

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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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



System	Actual Platforms	Operationally Deployed Strategic Nuclear Warheads (SORT ¹)	Platforms (START ²)	Accountable Warheads (START ²)
ICBMs				
Minuteman III	450	550	500	1200
• Mk-12A / Mk-21		550		
Other: PK			50	400
SLBMs (12 SSBNs and 2 SSBNs in overhaul) (24 tubes/boat)				
Trident II D5	288 (+48)	1152	336	2688
• Mk-4 / 4A		768		
• Mk-5		384		
Other: SSBNs			96	576
Bombers				
Combined	95	424	216	712
• B-52H	76	240	126	
• B-2	19	184	19	
Other: B-1B			71	
TOTAL	881	2126	1198	5576

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

Sources: ¹Robert S. Norris and Hans M. Kristensen, "Nuclear Notebook: U.S. nuclear forces, 2009," *Bulletin of the Atomic Scientists*, March/April 2009, p. 61.

²State Department, Bureau of Verification, Compliance, and Implementation. *START Aggregate Numbers of Strategic Offensive Arms*, and Fact Sheet, *The Legacy of START and Related U.S. Policies*, July 16, 2009; unpublished National Institute for Public Policy analysis.

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

Relative to today's Triad (ICBMs, SLBMs, long-range strategic nuclear bombers), what are the capabilities of potential alternatives?

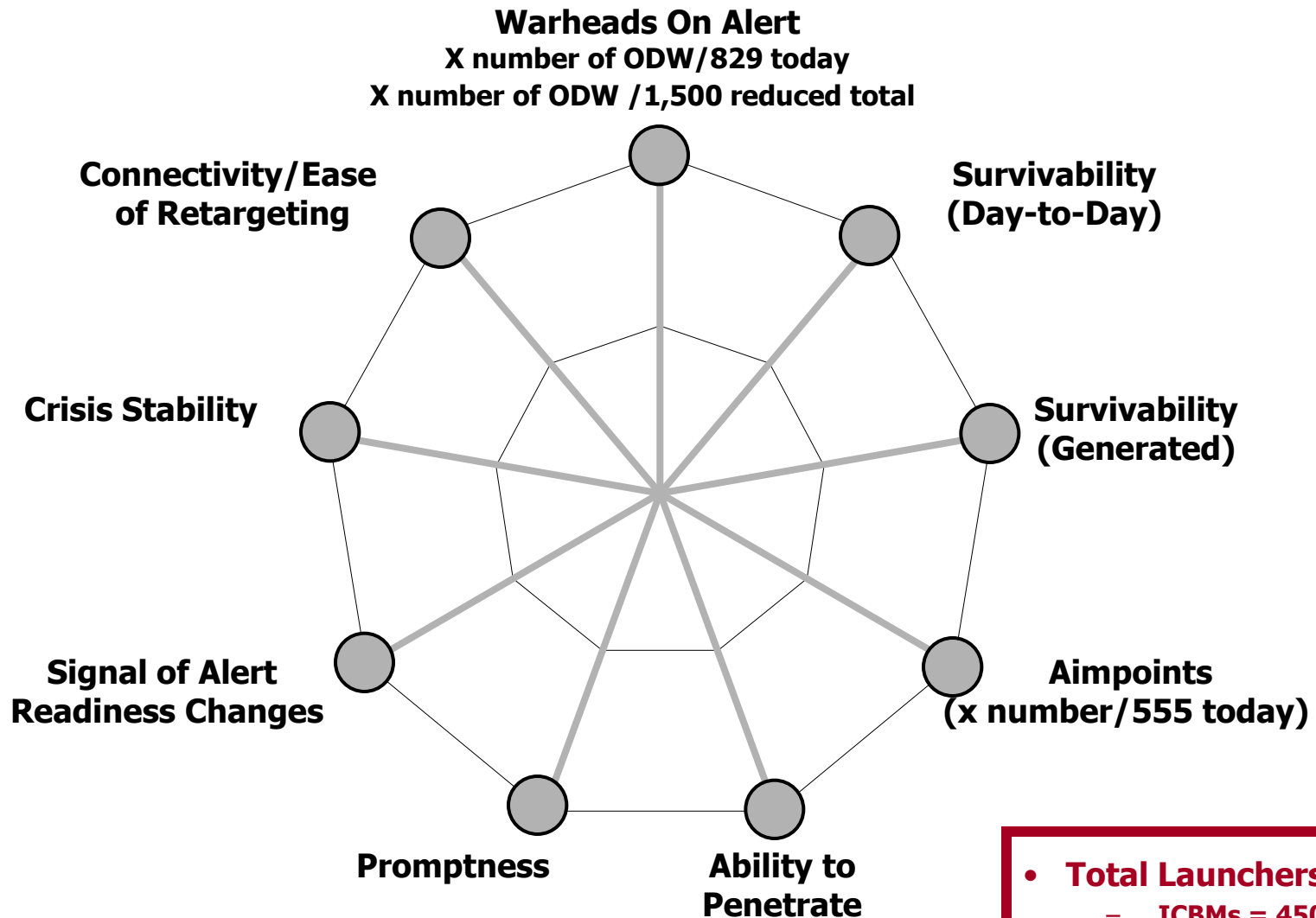
Range of Alternatives

- 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

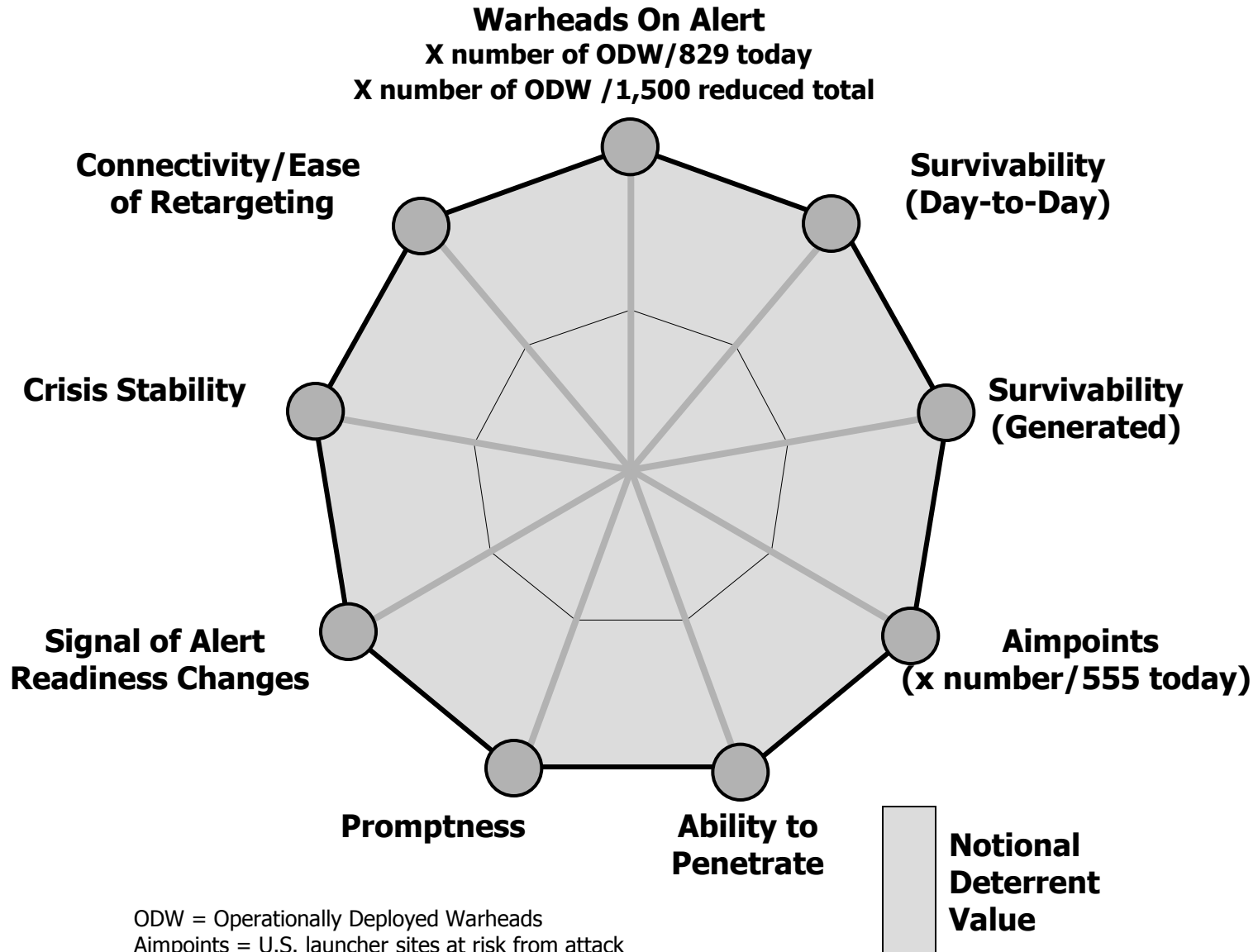
Potential Posture Options Are Measured Against Existing Triad Attributes



- **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



Monad Option – SLBMs Only

Assumptions

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



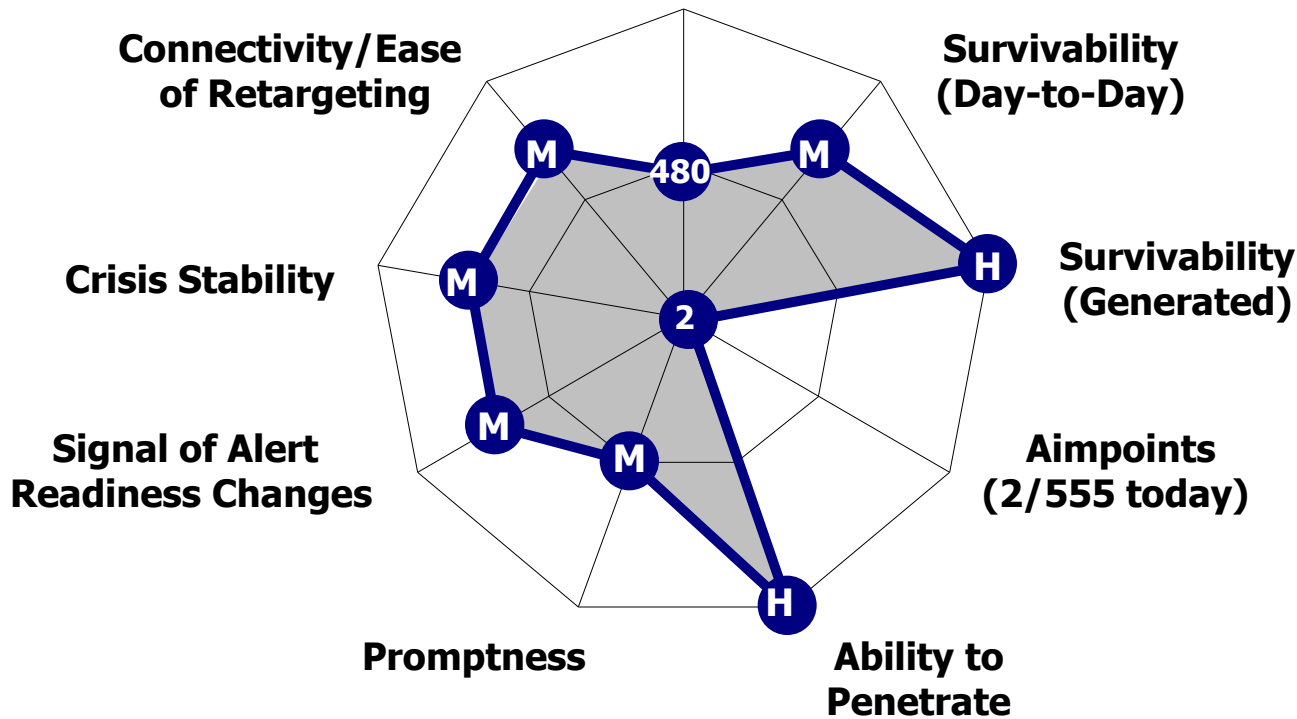
Implications

- To reach/maintain 1,500, additional 348 warheads required
 - ✓ – Add warheads to existing missiles → 5 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



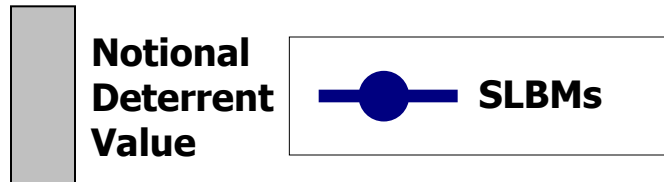
Monad Option – Flexible Enough to Reach 1,500-1,675 ODW Goal

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



- Survivability high for generated only; may require increased alert rate

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 = 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

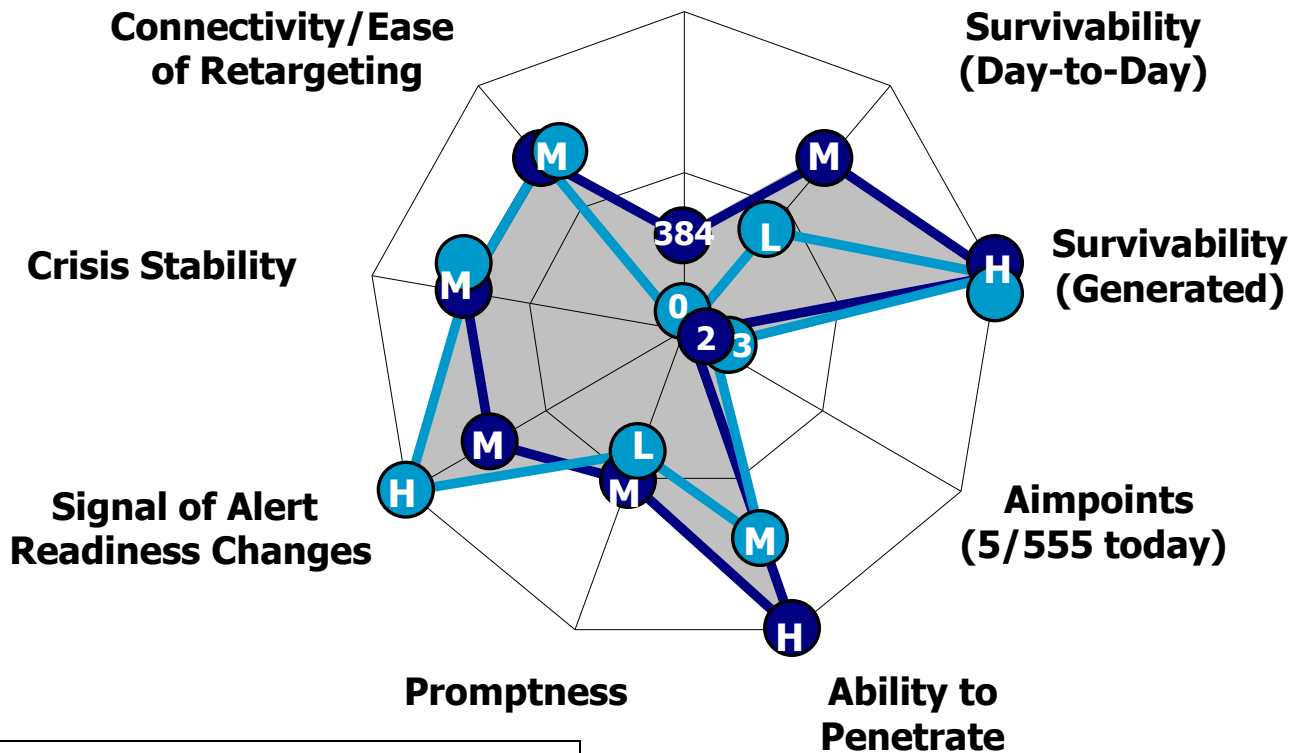
Implications

- 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

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



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

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

Notional Deterrent Value

—●— SLBMs
 —●— Bombers

- **Total Launchers = 383**
 - 288 SLBMs
 - 95 bombers

Dyad Option (2) – ICBMs and Bombers

Assumptions

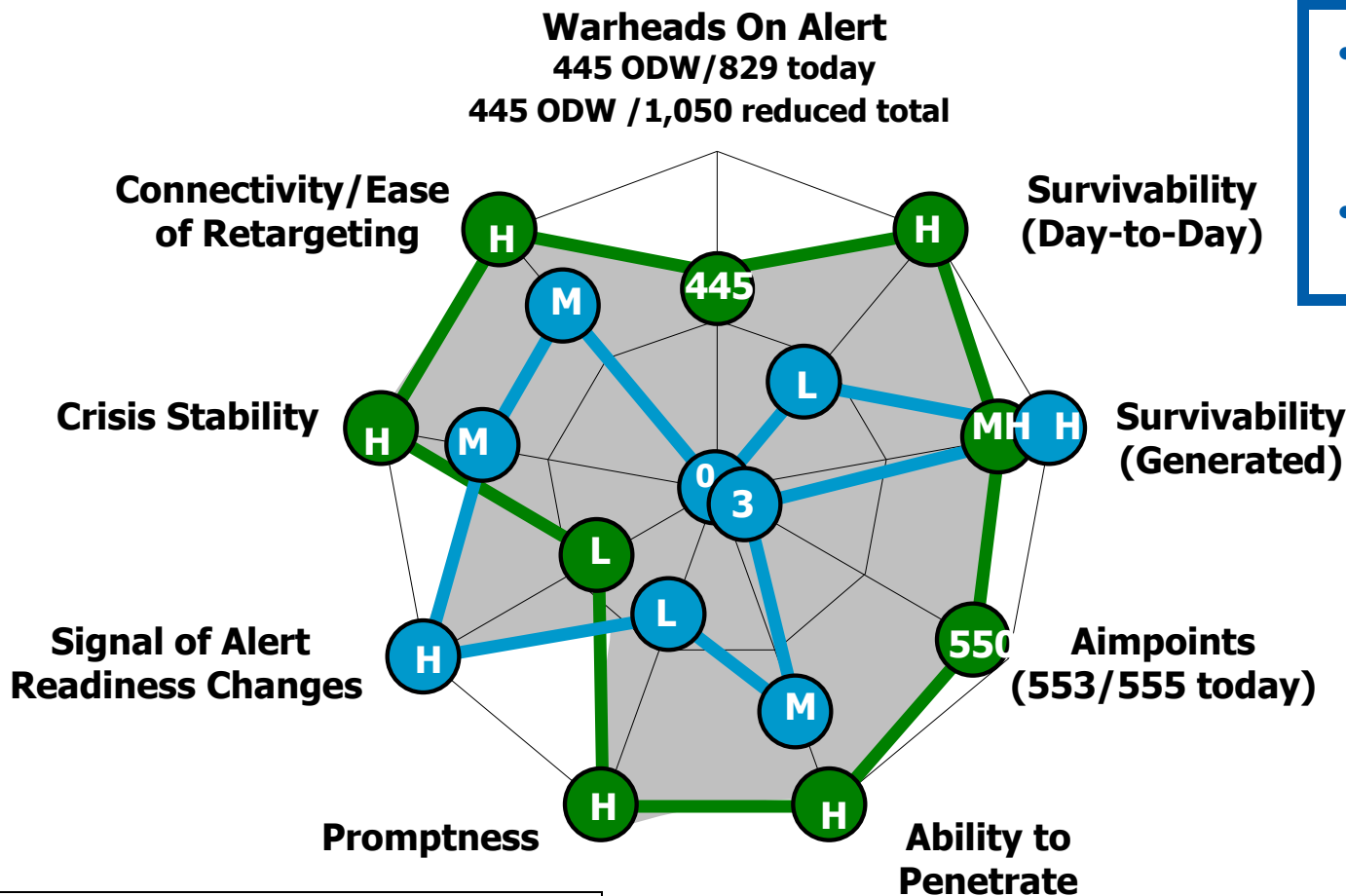
- Combines most responsive leg (ICBMs) and most flexible leg (bombers) of Triad

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



- 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

Notional Deterrent Value

● ICBMs
 ● Bombers

- **Total Launchers = 545**
 - 450 ICBMs
 - 95 bombers

Dyad Option (3) – ICBMs and SLBMs

Assumptions

- Combines two most survivable and responsive legs of Triad

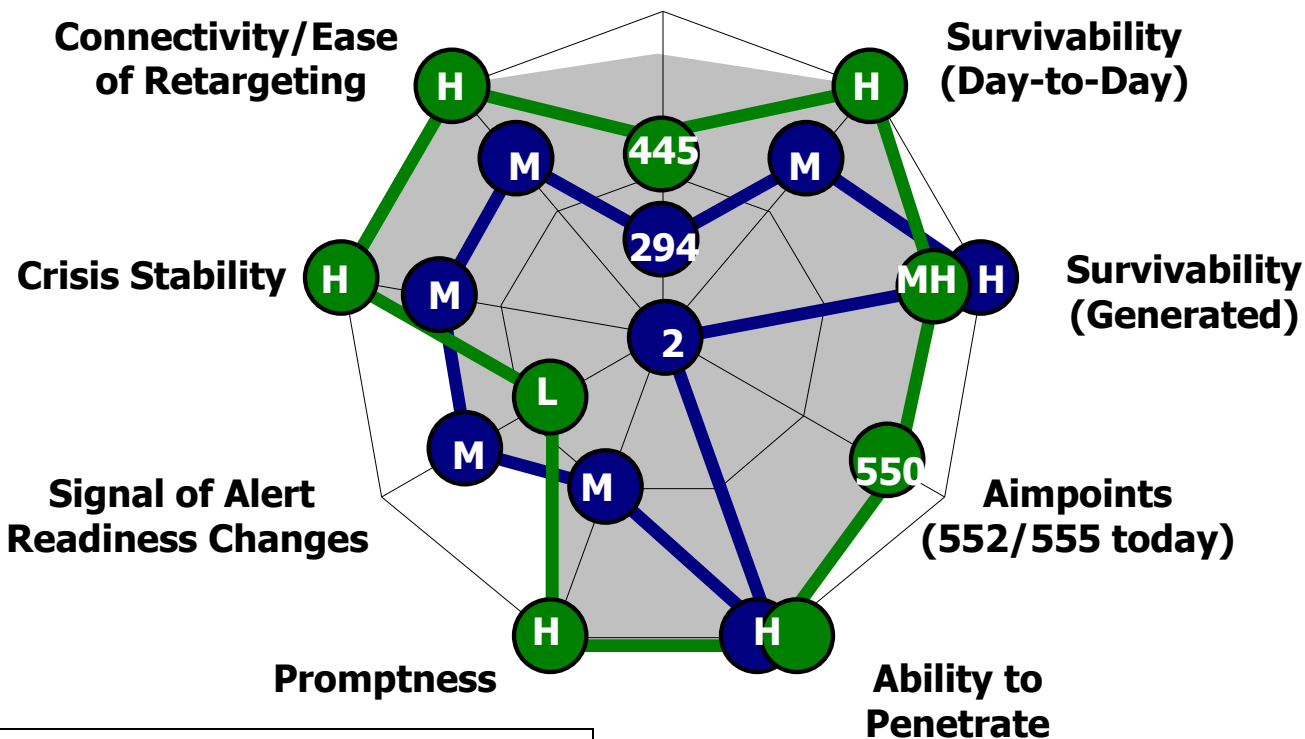
Implications

- 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



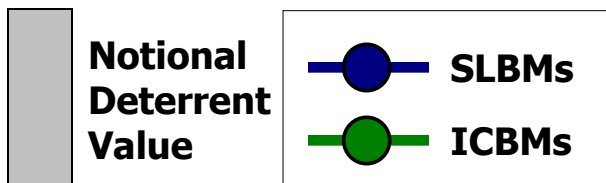
Dyad Option (3) – Maximum Leverage of Positive Attributes of ICBMs and SLBMs

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



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

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 = 738
 - 450 ICBMs
 - 288 SLBMs

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

Options	Annual Costs (\$ B)	Acquisition Priorities and Costs to 2050 (\$ B)
Triad <ul style="list-style-type: none"> • ICBMs • SLBMs • Bombers 	\$5.4 <ul style="list-style-type: none"> • \$1.1 • \$2.6 • \$1.7 	\$240 <ul style="list-style-type: none"> • ICBM mod (\$10) • Ohio Repl. (\$141) • ALCM-X + new Bomber (\$89)
Monad (SLBMs)	\$2.6	<ul style="list-style-type: none"> • Ohio Repl. (\$141) \$141
Dyad 1 (SLBMs + Bombers)	\$4.0	<ul style="list-style-type: none"> • Ohio Repl. (\$141) • ALCM-X + new Bomber (\$89) \$230
Dyad 2 (ICBMs + Bombers)	\$2.8	<ul style="list-style-type: none"> • ICBM-X + mod (\$10) • ALCM-X + new Bomber (\$89) \$99
Dyad 3 (ICBMs + SLBMs)	\$3.7	<ul style="list-style-type: none"> • ICBM mod (\$10) • Ohio Repl. (\$141) \$151

Ohio Repl. = Ohio Replacement Program

Sources: Brookings Institution, *What Nuclear Weapons Delivery Vehicles Really Cost*, August 1998; Steven M. Kosiak, *Spending on US Strategic Forces: Plans and Options for the 21st Century*, Center for Strategic and Budgetary Assessments (CSBA), 2006; 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; and Ronald O'Rourke, *Air Force Next-Generation Bomber: Background and Issues for Congress*, Congressional Research Service, August 3, 2009.

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

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Triad Assessment Metrics

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/ussbn.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.

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

- Brookings Institution, *What Nuclear Weapons Delivery Vehicles Really Cost*, August 1998
- Steven M. Kosiak, *Spending on US Strategic Forces: Plans and Options for the 21st Century*, Center for Strategic and Budgetary Assessments (CSBA), 2006
- 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
- Ronald O'Rourke, *Air Force Next-Generation Bomber: Background and Issues for Congress*, Congressional Research Service, August 3, 2009