Triad, Dyad, Monad?

Shaping U.S. Nuclear Forces for the Future

Presentation to the Air Force Association
Mitchell Institute for Airpower Studies

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Prelude to the Nuclear Posture Review (NPR)

The Joint Understanding for the START Follow-on Treaty

“...The Joint Understanding commits the United States and Russia to reduce their strategic warheads to a range of 1500-1675, and their strategic delivery vehicles to a range of 500-1100. ...”

_The White House, Office of the Press Secretary, July 6, 2009_

- U.S. policy supports a strategic nuclear Triad to maintain a strong, safe, secure, and reliable nuclear deterrent

- What is the best way to reduce U.S. strategic nuclear forces to meet START Follow-on Treaty goals while maximizing the deterrent value and stability of the Triad?
  - Review options by operationally deployed warheads (ODW) (1,500-1,675)
  - Review options by strategic delivery vehicles (launchers) (500-1,100)
  - Focus on deterring Russia and China
## Currently Deployed U.S. Weapons and Launchers Under START and SORT

<table>
<thead>
<tr>
<th>System</th>
<th>Actual Platforms</th>
<th>Operationally Deployed Strategic Nuclear Warheads (SORT)</th>
<th>Platforms (START)</th>
<th>Accountable Warheads (START)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ICBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minuteman III</td>
<td>450</td>
<td>550</td>
<td>500</td>
<td>1200</td>
</tr>
<tr>
<td>• Mk-12A / Mk-21</td>
<td></td>
<td>550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: PK</td>
<td></td>
<td></td>
<td>50</td>
<td>400</td>
</tr>
<tr>
<td><strong>SLBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trident II D5</td>
<td>288 (+48)</td>
<td>1152</td>
<td>336</td>
<td>2688</td>
</tr>
<tr>
<td>• Mk-4 / 4A</td>
<td></td>
<td>768</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mk-5</td>
<td></td>
<td>384</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: SSBNs</td>
<td></td>
<td></td>
<td>96</td>
<td>576</td>
</tr>
</tbody>
</table>

**TOTAL**

|                    | 881              | 2126                                                    | 1198              | 5576                        |

**Legend:** ICBM = Intercontinental Ballistic Missile, SLBM = Submarine-Launched Ballistic Missile, Mk = Mark, PK = Peacekeeper

Sources:  
Status of U.S. Strategic Nuclear Deterrent Forces

• ICBMs
  - MM III modernization and sustainment to 2030 (potential to 2050)
  - Minuteman evolution and/or new ICBM

• SLBMs
  - Ohio class SSBN will begin retiring in 2027 (deactivate 1/year to 2040)
  - Ohio Replacement Program under development (delivery by 2025)
  - Trident II D-5 life to 2042

• Bombers
  - NGLRS put on hold pending clarification of requirements
  - B-2 upgrades, service life extension to 2050
  - B-52H service life extension to 2044
  - ALCM life to 2020, but DoD has concerns about “obsolescence of parts/components”

With weakened bomber leg, U.S. may be moving to a de facto Dyad
Potential Posture Options Considered For Reduced Warhead Count

**Range of Alternatives**

- **Triad**
  - ICBMs, SLBMs, bombers
- **Monad**
  - SLBMs only
  - ICBMs only
  - Bombers only
- **Dyad**
  - SLBMs and bombers
  - ICBMs and bombers
  - SLBMs and ICBMs

**Alternatives Examined**

- **Triad**
  - ICBMs, SLBMs, bombers
- **Monad**
  - SLBMs only
- **Dyad**
  - SLBMs and bombers
  - ICBMs and bombers
  - SLBMs and ICBMs

*Relative to today’s Triad (ICBMs, SLBMs, long-range strategic nuclear bombers), what are the capabilities of potential alternatives?*
Potential Posture Options Are Measured Against Existing Triad Attributes

Warheads On Alert
- $X$ number of ODW/829 today
- $X$ number of ODW/1,500 reduced total

Connectivity/Ease of Retargeting

Survivability (Day-to-Day)

Survivability (Generated)

Signal of Alert Readiness Changes

Promptness

Ability to Penetrate

Aimpoints (x number/555 today)

• Total Launchers = 833
  - ICBMs = 450
  - SLBMs = 288
  - Bombers = 95

ODW = Operationally Deployed Warheads
Aimpoints = U.S. launcher sites at risk from attack
Potential Posture Options Are Measured Against Existing Triad Attributes

Warheads On Alert
X number of ODW/ 829 today
X number of ODW / 1,500 reduced total

Connectivity/ Ease of Retargeting
Survivability (Day-to-Day)

Crisis Stability
Survivability (Generated)

Signal of Alert Readiness Changes
Aimpoints (x number/ 555 today)

Promptness
Notional Deterrent Value

Ability to Penetrate

ODW = Operationally Deployed Warheads
Aimpoints = U.S. launcher sites at risk from attack
Monad Option – SLBMs Only

Assumptions

• SSBNs at sea typically viewed as the most survivable system
• Current warhead total: 1,152. Current missile total: 288

Implications

• To reach/maintain 1,500, additional 348 warheads required
  ✓ – Add warheads to existing missiles  \( \rightarrow 5 \text{ MIRVs} = 1,440 \)
  – Build additional submarines

• Very survivable at sea but boats in port are vulnerable to surprise attack
• Increased alert rate would reduce number in port
• Submarines provide secure second strike but missile launch pinpoints SSBN location
• Offers incentives to adversaries to pursue ASW technology breakthroughs
• High degree of risk in single leg Triad
Monad Option – Flexible Enough to Reach 1,500-1,675 ODW Goal

**Warheads On Alert**
480 ODW / 829 today
480 ODW / 1,440 reduced total

**Note:** Option compared to full Triad deterrent
H = High
M = Medium
L = Low
ODW = operationally deployed warheads
Aimpoints = U.S. launcher sites at risk from attack

- **Survivability** (Day-to-Day)
- **Survivability** (Generated)
- **Promptness**
- **Connectivity/ Ease of Retargeting**
- **Crisis Stability**
- **Signal of Alert Readiness Changes**
- **Ability to Penetrate**

**Notional Deterrent Value**

**SLBMs**

- **Total Launchers = 288**
  - Assumes 24 tubes/ SSBN
Dyad Option (1) – SLBMs and Bombers

Assumptions

• Combines most survivable leg (SSBNs) and most flexible leg (bombers)

• To reach/maintain 1,500, a reduction of 108 ODW is required
  – Retire 2 SSBNs and keep 456 ODW (bombers) or
  ✔ – Maintain 14 SSBNs and retire portion of B-52s

Implications

• Strong signaling potential

• Bombers could be used for discrete strikes

• Worst case for survivability
  – Small number of aim points
  – Submarines in port and non-alert bombers not be survivable from “bolt from blue” attack
Dyad Option (1) – Bomber Leg Increases Signaling Potential

- U.S. may need to increase alert levels for both SSBNs and bombers

Warheads On Alert
384 ODW/ 829 today
480 ODW / 1,360 reduced total

Connectivity/ Ease of Retargeting
Crisis Stability
Signal of Alert Readiness Changes
Promptness
Ability to Penetrate
Survivability (Day-to-Day)
Survivability (Generated)
Aimpoints (5/555 today)

Note: Option compared to full Triad deterrent
H = High
M = Medium
L = Low
ODW = operationally deployed warheads
Aimpoints = U.S. launcher sites at risk from attack

Total Launchers = 383
- 288 SLBMs
- 95 bombers
Dyad Option (2) – ICBMs and Bombers

Assumptions

• Combines most responsive leg (ICBMs) and most flexible leg (bombers) of Triad

Implications

• To reach/maintain 1,500, all SSBNs retired and:
  - Additional warheads added to ICBMs (550)
  - US would need to field additional bombers/ALCM-X/NGLRS

• Crisis stability underpinned by single-warhead ICBMs will be threatened by re-MIRVing

• Small number of bomber aim points may necessitate increase in alert rates
Dyad Option (2) – ICBMs Carry Burden of Deterrent Force

Warheads On Alert
445 ODW / 829 today
445 ODW / 1,050 reduced total

Connectivity/ Ease of Retargeting

Crisis Stability

Signal of Alert Readiness Changes

Promptness

Survivability (Day-to-Day)

Survivability (Generated)

Aimpoints (553/ 555 today)

Ability to Penetrate

Notional Deterrent Value

ICBMs

Bombers

• U.S. may consider increasing bomber alert rate
• Bombers increase signaling potential

Note: Option compared to full Triad deterrent
H = High
M = Medium
L = Low
ODW = operationally deployed warheads
Aimpoints = U.S. launcher sites at risk from attack

• Total Launchers = 545
  – 450 ICBMs
  – 95 bombers
Dyad Option (3) – ICBMs and SLBMs

Assumptions

• Combines two most survivable and responsive legs of Triad

Implications

• To reach/maintain 1,500, a reduction of 202 operationally deployed warheads is required
  – Retire 2 SSBNs or
  ✔ – Reduce SLBM MIRVing or
  – Reduce ICBM force

• Bombers are converted to conventional role or retired

• Vulnerability low; survivability maintained

• Prompt response

• Some operational flexibility but no recallability

• Crisis stability high
Dyad Option (3) – Maximum Leverage of Positive Attributes of ICBMs and SLBM

- Alert rate driven by ICBMs with secure second strike from SLBM

- Total Launchers = 738
  - 450 ICBMs
  - 288 SLBM

### Warheads On Alert
- 739 ODW / 829 today
- 739 ODW / 1,500 reduced total

### Notional Deterrent Value

- Total Launchers = 738
  - 450 ICBMs
  - 288 SLBMs

### Connectivity/Ease of Retargeting
- H = High
- M = Medium
- L = Low

### Crisis Stability
- H = High
- M = Medium
- L = Low

### Signal of Alert Readiness Changes
- H = High
- M = Medium
- L = Low

### Promptness
- H = High
- M = Medium
- L = Low

### Survivability (Generated)
- H = High
- M = Medium
- L = Low

### Survivability (Day-to-Day)
- H = High
- M = Medium
- L = Low

### Aimpoints (552/555 today)
- H = High
- M = Medium
- L = Low

### Ability to Penetrate
- H = High
- M = Medium
- L = Low

### Readiness Changes
- H = High
- M = Medium
- L = Low

**Note:** Option compared to full Triad deterrent

ODW = operationally deployed warheads

Aimpoints = U.S. launcher sites at risk from attack
Comparing Alternative Force Structures

• Triad continues to retain the most deterrent value – but requires significant investments in bomber leg

• Monad (SLBMs only)
  – Attributes are medium to weak relative to existing Triad or other Dyad options
  – Reduces overall U.S. deterrent to that similar to U.K. and France

• Of Dyads examined, ICBM/SLBM combination offers greatest deterrent value
  – Provides strong deterrent posture within 1,500 warhead limit when measured against current Triad
  – Approximately same number of warheads on alert as today’s force
  – Leverages positive attributes of both legs relative to existing Triad
## Comparing Platform Costs

<table>
<thead>
<tr>
<th>Options</th>
<th>Annual Costs ($ B)</th>
<th>Acquisition Priorities and Costs to 2050 ($ B)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Triad</strong></td>
<td>$5.4</td>
<td>$240</td>
</tr>
<tr>
<td>- ICBMs</td>
<td>$1.1</td>
<td>ICBM mod ($10)</td>
</tr>
<tr>
<td>- SLBMs</td>
<td>$2.6</td>
<td>Ohio Repl. ($141)</td>
</tr>
<tr>
<td>- Bombers</td>
<td>$1.7</td>
<td>ALCM-X + new Bomber ($89)</td>
</tr>
<tr>
<td><strong>Monad (SLBMs)</strong></td>
<td>$2.6</td>
<td>Ohio Repl. ($141)</td>
</tr>
<tr>
<td><strong>Dyad 1 (SLBMs + Bombers)</strong></td>
<td>$4.0</td>
<td>Ohio Repl. ($141)</td>
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<tr>
<td></td>
<td></td>
<td>ALCM-X + new Bomber ($89)</td>
</tr>
<tr>
<td><strong>Dyad 2 (ICBMs + Bombers)</strong></td>
<td>$2.8</td>
<td>ICBM-X + mod ($10)</td>
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<td>ALCM-X + new Bomber ($89)</td>
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<tr>
<td><strong>Dyad 3 (ICBMs + SLBMs)</strong></td>
<td>$3.7</td>
<td>ICBM mod ($10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ohio Repl. ($141)</td>
</tr>
</tbody>
</table>

*Ohio Repl. = Ohio Replacement Program*

Conclusions and Recommendations

Conclusions

• Optimize deterrent value as warheads are reduced to 1,500

• Ensure stability as launchers are reduced in new START treaty
  – Lower numbers of launchers reduce aim points and stability (e.g., one MM wing = 30% of U.S. aim points)

Near Term Recommendations

• Reshape the Triad for deterrence and stability
  – ICBMs: 450 missiles and single RV warheads as substitute for declining bomber leg
  – SLBMs: 288 launchers on 12 deployed SSBNs
  – B-2s: 16 nuclear designated aircraft to retain select release, signaling capability
  – B-52s: Reevaluate role as ALCM ages

Longer Term Recommendations

• Move to a de facto Dyad
  – ICBMs: Maintain and sustain service life
  – SSBNs: Pursue Ohio Replacement Program
  – Bomber: Develop new conventional bomber
    • Upgrade B-2s to maintain niche nuclear capability
Each leg of the Triad offers differing characteristics which together make it impossible for an adversary to strike the United States without suffering unacceptable damage in retaliation. Each leg offers differing strengths and weaknesses. To maintain deterrence for the long-term, each leg of the Triad must be modernized and sustained.

The following criteria define the axes of the “spider” charts shown for each option. The ratings for some of the axes are inherently subjective based on collective wisdom, and are intended to stimulate discussion.

- **Warheads on Alert (Alert Rate):** Bombers (B-2s and B-52s) are currently not on alert, hence 0%. For SSBNs, 4 of 14 boats are on patrol (though typically only two are in firing boxes).[1] Typically, 99% of the ICBMs are on alert. See http://www.fas.org/blog/ssp/2009/03/usssnbn.php

- **Survivability (Day-to-Day):** This estimates the potential vulnerability of each leg to a “bolt out of blue” strike. Bombers currently are not generated, hence could be caught on their bases. SSBNs at sea are highly survivable, but those in port are not. ICBMs with high alert rates could either ride out an attack (risking loss) or launch while under attack. Launch on warning is a destabilizing strategy not considered here, but an adversary could, of course, not dismiss such a potential reaction.

- **Survivability (Generated):** The SSBN and bomber legs of the Triad become more survivable as they are generated and depart their fixed bases or ports. But these high generation rates cannot be sustained for long periods of time.

- **Aimpoints:** The total number of submarine and bomber bases and individual ICBM silos at risk from an attack equate to enemy counterforce aimpoints. Currently the U.S. maintains two submarine ports (Bangor, Washington, and Kings Bay, Georgia) and three strategic bomber bases (B-52s at Minot and Barksdale AFBs, and B-2s at Whiteman AFB); there are 550 ICBM silos in 3 missile wings spread across 5 Western states. Options with a small number of aimpoints are less stabilizing because an adversary could have an incentive to strike during crisis.

- **Ability to Penetrate:** Due to their high speed and the difficulty of intercepting their re-entry vehicles, ICBMs and SLBMs feature a higher probability of surviving defenses than do penetrating bombers or air-launched cruise missiles.

- **Promptness:** The entire force of ICBMs can strike targets within 30 minutes of launch. The same holds true for SLBMs from patrol positions, but does not hold true for those submarines in port or out of launch position. Bombers are hours away from striking after launch.

- **Signal of Alert Readiness Changes:** Bombers and submarines offer the most potential to send signals to an adversary. Bombers can be armed and positioned on alert pads or launched to conduct airborne alerts. SLBMs at sea offer little capability to send signals given the risks of compromising their location, but sending submarines to sea to increase the number on patrol would send a powerful signal of U.S. concern. ICBMs offer minimal capability to signal increased alert levels to an adversary owing to their consistent high level of readiness.

- **Crisis Stability:** One of the fundamental tenets of the Triad is to reduce incentives for adversaries to strike first. Each leg contributes to stability differently depending on the number of aimpoints it presents to an adversary, pre-strike survivability characteristics, and speed or time to target.

- **Connectivity/ Retargetability:** Links to in-flight bombers and SSBNs are more limited compared to the ICBM fleet, which has dedicated land lines combined with other communications. Bombers, unlike missiles, can be retargeted or recalled once in flight.
Cost Analysis and Sources Used

Methodology and Assumptions

- **SSBNs/SLBMs:** Current SSBN count consists of 12 operational SSBNs and 2 SSBNs in overhaul, 24 tubes per boat. Ohio Replacement lifetime = 42 years, to 2070; D-5 SLEP to 2045, with new SLBM-X afterwards; RDT&E and Acquisition cost number includes 12 boats planned with tubes per boat likely to be between 16 and 24 (to be decided after 2009 Nuclear Posture Review). Development and procurement costs derived from Kosiak. Operations and sustainment (O&S) estimates for SSBNs derived from CBO and inflated to $FY10.

- **Bombers:** New Bomber costs derived from Kosiak; another source assumes 100 aircraft at $60-80 billion, averaged to $70 billion; see O'Rourke, p. 10. O&S for bombers derived from GAO and inflated to $FY10. ALCM-X costs assume ACM unit cost of $14.5 million ($FY10), excluding warhead costs, from Brookings.

- **ICBMs:** Assumes $250 million per year investment in ICBM upgrades and modifications for 40 years. Operations and sustainment (O&S) estimates for ICBMs derived from CBO and inflated to $FY10.

Sources

- Congressional Budget Office (CBO) *The START Treaty and Beyond*, 1991
- Government Accounting Office (GAO), *Air Force: Options to Retire or Restructure the Force Would Reduce Planned Spending*, 1996