

GRIPEN FUTURE DEVELOPMENT

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Abstract

Further development and enhancement of the Gripen Weapon System is a continuous process. Operational Gripens of the Swedish Air Force (JAS39 A/B) receive enhanced operational capabilities through new software editions every second year. This will continue in the years to come and will include various tactical functions as well as integration of new weapons and other external stores.

An advanced version, JAS39 C/D, will become operational 2004 with a number of important enhancements. The presentation will describe this in brief

The export version of Gripen is in most aspects identical to JAS39 C/D

For the Gripens to be delivered from 2010 and beyond, and for long-term upgrades of previous

delivered a/c, capability enhancements are planned in a number of areas. These will be described together with the rationales behind.

Gripen International (Saab and BAE SYSTEMS) are, together with other defense industries, now involved in increasing study and definition works around the long-term enhancements of Gripen. The work is supported by and performed in close contacts with the Swedish defense authorities.

1 The Gripen Family

As for most famous military aircraft there are and will be several versions of the Gripen multirole fighter. Gripen can be described as a family of aircraft in accordance with figure 1.1

We start with the two versions that are operational today in the Swedish Air Force, the

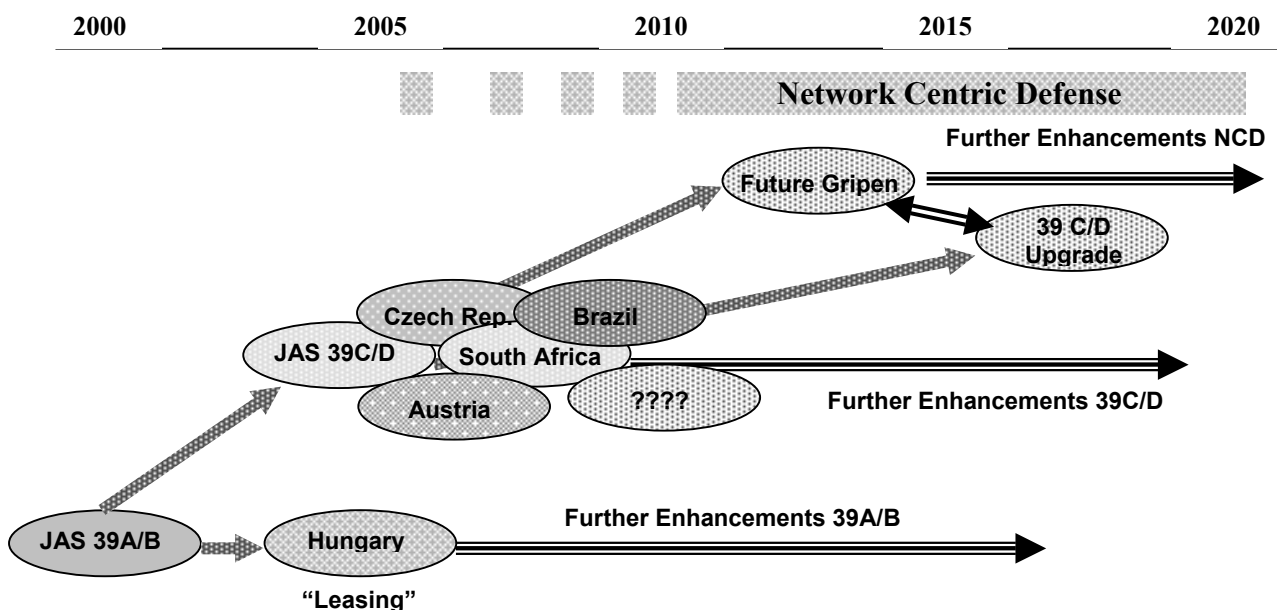


Figure 1.1 The Gripen Family

single seat JAS 39A and the dual seat JAS 39B. 14 aircraft of this version will be leased by Hungary from the Swedish government.

New versions, the single seat JAS 39C and the dual seat JAS 39D, are now in final development stages and deliveries will start shortly. JAS 39C/D is the baseline for the current export versions of Gripen that so far have been ordered by South Africa and down-selected by Czech Republic.

For the future we think that the export market will require an enhanced version of Gripen some time during the next decade. Most likely there will also be a demand, both from Sweden and export customers, for a significant system upgrade of earlier delivered aircraft.

For all versions of Gripen we foresee frequent "continuous" improvements through new software editions and integration of new weapons and other external stores. An important feature for the future will be to fully adapt to the requirements of Network Centric Defense, NCD

2 Current System

2.1 Operational Gripens

The Swedish Air Force currently operates more than 100 Gripen a/c at 3 wings.

The operational Gripens of the Swedish Air Force (JAS 39A/B) receive enhanced operational capabilities through new software editions every second year. This will continue in the years to come and will include various tactical functions as well as integration of new weapons and other external stores. There is also a hardware upgrade program ongoing by which JAS 39A/B will receive significant parts of the enhancement program that defines JAS 39C/D.

2.2 JAS 39C/D

The advanced version, JAS 39C/D, will become operational with the Swedish Air Force 2004 with a number of important enhancements.

Some examples:

- Increased take-off-, landing- and design mass
- In flight refueling capability
- Full authority digital engine control, FADEC
- New low noise auxiliary power unit APU
- Onboard oxygen generating system, OBOGS
- Advanced cockpit with 3 large 6"x 8" multi-function color displays and enhanced system controls and complete night vision adaptation. See figure 2.1



Figure 2.1. Advanced Cockpit

- A new systems computer with significantly increased performance and spare capacity.
- Enhanced internal data communication system with increased number of 1553B data buses and a high speed Ethernet system.
- Enhanced digital recording system based on high capacity solid state memories
- Enhanced communication system
- Enhanced highly integrated EW-system with increased use of decoys. See figure 2.2

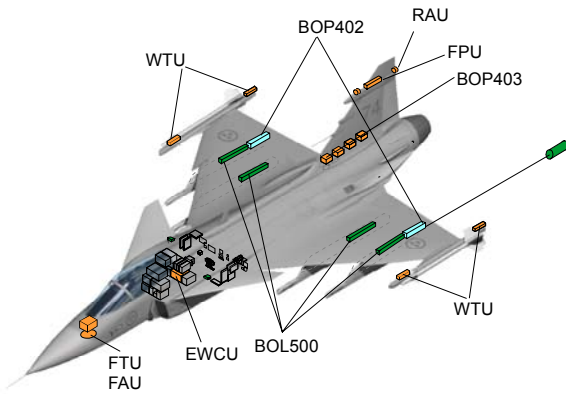


Figure 2.2. A highly integrated electronic warfare system

- A new integrated navigation and landing system based upon updates of the INS/GPS

by a terrain reference system using radar altimeter and an accurate terrain elevation database.

- Adaptation to export requirements and Swedish participation in Peace Support Operations
- Integration of new weapons and other external stores (recce pod, targeting pod etc)
- Enhanced Radar

The layout of the avionics system is schematically shown in figure 2.3.

The Swedish two-seat version, JAS39 D, will have special equipment and capability to be used with an advanced system operator (recce, EW etc) or a mission commander in the rear

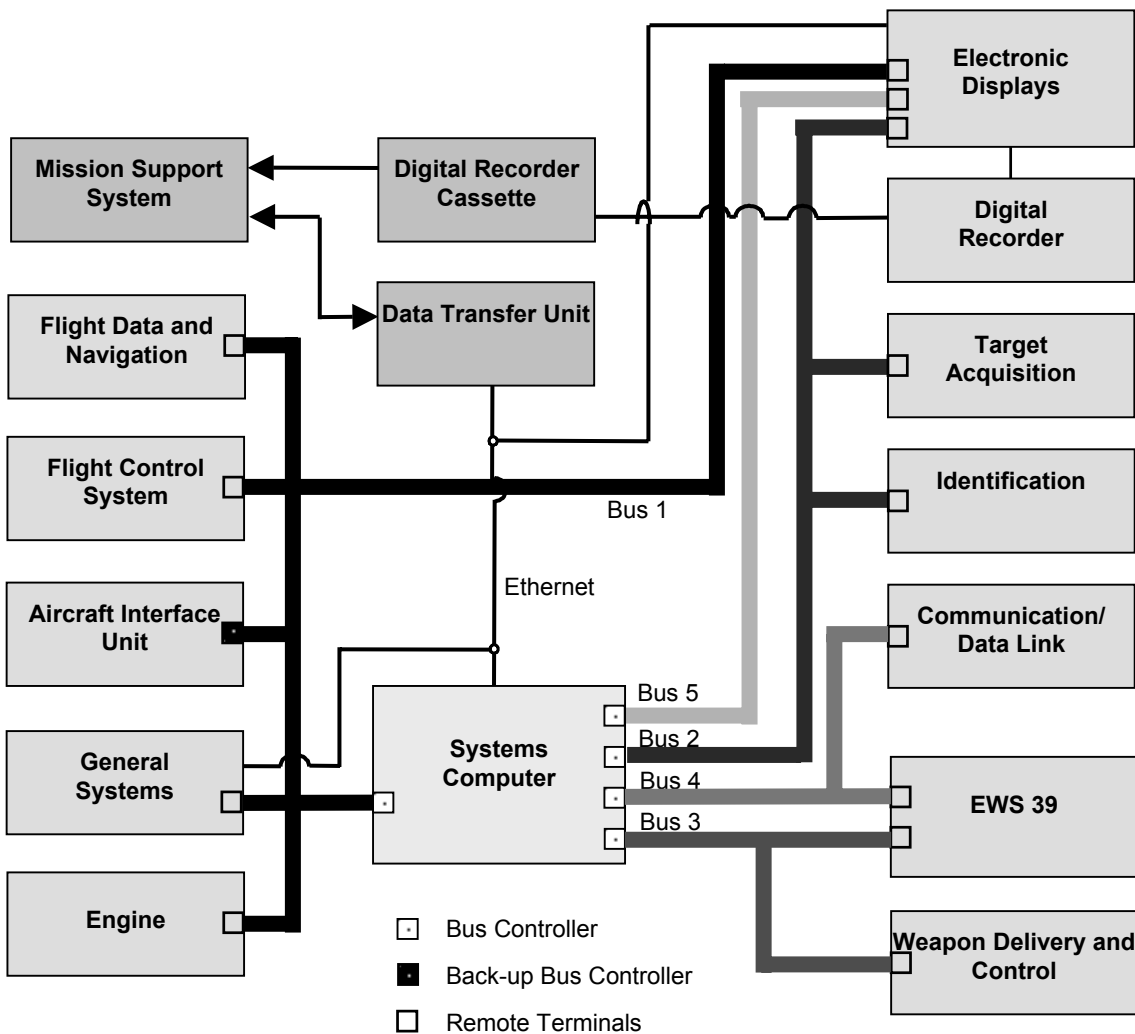


Figure 2.3 Gripen Avionic System

seat.

2.3 Export Gripen

The ambition is to keep the Gripen a/c for different customers as common as possible, but with possibility to easy adapt to specific customer requirements. The baseline export version of Gripen is in most aspects identical to JAS39 C/D. The major differences are:

- Full NATO adaptation of all systems, weapons, supply connections etc. The Swedish JAS 39C/D is partially NATO compliant and fulfil most requirements but not all
- Communication system that will be individually adapted to each customer and include cryptos.
- Customer adapted ECCM functionality
- Customer adapted EWS threat libraries
- Customer adapted electronic map and data bases

The list of available weapons to export customers includes some that are not in the Swedish inventory and some alternative versions.

The export customers are also offered options, which have been investigated and found to be possible to include with satisfactory low risk. These options include:

- Further weapons
- Various external pods (Recce, EW, Target Acquisition etc)
- Additional advanced communication (Link 16 etc.)

2.4 Upgrades of Current System

JAS39 C/D and the export Gripen have significant capacity for further upgrades in areas like:

- Integration of new weapons and other external stores

- Integration of new sensors and enhanced multi-sensor integration.
- Tactical software functions like, mission support and decision support.

The large multi-function color displays provide excellent interface to the pilot for these functions.

A Helmet Mounted Display, HMD, for use together with advanced WVR A-A Missiles, is one capability enhancement that is within current decided developments and export customers have selected the HMD.

3 Future Gripen

With Future Gripen we mean a new version to be produced and delivered to customers in the time frame beyond 2012 Future Gripen also means significantly enhanced and upgraded aircraft that originally was delivered to JAS 39C/D or export standard.

3.1 Requirements

The requirements on the future Export Gripen are determined by competition with the Joint Strike Fighter (JSF). It will not be possible to fully match the performance and capabilities of JSF. Our ambition is to offer the customer an aircraft that provide performance and capabilities that are not too far away from JSF to a significantly lower cost. For the upgrade program we will of course pay specific attention to the requirements of the Swedish Air Force. A significant factor in those requirements will be an advanced adaptation to Network Centric Defense.

The focus of the requirements on the basic aircraft will be as follows:

- Increased range/endurance
- A high degree of survivability
- Low production cost
- Low Life Cycle Cost (LCC)

The most important requirement areas for systems enhancements will be:

- Target detection & acquisition
- Communication
- Precision engagement
- Network Centric Defense, NCD
- Integrated use of sensor information
- Survivability
- HMI
- Low cost (development, procurement and LCC)

3.2 Proposed enhancements

3.2.1 Introduction

To meet the requirements a number of enhancements are studied and planned. There are of course still large uncertainties regarding the scope of the enhancement program both with respect to what should be included and to which performance level. The final decision will be influenced by further studies regarding the operational needs of different customers, other marketing aspects, possibilities of defining a viable business case, funding possibilities etc. Particular interest will be paid to the needs of the Swedish Air Force and other customers already operating Gripen.

3.2.2 Increased range/endurance

The small size of Gripen limits the amount of internal fuel and thereby its range and endurance. The introduction of in-flight refueling has diminished this problem but there are still a number of customers that require increased range and endurance.

The obvious solution is to increase the amount of fuel or to find an alternative engine with considerably lower specific fuel consumption (sfc). A fairly extensive study addresses this and we are looking both at increasing the internal fuel and conformal fuel tanks. Together with engine manufactures, we are also looking at new engines with lower sfc and increased thrust to compensate for the increased fuel mass. It is still too early to draw the conclusions of the study but we can see some promising possibilities.

3.2.3 Survivability

Increased survivability can be achieved by decreased signatures, improved battle damage tolerance and by enhanced EW capability.

Gripen is small and has a low radar signature. However we now see possibilities to further decrease the radar signature and also to improve the thermal signature.

Good battle damage tolerance and redundancy of essential systems have been important design requirements. This will continue to be important requirements for the enhancement program.

Enhanced EW capability will be achieved by introduction of

- Advanced missile warner
- Passive very accurate threat location based on high angular resolution
- Enhanced RWR and Internal Jammer
- Laser Warner

3.2.4 Target detection & acquisition

A new radar with advanced use of Active Electronic Scanning Array (AESA) technique and with significantly enhanced performance and new functionality will be introduced. Ericsson Microwave (EMW) is currently involved in an extensive study and an advanced research and demonstrator program in this area. See figure 3.1

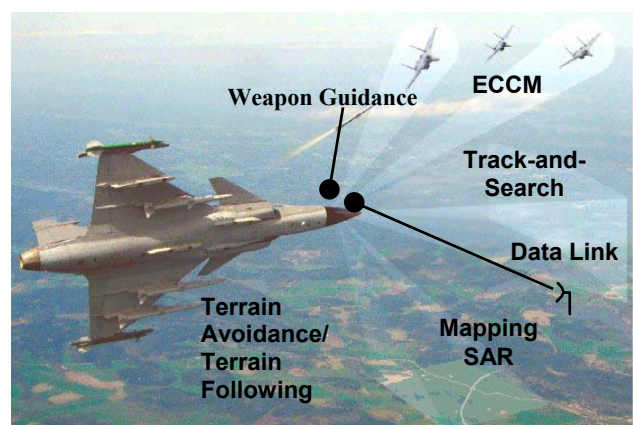


Fig 3.1 AESA radar

The AESA radar provides significant performance enhancements:

- Increased detection range and search volume.

- Enhanced tracking performance.
- Advanced search patterns and combinations of search & track.
- Enhanced situation awareness
- Increased jamming resistance
- Improved potential for “Terrain avoidance” & “Terrain following”

In addition to the AESA radar, passive target acquisition in the form of an advanced Infra Red Search and Track sensor (IRST) is introduced. See figure 3.2



Figure 3.2 IRST

3.2.5 Multi Sensor Integration

Gripen has an advanced integration of all sensor information and all data received through its data links. The planned enhancement with AESA, IRST and new EW-sensors will be used in highly advanced Multi Sensor Integration (MSI) functions.

Ericsson Microwave performs a study regarding a highly integrated multifunction defensive avionics system. It is likely that results from this study will influence the future Gripen MSI, and lead to increased situation awareness and survivability.

3.2.6 Communication

Gripen has state of the art data links for various purposes and the Swedish Air Force has been a forerunner in the advanced use of data links to enhance the tactical capability.

The future Gripen will have further enhanced communication including advanced high capacity data links and real-time broadband transmit and receive of sensor information. The balance between capacity and security will be further studied.

3.2.7 Avionics System Structure

The Avionics Core System with computers and data buses will be significantly updated and changed for several reasons:

- Need of significantly increased computer performance to match new sensors, new weapons, increased amount of software generated tactical functions and further developed HMI functionality.
- Need of a system that has increased flexibility for customer adaptation.
- Increased requirements regarding system safety and software criticality.
- Need of increased internal communication capacity and use of high-speed data busses.
- Obsolescence.
- Use of COTS (Commercial Of The Shelf) equipment when possible to increase flexibility and decrease cost.

A change of the avionics system structure is also driven by a desire to further expand the efficiency in software development.

3.2.7 HMI Enhancements

The advanced cockpit layout of JAS 39C/D and the export version will most likely be kept in the Future Gripen. However technology advances are carefully studied. New technology will be used if advantageous from a performance and cost point of view.

The current HMD will be replaced by an advanced version that will be used as a multi-purpose display and designation instrument.

Advanced Situation Awareness - HMI

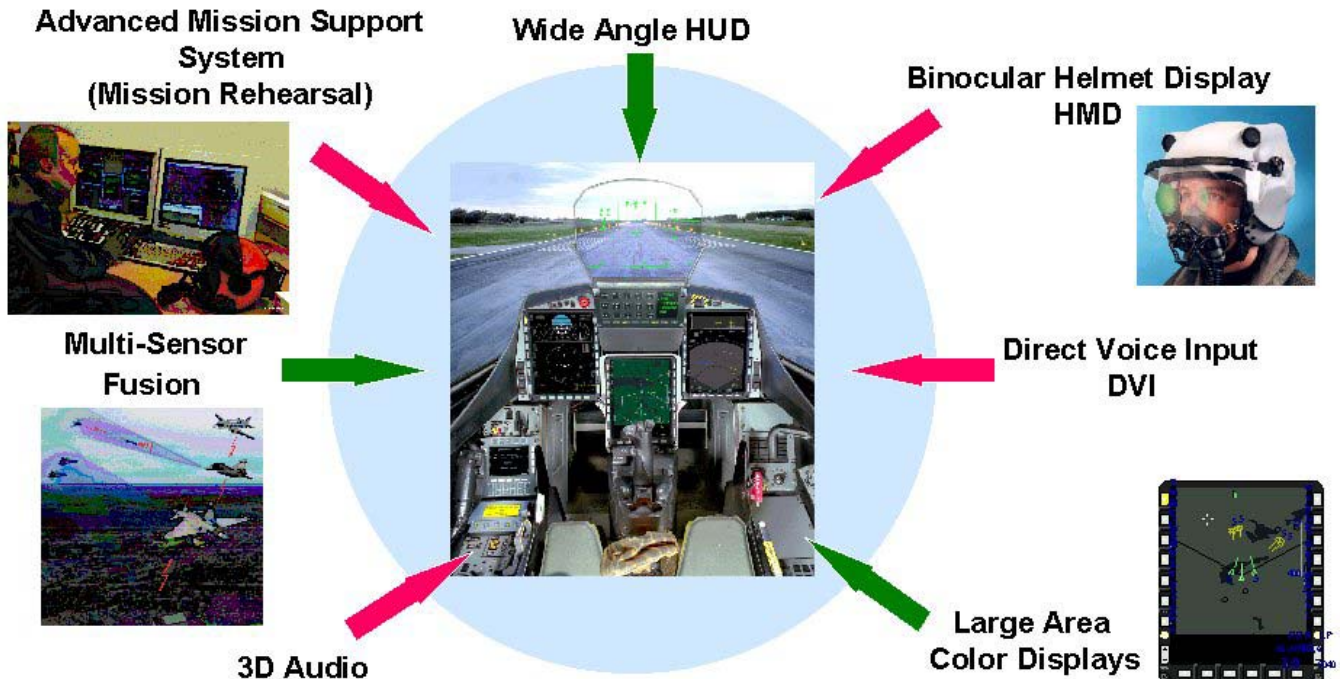


Figure 3.3 Advanced HMI

The excellent HMI of Gripen will be further enhanced by optimum use of the different display options for situation awareness and decision support. See figure 3.3

3.2.8 Network Centric Defense

For Sweden and for export countries, which have interest, Gripen will also be adapted to play a major roll in a future Network Centric Defense system. The data link system and the advanced HMI form the excellent base for this.

The dual-seat version can add another dimension to this as the displays and controls in the rear seat will be possible to operate completely independent of the front seat

4 Development activities

Gripen International (Saab Aerospace Gripen and BAE SYSTEMS) are together with other defense industries like Ericsson Microwave, Saab Avionics and Volvo Aero now involved in increasing study and definition works focused on the long term enhancements of Gripen. The work is supported by and performed in close contacts with the Swedish defense authorities.

5 Abbreviations

AESA	Active Electronic Scanning Array
APU	Auxiliary Power Unit
COTS	Commercial Of The Shelf
DVI	Direct Voice Input
ECCM	Electronic Counter Counter Measure

EMW	Ericsson Microwave
EW	Electronic Warfare
EWCU	Electronic Warfare Central Unit
EWS	Electronic Warfare System
EWS 39	Electronic Warfare System 39
FADEC	Full Authority Digital Engine Control,
FAU	Forward Antenna Unit
FPU	Fin Pod Unit
FTU	Forward Transmitter Unit
GPS	Global Positioning System
HMD	Helmet Mounted Display
HMI	Human Machine Interface
HUD	Head-Up Display
INS	Inertial Navigation System
IRST	InfraRed Search and Track
JSF	Joint Strike Fighter
LCC	Life Cycle Cost
MSI	Multi Sensor Integration
NCD	Network Centric Defence
OBOGS	OnBoard Oxygen Generating System,
RAU	Rear Antenna Unit
RWR	Radar Warner
SAR	Synthetic Aperture Radar
sfc	specific fuel consumption
WTU	Wing Tip Unit
WVR	Within Visual Range