

Notes

Systèmes Collectifs Adaptatifs et Systèmes Multi-Agents

Partie 4 - SMA and Ambient intelligence system



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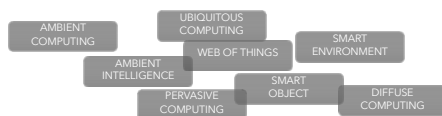
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Systèmes Collectifs Adaptatifs et Systèmes Multi-Agents Sommaire

Partie 3 : SMA and Ambient intelligence system

■ Definitions and Links Between Fundamental Notions



■ Toward a Link Between SMA and Ambient Intelligence



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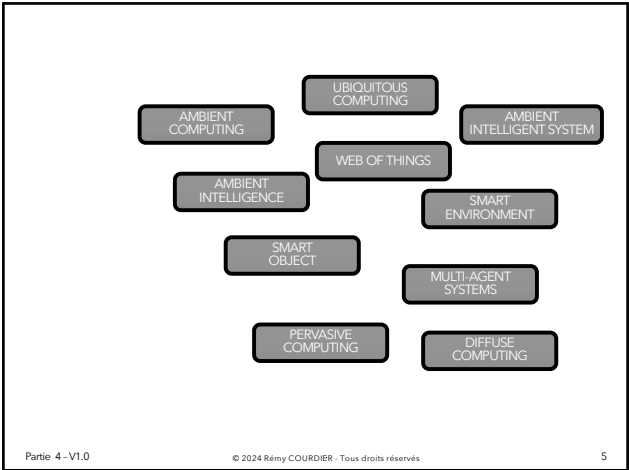
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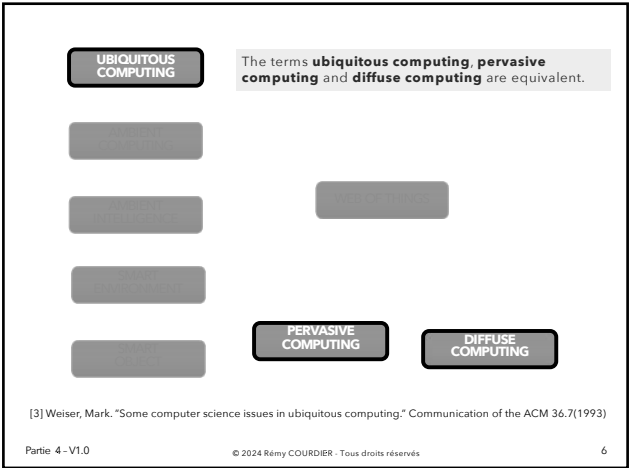
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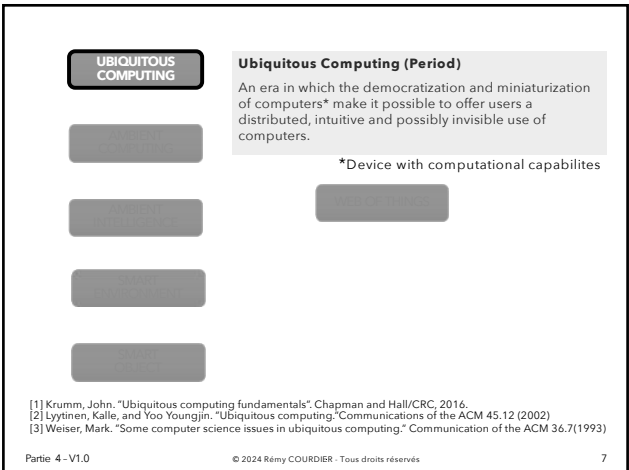
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UBIQUITOUS COMPUTING

Ubiquitous Computing (Period)

An era in which the democratization and miniaturization of computers make it possible to offer users a distributed, intuitive and possibly invisible use of computers.

Generalist Computer

First Era

Democratized Computer

Second Era

Ubiquitous Computer

Third Era

[1] J.Krumm

Period

[1] Krumm, John. "Ubiquitous computing fundamentals". Chapman and Hall/CRC, 2016.

[2] Lytinen, Kalle, and Yoo Youngjin. "Ubiquitous computing." Communications of the ACM 45.12 (2002)

[3] Weiser, Mark. "Some computer science issues in ubiquitous computing." Communication of the ACM 36.7(1993)

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Period

UBIQUITOUS COMPUTING

Domain

AMBIENT COMPUTING

engendered

Ambient Computing (Domain)

Emerging scientific domain of ubiquitous computing that aims to create ambient intelligence. This is an area touching many related fields such as : home assistance, robotics or artificial intelligence.

[4] Russell, Stuart J., and Norvig Peter. "Artificial intelligence: a modern approach." 2016.

[5] Cook, Diane J., et al. "Ambient intelligence : Technologies, applications, and opportunities." (2009)

[6] Aarts, Emile, and Wichert Reiner. "Ambient intelligence", 2009.

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Period

UBIQUITOUS COMPUTING

Domain

AMBIENT COMPUTING

Set of services

AMBIENT INTELLIGENCE

engendered

aims to create

Ambient Intelligence (Set of services)

A set of IT services which is interconnected, context-aware and naturally interactive and intelligent, in order to assist human activities. These services are based on a smart environment.

[4] Russell, Stuart J., and Norvig Peter. "Artificial intelligence: a modern approach." 2016.

[5] Cook, Diane J., et al. "Ambient intelligence : Technologies, applications, and opportunities." (2009)

[6] Aarts, Emile, and Wichert Reiner. "Ambient intelligence", 2009.

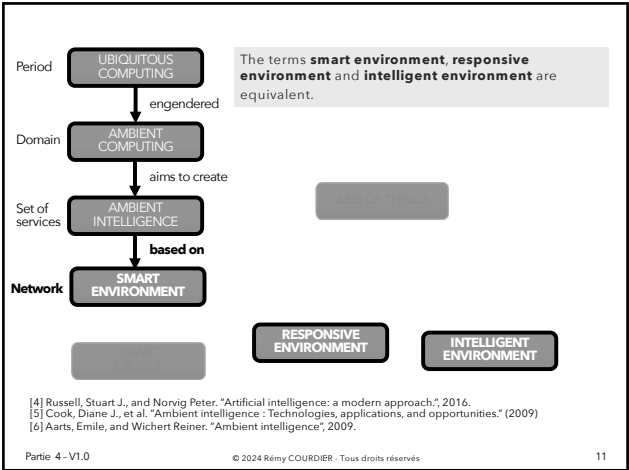
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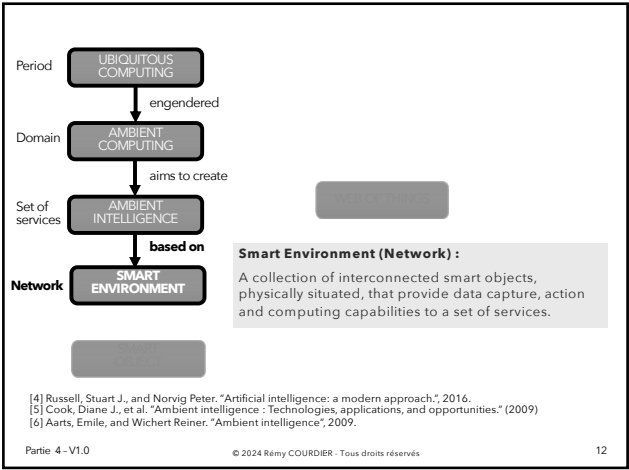
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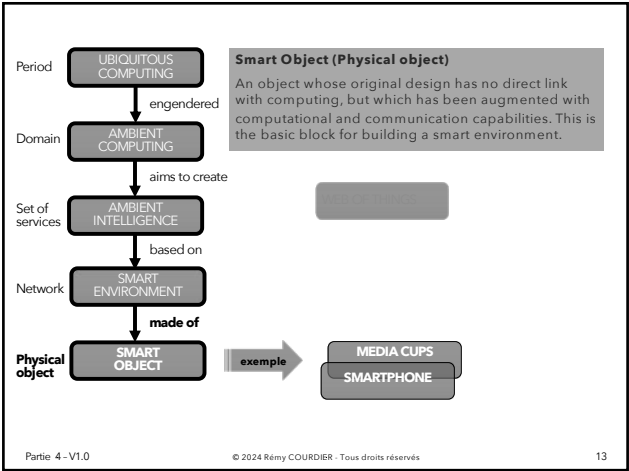
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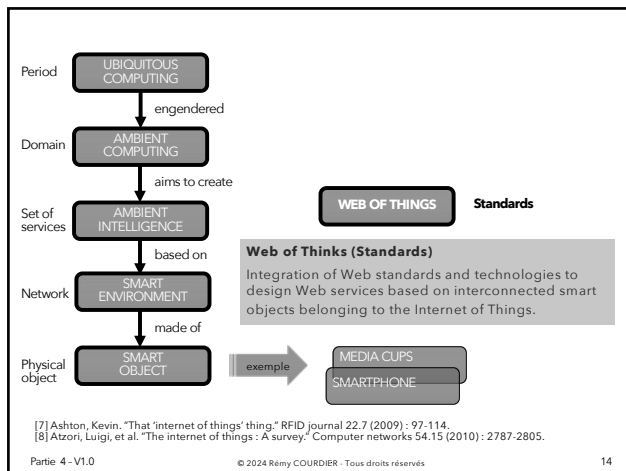
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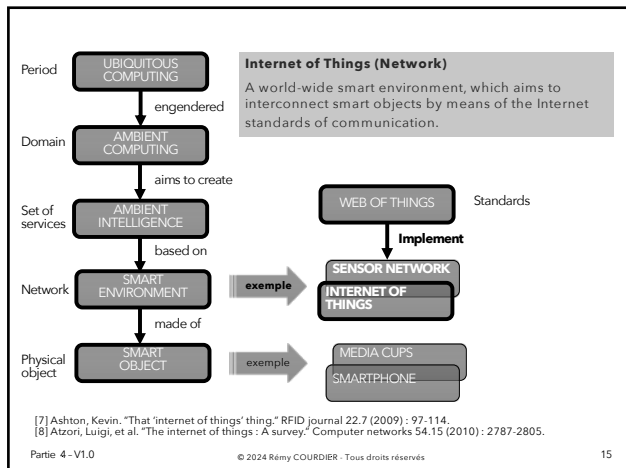
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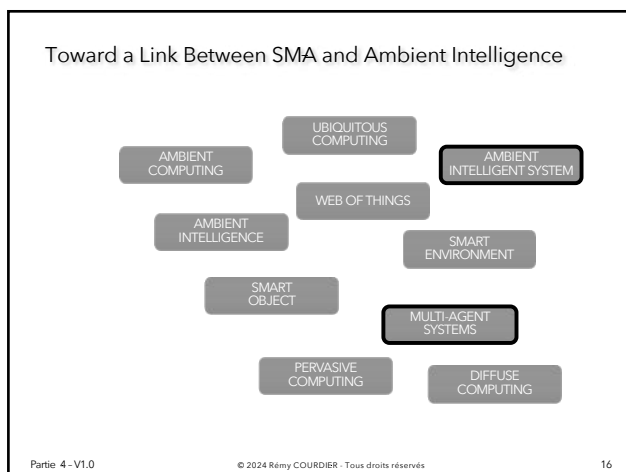
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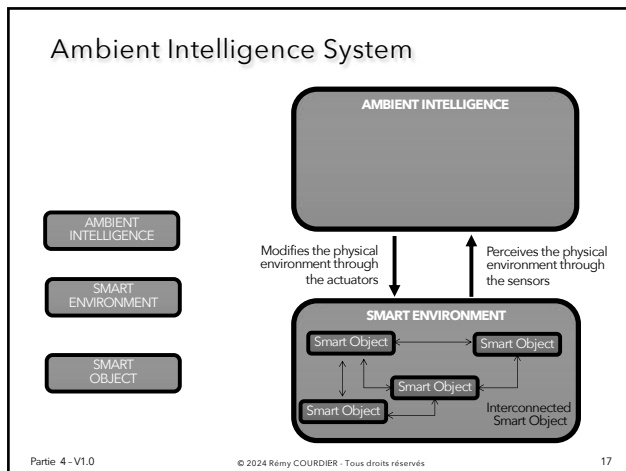
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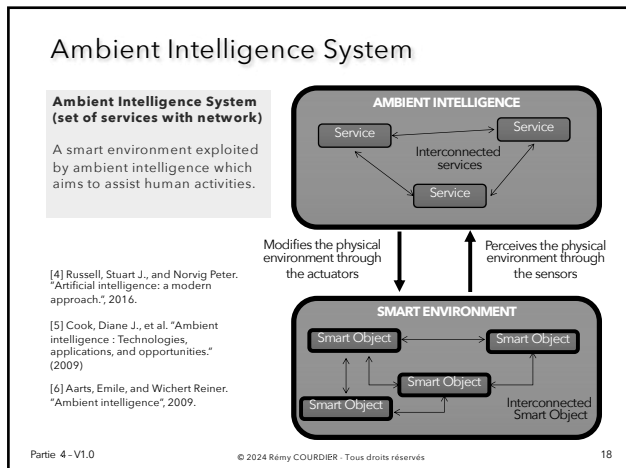
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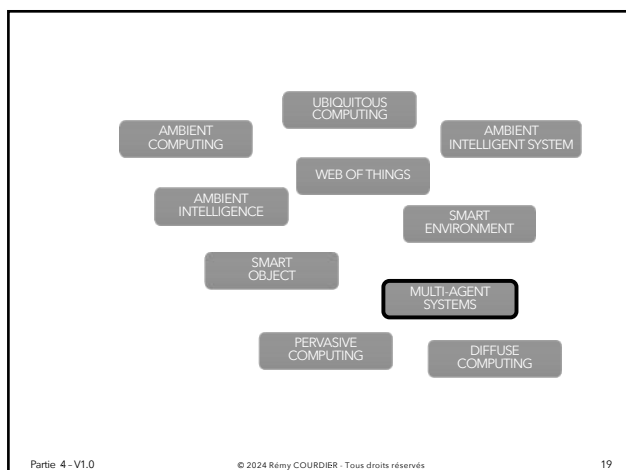
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Multi-Agent Systems

A such system is made up of the following elements:

- ✓ An environment E
- ✓ a set O of objects
- ✓ a set A of agents (A included in O)
- ✓ a set of relations R which link objects between them
- ✓ a set of operations Op allowing the agents to perceive, produce, consume, transform and handle objects

[9] Ferber, Jacques, and Weiss Gerhard. Multi-agent systems: an introduction to distributed artificial intelligence. Vol. 1. Reading : Addison-Wesley, 1999.

The diagram illustrates a Multi-Agent System. It consists of two main components: AGENTS and ENVIRONMENT. The AGENTS component contains three Agent boxes connected by arrows labeled 'Interconnected agents'. The ENVIRONMENT component contains four Object boxes, with one labeled 'Interconnected Object'. Arrows labeled 'Modifies the environment' and 'Perceives the environment' connect the AGENTS and ENVIRONMENT components.

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Multi-Agent Systems

Multi-Agent System

Computer system composed of multiple software, capable of autonomous, social and possibly reactive and proactive action. A multi-agent system is based on an environment which can be empty in some case.

[4] Russell, Stuart J., and Norvig Peter. "Artificial intelligence: a modern approach.", 2016.

[9] Ferber, Jacques, and Weiss Gerhard. Multi-agent systems: an introduction to distributed artificial intelligence. Vol. 1. Reading : Addison-Wesley, 1999.

[10] Wooldridge, Michael. An introduction to multiagent systems. John Wiley and Sons, 2009.

The diagram illustrates a Multi-Agent System. It consists of two main components: AGENTS and ENVIRONMENT. The AGENTS component contains three Agent boxes connected by arrows labeled 'Interconnected agents'. The ENVIRONMENT component contains four Object boxes, with one labeled 'Interconnected Object'. Arrows labeled 'Modifies the environment' and 'Perceives the environment' connect the AGENTS and ENVIRONMENT components.

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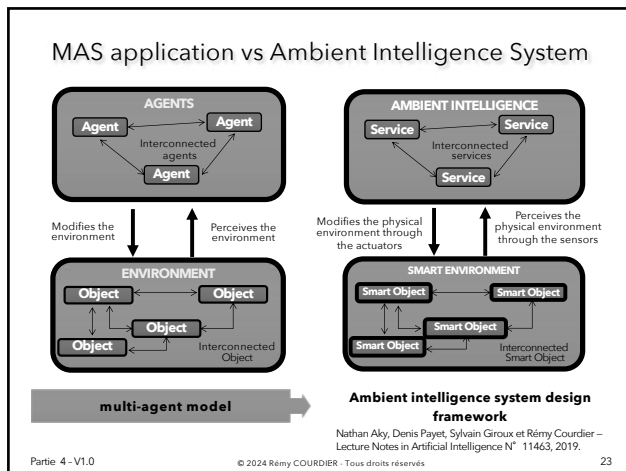
MAS application vs Ambient Intelligence System

The diagram compares a Multi-Agent model with Applications. The Multi-Agent model shows AGENTS (three Agent boxes) and ENVIRONMENT (four Object boxes). The Applications component shows three Service boxes connected by arrows labeled 'Interconnected services', and four Physical Object boxes connected by arrows labeled 'Autonomous functioning objects'. An arrow labeled 'to design' points from the Multi-Agent model to the Applications component.

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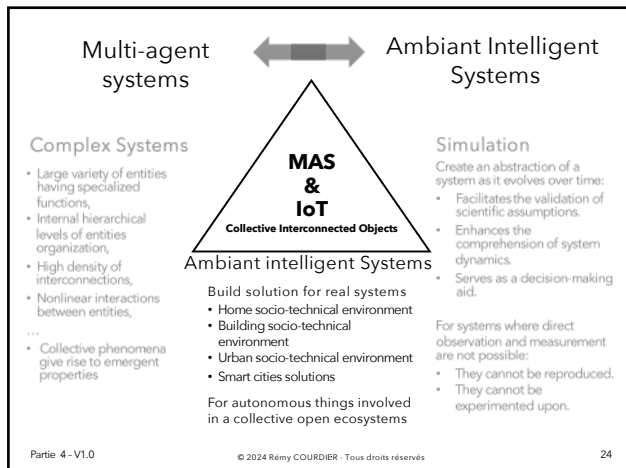
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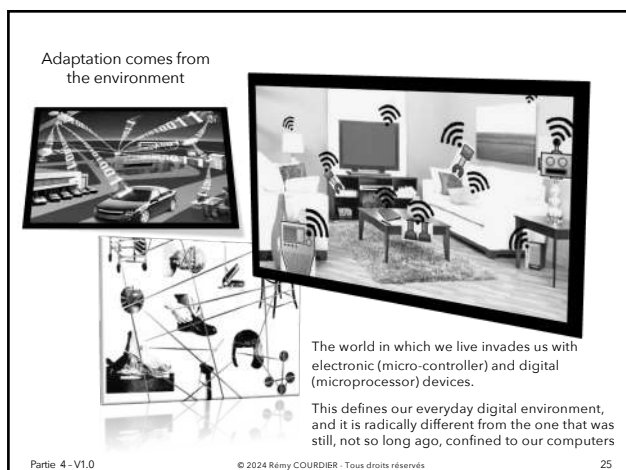
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The notion of computer system today ...
Dozens or even hundreds of computer components, which can:

- be embedded in many objects,
- work with all kinds of sensors and actuators,
- communicate with each other and provide more and more sophisticated services.

This new type of computer system is at the heart of Collective Adaptive Systems (Systèmes Collectifs Adaptatifs)

- Collective because groups of entities collaborate together
 - ✓ to achieve a common goal,
 - ✓ or use the synergy of the group to reach their own goal in a combined way.
- Adaptive because these groups are able to change their goals, organizational structures, and services at any time depending on the situation.

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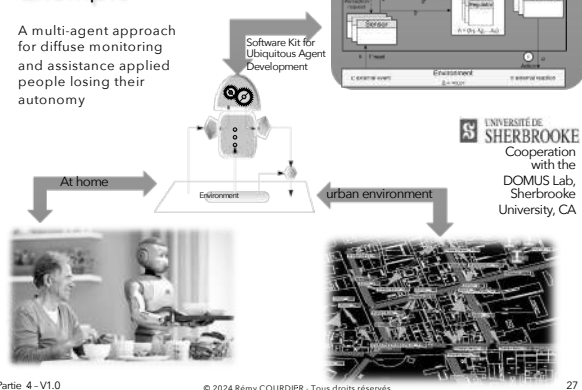
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Exemple

A multi-agent approach for diffuse monitoring and assistance applied people losing their autonomy



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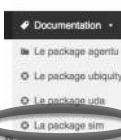


Example of an experimental platform

SKUAD: Software Library development
Software **K**it for **U**biquitous **A**gent **D**evelopment

A compact software library that can run on nano-computers and allows the management of ambient agents, sort of autonomous software components able to evolve in real time in our physical environment (ambient).

Hybrid collective adaptive systems
MAS Simulation & Hardware in the Loop



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Toward an hybrid ambient intelligent systems

Hybrid MAS framework allows ambient agents connected to real devices to be substituted for fully simulated virtual devices without changing the computer code.

AGENT U
Créer et gérer les agents

UDA
Environnement physique

Ubiquity
Environnement virtuel

Hub UDP
Mise en réseau des agents

Mode réel / Mode virtuel

Bimodalité

Squad architecture diagram

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Ecoconception in Smart Ambient Systems

Limiter l'impact écologique lié à la surabondance des appareils

Idee : Rendre l'utilisation d'une ressource informatique possible au-delà de l'objet qui le porte.

-> proposition d'un modèle conceptuel générique de décomposition et de mutualisation des possibilités réelles de nos ressources connectées.

Présence de fonctionnalités primaires présentes dans chacun des objets de notre quotidien mais dont l'utilisation est sous-exploitée

Objet Connecté

Objet Connecté

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Work with affordance in real environment

Composition adaptative des services :

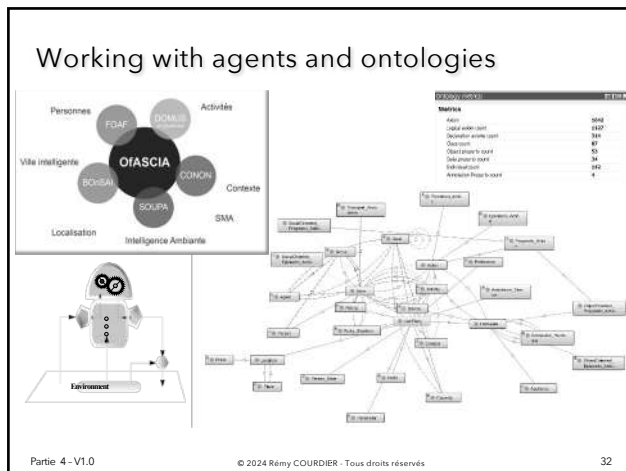
Notion Agent préemptif capable de recomposer dynamiquement des services grâce à la détection des affordances.

- limiter la charge cognitive liée à la gestion de l'environnement
- tirer profit d'un maximum d'objets connectés.

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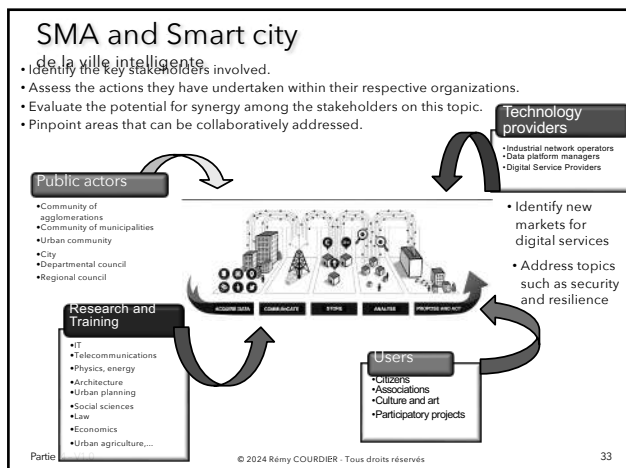
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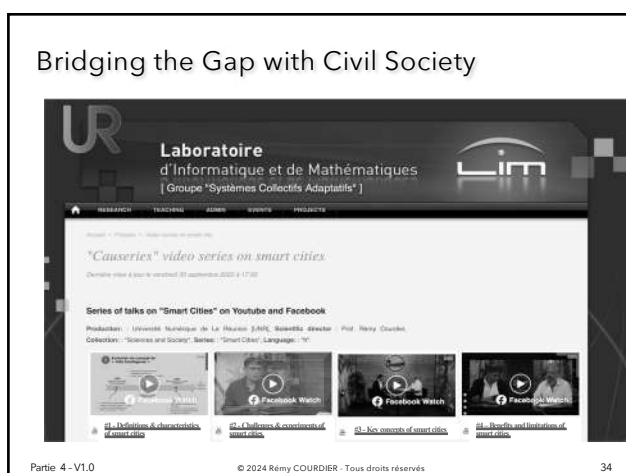
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