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Is Turkey sleepwalking out of the Alliance? An assessment of the F-35 deliveries and the S-400 acquisition.

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Executive Summary

The Turkish – American bilateral relationship is in a deep crisis. An alliance that took shape in the early post-War years has entered a period of heavy turbulence with an ever-growing set of unresolved disputes. This unprecedented cumulation of bilateral disputes is burdening a relationship vital to transatlantic security. It is also compounding efforts to settle differences with linkages being established between unrelated topics leading to an ever more difficult environment for diplomatic negotiations. The way forward requires a willingness to disconnect these problems from each other so that some confidence building can be engineered by individually resolving these disagreements.

With this understanding, this report will focus on one of these disagreements. Turkey is planning to acquire an advanced Russian strategic defensive weapon system, known as the S-400 Triumf. There is however rising concern in the US about this purchase by a NATO ally. Indeed the fear is that, even if not networked, potential backdoors in the S-400 system could study critical operational data and electromagnetic signatures of the high-end aircraft, and transmit them to the Russian military intelligence.

The prospect of sanctions has therefore been raised in addition to Congressional initiatives to prevent deliveries of the F-35 Lightning II to Turkey due to the risks of operating the S-400 and the F-35 together. Yet Ankara's resolve regarding its potential acquisition of the S-400 seems unaffected despite the rising political and military costs.

Both Ankara and Washington are so far acting in a way that is oblivious to the real consequences of such a scenario of divergence.

The case that we make in this detailed report is that a failure to eventually reach an understanding on the now interlinked S-400 & F-35 issue can potentially affect Turkey's capability to act as an interoperable and capable NATO ally. In other words, this disagreement raises the prospect of a severe damage to the NATO Alliance, and by extension, to transatlantic security.

One mooted option has been for Turkey's F-35s to be delivered through several degradations ensuring that the aircraft is handed over without connection to the ALIS cloud-based network. However, such a degradation will cut Turkey's F-35s' from rest of the global F-35 fleet around the world. Maintenance, life cycle, and operation costs will inevitably increase, and the Turkish military-industrial complex will have much less access to the engineering and supply chain.

Washington's intent to link the supply of the F-35s to Turkey to political conditions, like the release of the jailed pastor Brunson is incongruous. The US would naturally work diplomatically to get the release of the jailed pastor as its citizen. But seeking to leverage the potential delivery of the F-35s for this purpose is greatly misplaced. The threat is incommensurate with its long-term implications. It underestimates the negative impact, not only for the Turkey-US relationship but also more generally for transatlantic security, of Turkey not being able to get the delivery of this fifth-generation multirole aircraft. The linkage with Turkey's acquisition of the S-400 from Russia, however, is more relevant.

In our view, Ankara would need to adopt a political and diplomatic strategy that takes fully into account of this inevitable conclusion that the acquisition of the S-400s will have ramifications for the supply and operationalization of the F-35s. Either the US will need to be convinced that the delivery of the F-35s to a country that operates the Russia-made S-400s is not a real threat to the integrity of network-centric NATO platforms, or that the threat of cyber hacking –or digital espionage– emanating from the S-400s can categorically be eliminated, or Turkey would need to forego the acquisition – or at the very least the operationalization– of the S-400s. At present, there seems to be no real third option for Turkish policy-makers to sidestep these binary and mutually exclusive outcomes.

Introduction

The Turkish – American bilateral relationship is in a deep crisis. An alliance that took shape in the early post-War years has entered a period of heavy turbulence with an ever-growing set of unresolved disputes. This unprecedented cumulation of bilateral disputes is burdening a relationship vital to transatlantic security. It is also compounding efforts to settle differences with linkages being established between unrelated topics leading to an ever more difficult environment for diplomatic negotiations. The way forward requires a willingness to disconnect these problems from each other so that some confidence building can be engineered by individually resolving these disagreements.

With this understanding, this report will focus on one of these disagreements. Turkey is planning to acquire an advanced Russian strategic defensive weapon system, known as the S-400 Triumf, or SA-21 Growler in NATO designation. There is however rising concern in the US about this purchase by a NATO ally. Indeed, even if not networked, potential backdoors in the S-400 system could study critical operational data and electromagnetic signatures of the high-end aircraft, and transmit them to the Russian military intelligence. The prospect of sanctions has been raised in addition to Congressional initiatives to prevent deliveries of the F-35 Lightning II to Turkey due to the risks of operating the S-400 and the F-35 together. Yet Ankara's resolve regarding its potential acquisition of the S-400 seems unaffected despite the rising political and military costs. Both Ankara and Washington are so far acting in a way that is oblivious to the real consequences of such a scenario of divergence. The case that we make in this detailed report is that a failure to eventually reach an understanding on the now interlinked S-400 & F-35 issue can potentially affect Turkey's capability to act as an interoperable and capable NATO ally. In other words, this disagreement raises the prospect of a severe damage to the NATO Alliance, and by extension, to transatlantic security.

The report firstly examines in detail the arguments from a Turkish perspective of wanting to acquire the S-400 system. The initial chapter will therefore focus on strategic and operational level analyses of these acquisitions for Turkey's defense planning. In doing so, the first part will also provide a detailed air and missile threat assessment and will explore various counter-air concepts along with key contributions that the S-400 and the F-35 can offer. Under this heading, the role of NATO capabilities in Turkey's contemporary and near future ballistic missile defense capacity will also be examined.

The second chapter is predominantly allocated to the F-35 project. The aircraft is widely portrayed, only, through its stealth features in Turkey. The report will try to elaborate the underlying design philosophy of the aircraft, its battle management role in network-centric warfare, and how the F-35 can give an overall boost to the capabilities of other systems and platforms. This section will also assess US arguments about the risks triggered by the potential operationalization of the S-400 on the Turkish territory for the integrity of the F-35.

The concluding sections provides the political context and elaborates scenarios on how the two allies can possibly overcome their disagreements.

AIR AND MISSILE THREAT ASSESSMENT FOR TURKEY: ANALYZING THE UNDERLY-ING REASONS OF THE S-400 PROCUREMENT AND THE F-35 PROJECT

In terms of air and missile defense planning, at present, Turkey faces four major challenges. The first challenge, in fact a chronic one since the 1990s, remains Turkey's vulnerabilities against ballistic missile proliferation at its Middle Eastern doorstep. Secondly, Turkey's regional competitors are acquiring menacing A2/AD assets that could restrict the Turkish airpower in its operations. Thirdly, especially in recent years, changes in the Turkish military's force structure necessitate a more balanced counter-air posture through effective burden-sharing between SAM systems and fighter aircraft. Finally, the Turkish defense sector is now reaching a critical threshold that would allow it to produce more tech-driven, high-end systems. In doing so, technology transfer and co-production have become key priorities for the decision-makers.

Challenge 1: Mounting Ballistic Missile Proliferation Trends in the Middle East coupled with Problematic Weapon of Mass Destruction (WMD) Warhead Potential

The ballistic missile buildup along its borders pose various threats to Ankara. Firstly, its regional competitors' abilities to deep-target Turkey's population centers, its critical national infrastructure, and strategic military installations bring about a serious intrawar deterrence[1] gap that would restrict Turkish political-military decision-makers' *marge de manoeuvre* in wartime. In other words, ballistic missiles, especially when tipped with nuclear or non-nuclear WMD warheads, equip the adversary with the ability to determine escalation patterns within an ongoing armed conflict[2]. If one of the belligerents – in our case, potentially, Turkey facing Syria or Iran– does not have offensive strategic weapons capabilities *(for example, a ballistic missile inventory that can respond in kind)*, or at least defensive strategic weapons capabilities *(integrated ballistic missile defenses with preferably exo-atmospheric interception capacity against WMD warheads),* it would not be able to control the trajectory of war even if it enjoys traditional conventional superiorities. Indeed, Ankara, in recent years, showed a notable improvement in developing its own 'Bora' ballistic missile line with some 280km+ range[3]. However, compared to the Syrian and Iranian arsenals, and given Turkey's clean record regarding its commitments to the WMD non-proliferation regimes, the Bora missile cannot form a reliable offensive deterrent with its present limits.

Secondly, ballistic missiles enjoy high penetration capabilities. Compared to aircraft and airstrikes, these assets fly much faster and follow hard to detect trajectories some of which can be exo-atmospheric after certain ranges, and thereby, give minimum preparation time for defenses. In brief, they are shock weapons at strategic, operational, and tactical levels. Besides, due to their ability to hit major population centers and critical national infrastructure, ballistic missiles are terror weapons with devastating psychological warfare effects.

Thirdly and finally, these weapons are probably the best delivery means for WMDs. Even intercepting a WMD-warhead at endo-atmospheric levels may still not prevent potential contamination. More importantly, detecting the missile's payload is very complicated, and this very ambiguity itself brings about extra deterrence favoring the offensive.

The ballistic missile threat to Turkey, especially the one posed by the Syrian Arab Armed Forces' strategic weapons capabilities, was once more highlighted in the July 2018 NATO Brussels Summit Declaration[4]. Open-source military

1 "Intrawar deterrence is defined as the effort to control substantial military escalation during an ongoing war through the threat of large-scale and usually nuclear retaliation should the adversary escalate a conflict beyond a particularly important threshold. ...The concept of intrawar deterrence involves a process of explicit or tacit bargaining within an ongoing war that still has key limits or thresholds that have not been crossed" For the full text of the verbatim referred parts, see: W. Andrew, Terril. Escalation and Intra-war Deterrence during Limited Wars in the Middle East, the US Army SSI, Carlisle Barracks, 2009.

2 Ibid.

3 Defense News, https://www.defensenews.com/land/2018/05/02/turkey-seeks-to-expand-range-of-locally-built-missile/, Ac-cessed on: July 27, 2018.

4 July 2018 NATO Brussels Summit Declaration, article 49, "Syria has a significant inventory of short range ballistic missiles whose range covers part of NATO's territory and some of our partners' territories. Syria has used these missiles extensively against its own population. We remain concerned that Turkey has been hit three times in the last four years by missiles launched from Syria. We con-tinue to monitor and assess the ballistic missile threat from Syria", for the full text, see: https://www.nato.int/cps/en/natohq/official_texts_156624.htm, Accessed on: July 24, 2018.

surveys suggest that the Syrian Arab Armed Forces possess a menacing inventory of SS-21 Scarab tactical ballistic missiles, Scud-B (some 300km range) and Scud-C (500-600km range) short-range ballistic missiles, and the North Korea manufactured / modified Scud-D (700km)[5]. Notably, although the bulk of the Syrian Arab Army have suffered a serious level of attrition through the civil war, Assad's missile forces gained significant combat experience that should not be taken lightly. Saddam Hussein's missile forces, for example, had managed to minimize the Scud-B's approximately 90 minutes set up and launch procedures into less than 30 minutes[6]. Furthermore, recent conflict records suggest that, interestingly, Soviet-legacy missiles can still bleed modernly-equipped military formations. In September 2015, a SS-21 (OTR-21 Tochka) hit a Saudi forward base in Marib, Yemen, and killed 73 Coalition troops (mostly the United Arab Emirates personnel) along with tens of Yemenis[7].

All in all, despite the Turkish Armed Forces' open conventional superiorities over the civil war-torn Assad's forces, still, the Syrian Arab Army have the capabilities to hit forward-deployed Turkish contingents. Furthermore, the Baath regime retains the capability to target Turkey's critical national infrastructure and major population centers in southeastern Anatolia, and can theoretically threaten the capital, Ankara, with Scud-Ds in case the missiles are deployed to the air bases located in the north of the country. Furthermore, a notorious outsider, North Korea, plays a key role in Syria's (as well as Iran's) missile proliferation and WMD know-how[8].

Likewise, the ballistic missile dimension also comes into the picture when assessing the Turkish – Iranian military strategic balance. Although Tehran cannot match the Turkish inventory in many segments, its robust ballistic missile arsenal, by far the largest in the Middle East, remains a game-changer. Moreover, unlike the Syrian challenge, the Iranian missile forces can cover the entire Turkish territory including the nation's geopolitical core, Istanbul, along with the economic powerhouse region of Marmara centered on the city.

Taking advantage of the wording differences between the UN Security Council Resolution 1929 *(adopted in 2010, and prohibits Iran from undertaking ballistic missile activities)* and Resolution 2231 *(adopted in 2015, the resolution endorsing 'the nuclear deal', and calls upon Iran not to undertake any activity related to ballistic missiles designed to be capable of delivering nuclear weapons)*, Iran tested several missiles up until today[9]. Furthermore, on June 18, 2017, the Iranian Revolutionary Guards launched ballistic missiles from Kermanshah, Iranian territory, into the reported ISIS positions in Deyr ez-Zor, Syria. The incident marked Tehran's first use of ballistic missiles since the Iran – Iraq War. The missiles, probably belonging to the Zolfiqar-class, flew over the Iraqi territory, followed a flight path between 600 – 700 kilometers, and apparently, some of them hit their targets[10]. Finally, open-source imagery intelligence suggests that, for some time, Iran opts for establishing rocket and missile production complexes in Syria[11].

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5 For a detailed assessment and inventory, see: The IISS, the Military Balance 2018, Routledge, London, 2018; National Air and Space Intelligence Center – Defense Intelligence Ballistic Missile Analysis Committee, Ballistic and Cruise Missile Threat, Wright-Patterson AFB, 2017; Allessandra, Giovanzanti. Assesing North Korean Assistance to Syria's Weapons Programmes, Jane's IHS Mar-kit, 2018.

6 William, Rosenau. Special Operations Forces and Elusive Enemy Ground Targets, RAND, 2001, p.32.

7 Sebastien, Roblin. "SS-21 Scarab: Russia's Forgotten (but Deadly) Ballistic Missile", the National Interest, September 2016, https://nationalinterest.org/blog/ss-21-scarab-russias-forgotten-deadly-ballistic-missile-17679, Accessed on: July 24, 2018.

8 Alessandra, Giovanzanti, Assessing North Korean Assistance to Syria's Wepons Programmes, IHS Jane's, May 2018; Dany, Shoham. "Syria's Growing Chemical Weapons Entanglement", BESA Perspectives Papers No.816, April 2018; Paul K. Kerr. et.al. Iran – North Korea – Syria Ballistic Missile and Nuclear Cooperation, Congressional Research Service, 2016.

9 Kenneth, Katzman. Iran's Foreign and Defense Policies, Congressional Research Service, 2018, pp.12-13.

10 For a detailed assessment of Iran's solid-propelled tactical ballistic missile capability development efforts, see: Stéphane, Delory and Can Kasapoglu. Thinking Twice about Iran's Missile Trends: The Threat is Real but Different than Predicted, FRS, 2017.

11 Stéphane, Delory and Can Kasapoglu. Iran's Rising Strategic Foothold in Syria, FRS, 2018.

Retrieved from: *CSIS Missile Defense Project[12]. In addition to the referred source, it should be noted that the Fateh-110 line now reached an operational peak with the Zolfiqar missile, probably covering 700km+ range with more precision capabilities than Iran's Scud and North Korean arsenal based, liquid-fueled missile lines. Besides, the estimated range for the Sejil-2 solid-fueled MRBM could be higher. More importantly, Iran's solid-fueled family of missiles will enjoy much shorter launch cycles which would augment the surprise factor.*

In addition, Armenia's procurement of advanced Russian SS-26 Iskander missiles (the export variant with degraded, some 280km range[13]) as well as the Russian ballistic missile buildup in Crimea and Syria remain important factors for Turkey's air and missile threat environmen

12 Missile Defense Project, "Missiles of Iran," Missile Threat, Center for Strategic and International Studies, published June 14, 2018, last modified June 15, 2018, https://missilethreat.csis.org/country/iran/. Accessed on: July 27, 2018.

13 Eduard, Abrahamyan. "Armenia's New Ballistic Missiles will Shake up the Neighborhood", The National Interest, October 2016, https://nationalinterest.org/feature/armenias-new-ballistic-missiles-will-shake-the-neighborhood-18026?page=0%2C2, Ac-cessed on: July 28, 2018.

NATO Capabilities' Role in Turkey's Ballistic Missile Defense Posture

Notably, even if Ankara opts for off-the-shelf procuring the Patriot from the US, co-producing a new Ballistic Missile Defense (BMD) system –probably based on the Aster line– with EUROSAM, or even finalizing the S-400 deal, Turkey would still need larger NATO capabilities to address the ballistic missile challenge.

Since the first-generation systems emerged in the mid-20th century, ballistic missiles have greatly evolved. Contemporary ballistic missile technologies bring about very challenging attributes in flight trajectory characteristics, propulsion systems, warheads, re-entry & maneuverability, and accuracy. In brief, more advanced aerodynamics enabled deceptive maneuvers at the terminal-homing phase to stress BMD systems, terminal guidance made missiles more accurate, low warhead observability made warheads harder to detect, and finally, current ballistic missiles can follow alternating trajectories (for example lofted or depressed trajectories) to further complicate BMD systems' already highly demanding analyses that depend on seconds to calculate the threat profile[14].

At each stage of a ballistic missile's flight path *(boost, mid-course, and terminal phases)* there are clear advantages and disadvantages that any missile defense system would face[15]. The terminal phase is short, so it generally offers just one shot to intercept the threat *(a Patriot PAC-3 battery would engage an incoming ballistic missile at this stage).* The mid-course phase offers the longest window to engage, yet, there emerges several problems. Typically, a ballistic missile with a range of more than 600km would fly its mid-course at exo-atmospheric levels *(low exo-atmoshpere for shorter range systems and high exo-atmosphere for intercontinental ballistic missiles).* Tracking the missile through drastically shifting temperature, gravity, and air-resistance environments, and sometimes distinguishing it from decoys, remain indeed demanding. Lastly, the initial phase, namely the boost phase, aims to accelerate the missile until reaching endo-atmospheric or low exo-atmospheric orbits. Thus, due to the missile's burning rocket motors, distinct signatures are available. Yet, this phase offers a short window to engage. For example, a 600km-range ballistic missile's boost phase would last about 90 seconds[16]. Furthermore, boost phase interception of a missile necessitates complex ISTAR-strike networks.

All the abovementioned parameters and characteristics of the missile threat at different phases make multilayering, namely a layered set of measures to address each phase, a requisite for establishing an effective ballistic missile defense architecture[17].

Interoperable and integrated are the two key terms that best define the essential requirements for present and future air and missile defense. Simply put, modern air and missile defense architectures have to be interconnected and highly network-centric with complex sensor-to-shooter linkages in order to address the increasingly menacing challenges. In the absence of robust networking, the chances of scoring successful intercepts tend to be drastically low[18]. In other words, contemporary network-centric architectures are depicted by the 'any sensor-best shooter' design philosophy through which all sensors cue data intensively while the best interceptor of the layered defensive configuration engages the threat[19].

NATO's ballistic missile defense umbrella consists of a complex network to detect and track the missile threat. While satellite-based sensors focus on detecting the launch and tracking the boost phase, several ground and naval-based radars *(such as, the AN/TPY-2 radar [the system deployed in Kürecik, Turkey], the SMART-L radar, and the AN/SPY-*

14 For an introductory work on ballistic missile and ballistic missile defense, see. Khalid, Adbullah, Al Bu-Ainnain. Proliferation As-sessment of Ballistic Missiles in the Middle East, Inegma Special Report No.2, 2009.

15 For a detailed and comparative assessment of interception options at different phases, see: UNIDIR, Missile Defense Deterrence and Arms Control: Contradictory Aims or Compatible Goals, UNIDIR – Wilton Park, 2002.

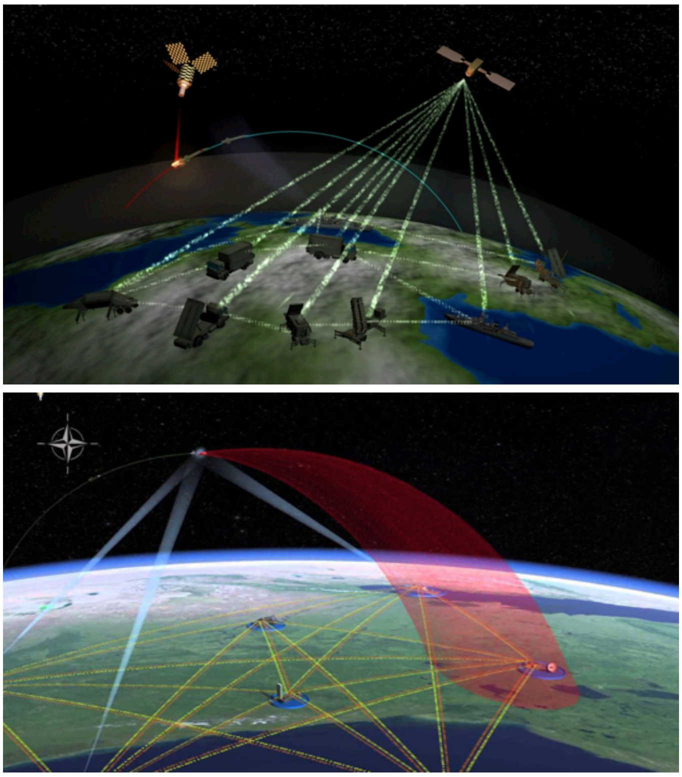
16 Ibid. p.6.

17 Ibid. pp.4-12.

18 Thomas, Karako and Wes Rumbaugh. Distributed Defense: New Operational Concepts for Integrated Air and Missile Defense, CSIS, 2018, pp.18-20.

19 Ibid.

1 radar of the Aegis Combat System) continue tracking the threat, and more importantly, share the data about the missile with each other as well as the Headquarters Allied Air Command in Ramstein, Germany. This complex system's utmost priority is intercepting the missile at exo-atmospheric levels *(i.e. by the Raytheon Standard Missile-3 interceptors deployed on BMD capable vessels with Aegis Combat System, forward-homeported in Rota, Spain)*[20]. NATO reports that when needed, the US Terminal High Altitude Area Defense (THAAD) systems, which can perform both exo and endo-atmospheric hits, can augment the architecture. Finally, at the terminal phase, Patriot and SAMP/T air and missile defense systems form the last line of defense endo-atmospheric capabilities[21].



NATO BMD Architecture Illustrated[22]

In the absence of the abovementioned network, Turkey's future S-400s will not be able to operate efficiently as ballistic missile defense assets. Furthermore, as highlighted earlier, even if Turkey completes any NATO-compatible system acquisition, be it the Patriot off-the-shelf or the EUROSAM co-production options, Turkish defense planners would still need the larger NATO architecture to protect the country from longer range threats and WMD warhead-tipped missiles. After all, "an architecture built upon the terminal defense is impractical"[23].

Furthermore, although the details of the subject should be elaborated in a separate and more technical study, integrating the S-400s to the Turkish national command & control, early warning and sensors networks by totally excluding the NATO infrastructure would be extremely demanding. For one, NATO contribution to Turkey's overall radar capabilities remains crucial. Secondly, Turkish systems' interfaces to external (NATO-compatible) systems (i.e. via Link16) make the situation more complicated. Thirdly, even if everything goes as planned in the S-400's integration to the national capabilities, as mentioned earlier, an effective ballistic missile defense requisites detecting and tracking the missile starting from the launch with real-time, precise information cueing between many components of an architecture. Thus, at the time being, Turkey's national network would not be able to compensate for the loss of NATO capabilities in the BMD segment. Besides, in early 2018, Turkey's main procurement body (the former SSM, recently SSB) kicked-off a project to connect the forthcoming F-35 into the Air Force Information System (HvBS)[24]. Yet, connecting the F-35 and the S-400 into the same C4I (command, control, communications, computers, intelligence) structure could prove to be unrealistic.

ASELSAN's HERIKKS Air Defense Early Warning Command and Control System[25]

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20 NATO, https://www.nato.int/cps/en/natohq/photos_112331.htm, Accessed on: July 25, 2018.

21 Ibid.

22 Ibid.

23 Ronald. C. Wiegand, "Heads not Tails": How to Best to Engage Theater Ballistic Missiles?, The US Air University Maxwell Air Force Base, 2006. p.19.

24 SSB, https://www.ssb.gov.tr/Images/Uploads/MyContents/V_20180103130752709974.pdf, Accessed on: July 28, 2018.

25 https://www.aselsan.com.tr/en-us/capabilities/command-control-communications-computer-and-intelligence-systems/battlefield-management-system-kopyas%C4%B1/herikks-air-defense-early-warning-command-and-control-system-kopyas%C4%B1, Accessed on: July 27, 2018.

Challenge 2: Mushrooming A2/AD (anti-access / area denial) Nodes at Turkey's Doorstep

The threat set in modern air operations is mainly dominated by missiles which form the backbone of the growing A2/AD (anti-access / area denial) zones. Merger of integrated air defenses and precision strike systems makes power projection and strategic maneuverability harder than ever. Besides, unmanned systems' rise in the recent decade could offer new horizons such as swarming. All these developments profoundly challenge the existing supremacy understanding since achieving dominance in all domains continuously may now sound like an unrealistic objective. In return, new concepts, such as the multi-domain battle are developed "to create temporary windows of superiority across multiple domains and throughout the depth of the battlefield"[26].

Turkey is increasingly being surrounded by contested airspaces. Especially, the flow of effective air defense equipment into the Middle East makes conventional militaries' job harder than ever. Firstly, drastic proliferation of man-portable air defense systems (MANPADS), and spread of these weapons among non-state actors including terrorist organizations, turn low altitudes, namely below 10,000 – 15,000 ft., into 'pensile minefields' especially for rotary-wing platforms[27]. In this regard, during Turkey's cross-border counter-terrorism campaigns in Syria, particularly during the Euphrates Shield, MANPADS and other the low-altitude air defense threats had significantly restricted the army aviation's attack helicopters and air assaults operations. In fact, air assault capabilities of the elite commando units, as well as the incorporation of attack helicopters into the inventory, played a key role at the 1990s' military success against the PKK terrorist organization. However, contemporary hybrid battle-spaces are seriously challenging such concepts.

Secondly, highly mobile, robust air defense systems with short-to-medium ranges make the A2/AD landscape very dangerous. In 2012, the reconnaissance variant of a Turkish F-4 was probably downed over Syria by such a system, Pantsyr S-1[28]. Following the civil war, Moscow boosted the delivery of the Pantsir variants to Syria. In April 2018, it was reported that some 40 additional systems were transferred to the Syrian Arab Air Defense Forces until then[29]. Moreover, another asset with similar capabilities, the SA-17, also entered the Syrian inventory[30]. In brief, these systems are highly mobile and survivable, and can menacingly capitalize on pop-up windows of opportunity even against advanced aircraft.

Thirdly, there is the issue of strategic SAM landscape at Turkey's doorstep. Without a doubt, the Russian involvement in the Syrian civil war, and introduction of the advanced systems such as the S-400 and the S-300V4, radically altered the entire air defense coverage. To put bluntly, in the absence of a diplomatic rapprochement with the Kremlin, Turkey's Syria campaigns could not have been realized, or could only be thinkable at the expense of risking a heavy air force attrition. Following the US-led punitive strikes against the chemical weapons use by Damascus, Moscow also raised the possibility of the S-300 PMU-2 delivery to the Syrian Arab Air Defense Forces[31]. Besides, Syria's Soviet-legacy, very long range S-200 SAM systems were also modernized by the Russian industry in recent years[32]. This modernization visibly paid-off when a Syrian S-200 downed an Israeli F-16I in early 2018, marking the first combat loss of an Israeli fighter in more than three decades[33].

Finally, Iran recently procured the S-300 PMU-2 long range, high altitude SAM systems from Russia[34]. This was one of

26 Thomas, Karako and Wes Rumbaugh. Distributed Defense: New Operational Concepts for Integrated Air and Missile Defense, CSIS, 2018, p.2.

27 Can, Kasapoglu. "Suriye Hava Sahasının Kontrolü. Mayın Tarlasında Uçmak", Anadolu Ajansı, February 2018, https://www.aa.com.tr/tr/analiz-haber/suriye-hava-sahasinin-kontrolu-mayin-tarlasinda-ucmak/1074824, Accessed on: July 27, 2018.

28 BBC, https://www.bbc.com/news/world-middle-east-18689037, Accessed on: July 27, 2018.

29 Ria Novosti, https://ria.ru/syria/20180409/1518206215.html, Accessed on: July 27, 2018.

30 Army Technology, https://www.army-technology.com/projects/buk-m2e-air-defence-missile-system/, Accessed on: July 27, 2018.

31 Haaretz, https://www.haaretz.com/middle-east-news/syria/russia-says-will-deliver-new-air-defense-systems-to-syria-soon-escalating-tensions-with-israel-1.6029530, Accessed on: July 27, 2018.

32 TASS, http://tass.com/defense/1000450, Accessed on: July 27, 2018.

33 Sebastien, Roblin. "Israeli's Deadly Air Force has been Destroying Syria's Russian-Built Air Defense Systems", The National Interest, May 2018, https://nationalinterest.org/blog/the-buzz/israelis-deadly-air-force-has-been-destroying-syrias-russian-25881?page=0%2C1, Accessed on: July 27, 2018.

34 The IISS, The Military Balance 2018, Routledge, London, 2018.

the most important moves of Tehran in military capability building following the nuclear deal, and could carry on with other game-changers, such as the Russian Su-30 supermaneuverable fighter aircraft[35]. Moscow seems open for Tehran's defense acquisition demands. Thus, although it is early to conclude, further transfers of advanced Russian arms could cause some shifts in the Turkish – Iranian air warfare balance which currently remains in favor of Ankara.

CATEGORY OF THE THREAT	CHARACTERISTICS OF THE THREAT
MANPADS (i.e. SA-14, SA-16, SA-18, SA-24)	Disruption of air assault operations and attack helicopters' close air-support, vital challenges to rotary-wing platforms and low-flying attack aircraft, disruption of mobility in complex battlefields, disruption of logistical operations, downing of helicopters will inevitably bring about risky combat search & rescue operations in hostile territory, can be used to threaten civilian aviation.
Advanced short-to-medium range SAM systems (i.e. Pantsyr-S1, SA-17)	High mobility and better survivability stress SEAD operations, can pose pop-up threats to air force and army aviation platforms, quick deployment capabilities put extra burden on military intelligence, provide cheaper and easier maintenance solutions, short-to-medium range engagement envelops threaten several mission and aircraft types, provide layered defense when interoperated with strategic SAM systems, can engage cruise missiles to protect strategic SAM systems.
Long Range / High Altitude Strategic SAM Systems (i.e. S-200, S-300 variants)	Can form menacing A2/AD nodes, significantly disrupts deep-strike operations, engagement envelops remain very dangerous for non-stealth aircraft – especially in the absence of electronic warfare measures–, when layered with other SAM systems can form layered coverage with more survivability, depending on deployment locations can project the threat into enemy territory, can support – and partially replace – combat air patrols.

Due to the civil wars and crises around its hinterland, as well as increasing hybrid and transnational characteristics of the terrorism threat, Turkey has a growing tendency to address the challenges at their sources, and beyond its borders. On the other hand, there is no certainty that the Russian consent would always be granted whenever Ankara decides to militarily intervene in Syria. Given the transnational geostrategic profile of the new threat landscape, Turkish defense planners should be well prepared to provide the required air cover for ground troops. Likewise, the Turkish Air Force has to develop very effective deep-strike, suppression of enemy air defenses (SEAD) and close air-support (CAS) capabilities in contested airspaces. Besides, integration between manned & unmanned aircraft with land-based fire-support elements should be improved. In fact, all these capabilities could be fostered by the F-35 acquisition, as explained by this report in detail.

On a final note, because Turkey's air threat assessment is increasingly dominated by the growing A2/AD capabilities of its competitors, the Turkish military's very need for stealth aircraft and the stealth aircraft's interoperability with other assets are becoming more crucial than ever. As underlined in a 2017 report penned by high-rank US Air Force officers:

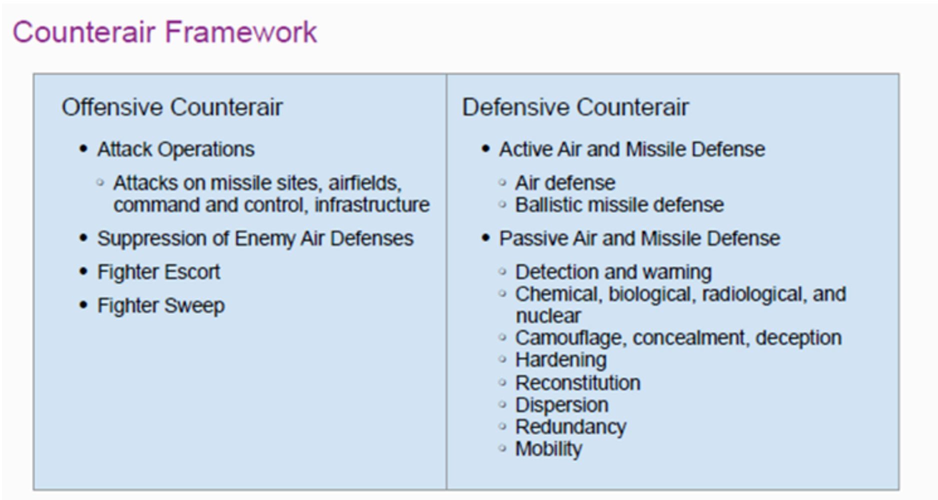
[35] Reuters, https://www.reuters.com/article/us-russia-iran-idUSKCN0VQ0NF, Accessed on: July 27, 2018.

"Stealth is a central tenet of aircraft survivability in the future air combat threat environment. It gives platforms an increased chance of survival against air defenses by reducing the number of sensors that can detect, track, and shoot while increasing the time it takes them to complete these tasks. In short, stealth lowers an adversary's probability of kill. The threat scenario and associated survivability equation are more complex now than ever, but one truth remains—the laws of physics ensure that stealth will always make an aircraft more survivable by enabling it to manipulate the same EMS on which modern sensors rely so heavily. …Today, the high threat A2/AD environments have progressed to the point that, in some cases, completely avoiding all detection may not be feasible, but neither is it necessarily required. …Each part of the kill chain must be effectively executed within a certain time window of opportunity in order to shoot down an aircraft. Therefore, an air defense system must be able to accurately detect, track, identify, and engage an incoming aircraft, which creates many opportunities for disruption"[36].

Challenge 3: Turkey's Urgent Need to Shift towards a More Balanced Counter-Air Operations Concept

Turkey's air defense and airspace control concepts have traditionally depended on offensive counter-air operations through robust fighter squadrons and combat air patrols. As explained by the 2017 EDAM report, given the problematic threat landscape ranging from the Mediterranean to the Middle East, the current air force structure is not suitable to sustain a multi-front air superiority, let alone air supremacy, in key areas of strategic interest. Thus, as illustrated below referring to a doctrinal source, Turkish defense planners need to mix offensive and defensive counter-air concepts. In doing so, fighter squadrons should be supported by adequate SAM configurations. This observation constitutes a strong argument for the acquisition of the S-400.

Briefly, EDAM's defense research concludes that the Turkish administration has intended to procure the Russian defensive strategic weapon system as a standalone air defense measure, rather than an integrated ballistic missile defense solution, to compensate for the shortcomings emanating from low, yet recovering, pilot-to-cockpit ratios[37]. The primary reason of the S-400's inability to address the missile challenge results from the lack of the necessary sensors, radars along with a layered and networked architecture, as explained in the previous section. For that, Ankara predominantly relies on NATO capabilities. In the meanwhile, Turkey has been cooperating with EUROSAM to co-produce NATO-friendly ballistic missile defense capabilities, while also focusing on the indigenous Hisar family of air defense systems at high, mid, and low altitudes[38]. In other words, the S-400 could best be depicted



Retrieved from: The US Joint Chiefs of Staff, Countering Air and Missile Threats, Joint Publication, 2017.

[36] Mark, Barrett and Mace Carpenter. Survivability in the Digital Age: The Imperative for Stealth, Mitchell Institute for Aerospace Studies, 2017. pp.30-31.

[37] Following the July 2016 coup attempt, Ankara focused on preventing infiltrations into the state security apparatus, and ensuring thorough background checks. Following the discharges, the Air Force's pilot-to-cockpit ratio saw the 0.8:1 low, while the optimum level should be between 1.25:1 to 1.5:1. Although maintaining personnel reliability is vital, Turkey's tough security environment urgently necessitated a stopgap measure. The S-400 deal surfaced amidst these drastic developments. For a detailed assessment, see: Can, Kasapoglu. Turkey's S-400 Dilemma, EDAM, 2017.

[38] Ibid.

as an urgent stopgap measure, as well as a way of political signaling to the West for voicing Turkey's unmet demands in defense sector by its decades-long allies.

Leaving aside the BMD shortfalls due to the absence of adequate networking, the S-400 is a robust, reliable SAM system offering effective air defense solutions. The launcher can operate several missiles of choice (i.e. 48N6, 48N6E, 48N6E-2, 48N6E-3), the longest range against aerodynamic targets can reach up to some 250 km, and against ballistic targets, hypothetically, some 60 km. The S-400 is reported to have some capability against stealth aircraft, and to be more resilient to electronic warfare and jammer activities[39]. More importantly, Russian military planners use the missile as the backbone of the national air defense deterrent which tells more than the known test results. At the time of writing, Russian sources reported that the 40N6E long range missiles with a range of some 400km completed the trials at the Kapustin Yar range[40]. Although the new 400km missiles could also end up in the exports to China and possibly India, so far, no available open-source news suggested the same for Turkey[41].

Nevertheless, all the range data regarding the SAM systems should be taken with grain of salt, especially when it comes to the 'S-400 euphoria' in the Turkish press. Above all, the curvature of the earth prevents air defense systems from seeing aircraft below the required altitudes. Besides, topographical challenges should also be taken into consideration. Terrain masking makes tracking targets harder. Last but not least, the open-source attributes of air defense systems, say 250km range of the S-400, cannot be generalized for all aircraft, at any given altitude or range. Air defense interceptors have a limited supply of velocity that would be further drained by maneuvers[42]. Thus, in a hypothetical scenario, the S-400's effective ranges against a tanker aircraft flying at high altitudes and a fighter aircraft flying low through mountainous terrain would not be the same. The latter could be engaged at shorter distances with lower kill probabilities.

Nevertheless, the S-400 can still offer strong air defense capabilities as a SAM system despite the drawbacks, even though it will have very limited capacity against ballistic missiles. Notably, some Western military experts consider the S-400 system in many respects more capable, more mobile, and more survivable than the US Patriot[43]. The flexible missile inventory of the S-400 batteries can be configured to counter a range of different targets to maintain some layering capability within the system[44]. The Russian SAM can also provide limited air cover to Turkey's land warfare efforts, and can play an essential role in the military balance in the Aegean.

One key issue about the S-400 procurement would be the SAM configuration. Clearly, in case Turkey ends up with the Russian system, protecting the high-end S-400s from low-flying cruise missile threats would be needed. In this respect, Turkey might carry on with an additional procurement package for the Pantsyr line short-to-medium range air defense systems, mirroring the Russian SAM configuration in Syria. In fact, if the S-400 deal is to be realized, and given the fact that Ankara openly voices its interest in co-producing the forthcoming S-500s[45], the procurement of tactical Pantsyr-S1 systems (NATO designation SA-22) or its recent upgrades could further strain Ankara – NATO ties. The Russian media already called such a procurement roadmap "a logical next step for Turkey"[46]. In fact, the Pantsyr-S1 sale to a US ally took place before. The United Arab Emirates, for example, is one of the operators of the Russian short-to-medium range system along with the US high-end Patriot PAC-3 and THAAD in its modern air and missile defense arsenal[47].

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39 IHS Jane's, Artillery & Air Defence, S-400, 2017

40 TASS, http://tass.com/defense/1011767, Accessed on: July 26, 2018.

41 Franz-Stefan, Gady. "Russia's S-400 Air Defense System to Receive New Long Range Missile", The Diplomat, July 2018, https://thediplomat.com/2018/07/russias-s-400-air-defense-system-to-receive-new-long-range-missile/, Accessed on: July 26, 2018.

42 Erik, Berglund et.al. The Long-Range Weapon Threat, FOI, 2017.

43 Keir, Giles. Russian Ballistic Missile Defense: Rhetoric and Reality, the US Army SSI, Carlisle Barracks, 2015, p.15.

44 Ibid. p.16.

45 Daily Sabah, https://www.dailysabah.com/defense/2018/06/14/erdogan-says-offered-putin-to-jointly-produce-s-500-missile-defense-systems, Accessed on: July 26, 2018.

46 Sputnik, https://sputniknews.com/analysis/201804271063964243-russian-pantsir-s400-turkey/, Accessed on: July 26, 2018.

47 The IISS, The Military Balance 2018, Routledge, London, 2018.

The Pantsyr S-1 (left) and the S-400 (right) forms the principal SAM configuration for the Russian contingent in Syria, along with several other systems from the BUK family. In case Turkey procures the S-400s, the SAM configuration requirements could lead to further acquisition of the Pantsyr line.

Assessing the S-400 Acquisition

From a defense planning perspective, Turkey's decision to shift towards a more balanced counter-air posture is certainly not without merit. Surface-to-air missiles could be employed successfully with different operational approaches. SAM systems increase the cost of the adversary's air operations. They can also reduce the air threat to military operations, and even support maneuver forces in land warfare under suitable topographical conditions. In fact, in doctrine, depending on geostrategic and defense economic parameters, even SAM-dominant force structures could offer more deterrent solutions than fighter-dominated ones in some cases, of course, if the necessary military planning is done in compliance with SAM survivability requirements[48]. *(As SAM success cases, the 2017 EDAM report drew attention to the Egyptian air defenses' performance during the 1973 War against the Israeli Air Force, as well as the Georgian SAM systems' kills during the 2008 Russo – Georgian conflict, albeit the latter marked a tactical achievement).*

As discussed earlier, the Turkish military's reshuffle, coupled with the worsening security environment from the Middle Eastern borders to the Mediterranean, urge Ankara to reconsider its defense planning priorities, and to adopt a more balanced counter-air posture**.** In this sense, SAM procurement for air defense purposes, to operate in a burden-sharing fashion with the fighter squadrons, remains a logical preference. Simply put, during the cross-border counter-terrorism campaign Operation Olive Branch, the initial Turkish air assault witnessed the participation of 72 aircraft to strike hostile targets harbored in Syria. This impressive air force package was tantamount to roughly the 25% of the total F-16 and F-4 2020 inventory of the Turkish Armed Forces. Furthermore, throughout the operations, many times 10 % of the mentioned arsenal flew combat missions over Afrin. Assuming that no air force in the world could sustain full combat readiness, the proportion of the participating aircraft within the combat-ready inventory would be even higher[49]. Under these demanding conditions, building a good SAM system coverage could relieve the burden of combat air patrols in the western or eastern skies of Turkey –depending on the locations of the planned air defense sites–, and could enable re-deploying the air force squadrons close to the area of operations more easily.

Furthermore, force generation for air defense units is less complicated when compared to managing a fighter aircraft pilot pool. The pilot-to-cockpit ratio cannot be reduced into, simply, the number of pilots available. In theory, sustaining an efficient pilot pool is about building a new generation of pilots (production), introducing them into their units and providing them with adequate flight hours (absorption), and maintaining the human resources both qualitatively and quantitatively (sustainment). Studies on air force readiness show that even if the pilot-to-cockpit ratio is at accepted standards, should the proportion of experienced pilots fall below 60% it could adversely affect the overall readiness[50].

48 For a comprehensive air defense force structure report, see: Michael, J. Lostumbo. Air Defense Options for Taiwan: An Assessment of Relative Costs and Operational Benefits, RAND, 2016.

49 Can, Kasapoglu and Sinan Ulgen. Operation Olive Branch: A Political-Military Assessment, 2018.

50 Albert, A. Robert et.al. Reducing Air Force Fighter Pilot Shortages, RAND, 2015. pp.6-8.

In brief, Turkish defense planners could more easily manage personnel requirements for SAM systems when compared to the fighter aircraft.

Theoretically, there are other advantages of SAM systems as well. In terms of defense economics, operating these assets could be less costly when compared to high-end fighters, especially at a time when the fifth generation will be replacing the fourth generation. When it comes to capability development timeline, building a robust SAM arsenal could be accomplished faster than building a numerically and qualitatively excellent fighter or multirole aircraft arsenal. From an operational standpoint, SAM coverage has more endurance than combat air patrols, and can provide all-time capability. Besides, they are less demanding, and do not need the complex infrastructures that are required for operating fighter squadrons.

On the other hand, SAM systems, and in particular Turkey's S-400 procurement, could also have some handicaps:

First, in order to boost the S-400's effectiveness in detecting its targets, the SAM system's interoperability with the airborne early warning and control (AEW&C) aircraft would be important. Indeed, the Turkish Air Force has these assets in its inventory[51]. There is also an ongoing NATO mission that includes AWACS support within the framework of Tailored Assurance Measures[52]. However, putting aside the NATO mission, even any attempt of building advanced datalink transfer between the Russian SAM and Turkey's Boeing 737-700 IGW AEW&C aircraft would exacerbate problems between Ankara and the NATO allies, let alone technical and financial hurdles of such an option.

Second, geographical features should be taken into consideration. For large countries, covering the majority of the airspace with SAM systems is not feasible. In air defense planning for such countries, SAM systems are used to augment the air defenses in specific areas[53].

Third, compared to SAM systems, aircraft remain more expensive, in many cases more vulnerable. But, it is more flexible in mission portfolio. Thus, the S-400's, or any SAM system's, benefits to Turkey would be limited in the variety of missions it can conduct. Especially, given the fact that the S-400 will do little BMD role in Turkey's case, the cost-benefit analysis for Ankara's defense economics would be a controversial issue.

Fourth, there is the issue of Russian presence in a key NATO country. The Russian sources openly stated that Moscow would not allow Turkey to conduct the primary maintenance of the S-400s, nor would it share the codes[54]. Thus, periodically, expert-level Russian visits to Turkish air defenses have to take place for these activities. Besides, Turkish air defense personnel will have to be trained by Russia. Interestingly, at the time of writing, Turkish press reported that Ankara offered a risk-mitigating way-forward to NATO circles. Ankara asked Moscow to train the Turkish military personnel to assemble and operate the S-400s without the Russians setting foot on the Turkish, namely NATO, territory[55].

Finally, there will be two additional, longer term concerns with respect to the S-400 procurement:

Unlike the Soviet model, air defense is not established as a separate branch within the Turkish doctrinal order of battle. It is a part of the air force which has always had a pilot-first structure. Following the incorporation of more strategic air defense systems into the Turkish arsenal, such as the EUROSAM co-production project, the Hisar line *(which is planned to have a long range / high altitude member in addition to the short and medium range ones),* and the S-400s, air defense units are expected to have a growing posture and intra-branch prestige. Naturally, more key posts would need to be filled by SAM officers and generals in compliance with the new mixed counter-air posture. Under these circumstances, having a NATO-compatible and Russian systems dichotomy might have military strategic

51 The Turkish Air Force, https://www.hvkk.tsk.tr/T%C3%BCrk_Hava_Kuvvetleri/Hakk%C4%B1m%C4%B1zda/G%C3%BCn%C3%BCm%C3%BCz_Hava_Kuvvetleri/Envanterdeki_U%C3%A7aklar, Accessed on: July 26, 2018.

52 NATO, https://www.nato.int/cps/en/natohq/topics_48904.htm#, Accessed on: July 26, 2018.

53 Shangsu, Wu. "Can Surfae-to-Air Missiles Replace Fighters in Southeast Asia, The Diplomat, February 2017, https://thediplomat.com/2017/02/can-surface-to-air-missiles-replace-fighters-in-southeast-asia/, Accessed on: July 26, 2018.

54 Sputnik, https://tr.sputniknews.com/rus_medyasi/201710021030395789-rusya-s400-kod-turkiye-vermeyecek/, Accessed on: July 26, 2018.

55 Daily Sabah, https://www.dailysabah.com/columns/ragip-soylu/2018/06/28/turkey-extends-s-400-offer-to-washington, Ac-cessed on: July 26, 2018.

cultural repercussions that could go well beyond the inventory issues. Simply put, among the S-400 air defense units, Russian foreign language skills and Russian military studies knowledge could turn into professional promotion priorities, while other BMD units (and flight crew) will take part in NATO capacities and missions. Alone, this would not be a negative factor, and Turkey could well make use of it as a member of the transatlantic alliance. However, in case the abovementioned, probable dichotomy leads to the emergence of two drastically different military schools within the Turkish Air Force –and if these schools include geopolitical considerations in addition to weapon systems familiarity–, then it might pose some challenges.

On the other hand, one might argue that operating the German Leopard-2 A4 and the American M-60 tanks did not bring about such a dichotomy of German and US military strategic cultures to the Turkish armored units. This objection would be sound and fair. However, when it comes to the EUROSAM Aster-30 derivatives or the S-400s, what we are talking are strategic weapon systems, not main battle tanks or MANPADS.

Apart from the strategic cultural drawbacks, the second concern could emanate from the nature of the Russian arms sales. Procuring the Russian arms has many advantages since Moscow puts forward less political constraints compared to the US. Besides, the Russian defense sector, the second largest arms exporter of the world *(India, China, and Vietnam remain the biggest markets for the Russian arms sales),* offers robust systems in some segments, for instance, air defense. However, on the political sphere, Russia takes well advantage of some countries' deteriorating relations with the US, and opts for capitalizing on the window of opportunity. Turkey and Egypt set examples in this regard[56]. Besides, Qatar and Saudi Arabia, traditional clients of the Western weaponry recently faced fluctuating relations with Washington, could also be the next destinations for the S-400s[57]. In brief, while Turkey sees the S-400 deal as a stopgap measure and the Turkish administration has no intention of replacing the NATO membership with a military-strategic alliance with Russia, Moscow's calculus could drastically differ from that of Ankara.

In fact, Russia can find ground to further capitalize on the deteriorating Turkish – American bilateral ties. Turkey has shown an open interest in co-producing the forthcoming (likely in the 2020s) S-500 line[58]. The S-500, another defensive strategic weapon system, is expected to develop more ballistic missile defense interception capabilities, and will be linked with the S-400[59]. Although a Turkish–Russian joint S-500 co-production is not a highly-likely project, as yet, such a hypothetical scenario would mark a true wildcard. Because, if realized, this low probability / high impact development would render Turkey's prospective S-400s no more a standalone capability. Besides, co-production of such a strategic weapon system will, inevitably, build very strong ties between the two nations' military-industrial complexes.

Nevertheless, just like the Russian efforts of capitalizing on the political fluctuations between the US and its traditional markets, for Turkey, voicing interest in the Russian arms could also be a way of political signaling to the West to gain more lucrative defense cooperation opportunities.

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[56] For a detailed study on the Russian arms exports, see: Richard, Connoly and Cecilie Sendstad, Russia's Role as an Arms Exporter: The Strategic and Economic Importance of Arms Exports for Russia, Chatham House, 2017.

[57] Tass, http://tass.com/defense/990709, Accessed on: July 26, 2018; Al Jazeera, https://www.aljazeera.com/news/2018/06/russia-supply-400-system-qatar-saudi-position-180602195629315.html, Accessed on: July 26, 2018.

[58] Daily Sabah, https://www.dailysabah.com/defense/2018/06/14/erdogan-says-offered-putin-to-jointly-produce-s-500-missile-defense-systems, Accessed on: July 26, 2018.

[59] Aachary, Keck. "Russia's S-500: The Ultimate Weapon that can Kill the B-2 F-22 and F-35?", The National Interest, April 2018, https://nationalinterest.org/blog/the-buzz/russias-s-500-the-ultimate-weapon-can-kill-the-b-2-f-22-f-35-25372, Accessed on: July 26, 2018.

TURKEY AND THE F-35: BOOSTING INFORMATION SUPERIORITY AND NETWORK-CENTRIC WARFARE

The F-35 is considered to be a complete shooter-sensor-battle manager with the capability of each aircraft acting as an independent node to function as a combat system[60]. The F-35 project goes well beyond multirole features, maintaining air superiority, or delivering a robust air-ground strike asset. As underlined by the Italian Air Force Chief Gen. Enzo Vecciarelli, *"the F-35 is not just a fighter but also the best asset than can be used in a growing number of hybrid situations to achieve information superiority"*[61].

It should be underlined that the F-35 is not just "an F-16 with stealth"[62]. Its design philosophy reflects the next generation network-centric warfare and advanced interoperability between high-end systems. In essence, the F-35 represents the peak of digitalized battle-space understanding of the 21st century.

Kinematically, the F-35 is less optimized for conducting air-to-air combat missions when compared to most fourth-generation fighters. With its maximum speed of Mach 1.6, it is slower than, say, the F-16 and the F-15. In many trials, the F-35 couldn't cope with high-performance four-generation fighter aircraft in short-range dogfights. Yet, the F-35 is not built for engaging in within-visual range dogfight situations in the first place[63]. In essence, this multirole asset is a stealth, low-observable aircraft that would use beyond-the-visual-range missiles (such as the AIM–120D) to perform air-to-air combat. In other words, when the Joint Strike Fighter hunts down its adversaries, it sneaks up on them, and avoids being seen before taking a shot. This is why some experts call the way F-35 would fight its air wars like a *"sniper, not a sword fighter"*[64].

A Network-Centric Warfare and 'Coalition' Asset

The F-35 Lightning II is able to transmit on Link 16 tactical data link with fourth-generation aircraft, and it also uses the stealthy MADL (Multifunction Advanced Data Link) to 'talk' among each other exclusively. This dual capability was tested in the 2017 Red Flag 17-1 exercises during which the F-35s communicated with the British Typhoons over Link 16 while using the MADL to share data stealthily with each other[65]. Furthermore, Northrop Grumman's Airborne Gateway node also successfully 'translated' and relayed data between the F-35s' MADL and the Typhoons' Link 16 during the Babel Fish III trials in the upper Mojave Desert, California, in summer 2017[66].

Maintaining advanced data link interoperability between the F-35 and legacy, fourth-generation platforms (as well as next generation assets that would need 'data translation') is not a merely technical feature. Rather, this recent –and still being developed– capability is about the future of warfare, and the F-35's essential role in it.

Some military thinkers tend to see the F-35 more than an excellent strike fighter, but, primarily a combat-ISTAR asset with a secondary strike role. In this calculus the F-35 would act like a force multiplier and battle manager for other platforms and systems that it would fight alongside. The underlying

60 Thomas, Karako and Wes Rumbaugh. Distributed Defense: New Operational Concepts for Integrated Air and Missile Defense, CSIS, 2018, p.21.

61 F-35 Lightning II Program, Italian Air Force Commander on How F-35 will Transform the Service", Public Release 2018 04 27, http://www.jsf.mil/news/docs/20180427_Italian_AF_Chief_interview_AW.pdf, Accessed on: July 18, 2018.

62 Justin, Bronk. Maximum Value from the F-35: Harnessing Transformational Fifth-Generation Capabilities for the UK Military, RUSI, Whitehall Report 1-16, 2016. p.1.

63 Sebastien, Roblin. "Is the F-35 Really Worth the $ 1,500,000,000,000 Price Tag?", The National Interest, April 2018, https://nationalinterest.org/blog/the-buzz/the-f-35-really-worth-the-1500000000000-price-tag-25487?page=0%2C2, Accessed on: July 19, 2018.

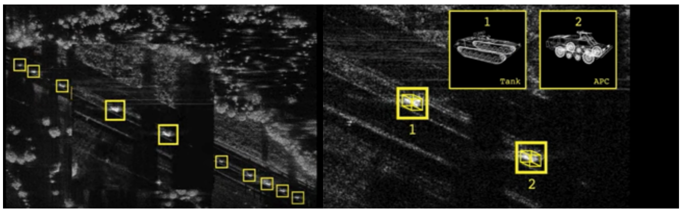
64 Ibid.

65 F-35 Lightning II Program, Public Release 2018 02 06, http://www.jsf.mil/news/docs/20180206_What_is_being_done_to_ensure_the_F-22_and_F-35_can_talk_to_each_other.pdf, Ac-cessed on: July 18, 2018.
It should be noted for military and defense professional readers that Northtrop Grumman also developed Battlefield Airborne Communications Node [BACN] to 'translate the MADL data into Link 16 format'. The BACN is mounted on a modified Global Hawk, the EQ4-B Net Hawk or an E-11A. For more information, see: Justin, Bronk. Maximum Value from the F-35: Harnessing Transforma-tional Fifth-Generation Capabilities for the UK Military, RUSI, Whitehall Report 1-16, 2016.

66 UK Defence Journal, https://ukdefencejournal.org.uk/raf-demonstrate-multifunction-advanced-data-link-interoperability-f-35b-typhoon/, Accessed on: July 19, 2018.

reason for this understanding is the Northrop Grumman designed state-of-the-art sensors of the aircraft that no other known system in the world matches[67]. The F-35 enjoys AN/AAQ-37 Distributed Aperture System (DAS) which equips the aircraft with 360 degree, spherical, advanced situational awareness. The DAS enables very effective missile detection and tracking capabilities, launch point detection features, infra-red search and track (IRST) capacity, weapons support along with day/night navigation[68]. The F-35 also has the AN/APG-81 active electronically scanned array (ASEA) radar that provides a wide-range of capabilities including air-to-air and air-to-surface combat roles, as well as stealth and electronic warfare dimensions. The AN/APG-81's automatic target cueing uses advanced algorithms that identifies military targets with high reliability. It supports the pilot with high-resolution, huge SAR maps[69].

The DAS System enables complete spherical sensor coverage around the F-35, able to detect a wide-array of threats ranging from tactical ballistic missile launch to SAM system, as well as enemy aircraft[70]



The AN/APG-81 ASEA Radar's automatic target cueing uses advanced algorithms to identify military targets with high confidence[71].

The UK, being the only tier-1 partner of the F-35 project (delivering about 15% of each aircraft), plans to operate its new fifth-generation assets along with its fourth-generation, legacy Typhoon arsenal following the life extension decision[72]. In doing so, the British military strategic community attaches utmost importance to the F-35's battle manager / state-of-the-art sensors role to support the Typhoon's capabilities in air-to-air and SEAD (suppression of enemy air defenses) missions. Open-source available combat scenarios suggest that the British F-35s could well be used to keep the Typhoons out of the engagement envelops of the enemy fighters and SAM systems. According to this view, the F-35s' advanced sensors will be used to detect the adversaries without entering the danger zone (thanks to the stealth, low observability features), transfer the data about the targets (through datalink 'translators'), and if necessary, even take over the guidance of beyond the visual range missiles launched by the Typhoons. All in all, the two platforms will operate as "symbiotic assets", trading the unmatched sensor capabilities with higher payloads[73].

[67] Justin, Bronk. Maximum Value from the F-35: Harnessing Transformational Fifth-Generation Capabilities for the UK Military, RUSI, Whitehall Report 1-16, 2016.pp.3-10.

[68] Northrop Grumman, AN/AAQ-37 Distributed Aperture System (DAS) for the F-35, http://www.northropgrumman.com/Capabilities/ANAAQ37F35/Pages/default.aspx, Accessed on: July 19.

[69] Northrop Grumman, AN/APG-81 Radar, http://www.northropgrumman.com/Capabilities/ANAPG81AESARadar/Pages/default.aspx, Accessed on: July 19, 2018. For the visual illustrations of the ASEA Radar performance against different targets sets, see: https://www.youtube.com/watch?v=wlwAOupjMeM, Accessed on: July 19, 2018.

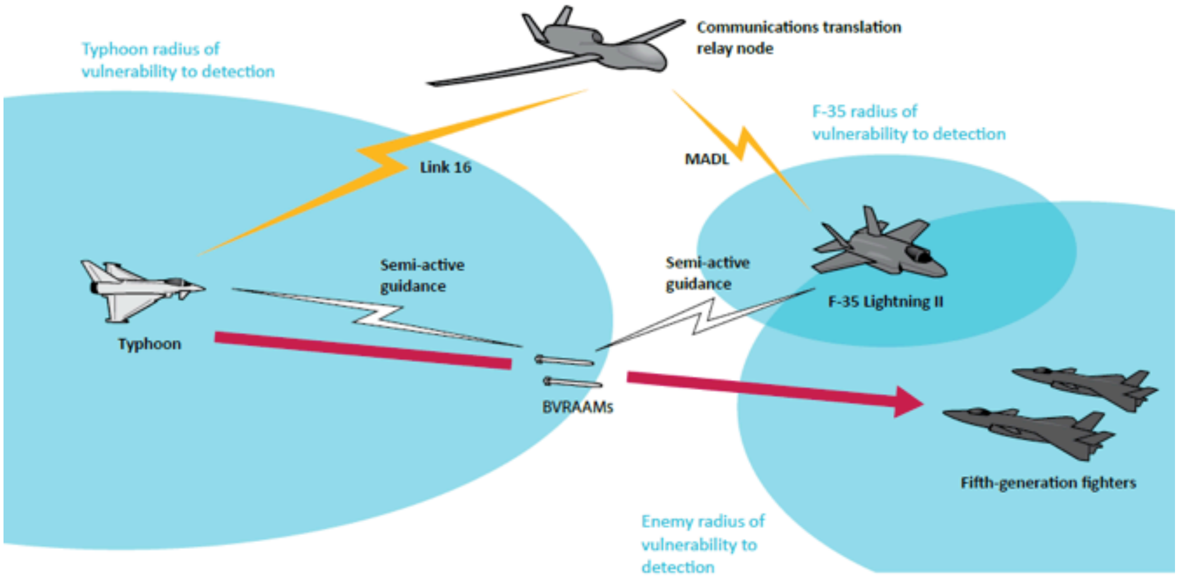
[70] https://www.youtube.com/watch?v=e1NrFZddihQ, Accessed on: July 19, 2018.

[71] https://www.youtube.com/watch?v=wlwAOupjMeM, Accessed on: July 19, 2018.

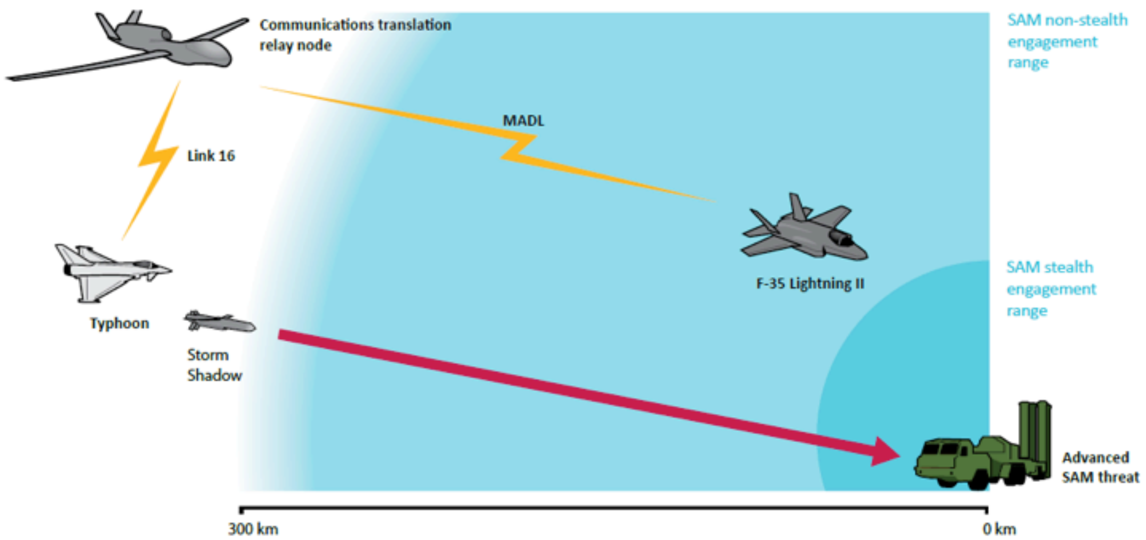
[72] For a complete assessment of the UK Air Warfare Understanding, see: The UK Ministry of Defence, Combat Air Strategy: An Am-bitious Vision for the Future, 2018.

[73] Justin, Bronk. Maximum Value from the F-35: Harnessing Transformational Fifth-Generation Capabilities for the UK Military, RUSI, Whitehall Report 1-16, 2016.pp. 10-11.

Below, referred visuals of a 2016 RUSI work showcases the abovementioned hypothetical scenarios:



Scenario 1: *Possible British use of the F-35 Lightning II aircraft as a 'battle manager'. Note that the fourth-generation Typhoon stays away from the enemy aircraft's engagement zone, and launches its beyond the visual range missiles onto the targets which were detected and cued by the F-35's advanced sensors. The F-35, much closer to the enemy aircraft, remains covert thanks to its stealth capabilities. A relay node enables the 'advanced data link translation' between Link 16 of the Typhoon and the MADL of the F-35. This approach enables the target acquisition and cueing to remain 'stealthy'. Finally, in the course of the flight, the F-35 also takes over the beyond the visual range missile, ensuring higher kill rates[74].*



Scenario 2: *The F-35 uses its stealth features, and thereby, the Typhoon remains able to receive combat ISTAR cueing about the enemy SAM system without entering the engagement envelope. Similar to the hypothetical scenario above, the two assets use advanced data link interoperability. In this scenario, the Typhoon launches a high-end, standoff air-ground munitions. Note that the engagement range of the SAM system for stealth and non-stealth aircraft,* ***theoretically,*** *differs to a considerable extent[75].*

[74] Ibid. p.10.

[75] Ibid. p.11.

Apart from the air force assets, the F-35's integration with naval platforms and systems also marks a milestone for further capability development. Simply put, having a stealth, very effective sensors platform, flying high and covertly, would be a force multiplier for navies that can work with the Joint Strike Fighter. The results are fairly promising in this regard. For example, during a live-fire test in September 2016 in New Mexico, a US Marine Corps F-35B successfully interoperated with the US Navy's Aegis system (through the Naval Integrated Fire Control – Counter Air [NIFC – CA] battle network), and "acted as an off-board sensor to detect an over-the-horizon threat (reportedly a cruise missile or a decoy mimicking the cruise missile) which was then destroyed by a Raytheon SM-6 missile[76].

Notably, some assessments conclude that the F-35's lucrative interoperability and network-centric warfare features make it a true asset for coalition warfare. In fact, the level of cooperation between the British Royal Air Force and the US Marine Corps has already showcased this potential throughout the F-35B trainings[77].

F-35's Integration with Land-Based Fire-Support Units: Deep-Shaping of the Battle-Space

The F-35 will not only transform the way of warfighting in air force and navy branches of the partner countries. In fact, the aircraft's unprecedented battle management capabilities would also transform the land warfare, especially fire-support operations through guided rocket systems.

The UK strategic community draws attention to the superb ISTAR edge of the F-35 which would make the aircraft a key support asset for ground forces in contested environments. Simply put, the F-35, due to its design and functions, has a limited combat payload to carry internally –except for the beast mode. Thus, it has to ensure effective interoperability with the army fire-support elements. In doing so, the army (along with the army aviation) platforms need advanced networking capabilities. In this respect, the British Ministry of Defense is working on the *Morpheus* next generation communications network to boost the interoperability capacity of attack helicopters and multiple launch rocket systems with the F-35Bs of the Royal Air Force and the Royal Navy[78].

Likewise, the US Armed Forces have been working on interoperating the F-35 with strong fire-power delivering ground assets, predominantly with the M142 HIMARS multiple rocket launcher, on a sensor-to-shooter integration basis. In doing so, the American military planners aim to combine the Joint Strike Fighter's capabilities in precisely detecting and identifying targets and transmitting the data rapidly to the HIMARS for all-weather, high-precision, long-range salvos[79]. Furthermore, this approach could, theoretically, also decrease the target decay time along with other vital benefits. More importantly, in the open-source scenarios that the US Armed Forces have been working on, the F-35 provides real-time combat ISTAR support to the land-based elements by penetrating into the enemy airspace. In other words, if completed, such an integration would boost the ability of deep-shaping the battle-space. In June 2017, the US Marine Corps and the US Air Force showcased the first joint live-fire integration exercise between the F-35 and the HIMARS, and engaged targets at some 42km range effectively[80].

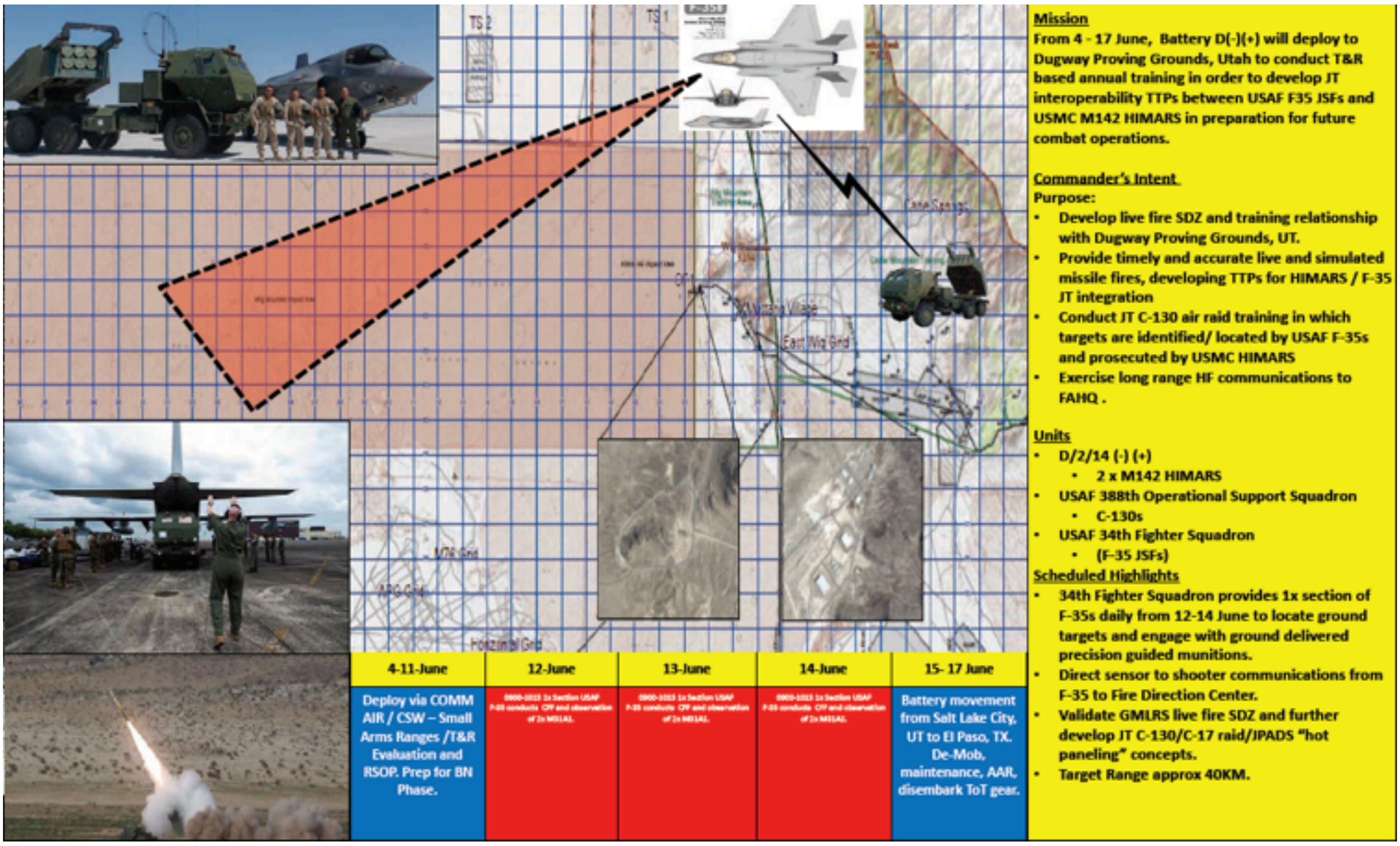
[76] Dave, Majumdar. "Game Changer: Combining Lockheed Martin's F-35 and AEGIS Missile Defense", The National Interest, Sep-tember 2016, https://nationalinterest.org/blog/the-buzz/game-changer-combining-lockheed-martins-f-35-aegis-missle-17695, Accessed on: July 19, 2018.

[77] George, Allison. "Why the F-35 is an Asset for the UK in Coalition Warfare", UK Defence Journal, June 2018, https://ukdefencejournal.org.uk/why-the-f-35-is-an-asset-for-the-uk-in-coalition-warfare/, Accessed on: July 19, 2018.

[78] For a comprehensive study of the British F-35B understanding, see: Justin, Bronk. Maximum Value from the F-35: Harnessing Transformational Fifth-Generation Capabilities for the UK Military, RUSI, Whitehall Report 1-16, 2016.

[79] Joe, Russo. "A Lethal Combination: F-35 Joint Strike Fighter and M142 HIMARS Sensor-to-Shooter Integration", The US Amry Fires Bulletin, November-December 2017, http://sill-www.army.mil/firesbulletin/archives/2017/nov-dec/articles/10_Russo.pdf, Accessed on: July 20, 2018.

[80] Ibid. It should be noted that currently the F-35 could not transmit a digital call for fire data by using the current Field Artillery Tactical Data System. During the exercises, the coordination was conducted through ultra-high frequency voice communications between the aircraft and the batteries.



Referred to the Col. Joe Russo's publication for the US Army Fires Bulletin, a mission slide from the June 2017 F–35 and M142 HIMARS integration exercise[81]. Despite the digital interoperability gaps, the combination of flying advanced sensors stealthily within deep enemy territory and delivering all-weather robust fire power remains very promising for further capability development efforts.

[81] Ibid.

MAKING THE MOST OF THE F-35: TURKEY'S POTENTIAL GAINS

In Turkey's case, the F-35 could make many contributions through its advanced characteristics. Without a doubt, the most important issue would be the deep-strike, network connectivity, and penetration capabilities underlined in previous sections. These abilities will prove even more vital as the A2/AD nodes around Turkey loom large.

Second, the F-35 will play a key battle-management role in air-to-air combat. Once procured, adapting the F-35's networking capabilities to the existing Link-16 user F-16s would be crucial in this regard. Furthermore, in the 2030s[82], the TAI TF-X, with twin-engine and low-observability features, is expected to lead the Turkish Air Force's air-superiority capacity. Thus, a doctrinal order of battle composed of the F-35 and the TF-X can indeed graduate the Turkish Air Force to one of the top level 5th generation aircraft operators of the world. Only, capitalizing on the lessons-learned from the US Air Force, and avoiding the initial 'communication' problems between the F-22 and the F-35 would be critical for the Turkish-military industrial complex[83].

Third, the F-35 offers a state-of-the-art platform for the integration of the Turkish defense sector's burgeoning smart munitions. The SOM-J long range air-launched cruise missile and the HGK smart bomb guidance kit already joined the club[84]. Although it remains speculative at the time being, , Turkey also produces its national air-to-air missile line with Gökdoğan and Bozdoğan[85] that can offer another integration window with the F-35.

During the delivery ceremony, Turkey's first F-35 was revealed with the SOM-J air-launched cruise missile and a bomb equipped with the HGK guidance kit[87].

Fourth, the F-35 will give a true boost to the Turkish Navy as well. First of all, it is already revealed that Ankara opts for operating its forthcoming power projection asset, TCG Anadolu Amphibious Assault Vessel (based on the Spanish Juan Carlos-1 class LHD), as a light aircraft carrier with some modifications (i.e. ski-jump)[88]. The Turkish press reported that in addition to the F-35A, Turkey could also procure F-35B short takeoff-vertical landing (STOVL) variant for the navy (although the official order for now is for 100 F-35As)[89]. Furthermore, the network-centric cooperation of the F-35 with other naval assets will provide the Turkish Navy with augmented warfighting capabilities.

The F-35 releasing a SOM-J cruise missile to strike a land target. The animation was retrieved from Lockheed Martin's official website, advertising the internal carriage integration for the Turkish cruise missile with ROKETSAN[86].

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82 SSB, https://www.ssb.gov.tr/Website/contentlist.aspx?PageID=362&LangID=2, Accessed on: July 28, 2018.

83 Business Insider, https://www.businessinsider.de/f-22-f-35-cant-talk-to-each-other-russia-china-2018-4?r=US&IR=T, Accessed on: July 28, 2018.

84 Anadolu Agency, https://www.aa.com.tr/en/science-technology/turkey-takes-delivery-of-first-f-35-fighter-jet-in-us/1181476, Accessed on: July 28, 2018.

85 Daily Sabah, https://www.dailysabah.com/defense/2018/03/26/turkeys-first-domestic-air-to-air-missiles-ready-for-further-tests-in-months-1522065493, Accessed on: July 28, 2018.

86 Lockheed Martin, https://www.lockheedmartin.com/en-us/products/som-j.html, Accessed on: July 28, 2018.

87 https://www.ainonline.com/aviation-news/defense/2018-06-22/turkey-receives-first-f-35-despite-political-row, Accessed on: July 28, 2018.

88 Anadolu Agency, https://www.aa.com.tr/en/todays-headlines/we-will-build-our-own-aircraft-carriers-erdogan/853272, Ac-cessed on: July 28, 2018.

89 Hurriyet Daily News, http://www.hurriyetdailynews.com/turkey-mulls-purchase-of-uss-f35-b-for-future-airplane-carrier-127923, Accessed on: July 28, 2018.

Turkey's Amphibious Assault Vessel displayed with light-aircraft carrier features. In the same news story, Anadolu Agency depicted the ship as Turkey's first aircraft carrier[90].

Finally, Both the British and American efforts to integrate the F-35 with land-based fire-support units offer an invaluable prospect for Turkey's military planning. The Turkish defense industry indigenously produces advanced, combat proven MLRS. Of these assets, the 122mm systems (TR-122), capable of engaging targets up to some 40km (with 2 x 20 tubes)[91], performed successfully during Turkey's cross-border counterterrorism campaigns in Syria, Operation Euphrates Shield and Operation Olive Branch. Especially during the Olive Branch, the Turkish MLRS showed a promising cooperation with Turkey's unmanned systems that cued ISTAR input to eliminate mobile, time-sensitive targets[92].

Notably, from a political-military standpoint, the above-mentioned cross-border efforts were enabled through a diplomatic rapprochement between Ankara and Moscow. As a result, the Syrian air defenses remained silent. In other words, Operation Euphrates Shield and Operation Olive Branch were not conducted under a heavily contested, hostile airspace – despite the fact that the Syrian Baath regime remains hostile to Turkey, and the Syrian Arab Air Defense Forces could, theoretically, pose a menacing layered air defense challenge–. In case the Turkish military-industrial complex follows suit (with the US and UK planning) in the future, and opts for integrating its indigenous, advanced land-based fire-support assets with the forthcoming F-35s, such an accomplishment would mark a robust capability development milestone for the Turkish Armed Forces' joint operations capacity. Clearly, the F-35, differently than Turkey's unmanned systems, could operate more safely and covertly in deep enemy territory. Given the fact that Turkish MLRS, which remains a well-established segment of the Turkish defense industries, deliver intensive, high-precision fire-power within 40kms range (i.e. by employing the 122mm systems)[93] and could cover up to 100+km (through

[90] Anadolu Ajansı, https://www.aa.com.tr/tr/turkiye/turkiyenin-ilk-milli-ucak-gemisi-tcg-anadolu-aa-tarafindan-goruntulendi/1098041, Accessed on: July 28, 2018.

[91] Roketsan, http://www.roketsan.com.tr/en/urunler-hizmetler/kara-sistemleri/satihtan-satiha-roket-sistemleri/t-122-cnra-122-mm-lik-cok-namlulu-roketatar/, Accessed on: July 20, 2018.

[92] For a comprehensive assessment of the level of integration between the Turkish artillery and unmanned aerial systems, see: Can, Kasapoglu and Baris Kirdemir. The Rising Drone Power: Turkey on the Eve of Its Military Breakthrough, EDAM, 2018.

[93] Roketsan, http://www.roketsan.com.tr/en/urunler-hizmetler/kara-sistemleri/satihtan-satiha-roket-sistemleri/t-122-cnra-122-mm-lik-cok-namlulu-roketatar/, Accessed on: July 20, 2018.

the 300mm systems)[94], these assets' integration with the F-35's advanced sensor and stealth features could equip the Turkish military with effective deep-shaping of the battle-space capabilities. Such a development would mark a real breakthrough in Turkey's defense posture against hybrid warfare challenges at its Middle Eastern doorstep.

All in all, the F-35 can offer a real boost to the Turkish military-industrial complex by beefing-up all branches of the Turkish Armed Forces, as well as through pioneering new cooperation explorations for the domestic defense industry. The future air warfighting environment will probably keep being characterized by complex electro-magnetic spectrum activities as well as menacing integrated air defenses. In addition, cyber-space and space domains will gain even more importance due to the growing information superiority competition in modern warfare[95]. Considering both industrial requirements and coalition warfare necessities, the concept of interoperability between different branches of the same nation, as well as between the allies, is becoming increasingly key.

More importantly, the aircraft fulfills the requirements of future air warfare which are information acquisition *(about the adversary)* and information denial *(about the aircraft, i.e. signature control)* capabilities, coupled with effective beyond the visual range combat *(engaging the adversary before they reach the weapon range)* and network connectivity *(boosted situational awareness and ability of sharing with friendly forces)* skills[96]. These features are also notable for the Greek – Turkish air warfare balance of power, keeping in mind that the Greek Air Force will have the most advanced F-16s in Europe through the F-16V modernization[97] which will equip the aircraft with active electronically scanned array radar, new mission computer, enhanced electronic warfare capabilities, and several cockpit improvements[98].

Aircraft Attributes of Growing Import	Rationale	Implications for Aircraft Design
Long-range sensors	Information Acquisition	All else being equal, bigger aircraft with their larger available space, weight, cooling capacity, and power allow for larger, more powerful RF and IR sensors with longest possible range.
Good all-aspect signature control across RF and IR regimes and effective RF and IR countermeasures	Information Denial	Subsonic tailless aircraft have significant advantages in achieving these goals. Just as with sensors, larger aircraft are able to carry larger and/or more RF and IR countermeasure systems.
Long-range air-to-air weapons	Kill adversaries before they reach their own sensor weapons employment range.	Larger aircraft enjoy significant payload advantages over smaller aircraft with the same range and should therefore be able to carry more and larger (longer-range) weapons. This applies both to missiles and eventually to directed-energy weapons.
Robust network connectivity	Shared information maximizes SA and leverages all available sensors in the battlespace.	Could be implemented on "fighter-size" or larger aircraft.

Emerging Combat Aircraft Capabilities, Retrieved from: John, Stillion. *Trends in Air-to-Air Combat. Implications for Future Air Superiority,* CSBA, 2015, p.58.

94 Roketsan, http://www.roketsan.com.tr/en/urunler-hizmetler/kara-sistemleri/satihtan-satiha-roketler/tr-300-topcu-roketleri/, Accessed on: July 20, 2018.

95 The UK Ministry of Defence, Combat Air Strategy: An Ambitious Vision for the Future, 2018. pp.11-12.

96 John, Stillion. Trends in Air-to-Air Combat. Implications for Future Air Superiority, CSBA, 2015, p.58.

97 Lockheed Martin, https://www.lockheedmartin.com/en-us/products/f-16/f-16-greece.html, Accessed on: July 28, 2018.

98 The Defense Post, https://thedefensepost.com/2018/04/28/greece-upgrade-85-f-16-fighter-jets-viper/, Accessed on: July 28, 2018.

THE F35 PLATFORM AND THE CYBER & ELECTRONIC THREAT FROM THE S400

All the abovementioned network-centric, fifth generation air warfare capabilities come at a price. Some experts underline that since the F-35 remains highly networked, the aircraft may be more prone to cyber-electronic hackings than any other warplane[99]. The F-35 is reported to have more than 8 million lines of software code, which is tantamount to four times larger than the world's first 5th generation fighter F-22 Raptor. The F-35 software operates in a broad fashion, ranging from radar functionality to weapons deployment and electronic attack[100]. This is why the concerns about operating the F-35 with the S-400 are profound and depend on logical grounds.

According to the US officials, from the outset, the F-35 was built to operate as a coalition asset with Washington`s partners and allies. Therefore, the on-board systems of the aircraft were specifically designed to overcome any potential software vulnerabilities. On the other hand, the F-35 also has unmatched off-board connectivity concerning maintenance and mission planning. These linkages bound each aircraft of the global fleet to each other, as well as to critical nodes such as the networks of the US Department of Defense and partner nations[101]. Hence, the off-board systems security and software resiliency against cyber breaches remain crucial to protect the F-35 from hostile activities. In this respect, the mentioned systems have been subject to hundreds of penetration tests so far[102]. On the other hand, when it comes to Turkey`s specific, individual case, it is not easy to conduct a penetration test to explore how operating both F-35s and an advanced Russian strategic SAM system –with potential cyber backdoors–could affect the global F-35 fleet`s resiliency in the face of hostile breach attempts into the networks. In fact, developing a good understanding of the global F-35 fleet concept remains key to analyze the problem. Because, in a flawed fashion, many international and domestic debates about the issue have been revolving around `Turkey`s F-35s`. However, the F-35 project is based on the unprecedented interdependency and connectivity between the entire platforms and operators around the world.

The F-35`s on-board and off-board sensors have real-time integration to enable decentralized operations, flexible allocation of targets, and multiple lines of effort. Strikingly, this very integration brings about capabilities and vulnerabilities at the same time. The global F-35 fleet, from different operator nations, can "talk" with each other through a distributed operational system. *"Therefore, the F-35 vulnerabilities tied to in-flight data dissemination do not just have the potential to limit the platform`s operational effectiveness, but have the potential to threaten the entire operational concept"*[103].

To grasp the abovementioned issues, a better understanding of the aircraft's cloud-based networking system is needed.

The F-35's Autonomic Logistics Information System (ALIS) is considered to be an important aspect of operating the aircraft in a cooperative sense. The system integrates a broad-array of capabilities including operations, supply chain, technical data, and maintenance through a single, secure information environment on a distributed network. As reported by Lockheed Martin, *"ALIS serves as the information infrastructure for the F-35 Lightning II, transmitting aircraft health and maintenance action information to the appropriate users on a globally distributed network"*[104]. ALIS has tens of applications for training, maintenance, technical data, and support. More importantly, it converts the F-35 data into actionable information[105].

99 Sebastien, Roblin. "Is the F-35 Really Worth the $ 1,500,000,000,000 Price Tag?", The National Interest, April 2018, https://nationalinterest.org/blog/the-buzz/the-f-35-really-worth-the-1500000000000-price-tag-25487?page=0%2C2, Accessed on: July 19, 2018.

100 Lockheed Martin. https://www.f35.com/about/life-cycle/software, Accessed on: July 28, 2018.

101 The US HASC Hearing, https://www.youtube.com/watch?v=kUl3hTtXlQM, Accessed on: July 30, 2018.

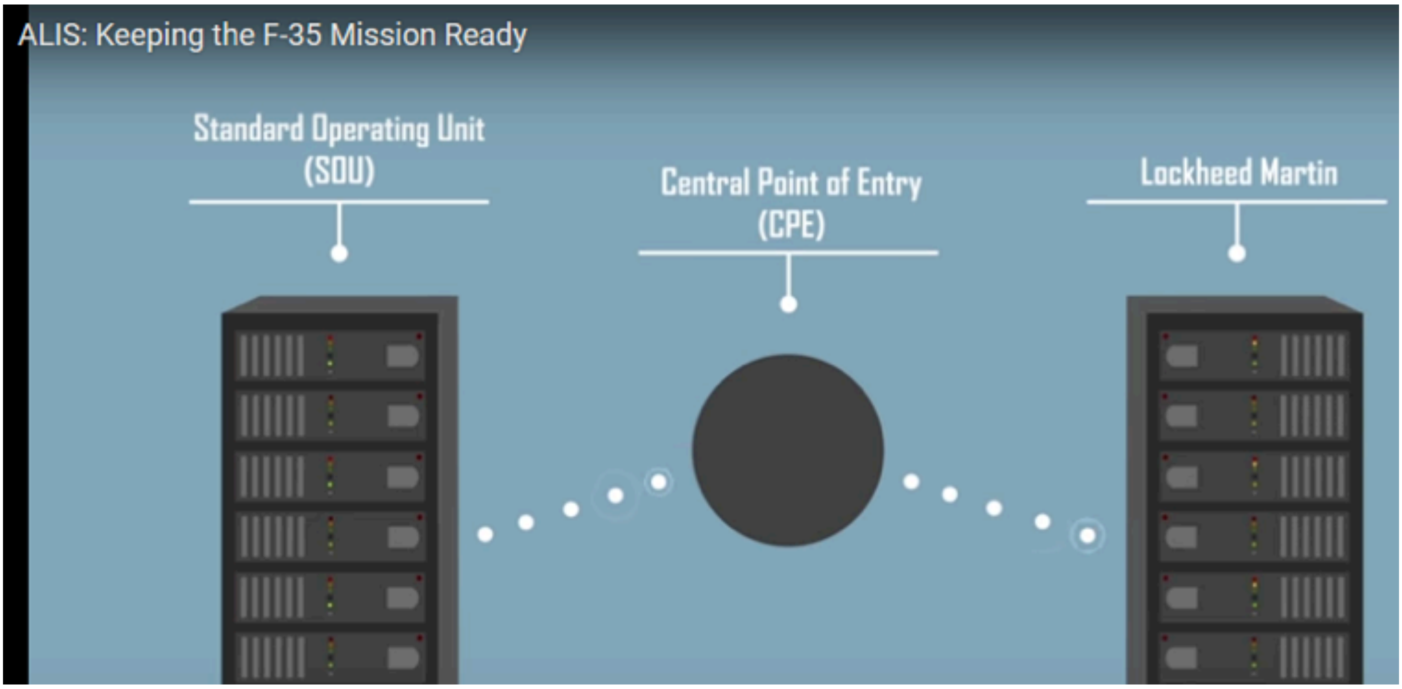
102 Ibid.

103 Jacquelyn, Schneider. Digitally-Enabled Warfare: The Capability – Vulnerability Paradox, Center for a New American Security, 2016, p.8.

104 Lockheed Martin, https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/f35-training/F-35-Lightning-II-PC-bifold-Blue_2015.pdf, Accessed on: July 19, 2018.

105 Lockheed Martin. https://www.lockheedmartin.com/en-us/products/autonomic-logistics-information-system-alis.html, Ac-cessed on: July 28, 2018.

Thus, hostile penetration into this availability should be avoided at all costs. Because, in a unique fashion, all F-35s around the world will be connected to each other through the ALIS system. Each Standard Operating Unit feeds information to the F-35 operating nation's Central Point of Entry, and this segment shares information with Lockheed Martin directly[106].



Retrieved from: Lockheed Martin[107]

In brief, ensuring undisrupted and efficient ALIS connection would equip an F-35 operator nation with more connectivity and better maintenance. For example, the UK plan to field fixed ALIS servers at the Royal Air Force Marham military base, as well as at HMS Queen Elizabeth and HMS Prince of Wales aircraft carriers. In addition, deployable ALIS servers were also incorporated into the British acquisition plan to be employed from detached mobile operating bases ashore[108]. Following suit, Turkey might need ALIS servers in key airbases, also possibly, in forward deployment centers (i.e. the Turkish contingent in Qatar), as well as on naval aviation combatants, such as the forthcoming TCG Anadolu Amphibious Assault Vessel (Turkey's first light aircraft carrier). For example, the US Marine Corps already fielded the deployable ALIS kit on the USS WASP LHD to support F-35 operations[109].

The ALIS software has been constantly upgraded. And, as the upgrades continue, so do the enormous penetration tests to ensure the network`s cyber resiliency. However, reportedly, the 2017 penetration test results already found some vulnerabilities that have not been remedied yet. Furthermore, experts indicate that more tests were needed to see if these vulnerabilities may have led to compromises of the F-35 data[110]. Furthermore, back in 2012, the US Navy`s red team hackers succeeded in breaking into the system without being detected[111]. Keeping in mind that the ALIS system provides information about the overall health,

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106 Ibid.

107 Ibid.

108 UK Defence Journal, https://ukdefencejournal.org.uk/3487-2/, Accessed on: July 30, 2018.

109 Lockheed Martin. https://www.lockheedmartin.com/en-us/news/features/2015/f35s-alis-at-sea.html, Accessed on: July 30, 2018.

110 Yasmin, Tadjeh. "F-35 Logistics Systems Faces Challenges", the National Defense, March 2018, http://www.nationaldefensemagazine.org/articles/2018/3/8/f-35-logistics-system-faces-challenges, Accessed on: July 30, 2018.

111 Reuters, https://www.reuters.com/article/us-lockheed-fighter-logistics/insight-lockheeds-f-35-logistics-system-revolutionary-but-risky-idUSBRE8AF09L20121116?feedType=RSS&feedName=topNews, Accessed on: July 31, 201.

locations, and maintenance needs of the global F-35 fleet around the world[112], any breach could lead to catastrophic results going well beyond any operator nation`s own squadrons.

Operating the F-35 and the S-400 together, technically, would therefore pose important risks not only to Turkey, but also to the entire current and future operators of the aircraft.

Firstly, by its design philosophy, the S-400 has various system integration features. Through interfaces and software, the S-400's battle management system can exchange data with several command posts, other battle management systems, and radar complexes[113]. This is a very understandable attribute given the central role of the weapon system in Russia's national air and missile defense architecture. Clearly, the S-400 has to be integrated with the S-300 variants, BUK family of missile systems, and the Pantsyr line in order to provide layered A2/AD bubbles[114]. Besides, in order to attract more export opportunities, the S-400 can potentially develop hybridization capabilities with other legacy Russian systems, as well as integration with non-Russian air defense components, depending on datalink modems and relevant software[115]. All these connectivity abilities could also boost the prospects of backdoor data transfers from the Turkish air and missile defense architecture. More importantly, as Ankara plans linking up the F-35 to the Air Force Information Systems Network (HvBS)[116], the S-400's potential link with the same network (or ability to penetrate into it if not networked directly) could bring about high risks to the security of the F-35s. In other words, providing the S-400 with the capabilities (or chances) to acquire the information collected and cued by the F-35 is, by all means, risky.

Secondly, contemporary Russian defense thinking considers electronic warfare (EW) to be a central pillar of future network-centric capabilities, and attaches utmost importance to the close relationship between signals intelligence (SIGINT), EW, and air defense. At present, further integration of the EW assets into the unified automated command & control systems, as well as their unification with the Identification Friend or Fore (IFF) systems, constitute the core efforts of the Russian military-industrial complex.[117] Regarding the S-400, for example, it is reported that the weapon system could use the data cued by the Moskva-1 advanced EW system[118]. The Moskva-1 collects radio-technical intelligence about sources of electromagnetic radiation (reportedly in a radius of some 400km), analyzes and classifies the signals, and can transmit the information to air defense systems[119]. Russian defense planners aim to modernize at least 80% of the current EW inventory by 2020. In fact, Syria already became a testbed in this sense[120]. The complete Russian EW arsenal close to Turkey's borders is unknown. Yet, there is no reason to firmly rule out the prospects of Moscow's attempts to enable data-sharing between the Turkish S-400s and the deployed Russian assets around Turkey. In brief, an S-400 coverage controlling the Turkish airspace, which is planned to host many routine F-35 flights daily, could offer an invaluable opportunity to the Russian EW – SIGINT – air defense trilateral complex to study the signatures of the stealth aircraft.

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112 Jacquelyn, Schneider. Digitally-Enabled Warfare: The Capability – Vulnerability Paradox, Center for a New American Security, 2016, p.8.

113 Carlo, Kopp. Almaz-Antey 40R6 / S-400 Triumf Self Propelled Air Defence System SA-21, http://www.ausairpower.net/APA-S-400-Triumf.html#mozTocId881394, Accessed on: August 07, 2018.s

114 Missile Defense Project, "Russian Air and Missile Defense," Missile Threat, Center for Strategic and International Studies, published June 14, 2018, last modified June 15, 2018, https://missilethreat.csis.org/system/russian-air-defense/, Accessed on: August 07, 2018.

115 Carlo, Kopp. Almaz-Antey 40R6 / S-400 Triumf Self Propelled Air Defence System SA-21, http://www.ausairpower.net/APA-S-400-Triumf.html#mozTocId881394, Accessed on: August 07, 2018.

116 Defense News, https://www.defensenews.com/air/2018/01/09/turkey-wants-to-link-f-35-jets-to-its-air-force-network/, Ac-cessed on: August 07, 2018.

117 Roger, N. McDermott, Russia's Electronic Warfare Capabilities to 2025: Challenging NATO in the Electromagnetic Spectrum, ICDS, 2017, pp.5-9.

118 Центр стратегических оценок и прогнозов, http://csef.ru/en/oborona-i-bezopasnost/505/rossijskie-sredstva-reb-prevoshodyat-amerikanskie-7963, Accessed on: August 07, 2018.

119 Samuel, Bendett. "America is Getting Outclassed by Russian Electronic Warfare", The National Interest, September 2017, https://nationalinterest.org/feature/america-getting-outclassed-by-russian-electronic-warfare-22380, Accessed on: August 07, 2018.

120 Roger, McDermott. "Russia's Electronic Warfare Advances Offers Stealth Capability for Fighter Aircraft", Euroasia Daily Monitor, Vol.15 No.91, June 2018, https://jamestown.org/program/russias-electronic-warfare-advances-offers-stealth-capability-for-fighter-aircraft/, Accessed on: August 07, 2018.

At this point, it should be underlined that overcoming the US' growing stealth capabilities remains a priority of Moscow's defense modernization roadmap. Furthermore, the S-400 is also advertised through its alleged anti-stealth capabilities. Thus, from Russian military planners' standpoint, having the S-400 in the same airspace with the F-35 sounds would be very valuable.

Thirdly there is the risk of Russian penetration into the F-35's off-board systems. Any kind of networking or penetration risk could enable the Russian operators to make their way into the global F-35 fleet. This would provide Moscow with very critical information about the locations and status of the F-35s around the world.

In return, some experts have suggested that in case Turkey continues with the S-400 procurement , its F-35s might be delivered without access to the ALIS network[121]. Such a move could restrict any potential cyber backdoors embedded in the S-400, but cannot prevent Russia from closely studying the aircraft`s signature. More importantly, in the absence of the ALIS connectivity, Turkey`s maintenance and operation burdens might be much higher than the other F-35 operators. Besides, it would bring the grave risk of isolating Turkey`s F-35s from rest of the global F-35 fleet and related software developments. In addition, it would block Ankara`s information channels to learn from the other partner nations.

THE WAY FORWARD

One year ago, in July 2017, EDAM published its widely quoted report, Turkey's S-400 Dilemma. Since then the disagreement has degenerated into a political dispute with significant ramifications for Turkey's defense posture as well as the future of Turkey-US relations.

Turkey initially argued for the acquisition of the S-400 as an air and missile defense solution, aiming to alleviate its strategic vulnerabilities in this area. It, however, became clear pretty soon that in the absence of any prospect of integration in the NATO infrastructure – or in any network that can match such capabilities –, the S-400 would fail to operate as initially aspired. Rather, it could be used solely as a SAM system to enhance air defense. As a standalone acquisition, the S-400 deal purchase could indeed be viewed as an urgent stopgap measure for Turkish defense planning. It would enhance Turkey's air defense capabilities and allow more tactical flexibility for Turkish military planners. The main counterargument would have been that for a NATO country, it would be an expensive procurement due to its standalone nature, as well as a dead end for any further integrated air and missile initiatives.

But now, the political context has changed. Turkey's potential S-400 purchase has become a political issue of high visibility. Ankara's S-400 acquisition exposes Turkey to the possibility of a set of US sanctions. The first set of possible sanctions are related to the Countering America's Adversaries Through Sanctions Act - CATSAA legislation which allows the U.S. to sanction countries who purchase weapons from Russia, Iran or North Korea. The Russian manufacturers of the S-400 are the targets of this legislation exposing Turkey to this regime of sanctions. The CATSAA legislation allows the US president to sidestep the proposed sanctions on grounds of national security. For long, it was believed that President Trump could rely on this privilege to eliminate the prospect of penalties to Ankara. But against the background of an increasingly acrimonious political relationship, it now more difficult to argue that the US President will risk a confrontation with the Congress on the S-400s. In late July, the US president even threatened Turkey with large sanctions following his disillusionment with Ankara linked to the failure to get the release of jailed American pastor Brunson.

In addition, and as a result of the rapidly deteriorating Turkey-US relations, the US Congress passed another piece of legislation tied to the Defense Authorization Act which jeopardizes the future delivery of the F-35s to Turkey. The reconciled version of the fiscal year 2019 defense authorization bill stipulates the suspension of transfers of the F-35s to Turkey until the Department of Defense issues a report assessing the impacts of removing the country from the F-35 program. The Pentagon is to issue this report to

[121] Sebastien, Roblin. "America`s Big Fear: Turkey Mixing F-35s and Russia`s S-400 Air Defense System", The National Interest, July 2018, https://nationalinterest.org/blog/buzz/americas-big-fear-turkey-mixing-f-35s-and-russias-s-400-air-defense-system-25152?page=0%2C1, Accessed on: July 31, 2018.

the lawmakers within 90 days of the passage of the National Defense Authorization Act. A s a result, Turkey is now faced with the unpalatable prospect of having to choose between the F-35 and the S-400.

In the Turkish domestic debate, the F-35 issue is often portrayed as (only) an advanced stealth aircraft that would augment the Turkish Air Force's warfighting capabilities; but if the project fails, it could be replaced, simply, by 'other' stealth assets. In fact, this is a fairly simplistic and superficial understanding when analyzing one of Ankara's major defense investments. The F-35 Lightning II, predominantly, is about gaining the information superiority in complex, highly-contested battle-spaces of the 21st century. The aircraft's unmatched sensors and advanced data-transmitting capabilities are designed to outclass the adversary through an intensive network-centric warfare approach. The F-35 is not built primarily for dogfights in hostile airspace, but rather, to conduct a battle-management role. Thus, when integrated with other assets adequately, it offers the potential of not only beefing-up an air force branch, but also entire armed forces –from navy to land-based precision fire-support units– by providing state-of-the-art situational awareness and combat ISTAR (intelligence, surveillance, target acquisition & reconnaissance) from deep enemy territory. Militarily, the F-35 could be depicted as the battle manager / sensor node of the network-centric warfare understanding. Finally the F-35 acquisition through level-3 partnership offers a true breakthrough window for capability development.

Due to all the abovementioned reasons, acquiring the F-35 Lightning II –without any degradations in technical attributes– and sustaining the Level-3 partnership to the Joint Strike Fighter Program will provide key benefits to Turkey's national defense capacity. For Turkey's defense planning and military strategic posture, the capabilities of the aircraft remain unprecedented. The F-35 could go well beyond being 'the backbone of the Turkish Air Force', and can play a profound role in pioneering the Turkish Armed Forces' network-centric warfare capacity. Especially, given the fact that hybrid threats are mounting in Turkey's regional security environment, present and potential hostile airspaces are becoming highly contested, and missile proliferation is on the rise, the F-35 will play a key role in building a robust deterrent.

As a result, Turkey's national interest and military capabilities would clearly be better served with the elimination of barriers to the delivery of fully configured F-35s. Turkey's ability over the long run to fully take part in future NATO air missions, which will increasingly rely on network-centric warfare, will also be potentially handicapped by a failure to integrate the F-35 to its air force structure. One mooted option has been for Turkey's F-35s to be delivered through several degradations ensuring that the aircraft is handed over without connection to the ALIS cloud-based network. However, such a degradation will cut Turkey's F-35s' from rest of the global F-35 fleet around the world. Maintenance, life cycle, and operation costs will inevitably increase, and the Turkish military-industrial complex will have much less access to the engineering and supply chain.

Washington's intent to link the supply of the F-35s to Turkey to political conditions, like the release of the jailed pastor Brunson is incongruous. The US would naturally work diplomatically to get the release of the jailed pastor as its citizen. But seeking to leverage the potential delivery of the F-35s for this purpose is greatly misplaced. The threat is incommensurate with its long-term implications. It underestimates the negative impact, not only for the Turkey-US relationship but also more generally for transatlantic security, of Turkey not being able to get the delivery of this fifth-generation multirole aircraft. The linkage with Turkey's acquisition of the S-400 from Russia, however, is more relevant.

In our view, Ankara would need to adopt a political and diplomatic strategy that takes fully into account of this inevitable conclusion that the acquisition of the S-400s will have ramifications for the supply and operationalization of the F-35s. Either the US will need to be convinced that the delivery of the F-35s to a country that operates the Russiamade S-400s is not a real threat to the integrity of networkcentric NATO platforms, or that the threat of cyber hacking –or digital espionage– emanating from the S-400s can categorically be eliminated, or Turkey would need to forego the acquisition – or at the very least the operationalization– of the S-400s. At present, there seems to be no real third option for Turkish policy-makers to side-step these binary and mutually exclusive outcomes.

ANNEX - F-35 FAST FACTS[122]

May 14, 2018

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F-35 LIGHTNING II PROGRAM STATUS AND FAST FACTS

PROGRAM STATUS

290+ AIRCRAFT DELIVERED

FLIGHT HOURS 135,00H

14 BASES WORLDWIDE

600+ PILOTS

5,600+ MAINTAINERS

RECENT MILESTONES

- Pentagon And Lockheed Martin Finalize 2018 F-35 Sustainment Contract To Enhance Readiness And Reduce Cost. (April 30)
- Lockheed Martin Opens New Facility To Support F-35 Production Growth. (April 30)
- U.S. Navy Strike Fighter Squadron 147 Executes First F-35C Flight. (April 18)
- F-35 Aircraft Make Their Debut in Germany For ILA Berlin. (April 20)
- Royal Air Force's Legendary Dambusters Squadron Reforms To Fly F-35 Jets. (April 18)
- F-35 Completes Most Comprehensive Flight Test Program In Aviation History. (April 12)
- F-35B Visits CENTCOM As It Prepares To Enter Theater. (April 4)
- U.S. Marine Fighter Attack Squadron (VMFA) 122 conducts first flight operations in the F-35B at MCAS Yuma, Arizona. (March 29)
- U.S. and Republic of Korea Officials Celebrate Debut of South Korea's First F-35A. (March 28)
- U.S Navy Conducts F-35C Carrier Qualifications Aboard the USS Abraham Lincoln. (March 23)
- U.S. Marine Corps F-35B joins the USS Wasp in Historic First Deployment at Sea. (March 5)
- Japan Air Self-Defense Force Commemorates First F-35 Arrival to Misawa Air Base. (Feb. 24)

PROGRAM COST

LRIP 10 Cost

F-35A	F-35B	F-35C
$94.3 M	$122.4 M	$121.2 M

Total Aircraft Quantities LRIP 1-10: 358

Cost Reduction Statistics

- More than 60% reduction in Unit Recurring Flyway cost since Lot 1
- 8% reduction in Unit Recurring Flyway since previous contract
- Blueprint for Affordability is delivering projected savings of more than $4 billion over the life of the program
- Second phase of the Blueprint for Affordability is projected to save an additional $2 billion over the life of the program
- As production ramps and additional improvements are implemented, Lockheed Martin's goal is to reduce the cost of an F-35A to $80 million by 2020.

PROGRAM OF RECORD

- U.S.A.: USAF 1,763 F-35As; DoN 693 F-35B/Cs; IOC: USMC: 7/15, USAF 8/16
- U.K.: RAF/RN 138 F-35s
- Italy: 60 F-35As/30 F-35Bs
- Netherlands: 37 F-35As
- Turkey: 100 F-35As
- Australia: 100 F-35As
- Norway: 52 F-35As
- Denmark: 27 F-35As
- Canada: 88 F-35As

FOREIGN MILITARY SALES

- Israel: 50 F-35As; IOC: IAF: 12/17
- Japan: 42 F-35As
- Republic of Korea: 40 F-35As

[122] Lockheed Martin, https://www.lockheedmartin.com/content/dam/lockheed-martin/aero/documents/F-35/f-35_fast_facts_may_2018.pdf, Accessed on: July 19, 2018.

LOCKHEED MARTIN

ECONOMIC IMPACT

- 1,600 suppliers around the globe, including more than 1,500 U.S.-based suppliers.
- Final Assembly factories in Fort Worth, Texas; Cameri, Italy; and Nagoya, Japan
- Suppliers located in 46 U.S. states and Puerto Rico
- 194,000 direct and indirect jobs supported in the US
- $31 billion of annual U.S. economic impact

F-35 PRODUCTION

*Planned delivery quantities beyond 2018 are approximate based on the current F-35 production profile.

F-35 LIGHTNING II SPECS	F-35A 	F-35B 	F-35C 
Length	51.4 ft / 15.7 m	51.2 ft / 15.6 m	51.5 ft / 15.7 m
Height	14.4 ft / 4.38 m	14.3 ft / 4.36 m	14.7 ft / 4.48 m
Wingspan	35 ft / 10.7 m	35 ft / 10.7 m	43 ft / 13.1 m
Wing area	460 ft2 / 42.7 m2	460 ft2 / 42.7 m2	668 ft2 / 62.1 m2
Horizontal tail span	22.5 ft / 6.86 m	21.8 ft / 6.65 m	26.3 ft / 8.02 m
Weight empty	29,300 lb	32,300 lb	34,800 lb
Internal fuel capacity	18,250 lb / 8278 kg	13,500 lb / 6,125 kg	19,750 lb / 8,960kg
Weapons payload	18,000 lb / 8,160 kg	15,000 lb / 6,800kg	18,000 lb / 8,160 kg
Standard internal weapons load	• 25 mm GAU-22/A cannon • Two AIM-120C/D air-to-air missiles • Two 2,000-pound GBU-31 JDAM guided bombs	• Two AIM-120C/D air-to-air missiles • Two 1,000-pound GBU-32 JDAM guided bombs	• Two AIM-120C/D air-to-air missiles • Two 2,000-pound GBU-31 JDAM guided bombs
Maximum weight	70,000 lb class	60,000 lb class	70,000 lb class
Propulsion* (uninstalled thrust ratings)	F135-PW-100 40,000 lb Max. 25,000 lb Mil. Vertical N/A	F135-PW-600 40,000 lb Max. 25,000 lb Mil. 40,500 lb Vertical	F135-PW-100 40,000 lb Max. 25,000 lb Mil. Vertical N/A
Speed (full internal weapons load)	Mach 1.6 (~1,200 mph)	Mach 1.6 (~1,200 mph)	Mach 1.6 (~1,200 mph)
Combat radius (internal fuel)	>590 nm / 1,093 km (USAF profile)	>450 nm / 833 km (USMC profile)	>600 nm / 1,100 km (USN profile)
Range (internal fuel)	>1,200 nm / 2,200 km (USAF profile)	>900 nm / 1,667 km (USMC profile)	>1,200 nm / 2,200 km (USN profile)
Max g-rating	9.0	7.0	7.5

All information current as of May 14, 2018

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Is Turkey sleepwalking out of the Alliance? An assessment of the F-35 deliveries and the S-400 acquisition.

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