The Collapse of American Air Power: The Failed Fighter Recapitalisation Plan

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The Shifting Global Strategic Balance

- The global proliferation of advanced fighter aircraft, guided missiles, and supporting capabilities such as AWACS and counter-stealth sensors has largely eroded the strategic advantages provided by US air power since the end of the Cold War.
- The US strategy for recapitalising its fighter fleet is based on many assumptions about the current and future capabilities of potential adversary nations which are no longer true.
- If the US does not fundamentally revise its fighter recapitalisation strategy to account for the growing sophistication of adversary systems, it will lose the capability to achieve air superiority.

The End of the Cold War

- When the Soviet Union collapsed, the US held a significant technological advantage over most Soviet systems and those exported to clients.
- The US had superior Intelligence Surveillance Reconnaissance (ISR) capabilities in the E-3 AWACS and RC-135V/W Rivet Joint, a large fleet of “teen series” fighters with modern digital avionics, the then new AIM-120 AMRAAM missile, and the superior YF-22A Raptor was in Dem/Val and intended to be procured by the hundred.
- The Russians had an advantage only in agile close combat AA-11 Archer missiles, and superior close combat agility in the then immature Su-27S Flanker fighter.

Technology Proliferation

- Over the last two decades Russian industry, and more recently Chinese industry, have absorbed or emulated most of the new technologies the US has employed to build fighters, weapons and supporting ISR systems.
- The latest Russian and Chinese fighters and Air to Air Missiles now match or outperform current build US products like the F-15, F-16, F/A-18, AIM-120 AMRAAM and AIM-9X Sidewinder.
- These products are proliferating globally.
- AWACS and other ISR systems have proliferated globally.
- *Russian industry has a well defined technological strategy for the defeat of US air power.*

The Changing Character of Air Combat

- At the end of the Cold War the US had a major *asymmetric* advantage in fighting for air superiority.
- The US had superiority in ISR systems, superiority in numbers of modern high performance fighters, and superiority in radar, missile and electronic warfare capabilities.
- Proliferation of modern systems now presents a future which will be *symmetric* – opponents will have most if not all of the technologies the US has available for air combat operations.
- *The US has lost its asymmetric advantage and will have only an incremental advantage in some technologies and aircraft types.*

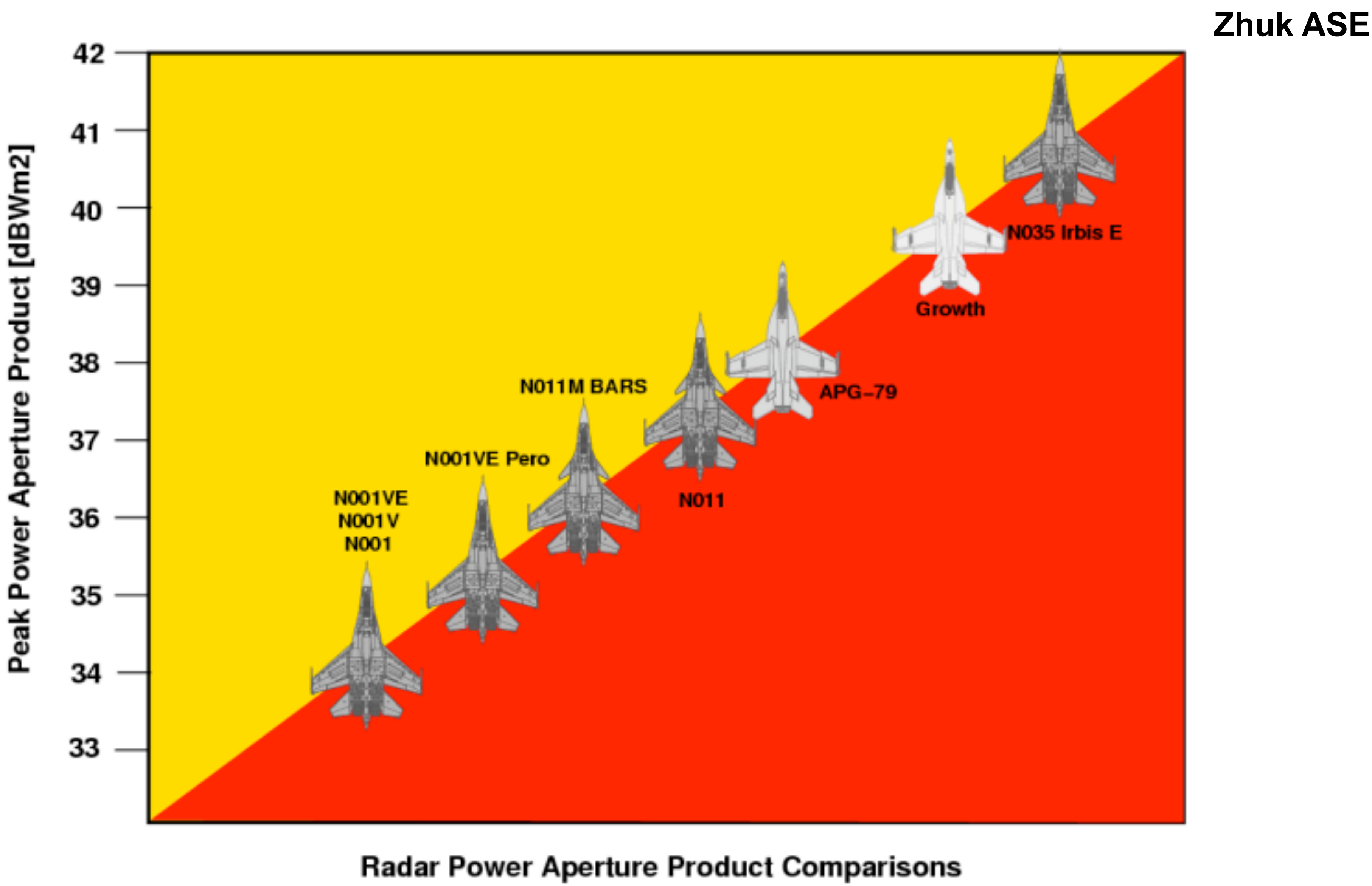
America's Eroding Technological Advantage

Phazotron Zhuk AE AESA Radar

Basic Technology – AESA/ESA Radar

- First Russian Zhuk-AE AESA was displayed two years ago; emulation of US radar module packaging technology will permit competitive Russian AESAs in much less than a decade.
- Russia will soon export the 20 kiloWatt rated Irbis E hybrid ESA which outperforms all but the US F-22 /APG-77(V)2 and planned F-15C/APG-63(V)3.
- All new Russian fighter radars use the same COTS digital processing technology as US radars.
- Current US AESAs only have better frequency agility over Russian hybrid ESAs.
- *The US technological advantage is now incremental and will erode over the next 5 years, as Russian industry closes the gap in module packaging.*

How do Russian Radars Compare?



Basic Technology – Radar Warning Equipment

- Globalised market for Gallium Arsenide commercial microwave chips and COTS computers has enabled advances in Russian radar warning and homing equipment.
- Technology for passive geolocation of radar emitters is now available to Russian fighter and ground based equipment manufacturers.
- Russian air combat doctrine now emphasises use of passive geolocation to target missiles in air combat engagements.
- *Globalised market for high performance commercial microwave components has destroyed the asymmetric technological advantage held by US in this area.*

Basic Technology – Radar Jamming Eqpt

- State of the art radar jammers are based on DRFM (Digital Radio Frequency Memory).
- Russian industry now exporting DRFM modules and jamming equipment based on DRFM modules.
- The US advantage is now only incremental, in DRFM accuracy, packaging and performance.
- Latest US AESA radars intended to provide jamming capability in S-/X-bands to supplement other electronic countermeasures.
- Russian hybrid ESA and AESA radars will replicate this capability over the next half decade.
- *Over the next decade Russian industry will close the remaining gap in these technologies.*

Basic Technology – InfraRed Sensors

- Russian industry now developing InfraRed (IR) QWIP (Quantum Well Imaging Photodetectors) using EU COTS processes.
- QWIP imaging chips central to next generation US FLIR, IRST, MAWS and IR missile guidance.
- Russia has licensed the French Thales Damocles optical targeting pod for manufacture, it is equivalent to the US AAQ-14 LANTIRN pod.
- The US advantage in infrared sensors is now largely incremental.
- EU exports have allowed Russian industry to reduce US lead to ~5 years in infrared systems.
- *Russian investment focus on air combat sensors vs US focus on targeting bombs against insurgents.*

Basic Technology – Fighter Engine Hot End

- US F119 engine for F-22 a major advance during 1990s, with "supercooled" turbine stage permitting supersonic cruise.
- Russian AL-41F engine for MFI demonstrator duplicated F119 capabilities a decade ago.
- AL-41F technology migrated into AL-31F-117S engine for Su-35-1/Su-35BM Flanker to provide supersonic cruise capability.
- New PAK-FA fighter to use a new engine, PAK-FA demonstrators to use AL-31F-117S.
- Durability of latest Russian engines increasingly competitive against US engines.
- *US advantage is now only incremental.*

Basic Technology – Fighter Engine Systems

- Modern US engines use Full Authority Digital Engine Control (FADEC) systems.
- FADECs now available for a range of Russian fighter engines including the AL-31F-117S.
- Only US F-22 F119-PW-100 engine uses 2D Thrust Vector Control (TVC) to improve agility and supersonic cruise performance.
- Russian 2D and 3D TVC nozzles now available for a range of fighter engines.
- Russian TVC nozzles integrated with digital flight controls – similar to F-22 technology.
- *Russia has clear advantage in TVC technology with no US plans to close this gap.*

Basic Technology – Fighter Systems

- Russian fighters are now built with numerous systems previously unique to US fighters:

1. quadruplex Digital Flight Control Systems (DFCS).
2. APUs (Auxiliary Power Unit) and OBOGS (OnBoard Oxygen Generating System) for forward deployed operations.
3. Large area AMLCD "glass cockpit" displays,and high performance COTS computer systems.
4. Integrated inertial/satellite navigation equipment.
5. Intraflight datalink and Link-16 class network terminals for situational awareness and data sharing.
6. Missile Approach Warning Systems.

Russian Su-35-1 Glass Cockpit – 2008
Large LCDs modelled on F-35 layout

Basic Technology – Active Radar Missiles

- Russian R-77 RVV-AE "AMRAAM-ski" (AA-12 Adder) similar in performance and guidance technology to US AIM-120 AMRAAM.
- Chinese PL-12 "Sino-AMRAAM" outranges most AMRAAM variants, and uses R-77 technology.
- Russian industry manufacturing derivative active radar seekers for other missiles, including R-27 (AA-10 Alamo).
- Latest Russian seekers based on digital COTS processing technology, including US designed Texas Instruments TMS320 chips.
- *US retains only an incremental advantage in seeker technology, no significant advantage in airframe and propulsion technology.*

Basic Technology – InfraRed Missiles

- The Soviet R-73 (AA-11 Archer) revolutionised close combat in 1990, introducing an agile seeker and TVC controls for agility.
- US AIM-9X emulates the AA-11 design.
- Russia developed the digital R-74, based on the AA-11 Archer airframe.
- China is developing a new agile close combat missile, using TVC technology.
- The AA-11 agile seeker is planned for advanced variants of the AA-10 and AA-12 missiles to defeat US RF countermeasures.
- *Russian QWIP imaging missile seekers will nullify current US advantage in IR imaging missile seekers over the next half decade.*

Basic Technology – Anti-Radiation Missiles

- The R-27P and R-27EP are X-band anti-radiation variants of the AA-10 Alamo, intended to home on the radar emissions of US fighters.
- There is no US or EU equivalent design.
- The AA-10 anti-radiation seeker is to be retrofitted to the AA-12 AMRAAM-ski to provide Russian built fighters with a mix of three different seeker types, intended to defeat US RF countermeasures.
- The Kh-31P anti-radiation missile is equivalent to the US AGM-88 HARM and can be carried by most current build Russian fighters.
- The US AGM-88E AARGM has a better seeker compared to the Kh-31P, *but there is no production US air-air anti-radiation weapon.*

Basic Technology - Very Long Range Missiles

- Contemporary Russian and Chinese air combat doctrine specifies denial or destruction of opposing ISR systems like the E-3 AWACS.
- Specialised very long range air to air missiles have been developed for this purpose.
- Vympel R-37 (AA-X-13 Arrow) – range 160 NMI.
- Novator R-172/KS-172 – range 160 to 210 NMI.
- These missiles are equipped with large active radar seekers and are autonomous once launched.
- *The US E-3 AWACS, E-2 Hawkeye, E-8 JSTARS and RC-135V/W Rivet Joint, KC-135R aerial refuelling tankers used as network relays, and Navy EA-6B /EA-18G support jammers are all susceptible.*
- *There is no equivalent US capability planned.*

Russian Beyond Visual Range Missiles

Seeker Technology:

A. Monopulse Active Radar

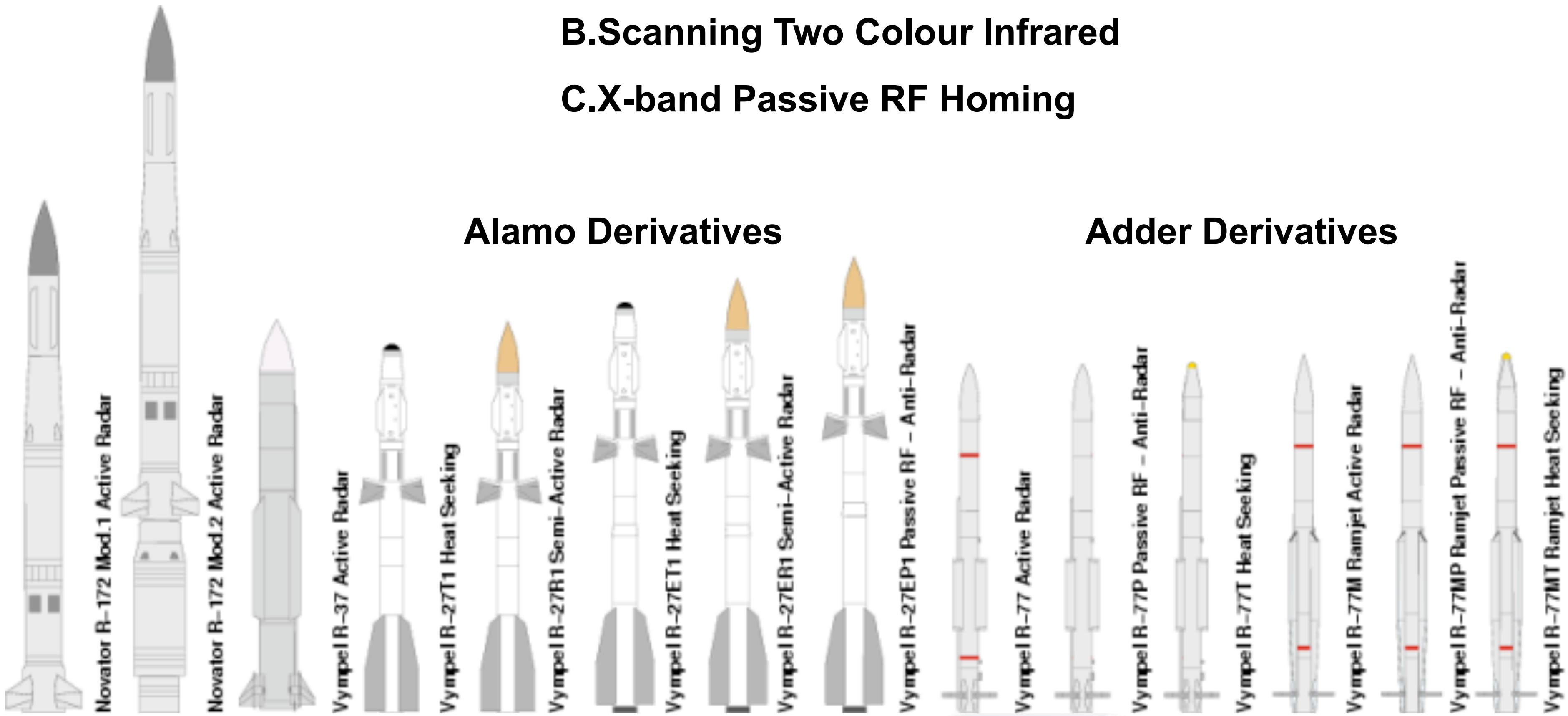
B. Scanning Two Colour Infrared

C. X-band Passive RF Homing

Counter-ISR

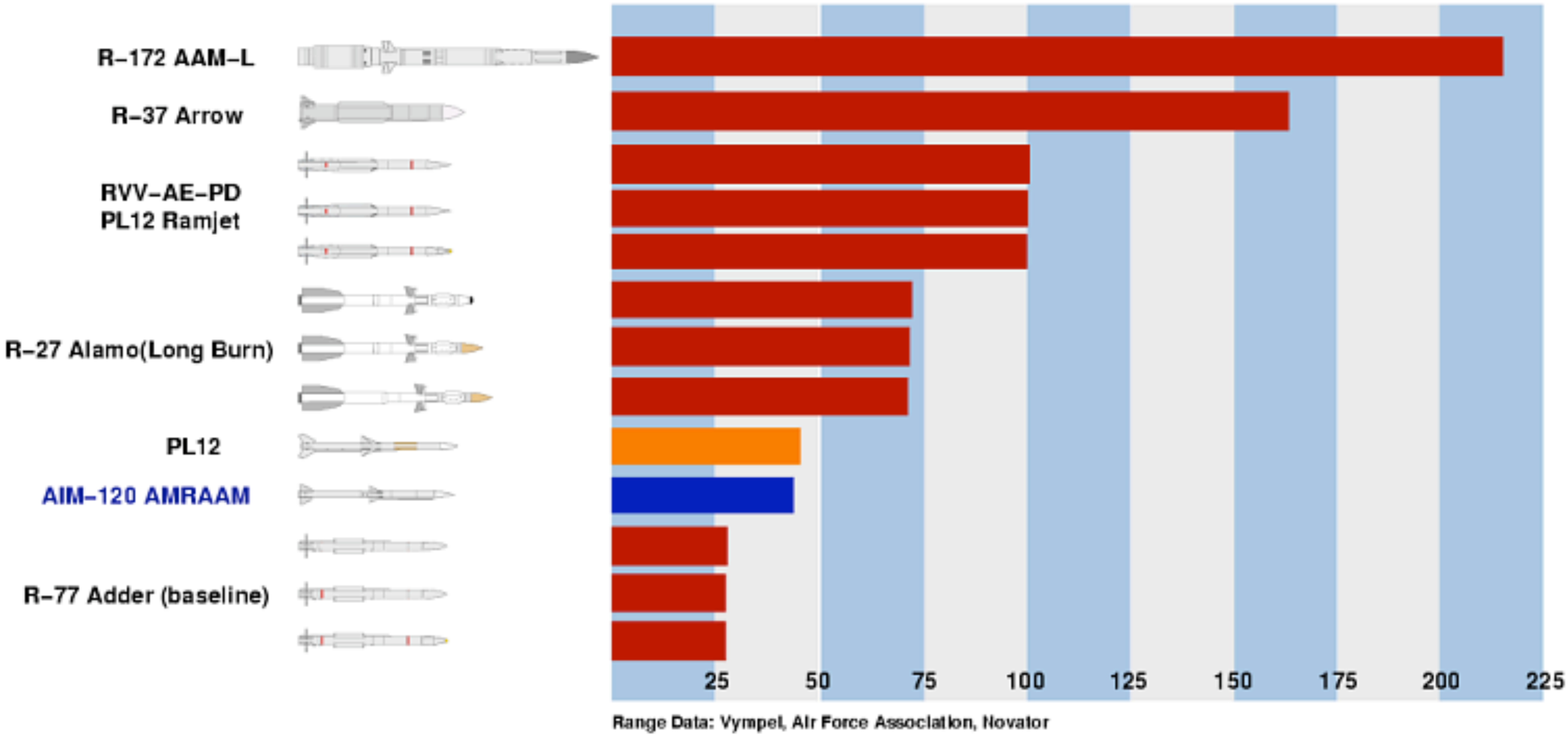
Alamo Derivatives

Adder Derivatives



Ramjet Engine

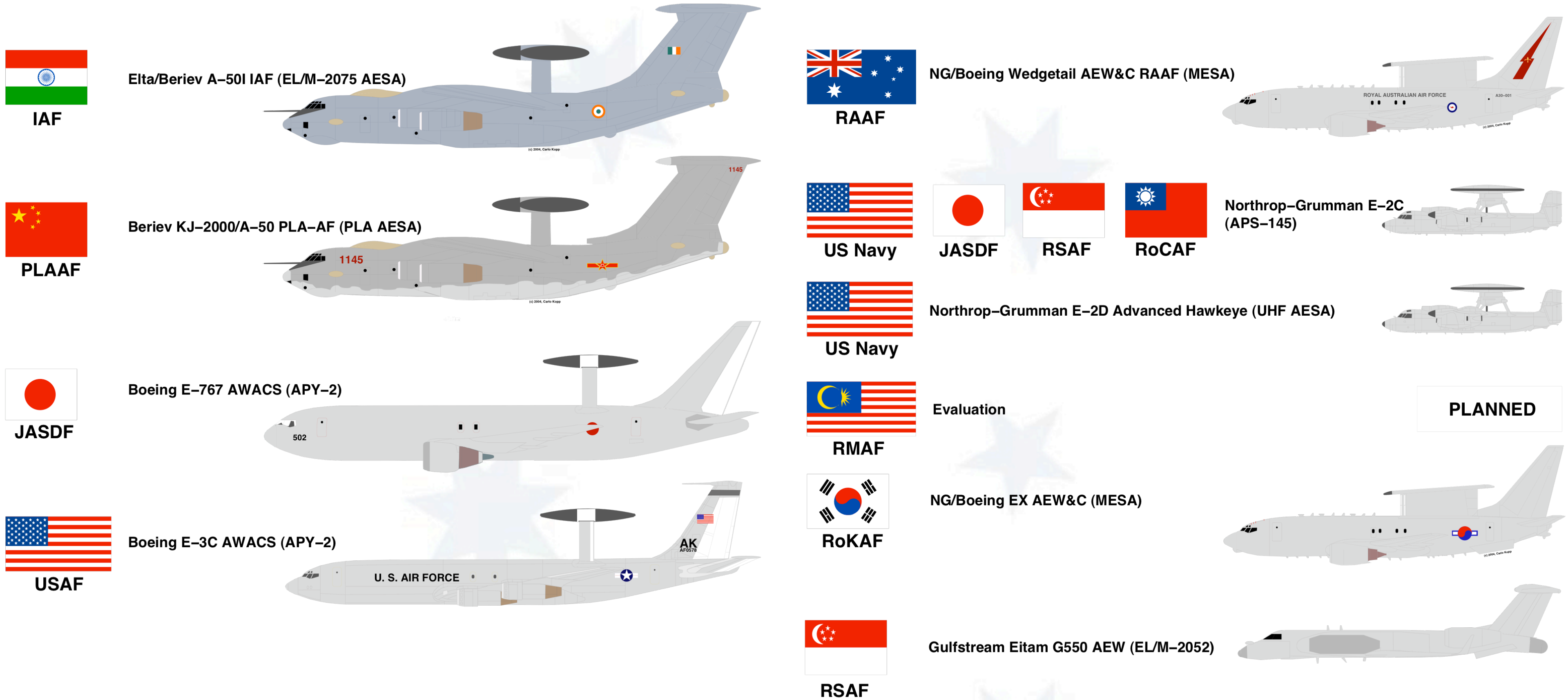
How do Russian BVR AAMs Compare?



- R-27 Alamo, R-77 Adder and RVV-AE-PD – active radar, anti -radiation and heatseeking guidance equipped variants.
- PL12 Ramjet reported development of baseline Chinese PL-12 AMRAAM analogue.

Basic Technology – AWACS / AEW&C

- AWACS and AEW&C systems have proliferated widely since 1991.
- Current systems have solid state AESA radars two generations beyond the E-3 AWACS and one generation beyond the E-8 JSTARS.
- Israeli Elta A-50I AESA AWACS exported to India and Singapore.
- Swedish Erieye AESA AEW&C exported widely, including Pakistan.
- China developing KJ-2000 AESA AWACS, plus an AESA AEW&C system based on the Erieye design.
- *US E-10 MC2A AWACS replacement cancelled, and JSTARS MP-RTIP AESA upgrade delayed and now uncertain. There is no plan for AWACS replacement.*


IAF
Elta/Beriev A–50I IAF (EL/M–2075 AESA)
PLAAF
Beriev KJ–2000/A–50 PLA–AF (PLA AESA)
1145
JASDF
Boeing E–767 AWACS (APY–2)
502
USAF
Boeing E–3C AWACS (APY–2)
U. S. AIR FORCE
AK
RAAF
NG/Boeing Wedgetail AEW&C RAAF (MESA)
US Navy
JASDF
RSAF
RoCAF
Northrop–Grumman E–2C (APS–145)
US Navy
Northrop–Grumman E–2D Advanced Hawkeye (UHF AESA)
RMAF
Evaluation
PLANNED
RoKAF
NG/Boeing EX AEW&C (MESA)
RSAF
Gulfstream Eitam G550 AEW (EL/M–2052)

Basic Technology – Aerial Refuelling

- Aerial refuelling capability has been a major asymmetric advantage held by the US since the late 1950s procurement of the KC-135 fleet.
- Tanker capabilities are now proliferating in Asia.
- Russian Il-78M Midas procured by China.
- Russian Il-78M Midas equipped with Israeli refuelling equipment procured by India.
- Chinese has converted numerous H-6 Badger bombers into tactical tankers, using UK hardware licensed during the 1980s.
- Russian buddy refuelling pod systems available now for most production Flanker variants.
- *US KC-X tanker recapitalisation delayed twice.*

Basic Technology – Guided Bombs

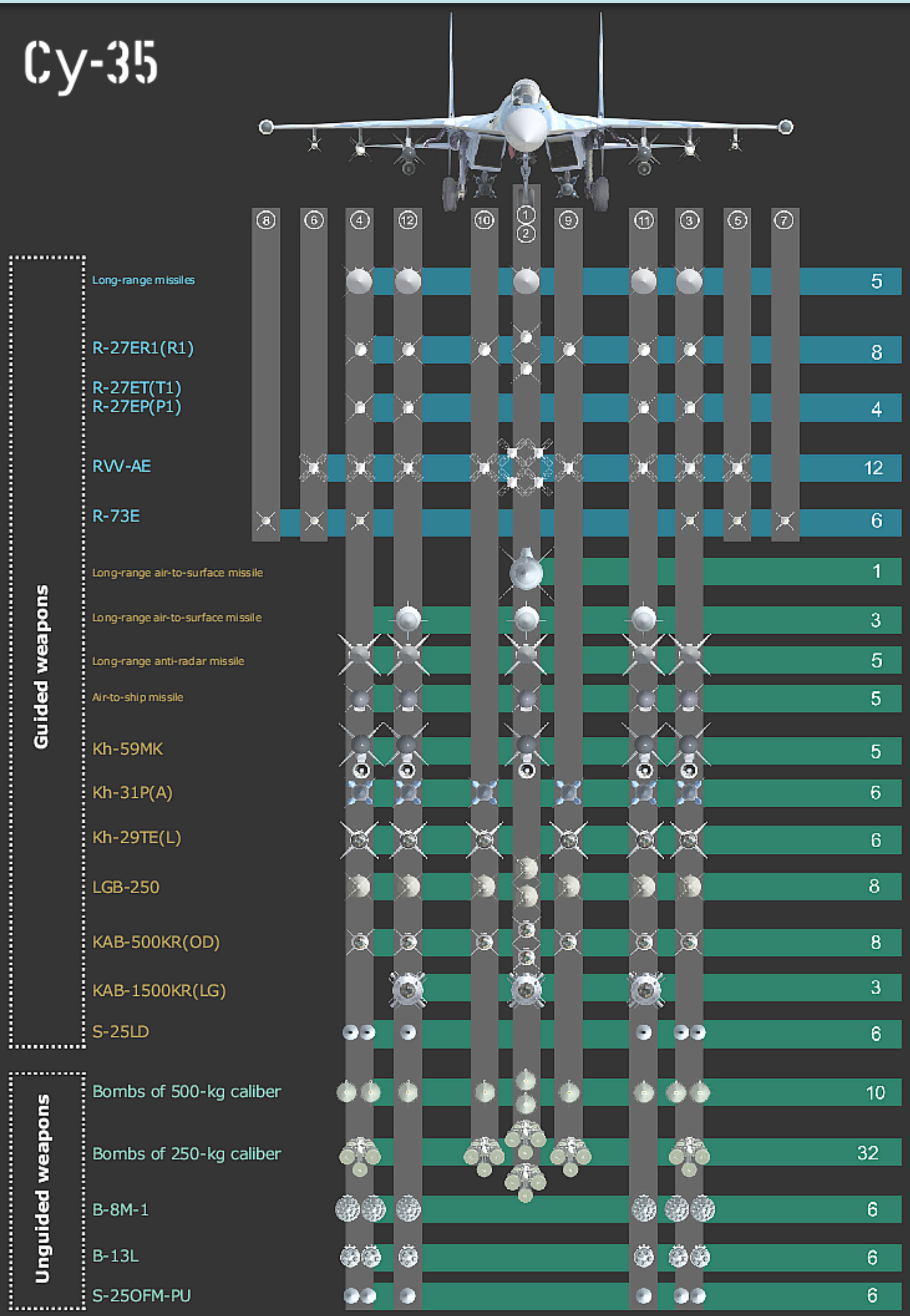
- Russia and China are exporting a range of smart bombs which are equivalent to US designs, and some which have no US equivalents.
- Russian KAB-500/1500 bombs supplied with satellite, laser, imaging infrared or TV image correlator guidance, with and without datalinks.
- Blast/fragmentation, bunker busting, fuel air and thermobaric warheads are available for all KAB-500 and -1500 subtypes.
- China is marketing a range of laser and satellite guided bombs, including a glidebomb design similar to the US-Australian JDAM-ER weapon.
- *The only US advantage is in more mature seeker technology and anti-jam GPS antennas.*

Basic Technology – Cruise Missiles

- Russia, China and India all manufacture and export various cruise missile designs.
- 3M14AE Sizzler – similar to Tomahawk MRASM, air launched.
- 3M54AE Sizzler – supersonic air launched, anti -ship with growth vs bunkers.
- Kh-41 Sunburn - supersonic air launched, anti -ship cruise missile.
- Kh-61 Stallion / Brahmos - supersonic air launched, anti-ship / land attack cruise missile.
- China manufacturing YJ-62 and DH-10 cruise missiles modelled on US Tomahawk TLAM.
- Russia and China have TERCOM, DSMAC and satellite / inertial guidance capabilities.

EXTERNAL STORES LOADOUT

Russian Su-35-1
Weapons Capabilities
2008 Brochure



Basic Technology – Stealth

- *Stealth is the only basic technology in which the US still retains a decisive lead in basic technology.*
- US has not made major investments to advance.
- Radar absorbent coatings and materials are used extensively on the new Su-35-1/Su-35BM Flanker and claimed to provide a 15 dB reduction in nose -on upper band radar signature.
- The new PAK-FA fighter now in development is claimed to employ proper stealth airframe shaping and is intended to have competitive stealth performance.
- *Russia likely to emulate US shaping techniques.*
- *Both Russian and Chinese industry aim to match US stealth technology over the coming decade.*

Basic Technology – Counter-Stealth

- Russia and China continue to develop and deploy a range of counter-stealth technologies.
- Digital VHF-band / "metric" and L-band / "decimetric' radars will defeat typical stealth shaping techniques in US fighters and UAVs.
- Digital processing upgrades to legacy VHF band radars: Spoon Rest, Tall King, Tall Rack.
- New VHF radars: Vostok E, YJ-27, Rezonans NE.
- New AESA radars: NNIIRT Nebo SVU, Nebo M RLM-M/D, VNIIRT Gamma DE series.
- All recent Russian radar designs VHF or L-band.
- Networking of radars and passive RF sensors.
- Passive RF TDOA/interferometer sensors: Orion /Vega, Kolchuga, Avtobaza, YLC-20 series.

Modern Counter-VLO Radar Examples

- 2 Metre Band VHF Operation
- Digital MTI Processing
- Automatic Frequency Agility
- STAP Clutter Processing
- Modern COTS Digital Processing
- Solid State COTS RF Amplifiers
- Networked with SAM Batteries
- High Mobility "Shoot and Scoot"
- All Terrain Vehicle Chassis

NNIIRT Nebo M VHF AESA 3D Search Radar

NNIIRT Nebo SVU VHF AESA 3D Search Radar

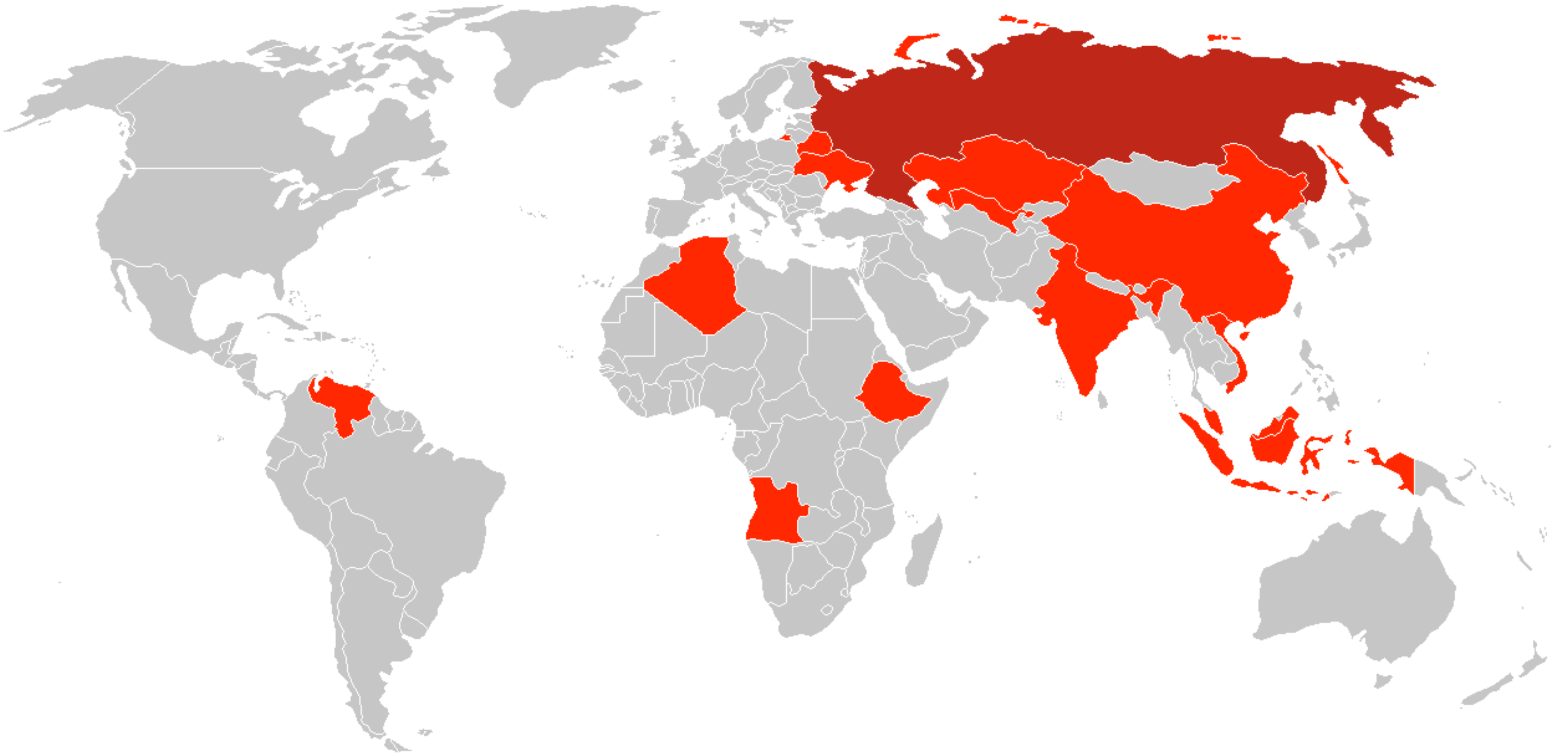
KBR Vostok E VHF Solid State 2D Search Radar

The Global Fighter Technology Proliferation Problem

Russian / Chinese Fighter Evolution

- 1990: Su-27S Flanker eq. F-15A/C / F-14A
- 1990: MiG-29SM Fulcrum eq. F-16A/C
- 1992: Su-27M/Su-35 eq F-15C
- 1994: Su-30MKK eq. baseline F-15E
- 1997: Su-30MK2 eq. baseline F-15E
- 2002: Su-30MKI eq. F-15E + APG-63(V)2 ESA
- 2005: J-10 Sinocanard eq F-16C
- 2007: Su-30MKM eq. F-15E + APG-63(V)2 ESA
- 2007: J-11B SinoFlanker eq. F-15C
- 2007: MiG-35 eq. F-16C Block 60
- 2008: Su-35-1/Su-35BM eq. F-15SE plus supersonic cruise capability.
- 2009: T-50 PAK-FA intended to match F-22A

Flanker Proliferation



- Su-35-1 currently of offer to China, Brazil, Venezuela and several other nations.
- Yet to be proven claims that Su-30MKM has been offered to Iran.

Flanker Proliferation

- China remains largest client to date, with ~550 Flanker variants in service or on order.
- China may continue to manufacture reverse engineered J-11B, eq. to Russian Su-27SM.
- Baseline Su-27SK exported to China, Vietnam, Indonesia, Ukraine, Belarus, Angola, Eritrea, Ethiopia, Kazakhstan. Russia operates ~400.
- Su-30MKK/MK2 exported to China, Vietnam, Indonesia, Algeria.
- Su-30MK variant ordered by Venezuela.
- Su-30MKI exported to India.
- Su-30MKM exported to Malaysia.
- Su-33 CV shipboard fighter ordered by China.

Diverse Flanker Variants Exported

- Flankers exported globally are typically "customised" with specific avionics and weapons.
- Indian Su-30MKI includes French avionics and Israeli electronic warfare systems.
- Su-30MKK/MK2 supplied to China includes unique radar and weapons configurations.
- Chinese redesigned J-11B includes unique planar array radar, systems, glass cockpit, MAWS and Chinese PL-12 Sino-AMRAAM missiles.
- The large number of different avionics systems, especially radar, presents genuine difficulty in designing electronic countermeasures to defeat the Flanker.
- Midlife upgrades further complicate this problem.

Proliferation Considerations

- Flanker remains most widely proliferated modern fighter aircraft, after the smaller US F-16.
- J-10 Sinocanard and J-11B SinoFlanker intended for export.
- Fulcrum was widely exported and remains in use.
- Stealthy PAK-FA also intended for export, with India likely to be first client.
- Export contracts often include support personnel from former Warpac nations, and in some instances, also combat pilots.
- *US forces could therefore encounter very modern fighters, with modern avionics and weapons mixes, flown and maintained by experienced and competent personnel, in any theatre of operations.*

Russian Technological Strategy and Air Combat Doctrine

Technological Strategy - Central to Planning

- Since the 1990s, Russian industry has developed a coherent and well thought out technological strategy for winning air wars.
- Operational analysis and modelling have been used extensively for strategy development.
- China has emulated Russian technological strategy.
- Conversely, the US has abandoned any pretense of having a technological strategy for the planning of its fighter fleet and force structure.
- US success in the Cold War resulted from good technological strategy applied to planning with both diligence and discipline.
- *US planning is now wholly by short term political, bureaucratic and commercial imperatives.*

Russian Technological Strategy

- Five "key imperatives" in the design of new Russian weapon systems:

1. Defeat opposing ISR systems from the outset of a conflict to gain "information superiority".
2. Dominate Beyond Visual Range (BVR) combat by exploiting superior speed, radar and missile range and diversity, and by exploiting networking and information superiority.
3. Dominate BVR combat by exploiting superior combat persistence and larger missile payloads.
4. Dominate close combat by exploiting superior agility and close combat missile technology.
5. Defeat opposing missile shots by exploiting advanced countermeasures and high agility.

Application of the Five "Key Imperatives"

- The performance, weapons mixes and payload, sensor fits and countermeasures fits of recent Russian fighter designs show a disciplined application of the five imperatives.
- For comparison, an Su-35-1 has a standard payload of up to 14 missiles, vs a US F-15 armed with 8 missiles, or an F-35 planned to carry 2-4.
- Information superiority achieved by very long range Counter-ISR missiles to negate US advantage in AWACS, JSTARS, Rivet Joint, UAVs, and by Counter-Stealth sensor technologies.
- Intra-flight and wide area networking datalinks.
- High power aperture fighter radars and IR sensors.
- Supporting counter-stealth sensors to be used.

America's Failed Fighter Recapitalisation Plan

Evolution of US Recapitalisation Strategy

- 1991 Dev/Val, selection of YF-22 as ATF solution to replace 600+ F-15A-E variants.
- 1995-2002 Joint Strike Fighter defined as multiservice “low component” in “high-low” mix with F-22A.
- 2002 LM X-35 selected as JSF solution.
- “Rumsfeld Edict” caps F-22A production to ~180 aircraft.
- April 2009 “Gates Edict” reaffirms F-22A production cap and accelerates F-35 production.

A. Key technology decisions made over a decade ago.
B. Build numbers chosen politically, not by analysis.
C. Absence of overarching US technological strategy.

Failed Assumptions in Recapitalisation Plan

1. Future air campaigns would be dominated by strike operations against poorly defended targets.
2. Future threat fighter aircraft would be a decade or more behind the US in capabilities.
3. Future opponents would not counter US ISR dominance or deploy their own ISR systems.
4. Future opponents would not develop technologies to degrade or overcome US stealth advantage.
5. Future opponents would not use diverse sensors and weapons mixes, or modern digital COTS technology.
6. F-35 JSF would not need good stealth, speed, agility.
7. F-35 JSF would be much cheaper than the F-22A.
8. Large numbers of F-35 could be built by 2015.

Current Realities in Recapitalisation Plan

1. Future air campaigns will be dominated by contests to control air space, with modern defences.
2. Future threat fighter aircraft will match or exceed most planned US capabilities.
3. Future opponents will counter US ISR dominance and will deploy their own ISR systems.
4. Future opponents will operate technologies to degrade or overcome US stealth advantage.
5. Future opponents will use diverse sensors and weapons mixes, modern digital COTS technology.
6. F-35 intended stealth, speed, agility not sufficient.
7. F-35 JSF is not much cheaper than the F-22A.
8. Large numbers of F-35 cannot be built by 2015.

Recapitalisation Plan Problems

- Failure to correctly anticipate future threat capabilities resulted in the F-35 being wrongly defined in performance and capabilities.
- The F-35 would require large numbers of supporting F-22A to suppress air defences and protect the F-35 from advanced fighters.
- Legacy fighters and ISR platforms no longer survivable in modern threat environments.
- The F-22 and B-2 are the only US systems viable in modern threat environments.
- The F-22 will under the current recapitalisation plan comprise only ~6% of the US fighter fleet.
- *Certainty of large combat losses of US aircraft in future air campaigns under current plan.*

Other Recapitalisation Plan Problems

- Legacy fighters including F/A-18E/F/G completely unusable for many contingencies.
- Navy and Marines will have NO capability to deal with advanced fighters and SAMs – wholly reliant upon supporting Air Force F-22 force.
- Ten combat coded F-22 squadrons will be overused and service life will be burned out very early.
- Unrealistic delivery schedules for replacement fighters will result in significant “fighter gap” in maintaining operational fighter squadrons.
- Delivery of 600 new fighters by 2020 requires production rate of 60 annually from 2010 – feasible for mature F-22 but not for new designs.
- *Certainty of US fighter fleet collapse by 2020.*

Unmanned Systems Not a Viable Alternative

- UCAVs often advocated as substitutes for manned fighters despite the reality that a UCAV with identical speed, range/payload, sensors and stealth to a manned jet will cost just as much.
- Smaller UCAVs susceptible to existing Russian and Chinese counter-stealth technologies.
- Unresolved basic technology problems – *fully autonomous operation requires yet to be invented Artificial Intelligence (AI) cognitive technology.*
- Unresolved legal problems - *delegating weapons release authority to autonomous AI system.*
- *Satellite uplinks for semi-autonomous control susceptible to jamming, while US lacks satellite bandwidth in already congested radio spectrum*.

F-22 Only Viable Alternative in 2010-2020

- Only F-22 can defeat advanced Flanker variants.
- Only F-22 can defeat the new PAK-FA fighter.
- Only F-22 can survive against advanced SAMs.
- Only F-22 has performance and systems growth capacity to match evolving threat systems.
- Only F-22 mature enough for volume production in 2010 – 2020 timeframe.
- Only F-22 mature enough to provide predictable Unit Procurement Costs and delivery schedules in 2010 – 2020 timeframe.
- Only F-22 has potential to yield a viable navalised air superiority fighter design before 2020.
- F-22 termination guarantees recapitalisation plan failure after 2010 and strategic consequences.

Conclusions

- Unless the US builds and deploys many more than the currently planned 187 F-22A Raptors, it will not be able to guarantee air superiority in any contingencies where opponents deploy advanced fighters and supporting air defence systems.
- The US force structure across all four services is predicated upon achieving and maintaining air superiority, without which there is potential for heavy combat losses in US personnel and materiel.
- Unless the US intends to opt out of fighting wars with industrialised nation state opponents over the next three decades, it will have to abandon the OSD mandated force structure plan for the Air Force, and procure many more F-22A Raptors.


Advanced Russian and Chinese Weapons

Post Cold War High Technology Weapons

- Advanced Derivative Fighters – Su-35BM, MIG-35, Su-30MK, Su-27SKM
- Low Observable Fighters – PAK-FA, J-XX
- Advanced Radars – Irbis E, Zhuk AE/ASE
- Cruise missiles – supersonic and subsonic
- Smart Bombs – EO, Laser, Satnav/Inertial
- Electronic Warfare – DRFM Jammers
- High Mobility Surface to Air Missiles
- Advanced Counter-VLO VHF Radars – Nebo SVU, JY-27, Vostok E

PAK-FA – F-22 Class Agility + Stealth

Sukhoi Su-35BM/Su-35-1 Flanker E+

Intended IOC 2011

Sukhoi Su-35BM/Su-35-1 Flanker E+

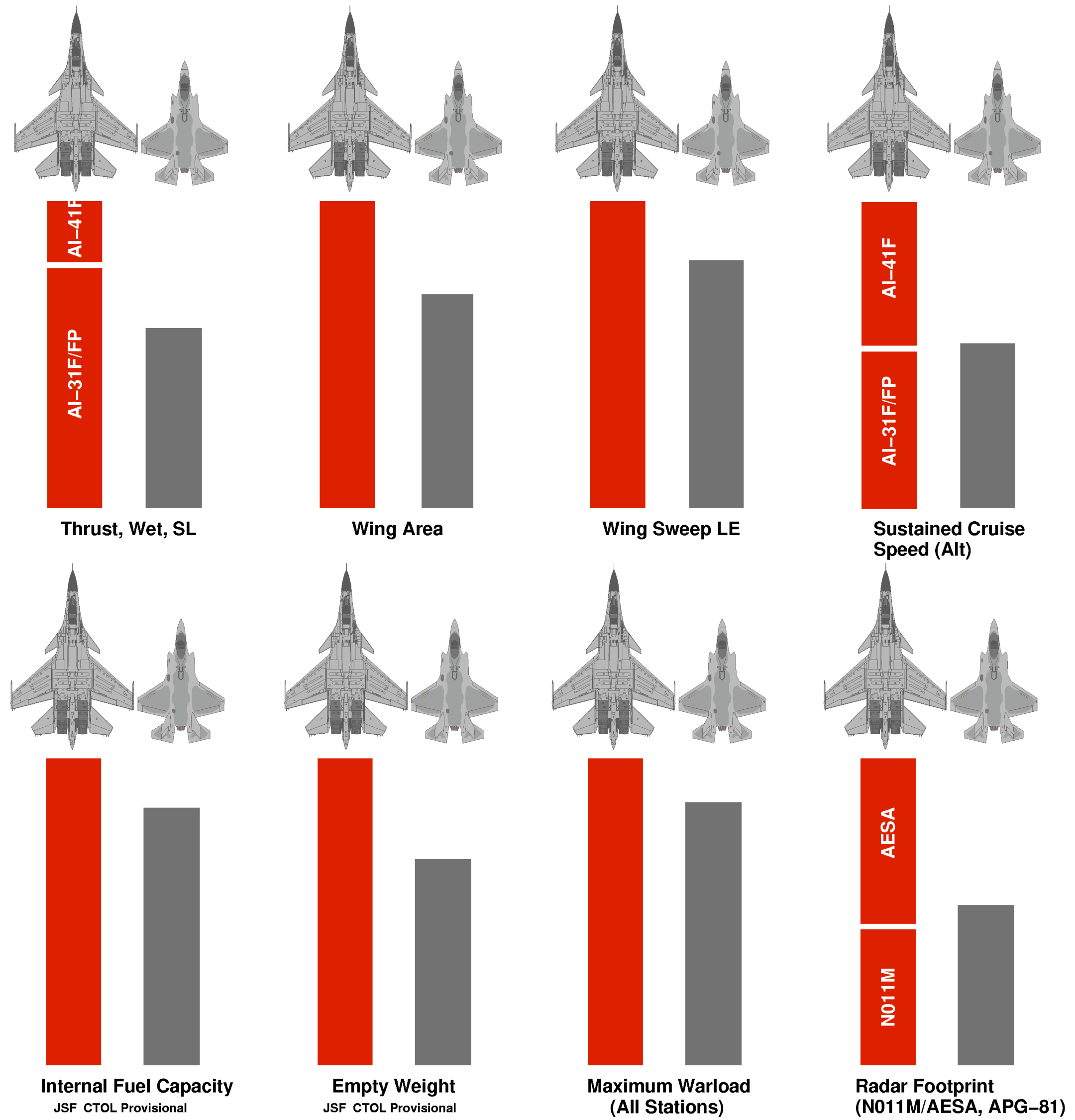
Sukhoi Su-35BM/Su-35-1 Flanker E+

- "Deep" redesign of Su-35 – fully digital weapon system, flight controls, systems
- Supersonic cruise AL-31FU-117S engines
- Large area glass cockpit emulating JSF
- Digital datalinks – TKS-2 and "JTIDS-ski"
- Radar absorbent materials – inlets
- Advanced 20 kiloWatt Irbis E hybrid ESA
- Optional Zhuk ASE 20+ kiloWatt AESA
- R-172, R-77M, RVV-AE-PD, R-27, R-74 AAMs; mostly digital designs

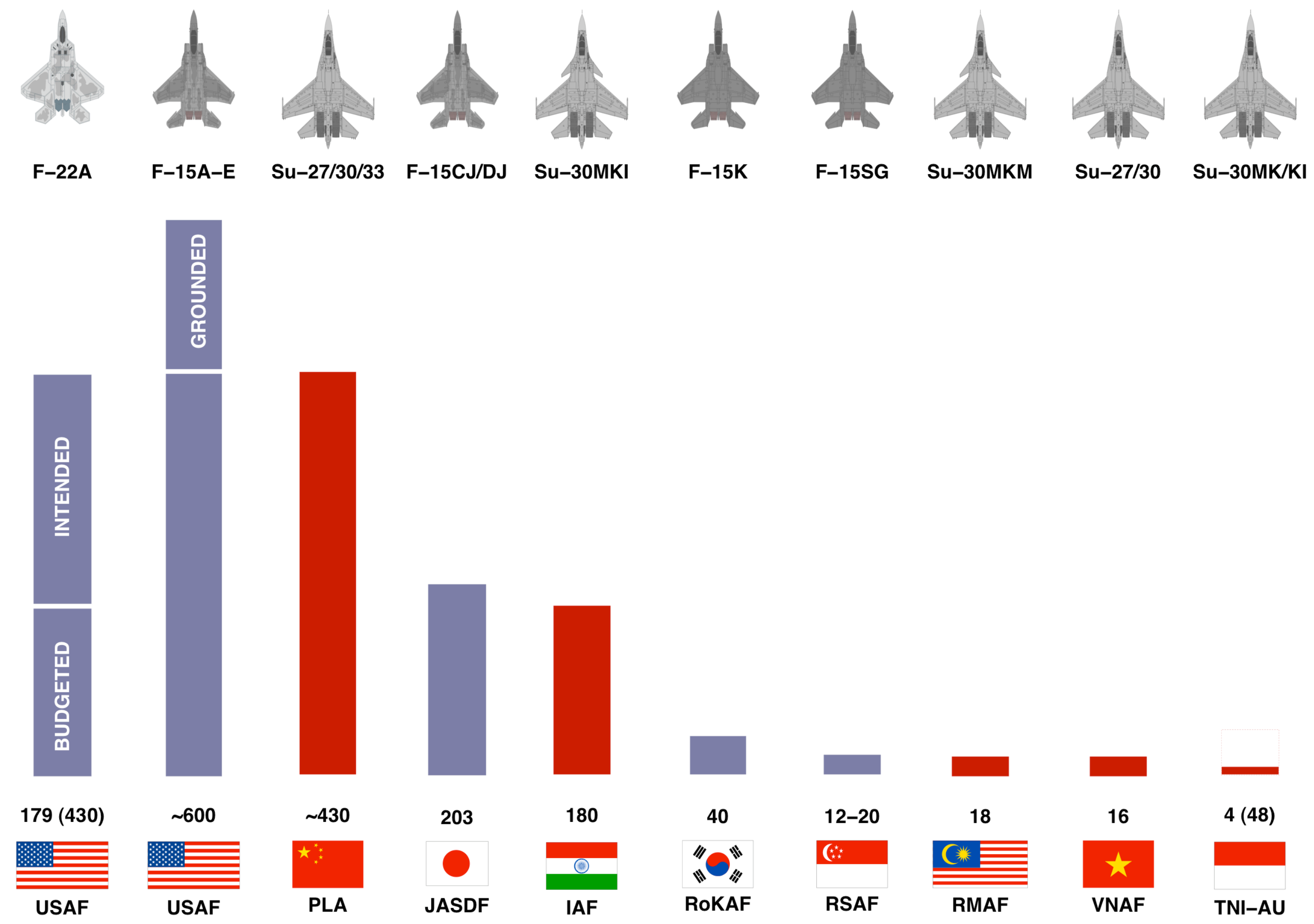
Sukhoi Su-35BM/Su-35-1 Flanker E+

- Khibiny M passive radio frequency surveillance and targeting system
- DRFM self protection jammer
- Missile Approach Warning System (MAWS)
- Electro-Optical targeting system for A/A and A/G
- Tail warning radar system
- Superior to all F-15, F-16 and F/A-18 variants, and Eurocanard fighters
- IOC ~ 2010-2011
- Intended for volume export

Flanker vs JSF



High Performance Fighters in Asia - 2009



RSK MiG-35 Fulcrum

RSK MiG-35 Fulcrum

RSK MiG-35 Fulcrum

- “Deep” redesign of MiG-29 – fully digital weapon system, flight controls, systems
- Zhuk AE Active Electronically Steered Array radar
- Digital datalinks – TKS-2 and “JTIDS-ski”
- Advanced Electro-Optical targeting system
- DRFM self protection jammer
- Missile Approach Warning System
- R-172, R-77M, RVV-AE-PD, R-27, R-74 AAMs; mostly digital designs

Su-30MK and Su-27SKM

- Digital derivatives of baseline Su-27SK and Su-30K – glass cockpits
- Full range of AAMs and smart PGMs
- Su-30MKI/MKM - digital flight controls and TVC engines – India and RMAF deployed
- Su-30MKK/MK2 – equiv F-15E – PLA-AF, PLA-N, TNI-AU, PAVN
- Many upgrade options especially in radar:
- Irbis E hybrid ESA, Zhuk-ASE AESA, Zhuk MSFE PESA, Pero reflective PESA

Su-30MKM Flanker H Malaysia – IOC 2009

- Based on Su-30MKI Flanker H but with improved systems, and French Thales Damocles EO targeting pod fitted.

Russian Missile Capabilities

- Diversity in missile seekers – active radar, infrared, passive X-band anti-radiation
- Diversity in missile airframes:
- R-27 Alamo family short and long burn
- R-77 Adder family AIM-120 AMRAAM class
- Ramjet RVV-AE-PD family MBDA Meteor class
- R-37 Arrow – 160 NMI – no equivalent
- R-172 – 200 NMI – no equivalent
- Jam resistant seekers, digital controls, midcourse datalinks

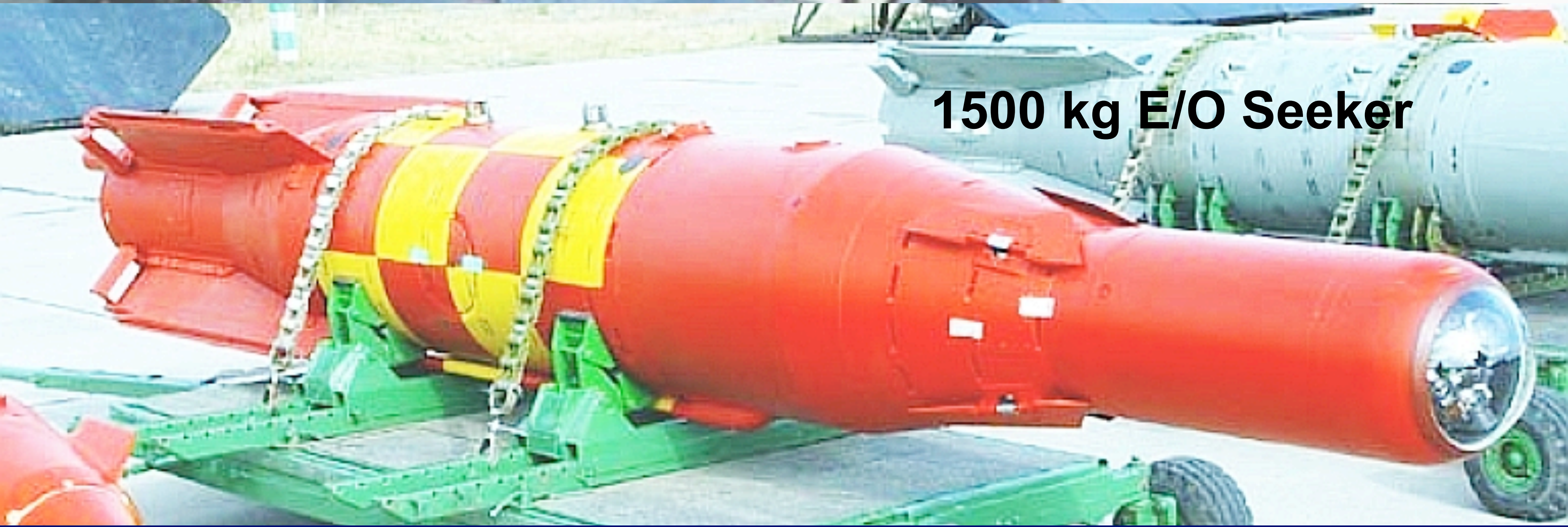
Su-35-1 Flanker – BVR Missiles (MAKS2007)

- R-172 also designated as R-100 and KS-172.

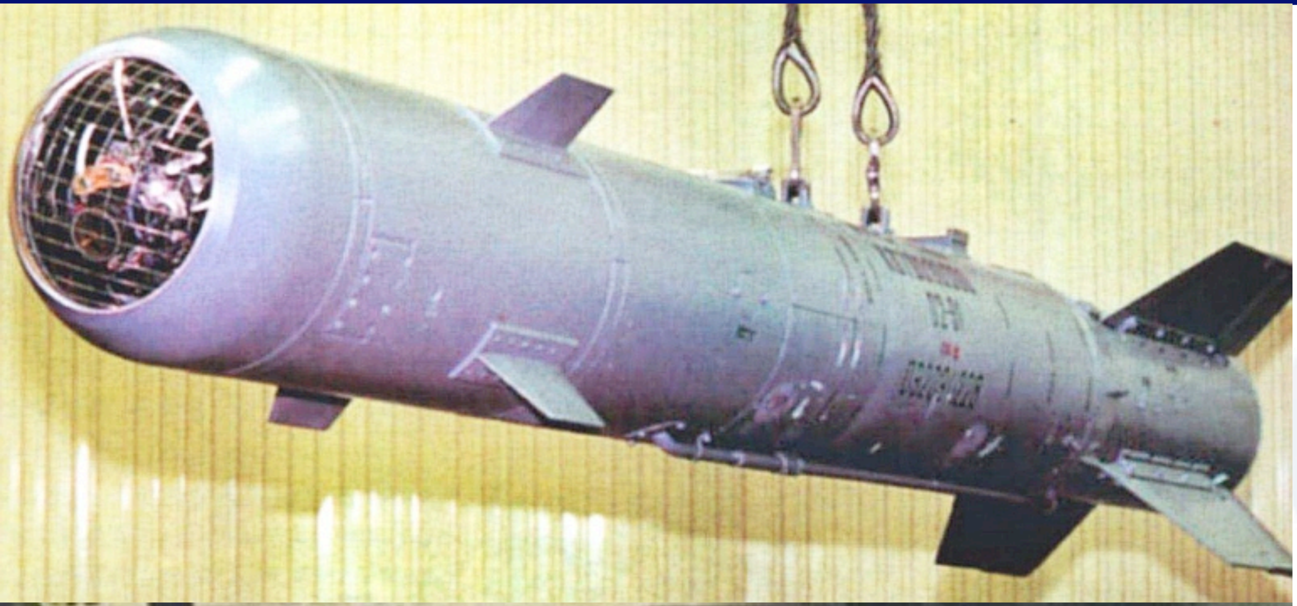
Smart Bombs - KAB-500/1500

- Fusion of Paveway and HOBOS technology
- Modular design – warheads and seekers
- Equivalents to Paveway/GBU-15/JDAM
- Warheads – blast/frag, concrete piercing, Fuel Air Explosive / Thermobaric
- ElectroOptical Correlator – cf US DSMAC
- ElectroOptical Datalink – cf US EGBU-15
- Semiactive Laser – cf US Paveway II/IV
- GPS/Glonass – cf US JDAM and SDB
- 1,000 lb and 3,000 lb standard warheads

Smart Bombs – GNPP KAB-1500



Smart Bombs - GNPP KAB-500



500 kg E/O Seeker

500 kg Laser Seeker

500 kg Satellite Guidance

Cruise Missiles

- Novator 3M54E/3M14 Sizzler – air, sub, ship and ground launched; subsonic and supersonic terminal stage variants; anti-ship and land attack variants;
- Kh-61 Yakhont/PJ-10 Brahmos A/S air, sub, ship and ground launched supersonic
- Raduga 3M80/81/82 Sunburn – air and ship launched supersonic ASCM
- Raduga Kh-55SM – eq US AGM-86
- DH-10 – eq US Tomahawk
- YJ-63 – eq US Tomahawk MRASM

Cruise Missiles – 3M54/SS-N-27 Sizzler

Kilo SSK; DDG/FFG SLCM

Su-27/30/35; MiG-29/35 ALCM

MZKT-7930 8 x 8 GLCM

Cruise Missiles – Yakhont/Brahmos / SS-N-26

Tatra 815 8 x 8 GLCM

Su-27/30/35 ALCM

SSK, DDG/FFG SLCM

3M80/81/82 Moskit / SS-N-22 Sunburn

Ship Launch – Type 956 DDG

Air Launch – Centreline Su-33/Su-35BM

Thermobaric or Shaped Charge W/H

Cruise Missiles – Kh-55, DH-10, YJ-63

KJ-2000 AWACS – AESA Technology

- The L-band AESA radar in this Chinese design is two generations of antenna technology ahead of the E-3 AWACS APY-2 radar.

Sukhoi Su-33/33UB Flanker D - CV

Su-33UB Navalised Flanker

Zhuk MSFE PESA / TVC

Su-33 Navalised Flanker

PLA-N – 48 Ordered

Tailhook/Ski-Jump

Full Su-30MK Capabilities

Single/Dual Variants

Sukhoi Su-34 Fullback – LRIP for RuAF

- Long Range Strike Fighter – F-111 Class
- PESA Attack Radar
- Khibiny M Emitter Locating System
- All Su-30MK Smart Weapons
- LRIP in 2007 – On Offer to PLA-AF/PLA-N

Chengdu J-10 Sino Canard Fighter

Su-33/35 Buddy Refuelling Capability

Il-78 Midas Tanker

End Presentation