Operational Capabilities of The Eurofighter Typhoon

Presented by Chris Worning
Test Pilot, EADS
Military Air Systems

Presentation Format

- Situational Awareness
- Low Workload
- Flexibility and Fire Power
- Performance
- Reliability

The Presenter:
- 15 years in the RDAF (F-100 and F-16)
- 15 years with EADS
- Current on 4 types (3 fighters)
- 10 years, ca. 500 hours Eurofighter
- 5000+ total flying hours
Military Air Systems

Situational Awareness
ECR-90 Captor Monopulse Doppler RADAR

- A-to-A modes
  - Search modes (VS, RWS, TWS, PS, PT)
  - Lock follow modes (STT, Visident, DGS)
  - Acquisition modes (HUDACQ, SACQ, VACQ, External, Sector)

- A-to-G modes
  - Real beam and high resolution mapping
  - Track modes
  - Air to surface ranging
  - SAR implementation capability
Military Air Systems

E-Scan Prototype
Environmental Tests
Military Air Systems

E-Scan Prototype installed in Hack Aircraft
Military Air Systems

E - Scan Installation Tests in Eurofighter
Eurofighter – IRST / FLIR Key Features

- **Infrared Search and Track:**
  - Tracking of airborne targets
- **Forward Looking Infrared (FLIR):**
  - Thermal image (virtual pictures)
  - Navigation and Landing Aid
- **Thermal Cueing:**
  - Determine the position of hot objects

- Works day and night
- Passive (Stealth)
- VERY difficult to disturb
- No counter stealth measures
Military Air Systems

IRST-Attack Format

B-Scope

- Semi-Scan Width

PPI

- Performance Indicator
- Elevation Side Scale
- Bars
- Elevation coverage
- Scan Azimuth Centre
- Semi-Scan Width
Military Air Systems

FLIR Picture Manching
20.9.06, 2052L
Military Air Systems

FLIR Picture Manching
20.9.06, 2100L
Data-Link (MIDS)

- Multiple targets from other players
- Discrete voice and automatic messages
  - Engagement Commands
  - Re-tasking
  - Weather/NBC status
  - Threat changes - (Real time)
- Situational Awareness
  - Wingman position
  - Escort positions
  - Threat development
- Stealth firing capability
- Target identification
Military Air Systems

**Eurofighter**

A Key System in the Network Centric Warfare

- Eurofighter will be the „backbone“ of Future European Combat Air Systems
- Multi-Role Capability is essential
- Operation with UAVs is likely to emerge in 2012+ timescales
Military Air Systems

Defensive Aids Sub-System (DASS)

- Laser Warner
- Flare
- Rear Missile Warner
- Flare
- Front Missile Warners
- Chaff
- Wing Tip ESM/ECM Pods
- Towed Decoy
- Warner
Military Air Systems

Defensive Aids Sub System

- Integrated within basic design
- Individually mounted, utilising wing tip pods for good all-round aspect and performance
- Provision for future growth and developments
- Interception, analysis, identification and prioritisation of transmissions and threats
- Range of countermeasures, automatically and manually deployed
Military Air Systems - Eurofighter – ESM-ECM Equipment
Military Air Systems

**Eurofighter – DASS Format**

- Airspeed
- Aircraft Heading
- Altitude
- Radar Range/Azimuth Coverage
- Range Circles 0, 20, 40 NM
- Chaff/Flare Load
- Elevation bar ±60°
- Elevation bar ±5°
- Towed Decoy Status

**PA Format**
Military Air Systems

Eurofighter Coordinated Countermeasures

<table>
<thead>
<tr>
<th>Manoeuvres</th>
<th>Expendables</th>
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<tbody>
<tr>
<td>• Last ditch Manoeuvre</td>
<td>ECM + Expendables + Manoeuvre</td>
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<tr>
<td>• Escape Manoeuvre</td>
<td>ECM + Expendables</td>
</tr>
<tr>
<td>• Support Manoeuvre</td>
<td>ECM + Manoeuvre</td>
</tr>
<tr>
<td>• Required Flight Condition</td>
<td>Expendables + Manoeuvre</td>
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</table>

**ECM (Jamming)**

### HUD indication

- **For Extensions:** Direction Limit Box
- **For Turns:** Direction Arrow

*Commanded Gs (pull)*

- Maneuver Name (BOOGEY-I) & Total maneuver time (13)
- Time to initiate next maneuver (v)
Military Air Systems

Eurofighter – Anti-jamming protection

- Safe radio communications (HAVEQUICK, SATURN)
- RADAR ECR-90 (ECM resistant)
- IRST/FLIR (not jamable)
- MIDS Link 16 LVT featuring:
  - Secure transmission (always encrypted)
  - ECCM (very fast frequency hopping)
  - Low probability of interception (spread spectrum)
Low workload
Military Air Systems

The cockpit problem

Rules of Engagement (Politicians)
Blue on Blue?

Has the wife/partner taken the Credit Card shopping?

Managing the:
Wingman
Tactics
Aircraft
Weather

Threats:
Bullets
Missiles
Germs
Radiation

Radio & Warnings & Data Link Audio

Radar Tracks
IRST Track
MIDS Track
DASS Track
Lookout

The cockpit problem
Military Air Systems

Sensor Fusion

Sensor Fusion: Sensor fused information presented to the pilot

- RADAR
- IRST
- DASS
- MIDS
- IFF
Military Air Systems

Eurofighter – Sensor Fusion

Scenario

Sensor Data

( : Radar, : MIDS : FLIR, : ESM )

Central Tracks

Sensor Fusion

Extended Spatial Coverage

Combined FLIR / IRST & Radar range / bearing precision

FLIR / IRST range & bearing Resolution

Radar range & bearing Resolution

Data Link

Radar

IR

ESM

ESM
Military Air Systems

Cockpit - Main Features

- Helmet Mounted Display
- Wide FOV HUD (Primary Flight Instrument)
- Multi-function colour Head-Down Displays
- HOTAS controls
- Direct Voice Input
- Multifunction Data Entry
- Reversionary Flight Instruments
- Integrated voice warnings and status system

\{ V-TAS \}
Military Air Systems

Cockpit Displays
Military Air Systems

MASS stby

EADS Defence & Security
Military Air Systems

After Take Off
Military Air Systems

Eurofighter Helmet
Military Air Systems

Cockpit Displays - Procedures

 PROCEDURES

THROTTLE. IDLE OR SHUT DOWN (IF POSSIBLE)
LAND. ASAP

CONTINUE

PAGE 1 OF 2
Military Air Systems

Cockpit Displays - Plates
Flight Control System

- **Primary Control Surfaces**
- **Secondary Control Surfaces**
- **Secondary FCS Functions**

- Foreplane
- Air Brake
- Outboard Flaperon
- Inboard Flaperon
- Rudder
- Nose Wheel Steering
- Air Intake Cowl Actuation
- Leading Edge Slats

Military Air Systems
Autopilot & Autothrottle

Autopilot modes
- Attitude Hold
- Altitude Acquire and Hold
- Heading Acquire and Hold
- Track Acquire and Hold
- Auto Attack
- Auto Cap
- Auto Approach
- Disorientation recovery

Autothrottle
- IAS/MACH Acquire and Hold
“Military Air Systems

“If it’s broke she’ll tell you”

“Nagging Nora”
Voice Control

“Fuel state”
“Say “please”

“Fuel state”
“Don’t use that tone with me!”

“FUEL STATE !!”
“Typical - want, want, want, and no manners”

“Alright - fuel state please”
“No, its too late now, you don’t really mean it”
Military Air Systems

DVI - Decide and Do (1)

“Target Wiskey, Victor, Assign Two, Xray, Yankee, Engage, GO”
Military Air Systems

DVI - Decide and Do (2)

„Sort 2“
Military Air Systems

Flexibility and Fire Power
Military Air Systems

Eurofighter – Operational Capabilities

Air to Air
- 27 mm Gun
- SRAAM
  - AIM-9L
  - IRIS-T
  - ASRAAM
- MRAAM
  - AMRAAM A/B/C-5/7
- Advanced MRAAM
  - Meteor
- Training ACMI pod

Air to Ground
- GBU 10/16/24
- GBU 32 (JDAM)
- PAVEWAY II/III/IV
- Litening III LDP
- ALCM
- Taurus
- Storm Shadow
- Brimstone

13 Hard points (8 wing/ 5 fuselage)

✅ Massive firepower
✅ Swing / Multi-role capability
✅ A-A active missiles & A-G high accuracy weapons
Military Air Systems

Stealth / Counter Stealth
A Broader Perspective

SENSOR FUSION
IRST + Passive Radar + ESM + MIDS
FULL PASSIVE SA!

Stealth?
Military Air Systems

Low Observability (LO) Operational Impact

The dilemma:
• Invisible but blind

Mitigation:
• External information
• Passive sensors
The dilemma:
• Visible

Mitigation:
• Highest possible situational awareness
• Maximum performance
• Defensive aids

Against LO/VLO threat (very unlikely):
- Stay passive
- IRST becomes primary internal sensor
Military Air Systems

IR Picture of VLO Bomber
Military Air Systems

Stealth

- Visual
  - Small airframe
  - Low engine emissions

- Radar
  - Airframe shaping
  - Very Low frontal RCS signature
  - Hidden engine compressor faces
  - Absorbent materials and coatings

- Electro-optic
  - Passive detection - IRST
  - Passive Night Vision - FLIR/NVE
  - Helmet-Aiming

- Defensive aids
  - Passive elements

- Communications
  - Secure radio transmissions
  - Datalink (MIDS)
Military Air Systems

RCS Test Facility Manching

Max Weight: <75 to
- EF 2000
- Transall (FTA)

* Radar Cross Section
* Identification of Radar Scatter Centers
Mechanische und Technische Daten des Antennensystems:

- Gesamtfrequenzbereich: 2.8 - 19.4 GHz
- Reflektorgröße: 5 m * 2 m
- Oberflächengenauigkeit: ±0.5 mm
- Windgeschwindigkeit (Überleben): < 110 km/h
- Gewinn: ≥28 dBi
- Pegelschwankung in der Vertikalebene (1.97°): ± 0.6 dB
- Pegelschwankung in der Horizontalebene (3.16°): ± 0.4 dB
- Nebenkeulendämpfung in der Vertikalebene (4.7°): ≥ 30 dB
Military Air Systems

Typical weapons configurations

Air-to-Air
- 6 BVRAAM
- 2 SRAAM
- 27 mm Gun
- 3 Tanks

Long Range Strike
- 2 Cruise Missiles
- 6 BVRAAM
- 2 SRAAM
- 27 mm Gun
- 1 Tank

Interdiction
Close Air Support
- 4 BVRAAM
- 2 SRAAM
- 27 mm Gun
- 1 LDP
- 4 GBU 16 or PW II or IV
- 2 Tanks
National Roles

• Home Defence
  – Airspace policing and defence
  – Information gathering (monitoring/identifying intruders)
  – Surface Attack (land and sea)

• Coalition Operations (Expeditionary Air)
  – Peace Keeping to all out conflict
  – Protection of own forces
  – Precision attack (land & sea targets)
  – Close Air Support

Fulfilling these roles needs ability to provide

proportional response

and credibility (political & operational)
Interoperability
Multi / Swing – Role

• **Key** capability which provides commanders (and politicians) with the required **flexibility** to meet/adapt to current and future operational requirements

• **Vital** capability for single type Air Forces
Military Air Systems

Performance
Military Air Systems

General Arrangement

Wing span - 10.95m (35 ft 11ins)
Length - 15.96m (52 ft 4 ins)
Height - 5.28m (17 ft 4 ins)

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<tr>
<td>500 NM</td>
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Military Air Systems

Take-Off Distances

Weight

23 t
Long Range Strike

20 t
Heavy A/A or Multirole

17 t
Air-to-Air

1500 ft 2500 ft 3500 ft 4500 ft

AB
Dry
Military Air Systems

Avionics Architecture

- Lighting
- Glareshields
- Warnings
- HUD
- MHDD
- VVR

Cockpit

CIU

Avionics

MLS
Rad Alt
DVI
CAMU
Radios
MDS
IFF

Attack

Map
FLIR
LINS
MDLR
GPS
HMSS
Radar

IPU
NC
CSG
AC

DASS
ACS

NSCAC

SCAC

Mil Std 1553 Databus
Stanag 3910 Databus(Fibre Optic)
Military Air Systems

Hydraulic System

- Two Independent Systems
- Flight control Protection

A - Gun
B - Nose Steering
  - Canopy
C - Park Brake
D - Airbrake
E - L. Utilities
F - R. Utilities
  - Landing Gear
  - FR Probe
  - Brakes
G - Slats
  - FCS
Military Air Systems

Electrical System

A - AC Generators
B - DC Generators
C - APU Generator
D - TRUs
E - Battery

DC Busbars
AC Busbars
Maintenance Busbars
### USAF flight safety statistics

Based on 48 aircraft over 35 years:

- **6 aircraft lost**
- **½ aircraft lost**

#### F-16 Engine-Related

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>F-16 Class A Mishaps</th>
<th>F-16 Engine-Related Class A Mishaps</th>
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#### F-15 Engine-Related

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Source: U.S. Air Force Safety Agency (via Flying Safety; 1/1/2006; Wolff, Bob)
Military Air Systems

Questions?