

Net Centric Maritime Warfare – Countering a ‘Swarm’ of Fast Inshore Attack Craft

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Running Order:

- Problem
- Requirement - FIAC types, options
- Model Selection
 - MANA - description, master scenario
- Results, Sensitivity cases
- Conclusions and Recommendations
- Lessons Learned

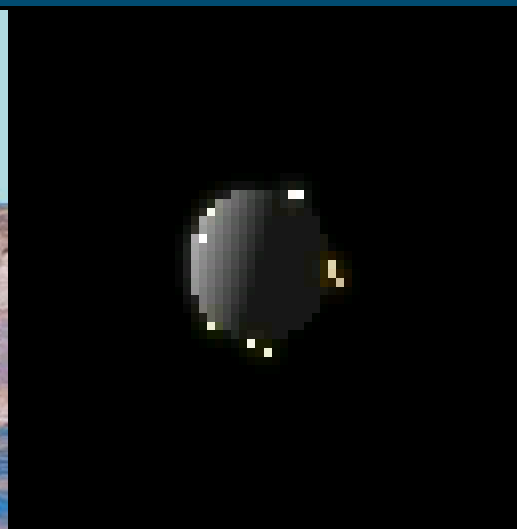
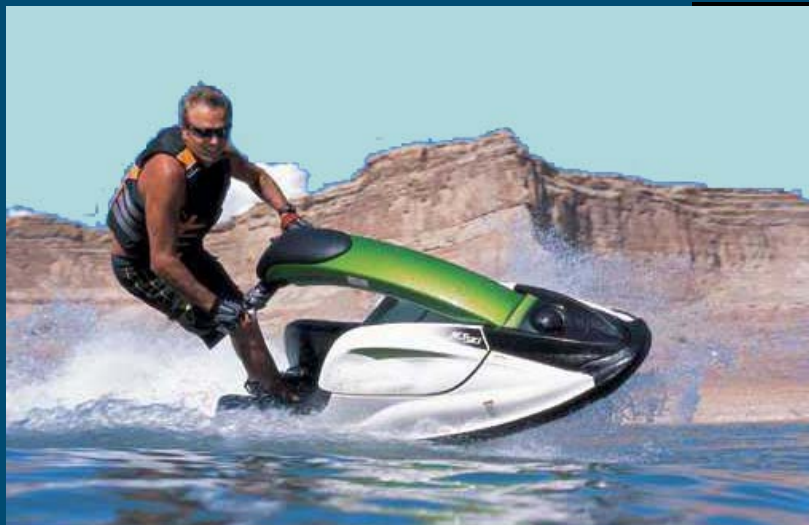
The Operational Problem:

Identity, Intent, RoE ?



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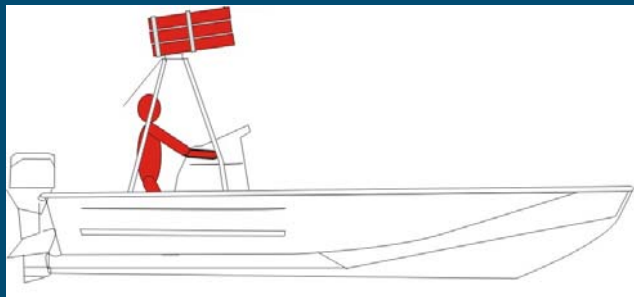
Cause



Effect

Fast Inshore Attack Craft or
Asymmetric Warfare

Tactics:



Fast Inshore Attack Craft
Asymmetric Warfare



Artists impression of a 'SWARM'

Types of FIAC:

Type 1	Jetski or Boston Whaler with Rocket Propelled Grenade (RPG) weapons or a large blast bomb used in a suicide attack. Credited with a firing range of 3-500m, at which point the enemy is assessed as a 'leaker', who has achieved their mission objectives by inflicting damage on the Coalition force.	
Type 2	Larger 'Boghammer' class boat with an unguided multiple launch bombardment rocket, or a larger anti-tank guided weapon with a launch range of 8km, at which point it then becomes a 'leaker'. The craft has weather protection and accommodation. The small crew allow it to remain at sea overnight.	
Type 3	Small Fast Patrol Boat (FPB) typified by Super Dvora, with smaller anti-ship missile or torpedo armament, and degree of sensor and Command and Control (C2) fit. Weapon ranges of 4 km (torpedo) out to 15 km (ASM) The vessel has more endurance than Type 2, allowing mission duration's of several days.	

'Degrees of networking' applicable to FIAC problem:

Sub-baseline:

No Communication

Ship is effectively a 'singleton' unit, operating in isolation.

Baseline (low):

Situational Awareness
Organic Targeting

Voice communications,
record message traffic, Link 11.

Intermediate:

SA, Organic Targeting,
Reachback to Intel

Local & wide-area networks, digital
file transfer, web browsing/chat
rooms, Link 16.

High:

SA, Organic Targeting,
Reachback to Intel,
Offboard Targeting of
Medium Range
Weapons

Full digital infrastructure, CEC
quality data exchange covering
both imagery and high-fidelity
remote targeting.

Target Set/FIAC:

Type 1
RPG/Suicide
(3-500 m)

Type 2
MLRS Rocket
(8 km)

Type 3
Missile/Torpedo
(8–15 km)

NCW capability:

Sub-baseline:
No Communication

Baseline (low):
SA,
Organic Targeting

Intermediate:
SA, Organic Targeting,
Reachback to Intel

High:
SA, Organic Targeting,
Reachback to Intel,
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Medium Range
Weapons

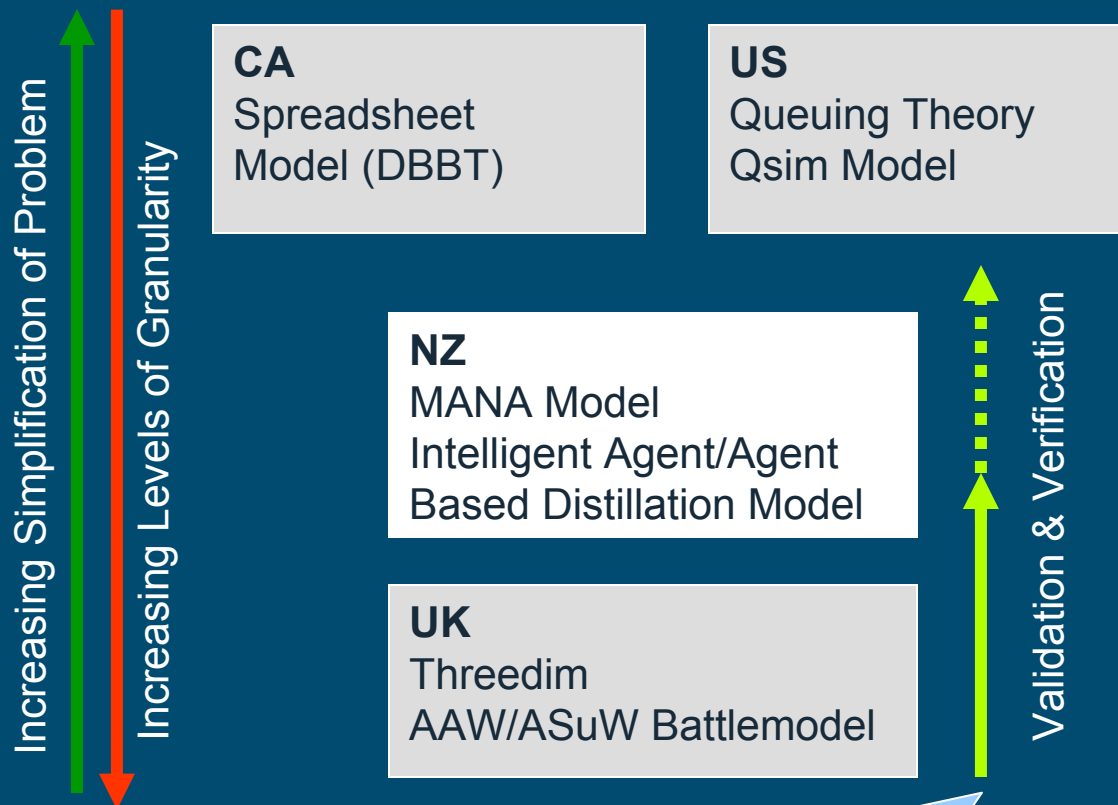
**Current
Capability**

Reference Case
(single ship, no consorts)

Variables include number in
attack, and sub-sets for
target variation, as single
axis 'sector' attack or
isotropic i.e. all round,
plus variation in speed

Overall Modelling Strategy

FIAC/SWARM — Family of Models



Use of lower model in tier to validate results of next higher level model

Strength/Weakness:

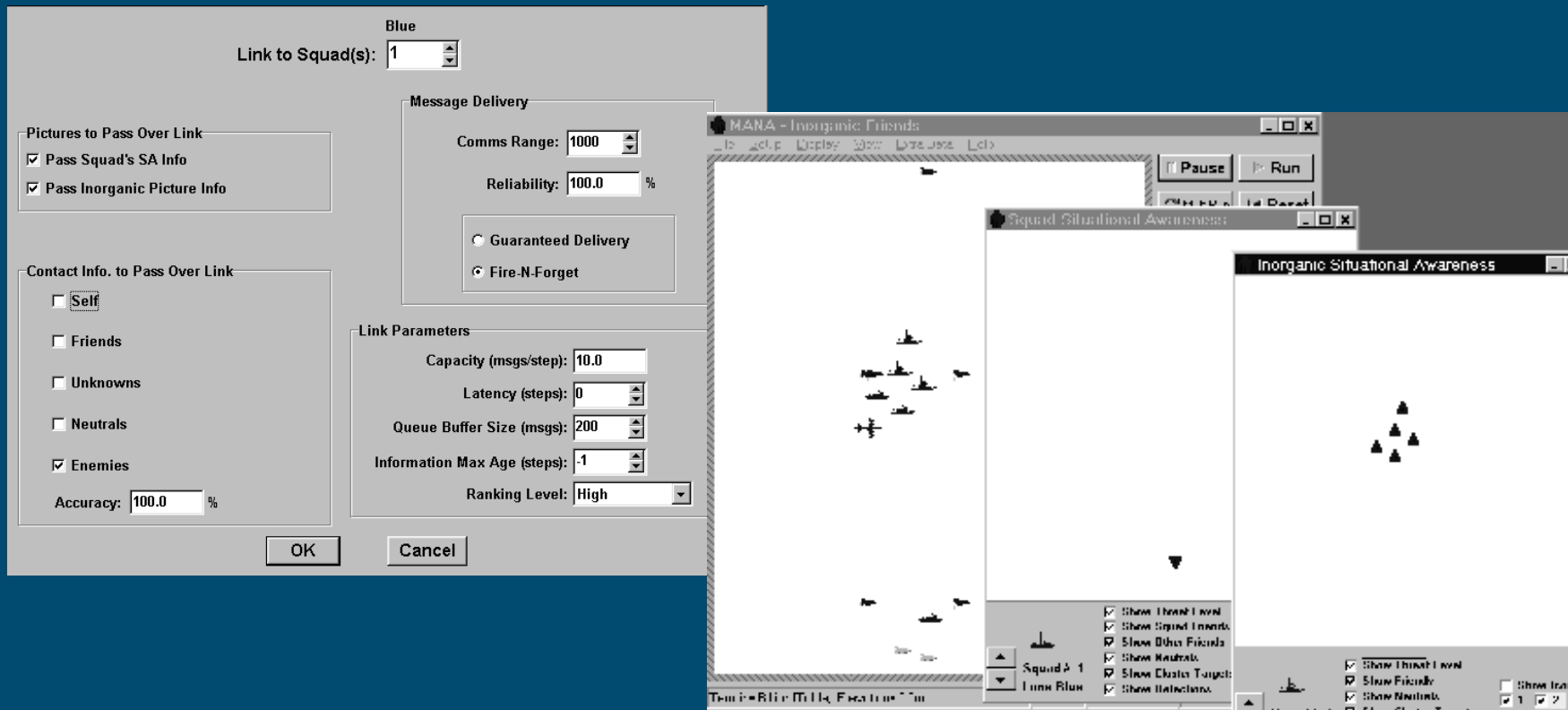
Meta-models. Safe use is dependant on being able to capture key details in an abbreviated form.

Inclusion of personality issues leads to good representation of target set and its swarming dynamics, but simplified grid and no weapon arcs.

Stronger representation of sensor and weapon details including arcs, but pre-programmed (i.e. dumb) target set.

MANA Model

Map-Aware Non-uniform Automata. Intelligent Agent-based distillation model, includes event-driven state changes, situational awareness, communications, weapons, and agent (personality) settings



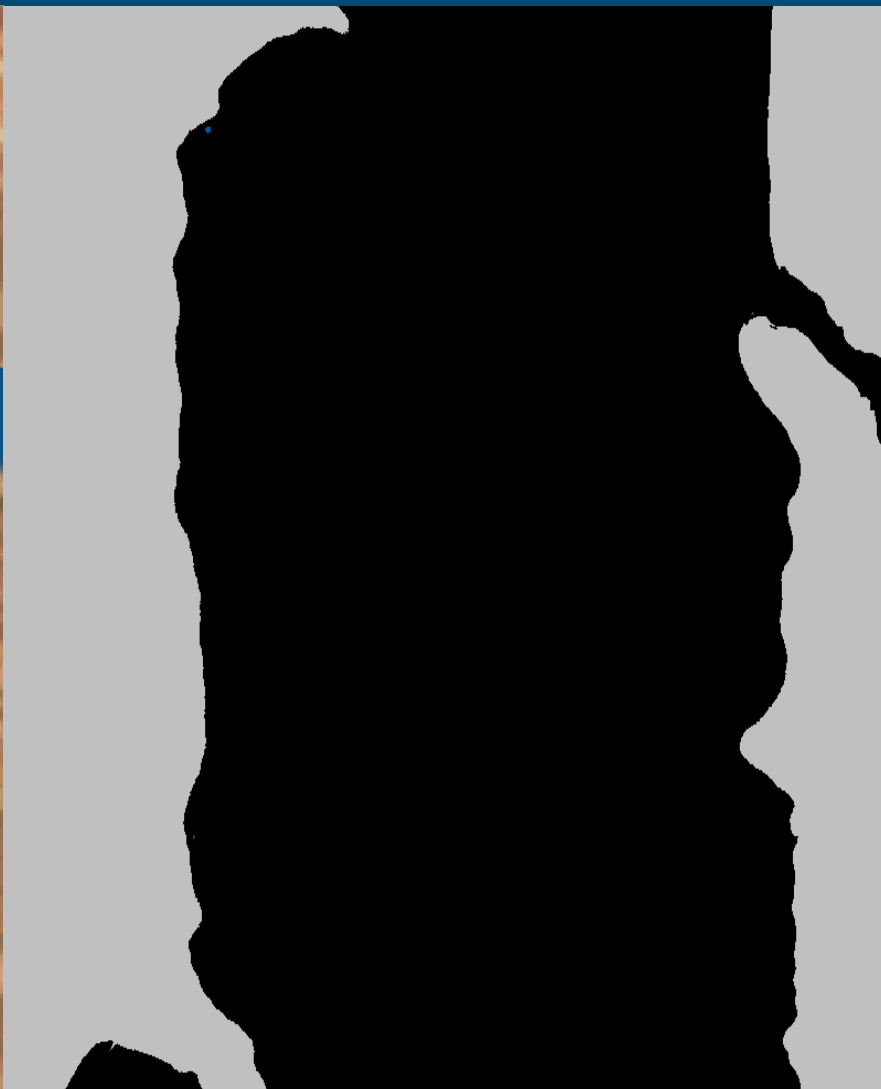
Swarm TACSIT

Tacsit: Blue force in confined sea room is attacked by a swarm of FIAC.

QUESTION - How does the level of Blue networking capability affect the efficacy of that force in an ASuW scenario in the Littoral with Red Fast Inshore Attack Craft (FIAC) swarming against it ?

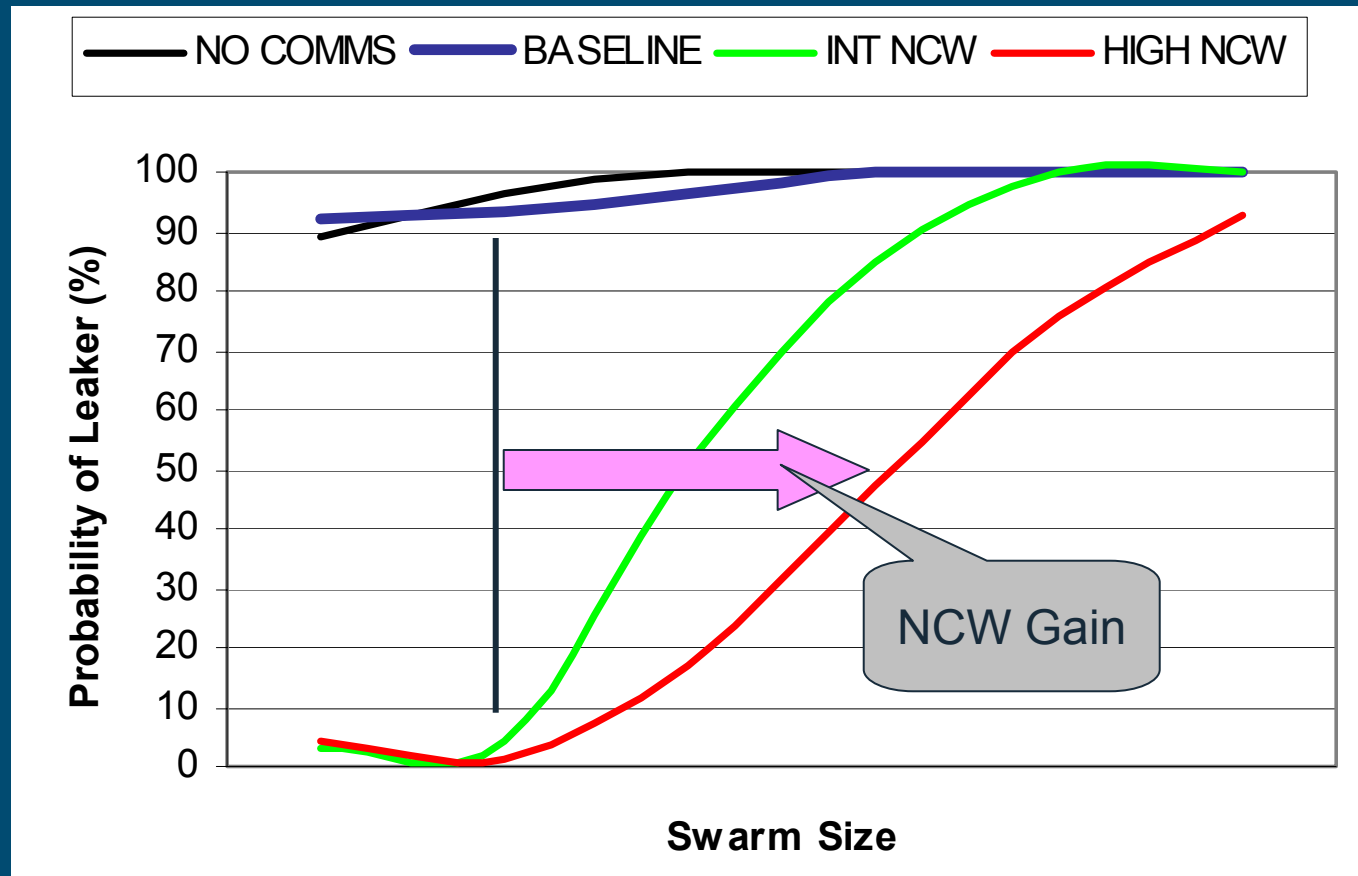
Hypothesis: Blue shared situational awareness and an associated sensor-to-effector capability reduces the number of leakers against Blue assets.

Threat. Characterised as: Type 1, Type 2 or Type 3 FIAC with appropriate weapon launch ranges. Variations on approach speed, and threat direction - single-sector 'swarm' attack, or isotropic, i.e. all round threat.



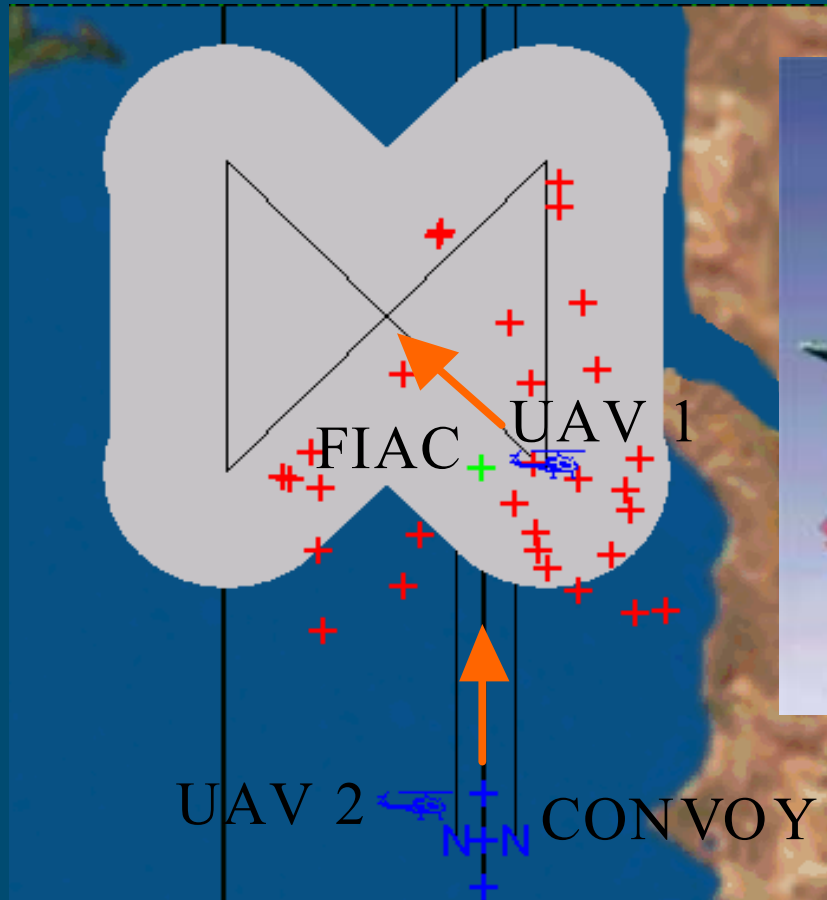
Type 1 FIAC - Concentrated Sector Attack

- Intermediate and High levels of networking increase Force survivability versus Type 1 FIAC by almost order of magnitude.

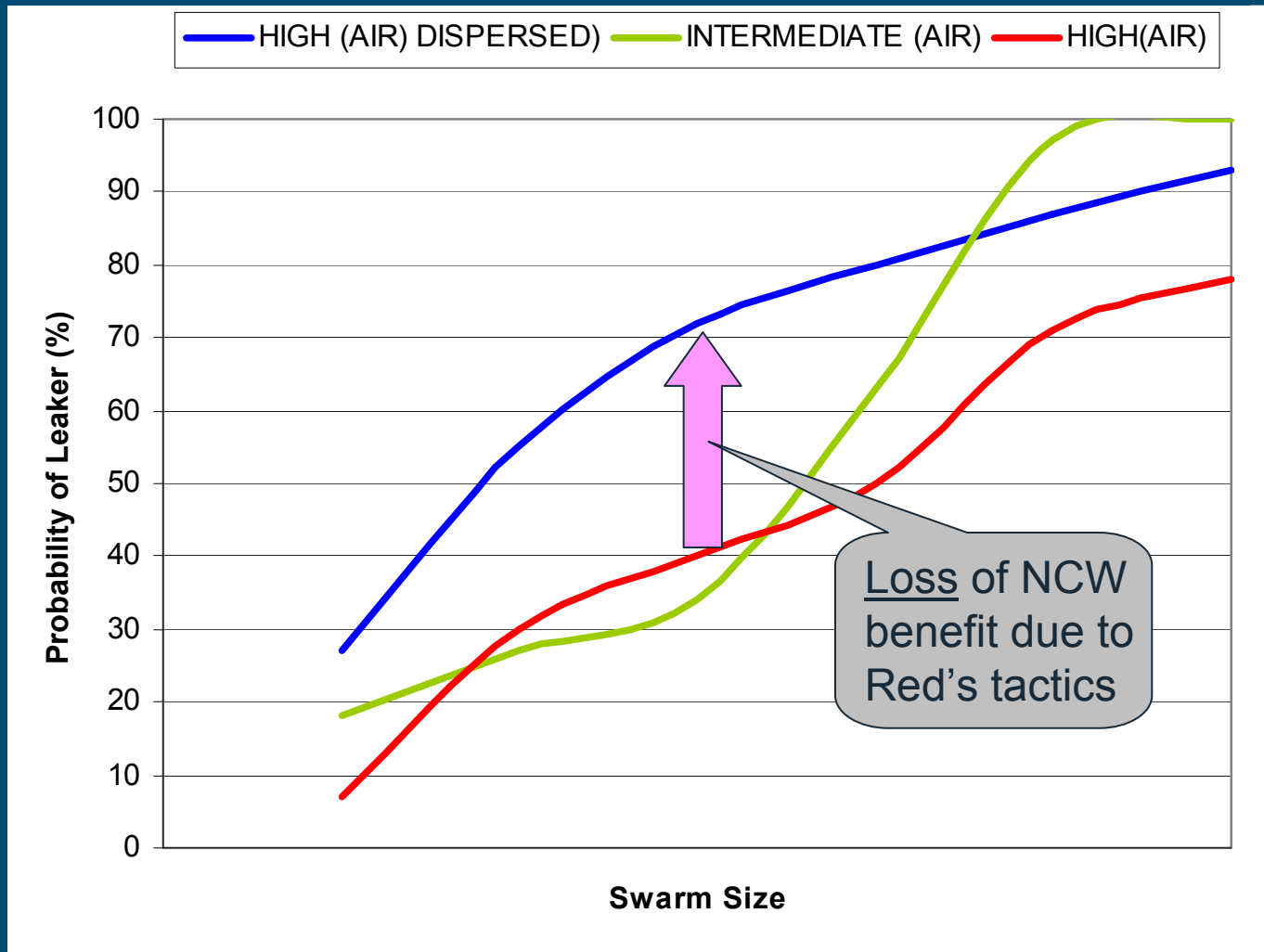


Type 1 FIAC - Widely Dispersed

Study introduces UAV - example is *Firescout*



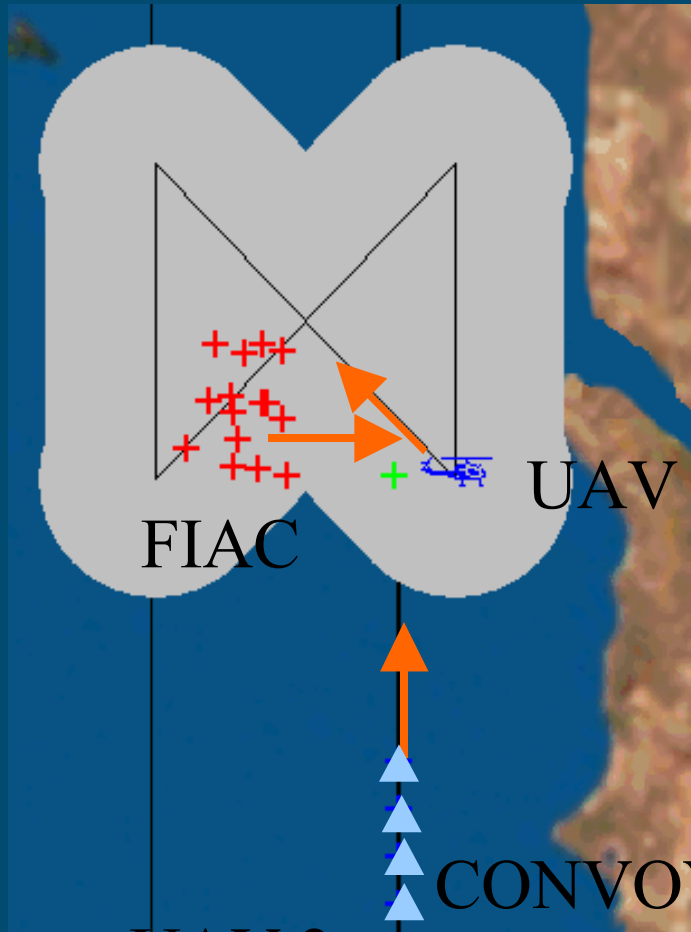
Blue curve is very highly dispersed swarm (over 4x previous area)



- Red gains leverage by dispersing more widely
- Sensitive to trade-off between area size & number of UAV platforms required simultaneously

Type 2 and 3 FIAC

Binary outcome - depends on sensing/weapon range exceeding Red launch range. Makes use of MR gun, smart rounds and helicopter/UCAV

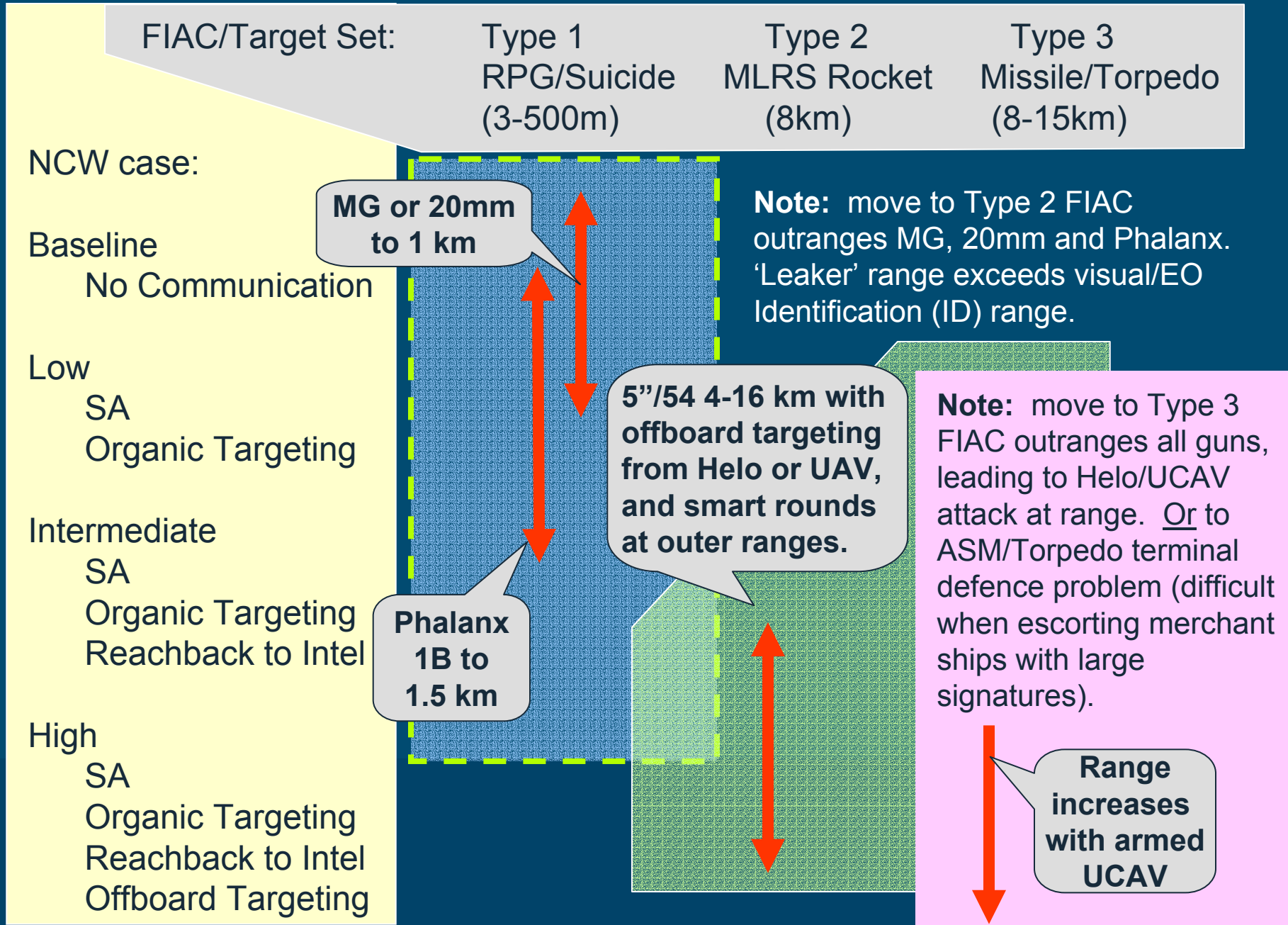


Sensitivity Cases:

Wide range of sensitivity cases and excursions:

- FIAC speed & numbers, personality
- RoE response delays, impact of intelligence
- Blue ship turning times, effect of 'offsets'
- Weapon slew times, and arcs (parametrically, crediting escorts with 1 or 2 CIWS, in lieu of actual arcs)
- Latency, data link net cycle time, data rate/speed
- Effectiveness of arming the HVU's

Problem Space - Progressive Networking & Weapon solutions



Operational Benefits:

- Better use of close range guns, by meeting RoE criteria at maximum range, and taking single Command engage decision (removing sequential delays).
- Use of Medium Calibre gun, through offboard electro-optic sensing and pointing, out to medium range, then (laser) designation for smart shells to maximum range.
- Move the battle outwards, using armed helicopter or UCAV

Likely enhancements:

1. Electro-optic equivalent to CEC, able to share short-range EO picture seamlessly, as a composite image to help ID.
2. 'SWARM potential' detector checking multiple CPA's for correlation peak, to counter slow approach of latent swarm.

Lines of Development [Grey areas tackled by AG-1]

US - DOTMLP	UK – TEPIDOIL	CA – PRICIE
Doctrine	Training	Personnel
Organization	Equipment	Research and Development / OR
Training	Personnel	Infrastructure and Organisation
Materiel	Information	Concepts, Doctrine & Collective Training
Leadership	Doctrine & Concepts	Information Management
People	Organisation	Equipment, Supplies and Services
	Infrastructure	
	Logistics	

The message is that any Coalition involvement in NCW/NEC is likely to cross all these boundaries, i.e our involvement in FORCEnet is not just with an equipment programme.

Conclusions/Recommendations (1):

- MANA agent based model is suitable for this type of netcentric warfare study.
- Saturation of present defences occurs at credible numbers of Type 1 FIAC (Jetski), with kills made well inside Red's potential weapon launch range.
- This can be countered by networking between escorts, helicopters/ UAV/UCAV and the merchant ships.
- For Type 1 FIAC, intermediate and high levels of networking increase Force survivability versus Type 1 FIAC by almost an order of magnitude.
- If the Type 1 FIAC swarm dispersed widely, some targets fall outside surveillance footprint. Potential doubling of leakers, shows Red's ability to compromise force defences, by outflanking limited ISR assets; demonstrates need for additional performance margin over previous slide.

Conclusions/Recommendations (2):

- For Type 2-3 FIAC using networked Air ISR, if Blue surveillance and weapon range exceed Red launch range the scenario is fully survivable, otherwise leakers are assured. A high level of networking is always necessary, but due to the outcomes, % improvement is not relevant.
- Trade-off between helo and UAV/UCAV depends on single sector or widespread (i.e. isotropic) threat driving numbers required, and all solutions require progressive networking, and matched weapons enhancements, subject of further Analysis of Alternatives (AoA).
- Potential technology requirements include networked sensor units, low latency communications, reachback, potentially an EO 'CEC style' net, a SWARM warner, co-ordinated RoE/Weapons free/ Fire co-ordination software, and smart gun rounds.

Back-up Slides

Swarm TACSIT

Tacsit: Blue force in confined sea room is attacked by a swarm of FIAC.

Modelling. Study has used MANA model with validation & verification from Threedim. MANA's strengths include representing the personality that drives the Swarm's dynamic tactics, rather than just a rigid target set.

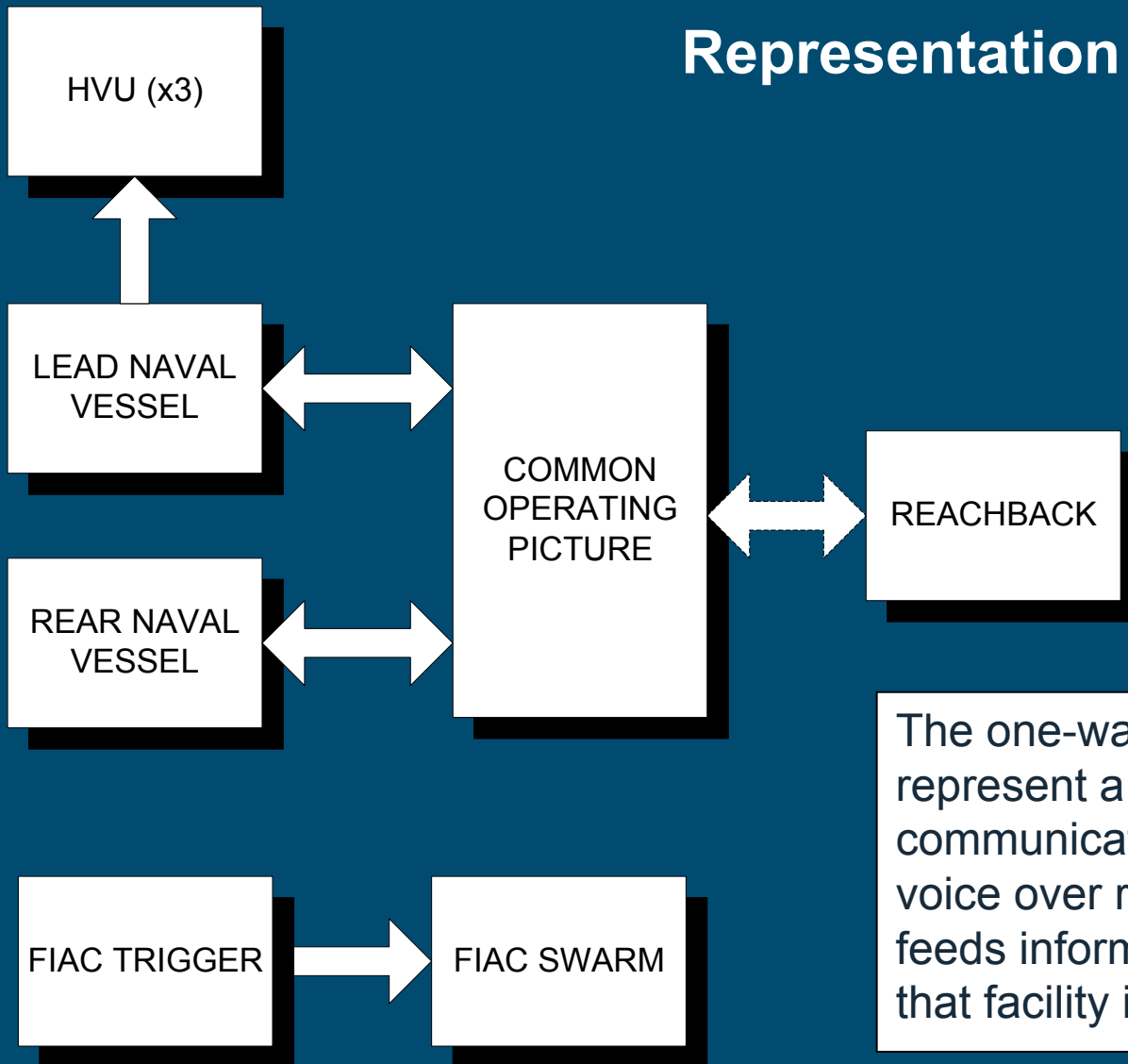
Metrics:

- Probability of one or more FIAC reaching firing position against HVU.
- Fractions of FIAC leaking, and of Blue escorts damaged.
- Collateral damage.

The study has represented four levels of Blue networking capability.

Overall, Intermediate and High levels of networking considerable increase Force survivability.

Representation of the Network



The one-way links shown represent a relatively simple communication method such as voice over radio. Reachback feeds information to the COP if that facility is available

Type 1 FIAC

Baseline Capability. Single ship defences are saturated by credible numbers of Type 1 FIAC attacking at 20 knots. This performance is speed dependant and reduces to fewer FIAC when they travel at 30 knots. Kills are made well inside Red's potential weapon launch range of 800m for heavy machine gun or RPG.

Force defence figures are lower than single ship case, since leaker can hit HVU.

This can be countered by networking between Blue surface assets. Improvement allows use of existing CR guns (MG, 20/30mm and Phalanx 1B) to maximum range, to defeat Type 1 threat.

- Full results include Red speed dependencies (leakers increase by 5-10-30% at 40 knots and reduce by 10-30% at 20 knots).

Type 1 FIAC - Widely Dispersed

For an 'isotropic' (i.e dispersed) attack, Blue relies on networking improvements and airborne ISR to allow use of existing weapons to medium range bracket to attack FIAC. With a very highly dispersed Swarm, some FIAC fall outside the surveillance footprint.

All curves are for isotropic attack. Green is Intermediate level networking (surveillance ISR only), and Red is High-level networking (adds offboard targeting). Blue curve is very highly dispersed swarm (over four times previous area).

- Potential doubling of leakers, shows Red's ability to compromise force defences, by outflanking limited ISR assets.
- Demonstrates need for additional performance margin over previous slide.

Trade-off between helo and UAV depends on size of threat surveillance area driving airframes required.

Type 2-3 FIAC

Current defences ineffective against Type 2 or 3 FIAC (8-15km weapons outrange Blue CR guns). Networking improvements between Blue assets allow:

- use of existing MR guns to medium range bracket to attack Type 2 FIAC, plus smart rounds to maximum range, to provide cover against closer Type 3 FIAC.
- maximum use of armed helicopters/UCAV to attrite raids further out. This is the only counter to longer-range Type 3 attack.

Force faces numerically fewer Type 2-3 FIAC. With networked Air ISR, if surveillance and weapon range exceed Red launch range (red line), scenario is fully survivable, otherwise leakers assured (blue line). Green curve is marginal case, where ranges are equal

- High Level of networking always necessary, but force defence requires greater sensor range and matched weapons that exceed Red's launch range. Due to outcomes, % improvement not relevant.

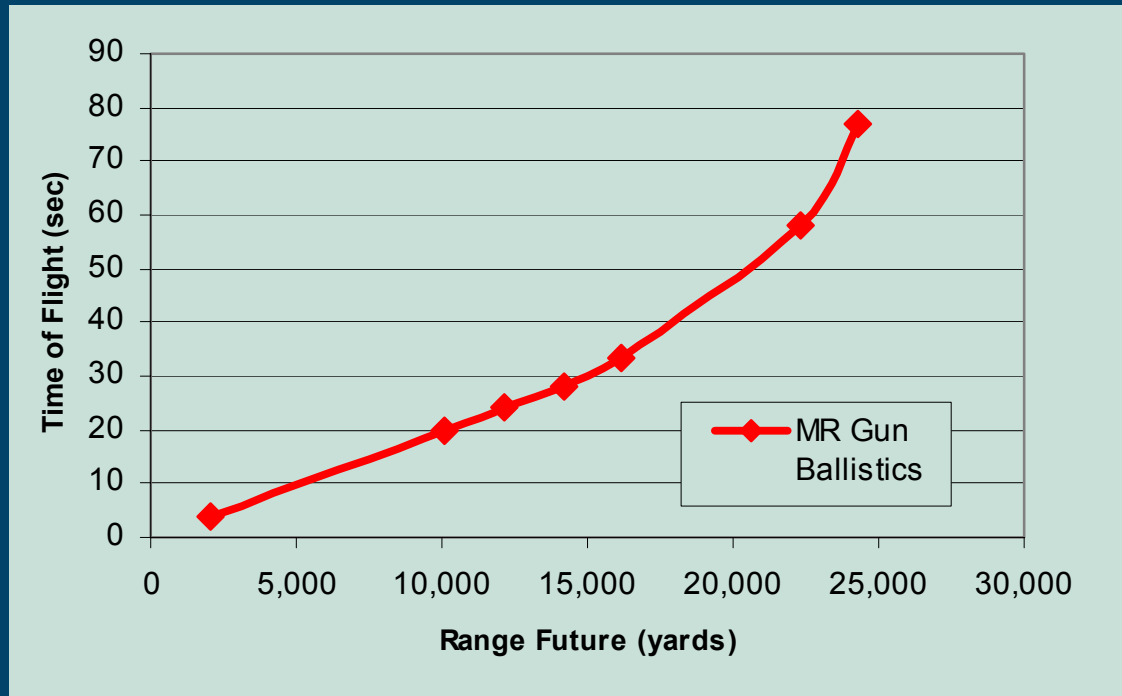
Medium Range Weapon Issues:

Previous slides made case to 'do something' outside close range (MG, 20-30mm, Phalanx 1B) gun range. Most nations use a medium range gun (57mm, 76mm, 4.5" or 5").

Expectation would be to capitalise on this investment before acquiring new weapon systems. But Time of Flight (ToF) becomes significant, in terms of targets uncertainty area during shells flight: typically ± 300 m for a 20 knot FIAC at 13km, rising to ± 800 m at 23 km.

Note - shells tend to burst early with non-optimal annular frag pattern, however, at the outer bracket (13–24 km), the uncertainty area grows from ± 300 m to ± 800 m.

Recommended solution is armed helicopter or UCAV (with Hellfire) or shift over the smart ammunition with airborne laser designator. This slows down the firing cycle but does make the most of existing investment. This is the only way to handle the Type 2 and 3 FIAC problem.



Medium Range Weapon Issues (2):

MR Gun Range Calculations

Range (nm)	1	5	6	7	8	11	12	13	14
Range (yd)	2,025	10,127	12,152	14,178	16,203	22,279	24,305	26,330	28,355
Range (m)	1,852	9,260	11,112	12,964	14,816	20,372	22,224	24,076	25,928
Tof (sec)	4	20	24	28	33.5	58	77		
FIAC movement @ 20 knots (m)	41	206	247	288	345	597	792		
FIAC movement @ 30 knots (m)	62	309	370	432	517	895	1188		
FIAC movement @ 45 knots (m)	93	463	556	648	776	1343	1783		
Uncertainty Radius (m)	41	206	247	288	345	597	792		
Lethal Range (m)	25	25	25	25	25	25	25		
Difference (m)	16	181	222	263	320	572	767		
Flash to Bang Time (sec)				39			67		
Bang to shell arrival (sec)				Nil			10		
Uncertainty radius post bang (m)				Nil			99		

At the outer bracket (13–24 km), the uncertainty area grows from ± 300 m to ± 800 m.

Recommended solution is armed helicopter or UCAV (with Hellfire) or shift over the smart ammunition (example is Semi-Active Laser Guided Projectile SAL GP) with airborne laser designator. This slows down the firing cycle (double ram), but does make the most of existing investment.

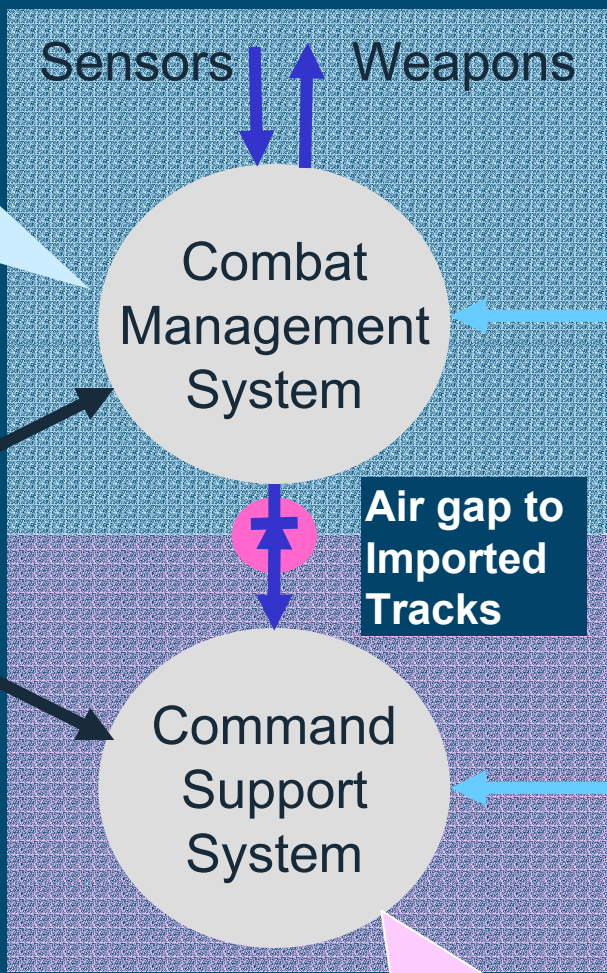
- This is the only way to handle the Type 2 and 3 FIAC problem.

Real Time (RT)/
Near-RT information,
tightly bounded
system design,
lower COTS content.



HCI

HCI



Air gap to
Imported
Tracks

Non-Real Time and
off-line information,
less bounded design,
higher COTS content.

NEC/NCW Information Products:

Tracking Network (CEC plots)
Data Network (Data Link
tracks and weapon control/
command/status messages)

Planning Network
Recognised Picture
Distributed Collaborative
Planning (with decision and
planning aids)
Messaging (formal+informal
i.e. e-mail)
MS Office attachments

Voice, VTC, record
message traffic (ACP etc)

Voice
Video
Printed material

Single Maritime Platform

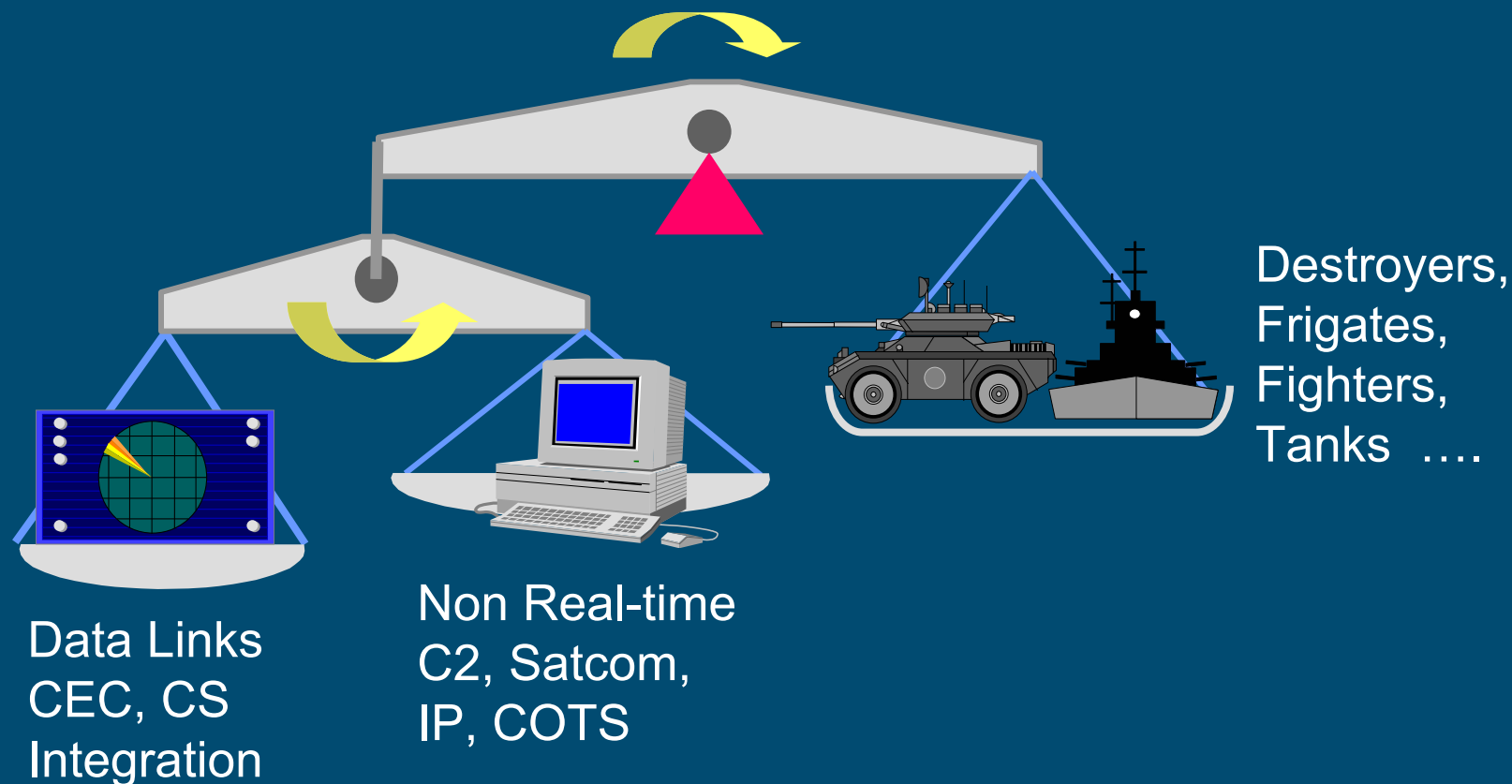
Offboard



Coalition Perspectives on FORCEnet:

- Partners cannot follow FORCEnet's 'spirals' blindly - we need to satisfy our own National approvals processes with evidence of benefit - we will need an overall roadmap and Allied exploitation plan. Previous quick wins like *Lotus Domino* have not been fully exploited due to uncertainty over the systems lifespan/duration
- The paradox is that options like Link 16 and CEC are the most expensive due to the Combat System integration costs involved. In contrast, non-real time C2 (largely satcom, IP and COTS) are cheaper, but have an air break from the effectors.
- A move toward persistent ISR with expendables could dis-enfranchise Coalition partners, due to lack of headroom in our EP budgets, and the undefined *last-mile* connectivity.
- The \$64k question is not NCW scale OA, but is actually High-Level Bol, since Nations will be balancing all the options, against assets like DD/FF or combat aircraft.

The Coalition bottom-line on NCW



This is a zero-sum game (in either ££, \$\$\$ or €), and is an issue for the respective Nation's Balance of Investment.