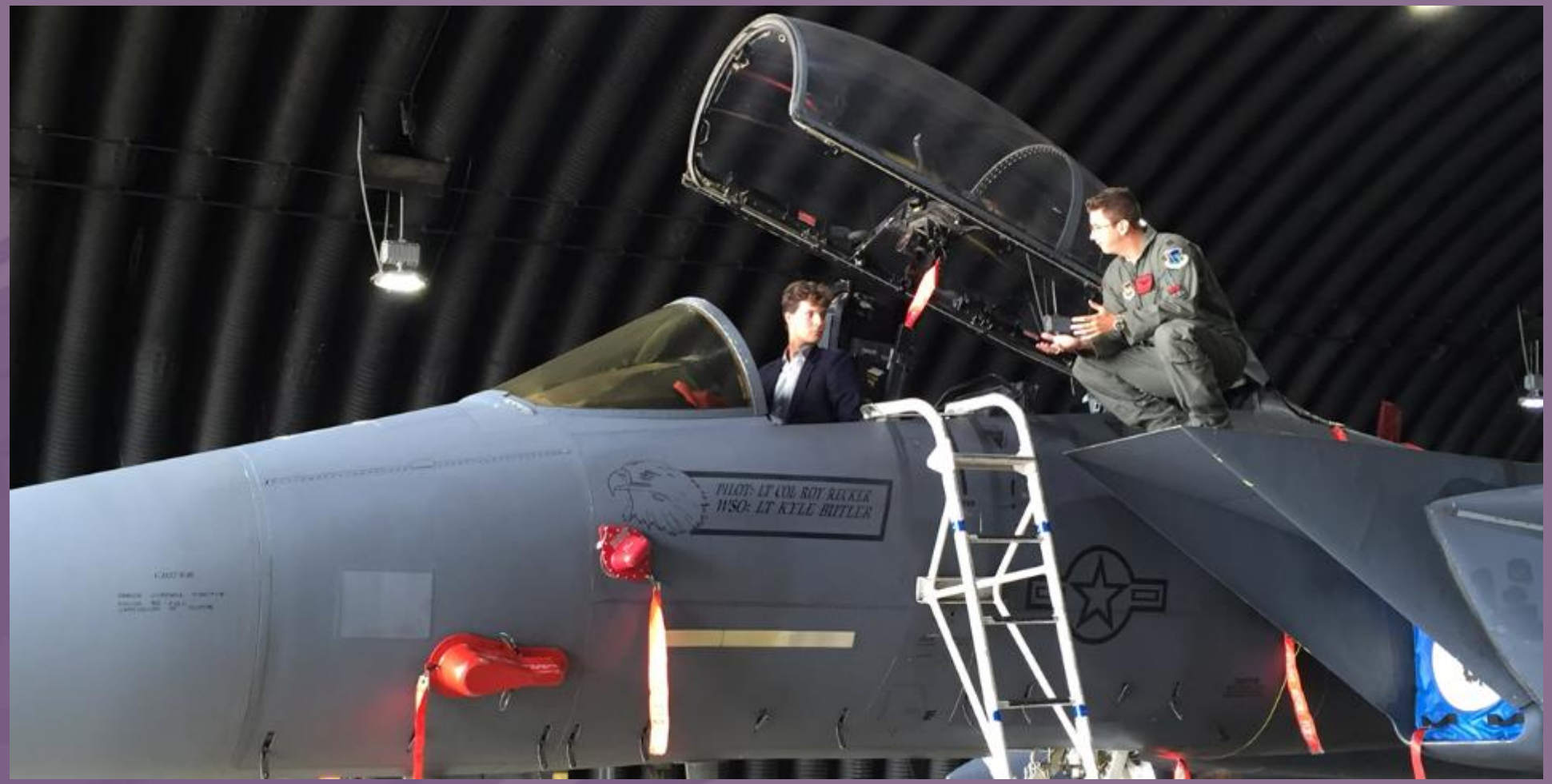
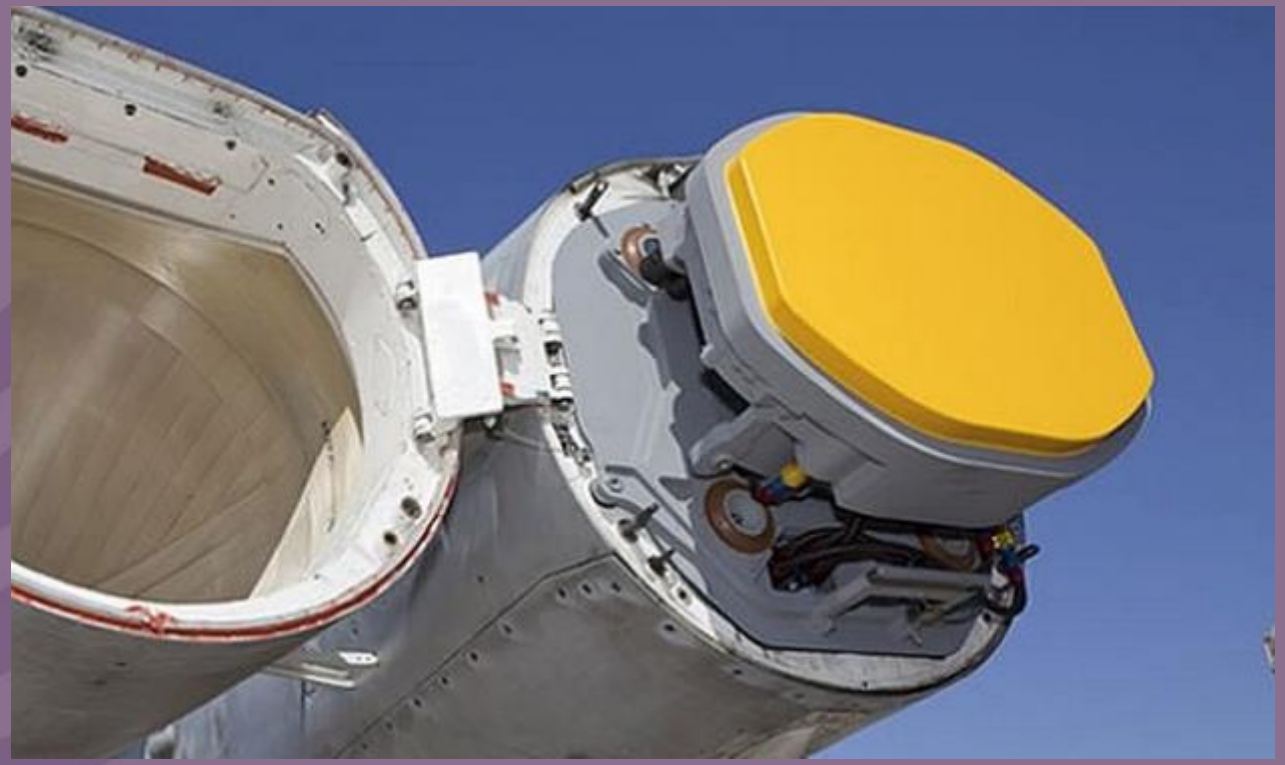
Radar and Sensor Evolution: Tends and Implications



Justin Bronk, Research Fellow, Military Sciences

AESAs and Why They Matter

- More effective in terms of detection ranges and resolution
- Ability to perform TWS engagements improved, multirole engagements, much better combat ID options.
- SAR mapping, ECM, even Cyber attacks – Flexible
- LPI/LPD is the most crucial factor. The haves and have nots.

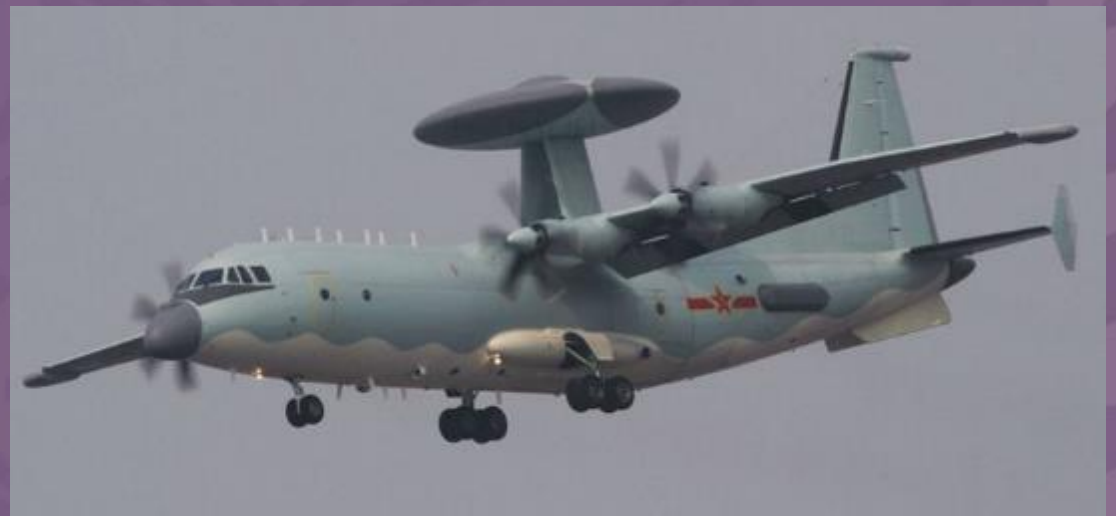


China is already in the AESA game

J-10C

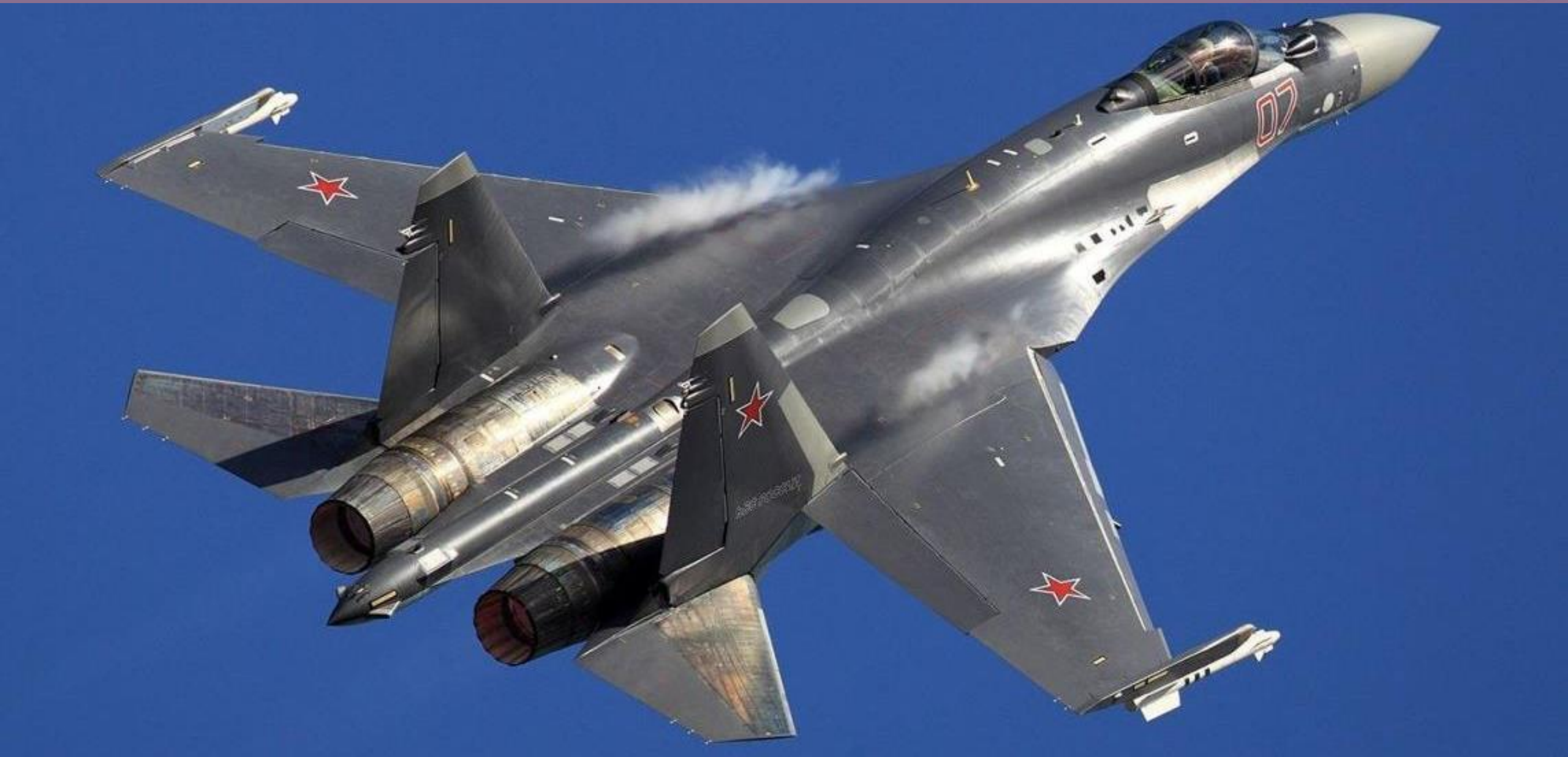
J-20A

KJ-500



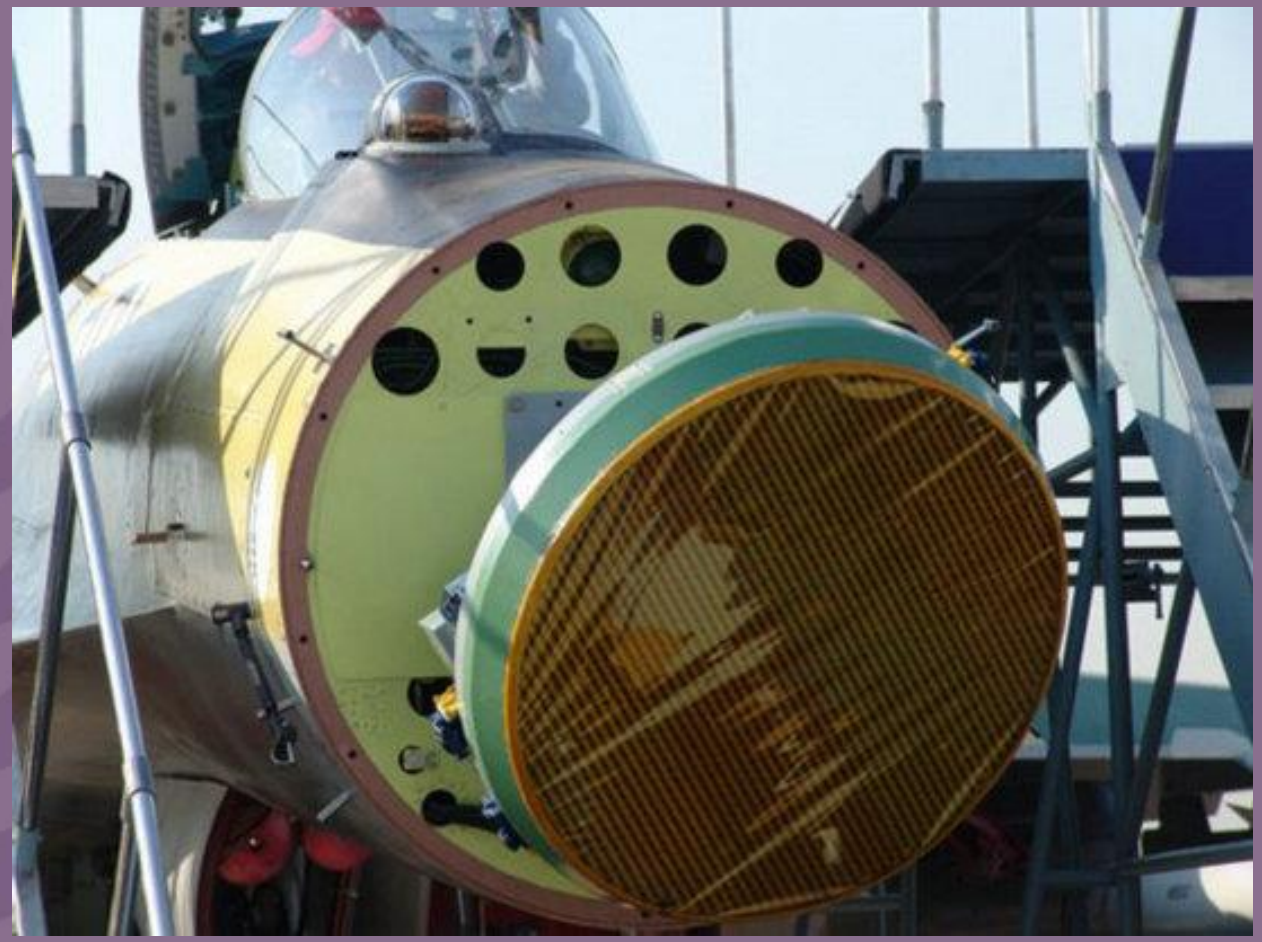
KJ-2000

The Russian Air Picture



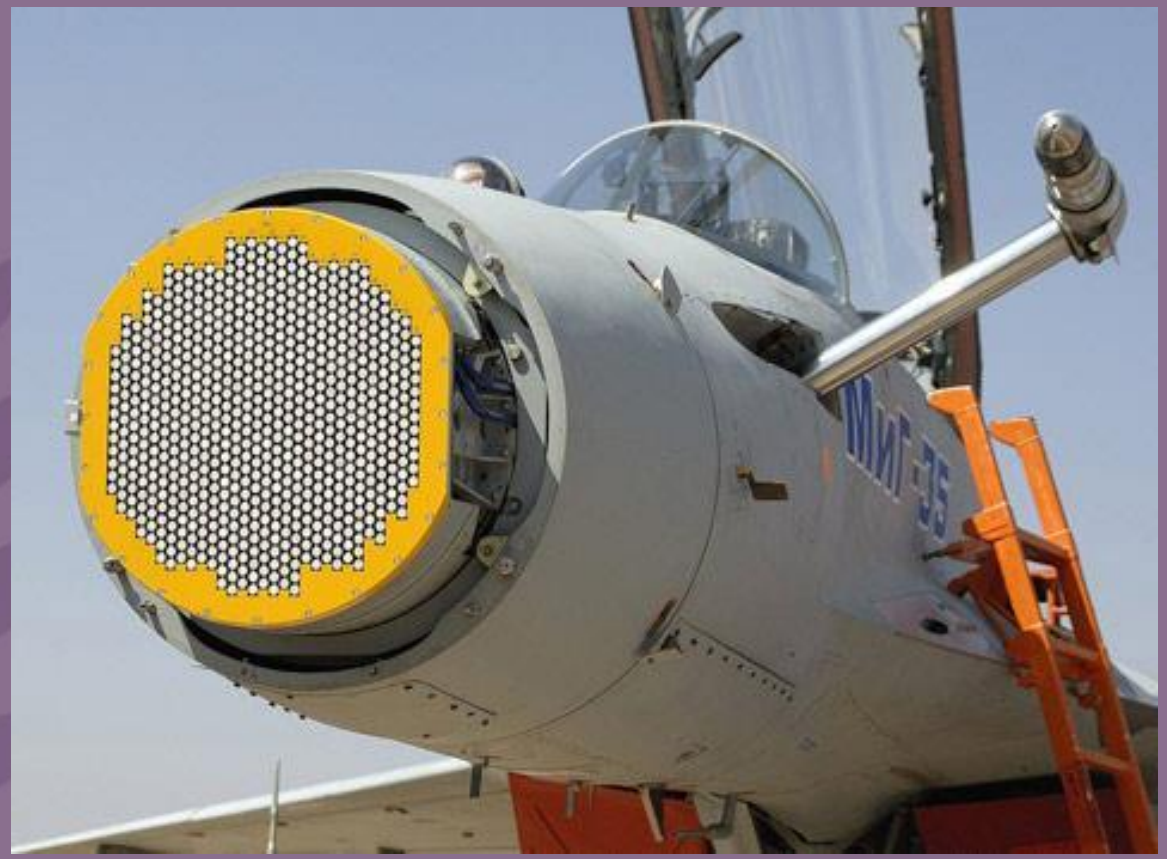
N001 Bars (Su-27) to N035 Irbis-E (Su-35)

- Roughly 5 times the power output of Su-27's original N001 Bars
- 50% increase in effective detection range to roughly 200nm against 3m2 RCS target
- Around 2.5 times as effective against defensive EW (jamming) using brute force 'burn through' approach. Effective within approx. 30-50nm
- Passive Electronically Scanned Array advantages; microsecond scan rates, 8+ target TWS capability, datalink functionality, surface mapping multirole options
- No reliable LPI scanning mode

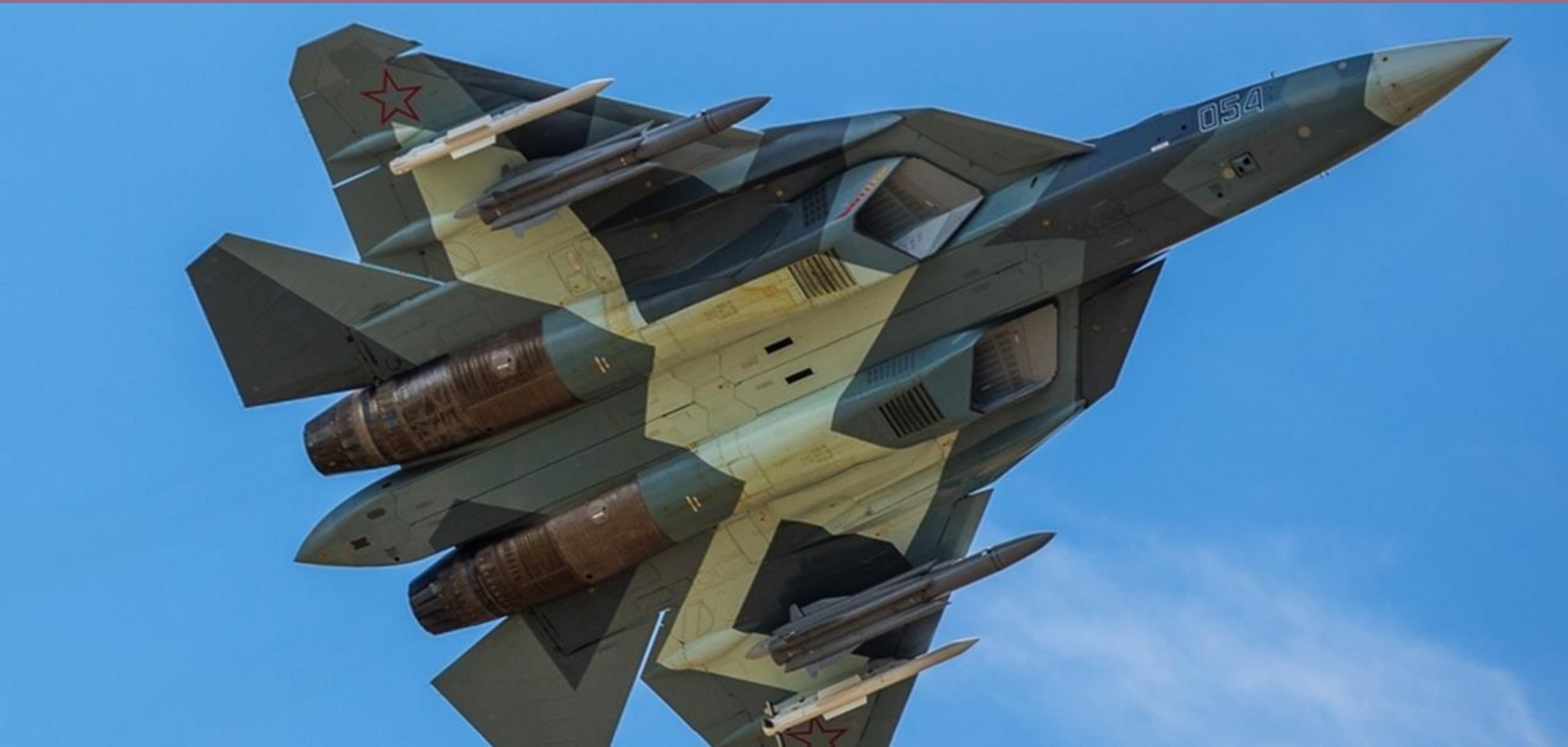


Zhuk-AE (Mig-35)

- Russia's first AESA radar
- Small radar aperture due to Mig-29 nose dimensions
- Only 6 currently on order for VKS (August 2018) but the aircraft officially demonstrated for the Russian Ministry of Defence in 2017 lacked an AESA and thrust vectoring.
- Cost reasons cited.
- Nominal intention to buy 170. Don't hold your breath. RSK-Mig's last hope for survival in fighter market

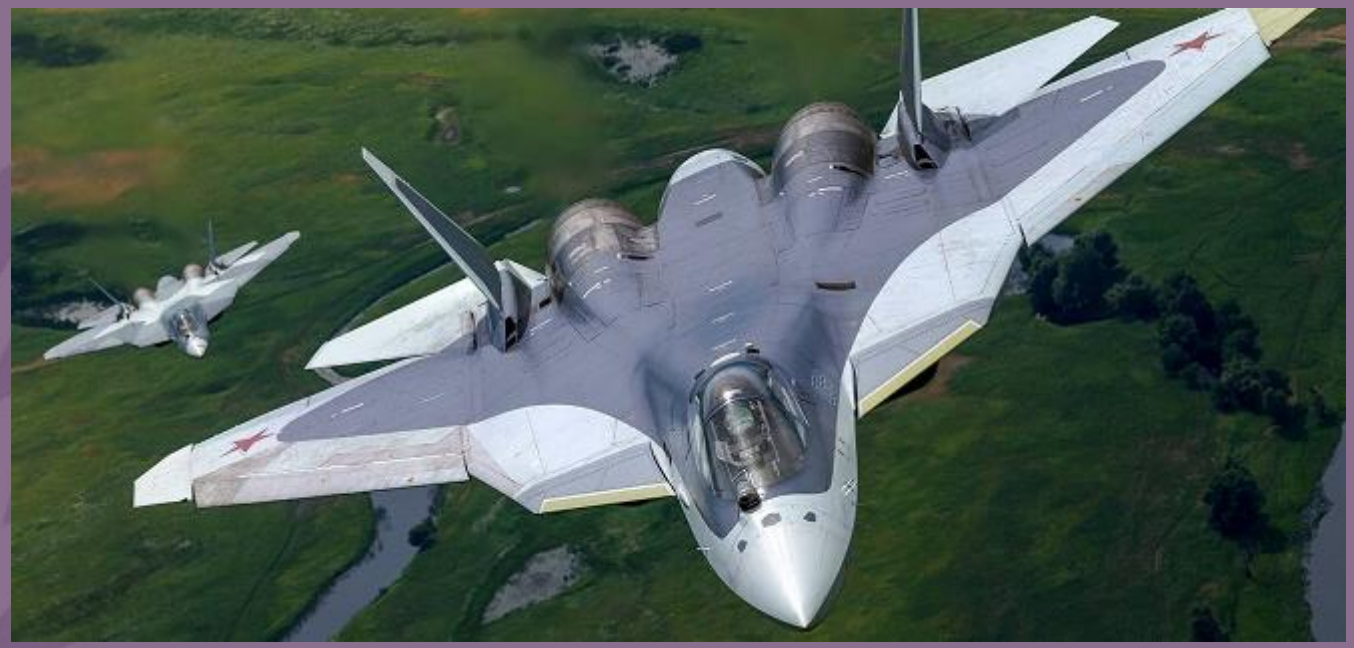


Su-57

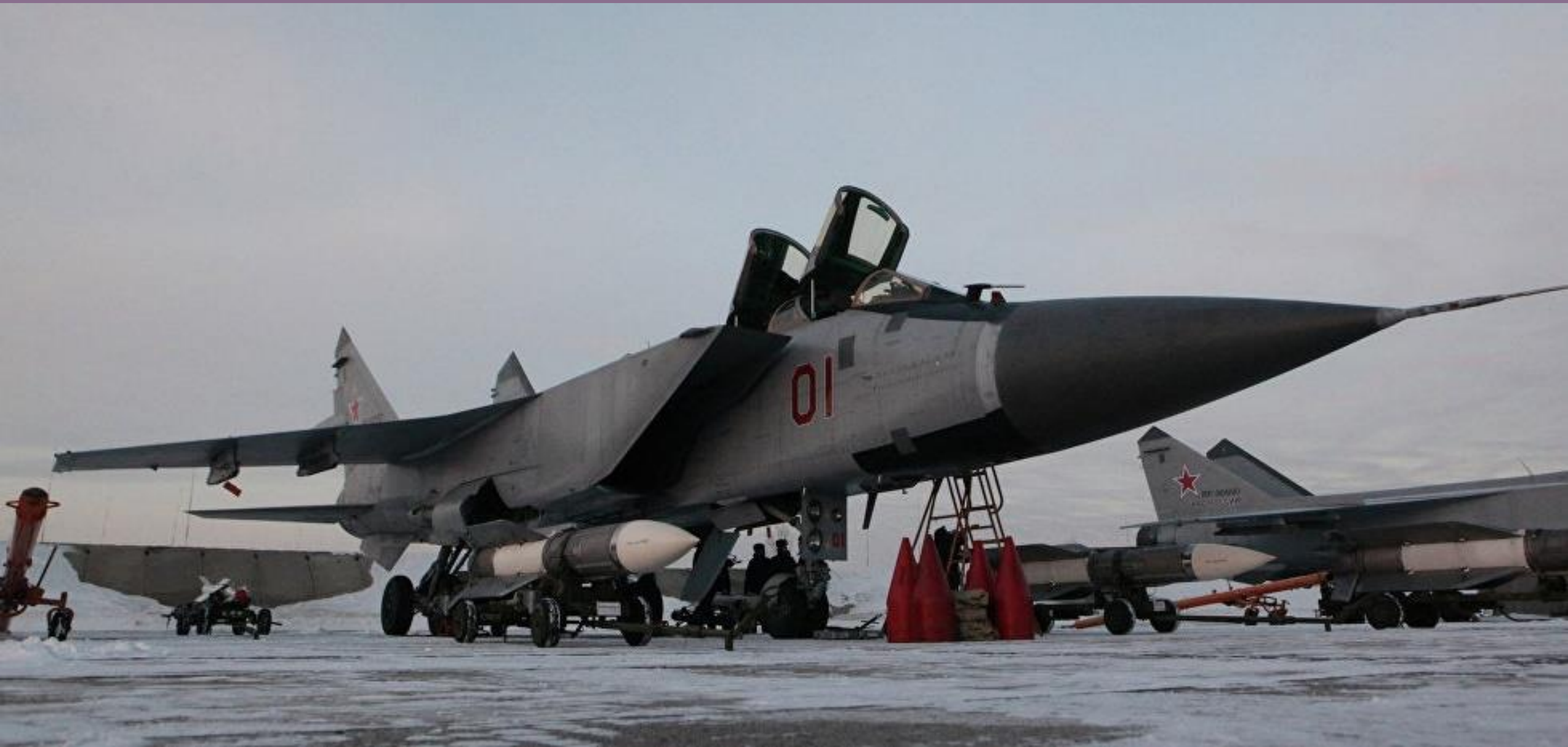


Su-57 – Dead on Arrival

- Limited success reducing RCS
- Multiple X/Ku Band, L-Band array integration failure. Western electronic components essential
- Serious quality control issues
- Feb 2018: Contract for 12 production aircraft signed by Russian MoD
- July 2018: Deputy Defence Minister Yuri Borisov states there are no longer plans for Russia to put the Su-57 into series production for the foreseeable future. ‘Su-35S more than adequate’.

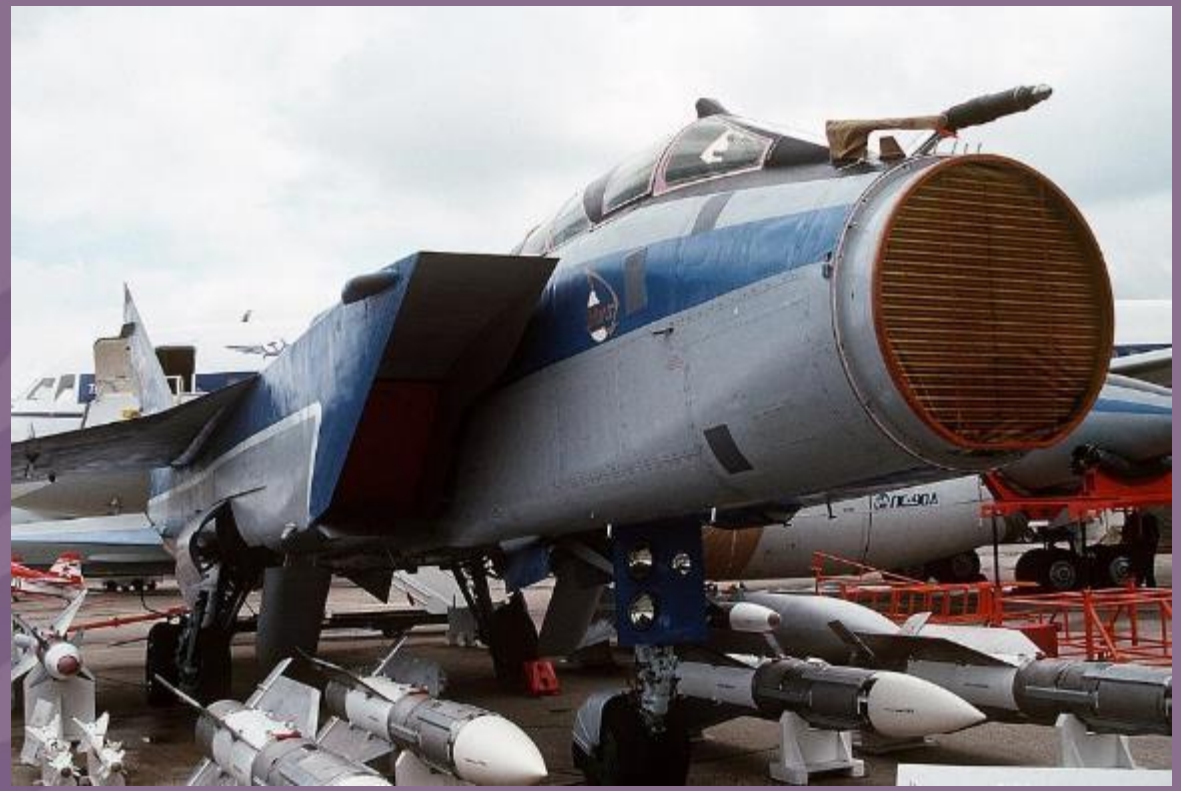


Mig-31BM – The Big Stick



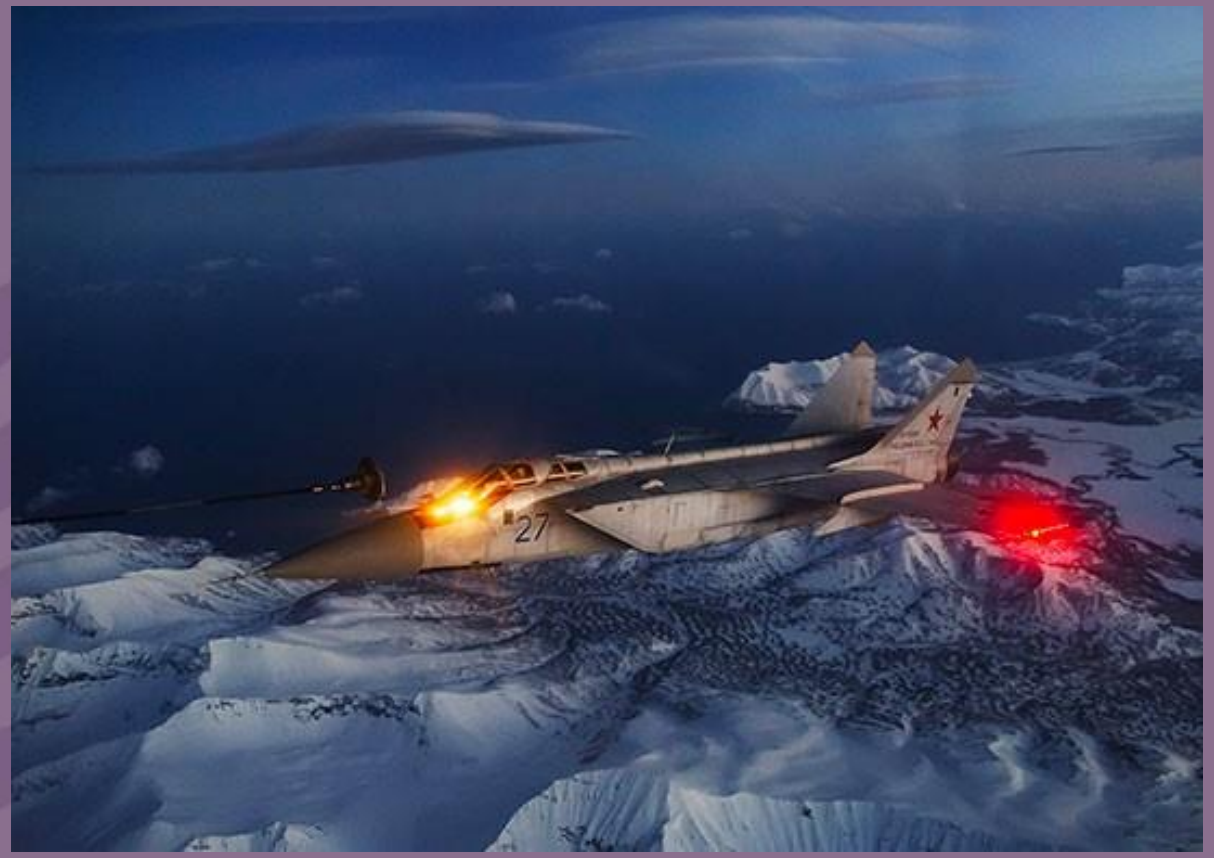
Mig-31BM – Zaslon-M/AM

- 4 times the power output of Su-35S Irbis-E
- Maximum range against large targets approx. 250nm. (R-37M theoretical range 220nm)
- Around 1.5 times as effective as Irbis-E against defensive EW (jamming) using brute force ‘burn through’ approach. Effective within approx. 50nm
- Passive Electronically Scanned Array optimised for look-down, shoot down performance against low-RCS cruise missiles at v. low altitudes
- No reliable LPI scanning mode



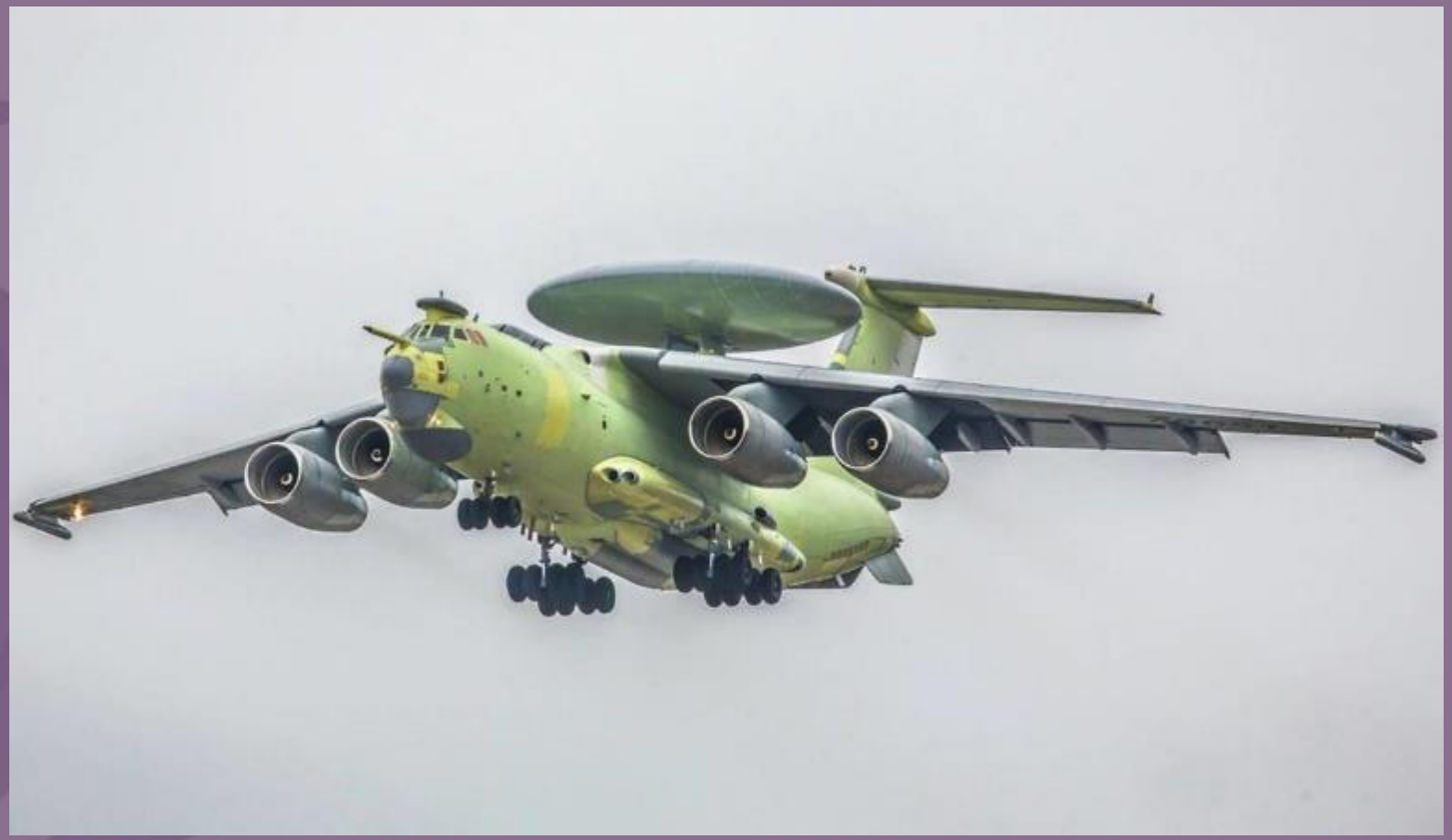
Mig-31BM/BSM – Airspace Quarterbacks

- Both BM and BSM modernisation programmes included improved data management systems, datalinks and equipment to allow an armed ABM&S role
- Designed to operate in flights of four aircraft significantly behind the main zone of contact. Exploiting Russia's geography. AAR Capable
- Extremely high powered PESA arrays with massive 1.4m aperture, extreme high-altitude performance and ability to cross-reference within a flight for multi-static exploitation.
- No reliable LPI scanning mode



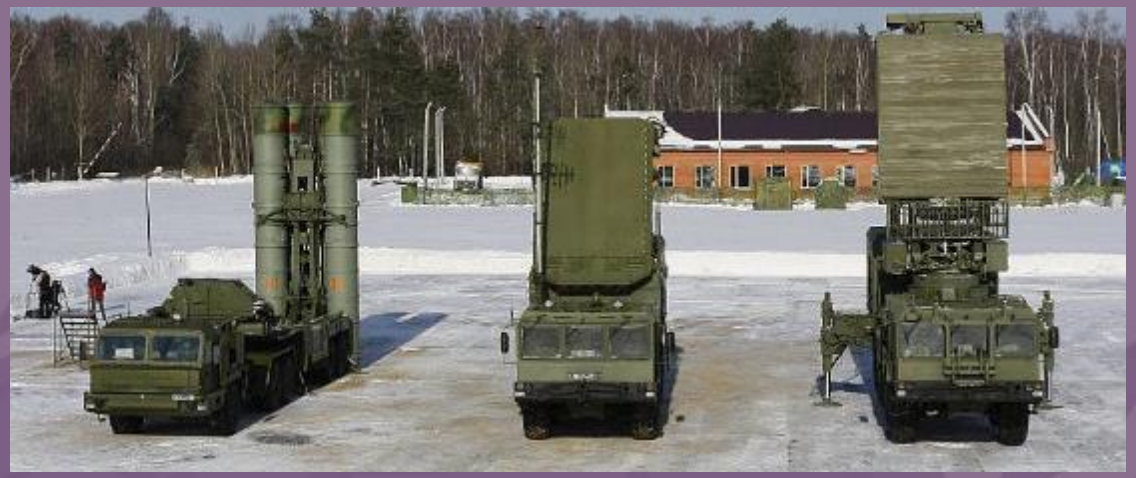
A-100 ‘Premier’

- Intended to replace A-50M and A-50U from 2020 onwards
- Key part of VKS situational awareness modernisation plan
- 1st test flight in Nov 2017
- Hybrid mechanically rotated AESA array
- Greatly expanded datalink and relay options
- Possible secondary active electronic warfare role



The Land Picture: Modularity in Action

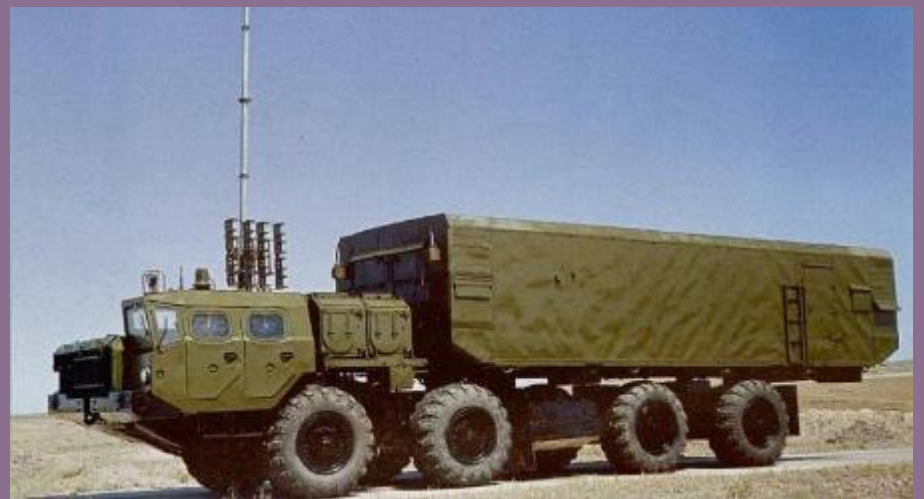
TEL 92N6A 96L6E



1L119 Nebo-M meter-band VHF ‘3D’ AESA

59N6 Protivnik GE decimetre band

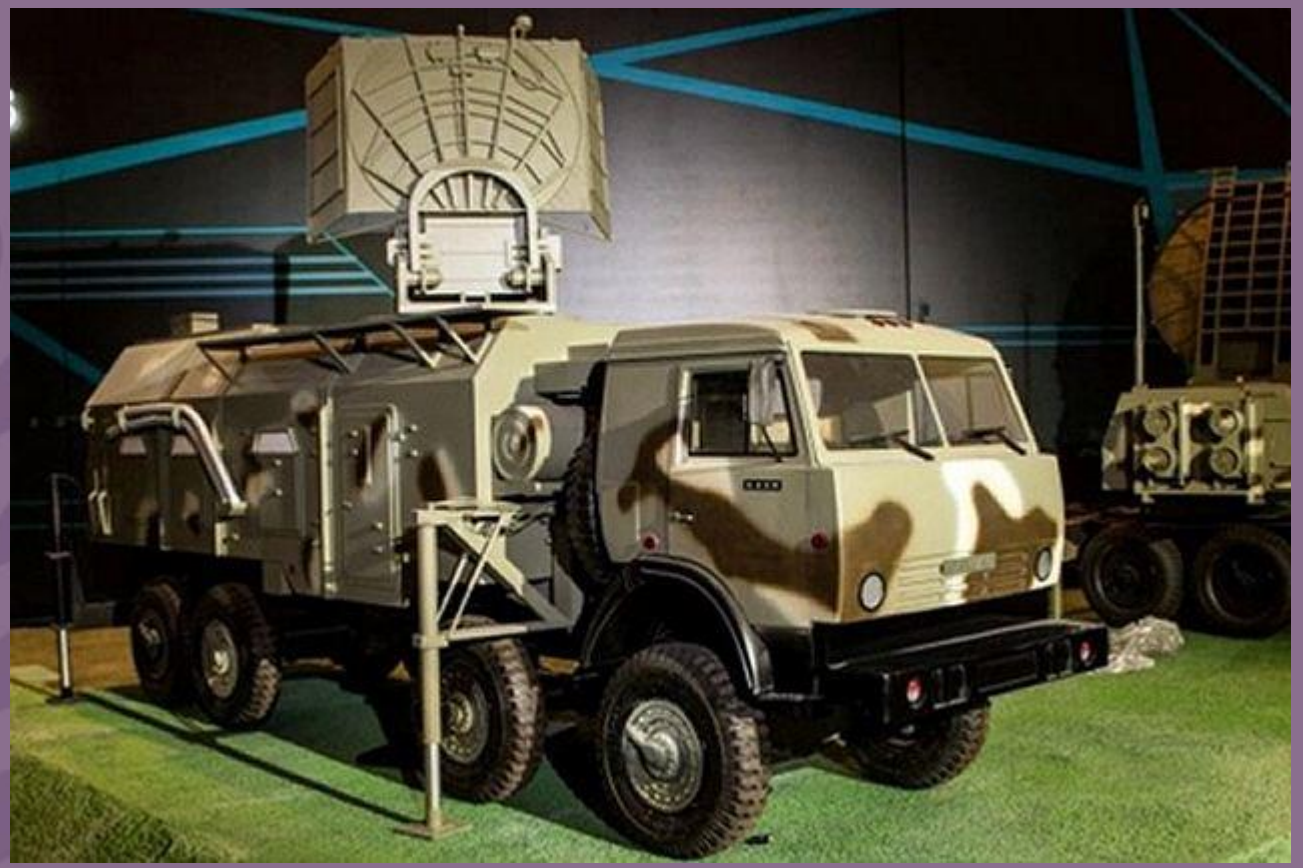
54K6E-2 Command Post



Exotic Multi-Static Arrays

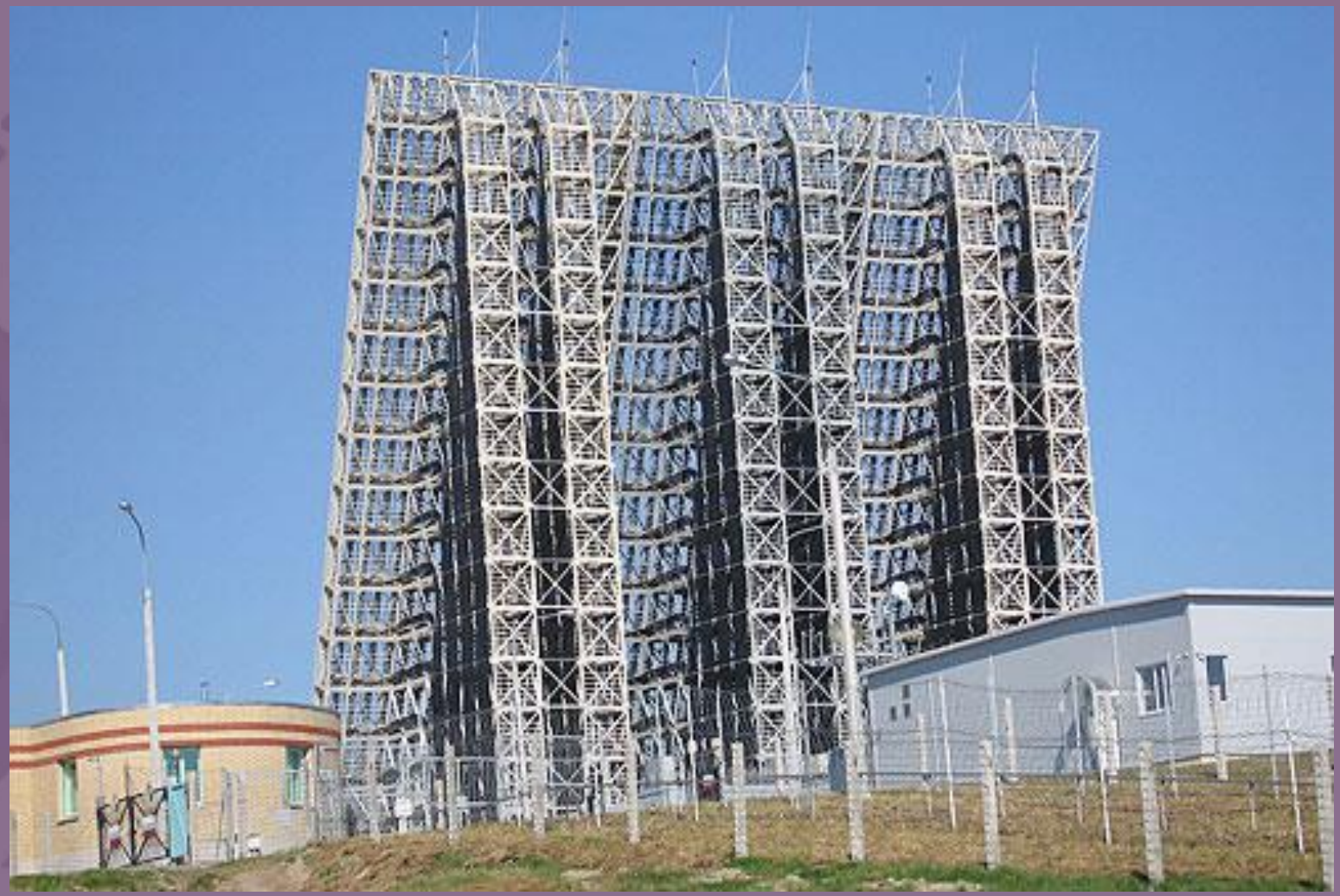
- Focus on exploiting Russian geography for multi-static radar techniques
- Passive ‘radars’ like the Moskva-1
- Attempting to overcome the limited resolution of metre/decimetre systems
- Countering stealth
- Required micro-electronics, network infrastructure for critical timing-based calculations.
- Kill chain still problematic. Missile seeker heads etc.

1L267 Moskva-1



Voronezh radar

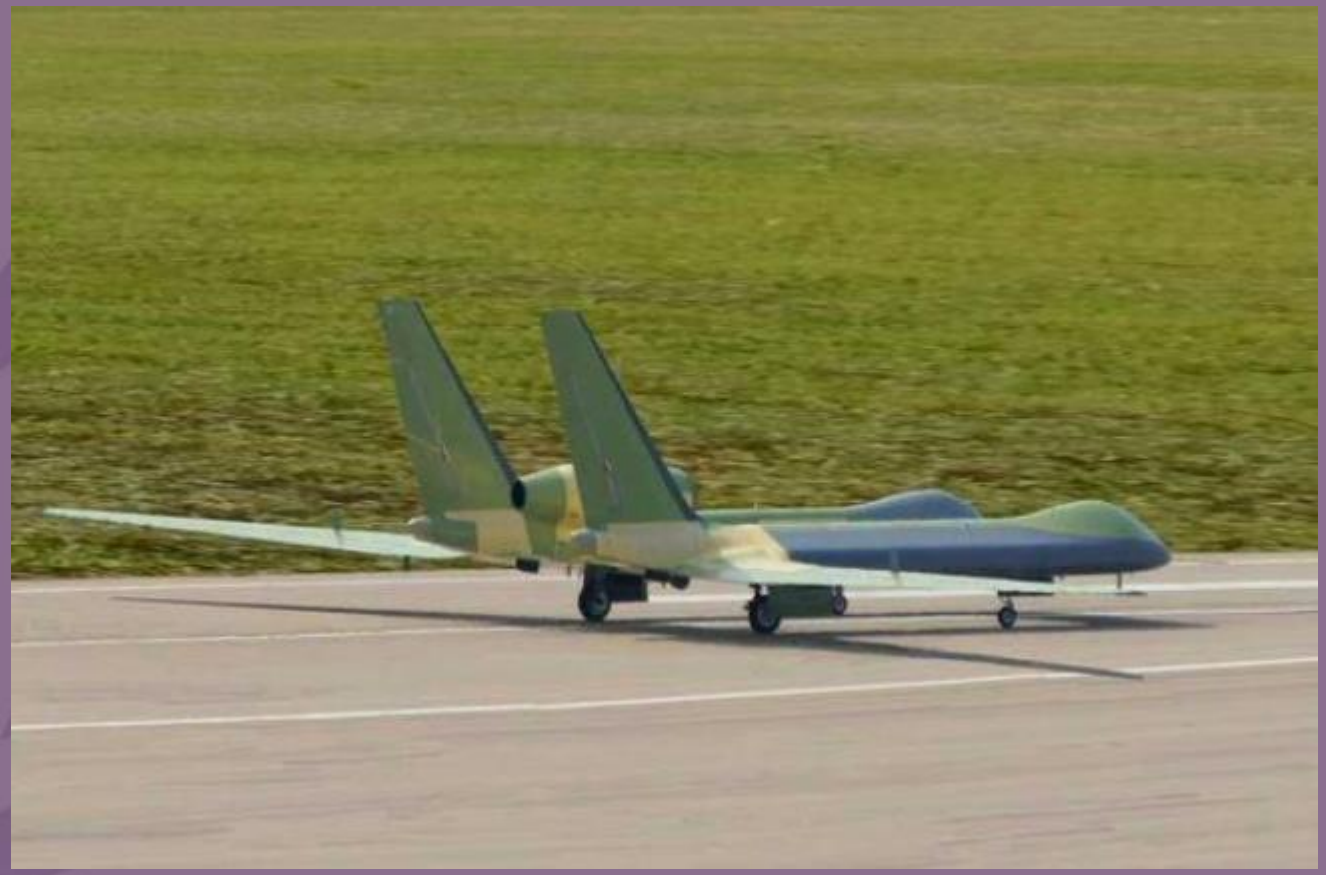
- Voronezh-M (77Ya6-M) - meter band (VHF)
- Voronezh-DM (77Ya6-DM) - decimeter band (UHF).
- Voronezh-VP (77Ya6-VP) - meter band (VHF). The only one built has 6 segments instead of the 3 of the Voronezh-M.
- System has a range of up to 10,000 km and is capable of simultaneously tracking 500 objects. Its horizon range is 6000 km. BMD focussed.
- Warning of package launch and assembly.



China Exploring All This and More

- Aerial multi-static arrays.
- Quantum Radar.
- Still no common air picture.
- Still no joint engagement zone capability

‘Divine Eagle’



So… Is Stealth Still Worth it?

Yes. It is likely to be theatre entry standard for ‘Wave One’ in all future high-intensity conflicts.

But lethality and kinematics matter more than they did.

Your kill chain must be more secure so that the enemy can only ‘die better informed’