



PERSPECTIVES

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[Iron Dome in Action: A Preliminary Evaluation](#)

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EXECUTIVE SUMMARY: The "Iron Dome" anti-rocket active defense system was first used by Israel in April 2011 with great technical success. This prompted defense officials to finally make public the strategic objectives and limitations of the system, which, until then, had not been divulged. It also expanded the public debate on missile defense from one that focused on the threat to Sderot and the Gaza envelope communities to a debate that included the threat of longer range rockets on larger cities deep within Israel. It can reasonably be concluded that the Iron Dome system has succeeded in saving lives and reducing damages, thus providing more flexibility to the political leadership for containing the fighting with the Hamas government in Gaza.

Introduction

Israel's new "Iron Dome" anti-rocket active defense system made its operational debut in southern Israel in two rounds of escalation in the fighting along the Gaza strip (April and August 2011). The development of active defense systems in Israel that started with Arrow in the early 1990's and in which Iron Dome is the latest chapter has always been accompanied by acrimonious public debate and behind-the-doors battles within the defense establishment. These battles have been mainly between the political leadership and the professional military echelons – which resisted the diversion of resources from offensive to defensive weapons.

This operational debut of Iron Dome, which can be characterized as a technical success, provides an opportunity to evaluate its performance and the degree to which it fulfilled its expectations. There exists a significant degree of ambiguity about the technical and strategic expectations from the

system, since Israel's defense establishment never specified them publicly. Similarly there exists significant ambiguity about the actual performance of the system in battle, as practically no official data was released. Yet the very appearance of Iron Dome on the battlefield generated world-wide interest and was widely reported in Israel and abroad. The wealth of public domain reports permits a preliminary evaluation of its performance and implications.

Objectives and Goals

The shock of the 2006 Lebanon War was a catalyst for Israel's decision to develop an anti-rocket system. In February 2007, Iron Dome was selected as the preferred system, though by that time, daily life in northern Israel had returned to normal. In the south, however, the tempo of the rocket offensive from Gaza was increasing. Accordingly, the public debate on Iron Dome revolved around its effectiveness in the lower limit of its capacity – namely rockets fired from 4 km away – and its ability to destroy mortar shells. Sderot, the city that suffered most from increasing Qassam rocket attacks, was the focal point of discussions on Iron Dome. The public debate barely touched on the need to defend larger cities deeper within Israel, despite the fact that longer range rockets from Gaza had been targeting Ashkelon since mid-2006.

Initially, much uncertainty surrounded Iron Dome's role in the overall response strategy to the rocket and missile threat on Israel. Its fundamental goals – what was it expected to defend against, who or what would be defended, and what were the required defense levels – were withheld from the public. From its laconic statements one might have concluded that the defense establishment saw the role of Iron Dome as limited to the defense of the Gaza envelope against Qassams.

For example, at the end of 2007, Ehud Barak, Israel's Minister of Defense, assumed that “within two and a half years we will be able to deploy the first system in Sderot.”¹ It was only after the initial success of Iron Dome in April 2011 that senior officials in Israel's Ministry of Defense (MOD) elaborated on its strategic objectives and limitations. Brig. Gen. (res.) Ophir Shoham, Director of the Ministry of Defense (MOD) Directorate for Research and Development (known by its acronym MAFAT), said that the system's strategic goal is to allow the political leadership room for maneuver and to provide an alternative to escalation².

¹ Amos Harel: "Minister of Defense: A missile defense system will protect Sderot within two and a half years," *Haaretz*, December 24 2007

² Anshel Pfeffer: "Ophir Shoham, Is it cost effective to intercept a rocket with a 100000 shekels interceptor?" *Haaretz*, April 11, 2011.

Then-head of MAFAT's R&D Division Brig. Gen. Danny Gold stated more specifically that the rationale for the system was threefold: ethical, economic and strategic. Ethically, the system represents the state's obligation to protect citizens' life and property. Economically, the system prevents the paralysis of the nation's economy. And strategically, "[the system] is a response to the main threat from the enemy" – a way to "avoid costly military operations and allow the political leadership to have alternative courses of actions other than escalation."³

As for the defensive capacity of Iron Dome, the program's manager at Rafael, Yossi Drucker, warned that no system guarantees 100 percent protection. The head of the MOD program office, Lieutenant Colonel C. similarly cautioned, "No system is hermetic; the citizens should avoid complacency,"⁴ And Israel's Minister of Defense Ehud Barak warned that "(Iron Dome) does not provide a 100 percent answer."⁵ In a wider perspective, MAFAT Director Ophir Shoham declared that "We do not presume to shoot down thousands of rockets. Rather, we aim to minimize the damage and let the Israel Defense Forces (IDF) do other things..."⁶ Such objectives are much wider than simply protecting the town of Sderot.

It is unclear whether such MOD considerations played a role in the decision to launch the development of Iron Dome in February 2007 or whether they were adopted only more recently. It is reasonable to assume, however, that such or similar arguments were made behind the scenes during the acerbic confrontations between the High Command and the political leadership about the need for active defense in general and Iron Dome in particular. Be it as it may, Iron Dome is now officially tasked to fulfill three goals: Protecting Israeli life and property, providing new flexibility to the political leadership, and giving the IDF extra time to prepare for offensive operations

Iron Dome in Action

The first operational use of Iron Dome in April 2011 was in reaction to an escalation in rocket attacks from Gaza on Israeli targets. After the IDF's offensive responses failed to stop the accelerated and deep-reaching attacks, a decision was made to deploy one of two available Iron Dome batteries over Beersheba. At this time, Iron Dome was not yet declared to have Initial Operational Capability. The deployment was completed on March 23, 2011

³ Noam Barkan, "Ruling the Dome," *Yediot Aharonot*, April 11, 2011.

⁴ *Ibid.*

⁵ Hanan Greenberg and Elior Levi, "Barak on Iron Dome: Does Not Provide a 100 Percent Answer," *Ynet*, March 25, 2011.

⁶ *Ibid.*

and was called an "operational experiment." As tensions continued to rise and with exchanges of fire along the Gaza border, the second available battery was deployed on April 4, near Ashkelon.

On April 7, as revenge for the targeted killing of three senior operatives, Hamas fired an anti-tank missile at an Israeli school bus, killing a 16-year-old boy. In response, the IDF ratcheted up its attacks on Palestinian targets while Gaza terrorist groups (not Hamas) launched long-range rockets at Ashkelon. The Iron Dome battery that had been deployed there achieved its first interception of a Palestinian rocket that day. Over the next couple of days, Iron Dome successfully destroyed several other rockets launched at Ashkelon, while the other battery, stationed in Beersheba, was first activated on April 8, destroying at least one Grad rocket aimed at the city. Media sources reported that the new system had destroyed eight of the nine rockets that it engaged. (According to the director of MAFAT, the success rate was nine out of 10). On April 11, the Palestinians declared a ceasefire and southern Israel returned to a state of tense calm.

The next period of escalation began on August 18, 2011 when Palestinian terrorists attacked several vehicles on the highway to Eilat, killing eight Israelis. In swift retaliation the IDF killed five senior operatives of the Popular Resistance Committees, held responsible by Israel for the cross-border raid. This led to an intensified rocket offensive from Gaza on Ashkelon, Beersheba and other areas deep within Israel. The two batteries defending Beersheba and Ashkelon destroyed a significant number of incoming rockets (but rockets fired at Ashdod, Kiryat Gat, Kiryat Malachi and other towns were not engaged because no additional batteries were available).

On August 20, the Palestinians fired the largest yet salvo of rockets (the media reported 11 simultaneous launches) at Beersheba. While many of the rockets were destroyed in mid-air, one penetrated the defense screen, killing an Israeli civilian and wounding 10. The next day, another three salvos were fired at Beersheba. No Israeli was injured, but one rocket hit an empty school that was likely located within the protective radius of Iron Dome. Seemingly then, this rocket managed to penetrate the defense screen.

The Palestinians declared another ceasefire on August 28, but the targeted killing of an Islamic Jihad operative spurred renewed rocket fire. This did not cause any further casualties in Israel and several more rockets were successfully intercepted. The IDF reacted with restraint and the rocket fire subsided after several days. According to the media, Iron Dome destroyed between 18 and 20 rockets during this period of escalation, but the Israeli defense establishment declined to provide official information on the success

rate. The sole official statement came from Israel's ambassador to the US, who cited an 85 percent success rate.⁷

Evaluating Iron Dome's Technical Performance

It seems that the achievements of Iron Dome in April pleasantly surprised the IDF and the Israeli public, yet its performance in August somewhat disappointed the public (but not the IDF). The initial successes created an unjustified perception among the public of a hermetic, leak-proof defense system. The few rockets that subsequently penetrated the system during the August fighting dispelled this perception and caused a degree of disillusionment.

In the absence of official figures, our system performance evaluation must rely on indirect evidence. A total of 300 to 350 rockets of all kinds were fired by the Palestinians at Israeli targets near Gaza and deeper into Israel in the course of the two cycles of violence. Only one Israeli was killed, which means then that the effective lethality of the rockets in the two events was 300 rockets per fatality (RPF).⁸

The lethality of the Gaza rockets during the eight-year (2001-2009) offensive on the Gaza envelope communities averaged 254 RPF⁹ – however, when the 300th rocket hit Israel, four fatalities had already been incurred, hence the initial RPF stood at 75. In the 2006 Lebanon War, the initial RPF stood at 50 (it later dropped to 75).

In both cases, initial lethality was higher than the average since it took some time for the public to comply with civil defense instructions and take shelter upon alerts. Media reports on the public's behavior during the two cycles of escalation in 2011 show that it resembled the initial pattern of the eight-year rocket offensive, with a sizable proportion of the public failing to take cover. Hence, it is legitimate to compare the effective lethality of the April and August 2011 cycles of attacks to the initial lethality of the two previous campaigns. From this perspective, the initial lethality in the 2011 escalations with an RPF of 300 was extraordinarily low¹⁰. Since this cannot be attributed

⁷ Eli Lake, "Israel Iron Dome Missile Defense System Hits 8% of Targets," *Washington Post*, August 29, 2011.

⁸ Lethality is reciprocal to RPF. A large RPF means that more rockets are needed to cause one fatality, and vice versa.

⁹ See "From Harassment to Strategic Threat" by the present author, BESA publication no. 87, page 17 fig. 3 (Hebrew).

¹⁰ According to a Ministry for Foreign Affairs website detailing Palestinian rocket and mortar fire on Israel, the number of rockets hitting Israel in April 2011 was 65, and in August 2011 149 – a grand total of 214 rockets. See http://www.mfa.gov.il/MFA/Terrorism-+Obstacle+to+Peace/Hamas+war+against+Israel/Palestinian_ceasefire_violations_since_end_Operatio

to public discipline or compliance with civil defense instructions,¹¹ it must have been Iron Dome's effectiveness that reduced the rockets' lethality by about two thirds. It seems, then, that Iron Dome has achieved a significant technical success.

Israeli and Palestinian Reactions

Initial reports of Iron Dome's success in April 2011 were received with some skepticism in Israel and even attributed by some commentators to pure luck. Nevertheless, when the April escalation ended with no Israeli casualties and the full extent of Iron Dome's capabilities was realized, euphoria prevailed.

Throughout this round of escalation, the pattern of rocket attacks from Gaza was markedly different than in the past. Sderot, previously a magnet for Qassam attacks, enjoyed relative calm, suffering only one rocket impact throughout the April fighting. The Palestinians, instead, evidently preferred to launch longer range rockets at larger cities deeper within Israel. This facilitated the task of Iron Dome since it had to deal with longer range targets.

During the next cycle of violence in August, the Palestinians maintained their new policy of attacking larger, more distant cities. Sderot was "neglected" once again, with only two rocket impacts. It seems that the Palestinians chose this time to attack cities defended by Iron Dome in order to probe its weaknesses and attempt to penetrate its defensive screen, thereby gaining "points" among constituents for any Israeli casualties. The heavy salvo on Beersheba on August 20 – that may well have been aimed at the equidistant, undefended city of Ashdod – lends credence to this theory.

The public responses in Israel following this second cycle of escalation were more muted than previously. This time, praises for the system's performance were accompanied by some criticism. Reuven Pedatzur, a *Haaretz* defense analyst and a long-time critic of missile defense in Israel (and abroad), declared that the Iron Dome concept collapsed because, among other things, "it was shown that civilians under attack could not maintain their daily life without fear".¹² A similar sentiment was expressed by former Israeli Minister of Defense Moshe Arens, who lauded the system's technical achievement but

n_Cast_Lead.htm. It is not clear whether this source is more reliable than general media. In any case, even with this lower estimate of the total number of rockets, the main conclusions herein remain valid.

¹¹ The victims of the Beersheba rocket attack on the night of August 20 failed to take cover when the rocket hit, see "ZAKA volunteer: the killed and wounded were not sheltered within a protected space" http://news.xoox.co.il/item_691648.htm

¹² Reuven Pedatzur, "The Collapsed Dome," *Haaretz*, August 26, 2011.

pointed out that despite the active defense, "the rockets forced the residents of southern Israel to run for shelter."¹³

Considering the warning of senior defense officials that Iron Dome cannot provide a hermetic, leak proof shield and the constant pleading by the Homeland Defense Command for the public to take cover even in cities defended by Iron Dome, it is difficult to see why both critics nurtured the mistaken notion that Iron Dome was supposed to provide "normal daily life without fear" under rocket fire.

Israel's defense establishment continued praising the system after the August events while mayors in southern Israel clamored for Iron Dome's deployment to their cities as it evoked a sense of security.¹⁴ Defense Minister Ehud Barak ordered the prompt deployment of a third Iron Dome battery to Ashdod and promised a fourth battery would be delivered by the end of 2011. It seems then that both the defense establishment and the general public regarded Iron Dome's performance in the August fighting as a success, despite the Beer Sheba casualties. It also appears that the IDF overcame its historical distaste for missile defense, embracing Iron Dome with some enthusiasm.

Palestinian officials kept silent about the debut of an active defense system in the arena. Yet some sense of the mood in Gaza can be deduced from media reports on Gazans' reactions. A Palestinian resident of Beit Lahia was quoted as saying: "People in the northern Gaza Strip can clearly see Iron Dome in action. The uselessness of our rockets was never as evident to the people as it is now."¹⁵

Strategic Implications

About two months after the April 2011 fighting, a senior Israel Air Force officer declared, "The success of Iron Dome saved the IDF another major operation in Gaza."¹⁶ In his view, the successful performance of the system provided decision makers with an added degree of freedom and gave them an alternative to a major offensive action. The enemy did not achieve its goal, became frustrated and ceased firing. The IDF has apparently concluded that its newly introduced active defense arm achieved its strategic goals: protecting Israeli life and property, providing new flexibility to the political

¹³ Moshe Arens, "An Imperfect Pride," *Haaretz*, August 31, 2011.

¹⁴ The mayor of Ashdod, Yechiel Lassri, told the *Walla* news website that "...the deployment of Iron Dome...is good news for the residents of Ashdod and adds to their sense of security," August 31, 2011.

¹⁵ Amira Hass, "In the Gaza strip they erected mourning huts for the victims of (Israel's) air raids, but not for the perpetrator of the (Eilat road) raid," *Haaretz*, August 25, 2011.

¹⁶ Amos Harel, "A senior IAF officer: the success of Iron Dome saved another IDF operation in Gaza," *Haaretz*, July 26, 2011.

leadership, and giving the IDF extra time to prepare for offensive operations. In the view of the above quoted officer, there was one further achievement: A dissuasive effect that was brought about by the enemy's sense of frustration, motivating him to cease his fire.

It is still too early to judge how accurate this evaluation is. Iron Dome did indeed save lives and protect property. It can also be reasonably concluded that the low number of civilian casualties allowed the political leadership to act with restraint and minimize its aerial attacks on Gaza, thereby reducing collateral damage and containing the situation.

However, it is hard to see how Israel would otherwise have risked a major ground offensive in Gaza when the collapse of the Mubarak regime has strained its relations with Egypt, when Israel was gearing up for a diplomatic battle over the Palestinian UN bid for statehood, and when the political damage from Operation Cast Lead was still fresh in mind.

As for the alleged dissuasive effect of Iron Dome, this did not prevent Palestinian armed organizations in Gaza from launching large-scale rocket attacks in August. In fact, Iron Dome may have challenged them to ratchet up their fire in an effort to break through the defensive shield.

Another lesson from the two recent periods of escalation was the race between the offense and defense. The lively public debate about Iron Dome focused exclusively on its capability to defend Sderot and other Gaza envelope communities, neglecting the growing threat on larger cities deeper within Israel. It is now clear that the system's architects were correct in designing it against both the shorter and longer range threats.

In conclusion, the jury is still out on the full implications of active defense for the Israeli-Palestinian battlefield. More data must be gathered (hopefully not too soon). Nevertheless, having already saved the lives of Israeli civilians and soldiers, and having helped the political leadership contain the fighting – which apparently it did – Iron Dome has already made a significant contribution to Israel's security.

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