Summary

• Why we have fighters
• Why UAVs are not the answer
• What fighters do
  • Classic and new missions
• How fighters do it
  • Aircraft characteristics
  • Weapons and equipment
• Stealth – an element of survivability
  • The three kinds of stealth
  • The price of LO
• Fighters as electronic platforms
The case for fighters

• What can...
  • Get anywhere in a 600 mile circle inside an hour?
  • Whether or not the locals are cooperating…
  • ID the good guys and the bad guys?
  • Place ordnance within 5-10 metres of the latter?
The case for fighters

- What can cover 600 miles, then
  - Launch a missile that will defeat the toughest air defenses
  - and fly through the President's window?
  - It’s not one of these…

- And do self-escorted ISR?
  - Not one of these…
The case for fighters

• What are the longest-serving weapon systems?

Nancy Reagan christens USS Ticonderoga, 5/81

Aegis cruisers, decommissioned after 18 years in service

5,000-hour RNIAF F-16 – will serve until 2020

Why do aircraft last 30-plus years?
• Upgradable
• Technology insertion through electronics
• Technology insertion through weapons
• Mobile – don’t have to be deployed/moving at all times
“No more manned fighters after JSF”

- Now a respectable meme
- Yes, UCAVs are here
  - Armed reconnaissance
    - Operational with Hellfire and LGB
    - Tested with AAMs (not successful)
- But permissive environment only
- Fast-jet, survivable UCAVs
  - Major programs under way
    - USN, Europe, UK, Russia
    - Offer advantages in range/payload
    - But only because they are subsonic
  - Can’t do air to air
  - Can’t do CAS
  - Persistent deep strike
  - Comparable to a subsonic attack aircraft
What fighters do…

• Classic fighter missions
  • Air combat
    • Homeland air defense
    • Deployed air defense
    • Counter-air & escort (air offense)
  • Air-to-surface
    • Strike and interdiction
    • Close air support
    • SEAD
    • Maritime strike

• Emerging missions
  • Air-to-ground
    • Non-traditional ISR
    • FAC-A, armed reconnaissance
    • DEAD
..and how they do it

• Characteristics
  • Mobile
    • Rapidly deployable with support
    • Reach extended with COTS tankers
  • Survivable
    • Self escort or mutual escort
    • Limited need for air defense cover
  • Durable
    • Upgradeable
    • Modular structure
    • Many in-service fighters are 25-plus years old
    • Long-term investment
What kind of fighter?

- Survivable
  - Able to complete its mission in the face of likely threats
  - Able to survive even in adverse situations
- Affordable
  - Losing a fighter must not be losing a national asset
  - Smaller nations still want more than 20 jets
    - Enough airplanes to deploy and sustain at the same time
    - Affordable alongside airlift, tankers, AEW
    - Reasonable share of national defense resources
    - Acquisition, operational and sustainment/upgrades
What kind of fighter?

• An aircraft that can’t be afforded is not effective

• Versatile
  • Adaptable *across missions*
  • Adaptable *through life*

• Versatility is the key to:
  • Long-term operational relevance
  • Long-term production, hence
  • Long-term development and support
Air vehicle requirements

- **Speed and agility**
  - Driven by threat and survivability
  - Engagement control is the classic value
- **Range**
  - Expected theatre of operations
  - Deployment
  - Size/cost trade versus tanker requirements
- **Payload**
  - Weapon and equipment characteristics
  - Target sets and missions, e.g.
    - Persistent CAS (many small weapons)
    - Swing-role (AA, AG weapons in same loadout)
- **Survivability**
  - Because if it can’t survive unescorted it is not a fighter
Survivability

- Elements of survivability have not changed
  - Speed, altitude, agility
    - Driven by air combat requirements
    - Agility close to pilot limits
    - Increasing sustained speed and height is expensive
  - Vulnerability
    - May be close to practical limit
  - Self-defense
    - Inherent quality of fighter versus attack aircraft
    - Situational awareness and weapons
  - Stand-off weapons
    - Valid for part of target set
    - RoE dependent
  - Prevent/delay detection, tracking or targeting
    - Electronic jamming
    - Reduce detectability
- Stealth or low observables (LO) is way to reduce detectability
Orthodox view of LO

• Traditional view
  • LO or not LO
  • LO has first shot, first kill
  • LO survives air threats
  • Non-LO cannot win
  • Non-LO is easily targeted

• This view is simplistic
There are three kinds of LO

- Reduced RCS
  - Narrowband
  - Limited aspect
  - Synergistic with active jamming

- LO
  - Wider bands
  - “Bow tie”
    - Lateral RCS peaks
  - No active jamming
  - Some variance within this group

- VLO
  - All RF bands
  - All aspect
  - Managed IR
  - Managed visual
LO is not free - 1

- F-35A and Typhoon
  - Similar installed thrust
  - Similar normal fuel loads
  - F-35A has 2 tonnes greater OEW
  - Typhoon has 17 per cent larger wing
    - Effective difference greater due to configuration
  - F-35A has no carriage flexibility in LO mode
    - Four stations in LO mode
    - Maximum of two offensive weapons (except SDB)
  - F-35A has less carriage flex in non-LO mode
    - No combat tanks in basic SDD
    - No one- or three-tank configurations
    - Only four heavy stations if more than two AMRAAMs carried
LO is not free - 2

- External fuel and loads are not all bad
  - Internal fuel volume adds cross-section (drag) and weight
  - External tanks not stressed for full envelope and 8000 h
  - Internal weapons not 100 per cent efficient
    - Bay volume much greater than weapon volume
  - External fuel is like staging in a rocket
- Other LO weight costs
  - Weight of RAM and RAS is still significant
  - Antennas/apertures large and heavy
- LO is largely fixed
  - Shape determines much of RCS
  - Upgrade would be major exercise
- Connectivity is a real issue
  - F-22-to-F-35 issue only just resolved
LO is not free - 3

• 1.5 X F-16 payload?

**F-35A KPPs**
- 600 nm hi-lo-hi
- 2 x 2000 lb JDAM
- 2 x AIM-120
- No SRAAMs
- External fuel is ferry-only
- Actual: 670 nm all-hi-alt
Counter-LO

- No “stealth-killer” invented yet
- But many potential solutions
  - New radar
    - Track before detect, AESA, bistatic
  - Old radar
    - VHF, OTH-metric
  - Different RF systems
    - Passive location, passive bistatic
  - Combined & networked systems
    - VHF or OTH show AESA where to look
  - New systems
    - Better IR, active IR
- Take advantage of operational realities
  - Glints from weapon bay opening
  - How does an LO fighter transmit to the net?
  - HUMINT reports take-off
    - F-35 will have unique acoustic signature
- Likely that threat will improve faster than F-35 can be upgraded
Fighter lethality

• New attributes
  • Information platform
    • Targeting pods & AESA
    • Onboard data storage and datalinks
  • Weapon platform
    • Increasing diversity of weapons
      • From long-range standoff to ultra-precise, low-yield
    • AAM load-out - Multi-shot tactics are real

Four GBU-38s, four SDBs, two GBU-12s, AMRAAMs, gun and Sniper...

... Five entirely different types of weapon
When the F-16 entered service...

This was the latest way to listen to disco

This was a cutting-edge accessory

This was very cool if you knew what it was for

There was a digital camera in here. But it was classified

And this was a couple of years away...

Today’s generals, vice-presidents and senior government officials were developing their combat skills with this
Targeting pods

- Instant precision bomber
  - New generation pods
    - Better IR range
      - ID quality
    - Better laser range
      - Designation and geolocation
  - Compatible with helmets
  - Available with datalinks

- Vital element of CAS
  - Receive/transmit imagery
  - Cue on to illuminated targets
  - Transmit imagery of target to JTAC
    - Confirm that you are looking at same target

- If you don’t do CAS in 2009, you are a paperweight
- Easily extrapolated into a recce sensor
AESA

- A super radar
  - Air tracks
  - Interleaved modes
  - High performance
- But more than that
  - Jammer
  - ESM
  - Communications
- Price in process of crashing
Digital EW & Information

• Massive improvement in EW
  • Wideband
  • Weapons-grade accuracy
  • Target ID
  • Specific Emitter ID will come
  • Jamming and active cancellation
  • SEAD/DEAD

• Displays
  • Sensor fusion a reality
  • Crew can absorb more information
  • Long-range situational awareness

• Recording
  • Record video, select frame, transmit
  • Far less bandwidth than UAV

“The American navy is now so worried about Sorbstiya jamming their new APG-79 radar that they are introducing a new infrared tracker on the F/A-18E/F.”

Col. Grigory Medved, on AusAirpower
Return of the two-seater?

• The fighter cockpit can be an information hub
• Different philosophies
  • F-22, F-35 – no two-seater
    • Relatively expensive to do
    • F-22: primarily air-to-air, no EO or IR
    • F-35: reliance on very advanced displays
  • MiG-35
    • Two-seater standard; common forward fuselage
  • Rafale
    • French AF decided on majority two-seater force in 1990s
  • Super Hornet
    • Most Block 2s are two-seaters, including all RAAF jets
  • Typhoon, Gripen
    • Most two-seaters deployed as classic trainers
• How will this change as information flow increases?
Conclusions

• The fighter will survive
• Classic themes are still relevant
  • Air combat capability
  • Mobility and lethality
• Versatility is key
  • Effectiveness and usability across conflict spectrum
  • Longevity equals affordability
• Stealth is one element of survivability
• The fighter is a platform for many technologies