Use of the concept of territoriality in design and production of Collaborative Situated Mixed Reality Learning Games

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Abstract

- Learning Games are mainly based on scenarios involving artificial situations inspired by real situations. In this contribution we present the use of ubiquitous computing in mixed reality to overcome the artificial situation of the problem, by recontextualization of problem knowledge and a communication centered solution.
- In the Mixed Reality paradigm, the use of mobile devices and tangible interfaces are used for merging digital and physical worlds. In this context, mixed reality technologies are responsible for collaboration, and provide users with better feedback by redefining digital data as information and control support of the physical world.
- However, technologies introduction increase complexity of the design already complex. The challenge is to combine learning usefulness of the pedagogical tool, motivational features from game principles, and advanced environment and technics from HCI to build a collocated and situated physical and numerical learning environment.
- To solve this problem, we propose a design process based on the MDA (Model-Driven Architecture) approach, allowing us to explain our Collocated and Situated Learning Game Architecture. We will focus our presentation on the use of the concept of territoriality in design and production of Learning Games. We will also illustrate our explanation by a concrete example of a Learning Game design.

Summary

- Introduction
- State of the art
- Case study
- Generalization
  - Process
  - Formalisms
  - Architecture
- Conclusion
- Bibliography

Introduction

- At the June Workshop session I discovered Territoriality concept and corresponding theory.
- I presented different mobility situations in which the concept of territoriality can find use.
- In this presentation we explain the use of territoriality concept in the design and implementation of a Serious / Learning Game.
- I propose to start by a case study and in the second time to explain process, formalisms and architecture integrating this concept of territoriality.

State of the art

- During this day you had important amount of information on territoriality concept and theory.
- I prefer to skip this aspect mainly because when we worked on it we didn't know that it calls territoriality, as M. Jourdain was always writing prose without knowing it.
- We prefer to explain our approach of HCSE (Human Computer Software Engineering) with:
  - Model Driven Architecture
  - Task modeling
  - CSCW
  - Augmented or mixed Reality
  - And situated computing

Case study: SEGAREM (SErious GAme in mixed Reality)

- **Computarization of an on-table game : Buckingham Lean Game**
- **Design a Mixed Reality learning game called : Lea(r)nIT**
- Objective :

  Develop methods, models and tools for design, production and execution of SErious GAme in mixed REality

- Research consortium: 1 lab. et 2 industrials

LIRIS TOTAL IMMERSION Symetrix

Buckingham Lean Game as case study

Learning game to consolidate and verify the learning of LEAN Manufacturing methods

Goal of the game: Improve the quality and productivity of a replicant production line to allow the survival of humanity 2 phases:

Phase de simulation :

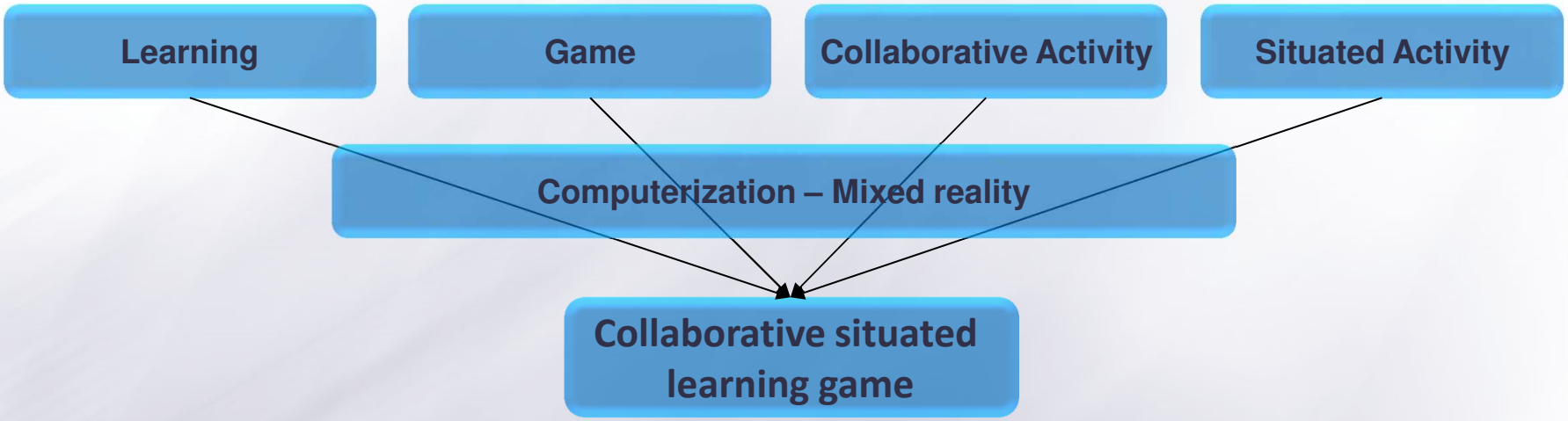
- Proposed roles: operators in a production chain
- Goal: Achieve maximum "quality" replicant in a 10 minute period

Improvement phase of the production chain:

- Proposed roles: LEAN engineers
- Goal: Propose a realistic and effective action plan

3 iterations of these 2 phases

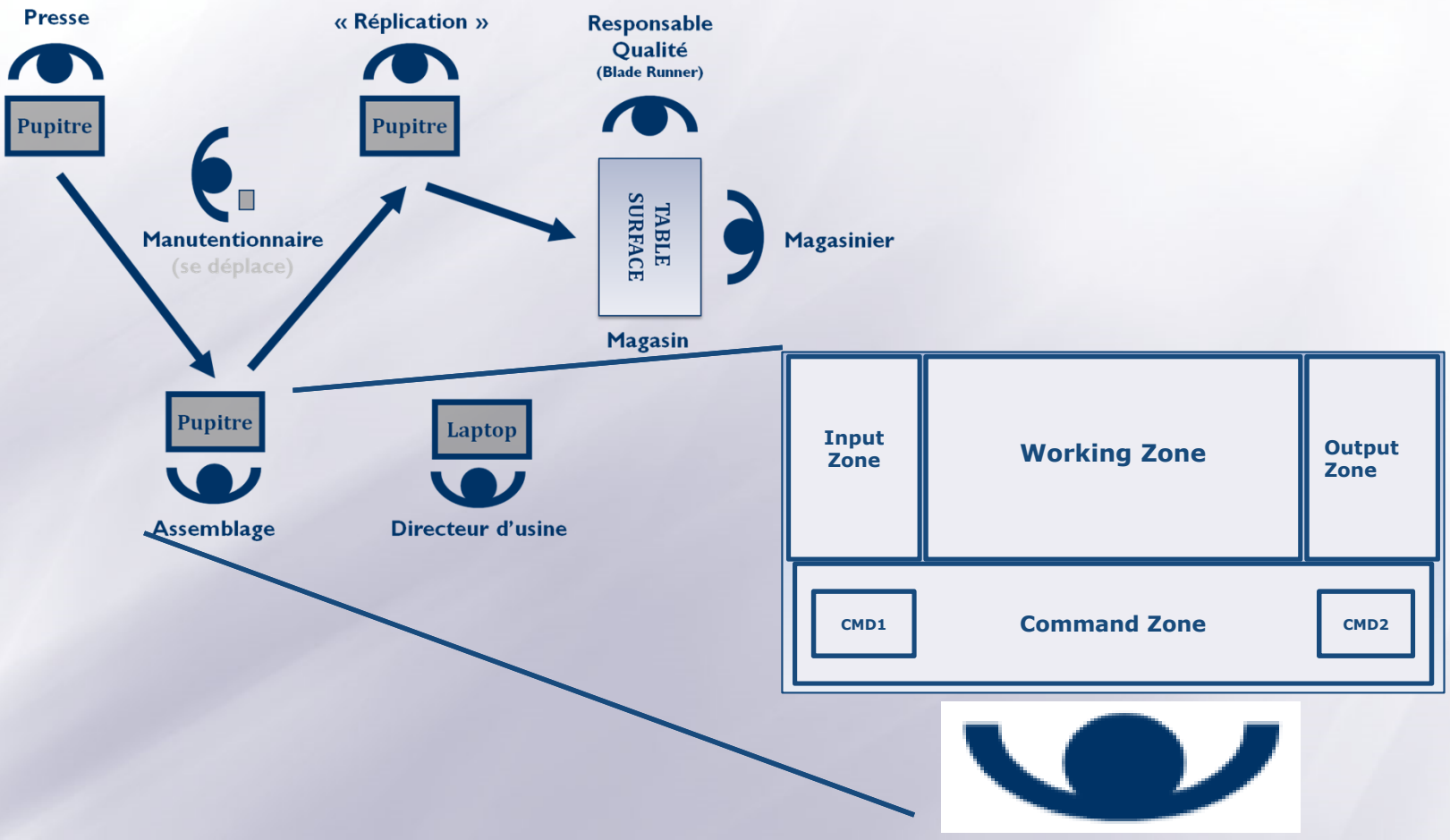
Definition of Serious / Learning Game



A co-located Collaborative Learning Games is "an educational tool implementing game mechanics taking place in a physical and digital environment and supporting collective problem-solving learning».

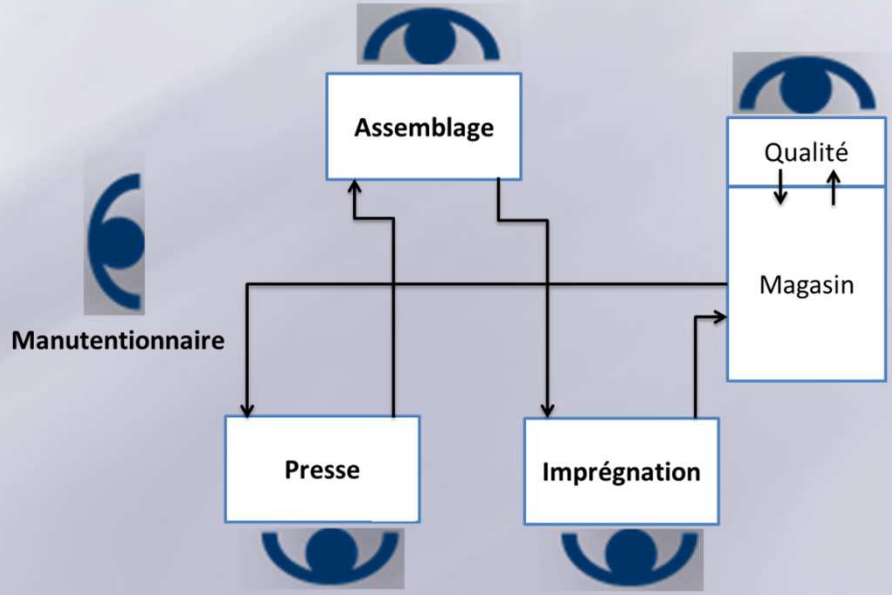
Develop methods, models and tools for design, production and execution of SErious GAme in mixed REality

Lea(r)nIt: general view



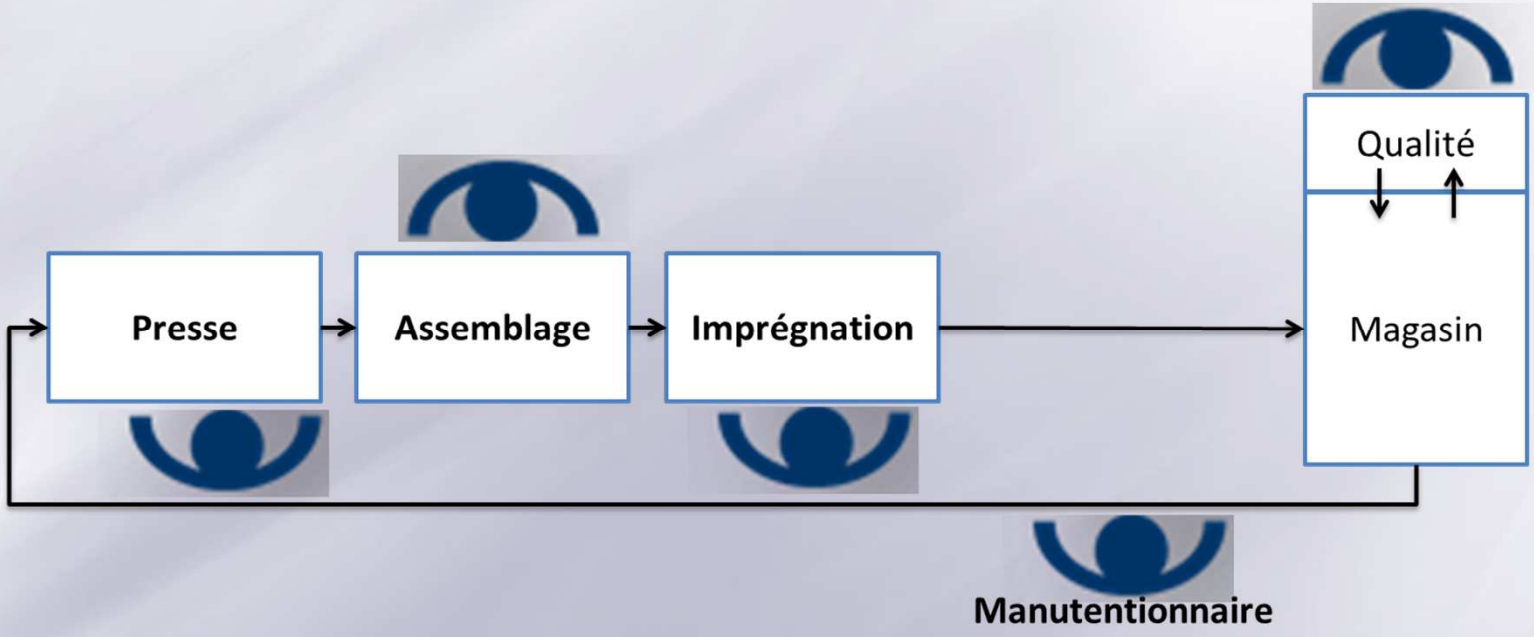
Simulation environment

- **Environment :**
  - 5 fix workstations
  - 1 mobile position
- **Cooperation work between 5 actors**
  - transformation of row materials to processed products
  - Move the products



Ameliorations of LEAN

- **Rationalization of working space**
  - Proximity of workstations
  - Minimizing material handling activity

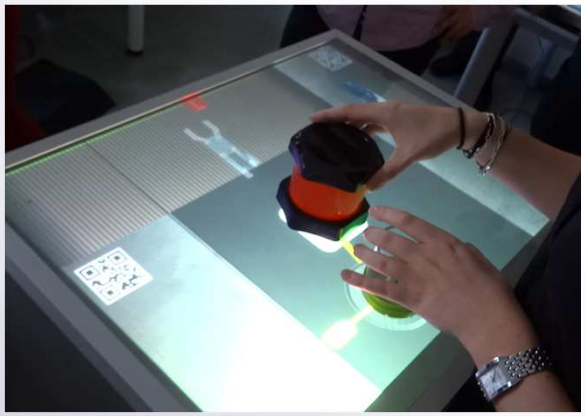


Computerization of the learning game

LEGO based game

- Automated management of the environment
- game rules / goals of the system Improvement management

Different interactions used



Press post

- Choice of body production from aggregates
- Using two-handed touchscreen interaction

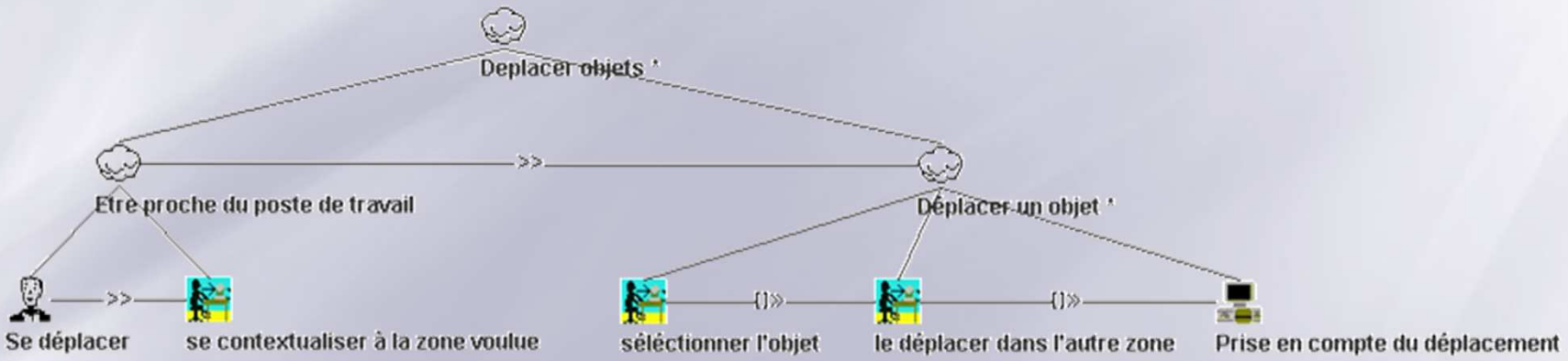
Assembly station

- Replicants' personality infusion
- Using two tangible interfaces

Impregnation station

- Replicants' personality infusion
- Using two tangible interfaces

Move between workplaces



Different design needs

Different interactions :

- Tactile
- Tangible
  - Objects on the table
  - Objects moved by users

Environment support system

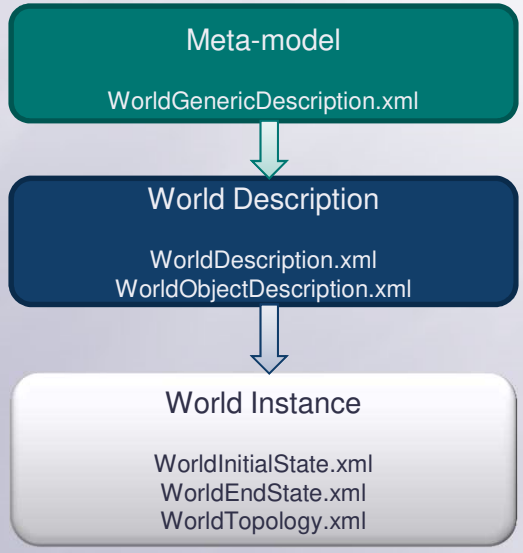
- Where users can move
- Physical devices are movable
- Devices allowing access to different parts of the digital environment
- Where the activity zones can be used by one or more users (on the same device or on different devices)

Territoriality concept

- Digital zone change according to the physical zone via QR codes

Development process

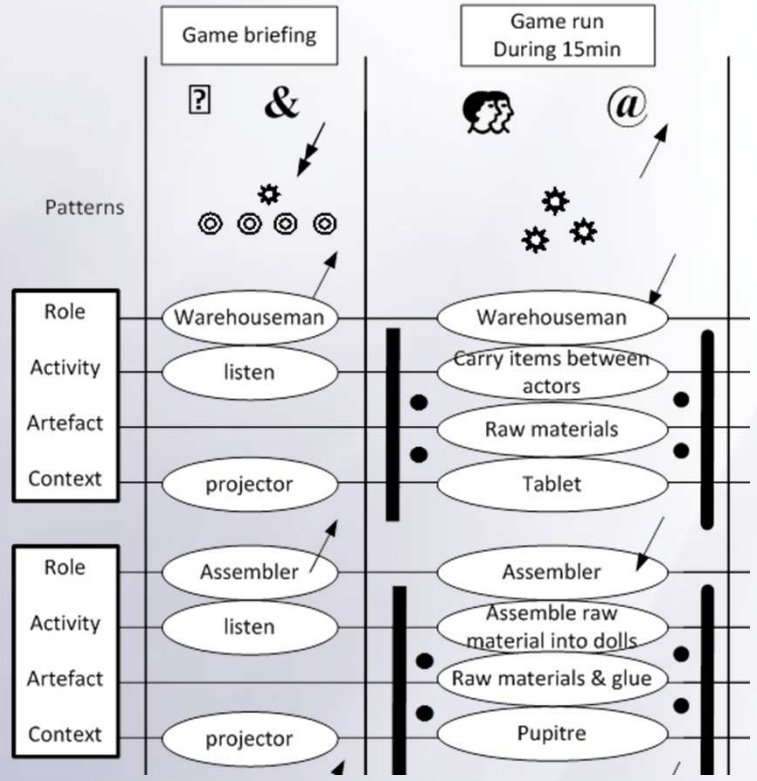
- MDA Approach
- Different models & formalisms
- Agile Methodology



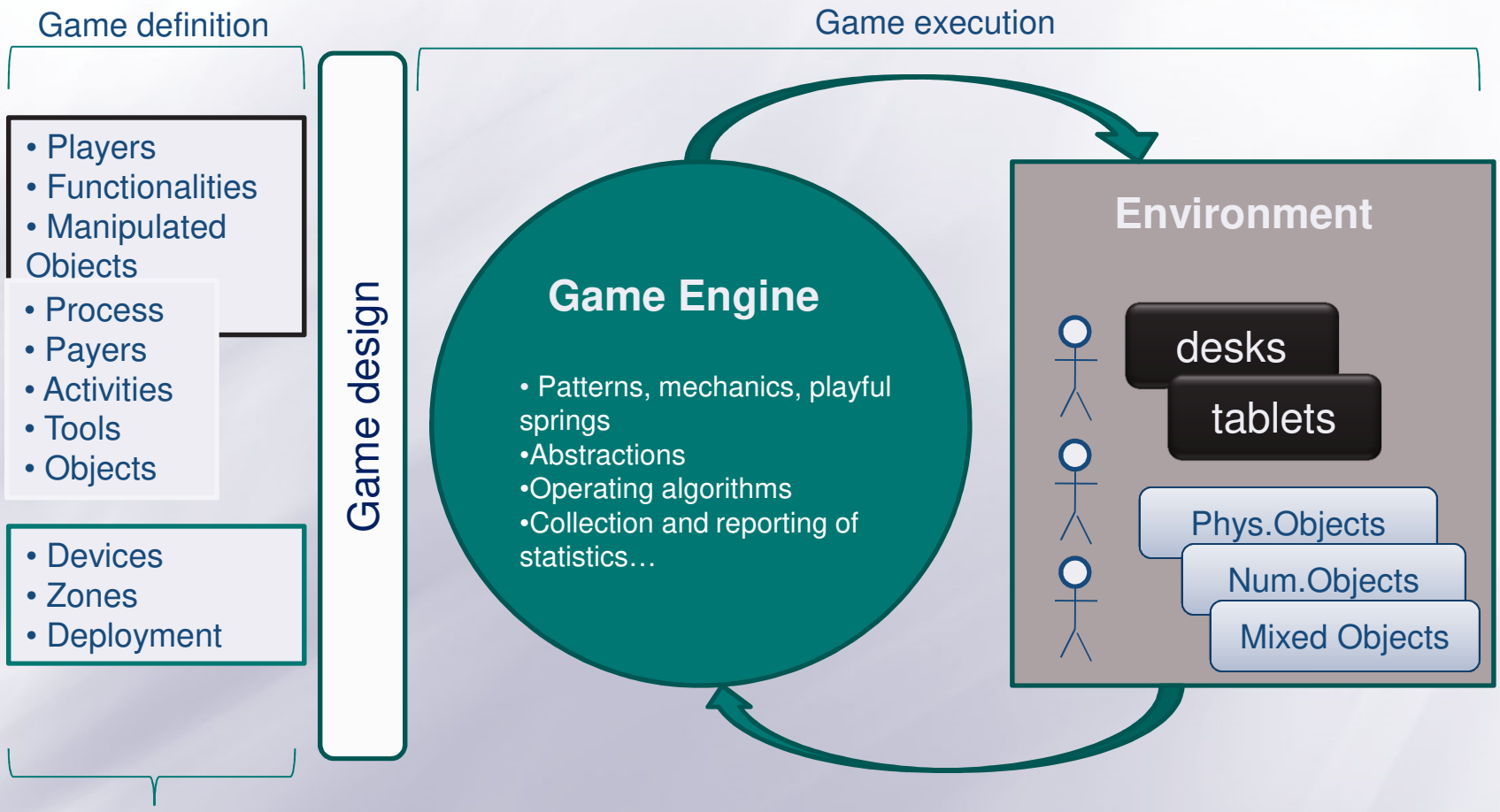
- **Process**
  - Iterative
  - Incremental
  - Adaptive

ORCHESTRA Model / Formalism

- Describes the organization of collaborative activities
- Describes the realization of synchronous collaborative activity
- Describes the participants individually according to:
  - Their role
  - Their goal (s)
  - The achievable task (s)
  - The usable artifact (s)
  - The place where the activities are carried out (context)



Game Design Framework



F-MRLG / Orchestra / eIRVO+

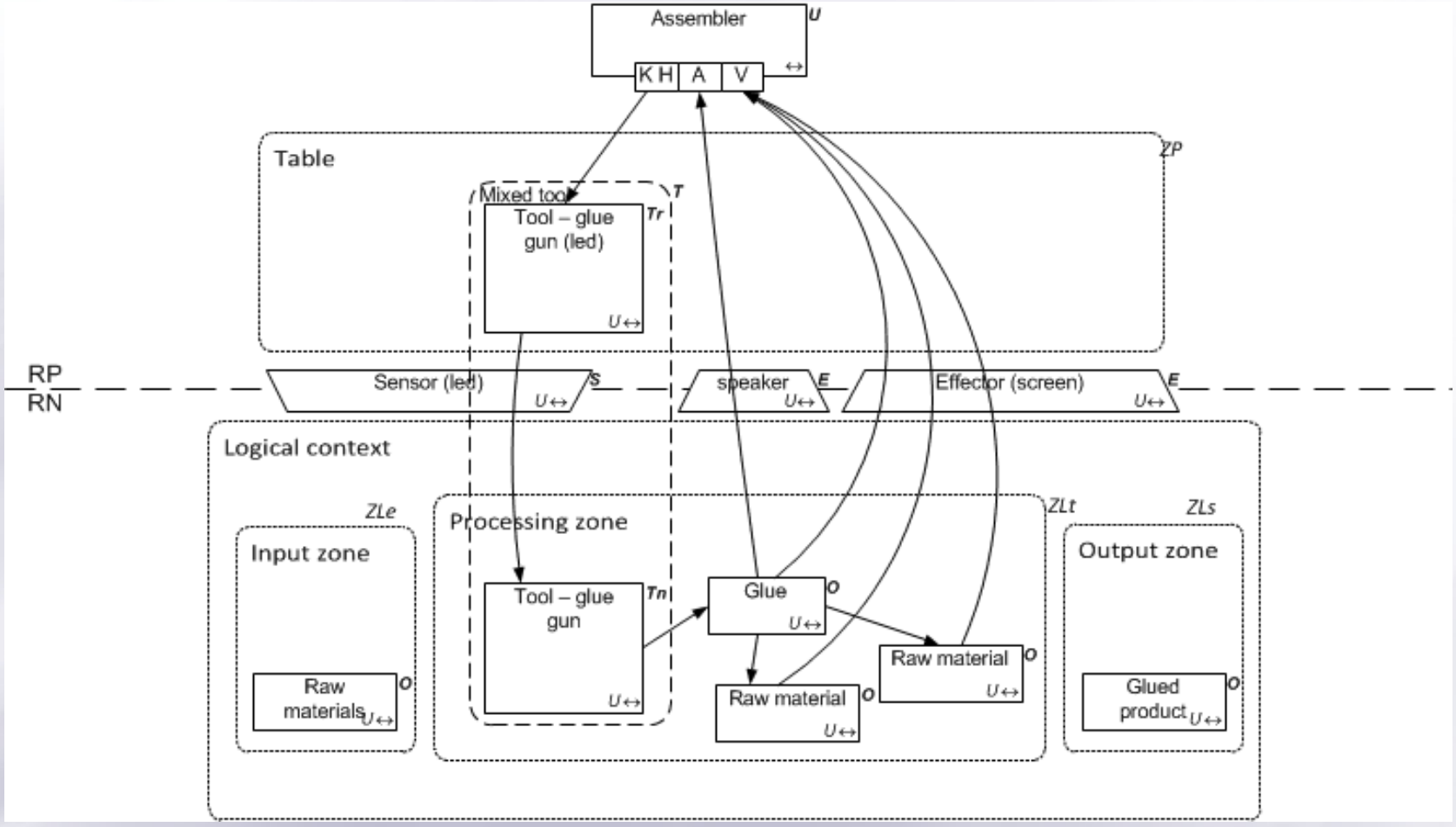
Game engine

Engine

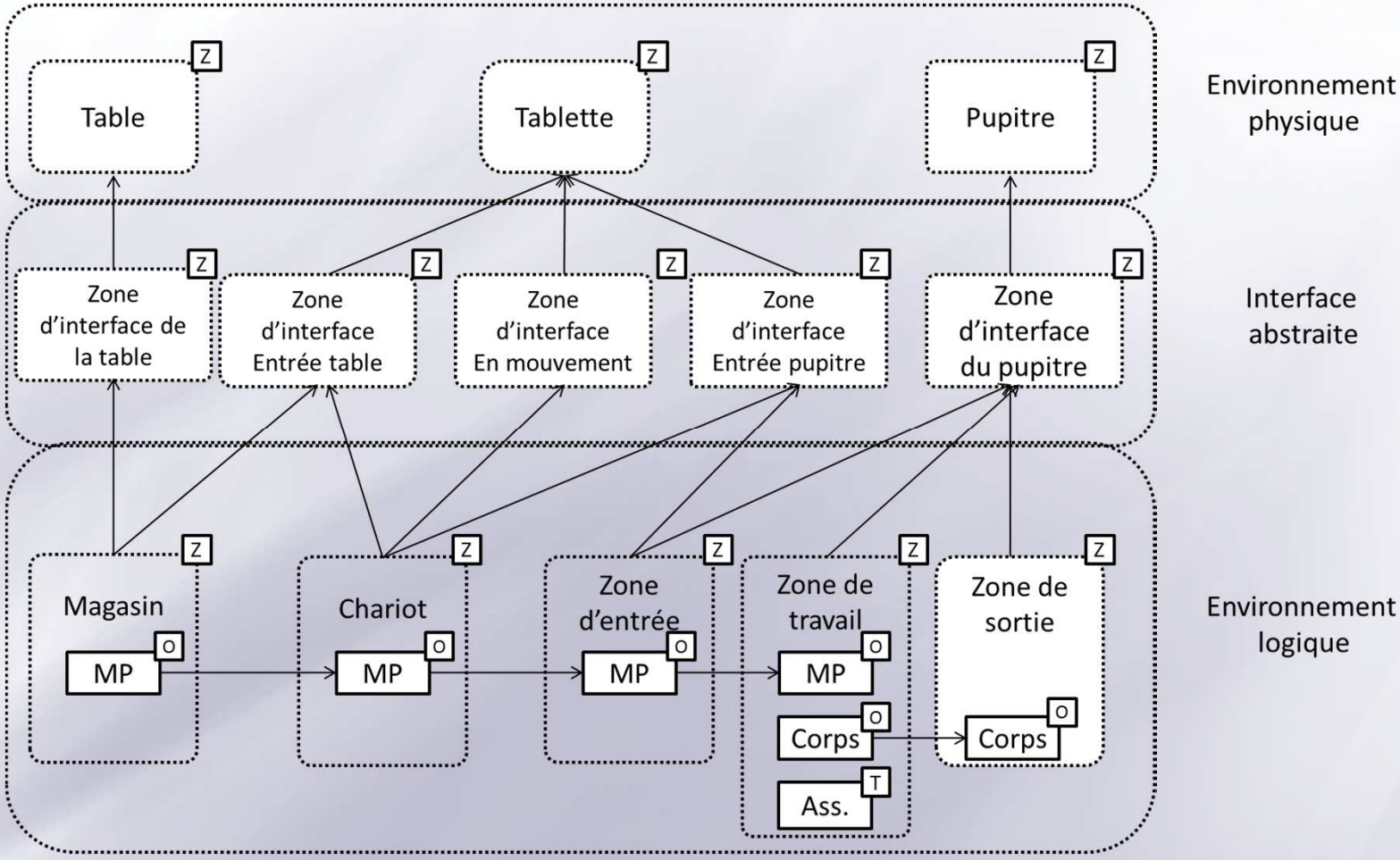
Identified kinematics cases

- **Imposed sequentiality:** the order of intervention in turn of the players
- **Parallel without constraint:** when every player can play at any time
- **Parallel with data synchronization:** when player behavior is conditioned by shared data / actions of others
- **Parallel with long-time synchronization:** when player behavior is conditioned by time-defined milestones.
- **Parallel with short-time synchronization:** with full synchronization of the world at each elementary time unit.

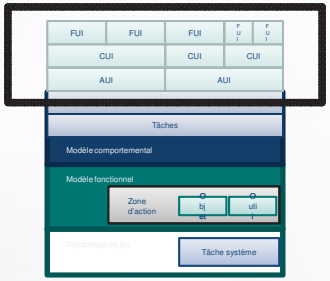
IRVO (Interaction with Real and Virtual Objects)



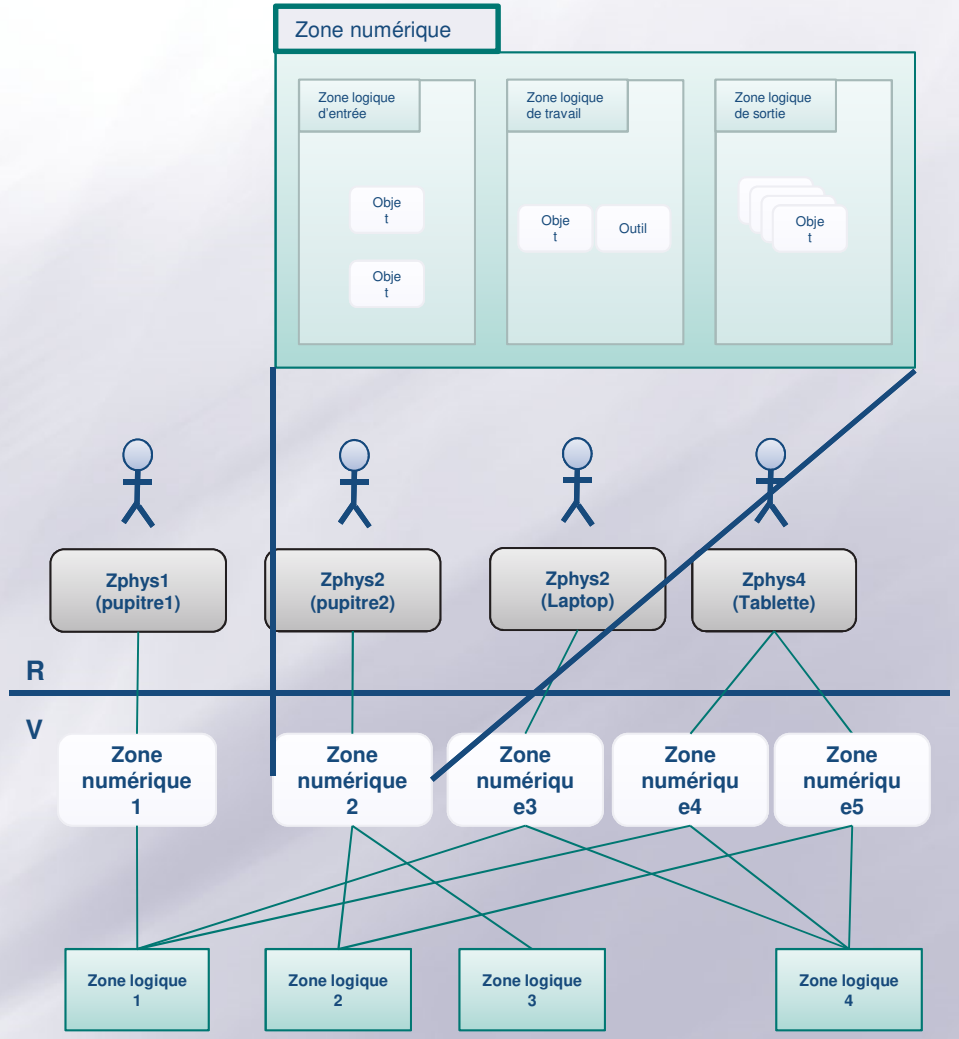
Environment model of Lea(r)nIT



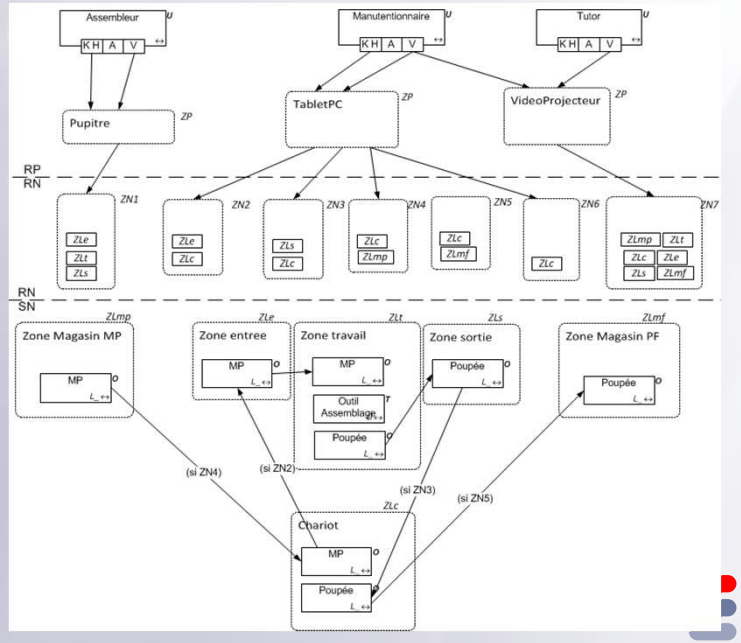
eIRVO+ = IRVO + Territoriality



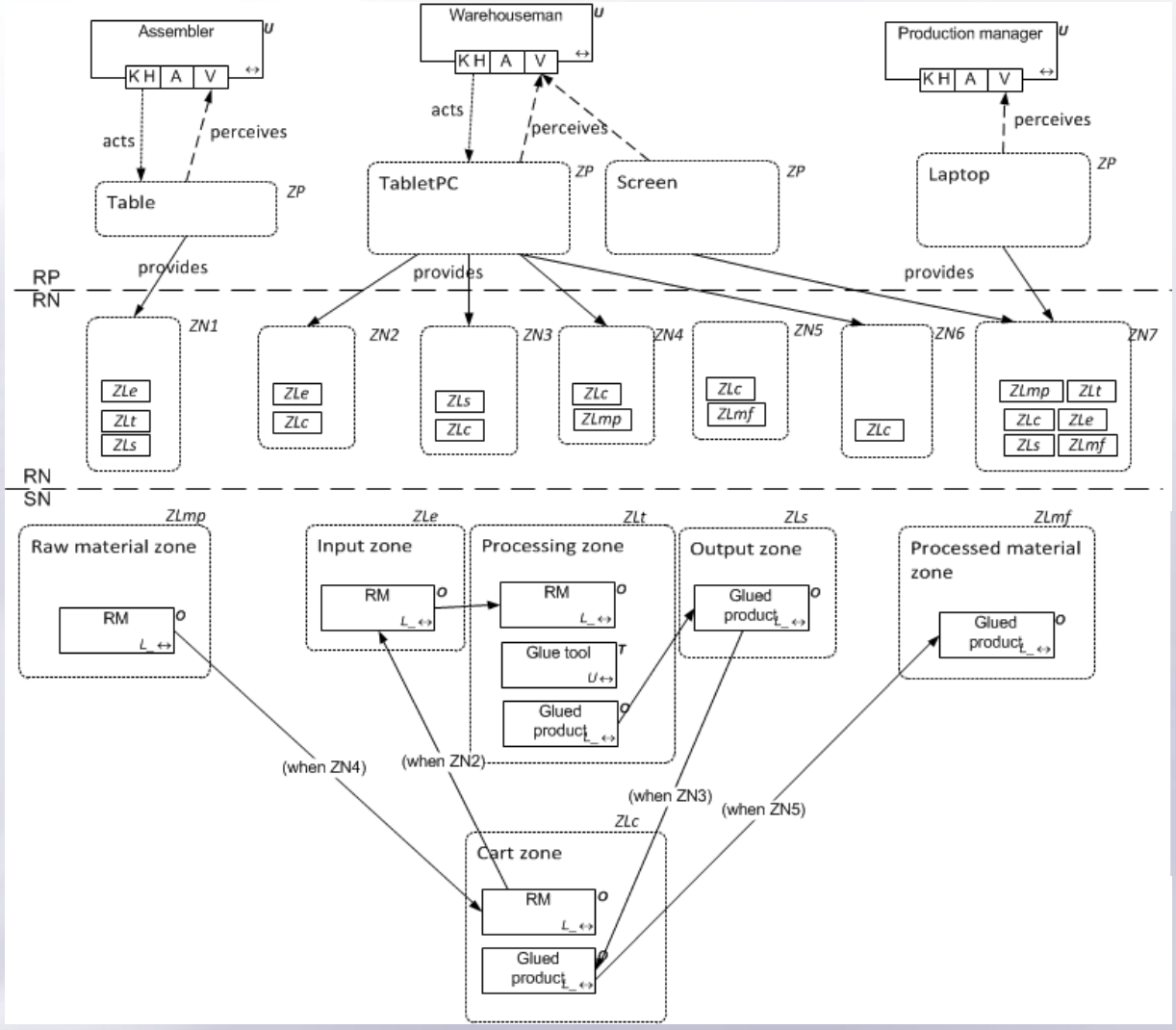
HCI

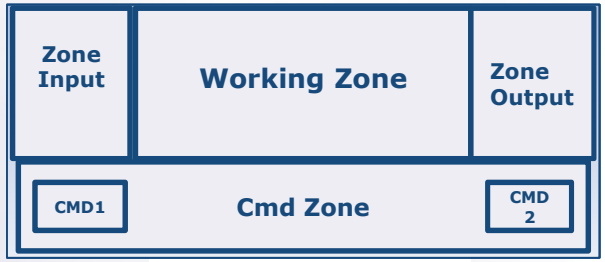


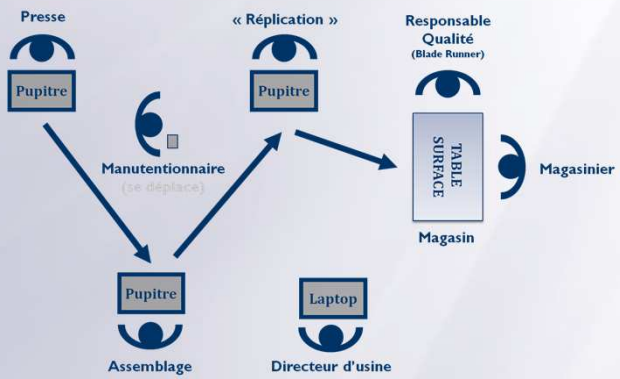
- Editor based on Visio et IRVO
- Generation of XML files



Territoriality management



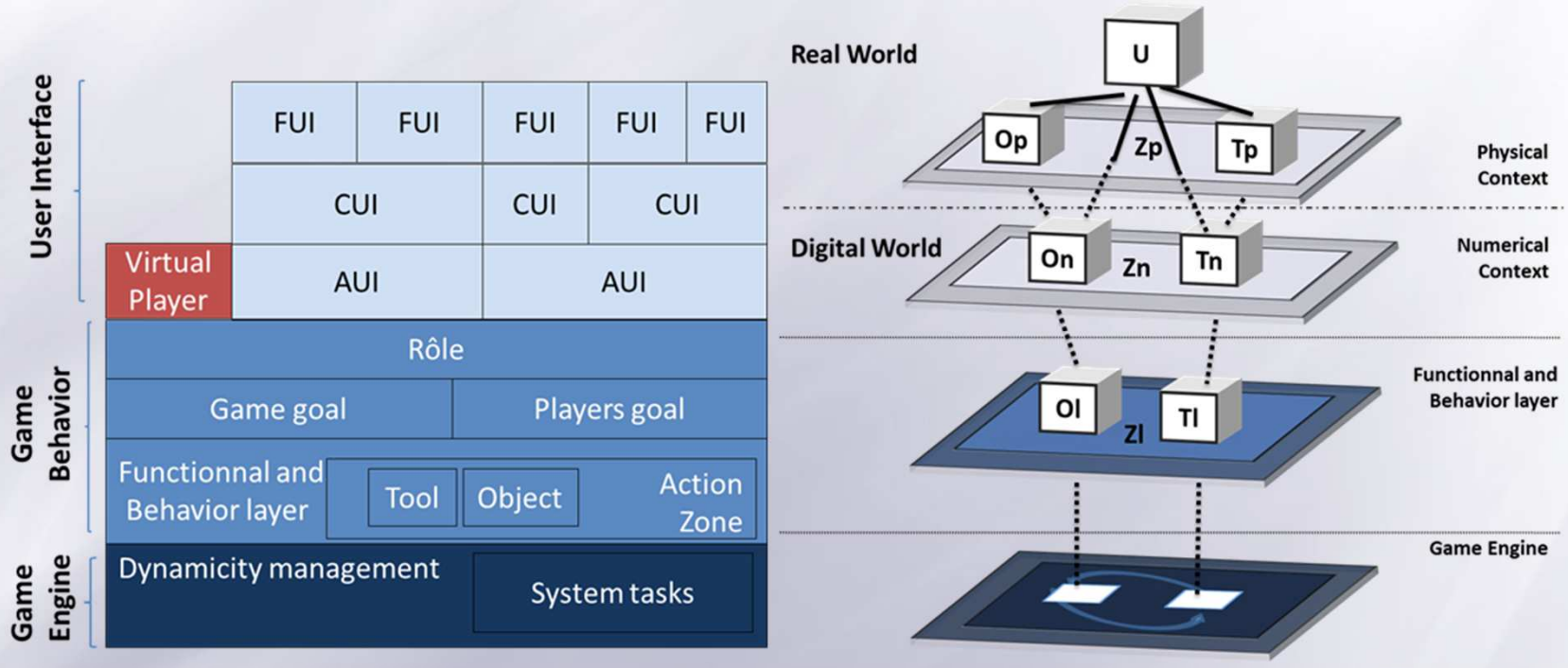




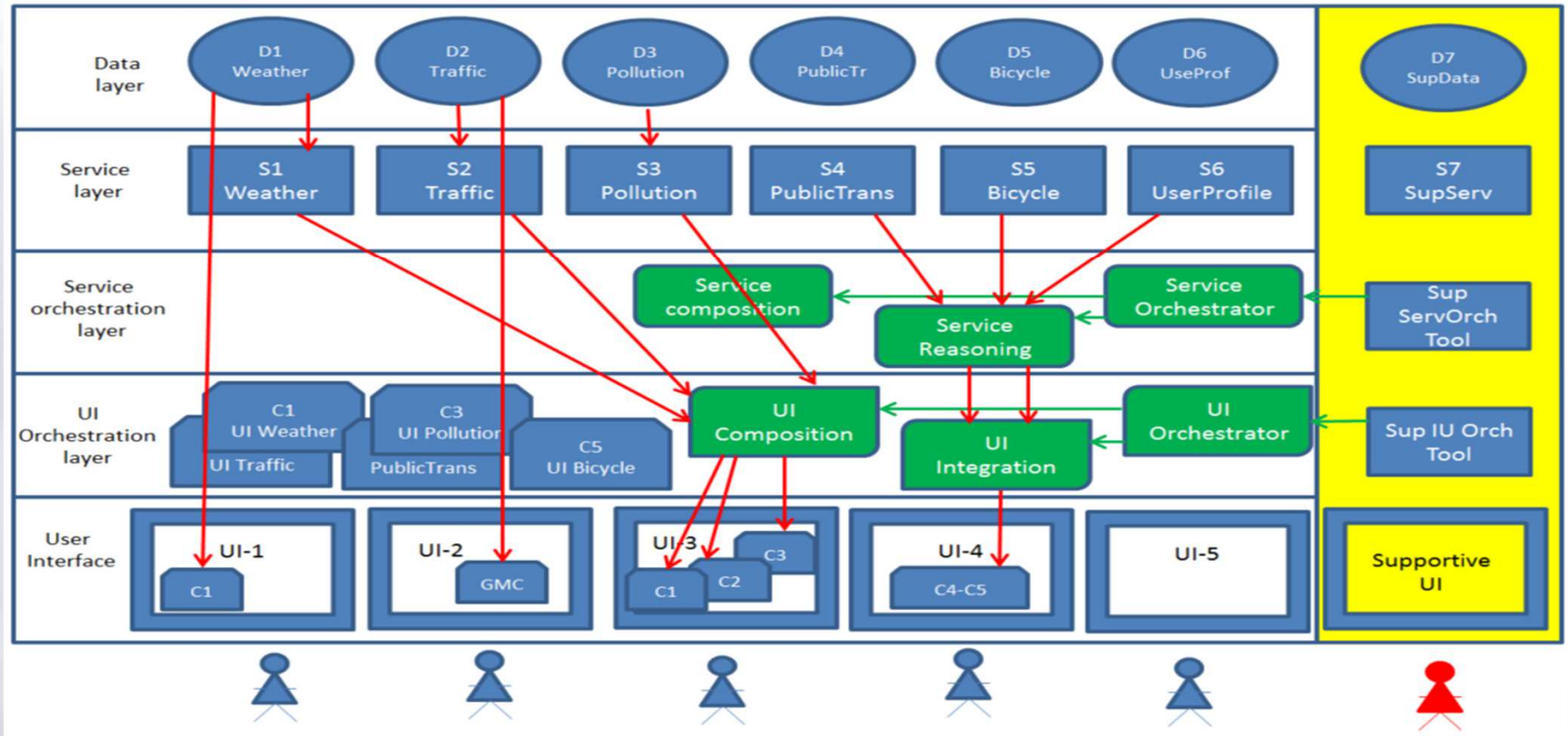
Design of game architecture

- **Collaboration: Enabling a multi-player gaming experience on heterogeneous physical devices**
  - allow rapid deployment of digital zones
  - allow rapid deployment of remote changes to user interfaces, game structure
- **HCI: Take into account different styles of interaction resulting from mixed reality (tangible interfaces, multi-touch, etc.)**
- **How it works: Support playful patterns**
  - be able to memorize a game state, reload it
  - allow traceability of tasks and user actions
- **Engine: support of different types of kinematics**

Generalization - architecture

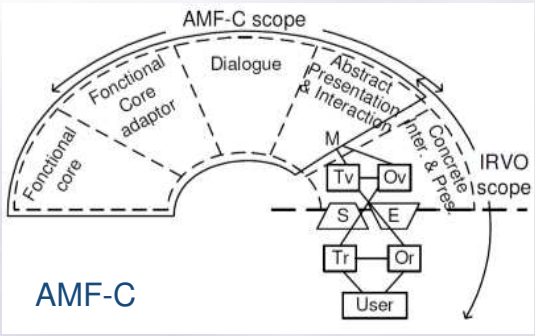


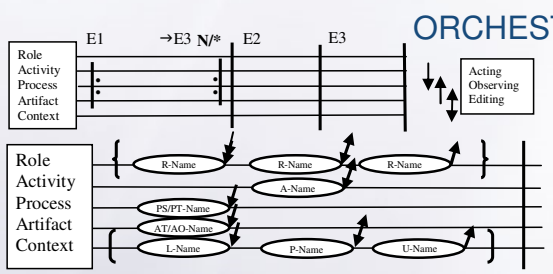
Supportive UI for five-layer mashup-based application architecture



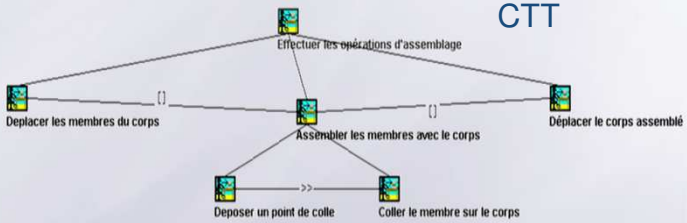
Models - formalisms

Task tree by CTT
Orchestration by ORCHESTRA
Architecture by AMF-C
AR by IRVO & eIRVO+
Supportive UI

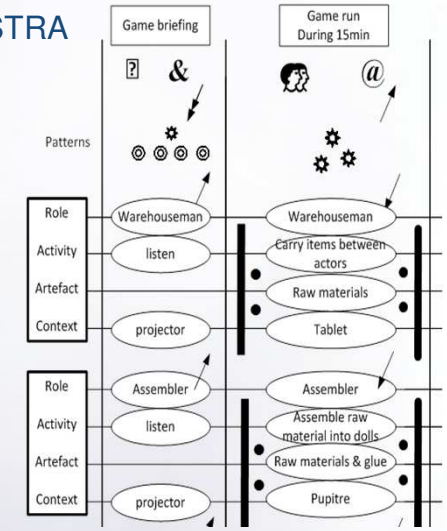




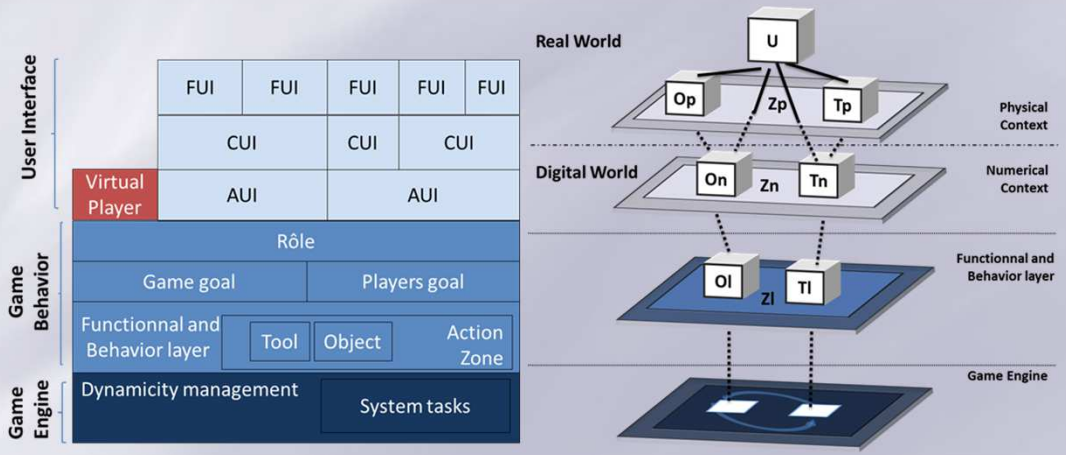
ORCHESTRA

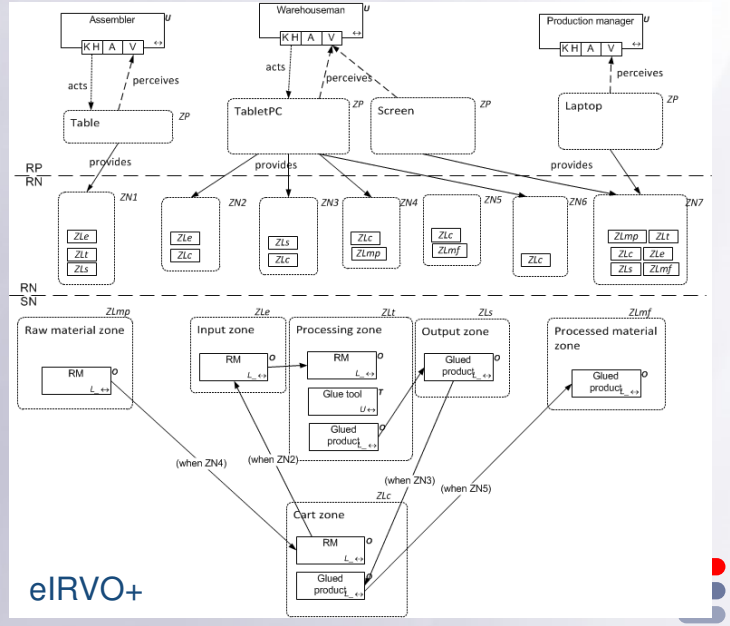


CTT

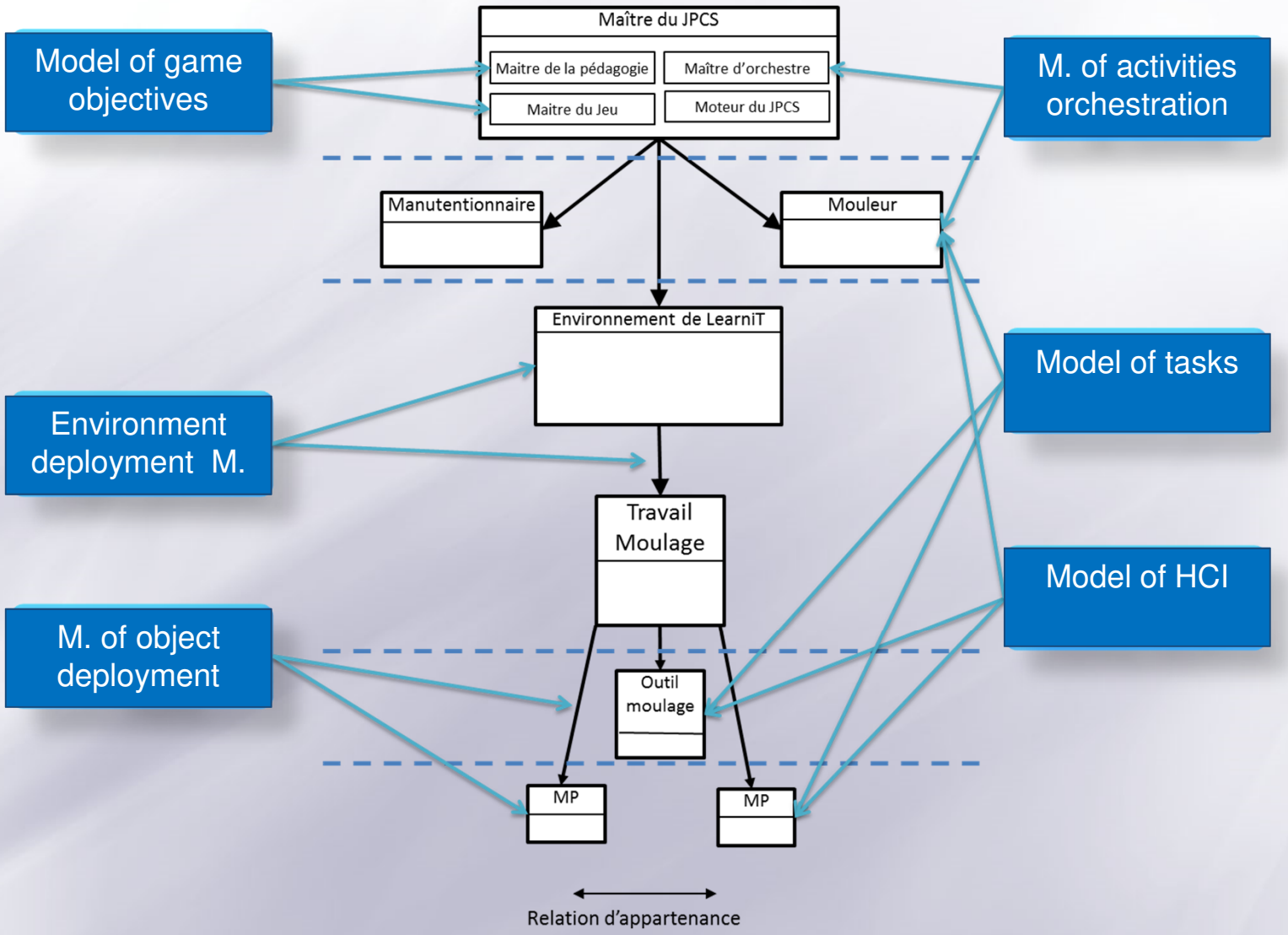


Integrate concept of territoriality for distributed & mobile applications is mandatory





Architecture – Model projections



Conclusion

- **Our approach, i.e. model, process, tools and architecture, is validated on a concrete LG prototype design and implementation. We also formulated and tested different configurations of physical and social contexts taking into account AR and tangible interfaces.**
- **The role of territoriality concept is important in this kind of applications or systems allowing to find appropriate supporting devices and the distribution of AR and tangibles interfaces**
- **Two main reasons for environment redistribution are:**
  - for more appropriate and attractive workstations distribution
  - for better LEAN process organization

Thanks for your attention

- Questions?
- Bertrand.David@ec-lyon.fr

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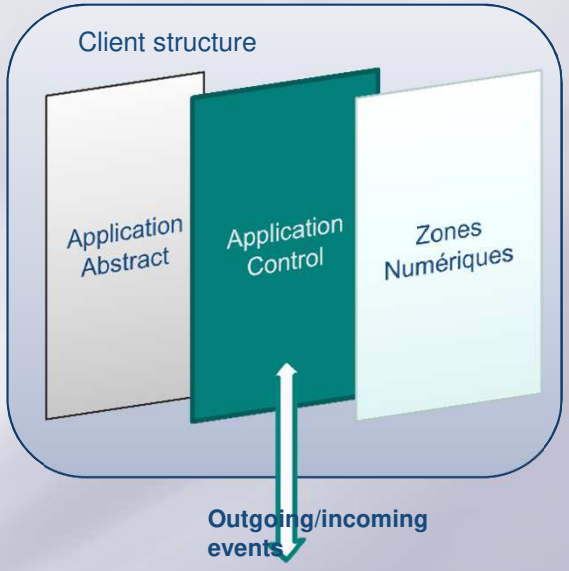
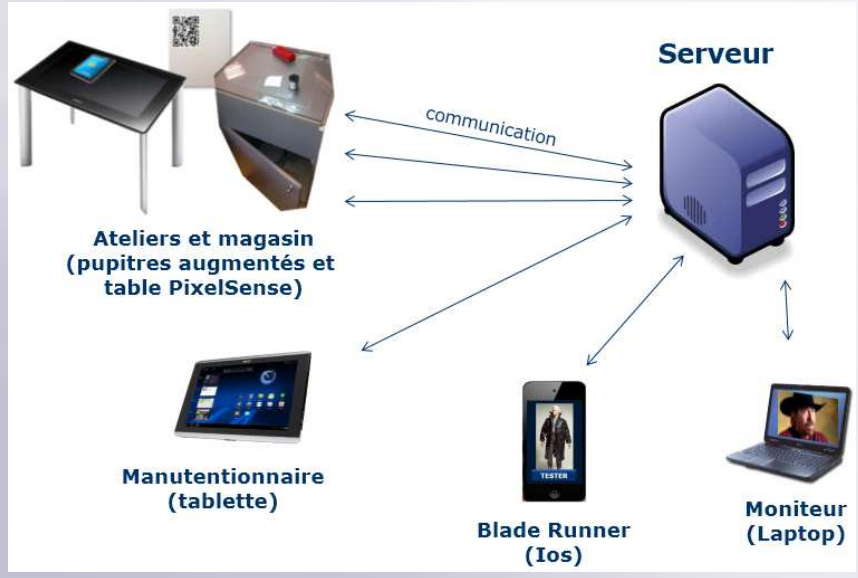
Technical Architecture

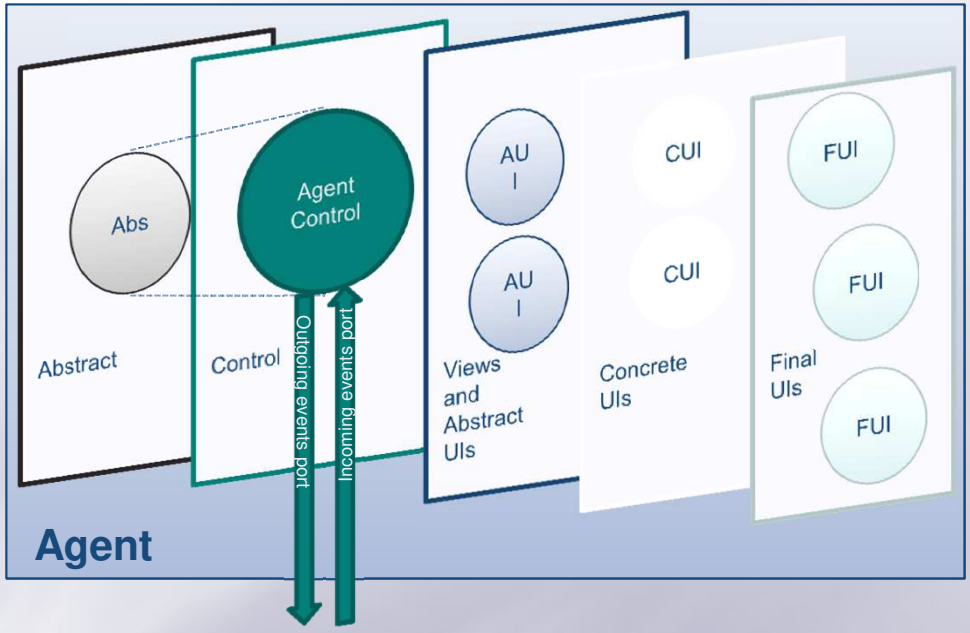
Client-server architecture

- The server ensures the integrity of the functional kernel
- Customers allow interacting with the game through ZNs

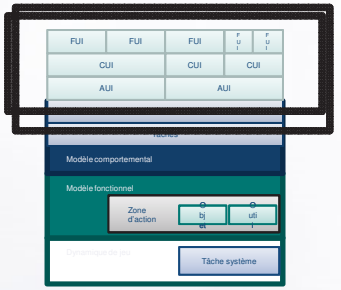




Agent based system



From/To other agent(s) or server



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