Sukhoi Fullback

by Dr Carlo Kopp

While the region has seen the deployment and manufacture of hundreds of Flankers since the early 1990s, all of these have been incremental developments of the baseline Su-27S and Su-27UB tandem seat airframes.

Since the early 1980s the Sukhoi bureau has been developing a family of derivative airframes, which utilise side by side seating. With ongoing industry speculation about regional buys of these aircraft, this month's analysis will explore the features, capabilities and growth potential of the Fullback family of Flanker derivatives.

Sukhoi Su-27KUB

The navalised Su-27K for Korabl'ny was developed for the Project 1143.5 55,000 tonne class aircraft carrier, of which four were to have been built. The Su-27K is the Russian equivalent to the US Navy F-14, but also important as it was the prototype for design features which migrated to a wide range of other Flanker variants and derivatives.

The Su-27K had folding wings and stabilators, strengthened undercarriage with twin nosewheels, upgraded hydraulics, a tailhook, enlarged flaperons, a modified ejection seat angle, folding outer wings and stabs, upgraded fly-by-wire, modified LERX (Leading Edge Root Extensions) with canards, enlarged leading edge slats and a deployable aerial refuelling probe. The refuelling probe modification included a pair of deployable floodlights in the nose, used to illuminate the tanker aircraft, here intended to be either an Il-78 Midas or another Su-27 buddy tanker carrying a centreline UPAZ hose-drogue pod. The probe permits a fuel transfer rate into the fighter of up to 1815kg (4000lbmin). Another notable Su-27K feature which migrated to later Flanker variants was the right offset infrared search and track (IRST) housing, this improving the pilot's downward view over the aircraft's nose. Production Su-27Ks operated by the Russian navy are often designated the Su-33.

Perhaps the most important feature of the Su-27K/Su-33 are the enlarged LERX/canards which increase the available body lift of the aircraft, and shift the centre of pressure forward thus enhancing achievable pitch rates. The Su-27 series shares with the F-14 series a large body lift capacity resulting from the wide fuselage tunnel. As a result of this the aircraft's effective wing loading is much lower than that of aircraft with different configurations. This is reflected in superb high alpha handling and sustained turn rates. The enlarged LERX/canards migrated to a range of other Flanker variants, including the Su-35, Su-37 and production Su-30MKI.

Experience from initial Su-27K flight testing and trials indicated that major issues would arise with training pilots for carrier recoveries. Without the large range of aircraft types, and specialised carrier trainers operated by the US Navy, the Soviet AV-MF needed an aircraft which was identical in handling to the basic Su-27K but dual seated, without the forward visibility impediments of the existing tandem configuration Su-27UB.

Design of the dual navalised combat trainer derivative began in 1989, the aim being to produce an airframe suitable for a range of other carrier based roles such as reconnaissance, aerial refuelling, maritime strike and support jamming, niches in the US Navy now being filled by the Super Hornet family.

The new Su-27KUB (Korabl'niy Uchebno-Boyeviy – Shipboard Trainer-Combat) included a radically revised forward fuselage and a range of incremental aerodynamic changes. The latter are cited as enlargement of the canards, stabilisers, fins and rudders. The wing fold position was moved further outboard.

The new side-by-side cockpit involved a major resculpting of the forward fuselage, with crew access via a nosewheel well deployable ladder. The crew sit on upward firing ejection seats under jettisonable canopy panels. The circular cross section of the nose was retained, but the baseline NIIP N-001 multimode radar was to be replaced by a Phazotron Zhuk derivative. The OEPS/OLS-27 IRST housing was located on the centreline of the cockpit.

The prototype Su-27KUB first flew in April 1999, but no significant production orders have materialised due to the collapse of Russian carrier aviation funding post 1991. The aircraft was to be built by KNAAPO at Komsomolsk Na Amure.

There have been claims that the Chinese navy has taken an interest in the Su-27KUB, but in the absence of a carrier fleet element many of the

aircraft's carrier specific design features are simply dead weight, compared to the coastal defence naval Su-30MK2, largely identical to the Chinese air force Su-30MKK. A land based Su-27KUB derived from the Su-30MK2 would offer more comfortable crew accommodation over the Su-30MK2 but the additional cost in such a unique variant may not justify its production. The hulk of the Russian carrier *Varyag* remains tethered in a Chinese shipyard.

The Su-27IB Fullback – Early Development

During the latter years of the Cold War, Soviet Frontal Aviation units employed a mixed fleet of battlefield interdiction and theatre strike aircraft. The most potent of these was the Sukhoi Su-24 Fencer, conceptually similar to a smaller F-111, supplemented by the even smaller Su-17 Fitter, a variable geometry derivative of the Su-7, and the MiG-23BM and MiG-27, both derivatives of the variable geometry MiG-23 interceptor.

Soviet doctrine during that period was being seriously challenged by large numbers of US and NATO teen series fighters, especially the F-15 and F-16. While Frontal Aviation MiG-29 and Su-27S fighters were to win the air battle, allowing the less agile Su-24, Su-17, MiG-23BM and MiG-27 to survive and attack their targets, it was evident to Soviet planners that replacements for these strike aircraft would need to be capable of surviving close contact with the F-16 and especially the F-15.

The Sukhoi bureau was intimately familiar with the problem to be solved, as designers of the earlier Su-7, and later Su-17/22 and Su-24, they had first hand exposure to the often conflicting design requirements of these roles.

Early Sukhoi thinking concentrated on adaptations of the baseline Su-27UB tandem seat trainer, a model since then implemented in the F-15E-like Su-30MK series exported to China and India. Frontal Aviation thinking was however that the crew station approach used in the Su-24 worked better for the high workload and potentially long endurance strike roles. Conceptual design of the Su-27IB as an Su-24 replacement began in 1983.

The Su-27IB (Istrebityel Bombardirovshchik – Fighter Bomber) concept solidified during this period, with a much enlarged side-by-side cockpit area more akin to a flightdeck in a larger bomber, in a substantially enlarged and reshaped forward fuselage. Specific aims of the new design were to provide better ergonomics for long range/long endurance/high workload profiles, better 'sanitary conditions' for the crew, facilities for the crew to eat meals on long duration profiles, and saving the cost of duplicated cockpit displays and instrumentation. The flightdeck was to be fully pressurised, obviating the need for the crew to wear masks through the whole flight. The whole flightdeck was surrounded by a welded titanium tub to protect the crew from ground fire.

Crew access was via a ladder in the nosewheel well, the dual nosewheel being relocated forward and retracting aft, opposite to production Su-27s. The crew sat on K-36DM zero-zero seats. The much enlarged chined and blended forward fuselage was attached to what was essentially a modified Su-27UB dual trainer airframe, with the production main undercarriage, wing and aft fuselage sting. The ventral stabiliser surfaces were removed.

The Su-27KUB is often confused with the Su-32/34, but is a unique design intended as a carrier based trainer and strike fighter (Sukhoi).

The T-10V-1 prototype displays its unique planform in flight (Sukhoi).

Designed as a 'deep strike fighter', the T-10V-1 prototype included Su-35 canards for low altitude ride improvement and load alleviation, the Su-35 wing and revised fixed inlets devoid of the foreign object suppression hardware used on the Su-27S and UB, and limiting supersonic dash speed to around Mach 1.6 to 1.8. The Su-27 stabilators and tails were retained. Internally the centre section was strengthened to accommodate a 45 tonne maximum gross weight, increased over the baseline 28 tonne Su-27S. Internal volume was increased by about 30% over the Su-27.

Other design features were to include a phased array multimode attack radar, internal forward looking IRST/TV/laser targeting system, external podded FLIR/laser targeting system, aft fire control and tail warning radar, and internal defensive jammers. Development was authorised in 1986 with the baseline configuration set in 1987. Leninetz, designers of the Backfire's Down Beat and Bear's Clam Pipe attack radars and the Foxhound's Zaslon phased array, were contracted to develop the radar, with Ural and Geofyzika contracted to develop the electro-optical systems.

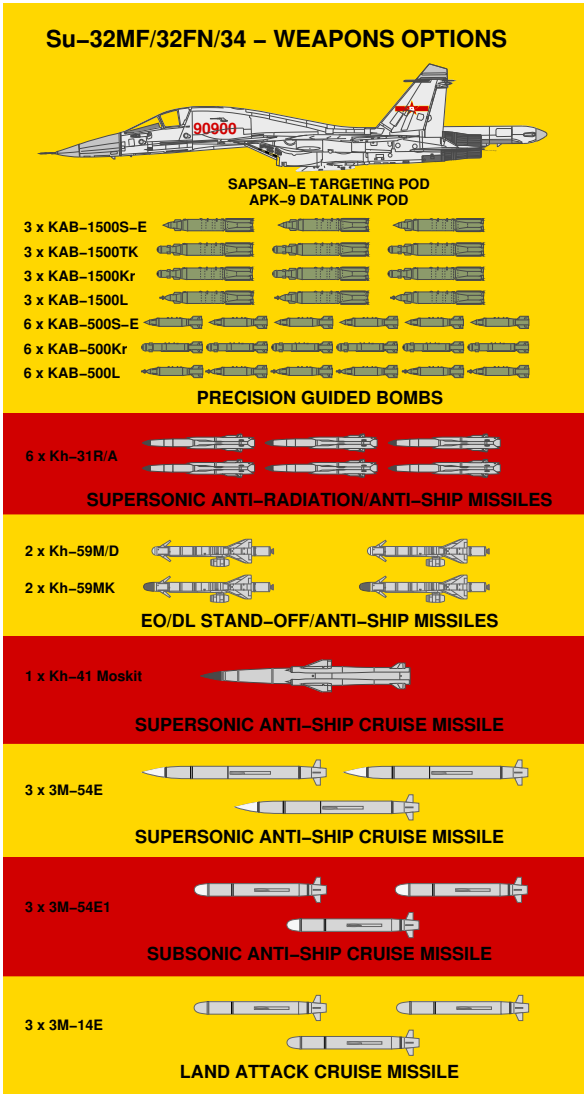
The Su-27IB was to be fitted with a heavily integrated digital weapon system, using glass cockpit components, thus emulating the shift first seen in the US with the 'digital' F-111D two decades earlier.

Weapons planned included the Kh-29 and S-25LD Maverick equivalents, the KAB-500Kr electro-optically precision guided bomb, the KAB-500L laser guided bomb, and the electro-optical/datalink guided KAB-1500TK GBU-15 equivalent. Three of the Kh-59 standoff weapons, similar to the AGM-142, were to be carried, or up to six Kh-31 and Kh-35 Kharpunski anti-shipping missiles. For defence suppression, up to six Kh-31R anti-radiation missiles were to be carried.

Defensive weapons were to include the GSh-301 30mm gun, up to eight R-73 Archer WVR AAMs and up to six R-27 BVR AAMs. A total payload of up to eight tonnes of dumb bombs were to be lifted, including payload of 36 x FAB-250 250kg (500lb) bombs. Six B-8M1 rocket pods for up to 120 S-8 rockets, or six B-13L pods for up to 30 S-13 rockets could be carried for close air support tasks.

The first prototype T-10V-1 flew in April 1990, and within months flew aerial refuelling trials and simulated carrier landing approaches on the *Tbilisi*, in the Black Sea. The aircraft was first publicly exhibited in 1992.

The second prototype, the T-10V-2, was built in 1993, adopting the Su-35 wing with additional stations, enlarged internal fuel tanks, enlarged spine and lengthened tail 'stinger', the production reinforced centre section design, and the rep-



Development Su-32/34 aircraft have been displayed with the full suite of current Russian precision guided munitions. The maritime Su-32FN has also been displayed with the Kh-41 Sunburn, and early mockups of the 3M-54 family (Author).

resentative production configuration of the tandem dual wheel main undercarriage. The first Low Rate Initial Production airframe, the T-10V5, was flown in early 1994 and renamed the Su-34, clearly a play on the aircraft's Frontal Aviation predecessor, the Su-24 Fencer.

This prototype was painted in an unusual blue/green camouflage, labelled the 'Su-32FN' and presented at the 1995 Paris Airshow as a maritime patrol and strike fighter. Two more Su-34s were built in 1996 and 1997, and presented at the Paris Airshow in 1997, again as the 'Su-32FN'. Russian sources claim this nomenclature was further changed with a new designation of 'Su-32MF', presumably for Mnogofunktsioniy Frontoviy (Multirole Tactical).

While the Su-32FN and Su-32MF/34 are essentially identical T-10V-5 derivative airframes, there are important differences in their intended roles and avionics, and both will be discussed separately.

In comparing the basic Su-32/34 airframe against western types, the design with 12.1 tonnes of internal fuel sits in between the F-15E and F-111 in combat radius and weapon payload capabilities. It will provide at lower gross weights lower agility than the F-15E, but higher agility than the F-111, rated at 7G against the 9G Su-30 series. Its top end supersonic performance is inferior to both US types.

Like both US types, the aircraft is intended to perform low altitude penetration using terrain following radar (TFR) functions. Unlike the F-15E with a podded LANTIRN TFR and the F-111 with a dedicated redundant APQ-171 TFR, the Su-32/34 uses a phased array which interleaves TFR and other modes, a concept used previously only in the B-1B's APQ-164 phased array radar.

The Su-32MF/Su-34 Fullback Strike Fighter

The basic configuration of the intended production Su-32MF/Su-34 aircraft is a multirole deep strike fighter, intended to perform the battlefield interdiction, close air support and deep strike roles now performed by the Su-24 in Russia, the F-15E in the US and the F-111 in Australia.

European reports claim that a production Su-32MF/34 would be fitted with the newer AL-41F engines, rated at 35,000lb (155kN) wet/SL/static thrust, rather than the AL-35F used in the demonstrators. The aircraft has an aerial refuelling probe, plumbing for three drop tanks, and can carry the UPAZ aerial refuelling pod performing as a buddy tanker.

The primary aircraft sensor is the large Leninets B-004 multimode phased array radar, which uses, like all current Russian designs, passive phase shifter technology with a travelling wave tube transmitter. The radar is claimed to be highly modular with redundant components, reflecting the APQ-164 model to achieve very high mission reliability on long endurance sorties. The X-band design is claimed to achieve a 15kW peak power rating, although production radars could see the use of higher rating TWT transmitters since developed for the NIIP BARS series.

The radar is claimed to provide a range of 200 to 250km (108 to 135nm) against large surface targets, ground mapping capability to 150km (81nm), Doppler beam sharpened ground mapping to 75km (40nm) and GMTI target tracking to 30km (16nm), the latter similar to contemporary western attack radars like the APG-76. Detection performance against fighter sized aerial targets is claimed to be 90km (48nm), comparable to the N-001 series. A synthetic aperture radar high resolution ground-mapping mode was planned, and given its existence in the evolved N-001/N-011M series, does not present difficulties.

The planned internal electro-optical suite appears to have vanished in more recent reports, with claims that the Sapsan-E thermal imaging and laser targeting pod will be carried externally, probably on the No 9 ventral inlet station.

The enlarged spine and tail 'stinger' are unique to the Su-32/34 series (Sukhoi).

The B004 multimode phased array attack radar is the most advanced strike radar ever designed for a Russian combat aircraft. Unlike the N011M/BARS, the B004 is an optimised bomber radar, similar in many capabilities to the APQ-164 in the B-1B, and sharing the same generation of antenna technology. This image shows a prototype radar, and also exposes the fixed geometry intakes unique to the Su-32/34 series (Sukhoi).

Development Su-32/34s are fitted with a large circular dielectric panel on the upper fuselage, which can only be a satellite communications antenna given its size and placement. No equipment type has been disclosed.

No disclosures have been made on what digital datalinks will be fitted – for situational awareness and air-to-air combat the latest TKS-2 is the prime candidate.

The cockpit uses a single dual combiner head-up display, and AMLCD displays. The widely photographed prototype cockpits are unlikely to represent a production configuration, given the layout of the more recent Su-30MK and Su-27SKM/SKU glass cockpits.

Defensive systems include a radar warning receiver, most likely the current variant of the SPO-32/L150 Pastel digital receiver carried by the Su-27/30. The podded wingtip mounted KNIRTI SPS-171/L005S Sorbtsiya-S H/I band defensive jammer has been reported, this system being an evolution of a jammer developed for the Backfire C. The Sorbtsiya-S, unlike many western jammer pods, is designed to operate in pairs and uses forward and aft looking steerable wideband arrays to maximise jamming effect. It is likely that a later generation variant of the Azovsky MAK series IR/UV Missile Approach Warning System will be used, such as the L-136 MAK-UFM – the L-082 MAK-UL was carried by the Su-24M in the same role. The APP-50 countermeasures dispenser common to the Su-27/30 is likely to be used. Like some Su-30/35 configurations, the aircraft is to carry the Phazotron/Rassvet N012 tail warning radar, in the aft 'stinger'.

For air combat the aircraft will be equipped to carry the same R-27 (AA-10 Alamo), R-73 (AA-11 Archer), and R-77 (AA-12 Adder) AAMs now carried by the Su-27/30. This will provide a credible BVR capability against closing fighters, and allows the Su-32MF/34 to be retasked as an air defence interceptor. The radar's GMTI capability is likely to be exploited for cruise missile defence tasks.

Like the Su-24 Fencer, the Su-32MF/34 is expected to be used for derivative roles. For tactical reconnaissance, the likely candidate pod is the recently revealed M400 centreline pod. It is equipped with a Raduga multi-band IR imaging system, AP-403 and AP-404 panoramic cameras, and optional modules with the M402 Pika SLAR radar and AK-108FM oblique camera.

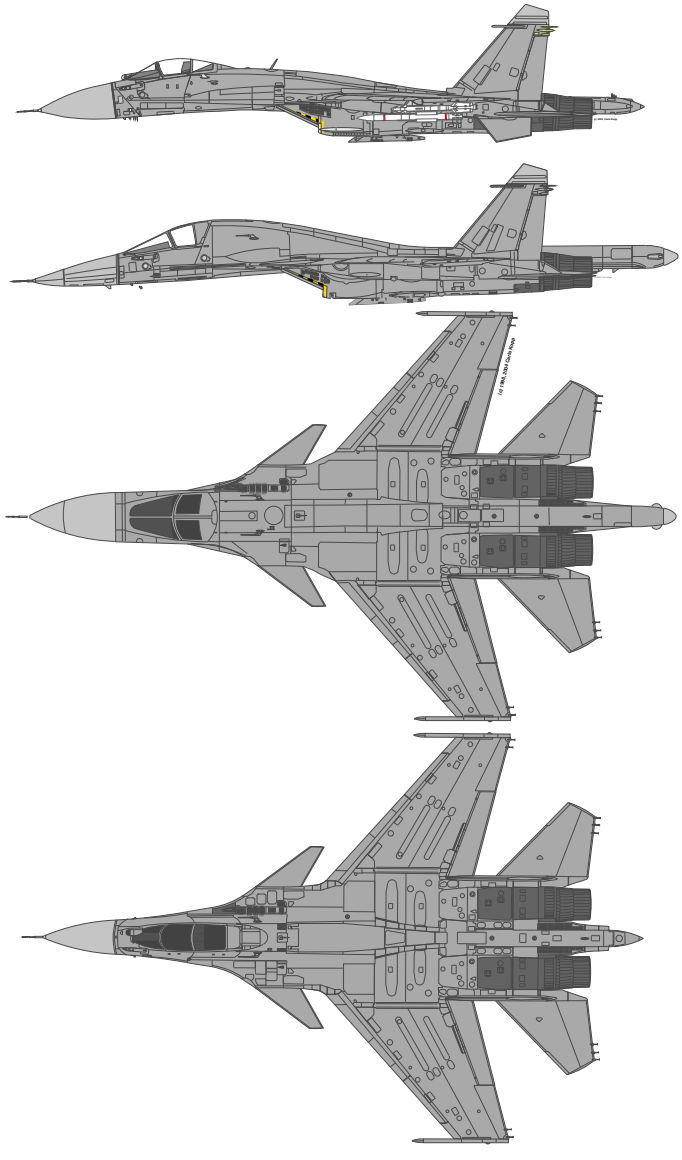
Of more interest in the longer term is the proposed support jamming variant, discussed in the Indian and Russian trade press. This aircraft is a Russian deuivalent to the EF-111A or EF-18G Growler, designed as a fast support jammer for escort and standoff jamming. The podded L175V/KS418 high power jammer is being developed for this purpose, it being an analog to the US ALQ-99 jamming pods on the EA-6B and EF-18G. The KS418 is believed to be related closely to the TsNIRTI MSP-418K support jamming pod, claimed to be designed around a DRFM (Digital RF Memory) jamming techniques generator.

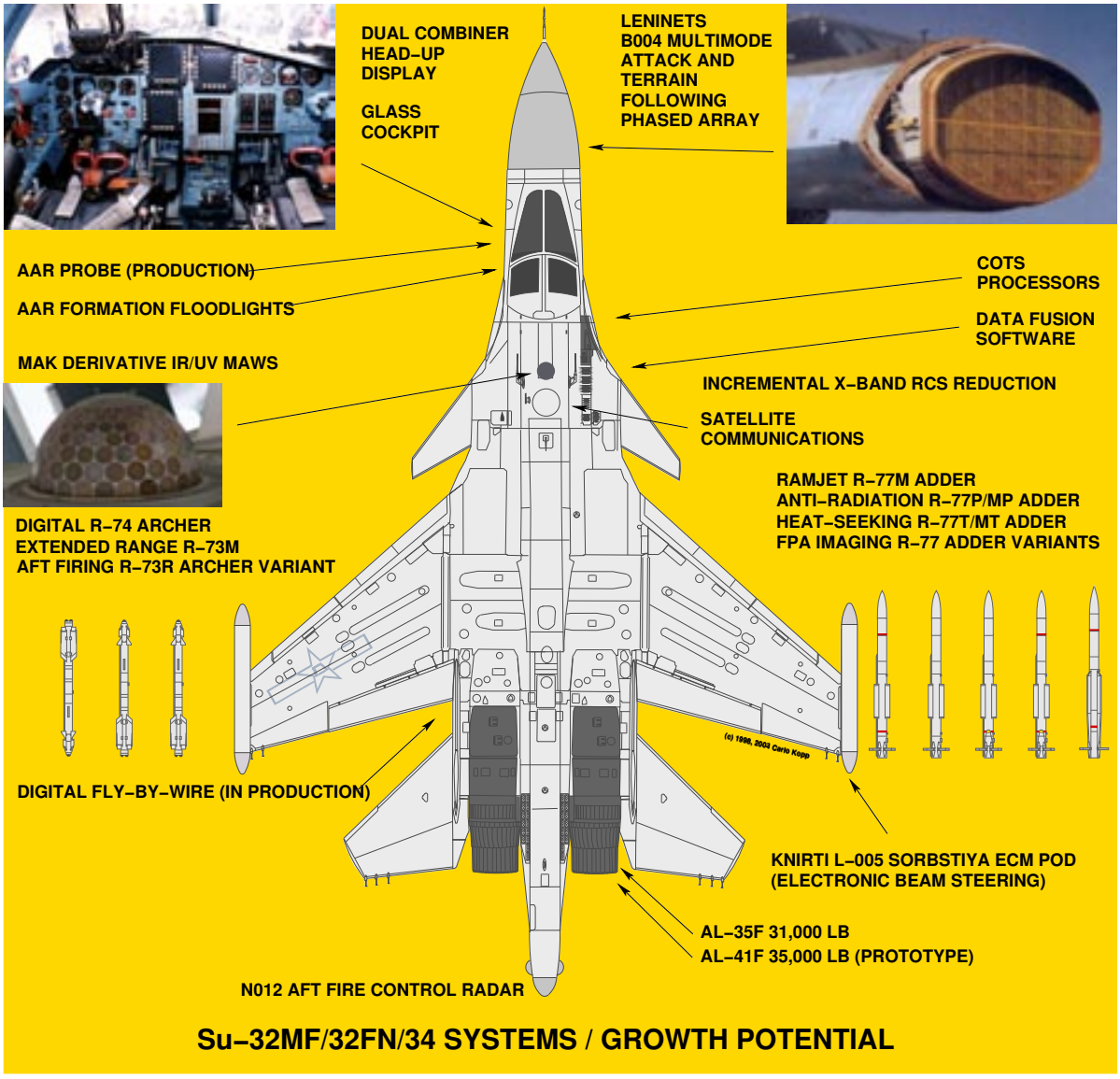
Air-to-ground weapon payloads for the Su-32MF/34 will include all of the stores currently cleared on the Su-35, Su-30MK and Su-27SKU. Beyond the weapons envisaged during the early development of the aircraft, the Kh-65 cruise missile has been discussed in European reports – three could be carried. It is certain the satellite aided inertially guided KAB-500/1500S-E will be included in any production configuration. Russian reports claim the aircraft was recently trialled in Chechnya.

In perspective, the Su-32MF/34 will provide an incrementally better penetration and strike capability over the top tier production Su-30MKI and Su-30MKK/MK2 configurations, by virtue of more internal fuel, higher gross weights, strike optimised avionics, better crew comfort and larger weapons payloads.

The Su-32MF/34 will with three 3000 litre external drop tanks and match the radius performance of the F-111, but with less disposable weapon payload. In the long term the Su-32MF/34 is important since it provides for a non-US sourced persistent battlefield strike fighter with the large weapon payload and sensor package to be effective. Datalinking to remote ISR platforms with SAR/GMTI is only a

The Su-32/34 series is a new design, despite its reuse of a large number of existing Flanker components. The fuselage is largely new, sharing only the aft engine nacelles with the Su-27/30. (Author)





Production Su-32/34s will carry a comprehensive offensive and defensive avionics suite, including full electronic warfare self protection, a tail warning radar, and the very capable B-004 phased array, capable of interleaving terrain following, groundmapping and GMTI modes. (Author)

matter of time, in technology terms.

The Su-32FN Fullback Maritime Patrol/Strike Fighter

The Su-32FN is a unique maritime patrol, anti-submarine warfare and maritime strike derivative of the T-10V design, designed to perform littoral and coastal maritime roles. The inclusion of an ASW capability in this aircraft created much debate during the 1990s, as this role in the west has traditionally fallen on specialised airliner derived airframes. The Soviet LRMP fleet comprised variants of the Tu-142M Bear and Il-38 May, derived from the Il-18 turboprop airliner.

To understand the reasoning behind an ASW equipped strike fighter it is necessary to explore latter Cold War Soviet maritime doctrine, and the concurrent US Navy maritime strategy. During this period the Soviets envisaged their ballistic missile armed SSBN fleet operating in 'bastions' near to Murmansk/Polyarnyy and Vladivostok, and other fleet elements defending the Baltic and Black Sea ports.

In the event of a full scale conflict with the west, the bastions, Baltic and Black Sea, would be the hunting ground for US Navy and Royal Navy SSNs, while the airspace would be actively contested by F-14s from US carriers and land based US Air Force F-15 sweeps. This is an environment which is not conducive to the longevity of LRMP turboprops like the Bear and May. This presented the Soviets with genuine issues in performing maritime patrol and ASW tasks and a highly survivable airframe was a must.

As the bastions and approaches to Baltic and Black Sea ports were close to existing land bases, a large strike fighter could provide credible on station endurance, where the station was perhaps 30 minutes of flying time from a runway. While a four hour on station endurance may be modest compared to a turboprop LRMP airframe, proximity to relief aircraft waiting to launch still makes this a viable concept.

The result of these pressures was the Su-32FN, devised for the AV-MF to absorb the roles of the AV-MF Su-24 Fencer regiments, and include the 'new'

This image captures the unique fuselage hump design, enlarged spine and tail 'stinger', and tandem mains to effect.

ASW role. It is essentially a supersonic, highly survivable equivalent to the Lockheed S-3 Viking.

The principal deviation from the baseline Su-32MF/34 was to be the addition of the 'Morskaya Zmyeya' (Sea Snake) maritime patrol avionic suite, since then to be fitted in the reported to be collapsed Indian Navy Bear F avionics upgrade, and a suite of maritime strike and ASW weapons. The suite is claimed to include an electronic support measures receiver and magnetic anomaly detector.

For 'classical' maritime strike roles, the Su-32FN is to be armed with up to six Kh-31A or Kh-31R ASMs, six Kh-35U ASMs, up to three Kh-59M/D standoff missiles, the potent supersonic Kh-41 Moskit (Sunburn) and 3M-54 Alfa supersonic ASMs.

Photographs indicate that the centreline adaptor for the Kh-41, developed for the Su-33, would be reused, although one mid 19a90s report claimed carriage of two rounds on wing stations. Original Alfa missile mockups were also photographed on the inboard wing stations, this missile has since evolved into the 3M-54/3M-14E series.

The more interesting stores are lightweight ASW torpedoes, carried in pairs on stations eight and nine, for a total of four rounds, and a conformal centreline pod which can be loaded with up to 72 sonobuoys of various types. An ASW patrol weapons mix would probably involve a mix of these stores, drop tanks and depth charges.

Like the conventional strike variants, the Su-32FN has yet to enter full scale production.

Fullback vs the Region

The funding shortfalls suffered by the Russian air force and naval air arm have seen the plan to replace the 400+ Su-24 Fencer inventory and remaining examples of the Su-17/22 and MiG-27 postponed repeatedly. Sukhoi and Rosoboronexport have understandably been actively marketing the aircraft for export. An export production run would see the non-recurring expenses in tooling up and completing avionics integration absorbed by an export client, reducing the cost to the Russian air force and other export clients.

While there has been some speculation about the Indian Air Force signing up, it has a big enough challenge in fielding its 180 aircraft run of Su-30MKIs, an aircraft which provides a large fraction of the Su-32MF/34's capabilities.

The more probable client in the forseeable future is China. While current reports indicate that the PLA-AF is focussing more on the Backfire, which provides long range punch without tanker support, the PLA-N air arm is subject to very different strategic and force structuring pressures. Unlike PLA-AF Badgers which have the option of launching long range land attack cruise missiles from outside the footprint of interceptor and SAM defences, the same is not true for maritime strike operations against surface warships, especially in the Taiwan Straits and South China Sea.

In a time of confrontation, this would be airspace vigorously contested by RoCAF fighters and likely US Navy F-14D and F/A-18s, yet the Badgers must close to a radar line of sight with their targets before they can launch their missiles. Anti-submarine patrol sorties also present a genuine challenge, with a real strategic need for the PLA-N due to Taiwan's attack submarine fleet planning and the prospect of US Navy nuclear attack subs blockading Chinese ports. The PRC faces a strategic problem not unlike the AV-MF did in defending its maritime bastions – turboprop LRMP aircraft stand little chance of surviving to perform their role.

We should not be surprised if the PLA-N air arm does order the Su-32MF/34, the Su-32FN, or some mix or hybrid of these types. The aircraft is a much better fit for the role than the current batch of several dozen Su-30MK2s, and can absorb the littoral maritime patrol/ASW role. This would permit remaining PLA-N H-6D Badgers to be converted into tankers to support the Sukhois.

The regional deployment of production Su-32/34 derivatives would present another incremental step in regional capability growth – a development must closely observe. ✈