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La cyber défense autonome : Clé du succès des futures technologies connectées ?

Dr Paul THERON, Thales, Directeur de la chaire Cyb'Air, Chairman AICA IWG
Deuxième journée de la chaire C3S, 11 décembre 2020

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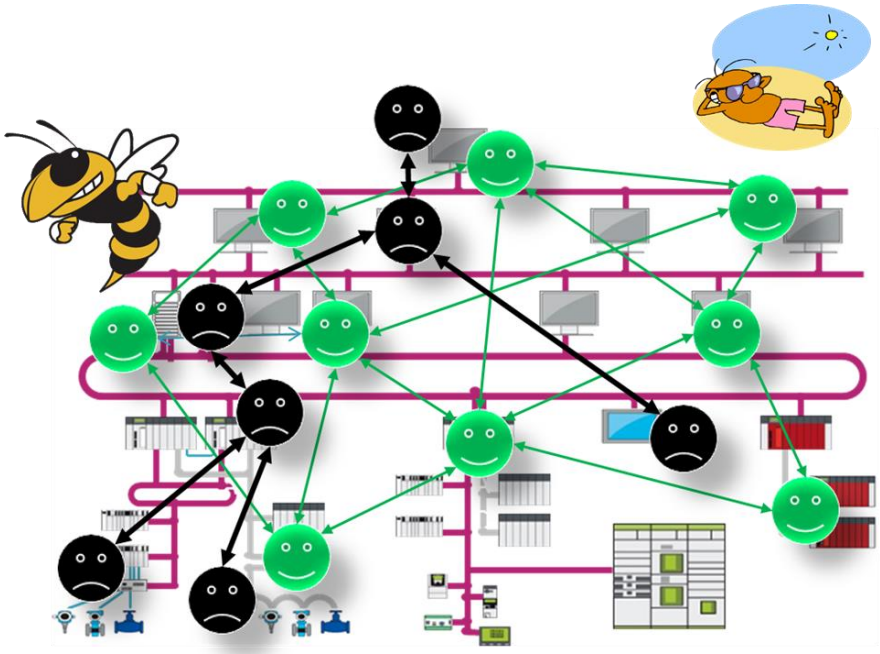
La cyber défense autonome ?



1. La cyber défense autonome comme hypothèse
2. Principes des agents AICA
3. Applications des agents AICA : Défense & systèmes civils
4. État de l'art
5. Défis scientifiques et techniques
6. Un premier prototype en construction
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8. AICA International Work Group
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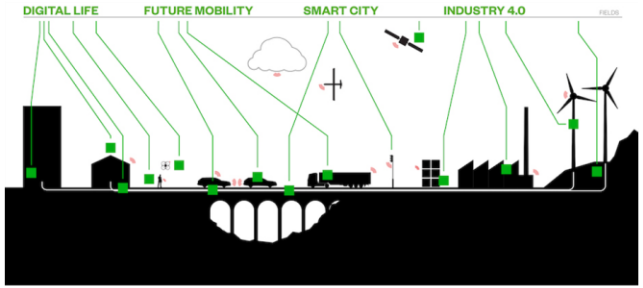
La cyber défense autonome comme hypothèse

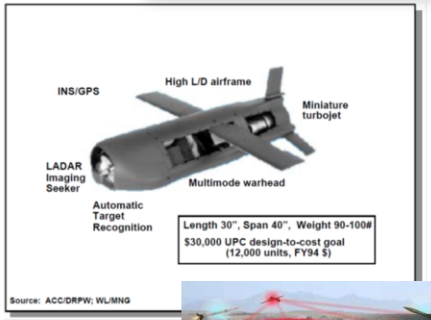
AUTONOMOUS CYBER-ATTACKS

5G

COMPLEXITY

AUTONOMY

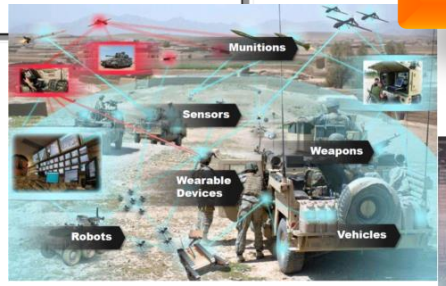




Quantum

LAWS

SAFETY & RAPIDITY



HUMAN COGNITIVE LIMITS

SDN

AI

Cloud

...

EFFICIENCY & RESILIENCE

Intelligent Things will fight intelligent Things

Kott, A., 018. *Bonware to the Rescue: the Future Autonomous Cyber Defense Agents.* Washington DC, Conference on Applied Machine Learning for Information Security, October 12, 2018, CAMLIS.

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Principes des agents AICA

Autonomous Intelligent Goodware will fight Autonomous Intelligent Malware

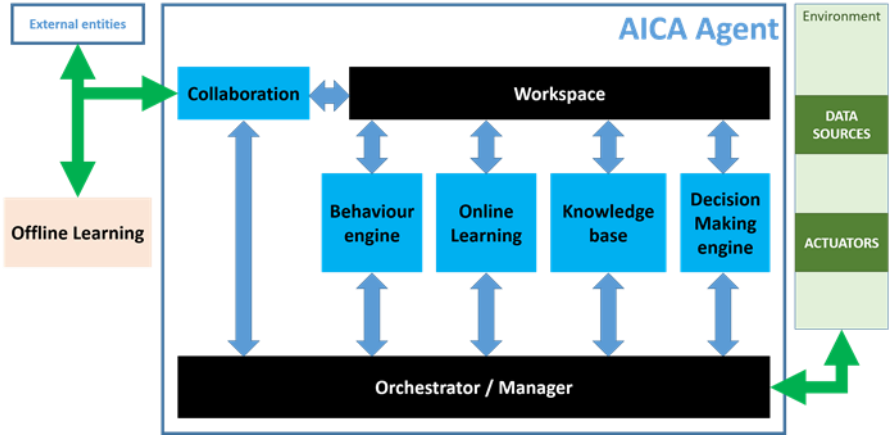
- Humans out of the loop
  - A major paradigm shift

Trustworthiness

Fitting the host architecture's constraints

Interoperability

Autonomous Intelligent Cyber-defence Agents (AICA)



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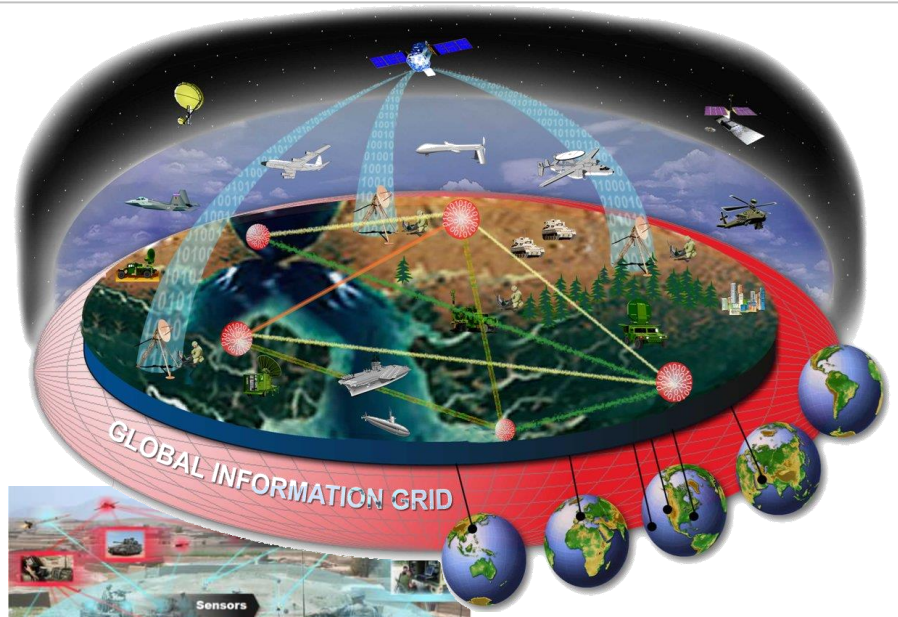
Applications des agents AICA : Défense & systèmes civils



Intelligent Things will fight intelligent Things

Kott, A., 018. *Bonware to the Rescue: the Future Autonomous Cyber Defense Agents.* Washington DC, Conference on Applied Machine Learning for Information Security, October 12, 2018, CAMLIS.

No Automation (Level 0)

- The human driver must complete all driving tasks even with warnings from vehicles.

Driver Assistance (Level 1)

- The automated system shares steering and acceleration/deceleration responsibility with the human driver under limited driving conditions (e.g., high speed cruising), and the driver handles the remaining driving tasks (e.g., lane change).

Partial Automation (Level 2)

- The automated system fully controls the steering and acceleration/deceleration of vehicles under limited driving conditions, and the human driver performs remaining driving tasks.

Conditional Automation (Level 3)

- The automated system handles all driving tasks under limited driving conditions, and expects that the human driver will respond to requests to intervene (i.e., resume driving).

High Automation (Level 4)

- The automated system handles all driving tasks under limited driving conditions even if the human driver does not respond to requests to intervene.

Full Automation (Level 5)

- The automated system takes full control of all driving tasks under all driving conditions that can be managed by a human driver.

MIN

MAX

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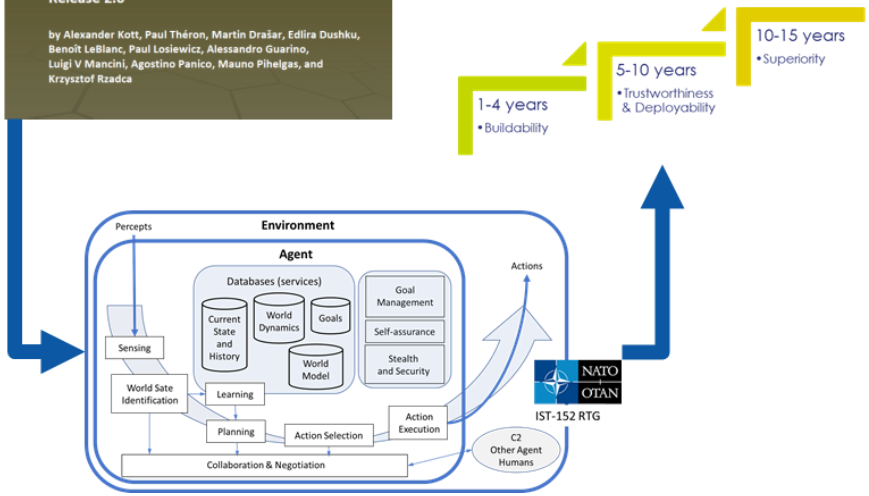
État de l'art



A really new research current

The heart of AICA agents is their Decision Making "engine"

- Trustworthiness ➔ Smart DM
- Many algorithmic bricks but…
  - No DM techniques integration framework

Implementing AICA agents

No doctrine yet

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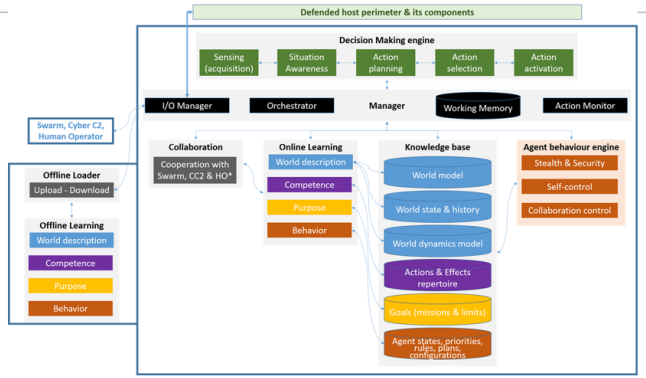
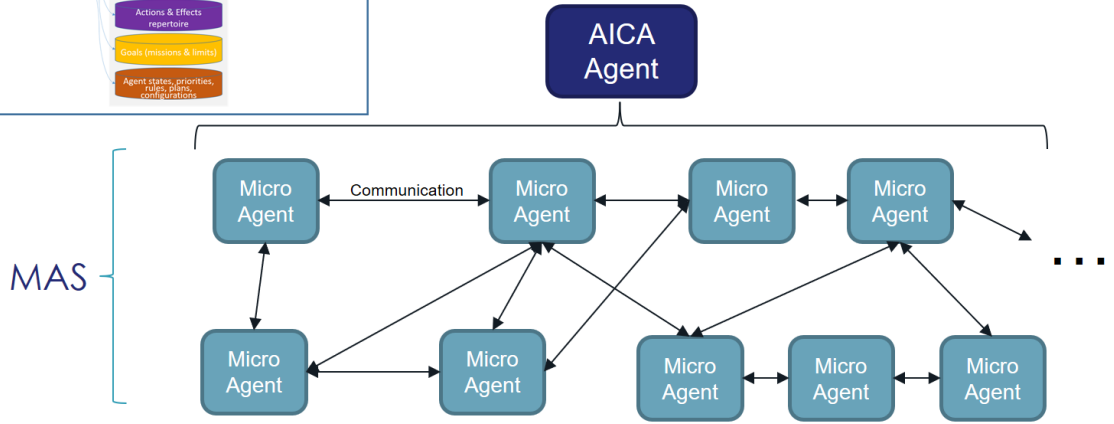
Défis scientifiques et techniques

Un premier prototype en construction

The MASCARA architecture: Each agent is a MAS



MASCARA: **M**ulti **A**gent **S**ystem **C**entric **A**ICA **R**eference **A**rchitecture



PUBLIC

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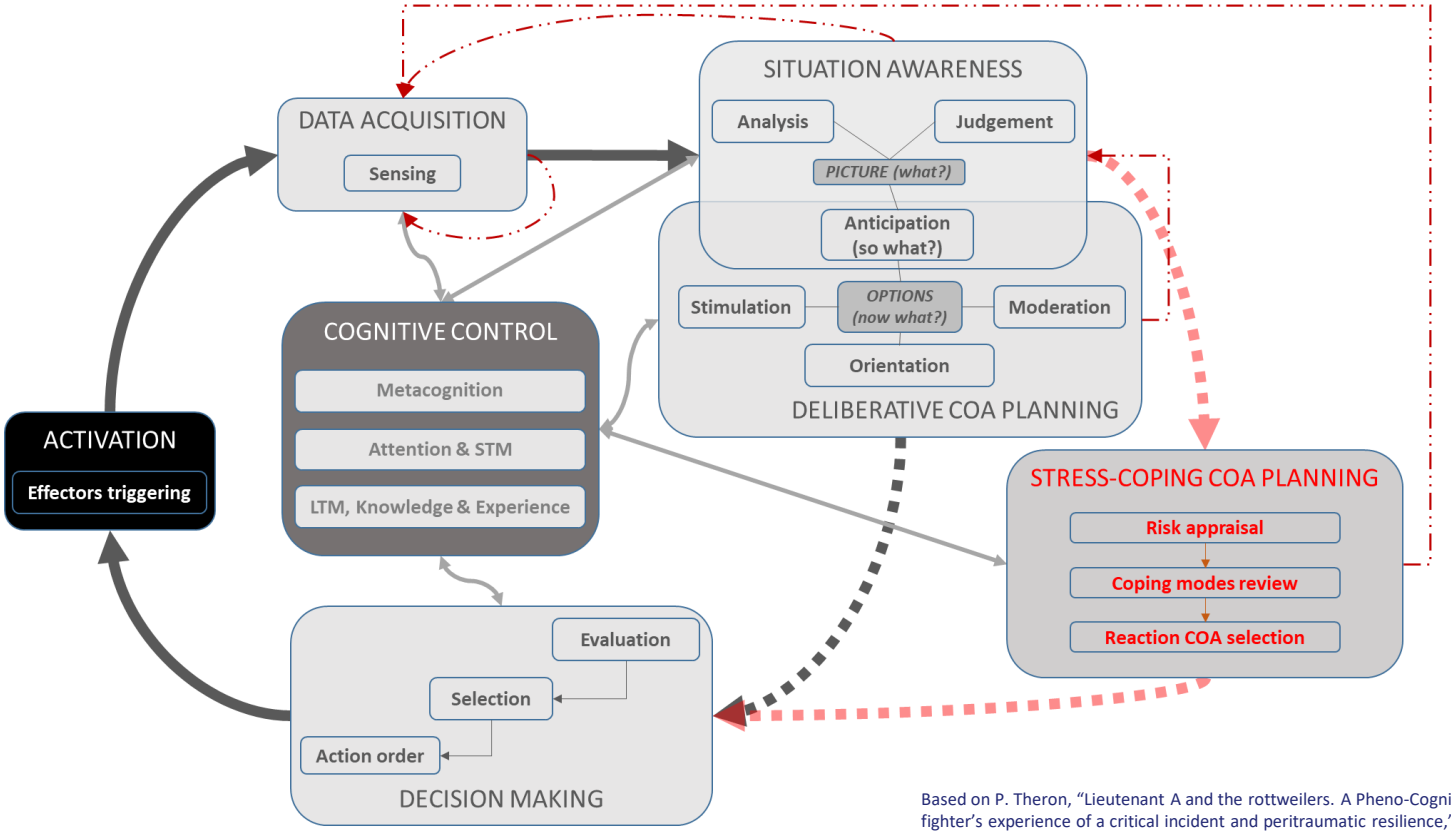
La prise de décision des agents



Based on P. Theron, "Lieutenant A and the rottweilers. A Pheno-Cognitive Analysis of a fire-fighter's experience of a critical incident and peritraumatic resilience," PhD Thesis, available at https://sites.google.com/site/cognitionresiliencetrauma, University of Glasgow, Scotland, 2014.

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AICA International Work Group

DEFENSE

- **OTAN** (NCIA)
- **OTAN** (CCDCOE)
- **US Army Research Laboratory**, USA;
- **US Army Corps of Engineers**, Boston, USA;
- **US Navy, Center for Naval Analyses**, USA;
- **Netherlands Defence Academy**;
- **Westpoint Academy**, USA;
- **Ministry of Defence,** UK;

UNIVERSITE & RECHERCHE

- **MIT**, USA;
- **Dartmouth College**, USA;
- **Indiana University,** USA;
- **Vanderbilt University**, USA;
- **Rochester Institute of Technology**, USA;
- **Pennsylvania State University**, USA;
- **Bordeaux INP**, ENSC, France;
- **Grenoble INP**, LCIS, France;
- **Universita di Roma La Sapienza**, Italie;
- **Universität der Bundeswehr München**, Allemagne;
- **University of Liechtenstein**;
- **Imperial College**, UK;
- **Masarick University**, Tchèquie
- **Czech Technical University**, Tchèquie;

INFRAS CRITIQUES & RECHERCHE

- **Pacific Northwest National Laboratory**, USA;
- **Argonne National Laboratory**, USA;
- **Idaho National Laboratory**, USA;

ETUDES AMONT/PRE-NORMALISATION

- **MITRE Corporation**, USA;

INDUSTRIES DE DEFENSE & ICT

- **Thales**, France ;
- **Raytheon Technologies,** USA;
- **Northrop Grumman**, USA;
- **Cythereal Predictive Cyber**, USA;
- **Boston Fusion,** USA;
- **Culmen, LLC**, USA;
- **PWC,** Norvège;
- **Riskaware,** UK;
- **NORSECON,** Suède;
- **StAG srl,** Italie.

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La chaire Cyb'Air

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AICA
AUTONOMOUS INTELLIGENT CYBERDEFENCE AGENTS
INTERNATIONAL WORK GROUP
Chapter

2017-2022, et au-delà…

Programme scientifique axé sur la cyber défense autonome (AICA agents)

Priorités (*Projets collaboratifs, Thèses, Post-docs, Projets de Master*)

- Développement d'un prototype d'agent AICA
- Environnement de simulation et d'essai
- Coopération Cyber Cognitive
- Cadres d'emploi

Collaborations académiques

- Grenoble INP / LCIS, Bordeaux INP / ENSC, Ecole de l'Air
- Autres chaires

Sponsors THALES DASSAULT AVIATION

Thèses, Post-docs, Master & Projets collaboratifs « AICA agents »

Thèses financées (CIFRE) & Post-docs

- Thales, Dassault, …
- École doctorale
  - Selon sujet de la thèse

Projets de Master

- Projets techniques ponctuels
- Formations dans les Masters

Et aussi les projets collaboratifs (longitudinaux)

- Études amont
- Études techniques
  - Prototypage et architecture des agents; Plateformes de simulation, test, entrainement…

Contact: paul.theron@thalesgroup.com

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Merci pour votre attention…

Et à votre disposition.





Quelques références

- https://arxiv.org/abs/1803.10664 (IST-152 RTG's AICA Reference Architecture final report)
- https://arxiv.org/abs/1804.07646 (Report of Oct 2017 Prague workshop)
- http://ceur-ws.org/Vol-2057 (proceedings of Oct 2017 Prague workshop)
- https://arxiv.org/abs/1806.08657 (ICMCIS conference paper, Warsaw, May 2018)
- https://www.springer.com/fr/book/9783030334314 (2020 Springer book chapter)
- https://ieeexplore.ieee.org/abstract/document/9091352 (2020 IEEE Security & Privacy paper)