EDAM Discussion Paper Series 2013/9

The Syrian Civil War:

Assessing the No-Fly Zone Option

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Executive Summary:

- ✓ *The imposition of a no-fly zone would significantly help to stop the Baathist dictatorship's forces from targeting Syrian citizens and the opposition elements given the importance of air-superiority to the regime's military campaign.*
- ✓ *Enforcing a no-fly zone over Syria would be a harder task than the recent Libya case. While Syria's ageing static air defenses, inadequate C4I (command, control, communications, computers, and intelligence) network, and relatively incapable fighter aircraft would not be sufficient to confront a U.S.-led operation, unpredictable deployment of man portable air defense systems (MANPADS) and mobile air defense systems under a constant relocation concept could cause problems for Western aircraft, especially at lower altitudes.*
- ✓ *The military scope of a possible no-fly zone operation would be critically important for determining the trajectory of the civil war. While the limited use of force could target facilities that enable the regime's air-superiority (runways, fuel storages, radars etc.), the total destruction of the regime's aircraft and strategic weapons systems would require a far larger commitment of military forces. Furthermore, a more comprehensive military approach could extend the scope of operations to target some critical land assets, such as the praetorian units of the regime.*
- ✓ *While passive and active defenses (distant basing, missile defenses and longer range stand-off weapons such as cruise missiles) provide some security against ballistic missile threat, Assad's possession of robust stockpiles of chemical (and allegedly biological) agents and ballistic missiles pose considerable challenges for neighboring countries. Thus, in order to limit the regime's long-range retaliatory capabilities, the air operation would likely have to target Syria's ballistic missiles, as well as aircraft capable of delivering WMD.*

INTRODUCTION

This work is the fourth paper of EDAM's *The Syrian Civil War* series[1]. The project is designed to shed light on this turmoil from a military strategic standpoint without getting lost in political debates.

EDAM's military analyses have discussed the major parameters and determinants of the civil war through the series' initial work, *The Syrian Civil War: A Military Strategic Assessment.* which we prefer to describe as "an introduction to the Syrian battleground". Subsequently the discussion paper series have continued with follow-up assessments on the civil war's weapons of mass destruction

[1] The author gives special thanks to Aaron Stein for his insightful contributions that enabled this report to address key issues effectively.

(WMD), strategic weapons systems, and the trajectory of the conflict after the regime's retaking of Qusayr.

This report analyzes the ongoing no-fly zone discussions solely through the prism of War Studies discipline. The assessment is based on a war-gaming scenario in which a United States-led coalition of blue forces would attempt to wage a no-fly zone operation against the red forces, representing the Baathist dictatorship's armed elements. In this scenario, the blue forces are assumed to have access to the British military facilities on the island Cyprus, along with Turkey's, Jordan's, and some of the GCC states' air bases (either these actors being a part of the coalition of the willing or supporting the operation). Military capabilities of Assad regime's foreign supporters, namely Iran and Russia, are kept out of calculus, owing to the assumption that both would not directly confront a U.S.-led coalition.

The model relies exclusively on open-source military data and surveys. By open-source data, we refer to military stats and analyses of reputable research organizations, open-source field manuals, unclassified and open technical details about weapon systems, and tools like Google-Earth for geographical and topographic assessments. The study is designed to assess a possible conflict at the strategic and operational levels, which would exclude analyzes on tactical level battles and engagements, and aims to provide a military *tour d'horizon* for readers.

In doing so, the study first focuses on operational options and capabilities of the blue forces, which represent a possible U.S.-led coalition, in comparison to the regime's air defense capabilities. The study then explains some key parameters of such a no-fly zone operation. Thirdly, the paper focuses on the regime's longer range weapons, the potential to use these weapons to strike targets in the region, and regional passive and active defense capabilities.

The study is designed to complement EDAM's previous work, thus we suggest reading the EDAM's previous publication, *The Syrian Civil War: Chemical Weapons Assessment*, for a more complete picture of the conflict.

1. Gaining Air Superiority and Suppression of Enemy Air Defenses (SEAD) Operations Assessment

Gaining air superiority as swift as possible would be one of the most essential factors for the establishment of a no-fly zone over Syria. In Syria, the significant threat emanating from surface to air missiles (SAMs) is far greater than the regime's Russian manufactured fighter jets which would make *suppression of enemy air defenses (SEAD)* operations very important.

The U.S. Department of Defense's *Dictionary of Military and Associated Terms* briefly defines SEAD as: *"activity that neutralizes, destroys, or temporarily degrades surface-based enemy air defenses by destructive and/or disruptive means".*[2] In a broader context, the Marine Corps Warfighting Publication *(3-22.2)* elaborates:

> *"SEAD is a tactical mission that supports other aviation missions. Rather than having an operational focus, SEAD is a supporting mission. All attacks on enemy air defenses are not SEAD. Likewise, SEAD is more than artillery-delivered suppression of known enemy air defense weapons during air operations".*[3]

SEAD missions can either be (1) *preplanned* which is briefly tantamount to a planned air-ground mission against known or suspected targets including air defenses, radar sites, and C3 (command, control, and communications) nodes; or (2) *reactive* which refers to efforts focusing on destroying or disrupting "pop-up" air-defenses (generally mobile SAMs) at lower echelons with specially designed air launched missile systems.[4]

Following a careful open-source comparative survey on potential operating assets and Syrian air defenses, and through simulating several brief war-gaming scenarios: EDAM's military assessment suggests that the regime's static SAM systems, such as SA-5 Gammon, would not pose an impassable threat to advanced aircrafts, and can be overcome by several measures, such as stand-off strikes through cruise missiles at the outset of a no-fly zone operation. The main challenges to a possible no-fly zone operation's SEAD mission would be: (1) Mobile SAM systems operating under a constant relocation concept, (2) and the widespread deployment of advanced MANPADS *(especially Igla class assets)* in the entire country at the hands of irregular groups. In military terms, at mid and high altitudes a US-led coalition is expected to operate satisfactorily, and possible *Preplanned SEAD* missions would likely be accomplished successfully. On the other hand, threat emanating from double-digit air defenses, such as the SA-22, should be taken seriously. Moreover, challenges towards a no-fly zone operation may likely occur at low altitudes and especially during Reactive *SEAD* missions.

Having a glimpse on Syria's air-defense posture might give a clear idea about our assessment.

Both the Syrian Army *(the equivalent of Land Forces in the Turkish Doctrinal Order of Battle)* and the Air Defense Force possess air-defense capabilities through a mix of static, towed, and self-propelled systems as well as anti-aircraft artillery.

The Air Defense Force is organized as a separate branch under the Syrian Arab Armed Forces' doctrinal order of battle. Following significant failures against the Israelis in 1982 First Lebanon War

[2] The US DoD, *Dictionary of Military and Associated Terms JP 1-02*, amended through 2011, p. 353
[3] Department of the Navy, MCWP 3-22.2, Washington D.C., 2001, p. 1-11
[4] Ibid. p.1-5

Damascus focused on improving its air defenses. Although the Baathist dictatorship's forces do not have the most advanced Russian SAMs – more specifically, the S-300 and the S-400 – Syria definitely possess a "dense" overlap of SAM systems that could be dangerous in case of a no-fly zone operation.

During the NATO air operations in Kosovo, strikingly when a stealth F-117 ground-attack aircraft was downed by a Serbian SA-3 on March 27 1999, constant tactical relocation of SAMs posed a critical challenge to the North Atlantic Alliance's forces.[5]

Open-source military surveys suggest that the Syrian Army air defense units possess mobile systems such as *(in NATO reporting names)* SA-8 Gecko, SA-9 Gaskin, SA-13 Gopher *(all three are very mobile systems that can easily and swiftly move and relocate)*, SA-11 *(Gadfly with multiple-target engagement capability)*, SA-22 *(Russian reporting name Pantsir S1, reportedly responsible for downing of the Turkish Phantom in 2012)*, SA-17[6]; while Air Defense Command possess SA-5 Gammon *(static system with very long range)* SA-6 Gainful *(self-propelled)*, SA-3 Goa, SA-2 Guideline *(both towed)* along with some 4,000 anti-aircraft artillery pieces *(both army and air defense branches possess anti-aircraft artillery)*[7].

Apart from mobile launcher systems, Syria's MANPADS represent a formidable challenge for military planners. A possible no-fly zone operation would have to face *Strela* series *(i.e. SA – 7 variants)* and more advanced *Igla* series *(i.e. SA-16, SA -18, and SA-24)* MANPADS at lower altitudes and shorter ranges. The *Igla* models and variants have a considerable capability against decoys and countermeasures – pieces of chafe, or metal designed to confuse heat seeking missile systems - and have better operational ranges, have more effective guidance systems, and utilize more advanced engagement aspects *(most of earlier MANPADS can only engage from behind while modern systems such as SA-18 have "all around engaging" capacity. Generally, MANPADS are assumed to be effective up to some 10.000 feet altitude).*[8]

Clearly, the regime's air defenses can cause some trouble at lower altitudes / shorter ranges through highly mobile, flexible systems. On the other hand, Syrian static air-defenses are ageing and could be eliminated easily at the initial SEAD stages of a possible no-fly zone operation. The regime's advantages in mobile systems / lower altitudes would probably cause a highly active and flexible air-defense strategy against a possible no-fly zone effort. The Baathist regime will probably try to regularly relocate mobile launchers and to spread MANPADS in urban and suburban areas. This strategy can mitigate effectiveness of munitions with GPS-based targeting system to some extent in

[5] Andrew Krepinevich, et al. *Meeting the Anti-Access and Area-Denial Challenge*, CSBA, Washington D.C. 2003, pp.21-23
[6] IISS, *The Military Balance: Middle East and North Africa,* Routledge, London, 2013.p. 404.
[7] IHS Jane's, *Jane's Sentinel Security Assessment- Eastern Mediterranean: Syria Air Force,*28 Jan 2012, p. 5.
[8] For a comprehensive assessment of MANPADS in contemporary warfare see: Australian Government Department of Foreign Affairs and Trade, *Man-Portable Air Defence System (MANPADS): Countering the Terrorist Threat,* Australian Strategic Policy Institute, 2008.

the absence of an efficient military intelligence. Moreover, the red forces' expected strategy of denying lower ranges might also cause difficulties in airborne observation and surveillance capacity that can cause poor target-detection and collateral damage.

In this regard, the training level and expertise of operators is another critical factor. Israel took advantage of poorly-trained SAM operators in 1982, and so did US in 1991 against Saddam's forces. However, in Kosovo, better trained operators proved their abilities by not turning their radars on until the last minutes to missile launch, and then by quickly shutting down the radars again. At this point, Russia's security assistance to the Baathist air defense elements would be important.

In sum, maintaining air-superiority might have very different outcomes at mid/high and lower altitudes for a no-fly zone operation. Operational risks at lower altitudes are expected to restrict flight patterns and courses of action, as well as denying some important assets' freedom of movement. On the other hand, the initial days of a no-fly zone operation would probably see Assad's static air defenses collapsing in a short time.

It is worth recalling that the US Air Forces' fixed-winged assets have had tremendous success during recent military operations. A multi-authored monograph by the Center for Strategic and Budgetary Assessments (CSBA) draws attention to the notable fact that "since 1979 Israeli and American F-15 pilots, plus one Saudi F-15 pilot who scored two kills during the 1991 Gulf War, have downed some 96 enemy fighters –including French-built F-1s as well as Russian-built Mig-29s and Mig-25s"[9]. After the development of the F-22 Raptor stealth air-superiority fighter, Washington and its allies have reached a much more robust control over the skies vis-à-vis potential enemy fighters. Thus, while Syria has a large number of aircraft, albeit with relatively low combat-readiness, the regime's heavy reliance on older platforms suggest that the blue team would quickly defeat the red team. For example, in 1982, the Israeli air force destroyed 87 Syrian fighter aircraft, without suffering a single loss. Yet, despite the United States' military preponderance and with exceptions such as Su-37 (Flanker F) type supermaneuverable fighters, which the Syrian Arab Air Force does not possess, the main challenge to American air assets would be SAMs, especially "double-digit" Russian systems.[10] With regard to more threatening double-digits, Syria is known to reach an agreement with Russia for the deployment of the S-300. However, as of the August 2013, Russia has yet to transfer the system to Syria. The S-300 transfer to the regime before any no-fly zone attempt could change the military strategic calculus.

As a final note, it should be mentioned that the regime's dense air-defenses and complexity of the battlefield is a cost increase factor. Recently, Gen. Martin Dempsey, the chairman of the U.S. Joint Chiefs of Staff, explained that a no-fly zone operation would cost about 1 billion dollars monthly with

[9] Andrew Krepinevich, et al. *Meeting the Anti-Access and Area-Denial Challenge*, CSBA, Washington D.C. 2003, p. 13
[10] Ibid. p. 15

the requirement of "hundreds of aircrafts".[11] Indeed, *"cost of maintaining the no-fly zones is highly sensitive to the operational tempo"*; for instance, during the Operation Southern Watch over Iraq, the Operation Desert Fox in 1998 had nearly doubled the annual no-fly zone costs to Washington.[12]

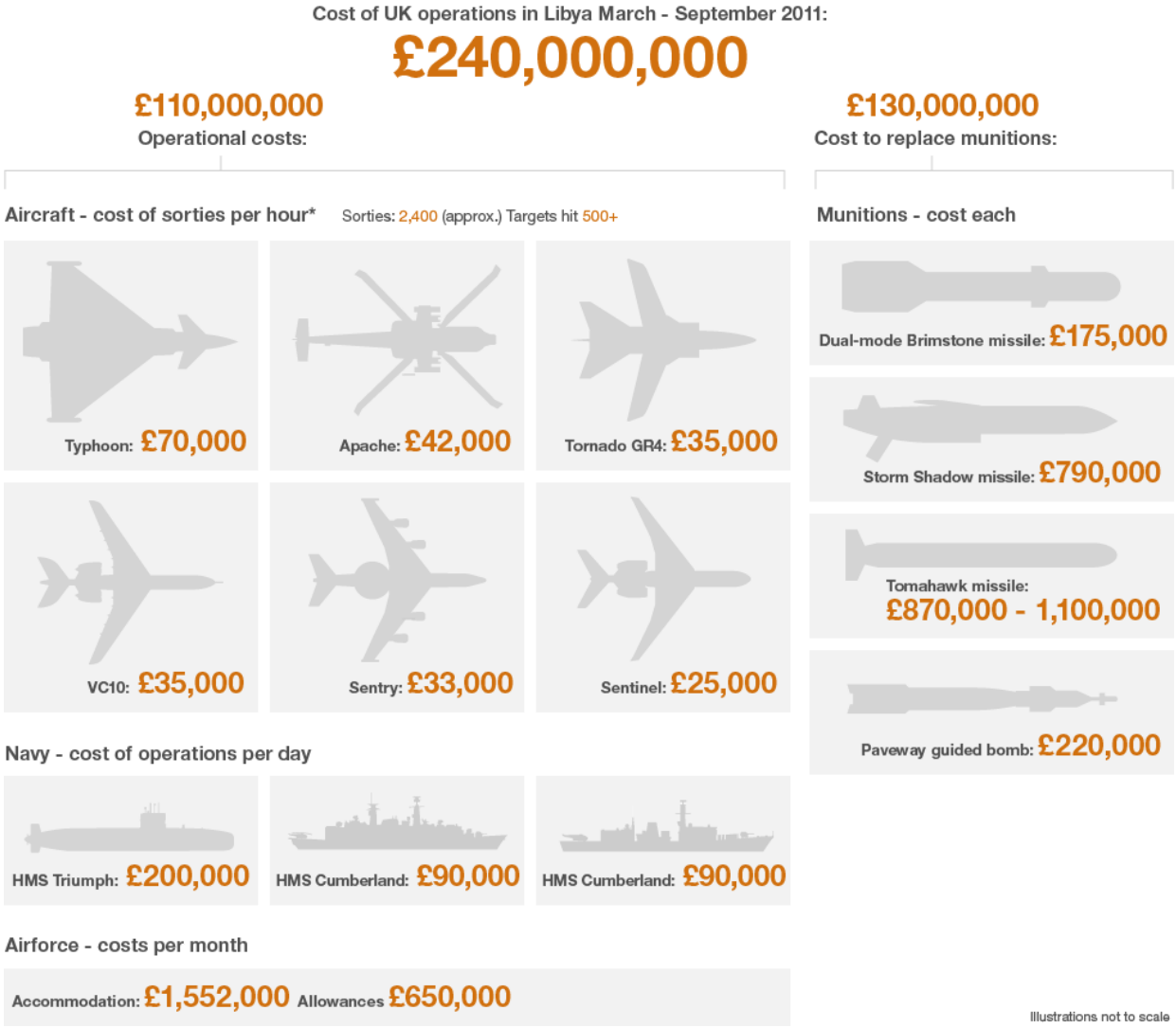
According to press sources, at the peak of the operational tempo, Washington spent at least 400 million dollars weekly for strike missions in Libya.[13] To be precise, each Tomahawk Missile cost more than 1 million dollars[14], while B-2s' 75 flight hours within 9 days between 19 -28 March had cost some 2.3 million dollars, excluding additional refueling costs of 0,8 million dollars. Moreover, if the United States were to lose a a single F-15 during combat operations, it would cost the Pentagon around 75 million dollars.[15] Therefore, any successful hit and down by the red forces' air defenses would not only cause a psychological discomfort, but also would increase the operation's economic burden to a certain extent.

Below, the BBC illustrates UK operational costs in Libya in about 7 months based on the British MoD's data[16]. By December 2011, the UK's Defense Secretary at that time, Phillip Hammond, indicated that the British operations in Libya had cost some 212 million pounds.[17] In other words, active air-ground strike missions always increase the costs of no-fly zone operations, and Syria would pose more targets in case of an operation than Libya did to the NATO mission. In this regard, the Center for Strategic and International Studies estimated that Libya had around 216 SAM systems before the start of military operations. In Syria, the regime has over four thousand systems.[18] Moreover, the mission in Libya also targeted Gadhafi's ground units. If a no-fly zone operation over Syria extends to target Assad's ground forces - *something that EDAM's military analysis considers with respect to the regime's praetorian units* - operational costs in Syria could be higher than estimated.

Nevertheless, "strategic cost" of inaction can still be overwhelming to estimated operational costs. For one, the Syrian Civil War's refugee crisis and regional risks emanating from the turmoil can well exceed a no-fly zone operation's estimated costs and possible losses. Without a doubt, Syria's

[11] "Top Military Leader No-Fly Zone in Syria could Cost Billion Dollars a Month", *The Washington Post*, 23 July 2013, http://www.washingtonpost.com/world/national-security/top-military-leader-outlines-costs-and-risks-of-greater-us-military-involvement-in-syria/2013/07/22/3631c74e-f314-11e2-8464-57e57af86290_story.html
Accessed on 28 July 2013.
[12] Todd, Harrison and Zack, Cooper. *Selected Options and Costs for a No-Fly Zone over Libya, CSBA*, March 2011, p.3.
[13] Al Arabiya, "US pays $100m daily for Odyssey Dawn: Report", http://www.alarabiya.net/articles/2011/03/23/142714.html, 23 March 2011, Accessed on: 29 July 2013.
[14] The Washington Post,"U.S. Spending on Military Operations in Libya Drains Pentagon", http://articles.washingtonpost.com/2011-03-23/world/35207671_1_operation-odyssey-dawn-military-operations-pentagon, 23 March 2011, Accessed on: 29 July 2013.
[15] Jeremiah, Gertler. *Operation Odyssey Dawn (Libya):Background and Issues for Congress, Congressional Research Service*, 2011, p. 25.
[16] BBC, "No End in Sight as RAF Marks 100 Days over Libya", http://www.bbc.co.uk/news/uk-13905914, 4 October 2011, Accessed on: 29 July 2013.
[17] BBC, "Hammond Says UK not Seeking 'Perfect Afghanistan' ".http://www.bbc.co.uk/news/uk-16080730, 8 December 2011. Accessed on: 29 July 2013.
[18] Aram, Nerguzian. *Instability in Syria: Assessing the Risks of Military Intervention*, CSIS, Washington D.C., 2011, p.16.

neighboring countries' threat perceptions with regard to regional instability and humanitarian crisis go well beyond the major Western actors. On the other hand, the bigger picture concerning Washington's strategic competition with Iran, one of the Baathist dictatorship's keen supporters, as well as Russia's involvement in the crisis already made Syrian turmoil a complicated issue of overall international affairs.



Source: BBC http://www.bbc.co.uk/news/uk-13905914 04 October 2011

In parallel with the air defenses, the red forces' shore-based anti-ship systems, especially the higher-end Yakhnot, should also be taken into consideration. The regime's naval anti-access & area denial capacity would necessitate a further, comprehensive assessment.

2. How to Hit: A Brief Analysis on Munitions Options

The *Operation Allied Force* in Kosovo introduced some "game-changing" developments in air-ground operational capabilities. One of these innovative developments was the employment of *joint direct-attack munitions (JDAM)*: a general-purpose bomb with GPS guidance and inertial navigation kits.[19] Unlike laser-guided munitions, which are sensitive to weather conditions and cloud cover, *JDA*Ms can be employed from high altitude nearly under all-weather conditions because of their reliance on global positioning satellites for guidance. Besides, their precision capabilities make *JDAMs* a weapon of choice especially on and around populated areas in order to avoid collateral damage.[20]

As indicated in the previous section, operating from higher altitudes might be a must under dense and menacing air defenses which Syria clearly sets and example. For instance, during the Operation Allied Force, even after initial SEAD efforts, remaining air defenses *(mobile batteries, MANPADS, and anti-aircraft artillery*) forced NATO to keep its air assets operating generally above 15,000 feet level. Although *JDAM* type smart-munitions served well in higher-altitude missions, air-defense danger at lower altitudes caused two important drawbacks to the NATO operations at that time: First, it denied robust close-air support assets such as the AC-130 gunship and the AH-64 attack helicopter which best operate at lower altitudes to a considerable extent. And second, finding Serbian forces on the ground became harder for the NATO aircraft. Difficulties in airborne observation have always been one of the biggest problems that lead to collateral damage and operational mistakes. For instance, on April 14 1999 a small group of civilians with vehicles, which were suspected to be Serbian forces committing ethnic cleansing by the NATO fighter jets flying above 15,000 feet, were bombed that tragically caused 73 killed and 36 wounded in Djakovica.[21] In case of a no-fly zone operation over Syria, such a collateral damage would be something that the Baathist dictatorship and its allies will look to exploit. Moreover, Syria's "MANPADS landscape" can pose threat up to some 10,000 feet altitude to combat flight missions which is an additional negative factor.

Recent records of US-led (and US-initiated) military interventions suggest that although higher proportions of munitions choice are *LGBs (laser-guided bombs)* and *JDAMs, Tomahawk Land Attack Missiles (TLAM)* and *Conventional Air-Launched Cruise Missiles (CALCM)* have been employed during the initial days of air campaigns. The latter two cruise missile assets are preferred to strike either heavily defended fixed targets at the outset of a campaign, or in order to avoid risks of employing manned aircraft in sensitive areas. Another reason behind the proportional differences in munitions choice is the cost gap between TLAM / CALCM and other ordnance preferences. More

[19] Bruce, R, Prine. et al. *Beyond Close Air Support: Forging a New Air-Ground Partnership*, RAND Project Air Force, Santa Monica, 2005. p.43
[20] Ibid. pp. 37-43
[21] Ibid. 42-45

specifically, the cost requirements for using cruise missiles throughout a military campaign is too high, thus necessitating the use of *JDAMs'* and *LGBs' to maintain* operational intensity.[22]

TLAM		Maverick		WCMD		LGB		JDAM	
%	Number	%	Number	%	Number	%	Number	%	Number
4	802	4.6	918	4.5	908	43.7	8,716	32.8	6,542

Employed Munitions during the Operation Iraqi Freedom
(total 89.6% excluding AGM-114 Hellfire, AGM-88 anti-radiation missile, and UK ordnance)
Source: Bruce, R, Prine. et al. *Beyond Close Air Support: Forging a New Air-Ground Partnership,* RAND Project Air Force, 2005, p.67
TLAM: *Tomahawk Land Attack Missile,* **Maverick:** *AGM-65 air-to-surface missile,* **WCDM:** *Wind-Corrected Munitions Dispenser,*
LGB: *Laser-Guided Bomb,* **JDAM:** *Joint Direct-Attack Munitions*

In the light of brief munitions info given above, it is argued that a possible no-fly zone operation's "overture" would be conducted by *Tomahawk* strikes from naval surface and submarine platforms against static SA-5 sites that can cause troubles for non-stealth and slower aircrafts. In this regard, a *Massachusetts Institute of Technology* working paper penned by Brian Haggerty suggests that initial *Tomahawk* strikes could theoretically include "time-sensitive targets" such as SA-2 and SA-3 batteries.[23]

Destroying the regime's hardened aircraft shelters would be another issue that a no-fly zone operation would have to deal with. Lessons-learned from the Operation Desert Storm (ODS) showed that destroying hardened shelters require "*LGB*-quality accuracy".[24] Furthermore, penetrating warheads would also be needed. During the ODS, *Paveway II* and *Paveway III* bombs with *BLU-109/B* warheads proved their reliability against hardened aircraft shelters.[25]

Some experts argue that the GBU-31 *JDAM* munitions combined with penetrator warheads would be sufficient to overcome the problem of hardened aircraft shelters. According to this analysis, one B-2 sortie / 8 hardened aircraft shelters ratio for a successful mission *(the B-2 stealth bomber can carry 16 GBU-31 JDAMs; two GBU-31 per shelter is calculated)* which would have to deal with an estimated number of some 205 shelters in total that would require 26 B-2 sorties for all hardened aircraft

[22] Barry, D, Watts. *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects,* CSBA, Washington D.C., 2007, pp. 238 – 240.
[23] Brian, T, Haggerty. *Safe Havens in Syria: Missions and Requirements for an Air Campaign,* SSP Working Paper, Massachusetts Institute of Technology, 2012, p.41.
[24] Barry, D, Watts. *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects,* CSBA, Washington D.C., 2007, p. 197.
[25] Ibid., p. 203.

shelters, assuming all sorties would accomplish the mission.[26] The B-2 fleet fall under the U.S. Air Force Global Strike Command umbrella, and based under the 509th Bomber Wing at Whiteman / Missouri which would mean they would fly from the continental United States by air-refueling. During a possible planned SEAD phase of the no-fly zone option, B-2s armed with weather-insensitive GBU-31 *JDAMs* with penetrator warheads, striking from high-altitudes would be immune to rogue MANPADS landscape of Syria.

3. Major Military Parameters of a Possible No-Fly Zone Operation

Planning a military operation is based on capabilities, intentions, and tradeoffs between different courses of action. When it comes to no-fly zone operations' basing options, choice of assets and munitions, and the scope itself would be important planning parameters.

Put simply, a no-fly zone operation against the Baathist dictatorship must be conducted (1) through effective sortie rates, (2) through an effective target acquisition, (3) by relying on accurate battlefield damage assessment, (4) and by preventing enemy retaliation that would exploit any base vulnerability.

3.1. Sortie Rates & Basing Options

Basing is one of the most important factors when assessing no-fly zone operational options in our case. Forward (or close) basing would enable shorter range assets, namely aircrafts with lower combat radius without air-refueling *(i.e. F-16 variants, and even F-15s despite their relatively higher combat radius slightly over 1,000 nautical miles)*, to enjoy high sortie rates that would foster their destructiveness.

One the one hand, the higher sortie rates through closer basing would enable more munitions to be delivered to targets in shorter time periods, which would make any air-ground mission more decisive in a given time. Yet, on the other hand, it would increase vulnerability of assets to retaliatory strikes. While a more cautious measure could be *distant basing and more intensive reliance air refueling and/or bombers* concept, this time such a course of action would reduce sortie rates; thus, especially given fighters' limited payloads, lower sortie rates would be tantamount to lower volume of ordnance delivered to eliminate the red forces' targets.[27]

At the same time, thanks to their higher combat radiuses longer-range heavy bombers, such as the *B-52* and the *B-2*, can mitigate basing problems to a considerable extent in terms of range. For instance, during the Operation Allied Force in 1999, B-2s conducted about 45 effective sorties flying from their

[26] Brian, T, Haggerty. *Safe Havens in Syria: Missions and Requirements for an Air Campaign*, pp. 40 – 42.
[27] For alternative strike systems and options in general see: Forest, E, Morgan. *Crisis Stability and Long Range Strike: A Comparative Analysis of Fighters, Bombers, and Missiles*, RAND Corporation, Santa Monica, 2013.

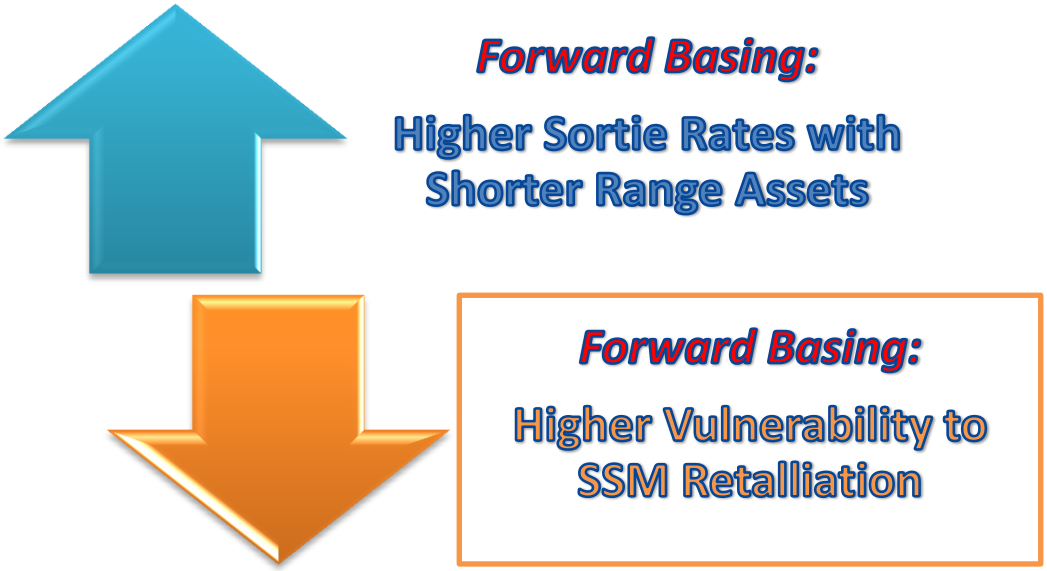
Whiteman Air Force Base home station in Missouri with a mission radius of some 10,000 kilometers.[28]

However, even with respect to long-range bombers, the relation between sortie rates and basing proximity would still be relevant. For instance, during the Operation Desert Storm (1991), B-52s flew from their bases in Fairford / UK, Diego Garcia, Moron / Spain, and Jeddah / Saudi Arabia. The shortest route, which was the one from Jeddah with less than 800 nautical miles when targeting Baghdad, enabled 16 B-52s to operate with 1.2 – 1.3 average sortie rates *(per day)*; while the remaining 40-50 bombers, which flew from the other three bases, generated less than 0.5 sorties per day. Furthermore, 16 B-52s flew from Jeddah completed some 46% of the total sorties while remaining 40-50 assets managed to generate 54% despite their numerical advantage over the bombers launching strikes from Saudi Arabia.[29]

In our case, a no-fly zone operation over Syria, forward basing at Incirlik / Turkey, British facilities in the island of Cyprus *(i.e. Akrotiri),* and probably Jordan's airfields would be critically important.[30] Such a basing posture, along with the support of at least one carrier strike group and its embarked air wing, would augment operating fighters' sortie rates and active operational (on-station) times. Besides, the GCC States' support, both by opening their airfields and airspaces and also by actively involving in no-fly zone combat operations, would also be critical. For instance, *B-2 Spirit* bombers can operate from Qatar's al Udaid Air Base[31]. Using al Udaid, in addition to other basing options (especially those of Saudi Arabia), would shorten flight routes compared to other routes from Europe and from Diego Garcia. However, it is likely that the blue forces would still fly some bombers from bases in the continental United States and Europe. Nevertheless, the use of regional air bases would be tantamount to higher sortie rates for bombers, which means that relatively small number of forward based assets could be used to meet operational requirements.

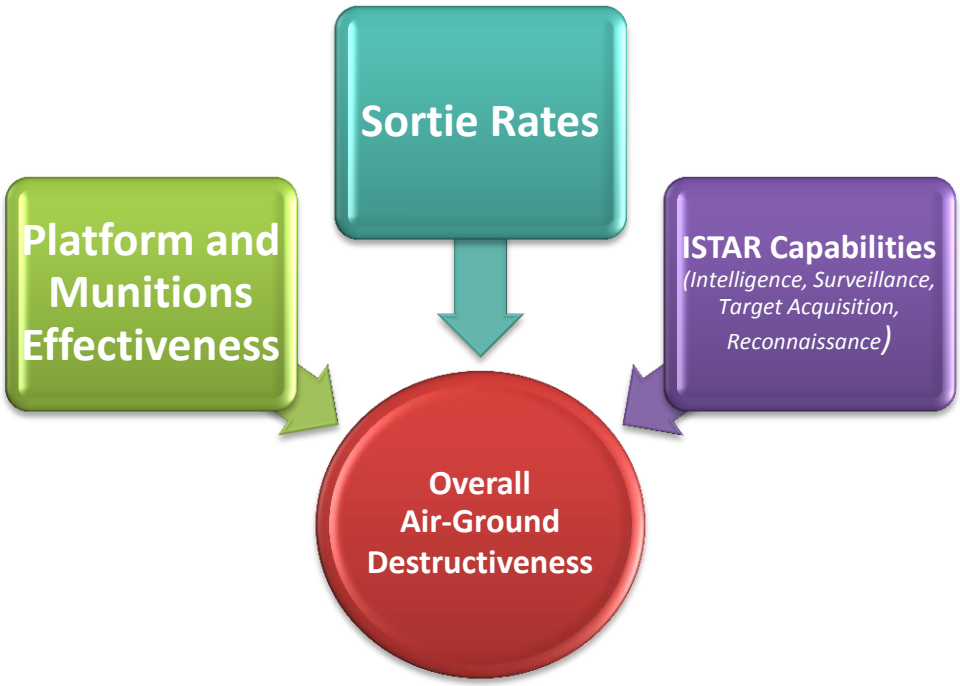
At the same time, Qatari al Udaid Base falls beyond Syria's surface-to-surface missiles (SSM) retaliation ranges that would mitigate operational risks, assuming Iran's missile forces would not go that far to retaliate a no-fly zone operation. The same could be said for some of the GCC bases that fall beyond the reach of Assad's ballistic missiles.

[28] Andrew Krepinevich, et al. *Meeting the Anti-Access and Area-Denial Challenge,* CSBA, Washington D.C. 2003, p. 15
[29] Ibid. p.16
[30] Brian, T, Haggerty. *Safe Havens in Syria: Missions and Requirements for an Air Campaign*, p.55.
[31] Anthony, Cordesman. et al. *US – Iranian Competition: The Gulf Military Balance –II*, CSIS, Washington D.C., p. 156.



Basing Tradeoffs: Closer Basing → Higher Sortie Rates → More Vulnerability

On the other hand, sortie rate is not the only variable when assessing the potency of an air-ground mission. Choice of munitions, ISTAR *(intelligence, surveillance, target acquisition, reconnaissance)* capabilities, and sortie rates together can constitute the framework of air-ground destructiveness.



EDAM Military Assessment Formulation: Judging Air-Ground Operations' Effectiveness

**Excluding surface and submarine launched missiles' effects*

3.2. Target Acquisition: Crippling the Regime's Military Machine

Target acquisition in a possible no-fly zone operation would not only determine the operation's military scope, but also its context and limits. Clearly, there would be some critical questions that need to be answered in order to understand the merits of enforcing a no-fly zone over Syria. For instance, would a possible operation include Assad's key operating armor units on the ground *(i.e. the 4th Armored Division)?* Would a possible no-fly zone effort aim to deny freedom of movement to the regime's air force, or would military operations focus on destroying Assad's air superiority completely? Some experts prefer to define the difference in operational scope with "no-fly zone & no-move zone" conduct[32].

3.2.1. Key Airfields and Air Bases

For gaining air superiority over Assad's air power, a combination of air defenses, command and control (C2) and radar installations should be eliminated, which is tantamount to some 22 targets; along with major airfields, hardened aircraft shelters, anti-ship cruise missile batteries *(ASCM),* and *SSM* batteries.[33]

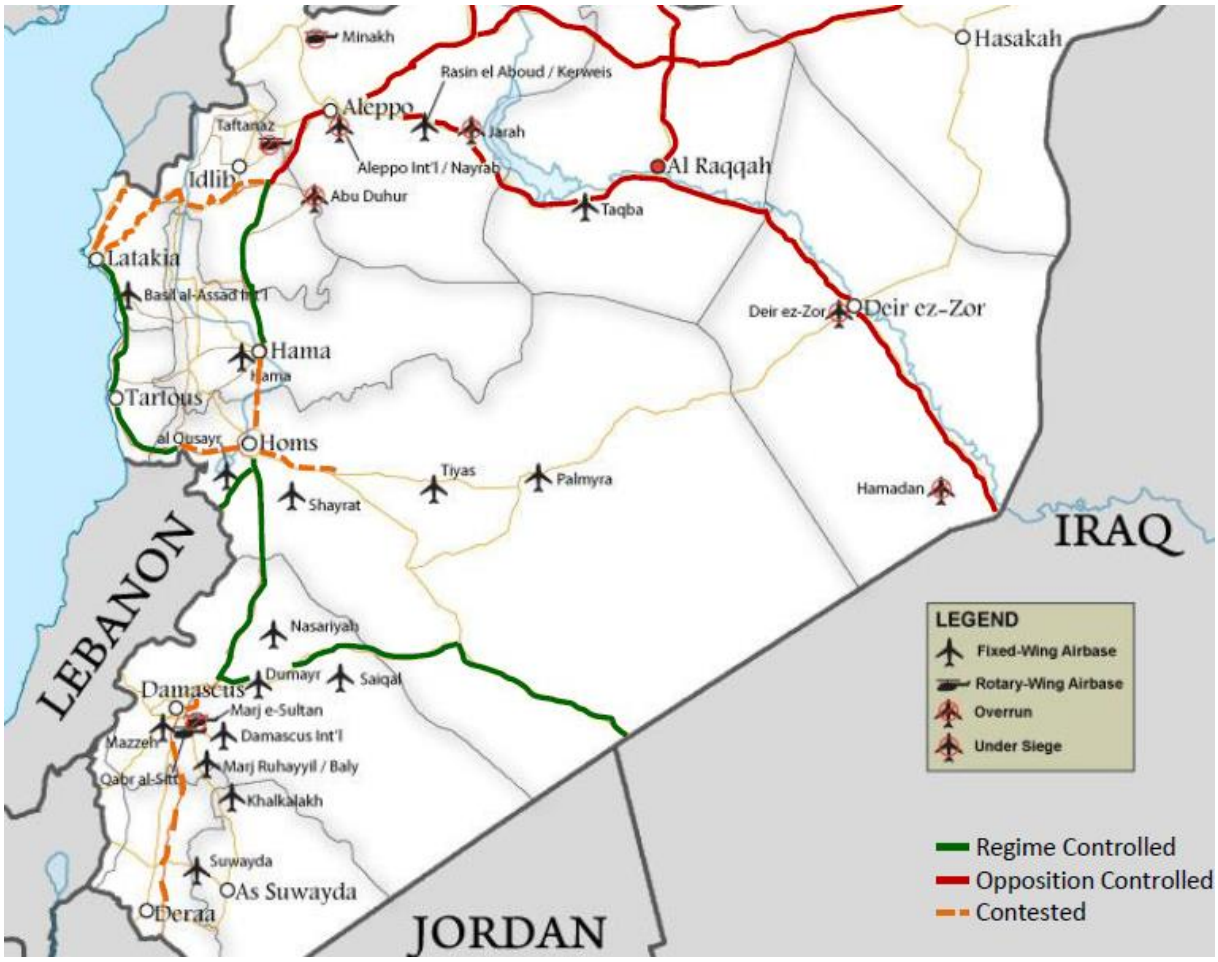
Tiyas Air Base *(34° 31′ 22″ N; 37° 37′ 48″ E)* would be one of the most important targets in case of a no-fly zone operation. Open-source military surveys suggest that several squadrons of *Mig-25* variants *(i.e. Mig-25 PD, Mig-25 RB)* were deployed at this base along with a squadron of *(the 819th Squadron) SU-24 MK* attack aircraft.[34] Tiyas Base has close to 1.1 million gallons of jet fuel stored on site and can support between 80 and 90 aircraft for both logistics and combat missions.[35] Similarly, Shayrat Air Base *(34° 29′ 30″ N; 36° 54′ 35″ E)* would probably be another focal point of a possible no-fly zone offensive due to deployed squadrons of *Mig-25, Mig-23,* and *Su-22* variants. In parallel, Sayqal Air Base *(33° 40′ 57″ N; 37° 12′ 50″ E)* with the relatively advanced Mig-29 deployment would also be another possible target.[36] Last but not least, Dumayr Base, located some 20 miles northeast of Damascus, would also be considered a high priority target for the blue team during military operations. The air base has 10,335 X 150 feet of main runway *(with a load classification number – LCN- of 39)* and can support a large variety of fighters and fighter-bombers.[37] Dumayr Base *(33° 36′*

[32] Anthony, Cordesman. "Syria: The Need for Decisive U.S. Action", http://csis.org/publication/syria-need-decisive-us-action, 14 June 2013, Accessed on: 14 July 2013.
[33] Brian, T, Haggerty. *Safe Havens in Syria: Missions and Requirements for an Air Campaign*, 2012, p. 40.
[34] IHS Jane's, *Jane's Sentinel Security Assessment- Eastern Mediterranean: Syria Air Force,*28 Jan 2012, pp. 5-6.
[35] William, D, O'Malley. *Evaluating Possible Airfield Deployment Options: Middle East Contingencies,* RAND Corporation Project Air Force, Santa Monica, 2001, pp. 87 -88.
[36] IHS Jane's, *Jane's Sentinel Security Assessment- Eastern Mediterranean: Syria Air Force,* pp. 3-8
[37] , D, O'Malley. *Evaluating Possible Airfield Deployment Options: Middle East Contingencies* p. 89.

35″ N; 36° 44′ 56″ E) hosts several squadrons of *Mig-25*, *Mig-23*, and *Su-22* variants.[38] Marj Ruhayyil (33° 17′ 11″ N; 36° 27′ 26″ E), which is believed to host squadrons of Su-22 and Mig-23 variants, and Hamah (35° 07′ 06″ N; 36° 42′ 40″ E) that hosts Mig-21 and Mig 29 squadrons could constitute other important targets for the blue forces.[39] Besides, although it is originally a trainer aircraft, L-39s were also employed in air-ground attacks that can constitute another target while the Syrian Air Force's transporter units can be targeted for curbing the Baathist dictatorship's ability to support isolated, besieged, or simply distant units. Open-source military surveys suggest that L-39s were mainly deployed at Jirah (36° 05′ 48″ N; 37° 56′ 11″ E) and Rasin al Aboud -Kowaires- (36° 11′ 14″ N; 37° 34′ 59″ E) air bases.[40] Following the seizure of Jirah Air Base by the opposition forces, Rasin Al Aboud remains as the only remaining known deployment center. However, the latter air base is also under the opposition siege and has been exposed to numerous attacks, even at the time of writing. Thus, it is argued, targeting L-39s would necessitate extra military intelligence efforts during a no-fly zone operation.

Above all, the bottom line of target acquisition with respect to airbases and air power is the very fact that while a limited approach can aim to destroy runways, fuel storages, radars, and other support facilities; a more comprehensive approach could also aim to destroy Syria's higher-end assets and bases for permanently undermining its capabilities for the rest of the civil war. An *Institute for the Study of War* (ISW)work assesses that crippling Assad's fixed-winged assets would force the regime to rely on rotary-winged fleet more that would be an easier target for MANPADS[41]. So far, the YouTube coverage of the Syrian Civil War has shown that with enough MANPADS capabilities, the opposition can deny lower altitudes to the regime's helicopters to a considerable extent. On the other hand, it should be noted that MANPADS proliferation at the hands of irregular groups would be a major concern for many regional actors and Washington in post-Assad scenarios. Especially possible future threats to airline security are likely to limit transfer of these systems to the opposition.

[38] IHS Jane's, *Jane's Sentinel Security Assessment- Eastern Mediterranean: Syria Air Force,* pp. 6–8.
[39] Ibid.
[40] Ibid. p.5.
[41] Elizabeth, O'Bagy et al., *Syrian Air Force and Air Defense Capabilities,* ISW, Washington D.C., May 2013, p.12.



Syrian Air Bases Update (Updated by May 2013)
Source: Elizabeth O'Bagy et al., ISW, *Syrian Air Force and Air Defense Capabilities,* May 2013.

4. Preventing the Retaliation: Eliminating Strategic Weapons and Missile Forces

As indicated in previous papers in *The Syrian Civil War* series, the Baathist regime's SSM capabilities, especially when combined with chemical and allegedly biological warheads, constitutes the dictatorship's strategic weapon systems which would serve as the red forces' most formidable retaliation asset in case of a no-fly zone operation. Apart from shorter range systems, such as the *SS-21*, Syrian missile forces possess three SSM brigades with capabilities (at least one of which) to launch SCUD types and variants[42]. This formidable arsenal can threaten targets from 300 kms *(via SCUD-B)* to some 700-800 kms *(via SCUD C about 600kms and via SCUD-D [No-Dong variant] some 700-800kms depending on warhead and other military parameters)*[43].

[42] For a comprehensive assessment see: The IISS, *Military Balance*, 2013, Routledge, London, 2013.
[43] For detailed information see: EDAM, *The Syrian Civil War: Chemical Weapons Assessment*, Istanbul, 2013.

Assuming a chemical-warhead / ballistic missile scenario, all of Jordan's territory and the British bases in Cyprus would be within the range of Assad's SCUD's missiles. When it comes to Turkey, the targets would strongly depend on launch sites' locations. However, from Baathist stronghold, such as the Allawite majority coast, major cities like Istanbul and Ankara are in range of Scud-D strikes. Open-source military surveys and commercial satellite imagery show that the Baathist regime has SSM facilities at southwest and northeast of the capital. The only exception is Al Safira Military Base near Aleppo which is believed to host WMD assets as well.[44] Therefore, while possible SCUD launches from the bases around Damascus might only threaten Turkey's southeastern population centers, key military bases such as Incirlik Base, and roughly the 2nd Tactical Air Command and the 7th Corps HQ in Diyarbakir; a SCUD-C or SCUD-D launch from Al Safira Base can theoretically hit the Turkish capital; though SCUD systems have relatively high *CEP*s (circular error probability) which makes them area weapons, which should preferably be launched in volleys against large-area targets, instead of being a weapon of choice to be used with high precision against point-targets.

A possible no-fly zone operation extended to eliminate the SSM and/or WMD retaliation threat would need to address two important factors. First, Syria's all surface-to-surface missile systems, including possible biological and chemical warhead deliverers, are mobile.[45] This fact would complicate the operational planning, and make *ISTAR (intelligence, surveillance, target acquisition, reconnaissance)* efforts more important; because the missile systems (and mobile *transporter-erector-launchers [TEL])* should be identified and destroyed in advance.

Another worry about the Baathist dictatorship's missile systems would be underground deployment. An analysis published by the CSIS on Syria's WMD capacity reports underground bunkers for storing missiles and TELs, and for hiding WMD production.[46] Especially, sheltered underground facilities near Damascus, Aleppo, and Hama, at which the Scud variants are believed to be both produced and assembled with the help of North Korean and Iranian technology[47], would be important targets for a possible no-fly zone operation's preventive strikes.

There are therefore three categorical measures *(passive defenses, active defenses, and preventive strikes)* that could be taken in order to mitigate the SSM retaliation threat.

Along with utilizing hardened shelters and more secure bases, at the operational level, passive measures include the use of dispersed-bases outside of Syrian missile range, or using a high number of bases with relatively small number of aircraft, or forward operating bases for quick refueling and

[44]IHS Jane's, *Jane's Sentinel Security Assessment- Eastern Mediterranean: Syria Strategic Weapon System,* p. 6.
[45] The United States DoD, *Ballistic Missile Defense* Review, Washington D.C., 2010, p.6
[46]For comprehensive information see : Anthony, Cordesman. *Syrian Weapons of Mass Destruction: An Overview,* CSIS, Washington D.C., 2008.
[47] Ibid. p. 9.

rearming operations.[48] In that sense, British bases in the island Cyprus and Turkey's Incirlik Airbase are within the projected range of Syria's SCUD systems even in case the missiles are launched from the red forces' bases around Damascus. Likewise, Jordan's fighter bases *(most likely Shaheed Mwaffaq and Prince Hasan bases)* offer excellent hard-surfaced runways, which can support most of the NATO standard tactical combat and transportation aircraft *(albeit in small numbers in Shaheed Mwaffaq)*[49], but an important proportion of Jordanian territory can be targeted by SCUD-Bs while the entire country falls under SCUD-C and SCUD-D range.

Under dispersed-basing modifications, Turkey's (southeastern), the UK's (in the island Cyprus), and Jordan's bases might be preferred as forward operating bases while the GCC states' facilities and more distant bases can be used for "full-service" safe nests in terms of passive defense measures. However, civil defense umbrella for civilian populations should also be considered in case of a WMD warhead–SSM strike threat.

In contrast to the passive defenses, active defenses include all efforts to *"detect, identify, track, engage, and damage or destroy the two types of offensive systems… -ballistic missiles and cruise missiles"* that the adversary could use to attack operating forces and disrupt the possible no-fly zone operation.[50] From a military standpoint, active defenses against the Baathist dictatorship's possible retaliation would necessitate joint efforts of *the Airborne Warning and Control System (AWACS),* ground based defense systems (Hawk SAM systems and Patriot variants in our case), fighters for air-ground missions (i.e. the F-15 and the F-16), and probably sea-based Aegis system in the Eastern Mediterranean for both direct interception and also for layered missile defense support, as well as protecting the British bases in Cyprus from SSM threats[51].

In that sense, the North Atlantic Alliance's Patriot BMD systems deployment upon Ankara's request, and Washington's Patriot deployment on the Jordanian soil fall under potential active defenses category in case of a no-fly zone operation.

However, solely relying on ballistic missile defense systems against possible red forces retaliation might have some serious problems, especially should the Baathist dictatorship decides to employ its WMD arsenal, given the fact that BMD systems –especially Patriots in our case– are not infallible. Therefore, preventive strikes against the Baathist dictatorship's retaliatory capabilities could still be needed along with passive and active defenses.

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[48] John, Stillon and David, T, Orletsky. *Airbase Vulnerability to Conventional and Cruise-Missile and Ballistic Missle Attacks: Technology, Scenarios, and U.S. Air Force Responses,* RAND Project Air Force, 1999, pp.39-41.
[49] Ibid, pp. 64 – 66.
[50] Ibid., p. 42.
[51] Although the Aegis system provides missile defense at primarily mid-course level, earlier tests of the system against "scud-like" (shorter range, non-separating) ballistic missiles showed successful interceptions. Besides, the system can cue detected and tracked ballistic missiles to other BMD platforms as a part of the layered missile defense approach.

4.1. The WMD Threat and Preventive Strike Necessity

To be clear, there is a significant difference between intercepting biological or chemical armed and conventional ballistic missiles. It is theoretically assumed that modern BMD systems can destroy SCUD-class ballistic missiles with a satisfactory interception rate, notwithstanding lack of battle-tested reliability so far. However, the mantra of biological and chemical warheads is to use a burst at a certain height within appropriate atmospheric conditions in order to create an aerosol cloud for releasing deadly droplets. Therefore, air temperature and density, which is related to the height of the burst, would determine the limits of ground contamination. In other words, a BMD interception, especially in the homing terminal phase of a missile, can even lead to the release of deadly chemical agents (and allegedly biological in the Syrian case) over the "protected" territory. As a matter of fact, a study published by the Massachusetts Institute of Technology discusses that the very difference between high and low altitude interceptions can only alter the exact pattern of damage instead of mitigating completely. Furthermore, the same study claims, high altitude interception is likely to increase unpredictability of contamination patterns on the ground which makes civil defense's work harder.[52] On the other hand, Uzi Rubin, former head of Israel's Arrow missile defense program, indicates that at very high altitudes, by which he refers above the jet stream level, an interception would be safe for the defender.[53]

In this regard, a memo, which was released following *the Arab Defence Journal's* visit to *Raytheon*, suggests that thanks to the PAC-3's modernized capabilities, now it is possible to ensure a "keep out altitude" for destroying ballistic missiles with chemical warheads and early release submunitions.[54] In parallel, a comprehensive article, co-authored by EDAM non-proliferation expert Aaron Stein for *the Rusi Journal*, notes that the PAC-3's hit-to-kill technology would enable to generate explosive power which should be adequate for vaporizing the WMD agent of a chemically-tipped Scud[55].

In addition, the difference between using hit-to-kill technology *(i.e. Patriot PAC-3 variant)* and high explosive warheads *(i.e.Arrow-2 – according to open-source info the kill vehicle is designed for initial hit-to-kill- with a proximity fuze for detonating the HE warhead[56])* should be examined in terms of potential contamination repercussions. If advanced military technical assessment finds meaningful

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[52] Theodore, A, Postol. *The Prospects for Successful Air-Defense Against Chemically-Armed Tactical Ballistic Missile Attacks on Urban Areas*, Defense and Arms Control Studies Program, Center for International Studies, Massachusetts Institute of Technology, Massachusetts, 1991, p.2.

[53] Uzi, Rubin. "Beyond Iraq: Missile Defense Proliferation in the Middle East", *Jerusalem Letter / Viewpoints No: 493*, Jerusalem Center for Public Affairs. Also it should be recalled tha the Arrow system has a longer operational range than Patriots.

[54] Simon, Taylor. *Arab Defence Journal – Visit to Raytheon's Patriot Manifacturing Site*,October 2012, Raytheon official website, http://www.raytheon.com/ourcompany/rtnwcm/groups/gallery/documents/digitalasset/rtn_110830.pdf, Accessed on: 29 July 2013.

[55] Shashank, Joshi and Aaron, Stein. "Not Quite 'Zero Problems': Ankara's Troubles in Syria", *The Rusi Journal*, Vol.158 No.1, 2013, pp.28-38.

[56] Nuclear Threat Initiative, *Israel Missile Chronology*, http://www.nti.org/media/pdfs/israel_missile.pdf?_=1316466791, Jan. 2010, Accessed on: 29 July 2013.

difference between hit-to-kill and explosive interception of chemically (and biologically) armed SCUDs, then not only the interception rates and altitudes but also type and variant of BMD systems' interceptor warheads can make a significant difference. Secondly, another mitigating countermeasure can be intercepting the missile at its boost or mid-course phases which Patriot type terminal-homing phase / point defense systems would not be suitable for the mission. However, boost and mid-course phase interceptions might cause contamination on the Syrian soil which would be dangerous for both the civil population and the opposition forces. Thirdly, more research is needed with respect to different behaviors of several chemical and biological agents that are supposed to be intercepted either below or above their burst altitudes.

In the light of discussion above, the real value of preventive strikes against SSM sites and systems can be better comprehended. Clearly, notwithstanding how high the BMD interception rates would be, a small proportion of successful strikes can have disproportionate strategic effects. Thus,given all operational drawbacks emanating from strategic weapons retaliation, destroying possible launch sites and ballistic missile systems can be a way of conduct in order to mitigate a possible Baathist aggression against forward operating bases, key targets, and population centers.

TURKEY'S KEY IMPORTANCE

Ankara's active involvement would be critical for the success of a no-fly zone operation over Syria. First, due to their proximities and NATO-standard facilities, Turkey's air bases, especially Incirlik, would provide some excellent forward-basing options to operating tactical fighters and tanker aircraft. As underlined in this study, access to Turkey's bases would enable higher sortie rates. Second, the Turkish Air Force's operational skills and regional familiarity would also be an important component of a no-fly zone effort. At this point, lessons-learned from the downed F-4 Phantom should be an important indicator when dealing with Assad's air defenses.

In case of an operation, the Baathist dictatorship's SSM retaliatory capabilities would pose a menacing threat towards the Turkish territory, against both civilian population and key military targets. Thus, robust preventive strikes against Syria's SSM capabilities at the outset of an operation would be in Turkey's defense interests. Nevertheless, with respect to the danger emanating from possible missed interceptions of BMDs when dealing with WMD-tipped Scud systems, the upcoming EDAM report is planned to cover the nation's level of readiness to counter WMD threat through both active and passive defenses.

For a long time, the Turkish administration has been voicing the need for more decisive action against the Baathist dictatorship of Syria. Furthermore, in accordance with this stance, top Turkish officials openly stressed the need, as well as their support, for the no-fly zone option. The decision-making process for involving in a no-fly zone effort, and domestic political debates on the Syrian crisis is out of this report's scope. However, it can be safely asserted that without Ankara's active political and military support a no-fly effort would not be impossible, but much more costly and harder.

Conclusion

In sum, a no-fly zone operation in Syria would definitely change the trajectory of the current battleground drastically in favor of the opposition. As indicated in the previous publications in the *Syria Civil War Series*, the Baathist dictatorship's air superiority is one of the first and foremost factors that have kept the regime robust despite all the degradation so far. Moreover, a possible no-fly zone operation can be extended to target critical land units, most importantly the regime's praetorians. Such a course of action can well pave the ground for Assad's military machine to collapse in a short time. Briefly, a no-fly zone operation would be decisive, and it can create a short-cut solution to the Syrian Civil War, at least from the military angle.

On the other hand, securing and maintaining a no-fly zone over Syria will be riskier than it was in Libya. First, while the Syrian air defenses and C4I capabilities are not state of the art in terms of military technology, they are dense and have numerical advantage. Second, following initial SEAD missions, targeting towed systems of the Air Defense Command, and especially locating and eliminating highly mobile systems under the army can cause some problems to military intelligence which may inflict collateral damages, especially close to urban and suburban areas. And third, Syria's rogue MANPADS threat landscape can be dangerous at lower altitudes. Furthermore, a no-fly zone over Syria would be costly due to its intensive operational requirements at the initial stages.

Nevertheless, if the West is determined to end to conflict in Syria and to stop the humanitarian tragedy by toppling Assad's dictatorship, then a no-fly zone operation can be suggested despite all the operational costs and risks. Because, although the current course of arming the opposition can help them to defend Aleppo as well as to keep their gains in the Jordanian border areas and Damascus' suburbs, it cannot be a silver bullet against the Assad regime which has been diligently supported by Moscow and Tehran. Furthermore, the instability in Syria is not only causing a moral crisis, but is also turning the current troublesome situation into a mass regional turmoil by igniting sectarian fault lines and creating a hardly controllable refugee problem right at already problematic border areas of neighboring countries.