THE MISSILE AGE



Transforming Defense

...characteristics of the future joint force



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This is the age of the small, the fast, and the many.

Small: Power and size are uncoupled

Fast: A shorter response with a faster rise time more precisely placed in time and space

Many: The power of the collective at lower cost over a larger area

Rebalance for the information age

“Demassification” through increased information fractions

Simplification through adaptive relocation of complexity & the human networked components vice integrated systems

Operations based on assured access, information superiority, control of initial conditions and rates of change

A priori access to the domains of conflict

Secure a superior information position and convert it to a competitive advantage

Leverage the path dependency of conflict

Corporate change based on co-evolution and continuous adaptive acquisition



Metrics for Defense Transformation ...using 'Real Options Theory'



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Quantification Required for Capabilities-Based Planning

- Projected Solution Longevity/Time Until Loss of Competitive Advantage (Time to Expiration of Solution)
- Current Cost (Exercise Price)
- Time Value of Money Factor (Risk-free Interest Rate)
- Capability Value = f (uncertainty, time) (Cash Flow Uncertainty)
- Present Value of Future Competitive Position (Present Value of Future Cash Flows)
- Rate of Value Decay/Cost of Longevity (Value Loss Over Duration of Solution)

Capability value over an uncertain future?
How to measure the value of uncertainty +?
How to correct tactical instability?

"Dissuasion" = f (present value of future capabilities, future value of present capabilities)



The Way Ahead

...Preventing Stasis



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- Manage risk by increasing speed
 - accelerate learning
- Don't pour legal concrete
 - goal posts are moving
- Preserve design teams
- Synchronize build rhythm
 - with evolving needs
- Shift focus from Seaframe particulars
 - to standards and interfaces
- Manage the networking processes (see FCS)