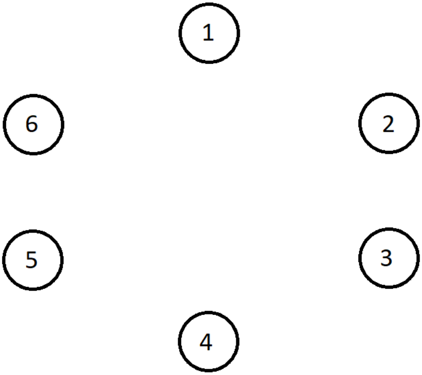
Reconfigurable vs. Static Communications

Mathieu Lehaut
Joint work with Nir Piterman

FM Retreat, 13/01/2023

Distributed setting

Agents communicating over channels



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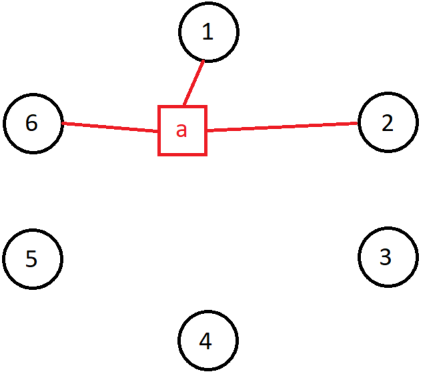

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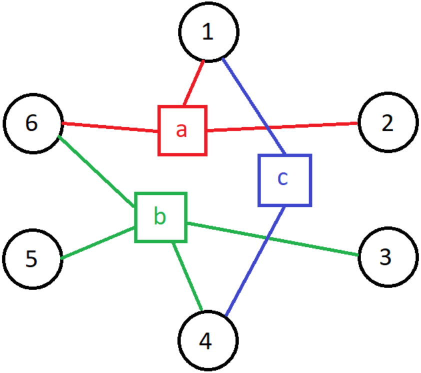

Static communications

Fixed architecture

Domain function $dom : Channels \rightarrow 2^{Agents}$

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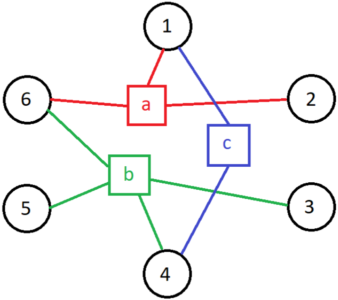

$dom(a) = \{1, 2, 6\}, dom(b) = \{3, 4, 5, 6\}, dom(c) = \{1, 4\}$

Reconfigurable communications

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Agents can change their interfaces after a communication

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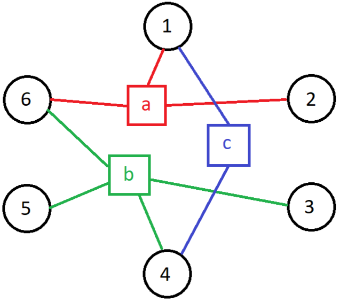

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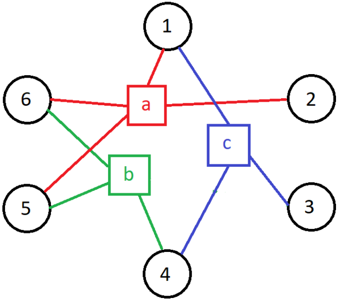

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- Sequence of channels used during execution, e.g. *ababc*

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- Difference between static/reconfigurable models?

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- Difference between static/reconfigurable models?
- Reconstruct model for agents from language?

Zielonka's Asynchronous Automata

Fix $\mathbb{P}$ set of processes, Σ set of channels, *dom* a domain function.

Definition

An AA is a tuple $\mathcal{A} = ((S_p)_{p\in\mathbb{P}}, (s_p^0)_{p\in\mathbb{P}}, (\delta_a)_{a\in\Sigma}, \mathrm{Acc})$

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States

$S_1 = \underline{r_1}, s_1, t_1$
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Accepting condition

$\mathrm{Acc} = \{(t_1, r_2, t_3, s_4)\}$

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$\delta_a(1, 2)$

$(r_1, r_2) \to (s_1, r_2)$

$\delta_b(3, 4)$

$(r_3, r_4) \to (s_3, r_4) \mid (t_3, r_4) \to (t_3, s_4)$

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$w = abcb \in \mathcal{L}$ (and *bacb* too)

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New stuff

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- Transitions of the form $s_p \xrightarrow{(a,m)} s'_p$

Example

From static to reconfigurable

Easy direction!

Theorem

Any AA can be simulated by a RA.

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Proof: All L_p are constant, set to $dom^{-1}(p)$

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(Bonus: local transitions $\Rightarrow$ M not needed)

From reconfigurable to static

Theorem

There are RA which cannot be “nicely” simulated by any AA.

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Proof idea: Set arbitrary subset of channels to be dependant

Conditions for distributability

Fix $\mathcal{A}$ over Σ and *dom*.

Diamond property

If $r \xrightarrow{a} s \xrightarrow{b} t$ with a, b independant,
then $r \xrightarrow{b} s' \xrightarrow{a} t$ also possible

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Thanks, questions?