Theme 1 - Autonomy Resilience


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Science and Technology for Safeguarding Australia

Ubiquitous Command and Control (UC2)

Year	Topic	Journal
1999	UC2 concept	IDC Conf
2005	Dialectic comparison to NCW	ICCRTS Conf
2007	UC2 concept detailed	IDT Journal
2012	Legal Agreement Protocol	Book Chapter
2012	Blueprints for Fusion, Resource Management & Policy Control	Int. Fusion Conf (3 papers)

UC2 is "unity *with* diversity"
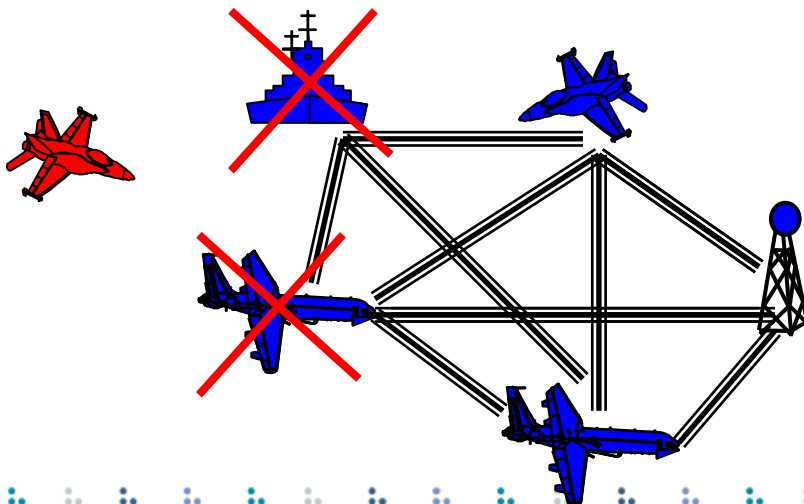
DEPARTMENT OF DEFENCE
DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

UC² System

- A UC² System is a system of assets, all of which possess a similar and significant C² capability.

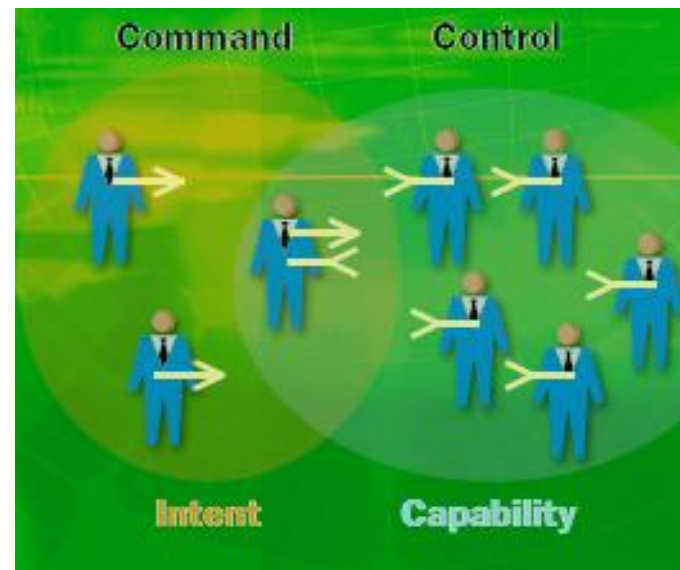A single asset may contain multiple elements possessing and similar and significant C² capability

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UC2 Tenets

1. Decision Devolution
2. Ubiquity of C2
3. Automated Decision Makers & Aids
4. Integration
5. Distributed & Decentralised
6. Socially coordinated
7. Management levels
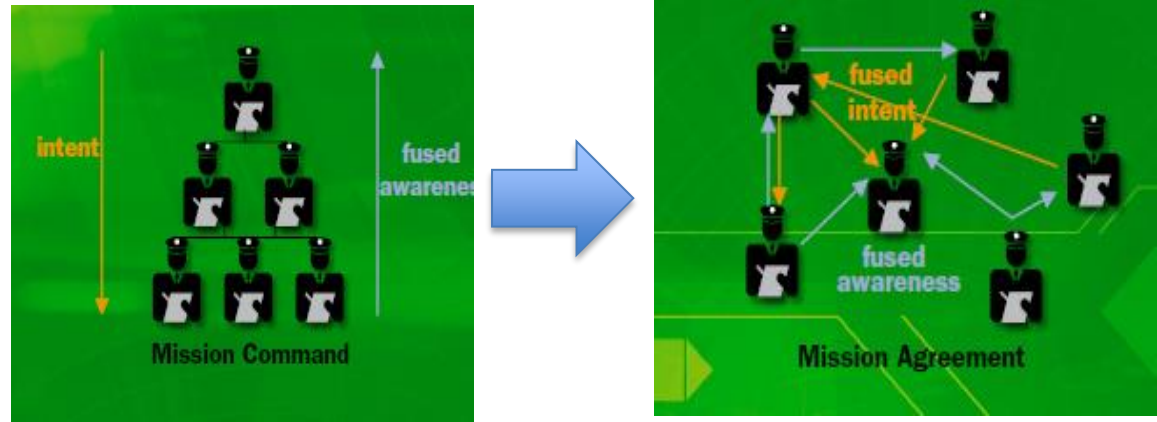
Achieve intent using capability given awareness

Like eBay: Buyers   Sellers

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Limitations (1)

- No semantic learning machines in 2005...

mite	container ship	motor scooter	leopard
mite	container ship	motor scooter	leopard
black widow	lifeboat	go-kart	jaguar
cockroach	amphibian	moped	cheetah
tick	fireboat	bumper car	snow leopard
starfish	drilling platform	golfcart	Egyptian cat

Machine learned Object-level identification

Semantic labelling   *Semantic Attention*   *Semantic Segmentation*

man in black shirt is playing guitar.

A woman is throwing a **frisbee** in a park.

However, …

x
"panda"
57.7% confidence

$+ .007 \times$

$\mathrm{sign}(\nabla_{x} J(\theta, x, y))$
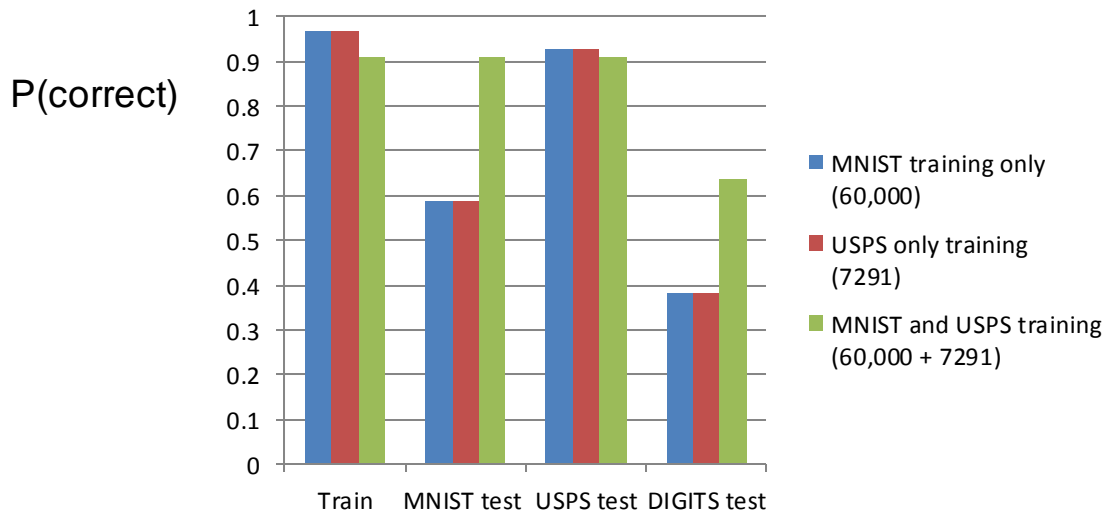"nematode"
8.2% confidence

$=$

$x + \epsilon\mathrm{sign}(\nabla_{x} J(\theta, x, y))$
"gibbon"
99.3 % confidence

Ian J. Goodfellow, Jonathon Shlens & Christian Szegedy, *Explaining and Harnessing Adversarial Examples*, http://arxiv.org/pdf/1412.6572v3.pdf

P(correct)

- MNIST training only (60,000)
- USPS only training (7291)
- MNIST and USPS training (60,000 + 7291)

Poor real-world performance on unseen independent data

Shallow ML performance on handwritten digits

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Limitations (2)

- Machine decision conceived as automation

Predictable Environments ← **AUTOMATION   AUTONOMY** → *Fundamentally Uncertain Environments*

Gen Helmuth Von Moltke

Unmanned Little Bird
Trusted Autopilot on seL4
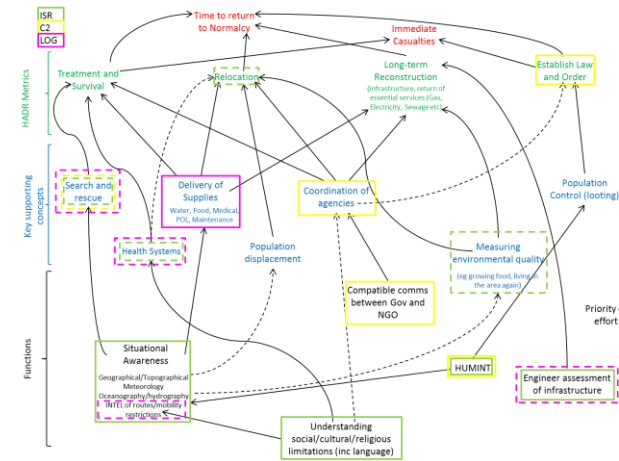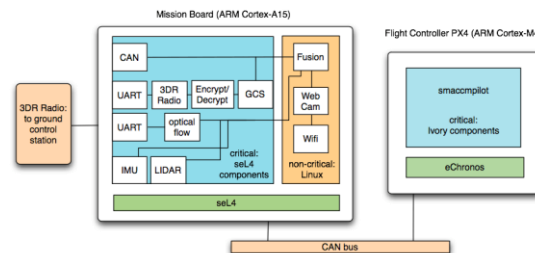
HA/DR scenario metrics for autonomy