

A Framework for Artificial Immune Systems for Speckled Computing

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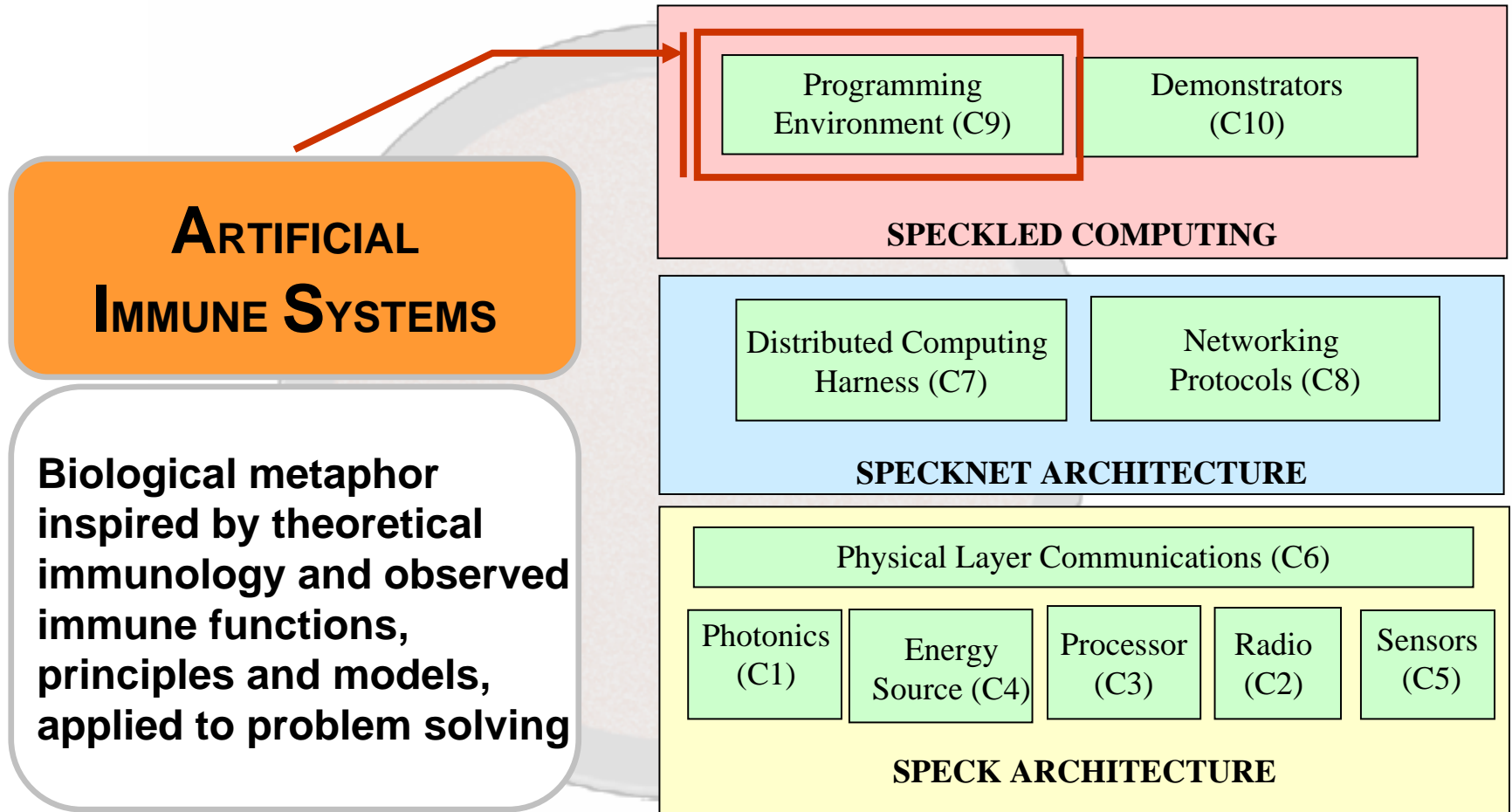
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Summary

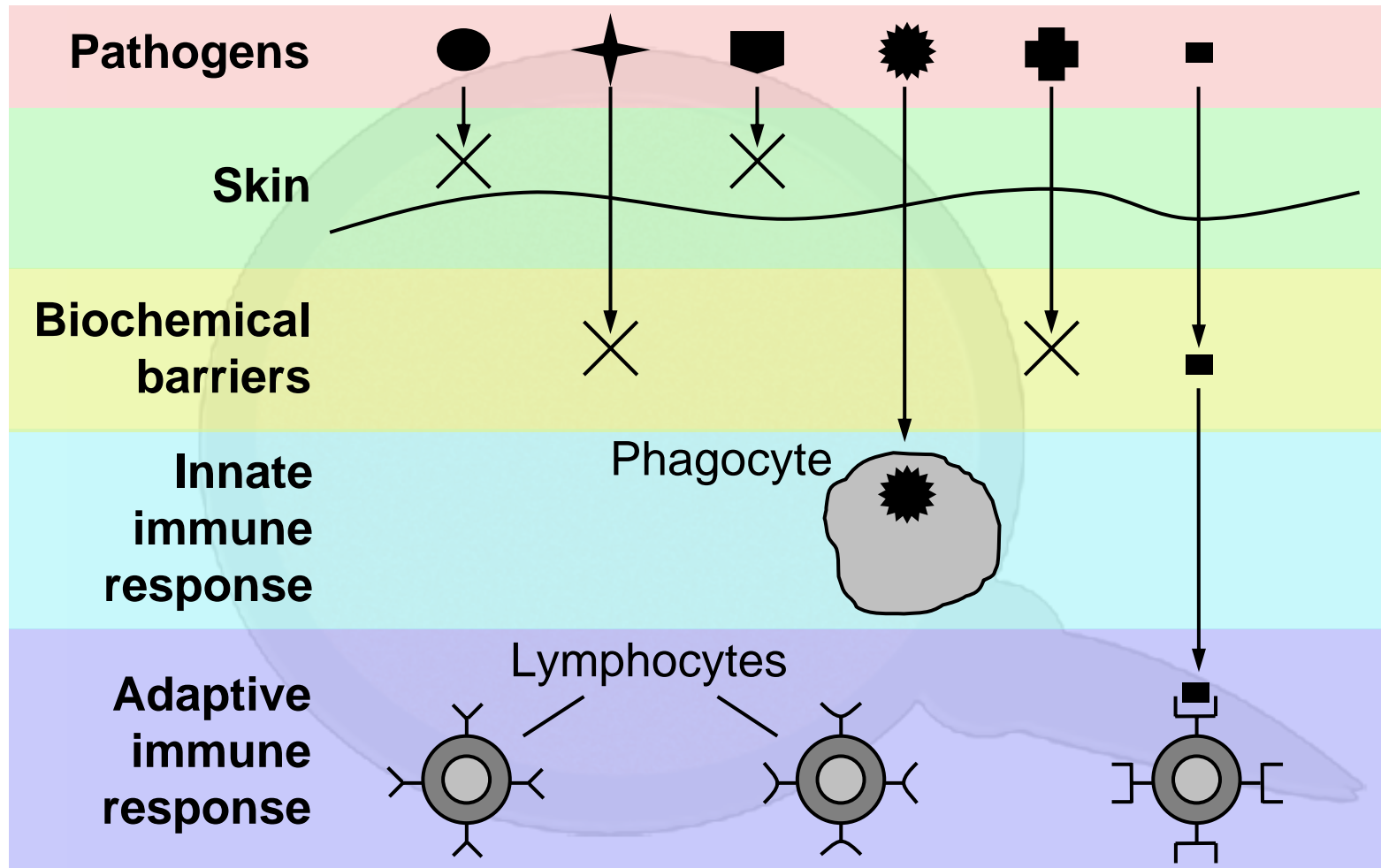
- Research Topic: AIS for Speckled Computing
- Immune System Overview
- Immune Model for Specknet
- Initial Generic AIS Framework
- Physical Constraints
- Suggested Types of Speck-Cells
- Example Scenario
- Future Work

Research Topic: AIS for Speckled Computing



D.K. Arvind, 2004

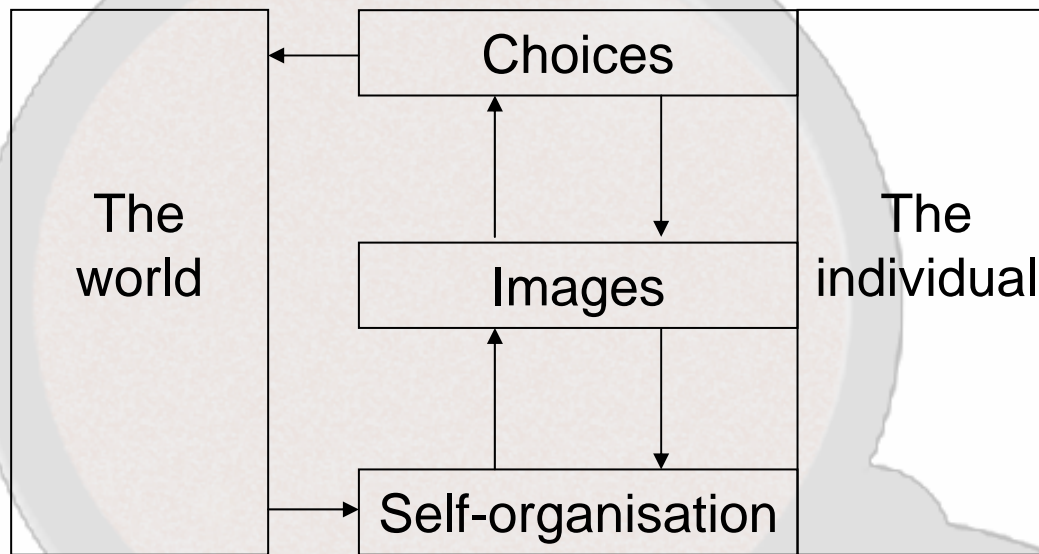
Immune System Overview



Jonathan Timmis, 2004

Immune Model For Specknet

- Many candidate immune viewpoints
- Choice of Cohen's cognitive model

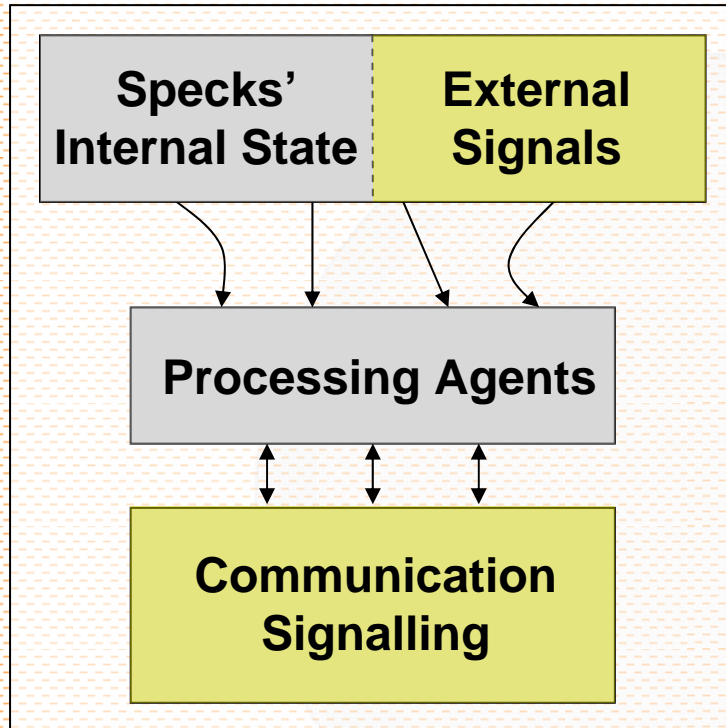


Irwin R. Cohen, 2000

- Approach based on *synthesis* rather than *analysis* of the immune system function

Initial Generic AIS Framework

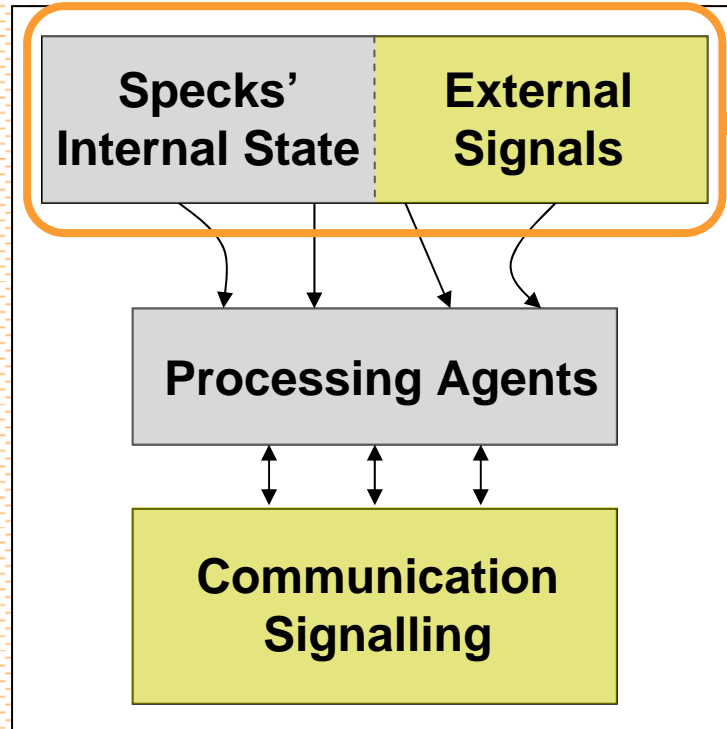
Environment



speck signal

Initial Generic AIS Framework

Environment



Specks' Context

- antenna state
- location
- power level
- sensor state
- transmitter state

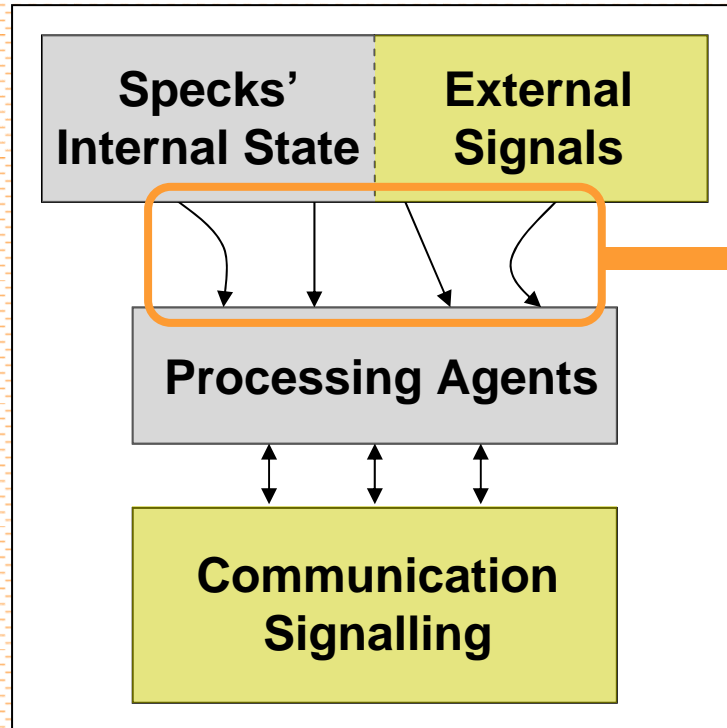
Sensor Values

- humidity
- light
- pressure
- temperature

speck signal

Initial Generic AIS Framework

Environment

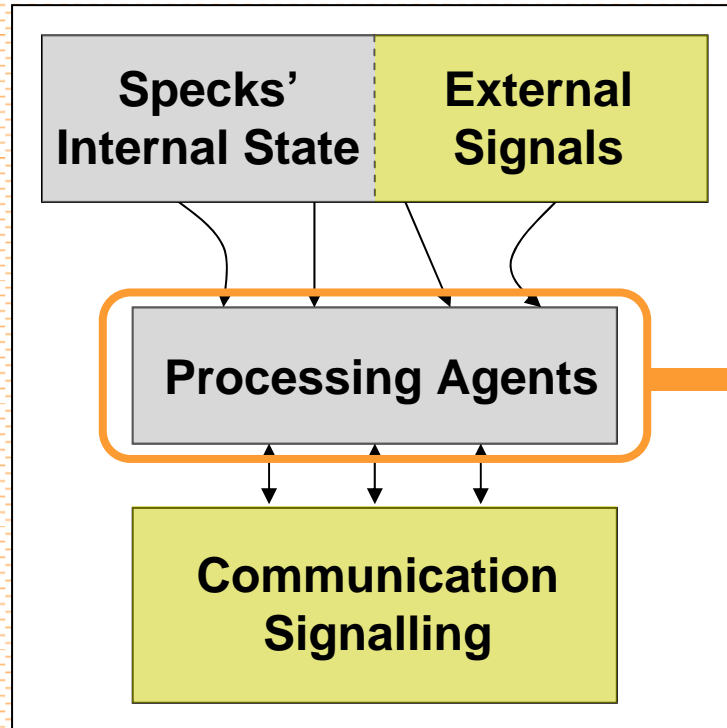


- Curved arrows express asynchronous communication
- Not all information is sent / received at the same time (time lags)
- System is independent of signalling time scale

speck signal

Initial Generic AIS Framework

Environment



Different types of specks

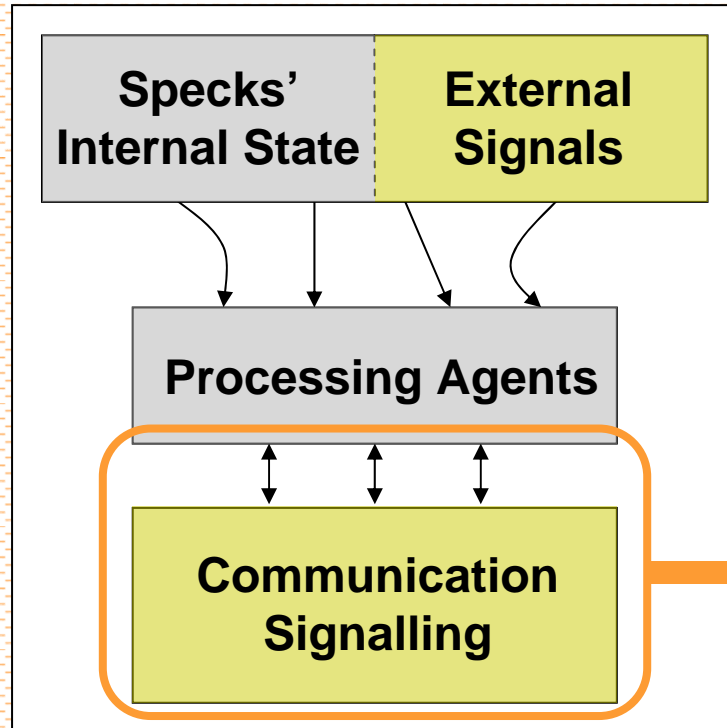
- collate (collect broadcasts)
- filter (accept some signals, reject others)
- transform
- process (e.g. extract average value)

information

speck signal

Initial Generic AIS Framework

Environment

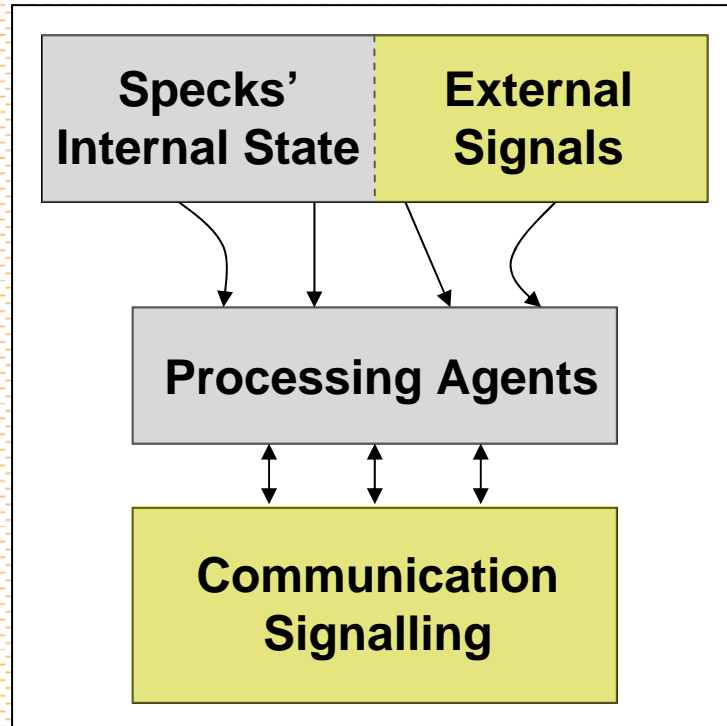


- Signal exchange between specks
- Specks broadcast, send and receive stimulatory / suppressive messages

speck signal

Initial Generic AIS Framework

Environment



speck signal

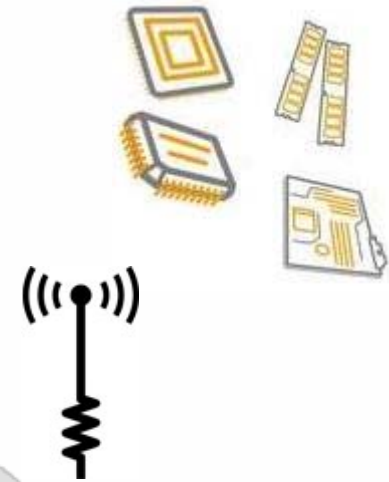
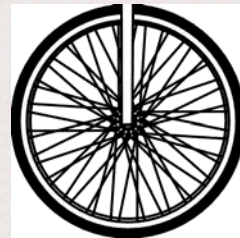
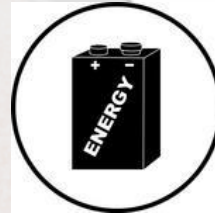
System is continuously active, in state of *maintenance* or *response*:

- **Maintenance**
 - Switch specks on/off to save power
 - Check malfunctions in network
- **Response**
 - Recognise “abnormal” situation
 - React to “danger”

Physical Constraints

- Specks are followed by certain limitations in terms of:

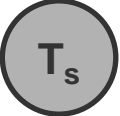



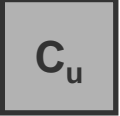
- battery energy
- transmitting range
- processing power
- memory
- mobility



- All constraints are inevitably taken into account during design process

Suggested Types of Speck-Cells

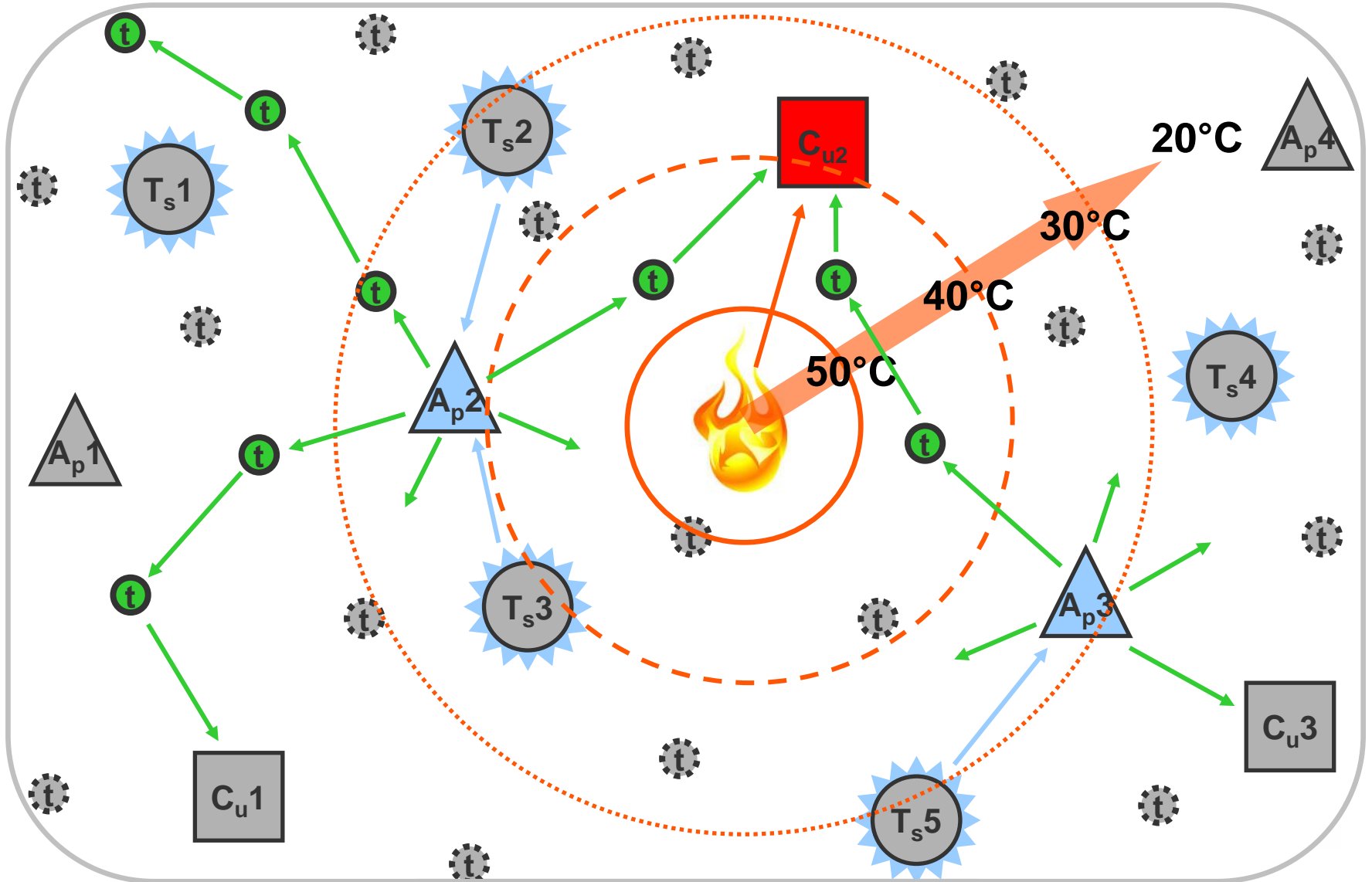
- To overcome hardware restrictions, split functionality into many types of specks

	Tissue speck-cell	bears sensors, broadcasts values, is often on <i>(analog circuit)</i>
  (ON) (OFF)	Transmitter speck	when activated relays information, otherwise remains off <i>(simple transmitter)</i>
	Antigen presenting speck-cell	receives signals, filters data and sends out extracted information <i>(processor unit with memory and extra power)</i>
	Co-responding unit speck	integrates collected information and decides action to perform <i>(processor unit with memory and extra power)</i>

Example Scenario: Fire Detection

- Speckled room
- Active speck-net in state of maintenance
- Introduction of heat source within room
- Specks
 - sense change in the environment
 - locate high temperature area
 - take action
 - light up a path away from fire spot
 - set off the alarm

Example Scenario: Abstract Representation



Future Work

- Describe AIS system in detail using Harel's statecharts that among others allow modelling:
 - hierarchy
 - concurrency
 - communication
- Conduct experiments in simulator
 - Become familiar with SpeckSim
 - Lay out a simple and clear scenario
 - Extend SpeckSim appropriately
 - Test AIS model, improve model, test...

Questions?

Thank you for your attention!



Any questions?

References

- Introduction to AIS (Jonathan Timmis, 2004)
(<http://www.artificial-immune-systems.org/ICARIS-2004/Programme.htm>)
- Tending Adam's Garden: Evolving the Cognitive Immune Self (Irun Cohen, 2000)