

Modelling Global and Local Name Spaces for Mobile Agents Using Object Nets

Michael Köhler and Berndt Farwer

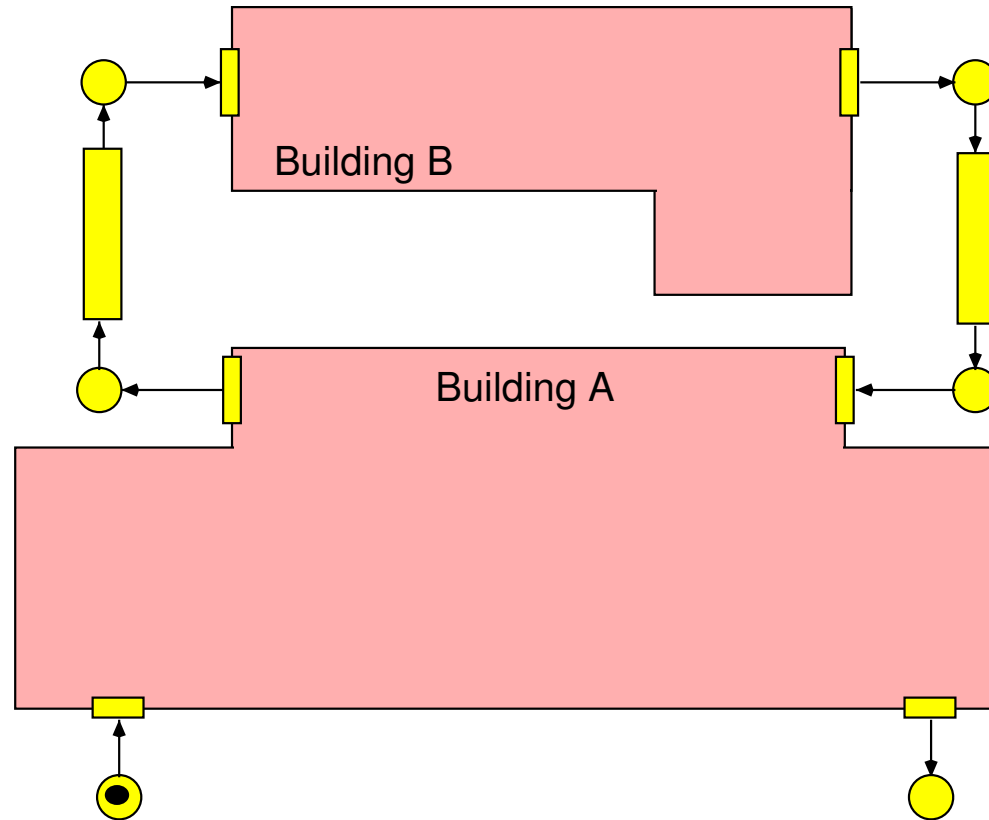
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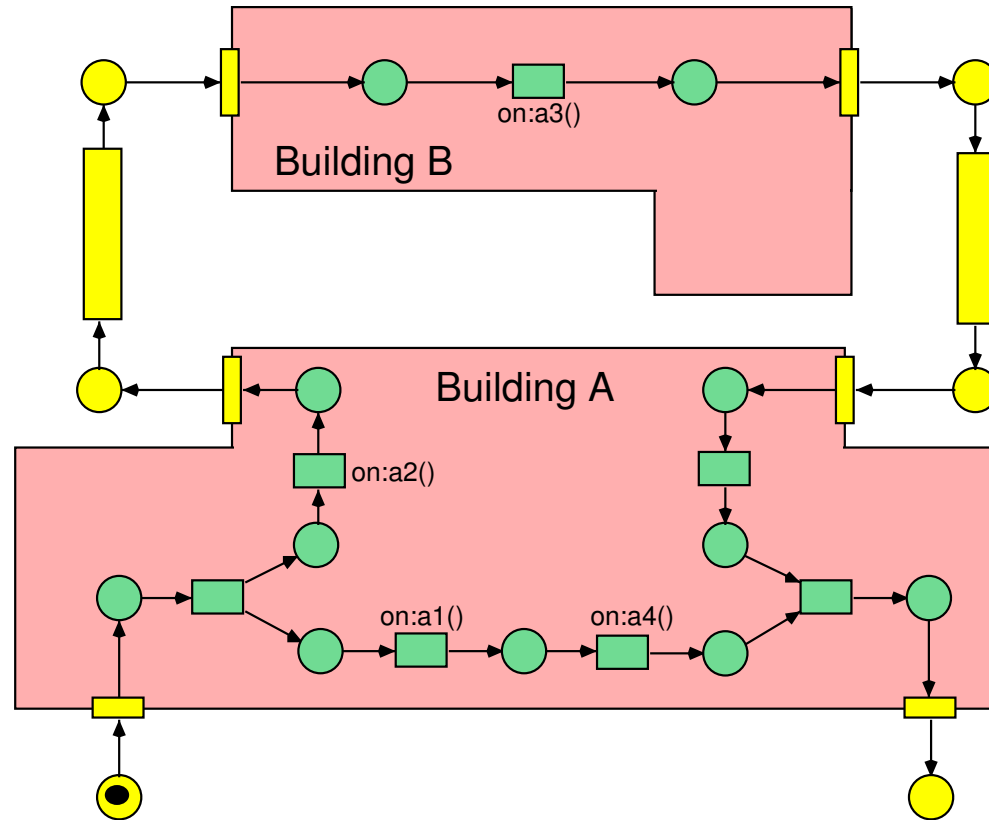
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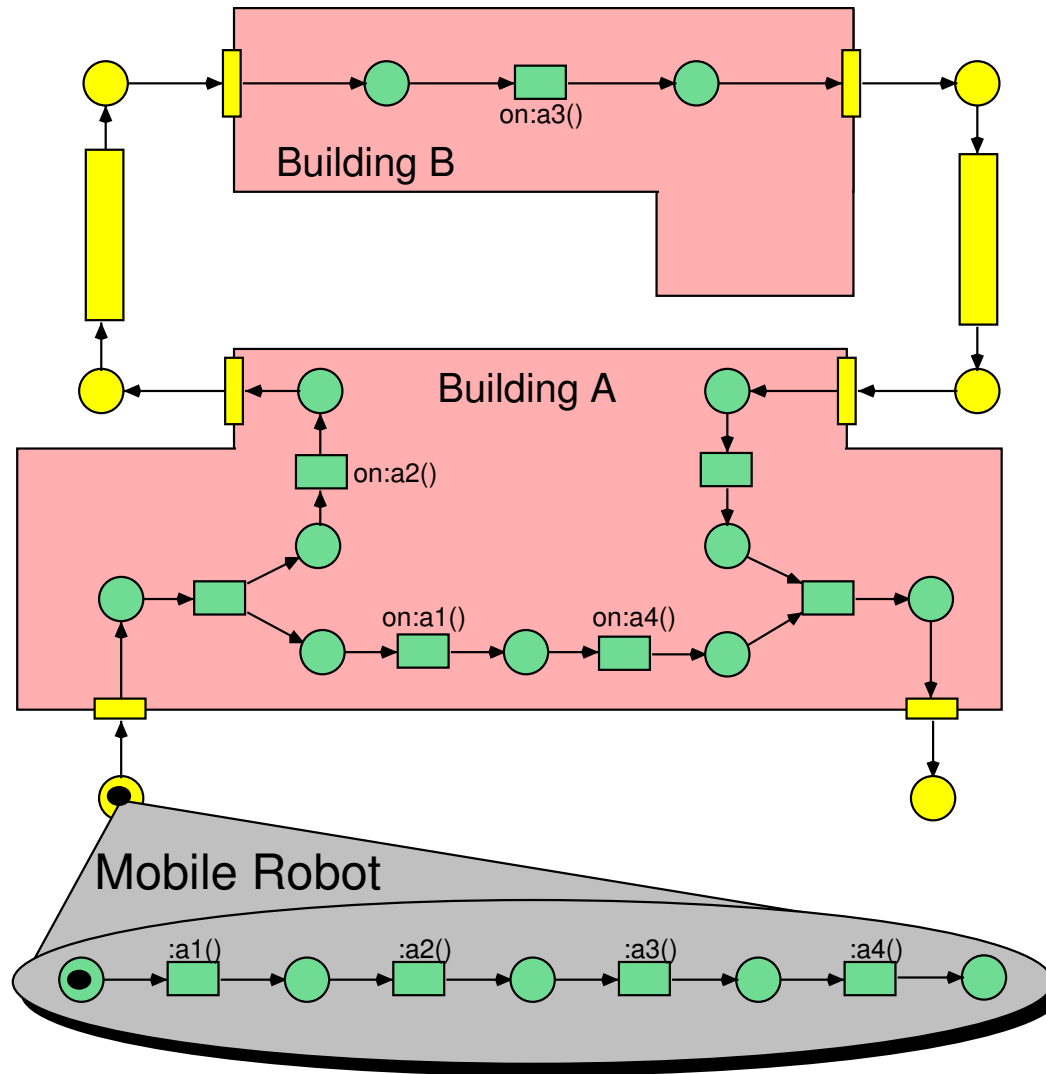
A Scenario



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Object Nets

Definition An *Object Net* is a tuple $OS = (\mathcal{N}, d, \Theta, \mathbf{M}_0)$, where

1. $\mathcal{N} = \{N_\bullet, N_s, N_3, \dots, N_n\}$ is a set of disjoint P/T-nets $N = (P_N, T_N, \mathbf{pre}_N, \mathbf{post}_N)$.
2. $d : P \rightarrow \mathcal{N}$ is the place typing.
3. $\Theta \subseteq \mathcal{T}$ is a finite set of synchronisations.
4. $\mathbf{M}_0 \in MS(\mathcal{P}(N_s))$ is the initial marking of the system-net $N_s \in \mathcal{N}$.



Net Tokens

How to define Net Tokens [Val98]?

1. Net Tokens as **References**:

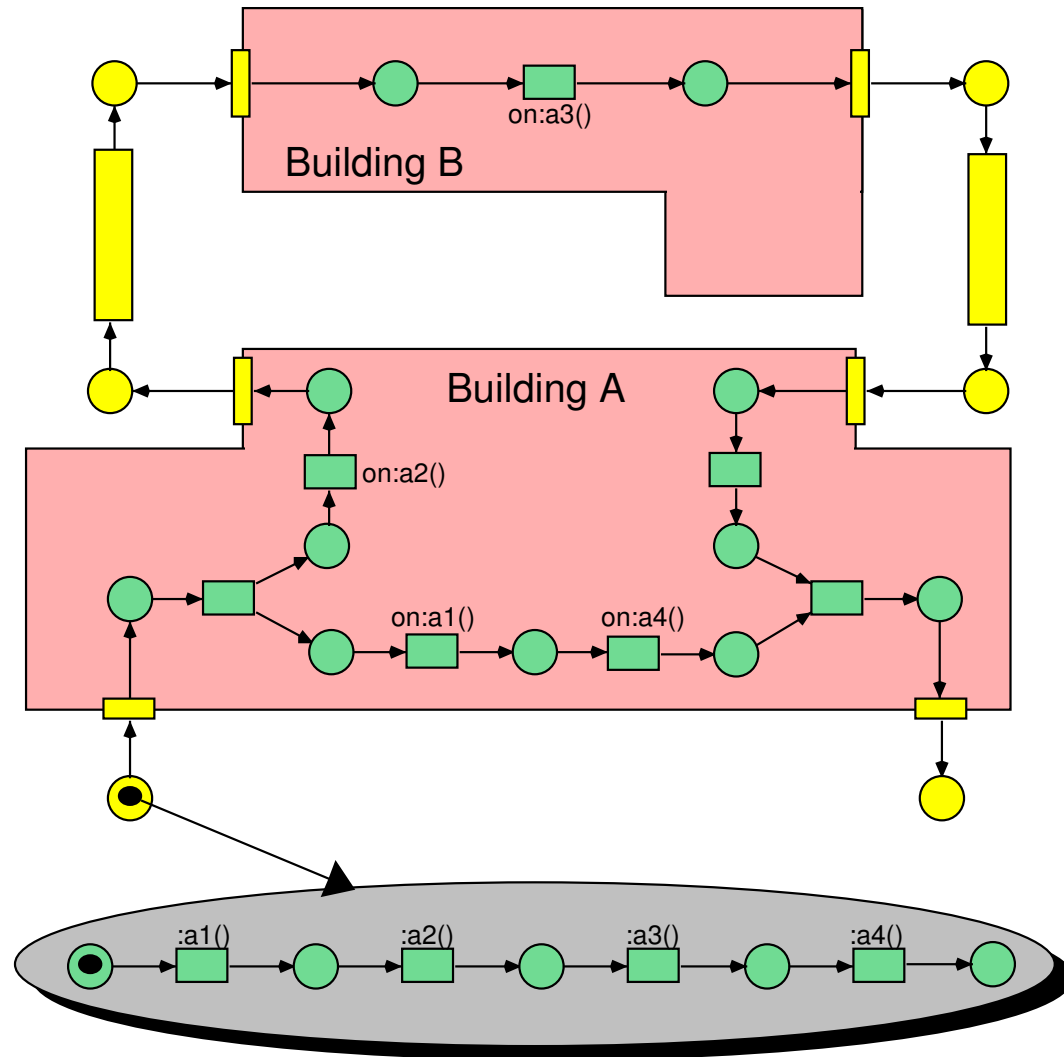
- Assumes a global name space (\rightarrow side effects)
- Easy to implement
- Closely related to programming languages

2. Net Tokens as **Values**:

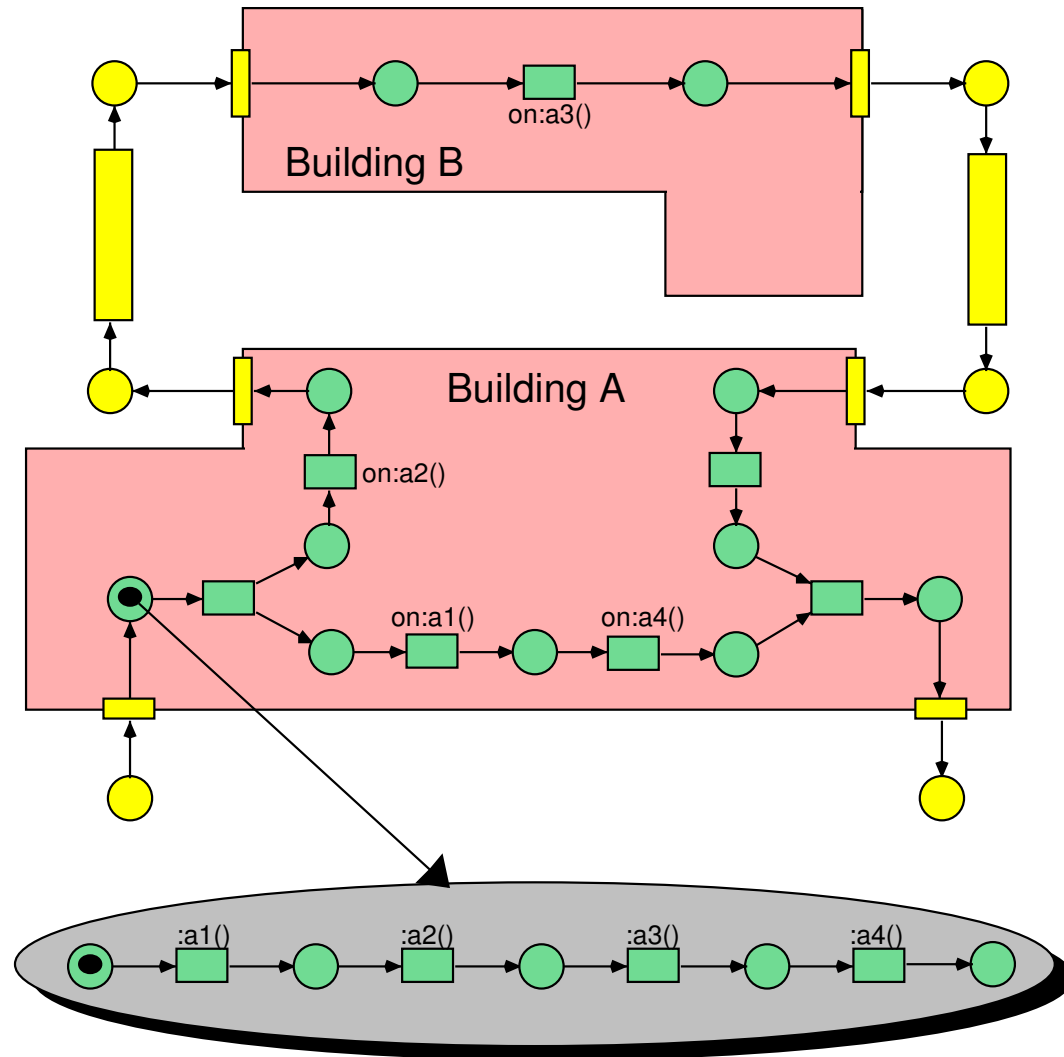
- Assumes a distributed space
- Easy to understand
- Adequate for mobility



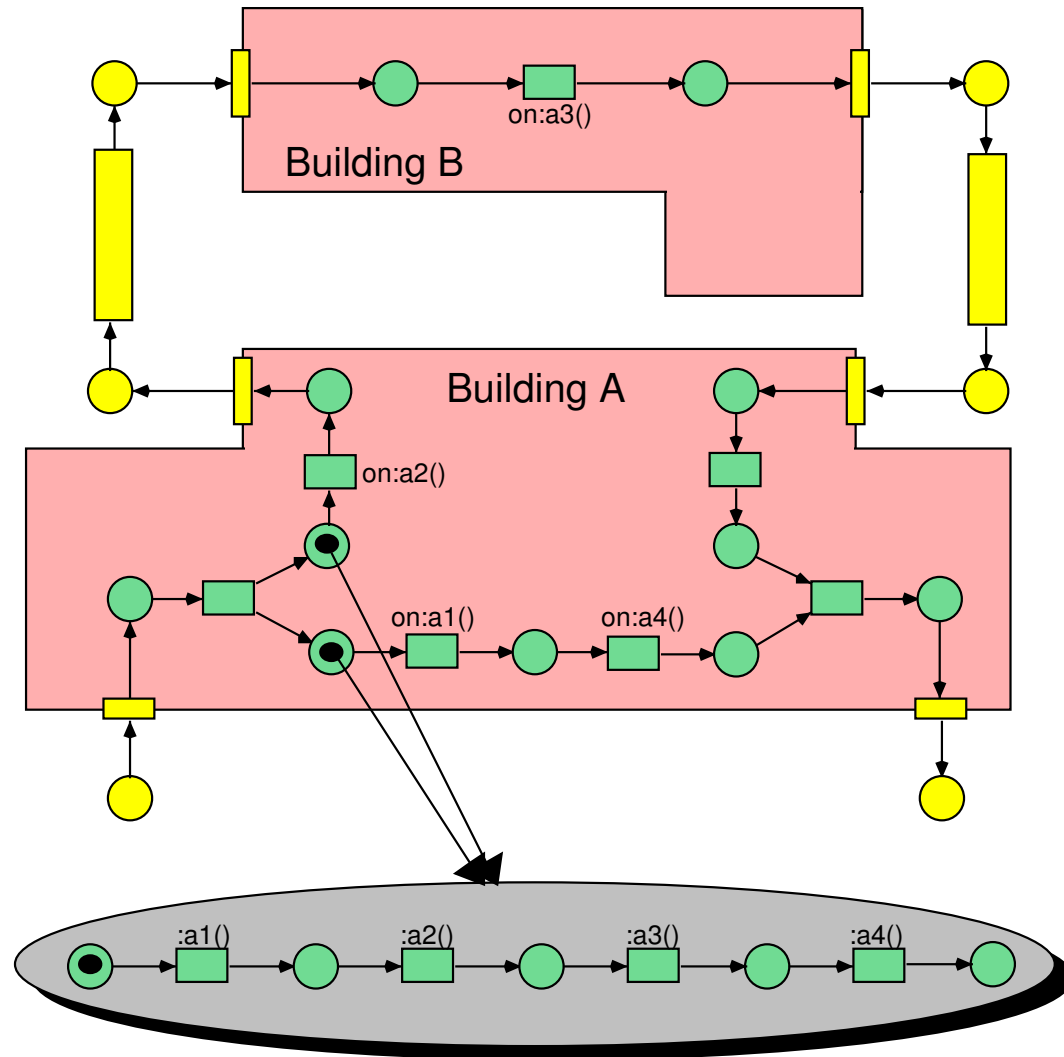
Reference Semantics



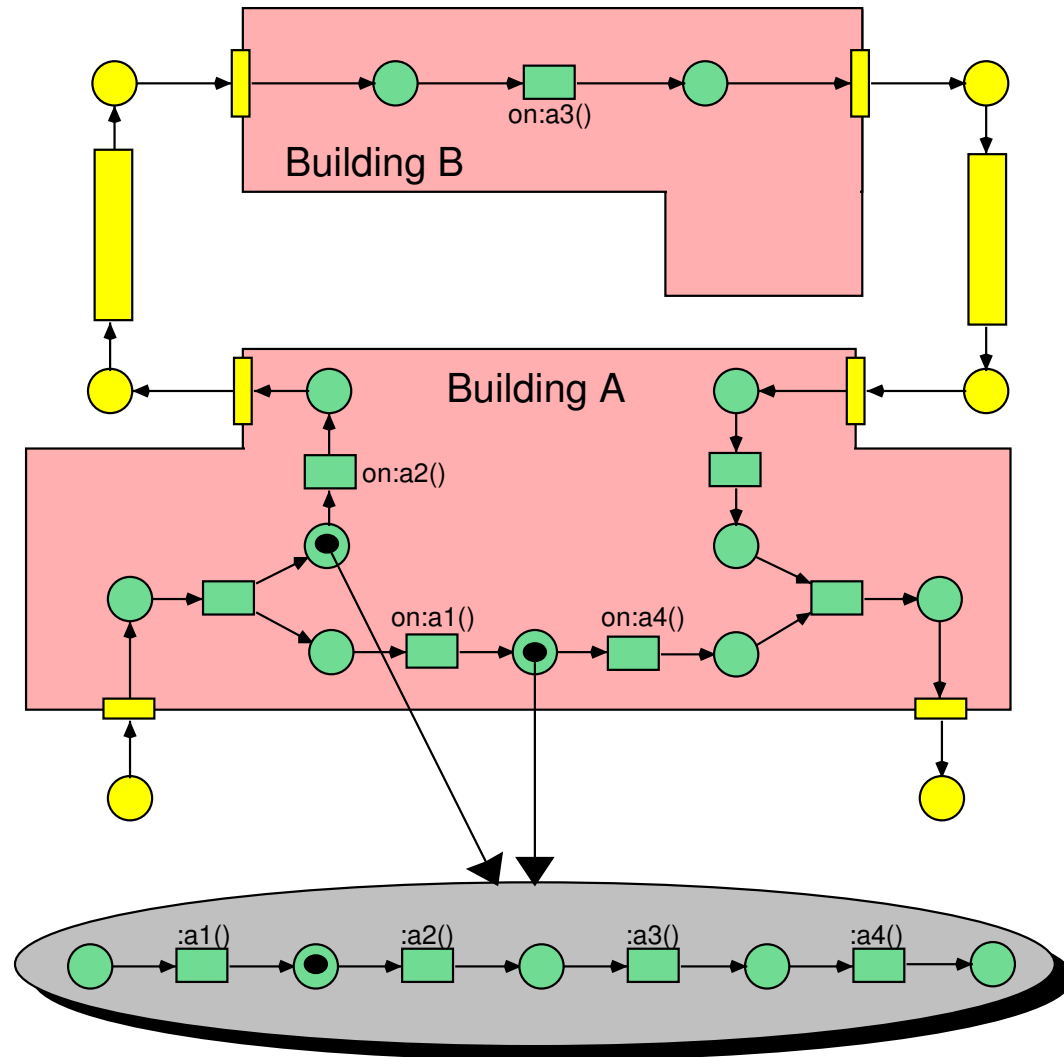
Reference Semantics



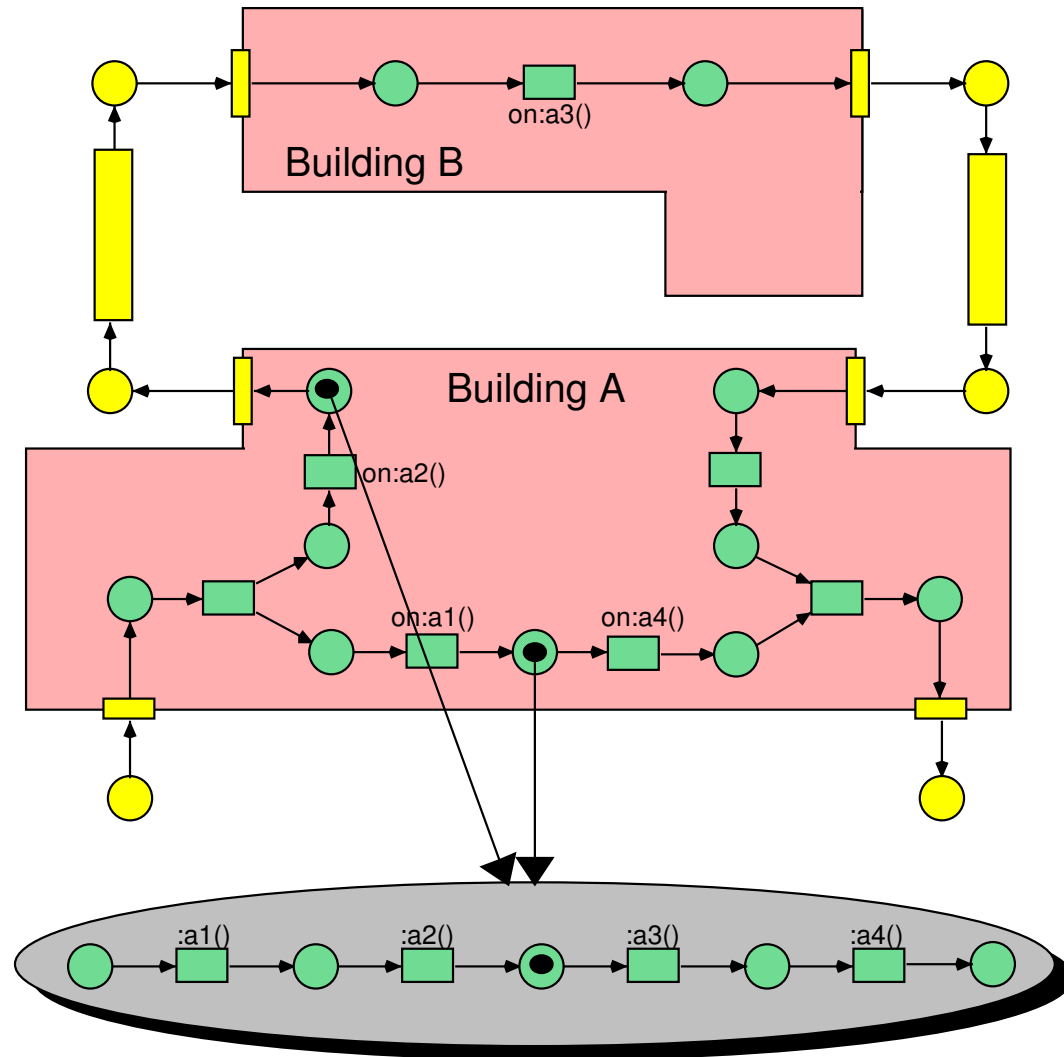
Reference Semantics



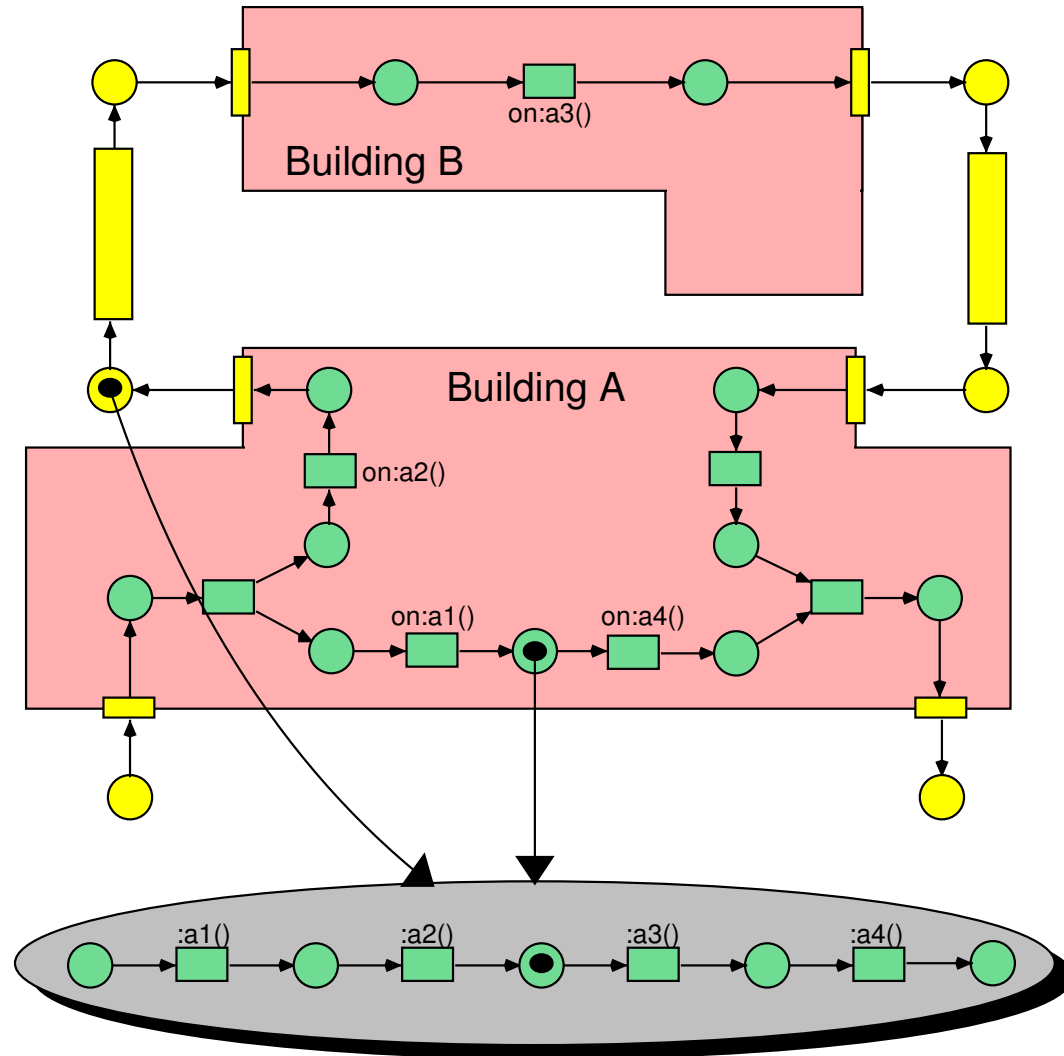
Reference Semantics



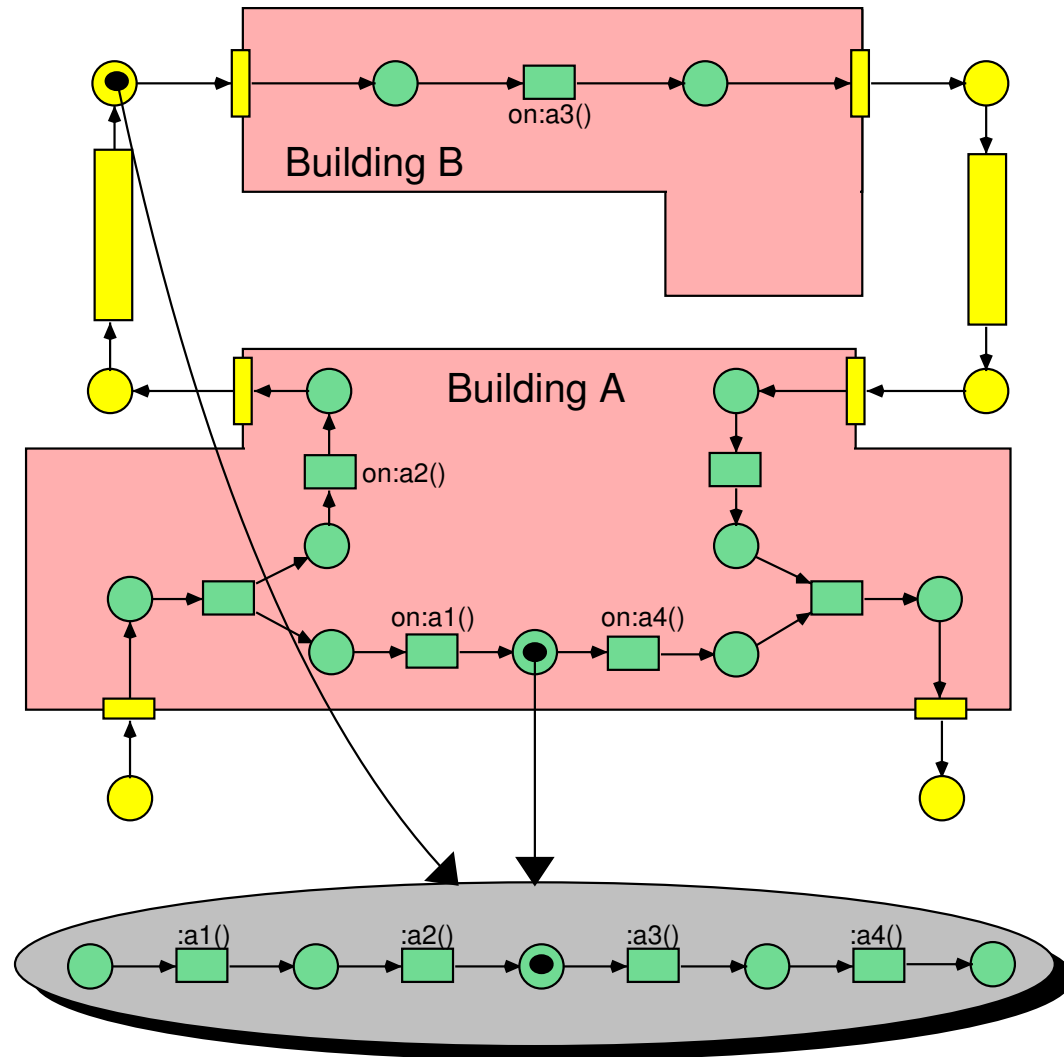
Reference Semantics



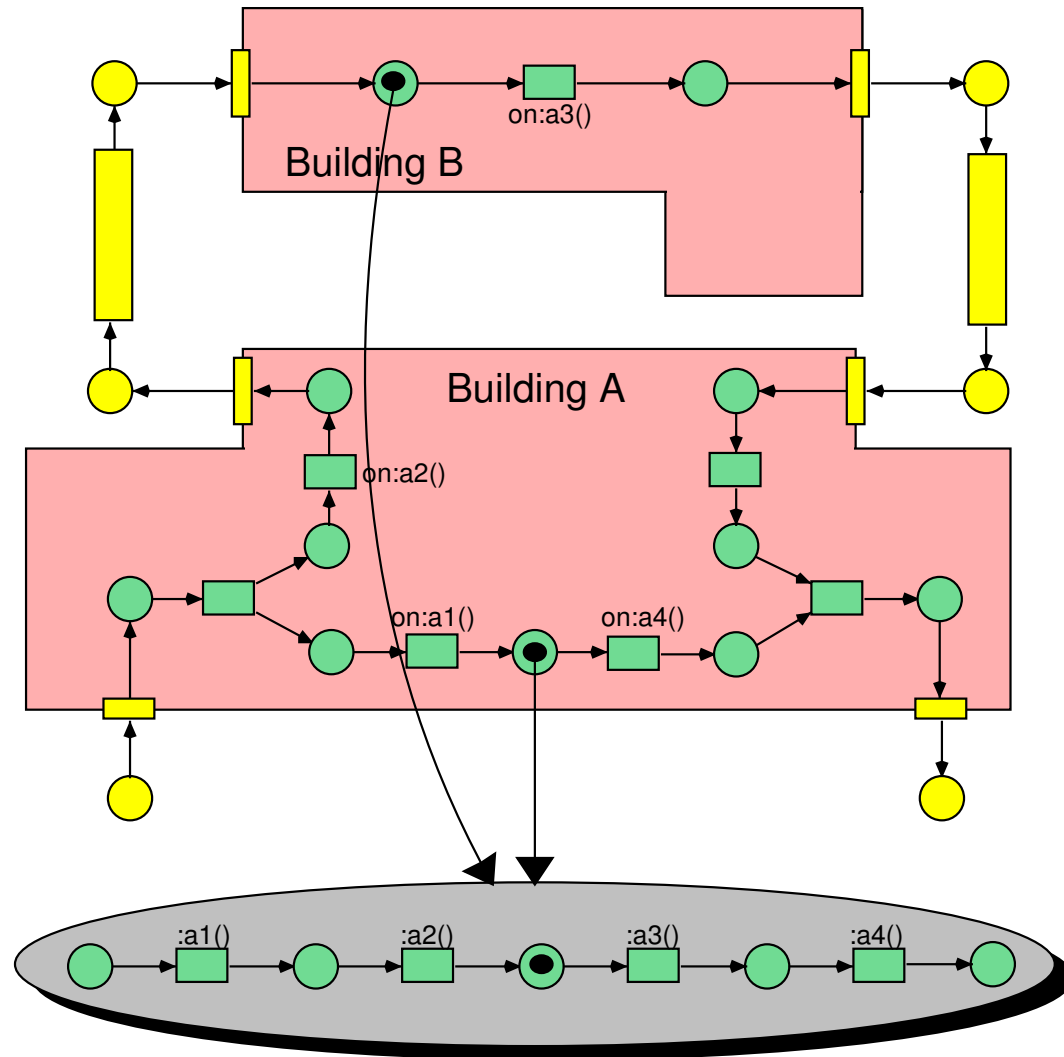
Reference Semantics



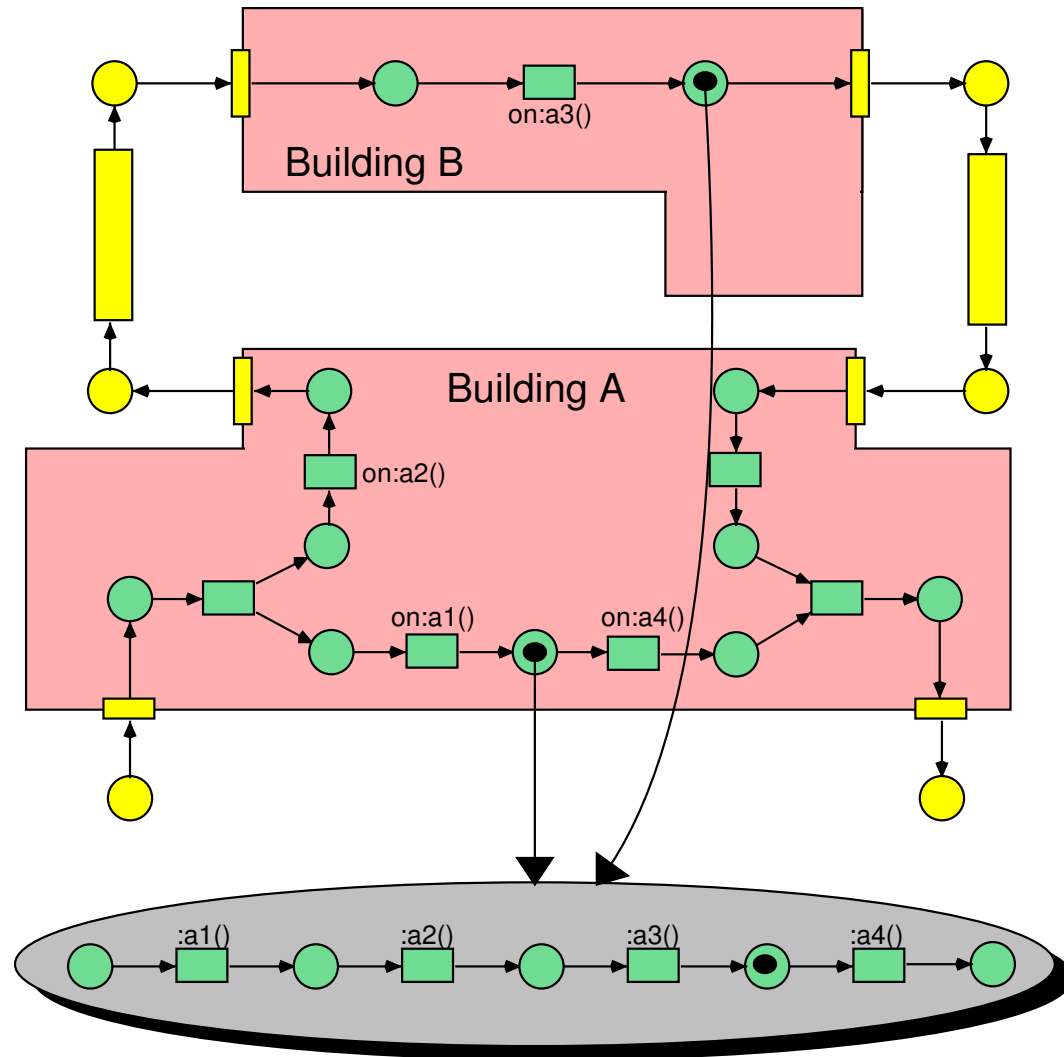
Reference Semantics



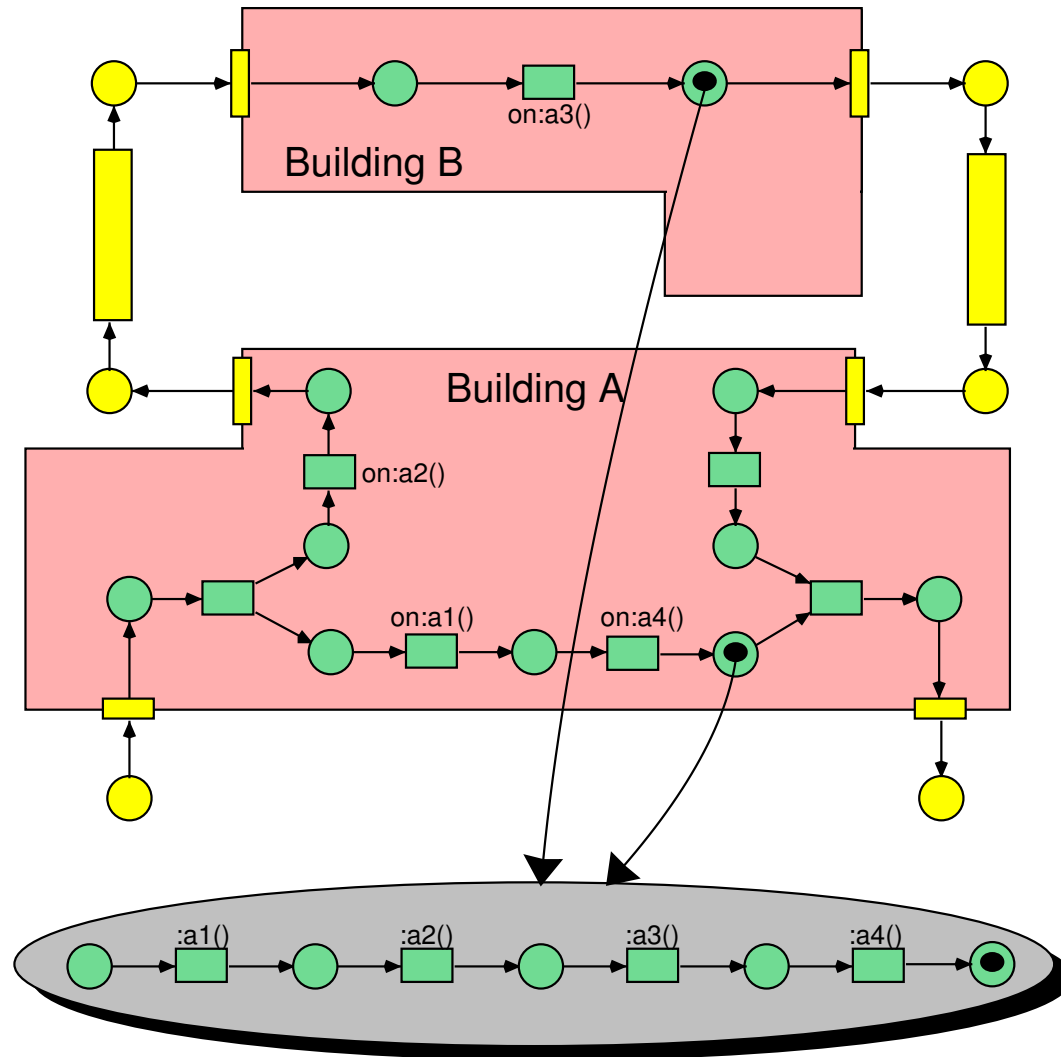
Reference Semantics



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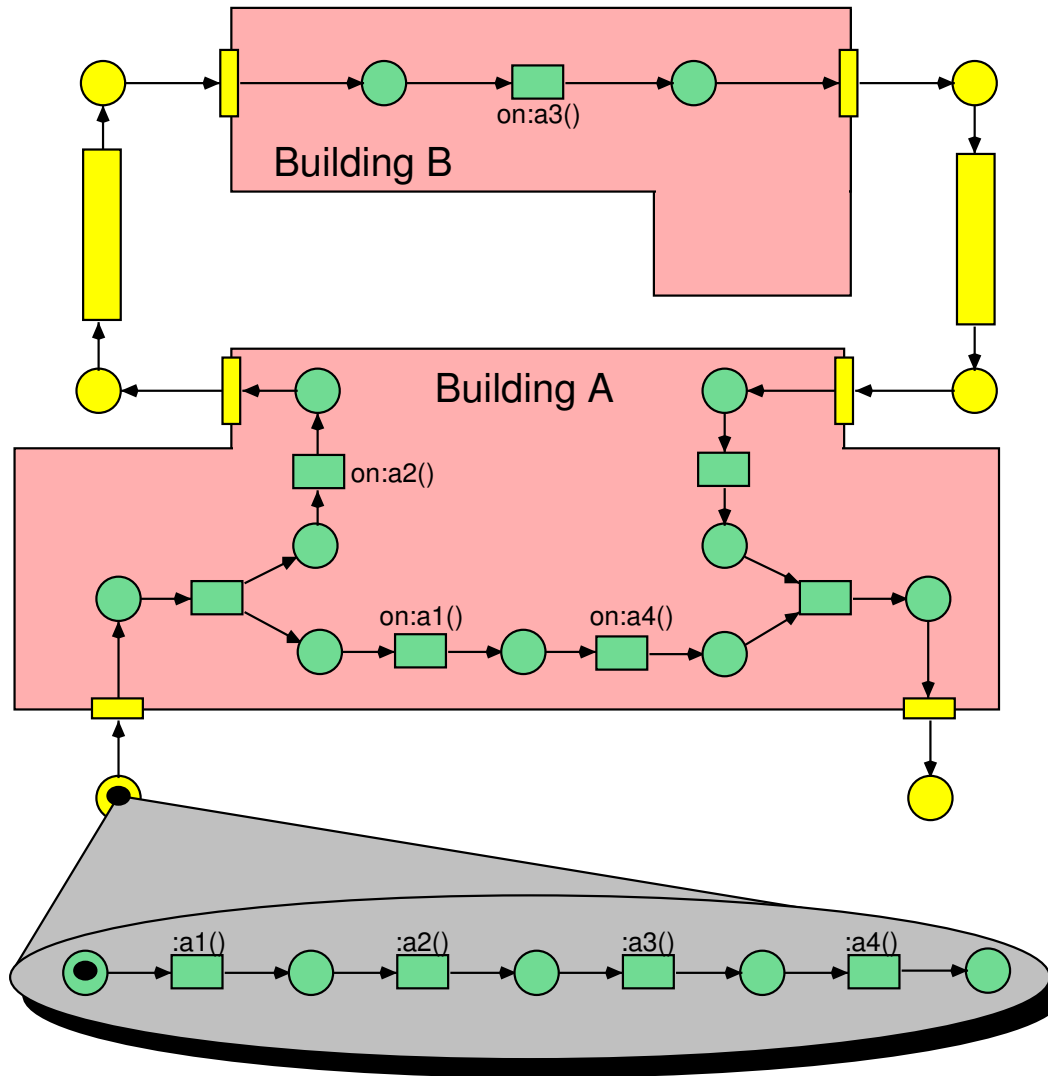
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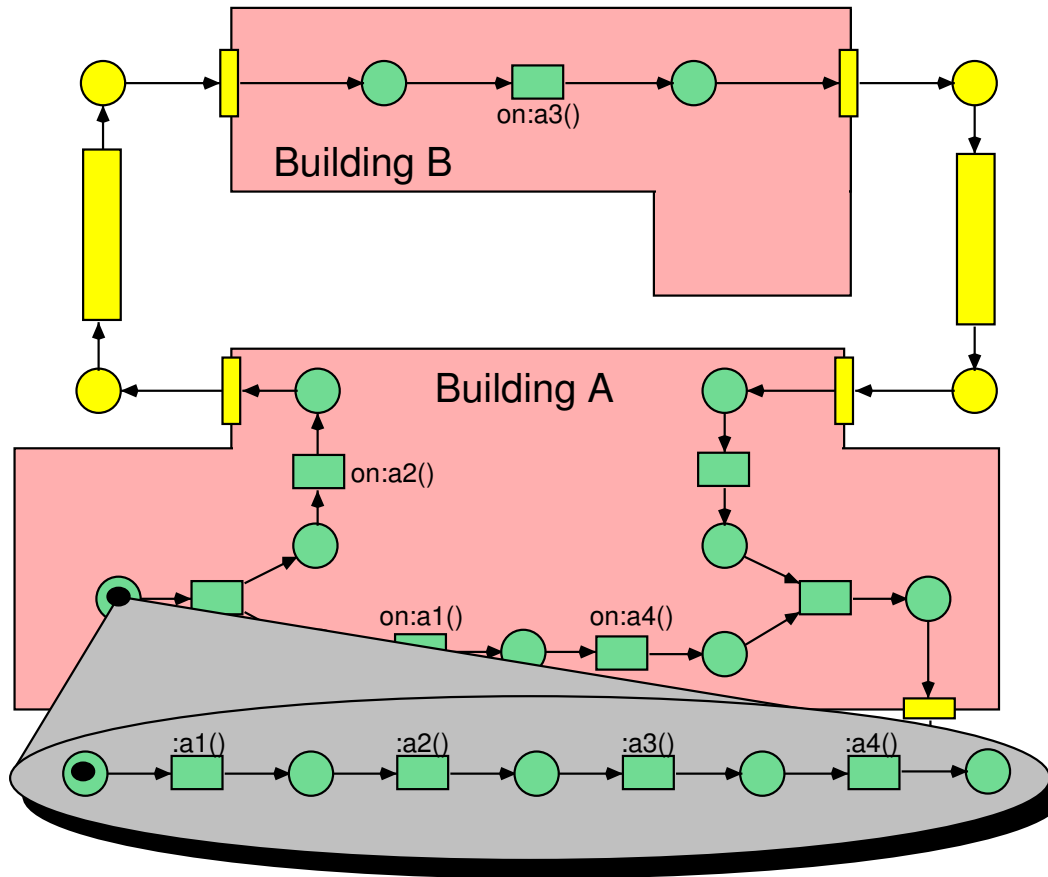
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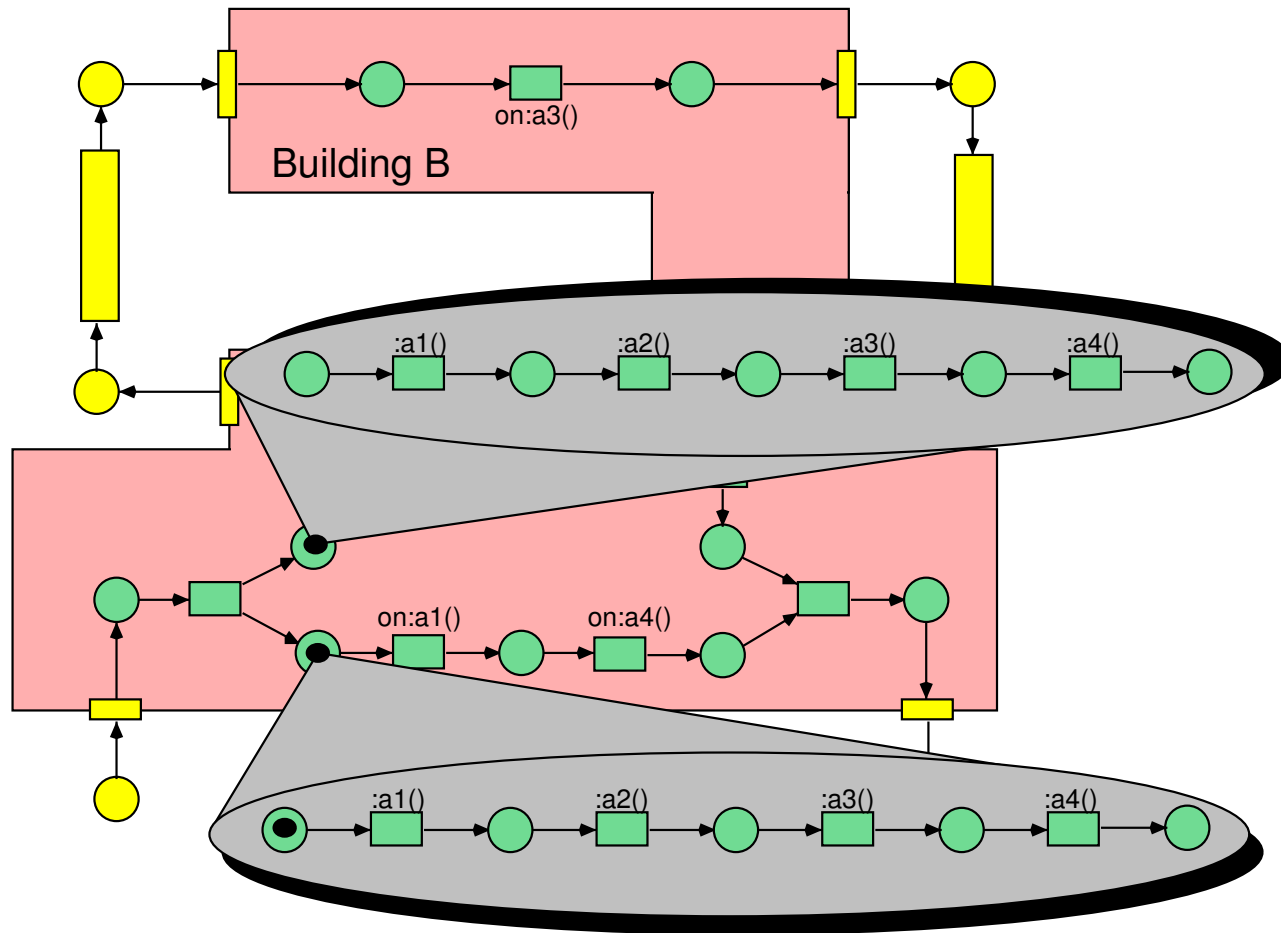
Value Semantics



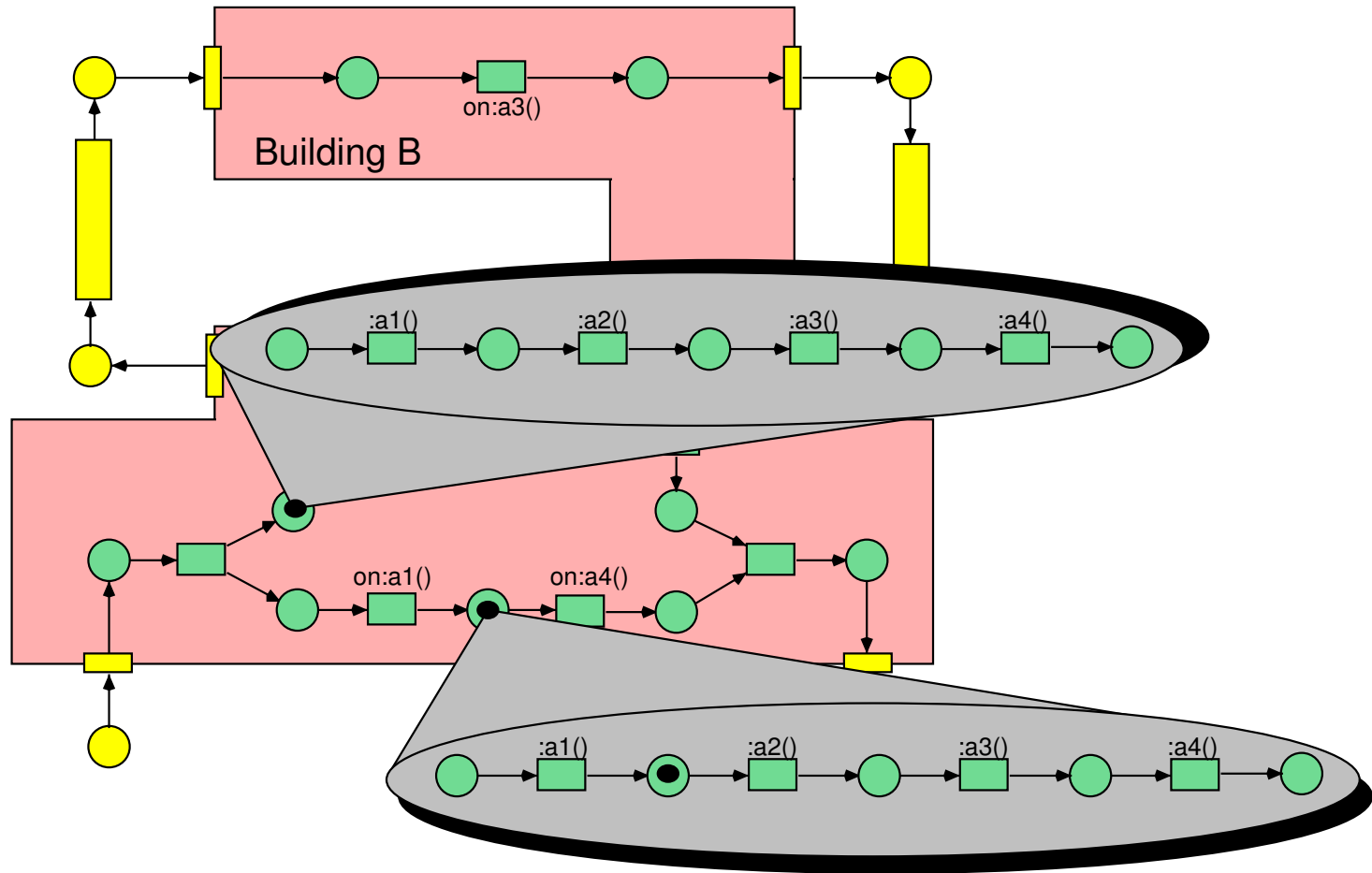
Value Semantics



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References/Values

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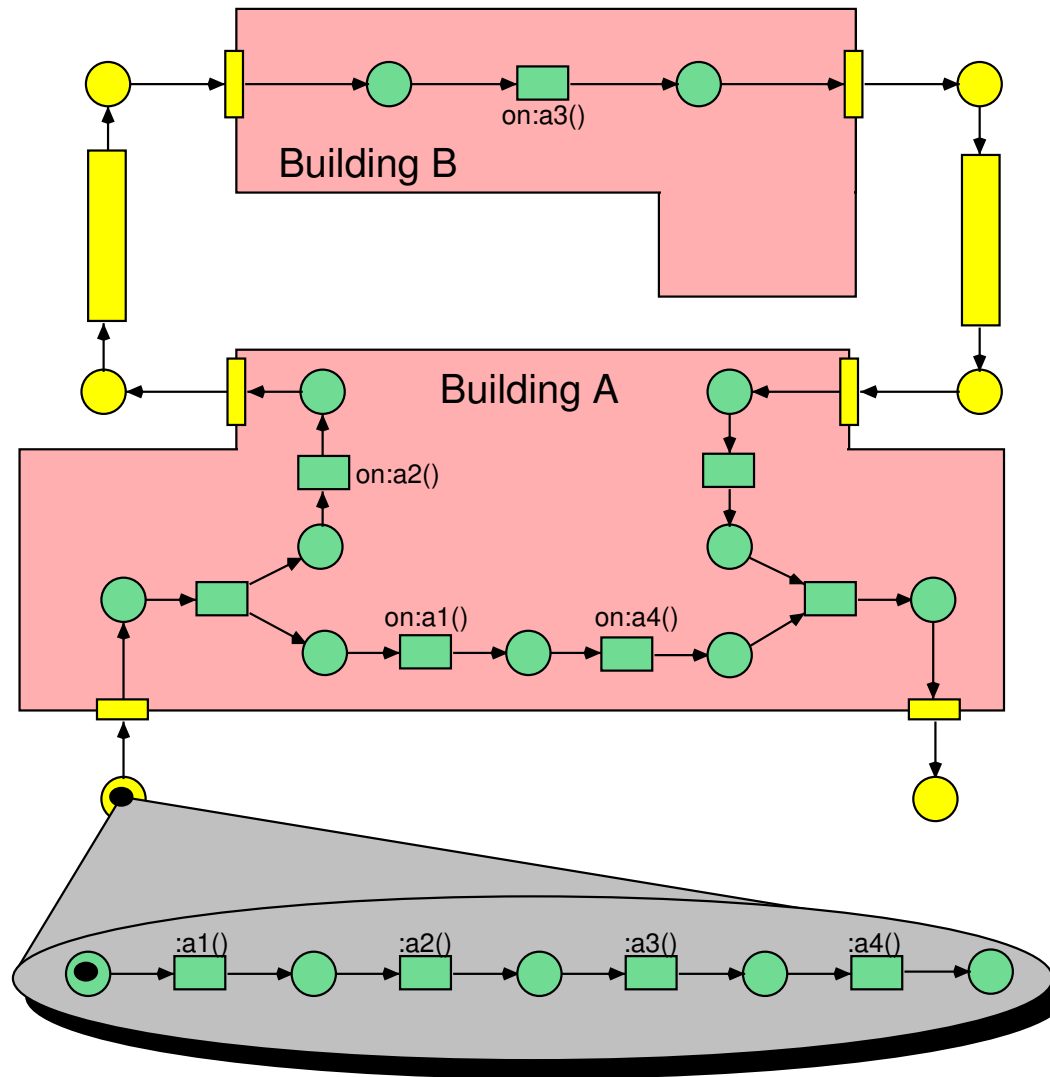
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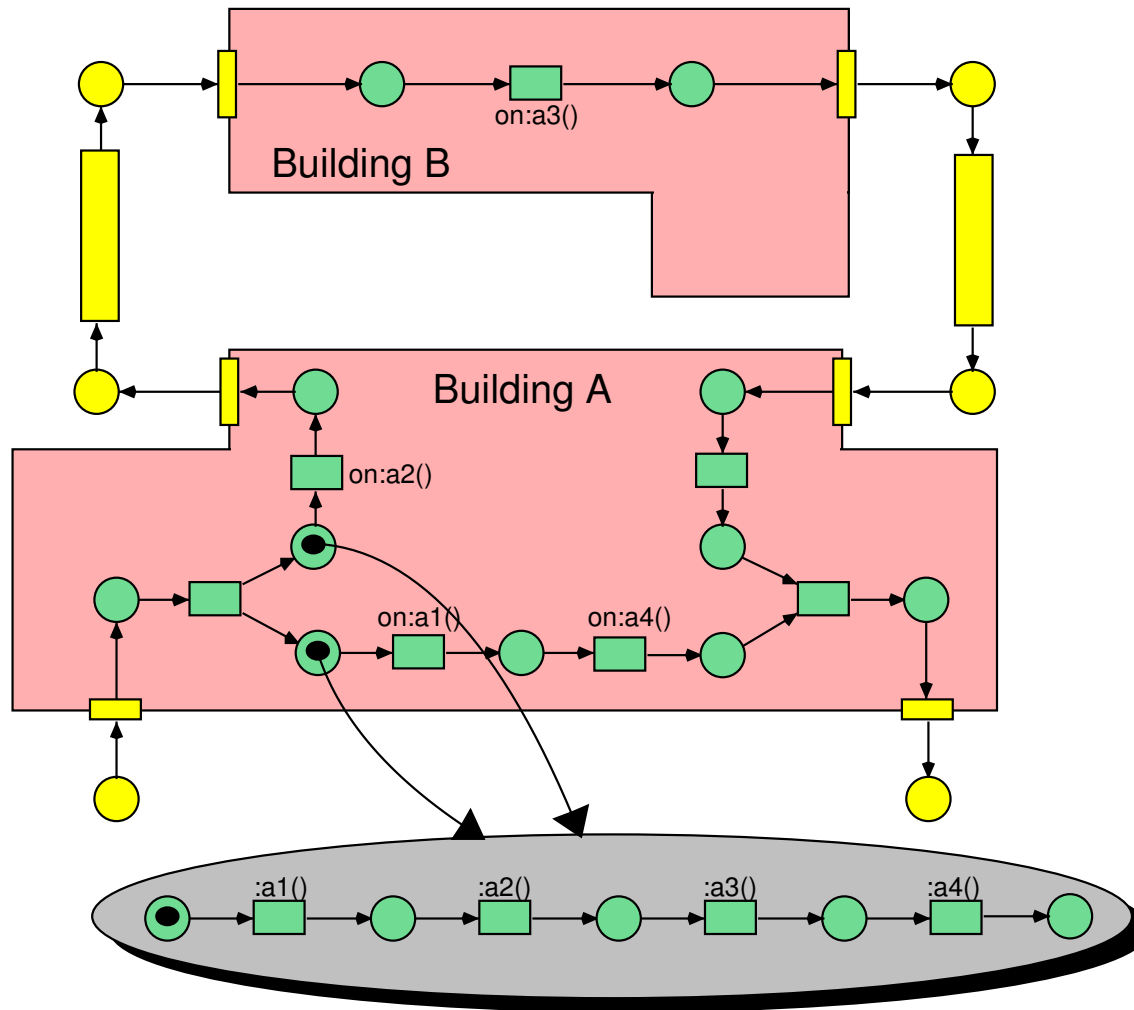
⇒ A generalised semantics is needed.



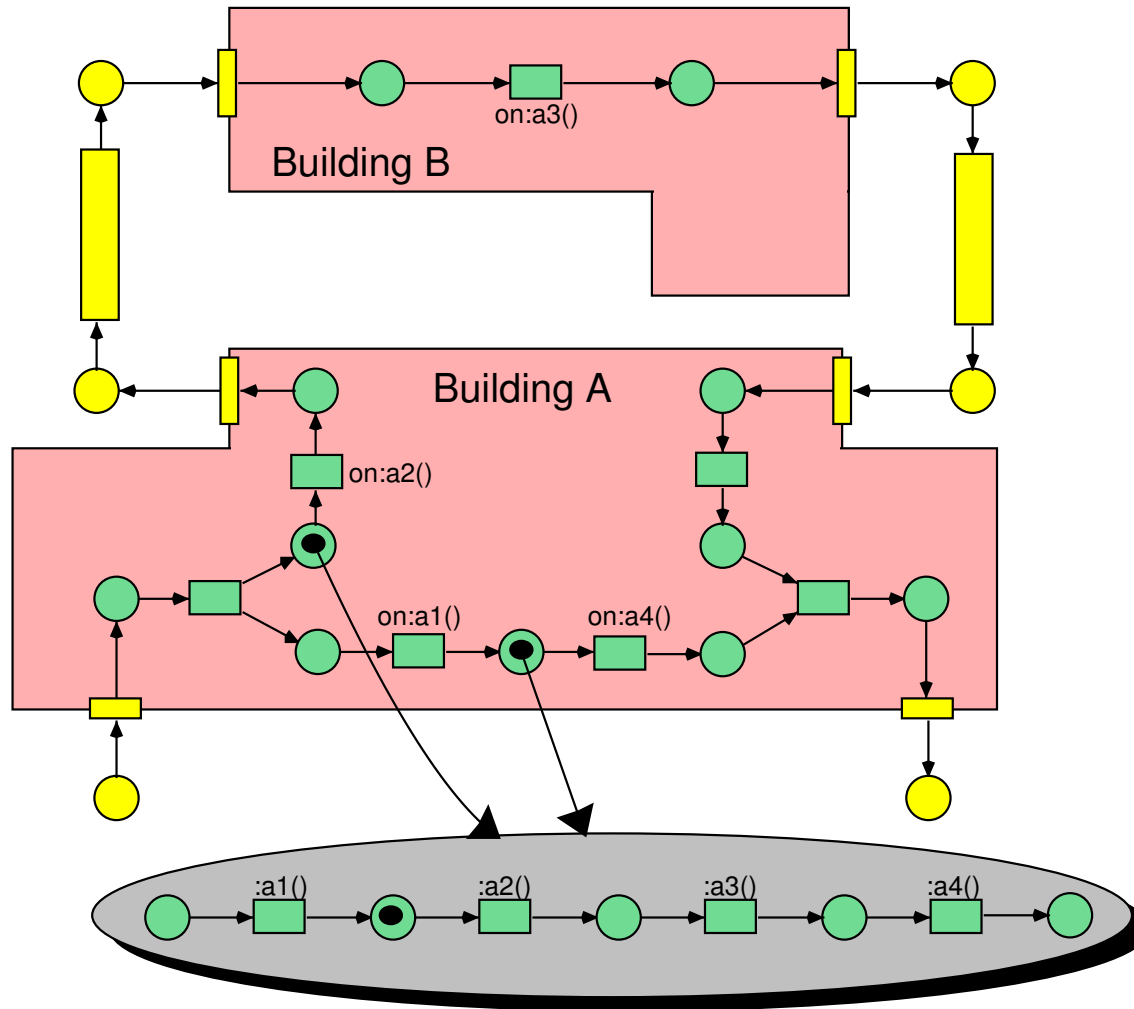
Generalised Semantics



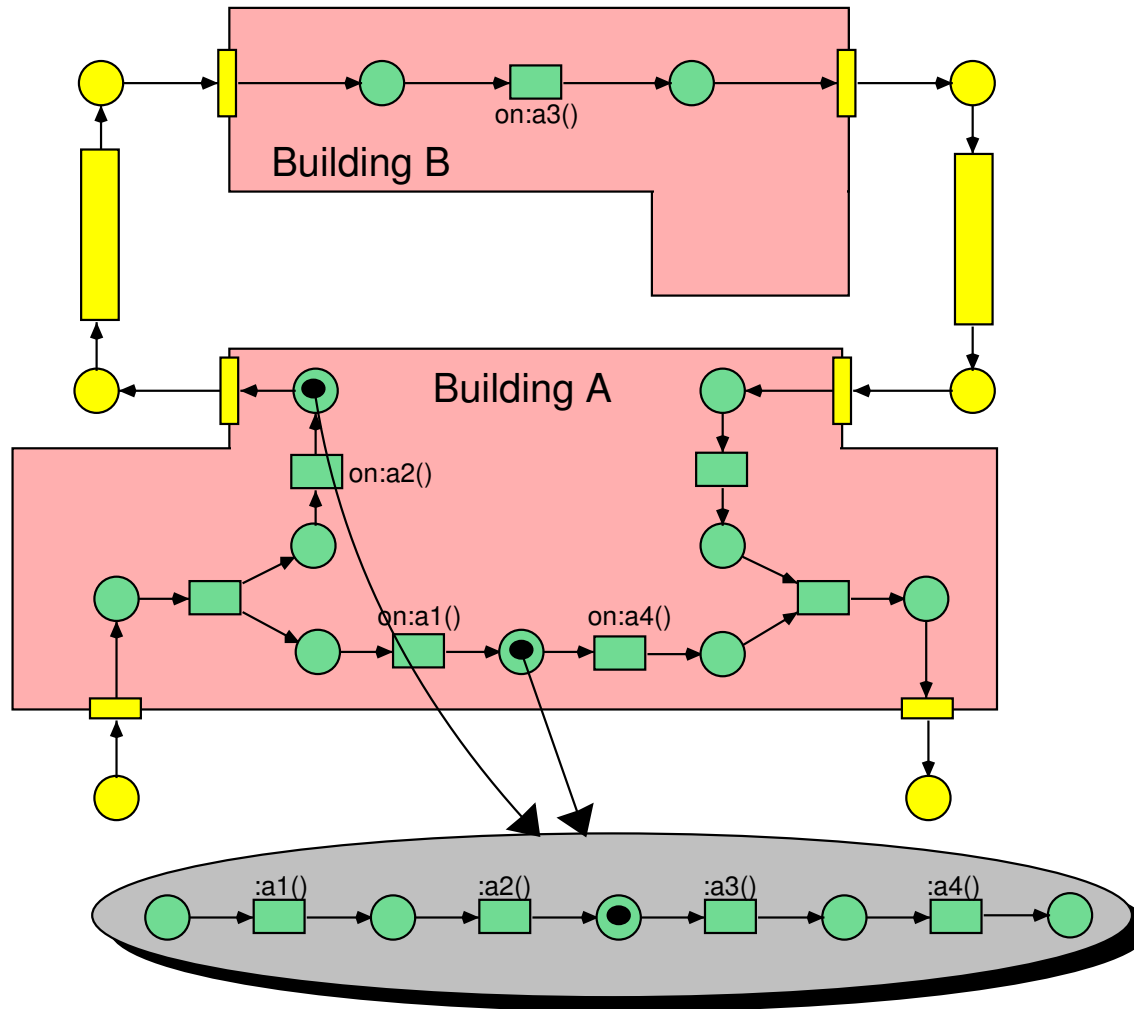
Generalised Semantics



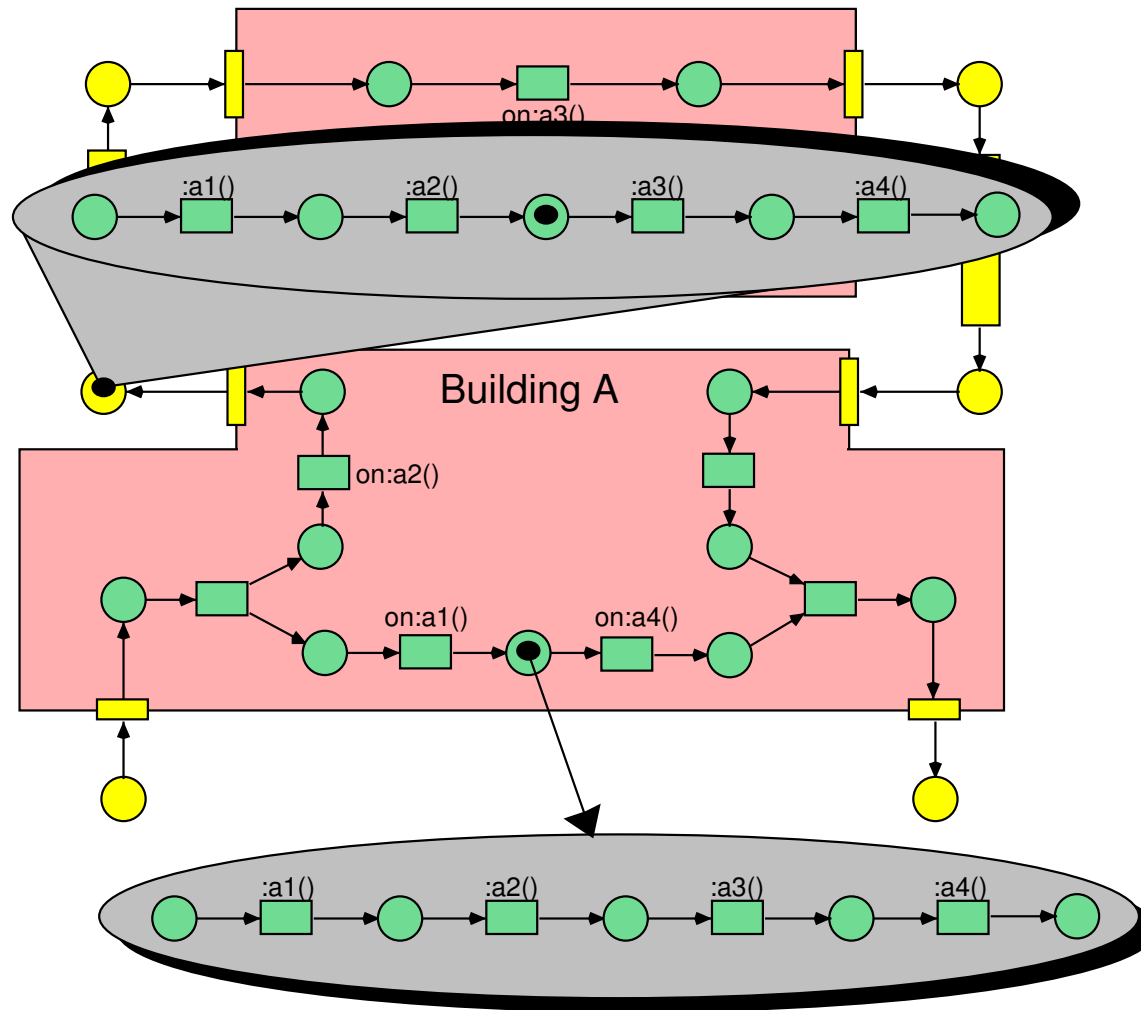
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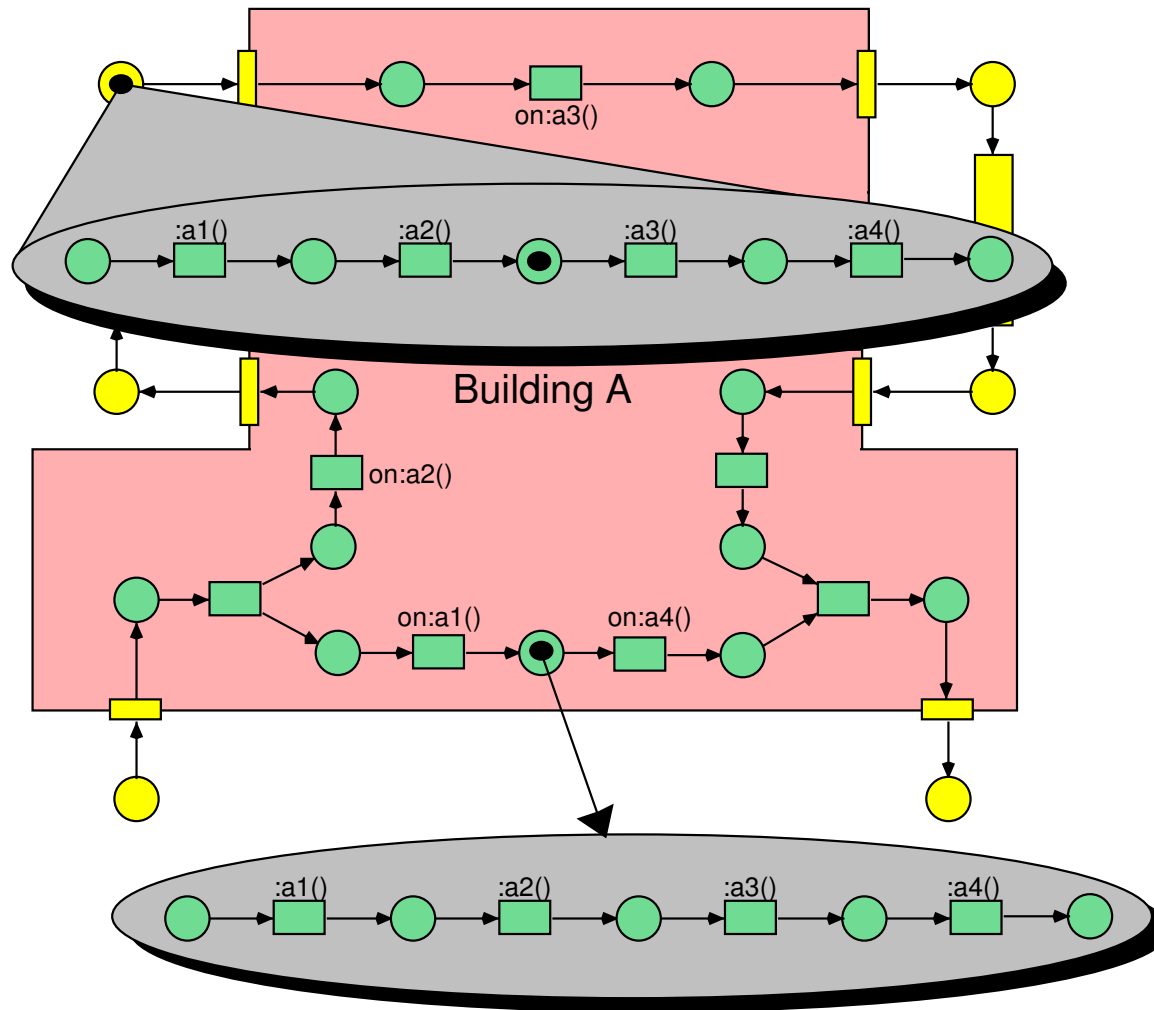
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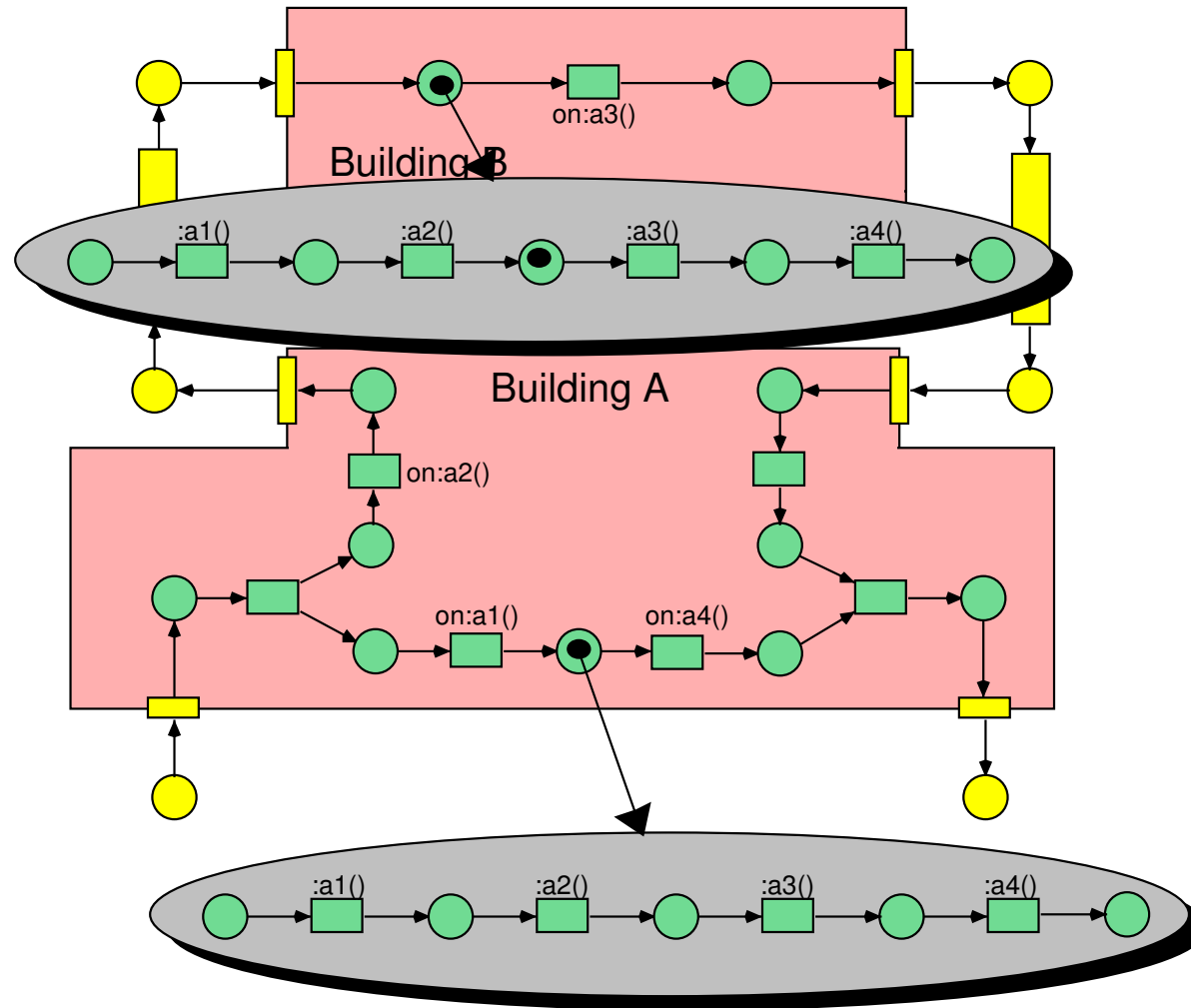
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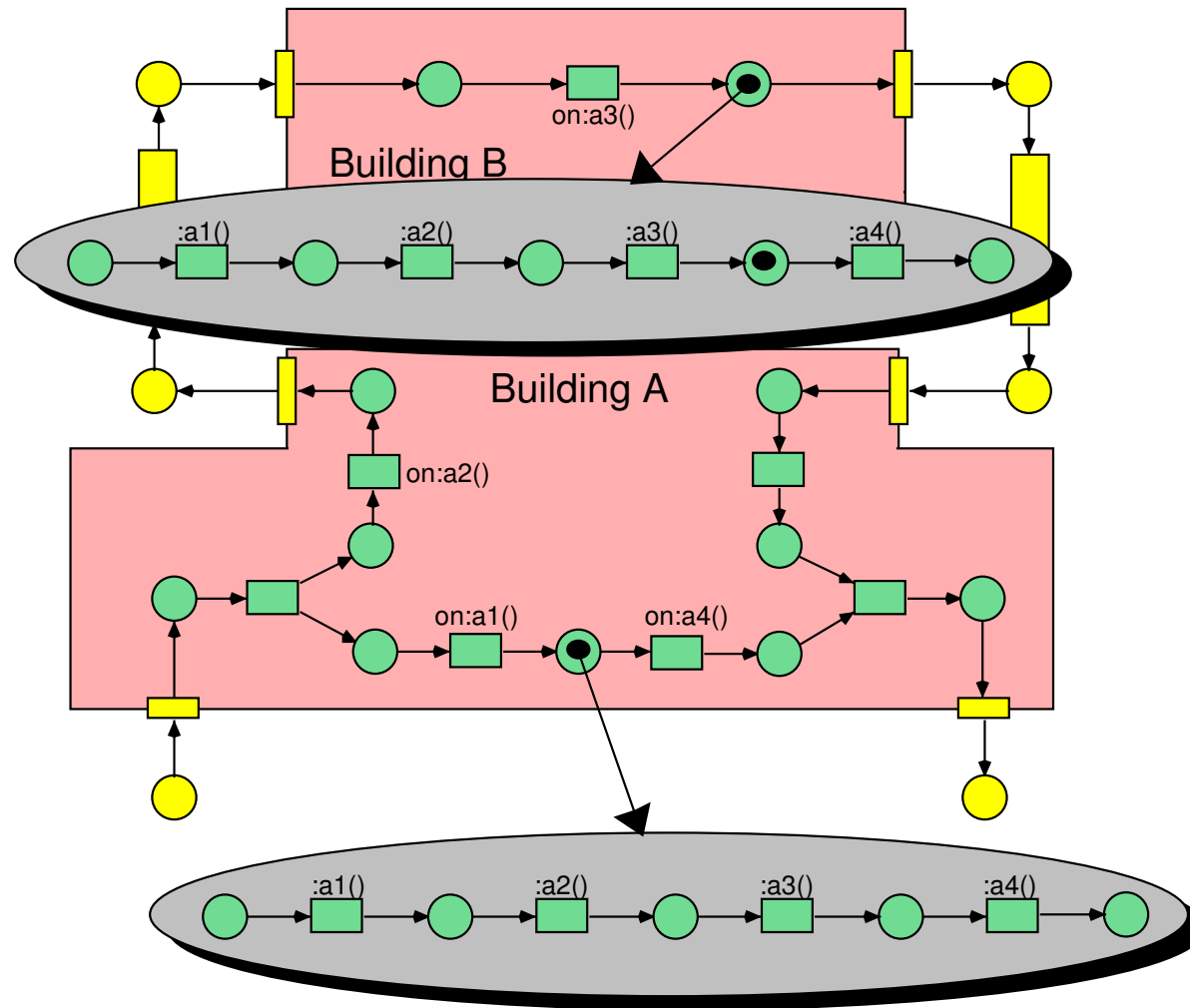
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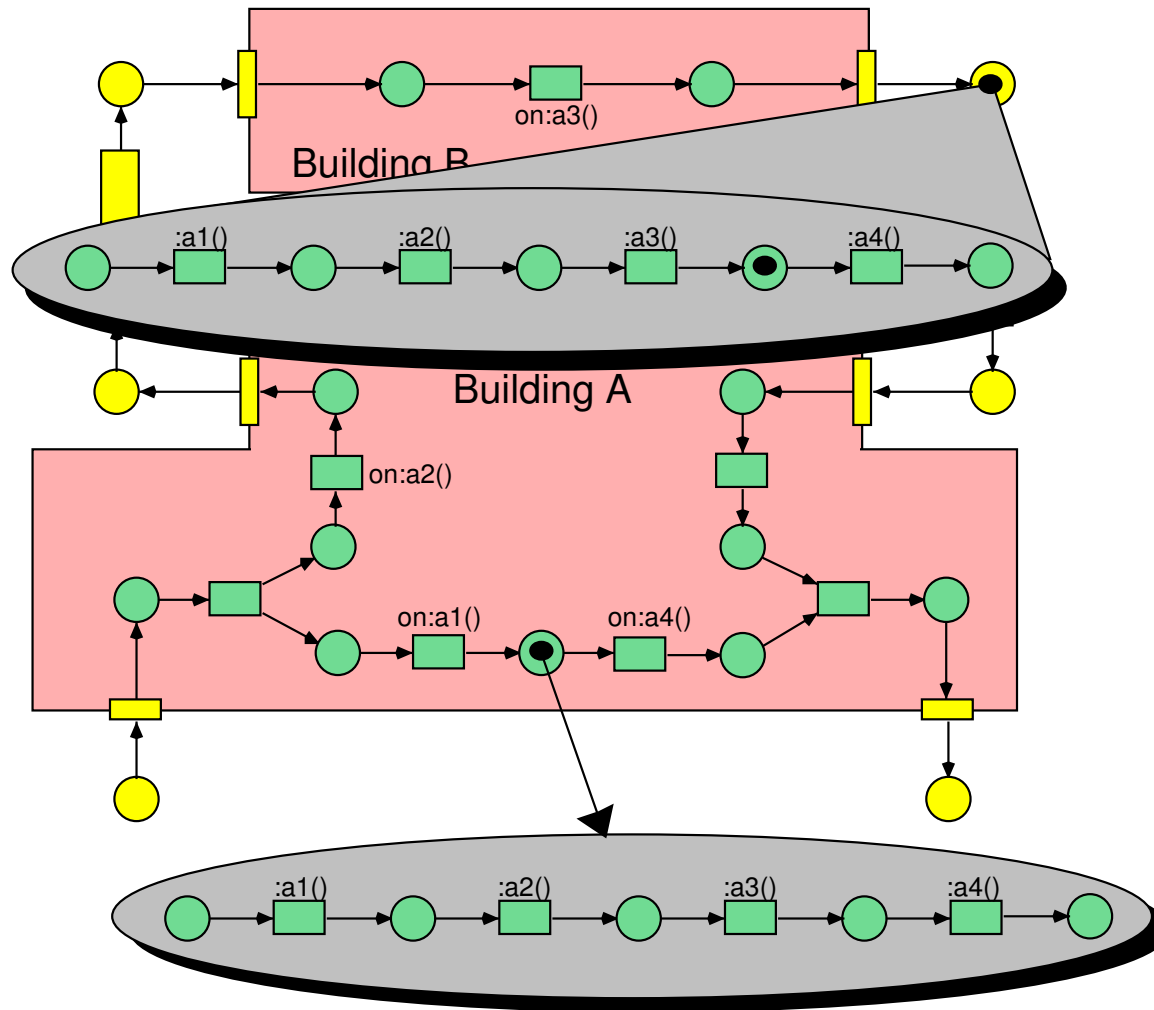
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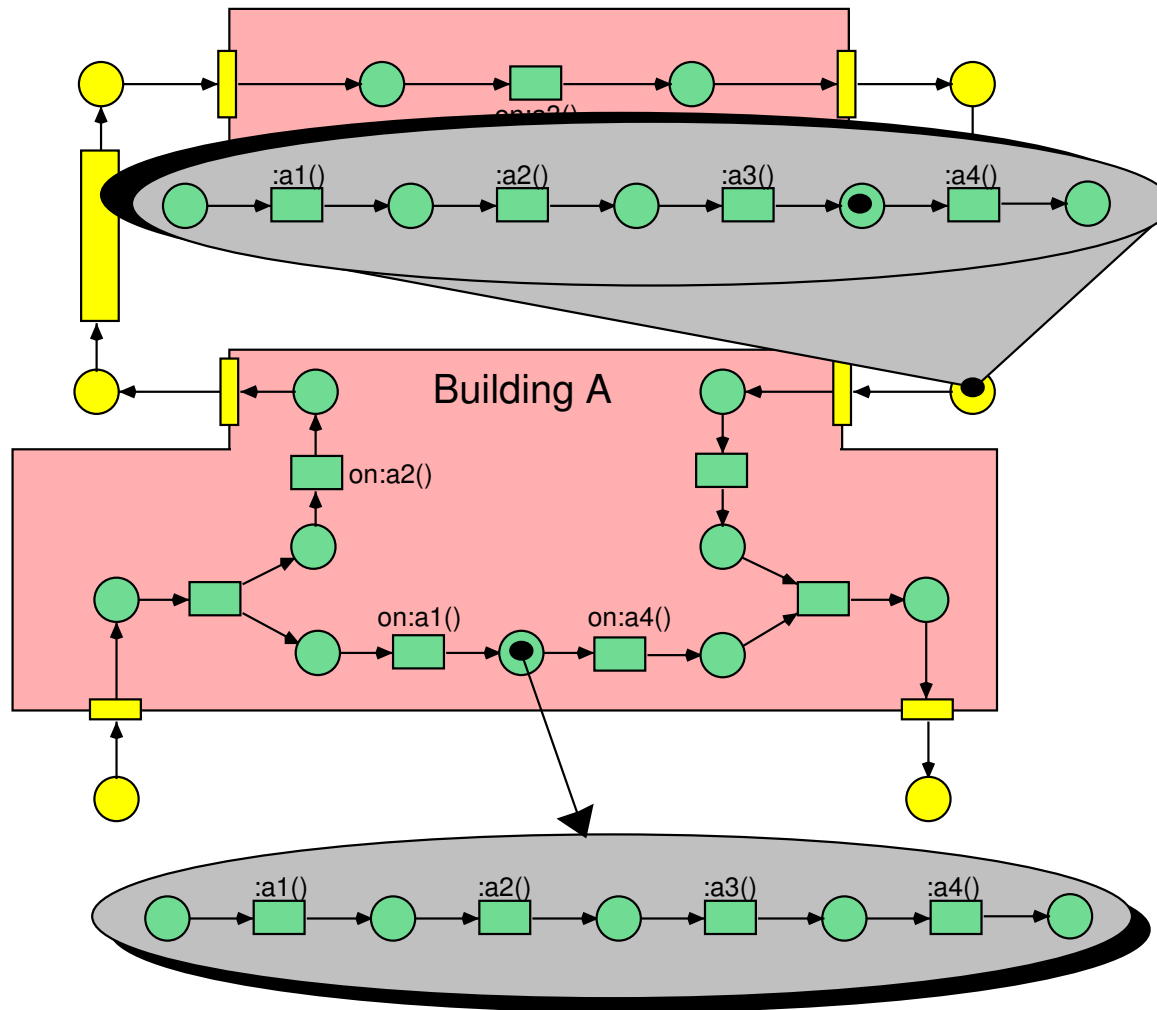
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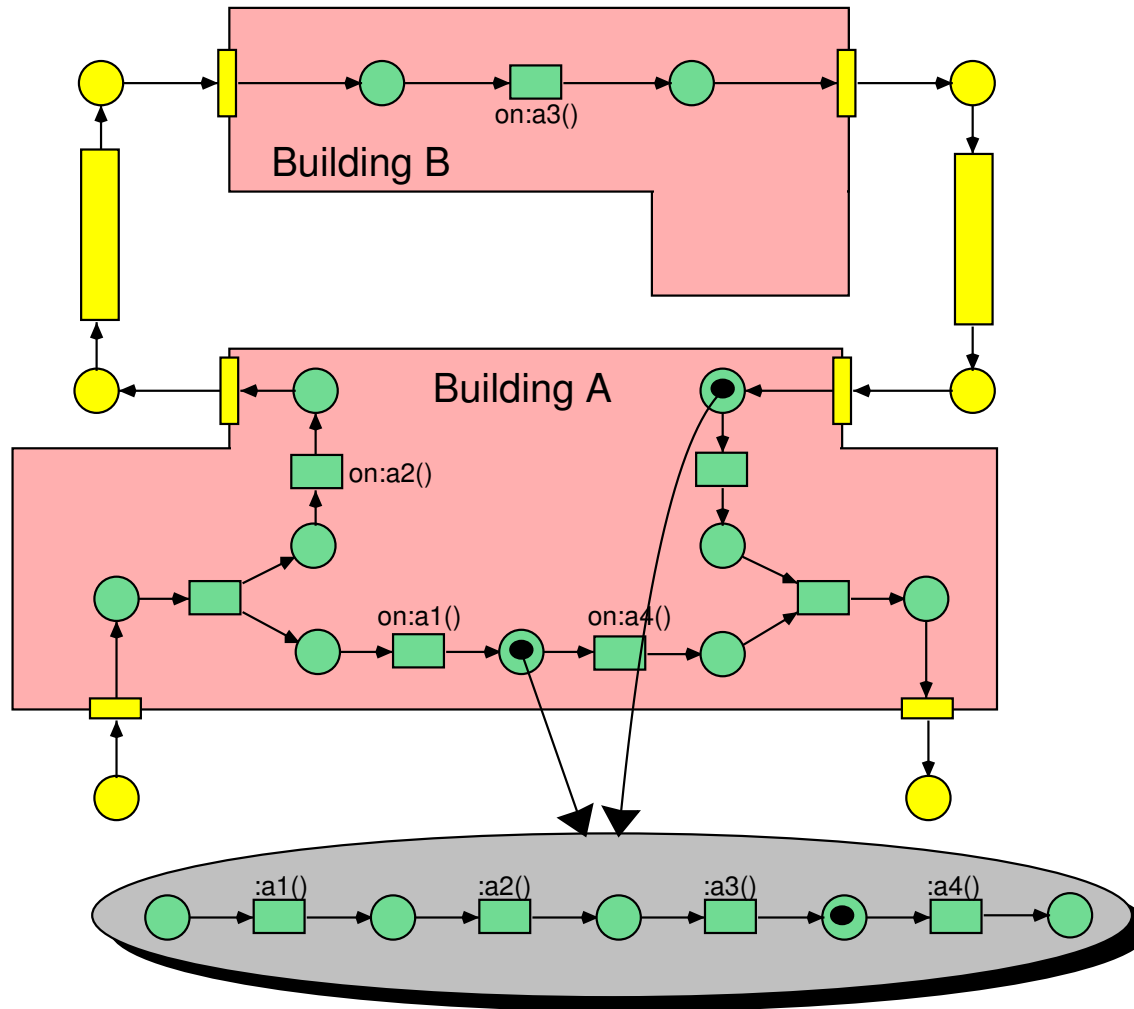
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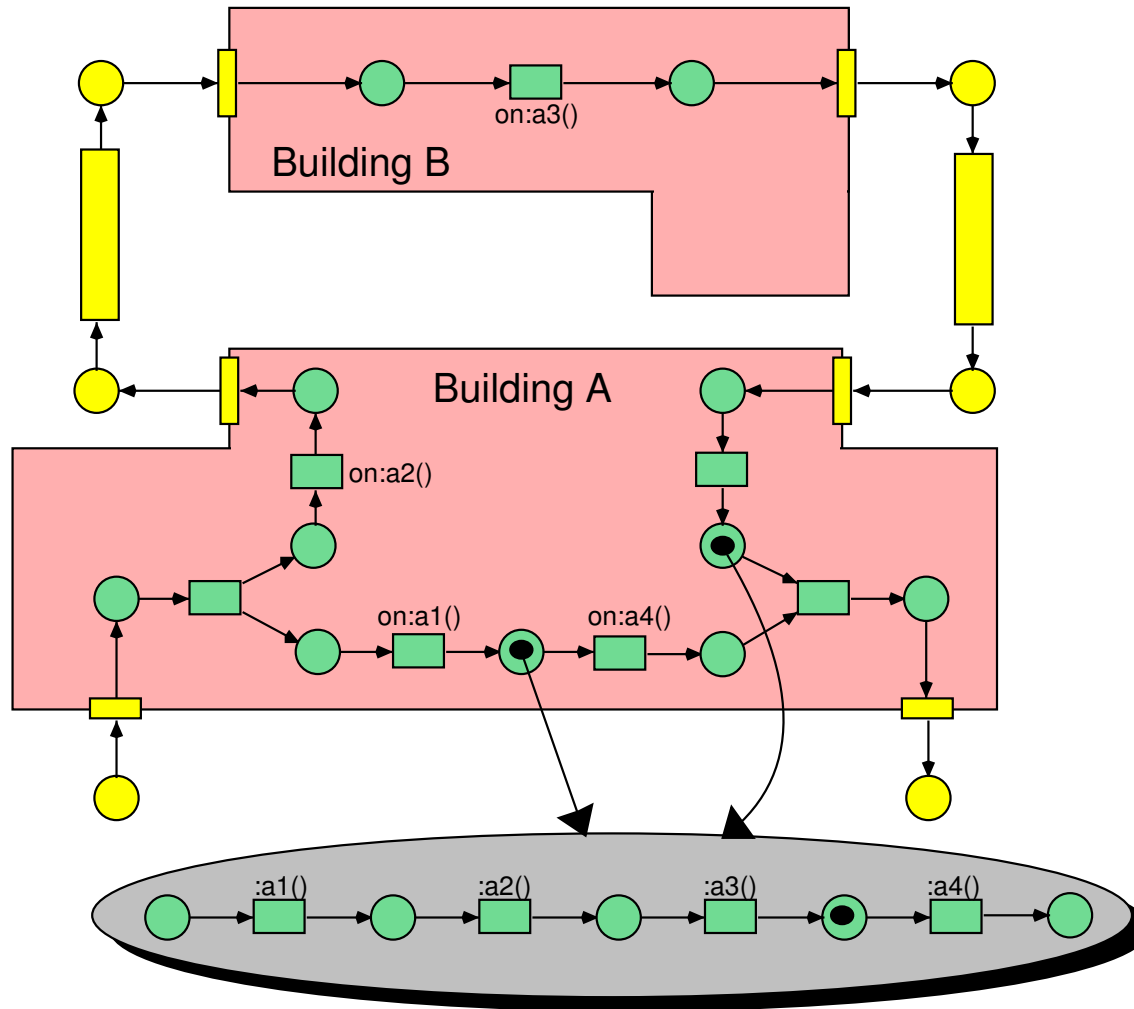
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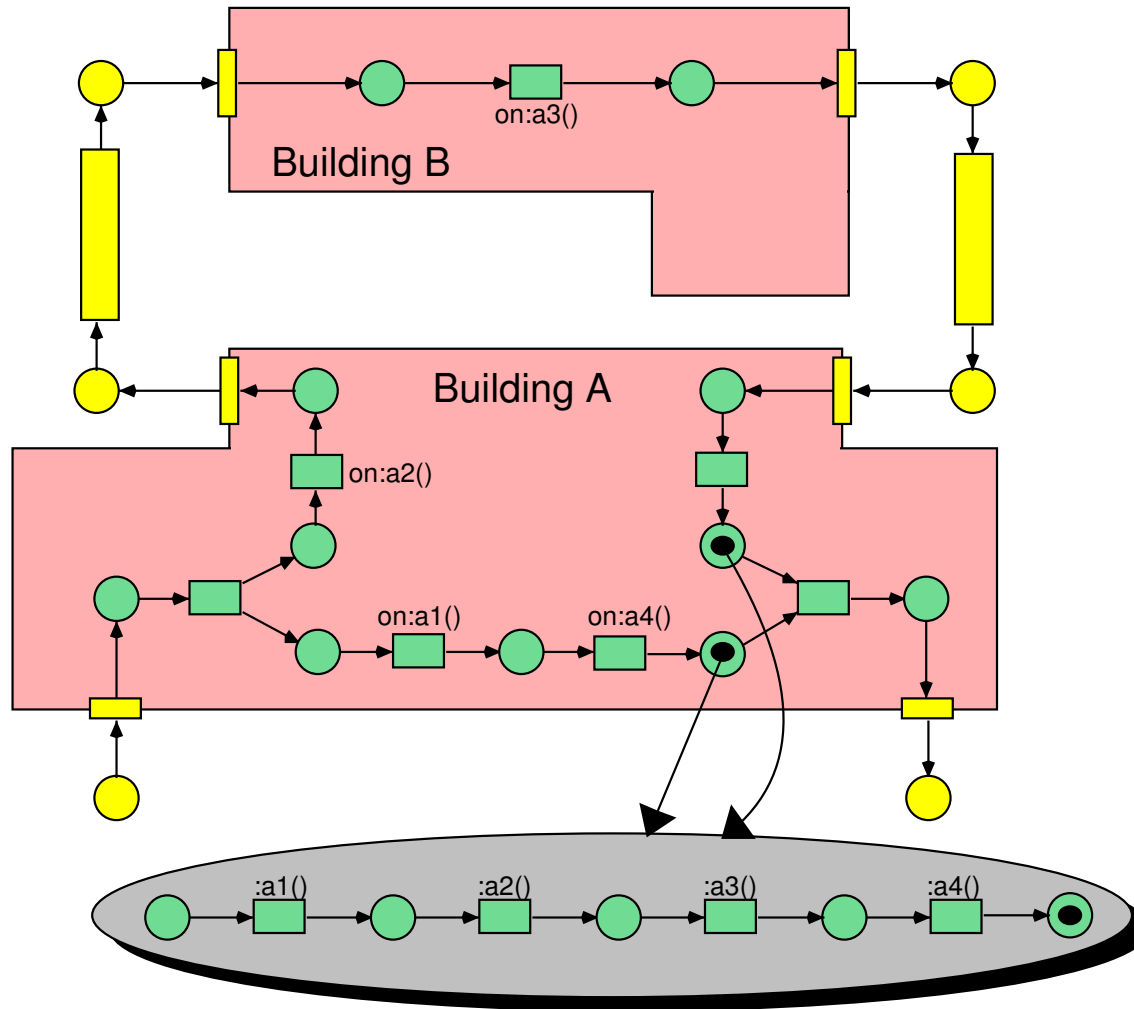
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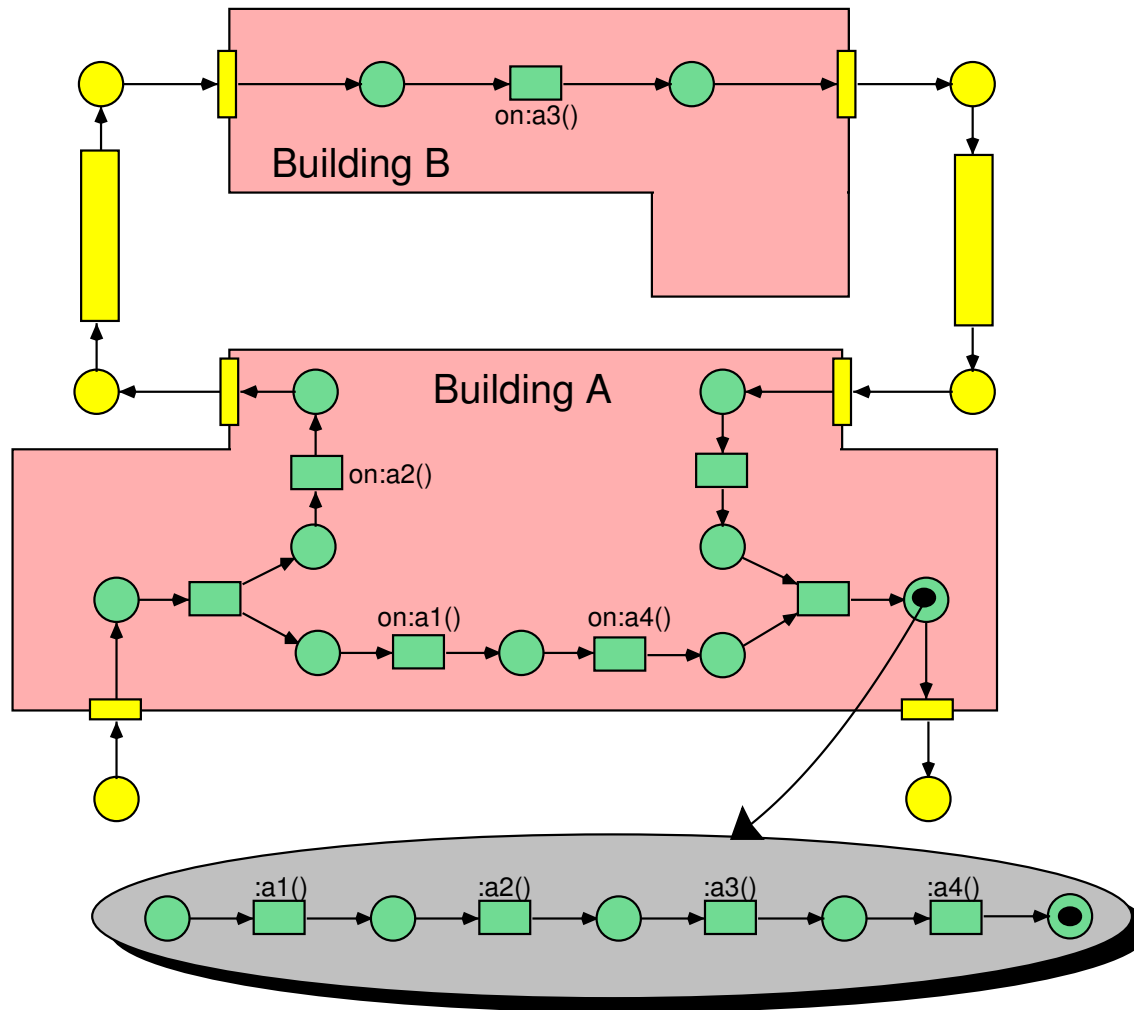
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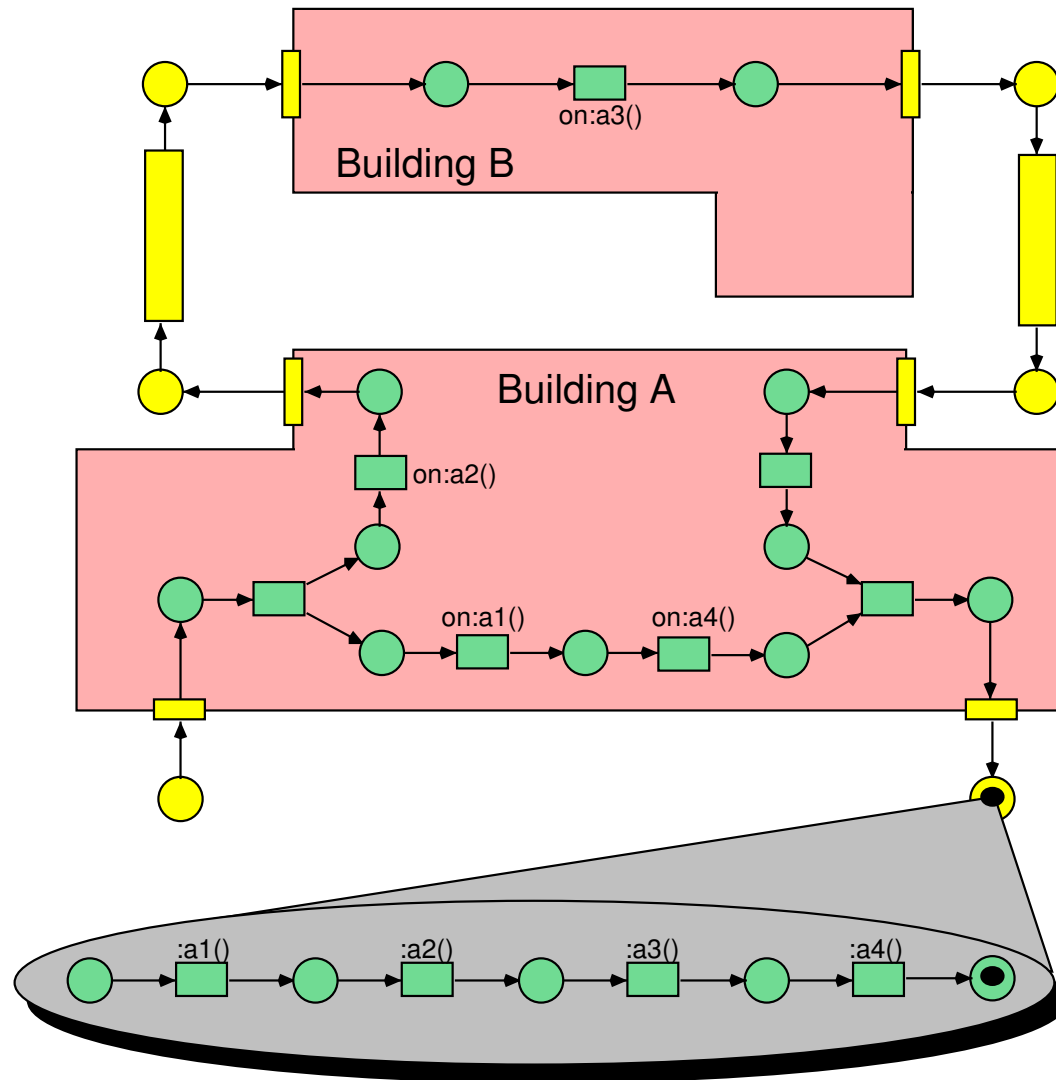
Generalised Semantics



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Generalised Semantics



Extended Object Nets

Theorem [KR04] A transition of an object net OS is activated w.r.t. reference semantics iff it is in the p/t-net $\mathfrak{fl}(OS)$

Basic Idea:

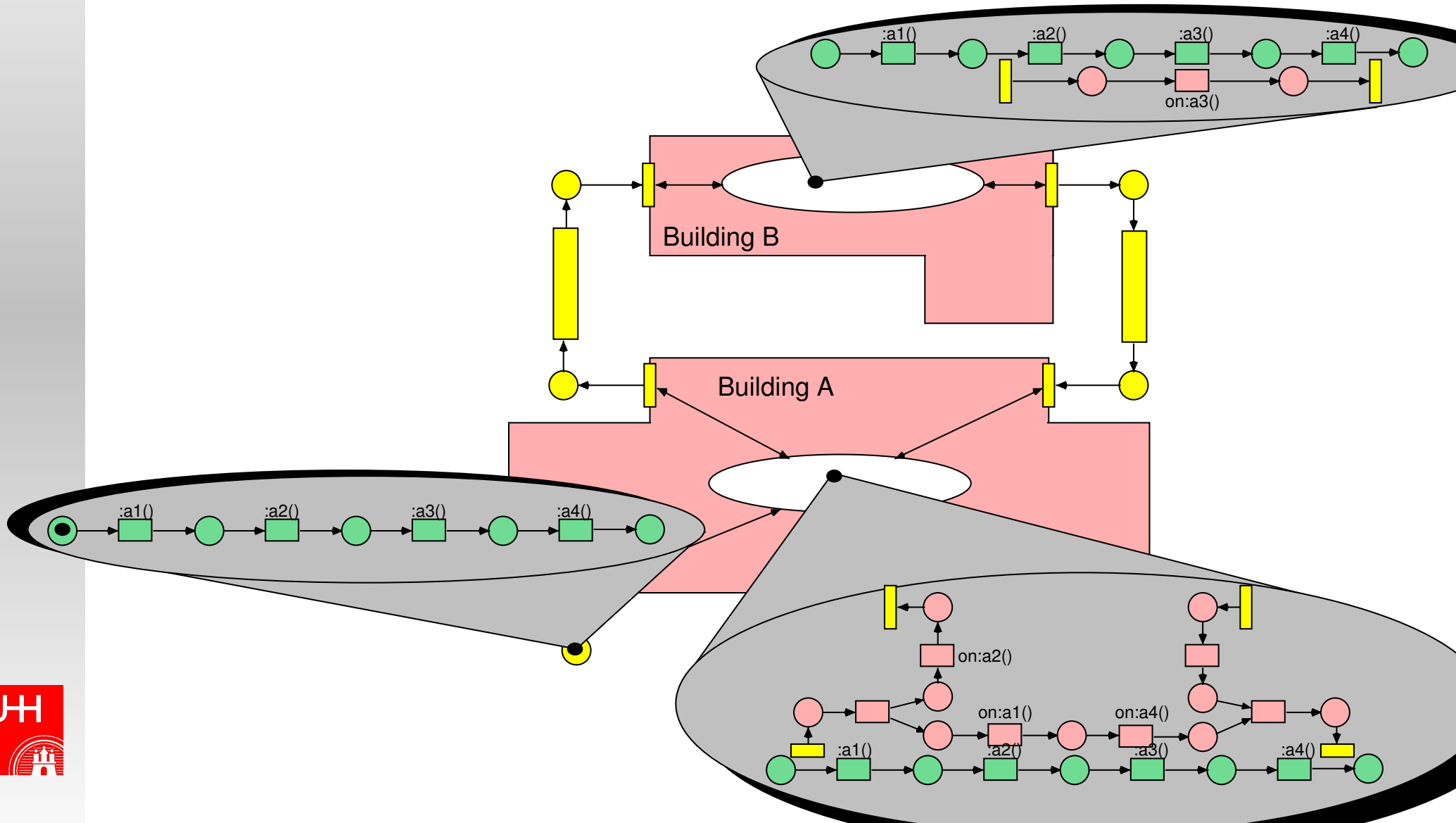
- Reference semantics is simulated by the p/t-net $\mathfrak{fl}(OS)$.
- Use $\mathfrak{fl}(OS)$ as a special token.
- Tokens can be transferred from an to $\mathfrak{fl}(OS)$.

Benefit:

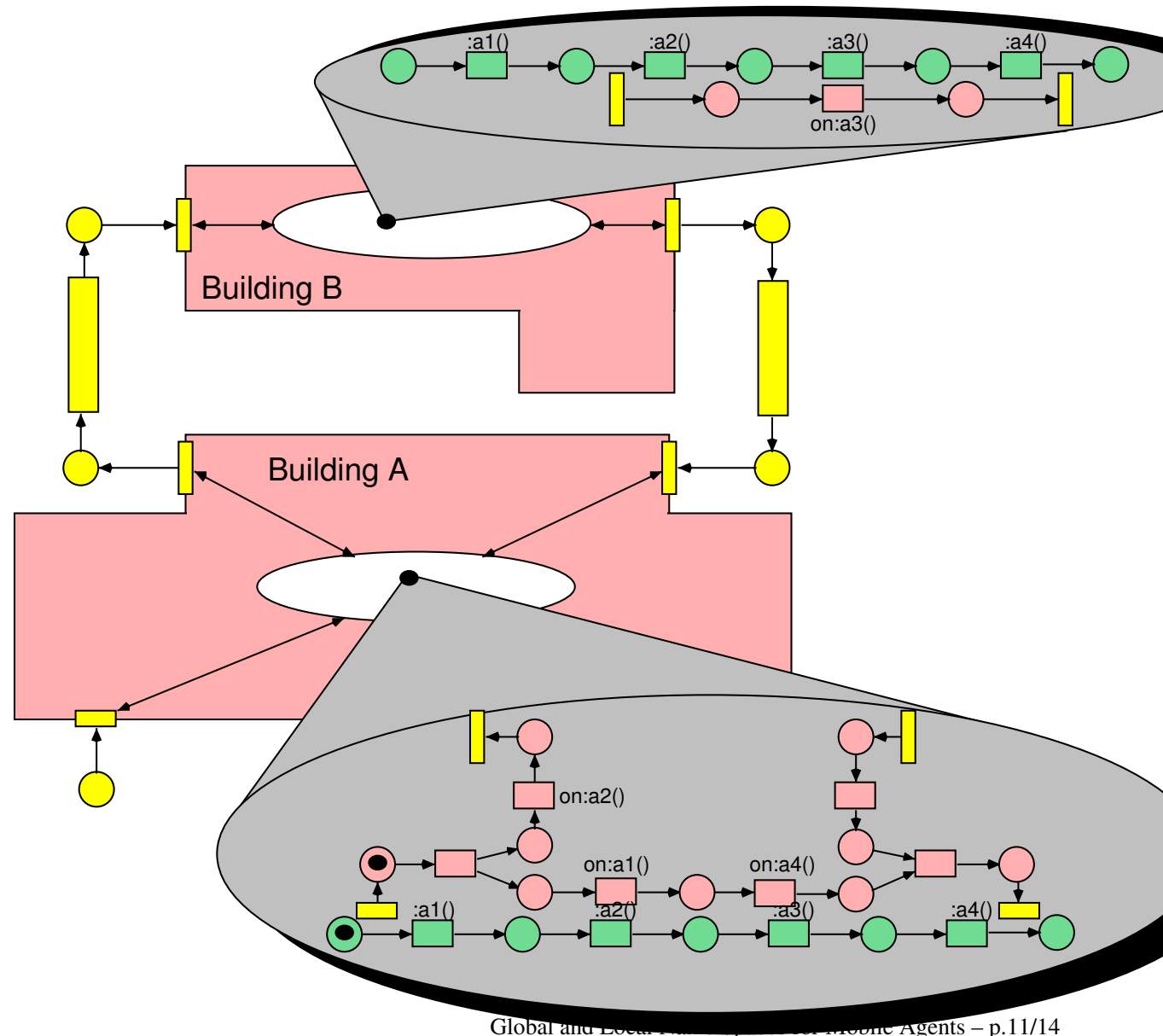
- The formalism is a canonical extension.
- Most properties of object nets are preserved.



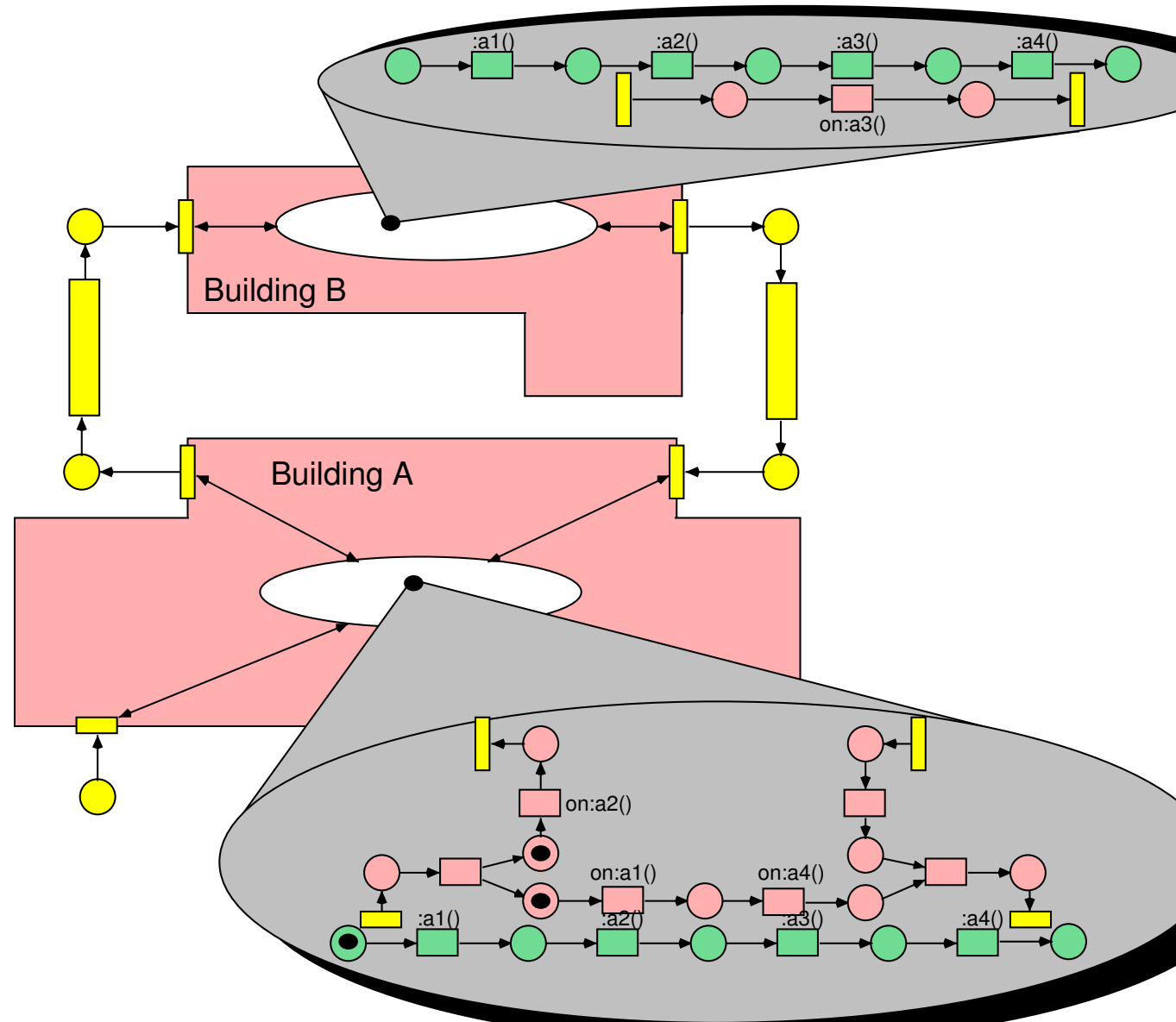
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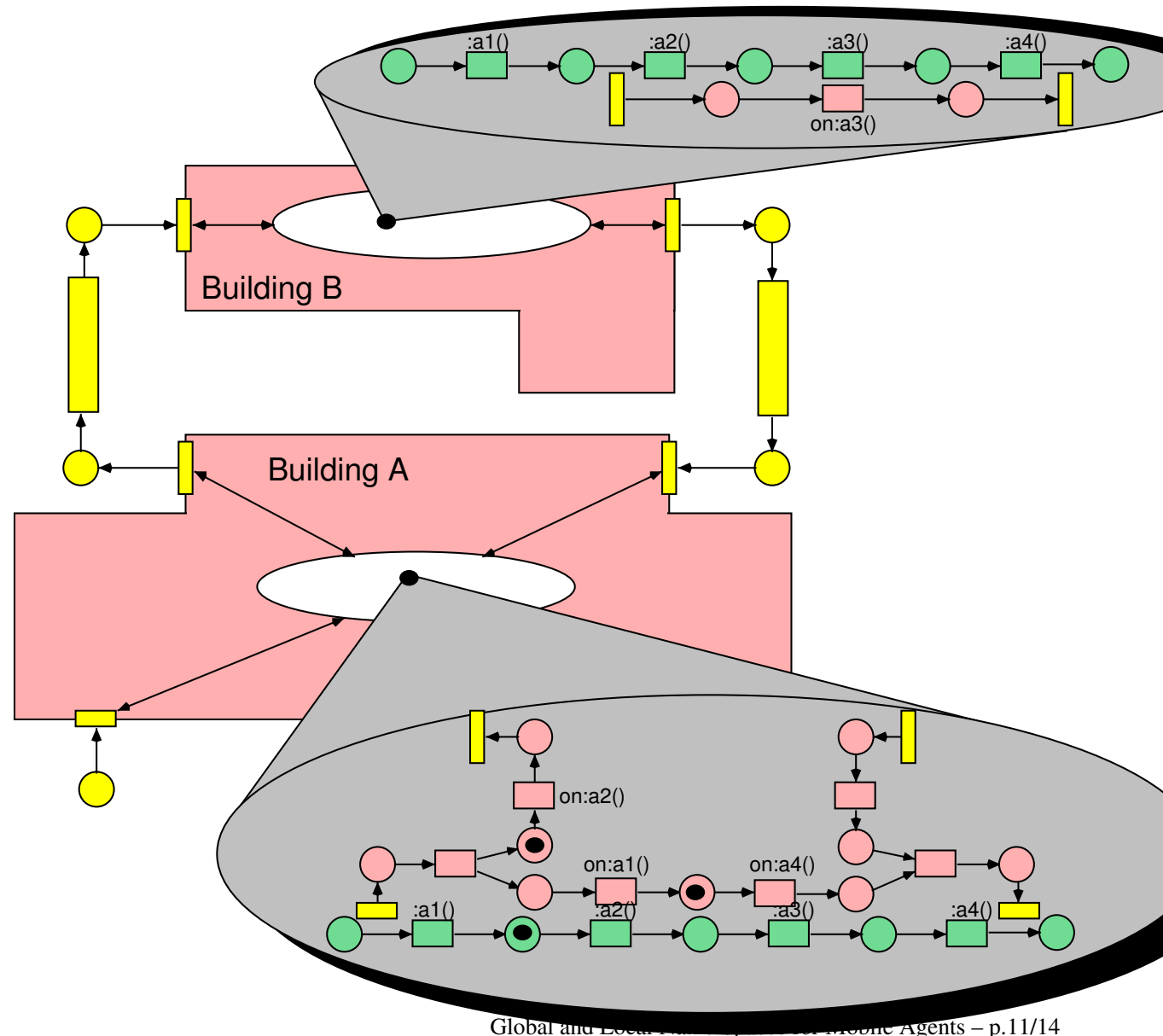
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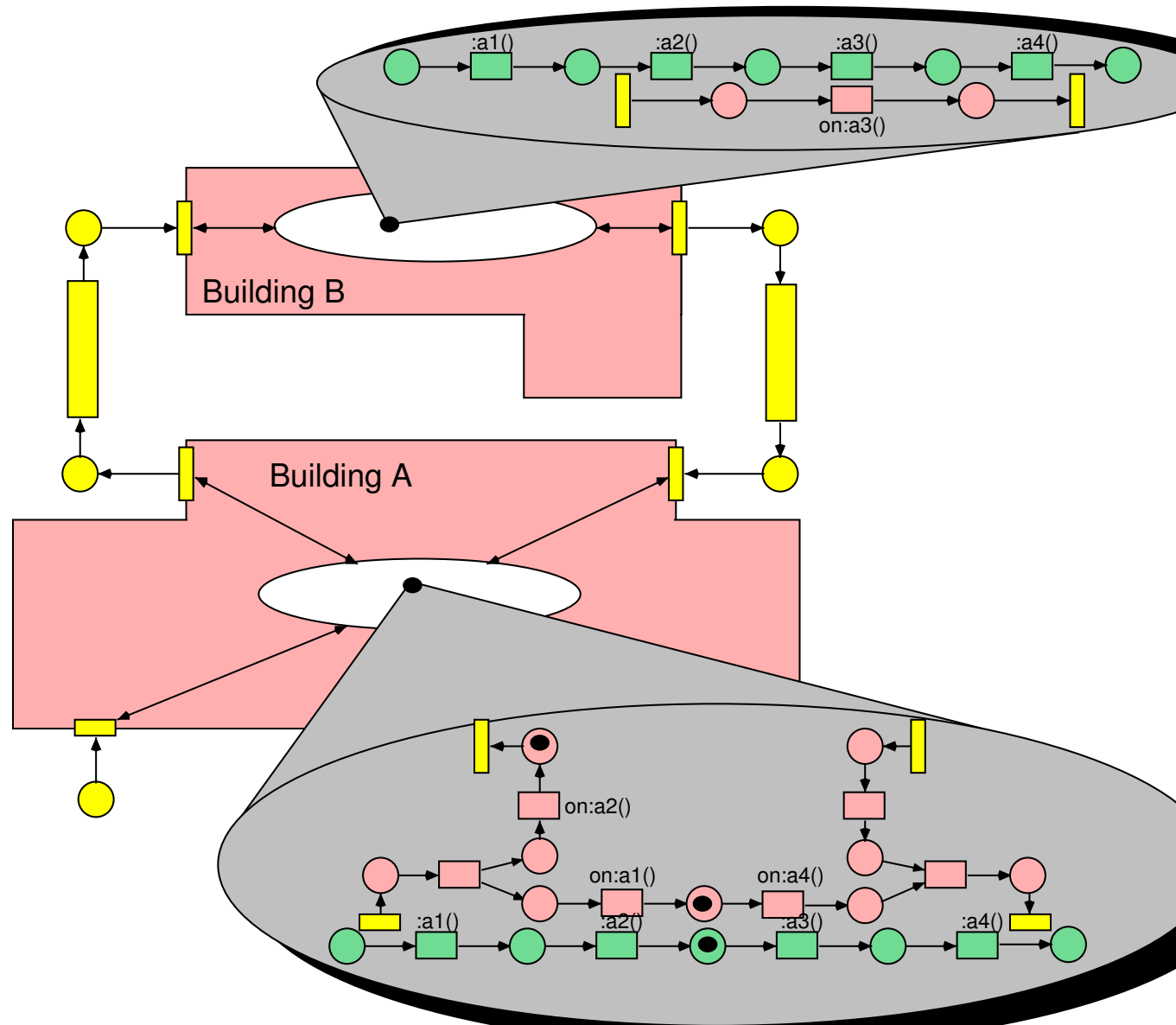
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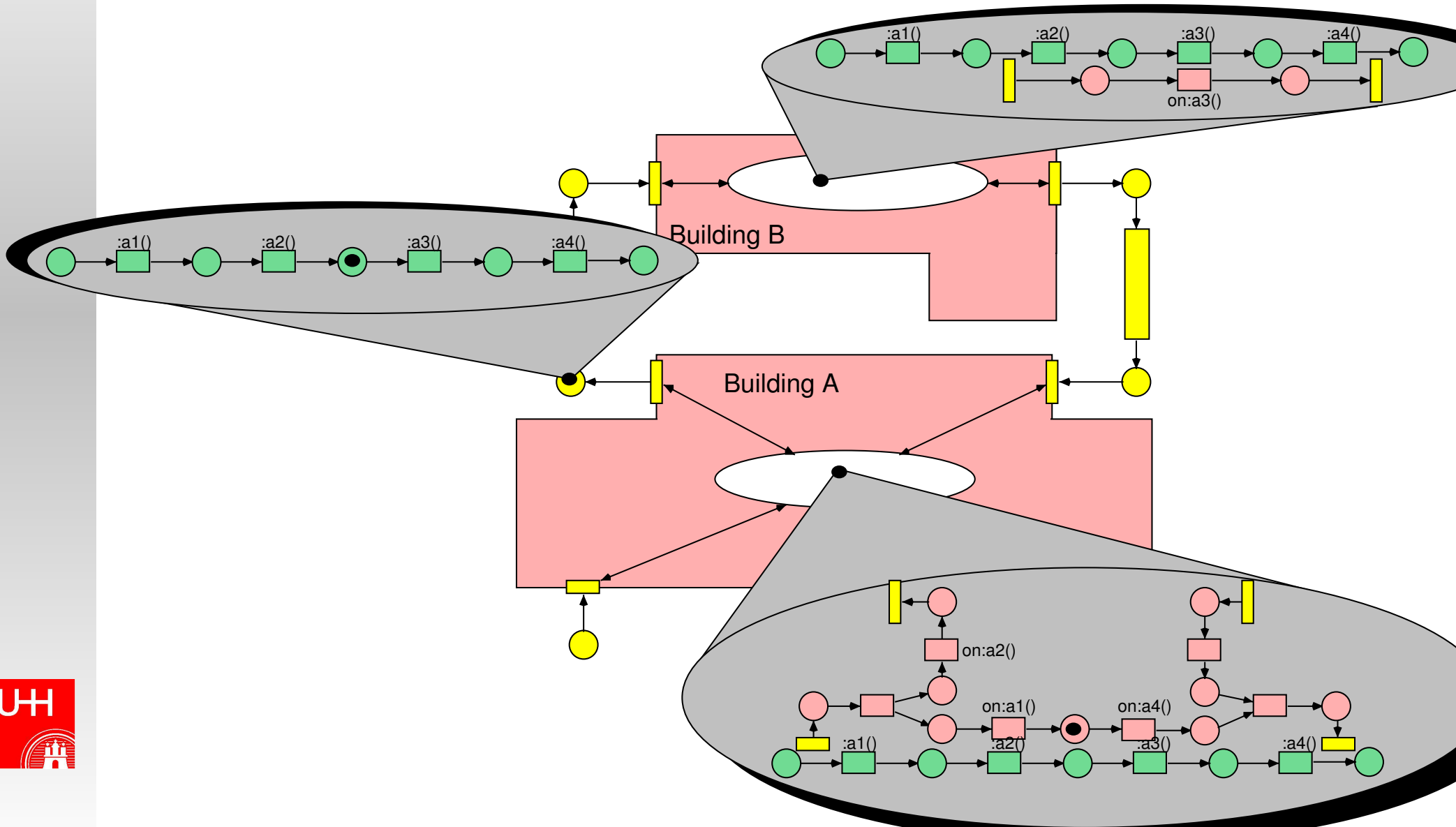
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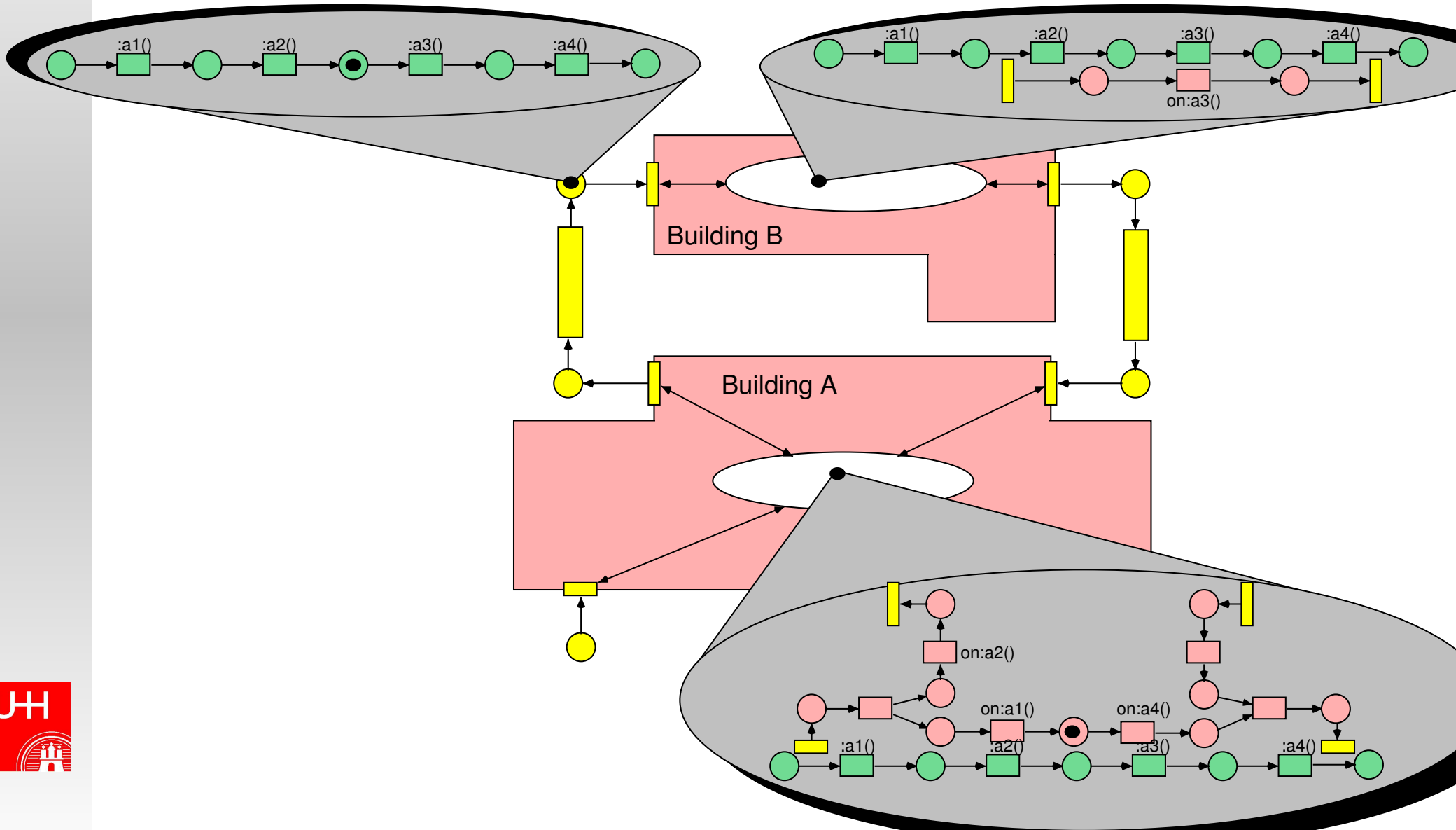
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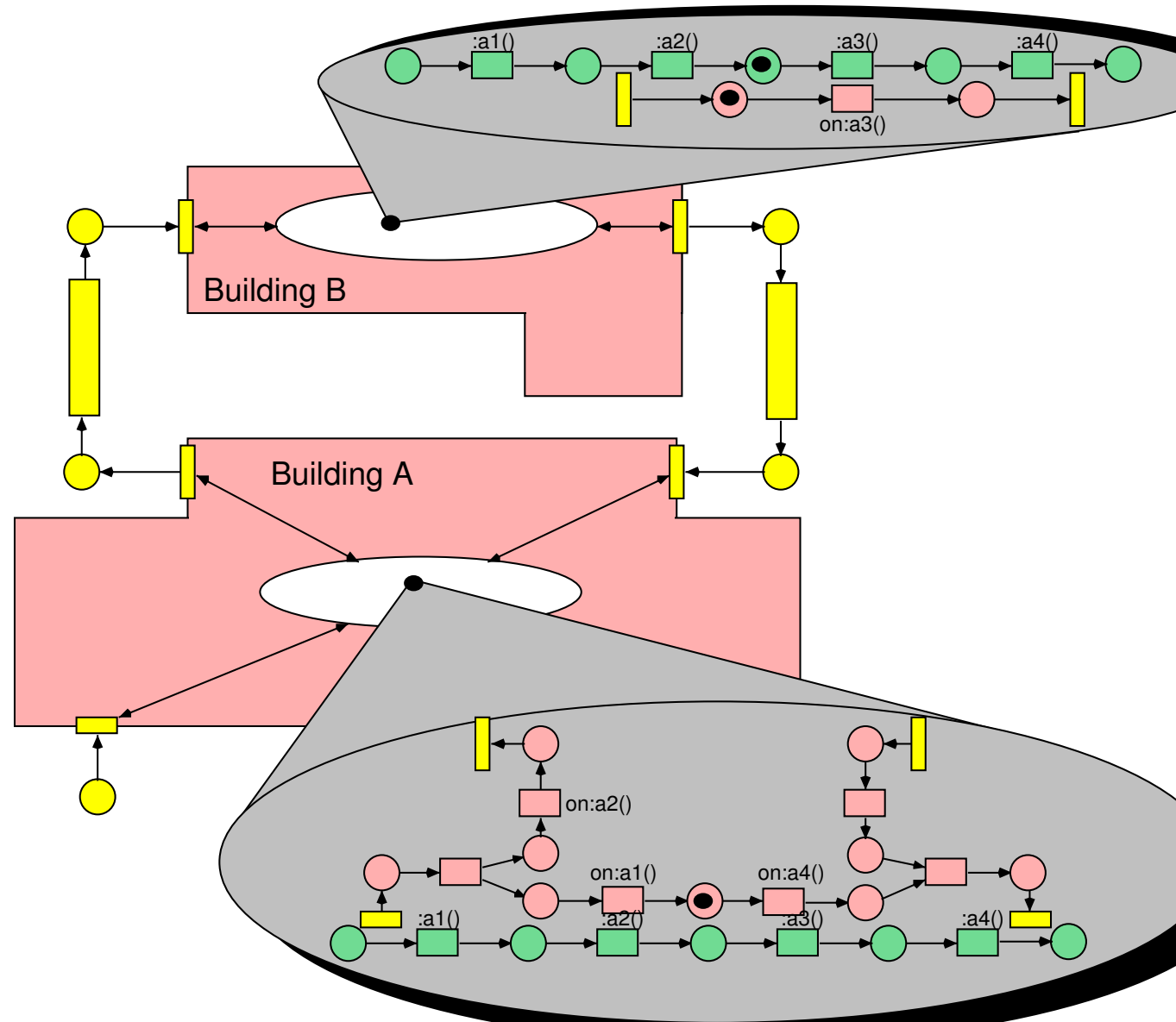
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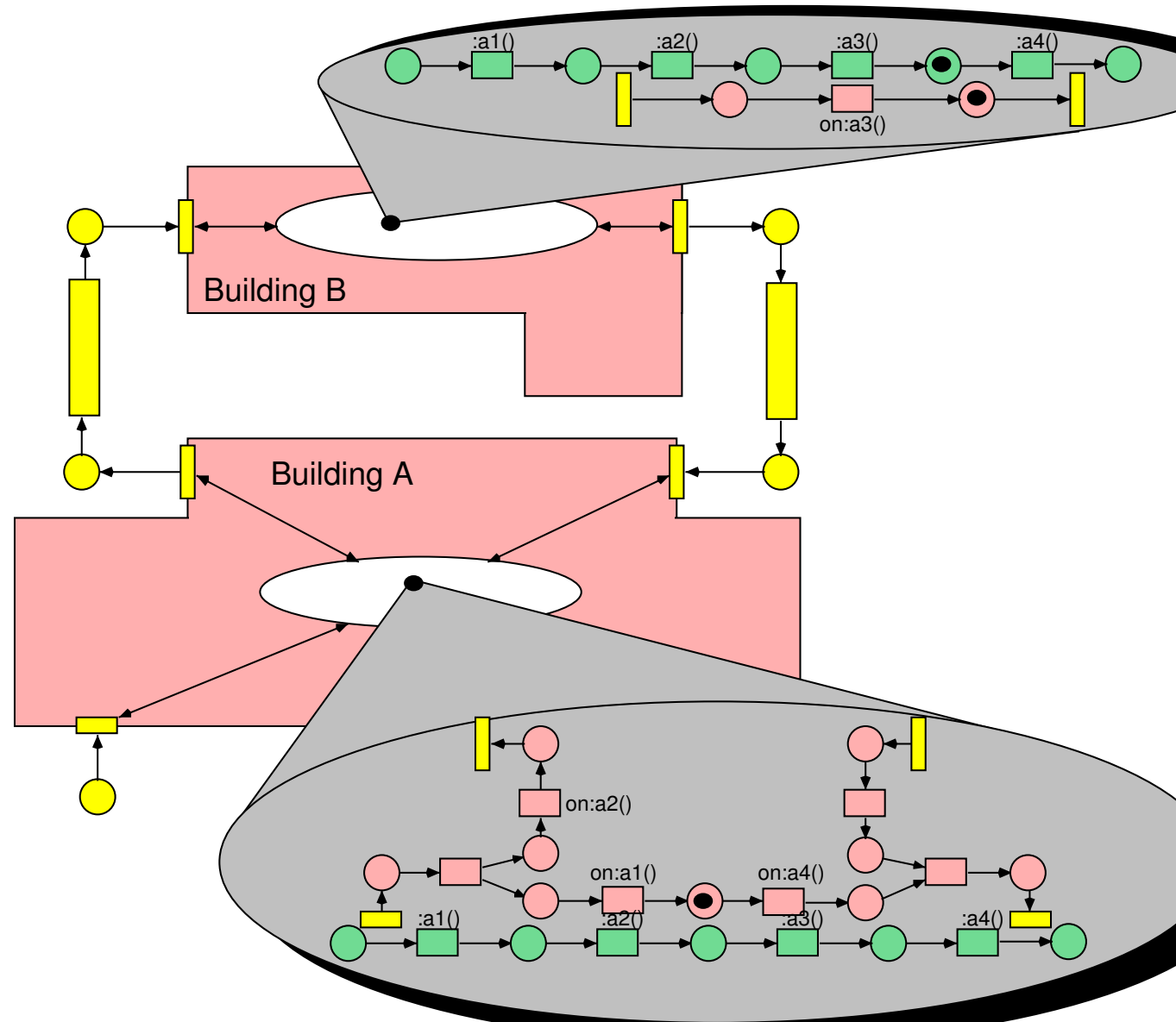
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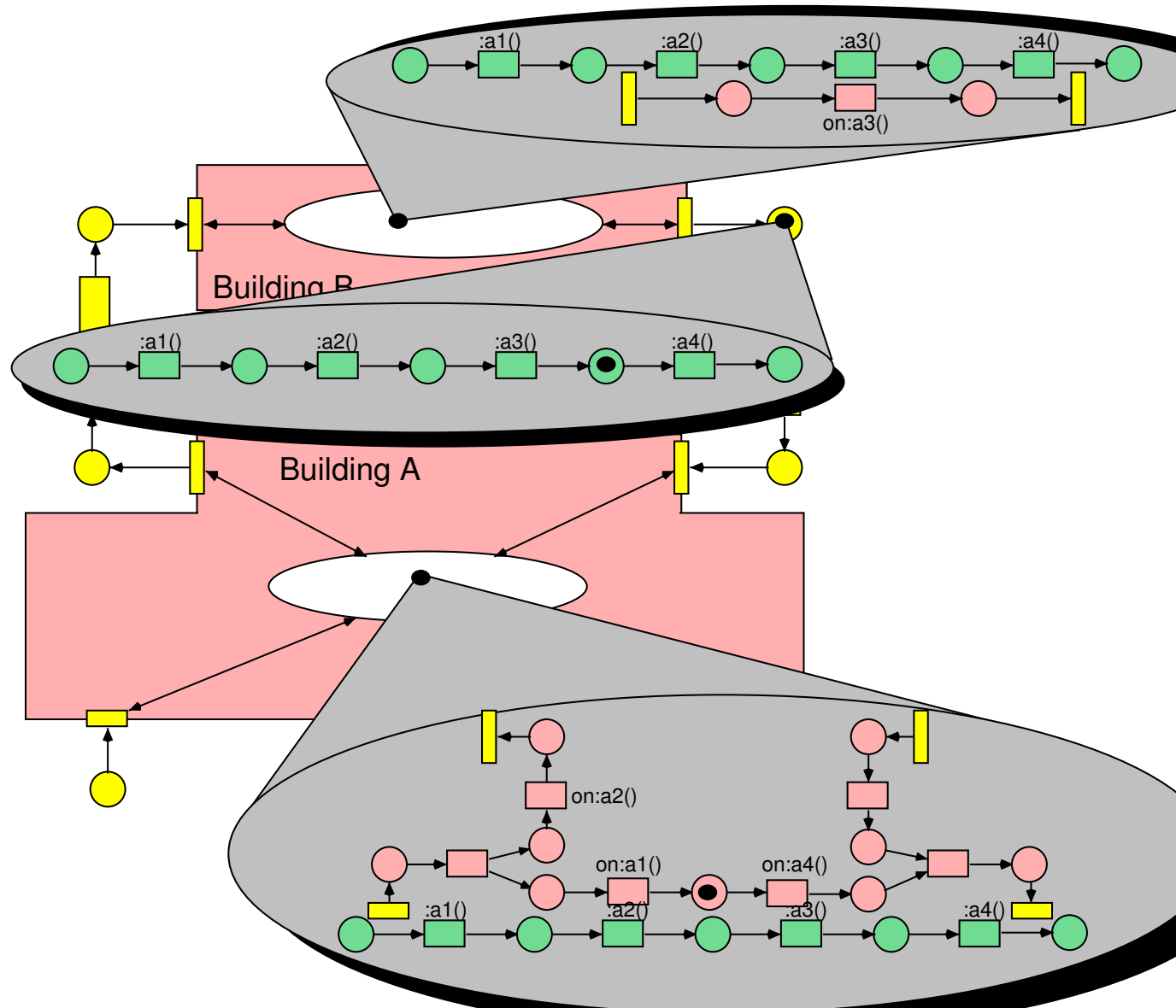
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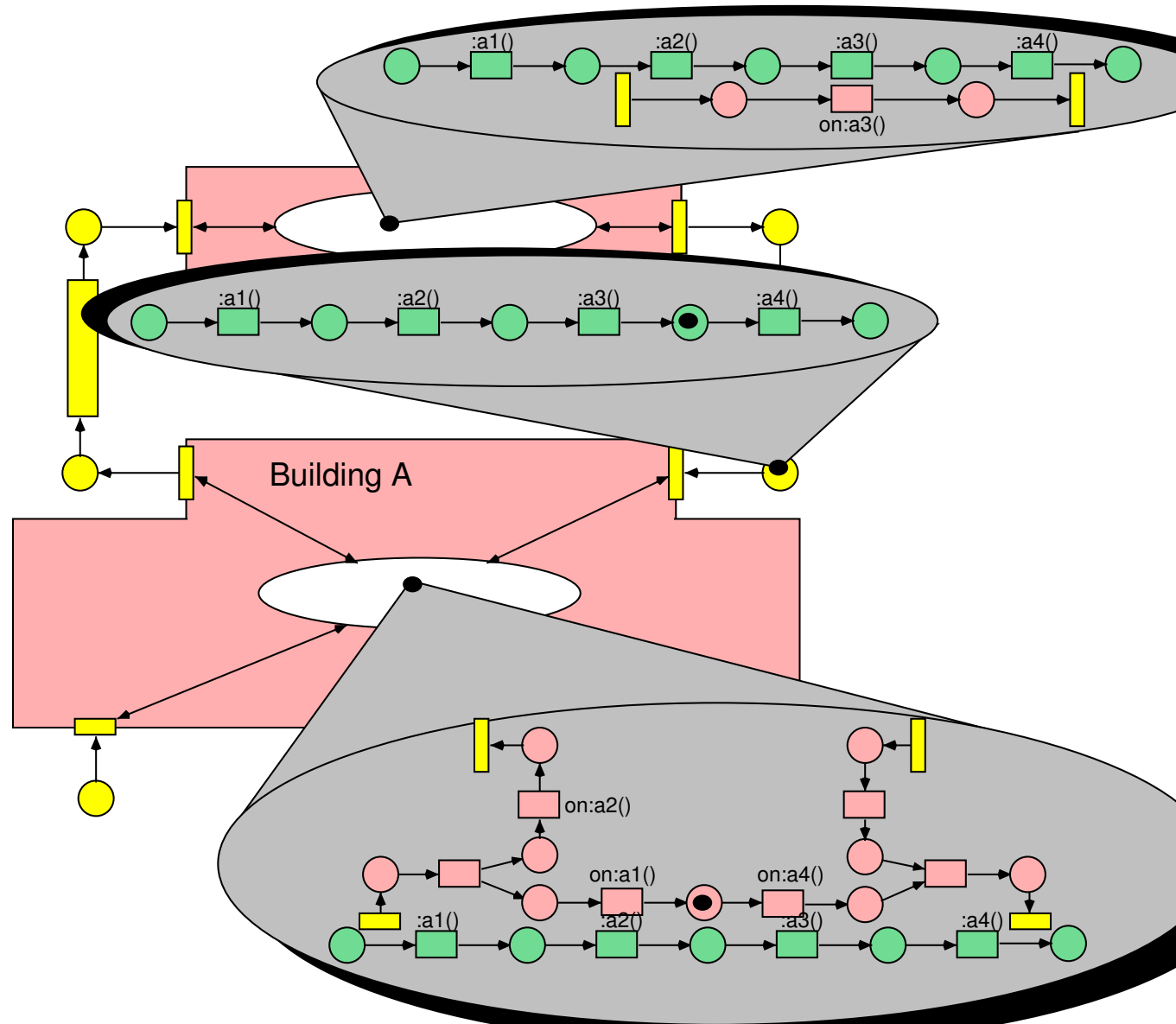
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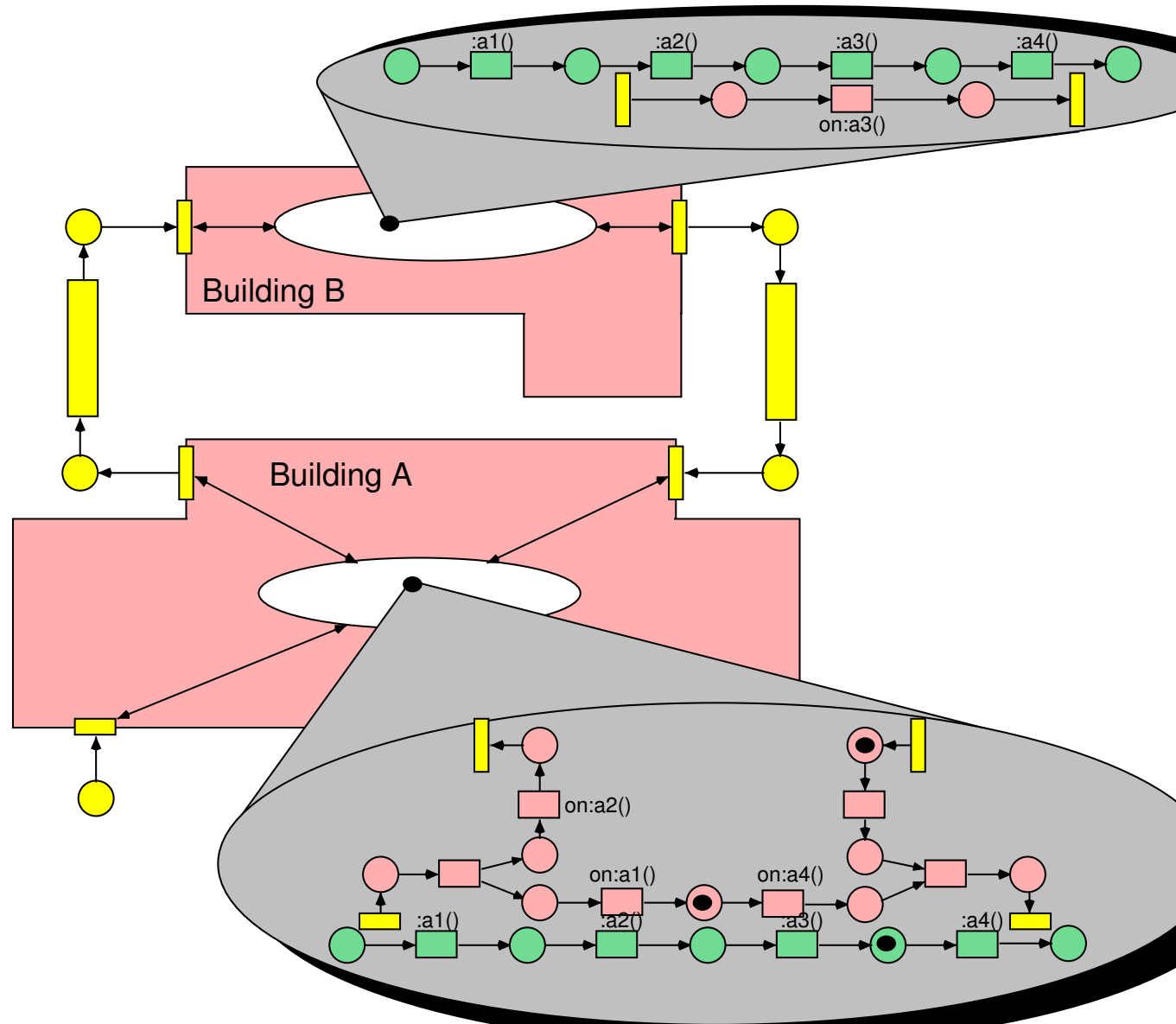
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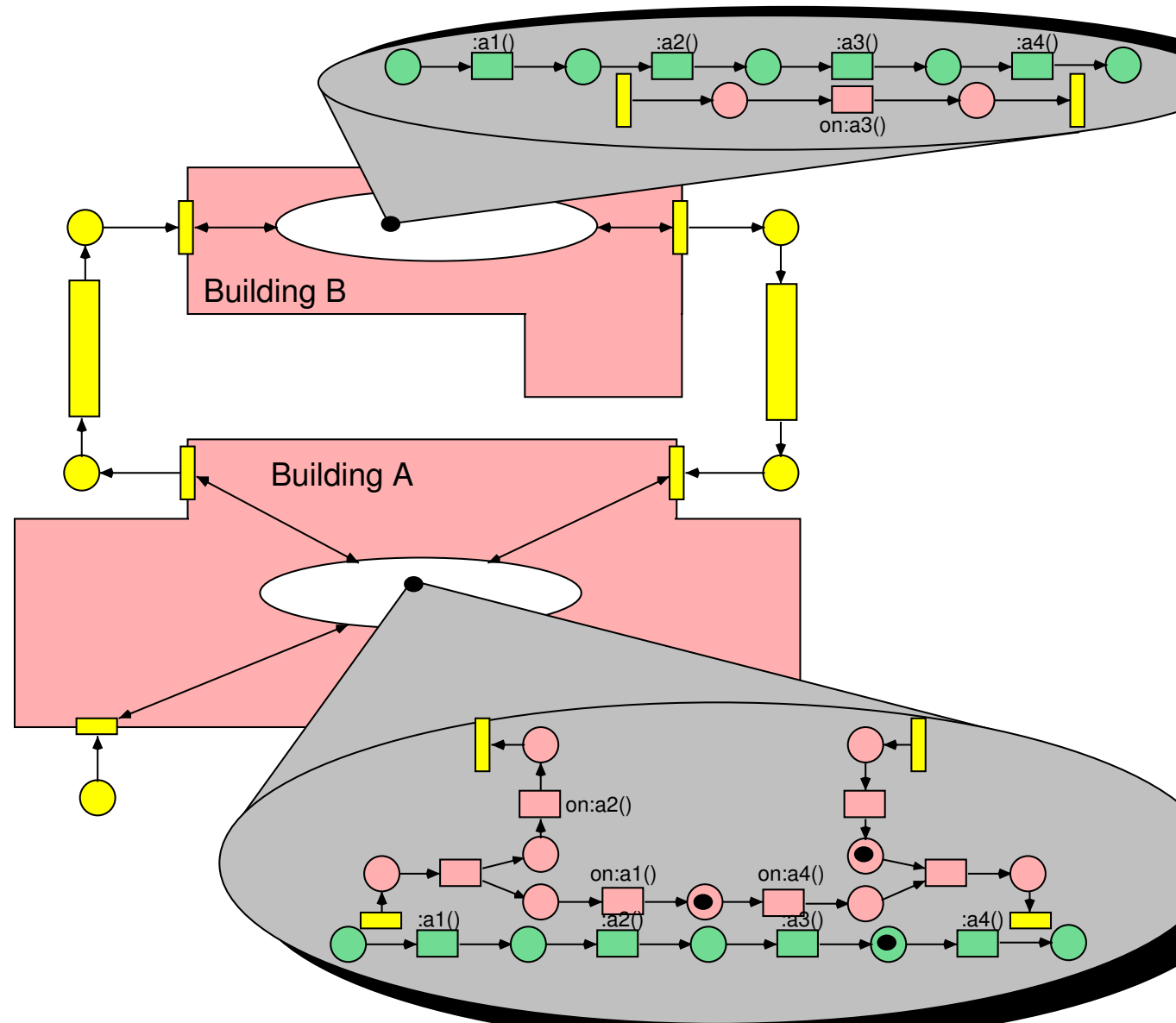
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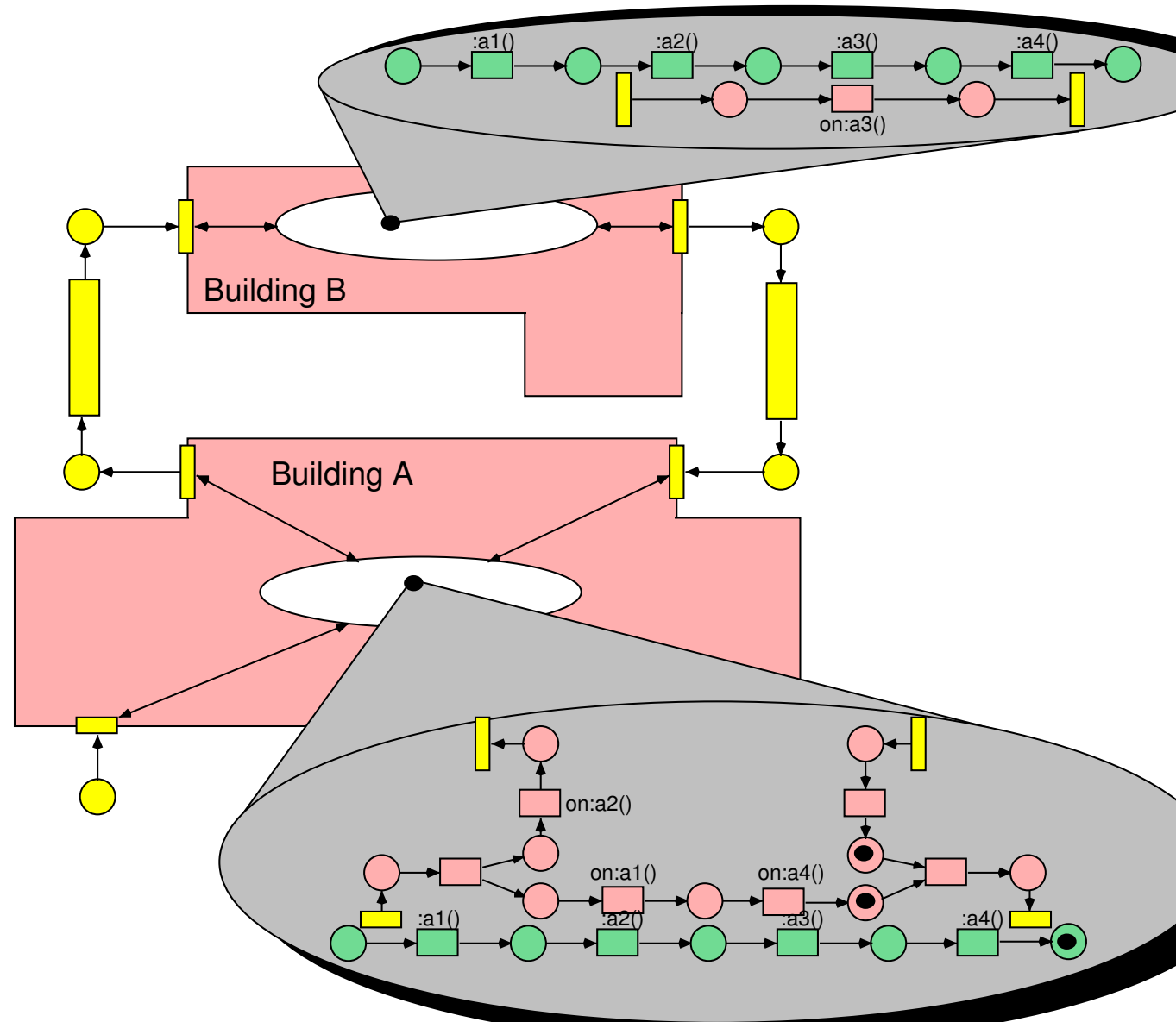
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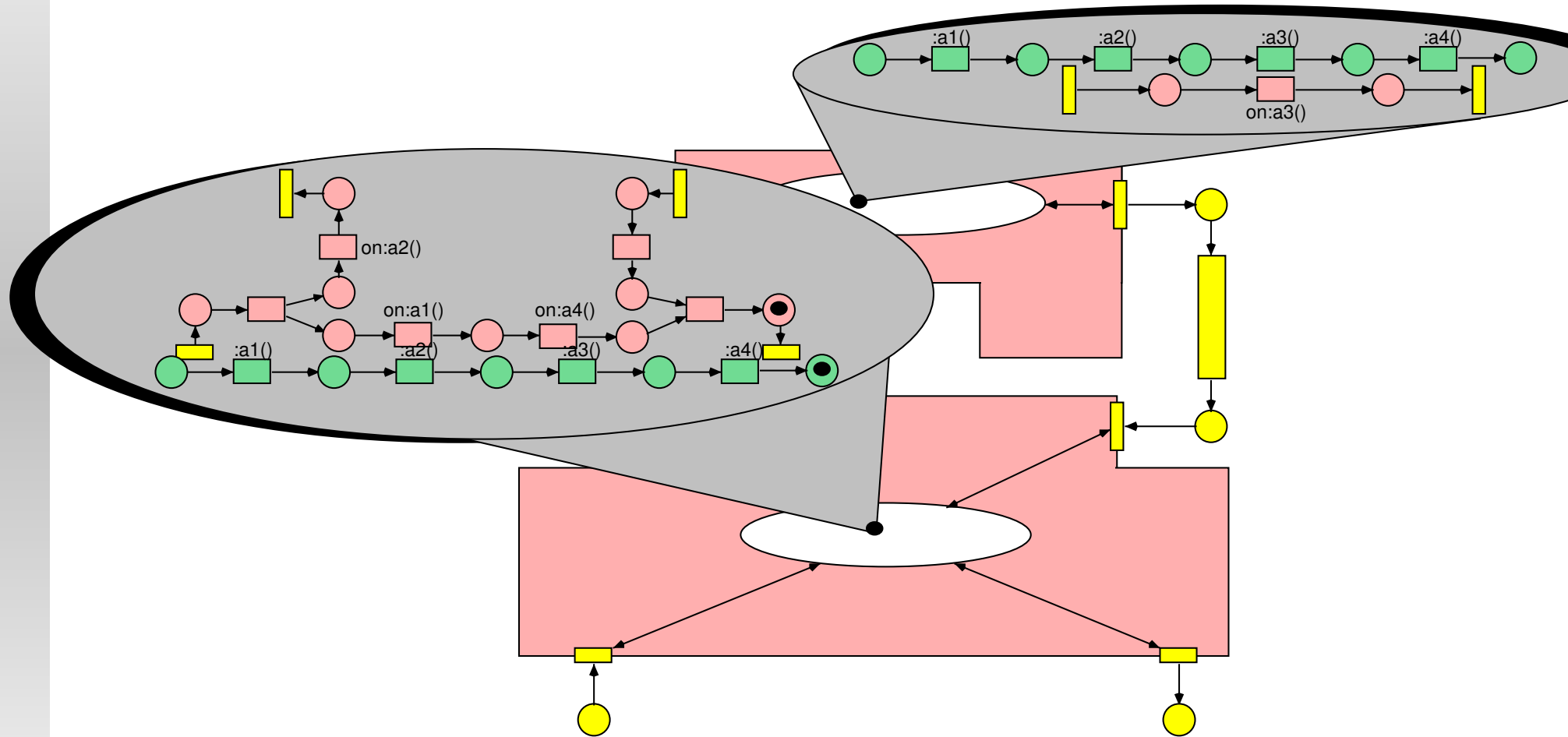
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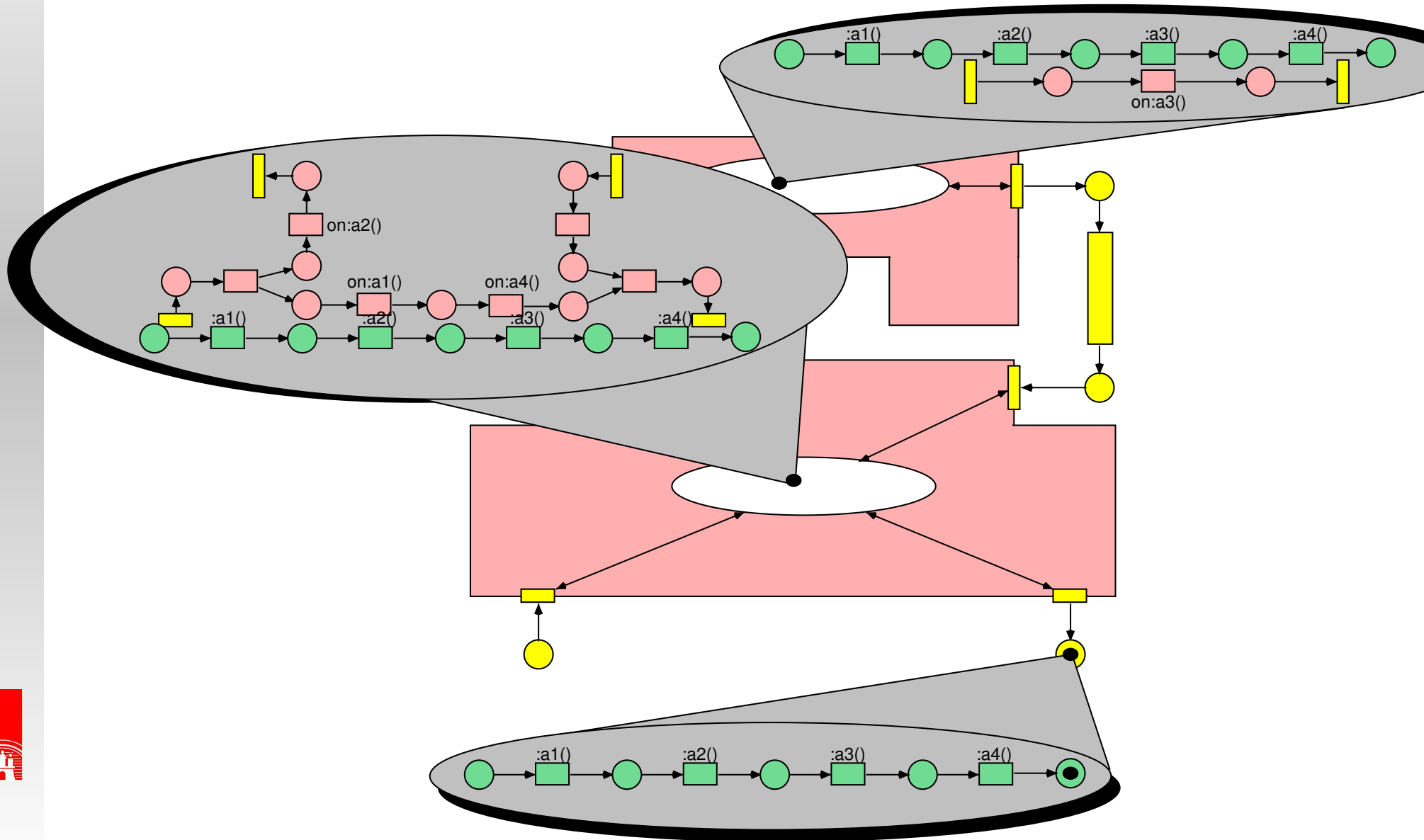
Generalised Semantics



Generalised Semantics



Generalised Semantics



Properties

Theorem Let θ be a transition that does not use $\text{fl}(OS)$. Then θ is enabled iff it is enabled with respect to value semantics.

Theorem [KR05] Let OS be an ordinary object net. Then θ is enabled w.r.t. reference semantics iff it is enabled w.r.t. value semantics.

Corollary Let OS be an ordinary object net [KR05, Definition 6] that does not use $\text{fl}(OS)$. Then θ is enabled iff it is enabled with respect to value semantics iff it is enabled for reference semantics.



Conclusion/Outlook

- Object Petri nets
- Reference vs. value semantics
- Global and local name spaces
- Generalised firing rule
- Generalised semantics as a special sub-class
- Most properties of object nets are preserved



Bibliography

References

- [KMR03] Michael Köhler, Daniel Moldt, and Heiko Rölke. Modelling mobility and mobile agents using nets within nets. In W. v. d. Aalst and E. Best, editors, *International Conference on Application and Theory of Petri Nets 2003*, volume 2679 of *Lecture Notes in Computer Science*, pages 121–140. Springer-Verlag, 2003.
- [KR04] Michael Köhler and Heiko Rölke. Properties of Object Petri Nets. In J. Cortadella and W. Reisig, editors, *International Conference on Application and Theory of Petri Nets 2004*, volume 3099 of *Lecture Notes in Computer Science*, pages 278–297. Springer-Verlag, 2004.
- [KR05] Michael Köhler and Heiko Rölke. Reference and value semantics are equivalent for ordinary Object Petri Nets. In P. Darondeau and G. Ciardo, editors, *International Conference on Application and Theory of Petri Nets 2005*, volume 3536 of *Lecture Notes in Computer Science*, pages 309–328. Springer-Verlag, 2005.
- [Val98] Rüdiger Valk. Petri nets as token objects: An introduction to elementary object nets. In Jörg Desel and Manuel Silva, editors, *Application and Theory of Petri Nets*, volume 1420 of *Lecture Notes in Computer Science*, pages 1–25, 1998.

