FUTURE EW CHALLENGES AND THE INFORMATION LAYER

mass
a Cohort plc company

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BACKGROUND AND CONTEXT

Weapon engagements of the future won't get any easier…. They will:

- **Be within a complex and congested EW environment**
- **Present scant warning cues to our platforms**
- **Be delivered so fast that man-in–the loop responses will be too late**

In the face of these challenges, how will our tactical use of EW have to change, and how will our strategic view of EW change?

What challenges does that present to the EW community?

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The Problem

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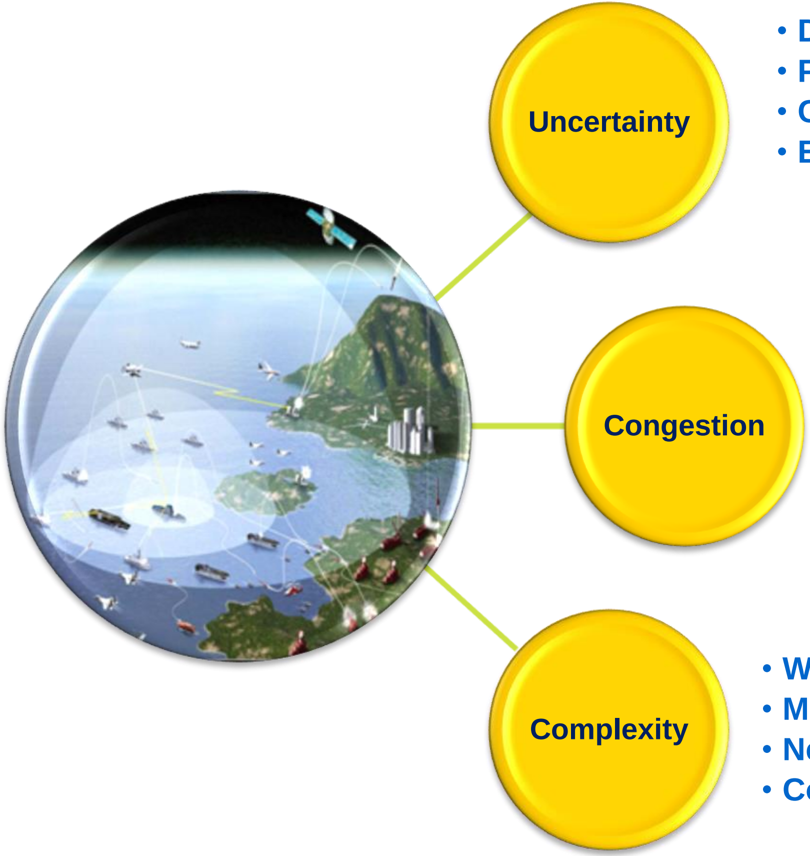
BATTLESPACE CHALLENGES



Uncertainty

- Data gaps
- Probability of Intercept
- Conflicting views
- Environmental effects

Congestion

- Technology proliferation
- More platforms
- Data-driven world

Complexity

- Waveform, weapon, sensors sophistication
- Multi-spectral engagements
- Networked systems
- Complex platforms (but reduced crew complement)

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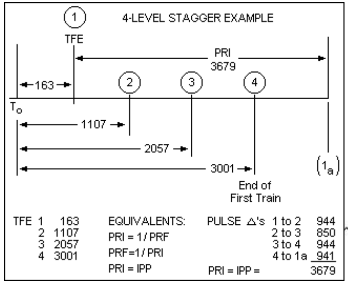
UNCERTAINTY / CONGESTION - WHAT IS ‘EW’ INFORMATION?

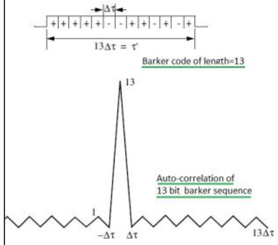
We’ve probably all been brought up to think of ‘parametrics’

- *RF, PRI, PD, Scan....3 element 4 position stagger..etc*
- *PDW, intrapulse, barker coding, UMOP*
- *Receiver Noise Figure, burn-through range, J to S ratio*



TFE	1	163	EQUIVALENTS:
	2	1107	PRI = 1/ PRF
	3	2057	PRF=1/ PRI
	4	3001	PRI = IPP

PULSE Δ's	1 to 2	944
	2 to 3	850
	3 to 4	944
	4 to 1a	941
PRI = IPP =		3679



Barker code of length=13

Auto-correlation of 13 bit barker sequence

But EW is about spectrum dominance within an ***environment***

- *Platform details (location, identity, affiliation etc)*
- *Confounding features (windfarms, 4G phone masts etc)*
- *Confounding effects (e.g. anomalous propagation)*

However, new types of information now have an effect on how we wage ***EW***

- *Network dependence vs standalone resilience*
- *Cyber protection and vulnerability*

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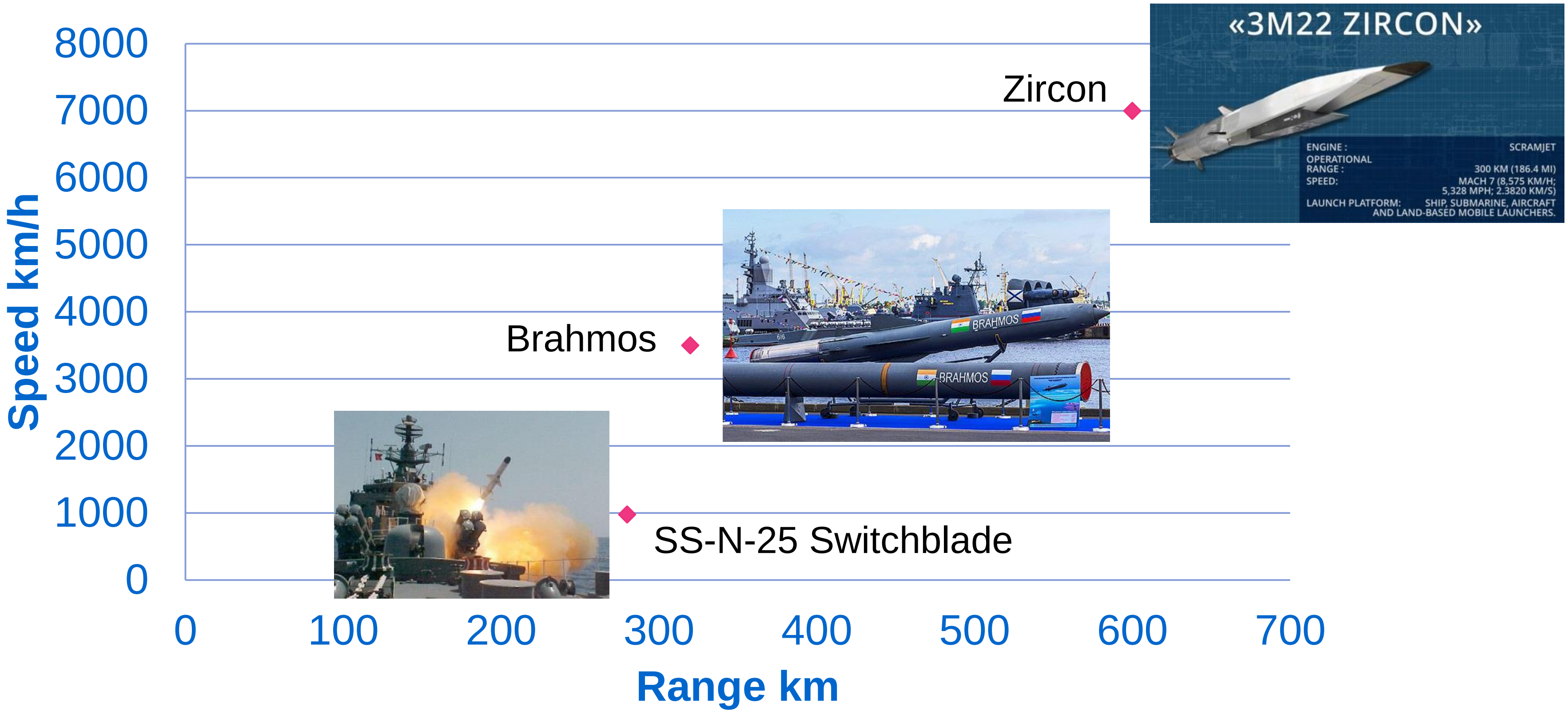
COMPLEXITY - THE HYPERSONIC ASM THREAT



ENGINE : SCRAMJET
OPERATIONAL RANGE : 300 KM (186.4 MI)
SPEED: MACH 7 (8,575 KM/H; 5,328 MPH; 2.3820 KM/S)
LAUNCH PLATFORM: SHIP, SUBMARINE, AIRCRAFT AND LAND-BASED MOBILE LAUNCHERS.

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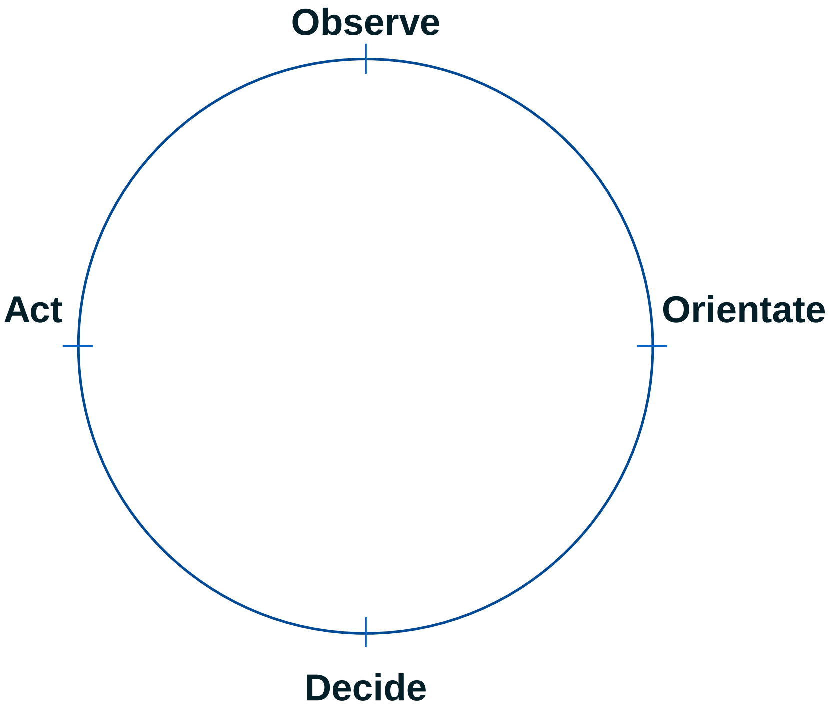
REVISITING THE OODA LOOP



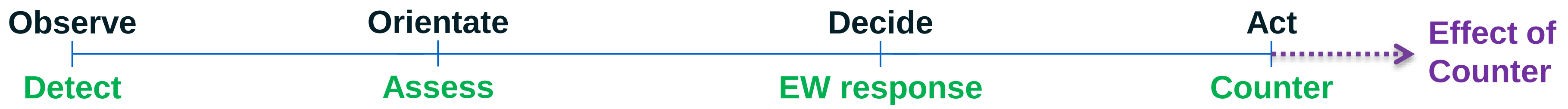
Observe

Orientate

Decide

Act

‘DEFENDING’ OODA



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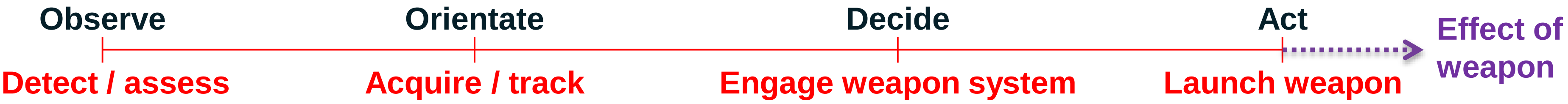
HOSTILE OODA



Observe

Detect / assess

Orientate

Acquire / track

Decide

Engage weapon system

Act

Launch weapon

Effect of weapon

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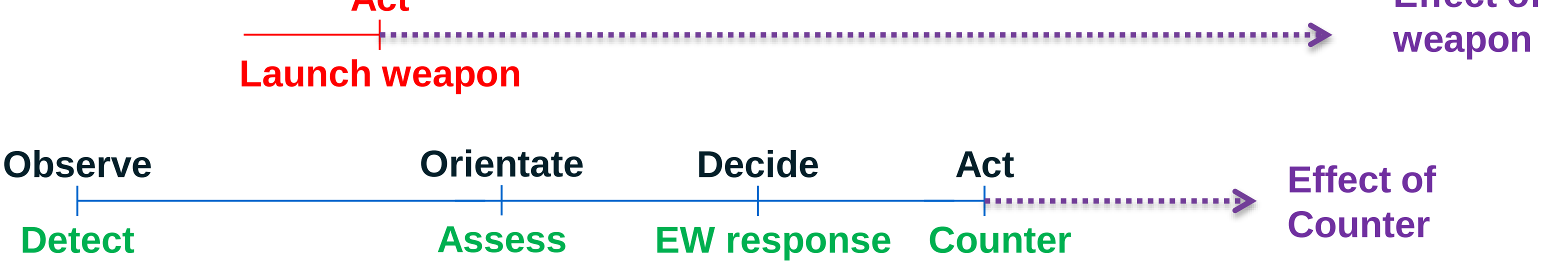
COMPARING TIMELINES #1

SS-N-25 980 km/h   (275 m/s)



Act

Launch weapon

Effect of weapon

Observe

Orientate

Decide

Act

Detect

Assess

EW response

Counter

Effect of Counter

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COMPARING TIMELINES #2

Brahmos 3500 km/h (~1000 m/s)

Act

Launch weapon

Effect of weapon

Observe **Orientate** **Decide** **Act**

Detect **Assess** **EW response** **Counter**

Effect of Counter

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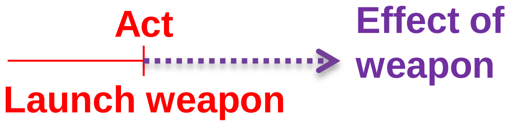
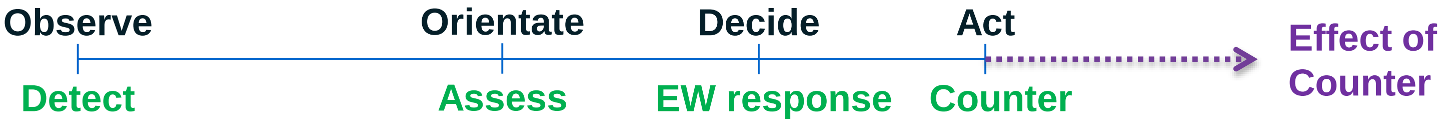
COMPARING TIMELINES #3

«3M22 ZIRCON»

ENGINE :	SCRAMJET
OPERATIONAL RANGE :	300 KM (186.4 MI)
SPEED:	MACH 7 (8,575 KM/H; 5,328 MPH; 2.3820 KM/S)
LAUNCH PLATFORM:	SHIP, SUBMARINE, AIRCRAFT AND LAND-BASED MOBILE LAUNCHERS.

Zircon 7000 km/h (~2000 m/s)





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PROBLEM SUMMARY

Data

- *We're highly dependent on it…but equally, overwhelmed by it*
- *Having 'data' isn't the same as a coherent authoritative picture*
- *Has our fixation on 'normal' EW data reduced our ability to consider and filter-out obfuscations in the EM environment?*

Decisions, Actions and Effects

- *Man-in-the-loop decision making and action initiation will be too slow to counter future threat weapon systems*
- *Will there be time for traditional CMs to have an effect on future threat weapon systems?*

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Potential Solutions

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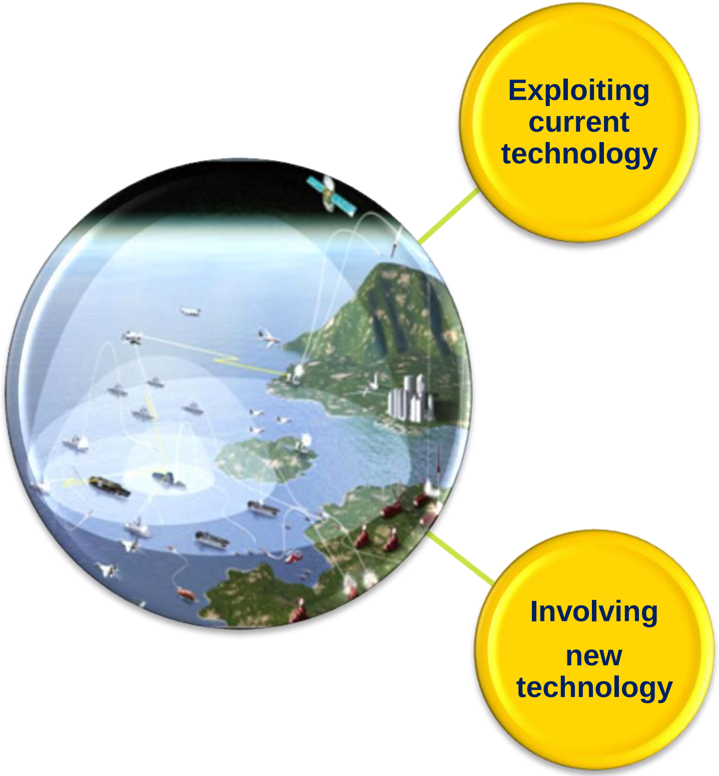
POTENTIAL SOLUTIONS - OVERVIEW



Exploiting current technology

- Full-spectrum, full-depth EW data management & exploitation
- Better knowledge of the Kill Chain
- Affecting the Kill Chain even earlier
- Better engagement modelling and full-spectrum / trans-spectrum CM development

Involving new technology

- Decision making aided by Machine Learning (ML)
- ML-led filtering of Situational Awareness picture
- Rapid communication & initiation of CMs
- Co-operative, co-ordinated defence and CMs
- Cyber: clarifying, focussing and converging it within traditional EW ConOps/ConEmp/ConUse

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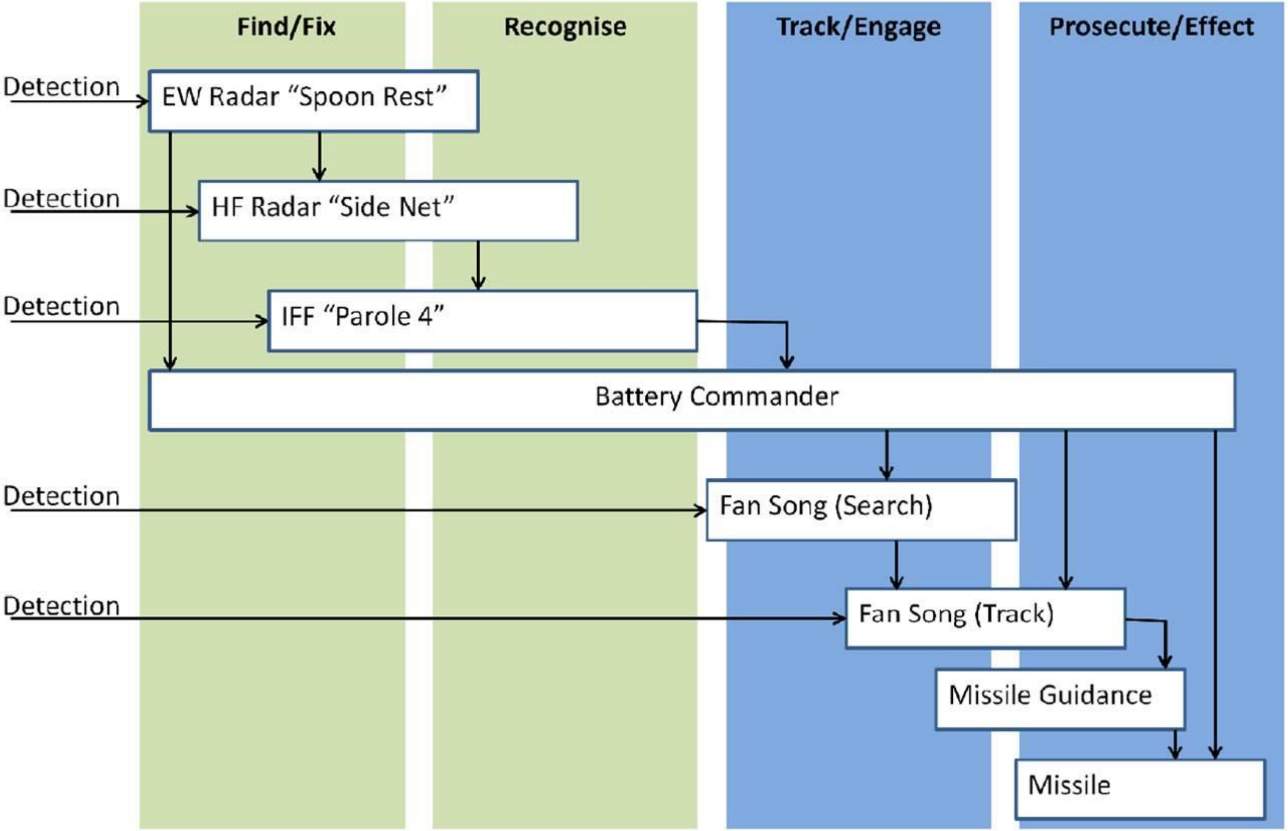
KILL CHAIN EXAMPLE 1



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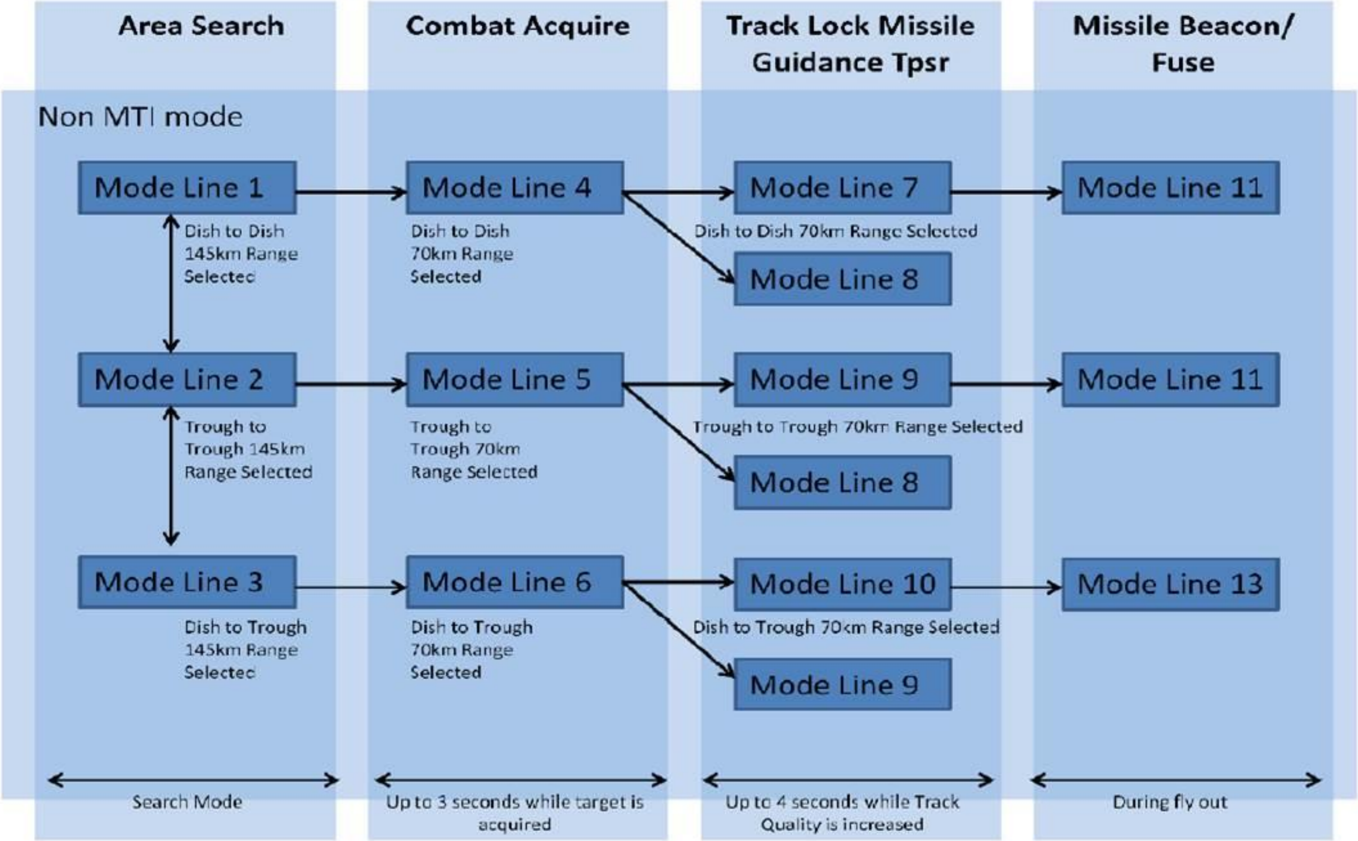
KILL CHAIN EXAMPLE 2



Area Search

Combat Acquire

Track Lock Missile Guidance Tpsr

Missile Beacon/ Fuse

Non MTI mode

Mode Line 1

Dish to Dish 145km Range Selectec

Mode Line 2

Trough to Trough 145km Range Selected

Mode Line 3

Dish to Trough 145km Range Selectec

Mode Line 4

Dish to Dish 70km Range Selected

Mode Line 5

Trough to Trough 70km Range Selected

Mode Line 6

Dish to Trough 70km Range Selected

Mode Line 7

Dish to Dish 70km Range Selected

Mode Line 8

Mode Line 9

Trough to Trough 70km Range Selected

Mode Line 8

Mode Line 10

Dish to Trough 70km Range Selected

Mode Line 9

Mode Line 11

Mode Line 11

Mode Line 13

Search Mode

Up to 3 seconds while target is acquired

Up to 4 seconds while Track Quality is increased

During fly out

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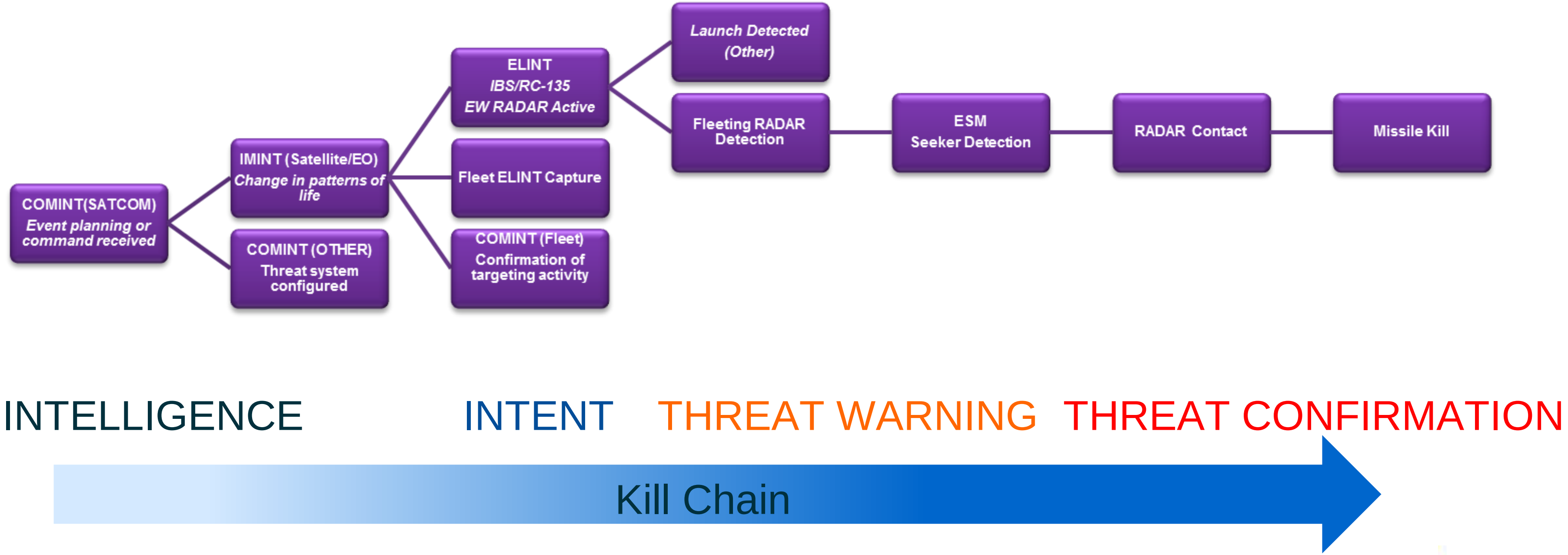
‘AWARENESS’ CHAIN



COMINT(SATCOM)
Event planning or command received

IMINT (Satellite/EO)
Change in patterns of life

COMINT (OTHER)
Threat system configured

ELINT
IBS/RC-135
EW RADAR Active

Fleet ELINT Capture

COMINT (Fleet)
Confirmation of targeting activity

Launch Detected (Other)

Fleeting RADAR Detection

ESM
Seeker Detection

RADAR Contact

Missile Kill

INTELLIGENCE

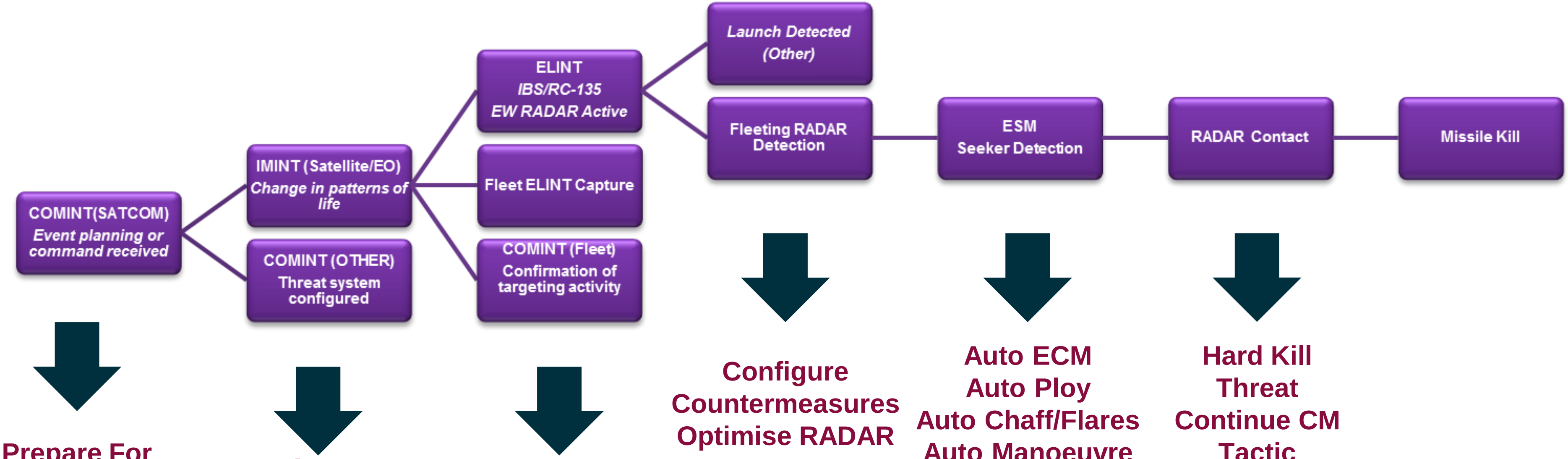
INTENT

THREAT WARNING

THREAT CONFIRMATION

Kill Chain

COUNTERING THE KILL CHAIN



COMINT(SATCOM)
Event planning or command received

IMINT (Satellite/EO)
Change in patterns of life

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Threat system configured

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Confirmation of targeting activity

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Fleeting RADAR Detection

ESM
Seeker Detection

RADAR Contact

Missile Kill

Prepare For Threat: Increase Threat State

Auto Configure Sensors

Mitigate Threat – Move Out of Threat Range (Task Dependent)

Configure Countermeasures Optimise RADAR

Auto ECM
Auto Ploy
Auto Chaff/Flares
Auto Manoeuvre
Configure Hard Kill Options

Hard Kill Threat
Continue CM Tactic

MACHINE LEARNING

Promises to offer potential solutions to our Battlespace Challenges:

ESM/ELINT Sensors:

- Modern ML techniques could improve identification of signals in congested and contested spectrum
- In future AI could allow sensors to be ‘dumber’ (more generic/modular) with most effort in post-sensor processing…
- …or AI-based RF digitisers to improve detection of complex and LPI emitters

Command Systems

- Anomaly detection reduces operator burden and improves sensemaking
- Automatic reconfiguring/optimisiation of sensor systems
- Force-level co-operation and optimisation

Platform Protection/Defensive Aids Suites

- Increased use of AI in decision making and info-presentation layers (user interface, SA , and C2): reduce manning, increase response speed, predict intent

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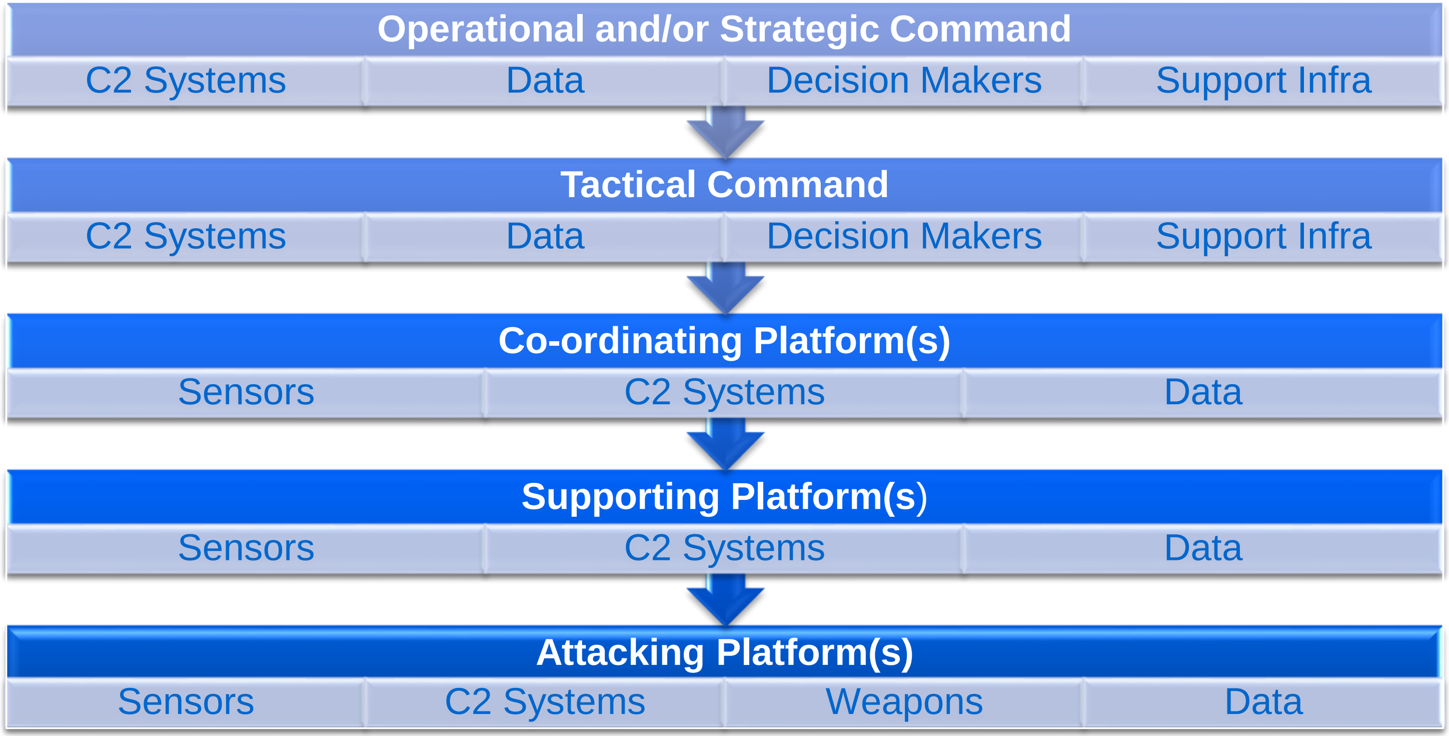
COUNTERING THE KILL CHAIN



Operational and/or Strategic Command

C2 Systems | Data | Decision Makers | Support Infra

Tactical Command

C2 Systems | Data | Decision Makers | Support Infra

Co-ordinating Platform(s)

Sensors | C2 Systems | Data

Supporting Platform(s)

Sensors | C2 Systems | Data

Attacking Platform(s)

Sensors | C2 Systems | Weapons | Data

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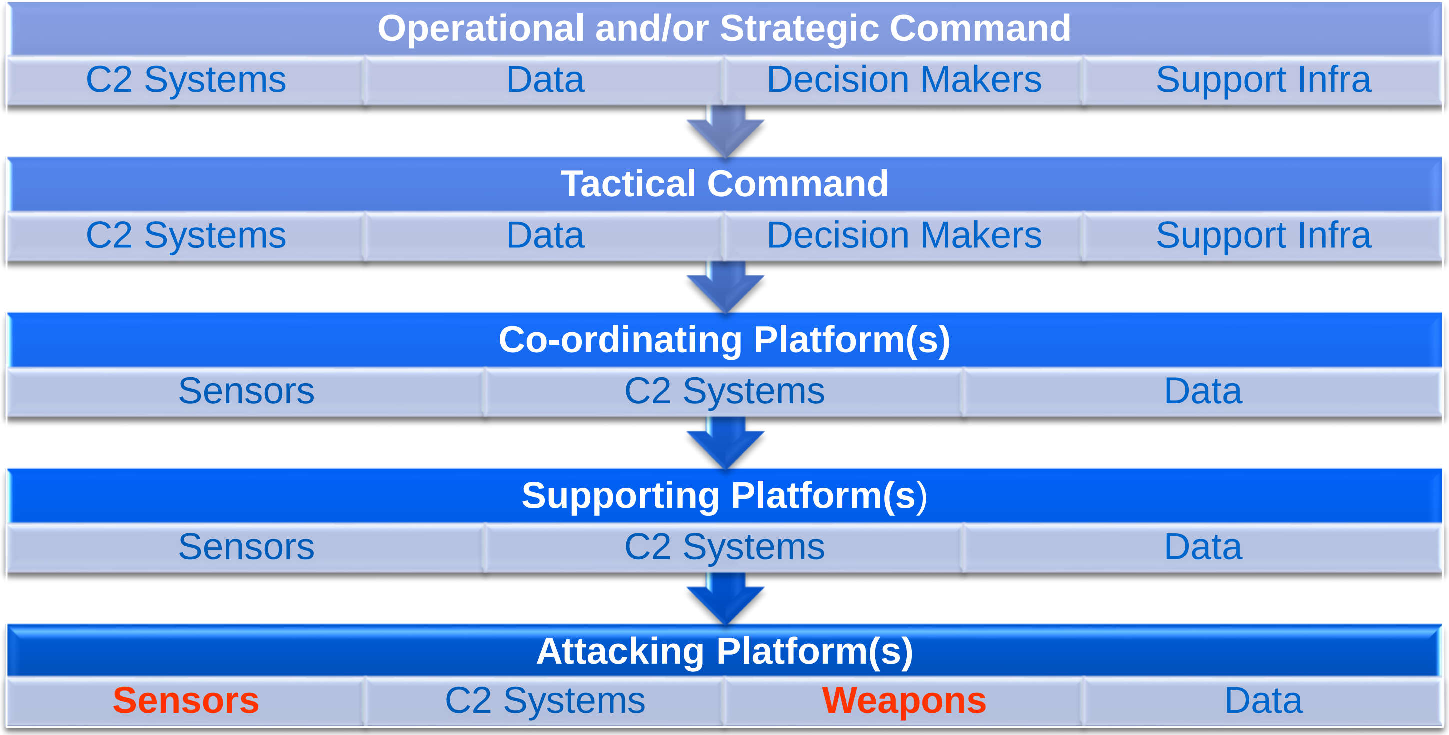
‘TRADITIONAL’ CM – PLATFORM PROTECTION



Operational and/or Strategic Command

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Tactical Command

C2 Systems | Data | Decision Makers | Support Infra

Co-ordinating Platform(s)

Sensors | C2 Systems | Data

Supporting Platform(s)

Sensors | C2 Systems | Data

Attacking Platform(s)

Sensors | C2 Systems | **Weapons** | Data

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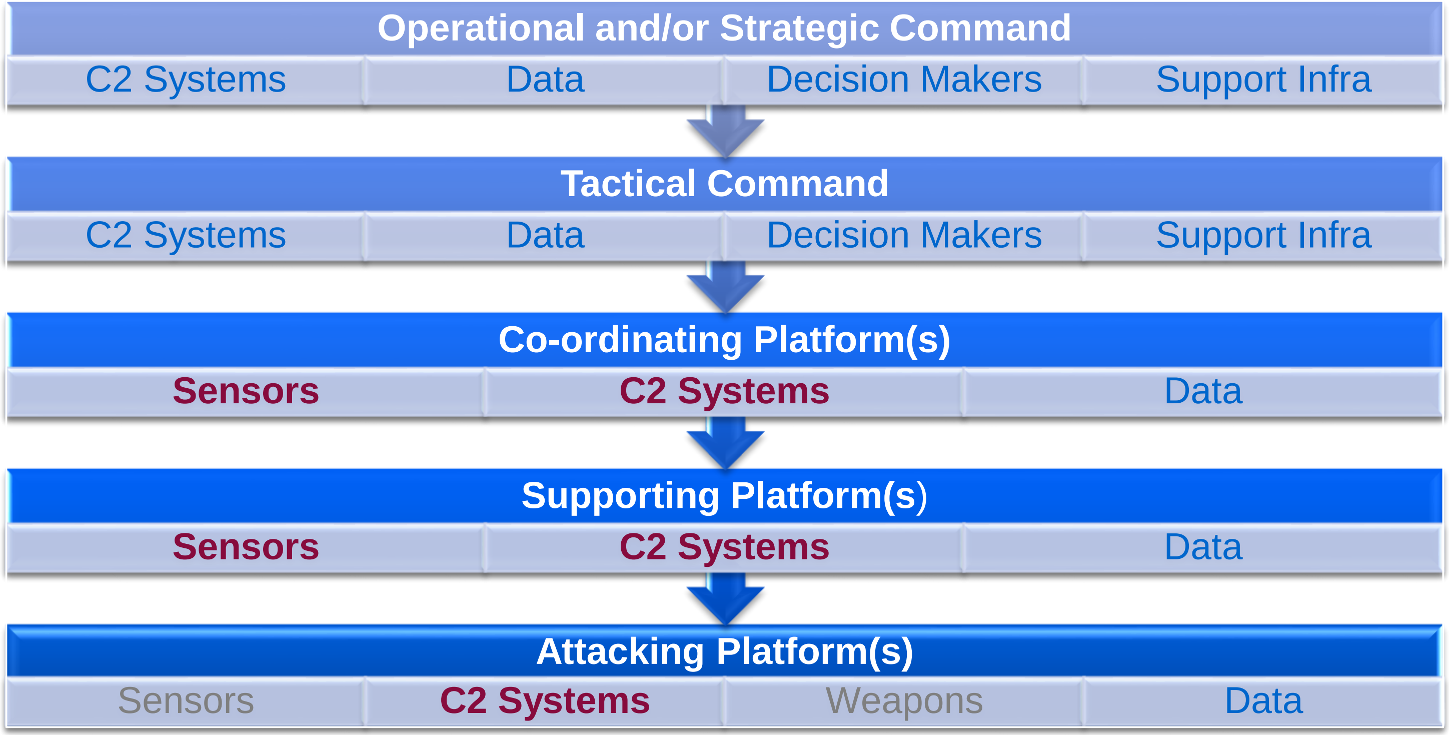
‘TRADITIONAL’ CM – STAND-OFF



Operational and/or Strategic Command

C2 Systems | Data | Decision Makers | Support Infra

Tactical Command

C2 Systems | Data | Decision Makers | Support Infra

Co-ordinating Platform(s)

Sensors | **C2 Systems** | Data

Supporting Platform(s)

Sensors | **C2 Systems** | Data

Attacking Platform(s)

Sensors | **C2 Systems** | Weapons | Data

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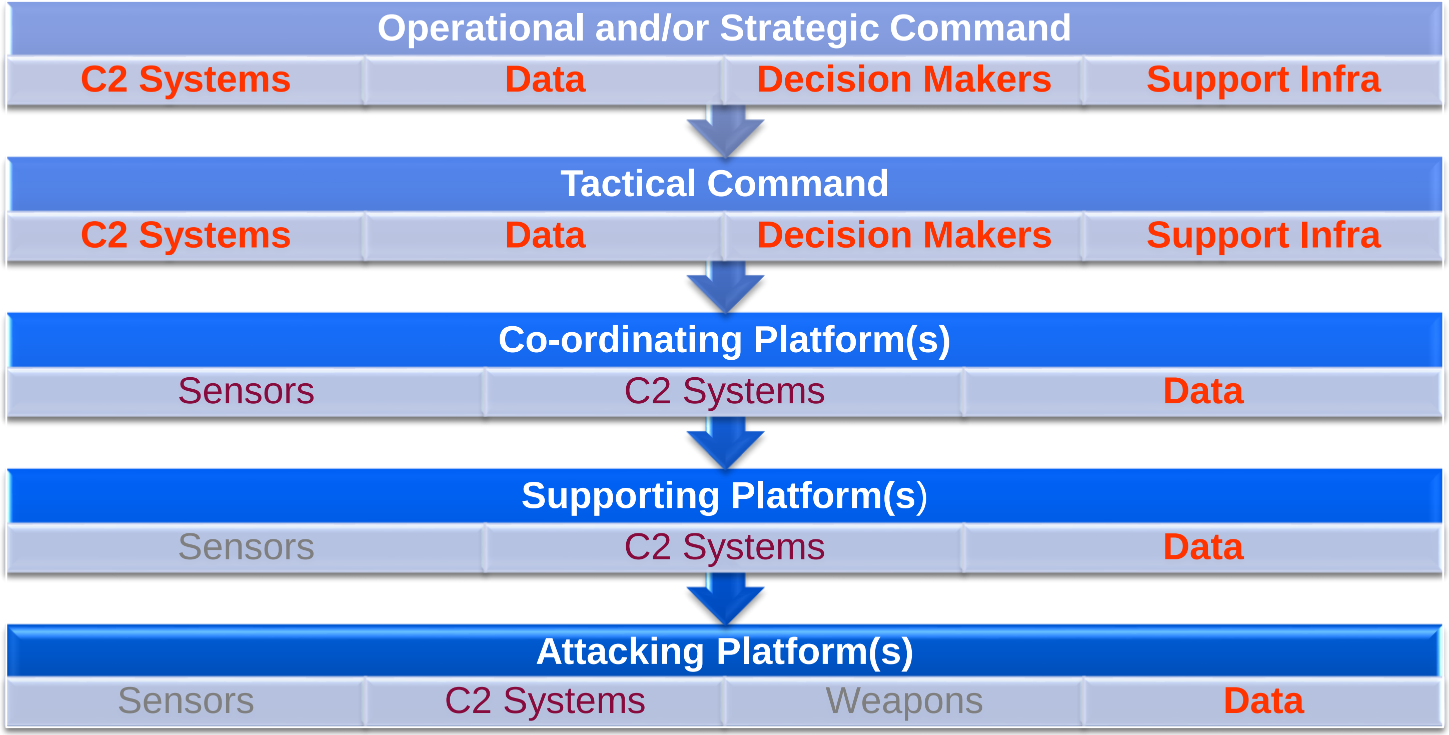
CM – CYBER?



Operational and/or Strategic Command

C2 Systems | Data | Decision Makers | Support Infra

Tactical Command

C2 Systems | Data | Decision Makers | Support Infra

Co-ordinating Platform(s)

Sensors | C2 Systems | Data

Supporting Platform(s)

Sensors | C2 Systems | Data

Attacking Platform(s)

Sensors | C2 Systems | Weapons | Data

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CONVERGENCE OF TRADITIONAL EW & CYBER

So, you're saying that Cyber should be incorporated as a CM technique for specific parts of the Kill Chain, which aren't addressed by traditional CMs?

Yes, Ron. Attacking the Kill Chain further up…using a broader range of techniques..

…but just *think* how our idea of CM Development will have to change…

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Challenges for the EW community

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CHALLENGES FOR THE EW COMMUNITY

Resource

- **Time, money and resources filling new Intel reqts**
- **Research & Development AI/ML and Cyber techniques**
- **Time, money and resources producing new CMs**
- **Development of new ConOps/ConUse/ConEmp**

Conceptual / Intellectual

- **If moving further up Kill Chain…how do we test, verify, and validate?**
- **Modelling of Cyber vulnerability and effects**
- **Combining Cyber with ‘traditional’ CM Development**

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Any Questions?

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