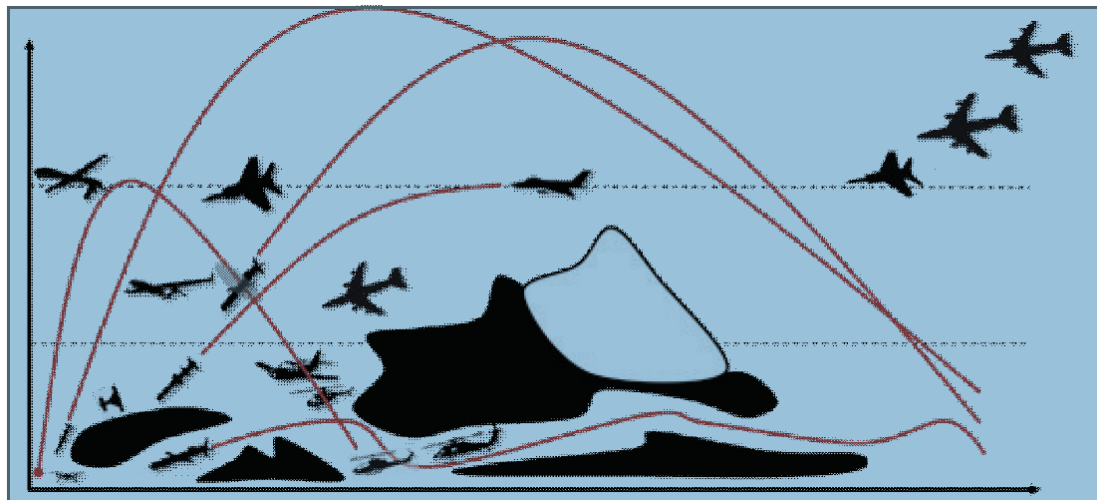


# Surveillance for Air Policing and Air Defence with **Active** and **Passive** Sensors



Peter Weber, SAF  
Head of ISR&EW

# ATC (civ) vs Surveillance (mil) (simplified)

<b>Cooperative</b> Targets (with flight plan)	<b>Non-Cooperative</b> Targets
Civilian ATC <b>SSR / MLAT for Identification</b> Radio Communication	Military Surveillance <b>PSR for Tracking</b> Radio Communication  → Focus on Military Surveillance

# Military Surveillance Scenario from "Peace" → Tension → Conflict / War

My personal considerations: based on Scenario assuming strong enemy

- **Red Force**

- Air power
- Reconnaissance (IMINT, SIGINT, HUMINT)
- CM, BM
- Cyber, EW, ...

- Inputs from

- Gulf war (1991) ; Libya (2011)
- Ukraine (2014 – 2022)
- Taiwan (2022)

Example for "Peace" to Tension to Conflict / War  
Example for "Peace" to Tension to ?

- Basics from ISR & EW

→ Conclusions may apply to many countries: **Blue Force**

## Considerations on the use of active / passive sensors

### Sensor Survivability

- Active Sensors (Ground Based Active Radar)
  - Permanent deployment easy to localize  
→ risk of destruction
  - semi-mob deployment to avoid enemy reconnaissance / destruction
  - PSR and SSR/IFF usually combined  
→ passive MLAT for SSR/IFF (Mode 5 Level 2) ?
- Passive Sensors (Passive Radar, MLAT, SIGINT)
  - are complementary to active sensors with the advantage of better **Survivability** (conflict)

### Performance Passive Radar

- Does not match (status 2022) performance of Active Radar
  - Tracking less accurate
  - Less range → limited early warning
  - Cueing for GBAD Radar possible
  - If standalone – no SSR/IFF capability
- Cannot replace Active Radar
- Stealth detection capability
- own TX: low cost & easily replaceable could improve coverage and detection
- Use cases for operation during Peace, Tension and Conflict ?

### Operation with Active Radar & Passive Radar (during Tension / Conflict / War)

- Optimization of Survivability vs Early Warning

# Concept study for increased Sensor Survivability

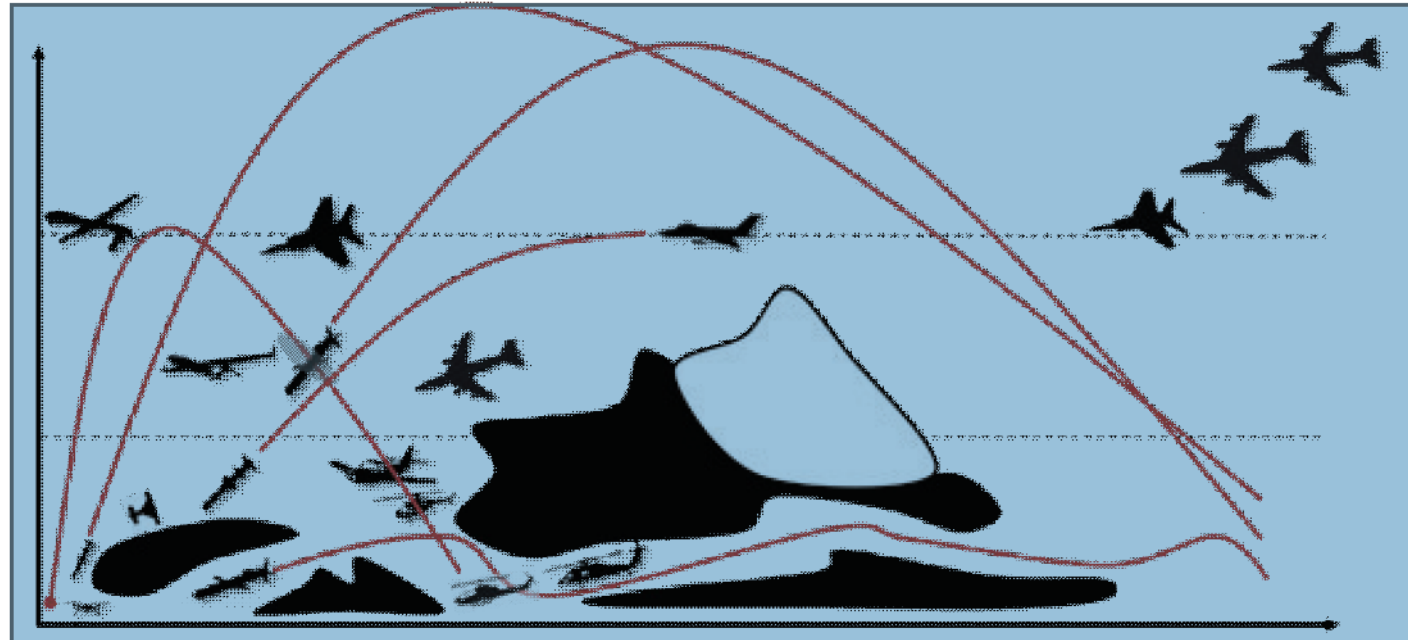
## 1) Objects of interest for **RAP** and **GBAD**

**Mil Aircraft**

**Missiles (CM, BM, hypersonic)**

- Range
- Altitude
- RCS

→ Sensor requirements for RAP, GBAD  
Tracking Targets:  $RCS=0.01m^2$  @ 200 km



## 2) **Sensor Contribution** to Detection / Location / Tracking + Identifikation

# Sensor Contribution to Detection / Location / Tracking + Identification

**Solution:** calculated based on assumptions on sensitivity, RCS, power  
(classified → only ideas)

Threats (Non-coop)	PSR S-,C- Band	SSR / IFF MLAT	Airborne	PCL	SIGINT
Fighter (0.001–1 m <sup>2</sup> )	ID NCTR			Detection: x km Tracking: y km	ID Radar WF
Mil Aircraft ; Heli					
Civ Aircraft	Tracking 400 km		vis ID	Tracking 100 km	
UAV (tact/mini/micro)					
CM / BM / hypersonic					

Are Sensor requirements for RAP, GBAD fulfilled ?

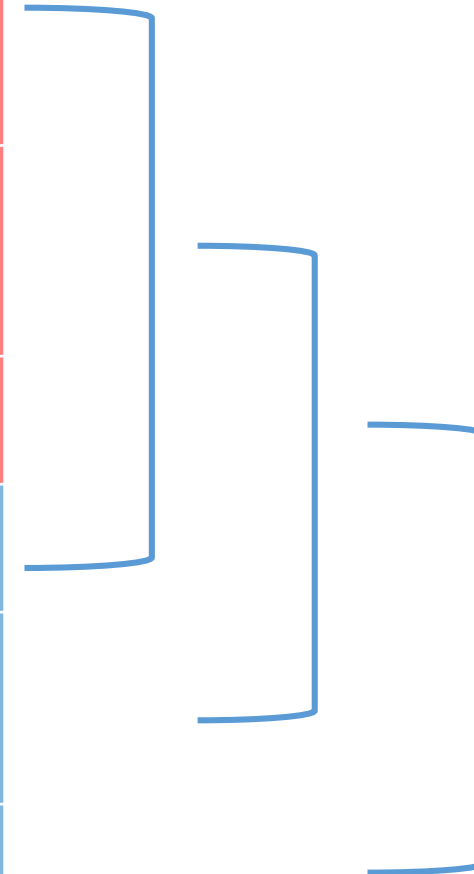
## Comparison of active / passive Radar (based on trials)

	Active Radar	Passive Radar	Criteria
Range	+	-	Early warning
Track Quality	+	Altitude poor	RAP GBAD (cueing)
Survivability	-	+	Reconnaissance by <b>red force</b>
HW vulnerability	- big damage	+ only antenna	Damage caused by <b>red force</b> strike
IFF	SSR / IFF	no IFF	Identification (SSR / IFF)
passive radar cannot substitute active radar			



# Surveillance for Air Policing and Air Defence

	"Peace"
<b>Provocation</b>	<ul style="list-style-type: none"><li>• Territory / Air space "violation"</li><li>• No transponder</li><li>• GPS Jamming / Spoofing</li></ul>
<b>Reconnaissance</b>	<ul style="list-style-type: none"><li>• IMINT (space, ...)</li><li>• SIGINT</li><li>• HUMINT</li></ul>
<b>Cyber attack</b> <b>EW attack</b>	May happen, but you don't know
<b>Air Policing</b> <b>Air Defence</b>	QRA → Reaction time Surveillance – early warning as expected ?
<b>Survivability</b> <b>- Sensors</b>	Sensors operated at permanent sites <ul style="list-style-type: none"><li>• Prepare für relocation (Semi-mobile)</li><li>• Passive</li></ul>
<b>Cyber defence</b> <b>ECCM</b>	Protect ICT against Cyber Resilient Sensors for Surveillance



Message **Make surveillance radar ready for conflict @ peace time**



# Surveillance for Air Policing and Air Defence



**Malaysia Airlines MH17**

	"Peace"	Tension
<b>Provocation</b>	<ul style="list-style-type: none"> <li>• Territory / Air space "violation"</li> <li>• No transponder</li> <li>• GPS Jamming / Spoofing</li> </ul>	Political pressure (nuke) Economical isolation Military "Training"
<b>Reconnaissance</b>	<ul style="list-style-type: none"> <li>• IMINT (space, ...)</li> <li>• SIGINT</li> <li>• HUMINT</li> </ul>	cont / incr →
<b>Cyber attack</b> <b>EW attack</b>		cont / incr →
<b>Air Policing</b> <b>Air Defence</b>	QRA → Reaction time Surveillance – early warning as exp ?	CAP GBAD (if required)
<b>Survivability</b> <b>- Sensors</b>	Sensors operated at perm sites <ul style="list-style-type: none"> <li>• Semi-mobile</li> <li>• Passive</li> </ul>	Relocate Active Radar for RAP and GBAD
<b>Cyber defence</b> <b>ECCM</b>	Protect ICT against Cyber Resilient Sensors for Surv	

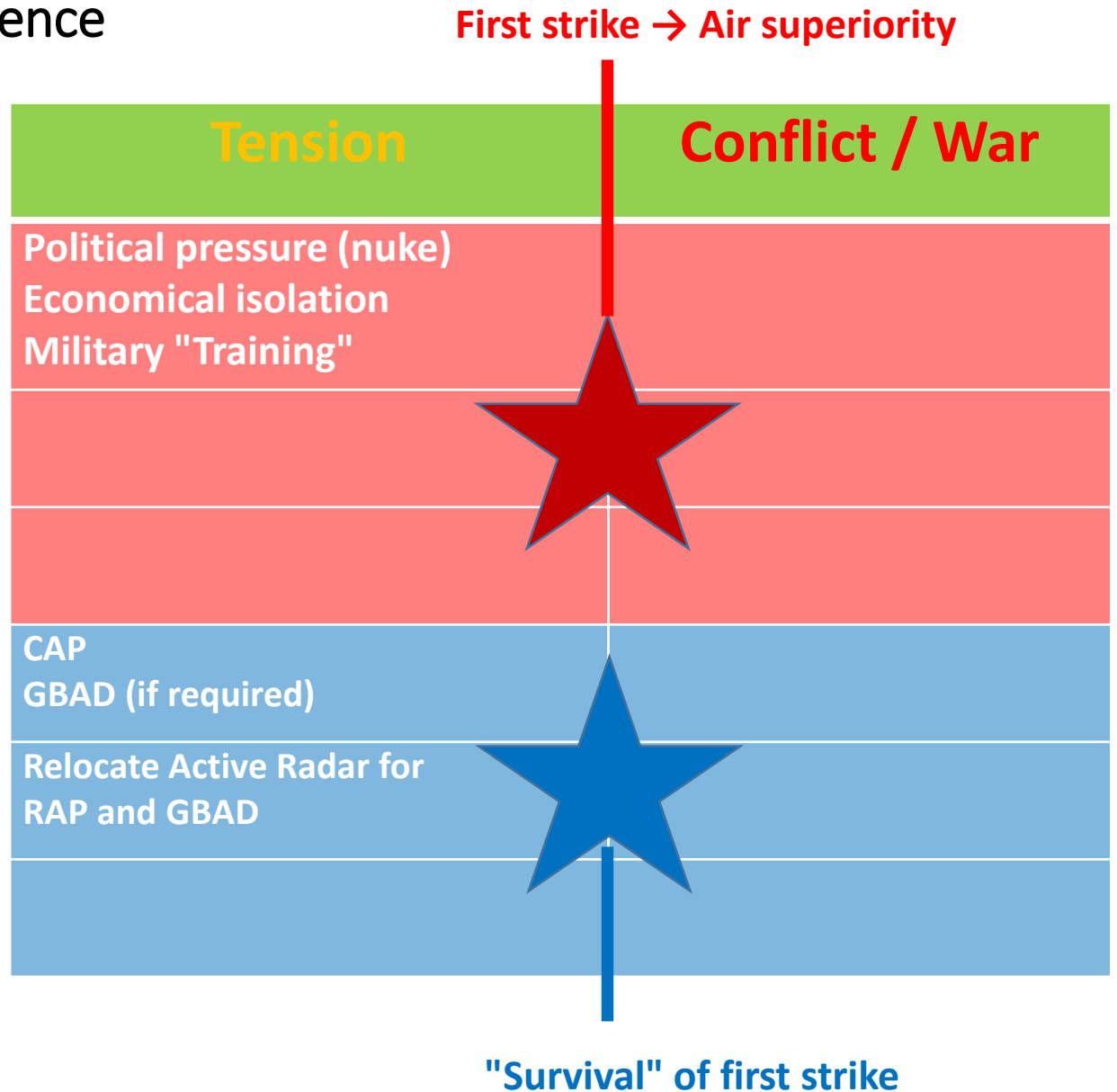
**When is the right time ?**

# Surveillance for Air Policing and Air Defence



## Strategy for Survival

Active sensors      easy to localize → semi-mobile  
 Passive sensors    difficult to localize



## Considerations on the use of active / passive sensors: update

### Sensor Survivability

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### Surveillance (during Tension / Conflict / War)

- Operation with semi-mobile active & passive sensors, using EMCON concept for optimized surveillance, early warning and survivability, thereby minimizing losses
- There is Potential for Surveillance beyond Radar (SIGINT, IFF / MLAT)