

Hierarchical Petri nets

dr. Tamás Bartha

dr. András Pataricza

dr. István Majzik

BME Department of Measurement and Information Systems

Hierarchical modeling

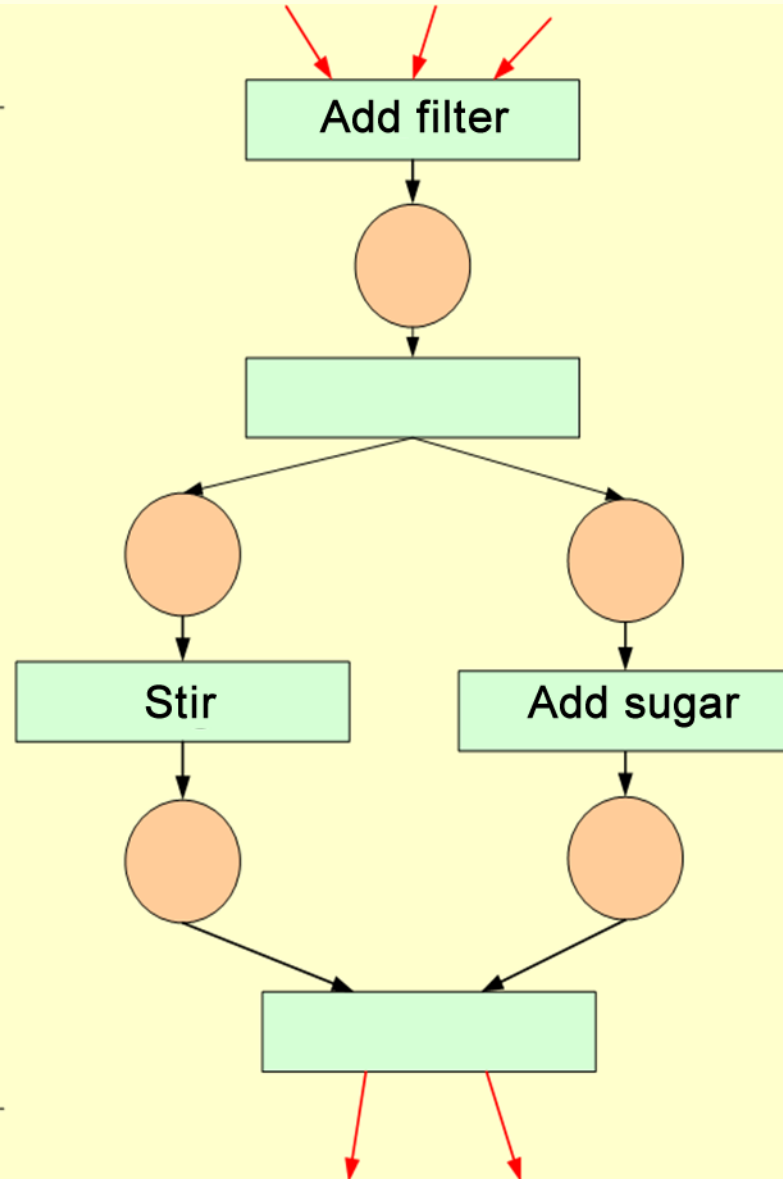
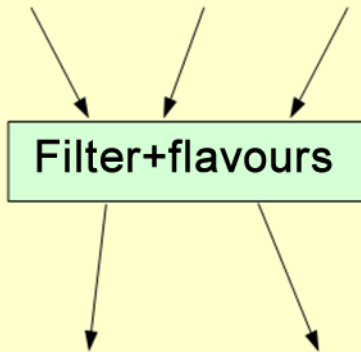
- **Hierarchy:** Model elements are placed on different levels of hierarchy
 - Clarity: System > subsystem > component
 - Reusable elements
- **Model refinement (top-down style)**
 - Systematically giving more details to elements
 - Subsystems are expanded during design
 - Removing “uncertainties”
 - Transparent (glass-)box from black box
- **Model building (bottom-up style)**
 - Building from subnets: as a higher level element
 - Goal is to reduce local complexity → clarity

Example: Refining activities

- Modeling: Systematic refinement of transitions
 - Giving more details to the activity
- Substituting partial Petri net models
 - Starting and ending with a transition
 - Original input and output arcs are connected to these
- Advices
 - A non-detailed activity can be used later for refinements
 - Detailed modeling increases complexity

Example: Transition refinement

Splitting the transition below:

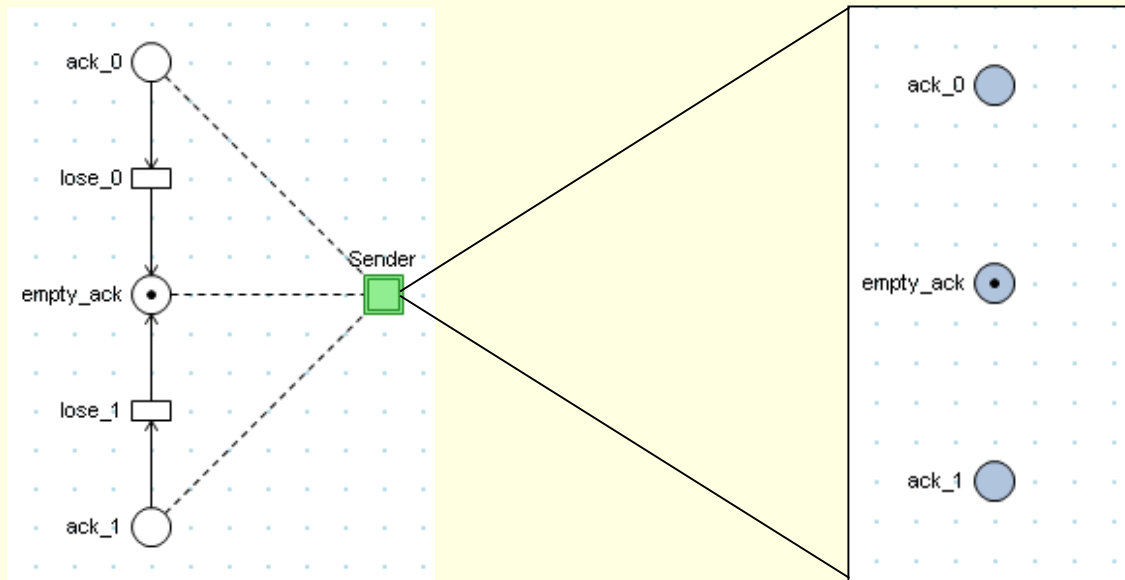


Hierarchical Petri nets

- “Main net” on top of hierarchy
- “Subnets” as building blocks
 - Transition to be refined
 - Place to be refined
- “Interaction points” between subnets:
Transitions or places
 - Interface transition
 - Interface place

Systematic refinement of transitions

- Refine transition with subnet
 - Higher level net: Transition to be refined as **substitute transition** (“coarse transition”)
 - Places of the higher level net can be connected (arcs)
 - Connected places appear in the subnet (for building subnet)



Systematic refinement of places

- Refine **place** with subnet
 - Higher level net: Place to refine as **substitute place** (“coarse place”)
 - Transitions of the higher level net can be connected (arcs)
 - Connected transitions appear in the subnet (for building subnet)

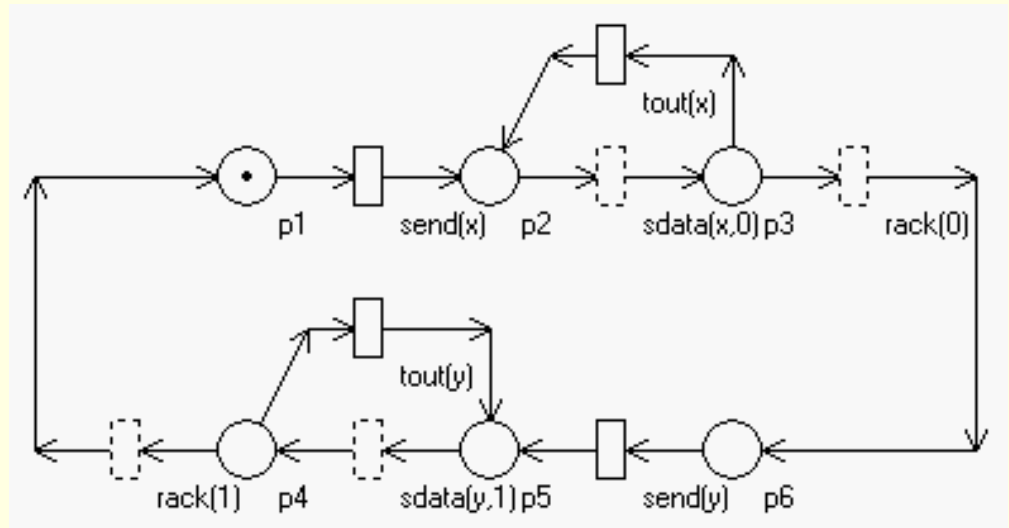
Supporting hierarchy

- DNAnet tool
 - Building from subnets (bottom-up)
 - Interaction points: places or transitions
 - Arcs between subnets can be connected to interaction points
 - Not a systematic refinement, only subnet reuse
- PetriDotNet tool
 - Coarse transition: subnet from transition
- Snoopy tool
 - Coarse transition: subnet from transition
 - Coarse place: subnet from place
 - Increasing clarity: global places / transitions

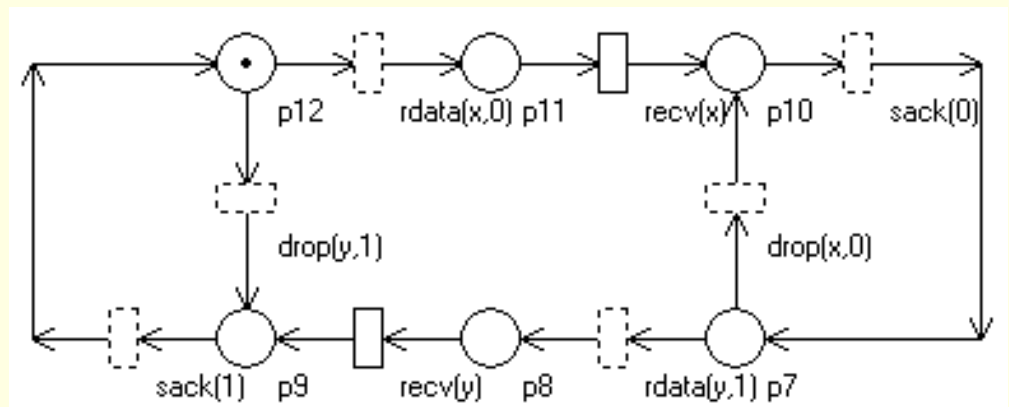
DNAnet ABP example: Processes

- Adding subnets:
 - Systematic model refinement is not supported
 - Reuse of elements is supported
- Process subnets
 - Interaction points are transitions here

Sender subnet



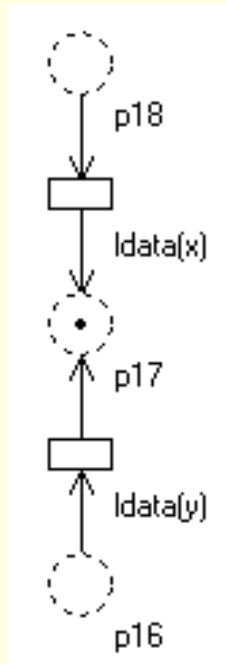
Receiver subnet



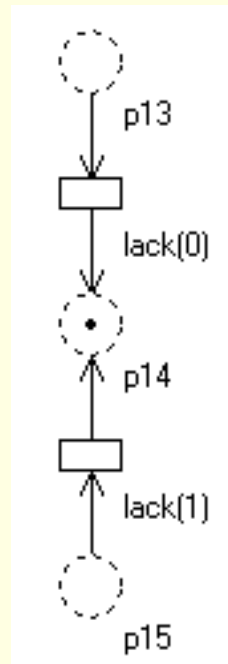
DNAet ABP example: Channels and connections

- Channel subnets

- Interaction points are places here



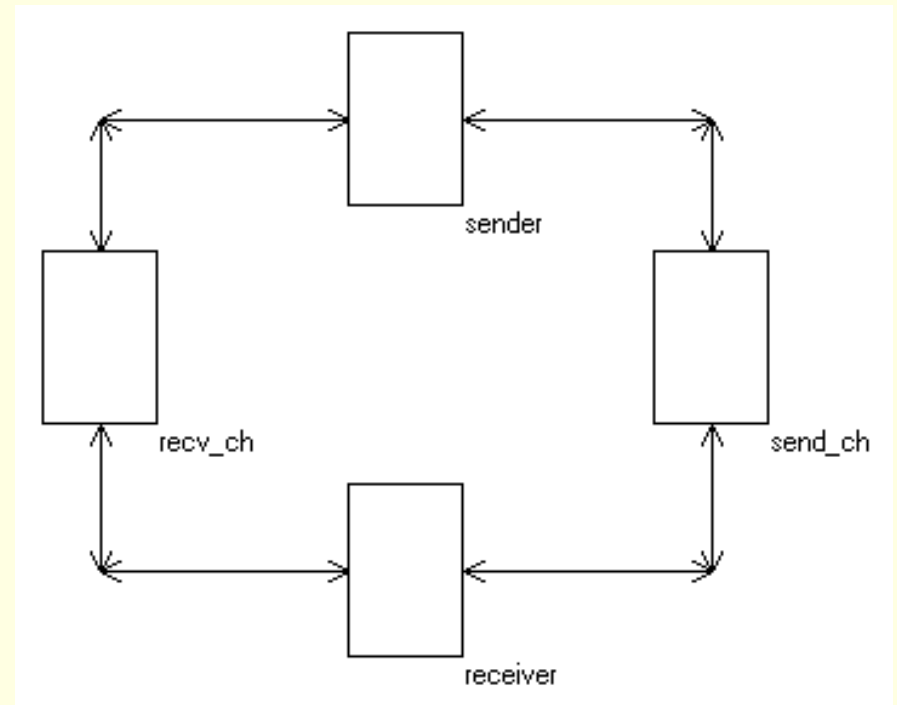
send_ch
subnet



recv_ch
subnet

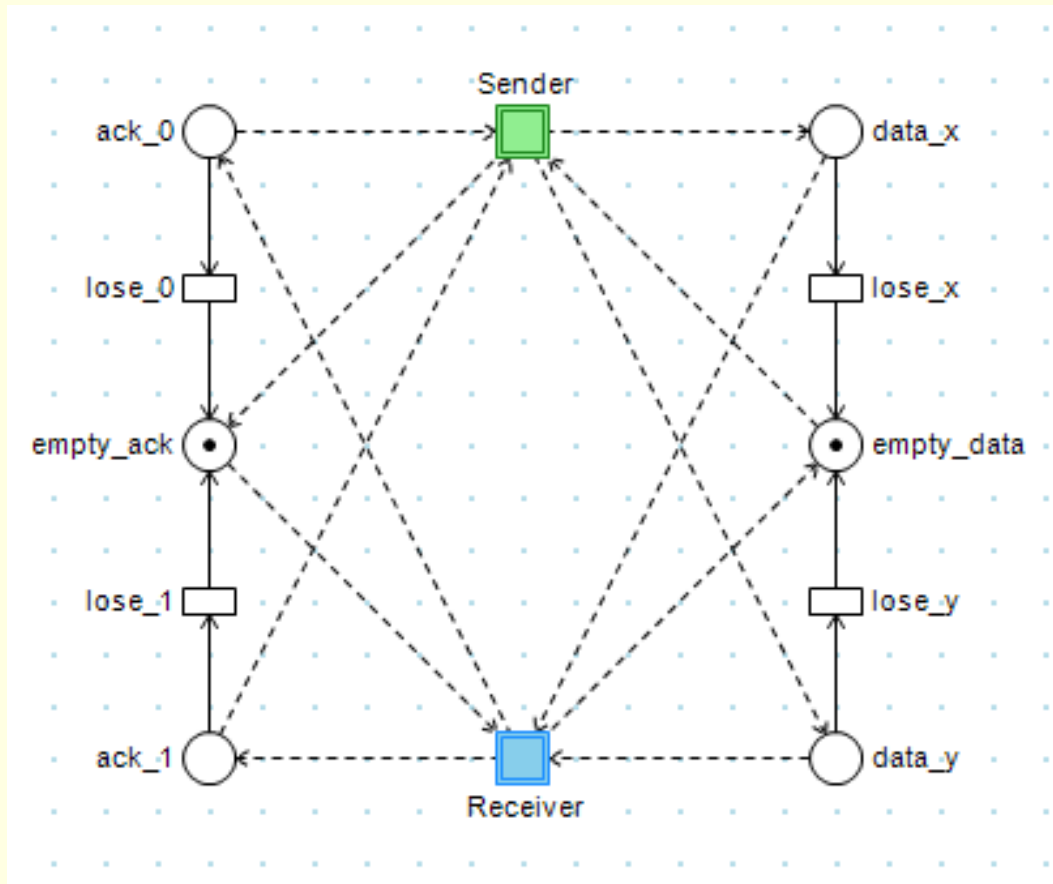
- Connecting subnets

- Arcs between subnets:
defining source and target
interaction points

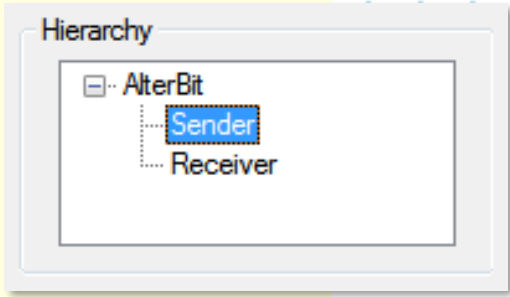


PetriDotNet: Connect subnets

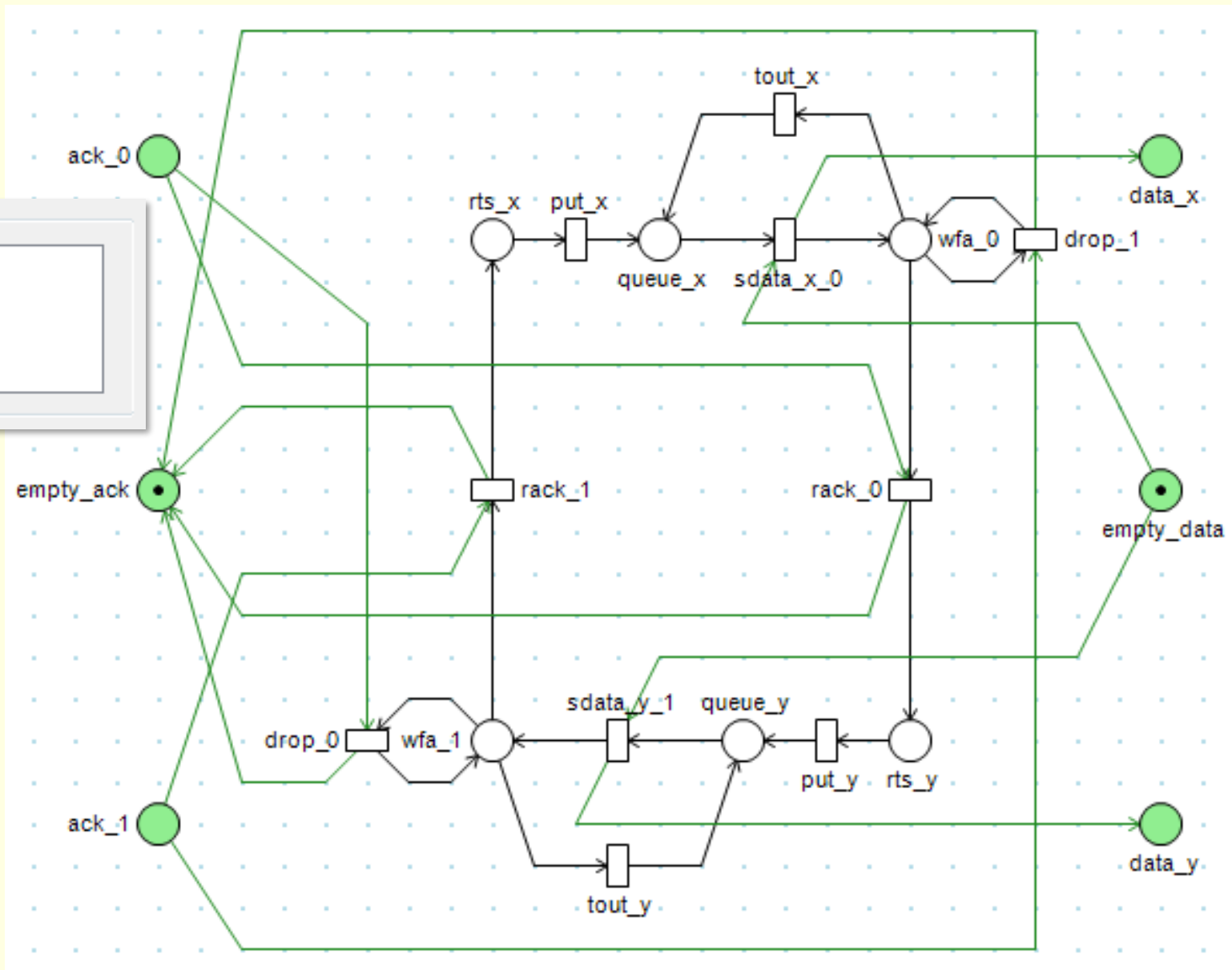
- Refineable element: Coarse transition
 - Input and output places can be added
 - These appear in the subnet (“as a reference”)



PetriDotNet ABP example: Sender process subnet



Green places: interfaces



Summary

- Hierarchical modeling
 - Model refinement
 - Model building
- Systematic model refinement
 - Coarse transitions
 - Coarse places
- Model building: reusing subnets
 - Interaction points: transitions or places