

SECURING ISRAEL'S AIRSPACE

An Overview of Israel's Air Defense Capabilities

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ISRAEL'S 5TH BLUE FLAG EXERCISE

- Around 80 aircraft from various countries participated in the Israeli air exercise which, as it turns out, was important for improved regional defense and for NATO. Britain participated for the first time along with the US, France, Italy, Germany and Greece from NATO. India also sent warplanes and a number of countries came as observers including the chief of the UAE Air Force. Other observers included Japan, Romania, Finland, the Netherlands, Australia, South Korea and Croatia.
- One of the main points of the exercise was to simulate air defenses and learn how to fly against them. Italy and Israel supplied F-35 stealth jets permitting the participants to take advantage of the F-35's superb radar set to fix enemy targets and share those targets with 4th-generation aircraft such as the F-16, the Mirage and the Eurofighter.
- But the real star of the show was Scorpius –Israel's new "soft kill" system

ISRAEL'S AIR DEFENSE SYSTEM

- Israel defends its airspace with aircraft, cruise missiles, drones and air defense systems (Iron Dome, David's Sling, Arrow 2, Arrow 3* and others)
- For strategic defense Israel has a nuclear "triad" consisting of intermediate range ballistic missiles (Jericho I, II, III), nuclear cruise missiles (Popeye, Popeye Turbo, AGM-142) and nuclear capable aircraft (F-4's and F-15's)
- Of utmost importance is protecting the state from attacks
- Major threats come from ballistic missiles, cruise missiles, drones
- Types of threats include conventional and nuclear bombs, chemical and biological weapons and radiological weapons
- Air defense systems are VERY EXPENSIVE to acquire and very expensive to operate because the cost of interceptor missiles can run into millions for each shot!

INTEGRATED AIR DEFENSES

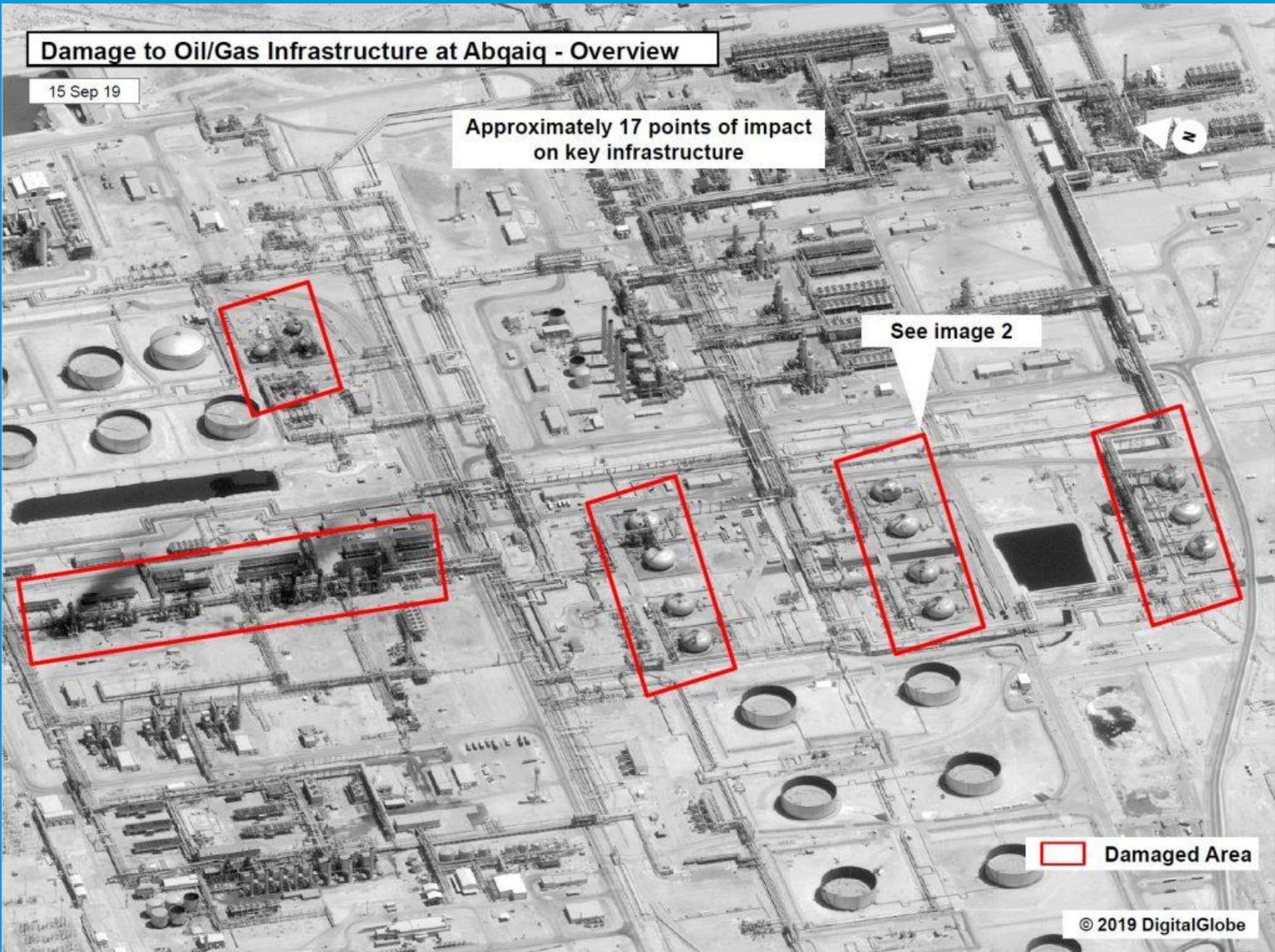
- Israel's ground based air defenses are increasingly integrated into a layered defense system to counter a variety of threats including ballistic missiles, cruise missiles and unmanned aerial vehicles
- In a layered system threats are "handed off" to the appropriate defense system cluster
- Iran has demonstrated it has long range ballistic missiles that derive from North Korean prototypes (No Dong 1, No Dong 2) and from Chinese and Russian technology
- Iran also has demonstrated it has cruise missiles that can fly long range operations without the need for a "man in the loop"
- Precision Iranian capabilities were put on show when Saudi oil installations were attacked by cruise missiles and drones (Abqaid-Khurais, September 2019)

Damage to Oil/Gas Infrastructure at Abqaiq - Overview

15 Sep 19

Approximately 17 points of impact on key infrastructure

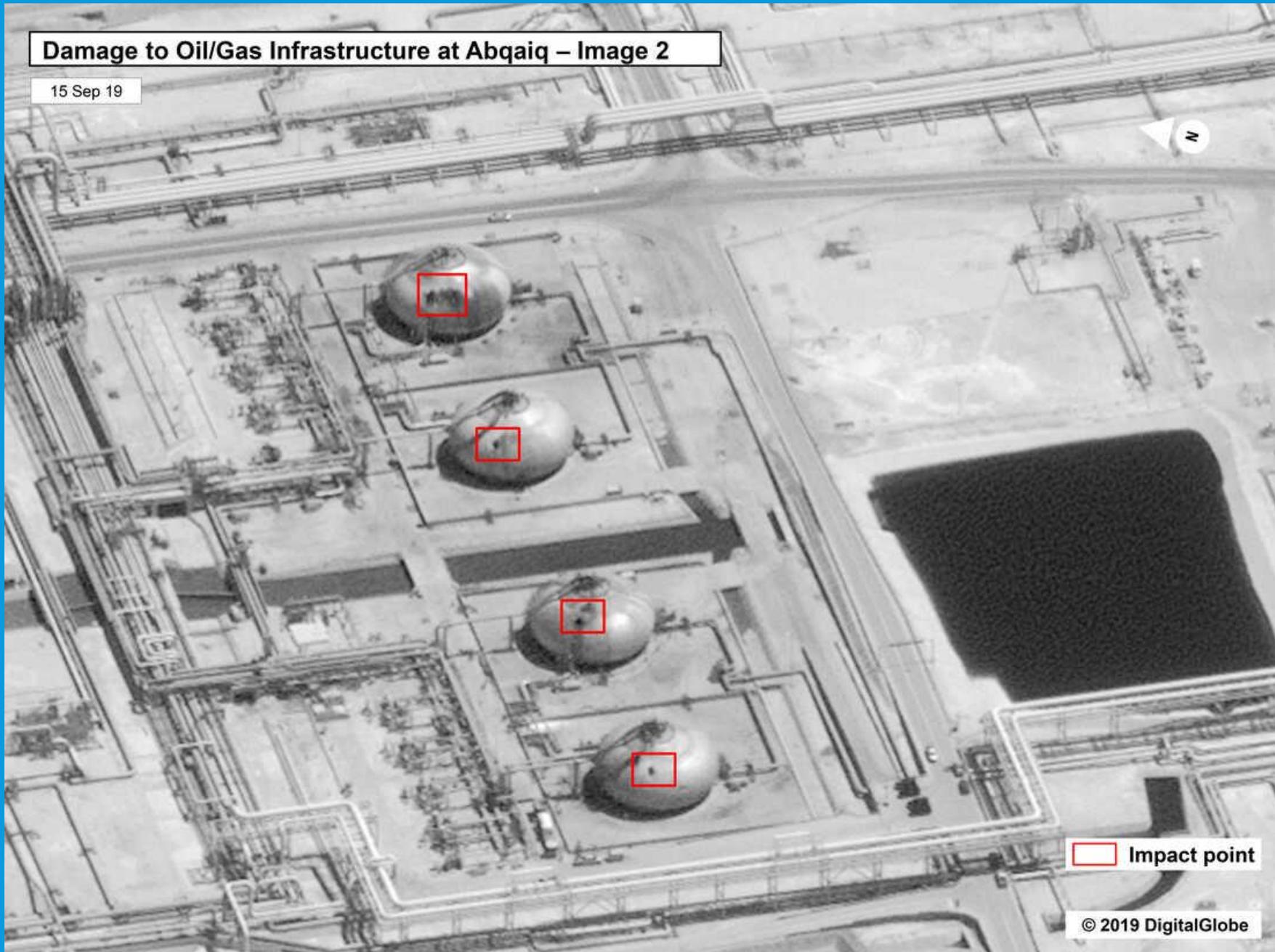
See image 2



 Damaged Area

Damage to Oil/Gas Infrastructure at Abqaiq – Image 2

15 Sep 19



 Impact point

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IRAN SHAHAB-3



MRBM variant can now reach 2,000 kilometers (1,200 mi) (can hit targets as far as Israel, Egypt, Romania, Bulgaria and Greece)

Shahab missiles RV variants



Shahab 3



Shahab 3B /
Ghadr 1/110



Shahab 3
NRV

The family of Shahab-3 warhead variants as compiled by Tal Inbar and Uzi Rubin. The NRV, the New Reentry Vehicle, is shown on the right. Note it's a triconic design but with a larger base diameter than the Ghadr-1 warhead.

“LOCAL” THREATS

- It is important to keep in mind that Iran can operate directly and indirectly from other locations including Iraq, Syria, Lebanon and Gaza
- Iran has provided increasingly sophisticated missiles to Hezbollah (Lebanon and Syria) and to Sh'ia militias in Iraq. It continues to supply Gaza with short range missiles and some drones.
- An important development is Iran's effort to introduce large quantities of Precision Guided rockets to Hezbollah and in the hands of Iranian forces in Syria. This includes putting in place manufacturing and assembly operations in Syria for Precision Guided weapons.

ISRAEL'S RESPONSE IN SYRIA

- Jane's defense news analysts said that over a three-year span Israel had used 4,239 weapons against 955 targets with 70% of Israeli pilots involved in the campaign, with the new F-35I Adir fighter jets leading dozens of missions.
- "It's been...months of painful hits, not (any more) limited to the Golan Heights or southern Syria (close to Israel) or around the outskirts of Damascus, they've gone north to Aleppo and Hama and to Al Bukamal on the Iraqi border," a Syrian military defector, Brigadier General Ahmad Rahal, told Reuters.
- However, some underground compounds stretch as many as 10 km (6.2 miles), making them difficult to penetrate thoroughly even for Israel's satellite-guided, 500-pound "bunker-buster" bombs, according to a senior Western intelligence source.

FINDING SOLUTIONS TO PGMS, DRONES

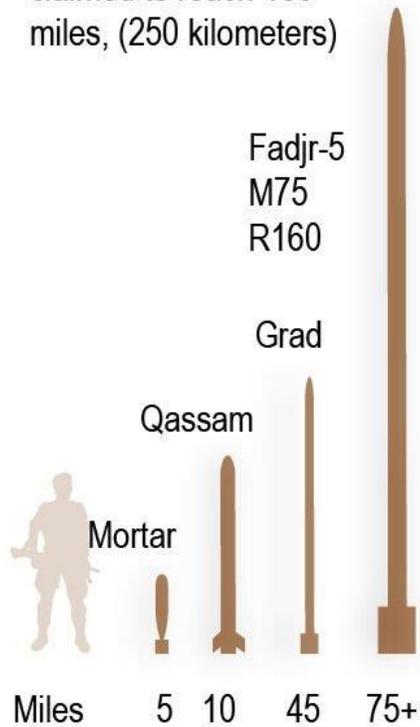
- Most of the “local” missile threats to Israel were from inaccurate weapons such as SCUD missiles from Syria and Lebanon and mostly short range missiles from Gaza
- Gaza claims to have a longer range missile called Ayyash 250 which allegedly can hit Tel Aviv but most are short range rockets (Qassam, 6 to 12 miles)
- An “advantage” to Israel facing inaccurate missiles and rockets is it could sort out what were likely to hit civilian populations and sensitive targets from those that would not (a key feature in Iron Dome)
- With the rise in precision guided threats, that “advantage” disappears and taxes conventional air defense systems to take care of all or most threats
- Israel faces one of two choices: either to liquidate the source of the threats (requiring a major land army attack) or to counter the precision guided weapons



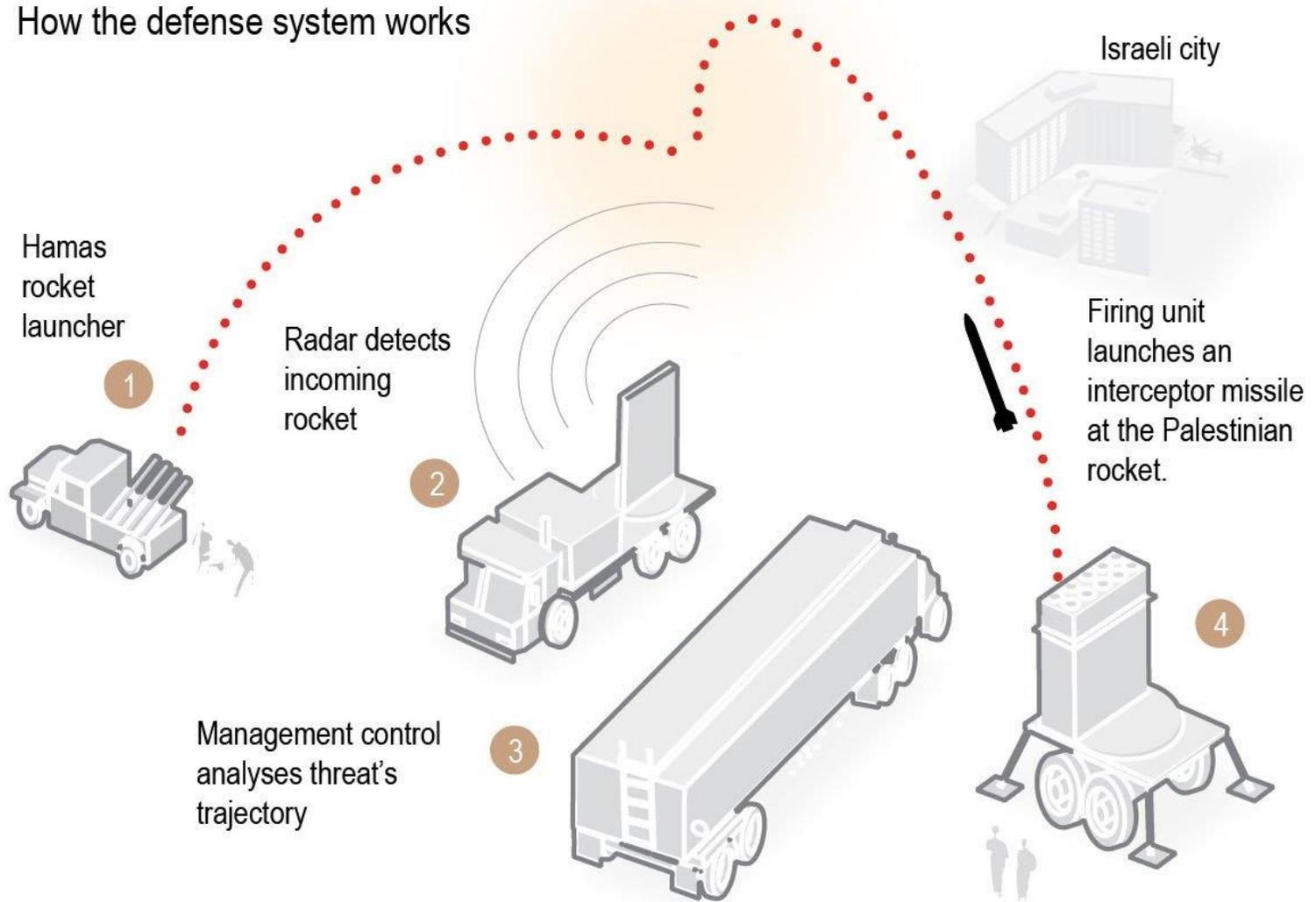
Israel's 'Iron Dome' rocket defense

Hamas arsenal

Typical range for four categories of Hamas rockets. A new rocket called the Ayyash is claimed to reach 150 miles, (250 kilometers)



How the defense system works



SOURCE: Israeli Defense Forces

ELECTRONIC DEFENSE

- An alternative to using kinetic interceptor missiles (a la Iron Dome, David's Sling, Arrow 2 and Arrow 3 plus Patriot PAC-2/PAC-3) is to defeat them electronically
- While mechanically guided missiles (aka SCUDs) do not use electronic or electro-optic sensors and rely on gyroscopes and launch angles for aiming, precision guided weapons use a variety of sensors (hardware and software) including radars, TV-Imaging, infrared and radars plus GPS and radio guidance
- Iran successfully intercepted and landed a sophisticated US electronic spying drone by intercepting and faking GPS signals and also grabbed control of the "man in the loop" to bring the drone in for a landing
- On 5 December 2011, an American Lockheed Martin RQ-170 Sentinel unmanned aerial vehicle (UAV) was captured by Iranian forces near the city of Kashmar in northeastern Iran. The Iranian government announced that the UAV was brought down by its cyberwarfare unit which commandeered the aircraft and safely landed it, after initial reports from Western news sources claimed that it had been "shot down"



KRAKUSHKA (BELLADONNA)

- The Krasukha is a broadband multifunctional jamming station manufactured by KRET (“Concern Radio Electronic Technologies”), part of the Rostec Group. Since 2014, the company has been under US sanctions for its activities in Ukraine and in Crimea.
- Krakushka was used successfully in defending the Hmeymim Air Base in Syria that was attacked by armed, if not primitive, swarming drones. An earlier strike by such drones had caused significant damage at the base, destroying some aircraft, and alarmed Russia’s military about a significant vulnerability at Hmeymim
- Krakushka jams communications in the same way it blanks out radars; it does not, however, control the jammed drones.
- The Russian press claims that at least nine Bayraktar drones were shot down on or about October 19. Some photos of the drones that crashed have been released by Armenia and have appeared in the Russian press, principally at Avia.pro.

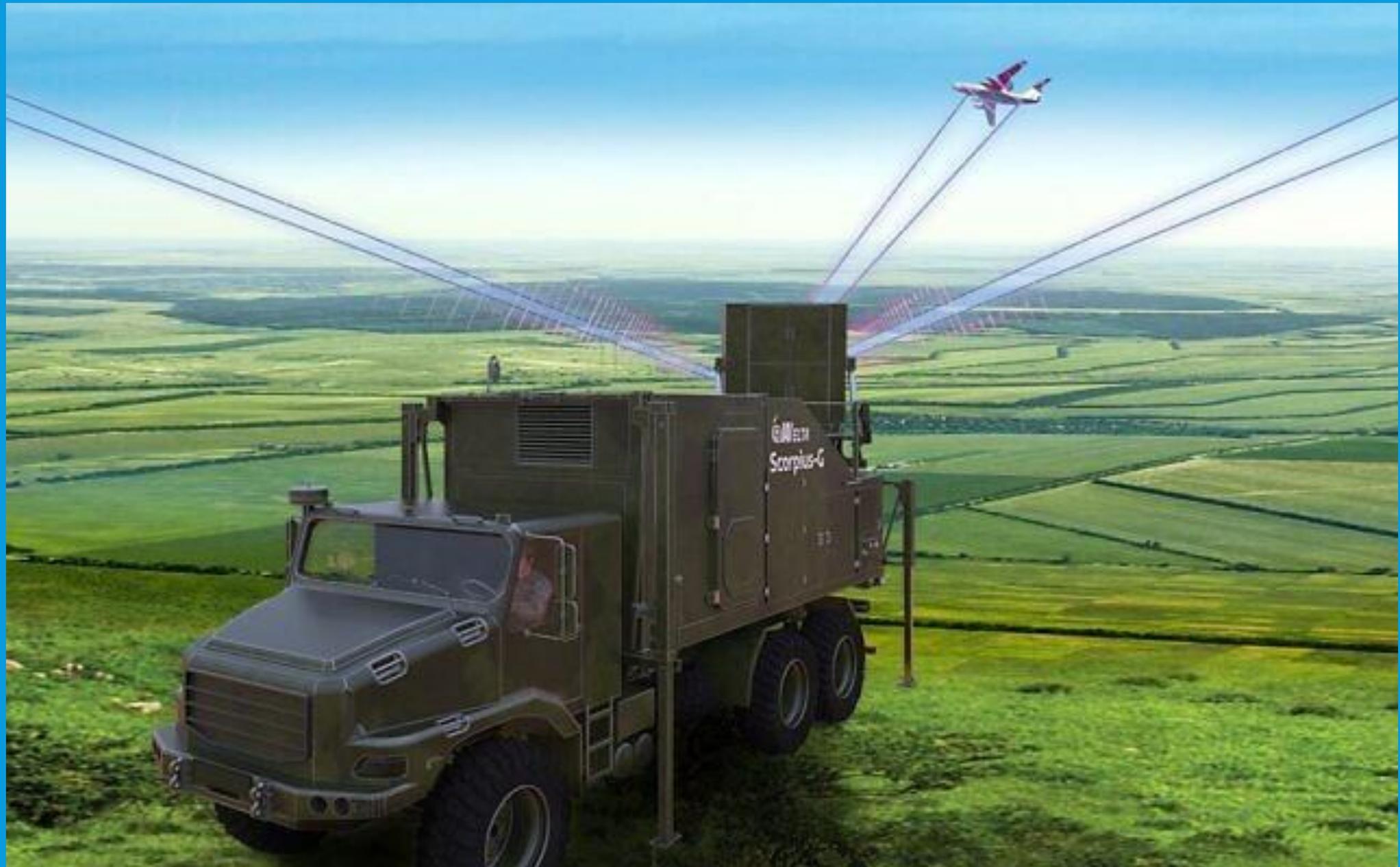


LIMITATIONS OF KRAKUSHKA

- Krakushka is a “force” jammer that shuts down GPS and all radio signals
- It covers a wide area but it also would jam air defenses and tactical communications
- It is particularly good against “man in the loop” systems since it can break communications
- Oddly, the Turkish Bayraktar drones when jammed could not fly home to base automatically for reasons unknown but suggesting the Krakushka jammer was strong enough to “fry” the Bayraktar computer
- Krakushka is vulnerable to radiation attack missiles (air to ground) such as the AGM-88 Harm and the Israeli Delilah cruise missile

ISRAEL'S SCORPIUS SYSTEM

- Scorpion was introduced at the 5th Blue Flag Exercise in Israel at the Uvda Air Base in the southern Negev from October 17th until October 28th
- Blue Flag is described as an international training exercise hosting air forces from around the world to strengthen cooperation between the nations. This year, apart from F-16I, F-35I, and G550 AEW&C aircraft from the Israeli Air Force, the exercise included USAF F-16C/Ds from Germany, RAF Eurofighter Typhoons, Indian Air Force Mirage 2000s, Greek F-16C/Ds, Italian F-35As, and German Eurofighters.
- Israeli F-16Is played the Red Force in the exercise, and were supported by an IDF Patriot SAM battery, and various emulators capable of simulating Russian S-75/SA-2, S-125/SA-3, 2K12/SA6, 9K33/SA-8 and Pantsir-S1/SA-22 SAM systems.
- The real star of the show was Israel's new non-kinetic air defense system called Scorpion.



SCORPIUS FEATURES

- Scorpion comes in land mobile, at sea and aircraft pod versions as well as a training version



AESA RADAR

- Scorpion combines wide area search and narrow beam attack using AESA radar
- AESA (Active Electronically Scanned Array) radar
- Scorpion is the first system that does not have to blank out large areas to operate as a jammer
- It can kill radio and radar signals of all kinds
- It is frequency agile meaning it can go after signals coming from hostile threats including aircraft, missiles, drones, cruise missiles
- It can jam not only man in the loop but onboard sensors such as radars and GPS
- The system is particularly important as a countermeasure against precision guided systems

SWARM ATTACKS

- AESA makes it possible to go after “swarm” type attacks which are becoming increasingly common
- Swarm attacks are designed to saturate conventional air defenses with too many targets so that some part of the swarm gets through
- Drones and cruise missiles are increasingly cheap and dangerous
- Because Scorpius is non-kinetic the kill cost is only the cost of operating the system –not the cost of expensive interceptor missiles
- A Patriot interceptor missile costs between \$1 million and \$6 million each!
- Iron Dome interceptor missiles cost \$150,000 per shot!
- Arrow 2 costs around \$3 million per missile!

BEYOND VISUAL RANGE

- Beyond Visual Range (BVR) air to air missiles are becoming widespread as Chinese and Russian BVM missiles proliferate globally
- BVR air to air missiles typically have a range of 75 miles or more
- Not all aircraft can be “stealth” birds such as the F-35 and even the F-35 has vulnerabilities to some air to air missiles
- Adding a Scorpius pod to friendly aircraft ought to make it possible to defeat BVR missiles that depend on radar to hit their targets (sometimes also combine radar with IR detectors)
- It is likely that the pod version of Scorpius will quickly become a strong seller in friendly countries (eg, NATO)

CONCLUSIONS

- Protecting national airspace from threats is of growing importance especially as new types of threats (UAVs, Missiles, PGMs) proliferate
- Israel has pioneered integrated air defenses and layered defenses
- Adding Scorpius to the Israeli mix may be a revolutionary step in modern warfare and far outperforms “conventional” jammers, even advanced systems such as Russia’s Krakushka
- Friendly states in the Middle East can help neutralize missile and air threats with systems like Scorpius
- Beyond the Middle East, NATO and Pacific allies and friends could offset threats from Russia and China with Scorpius