Discrete Inter-agent Dynamics, Sending & Receiving Messages

Nathaniel Osgood

Using Modeling to Prepare for Changing Healthcare Needs

Duke-NUS

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Discrete Agent Coupling via Messages

- Within AnyLogic, agents can be coupled by either discrete (instantaneous and individuated) or continuous (ongoing and gradual) coupling
- The preferred mechanism for discrete coupling is *messages* sent between agents
  - Many types of messages payloads are possible
  - An agent can send a given message to one or more agents
  - Frequently messages are sent locally to neighbors within the environment
    - Neighboring nodes on the network
    - Nearby neighbors in space

Messages & Statecharts

- Messages may be handled in many ways
- One of the most common ways in which messages are handled is by statecharts
  - A transition can be triggered ("guarded" or gated) by a message
  - A transition may be associated with an action that fires off a message to other agents (or to other statecharts within the agent)

Hands on Model Use Ahead

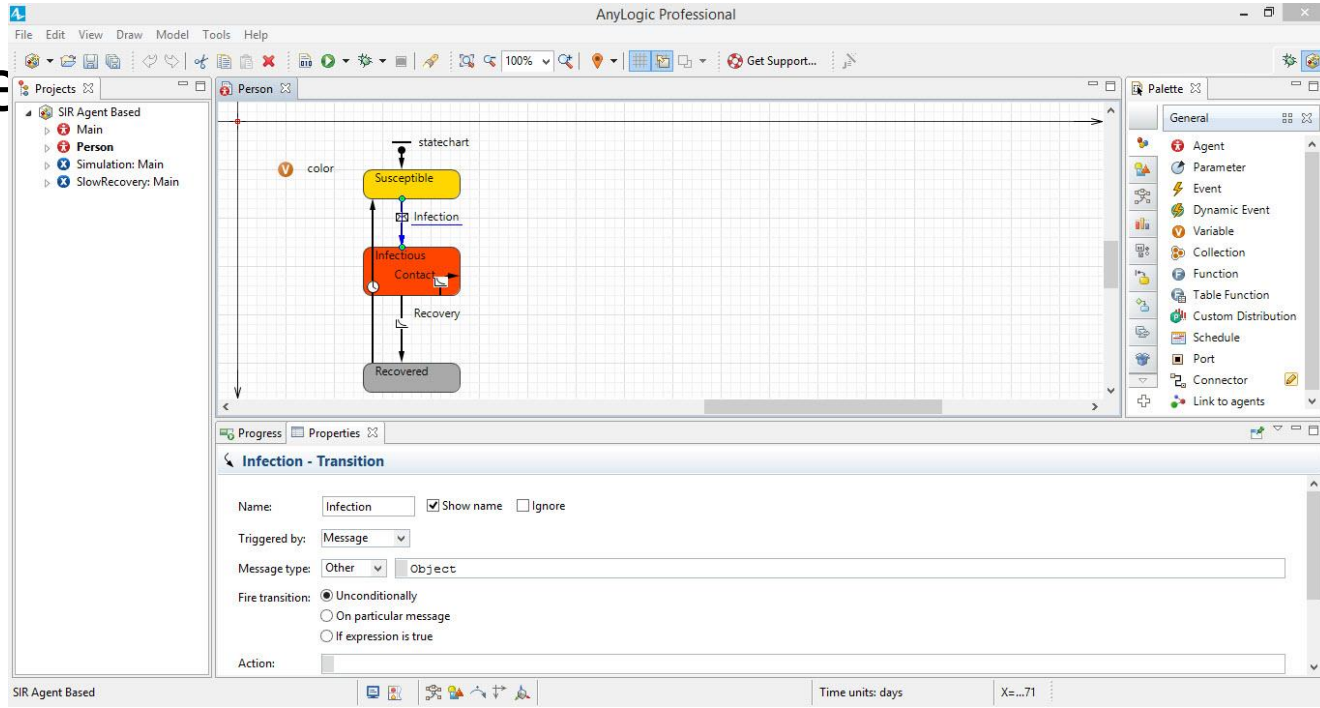
Load Sample model:

SIR Agent Based.alp

Open Up “Person” class

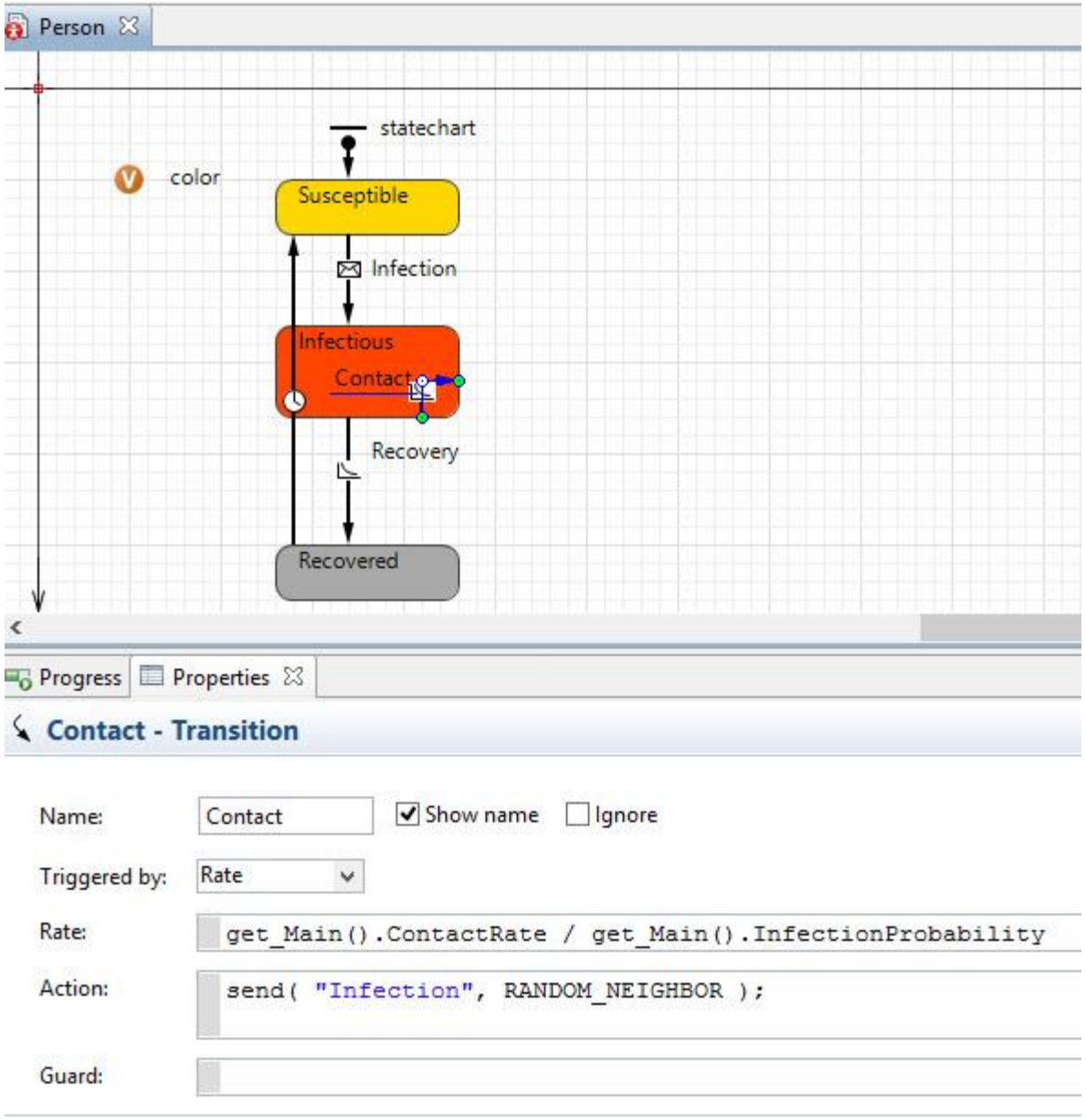
Receiving a Message

- In this case, only 1 message type exists, so the simple fact that a message has been received is sufficient; there is no need to inspect message contents



Sending a Message

- (Self-transition because remains in state)



Message Sending

- Messages may be sent to either
  - A particular, explicitly specified agent
  - An implicitly specified class of agents
    - Neighboring agents in the environment topology
    - Random agents
    - All agents
    - Any connected agents
    - All connected agents
- Mechanism:
  - send(*Message*, *DestinationObject*)
  - send(*Message*, *AgentClassId*)

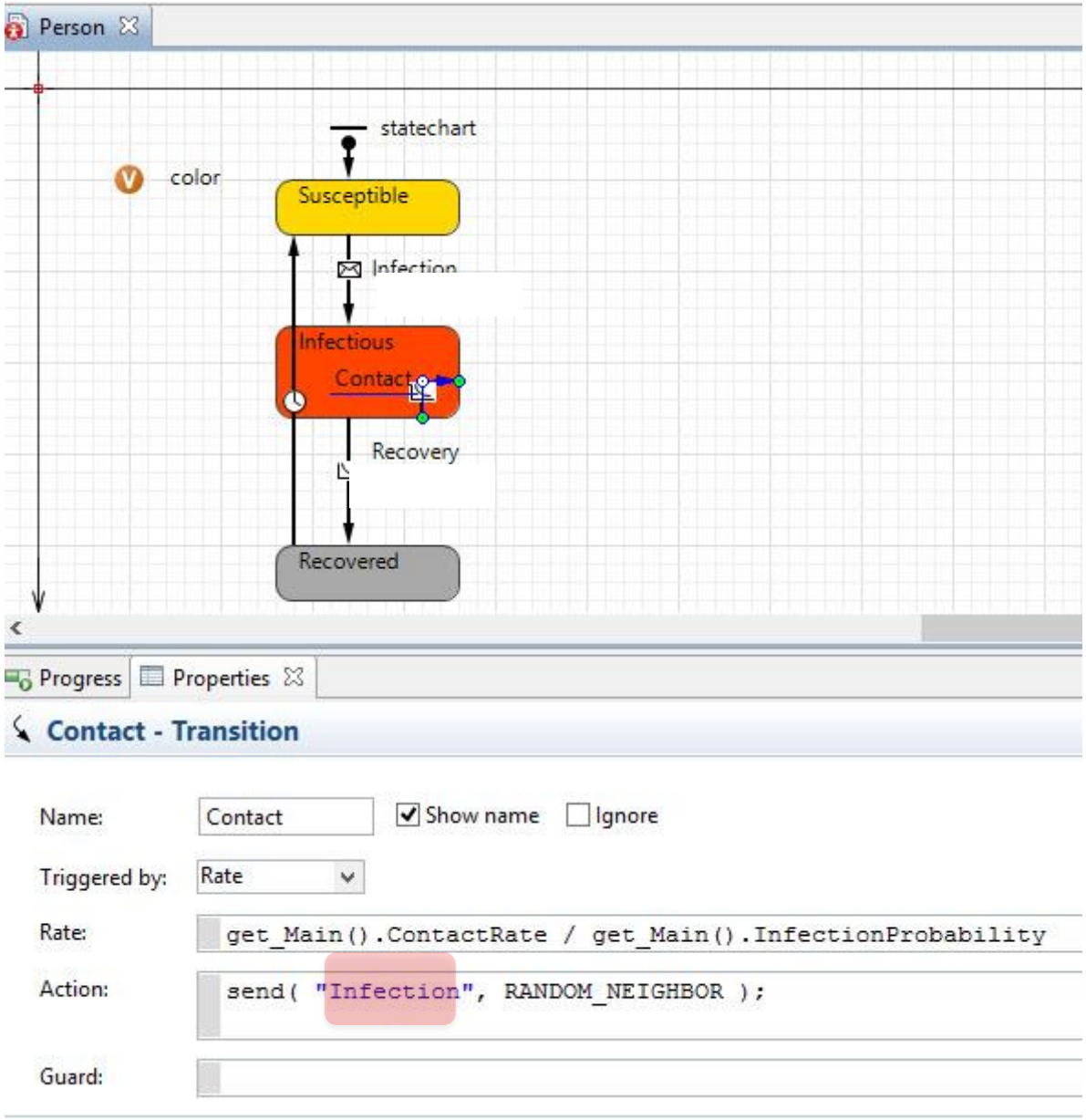
Synchronous vs. Asynchronous Delivery

- Messages may be sent in two ways
  - Via ***send***: Asynchronous (scheduled)
    - Delivery occurs sometime after call to send
    - This is like sending a text message – it can be read later
  - Via ***deliver:*** Synchronous (immediately called)
    - Risks infinite loops in delivery (if destination also calls deliver in the reverse direction)
    - This is like calling the other person's phone – you demand their attention immediately

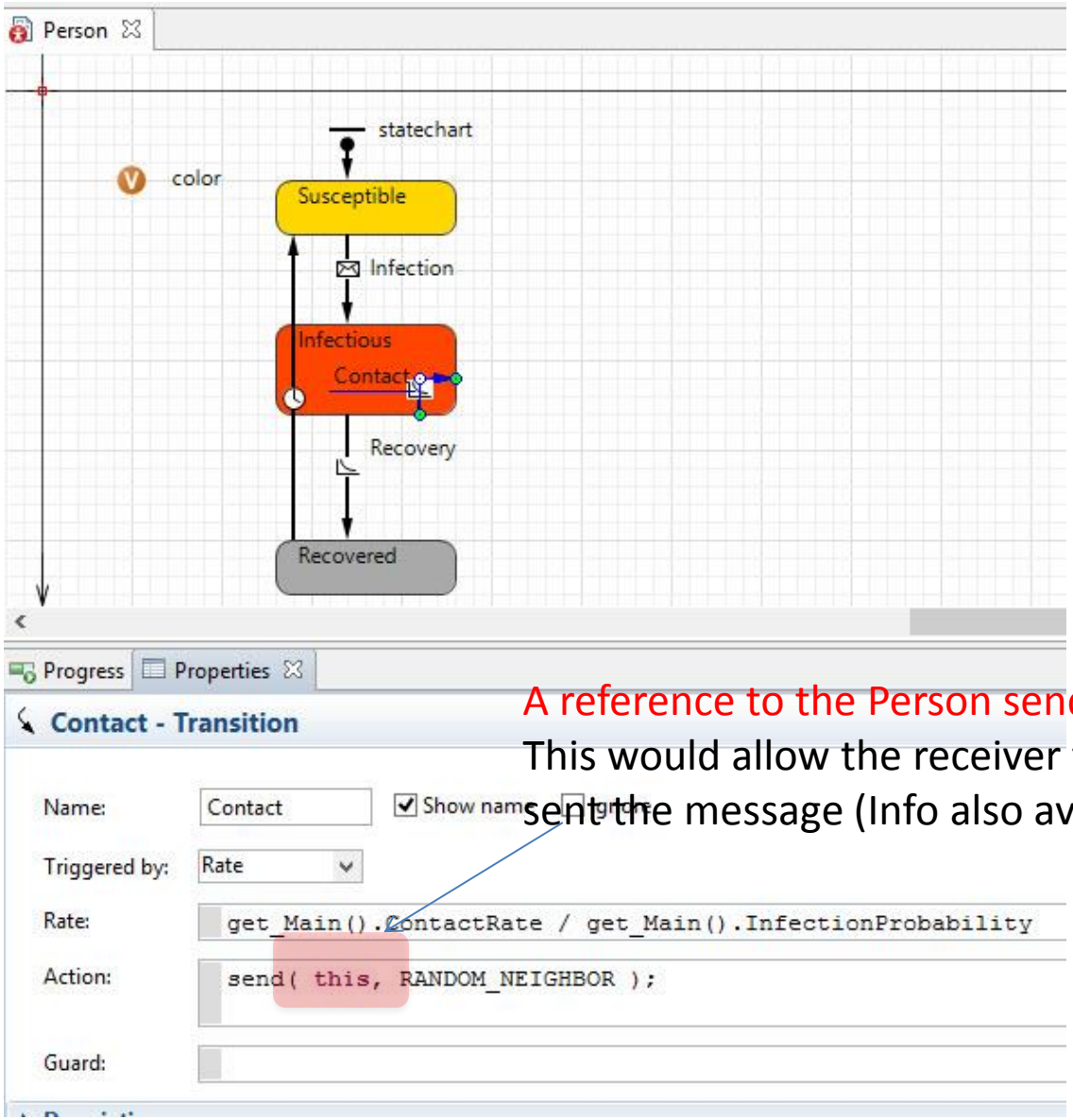
Message Payloads

- Sometimes just the fact that a message has been sent provides us with all of the information we need
- Sometimes just distinguishing different message types is sufficient
- We will sometimes send messages with payloads of data that provide extra information, e.g.
  - The agent that sent the message (eg that is infecting us)
  - Particular parameters
- Can send messages different payload types
  - Boolean/int/double/String/Other (can specify class type)

Sending a Message with a String Payload



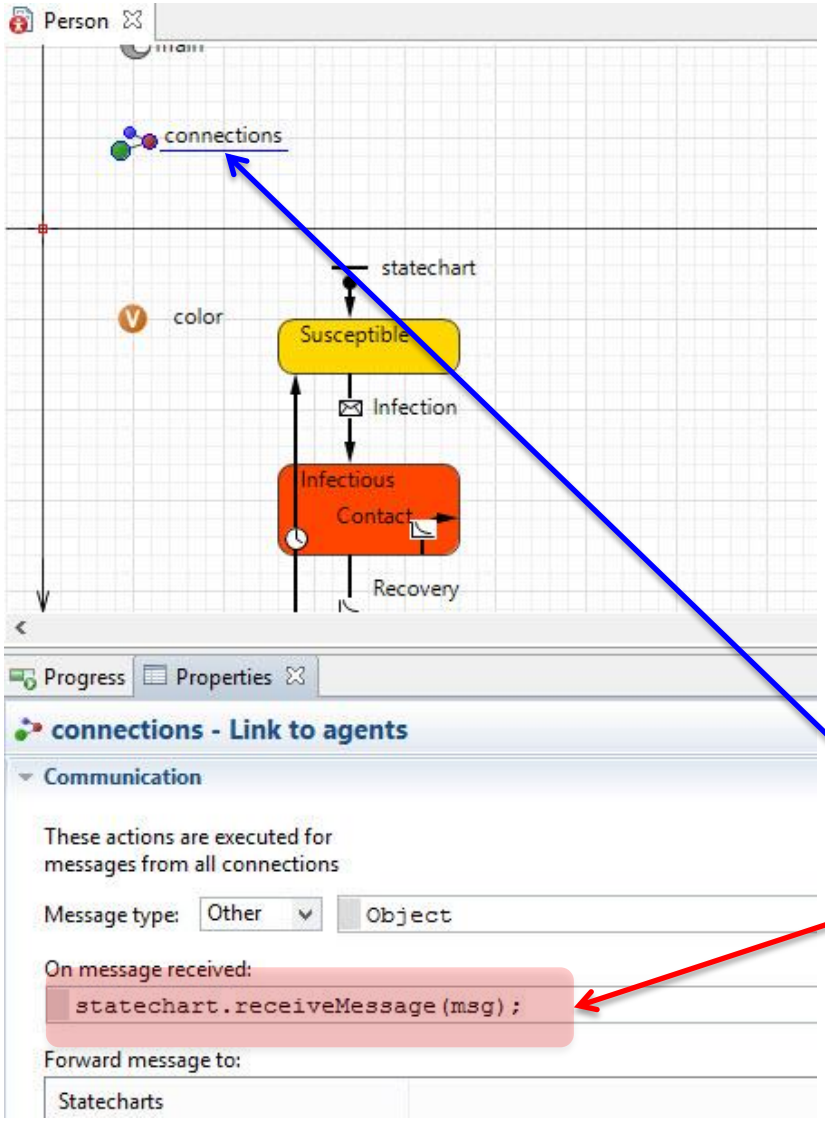
Sending a Message with Object Payload



A reference to the Person sending the message!

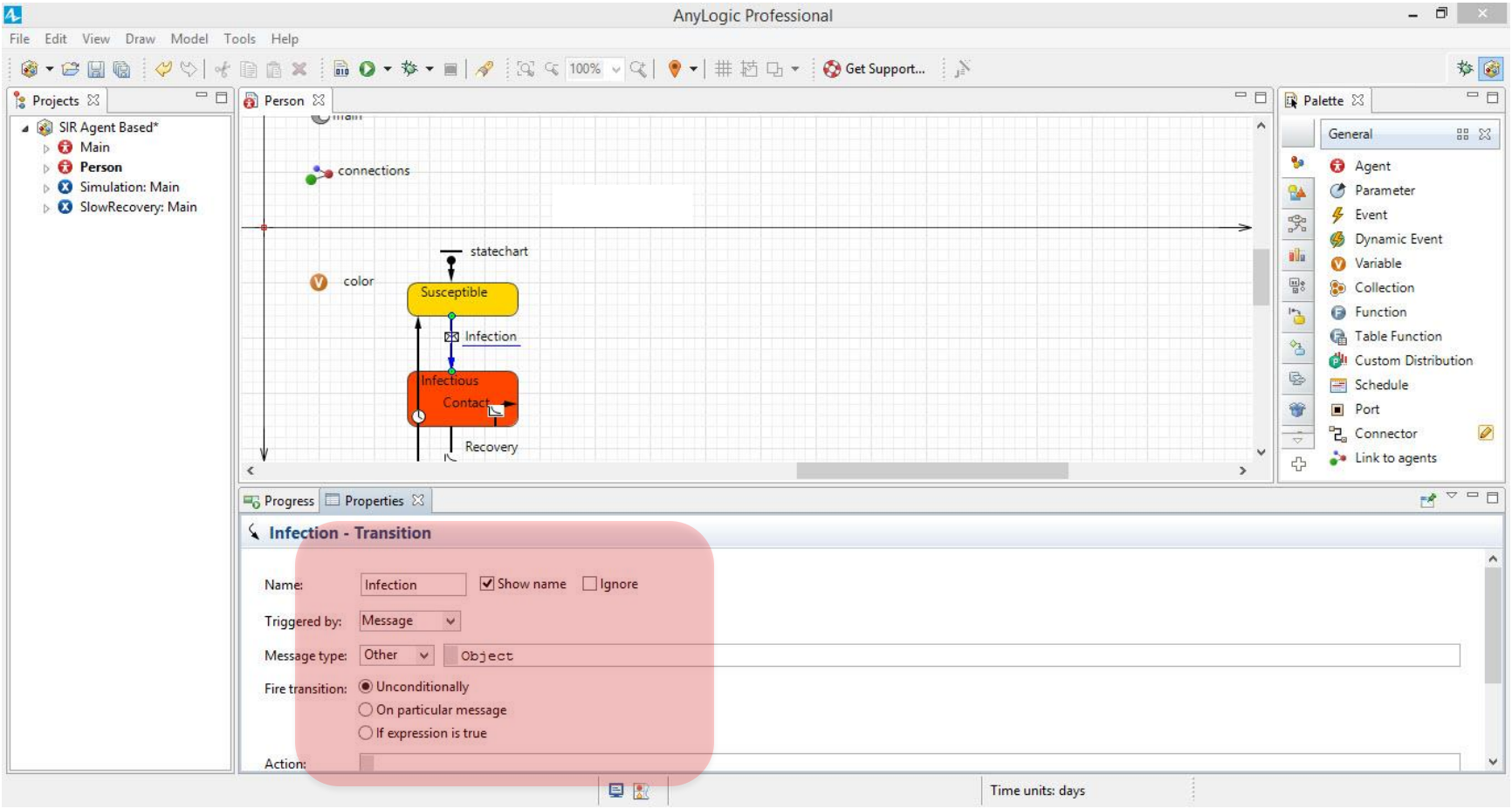
This would allow the receiver to know who sent the message (Info also available in other ways)

Receiving a Message: Forwarding Messages on to the Statechart

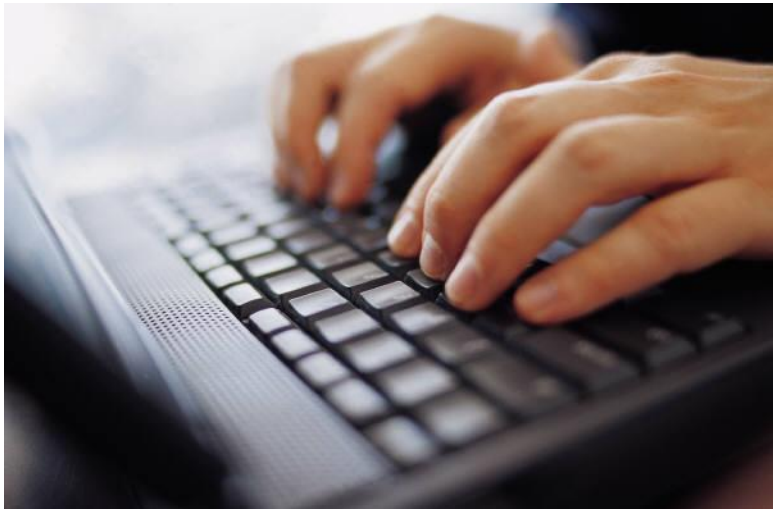


The action for Handling received messages delegates to the Statechart object

Receiving a Message



Hands on Model Use Ahead

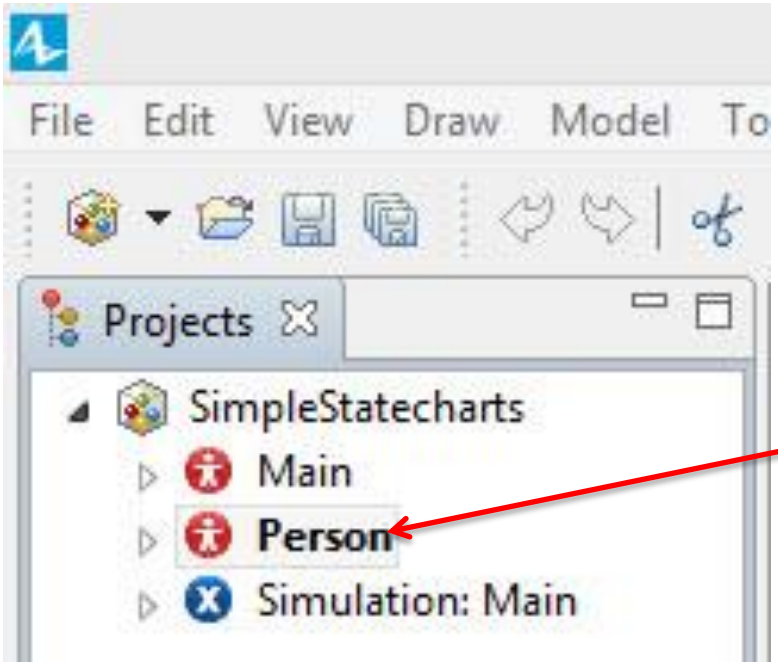


Load Previous Built [& Provided] Model:

SimpleStatecharts

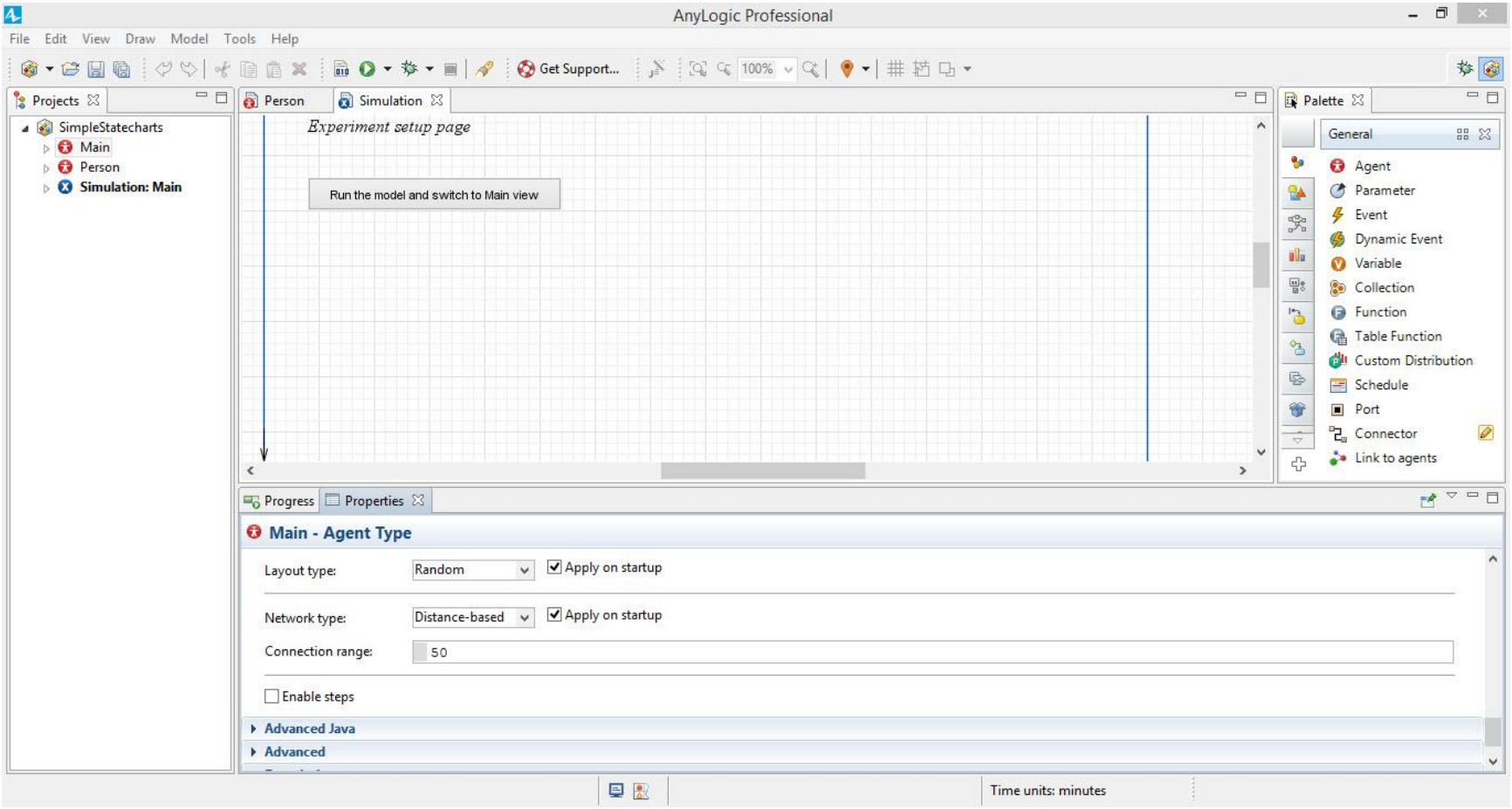
Save as **SimpleNetworkTransmission**

Open Up Canvas for “Main”
(In case it is not already open)

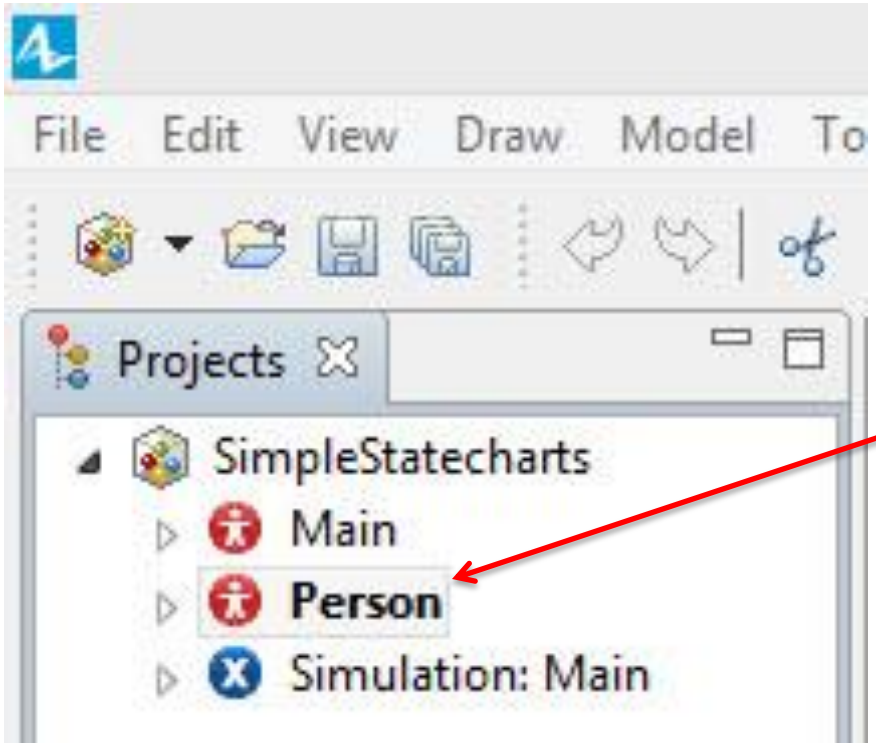


Double Click Here

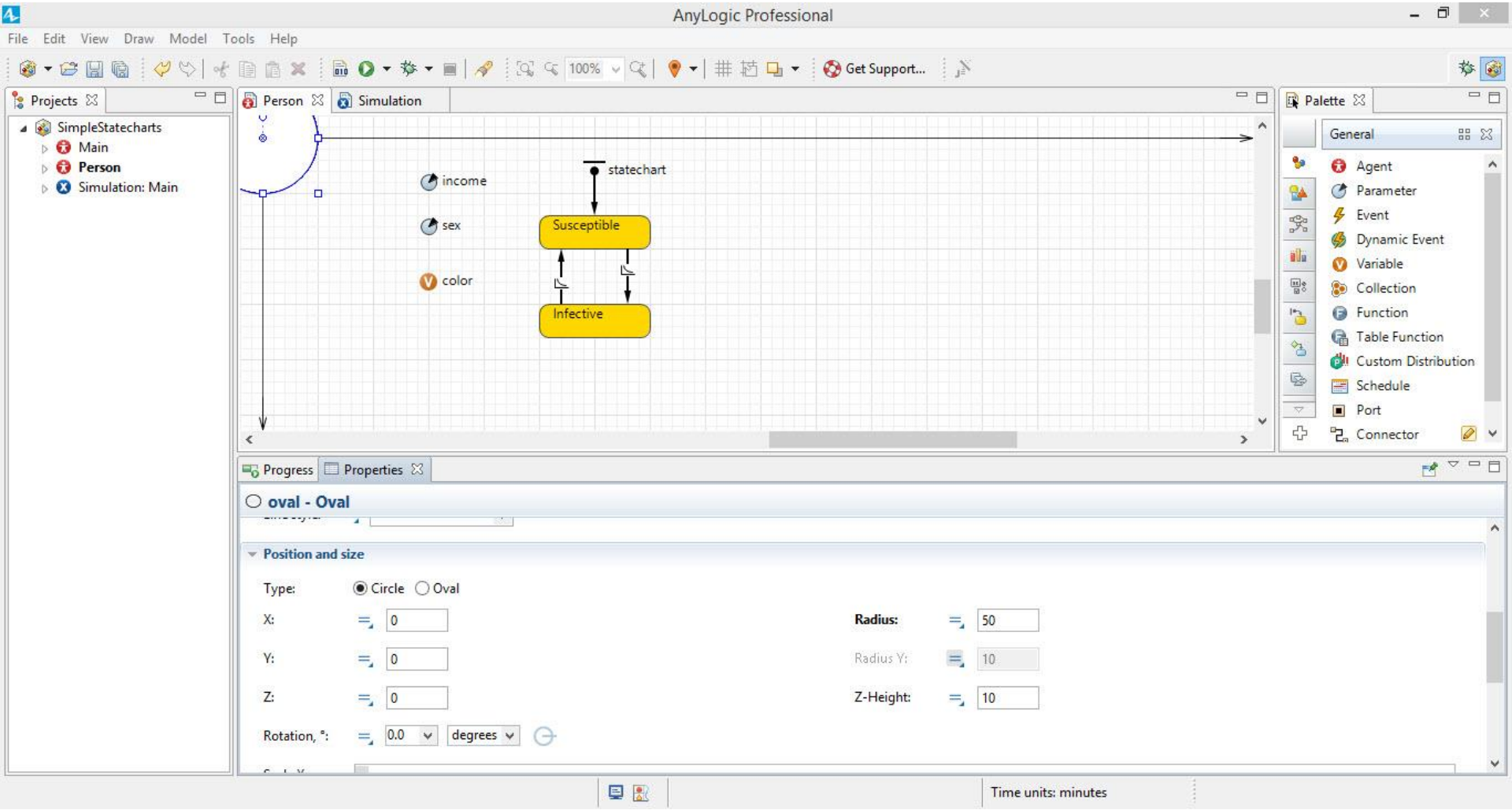
Place Agents in a Distance Based Network



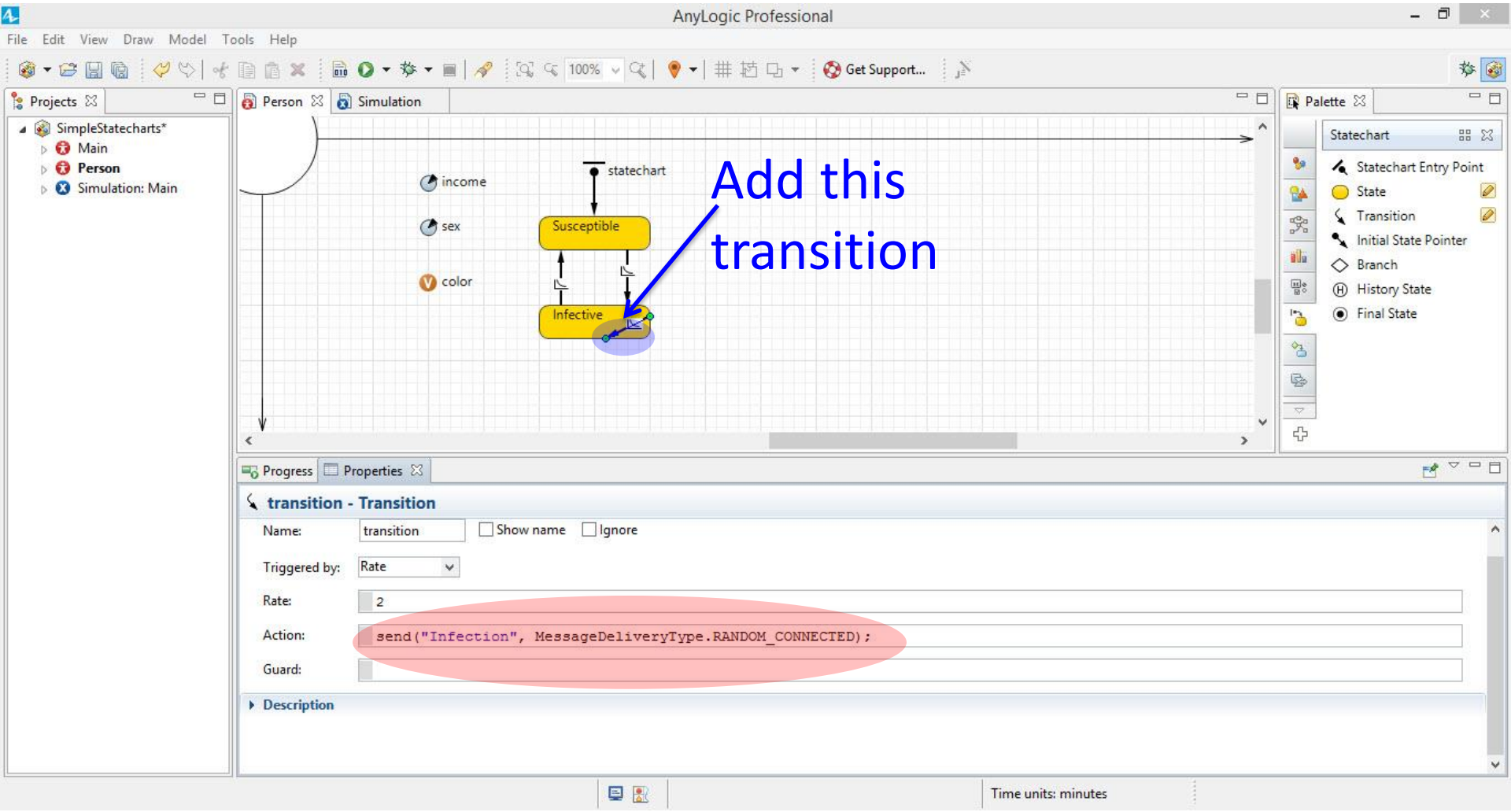
Open Up Canvas for “Person”
(In case it is not already open)



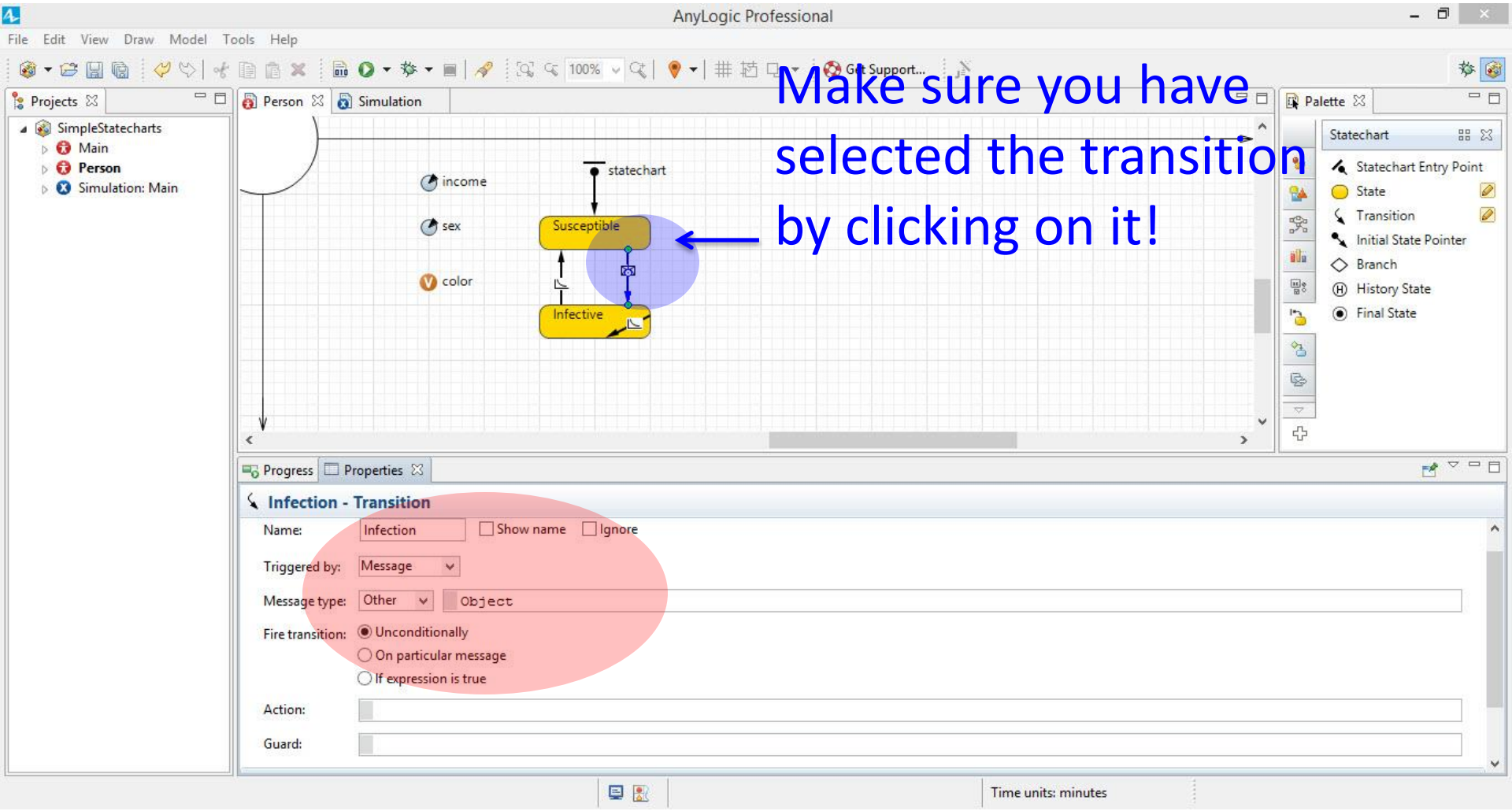
Set Persons's Representation Radius to 50 (If inner circles overlap, in network contact)



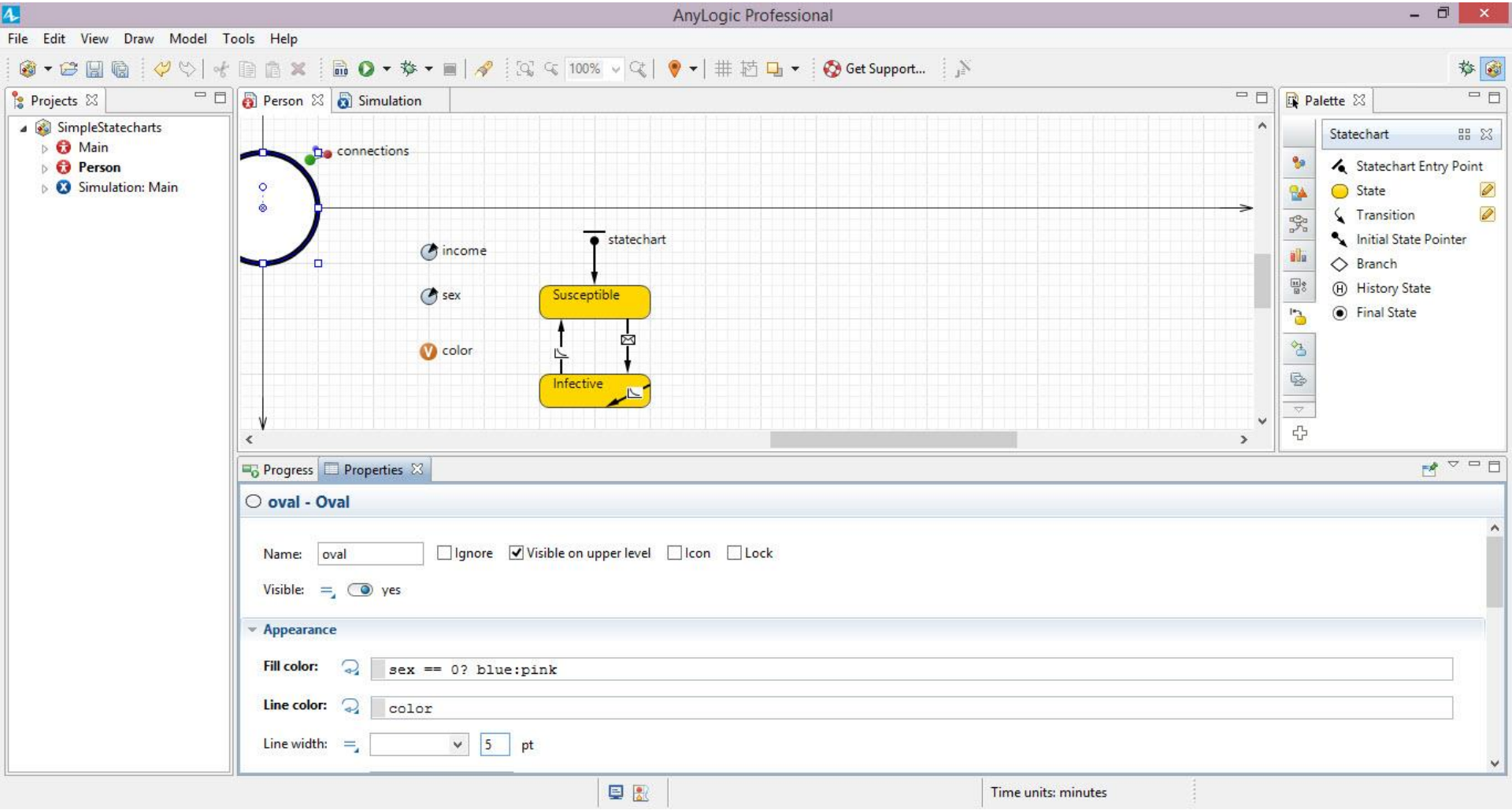
Sending Messages
Using a “Contact” Event to Spread Infection



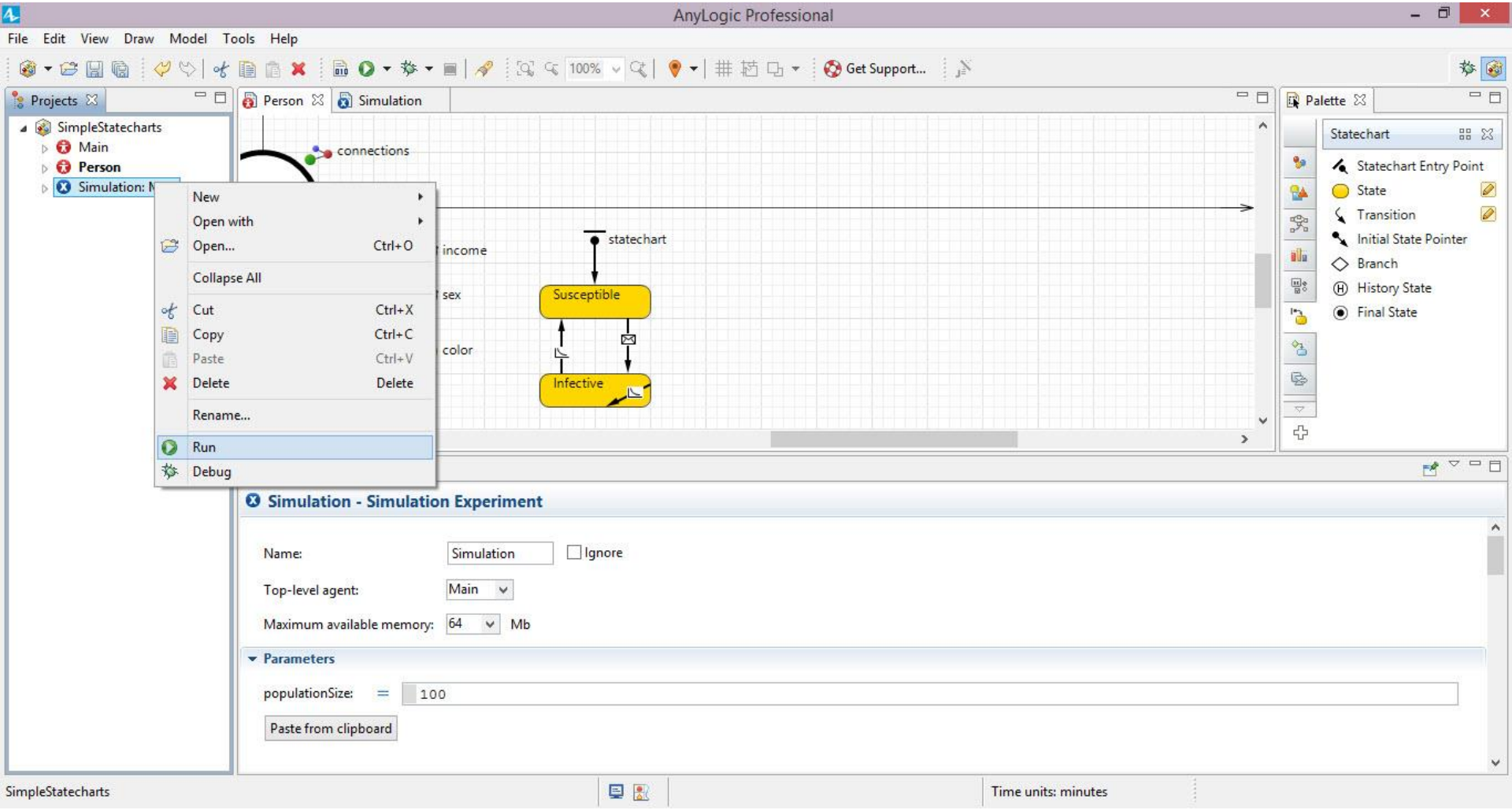
Making Infection Depend on a Message (Using a Message Triggered Transition)



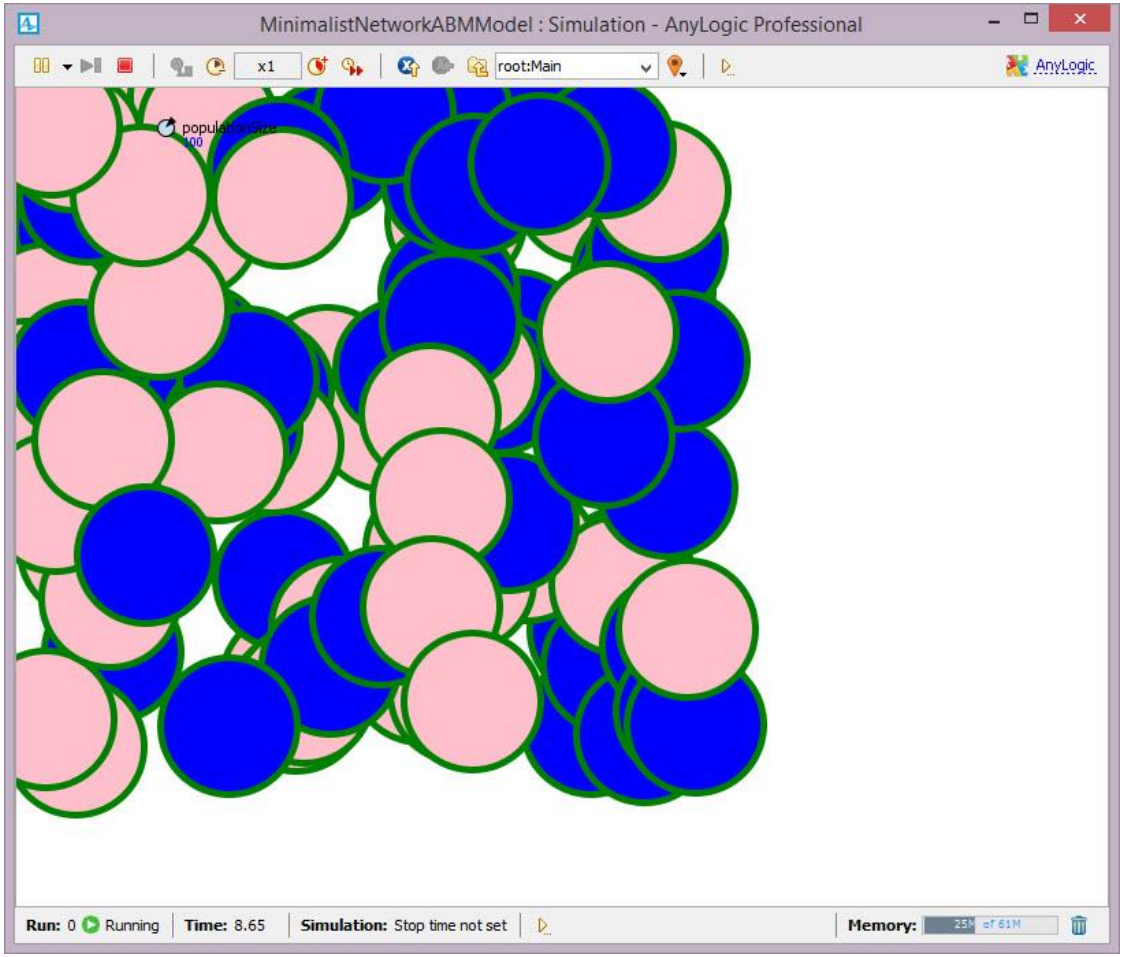
Run the Model



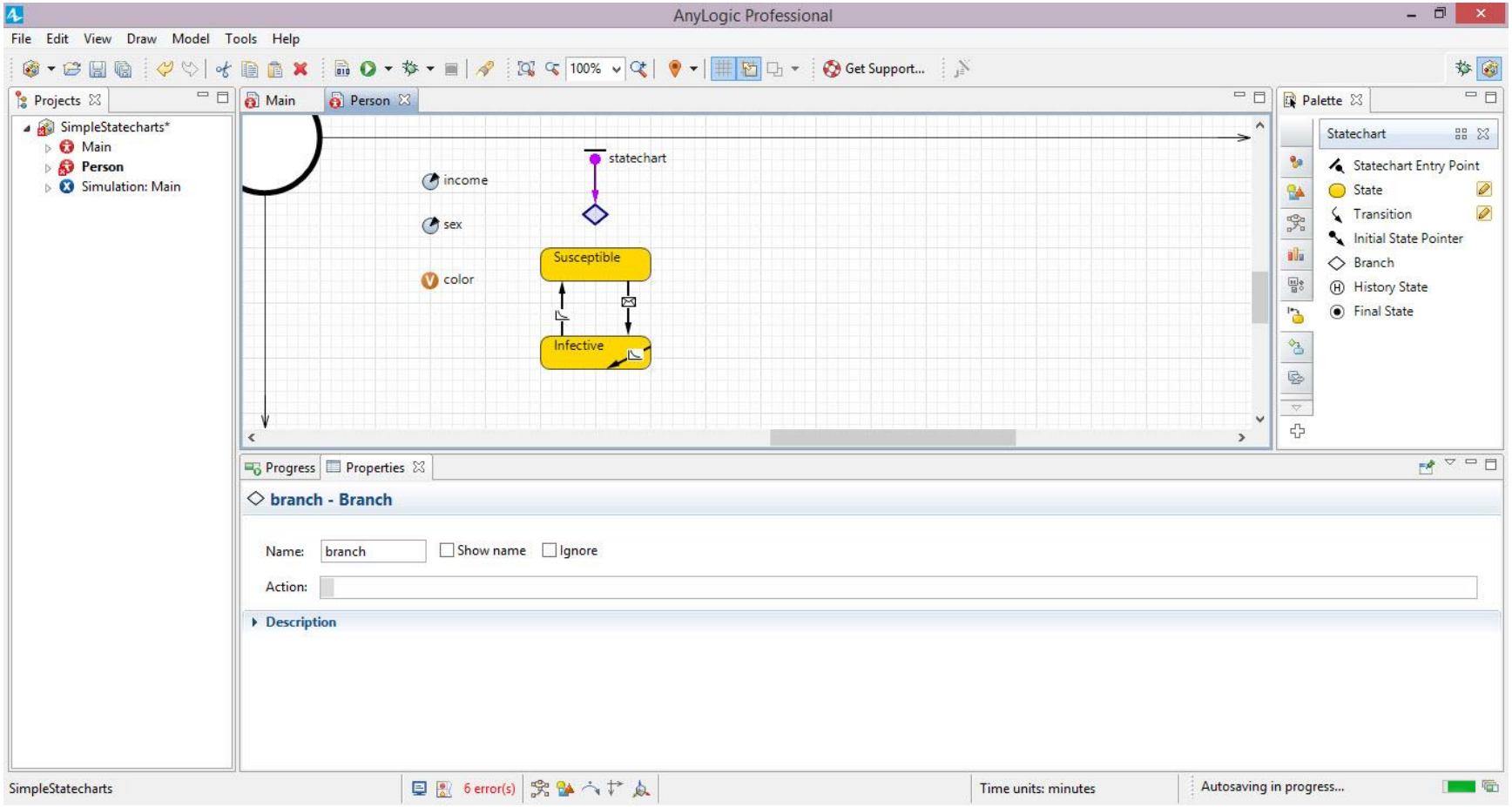
Run the Model



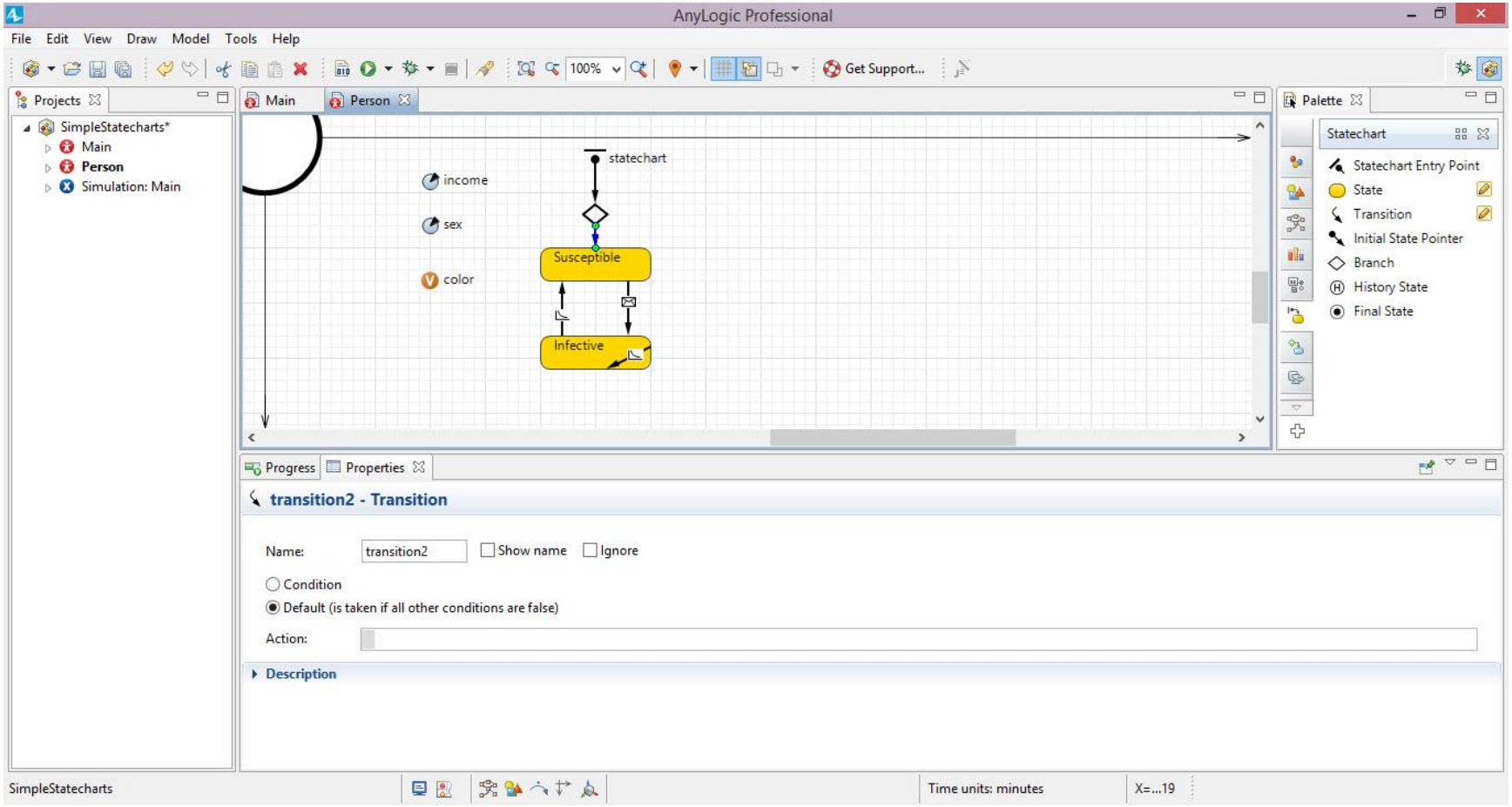
Why No Infection?



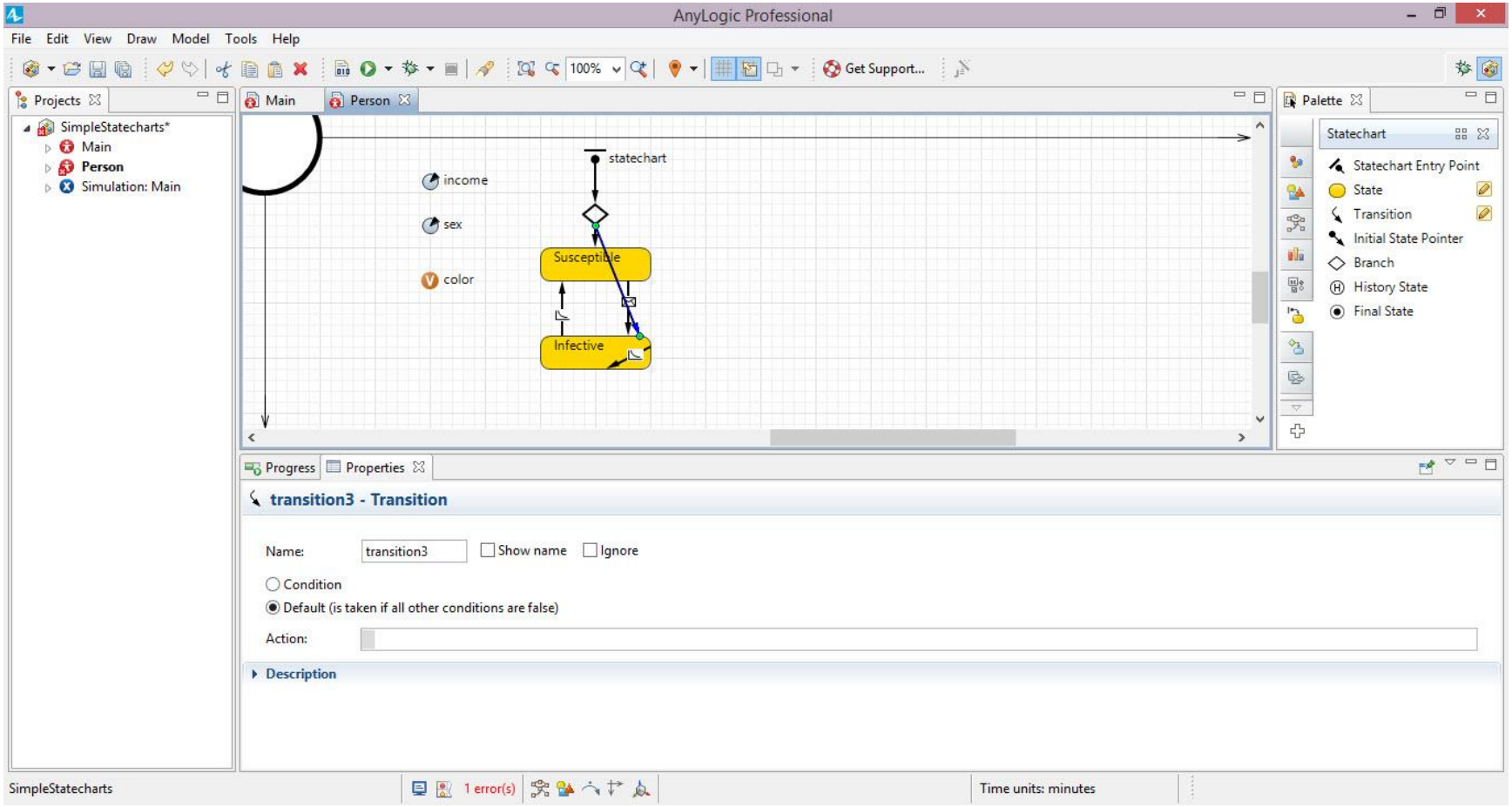
Making the Initial Population Include Some Infectives: Adding a Branch



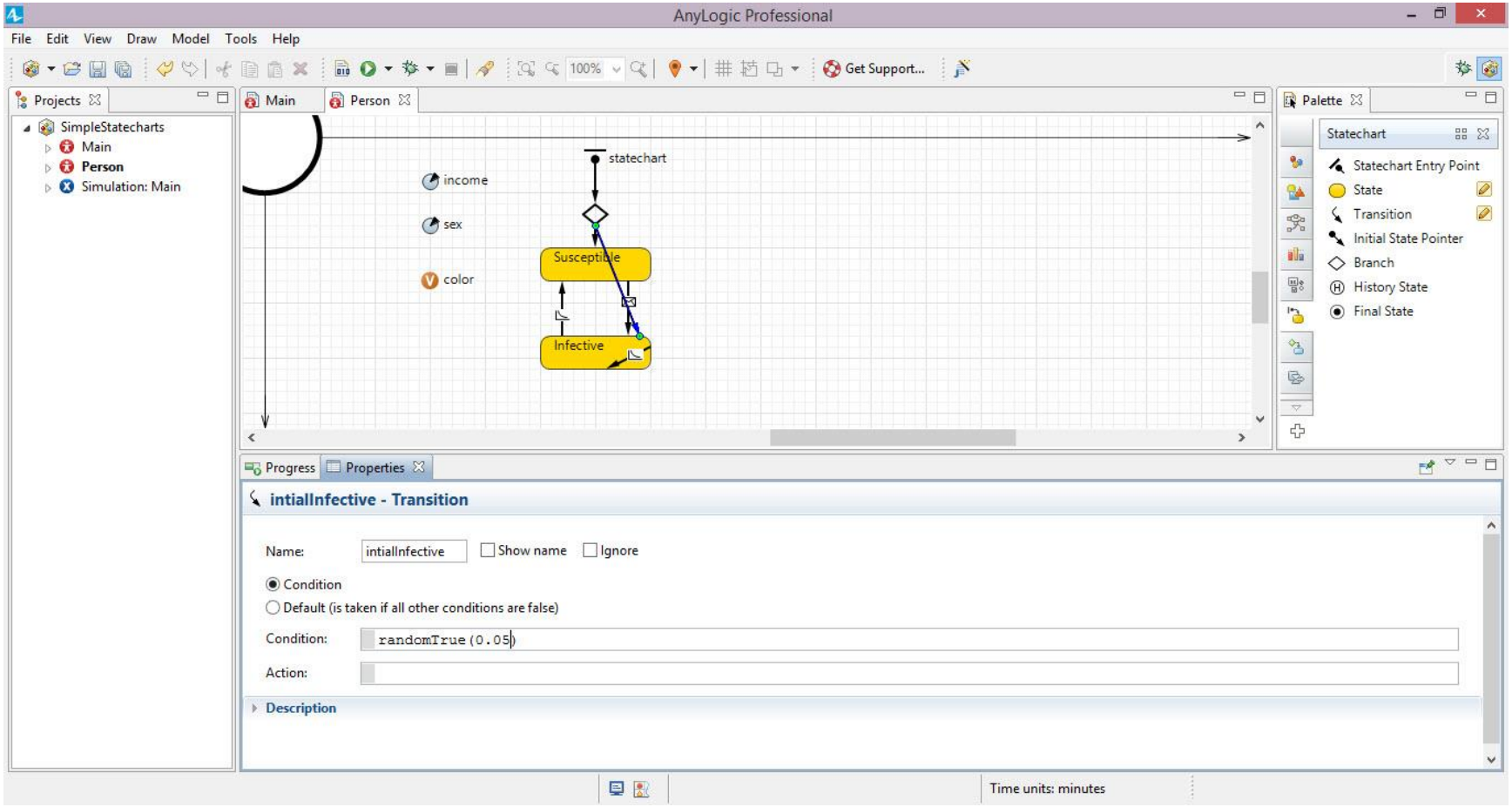
Making the Initial Population Include Some Infectives: Default is Susceptible



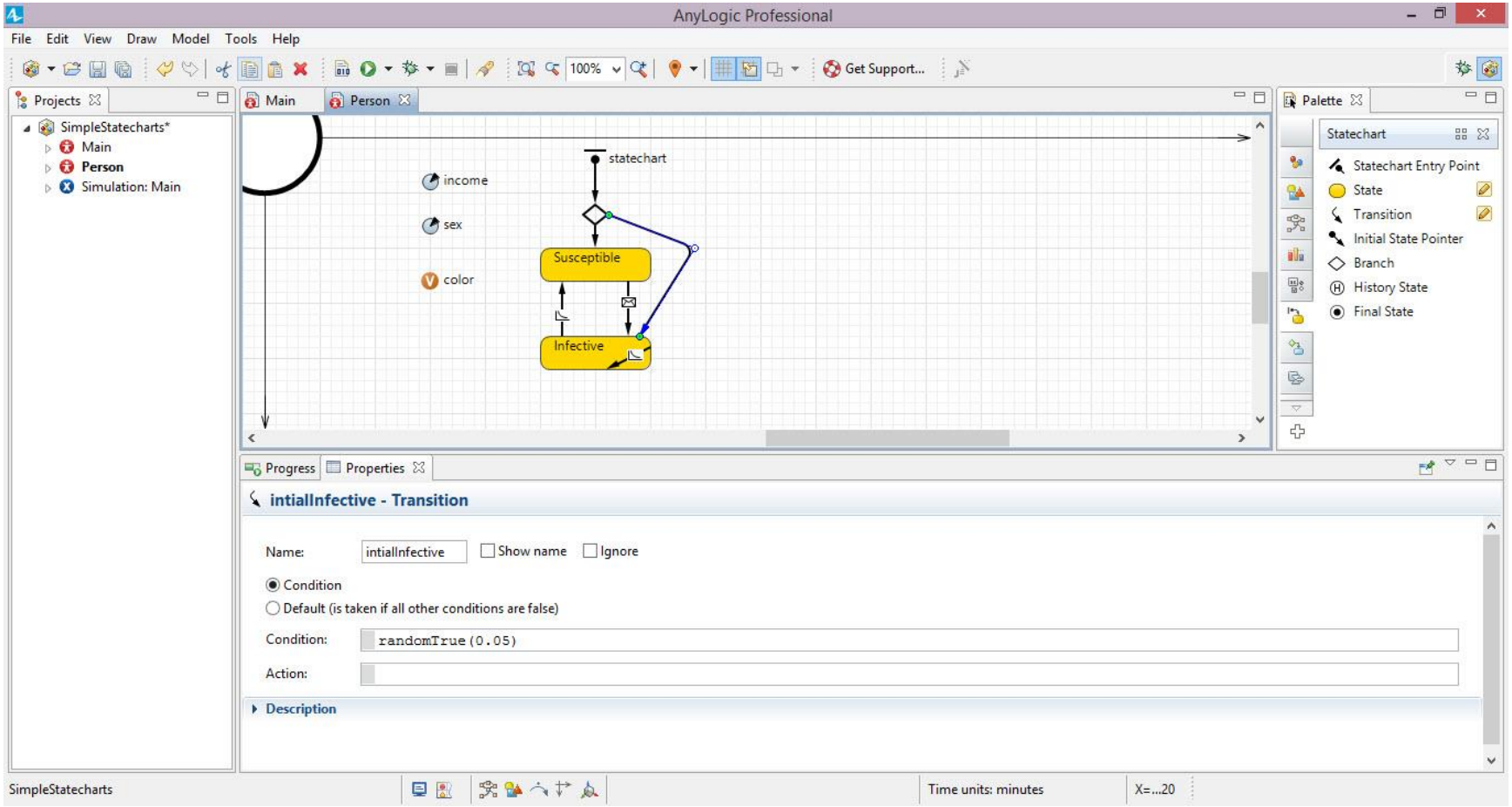
Transition So 5% of the Population Starts Infective



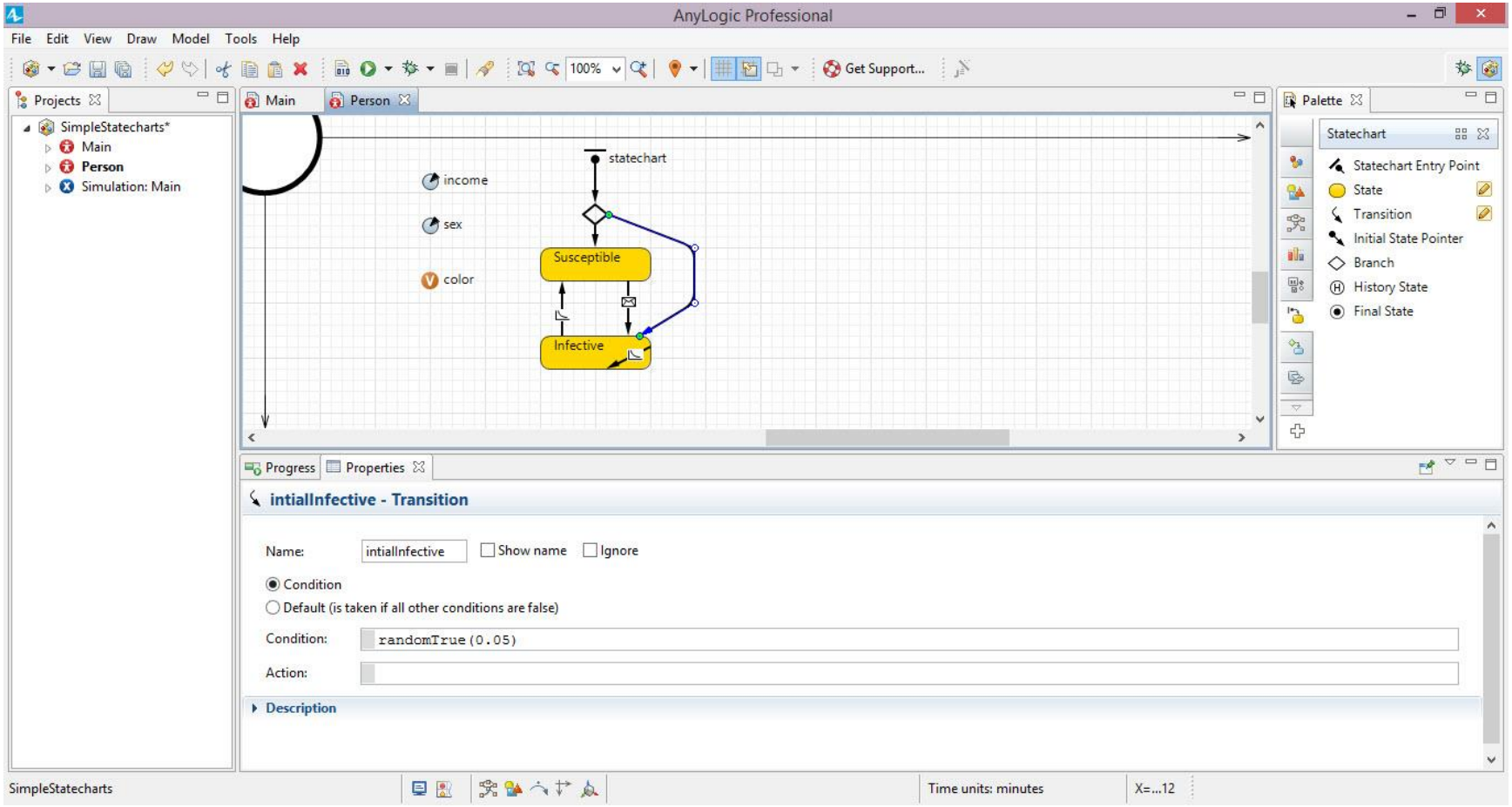
Prettifying: Double-Click on Transition to Add an Extra "Handle" to Shape Transition



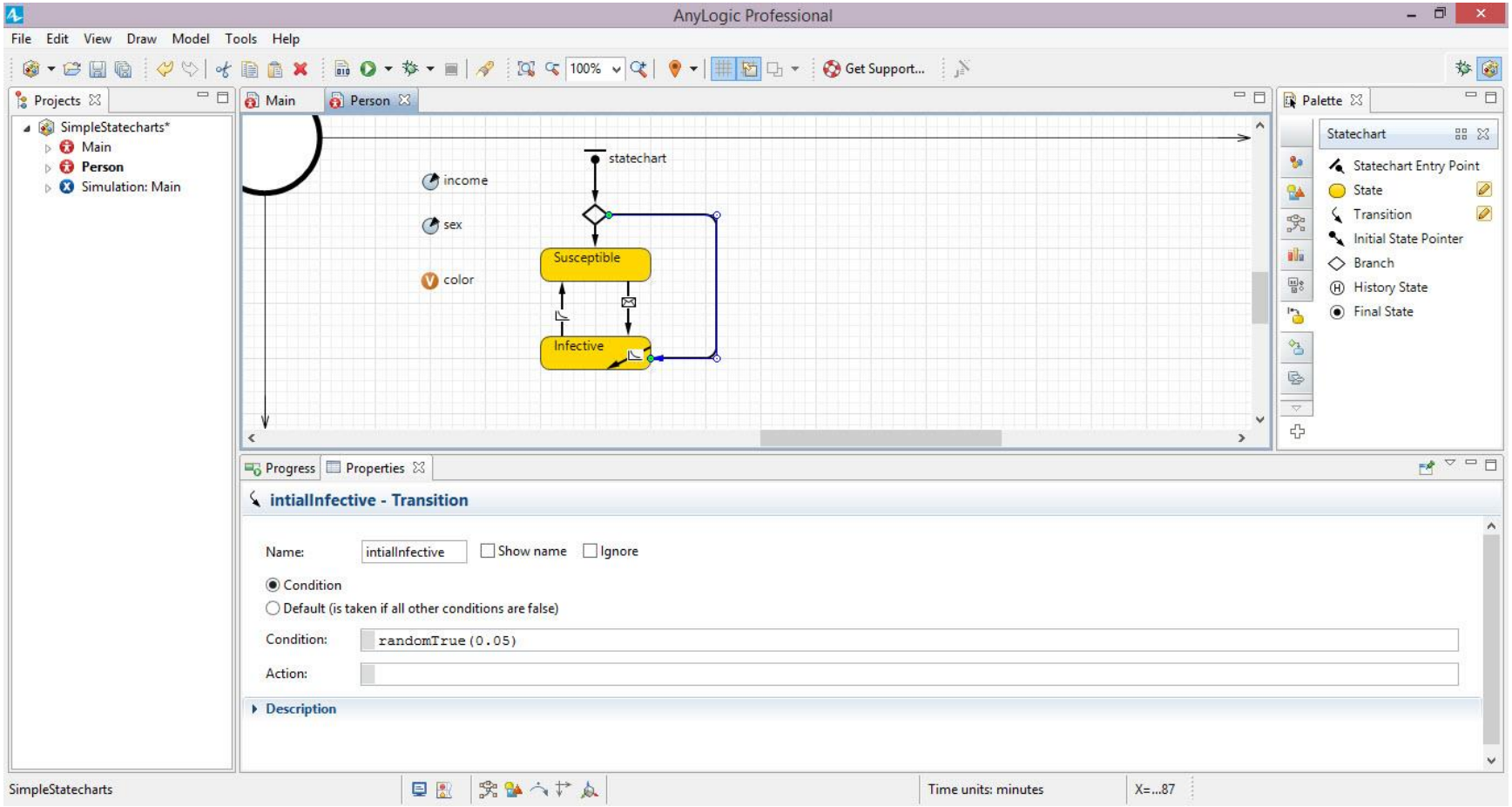
Prettifying: Drag New Handle to Right, to Route around “Susceptible” State



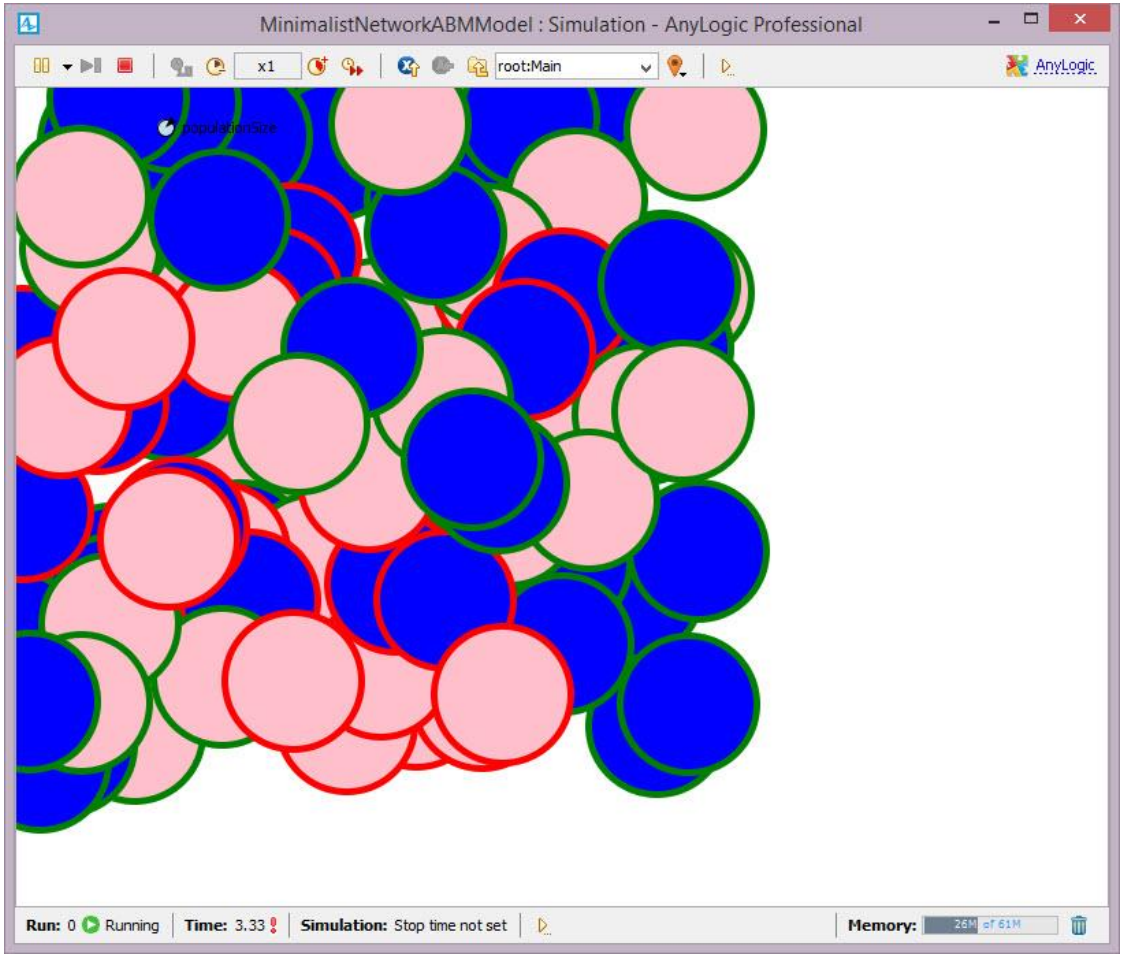
Add Another Handle, Further Down



By Dragging New Handle Further Shape Transition



Infection Spread in the Network



Infection Percolation over the Network