Toward Socio-Technical Urban Superorganisms

perspectives on situated awareness & participation

Franco Zambonelli

Università di Modena e Reggio Emilia

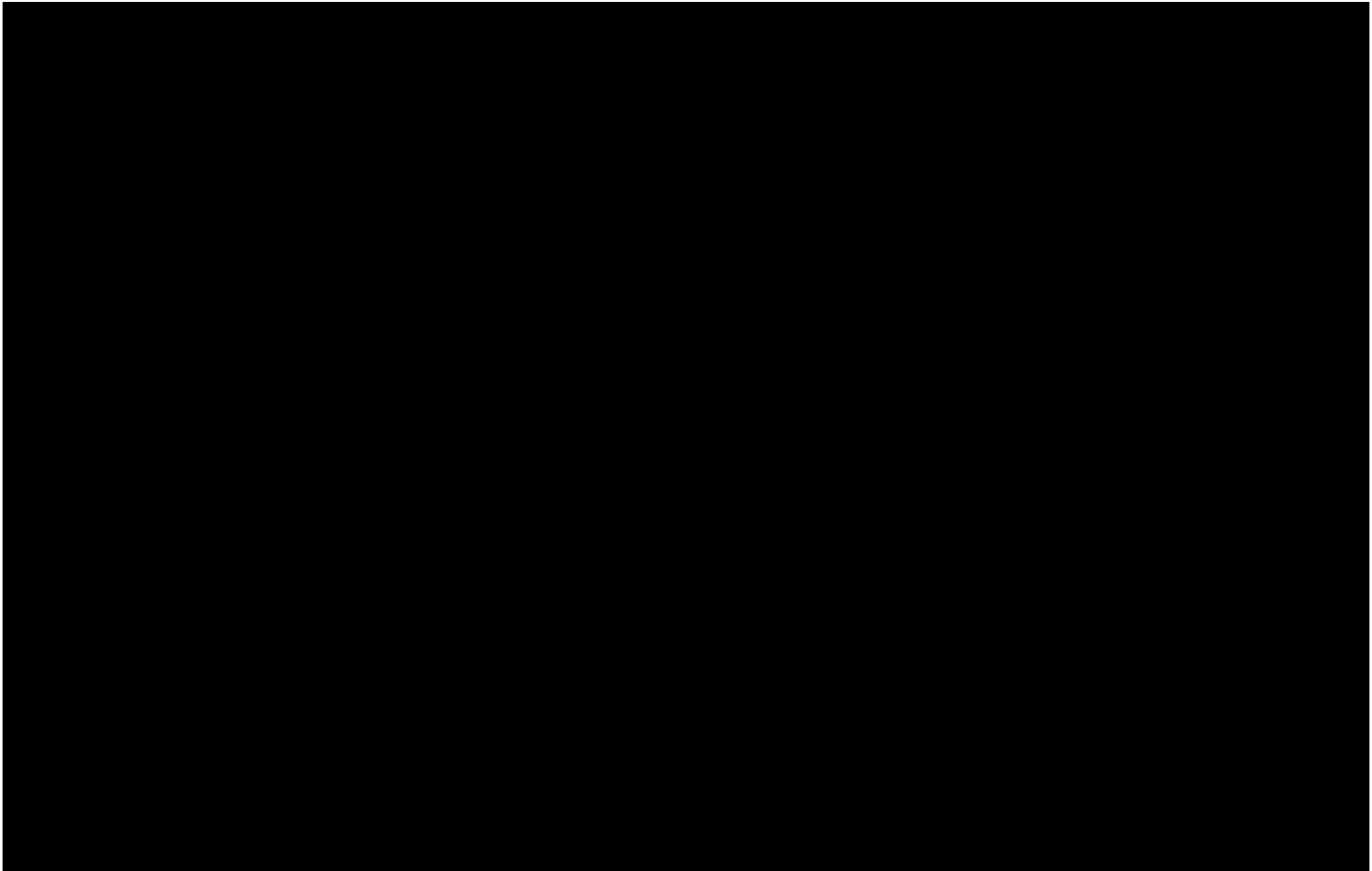
franco.zambonelli@unimore.it

Collective…What?

E Pluribus Unum

E Pluribus Unum

E Pluribus Unum



Superorganisms

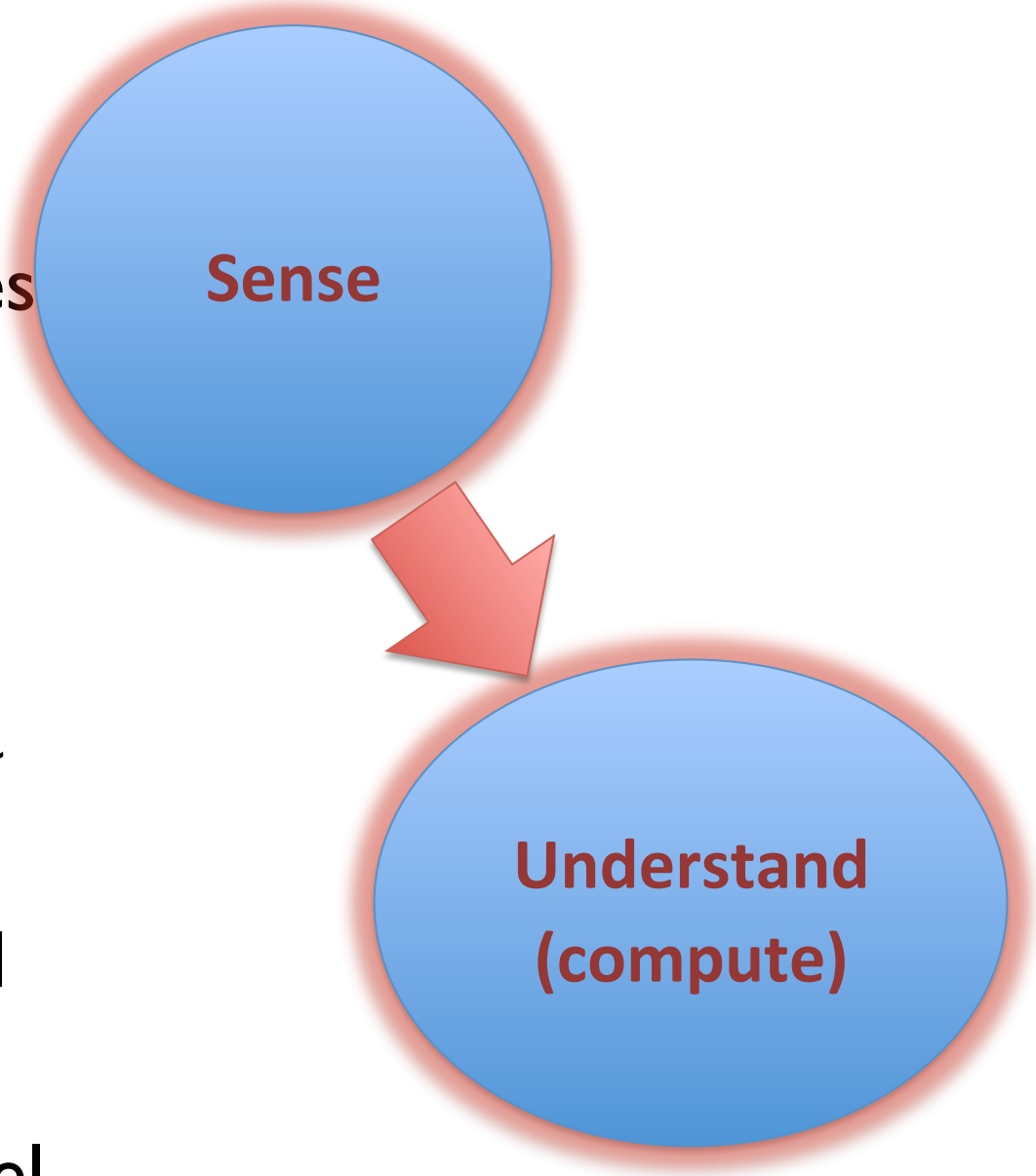
- Colonies of ants, termites, etc.
- Organisms composed of many individual ones
- That exhibit finalized collective participative behaviors (or “collective intelligence”)

Urban Superorganisms

- Can our urban environments become superorganisms?
- What could this actually mean?
- Why socio-technical?

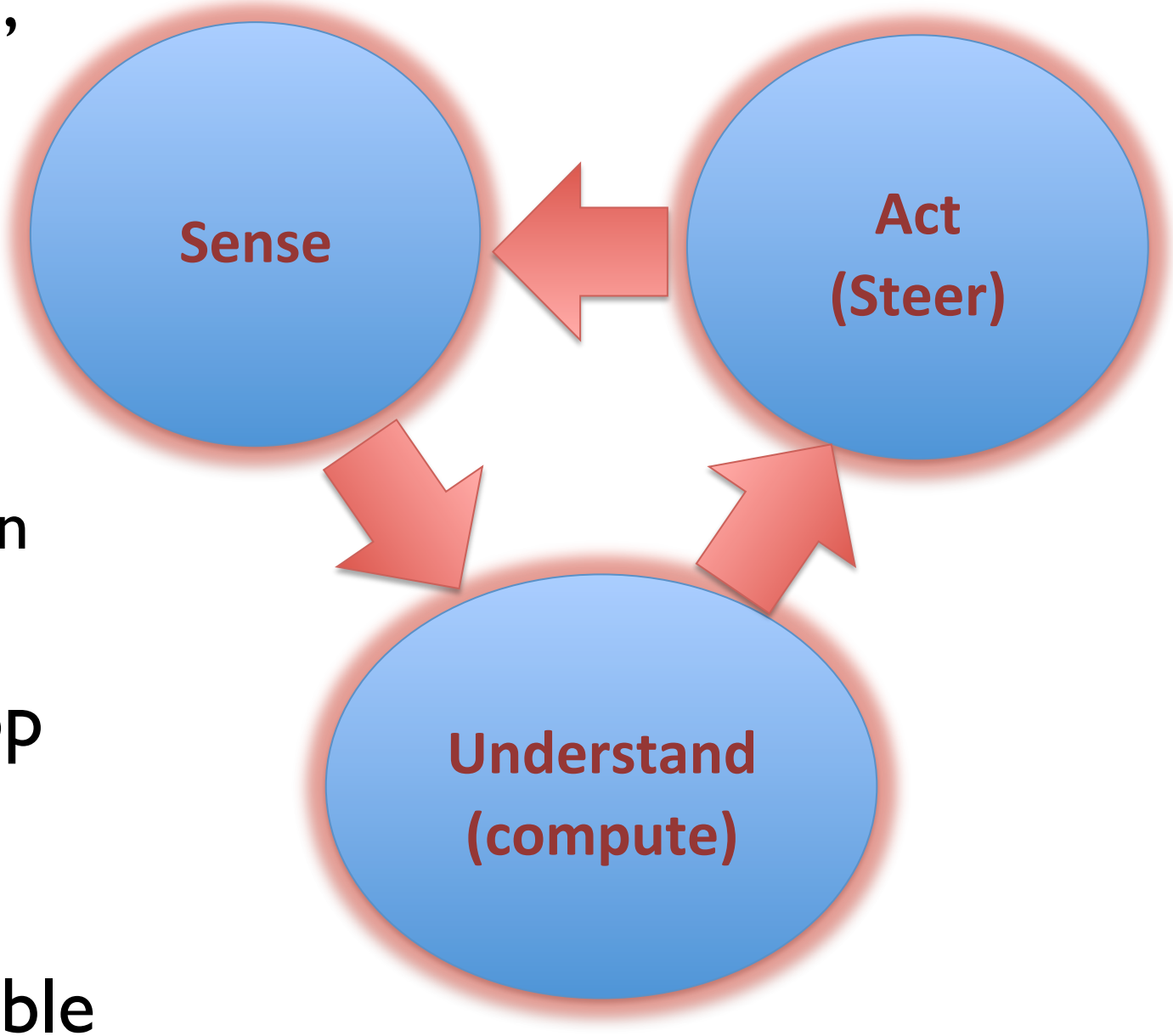
Smart Cities: From Senseable…

- Sensing what's happening
  - Via ICT devices
  - And social networks
- To better understand (via data analysis)
  - City and social dynamics
  - At a global level



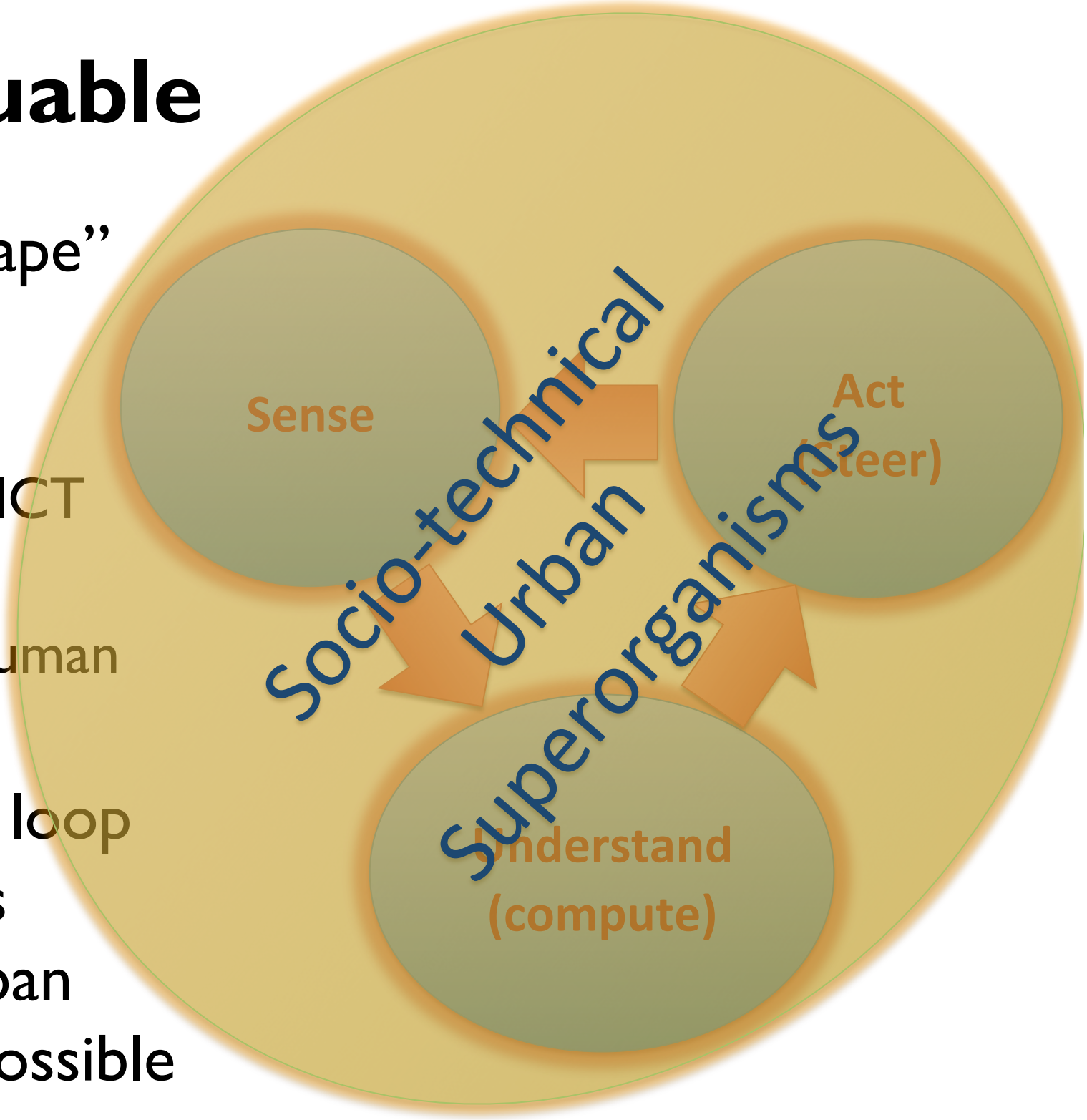
…To Actuable

- We can "shape" other than understand
  - Actuating ICT devices
  - Steering human actions
- Closing the loop that enables finalized urban behaviors possible



…To Actuable

- We can "shape" other than understand
  - Actuating ICT device
  - Steering human actions
- Closing the loop that enables finalized urban behaviors possible



Urban Superorganisms: ICT Side

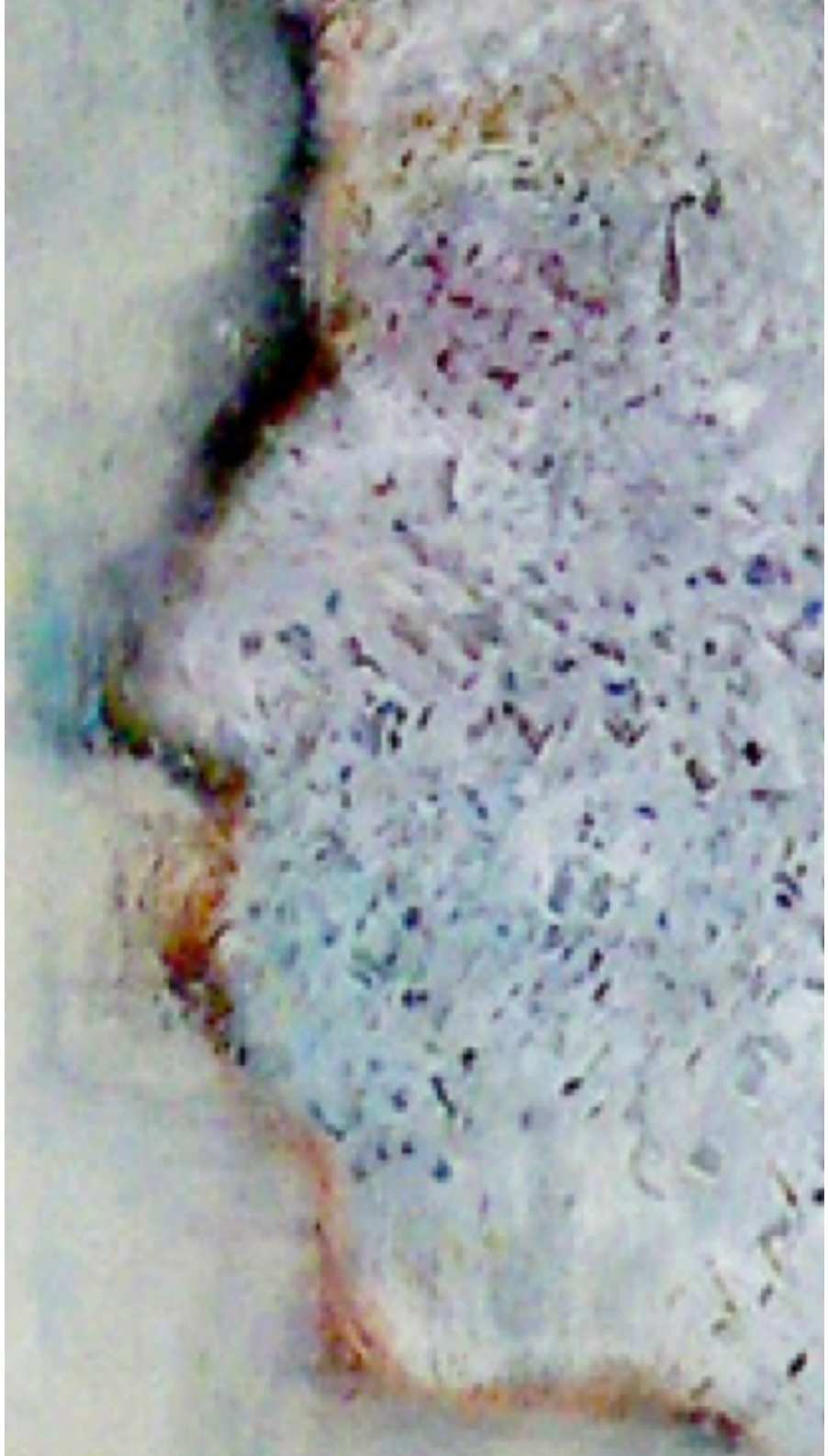
- An ICT-enriched urban environment with rich sensing, actuating, and computing (SAC) capabilities
  - **Sensing**: sensor networks, tags, smart objects,etc.
  - **Actuating**: traffic controllers, public digital displays, critical infrastructures
  - **Computing**: highly distributed and decentralized, with inter-connected computational engines everywhere

Urban Superorganisms: Human Side

- People with smart phones or alike (or whatever will appear in the future as wearable devices) contribute to such SAC capabilities
  - **Sensing**: the 5 senses + smart phones
  - **Actuating**: the body
  - **Computing**: human & social intelligence

Urban Superorganisms: Putting All Together

- The ICT and Human/Social level blurred to the point of invisibility:
- Complementing each other in a process of high value co-creation
- In the resulting overall "urban organism", we can achieve very high-levels of collective
  - Perception
  - Awareness
  - Action
- Dramatically changing the way we move, live, work, and play, in our towns



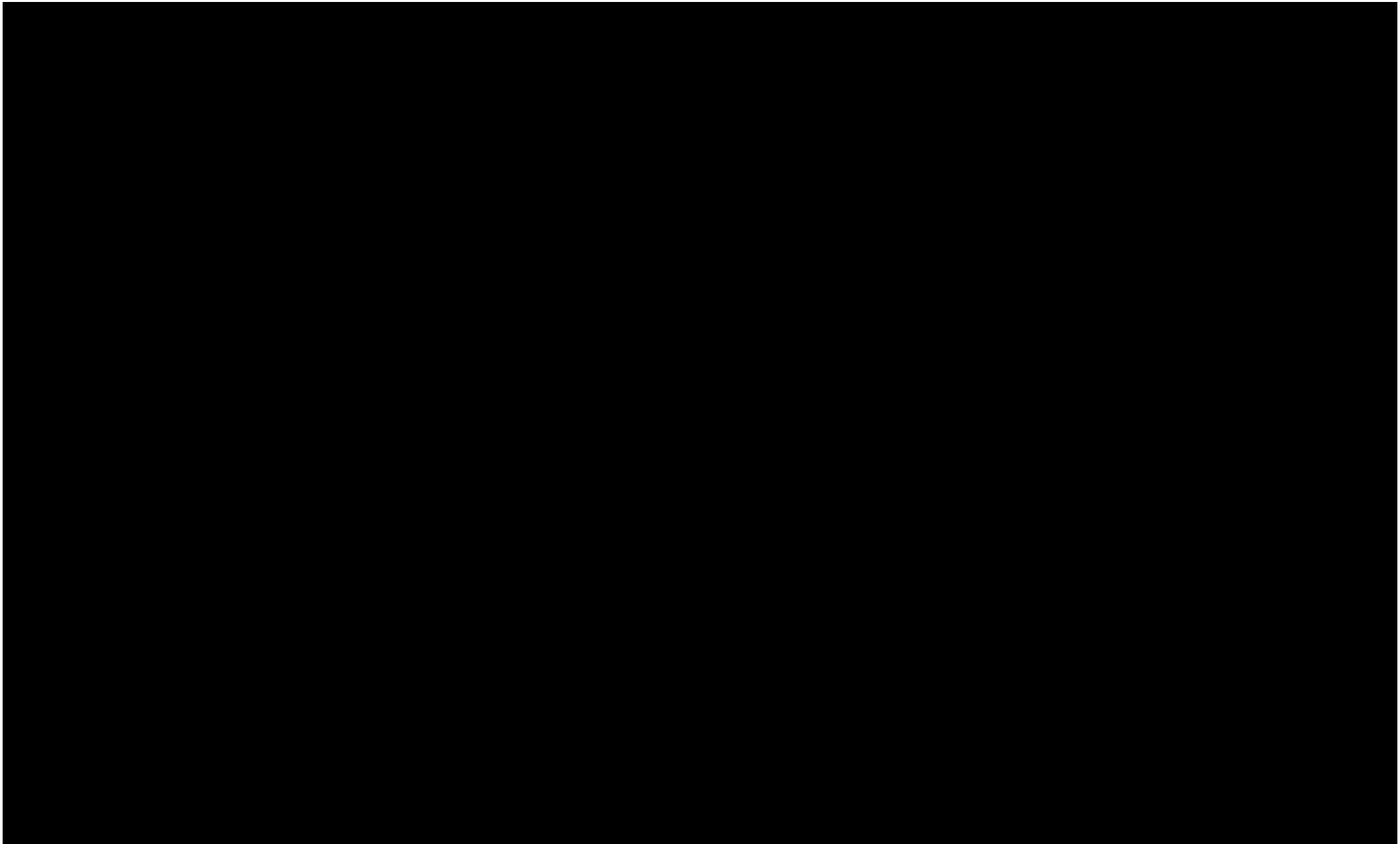
Living in a Superorganism

- Collective vs individual awareness
  - Reflecting on ourselves as members of a community
- Be capable of understanding and acting together in real time
  - Immediate feedback to/from the community

Collective Mobility, for Instance

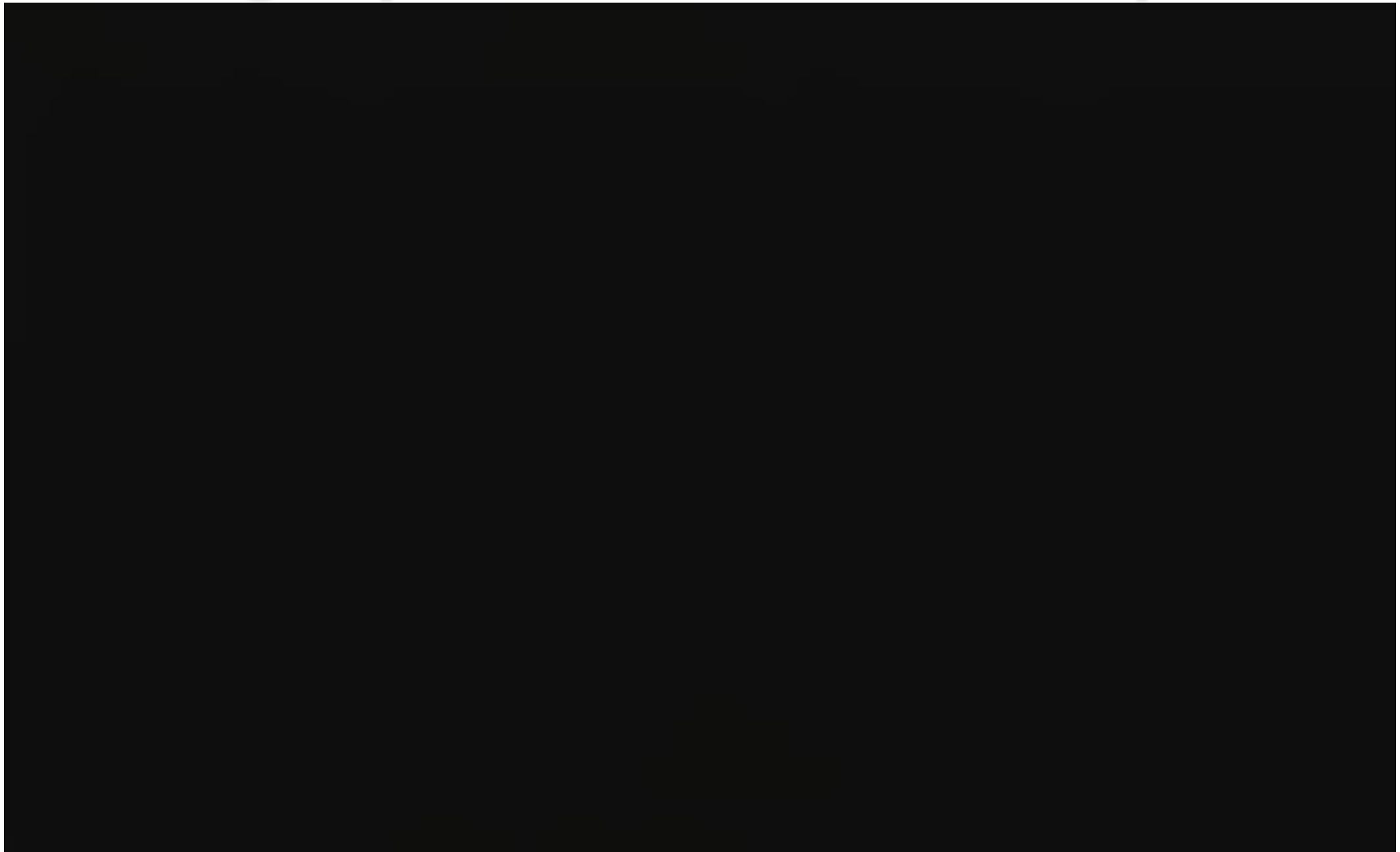
- **Mobility** *per se* :: steer for car, bike, ride sharing
- **Childcare** :: steering & monitoting children on their way to school
- **Exhibitions** :: steer to avoid crowd or suggest paths
- All of these requiring collective sensing awareness and action
- And relying on a ***trade off between bottom up self-organization of behaviors and top-down behavior steering***

Traffic Steering:
Top-down non participatory design

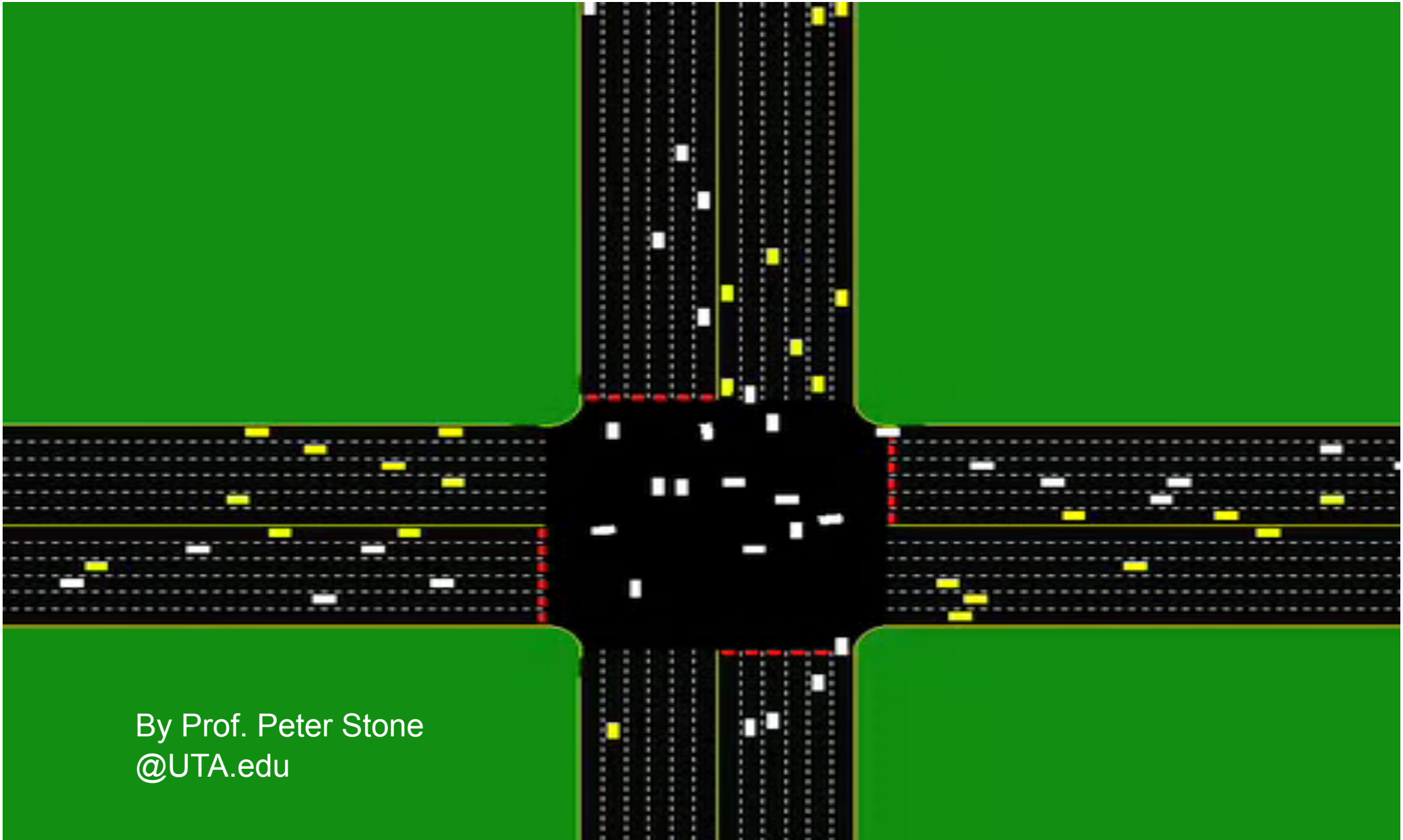


Traffic Steering: bottom up self-organizing solution

Traffic Steering:
mixing top down and bottom up



Traffic Steering:
Future socio-technical superorganisms



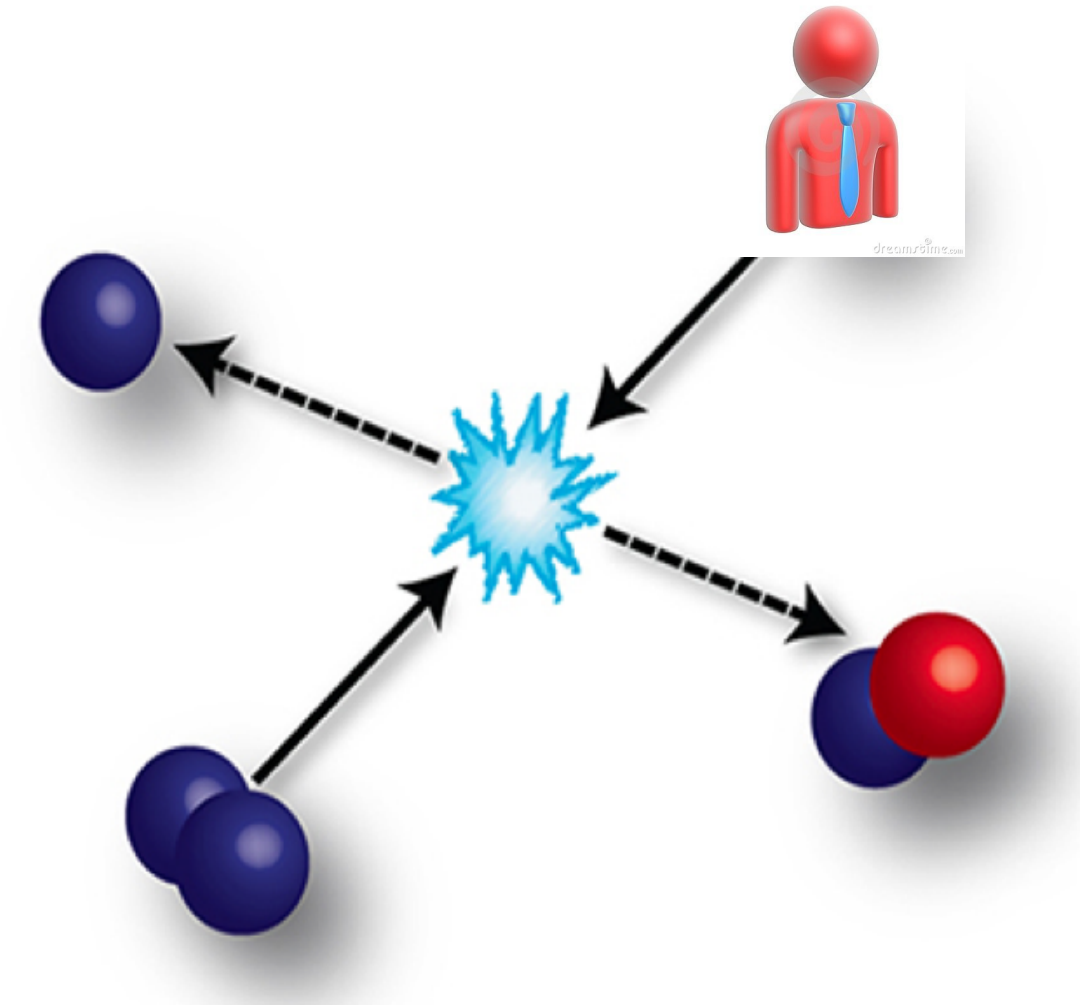
By Prof. Peter Stone
@UTA.edu

The SAPERE Project

- SAPERE "Self-aware Pervasive Service Ecosystems"
  - EU FP7 FET
  - Starting October 1st 2010, lasting 3 years
- Key Challenges
  - To define and implement a framework for adaptive service ecosystems
  - Models + Middleware
  - Experience with pervasive urban services and pervasive displays

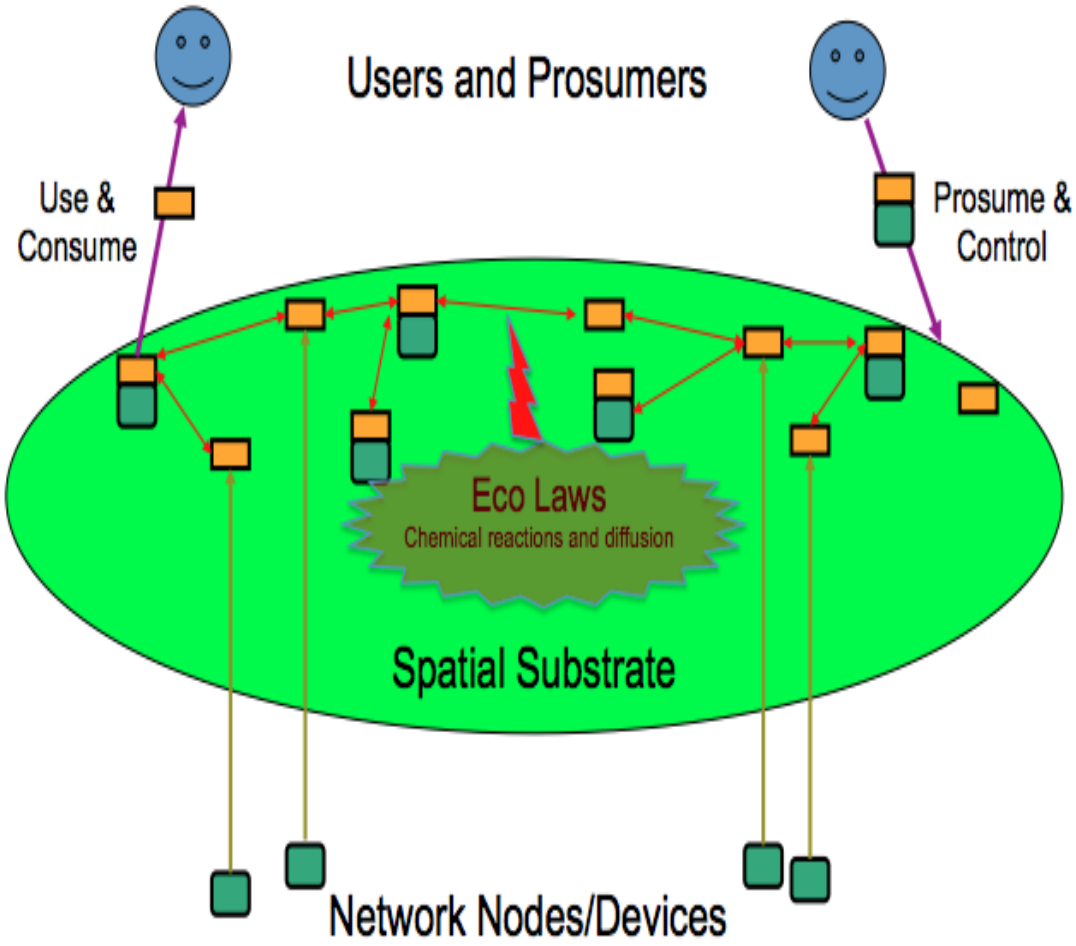
The SAPERE Approach

- Nature-inspired (Biochemical)
  - Simply metaphor for combining/aggregating services in a spontaneous way
  - Whether human or ICT ones
- Spatially-situated
  - To match the nature of urban scenarios
- Adaptive
  - Spontaneous reconfiguration of activities and interactions



The SAPERE Architecture

- Humans & ICT Devices
  - Interact by injecting/ consuming service/data components
- Service Components
  - Execute in a sort virtual "Spatial substrate"
  - Moving, acting, composing, as from eco-laws
- Eco Laws
  - Rule local activities and interactions
  - Apply based on state of local components
  - Self-organization of collective behavior



Steering Mobility in SAPERE

First case: circumventing the crowd

Steering Behaviors in SAPERE with an Ecosystem of Displays

Open Challenges

- Tools to engineer
  - What programming languages and abstractions?
  - Role of existing social networks in future ecosystems?
- Engineerng and controlling emergent behaviors
  - How to find the proper tradeoff between top down design and bottom up self-organization
  - What you steer is what you get?
- Incentives for human participation
  - Reputation, virtual money, situated games, or what?

Conclusions

- Our future cities will become sorts of superorganisms
  - Human & ICT tightly coupled
  - Collective participation and action
- How can we engineer these?
  - SAPERE is doing some steps in the right direction
  - Yet there are a lot of challenges to solve