[*Espresso-Fastar* Workshop, Schanskop/Pretoria, October 2007]

A new CSP Operator for Partial Parallelism

Strauss/Kourie/Gruner/Roggenbach/Watson

[submitted to: Information Processing Letters – awaiting Review]

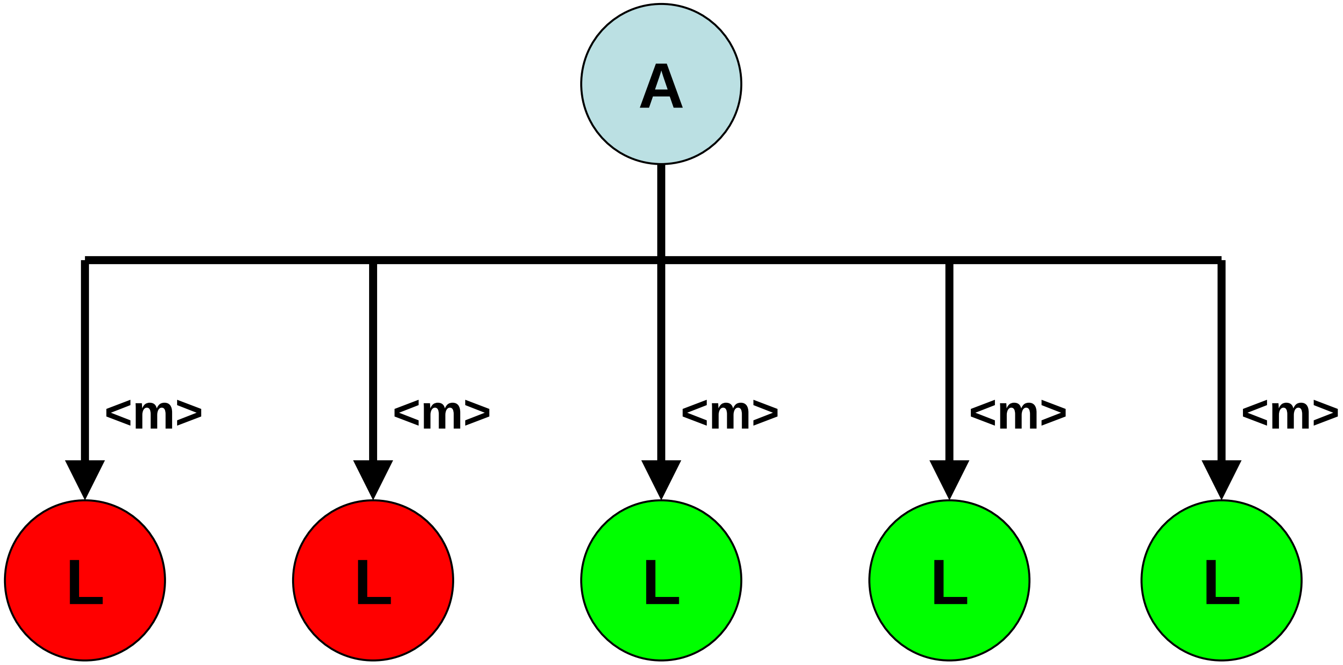
Summary

- In our recent submission to the Information Processing Letters, we introduced a novel CSP Operator, characterized by *optional* (or partial) *Parallelism*
- We describe relevant application scenarios and provide the semantics of the operator in the basic trace-model $\mathcal{T}$

Context of the Work

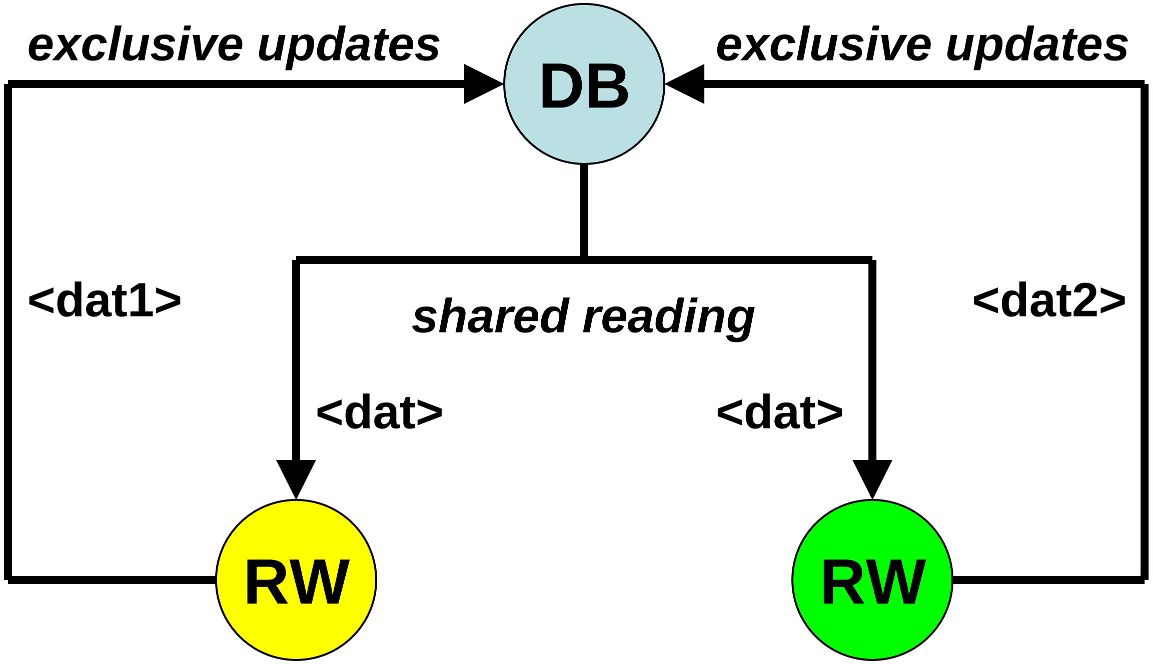
- Upcoming PhD Thesis: Tinus Strauss
- British/South-African Research Project: Roggenbach (GB) / Kourie-Gruner (ZA)
  - – *Grant Acknowledgments:*
    - NRF
    - Royal Society

Scenario (1): Broadcasting



{ cannot react } { ready to react }

Scenario (2): Read-and-Update



Comparison of CSP Operators

- Classical Parallelism Operator: “**all or nothing”**
- Either every Listener reacts, or the system does not progress
- Not suitable for modeling those scenarios

- **New Partial** Parallelism Operator: **“some may sleep”**
- System can make progress if at least one Listener can react
- Suitable for modeling those scenarios

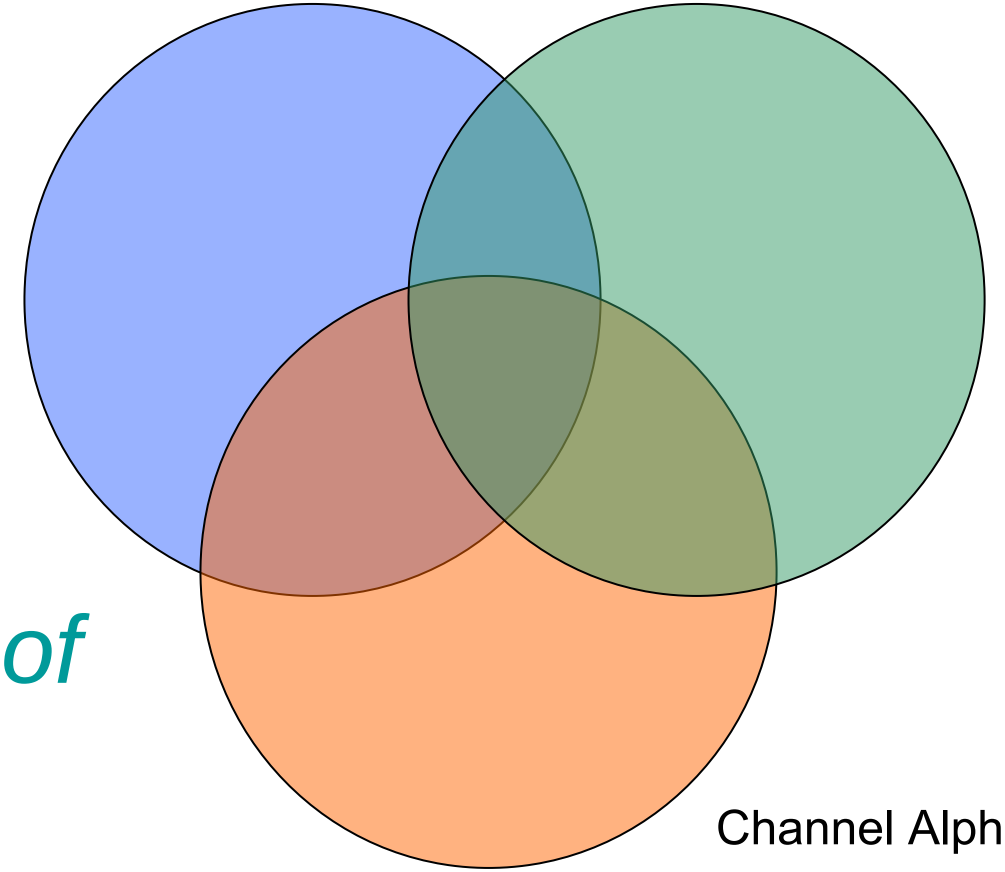
Comparison of CSP Operators

- The semantics of CSP Operators can be defined inductively in terms of Step-Rules
- Given two processes P_1 and P_2 and some Operator Ω, the Step-Rule describes what can happen ***next*** in the combined process **P** = (P_1 Ω P_2)
- Thereby it is also taken into account:
  - *what alphabet can be processed* by P_1
  - *what alphabet can be processed by* P_2
  - *what alphabet is allowed on their link-channel*

Comparison of CSP Operators

- The formal description of the new Partial Parallel Operator (in terms of Step-Rules and Channel-Alphabets) reveals a **wider applicability of the new Partial Parallel** Operator, in comparison with the classical Parallel Operator.

Comparison of CSP Operators



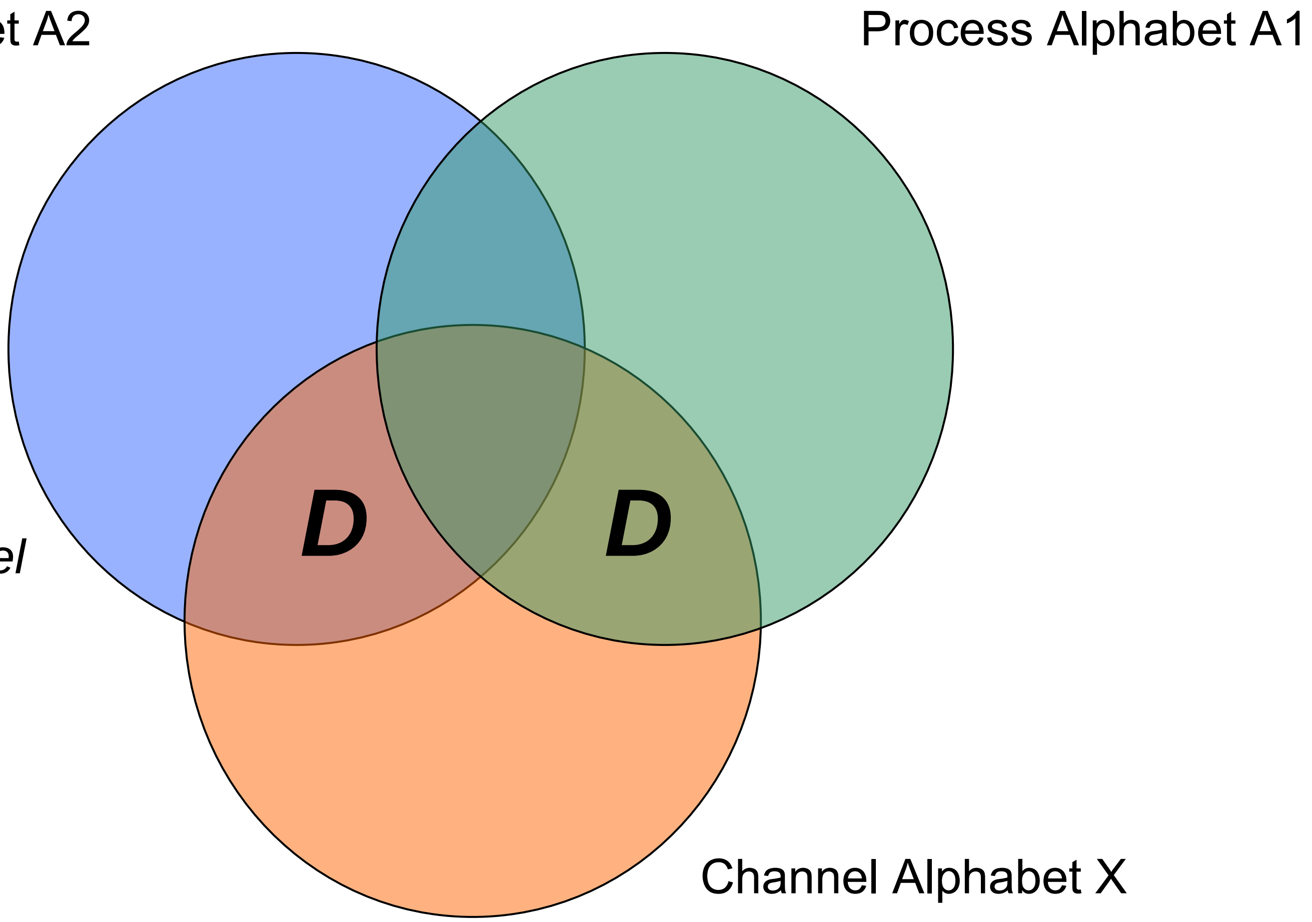
Process Alphabet A2

Process Alphabet A1

Domain of Events

Channel Alphabet X

Comparison of CSP Operators



Classical Parallel Operator, unlike the partial one, DEADLOCKS if event is from sub-domain ***D***

Properties of the new Operator

- **The new Partial Parallel Operator is <u>continuous</u> in the Trace Model $\mathcal{T}$**
- Note:
  - Continuity is necessary for ***Fixpoint*** Proofs
  - The ***Fixpoint*** property is necessary for the validity of recursive process definitions with the new Operator, of kind **P** = (... Ω ... **P** ...)

Properties of the new Operator

- **The new Partial Parallel Operator is** also
  - ***idempotent***
  - ***symmetric***
  - ***associative***

  in the Trace Model $\mathcal{T}$

Properties of the new Operator

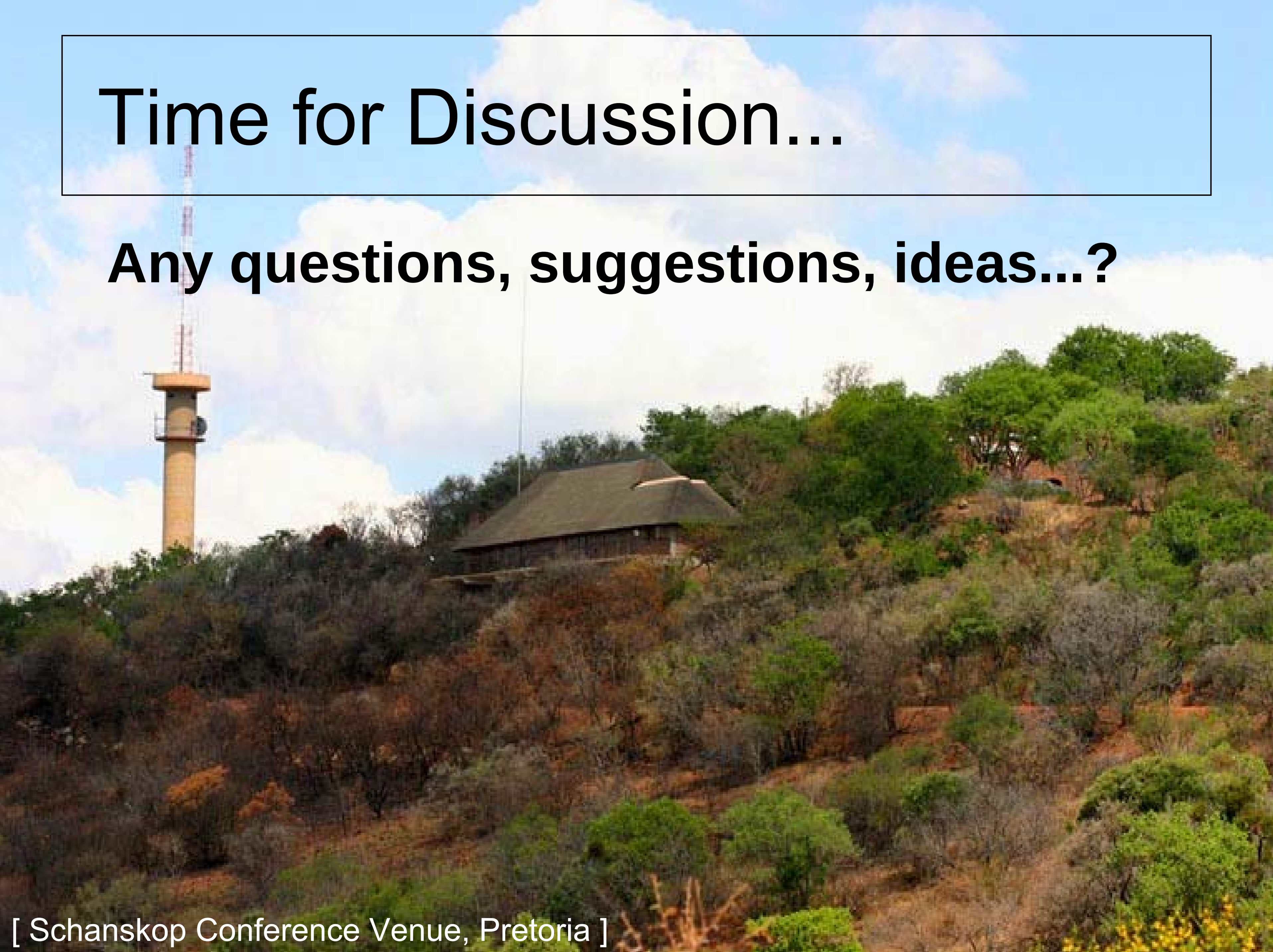
- $\mathbf{P}_1 \; \Omega_{\{\,\}} \; \mathbf{P}_2 \qquad = \mathbf{P}_1 \; ||| \; \mathbf{P}_2$
  - like classical on empty channel alphabet
- $\mathbf{P} \;\; \Omega \; \mathrm{STOP} \qquad = \mathbf{P}$
- $\mathbf{P} \;\; \Omega \; \mathrm{SKIP} \qquad = \mathbf{P}$
- $\mathbf{P}_1 \; \Omega \; (\mathbf{P}_2 \Box \mathbf{P}_3) = (\mathbf{P}_1 \; \Omega \; \mathbf{P}_2) \Box (\mathbf{P}_1 \; \Omega \; \mathbf{P}_3)$
- Note:
  - A number of further properties can be found in our paper submitted to the Inform.Proc.Letters

Possible Future Work

- More Proofs (*not all Properties yet proven*)
- More Properties (*only most obvious found*)
- Other Semantic Domains (*not only* $\mathcal{T}$)
- Variants of the Operator (*e.g. parameters*)
- Experimental Validation and Tool-Support
- **Unified Theory** of Process Modeling (*?!?*)

Time for Discussion...

Any questions, suggestions, ideas...?



[Schanskop Conference Venue, Pretoria]